Mainframe As A Green Machine -- And More

ROI -- 2007 to 2013

Advantage Mainframe: Mainframe ROI Shows Ten Times Cost Advantage Over Distributed Servers For Large Data Centers, 2007 to 2013

Torrie The Cat in the Tulips *Picture by Susan Eustis*

WinterGreen Research, Inc.
Lexington, Massachusetts **www.wintergreenresearch.com**

ABOUT THE COMPANY

WinterGreen Research,

Founded in 1985, provides strategic market assessments in software, communications products, communications services, and advanced technology.

Reports focus on opportunities to expand existing markets or develop new markets. The reports access corporate positioning, market strategies, and product marketing opportunities. Reports evaluate the impact of new technologies. Reports assess the strategies and positions of leading participants.

The principals of WinterGreen Research have been involved in analysis and forecasting of international business opportunities in healthcare, energy, telecommunications, and advanced computer technology markets for over 30 years.

Research Methodology

WinterGreen Research authors use a structured, consistent, and detailed research approach. The methodology supports an analytical approach to market research. In depth comparisons are made of many aspects of the market. Data relating to Industry segments is developed to permit presentation of forecasts and market share positioned to have substantive value.

Research has been automated using automation of interactive surveys that implement delta trend analysis and instant messaging in combination with e-mail. Automation is made possible because of a proprietary engine that implements multi-layered cell based analysis. Modular systems support dynamic computing that use a graphical configuration engine to reach more people in a research modality.

Full spectrum research and information services, including market reports, customized research, and customer interviewing are available, reports and research are positioned to provide strategic value to industry participants, strategic planners, and product managers.

New systems combine sales tools and independent industry analysis, seeking to leverage the expertise of the sales force and combine it with the skepticism of the analysts to provide accurate return on investment analysis.

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Mainframe As A Green Machine -- And More

ROI -- 2007 to 2013

Mainframe ROI Shows Ten Times Cost Advantage Over Distributed Servers For Large Data Centers

Mainframe as a Green Machine

The mainframe electricity costs are ten times less than that of a data center. The costs of electricity are certain to escalate, creating an even more dramatic difference between the mainframe and distributed server systems. In some parts of the country particularly in the Southwest, they have simply run out of electricity. In other parts of the country, for example Seattle, the cost of electricity goes to $.52 per kilowatt-hour at peak hours of air conditioning use, considerably higher than the $.12 per kilowatt-hour used in this analysis. Thus market forces will surely force use of the mainframe as a green

Resurgence Of The Mainframe

The biggest challenge facing the analyst community is the resurgence of the mainframe. The mainframe has shared workload capability that is being upgraded to provide capability of real time processing. Services oriented architecture (SOA) provides the new flexibility for the mainframe providing for reusable components of code.

SOA is used to create flexible response to changing market conditions. SOA collaborations create a way to reuse existing modules of code and organize business process. Automated process depends on having the ability to combine SOA modules from the desktop. SOA collaboration code comes from the existing engine vendors supporting modules.

IBM is the leader in creating the ability to consolidate its integration modules with foundation architecture. The foundation architecture is well evolved as the middleware product set configured as an engine that supports Web services implementation. IBM SOA is the defacto industry standard software used in creating business integration foundation systems.

Real Time Internet Processing

Real time Internet processing is needed in a range of applications to adapt to the new channel for business process. The Internet is central to the supply chain and it is used as a vehicle for direct sales. The Internet changes everything. Data centers cost $60 million to build, the mainframe can handle the same level of transactions

and network traffic with a $6 million installation. This means the mainframe provides a ten time cost advantage to the enterprises that adopt it for new workload.

IT System Reliability

IT system reliability return on investment ROI is measured by SLA service level availability and the cost of downtime to an organization. As the Internet emerges as a significant channel, the industry measure of the cost of downtime is $1 million per minute system reliability becomes a significant competitive market factor.
Efficient IT operations represent a primary cost of doing business. It is here that the mainframe achieves competitive advantage. The most efficacious measure of IT processing is measure of workload that can be preformed reliably and securely.
Mainframe vs. distributed server ROI analysis compares and contrasts the features and benefits of the two computing systems for a particular set of metrics for a particular application. Benefits of the mainframe recognized by the industry are scalability, availability, security, shared workload efficiency, network efficiency, throughput efficiency, integration efficiency, and electrical and space efficiency.

Overview Page

Following is the WinterGreen Research mainframe v. distributed return on investment summary page analysis. The page is available online using a promotional or other special code to create a user name and password. It shows that for a particular banking application the mainframe is far more than 10 times less expensive than distributed servers.
The total cost advantage of the mainframe for one application is over $2 million per year, for every year.

Total Advantage Mainframe One Application - vs. 13 Servers (In Thousands of Dollars)	**2,788**	000$	**2,263**	**2,305**	**2,444**	**2,393**	**2,438**

The WinterGreen Research ROI tool lets people chose their own values for metrics and change the assumptions based on a particular situation in an IT data center.
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Mainframe As A Green Machine -- And More

Mainframe vs. Distributed Return on Investment (ROI) Analysis, 2007-2013

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List of Tables and Figures

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Mainframe vs. Distributed Return on Investment (ROI) Executive Summary

Mainframe Is A Green Machine --- Overview

The mainframe is a green machine. It uses far less power than a large data center. The differences are quantum. A small refrigerator size box, vs. a warehouse full of servers that use twice as much electricity for air conditioning as they do for processor power, there is not any choice when a realistic analysis is done.

ROI return on investment analysis shows advantage mainframe because of the efficiencies provided by shared workload, the security, reliability, and infrastructure. Analyst assumptions show how to measure one application at a time to build an assessment of what systems are more efficient.

The ROI analysis is available online using a promotional or other special code to create a user name and password. The online tool permits users to insert their own assumptions and calculate the ROI based on a particular situation. It shows that for a particular application the mainframe is far more than 10 times less expensive than distributed servers.

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Advantage Mainframe

The total cost advantage of the mainframe for one application is over $2 million per year, for every year. Every category provides better ROI from using the shared workload environment of the mainframe.

Security, scalability, and reliability are significant features of the mainframe giving it competitive advantage. For large data centers with shared workload environments, the mainframe has a significant cost advantage.

	2007		2008	2009	2010	2011	2012
Total Advantage Mainframe Per One Application, Per Year	**2,788**	**000$**	**2,263**	**2,305**	**2,444**	**2,393**	**2,438**

The costs of electricity are certain to escalate, creating an even more dramatic difference between the mainframe and distributed server systems.

In some parts of the country particularly in the Southwest, they have simply run out of electricity. In other parts of the country, for example Seattle, the cost of electricity goes to $.52 per kilowatt-hour at peak hours of air conditioning use, considerably higher than the $.12 per kilowatt-hour used in this analysis. Thus market forces will surely force use of the mainframe as a green machine.

TABLE ES-1

SUMMARY OVERVIEW COST ADVANTAGE OF MAINFRAME VS. DISTRIBUTED SYSTEMS SINGLE APPLICATION ANALYSIS

Summary Page:
Overview

Current Scenario: Scenario 1 | Go | Scenarios | Print | Calculate

Cost Advantage of Mainframe vs. Distributed Systems for Single Application	Initial	Unit	2008	2009	2010	2011	2012
Service Level Availability	1,618	000$	1,545	1,594	1,646	1,698	1,756
Disaster Recovery	233	000$	236	241	247	253	259
Hardware	97	000$	14	14	108	14	14
Scalability	27	000$	6	5	5	5	4
Network	321	000$	3	4	5	6	7
Security	317	000$	326	336	346	357	367
Software	52	000$	9	-15	-41	-71	-,104
Infrastructure	118	000$	120	123	126	129	132
Total Advantage Mainframe	**2,788**	000$	**2,263**	**2,305**	**2,444**	**2,393**	**2,438**

Source: Wintergreen Research, Inc.

Mainframe As a Green Machine

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SOA Foundation Architecture Addresses Flexible Response To Changing Market Conditions

The software ROI analysis is the only one that shows the mainframe as costing more than the distributed systems; this is because the mainframe provides a way to implement SOA and SOA provides huge opportunity to the investment. The SOA investment is an opportunity investment. Analysis of the software license and yearly maintenance costs giving a direct comparison for the mainframe and distributed systems shows SOA as a huge investment vehicle.

SOA is the big news here, creating automation of business process from the desktop and providing integration systems that provide flexible systems implementation. SOA holding the promise of process from desktop icons brings a revolution to business promising improved productivity.

SOA is a mainframe technology, providing vast returns on investment for the business, creating tremendous opportunities for growth and competitive advantage to enterprises that embrace the architecture of reusable components of code. Thus, the software model presented here that shows significant investment in SOA should be accompanied by an additional model that shows the business benefit anticipated to be realized from SOA investment. That model is not described here because it is industry specific and business specific and needs to be built in a customized manner.

IBM has been a leader in SOA and in creating the ability to consolidate its integration modules with foundation architecture. Business integration foundation systems create a way to organize supporting modules. Application integration systems are evolving to support business flexibility by enabling integration of systems dynamically. Applications are being interconnected using integration to create cross-departmental processes. Processes are implemented in real time.

Business integration is positioned as middleware useful in the transformation of business process to make it more flexible and adaptive to change. It is used to leverage making legacy applications more flexible. EAI extends existing technology investment by providing tools and middleware for interconnecting systems.

Resurgence Of The Mainframe

The biggest challenge facing the analyst community is the resurgence of the mainframe. The mainframe has shared workload capability that is being upgraded to provide capability of real time processing. Services oriented architecture (SOA) provides the new flexibility for the mainframe providing for reusable components of code.

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Cost of Electricity Escalating

The mainframe is a significantly more efficient computing server when looked from the cost of electricity. Here there is a comparison of the cost of running an application in a shared workload environment vs. running 13 separate distributed servers.

The costs of electricity are certain to escalate, creating even more difference between the systems. As market forces increase focus on use of the mainframe as a green machine significant changes will occur in the IT data centers.

For one application, the cost of the distributed server is $118.3 thousand for power and floor space, while the cost of the mainframe is $96 for power and floor space.

Data Center Cost Metrics

Following are data center cost metrics for a sample IT department. The $18 per square foot includes an aspect of the following that are needed in a hardened data center: In the context of these metrics, the smaller footprint of the mainframe provides significant advantage mainframe.

TABLE ES-2

DATA CENTER COST METRICS

- # Fault tolerant electrical grid
- # 2000 amps of 480v input power
- # Main transfer switch
- # 500KVA Powerware UPS units with 90 batteries per unit
- # Standalone PDUs at each cabinet row
- # 1.5-megawatt generator (2200-gallon tank)
- # DataTrax monitoring software for all data center infrastructure
- # 1-megawatt generator (2000-gallon tank)
- # 22,000 sq. ft. facility
- # 18,000 sq. ft. of raised floor
- # 26-ton data air AC units
- # Very Early Smoke Detection Apparatus (VESDA)
- # Pre-action dry pipe sprinkler system
- # 220 smoke detectors in an integrated system
- # Simplex security badge entry/exit on all doors to facility
- # Earthquake protection for the building

Source: Wintergreen Research, Inc.

With the quantity of data doubling every 7 months, the mainframe may very well become the server of the future, proliferating in the same manner distributed servers proliferate now.

A significant aspect of the $ per square foot is the consideration of the network architecture in the distributed systems that utilizes the enterprise grade routing and switching engines like what is offered by Juniper and Cisco. Whereas the exchange of information, the failover and load balancing depends on the network in the data center for distributed systems, the mainframe is able to make memory look like the network when the servers are implemented as virtual images on the mainframe.

The virtual Linux images are able to exchange information through dynamic allocation of memory, leveraging the failover and load balancing of WebSphere via dynamic memory allocation in the z/VM environment.

Security Cost Analysis - Mainframe vs. Distributed System

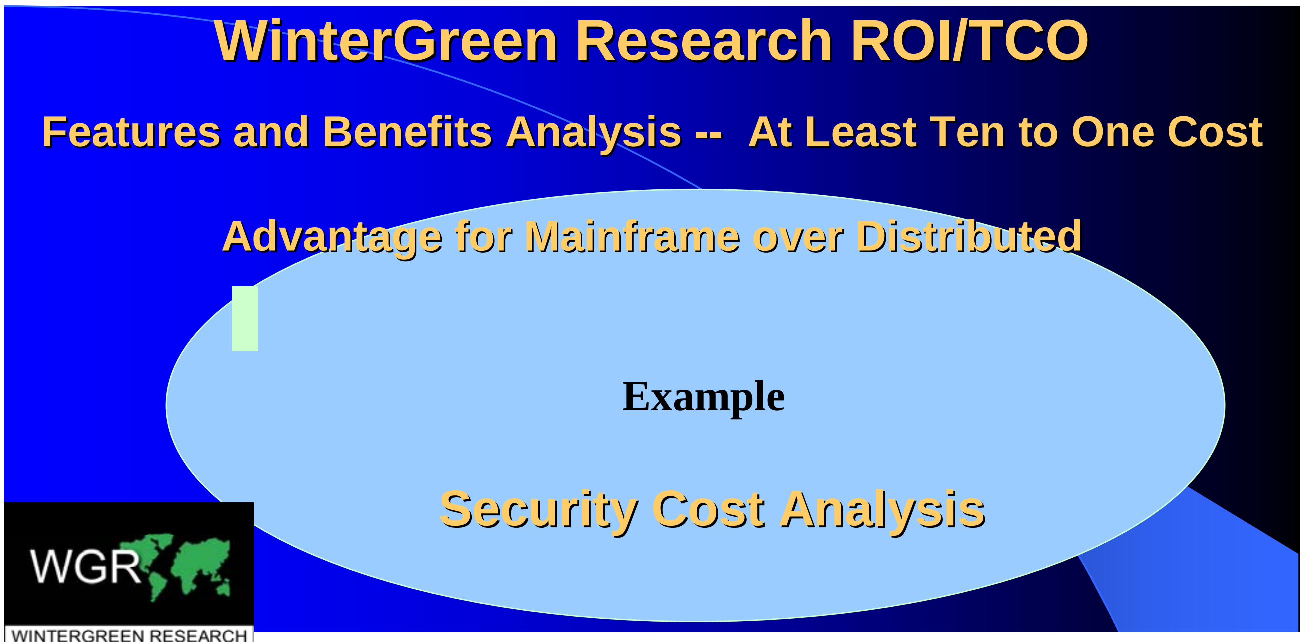
External attacks and security threats are virtually unknown to mainframe users. This unparalleled security results from the mainframe's architecture and complementary technologies such as identity and access management, which have always been an integral part of the mainframe ecosystem.

The function of every security system is to connect users to the system resources to which they are authorized. At the same time, the IT infrastructure must manage resources and users so that access to programs and data is protected and intrusion is detected across the entire enterprise.

The challenge is to manage and maintain a consistent security strategy to allow resource protection without negatively impacting productivity.

FIGURE ES-3

SECURITY COST ANALYSIS - MAINFRAME VS. DISTRIBUTED SYSTEM



Wintergreen Research ROI ENGINE

welcome, Sue6A
[log off][My Account]

View Sessions | Help

Summary Page: **sec**

Current Scenario: Scenario 1 | Go | Scenarios | Print | Display Calc List | Calculate

Security Cost Analysis - Mainframe Versus Distributed System		Current	Unit	2006	2007	2008	2009	2010
Analyst Comments - Security								
Total Annual Security Costs - Distributed System	330.5	330.5	$000	340.4	350.7	361.2	372.0	383.2
Total Annual Security Costs - Mainframe	13.3	13.3	$000	13.7	14.1	14.5	14.9	15.4
Cost Differential		Total	Unit	2006	2007	2008	2009	2010
Security Cost Differential - Mainframe vs. Distributed System		**317.3**	$000	**326.8**	**336.6**	**346.7**	**357.1**	**367.8**

Source: Wintergreen Research, Inc.

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Number Of Servers – Web Application

This section provides an analysis of mainframe MIPs to distributed server hardware equivalency. A Web application is considered here. For ease of analysis, the applications on the mainframe system are divided into the following:

- Very large applications
- Large applications
- Mid-range applications
- Other applications

Within 5 applications migrated, the mainframe hardware software analysis illustrates advantage mainframe.

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TABLE ES-4

HARDWARE AND SOFTWARE COST DIFFERENTIAL MAINFRAME VS. DISTRIBUTED

In Thousands of Dollars

	Number of Applications								ave 4.435 p
Mainframe vs. Distributed WAS Application Analysis	1	5	25	50	100	150	200	250	310
Cost of Distributed Server Hardware ($000)	105.5	461.9	894.2	1,788.5	3,577.0	5,365.4	7,153.9	8,942.4	11,088.6
Cost of Mainframe Hardware and Software - Discounted	1,159.1	1,159.1	1,159.1	2,117.4	2,117.4	2,925.6	5,974.9	5,975.6	5,976.4
Selected Comparative Operational Costs For Application Production Server -- Distributed WAS Servers									
Distributed Server SLA Technician and Developer	425.8	1,864.3	2,706.9	5,413.8	10,827.7	16,241.5	21,655.4	27,069.2	33,565.8
Distributed Server Network	51.7	226.3	328.7	657.3	1,314.6	1,971.9	2,629.2	3,286.5	4,075.3
Distributed Server Database	38.6	168.9	245.2	490.4	980.9	1,471.3	1,961.7	2,452.2	3,040.7
Distributed Server Power and Air Conditioning	57.3	250.9	364.3	728.6	1,457.3	2,185.9	2,914.6	3,643.2	4,517.6
Distributed Server Floorspace	56.8	248.7	361.1	722.3	1,444.5	2,166.8	2,889.1	3,611.4	4,478.1
Distributed Server Security	331.1	1,449.7	2,105.0	4,210.1	8,420.1	12,630.2	16,840.2	21,050.3	26,102.4
Subtotal Distributed	961.3	4,208.9	6,111.3	12,222.6	24,445.1	36,667.7	48,890.2	61,112.8	75,779.8
% Efficiency Because of Scalability	1.0	56.0	45.0	67.0	75.0	78.0	79.0	82.0	83.1
Cost of Servers	951.7	1,851.9	3,361.2	4,033.4	6,111.3	8,066.9	10,266.9	11,000.3	12,837.1
Hardware Cost Differential - Mainframe vs. Distributed System: Cost Comparison Distributed Server Hardware Cost vs. Mainframe Hardware and Software Costs	-1,053.6	-697.2	-264.9	-329.0	1,459.5	2,439.8	1,179.0	2,966.8	5,112.2
Cost Differential - Mainframe Selected Operations Costs	84.2	119.2	175.9	346.0	627.2	883.2	909.1	997.3	1,267.2
Cost Differential - Distributed Selected Operations Costs	951.7	1,851.9	3,361.2	4,033.4	6,111.3	8,066.9	10,266.9	11,000.3	12,837.1
Operations Cost Differential - Mainframe vs. Distributed System:	867.5	1,732.7	3,185.3	3,687.4	5,484.1	7,183.7	9,357.8	10,003.0	11,569.9
Operations, Software, and Hardware Cost Differential - Mainframe vs. Distributed	-186.1	1,035.4	2,920.4	3,358.5	6,943.6	9,623.5	10,536.8	12,969.8	16,682.0

SOURCE: WINTERGREEN RESEARCH, INC.

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Using the ROI Tool

After the username and password are created, the user can enter metrics that are relevant to a particular IT department, creating a comprehensive analysis that is customized for a particular situation.

The ability to completely customize an analysis for any particular IT department situation is a protection against having a particular sales force provide an inaccurate presentation of relative costs.

The online tool is designed to allow different groups to enter different numbers and thereby create analyses that are based on different assumptions and different metrics and easily compare the numbers.

When the analysis on many applications running on the mainframe is made, it becomes apparent that the most significant aspect of the system is the ability to optimize the WebSphere implementations. When WebSphere is optimized then it is easy to get 310 applications running together on the mainframe. When it is not, one application can consume the entire mainframe.

This analysis indicates that when you compare the cost of distributed software hardware to combined mainframe hardware and software. After 5 applications are migrated, the mainframe is cost efficient. This assumes the migration of several midsize applications.

FIGURE ES-5

E-APPLICATION MAINFRAME VS. DISTRIBUTED COMPARISON OF SCENARIOS ANALYSIS

Comparison of Scenarios - SLA

Number of Applications

1	5	25	50	100	150	200	250	310

Mainframe vs. Distributed WAS Application Analysis Hardware Cost Differential - Mainframe vs. Distributed System: Cost Comparison Distributed Server Hardware Cost vs. Mainframe Hardware and Software Costs

-1,053.6	-697.2	-264.9	-329.0	1,459.5	2,439.8	1,179.0	2,966.8	5,112.2

Operations, Software, and Hardware Cost Differential - Mainframe vs. Distributed

Here Mainframe Is cost efficient after 5 Applications are transferred Over

-186.1	1,035.4	2,920.4	3,358.5	6,943.6	9,623.5	10,536.8	12,969.8	16,682.0

Operations, Software, and Hardware Cost Differential - Mainframe vs. Distributed

3,725.0	8,657.3	16,764.6	19,936.8	32,035.8	42,730.9	52,728.9	58,169.6	69,402

Once the issues of 5 nines vs. 3 nines are factored in, the mainframe is more efficient immediately.

Source: Wintergreen Research, Inc.

When the analysis of shared workload is compared to distributed servers, it is necessary to look at the costs of running applications of various sizes on the servers. The different size applications have different ROI on different servers.

FIGURE ES-6

WEBSPHERE E-APPLICATION. DISTRIBUTED SELECTED APPLICATION ANALYSIS

Distributed WebSphere Application Server WAS Application Analysis

Number of Applications

In Thousands of Dollars

	1	5	25	50	100	150	200	250	310	340
Total Cost of Distributed Server Hardware Per One Large Application Server 25 Servers ($000)	0.0	202.5	186.3	372.6	558.9	652.1	652.1	652.1	652.1	745.2
Total Cost of Distributed Server Hardware Per One Application Server 13 Servers ($000)	105.5	105.5	97.1	194.1	291.2	339.7	339.7	339.7	339.7	388.2
Total Cost of Distributed Server Hardware Per One Midsize Application Server 9 Servers ($000)	0.0	72.9	570.1	1,073.1	1,844.4	2,548.6	3,152.2	4,124.7	5,969.1	6,304.4
Total Cost of Distributed Server Hardware Per One and Many Average Application Server Applications ($000)	105.5	461.9	894.2	1,788.5	3,577.0	5,365.4	7,153.9	8,942.4	11,088.6	12,161.7

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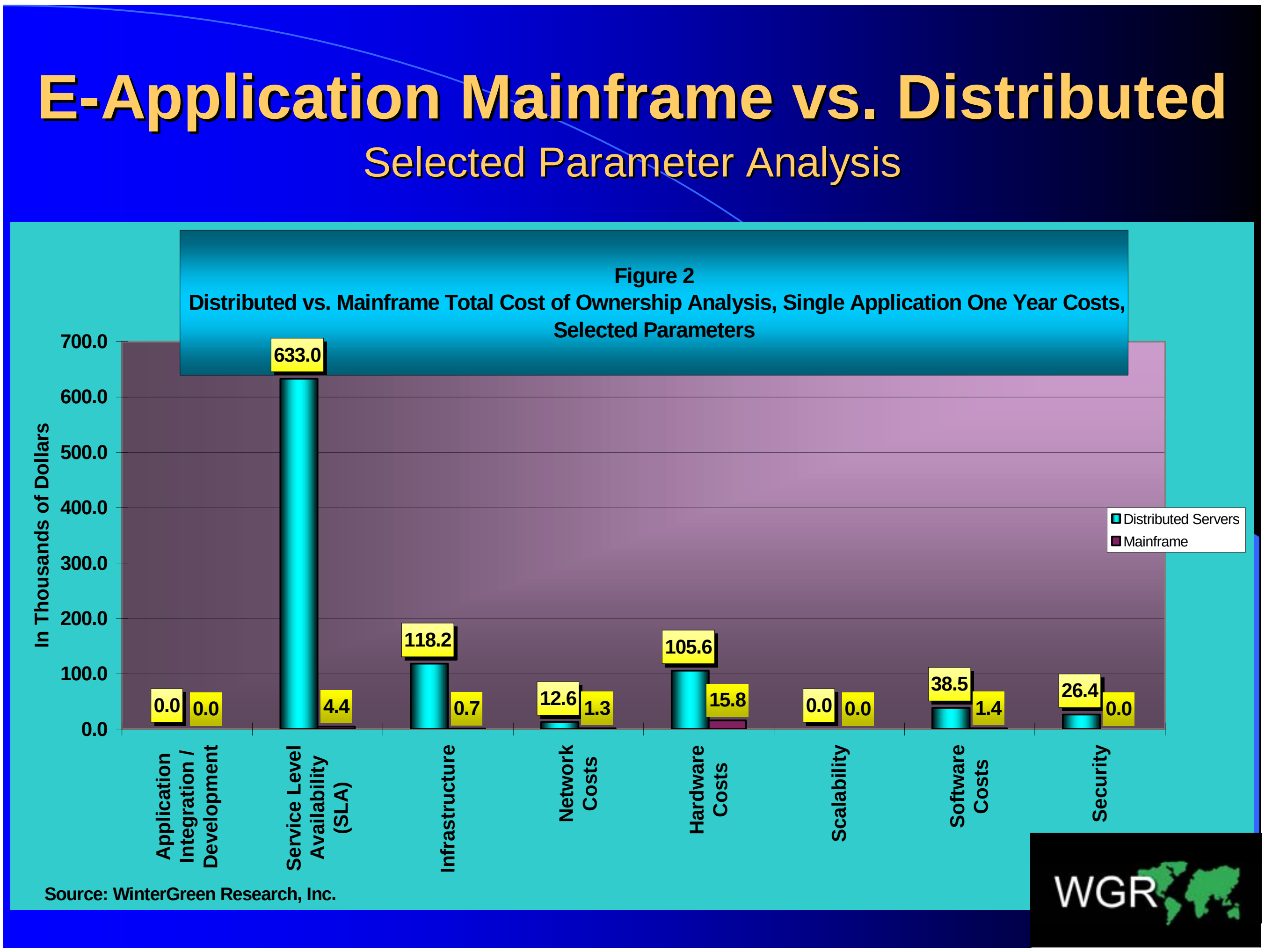
The mainframe single application costs are significantly smaller than the distributed server costs.

FIGURE ES-7

E-APPLICATION MAINFRAME VS. DISTRIBUTED SELECTED PARAMETER ANALYSIS



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Distributed server ROI cost analysis models describe market segments for single, 300, and 1,400 applications. This analysis shows that for one application in 2007 the distributed server costs are $934,000 (See Figure ES-8) compared to $23,600 (See Figure ES-9) for the mainframe. These are real numbers from a real IT department, but each IT department is different and each application is different, stimulating interest in the online ROI tool. This application was chosen because it did seem to be representative of many applications coming online.

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FIGURE ES-8

DISTRIBUTED SERVER ROI COST ANALYSIS MODEL MARKET SEGMENT SINGLE, 300, AND 1,400 APPLICATIONS

ROI Cost Analysis Model Market Segment Analysis
Single, 300, and 1400 Applications
Selected Parameters
(In Thousands of Dollars)

	Single Application 000$	Single Application 000$	300 Applications 000$	1400 Applications 000$
# Servers	13	28	2,400	15,000
# Servers per Application	1	1	8	11
Application Integration / Development Database	0.0	283.3	2,549.7	15,298.2
Service Level Availability (SLA)	633.0	1,266.0	6,963.0	20,889.0
Hardware Technicians	288.0	576.0	3,168.0	9,504.0
Software Developers	345.0	690.0	3,795.0	11,385.0
Infrastructure	118.2	236.4	1,300.2	7,801.2
Server Electricity	20.5	41.0	225.5	1,353.0
Air Conditioning Electricity	41.0	82.0	451.0	2,706.0
Floor Space	56.7	113.4	623.7	3,742.2
Network Costs	12.6	25.2	138.6	831.6
Cabling	12.6	25.2	138.6	831.6
Hardware Costs	105.6	126.7	1,161.6	18,585.6
Servers	105.6	126.7	1,161.6	18,585.6
Scalability	0.0	0.0	0.0	0.0
Servers	0.0	0.0	0.0	0.0
Software Costs	38.5	77.0	423.5	2,541.0
Database	38.5	77.0	423.5	2,541.0
Security	26.4	52.8	290.4	1,742.4
Extra Software	26.4	52.8	290.4	1,742.4
Total (000$)	934.3	2,067.4	12,827.0	67,689.0

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FIGURE ES-9

MAINFRAME ROI COST ANALYSIS MODEL MARKET SEGMENT SINGLE, 300, AND 1,400 APPLICATIONS

Table 2
ROI Cost Analysis Model Market Segment Analysis, Single Application, 300 Applications, and 1400 Applications -- Mainframe Selected Parameters
(In Thousands of Dollars or # of MIPs)

	Single Application 000$	Single Application 000$	300 Applications 000$	1400 Applications 000$
# MIPs per Application				
Runtime	16	21	200	2000
Allocated	3.799	5.9	67.0	2000.0
Application Integration /				
Development	0.0	2.2	19.8	118.8
Database				
Service Level Availability (SLA)	4.4	8.8	48.4	290.4
Hardware Technicians	1.4	2.8	15.4	92.4
Software Developers	3.0	6.0	33.0	198.0
Infrastructure	0.716	1.432	78.456	1,242.360
Server Electricity	0.019	0.038	8.4	343.5
Air Conditioning Electricity	0.019	0.038	8.4	343.5
Floor Space	0.678	1.356	61.7	555.3
Network Costs	1.3	2.6	14.3	85.8
Cabling	1.3	2.6	14.3	85.8
Hardware Costs	15.8	31.6	347.6	3,823.6
MIPs	15.8	31.6	347.6	3,823.6
Software Costs	1.4	2.8	15.4	92.4
Database	1.4	2.8	15.4	92.4
Security	0.0	0.0	0.0	0.0
Extra Software	0	0.0	0.0	0.0
Total (000$)	23.6	49.4	524.0	5,653.4

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Mainframe vs. distributed server ROI cost analysis of how many applications need to be moved before the mainframe is more efficient than the distributed servers shows that by the time five applications are moved over. The issue is how to make the WebSphere operate in an optimized manner. The companies that are doing that are very happy with the behavior of new Web workload on the mainframe. The companies that are still on distributed servers are running the IT department at a higher cost structure giving competitors competitive advantage and creating risk structures for strategic positioning.

FIGURE ES-10

MAINFRAME VS. DISTRIBUTED SERVER ROI COST ANALYSIS OF HOW MANY APPLICATIONS NEED TO BE MOVED BEFORE THE MAINFRAME IS MORE EFFICIENT THAN THE DISTRIBUTED SERVERS

Comparison of Scenarios

Number of Applications	1	5	25	50	100	150	200	250	310
Mainframe vs. Distributed WAS Application Analysis Hardware Cost Differential - Mainframe vs. Distributed System: Cost Comparison Distributed Server Hardware Cost vs. Mainframe Hardware and Software Costs	-1,053.6	-697.2	-264.9	-329.0	1,459.5	2,439.8	1,179.0	2,966.8	5,112.2
Operations, Software, and Hardware Cost Differential - Mainframe vs. Distributed	-186.1	1,035.4	2,920.4	3,358.5	6,943.6	9,623.5	10,536.8	12,969.8	16,682.0

Here Mainframe Is cost efficient after 5 Applications are transferred Over

Source: Wintergreen Research, Inc.

Hardware cost of distributed server data centers is $60 million or more and the Table below illustrates some of the segmentation of those costs.

TABLE ES-11

HARDWARE COST OF DISTRIBUTED SERVER DATA CENTER

Hardware Cost Differential - Mainframe vs. Distributed System: Cost Comparison Distributed Server Hardware Cost vs. Mainframe Hardware and Software Costs	-1,053.6	-697.2	-264.9	-329.0	1,459.5	2,439.8	1,179.0	2,966.8	5,112.2
Operations, Software, and Hardware Cost Differential - Distributed vs. Mainframe ($000)	-186.1	1,035.4	2,920.4	3,358.5	6,943.6	9,623.5	10,536.8	12,969.8	16,682.0
Cost Differential - Mainframe Selected Operations Issues Costs ($000)	21.7	30.8	45.4	89.3	161.9	227.9	234.6	257.4	327.0
Cost Differential - Distributed Selected Operations Issues Costs ($000)	3,932.8	7,652.7	13,889.7	16,667.6	25,254.0	33,335.3	42,426.7	45,457.2	53,047.5
Operations Issues Cost Differential - Mainframe vs. Distributed System: ($000)	3,911.1	7,621.9	13,844.3	16,578.3	25,092.1	33,107.4	42,192.1	45,199.8	52,720.5
Operations, Software, Issues, and Hardware Cost Differential - Distributed vs. Mainframe ($000)	3,725.0	8,657.3	16,764.6	19,936.8	32,035.8	42,730.9	52,728.9	58,169.6	69,402.6

Once the issues of 5 nines vs. 3 nines are factored in, the mainframe is more efficient immediately.

Source: Wintergreen Research, Inc.

Hardware ROI Calculations

IBM System z TCO illustrates the mainframe has substantial updates and cost efficiencies achieved over the last decade, becoming more affordable system, more attuned to modern APIs and middleware, and more network-savvy.

Also, it states that it no longer makes sense for the large enterprise to measure TCO strictly on a one-application-per-server basis, and that TCO must be measured for 10-50 applications on one mainframe versus 10-20 blades or a grid of 50 distributed systems.

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A ROI / TCO assessment reflects aspects of the use and maintenance of the system, including the cost associated with planned and unplanned failure or outage, costs of disaster recovery, diminished performance incidents (i.e. if users are kept waiting), marginal incremental growth, costs of security breaches, and more.

System Reliability Return On Investment (ROI)

The biggest challenge facing the analyst community is the resurgence of the mainframe. The mainframe has shared workload capability that is being upgraded to provide capability of real time processing. Services oriented architecture (SOA) provides the new flexibility for the mainframe providing for reusable components of code.

SOA is used to create flexible response to changing market conditions. SOA collaborations create a way to reuse existing modules of code and organize business process. Automated process depends on having the ability to combine SOA modules from the desktop. SOA collaboration code comes from the existing engine vendors supporting modules.

IBM is the leader in creating the ability to consolidate its integration modules with foundation architecture. The foundation architecture is well evolved as the middleware product set configured as an engine that supports Web services implementation. IBM SOA is the defacto industry standard software used in creating business integration foundation systems.

Real time Internet processing is needed in a range of applications to adapt to the new channel for business process. The Internet is central to the supply chain and it is used as a vehicle for direct sales. The Internet changes everything. Data centers cost $60 million to build, the mainframe can handle the same level of transactions and network traffic with a $6 million installation. This means the mainframe provides a ten time cost advantage to the enterprises that adopt it for new workload.

IT system reliability return on investment ROI is measured by SLA service level availability and the cost of downtime to an organization. As the Internet emerges as a significant channel, the industry measure of the cost of downtime is $1 million per minute system reliability becomes a significant competitive market factor.

Efficient IT operations represent a primary cost of doing business. It is here that the mainframe achieves competitive advantage. The most efficacious measure of IT processing is measure of workload that can be preformed reliably and securely.

Mainframe vs. distributed server ROI analysis compares and contrasts the features and benefits of the two computing systems for a particular set of metrics for a particular application. Benefits of the mainframe recognized by the industry are scalability, availability, security, shared workload efficiency, network efficiency, throughput efficiency, integration efficiency, and electrical and space efficiency.

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Mainframe Has Ten to One Cost Advantage over Distributed Systems

Mainframe has a ten to one cost advantage over distributed systems. The analysis is conducted on an application-by-application basis. The analysis is based on looking at models based on the features and benefits of systems.

For one application using 13 servers and running in 16 MIPs on the mainframe, the one year cost advantage of the mainframe is $2.8 million. The reason is that the mainframe manages shared workload and runs at 85% utilization with 5 minutes of downtime per year, and security that is impenetrable while the distributed servers run at 15% utilization, with 56 hours of downtime per year, and security that is vulnerable.

The WinterGreen Research ROI site is useful because it offers an online tool where users can type in metrics specific to their IT situation and look at the result of the analysis that are specific to their particular situation.

Mainframe vs. distributed server ROI analysis compares and contrasts the features and benefits of the two computing systems for a particular set of metrics for a particular application. Benefits of the mainframe recognized by the industry are scalability, availability, security, shared workload efficiency, network efficiency, throughput efficiency, integration efficiency, and electrical and space efficiency.

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Downtime In SLA On A Distributed System

A downtime in SLA on a distributed system necessitates manual effort to keep the system running and restore the required SLA. Here, a case study of e-loan application distributed system in a bank is considered for analyzing the business cost incurred in the event of SLA downtime.

The cautious assumption is made that for 56 hours of downtime during the year, that the professional bankers lose one hour of automated process that must be done by hand. No calculation of lost business is made; it is just assumed that all the downtime is covered by manual process that would otherwise be automated and that when the system comes up, the manual processes are performed automatically, just in a delayed manner.

The cost of the professional banker is a fully loaded cost that includes several support personnel as well that be come involved in making the manual process accurate. The application considered here is a specialized loan application for a large bank. This cost is $845,000 for one application. If you consider that a large bank will have 850 mid size applications that may be impacted by the system this gives an indication of the real costs of downtime.

Downtime In SLA On A Mainframe

Business cost of SLA downtime on mainframe is less because the system is only down 5 minutes per year, a significant difference from 56 hours per year. A downtime in SLA on a mainframe system does not necessitate as much manual effort to keep the system running and restore the required SLA, as required in a distributed system.

Here, a case study of e-loan application mainframe system in a bank is considered for analyzing the business cost incurred in the event of SLA downtime.

Complexity Of Computing Environment Function Of Increasing Workload

The pace of information doubling is at once every 7 months by mid2007. The pace is increasing. Vertical clustering is used to check the dispatching efficiency of a single system. In a vertical cluster, the servers compete with each other for resources.

The complexity of today's computing environment is staggering. Whether measured by the number of databases, the pace of new application deployment, the drive toward real-time business intelligence or the demanding service-level requirements, IT organizations have their hands full.

Each new application brings its own data, including some that may overlap with data in other application domains and must therefore be synchronized. Business intelligence applications must now support tactical decisions based on real-time data.

Businesses are driven to increase data redundancy not only for availability, but also for regional performance and low-cost capacity. Addressing these data placement requirements mandates an efficient solution that can minimize impact to computer systems, applications, and networks.

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IBM WebSphere Replication Server and IBM WebSphere Data Event Publisher enable changed data capture and data replication solutions. The relative cost of a distributed server data center as compared to the mainframe is central to consideration of how to manage the explosion in management of real time information systems.

IBM System z Advantages

IBM System z9 mainframe is a sophisticated computing system with security and virtualization capabilities that can enable it to act as the hub in a new era of collaborative computing. System z9 was designed to be one of the most open, reliable and secure computing systems ever built for business.

More than nine years of use of mainframe system z9, in leading enterprise organizations, give testimony to its stability and reliability. System z9 provides advanced protection against internal and external risks.

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TABLE ES-12

IBM SYSTEM Z RELIABILITY FUNCTIONS

- Process one billion transactions per day, more than double the performance of its predecessor, the "T-Rex" zSeries z990 mainframe, at its launch.
- Enable businesses to safely transport encrypted data to partners, suppliers, and remote or archive sites -- helping to protect data in the event of media loss or inadvertent compromise.
- Run five world-class operating systems, which can enable transport of data in a security-rich environment between multiple computing platforms and virtualization of hundreds of applications, including Java-based applications.
- Process up to 6,000 secure online handshakes per second -- approximately three times as many as before. This helps businesses better serve e-commerce customers and process more sales quicker.
- Resist known security threats.

Source: Wintergreen Research, Inc.

System z9 facilitates management security and manages implementation of efficiency of systems resources across the entire corporate IT network. In this way, the mainframe is designed to provide a central point of control. The System z9 delivers virtualization and collaborative capabilities. A single System z9 is designed to optimize hardware, networking and software so that businesses can manage and secure workloads equivalent to hundreds of distributed servers in a fraction of the space.

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TABLE ES-13

SYSTEM Z9 FACILITATION OF SECURITY

- Enhanced book availability to help reduce planned outages
- If a book fails, businesses may recover resources without an outage
- Ability to add and repair memory without an outage
- Ability to apply some driver maintenance without an outage
- The largest System z9 (54-way) is designed to provide nearly twice the total system capacity than a z990 (32-way)
- System has scaling designed to meet fluctuating demand.
- z/OS is designed to optimize performance of the IP networks across a cluster of servers with a new TCP/IP Sysplex load balancing advisor
- Coordinates with network routers and switches from Cisco
- Allows better load balancing decisions
- Designed to protect busy servers / Provides resources where the business needs them
- Offers 80 percent greater I/O bandwidth / Expanded I/O addressability capabilities
- Multiple sub-channel sets for parallel access volumes

Source: Wintergreen Research, Inc.

WebSphere Service Level Availability Analysis -- Mainframe Vs. Distributed Server Analysis

Optimization of WebSphere Applications For z/OS

The underlying technology associated with applications like IBM WebSphere Application Server is nearly identical on each platform. As a result, standard applications can be developed in the same manner for z/OS as they are for distributed environments.

But, consider a total distributed environment, with available on-the-floor capacity encompassing storage, testing, production and disaster recovery. Accommodating this capacity requires scaling up with more servers.

They are less efficient and require additional software to run on them. Consider the necessary inefficiencies of a server environment. Since companies need to over-configure their systems for spikes, disaster recovery and the like, servers usually run at about 20 - 30 % of capacity. IT departments start out thinking they can run the distributed servers at 50% utilization, but when the first spike brings the cluster to a grinding halt, they back off a little, and the second spike that has that effect makes them back off more, and so forth until in reality distributed servers generally run at 15% utilization.

Translated, it means significant unused, wasted computing capacity — that is, idle inefficiency. Consider also the labor costs. Add servers, and you must add staff to manage them. New distributed technology requires new skills, because there is new programming involved. These additional labor costs can far exceed the cost of hardware and software licensing combined.

System Reliability Return On Investment

IT system reliability return on investment is measured by SLA service level availability and the cost of downtime to an organization. As the Internet emerges as a significant channel, the industry measure of the cost of downtime is $1 million per minute. It is here that the mainframe achieves competitive advantage. The most efficacious measure of IT processing is measures of workload that can be preformed.

Mainframe vs. distributed server ROI analysis compares and contrasts the features and benefits of the two computing systems. Benefits of the mainframe recognized by the industry are scalability, availability, security, shared workload efficiency, network efficiency, throughput efficiency, integration efficiency, and electrical and space efficiency.

Server Dysfunction Attributable To Shared Memory Space

Another aspect of the difference between the memory environments of the distributed servers and the mainframe is the ability to prevent attempts to overwrite memory space currently being used. The mainframe has far more sophisticated systems in place to prevent failures that are almost impossible to detect because the failure is the result of a process resident in memory that was dislodged by another process that took the same memory space.

Once the process is dislodged, it is almost impossible to go back and see what was happening before the machine crashed. Systems that do that on distributed server create enormous overhead.

Server dysfunction attributable to shared memory space is a significant aspect of the difference between 3 nines (99.9%) of availability on the servers and five nines (99.999%) availability on the mainframe.

Distributed Systems Churning The Databases

One real problem with distributed systems is that they are churning the databases as they try to achieve backup. Data gets copied from one place to another. Application analysis of a single application illustrates the value of the mainframe. The mainframe uses a lot less processing power because the database is much more efficient with less churn, the workload is managed more efficiently, and the system shares resources..

Server to MIP Conversion

Server to MIP conversion depends primarily on the optimization of WebSphere for the mainframe environment. Server to MIP conversion is a calculation that takes into consideration the fact that the mainframe can replace the computing capability of multiple sets of fifteen to fifty large, scaled-up distributed systems that may be running a single application. This shared workload capability of the mainframe reduces the acquisition cost of mainframe, compared to that of several distributed systems that need to be managed.

IBM System z ROI mainframe has substantial updates that improve the return on investment (ROI). As the mainframe has become more affordable, it is also more attuned to APIs and middleware. It works on the network to manage workload in real time. New workload is fundamentally Internet based applications that leverage the Internet as a channel.

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It no longer makes sense for the large enterprise to measure ROI strictly on a one-application-per-server basis. ROI is measured for 200 applications on one mainframe leveraging shared workload versus 10-20 blades running 10 applications or a grid of 50 distributed systems running 5 applications.

For mainframe systems, the ROI is ten times better than Unix, Linux, Windows and other alternatives. For Linux systems running on the mainframe, the ROI is seven times better than the mainframe. ROI advantages are 30% to 60 % better than 30 distributed Sun servers or 300 distributed Linux Servers. In all mixed workload set-ups, mainframe systems are economically justified because they are designed to provide security and efficiency in shared systems processing environments.

Cost of Downtime

The costs of downtime are significant. The cost to create distributed systems that have little or no downtime is high. A few servers can be made highly reliable, but the costs of creating an entire data center that is reliable is a different story.

Protection against unavailability of applications and loss of data due to outages and disasters is a necessity. With increase in customer demand, for newer services, it is essential to ensure increased system availability and uninterrupted workflow, at a reasonable price. Businesses need access to information, 24 hours a day and 365 days a year. Both planned and unplanned outages affect revenue and customer morale.

Even a temporary loss of access to electronic information can be costly. Providing rapid, reliable information access is critical in the competitive e-business world. Defense against catastrophic information loss has become a strong driver of information and data lifecycle management initiatives in companies around the globe.

TABLE ES-14

COST PER HOUR OF DOWNTIME

Business Operation (Dollars in Thousands)	Cost per Hour of Downtime
• Communications	$10,000
• Healthcare / Physician Lost Productivity	$ 7,000
• Financial / Broker	$ 6,540
• Financial / Credit Card	$ 3,670
• Retail	$ 2,875
• Media / Pay per View	$ 2,180
• Airline Ticketing	$ 1,991
• Event Ticket Sales	$ 1,981

Source: Wintergreen Research, Inc.

To overcome downtime, clustering solutions are not as efficient as the mainframe. By combining commodity servers running Linux or Windows with High Availability (HA) clustering solutions, considerable cost savings can be achieved, compared to proprietary solutions, yet maintaining application availability. .

While selecting the appropriate high availability solution for a business, it is essential to list the applications and services that are indispensable to the customer, in the order of priority and the cost incurred during an outage of each of these applications. Following are the items to be noted, during selection of a HA solution:

OS And Application Support Versions

OS and application support versions relate to a solution that requires advanced versions of OS or application software. It is not likely to provide cost-benefits. But, use of a suitable high availability middleware enables use of standard versions that prove to be cost-beneficial and meet the HA requirements.

Application-focused data replication, high availability clustering and disaster recovery solutions are easy to deploy and operate, and enable enterprises of all sizes to ensure continuous availability of business-critical applications, servers and data. The solutions are proven in the most demanding of environments and are integrated to deliver flexibility, scalability and a fast return on investment.

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Enterprise application servers are evolving to play a more vital role. With this increased responsibility comes increased risk. Business integration, globalization, collaboration are just three factors that are driving the need for organizations to focus on ensuring availability of business critical applications. No longer can system downtime be measured in hours or days, when business success and customer loyalty are measured in minutes and seconds.

Network System Cost Comparisons on Mainframe vs. Distributed Servers

The network equipment costs of IBM System z are 75% less than for distributed systems. Communications on the mainframe happen across the internal backplane making the mainframe more efficient. The effect of mainframe backplane management of data means fewer physical switches, hubs and routers are needed to support communications to external processor resources.

Distributed systems need one or several Ethernet controllers to conduct I/O between other clustered or connected distributed servers and more number of hubs, routers, switches, and bridges than a self-contained, scaled-up System z.

An increase in the number of components translates to additional deployment, cabling, management and maintenance expenses. This also increases the power consumption.

1. Mainframe vs. Distributed Service Level Availability SLA Return on Investment (ROI) Model Description

1.1 Reliability Is Foundation of Business Systems

Business systems depend on a reliable, available system because they represent automation of process and the automated process is so much more efficient than manual process that the business does not run very well if the automated process is not available. The reliable business system foundation provides organization for automated process. Software modules provide flexible response to changing market conditions. Transaction management and integration are intertwined with system reliability and availability.

With the Internet, batch processing has moved to real time processing. Service level availability (SLA) depends on features and benefits that relate to real time runtime support for business process automation. Systems depend on the ability to create applications quickly and in a flexible manner.

1.1.1 System Reliability Return On Investment

IT system reliability return on investment ROI has a significant measure of SLA service level availability analysis and the cost of downtime to an organization.

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As the Internet emerges as a significant channel, the industry measure of the cost of downtime is $1 million per minute system reliability becomes a significant competitive market factor.

Efficient IT operations represent a primary cost of doing business. It is here that the mainframe achieves competitive advantage. The most efficacious measure of IT processing is measure of workload that can be preformed reliably and securely.

TABLE 1-1

WINTERGREEN RESEARCH MAINFRAME VS. DISTRIBUTED RETURN ON INVESTMENT SLA SERVICE LEVEL AVAILABILITY SUMMARY PAGE

SLA - Analysis of Costs Needed to Achieve 5 Nines of Availability And Costs of Not Having 5 Nines of Availability	Current	Unit	2007	2008	2009	2010	2011
SLA Analyst Comments							
SLA - Distributed Server Cost Analysis	**Initial**	**Unit**	**2007**	**2008**	**2009**	**2010**	**2011**
Labor Costs For Hardware Technicians Needed to Achieve SLA On Distributed System	325.0	(000)$	334.8	345.6	357.1	368.6	381.3
Labor Costs For Software Developers Needed to Achieve SLA On Distributed System	270.0	(000)$	278.2	287.1	296.7	306.2	316.7
Costs of Software Needed to Achieve SLA On Distributed System	49.1	(000)$	8.8	8.8	8.8	8.8	8.8
Business Cost of SLA Downtime On Distributed System	845.8	(000)$	871.4	899.5	929.4	959.4	992.3
Total Labor, Software, and Business Costs to Achieve SLA On Distributed System	**1,489.9**	(000)$	**1,493.2**	**1,541.1**	**1,592.0**	**1,643.1**	**1,699.1**
SLA - Mainframe Cost Analysis	**Initial**	**Unit**	**2007**	**2008**	**2009**	**2010**	**2011**

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Labor Costs For Hardware Technicians Needed to Achieve SLA On Mainframe	1.7	(000)$	1.7	1.8	1.8	1.9	2.0
Labor Costs For Software Developers Needed to Achieve SLA On Mainframe	3.0	(000)$	3.1	3.2	3.3	3.4	3.5
Costs of Software Needed to Achieve SLA On Mainframe	3.0	(000)$	0.1	0.1	0.1	0.1	0.1
Business Cost of SLA Downtime On Mainframe	0.1	(000)$	0.0	0.0	0.0	0.0	0.0
Total Labor, Software, and Business Costs to Achieve SLA On Mainframe	**7.7**	(000)$	**4.9**	**5.1**	**5.2**	**5.4**	**5.6**
Cost Differential	**Total**	**Unit**	**2007**	**2008**	**2009**	**2010**	**2011**
Cost Differential For Labor and Software To Achieve Service Level Availability On Mainframe vs. Distributed Systems	**1,482.2**	(000)$	**1,488.3**	**1,536.0**	**1,586.8**	**1,637.7**	**1,693.5**

Calculate

Display Calculations

Summary Page:
SLA Service Level Availability

Current Scenario: Scenario 1 | Go | Scenarios | Print | Display Calc List | Calculate

The online tool has the capability of letting users calculate the page using different metrics and creating multiple scenarios to accommodate different viewpoints from within an organization.

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1.2 Cost Of Downtime

IT systems are the lifeblood of businesses, and are business critical. The automation of process is at the foundation of the enterprise. Information is an asset. The cost of downtime is approaching $1 million per minute for some companies. In this context, continuous operation is a serious matter. .

- The risks involved in managing application service in a heterogeneous environment relate to downtime and security

- The next generation of technology is suited to diverse execution environments

1.2.1 Business Cost of SLA Downtime on Distributed System

A downtime in SLA on a distributed system necessitates manual effort to keep the system running and restore the required SLA. Here, a case study of e-loan application distributed system in a bank is considered for analyzing the business cost incurred in the event of SLA downtime.

The cautious assumption is made that for 56 hours of downtime during the year, that the professional bankers lose one hour of automated process that must be done by hand. No calculation of lost business is made; it is just assumed that all the downtime is covered by manual process that would otherwise be automated and that when the system comes up, the manual processes are performed automatically, just in a delayed manner.

The cost of the professional banker is a fully loaded cost that includes several support personnel as well that be come involved in making the manual process accurate. The application considered here is a specialized loan

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application for a large bank. This cost is $845,000 for one application. If you consider that a large bank will have 850 mid size applications that may be impacted by the system this gives an indication of the real costs of downtime.

FIGURE 1-2

BUSINESS COST OF SLA DOWNTIME ON DISTRIBUTED SYSTEM

1. Manual Banking Costs for SLA Downtime On Distributed System		
2. Name of Application -- E_Loan	Current	Unit
3. Analyst assumption, 2 nines of availability - 101.4 hours of downtime per year, , 3 nines of availability - 53.3 hours of downtime per year, 4 ni both numbers below--- E_Loan		
4. SLA Number of Nines Indicating Level of Availability	3.0	#
5. Hours Per Year of Downtime	53.3	Hours
6. Percent Hours Per Year of Downtime Occurring During Working Hours	23.7	%
7. Hours Per Year of Downtime During Working Hours	12.6	hours
8. % Downtime Administrative/Banker Spends Doing Manual Entry (Annually)	8.0	%
9. Hours per Administrative/Banker Spent Doing Manual Entry to Track Loans As A Percent Of Downtime	1.0	hours
10. Application Outage Cost -- E_Loan Manual Input	Current	Unit
11. Number of Administrative/Banker Doing Manual Input to E-Loan	4,500.0	#
12. Dollars Per Hour (Fully Loaded) Per Administrative/Banker For Manual Input of Loans	186.0	$/hour
13. Cost Per Hour for All Administrative/Banker Doing Manual Input Due to Application Downtime	837,000.0	$
14. Cost Per Year of Administrative/Banker Manual Input Due to Application Downtime (hours of Administrative/Banker manual input due to downtime times cost per hour)	845,845.4	$
15. Unit Conversation - $ to 000$	1,000.0	$ to 000$
16. 000$ - Cost Per Year of Administrative/Banker Manual Input Due to E-Loan Application Downtime	845.8	000$

Source: Wintergreen Research, Inc.

It is assumed that the e-loan application distributed system has 3 nines of availability and it corresponds to 53.3 hours of downtime per year. A downtime during off-peak hours, such as on weekends and holidays is not considered for the purpose of cost analysis.

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For the current year, 23.7% of the total downtime occurs during working hours. Hence, the number of working hours for which the distributed system is unavailable is 12.6

FIGURE 1-3

COST ANALYSIS OF MANUAL INPUT DURING DOWNTIME OF E-LOAN APPLICATION DISTRIBUTED SYSTEM

10. Application Outage Cost -- E_Loan Manual Input	Current	Unit
11. Number of Administrative/Banker Doing Manual Input to E-Loan	4,500.0	#
12. Dollars Per Hour (Fully Loaded) Per Administrative/Banker For Manual Input of Loans	186.0	$/hour
13. Cost Per Hour for All Administrative/Banker Doing Manual Input Due to Application Downtime	837,000.0	$
14. Cost Per Year of Administrative/Banker Manual Input Due to Application Downtime (hours of Administrative/Banker manual input due to downtime times cost per hour)	845,845.4	$
15. Unit Conversation - $ to 000$	1,000.0	$ to 000$
16. 000$ - Cost Per Year of Administrative/Banker Manual Input Due to E-Loan Application Downtime	845.8	000$

Source: Wintergreen Research, Inc.

It is calculated that, during the downtime, 1 hour is spent by an administrative or banker, to perform manual entry to track loans, that would have otherwise been an automatic procedure.

During the downtime, 4,500 administrative/bankers perform manual input to the distributed system. The cost incurred for each individual performing manual input per hour is $186. Hence the total cost per hour, for all the individuals performing manual input is $837,000.

The total cost incurred for manual input during e-loan application downtime, for the current year is $ 845,845.

FIGURE 1-4

YEARLY GROWTH IN COST OF MANUAL INPUT DURING DOWNTIME OF E-LOAN APPLICATION TO ACHIEVE SLA ON DISTRIBUTED SYSTEM

17. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
18. % Increase (Decrease) In Number of Clinicians / Physicians Doing Manual Input		%	1.0	1.2	1.3	1.2	1.4
19. % Increase (Decrease) In Cost Per Hour (Fully Loaded) Administrative/Banker		%	2.0	2.0	2.0	2.0	2.0

Source: Wintergreen Research, Inc.

For years 2008 through 2012: the average number of bankers required for manual input to the e-loan system will increase by 1.0%, 1.2%, 1.3%, 1.2% and 1.4% for the respective years. This increase is calculated with respect to the previous years. The average cost per banker will increase by 2% every year.

FIGURE 1-5

TOTAL ANNUAL COST OF MANUAL INPUT DURING DOWNTIME OF E-LOAN APPLICATION TO ACHIEVE SLA ON DISTRIBUTED SYSTEM

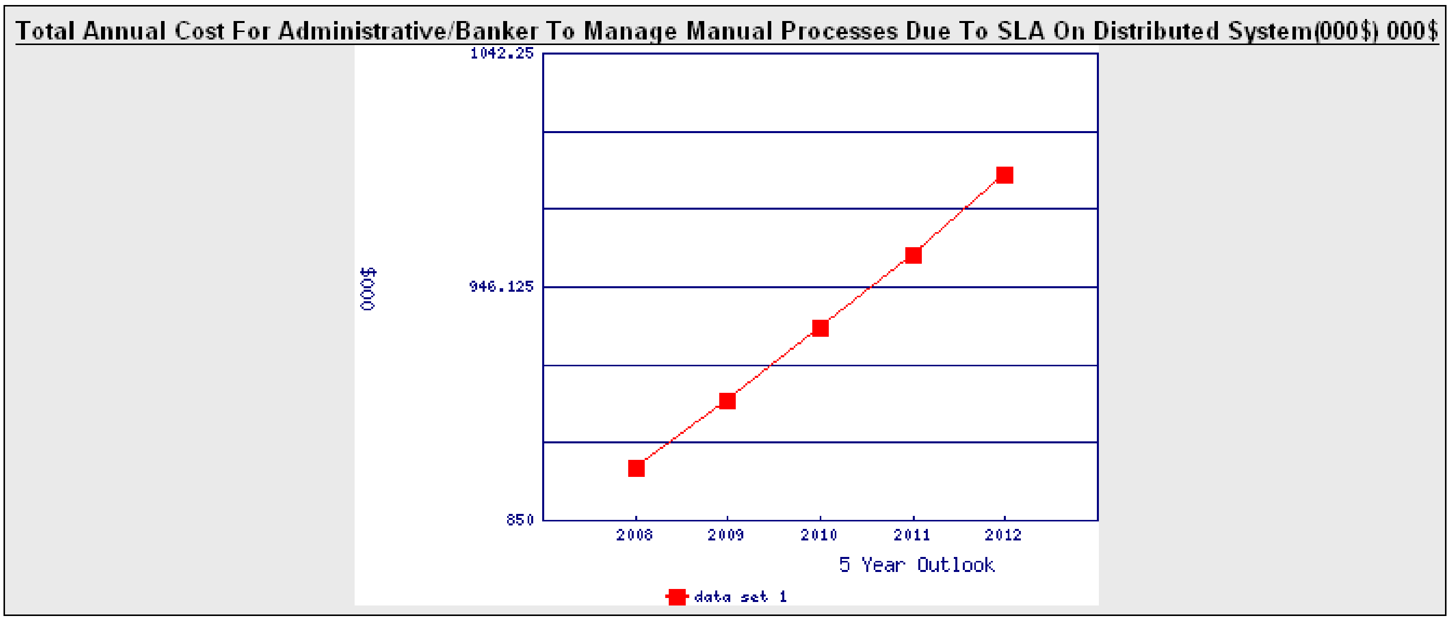
20. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
21. # Of Administrative/Banker Doing Manual Input	4,500.0	#	4,545.0	4,599.5	4,659.3	4,715.2	4,781.3
22. Dollars Per Hour (Fully Loaded) Administrative/Banker	186.0	$/hour	189.7	193.5	197.4	201.3	205.4
23. Cost Per Hour For All Administrative/Banker (Fully Loaded) Doing Manual Input	837,000.0	$/hour	862,277.4	890,077.2	919,681.2	949,331.7	981,874.8
24. Total Annual Cost For Administrative/Banker To Manage Manual Processes Due To SLA On Distributed System(000$)	**845.8**	000$	**871.4**	**899.5**	**929.4**	**959.4**	**992.3**

Source: Wintergreen Research, Inc.

The number of bankers performing manual input to the e-loan application distributed system, during downtime will thus increase to 4781.3 in year 2012.

FIGURE 1-6

FIVE YEAR OUTLOOK IN THE COST OF MANUAL INPUT DURING DOWNTIME OF E-LOAN APPLICATION TO ACHIEVE SLA ON DISTRIBUTED SYSTEMS



Source: Wintergreen Research, Inc.

The above graph depicts a five-year outlook - The total annual cost required for bankers to perform manual input to the e-loan application distributed system to achieve SLA will increase to $992,300 in 2012.

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1.2.2 Business Cost of SLA Downtime on Mainframe

Business Cost of SLA Downtime on Mainframe is less because the system is only down 5 minutes per year, a significant difference from 56 hours per year. A downtime in SLA on a mainframe system does not necessitate as much manual effort to keep the system running and restore the required SLA, as required in a distributed system. Here, a case study of e-loan application mainframe system in a bank is considered for analyzing the business cost incurred in the event of SLA downtime.

FIGURE 1-7

BUSINESS COST OF SLA DOWNTIME ON MAINFRAME SYSTEM

1. Manual Administrative / Banker Costs for SLA Downtime On Mainframe		
2. Name of Application -- E_Loan	Current	Unit
3. Analyst assumption, 2 nines of availability - 101.4 hours of downtime per year, , 3 nines of availability - 53.3 hours of downtime per year, 4 ni both numbers below--- E_Loan		
4. SLA Number of Nines Indicating Level of Availability	5.0	#
5. Hours of Downtime	0.001	Hours
6. % Downtime Administrative / Banker spends doing manual entry	8.0	%
7. Hours per Administrative / Banker Spent Doing Manual Entry to Track Loans As A Percent Of Downtime	0.0	$

Source: Wintergreen Research, Inc.

It is assumed that the e-loan application mainframe system has 5 nines of high availability and it corresponds to 0.001 hours of downtime per year. The banker spends just 8% of this downtime, performing manual entry, in order to restore the SLA.

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FIGURE 1-8

COST ANALYSIS OF MANUAL INPUT DURING DOWNTIME OF E-LOAN APPLICATION MAINFRAME SYSTEM

8. Application Outage Cost -- E_Loan Manual Input	Current	Unit
9. Number of Clinicians / Physicians Doing Manual Input to E-Referal	4,500.0	#
10. Dollars Per Hour (Fully Loaded) Administrative / Banker	186.0	$/hour
11. Cost Per Hour for All Clinicians / Physicians Doing Manual Input Due to Application Downtime	837,000.0	$
12. Cost Per Year of Administrative / Banker Manual Input Due to Application Downtime (hours of downtime times cost per hour)	67.0	$
13. Unit Conversation - $ to 000$	1,000.0	#
14. 000$ - Cost Per Year of Administrative / Banker Manual Input Due to E-Loan Application Downtime	0.1	000$

Source: Wintergreen Research, Inc.

During the downtime, 4,500 administrative/bankers perform manual input to the e-loan application mainframe system. The cost incurred for each individual performing manual input per hour is $186. Hence the total cost per hour, for all the individuals performing manual input is $837,000.

The total cost incurred for manual input during e-loan application downtime, for the current year is $67.

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FIGURE 1-9

YEARLY GROWTH IN COST OF MANUAL INPUT DURING DOWNTIME OF E-LOAN APPLICATION TO ACHIEVE SLA ON MAINFRAME SYSTEM

15. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
16. % Increase (Decrease) In Number of Clinicians / Physicians Doing Manual Input		%	1.0	1.2	1.3	1.2	1.4
17. % Increase (Decrease) In Cost Per Hour Fully Loaded Administrative / Banker		%	2.0	2.0	2.0	2.0	2.0

Source: Wintergreen Research, Inc.

For years 2008 through 2012 The average number of bankers required for manual input to the e-loan system during downtime will increase by 1.0%, 1.2%, 1.3%, 1.2% and 1.4% for the respective years. This increase is calculated with respect to the previous years. The average cost per banker will increase by 2% every year.

FIGURE 1-10

TOTAL ANNUAL COST OF MANUAL INPUT DURING DOWNTIME OF E-LOAN APPLICATION TO ACHIEVE SLA ON MAINFRAME SYSTEM

18. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
19. # Of Clinicians / Physicians Doing Manual Input	186.0	#	189.7	193.5	197.4	201.3	205.4
20. Cost Per Hour of Fully Loaded Clinicians / Physicians Doing Manual Input	837,000.0	$	0.0	0.0	0.0	0.0	0.0
21. Total Annual Cost For Clinicians Physicians To Manage Manual Processes Due To SLA On Mainframe (000$)	**0.1**	000$	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Source: Wintergreen Research, Inc.

The number of bankers performing manual input to the e-loan application mainframe system, during downtime will thus increase to 205.4 in year 2012.

The graphs in the **Wintergreen Research** ROI tool depict a five-year outlook - The total annual cost required for bankers to perform manual input to the e-loan application mainframe system to achieve SLA will remain zero.

1.3 SLA Analyst Comments

The availability and performance of IT infrastructure is vital to the functioning and continuity of any business. End users of the business service report most of the application interruptions or performance problems to IT. Information on the actions needed to be taken at the appropriate time must move across IT silos.

An availability management solution must be able to collect all the events and data from various systems, bring them together and analyze them at a central point.

A common platform, that integrates core IT processes, reduces the labor cost associated with managing IT services and increases the effectiveness of IT operations, is essential. Ensuring peak performance and availability, cost efficiently, through intelligent management software solutions will help meet and exceed both internal and external SLA and reduce total cost of ownership.

This enables a quicker problem diagnosis and helps reallocate resources to ensure seamless availability of a potentially failing process.

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1.3.1 Availability Management Solutions

The availability management solutions by MQSoftware, Tivoli, and BMC provide the lifeline for complicated e-businesses. These solutions constantly gather information on hardware, software and network devices, and, in many cases, rectify problems before they actually occur.

MQSoftware Qnami! is able to identify bottlenecks at the node level and prevent system failure before it happens. IBM Tivoli intelligent solutions monitor e-business at the component, business system and enterprise levels.

This technology identifies critical problems as well as minor error symptoms, and either notifies support staff with the appropriate message, or automatically fixes the problem, thereby reducing operating expenses and improving staff efficiency.

SteelEye Technology, Inc. is the leading provider of data and application availability management solutions for business continuity (BC) and disaster recovery on Linux and Windows. Despite growth in industry-wide adoption of formalized systems management, back up and disaster recovery plans designed to avert trouble before it occurs, the percentage of organizations that have had the necessity to invoke disaster recover plans stands at 45%.

Many organizations are still not prepared for an IT disaster. An international survey reported that on average, organizations have less than 48 hours to correct outages before the downtime becomes a potentially fatal issue. Organizations report that more than four hours of outage is disastrous.

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1.3.2 IBM WebSphere for z/OS Uses zSeries Platform Internal Error Detection

IBM WebSphere for z/OS uses the zSeries platform's internal error detection and correction internal capabilities. WebSphere for z/OS has recovery termination management that detects, isolates, corrects and recovers from software errors. WebSphere for z/OS can differentiate and prioritize work based on service level agreements. It offers clustering capability as well as the ability to make non-disruptive changes to software components, such as resource managers.

In a critical application, WebSphere for z/OS can implement a failure management facility of z/OS called automatic restart manager or ARM. This facility can detect application failures, and restart servers when failures occur. WebSphere uses ARM to recover application servers. Each application server running on a z/OS system is registered with an ARM restart group.

IBM WebSphere solutions enable clients to leverage their existing and newly created assets to participate in an SOA by abstracting the individual complexities of their applications and systems into a more meaningful business representation. This means that although the underlying technologies might change (such as applications, data sources, middleware, IT vendors and suppliers) the business view of the assets can remain stable. Conversely, the business view of the assets can change whenever the business deems necessary—allowing for business flexibility— independent of the technology changes.

WebSphere for z/OS can implement a feature called clustering. Clustering technology is used extensively in high availability solutions involving WebSphere.

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1.4 Distributed Server (99.9%) System Availability Is 56 Hours Of Downtime Per Year

A distributed server cluster consists of multiple copies of the same component with the expectation that at least one of the copies will be available to service a request. In general, the cluster works as a unit where there is some collaboration among the individual copies to ensure that the request can be directed toward a copy that is capable of servicing the request.

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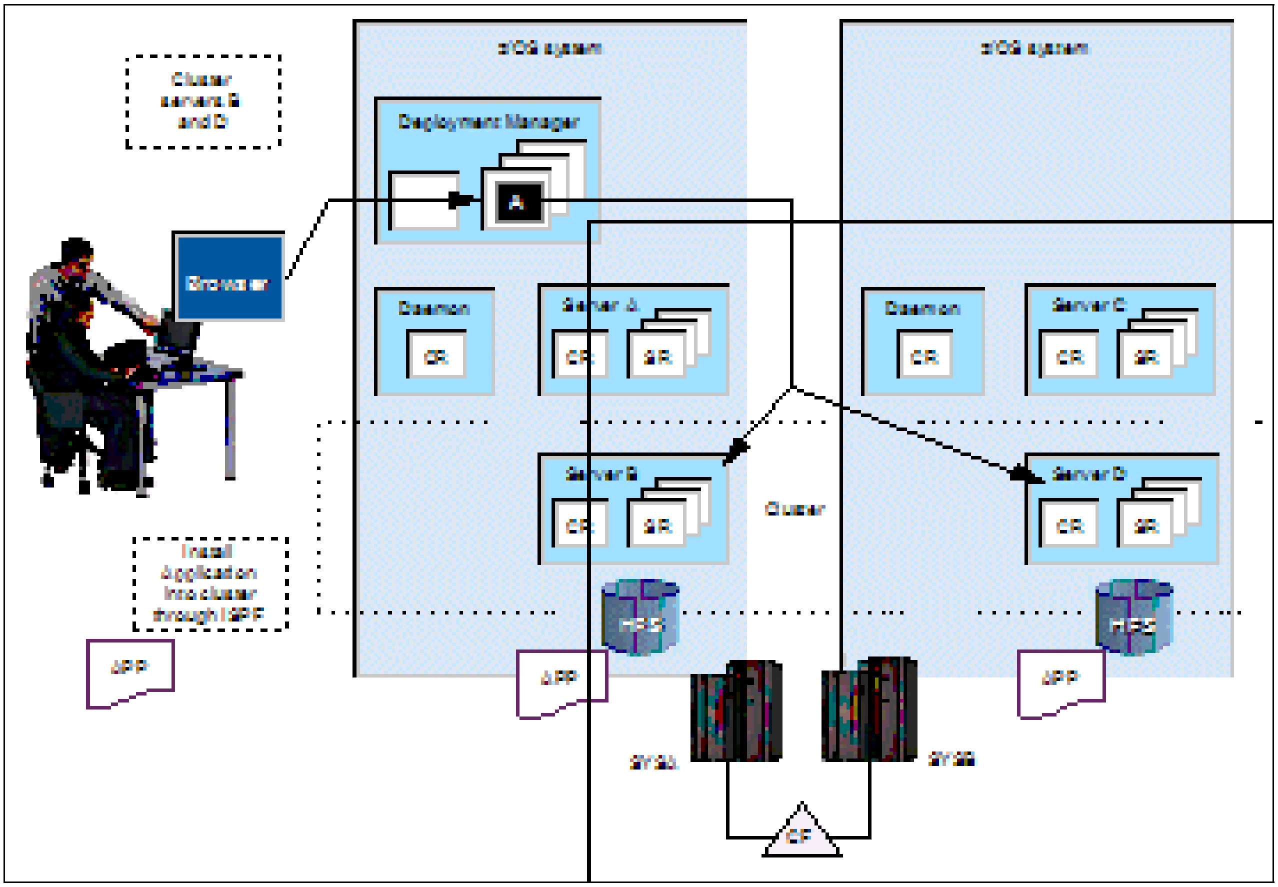
FIGURE 1-11

CLUSTER MANAGEMENT ACHIEVES SERVICE LEVELS OF AVAILABILITY



Source: Wintergreen Research, Inc.

Designers of a high availability solution participate in establishing a service level as they determine the number and placement of individual members of clusters. WebSphere for z/OS provides management for some of the clusters needed to create the desired service level.

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Greater service levels of availability can be obtained as WebSphere clusters are supplemented with additional cluster technologies.

1.4.1 Clustering Of Servers In A Cell

A WebSphere Application Server cluster is composed of individual cluster members, with each member containing the same set of applications. In front of a WebSphere Application Server cluster is a workload distributor, which routes the work to individual members.

Clusters can be vertical within an LPAR (that is, two or more members residing in a z/OS system) or they can be placed horizontally across LPARs to obtain the highest availability in the event an LPAR containing a member has an outage.

Workload in this case can still be taken on from the remaining cluster members. Also within these two configurations, it is possible to have a hybrid in which the cluster is composed of vertical and horizontal members.

1.4.2 Vertical And Horizontal Clusters

Vertical clustering is used to check the dispatching efficiency of a single system. In a vertical cluster, the servers compete with each other for resources.

The complexity of enterprise computing environments is staggering. Whether measured by the number of databases, the pace of new application deployment, the drive toward real-time business intelligence or the demanding service-level requirements, IT organizations have their hands full.

Each new application brings its own data, including some that may overlap with data in other application domains and must therefore be synchronized. Business intelligence applications must now support tactical decisions based on real-time data. And businesses are driven to increase data redundancy not only for availability, but also for regional performance and low-cost capacity. Addressing these data placement requirements mandates an efficient solution that can minimize impact to computer systems, applications, and networks. IBM WebSphere Replication Server and IBM WebSphere Data Event Publisher enable changed data capture and data replication solutions.

1.5 Running The Distributed Servers At 50% Utilization

IT departments start out thinking they can run the distributed servers at 50% utilization, but when the first spike brings the data center cluster to a grinding halt, they back off a little, and the second spike that has that effect of slowing the web services to a crawl, makes the IT department back off more, and so forth until in reality distributed servers generally run at 15% utilization.

Translated, it means significant unused, wasted computing capacity — that is, idle inefficiency is part of the data center implementation.

Consider also the labor costs. Add servers, and you must add staff to manage them. New distributed technology requires new skills, because there is new programming involved. These additional labor costs can far exceed the cost of hardware and software licensing combined.

1.5.1 Disaster Recovery On Linux And Windows

Data and application availability management solutions are being further evolved for business continuity and disaster recovery on Linux and Windows. WebSphere service level availability application server-focused distributed server data replication, high availability, clustering, data storage, and disaster recovery solutions are targeted to the Linux and Unix systems on distributed servers.

WebSphere application-focused distributed server data replication, high availability clustering and disaster recovery solutions metrics describe the costs of achieving reduced downtime in a distributed server environment. Labor and management costs to achieve WebSphere high availability and scalability on distributed systems frequently represent 50% to 70% of the total systems cost.

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1.5.2 Windows, Unix, Linux, or Intel servers High Availability (HA) Clustering Solutions

Combining commodity Unix, Linux, or Intel servers running Windows or Windows with High Availability (HA) clustering solutions includes a labor component to achieve quickly replacing malfunctioning boards. Businesses can achieve 99.999% uptime for business critical applications using Linux or Unix. The issue is the cost for system aspects relative to a mainframe system, as discussed further in this analysis.

Technician tasks for managed components on distributed servers for WebSphere include clustering, clustering membership, and service level availability, registration and un-registration, protection group management, event/message control, establishing event/message priorities, event/message ordering, guaranteed message delivery, persistence on distributed servers for WebSphere; technician tasks, means of achieving load distribution, clustering, adding, removing and enumerating members, lock, unlock and shut down a cluster or a cluster node on distributed servers for WebSphere

1.5.3 Distributed Systems Churning The Databases

One real problem with distributed systems is that they are churning the databases as they try to achieve backup. vData gets copied from one place to another. Applications alone illustrate the value of the mainframe. The mainframe will use a lot less processing power because the database is much more efficient with less churn.

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1.5.4 Server Dysfunction Attributable To Shared Memory Space

Another aspect of the difference between the memory environments of the distributed servers and the mainframe is the ability to prevent attempts to overwrite memory space currently being used. The mainframe has far more sophisticated systems in place to prevent failures that are almost impossible to detect because the failure is the result of a process resident in memory that was dislodged by another process that took the same memory space.

Once the process is dislodged, it is almost impossible to go back and see what was happening before the machine crashed. Systems that do that on distributed server create enormous overhead.

Server dysfunction attributable to shared memory space is a significant aspect of the difference between 3 nines (99.9%) of availability on the servers and five nines (99.999%) availability on the mainframe.

1.5.5 Analyst Assumptions

The analyst assumptions here are that availability and reliability can be equally high at five nines (99.999%), the same for mainframe, Unix/Linux, or Intel servers, but that the costs to achieve high availability on the different platforms are different. For example, the mainframe is a robust platform, with thousands of systems providing less that 5 minutes of downtime per year all over the world, every year.

Costs are relative to cluster and data backup software support for distributed servers. Outages, when they do occur are more difficult to recover from with distributed systems, creating cost centers to retrieve misplaced transactions. Bottlenecks have the same difficulties.

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1.6 Optimization of WebSphere Applications For z/OS

The underlying technology associated with applications like IBM WebSphere application server is nearly identical on each platform. As a result, standard applications can be developed in the same manner for z/OS as they are for distributed environments, but they need to be optimized to leverage the ROI achieved from shared workload.

But, consider a total distributed environment, with available on-the-floor capacity encompassing storage, testing, production and disaster recovery. Accommodating this capacity requires scaling up with more servers.

The distributed servers are less efficient and require additional software to run on them to gain reliability and disaster recovery capability. Consider the necessary inefficiencies of a server environment. Since companies need to over-configure their systems for spikes, disaster recovery and the like, servers may run at about 20 - 30 % of capacity, but more often at 5% to15% utilization, the mainframes are significantly more efficient than the distributed servers overall.

1.7 Mainframe vs. Distributed System - Server Core Limitations And Secondary Cache Memory Issues

Distributed server core and secondary cache memory is not always available where and when it is needed; instead it is locked in the server and cannot be distributed. On the mainframe the advantage is that shared workload depends on shared core and cache memory accessible at backbone speeds to any processor that needs it.

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The distributed servers are optimized to fail over to one other server. Each server is typically configured with core processors that have 64KB Level one cache memory. Level 2 cache is 9MB at the high end. There is an affinity between two distributed servers that optimizes the fail-over. But, the affinity stops there. Distributed servers are not able to achieve shared workload optimization in the manner that a mainframe can.

When the fail over and load balancing aspects of an application server are implemented for the distributed systems, the affinity servers work very efficiently together, but they do not share memory with other servers in the group beyond the two affinity servers.

Thus, when there is additional capacity needed between servers, the systems are limited by memory. There may be excess memory sitting in other servers, but the servers that need the memory cannot access it. This is an inherent limitation that is solved by the mainframe.

The mainframe is optimized to manage large shared workloads. There is a significant difference in the memory configurations of the two types of systems – mainframe vs. distributed and this impacts the ROI. The mainframe has 512 Kb of level one cache that can be shared between any workloads. This is divided as 256 Kb for data and 256Kb for instructions as the level one processing level. This configuration is true for Z OS shared workload and for virtual Linux servers running on Z.

With the mainframe, if there is peak demand on a particular part of the system, resources from other applications or other virtual servers are automatically reallocated to the part of the system that is seeing peak demand. This creates significant process efficiency.

1.7.1 Application Integration Market Trends

IT managers in the enterprise use EAI improve the efficiency of internal network communication and implement external B2B and Internet exchange operations using application integration. Vendors are implementing return on investment tools that operate in the background to gather metrics that prove the efficiency of the integration systems.

TABLE 1-12

NETWORK BUSINESS INTEGRATION (BI)

- Integration of servers
- Implementation of clustered and grid systems
- Means to leverage blade technology
- Address business needs of workers and partners
- Achieve efficient information access for management
- Implement enterprise-wide communication
- Leverage virtual private network technology (VPN) for communication over the Internet
- Tie together back end systems
- Tie back end systems to front end systems
- Leverage efficiency of front-end systems
- Create greater access to computer telephony integration and call center help desk systems
- Support business process systems automation
- Implement business exchanges

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TABLE 1-12 (CONTINUED)

NETWORK BUSINESS INTEGRATION (BI)

- Implement B2B systems
- Permit businesses to achieve a level of integration that improves business efficiency.

Source: WinterGreen Research, Inc.

Networks have made the integration systems an essential aspect of doing business. Businesses rely on significant integration of servers to address the business needs of division, partners, distributors, and other affiliated groups to achieve efficient information access, enterprise-wide communication, and business process systems automation. Application integration (EAI) permits businesses to achieve a level of integration that improves business efficiency. Table 1-12 illustrates networked business systems integration.

1.7.2 Co-existence of Mainframe and Distributed Computing Environments

Information systems of many large organizations have evolved from traditional mainframe-based systems to include distributed computing environments. This evolution has been driven by the benefits offered by distributed computing.

Lower incremental technology costs, faster application development and deployment, increased flexibility, and improved access to business information are the benefits of distributed computing.

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Large-scale mission-critical applications enable and support fundamental business processes. Airline reservations, credit card processing, and customer billing and support systems, have largely remained in mainframe environments.

The high levels of reliability, scalability, security, manageability and control required for this complex, transaction-intensive systems have been provided by application server functionality included in the mainframe operating system.

Mainframe environments offer flexibility, better development environments, and improved maintenance cycles. The previously limited, character-based user interfaces are being improved for the Nintendo generation.

The coexistence of distributed and mainframe computing creates a need for enterprise application integration. Shortcomings of each type of system have forced organizations to seek EAI solutions. These enable overcoming the limitations of distributed computing for mission-critical applications, while providing access to the robust computing infrastructure from outside the mainframe environment.

1.7.3 Internet Impact

The Internet is an element of enterprise infrastructure. Businesses use the Internet as a channel to move product and partner. The Internet provides a means of selling products to consumers and distributors, buying components, or whole products from suppliers, opening new customer accounts, scheduling service installation, providing account information and customer care, enabling reservations, funds transfers, bill payments and securities trading, and gathering information about customers and their buying habits.

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1.7.4 SLA- Analysis Of Costs Needed To Achieve 5 Nines (99.999%)System Availability And Costs Of 3 Nines (99.9%) Of Availability

Analysis of costs to achieve the required 99.999% service level availability in distributed and mainframe systems involves an understanding of the importance and relevance of service level availability and the total labor, software and business costs incurred for both the systems.

1.7.5 (99.999%) System Availability Is Five Minutes Of Downtime Per Year

1.7.6 (99.9%) System Availability Is Fifty Six Hours Of Downtime Per Year

The difference in system reliability has significant costs associated with it.

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1.7.7 System z9 Provides 99.999% Reliability

System z9 provides 99.999% reliability built on IBM mainframe 41-year heritage as a secure-rich system. Advanced hardware stability and reliability contribute to the experience of 9 or more years of continuous operation by leading banking organizations. The System z9 provides advanced protection against internal and external risks.

Enterprise application servers are evolving to play a more vital role in the data center. With this increased responsibility comes increased risk. Business integration, globalization, collaboration are just three factors that are driving the need for organizations to focus on ensuring availability of business critical applications. No longer can system downtime be measured in hours or days, when business success and customer loyalty are measured in minutes and seconds.

1.8 WebSphere Service Level Availability Analysis -- Mainframe Vs. Distributed Server Analysis

Data and application availability management solutions are for business continuity and disaster recovery. WebSphere service level availability application server-focused mainframe and distributed server data replication, high availability, clustering, data storage, and disaster recovery solutions can be described in metrics that translate toROI different for each application in each IT department.

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TABLE 1-13

REAL TIME APPLICATION SERVICE LEVEL AVAILABILITY ANALYSIS -- MAINFRAME VS. DISTRIBUTED SERVER ANALYSIS TOPICS

- Availability Downtime Per Year
- Distributed systems support high availability that reaches to 55 minutes of downtime for an entire year, for both planned and unplanned outages
- High availability clustering software solutions are needed for Windows and Linux on Intel servers
- Integrated monitoring and detection of problem at node and individual service level
- Recovery in-node and across-node
- Transparency to client connections of server-side recovery
- Protection for planned and unplanned downtime
- Off-the-shelf protection for wide range of applications, databases, and infrastructure
- Data replication challenges are solved and risk is eliminated. Data Replication offers users the ability to protect data more quickly and efficiently than traditional, standalone backup technologies.

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TABLE 1-13 (CONTINUED)

REAL TIME APPLICATION SERVICE LEVEL AVAILABILITY ANALYSIS -- MAINFRAME VS. DISTRIBUTED SERVER ANALYSIS TOPICS

- Ability to pause the replication process allows IT departments to combine replication and backup technologies into a single integrated, low latency solution. By performing real-time replication in conjunction with periodic tape backups, users can quickly migrate online backups to media suitable for long-terms storage while retaining the immediate availability of data in the event of a local failure.

- Automated application monitoring, failover and fail back, are supplemented with data replication that provides an immediate path towards achieving higher availability.

- Windows with High Availability (HA) clustering solutions that include a labor component to quickly replace malfunctioning boards, businesses can achieve 99.999% uptime for business critical applications.

- Technician tasks include registration and un-registration, protection group management,

- Technician tasks include event/message control, establishing event/message priorities, event/message ordering, guaranteed message delivery, persistence on distributed servers for WebSphere application server

- Technicians tasks include means of achieving load distribution, clustering, adding,

Source: Wintergreen Research, Inc.

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TABLE 1-14

REAL TIME APPLICATION SERVICE LEVEL AVAILABILITY ANALYSIS -- MAINFRAME VS. DISTRIBUTED SERVER ANALYSIS FUNCTIONS

- Supports a wide range of data storage subsystems and configurations
- Has ability to use heterogeneous solution components
- Supports more than two nodes within a cluster
- Support for Active/Active and Active/Standby configurations
- Ability to easily protect custom business applications without requiring reengineering
- Ease of deployment and administration
- Replication of data at the block level allows those blocks to be user defined. Users can decide to mirror in increments as small as a single byte, and most importantly select to replicate only changed data in order to minimize the impact of systems and network bandwidth.
- This involves knowing what processes are running simultaneously and what needs to be allocated as blocks.
- Data replication enables users to define how and when data is mirrored, with facilities continuous, periodic and scheduled replication, as well as synchronous or asynchronous replication.
- Change logging, synchronization of disks is fast and dependable.

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TABLE 1-14 (CONTINUED)

REAL TIME APPLICATION SERVICE LEVEL AVAILABILITY ANALYSIS -- MAINFRAME VS. DISTRIBUTED SERVER ANALYSIS FUNCTIONS

- Local backup and recovery is achieved with a variety of automated backup procedures that eliminate the need to disrupt daytime work activity, or schedule lengthy midnight backup sessions.

- In addition to enabling fast efficient data protection, and low-latency restoration of data for users, cluster ready means that as business needs evolve over time, IT organizations can scale their level of high availability protection with cluster monitoring, failover and disaster recovery capabilities across a broad range of application and database environments.

- Application-focused data replication, high availability clustering and disaster recovery solutions are easy to deploy and operate, and enable enterprises of all sizes to ensure continuous availability of business-critical applications, servers and data.

- Solutions are proven in the most demanding of environments and are integrated to deliver flexibility, scalability and a fast return on investment.

- Enterprise application servers are evolving to play a more vital role. With this increased responsibility comes increased risk. Business integration, globalization, collaboration are just three factors that are driving the need for organizations to focus on ensuring availability of business critical applications. No longer can system downtime be measured in hours or days, when business success and customer loyalty are measured in minutes and seconds.

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TABLE 1-14 (CONTINUED)

REAL TIME APPLICATION SERVICE LEVEL AVAILABILITY ANALYSIS -- MAINFRAME VS. DISTRIBUTED SERVER ANALYSIS FUNCTIONS

- IT use of distributes servers to host application servers depends on the availability of significant improvements in server, storage and network architectures. Growing transaction volumes and complex application and database integration serve to maintain a relatively high risk of failure, creating need for the reliability and scalability provided by the mainframe.

- Solution by combining commodity Unix, Linux, or Intel servers running Windows or removing and enumerating members, lock, unlock, and shut down a cluster or a cluster node

- Technician tasks include checkpoint services, checkpoint replicas, checkpoint data access, reads, writes, updates, and deletes, and saving state for WebSphere service level availability on distributed servers

- Technician tasks include providing synchronous updates and asynchronous updates on distributed servers for WebSphere

- Technician tasks include deciphering trace messaging manager, decipher log manager for messaging, and manage scheduling

- Based on 5 nines 99.999% high availability service level

- Average number of outages per month (#)

TABLE 1-14 (CONTINUED)

REAL TIME APPLICATION SERVICE LEVEL AVAILABILITY ANALYSIS -- MAINFRAME VS. DISTRIBUTED SERVER ANALYSIS FUNCTIONS

- Want to calculate the average efficiency plus a weighting factor to give more weight to particular characteristic over another. I for example, the I/O is less significant factor, that is given a lower weight in the weighing calculation (which are ranked arbitrarily fro 1 to 10,with one being the least weight and 10 the highest weight. Etc. Weigh each factor. Want to give a weight from 1 to 10 on each %.

- After the weighting process is complete, calculate the average efficiency of each system. So have 20% * 80% /2 to get average. So I multiply the 20% by 8 and the 80% by 5 before I calculate the average to get the weighted average.

- # technicians for 24 x 7 operation, 3 shifts per weekday, 5 technicians per shift, 3 technicians per week end shift. 15 to cover the week, 6 to cover the weekend.

- * for mainframe # technicians for 24 x 7 operation, 3 shifts per weekday, 2 technicians per shift, 1 technicians per week end shift. 2 to cover the week, 1 to cover the weekend.

- Log manager requires 450 technician minutes for each minute of downtime to trace misplaced transactions after outage

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TABLE 1-15

HIGH AVAILABILITY DOWNTIME

- # Nines Amount of Downtime
- Five Nines 99.999 5 min
- Four Nines 99.99 12 hours
- Three Nines 99.9 56.2 hours
- Two Nines 99.8 67.5 hours
- One Nine 99.2 99.9 hours

Source: Wintergreen Research, Inc.

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TABLE 1-16

FUNCTIONS OF HIGH AVAILABILITY

- Registration and un-registration of managed components
- Health monitoring
- Protection group management
- Error Reporting
- Event/Message Control
- Providing guaranteed delivery
- Event/message priorities
- Event/message ordering
- Retention time
- Persistence
- Message queues
- Load distribution
- Clustering
- Cluster membership adding, removing and enumerating members
- Lock, unlock and shut down a cluster node
- Lock, unlock and shut down a cluster
- Providing Checkpoint Services

TABLE 1-16 (CONTINUED)

FUNCTIONS OF HIGH AVAILABILITY

- Saving state
- Checkpoint replicas
- Checkpoint data access   reads, writes, updates, and deletes
- Synchronous update
- Asynchronous update

Source: Wintergreen Research, Inc.

IT systems and information are critical to the efficient functioning of an enterprise. The cost of downtime runs to millions of dollars. In this context, continuous and seamless business operation is paramount. Availability in distributed systems does not exceed three nines. This amounts to 56 hours of down time per year.

1.8.1 Cost Comparison, Presuming High 99.999% Availability For Both Mainframe And Distributed Systems

Achieving a high availability of 99.999% for both mainframe and distributed systems depends on leveraging the particular strengths of a system. The mainframe systems depend on leveraging the systems aspects dedicated to managing shared workload, while the distributed servers need significant software middleware, security appliances, and systems monitoring to achieve high availability, creating a server that is in no way cost competitive with the mainframe.

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In distributed systems, the server core and secondary cache memory are not always available where and when they are needed; instead memory is locked in the server and cannot be distributed. In mainframe systems, the cache memory is accessible through a backbone, to any processor that needs it at any time.

In distributed and mainframe systems, there may be attempts to overwrite memory space currently being used. This results in failures in the distributed environments but is managed by the mainframe. The mainframe is sophisticated enough to prevent such failures that cannot be easily detected by the user or administrator.

Once memory is overwritten, it is close to impossible to recover from the system crash, without loss of important data. Separate expensive disaster recovery centers may need to be established to attempt recovery of lost data. This is a major drawback of distributed systems.

In distributed systems, failures increase administrative costs as administrators try to identify the root-cause of the problem and troubleshoot it. This process is time consuming. An outage leads to loss of revenue either from customers or in terms missed employee work. Hence, server dysfunction attributable to shared memory space is a significant aspect of the difference between the distributed and mainframe systems.

Many z/OS customers have business requirements for continuous system availability. System down time or unplanned outages, even of short duration, can cost millions of dollars in lost revenue or other significant negative business impact. z/OS customers do not think about availability in terms of having an outage; they think in terms of maintaining systems capability continuously.

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On a distributed platform, unscheduled outages occur for several reasons, including power failures, computer viruses, natural disaster, or product/platform failures. There are steps that can be taken to avoid such outages, usually by configuring redundant portions of the server environment.

This significantly reduces the capacity available on the floor -- often servers are configured at about 10% utilization. Inadequate preparations can lead to downtime costs that are much more severe than the costs to avoid them. The costs involved in these preparations are very high.

For instance, presuming a mainframe system solution, the incremental hardware, software and people costs for one application in a shared workload environment are $30,000/year. This solution cost is dominated by software costs. For a comparable distributed system single application solution, the incremental costs are typically $1.6M to $2.4M/year. These solutions are dominated by people cost. In addition, unscheduled and scheduled outage costs can typically add $1M to $2M to a distributed system.

System z running z/OS is the best platform for Java/Websphere/DB2 applications with the lowest Total Cost of Ownership (TCO).

1.9 Data Center Outages

Preparing for data center outages is no longer optional. Server and application failures, site outages, natural disasters, and even simple human error can represent a serious threat to business operations and service levels. After all, data centers bear the responsibility for managing and protecting a company's most valuable asset—its data.

Enterprise application servers are evolving to play a more vital role in the data center. With this increased responsibility comes increased risk. Business integration, globalization, collaboration are just three factors that are driving the need for organizations to focus on ensuring availability of business critical applications. No longer can system downtime be measured in hours or days, when business success and customer loyalty are measured in minutes and seconds.

Technician tasks for managed components on distributed servers for WebSphere include clustering, clustering membership, and service level availability, registration and un-registration, protection group management, event/message control, establishing event/message priorities, event/message ordering, guaranteed message delivery, persistence on distributed servers for WebSphere; technician tasks, means of achieving load distribution, clustering, adding, removing and enumerating members, lock, unlock and shut down a cluster or a cluster node on distributed servers for WebSphere

1.9.1 Distributed Server High Availability

While performing regularly scheduled backups protects against many types of data loss, backup provides only one layer of availability that businesses need to guard against downtime. Clustering can be used to guard against component failure while ensuring application availability and avoiding substantial downtime.

Replication can be used to protect against substantial data loss. Both replication and clustering are vital to retrieving the critical applications of a business operation in the event of a disaster.

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Clustering protects against server, application, and database downtime by eliminating the single point of failure found within a single server. Clustering eliminates the need for additional application servers in the data center to otherwise guarantee availability.

Replication is designed to copy data to another location to protect it from disasters. Many replication tools allow organizations to replicate their data across disparate storage devices, over a standard IP connection, and across any distance.

1.9.2 Validation and Testing

Data replication and application clustering help protect IT and business operations in the event of a site outage or other event. Yet because application and storage configurations change so frequently and most organizations simply lack the time or budget for testing their infrastructure, the effectiveness of these tools can fall short of meeting the availability needs of the business.

Testing is often difficult and time-consuming, hardware resources are scarce, and there is virtually no way to avoid at least some level of disruption to the production environment when testing a business continuity or recovery plan.

At the same time, testing presents significant advantages to businesses. Organizations that test their recovery plans gain a more complete and accurate picture of their plan's and can identify (and make needed changes to) the plan before disaster strikes.

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Consequently, it is critical that companies test, plan, and validate recovery scenarios in production without disruption. This includes verifying that applications are migrated to the most appropriate server based on planned failover strategy, and testing those strategies on any desktop or laptop computer.

Because it is also important to plan for optimal bandwidth when replicating data between sites, testing a recovery plan also includes analyzing the organization's network environment over a period of time to determine how much data is being written, and, in turn, establishing optimal bandwidth recommendations based on activity and specific parameters.

To complete the recovery plan test, replicated data as well as applications are validated, as are any new data, hardware, or application configurations. Automated tools make this simple. It brings up a database or application to make sure the application is capable of coming online as the secondary in case of a fault at a primary site.

Space-optimized snapshots can be used for bringing applications online at a secondary site, enabling organizations to test their recovery plan without having a complete extra copy of data. When testing is complete, the snapshot is destroyed so that the disk space can be available for future tests.

Organizations continue to work to defend the availability and performance of critical data and applications. By leveraging tools to apply best-practice approaches for optimizing performance and ensuring availability, organizations not only protect against costly downtime, but they also safeguard the quality of service their customers demand in today's highly competitive business environment.

As organizations continue to evolve their multi-tier information architectures, Intel-based servers are increasingly being deployed to support business critical applications. Not only are departmental applications, such as messaging and collaboration evolving to play a more vital role, dramatic increases in the price/performance of Intel servers are also enabling them to take the place of proprietary, and more expensive RISC-based technology.

With this increased responsibility comes increased risk. Business integration, globalization, collaboration are just three factors that are driving the need for organizations to focus on ensuring availability of business critical applications. No longer can system downtime be measured in hours or days, when business success and customer loyalty are measured in minutes and seconds.

1.9.3 Intel Servers Intersect With Growing Transaction Volumes And Complex Application And Database Integration Serve To Maintain A Relatively High Risk Of Failure

IT use of distributed servers depends on the availability of significant improvements in server, storage, and network architectures. Growing transaction volumes and complex application and database integration serve to maintain a relatively high risk of failure, creating need for the reliability and scalability provided by the mainframe.

Unfortunately, despite significant improvements in server, storage and network architectures, growing transaction volumes and complex application and database integration serve to maintain a relatively high risk of failure.

By combining enterprise servers and clustering solutions, businesses can achieve between 99% and 99.9% uptime for business critical applications at a fraction of the cost historically associated with proprietary RISC-based systems. For instance, commodity Intel servers running Windows or Windows can be combined with high availability (HA) clustering solutions.

1.9.4 Mainframe and Distributed Systems Service Level Availability (SLA) Cost Differential

The purpose of the online ROI section is to explain and analyze the cost differential between the mainframe and distributed systems for the following while achieving the required levels of service level availability (SLA): By using an online ROI tool, users can create scenarios and input their own metrics, creating a realistic picture of what is going on in a particular IT department. Following is a summary of the analyst assumptions.

TABLE 1-17

MAINFRAME AND DISTRIBUTED SYSTEMS SERVICE LEVEL AVAILABILITY (SLA) COST SUMMARY PAGE METRICS

- Labor costs for hardware technicians to create systems that do not go down
- Labor costs for software developers to create systems that do not go down
- Software costs
- Cost of downtime because of impact on professionals
- Cost of downtime because of lost business
- Cost of downtime because of negative impact on brand

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- Cost of downtime because of technician and developer costs to get system up and running again

Source: Wintergreen Research, Inc.

FIGURE 1-18

WORKING OUT THE COST DIFFERENTIAL FOR MAINFRAME AND DISTRIBUTED SYSTEMS SERVICE LEVEL AVAILABILITY (SLA)

3. SLA - Distributed Server Cost Analysis	Initial	Unit	2008	2009	2010	2011	2012
4. Labor Costs For Hardware Technicians Needed to Achieve SLA On Distributed System	288.0	(000)$	296.7	306.3	316.4	326.7	337.8
5. Labor Costs For Software Developers Needed to Achieve SLA On Distributed System	345.0	(000)$	355.4	366.9	379.1	391.3	404.7
6. Costs of Software Needed to Achieve SLA On Distributed System	147.4	(000)$	26.5	26.5	26.5	26.5	26.5
7. Business Cost of SLA Downtime On Distributed System	845.8	(000)$	871.4	899.5	929.4	959.4	992.3
8. Total Labor, Software, and Business Costs to Achieve SLA On Distributed System	**1,626.2**	(000)$	**1,550.0**	**1,599.2**	**1,651.5**	**1,703.8**	**1,761.3**
9. SLA - Mainframe Cost Analysis	Initial	Unit	2008	2009	2010	2011	2012
10. Labor Costs For Hardware Technicians Needed to Achieve SLA On Mainframe	1.4	(000)$	1.4	1.5	1.5	1.6	1.6
11. Labor Costs For Software Developers Needed to Achieve SLA On Mainframe	3.0	(000)$	3.1	3.2	3.3	3.4	3.5
12. Costs of Software Needed to Achieve SLA On Mainframe	3.0	(000)$	0.1	0.1	0.1	0.1	0.1
13. Business Cost of SLA Downtime On Mainframe	0.1	(000)$	0.0	0.0	0.0	0.0	0.0
14. Total Labor, Software, and Business Costs to Achieve SLA On Mainframe	**7.5**	(000)$	**4.6**	**4.8**	**4.9**	**5.1**	**5.3**
15. Cost Differential	Total	Unit	2008	2009	2010	2011	2012
16. Cost Differential For Labor and Software To Achieve Service Level Availability On Mainframe vs. Distributed Systems	**1,618.8**	(000)$	**1,545.4**	**1,594.4**	**1,646.5**	**1,698.8**	**1,756.1**

Source: Wintergreen Research, Inc.

As shown in the figure above the cost differential between the Distributed Server and Mainframe is calculated by adding the respective cost contributors and subtracting the total Mainframe cost from the total Distributed Server cost.

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Labor is a significant aspect of the return on investment analysis, generally accounting for 50% to 70% of IT costs. The most significant aspect of achieving reliability on the distributed servers is the reliability of systems. When there is downtime, analysts calculate a cost of $1 million per minute. If there are 53 hours of downtime on distributed systems vs. 5minutes of downtime on a mainframe, the cost differentials are significant. For the one application illustrated here, Even calculating that the system forced professionals to do manual process for one hour per year, (out of the 53 hours of downtime per year), and making the conservative assumption that only one third of the professionals are impacted (this application is used by all professionals in the organization many times per hour), the cost to the enterprise is $1 million per year for downtime on this one very small application that runs on 13 servers. This organization has 15,000 servers.

1.9.5 Distributed Server Service Level Availability SLA Cost Analysis

Distributed server service level availability SLA cost analysis relates to the variable costs associated with keeping the IT systems running reliably and to the costs of downtime to the enterprise organization.

FIGURE 1-19

DISTRIBUTED SERVER COSTS

3. SLA - Distributed Server Cost Analysis	Initial	Unit	2008	2009	2010	2011	2012
4. Labor Costs For Hardware Technicians Needed to Achieve SLA On Distributed System	288.0	(000)$	296.7	306.3	316.4	326.7	337.8
5. Labor Costs For Software Developers Needed to Achieve SLA On Distributed System	345.0	(000)$	355.4	366.9	379.1	391.3	404.7
6. Costs of Software Needed to Achieve SLA On Distributed System	147.4	(000)$	26.5	26.5	26.5	26.5	26.5
7. Business Cost of SLA Downtime On Distributed System	845.8	(000)$	871.4	899.5	929.4	959.4	992.3
8. Total Labor, Software, and Business Costs to Achieve SLA On Distributed System	**1,626.2**	(000)$	**1,550.0**	**1,599.2**	**1,651.5**	**1,703.8**	**1,761.3**

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Source: Wintergreen Research, Inc.

1.9.6 Distributed Server costs comprise the following components:

TABLE 1-20

COST ANALYSIS FOR DISTRIBUTED SERVER SLA

- Labor Costs for Hardware Technicians Needed to Achieve SLA on Distributed System
- Labor Costs for Software Developers Needed to Achieve SLA on Distributed System
- Costs of Software Needed to Achieve SLA on Distributed System
- Business Cost of SLA Downtime on Distributed System

Source: Wintergreen Research, Inc.

1.9.7 Labor Costs for Hardware Technicians Needed to Achieve SLA on Distributed System

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FIGURE 1-21

COST FOR HARDWARE TECHNICIANS TO DISTRIBUTED SYSTEM SLA MANAGEMENT METRICS

2. Analyst Metric To Set Stage For SLA Hardware Calculation	Current	Unit
3. # of Applications	1.0	#
4. Current Labor Costs for Hardware Technicians to Achieve SLA on Distributed System	Current	Unit
5. Average Annual Costs Per Hardware Technician To Manage SLA on Dedicated Servers (annual fully loaded cost)	180.0	000$
6. # Full Time Hardware Technicians To Manage Distributed Server Clustering And Service Level Availability During Normal Operation	1.1	#
7. # Extra Hardware Technicians To Manage Scheduling, Messaging Manager, Scheduling, And Recovery From Down Time Or Lost Transactions Efforts(# In Employee Years)	0.5	#
8. Total # Hardware Technicians Per Year To Manage SLA On Distributed Servers	1.6	#
9. Current Annual Cost For Hardware Technicians To Achieve SLA On Distributed Servers	288.0	000$

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FIGURE 1-22

COST FOR HARDWARE TECHNICIANS TO DISTRIBUTED SYSTEM SLA MANAGEMENT FIVE YEAR ASSUMPTIONS

5-Year Assumptions	**Current**	**Unit**	**2007**	**2008**	**2009**	**2010**	**2011**
% Increase (Decrease) In # Hardware Technicians To Manage Distributed Server Clustering And Service Level Availability		%	1.0	1.2	1.3	1.2	1.4
% Increase (Decrease) In Hardware Technician Pay For People Needed To Manage Distributed Server Clustering And Service Level Availability During Normal Operation		%	2.0	2.0	2.0	2.0	2.0
Estimated Total Costs	**Current**	**Unit**	**2007**	**2008**	**2009**	**2010**	**2011**
# Of Hardware Technicians To Maintain Service Level Agreement on Distributed System (# In Employee Years)	2.500	#	2.5	2.6	2.6	2.6	2.7
Average Annual Costs Per Hardware Technician to Manage SLA on Distributed System (annual fully loaded cost - 000$)	130.0	000$	132.6	135.3	138.0	140.7	143.5
Total Annual Cost For Hardware Technicians To Manage SLA On Distributed System(000$)	**325.0**	**000$**	**334.8**	**345.6**	**357.1**	**368.6**	**381.3**

On Line Version

10. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2
11. % Increase (Decrease) In # Hardware Technicians To Manage Distributed Server Clustering And Service Level Availability		%	1.0	1.2	1.3	1.2	1.4
12. % Increase (Decrease) In Hardware Technician Pay For People Needed To Manage Distributed Server Clustering And Service Level Availability During Normal Operation		%	2.0	2.0	2.0	2.0	2.0
13. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2
14. # Of Hardware Technicians To Maintain Service Level Agreement on Distributed System (# In Employee Years)	1.600	#	1.6	1.6	1.7	1.7	[illegible]
15. Average Annual Costs Per Hardware Technician to Manage SLA on Distributed System (annual fully loaded cost - 000$)	180.0	000$	183.6	187.3	191.0	194.8	19
16. Total Annual Cost For Hardware Technicians To Manage SLA On Distributed System(000$)	**288.0**	000$	**296.7**	**306.3**	**316.4**	**326.7**	**3**

Source: Wintergreen Research, Inc.

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The average number of hardware technicians required for SLA achievement is 1.6. Hardware technicians are required for primarily two major operation functions:

- Regular Operation and Maintenance activities such as Distributed Server Clustering and SLA management: These operations require 1.1 technicians
- Recovery Operations such as management of scheduling, messaging manager and down time transaction recovery: These operations require 0.5 technicians

The average annual salary per technician assumption is $ 180,000. Therefore the cost of hardware technicians required for maintaining the SLA for one application is $ 288,000

For years 2008 through 2012:

The average number of hardware technicians required will increase by 1.0%, 1.2%, 1.3%, 1.2% and 1.4% for the respective years. This increase is calculated with respect to the previous years.

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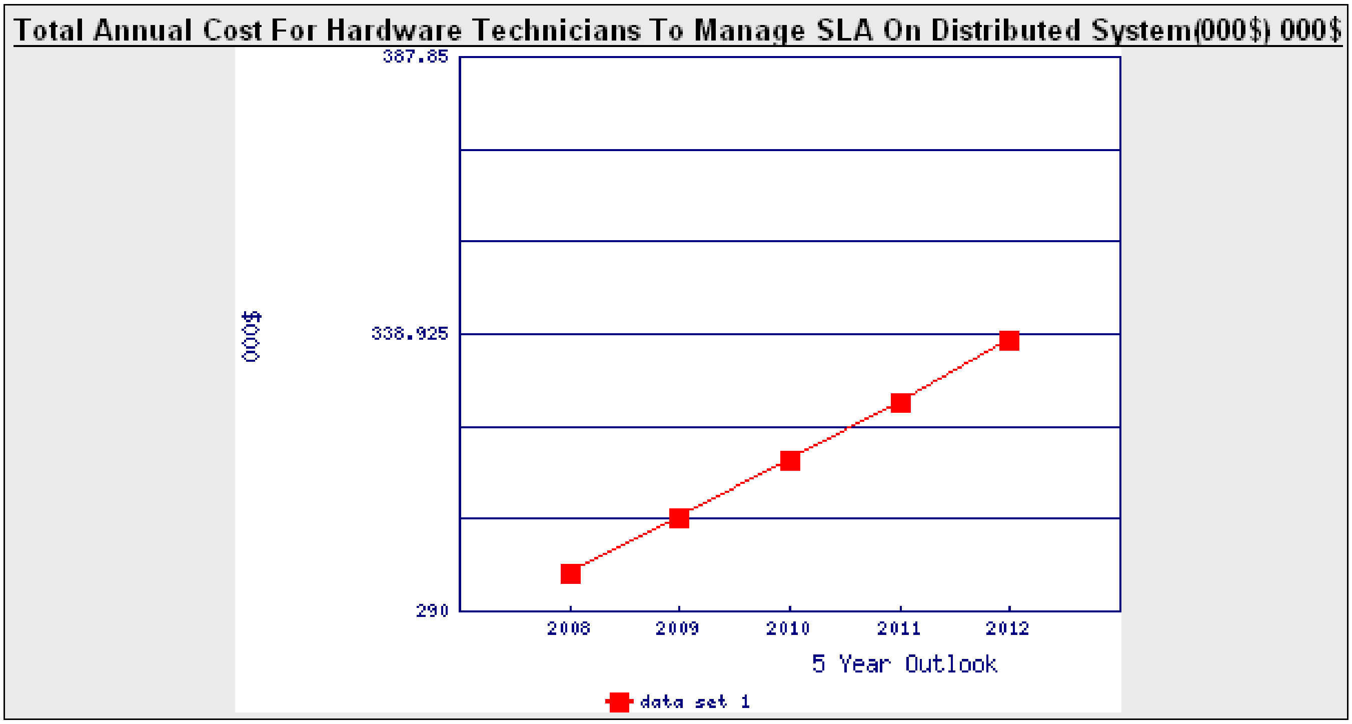
FIGURE 1-23

COST FOR HARDWARE TECHNICIANS TO DISTRIBUTED SYSTEM SLA MANAGEMENT IN A GRAPHICAL FORMAT



Source: Wintergreen Research, Inc.

See the graph above for a five-year outlook in the annual cost required for hardware technicians to manage SLA for Distributed Servers for years 2008 through 2012. The average salary per technician will increase by 2% every year. The annual cost required for hardware technicians to manage SLA for Distributed Servers will thus increase from $288,000 to $ 337,800.

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1.9.8 Labor Costs for Hardware Technicians Needed to Achieve SLA on Mainframe

FIGURE 1-24

COSTS FOR HARDWARE TECHNICIANS TO MAINFRAME SLA MANAGEMENT 2007 ANALYSIS

1. Current Labor Costs for Hardware Technicians to Achieve SLA On Mainframe		
2. Analyst Metric To Set Stage For SLA Hardware Calculation	Current	Unit
3. # of MIPS For Application Runtime	6.0	#
4. Current Labor Costs for Hardware Technicians to Achieve SLA on Mainframe	Current	Unit
5. Average Annual Costs Per Hardware Technician To Manage SLA on Mainframe (annual fully loaded cost)	140.0	000$
6. # Full Time Hardware Technicians To Manage Clustering And Service Level Availability During Normal Operation Per Year	0.010	#
7. # Extra Hardware Technicians To Manage Scheduling, Messaging Manager, Scheduling, And Recovery From Down Time Or Lost Transactions Efforts (# In Employee Years)	0.000	#
8. Total # Hardware Technicians Per Year To Manage SLA On Mainframe	0.010	#

Source: Wintergreen Research, Inc.

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FIGURE 1-25

COSTS FOR HARDWARE TECHNICIANS TO MAINFRAME SLA MANAGEMENT FIVE ANALYSIS

5-Year Assumptions	Current	Unit	2007	2008	2009	2010	2011
% Increase (Decrease) In # Hardware Technicians To Manage Mainframe Clustering And Service Level Availability		%	1.0	1.2	1.3	1.2	1.4
% Increase (Decrease) In Hardware Technician Pay For People Needed To Manage Mainframe Clustering And Service Level Availability During Normal Operation		%	2.0	2.0	2.0	2.0	2.0
Estimated Total Costs	**Current**	**Unit**	**2007**	**2008**	**2009**	**2010**	**2011**
# Of Hardware Technicians To Maintain Service Level Agreement on Mainframe (# In Employee Years)	0.012	#	0.0	0.0	0.0	0.0	0.0
Average Annual Costs Per Hardware Technician to Manage SLA on Mainframe (annual fully loaded cost - 000$)	140.0	$	142.8	145.7	148.6	151.5	154.6
Total Annual Cost For Hardware Technicians To Manage SLA On Mainframe(000$)	**1.7**	000$	**1.7**	**1.8**	**1.8**	**1.9**	**2.0**

Source: Wintergreen Research, Inc.

For the current year:

Average number of hardware technicians required for SLA achievement is 0.010.

Hardware technicians are required primarily for regular Operation and Maintenance activities such as cluster management and SLA management: These operations require 0.010 technicians.

Since recovery operations such as management of scheduling, messaging manager and down time transaction recovery are inbuilt in a Mainframe system, no technician is required to perform these tasks manually. The average annual salary per technician is $ 140,000.

Therefore the cost of hardware technicians required for maintaining the SLA is $ 1,400.

For years 2008 through 2012:

The average number of hardware technicians required will increase by 1.0%, 1.2%, 1.3%, 1.2% and 1.4% for the respective years. This increase is calculated with respect to the previous years.

The average salary per technician will increase by 2% every year.

The annual cost required for hardware technicians to manage SLA for Mainframe will increase from $1,400 to $ 1,600.

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1.9.9 Labor Costs for Software Developers Needed to Achieve SLA on Distributed System

FIGURE 1-26

COST FOR SOFTWARE DEVELOPERS TO DISTRIBUTED SYSTEM SLA MANAGEMENT

2. Analyst Metric To Set Stage For SLA Software Calculation	Current	Unit
3. # of Applications	1.0	#
4. Current Labor Costs for Software Developers to Achieve SLA on Distributed System	Current	Unit
5. Average Annual Costs Per Software Developer To Manage SLA on Dedicated Servers (annual fully loaded cost)	150.0	000$
6. # Full Time Software Developers To Manage Distributed Server Clustering And Service Level Availability During Normal Operation	2.0	#
7. # Extra Software Developers To Manage Scheduling, Messaging Manager, Scheduling, And Recovery From Down Time Or Lost Transactions Efforts(# In Employee Years)	0.3	#
8. Total # Software Developers Per Year To Manage SLA On Distributed Servers	2.3	#

Source: Wintergreen Research, Inc.

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FIGURE 1-27

COST FOR SOFTWARE DEVELOPERS TO DISTRIBUTED SYSTEM SLA MANAGEMENT

10. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
11. % Increase (Decrease) In # Developers To Manage Distributed Server Clustering And Service Level Availability		%	1.0	1.2	1.3	1.2	1.4
12. % Increase (Decrease) In Developers Pay For People Needed To Manage Distributed Server Clustering And Service Level Availability During Normal Operation		%	2.0	2.0	2.0	2.0	2.0
13. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
14. # Of Software Developers To Maintain Service Level Agreement on Distributed System (# In Employee Years)	2.300	#	2.3	2.4	2.4	2.4	2.4
15. Average Annual Costs Per Software Developer to Manage SLA on Distributed System (annual fully loaded cost - 000$)	150.0	000$	153.0	156.1	159.2	162.4	165.6
16. Total Annual Cost For Software Developers To Manage SLA On Distributed System(000$)	**345.0**	000$	**355.4**	**366.9**	**379.1**	**391.3**	**404.7**

Source: Wintergreen Research, Inc.

For the current year: the average number of software developers required for SLA achievement is 2.3. Software developers are required primarily for regular Operation and Maintenance activities such as Distributed Server Clustering and SLA management: These operations require 2.0 software developers.

Recovery operations such as management of scheduling, messaging manager and down time transaction recovery require 0.3 software developer. The average annual salary per developer is $ 150,000.

Therefore the cost of software developers required for maintaining the SLA is $ 345,000. For years 2008 through 2012: the average number of software developers required will increase by 1.0%, 1.2%, 1.3%, 1.2% and 1.4%

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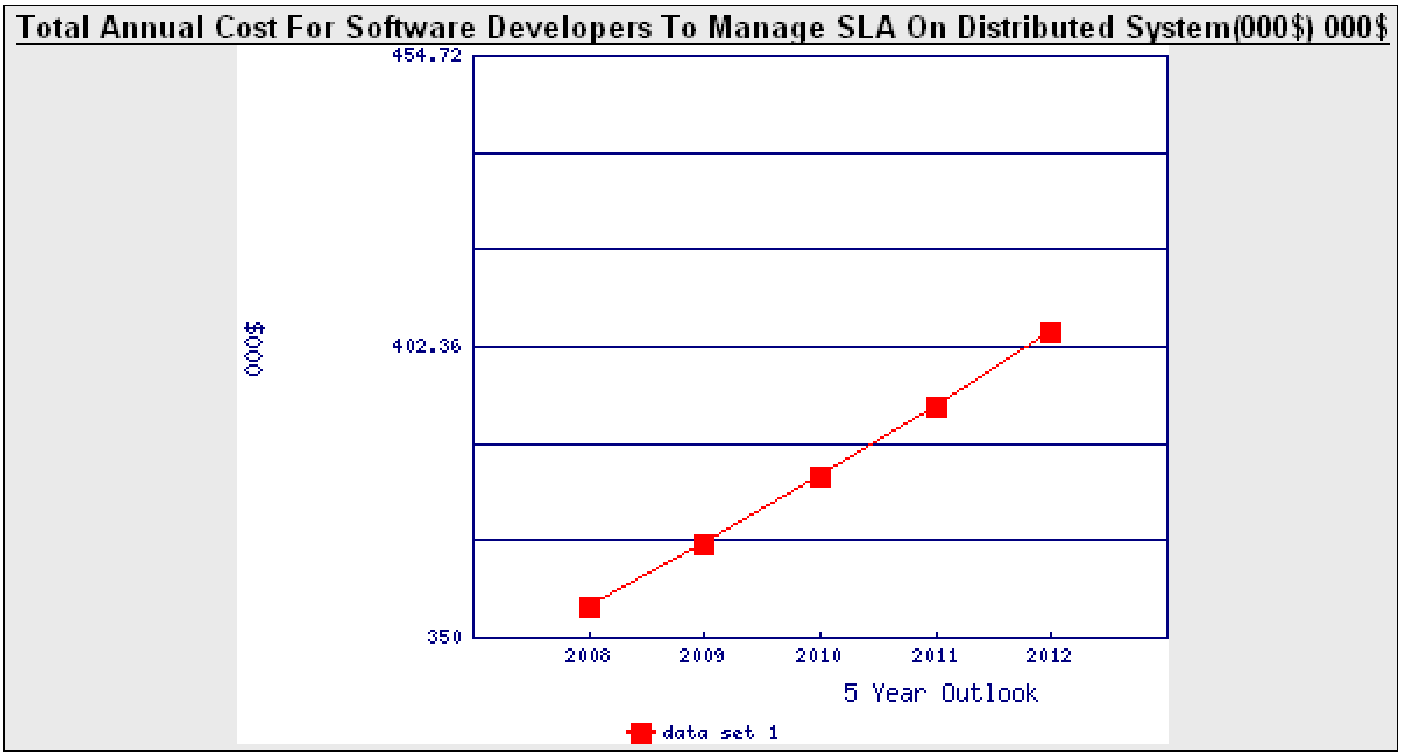
for the respective years. This increase is calculated with respect to the previous years.

FIGURE 1-28

COST FOR SOFTWARE DEVELOPERS TO DISTRIBUTED SYSTEM SLA MANAGEMENT IN A GRAPHICAL FORMAT



Source: Wintergreen Research, Inc.

See the graph above for a five-year outlook in the annual cost required for software developers to manage SLA for Distributed Servers for years 2008 through 2012. The average salary per developer will increase by 2% every year. The annual cost required for software developers to manage SLA for Distributed Servers will thus increase from $345,000 to $ 404,700.

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1.10 Data Replication Solutions

Centralized backup and automated replication are implemented over WAN. Organizations may be spread across campuses, cities, countries or around the world. Data replication solutions enable use of the same disk-to-disk procedures available for LAN environments, over the WAN. Data replication solutions enable an organization to consolidate, centrally backup and manage critical data from all its locations.

Disaster recovery protection can be achieved with wide area data replication. Disaster recovery is critically dependent upon the ability to seamlessly replicate data over a wide area. LifeKeeper Data Replication provides the ability to easily and securely establish an off-site location for data storage and protection. The ability to replicate only changed data asynchronously, combined with tools for logging and integration with schedulers, makes LifeKeeper Data Replication the fastest and most effective solution for wide area data mirroring available.

Following include the key features of a Data Replication solution:

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TABLE 1-29

KEY FEATURES OF A DISTRIBUTED SERVER DATA REPLICATION SOLUTION

- Continuous, periodic, or scheduled mirrors
- User-definable block level mirrors
- Change-level data replication
- Elimination of "white space" from replication process
- Rapid volume-based replication
- Persistent intent log enables fast re-sync
- Synchronous or asynchronous mode
- Replication pause capability
- Lock and unlock target
- Enables partial re-sync
- Replication over local or wide area networks
- Intuitive, easy to use graphical interface
- Integrates with clustering to support non-shared storage failover, or wide area disaster recovery
- Runs on Windows & Linux
- Runs on all major Intel server systems

Source: Wintergreen Research, Inc.

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1.10.1 Software For Application Functionalities

Software for various functionalities is additionally loaded on corresponding CPUs in the distributed systems.

TABLE 1-30

SOFTWARE PACKAGES TO ACHIEVE SLA ON DISTRIBUTED SYSTEM

- Monitoring and Management (M&M) Software
- Registration Software
- Protection Group Management Software
- Event/Message Control Software
- Guaranteed Message Delivery Software
- Event/Message Priorities, Event/Message Ordering, And Persistence Software
- Load Distribution, Clustering, Cluster Membership Systems Management Software
- Checkpoint Software
- Synchronous Update and Asynchronous Update Software
- Trace and Trace Manager Software

Source: Wintergreen Research, Inc.

Mainframes have all the necessary software inbuilt and is available as part of the purchase price of the mainframe package. In a distributed system, these

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are additional initial costs, to get the system running. Following are the different software packages needed for a distributed system application:

FIGURE 1-31

NUMBER OF SERVERS FOR SLA SOFTWARE CALCULATION

2. Analyst Metric To Set Stage For SLA Software Calculation	Initial	Unit
3. Total # of Servers For The Application	14.0	#

Source: Wintergreen Research, Inc.

To analyze the software costs needed to achieve SLA on a distributed system, we consider an application where the total number of servers initially deployed is 14. The following calculations are for the year 2007.

FIGURE 1-32

COST OF MONITORING AND MANAGEMENT SOFTWARE FOR DISTRIBUTED SYSTEMS

4. SLA Software Costs - Monitoring and Management (M&M) Software	Current	Unit
5. Total # of CPUs Running M&M Software	45.0	#
6. $ Per CPU - SLA Software Costs For Monitoring and Management (M&M)	250.0	$
7. Total Costs - SLA Monitoring and Management (M&M) Software	11,250.0	$

Source: Wintergreen Research, Inc.

CPUs are required to run the software that monitors and manages the distributed system. The cost of SLA software to be loaded on each CPU for monitoring and management of the system is $250. The total number of CPUs

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required for the application is 45. Hence the total cost of monitoring and management software running on all the CPUs in the application is $11,250.

FIGURE 1-33

COST OF REGISTRATION AND UN-REGISTRATION SOFTWARE FOR DISTRIBUTED SYSTEMS

8. SLA Software Costs - Registration And Un-Registration Of Managed Components	Current	Unit
9. Total # of CPUs Running Registration Software	45.0	#
10. $ Per CPU - SLA Software Costs For Registration	300.0	$
11. Total Costs - SLA Registration Software	13,500.0	$

Source: Wintergreen Research, Inc.

CPUs are required to run the registration software. The cost of SLA software to be loaded on each CPU, for registration, is $300. The total number of CPUs required for the application is 45. Hence the total cost of registration and un-registration software running on all the CPUs in the application is $13,500.

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FIGURE 1-34

COST OF PROTECTION GROUP MANAGEMENT SOFTWARE FOR DISTRIBUTED SYSTEMS

12. SLA Software Costs - Protection Group Management	Current	Unit
13. Total # of CPUs Running Protection Group Management Software	45.0	#
14. $ Per CPU - SLA Software Costs For Protection Group Management	700.0	$
15. Total Costs - SLA Protection Group Management Software	31,500.0	$

Source: Wintergreen Research, Inc.

CPUs are required to run the protection group management software. The cost of SLA software to be loaded on each CPU, for protection group management, is $700. The total number of CPUs required for the application is 45. Hence the total cost of monitoring and management software running on all the CPUs in the application is $31,500.

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FIGURE 1-35

COST OF EVENT/MESSAGE CONTROL SOFTWARE FOR DISTRIBUTED SYSTEMS

16. SLA Software Costs - Event/Message Control	Current	Unit
17. Total # of CPUs Running Event/Message Control Software	45.0	#
18. $ Per CPU - SLA Software Costs For Event/Message Control	120.0	$
19. Total Costs - Event/Message Control Software	5,400.0	$

Source: Wintergreen Research, Inc.

CPUs are required to run the event/message control software. The cost of SLA software to be loaded on each CPU, for event/message control, is $120. The total number of CPUs required for the application is 45. Hence the total cost of event/message control software running on all the CPUs in the application is $5,400.

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FIGURE 1-36

COST OF GUARANTEED MESSAGE DELIVERY SOFTWARE FOR DISTRIBUTED SYSTEMS

20. SLA Software Costs - Guaranteed Message Delivery	Current	Unit
21. Total # of CPUs Running Guaranteed Message Delivery Software	45.0	#
22. $ Per CPU - SLA Software Costs For Guaranteed Message Delivery	400.0	$
23. Total Costs - Guaranteed Message Delivery Software	18,000.0	$

Source: Wintergreen Research, Inc.

CPUs are required to run the guaranteed message delivery software. The cost of SLA software to be loaded on each CPU, for event/message control, is $400. The total number of CPUs required for the application is 45. Hence the total cost of monitoring and management software running on all the CPUs in the application is $18,000.

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FIGURE 1-37

COST OF EVENT/MESSAGE PRIORITY, ORDERING AND PERSISTENCE SOFTWARE FOR DISTRIBUTED SYSTEMS

24. SLA Software Costs - Event/Message Priorities, Event/Message Ordering, And Persistence	Current	Unit
25. Total # of CPUs Running Event/Message Priorities, Event/Message Ordering, And Persistence Software	45.0	#
26. $ Per CPU - SLA Software Costs For Event/Message Priorities, Event/Message Ordering, And Persistence For SLA	110.0	$
27. Total Costs - Event/Message Priorities, Event/Message Ordering, And Persistence Software	4,950.0	$

Source: Wintergreen Research, Inc.

CPUs are required to run the event/message priority, ordering and persistence software. The cost of SLA software to be loaded on each CPU, for event/message control, is $110. The total number of CPUs required for the application is 45. Hence the total cost of monitoring and management software running on all the CPUs in the application is $4,950.

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FIGURE 1-38

COST OF LOAD DISTRIBUTION AND CLUSTER MEMBERSHIP SOFTWARE FOR DISTRIBUTED SYSTEMS

28. SLA Software Costs - Load Distribution, Clustering, Cluster Membership Systems Management, Including Adding, Removing And Enumerating Members, Lock, Unlock And Shut Down A Cluster Or A Cluster Node	Current	Unit
29. Total # of CPUs Running Software for Load Distribution, Clustering, Cluster Membership Systems Management (Including Adding, Removing And Enumerating Members, Lock, Unlock And Shut Down A Cluster Or A Cluster Node for SLA)	45.0	#
30. $ Per CPU - SLA Software Costs For Achieving Load Distribution, Clustering, Cluster Membership Systems Management (Including Adding, Removing And Enumerating Members, Lock, Unlock And Shut Down A Cluster Or A Cluster Node)	815.0	$
31. Total Costs - Software for Load Distribution, Clustering, Cluster Membership Systems Management	36,675.0	$

Source: Wintergreen Research, Inc.

CPUs are required to run the load distribution and cluster membership software. The cost of SLA software to be loaded on each CPU, for event/message control, is $815. The total number of CPUs required for the application is 45. Hence the total cost of monitoring and management software running on all the CPUs in the application is $36,675.

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FIGURE 1-39

COST OF CHECKPOINT MANAGEMENT SOFTWARE FOR DISTRIBUTED SYSTEMS

32. SLA Software Costs - Checkpoint Services, Checkpoint Replicas, Checkpoint Data Access Reads, Writes, Updates, And Deletes, And Saving State	Current	Unit
33. Total # of CPUs Running Software for Checkpoint Services, Checkpoint Replicas, Checkpoint Data Access Reads, Writes, Updates, And Deletes, And Saving State	45.0	#
34. $ Per CPU - SLA Software Costs For Checkpoint Services, Checkpoint Replicas, Checkpoint Data Access Reads, Writes, Updates, And Deletes, And Saving State	110.0	$
35. Total Costs - Software for Checkpoint Services, Checkpoint Replicas, Checkpoint Data Access Reads, Writes, Updates, And Deletes, And Saving State	4,950.0	$

Source: Wintergreen Research, Inc.

CPUs are required to run the checkpoint management software. The cost of SLA software to be loaded on each CPU, for event/message control, is $110. The total number of CPUs required for the application is 45. Hence the total cost of monitoring and management software running on all the CPUs in the application is $4,950.

FIGURE 1-40

COST OF SYNCHRONOUS AND ASYNCHRONOUS UPDATE SOFTWARE FOR DISTRIBUTED SYSTEMS

36. SLA Software Costs - Synchronous Updates And Asynchronous Updates	Current	Unit
37. Total # of CPUs Running Software for Synchronous Updates And Asynchronous Updates	45.0	#
38. $ Per CPU - SLA Software Costs For Providing Synchronous Updates And Asynchronous Updates	220.0	$
39. Total Costs - Software for Synchronous Updates And Asynchronous Updates	9,900.0	$

Source: Wintergreen Research, Inc.

CPUs are required to run the synchronous and asynchronous update software. The cost of SLA software to be loaded on each CPU, for event/message control, is $220. The total number of CPUs required for the application is 45. Hence the total cost of monitoring and management software running on all the CPUs in the application is $9,900.

FIGURE 1-41

COST OF TRACE AND TRACE MANAGER SOFTWARE FOR DISTRIBUTED SYSTEMS

40. SLA Software Costs - Trace and Trace Manager	Current	Unit
41. Total # of CPUs Running Trace and Trace Manager Software	45.0	#
42. $ Per CPU - SLA Software Costs For Trace and Trace Manager	250.0	$
43. Total Costs - Trace and Trace Manager Software	11,250.0	$

Source: Wintergreen Research, Inc.

CPUs are required to run the trace and trace manager software. The cost of SLA software to be loaded on each CPU, for event/message control, is $250. The total number of CPUs required for the application is 45. Hence the total cost of monitoring and management software running on all the CPUs in the application is $11,250.

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FIGURE 1-42

TOTAL COST OF SOFTWARE TO ACHIEVE SLA FOR DISTRIBUTED SYSTEMS

44. Total Software Costs	Current	Unit
45. Total $ For Extra Software To Achieve SLA On Distributed Servers	147,375.0	$
46. Unit Conversation - $ to 000$	1,000.0	#
47. 000$ - Total Initial Costs For Extra Software To Achieve SLA On Distributed Servers	147.4	000$

Source: Wintergreen Research, Inc.

The total initial software cost to achieve SLA on distributed system is the sum of the individual software costs discussed above. This total cost is $147,375 for the distributed system.

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FIGURE 1-43

YEARLY GROWTH IN SOFTWARE MAINTENANCE COST TO ACHIEVE SLA FOR DISTRIBUTED SYSTEMS

48. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
49. % Of Software Costs Incurred (Total for 5 years Represents Maintenance Percent)		%	18.0	18.0	18.0	18.0	18.0
50. Estimated Yearly Costs	Current	Unit	2008	2009	2010	2011	2012
51. 000$ - Yearly Software Costs To Achieve Service Level Availability On Distributed System (Initial Costs And Maintenance Costs In Years Thereafter)	147.4	000$	26.5	26.5	26.5	26.5	26.5

Source: Wintergreen Research, Inc.

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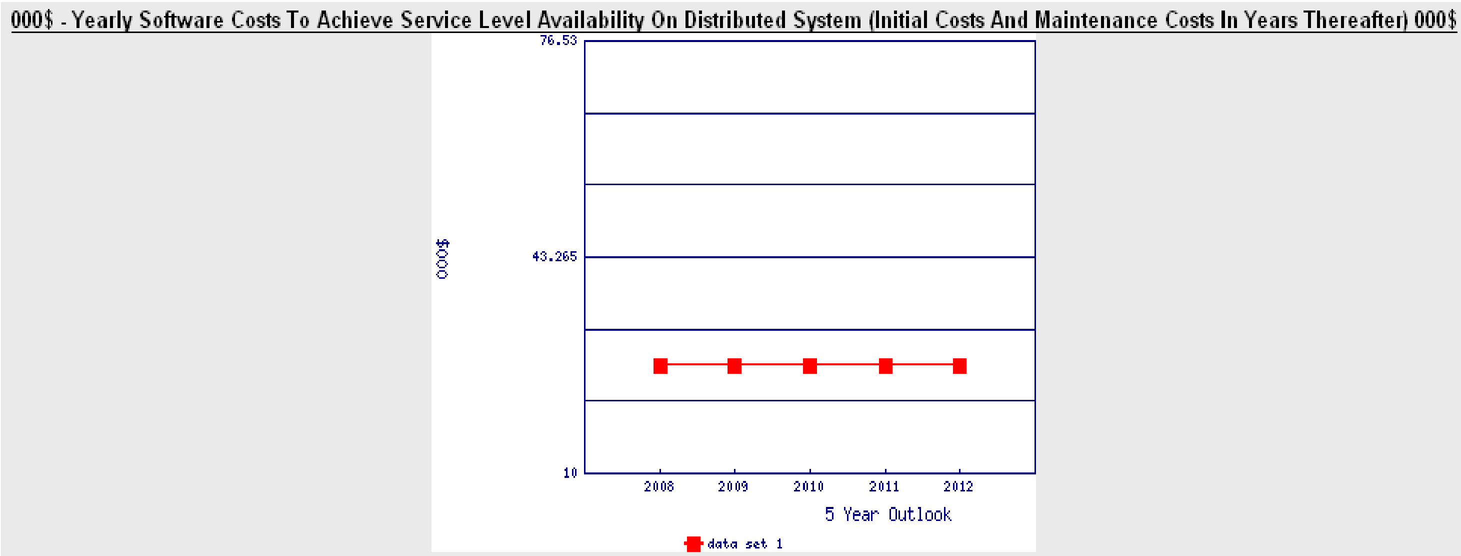
FIGURE 1-44

FIVE-YEAR OUTLOOK FOR SOFTWARE MAINTENANCE COST TO ACHIEVE SLA FOR DISTRIBUTED SYSTEMS



Source: Wintergreen Research, Inc.

No software is maintenance-free. It is forecast that the software maintenance cost will increase by 18% every year. Hence for the years 2008 through 2012, the software maintenance costs will be $26,500. The graph above depicts this five-year outlook.

1.11 Mainframe Service Level Availability SLA Cost Analysis

TABLE 1-45

SLA MAINFRAME COST ANALYSIS

9. SLA - Mainframe Cost Analysis	Initial	Unit	2008	2009	2010	2011	2012
10. Labor Costs For Hardware Technicians Needed to Achieve SLA On Mainframe	1.4	(000)$	1.4	1.5	1.5	1.6	1.6
11. Labor Costs For Software Developers Needed to Achieve SLA On Mainframe	3.0	(000)$	3.1	3.2	3.3	3.4	3.5
12. Costs of Software Needed to Achieve SLA On Mainframe	3.0	(000)$	0.1	0.1	0.1	0.1	0.1
13. Business Cost of SLA Downtime On Mainframe	0.1	(000)$	0.0	0.0	0.0	0.0	0.0
14. Total Labor, Software, and Business Costs to Achieve SLA On Mainframe	7.5	(000)$	4.6	4.8	4.9	5.1	5.3

Source: Wintergreen Research, Inc.

Mainframe costs comprise of the following components.

TABLE 1-46

COST ANALYSIS FOR MAINFRAME SLA

- Labor Costs for Hardware Technicians Needed to Achieve SLA on Mainframe
- Labor Costs for Software Developers Needed to Achieve SLA on Mainframe
- Costs of Software Needed to Achieve SLA on Mainframe
- Business Cost of SLA Downtime on Mainframe

Source: Wintergreen Research, Inc.

1.11.1 Labor Costs for Software Developers Needed to Achieve SLA on Mainframe

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FIGURE 1-47

COSTS FOR SOFTWARE DEVELOPERS TO MAINFRAME SLA MANAGEMENT

1. Current Labor Costs for Software Developers to Achieve SLA On Mainframe		
2. Analyst Metric To Set Stage For SLA Software Calculation	Current	Unit
3. # of Applications	1.0	#
4. Current Labor Costs for Software Developers to Achieve SLA on Mainframe	Current	Unit
5. Average Annual Costs Per Software Developer To Manage SLA on Mainframe (annual fully loaded cost)	150.0	000$
6. # Full Time Software Developers To Manage Mainframe Clustering And Service Level Availability During Normal Operation	0.020	#
7. # Extra Software Developers To Manage Scheduling, Messaging Manager, Scheduling, And Recovery From Down Time Or Lost Transactions Efforts(# In Employee Years)	0.000	#
8. Total # Software Developers Per Year To Manage SLA On Mainframe	0.020	#
9. Current Annual Cost For Software Developers To Achieve SLA On Mainframe	3.000	000$

10. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
11. % Increase (Decrease) In # Developers To Manage Mainframe Clustering And Service Level Availability		%	1.0	1.2	1.3	1.2	1.4
12. % Increase (Decrease) In Developers Pay For People Needed To Manage Mainframe Clustering And Service Level Availability During Normal Operation		%	2.0	2.0	2.0	2.0	2.0
13. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
14. # Of Software Developers To Maintain Service Level Agreement on Mainframe (# In Employee Years)	0.020	#	0.0	0.0	0.0	0.0	0.0
15. Average Annual Costs Per Software Developer to Manage SLA on Mainframe (annual fully loaded cost - 000$)	150.0	$	153.0	156.1	159.2	162.4	165.6
16. Total Annual Cost For Software Developers To Manage SLA On Mainframe(000$)	**3.0**	000$	**3.1**	**3.2**	**3.3**	**3.4**	**3.5**

Source: Wintergreen Research, Inc.

For the current year 2007 the application with 14 servers has an average number of software developers required for SLA achievement is 0.020. Full-time software developers are required primarily for regular operation and maintenance activities such as distributed server clustering and SLA management: These operations require 0.020 technicians.

Recovery operations such as management of scheduling, messaging manager and down time transaction recovery do not require software developers. The average annual salary per developer is $ 150,000.

Therefore the cost of software developers required for maintaining the SLA is $ 3,000. For years 2008 through 2012:

The average number of software developers required will increase by 1.0%, 1.2%, 1.3%, 1.2% and 1.4% for the respective years. This increase is calculated with respect to the previous years. The average salary per developer will increase by 2% every year.

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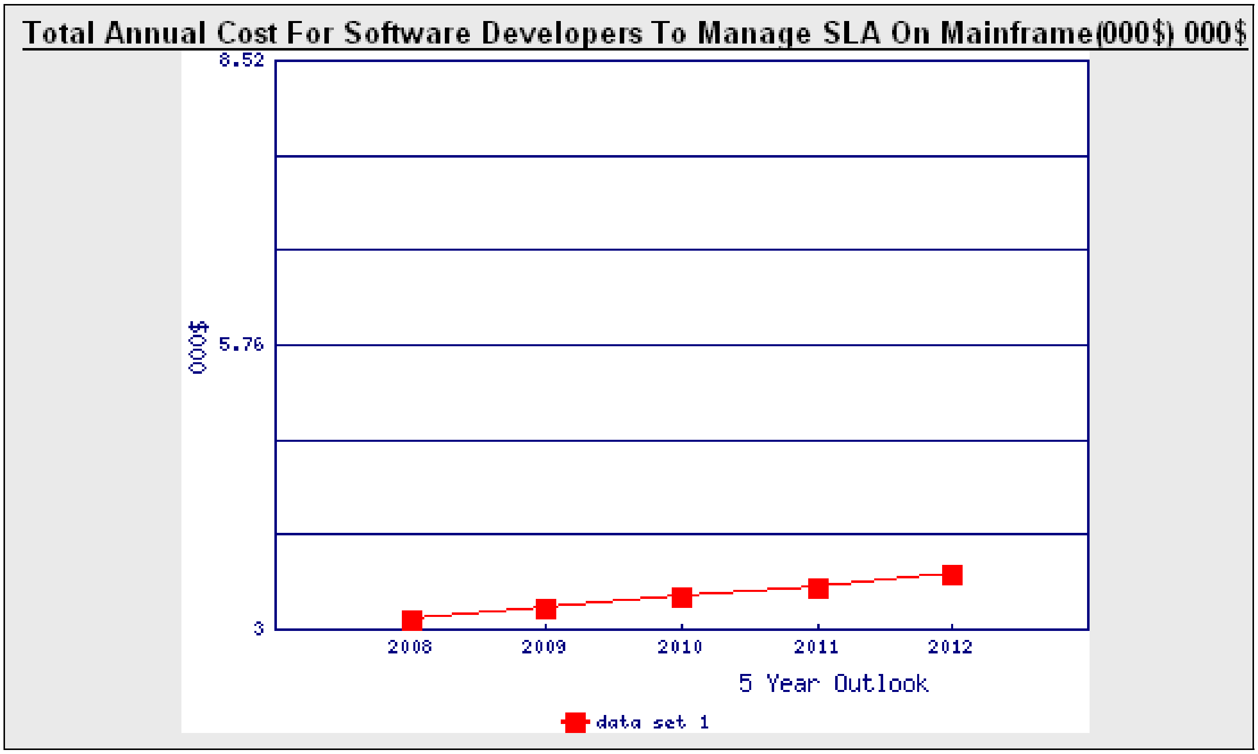
FIGURE 1-48

FIVE YEAR OUTLOOK IN THE COST OF SOFTWARE DEVELOPERS TO MANAGE SLA ON MAINFRAME



Source: Wintergreen Research, Inc.

The annual cost required for software developers to manage SLA for Distributed Servers will thus increase from $3,100 to $ 3,500. The above graph shows this five-year outlook.

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1.11.2 Costs of Software Needed to Achieve SLA on Mainframe

Software is essential to the functioning of any system. The CPU speed of mainframes is measured in terms of millions of instructions per second (MIPS). MIPS provide software execution capabilities. Following are the various software packages to achieve SLA on Mainframe system:

TABLE 1-49

SOFTWARE PACKAGES TO ACHIEVE SLA ON MAINFRAME SYSTEM

- Monitoring and Management (M&M) Software
- Registration Software
- Protection Group Management Software
- Event/Message Control Software
- Guaranteed Message Delivery Software
- Event/Message Priorities, Event/Message Ordering, And Persistence Software
- Load Distribution, Clustering, Cluster Membership Systems Management Software
- Checkpoint Software
- Synchronous Update and Asynchronous Update Software
- Trace and Trace Manager Software

Source: Wintergreen Research, Inc.

Though most of these software packages are available as part of the purchase price of the mainframe system, extra software may be needed to cater to enhanced functionalities. The analysis below shows the cost calculations for extra software needed for the mainframe system.

FIGURE 1-50

NUMBER OF MIPS FOR SOFTWARE TO ACHIEVE SLA ON MAINFRAME

1. Current Costs for Software to Achieve SLA On Mainframe		
2. Analyst Metric To Set Stage For SLA Software Calculation	Current	Unit
3. Total # of MIPS For The Application (Runtime)	6.0	#

Source: Wintergreen Research, Inc.

To analyze the extra software costs needed to achieve SLA on a mainframe system, we consider an application where the total number of servers initially deployed is 6. The following calculations are for the current year.

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FIGURE 1-51

COST OF EXTRA MONITORING AND MANAGEMENT SOFTWARE FOR MAINFRAME SYSTEMS

4. SLA Software Costs - Extra Monitoring and Management (M&M) Software	Current	Unit
5. Total # of MIPs Running Extra M&M Software	0.0	#
6. $ Per MIP - SLA Software Costs For Monitoring and Management (M&M)	0.0	$
7. Total Costs - SLA Monitoring and Management (M&M) Software	0.0	$

Source: Wintergreen Research, Inc.

Mainframe systems do not need extra monitoring and management software, as all the required functionality is already built-in. This reduces the burden on the MIPs. There is no additional cost for monitoring and management software, as compared to $11,250 for distributed systems.

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FIGURE 1-52

COST OF EXTRA REGISTRATION AND UN-REGISTRATION SOFTWARE FOR MAINFRAME SYSTEMS

8. SLA Software Costs - Extra Registration And Un-Registration Of Managed Components	Current	Unit
9. Total # of MIPs Running Registration Software	0.0	#
10. $ Per MIP - SLA Software Costs For Registration	0.0	$
11. Total Costs - SLA Registration Software	0.0	$

Source: Wintergreen Research, Inc.

Mainframe systems do not need extra registration and un-registration software, as all the required functionality is already built-in. This reduces the burden on the MIPs. There is no additional cost for registration and un-registration software, compared to $13,500 for distributed systems.

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FIGURE 1-53

COST OF EXTRA PROTECTION GROUP MANAGEMENT SOFTWARE FOR MAINFRAME SYSTEMS

12. SLA Software Costs - Extra Protection Group Management	Current	Unit
13. Total # of MIPs Running Protection Group Management Software	0.0	#
14. $ Per MIP - SLA Software Costs For Protection Group Management	0.0	$
15. Total Costs - SLA Protection Group Management Software	0.0	$

Source: Wintergreen Research, Inc.

Mainframe systems do not need extra protection group management software, as all the required functionality is already built-in. This reduces the burden on the MIPs. There is no additional cost for protection group management software, compared to $31,500 for distributed systems.

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FIGURE 1-54

COST OF EVENT/MESSAGE CONTROL SOFTWARE FOR MAINFRAME SYSTEMS

16. SLA Software Costs - Event/Message Control	Current	Unit
17. Total # of MIPs Running Event/Message Control Software	6.0	#
18. $ Per MIP - SLA Software Costs For Event/Message Control	0.0	$
19. Total Costs - Event/Message Control Software	0.0	$

Source: Wintergreen Research, Inc.

A total of 6 MIPS are required to run the event/message control software for mainframe systems. But, since the necessary software is already present in the initial mainframe package, cost for event/message control software is zero, compared to $5,400 for distributed systems.

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FIGURE 1-55

COST OF GUARANTEED MESSAGE DELIVERY SOFTWARE FOR MAINFRAME SYSTEMS

20. SLA Software Costs - Guaranteed Message Delivery	Current	Unit
21. Total # of MIPs Running Guaranteed Message Delivery Software (Runtime)	6.0	#
22. $ Per MIP - SLA Software Costs For Guaranteed Message Delivery	500.0	$
23. Total Costs - Guaranteed Message Delivery Software	3,000.0	$

Source: Wintergreen Research, Inc.

A total of 6 MIPs are required to run the guaranteed message delivery software for mainframe systems. The cost of guaranteed message delivery software, per MIP is $500. Hence the total cost of guaranteed message delivery software to be run on the mainframe system is $3,000. This is negligible compared to the $18,000 incurred for distributed systems.

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FIGURE 1-56

COST OF EVENT/MESSAGE PRIORITIES, ORDERING AND PERSISTENCE SOFTWARE FOR MAINFRAME SYSTEMS

24. SLA Software Costs - Event/Message Priorities, Event/Message Ordering, And Persistence	Current
25. Total # of MIPs Running Event/Message Priorities, Event/Message Ordering, And Persistence Software	0.0
26. $ Per MIP - SLA Software Costs For Event/Message Priorities, Event/Message Ordering, And Persistence For SLA	0.0
27. Total Costs - Event/Message Priorities, Event/Message Ordering, And Persistence Software	0.0

Source: Wintergreen Research, Inc.

Mainframe systems do not need extra event/message priorities, ordering and persistence software, as all the required functionality is already built-in. This reduces the burden on the MIPs. There is no additional cost for event/message priorities, ordering and persistence software, compared to $4,950 for distributed systems.

FIGURE 1-57

COST OF LOAD DISTRIBUTION AND CLUSTERING SOFTWARE FOR MAINFRAME SYSTEMS

28. SLA Software Costs - Load Distribution, Clustering, Cluster Membership Systems Management, Including Adding, Removing And Enumerating Members, Lock, Unlock And Shut Down A Cluster Or A Cluster Node	Current	Unit
29. Total # of MIPs Running Software for Load Distribution, Clustering, Cluster Membership Systems Management (Including Adding, Removing And Enumerating Members, Lock, Unlock And Shut Down A Cluster Or A Cluster Node for SLA)	6.0	#
30. $ Per MIP - SLA Software Costs For Achieving Load Distribution, Clustering, Cluster Membership Systems Management (Including Adding, Removing And Enumerating Members, Lock, Unlock And Shut Down A Cluster Or A Cluster Node)	0.0	$

Source: Wintergreen Research, Inc.

A total of 6 MIPS are required to run the load distribution and clustering software for mainframe systems. But, since the necessary software is already present in the initial mainframe package, cost for load distribution and clustering software is zero, compared to $36,675 for distributed systems.

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FIGURE 1-58

COST OF CHECKPOINT SOFTWARE FOR MAINFRAME SYSTEMS

32. SLA Software Costs - Checkpoint Services, Checkpoint Replicas, Checkpoint Data Access Reads, Writes, Updates, And Deletes, And Saving State	Current	Unit
33. Total # of MIPs Running Extra Software for Checkpoint Services, Checkpoint Replicas, Checkpoint Data Access Reads, Writes, Updates, And Deletes, And Saving State	0.0	#
34. $ Per MIP - SLA Software Costs For Checkpoint Services, Checkpoint Replicas, Checkpoint Data Access Reads, Writes, Updates, And Deletes, And Saving State	0.0	$
35. Total Costs - Software for Checkpoint Services, Checkpoint Replicas, Checkpoint Data Access Reads, Writes, Updates, And Deletes, And Saving State	0.0	$

Source: Wintergreen Research, Inc.

Mainframe systems do not need extra checkpoint software, as all the required functionality is already built-in. This reduces the burden on the MIPs. There is no additional cost for checkpoint software, compared to $4,950 for distributed systems.

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FIGURE 1-59

COST OF SYNCHRONOUS AND ASYNCHRONOUS UPDATE SOFTWARE FOR MAINFRAME SYSTEMS

36. SLA Software Costs - Synchronous Updates And Asynchronous Updates	Current	Unit
37. Total # of MIPs Running Extra Software for Synchronous Updates And Asynchronous Updates (Runtime)	6.0	#
38. $ Per MIP - SLA Software Costs For Providing Synchronous Updates And Asynchronous Updates	0.0	$
39. Total Costs - Software for Synchronous Updates And Asynchronous Updates	0.0	$

Source: Wintergreen Research, Inc.

A total of 6 MIPS are required to run the synchronous and asynchronous update software for mainframe systems. But, since the necessary software is already present in the initial mainframe package, cost for synchronous and asynchronous update software is zero, compared to $9,900 for distributed systems.

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FIGURE 1-60

COST OF TRACE AND TRACE MANAGER SOFTWARE FOR MAINFRAME SYSTEMS

40. SLA Software Costs - Trace and Trace Manager	Current	Unit
41. Total # of MIPs Running Extra Trace and Trace Manager Software	6.0	#
42. $ Per MIP - SLA Software Costs For Trace and Trace Manager	0.0	$
43. Total Costs - Trace and Trace Manager Software	0.0	$

Source: Wintergreen Research, Inc.

A total of 6 MIPS are required to run the trace and trace manager software for mainframe systems. But, since the necessary software is already present in the initial mainframe package, cost for trace and trace manager software is zero, compared to $11,250 for distributed systems.

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FIGURE 1-61

TOTAL COST OF SOFTWARE TO ACHIEVE SLA FOR MAINFRAME SYSTEMS

44. Total Software Costs	Current	Unit
45. Total $ For Extra Software To Achieve SLA On Distributed Servers	3,000.0	$
46. Unit Conversation - $ to 000$	1,000.0	#
47. 000$ - Total Costs For Extra Software To Achieve SLA On Mainframe	3.0	000$

Source: Wintergreen Research, Inc.

The total software cost to achieve SLA on mainframe system is the sum of the individual software costs discussed above. This total cost is $3,000 for the mainframe system.

FIGURE 1-62

TOTAL COST OF SOFTWARE TO ACHIEVE SLA FOR MAINFRAME SYSTEMS

48. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
49. % Of Software Costs Incurred (total of 5 years must be 100%)		%	3.5	3.4	3.3	3.2	3.1
50. Estimated Years Costs	Current	Unit	2008	2009	2010	2011	2012
51. 000$ - Yearly Software Costs To Achieve Service Level Availability On Mainframe	3.0	000$	0.1	0.1	0.1	0.1	0.1

Source: Wintergreen Research, Inc.

For years 2008 through 2012:

The variation in software costs, over the current year, is 3.5%, 3.4%, 3.3%, 3.2% and 3.1% for the respective years.

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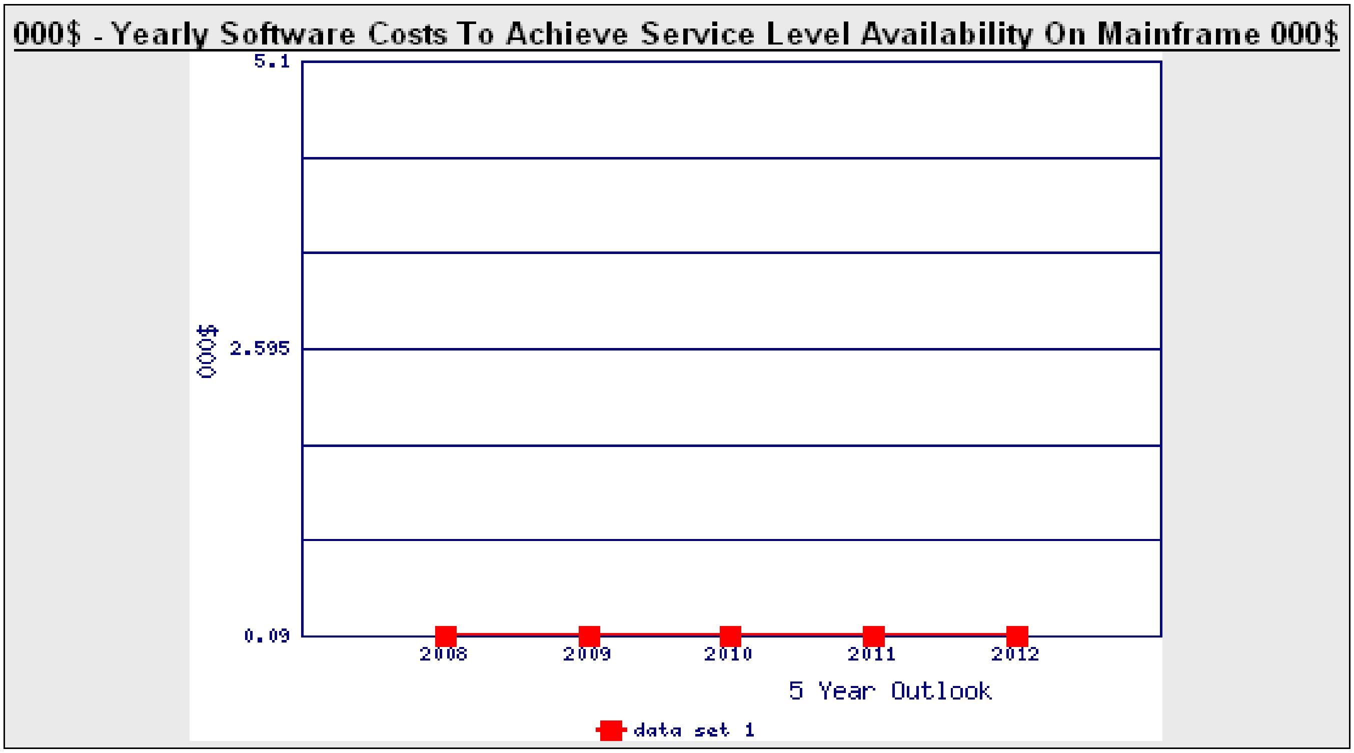
TABLE 1- 63

FIVE-YEAR OUTLOOK OF SOFTWARE COSTS TO ACHIEVE SLA ON MAINFRAME SYSTEMS



Source: Wintergreen Research, Inc.

The above graph shows the five-year outlook of incremental software costs to achieve SLA on mainframe systems.

The yearly incremental software cost is $100 for mainframe systems, compared to the whopping $26,500 for distributed systems.

1.12 Backup For Data Protection

Best practices for guarding against downtime and data loss continue to include the implementation of data protection, replication, and clustering technologies. When used in combination with application performance management technologies that optimize the performance of applications, organizations have a powerful toolset for ensuring both uptime and quality of service.

Best practices for data and application availability begin with a data protection strategy. Traditional tape backups have proven to be an effective and inexpensive means for data protection and recovery, and its portability makes it appropriate for off-site storage. Tape is slow, complex, and often unreliable. What is more, recovering from tape can be time-consuming and cumbersome.

Disk-based backups offer several advantages over tape, including greater reliability, increased speed, and flexibility. Recovery is also faster and more efficient than tape since the backup is on disk. Disk-based backup also supports incremental backup and restore capabilities, enabling organizations to better avoid unacceptable interruptions to business operations. Plus, disk-based backup integrates with tape-based technologies to enable long-term data protection or off-site storage.

1.13 Archival Storage Ultra Density Optical

Archival storage forecasts are driven off the assumption of 125% growth occurring in 2008 is a result of over 100 successful trials where people begin to realize this is the technology of choice for archival storage, in combination with the rapidly ballooning increase in quantities of data that need archival storage efficiently.

1.13.1 Plasmon Ultra Density Optical G104-U4N0LNNNE Removable Disc Library

DESC: Plasmon G-Series 5.25 inch optical libraries are the market-leading solution for professional archival storage. They feature the reliable architecture and high data availability and support multiple optical media. Systems are able to minimize the cost and frequency of media migration.

Support for both 30GB UDO Ultra Density Optical and 9.1GB MO Magneto Optical storage technologies provides a backward-compatible archive platform. There is 30GB UDO Ultra Density Optical capability now.

1.13.2 Plasmon Is A Primary Provider Of UDO Optical Archival Storage

Plasmon is the primary provider of UDO, which increases capacities by using an extremely focused blue laser to write and read data. IT never purchased optical. Optical storage was always part of scanning and archives, and used for things like check images.

Demand for enterprise archival storage, combined with the more attractive economics of the latest optical technology, makes optical storage a viable alternative to tape at the low end and to inexpensive disk (ATA/SATA) at the high end.

Optical storage economics mean that archival storage can be implemented using optical systems that are efficient. Each new application brings its own data, including some that may overlap with data in other application domains and must therefore be synchronized. Business intelligence applications support tactical decisions based on real-time data.

Businesses are driven to increase data redundancy not only for availability, but also for regional performance and low-cost capacity. Addressing these data placement requirements mandates an efficient solution that can minimize impact to computer systems, applications, and networks. IBM WebSphere Replication Server and IBM WebSphere Data Event Publisher are among products that enable changed data capture and data replication solutions creating the need for ultra density optical (UDO) archival storage systems.

Here is where the dashboards come in handy, the need for every business intelligence application to now support tactical decisions based on real-time d

1.13.3 Mempile Optical Archival Storage Proprietary Chromophores

Addressing the explosion in multi-media content and growing demands for high capacity archiving at home and in the enterprise, Mempile offers the TeraDisc™. It is based on advanced materials technology. The TeraDisc next generation of archiving has high density storage cabilities.

Capacity exceeds 1000 GB on a single, removable disc. The TeraDisc enables simple, cost-effective, permanent archiving of content. Mempile has developed a removable optical storage technology allowing for the storage of 1 Terabyte (1,000 Gigabytes) of information on a single inexpensive disc.

The device builds on the existing know-how attained through the development of CDs and DVDs, extending it so as to write layers upon layers of stacked information. This quantum leap in storage capacity (viz., equivalent to 200 DVDs on a single disc) allows it to offer a unique and exceptional solution for the personal video recording, high-resolution TV, and archiving markets.

The product looks like the familiar removable optical devices; the disc itself is 12cm in diameter and made out of an inexpensive translucent polymer.

A Mempile disc contains light sensitive molecules (chromophores) capable of switching between two distinct states upon the application of light. Due to the nonlinear nature of the light-matter interaction, when focusing the applied light inside the material using a lens, only those molecules present near the focal point will interact and switch state.

This provides three-dimensional accessing of small volumes within the material, allowing the writing of data bits selectively within the bulk of the material. Reading is performed in a similar way.

Light that does not result in writing excites the chromophores making them emit light. The amount of light emitted is highly sensitive to there being "written" or "unwritten" molecules near the focal point, allowing this process to be used as a reading mechanism.

Proprietary chromophores have been developed and synthesized. They have the stability, light sensitivity, and amenability capabilities inside a disc matrix. They have been inserted inside a matrix of PMMA (i.e., Perspex, Lucite, Plexiglass) and injection-molded into discs.

Scaling-up of these processes is underway. The three-dimensional nature of disc and the fact that data is not written physically, but in virtual layers, necessitated the development of novel tracking algorithm allowing for the reliable accessing of data at varying depths within the material. Solutions where developed and shown to work using computer simulations; initial tests using the discs gave very positive results.

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TABLE 1-64

WORLDWIDE ARCHIVAL OPTICAL STORAGE SYSTEMS SHIPMENTS MARKET FORECASTS, PETABYTES AND DOLLARS, 2007-2013

Worldwide Archival Optical Storage Systems Shipments Market Forecasts, Petabytes and Dollars, 2007-2013
In Millions of Dollars

	2006	2007	2008	2009	2010	2011	2012	2013
Ultra Density Optical Storage								
Number of Petabytes Shipped	35.6	76.2	207.2	725.3	1,798.7	3,147.7	4,878.9	6,537.7
% Growth	124.0	114.0	172.0	250.0	148.0	75.0	55.0	34.0
000$/Petabyte	78.1	0.1	0.2	0.3	0.5	0.7	0.8	0.8
Gigabytes per Jutebox	30.0	60.0	125.0	250.0	1,000.0	1,500.0	1,750.0	2,000.0
Price per Gigabyte Media ($)	2.0	1.0	0.5	0.250	0.063	0.031	0.016	0.008
% Growth	2.0	3.0	3.0	3.0	3.0	3.0	3.0	4.0
Price per Jutebox (000)$	234.0	227.0	215.6	198.4	174.6	148.4	117.2	83.2
% Growth	-2.0	-3.0	-5.0	-8.0	-12.0	-15.0	-21.0	-29.0
Archival Storage								
Juteboxes (MM$)	456.0	574.6	1,292.8	2,133.1	3,306.2	4,794.0	6,472.0	8,154.7
% growth	17.0	26.0	125.0	65.0	55.0	45.0	35.0	26.0

Source: WinterGreen Research, Inc.

TABLE 1-65
WORLDWIDE ARCHIVAL ULTRA DENSITY OPTICAL STORAGE MARKET FORECASTS, 2007-2013

Worldwide Archival Ultra Density Optical Storage Market Forecasts, 2007-2013 In Millions of Dollars	2006	2007	2008	2009	2010	2011	2012	2013
Broadcast Libraries								
Air (MM$)	50.2	51.7	77.6	106.7	132.2	143.8	174.7	203.9
% of Total Market	11.0	9.0	6.0	5.0	4.0	3.0	2.7	2.5
Petabytes Storage	3.9	6.9	12.4	36.3	71.9	94.4	131.7	163.4
Film & Video Archives (MM$)	100.3	120.7	258.6	405.3	595.1	815.0	1,035.5	1,223.2
% of Total Market	22.0	21.0	20.0	19.0	18.0	17.0	16.0	15.0
Petabytes Storage	7.8	16.0	41.4	137.8	323.8	535.1	780.6	980.7
Production / Editing (MM$)	22.8	16.1	33.6	46.9	49.6	24.0	25.9	24.5
% of Total Market	3.0	2.8	2.6	2.2	1.5	0.5	0.4	0.3
Petabytes Storage	1.1	2.1	5.4	16.0	27.0	15.7	19.5	19.6
Medical Records/Compliance (M	155.0	149.4	374.9	682.6	1,157.2	1,773.8	2,394.6	3,017.2
% of Total Market	24.0	26.0	29.0	32.0	35.0	37.0	37.0	37.0
Petabytes Storage	8.5	19.8	60.1	232.1	629.5	1,164.6	1,805.2	2,419.0
Video Security /Surveillance (M	13.7	23.0	64.6	128.0	231.4	335.6	453.0	570.8
% of Total Market	3.0	4.0	5.0	6.0	7.0	7.0	7.0	7.0
Petabytes Storage	1.1	3.0	10.4	43.5	125.9	220.3	341.5	457.6
Business Dashboard / Complia	114.0	213.7	483.5	763.6	1,140.7	1,701.9	2,388.2	3,115.1
% of Total Market	37.0	37.2	37.4	35.8	34.5	35.5	36.9	38.2
Petabytes Storage	13.2	28.3	77.5	259.6	620.5	1,117.4	1,800.3	2,497.4
Archival Ultra Density Optical Storage (MM$)	456.0	574.6	1,292.8	2,133.1	3,306.2	4,794.0	6,472.0	8,154.7
% growth	89.0	54.0	125.0	65.0	55.0	45.0	35.0	26.0
Petabytes Storage	35.6	76.2	207.2	725.3	1,798.7	3,147.7	4,878.9	6,537.7

Source: WinterGreen Research, Inc.

One of the most recent advancements in backup is continuous data protection, which provides the core benefits of disk-based protection while eliminating some of the challenges of more traditional technologies. Many continuous data protection tools also provide tape-based backup for archival and storage.

Continuous data protection captures only changed portions of files, thereby simplifying backup, and can also back up multiple file servers simultaneously for greater efficiency. Recovery is also quick and flexible, allowing end users to retrieve their own files.

1.14 GoAhead Software Middleware For Highly Available Distributed Systems

GoAhead® Software is the worldwide leader in open standards-based high availability and systems management middleware for carrier-grade and mission critical systems. GoAhead Software is deployed on more than 15,000 nodes worldwide. GoAhead Software middleware is for systems requiring 99.999% or greater availability. GoAhead has a standards-based, Application Ready Platform™. It is the solution for equipment manufacturers who want to speed time to market and reduce development and integration costs.

Motorola, Alcatel, Italtel, Operax, Lockheed Martin and Honeywell are utilizing GoAhead solutions.

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1.14.1 SteelCloud and GoAhead Software Strategic Alliance

SteelCloud is using GoAhead software middleware to enhance its high availability server line. SteelCloud is an integrator of network centric and embedded computing solutions. A strategic alliance with GoAhead® Software permits SteelCloud to integrate GoAhead SelfReliant®, high-availability and management software with AdvancedTCA and MicroTCA server platforms.

Equipment manufacturers use standards-based solutions. Solutions that are application ready can use GoAhead SelfReliant to add proven high availability capabilities to the SteelCloud platforms. Customers achieve the flexibility, cost and time efficiencies offered by standards in a fully integrated, validated platform.

1.14.2 GoAhead SelfReliant Proven High Availability Capabilities

The SteelCloud platforms provide federal integrators with a standards-based, application-ready platform, for developing mission-critical applications for the United States Department of Defense or any environment that requires 99.999% availability.

Integrated SelfReliant software means a SteelCloud high availability server allows federal integrator customers to dramatically shorten the time it takes for them to deliver an ultra high availability solution. The SteelCloud high availability systems provide application development teams with an integrated and tested platform. This allows them to focus efforts on software application development and functionality which leads to their competitive differentiation.

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GoAhead addresses growing demand for high-availability systems in both federal and industrial markets. The servers with SelfReliant middleware start at $275,000. The alliance with GoAhead permits SteelCloud to provide the software separately.

Equipment manufacturers use standards-based solutions. Solutions that are application ready can use GoAhead SelfReliant to add proven high availability capabilities to the server platforms. Customers achieve the flexibility, cost and time efficiencies offered by standards in a fully integrated, validated platform.

1.14.3 GoAhead Integrated Middleware For Telecom

GoAhead Software builds integrated middleware for telecom, military and aerospace equipment manufacturers of mission-critical systems and applications. Fully integrated, application ready platforms mean GoAhead products and services help equipment manufacturers achieve faster time to market and lower development costs.

Middleware is deployed on 15,000 nodes worldwide. GoAhead delivers the software and the expertise necessary to ensure success for a broad range of development projects such as wireless base station controllers, Node Bs, softswitches, defense applications and industrial controllers.

Deployed on more than 15,000 nodes worldwide, GoAhead Software is used for building middleware for systems requiring 99.999% or greater availability. GoAhead's standards-based, Application Ready Platform™ is the solution for equipment manufacturers who want to speed their time to market and reduce development and integration costs. Industry leaders such as Motorola,

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Alcatel, Italtel, Operax, Lockheed Martin and Honeywell are utilizing GoAhead solutions to gain a competitive edge.

1.14.4 GoAhead SelfReliant

Leading high availability solution integrated with IBM, RadiSys and performance technologies offers equipment manufacturers application-ready platforms. GoAhead® software is used for building integrated middleware for highly available systems.

SelfReliant® high availability (HA) and systems management software offers pre-integration with leading hardware platforms. RadiSys Promentum™, IBM BladeCenter® T and Performance Technologies Advanced Managed Platforms™. Equipment manufacturers of telecom, defense and aerospace systems utilize GoAhead's standards-based, commercial-off-the-shelf (COTS) solution to reduce costs and accelerate time-to-market.

Pre-integration with leading hardware platforms allows equipment manufacturers to bring differentiated products to market while meeting stringent time and budget requirements. Standards-based building blocks enable customers to choose best- of-breed for each component and to work to integrate components.

Pre-integrating with advanced platforms gets systems managed. IBM BladeCenter T, RadiSys Promentum and performance technologies are evolved. The burden of integration is removed. Customers get components that work well together.

Application-ready platforms include validated, out-of-box capabilities, platform management, and comprehensive high availability. System

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management includes areas of focus to include resource discovery and system model instantiation, shelf manager integration, alarm management, hot swap management and integration with vendor-specific systems management capabilities.

This is accomplished using the service availability forum (SA Forum) hardware platform interface (HPI).

1.14.5 GoAhead® Software

GoAhead® Software provides commercial off-the-shelf high availability (HA) software. GoAhead® Software offers high availability, systems management, and messaging middleware. Solutions are targeted to developers of highly available embedded systems.

Products are used in communications, military/aerospace, industrial controls and other industries. Availability and management solutions are addressed with a portfolio of platform-independent middleware that is deployed in networks worldwide. Products are used by developers and help reduce project risk, lower costs and achieve faster time-to-market.

1.14.6 GoAhead Software Supports Service Availability Forum Application Interface Specification

GoAhead Software supports the service availability forum application interface specification. A product suite has an interface for highly available applications that allows developers to write application software that is portable across different vendors' implementations of high availability middleware.

GoAhead AIS compliant suite is available during the first half of 2005. GoAhead continues to support and evolve its existing SelfReliant® suite that provides high availability, systems management and distributed messaging software for developers of highly reliable systems.

GoAhead is software modules can be used to build carrier-grade application-ready platforms. SelfReliant AIS-compliant products are evolving.

1.14.7 GoAhead SelfReliant

GoAhead SelfReliant has high availability middleware to support the service availability forum HPI B specification. GoAhead SelfReliant is a portfolio of platform-independent middleware delivering high availability, systems management and messaging services to developers of highly available embedded systems.

SelfReliant middleware is deployed in networks worldwide ensuring 99.999% or better levels of availability. It features a modular architecture, easy-to-implement functionality and support for the service availability forum industry standard interface specifications. SelfReliant offers a choice of four products.

By providing a fully integrated, application ready platform, GoAhead products and services help equipment manufacturers achieve faster time to market and lower development costs. GoAhead 6,000 units deployed around the globe, deliver middleware for wireless base station controllers, softswitches, defense applications and industrial controllers.

SelfReliant high availability, systems management, and distributed messaging software is for developers of highly reliable systems that require 99.999% or better availability, sub-second stateful failover, fast distributed messaging, low system resource consumption, and integrated functionality.

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It is a leading solution for building standards-based platforms. The product delivers ease of use, performance, and development tools. GoAhead SelfReliant supports the Service Availability Forum Hardware Platform Interface (HPI) A.01.01 and HPI B.01.01 specifications, as well as the Application Interface Specification (AIS) B.01.01.

The adoption of open standards enables the industry to shorten development cycles, reduce development costs, and lower total cost of ownership. GoAhead implementation of the SA Forum HPI B.01.01 release includes support for AdvancedTCA®. ATCA-based implementations support positions GoAhead SelfReliant as a strongest commercial off-the-shelf middleware offering.

1.15 SteelEye LifeKeeper

With SteelEye LifeKeeper, IT departments aim to achieve just between 8 and 55 minutes of downtime for an entire year, for both planned and unplanned outages. These targets are achievable when there are a few servers managing a discrete application. E.g., if the applications are a mail server or limited business critical financial management or manufacturing system, the applications are stable.

But, the downtime for an entire year gets a lot longer when the systems get bigger. They are very problematic in a large data center.

The addition of many, many clustered systems and several applications managed in the cluster create a difficulty in achieving above 99.9% availability or56hours of downtime per year. Following include the requirements from high availability clustering solution for Windows and Linux on Intel servers:

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TABLE 1-66

REQUIREMENTS FROM HIGH AVAILABILITY CLUSTERING SOLUTION

- Support for standard versions of Operating System and Application support
- Support for a wide range of data storage subsystems and configurations
- Ability to use heterogeneous solution components
- Support for more than two nodes within a cluster
- Support for Active/Active and Active/Standby configurations
- Integrated monitoring and detection of problem at node and individual service level
- Recovery in-node and across-node
- Transparency to client connections of server-side recovery
- Protection for planned and unplanned downtime
- Off-the-shelf protection for wide range of applications, databases, and infrastructure
- Ability to easily protect custom business applications without requiring reengineering
- Ease of deployment and administration

Source: Wintergreen Research, Inc.

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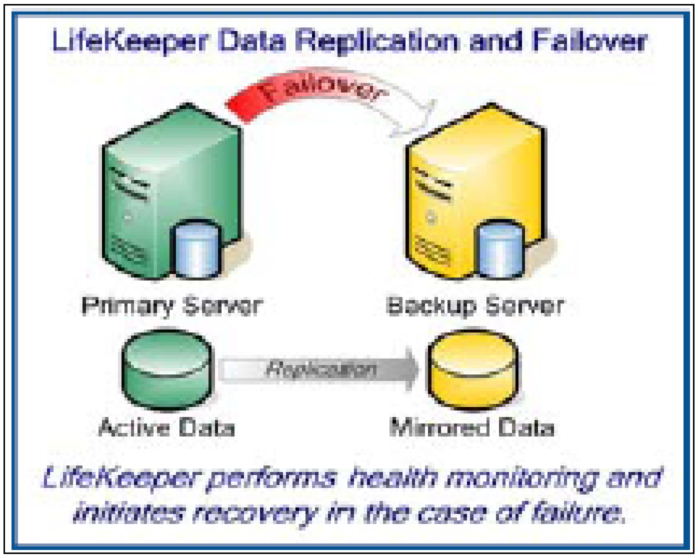
1.15.1 Replication and LifeKeeper Clustering Software

In addition to enabling quick and efficient data protection, and low-latency restoration of data for users, LifeKeeper Data Replication is cluster-ready. This means that, as business needs evolve over time, IT organizations can easily scale their level of high availability protection with techniques such as cluster monitoring, failover and disaster recovery capabilities across a broad range of application and database environments.

FIGURE 1-67

STEELEYE LIFEKEEPER DISTRIBUTED SERVER DATA REPLICATION AND FAILOVER



Source: SteelEye

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1.16 Data Replication Issues

Ability to use heterogeneous solution components

Data storage configuration support – To setup an efficient HA cluster, it is essential for all the systems to have access to the data that is required by the application to be protected. The HA solution must be compatible with all possible data configurations such as shared SCSI, fiber channel storage etc needed for data sharing.

Heterogeneous solution elements – In solutions for hardware requirements, it is common to have identical configurations for all systems in the cluster. This impacts the ability to use scaled-down servers for back-up and to reuse existing hardware in a cluster. The HA solution must be able to use heterogeneous solution elements.

Supports a wide range of data storage subsystems and configurations

Support for more than two nodes within a cluster

Inclusion of more than two nodes in a cluster – The number of nodes that can be included in a cluster determines the extent of scalability. Basic HA solutions restrict usage to a single active-passive two-node cluster. Though this increases availability in the form of a standby server, a failure in one server

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causes the other server in the two-node configuration to become a single-point-of-failure. By using more than two nodes in a cluster, protection levels increase, in addition to improvement in scalability.

Support for Active/Active and Active/Standby configurations

Support for Active/Active and Active/Standby configurations – In an active/standby configuration, one server remains idle, ready to take over from its cluster member. In this scenario, resource is under-utilized. Deploying cluster nodes in active/active configuration enables balanced utilization of resources and justifies the investment of resources.

Integrated Monitoring And Detection Of Problem At Node And Individual Service Level

Integrated monitoring and detection of problem at node and individual service level – In all HA solutions, servers within a cluster can signal and interact with each other, in order to detect failures and initiate timely recovery. This solution can not detect failures individual processes and services that do not impact the signaling between servers. Thus, an ideal HA solution must include an integrated monitoring and failure detection both at the node and at the service level.

Recovery in-node and across-node

Recovery in-node and across-node – Recovery from failures must be enabled both across cluster nodes and within a node. In recovery across-node, one node takes over the entire functionality of another node. In case of system-level failure detection, the other cluster members start recovery operations for the corresponding server immediately. This method is fast and reduces down time.

Transparency to client connections of server-side recovery

Transparency to client connections of server-side recovery – It is essential for the server-side recovery of an application or node to be transparent to client-side users. By the use of virtualized IP addresses and server names, mapping of virtual resources to physical cluster entities during recovery and automatic update of network outing tables, no changes are needed to client systems, in order to be able to access recovered data and applications.

HA solutions that necessitate manual changes to the client-side configuration significantly increase recovery time and are likely sources of further errors due to manual intervention. It s essential for automated recovery at both the client and the server.

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Protection for planned and unplanned downtime

Protection for planned and unplanned downtime – The HA solution, in addition to protection against unscheduled outages, must facilitate reduction in downtime due to scheduled maintenance work. The solution must enable manual movement of applications between cluster members, on-demand. Also, it must be possible for the applications and users to migrate to the second server, during a maintenance activity on the first. This eliminates downtime due to maintenance.

Off-the-shelf protection for wide range of applications, databases, and infrastructure

Off-the-shelf protection for wide range of applications, databases, and infrastructure – HA solutions must enable monitoring of resources such as files systems, IP addresses, applications and databases, using modules that are referred to as 'recovery modules'. Availability of these modules as part of the solution package has the advantage of support and maintenance that may be needed for the modules.

Ability to easily protect custom business applications without requiring reengineering

Ability to easily protect custom business applications without requiring reengineering – Applications that are custom to an organization can not be protested and recovered using generic vendor modules. To protect business applications specific to an organization, it must be integrated with the HA solution in such a way that the applications do not require modification. The method of achieving this must be part of the documentation of a good HA solution package.

Ease of deployment and administration

Ease of deployment and administration – HA clusters are not necessarily expensive and complex to deploy and administer. Wizard-based interfaces with capabilities for auto-discovery and single-point monitoring of the entire cluster, eases initial cluster configuration and management. Data and information related to and used by the cluster must be backed-up and available easily, in case of an outage.

1.17 Data Replication Solutions

Data replication challenges are solved and risk is eliminated. Data Replication offers users the ability to protect data more quickly and efficiently than traditional, standalone backup technologies.

A major challenge faced by organizations is to manage critical data infrastructure so as to make it accessible to all users at all times. This becomes a more difficult task when systems fail or natural disasters such as floods, storms and fire, place business critical information at risk of being lost permanently.

In addition to these challenges, IT organizations have also reached the boundary points in terms of time and resources, and are transgressing the limits of existing backup procedures, to replicate data.

Data replication solutions address these challenges and eliminate the risk. It is an industry-proven solution that works on Windows and Linux. This solution enables protection of data more quickly and efficiently than traditional, standalone backup technologies.

Linux or Windows clustering solutions work in conjunction with high availability software. Clusters of this kind can run in active/active or active/passive configurations and have been designed to run on commodity hardware. This solution is geared towards application availability and data replication.

The family of application-focused data replication, high availability-clustering and disaster recovery solutions are easy to deploy and operate, and enable enterprises of all sizes to ensure continuous availability of business-critical applications, servers and data. The solutions are proven in the most demanding of environments and are integrated to deliver flexibility, scalability and a fast return on investment.

Enterprise-grade reliability while simplifying implementation with certified solutions for a wide range of applications and databases running on Windows and Linux, including mySAP, Exchange, Apache, Oracle, DB2, SQL Server, MySQL, PostgreSQL and others.

1.17.1 Replication Of Data At The Block Level

Key benefits provided by data replication solutions relate to replication of data at the block level:

Replication of data at the block level allows those blocks to be user defined. Users can decide to mirror in increments as small as a single byte, and most importantly select to replicate only changed data in order to minimize the impact of systems and network bandwidth. This involves knowing what processes are running simultaneously and what needs to be allocated as blocks.

Performance and efficiency are achieved as systems enable improvement in performance and efficiency, by replicating data at the block level and by allowing those blocks to be user defined. Users can decide to mirror in increments as small as a single byte, and most importantly select to replicate only changed data in order to minimize the demand on systems and network bandwidth.

This is critical during replication of data over long distances. This involves knowing what processes are running simultaneously and what needs to be allocated as blocks.

1.17.2 Flexibility And Security Achieved Via Data Replication For Distributed Systems

Data Replication enables users to define how and when data is mirrored, with facilities for continuous, periodic and scheduled replication, as well as synchronous or asynchronous replication.

Flexibility and security are achieved via data replication introduces flexibility, by enabling users to define how and when data is mirrored, with facilities for continuous, periodic and scheduled replication, as well as synchronous or asynchronous replication. In addition, with change logging feature, re-synchronization of disks in the event of failure, is quick and reliable.

Change logging makes synchronization of disks fast and dependable.

Local Backup and Recovery is achieved with a variety of automated backup procedures that eliminate the need to disrupt daytime work activity, or schedule lengthy midnight backup sessions.

Local backup and recovery is a solution for the backup procedures of small and medium-sized organizations. Using custom automated backup procedures can be setup by the IT department. This eliminates the need to stall user's daytime work activity, or schedule lengthy midnight backup sessions. The disk-to-disk backup feature protects the organization's data in the event of a failure.

Ability to pause the replication process allows IT departments to combine replication and backup technologies into a single integrated, low latency solution. By performing real-time replication in conjunction with periodic tape backups, users can quickly migrate online backups to media suitable for long-terms storage while retaining the immediate availability of data in the event of a local failure.

Integration with other backup technologies – The ability to pause the replication process allows IT departments to combine both replication and backup technologies into a single integrated, low latency solution. Data storage and archiving is achieved by performing real-time replication in conjunction with periodic tape backups. During a system failure, recovery process is speedier, due to ready availability of data on the hot disk.

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Automated application monitoring, failover and fail back, are supplemented with data replication that provides an immediate path towards achieving higher availability.

In addition to enabling fast efficient data protection, and low-latency restoration of data for users, cluster ready means that as business needs evolve over time, IT organizations can scale their level of high availability protection with cluster monitoring, failover and disaster recovery capabilities across a broad range of application and database environments.

Low cost, high availability, and scalability are achieved by cautious combination of middleware and limited application clustering. High availability clustering software provides a secure, automated, and highly available system that can be deployed at a reasonable price for smaller installations.

The solution enables a secure environment with real-time data backup facilities, such a failure in the primary system provides automated failover to assure continuous system and application availability.

Even with existing hardware systems, a highly available and secure system can be established by inclusion of data replication functions

Mainframe vs. Distributed SLA Service Level Availability Return on Investment (ROI) Model Description

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2. Mainframe vs. Distributed Disaster Recovery Development Return on Investment (ROI) Model Description

2.1 Business Integration Foundation Systems

Business integration foundation systems form the basis for cross platform, cross application systems integration used to implement disaster recovery in large data center environments. SOA is the big news here, creating automation of integration systems and holding the promise of process from desktop icons.

IBM has been a leader in creating the ability to consolidate its integration modules with foundation architecture. Business integration foundation systems create a way to organize supporting modules. Application integration systems are evolving to support business flexibility by enabling integration of systems dynamically. Applications are being interconnected using integration to create cross-departmental processes. Processes are implemented in real time.

IBM application integration middleware is used to design and implement complex IT systems in the context of implementing high security in business processes. Larger clients are aiming to reduce IT costs for Web-based systems through server consolidation and the deployment of Linux®-based systems. The key challenge addressed by IBM EAI middleware is to support the implementation of a robust, flexible, platform to support requirements.

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2.2 Disaster Recovery In Distributed Servers Needs Application Integration

Application integration middleware software (EAI) is useful for implementing disaster recovery in distributed servers. Middleware supplements distributed operating systems or the cluster software. Middleware recognizes exactly what was happening in the application at the time the process stopped running. When a server goes down, it is necessary to know what was happening in the application when the machine suddenly stopped running.

The cost differential in disaster recovery application development in mainframe vs. distributed systems is $231,500 for the current year and increases to $259,400 in 2012, proving the cost efficiency of mainframe on a yearly basis.

There is nothing inherent in the server architecture or operating system cluster management system that provides back up and recovery for an application. The system can be restarted, but it is impossible without specialized integration software to know which of the many applications on the server were running when the server went down or what the applications that were running were doing.

Disaster recovery EAI and middleware is useful for distributed computing environments because it is specialized to manage applications when they are running and when they go down. The ROI tool illustrates the differences between the mainframe and the distributed servers in the context of application disaster recovery. The middleware needs to be implemented in both the distributed and mainframe environments, but the relatives costs of implementation are significantly different.

The cost of the disaster recovery middleware integration effort for the distributed servers is $233,000 and for the mainframe is $2,200. The significant difference arises because the mainframe is designed to manage the application states and not go down – both things, and the special integration is a significantly larger effort for the distributed systems, and the integration needs to be implemented for every server.

The reason the mainframe has such significant advantage is that it has shared workload and a very elaborate failover and orderly restart system so that hardware failures are generally invisible to the application. In addition, the mainframe is highly reliable, with an average of 5 minutes of downtime per year, the disaster recovery systems are already built into the system.

FIGURE 2-1

WORKING OUT THE DISASTER RECOVERY DEVELOPMENT COST DIFFERENTIAL BETWEEN MAINFRAME AND DISTRIBUTED SYSTEMS

Disaster Recovery	Current Scenario 1	Scenarios		Calculate			
1. Disaster Recovery Development Costs - Distributed vs. Mainframe	Initial	Unit	2008	2009	2010	2011	2012
2. Analyst Remarks							
3. Disaster Recovery Development On Distributed Systems	233.7	000$	238.6	243.9	249.5	255.5	261.9
4. Disaster Recovery Development On Mainframe	2.2	000$	2.3	2.3	2.4	2.5	2.5
5. Cost Differential	Total	Unit	2008	2009	2010	2011	2012
6. Cost Differential - Disaster Recovery Development - Distributed vs. Mainframe	231.5	000$	236.3	241.5	247.1	253	259.4

WEB PAGE VERSION

Summary Page: Disaster Recovery	Current Scenario: Scenario 1	Go	Scenarios	Print	Display Calc List	Calculate	
1. Disaster Recovery Development Costs - Distributed vs. Mainframe	Initial	Unit	2008	2009	2010	2011	2012
2. Analyst Remarks							
3. Disaster Recovery Development On Distributed Systems	233.7	000$	238.6	243.9	249.5	255.5	261.9
4. Disaster Recovery Development On Mainframe	2.2	000$	2.3	2.3	2.4	2.5	2.5
5. Cost Differential	Total	Unit	2008	2009	2010	2011	2012
6. Cost Differential - Disaster Recovery Development - Distributed vs. Mainframe	231.5	000$	236.3	241.5	247.1	253.0	259.4

Source: Wintergreen Research, Inc.

2.2.1 Analysis Is For A Single Application That Has 13 Distributed Servers And Runs In 16mips On The Mainframe

This analysis is for a single application that has 13 distributed servers and runs in 16MIPs on the mainframe. Cluster software has more robust functionality and is analyzed elsewhere. The chart above shows the information in a chart and then illustrates the format of the ROI online tool.

This analysis is for a single application that has 13 distributed servers and runs in 16MIPs on the mainframe. Cluster software has more robust functionality and is analyzed elsewhere. The chart below shows the information in a chart and then illustrates the format of the ROI online tool. The online WinterGreen ROI tool permits people to enter a metric and push calculate to customize the analysis.

2.2.2 Disaster Recovery Depends on Integration

IT distributed servers need integration application development to achieve the capability to recover the state information from an application if the server goes down. The cluster software that helps with system recovery once a server goes down, does not preserve the information about the application that is needed to bring the application back up.

Once the cost differentials for the mainframe vs. include analysis of integration with existing applications and databases the significant cost differential between the mainframe vs. distributed becomes apparent. The cost of initial development is generally the same on either the mainframe or the distributed server platform.

There are additional application integration development needs that have price differentials between mainframe and distributed servers. SOA development projects and supporting application services projects have significantly different costs for distributed systems vs. the mainframe.

2.2.3 Management Of The Application On Each Server When The Server Goes Down

Application development associated with integration and disaster recovery is many times more expensive on the distributed platforms than it is on the mainframe. With the distributed systems there are application integration development needs relating to management of the application when it goes down on each server that do not exist for the mainframe.

There is no correlate on the mainframe because the mainframe is a shared workload environment. One environment manages multiple applications or multiple instances of the same application with one piece of middleware.

2.2.4 Making Communication Work Between Applications

There is a significant price differential between a mainframe and distributed system. Distributed servers have unique requirements for integration. These relate to the hand coding needed to ensure continuity of process when a server goes down. Making communication work between applications is a complex process in a distributed environment.

Supplying integration is complex because there is the mapping that needs to be set up to manage all the processes that run in the background to handle the cluster and security as well as talking to other applications.

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This process is generally managed on the mainframe without further application integration because the entire mapping is done by the Z operating system whereas that distributed server mapping needs to be constructed manually for every distributed server each time anything is changed on the server, not just once.

On each of the distributed servers, there is a build application request from one end and the application integration is a manual process that takes several steps to turn that request around to make a response to the other end where the request cam from, and to keep track of all the requests that may come quickly from a lot of different directions, and this needs to be managed asynchronously, otherwise a lot of messages may be dropped.

The distributed servers pick one transaction up and use application integration so the server does not have to wait for every task to complete before it gets the next task. The application integration is needed to keep track of every request that flowed through the pipeline. Exception handling is a primary aspect of the application integration effort.

The complex process of application integration may lead to exceptions that demand human intervention.

2.3 Disaster Recovery Development on Distributed Systems

Technician costs account for the largest element of IT cost. Distributed platforms typically require more headcount than the mainframe to support an equivalent workload. The list of tasks to be performed by a technician, in a distributed system is huge.

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TABLE 2-2

TECHNICIAN TASKS FOR MANAGED COMPONENTS ON DISTRIBUTED SERVERS

- Management of hardware resources and diagnostics, including error reporting and hot swap in failure situations

- Alarm management, including problem determination, detection of defects and recovery from failures, handling service degeneration, setting thresholds for alarms and events

- Event/message handling, including implementation of guaranteed delivery, event/message prioritizing, event/message ordering, retention time, persistence, message queuing and load distribution

- Network administration and availability management, including registration and un-registration of managed components, health monitoring, failover and switchover at both the resource and node level, protection group management and error reporting

- Cluster management, including cluster membership, adding, removing and enumerating members, locking, unlocking and shutting down a cluster node, locking, unlocking and shutting down a cluster

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TABLE 2-2 (CONTINUED)

TECHNICIAN TASKS FOR MANAGED COMPONENTS ON DISTRIBUTED SERVERS

- Checkpoint service management, including saving state, checkpoint replication, checkpoint data access, reading, writing, updating, deleting, synchronous update and asynchronous update

- Data management, ensuring availability of data, across various components of thr distributed system as and when required

- Interoperability issue management, among various components of the distributed network

- Performance management, including behavior of the system under various load conditions and scenarios

Source: Wintergreen Research, Inc.

In a mainframe environment, the tools and software execute on a common platform, often leveraging common architectures and user interfaces. It tends to experience fewer interoperability challenges, and ultimately costs less to maintain.

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Cost analysis of disaster recovery development for distributed system involves a study of the following costs:

TABLE 2-3

METRICS FOR COST ANALYSIS FOR DISASTER RECOVERY DEVELOPMENT FOR DISTRIBUTED SYSTEM

- Human resource costs
- Core application integration costs
- Core database modification costs
- Core Web (SOA) application integration costs
- Core Operating System Management programming costs
- Integration system broker and transformation programming costs

Source: Wintergreen Research, Inc.

All calculations made are for the current year, unless specified otherwise.

2.3.1 Human Resource Costs

FIGURE 2-4

WORKING OUT THE COST ANALYSIS FOR HUMAN RESOURCES FOR DISASTER RECOVERY DEVELOPMENT FOR DISTRIBUTED SYSTEM

2. Human Resources Costs	Initial	Unit
3. Labor Cost Per Programmer Per Week To Develop Core Disaster Recovery On Distributed System (Fully Loaded Cost)	2.9	000$
4. Labor Cost per DBA Per Week On Distributed System (Fully Loaded Cost)	3.2	000$
5. Labor Cost Per Programmer Per Week To Develop WEB (SOA) Applications On Distributed System (Fully Loaded Cost)	2.0	000$

Source: Wintergreen Research, Inc.

Human resources for disaster recovery development on distributed systems comprise the following:

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TABLE 2-5

HUMAN RESOURCES FOR DISASTER RECOVERY DEVELOPMENT ASSUMPTIONS

Analyst Assumtions for Metrics: Fully Loaded Cost

- Programmer for development of core disaster recovery each with an all-inclusive pay of $2,900 per week
- Programmer for development of Web (SOA) applications, each with an all-inclusive pay of $3,200 per week
- Database administrator (DBA), each with an all-inclusive pay of $2,000 per week
- **Source: Wintergreen Research, Inc.**

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2.3.2 Middleware Core Disaster Recovery

FIGURE 2-6

WORKING OUT THE COST AND TIME ANALYSIS FOR CORE DISASTER RECOVERY DEVELOPMENT/MODIFICATION FOR DISTRIBUTED SYSTEM

6. Core Disaster Recovery	Initial	Unit
7. # of core application components to be developed / modified on distributed system	1.0	#
8. # of programmers to develop / modify core applications on distributed system	3.0	#
9. # of weeks to develop / modify core applications on distributed system	5.0	weeks
10. # of DBAs to support development / modification of core applications on distributed system	8.0	dba_core_apps
11. # of weeks of DBA support for development / modification of core applications on distributed system	0.4	weeks_dba_core_apps
12. 000$ Costs of core application development	53.740	000$

Source: Wintergreen Research, Inc.

Here the assumption is that 3 programmers and 8 DBAs are needed to work for 5 weeks and 0.4 week respectively, to develop/modify 1 core application on the distributed system, at a cost of $53,740. Each user of the mainframe vs. distributed ROI models can make assumptions based on the particular situation in their situation.

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FIGURE 2-7

YEARLY GROWTH IN TOTAL COST FOR CORE DISASTER RECOVERY DEVELOPMENT FOR DISTRIBUTED SYSTEM

13. % Change In Ongoing Core Application Development Costs On Distributed Systems		%	2.1	2.2	2.3	2.4	2.5
14. Cost To Develop / Modify Core Applications On Distributed System	53.740	000$	54.869	56.076	57.365	58.742	60.211

Source: Wintergreen Research, Inc.

This analysis is for the years 2008 through 2012:

The core application development costs increase by 2.1%, 2.2%, 2.3%, 2.4% and 2.5% for the respective years. Hence, the cost to develop/modify core applications on the distributed system increases from $54,869 to $60,211.

2.3.3 Core Database Modification

FIGURE 2-8

WORKING OUT THE COST AND TIME ANALYSIS FOR CORE DATABASE DEVELOPMENT/MODIFICATION FOR DISTRIBUTED SYSTEM

15. Core Database Modification	Initial	Unit
16. # of databases to be developed / modified on distributed system	1.0	dbs
17. # of core programmers to develop / modify databases on distributed system	0.4	pgm_dbs
18. # of Web (SOA) programmers to develop / modify databases on distributed system	0.2	pgm_dbs
19. # of DBAs to support development / modification of databases on distributed system	2.0	dbas_dbs
20. # of weeks of core programmer time to develop / modify databases on distributed system	7.0	weeks_cp_dbs
21. # of weeks of WEB (SOA) programmer time to develop / modify databases on distributed system	3.0	weeks_wp_dbs
22. # of weeks of DBA support for development / modification of databases on distributed system	1.0	weeks_dba_dbs
23. 000$ Costs for database development	15.720	000$

Source: Wintergreen Research, Inc.

0.4 core programmer, 0.2 Web (SOA) programmer and 2 DBAs need to work for 7 weeks, 3 weeks and 1 week respectively, to develop/modify 1 database on the distributed system, at a total cost of $15,720.

FIGURE 2-9

YEARLY GROWTH IN TOTAL COST FOR DATABASE DEVELOPMENT FOR DISTRIBUTED SYSTEM

24. % Change In Ongoing Data Base Development Costs On Distributed Systems		%	2.1	2.2	2.3	2.4	2.5
25. Cost To Develop / Modify Databases On Distributed System	15.720	000$	16.050	16.403	16.780	17.183	17.613

Source: Wintergreen Research, Inc.

For the years 2008 through 2012:

The database development costs increase by 2.1%, 2.2%, 2.3%, 2.4% and 2.5% for the respective years. Hence, the cost to develop/modify the database on the distributed system increases from $16,050 to $17,613.

2.3.4 Core Web SOA Disaster Recovery

Figure 2-10

Working Out The Cost And Time Analysis For Core Web (SOA) Disaster Recovery Development/Modification For Distributed System

26. Core Web SOA Disaster Recovery	Initial	Unit
27. # of WEB (SOA) applications to be developed / modified on distributed system	1.0	web_apps
28. # Of Programmers To Develop / Modify WEB (SOA) Applications On Distributed System	0.6	pgm_web_apps
29. # Of Weeks To Develop / Modify WEB (SOA) Applications On Distributed System	4.0	weeks_web_apps
30. # of DBAs To Support Development / Modification Of WEB (SOA) Applications On Distributed System	0.7	dba_web_apps
31. # Of Weeks Of DBA Support For Development / Modification Of Web (Soa) Applications On Distributed System	2.0	weeks_dba_web_apps
32. 000$ Costs of Web / SOA Application Development	9.280	000$

Source: Wintergreen Research, Inc.

0.6 programmer and 0.7 DBA need to work for 4 weeks and 2 weeks respectively, to develop/modify 1 Web (SOA) application on the distributed system, at a total cost of $9,280.

Figure 2-11

Yearly Growth In Total Cost For Web (SOA) Disaster Recovery For Distributed System

33. % Change In Ongoing SOA Development Costs On Distributed Systems		%	2.1	2.2	2.3	2.4	2.5
34. Cost To Develop / Modify Web (SOA) Applications On Distributed System	9.280	000$	9.475	9.683	9.906	10.144	10.397

Source: Wintergreen Research, Inc.

For the years 2008 through 2012:

The SOA disaster recovery development costs increase by 2.1%, 2.2%, 2.3%, 2.4% and 2.5% for the respective years. Hence, the cost to develop/modify SOA on the distributed system increases from $9,475 to $10,397.

2.3.5 Core Operating System Management Programming

FIGURE 2-12

WORKING OUT THE COST AND TIME ANALYSIS FOR CORE OPERATING SYSTEM MANAGEMENT PROGRAMMING FOR DISTRIBUTED SYSTEM

35. Core Operating System Management Programming	Initial	Unit
36. # of operating systems to be installed on distributed system	1.0	os
37. # Of Programmers To Develop OS On Distributed System	1.0	pgm_os
38. # Of Weeks To Develop / Modify OS On Distributed System	15.0	weeks_web_apps
39. # of DBAS To Support Development / Modification Of OS On Distributed System	0.2	OS
40. # Of Weeks Of DBA Support For Development / Modification Of OS On Distributed System	4.0	weeks_os
41. 000$ Costs of Operating System Management Development	32.560	000$

Source: Wintergreen Research, Inc.

1 programmer and 0.2 DBA need to work for 15 weeks and 4 weeks respectively, to develop/modify 1 core Operating System on the distributed system, at a total cost of $32,560.

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FIGURE 2-13

YEARLY GROWTH IN TOTAL COST FOR CORE OPERATING SYSTEM MANAGEMENT PROGRAMMING DEVELOPMENT FOR DISTRIBUTED SYSTEM

42. % Change In Ongoing Operating Systems Development Costs On Distributed Systems		%	2.1	2.2	2.3	2.4	2.5
43. Cost To Develop / Modify Operating Systems On Distributed System	32.560	000$	33.276	34.008	34.791	35.626	36.516

Source: Wintergreen Research, Inc.

For the years 2008 through 2012:

The Operating Systems development costs increase by 2.1%, 2.2%, 2.3%, 2.4% and 2.5% for the respective years. Hence, the cost to develop/modify core Operating Systems on the distributed system increases from $33,276 to $36,516.

2.3.6 Integration System Broker and Transformation Programming

FIGURE 2-14

WORKING OUT THE COST AND TIME ANALYSIS FOR INTEGRATION SYSTEM BROKER AND TRANSFORMATION PROGRAMMING FOR DISTRIBUTED SYSTEM

44. Integration System Broker and Transformation Programming	Initial	Unit
45. # of Integration Broker and Transformation Nodes To Be Installed On Distributed System	45.0	#
46. # Of Programmers To Develop Broker and Transformation Integrated Systems On Distributed System	0.2	#
47. # Of Weeks To Develop / Modify Broker and Transformation Integrated Systems On Distributed System	2.0	#
48. # of DBAS To Support Development / Modification Of Integrated Broker and Transformation Systems On Distributed System	0.4	#
49. # Of Weeks Of DBA Support For Development / Modification Of Integrated Broker and Transformation Systems On Distributed System	1.5	#
50. 000$ Costs of Broker and Transformation Integration Systems Development	122.400	000$

Source: Wintergreen Research, Inc.

0.2 programmer and 0.4 DBA need to work for 2 weeks and 1.5 weeks respectively, to develop/modify 45 broker and transformation node integrated system on the distributed system, at a total cost of $122,400.

FIGURE 2–15

YEARLY GROWTH IN TOTAL COST FOR INTEGRATION SYSTEM BROKER AND TRANSFORMATION PROGRAMMING FOR DISTRIBUTED SYSTEM

51. % Change In Ongoing Integration Systems Development Costs On Distributed Systems		%	2.1	2.2	2.3	2.4	2.5
52. Cost To Develop / Modify Integration Broker Systems On Distributed System	122.400	000$	124.970	127.720	130.657	133.793	137.138

Source: Wintergreen Research, Inc.

For the years 2008 through 2012:

The transformation node integrated system development costs increase by 2.1%, 2.2%, 2.3%, 2.4% and 2.5% for the respective years. Hence, the cost to develop/modify transformation node integrated system on the distributed system increases from $124,970 to $137,138.

FIGURE 2–16

TOTAL COSTS OF DISASTER RECOVERY DEVELOPMENT IN DISTRIBUTED SYSTEM

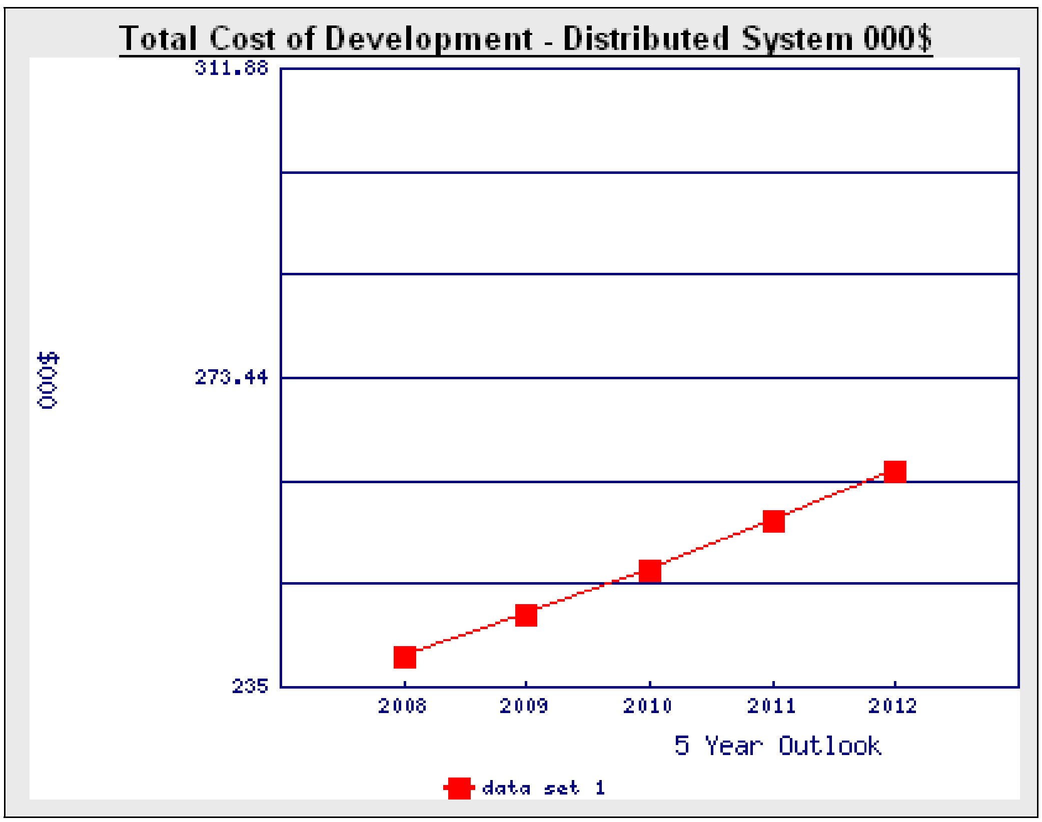
53. 5-Year Estimated Annual Costs	Initial	Unit	2007	2008	2009	2010	2011
54. Total Cost of Development - Distributed System	233.700	000$	238.640	243.890	249.500	255.488	261.875

Source: Wintergreen Research, Inc.

The total cost of disaster recovery development in the distributed system is $233,700 for the current year. It is the sum total of the development costs incurred on human resources, core application integration, database development, SOA disaster recovery, operating system development and disaster recovery system broker and transformation programming for distributed system.

FIGURE 2–17

FIVE-YEAR OUTLOOK OF MIDDLEWARE DISASTER RECOVERY DEVELOPMENT COSTS IN DISTRIBUTED SYSTEM



Source: Wintergreen Research, Inc.

The above graph shows a five-year outlook in the total cost of disaster recovery application integration development in distributed system. The cost increases from $238,640 in 2008 to $261,875 in 2012.

2.4 Application Integration Development on Mainframe

Cost analysis of disaster recovery development for mainframe system involves a study of the following costs:

TABLE 2-18

METRICS FOR COST ANALYSIS FOR MIDDLEWARE DISASTER RECOVERY DEVELOPMENT FOR MAINFRAME

- Human resource costs
- Core application integration costs
- Core database development costs
- Core Web (SOA) application integration costs
- Core Operating System Management programming costs
- Integration system programming costs

Source: Wintergreen Research, Inc.

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All calculations made are for the current year 2007.

2.4.1 Human Resources Costs

FIGURE 2-19

WORKING OUT THE COST ANALYSIS FOR HUMAN RESOURCES FOR DISASTER RECOVERY DEVELOPMENT FOR MAINFRAME SYSTEM

2. Human Resources Costs	Initial	Unit
3. $ per fully loaded programmer per week to develop core application integration on mainframe	1.1	000$
4. $ per fully loaded DBA per week on mainframe	2.2	000$
5. $ per fully loaded programmer per week to develop WEB (SOA) applications on mainframe	1.5	000$

Source: Wintergreen Research, Inc.

Human resources for disaster recovery development on mainframe comprise the following.

TABLE 2-20

HUMAN RESOURCES METRICS FOR DISASTER RECOVERY DEVELOPMENT ON MAINFRAME

- Programmer for development of core disaster recovery, each at a pay of $1,100 per week

- Programmer for development of Web (SOA) applications, each at a pay of $2,200 per week

- DBA, each at a pay of $1,500 per week

Source: Wintergreen Research, Inc.

These costs are smaller when compared to the corresponding human resources costs for distributed system development. The costs become higher when the aspect of optimization of WebSphere for the mainframe is considered.

2.4.2 Core Disaster Recovery

FIGURE 2-21

WORKING OUT THE COST AND TIME ANALYSIS FOR CORE DISASTER RECOVERY DEVELOPMENT/MODIFICATION FOR MAINFRAME SYSTEM

6. Core Disaster Recovery	Initial	Unit
7. # Of Core Disaster Recovery To Be Developed / Modified On Mainframe	1.0	core_apps
8. # Of Programmers To Develop / Modify Core Applications On Mainframe	0.7	pgm_core_apps
9. # Of Weeks To Develop / Modify Core Applications On Mainframe	1.1	weeks_core_apps
10. # of DBAs To Support Development / Modification Of Core Applications On Mainframe	0.2	dba_core_apps
11. # Of Weeks Of DBA Support For Development / Modification Of Core Applications On Mainframe	0.3	weeks_dba_core_apps
12. $ Costs Of Core Application Development	0.979	$

Source: Wintergreen Research, Inc.

0.7 programmer and 0.2 DBA are needed to work for 1.1 weeks and 0.3 week respectively, to develop/modify 1 core application on the mainframe system, at a cost of $979. This reduced cost is a major benefit of mainframe systems.

FIGURE 2-22

YEARLY GROWTH IN TOTAL COST FOR CORE DISASTER RECOVERY DEVELOPMENT FOR MAINFRAME SYSTEM

13. % Change In Ongoing Core Application Development Costs On Mainframe		%	2.1	2.2	2.3	2.4	2.5
14. Cost To Develop / Modify Core Applications On Mainframe	0.979	000$	1.000	1.022	1.045	1.070	1.097

Source: Wintergreen Research, Inc.

For the years 2008 through 2012:

The core disaster recovery development costs increase by 2.1%, 2.2%, 2.3%, 2.4% and 2.5% for the respective years. Hence, the cost to develop/modify core applications on the mainframe system marginally increases from $1,000 to $1,097.

2.4.3 Core Database Development

FIGURE 2-23

WORKING OUT THE COST AND TIME ANALYSIS FOR CORE DATABASE DEVELOPMENT/MODIFICATION FOR MAINFRAME SYSTEM

15. Core Database Development	Initial	Unit
16. # Of Databases To Be Developed / Modified On Mainframe	0.3	dbs
17. # Of Core Programmers To Develop / Modify Databases On Mainframe	0.1	pgm_dbs
18. # of Web (SOA) Programmers To Develop / Modify Databases On Mainframe	0.2	pgm_dbs
19. # of DBAs To Support Development / Modification Of Databases On Mainframe	0.1	dbas_dbs
20. # Of Weeks Of Core Programmer Time To Develop / Modify Databases On Mainframe	0.5	weeks_cp_dbs
21. # of weeks of WEB (SOA) Programmer Time To Develop / Modify Databases On Mainframe	0.6	weeks_wp_dbs
22. # Of Weeks Of DBA Support For Development / Modification Of Databases On Mainframe	0.2	weeks_dba_dbs
23. $ Costs For Database Development	0.084	$

Source: Wintergreen Research, Inc.

0.1 core programmer, 0.2 Web (SOA) programmer and 0.1 DBA need to work for 0.5 week, 0.6 week and 0.2 week respectively, to develop/modify 0.3 databases on the mainframe system, at a total nominal cost of $84.

FIGURE 2-24

YEARLY GROWTH IN TOTAL COST FOR DATABASE DEVELOPMENT FOR MAINFRAME SYSTEM

24. % Change In Ongoing Data Base Development Costs On Mainframe		%	2.1	2.2	2.3	2.4	2.5
25. Cost To Develop / Modify Databases On Mainframe	0.084	000$	0.085	0.087	0.089	0.091	0.094

Source: Wintergreen Research, Inc.

For the years 2008 through 2012: The database development costs increase by 2.1%, 2.2%, 2.3%, 2.4% and 2.5% for the respective years. Hence, the cost to develop/modify the database on the mainframe system increases from $85 to just $94.

2.4.4 Core Web SOA Disaster Recovery

FIGURE 2-25

WORKING OUT THE COST AND TIME ANALYSIS FOR CORE WEB (SOA) DISASTER RECOVERY DEVELOPMENT/MODIFICATION FOR MAINFRAME SYSTEM

26. Web SOA Disaster Recovery	Initial	Unit
27. # of WEB (SOA) Applications To Be Developed / Modified On Mainframe	0.8	web_apps
28. # Of Programmers To Develop / Modify WEB (SOA) Applications On Mainframe	0.5	pgm_web_apps
29. # Of Weeks To Develop / Modify WEB (SOA) Applications On Mainframe	1.2	weeks_web_apps
30. # of DBAs To Support Development / Modification Of WEB (SOA) Applications On Mainframe	0.2	dba_web_apps
31. # Of Weeks Of DBA Support For Development / Modification Of WEB (SOA) Applications On Mainframe	0.1	weeks_dba_web_apps
32. $ Costs of Web / SOA Application Development	0.130	$

Source: Wintergreen Research, Inc.

0.5 programmer and 0.2 DBA need to work for 1.2 weeks and 0.1 week respectively, to develop/modify 0.8 Web (SOA) application on the mainframe system, at a total cost of a nominal $130.

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FIGURE 2-26

YEARLY GROWTH IN TOTAL COST FOR WEB (SOA) DISASTER RECOVERY DEVELOPMENT FOR MAINFRAME SYSTEM

33. % Change In Ongoing SOA Development Costs On Mainframe		%	2.1	2.2	2.3	2.4	2.5
34. Cost To Develop / Modify Web (SOA) Applications On Mainframe	0.130	000$	0.133	0.136	0.139	0.143	0.146

Source: Wintergreen Research, Inc.

For the years 2008 through 2012: The SOA development costs increase by 2.1%, 2.2%, 2.3%, 2.4% and 2.5% for the respective years. Hence, the cost to develop/modify Web (SOA) applications on the mainframe system marginally increases from $133 to $146.

2.4.5 Core Operating System Management Programming

Figure 2-27

Working Out The Cost And Time Analysis For core Operating System Management Programming For Mainframe System

35. Core Operating System Management Programming	Initial	Unit
36. # of operating systems to be installed on mainframe	0.002	os
37. # Of Programmers To Develop / Modify OS On Mainframe	0.005	os
38. # Of Weeks To Develop / Modify OS On Mainframe	1.0	weeks_os
39. # of Programmers To Support Development / Modification Of OS On Distributed System	0.7	dba_web_apps
40. # Of Weeks Of DBA Support For Development / Modification Of OS On Distributed System	0.4	weeks_os
41. 000$ Costs of Operating System Management Development	0.001	000$

Source: Wintergreen Research, Inc.

0.005 programmer and 0.7 DBA need to work for 1 week and 0.4 week respectively, to develop/modify 0.002 core Operating System to be installed on the mainframe, at a total cost of just $1.

Figure 2-28

Yearly Growth In Total Cost For Core Operating System Management Programming Development For Mainframe System

42. % Change In Ongoing Operating Systems Development Costs On Mainframe		%	2.1	2.2	2.3	2.4	2.5
43. Cost To Develop / Modify Operating Systems On Mainframe	0.001	000$	0.001	0.001	0.001	0.001	0.001

Source: Wintergreen Research, Inc.

For the years 2008 through 2012:

The Operating Systems development costs increase by 2.1%, 2.2%, 2.3%, 2.4% and 2.5% for the respective years. Hence, the cost to develop/modify core Operating Systems on the mainframe system remains at $1.

2.4.6 Integration System Programming

FIGURE 2-29

WORKING OUT THE COST AND TIME ANALYSIS FOR INTEGRATION SYSTEM PROGRAMMING FOR MAINFRAME SYSTEM

44. Integration System Programming	Initial	Unit
45. # of Integration Systems To Be Installed On Mainframe	1.0	#
46. # Of Programmers To Develop Integrated Systems On Mainframe	0.2	#
47. # Of Weeks To Develop / Modify Integrated Systems On Mainframe	3.0	#
48. # of Programmers To Support Development / Modification Of Integrated Systems On Mainframe	0.7	#
49. # Of Weeks Of DBA Support For Development / Modification Of Integrated Systems On Mainframe	0.1	#
50. 000$ Costs of Integration Broker and Transformation Integration and System Management Development	1.054	000$

Source: Wintergreen Research, Inc.

0.2 programmer and 0.7 DBA need to work for 3 weeks and 0.1 week respectively, to develop/modify 1 integrated system on the mainframe, at a total cost of $1,054.

FIGURE 2–30

YEARLY GROWTH IN TOTAL COST FOR INTEGRATION SYSTEM BROKER AND TRANSFORMATION PROGRAMMING FOR MAINFRAME SYSTEM

51. % Change In Ongoing Integration Systems Development Costs On Mainframe		%	2.1	2.2	2.3	2.4	2.5
52. Cost To Develop / Modify Integration Systems On Mainframe	1.054	000$	1.076	1.100	1.125	1.152	1.181

Source: Wintergreen Research, Inc.

For the years 2008 through 2012:

The integrated system development costs increase by 2.1%, 2.2%, 2.3%, 2.4% and 2.5% for the respective years. Hence, the cost to develop/modify disaster recovery system on the mainframe system increases from $1,076 to $1,181.

FIGURE 2–31

TOTAL COSTS OF DISASTER RECOVERY APPLICATION INTEGRATION DEVELOPMENT IN MAINFRAME SYSTEM

53. Estimated Annual Costs 5-Year Assumptions	Initial	Unit	2008	2009	2010	2011	2012
54. Total Cost of Development - Mainframe	2.248	000$	2.296	2.346	2.400	2.458	2.519

Source: Wintergreen Research, Inc.

The total cost of disaster recovery development in the mainframe is $2,248 for the current year. It is the sum total of the development costs incurred on human resources, core disaster recovery, database development, SOA disaster recovery, operating system development and integration system programming for mainframe system.

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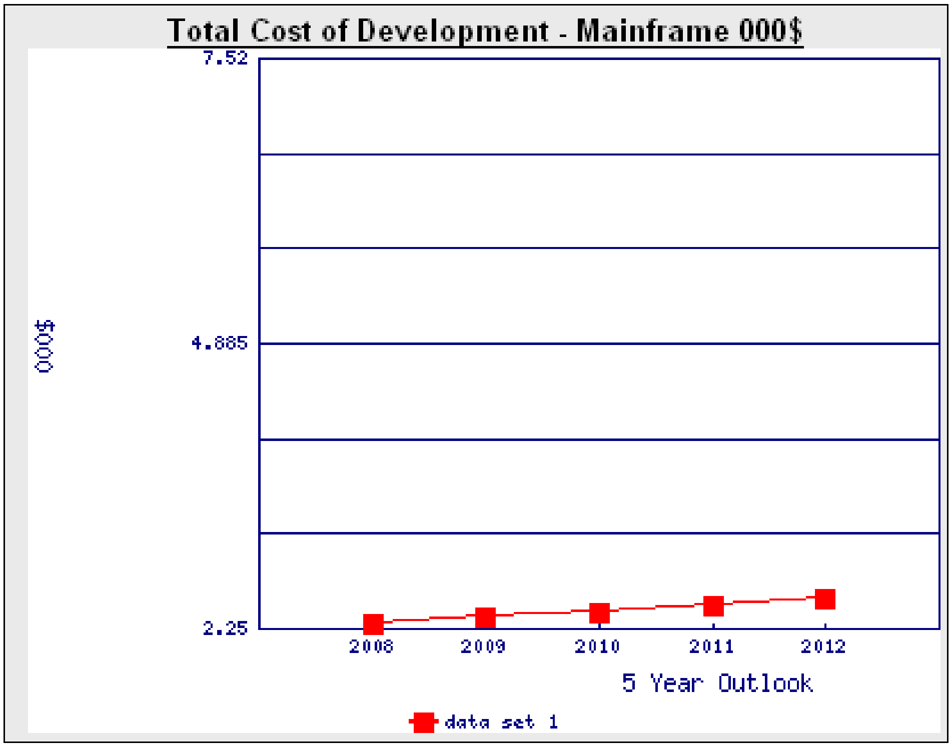
FIGURE 2–32

FIVE-YEAR OUTLOOK OF APPLICATION INTEGRATION DEVELOPMENT COSTS IN MAINFRAME SYSTEM



Source: Wintergreen Research, Inc.

The above graph shows a five-year outlook in the total cost of disaster recovery development in mainframe system. The cost increases from $2,296 in 2008 to $2,519 in 2012 based on the value of shared workload and application middleware systems optimization.

Thus the cost differential in disaster recovery development in mainframe vs. distributed systems is $231,500 for the current year and increases to $259,400 in 2012, proving the cost efficiency of mainframe.

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3. Hardware Cost Comparison -- Mainframe vs. Distributed

3.1 Hardware Cost Comparison

Mainframe hardware is commonly perceived as more expensive than distributed servers, with upfront costs running about two to three times more. But a closer look at depreciation schedules shows otherwise.

The lifespan for the mainframe lasts a decade or more, compared with three to five years for a distributed server. Companies allocate those mainframe costs back to the departments and others who use related applications using a charge back system that is deceptive. Mainframe depreciation schedules continue on for two or three times as long. Organizations often forget this calculation when comparing mainframe and distributed costs.

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FIGURE 3-1

WORKING OUT THE HARDWARE COST DIFFERENTIAL BETWEEN MAINFRAME AND DISTRIBUTED SYSTEMS

Summary Page:
Hardware

Current Scenario: Scenario 1 Go Scenarios | Print | Display Calc List | Calculate

1. Hardware Cost Comparison - Mainframe vs. Distributed System	Initial	Unit	2008	2009	2010	2011	2012
2. Analyst Remarks							
3. Number of Servers - E-Referral	13.0	#					
4. Number of Mainframe MIPs - E-Referral	3.8	MIPs					
5. Distributed System - Hardware Purchase And Maintenance Costs	105.6	000$	15.8	15.8	110.2	15.8	15.8
6. Mainframe - Hardware Purchase And Maintenance Costs	7.6	000$	1.5	1.5	1.5	1.5	1.5
7. Cost Differential	Total	Unit	2008	2009	2010	2011	2012
8. Hardware Cost Differential - Mainframe vs. Distributed System	**97.9**	000$	**14.3**	**14.3**	**108.7**	**14.3**	**14.3**

Source: Wintergreen Research, Inc.

Here is a comparison of costs of MIP, CPU license, RAM, hard disk and server for PC, Unix (low end), Unix (high end) and Mainframe.

FIGURE 3-2

SERVER AND MAINFRAME HARDWARE COSTS

	PC	**Unix (Low end)**	**Unix (High end)**	**Mainframe**
Price per MIP	$2	$480	$567	$1,500
16 CPU License	$32,000	$50,000	$65,000	$1,177,000
1 Gig RAM	$500	$5,000	$6,000	$10,000
1.2 Terabyte Disk	$1,500	$24,000	$25,000	$78,000
Avg Server Cost	$30,000	$95,000	$115,000	$500,000

Source: Wintergreen Research, Inc.

3.1.1 Acquisition Costs

Server to MIP conversion is based on assumptions about how the mainframe can replace the computing capability of many large, scaled-up distributed systems. The shared workload capability of the mainframe reduces the acquisition cost of mainframe, compared to that of several distributed systems that need to be managed.

3.2 Mainframe Updates And Cost Efficiencies

IBM System z TCO illustrates the mainframe has substantial updates and cost efficiencies achieved over the last decade, becoming more affordable system, more attuned to modern APIs and middleware, and more network-savvy. It no longer makes sense for the large enterprise to measure TCO strictly on a one-application-per-server basis, TCO must be measured for 10-250 applications on one mainframe versus 10-20 blades or a grid of 50 distributed systems.

For mainframe systems, the TCO is ten times better than Unix, Linux, Windows and other similar alternatives. TCO advantages are 7 times less expensive when the Linux workload is virtualized on the mainframe. Distributed Sun servers or distributed Linux servers are more expensive in a data center environment. In mixed workload set-ups, mainframe systems are economically justified.

3.2.1 Labor Costs For A System With Different Functioning Workloads

For a mainframe system with different functioning workloads, the labor costs are a fraction of those that are required for distributed systems.

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Labor costs typically represent 40% of the data center costs, electricity costs are 35% of the data center costs while hardware costs are typically less than 18 % of the data center costs.

Shared workload is the most significant aspect of reducing hardware costs. Shared workload increases the ability to provide adequate systems security. The mainframe reduces costs across the board, electricity is less, labor is less, and utilization of the hardware is significantly higher.

When vitalizing on the mainframe, key savings come from reduced management and maintenance costs. Centralizing more operations on one platform at a single geographical location, rather than managing servers across multiple branches or locations can reduce maintenance expenses. New broadband capabilities make that possible. That ability can help reduce the number of people needed to manage distributed servers and reassign them to higher-level tasks to better achieve business goals.

Mainframe systems are advantageous in terms of economies of scale. It can handle a large number of users more efficiently than a distributed system. IBM System z provides automation of security and management systems that eliminates the need for manual intervention. This reduces the chances of manually induced errors.

3.3 Acquisition Costs

Server to MIP conversion is a complex calculation that takes into consideration the fact that the mainframe can replace the computing capability of multiple sets of fifteen to fifty large, scaled-up distributed systems that may be running a single application. This shared workload capability of the mainframe reduces the acquisition cost of mainframe, compared to that of several distributed systems that need to be managed.

IBM System z ROI mainframe has substantial updates that improve the return on investment (ROI). As the mainframe has become more affordable, it is also more attuned to APIs and middleware. It works on the network to manage workload in real time. New workload is fundamentally Internet based applications that leverage the Internet as a channel.

It no longer makes sense for the large enterprise to measure ROI strictly on a one-application-per-server basis. ROI is measured for 200 applications on one mainframe leveraging shared workload versus 10-20 blades running 10 applications or a grid of 50 distributed systems running 5 applications.

For mainframe systems, the ROI is ten times better than Unix, Linux, Windows and other alternatives. For Linux systems running on the mainframe, the ROI is seven times better than the mainframe. ROI advantages are 30% to 60 % better than 30 distributed Sun servers or 300 distributed Linux Servers. In all mixed workload set-ups, mainframe systems are economically justified because they are designed to provide security and efficiency in shared systems processing environments.

3.3.1 Labor Costs For a Mainframe System

For a mainframe system with different functioning workloads, the labor costs are a fraction of those that are required for distributed systems. When virtualizing on the mainframe, key savings come from reduced management and maintenance costs.

Centralizing operations on one platform at a single geographical location and serving multiple locations from the single location can reduce maintenance expenses. Rather than managing servers across multiple branches or locations, a centralized IT is more efficient.

Branches may have distributed servers that are connected to the mainframe. That ability can help reduce the number of people needed to manage distributed servers and reassigns them to higher-level tasks to better achieve business goals. Mainframe systems are advantageous in terms of economies of scale. They can handle a large number of users more efficiently than a distributed system. (See Figure 3-3.) The analysis is per year for query intensive applications for 2007.

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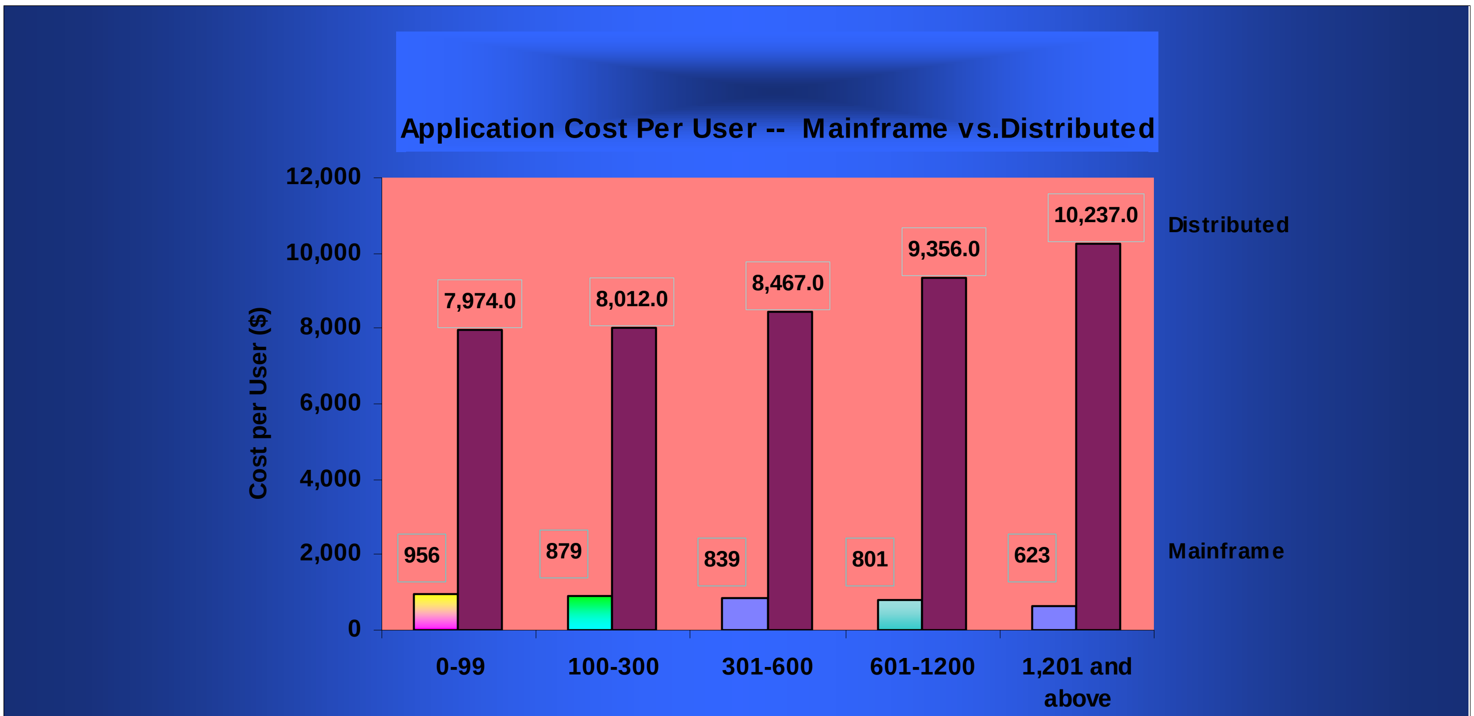
FIGURE 3-3

APPLICATION COST PER USER MAINFRAME VS, DISTRIBUTED SERVER



Source: WinterGreen Research, Inc.

TABLE 3-4

ROI COST PER USER PER YEAR QUERY INTENSIVE APPLICATIONS

MAINFRAME VS. DISTRIBUTED SERVER

ROI Cost Per User Per Year Query Intensive Applications Mainframe vs, Distriburted Server (In Dollars)		
Number of Users	**Mainframe**	**Unix**
0-99	**956**	**7,974**
100-300	**879**	**8,012**
301-600	**839**	**8,467**
601-1200	**801**	**9,356**
1,201 and above	**623**	**10,237**
Source: WinterGreen Research, Inc.		

System z of IBM provides a superior automation management system that eliminates the need for manual intervention. This also reduces the chances of manually induced errors.

3.4 Specialty Engines zAAP (System z Application Assist Processor) and zIIP (System z9 Integrated Information Processor)

For Java and selected DB2 workloads, specialty engines zAAP (System z Application Assist Processor) and zIIP (System z9 Integrated Information Processor) are designed to lower both hardware and software costs dramatically. IBM's new pricing model System z application license charges (zNALC) encourages new applications including Java applications running under Websphere Application Server (WAS), by discounting 80-90% on monthly license charges (MLC) of z/OS.

More cost savings come from IBM's pricing curves and trade-in policies, lower storage, disaster recovery and energy costs, staffing efficiency, and high utilization. A Java/Websphere application analyzes the costs of acquisition comparison between systems z and distributed systems. It demonstrates that the distributed cost is 10 times more than the mainframe cost.

System z offers unmatched reliability, scalability, and security, and help customers improve productivity of Java/Websphere/DB2 applications development with tooling, in addition to lower TCA. Therefore, it ultimately minimizes the TCO. IDC (a subsidiary of International Data Group) is the premier global provider of market intelligence and advisory services for IT industry. Their recent study proves that the TCO of the mainframe is only 56% of the distributed systems, considering the costs of hardware, software, services, networking, IT staff and user downtime.

zIIP and zAAP are specialty engines on System z designed to lower the costs of selected DB2 and Java workloads.

zIIP and zAAP specialty engines are priced much lower than the general purpose z processors. A 580 Millions of Instructions Per Second (MIP) specialty engine processor is typically $125K for an EC class machine and $95K for a BC class machine at US list price for one time charge, about 9% of the price of a general processor. There is no charge of any IBM software running on zIIP or zAAP. Typically, upgrades to next generation of the zIIP and zAAP processors are free.

Therefore, if 50% of the workloads are redirected to these specialty engines, savings of 50% on the software cost and more than 45% on the hardware cost can be achieved.

zAAP is used to redirect Java workloads. In Websphere scenarios up to 85% of the workload can be redirected to zAAP. Some customers even reported 97% of workload redirected to zAAP, therefore dramatically lowering software costs.

The zIIP specialty engine is used to redirect selected DB2 workloads. In database server scenarios, up to 40% of the queries received via DRDA Remote Access Protocol can be redirected. In data warehouse scenarios, up to 80% parallel queries can be redirected. Some of the index maintenance utilities can be redirected to zIIP too. In a SAP or data warehouse scenario, 40% redirect ratio is typical.

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3.5 Number Of Servers – Web Application

This section provides an analysis of mainframe MIPs to distributed server hardware equivalency. A Web application is considered here. For ease of analysis, the applications on the mainframe system are considered to be a midsize enterprise class application:

3.5.1 Hardware Equivalency Analysis Between Mainframe MIPs and Distributed Server

FIGURE 3-5

WORKING OUT THE HARDWARE EQUIVALENCY ANALYSIS BETWEEN MAINFRAME MIPS AND DISTRIBUTED SERVER FOR WEB BASED E-APPLICATION

1. Mainframe MIPs to Distributed Server Hardware Equivalency Analysis -- For E-Referral			
2. This Portion of the Server Hardware to Mainframe MIPs Equivalency Analysis is Based On Consideration of The Number and Variety Of Applicatior			
3. # Servers For E-Referral	13.0	#	
4. Core Mainframe Application And Database Use of MIPs			
5. Start By Arbitrary Assumptions Of Particular # Of Applications and # Of MIPs Each Application Uses At Runtime On Mainframe			
6. Complement Analysis With Arbitrary Assumptions Of # Of MIPs That Set of Applications Has Allocated On Mainframe			
7. Assume Arbitrary # Of Applications On Mainframe	3,000.0	#	
8. Assume Arbitrary # Of MIPs On Mainframe	3,000.0	#	

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The number of servers required for the e-referral application is 13. For cost analysis, we are assuming that there are 3,000 applications on the mainframe and that 3,000 MIPs have been allocated on the mainframe, for that set of applications. They do not all run at the same time.

3.5.2 Core Very Large Application Use of MIPs

FIGURE 3–6

ANALYSIS OF TRANSACTIONS IN VERY LARGE APPLICATIONS ON MAINFRAME

9. Core Very Large Application Use of MIPs		
10. # Of Very Large Applications	3.0	#
11. Average # Of Transactions Per Second For Each Very Large Application On Mainframe	1.3	#
12. # Of Seconds In Year Of Processing (Seconds * Minutes * Hours * Days in Working Year)	10,756,800.0	#
13. # Of Transactions Processed Per Year For One Very Large Application	13,983,840.0	#
14. Unit Conversion - # to MM	1,000,000.0	#
15. # Of Transactions Processed Per Year For One Very Large Application	14.0	# in millions
16. # Of Transactions Processed Per Year For All Very Large Applications	42.0	# in millions

Source: Wintergreen Research, Inc.

There are 3 very large applications. On an average, 1.3 transactions take place per second, on these applications.

10,756,800.0 seconds are required for processing the 14 million transactions for one very large application, in one year. Hence, 42 million transactions are processed per year, for all very large applications.

FIGURE 3–7

MIPS CALCULATION IN VERY LARGE APPLICATIONS ON MAINFRAME

17. MIP Calculation Based On Throughput		
18. # Of MIPs Used At Runtime By One Very Large Application	600.0	#
19. # Of MIPs Allocated To One Very Large Application	450.0	#
20. # Of MIPs Allocated To All Very Large Applications	1,350.0	#

Source: Wintergreen Research, Inc.

600 MIPs are used by one very large application. The total number of MIPs allocated to all very large applications is 1,350.

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3.5.3 Core Large Application Use of MIPs

FIGURE 3–8

ANALYSIS OF TRANSACTIONS IN LARGE APPLICATIONS ON MAINFRAME

21. Core Large Application Use of MIPs		
22. # Of Large Applications	38.0	#
23. Average # Of Transactions Per Second For Each Large Application On Mainframe	1.6	#
24. # Of Seconds In Year Of Processing (Seconds * Minutes * Hours * Days in Working Year)	15,750,800.0	#
25. # Of Transactions Processed For One Large Application	25,201,280.0	#
26. Unit Conversation - # to MM	1,000,000.0	#
27. # Of Transactions Processed Per Year For One Large Application	25.2	# in millions
28. # Of Transactions Processed Per Year For All Large Applications	957.6	# in millions

Source: Wintergreen Research, Inc.

There are 38 large applications assumed in the analysis. On an average, 1.6 transactions take place per second, on these applications in mainframe.

15,750,800.0 seconds are required for processing the 25.2 million transactions for one large application, in one year. Hence, 957.6 million transactions are processed per year, for all large applications.

FIGURE 3–9

MIPS CALCULATION IN LARGE APPLICATIONS ON MAINFRAME

29. MIP Calculation Based On Throughput		
30. # Of MIPs Used At Runtime By One Large Application	200.0	#
31. # Of MIPs Allocated to One Large Application	20.0	#
32. # Of MIPs Allocated to All Large Applications	760.0	#

Source: Wintergreen Research, Inc.

200 MIPs are used by one large application. The total number of MIPs allocated to all large applications is 760.

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3.5.4 Core Midrange Application Use of MIPs

FIGURE 3–10

ANALYSIS OF TRANSACTIONS IN MID-RANGE APPLICATIONS ON MAINFRAME

33. Core Midrange Application Use of MIPs		
34. # Of Mid Range Applications	3,000.0	#
35. Average # Of Transactions Per Second For Each Mid Range Application On Mainframe	0.3	#
36. # Of Seconds In Year Of Processing (Seconds * Minutes * Hours * Days in Working Year)	2,116,800.0	#
37. # Of Transactions Processed For One Mid Range Application	635,040.0	#
38. Unit Conversion - # to MM	1,000,000.0	#
39. # Of Transactions Processed Per Year For One Mid Range Application	0.6	# in millions
40. # Of Transactions Processed Per Year For All Mid Range Applications	1,905.1	# in millions

Source: Wintergreen Research, Inc.

There are 3,000 mid-range applications assumed. On an average, 0.3 transactions take place per second, on these applications in mainframe.

2,116,800.0 seconds are required for processing the 0.6 million transactions for one mid-range application, in one year. Hence, 1,905.1 million transactions are processed per year, for all mid-range applications.

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FIGURE 3–11

MIPS CALCULATION IN MID-RANGE APPLICATIONS ON MAINFRAME

41. MIP Calculation Based On Throughput		
42. # Of MIPs Used At Run Time By One Mid Range Application	5.0	#
43. # Of MIPs Allocated One Mid Range Application	0.2	#
44. # Of MIPs Allocated to All Mid Range Applications	600.0	#

Source: Wintergreen Research, Inc.

5 MIPs are used by one mid-range application. The total number of MIPs allocated to all mid-range applications is 600.

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3.5.5 Core Other Application Use of MIPs

FIGURE 3–12

ANALYSIS OF TRANSACTIONS IN OTHER APPLICATIONS ON MAINFRAME

45. Core Other Application Use of MIPs		
46. # Of Other Applications	300.0	#
47. Average # Of Transactions Per Second For Each Other Application On Mainframe	0.8	#
48. # Of Seconds In Year Of Processing (Seconds * Minutes * Hours * Days in Working Year)	10,116,800.0	#
49. # Of Transactions Processed For One Other Application	8,093,440.0	#
50. Unit Conversation - # to MM	1,000,000.0	#
51. # Of Transactions Processed Per Year For One Other Application	8.1	# in millions
52. # Of Transactions Processed Per Year For All Other Applications	2,428.0	# in millions

Source: Wintergreen Research, Inc.

There are 300 applications other than the ones discussed above. On an average, 0.8 transactions take place per second, on these applications in mainframe.

10,116,800.0 seconds are required for processing the 8.1 million transactions for one other application, in one year. Hence, 2,428 million transactions are processed per year, for all other applications.

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FIGURE 3–13

MIPS CALCULATION IN OTHER APPLICATIONS ON MAINFRAME

53. MIP Calculation Based On Throughput		
54. # Of MIPs Used At Runtime By One Other Application	2.5	#
55. # Of MIPs Allocated to One Other Application	0.1	#
56. Total # Of MIPs Allocated By Very Large, Large, and Mid Range Applications	2,710.0	#
57. Total # Of MIPs Allocated By All Other Applications	290.0	#

Source: Wintergreen Research, Inc.

2.5 MIPs are used by one other application. The total number of MIPs allocated to all other applications is 290. The sum total number of MIPs allocated to all very large, large and mid-range applications is 2,710.

FIGURE 3–14

MIPS CALCULATION FOR E-REFERRAL APPLICATION

58. Mainframe MIPs to - Server Hardware Equivalency Analysis E-Referral Application		
59. # MIPs E-Referral Application	3.8	#

Source: Wintergreen Research, Inc.

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The number of MIPs for the e-application is 16 total when the application is running, but it shows up in the analysis as 3.8 because it does not run all the time. This demonstrated the advantage of shared workload in the ROI analysis of hardware costs. Distributed servers tend to run one or two applications because of the difficulty managing spikes in demand. The mainframe is optimized to manage spikes automatically, so it can have many different applications that run at different times.

3.6 Distributed System – Hardware Purchase, Maintenance And Replacement Costs

This section analyses the hardware purchase and maintenance costs for the distributed system application. The distributed server computer – HP, Sun, or Dell is being considered for analysis.

Distributed system server hardware costs are divided into the following:

- Primary server costs – web presentation, application, distributed database
- Ancillary server costs – web presentation, application, distributed database

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3.6.1 Total Server Hardware Costs

FIGURE 3–15

HARDWARE COST CALCULATION IN DISTRIBUTED SYSTEM

3. Total Hardware Costs - Complete Server Hardware		
4. 000$ Per Primary Production Server	8.0	000$
5. 000$ Per Ancillary Server	5.0	000$

Source: Wintergreen Research, Inc.

The cost per primary production server in the distributed system is $8,000. The cost per ancillary server in the distributed system is $5,000.

3.6.2 Cost of Primary Servers

FIGURE 3–16

PRIMARY SERVER COST CALCULATION IN DISTRIBUTED SYSTEM

6. # And Cost Of Primary Servers	Initial	Unit
7. # Of Distributed Web Presentation Servers	2.0	#
8. # Of Distributed Application Servers	4.0	# servers
9. # Of Dedicated Distributed Database Servers	1.0	#
10. # Of Primary Distributed Servers	7.	servers
11. 000$ Cost Of Primary Distributed Servers	56.0	000$

Source: Wintergreen Research, Inc.

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As part of the primary servers, there are 2 web presentation servers, 4 application servers, 1 dedicated database server and 7 primary servers in the distributed system. $56,000 is the cost of primary distributed servers.

3.6.3 Cost of Ancillary Servers

FIGURE 3–17

ANCILLARY SERVER COST CALCULATION IN DISTRIBUTED SYSTEM

12. # And Cost Of Distributed Test, Development, Database, and Backup Ancillary Servers	Initial	Unit
13. # Of Distributed Web Presentation Servers-test	2.0	#
14. # Of Distributed Application Servers	3.0	servers
15. # Of Dedicated Distributed Database Servers-test	1.0	#
16. # Of Distributed Backup Servers	0.0	#
17. # Of Test/Staging/QA Distributed Servers	6.	servers
18. 000$ Cost Of Primary Distributed Servers	30.0	000$

Source: Wintergreen Research, Inc.

As part of the ancillary servers, there are 2 web presentation test servers, 3 application servers, 1 distributed database test server and 6 test/staging/QA distributed servers. $30,000 is the cost of ancillary distributed servers.

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3.6.4 Distributed Server Costs

FIGURE 3–18

WORKING OUT DISTRIBUTED SERVER COSTS

19. Distributed Server Costs	Initial	Unit
20. Total # of Distributed Servers	13.	servers
21. Total Cost of Distributed Servers	86.0	000$

Source: Wintergreen Research, Inc.

There are a total of 13 distributed servers, accounting for a total of $86,000, in the distributed computer system.

3.6.5 Distributed Server Disk Costs

FIGURE 3–19

WORKING OUT DISK COSTS FOR DISTRIBUTED SERVERS

22. Disk Costs For Distributed Servers	Initial	Unit
23. # Of Terabytes Of Disk Storage On Core Distributed Servers	0.000	#
24. # Of Terabytes Of Disk Storage On Backup, Test, And Development Distributed Server	0.000	#
25. Total # Of Terabytes Of Disk Storage	0.000	#
26. Cost of Terabytes Of Disk Storage (000$ per terabyte)	5.0	000$
27. Total Cost Of Terabytes Of Disk Storage	0.0	000$

Source: Wintergreen Research, Inc.

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There are no terabytes of disk storage on the distributed servers and hence no cost incurred.

3.6.6 Distributed Server Memory Costs

FIGURE 3–20

WORKING OUT MEMORY COSTS FOR DISTRIBUTED SERVERS

28. Memory Costs	Initial	Unit
29. # of Gigs Production Distributed Server Memory	105.0	#Gigs
30. # of Gigs Development, Test, Database And Backup Distributed Server Memory	106.0	#Gigs
31. Cost Per Gig For Distributed Server Computer Memory (000$ per Gig)	0.050	000$
32. 000$ Total Cost For Distributed Server Computer Memory	10.6	000$

Source: Wintergreen Research, Inc.

105 Gigs of production server memory and 106 Gigs of development, test, database and backup server memory are required by the distributed system. At the rate of $50 per Gig of memory, the total cost of memory in the distributed system is $10,600.

3.6.7 Distributed Server Storage Costs

FIGURE 3–21

WORKING OUT STORAGE COSTS FOR DISTRIBUTED SERVERS

33. Storage Costs For Distributed Server Computers	Initial	Unit
34. 000$ Costs For Core Tape Storage Units	0.0	(000)$
35. 000$ Costs For Backup, Test, And Development Computer Tape Storage Units For Distributed Servers	0.0	(000)$
36. 000$ Costs For Core Computer San And NAS Storage Units For Distributed Servers (assuming 1.8 terabytes of space)	9.0	(000)$
37. 000$ Costs For Backup, Test, And Development Computer San And NAS Storage Units For Distributed Servers	0.0	(000)$
38. Total Costs of Disk, San, and Tape Storage For Core, Backup, Test, And Development	9.0	000$

Source: Wintergreen Research, Inc.

$9,000 is the total storage cost, which comprises costs for core computer San and NAS storage units for distributed servers.

3.6.8 Total Server Hardware Costs

FIGURE 3–22

TOTAL SERVER HARDWARE COSTS

39. Total Hardware Costs - Complete Server Hardware	Initial	Unit
40. Total Hardware Costs - Complete Server Hardware	**105.5**	000$
41. Average Cost Per Unit (Including all Hardware Costs)	**8.12**	000$

Source: Wintergreen Research, Inc.

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The total hardware costs for the complete server hardware is $105,500 and the average cost per unit is $8,120.

FIGURE 3–23

WORKING OUT HARDWARE PURCHASE AND REPLACEMENT COSTS

42. Hardware Purchase and Replacement Costs	Initial	Unit	2008	2009	2010	2011	2012
43. % Increase/Decrease in Average Price Per Unit (server)		%	-3.0	-3.0	-5.0	-6.0	-8.0
44. Estimated Average Price Per Unit	8.1	000$	7.9	7.6	7.3	6.8	6.3
45. Distributed Server Purchase and Replacement (enter # units)	13.0	units	0.0	0.0	13.0	0.0	0.0
46. Estimated Total Cost of Servers and Replacement	**105.5**	000$	**0.0**	**0.0**	**94.3**	**0.0**	**0.0**

Source: Wintergreen Research, Inc.

For the current year, the estimated average price per server unit is $8,100 and that 13 server units need to be purchased. The total server cost is $105,500.

For years 2008 through 2012:

The average price per server unit decreases by 3.0%, 3.0%, 5%, 6% and 8% for the respective years. 13 server units need to be replaced in 2009, at a cost of $94,300. There is no necessity for replacement of server units in the other years being discussed.

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3.6.9 Hardware Maintenance Costs

FIGURE 3–24

WORKING OUT HARDWARE MAINTENANCE COSTS

47. Hardware Maintenance Costs	Initial	Unit	2008	2009	2010	2011	2012
48. Annual Maintenance Costs As a % of Hardware Costs		%	15.0	15.0	15.0	15.0	15.0
49. Annual Server Maintenance Costs		000$	**15.8**	**15.8**	**15.8**	**15.8**	**15.8**
50. Annual Financing Available	0.0	%	0.0	0.0	0.0	0.0	0.0

Source: Wintergreen Research, Inc.

For years 2008 through 2012:

The annual maintenance costs for hardware is $15,800 every year. Financing is not available for any of the years.

FIGURE 3–25

WORKING OUT TOTAL HARDWARE PURCHASE, MAINTENANCE AND REPLACEMENT COSTS

51. Total Costs	Initial	Unit	2008	2009	2010	2011	2012
52. Total Costs - Hardware Purchase, Maintenance and Replacement - Distributed System	105.5	000$	15.8	15.8	110.2	15.8	15.8
53. Impact of Annual Server Financing Available For Bundled Software, Hardware, and Services	0.0	000$	0.0	0.0	0.0	0.0	0.0
54. Total Costs Including Annual Server Financing Available For Hardware Purchase, Maintenance and Replacement	105.5	000$	15.8	15.8	110.2	15.8	15.8

Source: Wintergreen Research, Inc.

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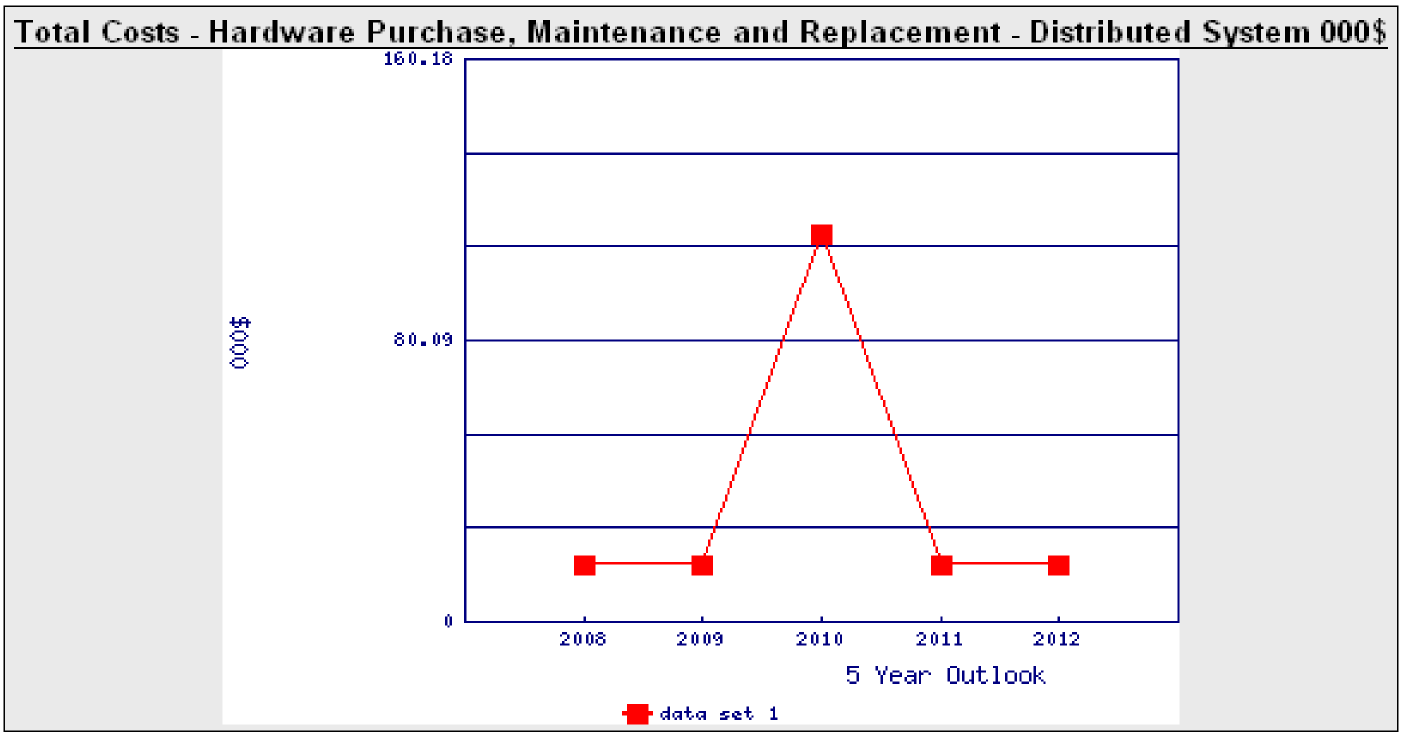
Total costs including hardware purchase, maintenance, replacement and financing available for the distributed system is $105,500 for the current year.

FIGURE 3–26

FIVE-YEAR OUTLOOK OF TOTAL HARDWARE PURCHASE, MAINTENANCE AND REPLACEMENT COSTS IN DISTRIBUTED SYSTEM



Source: Wintergreen Research, Inc.

The above graph shows a five-year outlook of total hardware costs including purchase, maintenance and replacement in distributed systems.

The total costs peak in 2010, to a whopping $110,200.

3.7 Mainframe – Hardware Purchase, Maintenance And Replacement Costs

This section analyses the hardware purchase, maintenance and replacement costs for the mainframe system application.

Mainframe system hardware costs are divided into the following:

- zIIP costs
- zAAP costs
- Disk storage costs
- Memory costs

All calculations are for the current year, unless specified otherwise.

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3.7.1 Total Mainframe Hardware Costs

FIGURE 3–27

WORKING OUT TOTAL HARDWARE PURCHASE, MAINTENANCE AND REPLACEMENT COSTS

2. Total Hardware Costs - Complete Mainframe Hardware		
3. # of MIPS	3.8	MIPS
4. 000$ Per Mip	1.4	000$
5. 000$ Total Cost Of MIPS	5.1	000$
6. # of zIIPS	0.0	zIIPS
7. 000$ Per zIIP	125.0	000$
8. 000$ Total Cost Of zIIPS	0.0	000$
9. # of zAAPS	0.0	zAAPS
10. 000$ Per zAAP	125.0	000$
11. 000$ Total Cost Of zAAPS	0.0	000$

Source: Wintergreen Research, Inc.

3.8 MIPs needed for the mainframe hardware system cost a total of $5,100. No zIIPs and zAAPs are assumed needed for the mainframe hardware system, but if the application processing is off loaded the ROI becomes even more favorable for the mainframe vs. the servers.

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3.7.2 Total Mainframe Disk Costs

FIGURE 3–28

WORKING OUT TOTAL DISK COSTS FOR MAINFRAME

12. Disk Costs For Mainframe	Initial	Unit	
13. # Of Terabytes Of Disk Storage On Mainframe	0.050	#	
14. 000$ Per Terabyte Of Disk On Mainframe	10.0	000$	
15. Total 000$ Cost Of Disk Storage on Mainframe	0.0	000$	

Source: Wintergreen Research, Inc.

With an initial requirement of just 0.050 terabytes of disk storage, the total cost of disk storage on mainframe is close to zero.

3.7.3 Total Mainframe Memory Costs

FIGURE 3–29

WORKING OUT TOTAL MEMORY COSTS FOR MAINFRAME

16. Mainframe Memory Costs	Initial	Unit
17. # of Gigs Mainframe Memory	0.5	#Gigs
18. Cost Per Gig For Mainframe Memory (000$ per Gig)	0.750	000$
19. 000$ Total Cost For Mainframe Memory	0.375	000$

Source: Wintergreen Research, Inc.

0.5 Gigs of mainframe memory, at a cost of $750 per Gig is needed initially. This amounts to total mainframe memory cost of $375.

3.7.4 Total Mainframe Storage Costs

FIGURE 3–30

WORKING OUT TOTAL STORAGE COSTS FOR MAINFRAME

20. Storage Costs For Mainframe	Initial	Unit
21. # Terabytes of Tape Storage	0.10	#
22. Price per Terabyte Mainframe Tape Storage	1.0	(000)$
23. Total 000$ Tape Storage Cost For Mainframe	0.10	000$
24. # of Terabytes SAN or NAS Storage	0.40	#
25. Price per Terabyte For Mainframe SAN And NAS Storage	5.0	(000)$
26. Total SAN,NAS Storage Cost For Mainframe	2.0	000$

Source: Wintergreen Research, Inc.

0.10 Terabytes of tape storage is required initially for the mainframe system. At a price of $1,000 per Terabyte of tape storage, the total tape storage cost for mainframe is $100.

0.4 Terabytes of SAN or NAS storage is required initially for the mainframe system. At a price of $5,000 per Terabyte of SAN/NAS storage, the total SAN, NAS storage cost of mainframe is $2,000.

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3.7.5 Total Complete Mainframe Hardware Costs

FIGURE 3–31

WORKING OUT TOTAL COSTS FOR THE COMPLETE MAINFRAME HARDWARE

27. Total Hardware Costs - Complete Mainframe Hardware	Initial	Unit
28. Total Hardware Costs - Complete Mainframe Hardware	7.6	000$
29. Average Cost Per MIP (Including all Hardware Costs)	2.0	000$

Source: Wintergreen Research, Inc.

The total complete mainframe hardware cost is the sum of the costs for disk, memory, storage, zAAP and zIIP for the mainframe system. This amounts to $7,600. The average cost per MIP is $2,000.

3.7.6 Mainframe Hardware Purchase And Replacement Costs

FIGURE 3–32

WORKING OUT PURCHASE AND REPLACEMENT COSTS FOR MAINFRAME HARDWARE

30. Hardware Purchase and Replacement Costs	Initial	Unit	2008	2009	2010	2011	2012
31. % Increase/Decrease in Average Price Per MIP		%	-3.0	-3.0	-3.0	-3.0	-3.0
32. Estimated Average Price Per MIP	2.0	000$	1.9	1.9	1.8	1.8	1.7
33. MIP Purchase and Replacement (enter # units)	3.8	units	0.0	0.0	0.0	0.0	0.0
34. Estimated Total Cost of MIP Purchase and Refresh	7.6	000$	0.0	0.0	0.0	0.0	0.0

Source: Wintergreen Research, Inc.

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It is estimated that 3.8 MIPs need to be purchased initially, at a total cost of $7,600. Though he application runs in 16 MIPs, it does not use the entire mainframe 24 x 7, with a shared workload computing environment, the system has efficiencies that need to be accounted for by calculating the amount of time the capacity is actually being used.

For the years 2008 through 2012:

The average price per MIP reduces by 3% every year. Since no MIP units are required to be replaced, the cost of MIP during this period is zero.

3.7.7 Mainframe Maintenance Costs

FIGURE 3–33

WORKING OUT MAINTENANCE COSTS FOR MAINFRAME HARDWARE

35. Hardware Maintenance Costs	Initial	Unit	2008	2009	2010	2011	2012
36. Annual Maintenance Costs As a % of Hardware Costs - Mainframe		%	20.0	20.0	20.0	20.0	20.0
37. Annual Mainframe Maintenance Costs		000$	1.5	1.5	1.5	1.5	1.5
38. Annual Financing Available	0.0	%	0.0	0.0	0.0	0.0	0.0

Source: Wintergreen Research, Inc.

For years 2008 through 2012:

The annual maintenance costs for hardware is $1,500 every year. Financing is not available for any of the years.

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3.7.8 Total Mainframe Hardware Purchase, Maintenance, Replacement And Annual Financing Costs

FIGURE 3–34

WORKING OUT TOTAL HARDWARE PURCHASE, MAINTENANCE, REPLACEMENT AND ANNUAL FINANCING COSTS

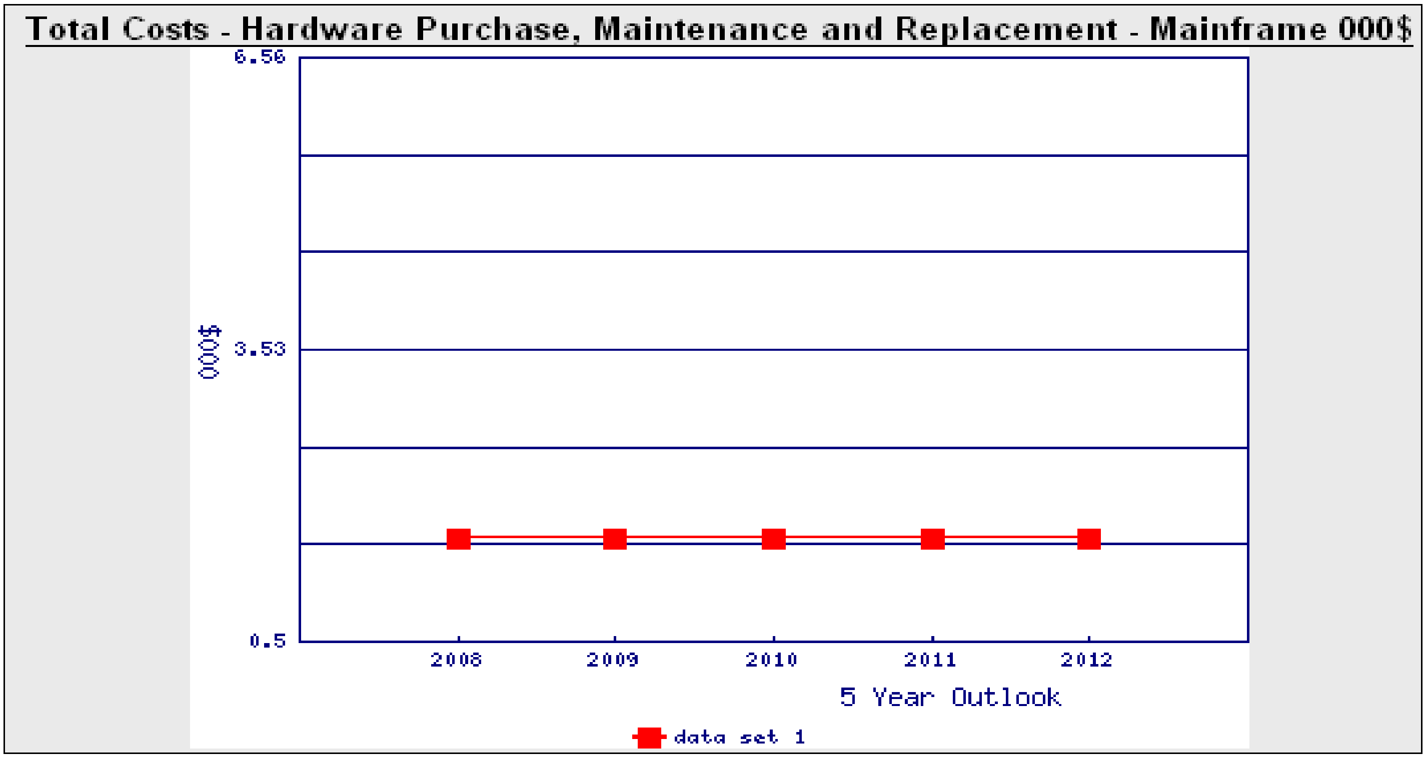
39. Total Costs	Initial	Unit	2008	2009	2010	2011	2012
40. Total Costs - Hardware Purchase, Maintenance and Replacement - Mainframe	7.6	000$	1.5	1.5	1.5	1.5	1.5
41. Impact of Annual Server Financing Available For Bundled Software, Hardware, and Services	0.0	000$	0.0	0.0	0.0	0.0	0.0
42. Total Costs Including Annual Server Financing Available For Hardware Purchase, Maintenance and Replacement	7.6	000$	1.5	1.5	1.5	1.5	1.5

Source: Wintergreen Research, Inc.

Total costs including hardware purchase, maintenance, replacement and financing available for the mainframe system is $7,600 for the current year.

FIGURE 3–35

FIVE-YEAR OUTLOOK OF TOTAL HARDWARE PURCHASE, MAINTENANCE AND REPLACEMENT COSTS IN MAINFRAME SYSTEM



Source: Wintergreen Research, Inc.

The above graph shows a five-year outlook of total hardware costs including purchase, maintenance and replacement in mainframe systems.

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For years 2008 through 2012, the total costs remain constant at $1,500. This cost pattern is uniform, predictable and a fraction of that in distributed systems analyzed earlier.

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4. Hardware Scalability Cost Analysis -- Mainframe vs. Distributed Return on Investment (ROI)

4.1 Cost Differential Of Hardware Scalability Costs

This chapter works out the cost differential of hardware scalability costs of mainframe and distributed systems. It includes an analysis of the yearly maintenance costs to achieve scalability.

Every enterprise is positioned to participate in growth markets. The only way to remain profitable is to achieve automated process. Systems that scale easily are a significant aspect of leveraging the Web for the supply chain and as a new channel.

As companies seek to outsource aspects of the business that are not core, computing systems are needed to manage the outsourced capabilities.

Scalability is different from the servers or mainframe capacity used for the IT. Scaling of systems relates to that part of capacity that is in addition to what has been originally planned for. Scalability of systems is in response to market growth and the need for additional capacity and is treated separately in the analysis.

4.1.1 Scalability Costs

The scalability of distributed systems is problematic. Cost comparisons illustrate that the mainframe is ten times less expensive than distributed systems. Scalability analysis is a significant aspect of the cost differential.

Though a distributed network becomes more capable with increase in the number of hosts, the overhead required to maintain the coherence of a distributed network is high. As the size of the distributed system grows, the overhead grows too.

Hence, the system will not scale well. In mainframe systems, extra computing power can be added, as per business needs, without the requirement for additional servers. Shared workload gives the advantage to the mainframe.

Using mainframe adapter suites that run on a common architecture, it is possible to reduce the complexity of integration of various mainframe components with application platform suites. This eliminates the need for intermediate gateways for interoperability.

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FIGURE 4-1

WORKING OUT THE HARDWARE SCALABILITY COST DIFFERENTIAL BETWEEN MAINFRAME AND DISTRIBUTED SYSTEMS

Summary Page: **Scalability** — Current Scenario: Scenario 1 | Go | Scenarios | Print | Display Calc List | Calculate

1. Hardware Scalability Cost Analysis	Current	Unit	2008	2009	2010	2011	2012
2. Analyst Comments Hardware Scalability For Mainframe and Distributed Systems							
3. Total Hardware Purchase And Yearly Maintenance Costs To Achieve Scalability On Distributed System		000$	7.8	7.6	7.2	6.8	6.2
4. Total Hardware Purchase And Yearly Maintenance Costs To Achieve Scalability On Mainframe		000$	1.7	1.6	1.5	1.5	1.3
5. Cost Differential	Total	Unit	2008	2009	2010	2011	2012
6. Cost Differential - Hardware Scalability On Mainframe vs. Distributed System	27.9	000$	6.1	5.9	5.7	5.3	4.9

Source: Wintergreen Research, Inc.

4.2 Analyst Comments – Hardware Scalability for Mainframe and Distributed Systems

Load balancing overhead is required to achieve desired capacity. Load balancing does tie up MIPs. Processing efficiency is impacted by the need to manage clustering and security solutions on distributed systems. These processes are optimized by the mainframe.

Hardware redundancy depends on ports, memory, CPU MIPs, disk space, data base instances, and servers (with CPU, memory, disk, ports). Calculations of hardware costs depend on analysis of how much capacity is required to support the expected number of simultaneous users.

Load balancing software depends on labor input that creates cost centers to design, develop, implement, and install systems.

Scalability Additional Cost - WebSphere Application Server mainframe vs. distributed server assumptions - There are a number of technical limitations with respect to distributed server farm scalability, which mainframes overcome. In particular, distributed servers are far more difficult to manage than a centralized mainframe system, and coordinating the application, database, and network components on different boxes requires far more manpower and expertise in distributed environments.

This expertise is not in plentiful supply. The implications with respect to hardware relate to significant increased costs over the lifetime of the hardware for distributed servers. The need to purchase enough distributed server boxes to meet peak demand creates compelling need to plan and purchase to a level of peak capacity, while mainframe capacity can be turned on and off. The need to purchase extra boxes and the need for extra capacity to mange fault tolerance and failover create the need for more servers as systems scale.

The dollars per MIP calculation needs a factor, not included above, to take into account the relative efficiency of MIP processing on different systems. A mainframe is optimized for reliability and application operational efficiency. Distributed systems are not efficient in a database centric computing environment, and furthermore devote MIPS to cluster and security management that are used for application processing on the mainframe.

Assumption is that incremental steps to gain hardware capacity are each priced separately for WebSphere mainframe system

The Scale-up systems relate to server consolidation solutions. Typically they offer the physical consolidation of systems and applications on fewer, more powerful servers collocated in fewer locations. Typically the final operating budget might be smaller because of less location overhead and Moore's Law of higher throughput for the same price. Utilization might improve, but primarily throughput is improved through the use of more expensive, powerful servers with higher acquisition, operating and maintenance costs.

The scale-out server consolidation solutions are based on adding large numbers of inexpensive, less powerful systems can be less expensive to acquire, but adding more unique installations can cost more to monitor, operate, and maintain for high quality service delivery. Upgrading, expansion, and business strategy changes become deterrents to customer investments and barriers to expansion.

Adding more servers without extensive setup depends on being able to upgrade by recreating an image on one centralized image server or net boot location and the normal provisioning process. Changes in policy can be implemented by reprioritizing or changing the application mix and load allowances, dynamically online. The resources are virtualized and can be redeployed without effort. QoS metrics are dynamically changeable.

Network access is based on virtual addresses; so less networking upgrade is required, and network requests are routed to available servers. High availability and scalability are inherent in the infrastructure; so, they do not have to be rebuilt every time demand changes.

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4.3 Hardware Scalability Purchase and Maintenance Costs on Distributed System

Distributed servers can either be rack-mounted or blade type. The distributed system application being considered here is a data center.

All calculations are for the current year, unless specified otherwise.

FIGURE 4-2

WORKING OUT THE HARDWARE SCALABILITY METRICS FOR DISTRIBUTED SERVERS

2. Hardware Scalability Analyst Crosscheck Metrics	Current	Unit
3. # Of Servers In The Data Center	1,500.0	#
4. Useful Life of Rack Mounted Distributed Servers (years)	3.0	# years
5. Useful Life of Blade Distributed Servers (Years)	3.0	# years
6. # Primary Production Servers	7.0	#
7. # Ancillary Development And Testing Servers	6.0	#
8. # Fault Tolerant And Failover Servers	0.0	#
9. # SAN, NAS, and independent storage devices	0.0	#

Source: Wintergreen Research, Inc.

1,500 servers are needed for the data center. The useful life for rack-mounted and blade distributed servers is 3 years. There are 7 primary production servers and 6 ancillary development/testing servers in the distributed system.

FIGURE 4-3

WORKING OUT THE STORAGE AND SERVER COST ANALYSIS TO ACHIEVE SCALABILITY FOR DISTRIBUTED SYSTEMS

10. Hardware Scalability Distributed Systems Costs	Current	Unit	2008	2009	2010	2011	2012
11. Cost Per Rack Mounted Server	7.0	000$					
12. % Change In Price Of Rack Mounted Server Hardware and Maintenance		%	-3.0	-3.0	-5.0	-6.0	-8.0
13. Cost of Rack Mounted Server		000$	6.8	6.6	6.3	5.9	5.4
14. # Production Standalone Rack Mounted Servers Added Per Year		#	1.0	1.0	1.0	1.0	1.0
15. Cost of Rack Mounted Servers To Achieve Scalability (000$)		000$	**6.8**	**6.6**	**6.3**	**5.9**	**5.4**
16. Cost Per Blade Server	42.0	000$					
17. % Change In Price Of BladeServer Hardware		%	-3.0	-3.0	-5.0	-6.0	-8.0
18. Cost of Blade Server		000$	40.7	39.5	37.5	35.3	32.5
19. # Production Standalone Blade Servers Added Per Year		#	0.000	0.000	0.000	0.000	0.000
20. Cost of Blade Servers To Achieve Scalability (000$)		000$	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
21. Cost per SAN or storage device	15.0	000$					
22. % Change In Price Of SAN or storage device		%	-3.0	-3.0	-5.0	-6.0	-8.0
23. Cost of SAN or storage device		000$	14.6	14.1	13.4	12.6	11.6
24. # SAN Or Other Storage Devices Added Per Year		#	0.000	0.000	0.000	0.000	0.000
25. Cost of SAN or NAS storage (000$)		000$	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Source: Wintergreen Research, Inc.

4.3.1 Analysis For Rack-Mounted Server

$7,000 is the price per rack-mounted server.

For the years 2008 through 2012:

The price of rack-mounted server hardware and maintenance decreases by 3%, 3%, 5%, 6% and 8% for the respective years. One production standalone rack-mounted server is required to be added per year.

The cost of rack-mounted server decreases from $6,800 in 2008 to $5,400 in 2012. This is the total cost of rack-mounted server to achieve scalability.

4.3.2 Analysis For Blade Servers

$42,000 is the price per blade server.

For the years 2008 through 2012:

The price of blade server hardware and maintenance decreases by 3%, 3%, 5%, 6% and 8% for the respective years. No production standalone blade server is required to be added after the initial purchase. Hence the total cost of blade server to achieve scalability remains zero.

4.3.3 Analysis for SAN or Storage Device

$15,000 is the price per SAN or other storage device.

For the years 2008 through 2012:

The price of blade server hardware and maintenance decreases by 3%, 3%, 5%, 6% and 8% for the respective years. No SAN or other storage device is required to be added after the initial purchase. Hence the total cost of SAN or other storage device remains zero.

FIGURE 4-4

WORKING OUT THE TOTAL HARDWARE SCALABILITY COSTS FOR DISTRIBUTED SYSTEMS

26. Hardware Scalability Costs	Current	Unit	2008	2009	2010	2011	2012
27. Total Hardware And Storage Costs (000$)		000$	6.8	6.6	6.3	5.9	5.4
28. Vendor Maintenance as a % Of Hardware Costs		%	15.0	15.0	15.0	15.0	15.0
29. Vendor Maintenance Costs (000$)		000$	1.0	1.0	0.9	0.9	0.8
30. 000$ Total Hardware, Storage, And Yearly Vendor Maintenance Costs Of Distributed Systems To Achieve Scalability		000$	**7.8**	**7.6**	**7.2**	**6.8**	**6.2**

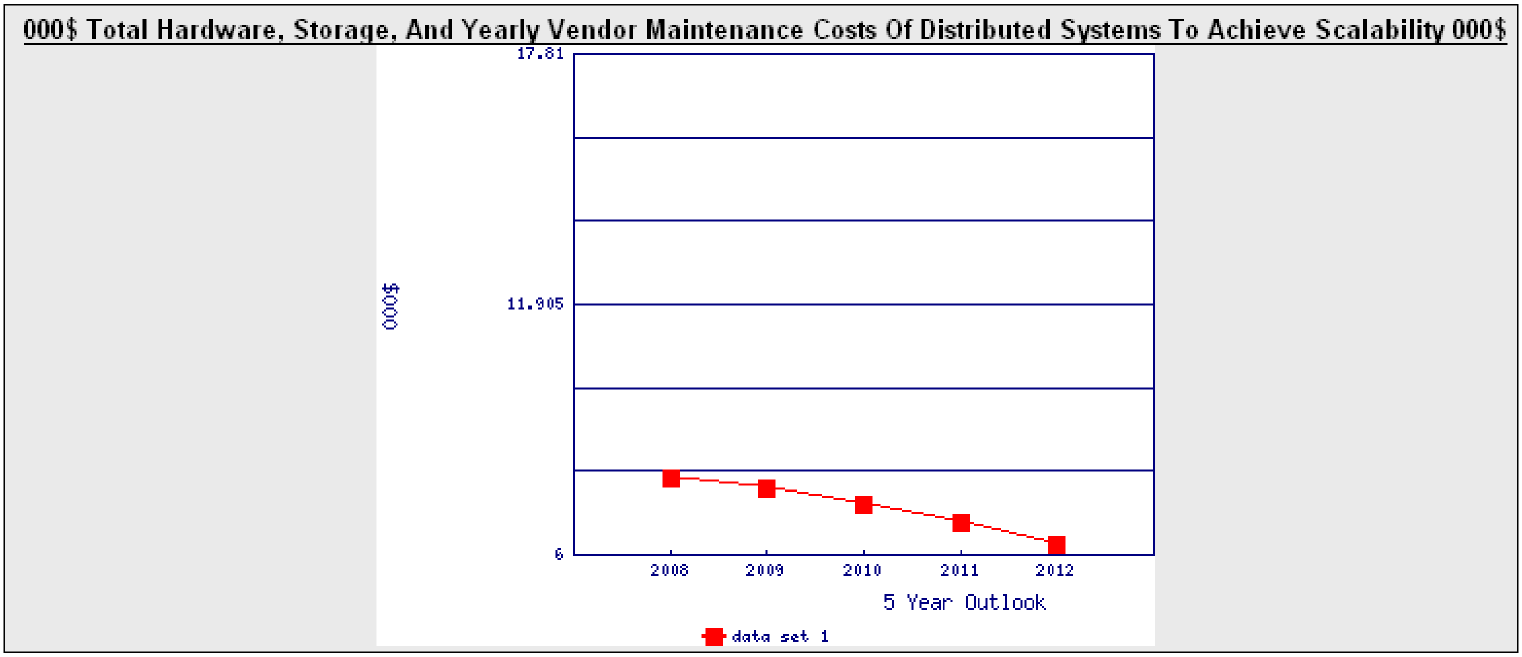
Source: Wintergreen Research, Inc.

For years 2008 through 2012:

The total hardware and storage costs for distributed systems decrease from $6,800 to $5,400. Yearly maintenance of hardware is a vital activity. The maintenance costs required to be paid to the vendor are $1,000, $1,000, $900, $900 and $800 for the respective years.

FIGURE 4–5

FIVE-YEAR OUTLOOK OF TOTAL HARDWARE, STORAGE, AND YEARLY VENDOR MAINTENANCE COSTS OF DISTRIBUTED SYSTEMS TO ACHIEVE SCALABILITY



Source: Wintergreen Research, Inc.

The above graph shows the five-year outlook of the total hardware, storage and yearly maintenance costs for distributed systems. This amount decreases from $7,800 in 2008 to $6,200 in 2012.

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4.4 Hardware Scalability Purchase and Maintenance Costs on Mainframe

The mainframe system application being considered here, for analysis of costs for hardware scalability, is a data center.

All calculations are for the current year, unless specified otherwise.

FIGURE 4-6

WORKING OUT THE HARDWARE SCALABILITY METRICS FOR MAINFRAME

2. Hardware Scalability Analyst Crosscheck Metrics	Current	Unit
3. # of Mainframe MIPs in the Data Center	3,200.0	#

Source: Wintergreen Research, Inc.

There are 3,200 MIPs in the data center application being considered.

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FIGURE 4-7

WORKING OUT THE TOTAL COST OF MIPS TO ACHIEVE SCALABILITY FOR MAINFRAME

4. Total Cost of MIPS to Achieve Scalability	Current	Unit	2008	2009	2010	2011	2012
5. 000$ Per MIP	1.350	000$					
6. % Change In Price Per MIP		%	-3.0	-3.0	-3.0	-3.0	-3.0
7. # Mainframe MIPs Added Per Year To Achieve Scalability		# MIPs	0.001	0.001	0.001	0.001	0.001
8. Total Costs per MIP		000$	1.3	1.3	1.2	1.2	1.2
9. Total Costs of MIPs to Scale Mainframe		000$	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**

Source: Wintergreen Research, Inc.

The cost per MIP is $1,350.

For the years 2008 through 2012:

The cost per MIP decreases by 3% every year.

0.001 MIPs are added every year, at a cost of $1,300, $1,300, $1,200, $1,200 and $1,200 for the respective years. Hence the total cost of MIPs to achieve scalability on mainframe is $1 per year.

FIGURE 4-8

WORKING OUT THE TOTAL COST OF STORAGE TO ACHIEVE SCALABILITY FOR MAINFRAME

10. Total Cost of Storage to Achieve Scalability	Current	Unit	2008	2009	2010	2011	2012
11. 000$ Per SAN Or Storage Device	15.000	000$					
12. % Change In Price Per SAN Or Storage Device		%	-3.0	-3.0	-5.0	-6.0	-8.0
13. Total Costs per SAN		000$	14.6	14.1	13.4	12.6	11.6
14. # SAN Or Other Storage Devices Added Per Year		#	0.100	0.100	0.100	0.100	0.100
15. Total Cost for SAN or NAS Storage To Achieve Scalability		000$	**1.5**	**1.4**	**1.3**	**1.3**	**1.2**

Source: Wintergreen Research, Inc.

The cost per SAN or other storage device is $15,000.

For the years 2008 through 2012:

The cost per SAN or other storage device decreases by 3%, 3%, 5%, 6% and 8% for the respective years.

0.1 SAN or other storage devices are added every year, at a cost of $14,600, $14,100, $13,400, $12,600 and $11,600 for the respective years. Hence the total cost of SAN or other storage device to achieve scalability on mainframe is $1,500, $1,400, $1,300, $1,300 and $1,200 for the respective years.

FIGURE 4-9

ESTIMATED ANNUAL COSTS OF HARDWARE, STORAGE AND VENDOR MAINTENANCE TO ACHIEVE SCALABILITY FOR MAINFRAME

16. Estimated Annual Costs	Current	Unit	2008	2009	2010	2011	2012
17. 000$ Total Hardware And Storage Costs Of Mainframe To Achieve Scalability		000$	1.5	1.4	1.3	1.3	1.2
18. Vendor Maintenance as a % Of Total Hardware Costs		%	15.0	15.0	15.0	15.0	16.0
19. 000$ Mainframe Maintenance Costs To Achieve Scalability		000$	0.2	0.2	0.2	0.2	0.2
20. 000$ Total Hardware, Storage, And Yearly Vendor Maintenance Costs Of Mainframe To Achieve Scalability		000$	**1.7**	**1.6**	**1.5**	**1.5**	**1.3**

Source: Wintergreen Research, Inc.

For years 2008 through 2012:

The total hardware and storage costs to achieve scalability for mainframe systems decrease from $1,500 to $1,200. Yearly maintenance of hardware is a vital activity. The maintenance costs required to be paid to the vendor are $200 every year.

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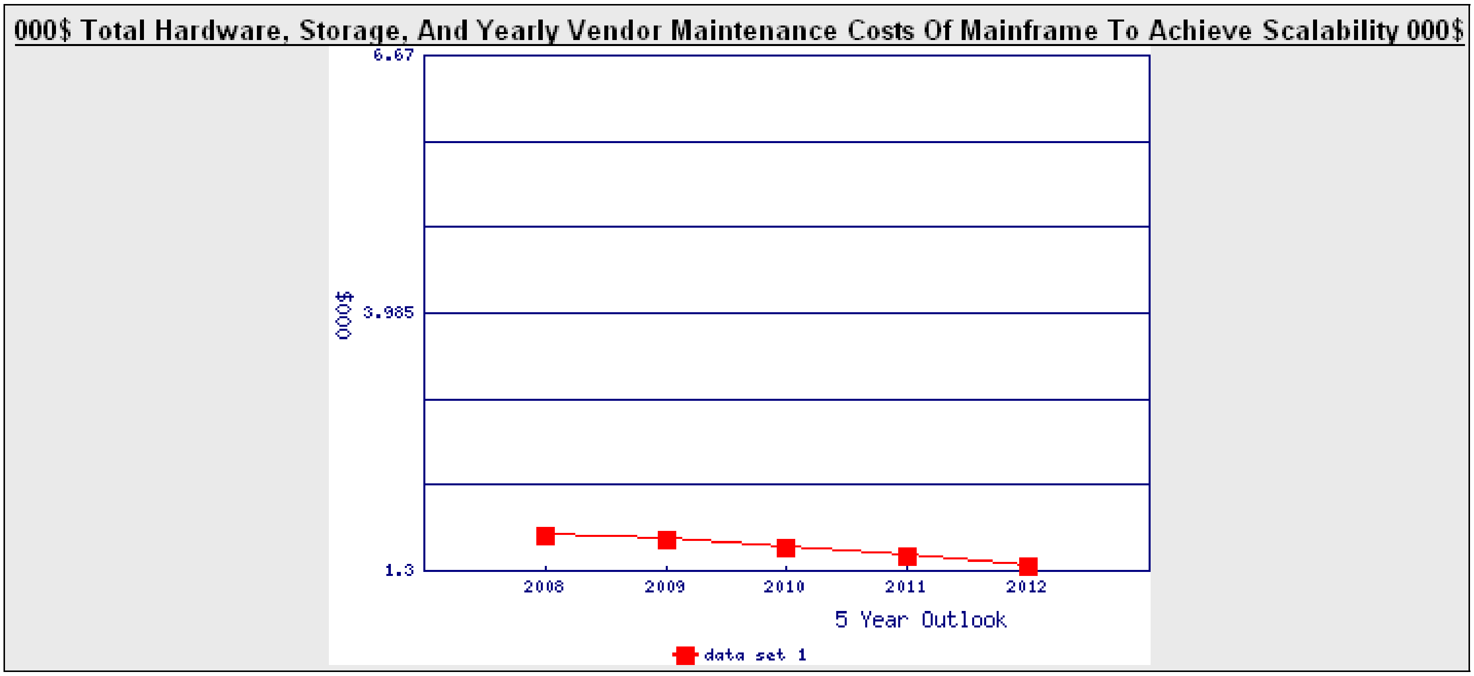
FIGURE 4–10

FIVE-YEAR OUTLOOK OF TOTAL HARDWARE, STORAGE, AND YEARLY VENDOR MAINTENANCE COSTS OF MAINFRAME SYSTEMS TO ACHIEVE SCALABILITY



Source: Wintergreen Research, Inc.

The above graph shows the five-year outlook of the total hardware, storage and yearly maintenance costs for mainframe systems. This amount decrease from $1,700 in 2008 to $1,300 in 2012.

This is just a fraction of the costs incurred to achieve scalability on distributed systems.

The cost differential to achieve hardware scalability on mainframe systems vs. distributed systems is a huge $27,900 for the current year.

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5. Mainframe vs. Distributed Servers Network System Return on Investment (ROI) Model Description

5.1 Network Equipment Costs

The network equipment costs of IBM System z are 75% less than for distributed systems. Communications on the mainframe happen across the internal backplane making the mainframe more efficient. The effect of mainframe backplane management of data means fewer physical switches, hubs and routers are needed to support communications to external processor resources.

Distributed systems need one or several Ethernet controllers to conduct I/O between other clustered or connected distributed servers and more number of hubs, routers, switches, and bridges than a self-contained, scaled-up System z.

An increase in the number of components translates to additional deployment, cabling, management and maintenance expenses. This also increases the power consumption.

5.1.1 Network ROI Analyst Comments

Quality of Service (QoS) and support for voice over IP (VoIP) are network issues:

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QoS enables providing better service to selected flows. Raising the priority of a flow or limiting the priority of another flow does this. Congestion-management tools raise the priority of a flow by queuing and servicing queues.

The queue management tool used for congestion avoidance raises priority by dropping lower-priority flows before higher-priority flows. Policing and shaping provide priority to a flow by limiting the throughput of other flows. Link efficiency tools limit large flows to show a preference for small flows.

QoS can be accomplished using traffic controls. QoS tools can help alleviate most congestion problems.

Many times there is just too much traffic for the bandwidth supplied.

5.1.2 Basic QoS Architecture:

The basic architecture of QoS depends on identification and marking techniques for coordinating packets end to end between network elements. QoS starts within a single network element (for example, queuing, scheduling, and traffic-shaping tools). QoS signaling techniques are needed to co-ordinate QoS end-to-end between network elements.

QoS policy, management, and accounting functions are needed to control and administer end-to-end traffic across a network. QoS implementation has three main components - client node, connected network, and policy/management/accounting block.

Identification and marking is accomplished through classification and reservation. To provide preferential service to a type of traffic, it must first be identified. Then, the packet must be marked, if it is not already marked. These two tasks make up classification.

When the packet is identified but not marked, classification is on a per-hop basis. This is when the classification pertains only to the device that it is on, not passed to the next router. This happens with priority queuing (PQ) and custom queuing (CQ).

When packets are marked for network-wide use, IP precedence bits can be set. IP precedence signaling differentiated QoS creates better network control. Common methods of identifying flows include access control lists (ACLs), policy-based routing, committed access rate (CAR), and network-based application recognition (NBAR).

5.1.3 Congestion Management, Queue Management, Link Efficiency, And Shaping/Policing Tools

Congestion management, queue management, link efficiency, and shaping/policing tools provide QoS within a single network element.

Congestion Management is an issue for QoS. Because of the bursty nature of voice/video/data traffic, sometimes the amount of traffic exceeds the speed of a link. At this point, what will the router do? Will it buffer traffic in a single queue and let the first packet in be the first packet out? Or, will it put packets into different queues and service certain queues more often? Congestion-management tools address these questions. Tools include priority queuing (PQ), custom queuing (CQ), weighted fair queuing (WFQ), and class-based weighted fair queuing (CBWFQ).

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Queue Management is part of QoS. Because queues are not of infinite size, they can fill and overflow. When a queue is full, any additional packets cannot get into the queue and will be dropped. This is a tail drop. The issue with tail drops is that the router cannot prevent this packet from being dropped (even if it is a high-priority packet).

A mechanism is necessary to try to make sure that the queue does not fill up. This creates room for high-priority packets.

5.1.4 Allow Criteria For Dropping Packets

A mechanism is needed to allow criteria for dropping packets to be implemented as packet identifiers that are attached to lower priority packets permitting them to be dropped before the system is dropping higher-priority packets.

Weighted early random detect (WRED) provides both of these mechanisms.

Link Efficiency is implemented many times as low-speed links present an issue for smaller packets. Serialization delay of a 1500-byte packet on a 56-kbps link is 214 milliseconds. If a voice packet were to get behind this big packet, the delay budget for voice would be exceeded even before the packet left the router. Link fragmentation and interleave allow this large packet to be segmented into smaller packets interleaving the voice packet. Interleaving is as important as the fragmentation. There is no reason to fragment the packet and have the voice packet go behind all the fragmented packets.

Serialization delay is the time that it takes to put a packet on the link.

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Packet size is calculated as 1500-byte packet ¥ 8 bits/byte = 12,000 bits

Line rate is calculated as 56,000 bps

Result is calculated as12,000 bits/56,000bps = .214 sec or 214 msec

5.2 Network Integration

Network Integration is combination of products and services that make systems manage the converged voice and data networks in an Internet protocol infrastructure. The networking integration solutions comprise wired and wireless LAN and WAN products, services, and solutions.

Recognizing the necessary migration of intelligence and functionality to the network edge, the solutions are implemented as adaptive edge architecture. An adaptive edge architecture strategy is useful as a comprehensive and inclusive network design strategy that is adaptable, scalable and completely interoperable for achieving command from the network core center with control to the network edge.

Combined hardware, software, and services solution that address network integration issues are in use. Expertise in network design, deployment and network integration assists the process of transition into multimedia services through edge technology.

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5.2.1 High-Level Support And Lifecycle Management Services

High-level support and lifecycle management services are needed to make the network efficient at the edge. In turn-key projects, integrators supply infrastructure products, including upgrade of the core network, radio access and transmission equipment as well as managing, implementing and optimizing network integration.

5.3 Summary Cost Differential Between Mainframe And Distributed Systems Network Equipment

FIGURE 5-1

WORKING OUT THE NETWORK EQUIPMENT/CABLING COST AND QOS COST DIFFERENTIAL BETWEEN MAINFRAME AND DISTRIBUTED SYSTEMS

(NEXT PAGE)

Sample from ROI Page

1. Network System Cost Comparisons on Mainframe	Initial	Unit	2007	2008	2009	2010	2011

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vs. Distributed Servers							
2. Network Analyst Comments							
3. Network and Quality of Service (QoS) Voice VoIP Systems On Distributed Systems	Current	Unit	2007	2008	2009	2010	2011
4. Network Equipment and Cabling Costs Distributed Servers	51.6	000$	1.4	2.4	3.3	4.3	5.3
5. Network Quality of Service (QoS) Costs Distributed Servers	288.0	000$	3.0	3.1	3.1	3.1	3.2
6. Total Network and Quality of Service (QoS) Costs On Distributed System	**339.6**	000$	**4.5**	**5.4**	**6.4**	**7.4**	**8.4**
7. Network and Quality of Service (QoS) On Mainframe	Current	Unit	2007	2008	2009	2010	2011
8. Network Equipment and Cabling Costs Mainframe	13.6	000$	0.4	0.4	0.4	0.4	0.4
9. Network Quality of Service (QoS) Voice VoIP Systems Costs Mainframe	4.2	000$	0.5	0.5	0.4	0.4	0.3
10. Total Network and Quality of Service (QoS) Costs Mainframe	**17.8**	000$	**0.9**	**0.9**	**0.8**	**0.8**	**0.7**
11. Cost Differential	Initial	Unit	2007	2008	2009	2010	2011
12. Network Systems Costs Comparison Mainframe vs. Distributed Servers	**321.9**	000$	**3.6**	**4.6**	**5.6**	**6.6**	**7.7**

Source: Wintergreen Research, Inc.

A study of the network costs for mainframe and distributed systems include the following major cost components:

TABLE 5-2

MAINFRAME AND DISTRIBUTED SYSTEMS - NETWORK COST ANALYSIS PARAMETERS

- Network equipment costs
- Network cabling costs
- Network QoS costs

Source: Wintergreen Research, Inc.

5.4 Network and Quality of Service (QoS) Voice VoIP Systems on Distributed Systems

Costs of network and QoS VoIP systems on distributed systems are being analyzed under the following sections:

- Network equipment and cabling costs
- Network QoS costs

5.4.1 Network equipment and cabling costs in distributed servers

For accuracy in calculations, the network equipment costs for VoIP on distributed systems are further subdivided into the following:

- Costs for distributed server routers
- Costs for distributed server switches

The network cabling costs are further subdivided into the following:

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- Costs for cables
- Costs for associated connectors
- Costs for extenders
- Costs for repeaters
- Costs for transceivers
- Costs for hubs
- Costs for testers
- Costs for Power over Ethernet
- Costs for media converters

All calculations made are for the current year, unless specified otherwise.

Network costs for distributed server routers

FIGURE 5-3

WORKING OUT THE NETWORK COSTS FOR DISTRIBUTED SERVER ROUTERS

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2. Network Costs For Distributed Server Routers	Initial	Unit	2008	2009	2010	2011	2012
3. 000$ Per Router	160.0	000$	162.4	164.8	167.3	169.8	172.4
4. % Change In Price of Distributed Server Routers		%	1.5	1.5	1.5	1.5	1.5
5. # Routers - Initial Investment and # Added Per Year	0.020	# Routers	0.002	0.002	0.002	0.002	0.002
6. Total Cost For Routers	3.200	000$	0.325	0.330	0.335	0.340	0.345

Source: Wintergreen Research, Inc.

The number of routers purchased as part of the initial investment is 0.020.

The cost per router is $160,000. Hence the total initial investment for routers in the distributed server is $3,200.

For years 2008 through 2012:

The price of distributed server routers will increase by 1.5% every year. The number of routers added to the distributed server system will be 0.002 every year. Hence, the total cost of additional routers will increase from $325 in 2008 to $345 in 2012.

5.4.2 Network Costs For Distributed Server Switches

FIGURE 5-4

WORKING OUT THE NETWORK COSTS FOR DISTRIBUTED SERVER SWITCHES

7. Network Costs For Distributed Server Switches	Initial	Unit	2008	2009	2010	2011	2012
8. 000$ Per Switch	90.0	000$	91.5	93.1	94.7	96.3	97.9
9. % Change In Price of Distributed Server Switches		%	1.7	1.7	1.7	1.7	1.7
10. # Switches - Initial Investment and # Added Per Year	0.020	# Switches	0.002	0.002	0.002	0.002	0.002
11. Total Cost For Switches	1.800	000$	0.183	0.186	0.189	0.193	0.196

Source: Wintergreen Research, Inc.

The number of switches purchased as part of the initial investment is 0.020

The cost per switch is $90,000. Hence the total initial investment for switches in the distributed server is $1,800.

For years 2008 through 2012:

The price of distributed server switches will increase by 1.7% every year. The number of switches added to the distributed server system will be 0.002 every year. Hence, the total cost of additional switches will increase from $183 in 2008 to $196 in 2012.

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5.4.3 Network Costs For Cabling In Distributed Server

FIGURE 5-5

WORKING OUT THE NETWORK COSTS FOR CABLING IN DISTRIBUTED SERVER

12. Network Costs for Cabling	Initial	Unit	2008	2009	2010	2011	2012
13. 000$ Per Bundle of 100 Cables, And Associated Connectors, Extenders, Repeaters, Transceivers, Hubs, Testers, Power Over Ethernet, Transceivers, And Media Converters	90.0	000$	90.9	91.8	92.7	93.7	94.6
14. % Change In Price of Cabling and Network Attachments		%	1.0	1.0	1.0	1.0	1.0
15. # Bundles - Initial Investment and # Added Per Year	0.140	# Bundles	0.010	0.020	0.030	0.040	0.050
16. Total Cost For Cabling	12.600	000$	0.909	1.836	2.782	3.746	4.730

Source: Wintergreen Research, Inc.

The number of cable bundles purchased as part of the initial investment is 0.140. The cost per a bundle of 100 cables is $90,000. Hence the total initial investment for cable bundles in the distributed server is $12,600. For years 2008 through 2012:

The price of distributed server cable bundles will increase by 1.0% every year. The number of cable bundles added to the distributed server system will be 0.010, 0.020, 0.030, 0.040 and 0.050 for the respective years. Hence, the total cost of cabling in the distributed server will increase from $909 in 2008 to $4730 in 2012.

5.4.4 Network Costs For Broadband Connectivity In Distributed Server

FIGURE 5-6

WORKING OUT THE NETWORK COSTS FOR BROADBAND CONNECTIVITY IN DISTRIBUTED SERVER

17. Network Costs for Broadband Connectivity	Initial	Unit	2008	2009	2010	2011	2012
18. 000$ Per Broadband Connection	85.0	000$	87.5	90.2	92.9	95.7	98.5
19. % Change In Price of Broadband Connection		%	3.0	3.0	3.0	3.0	3.0
20. # Broadband Lines - Initial # Lines and # Broadband Connectivity Lines Per Year	0.400	# lines	0.000	0.000	0.000	0.000	0.000
21. Total Costs For Broadband Connectivity	34.000	000$	0.000	0.000	0.000	0.000	0.000

Source: Wintergreen Research, Inc.

The number of broadband lines required as part of the initial investment is 0.400. The cost per broadband connection is $85,000. Hence the total initial investment for broadband lines in the distributed server is $34,000.

For years 2008 through 2012:

The cost of a broadband connectivity line will increase by 3.0% every year. No broadband line will be required for at least five years after the initial investment. Hence there will be no additional broadband connectivity cost in the distributed server.

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FIGURE 5-7

WORKING OUT THE TOTAL NETWORK COSTS FOR DISTRIBUTED SERVER SYSTEM

22. Total Network Costs	Initial	Unit	2008	2009	2010	2011	2012
23. Total Network Costs for Distributed System	51.6	000$	1.4	2.4	3.3	4.3	5.3

Source: Wintergreen Research, Inc.

The total networks costs for the distributed server is the sum of the total costs for routers, switches, cabling and broadband connectivity for the distributed server. For the current year, the total network cost is $51,600.

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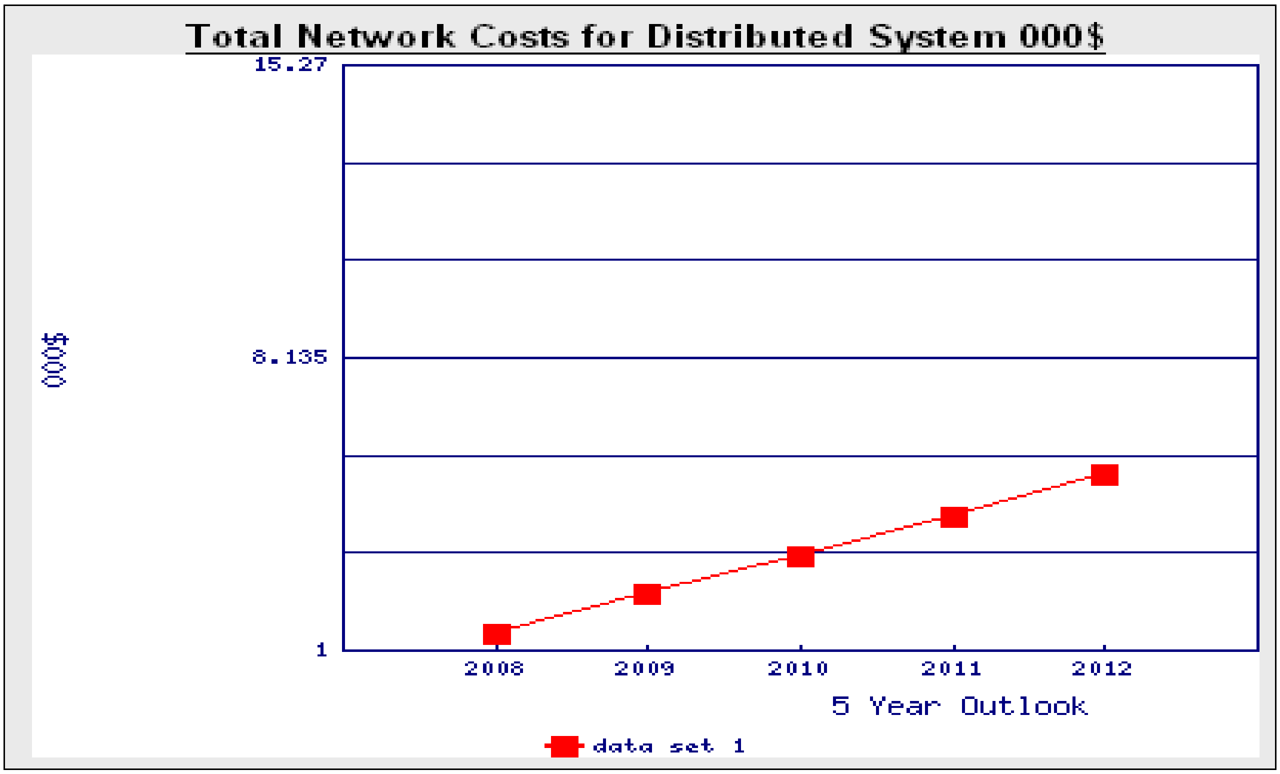
FIGURE 5–8

FIVE-YEAR OUTLOOK OF TOTAL ADDITIONAL NETWORK COSTS FOR DISTRIBUTED SYSTEM



Source: Wintergreen Research, Inc.

The above graph shows a five-year outlook of additional network costs for distributed server system.

For years 2008 through 2012:

The additional network costs will increase from $1,400 to $5,300.

5.4.5 Network Quality of Service (QoS) VoIP Costs In Distributed Servers

Analysis of network QoS costs in distributed servers involve cost calculations of the following:

- Network QoS costs
- Network dedicated VoIP switch server costs
- Network VoIP special cabling costs
- Network broadband digital loop carrier costs

All calculations are for the current year, unless specified otherwise.

Network QoS costs in distributed server system

FIGURE 5–9

NETWORK QOS COSTS FOR DISTRIBUTED SYSTEM

1. Network Quality of Service (QoS) Costs Distributed Servers	Initial	Unit	2008	2009	2010	2011	2012
2. 000$ Per Edge Router	1.6	000$	1.6	1.7	1.8	1.8	1.9
3. % Change In Price of Distributed Server Edge Routers		%	3.1	3.2	3.3	3.4	3.5
4. # Edge Routers - Initial Investment and # Added Per Year	0.400	# Routers	0.007	0.006	0.005	0.004	0.003
5. Total Cost For Edge Routers	0.640	000$	0.012	0.010	0.009	0.007	0.006

Source: Wintergreen Research, Inc.

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The number of edge routers purchased as part of the initial investment is 0.400

The cost per edge router is $1600. Hence the total initial investment for edge routers in the distributed server is $640.

For years 2008 through 2012:

The cost of distributed server edge router will increase by 3.1%, 3.2%, 3.3%, 3.4% and 3.5% for the respective years. The number of edge routers added to the distributed server system will be 0.007, 0.006, 0.005, 0.004 and 0.003 for the respective years. Hence, the total cost of additional edge routers in the distributed server will decrease from $12 in 2008 to $6 in 2012.

5.4.6 Network VoIP Switch Server Costs In Distributed Systems

FIGURE 5–10

NETWORK VOIP SWITCH SERVER COSTS FOR DISTRIBUTED SYSTEM

6. Network Costs For Distributed Dedicated VoIP Switch Servers	Initial	Unit	2008	2009	2010	2011	2012
7. 000$ Per Distributed Dedicated VoIP Switch Servers	2.2	000$	2.3	2.3	2.4	2.5	2.6
8. % Change In Price of Distributed Dedicated VoIP Switch Servers		%	3.0	3.0	3.0	3.0	3.0
9. # Distributed Dedicated VoIP Switch Servers - Initial Investment and # Added Per Year	2.000	# Servers	0.002	0.001	0.001	0.004	0.003
10. Total Cost For Distributed Dedicated VoIP Switch Servers	4.400	000$	0.005	0.002	0.002	0.010	0.008

Source: Wintergreen Research, Inc.

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The number of dedicated VoIP switch servers purchased as part of the initial investment is 2. The cost per dedicated VoIP switch server is $2,200. Hence the total initial investment for dedicated VoIP switch in the distributed server is $4,400.

For years 2008 through 2012:

The cost of dedicated VoIP switch will increase by 3.0% every year. The number of dedicated VoIP switches added to the distributed server system will be 0.002, 0.001, 0.001, 0.004 and 0.003 for the respective years. Hence, the total cost of additional dedicated VoIP switches in the distributed server will continue fluctuating and reach $8 in 2012.

5.4.7 Network VoIP Special Cabling Costs In Distributed Systems

FIGURE 5–11

NETWORK VOIP SPECIAL CABLING COSTS FOR DISTRIBUTED SYSTEM

11. Network Costs for VoIP Special Cabling	Initial	Unit	2008	2009	2010	2011	2012
12. 000$ Per Bundle of 50 VoIP Special Cables And Ancillary Equipment	70.0	000$	70.7	71.4	72.1	72.8	73.6
13. % Change In Price of VoIP Special Cabling		%	1.0	1.0	1.0	1.0	1.0
14. # Bundles - Initial Investment and # Added Per Year	4.000	# Bundles	0.000	0.000	0.000	0.000	0.000
15. Total Cost For VoIP Special Cabling	280.000	000$	0.000	0.000	0.000	0.000	0.000

Source: Wintergreen Research, Inc.

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The number of dedicated VoIP special cable bundles purchased as part of the initial investment is 4. Each bundle consists of 50 cables and ancillary equipment.

The cost per dedicated VoIP special cable bundle is $70,000. Hence the total initial investment for dedicated VoIP special cable bundles in the distributed server is a whopping $280,000.

For years 2008 through 2012:

The cost of dedicated VoIP special cable bundle will increase by 1.0% every year. But, no dedicated VoIP special cable bundle will be needed for the distributed server systems after the initial investment. Hence, the total cost of additional dedicated VoIP special cable bundles in the distributed server will remain zero in the years being analyzed.

5.4.8 Network Broadband Digital Loop Carrier Costs In Distributed Systems

FIGURE 5–12

NETWORK BROADBAND DIGITAL LOOP CARRIER COSTS FOR DISTRIBUTED SYSTEM

16. Network Costs for Broadband Digital Loop Carriers	Initial	Unit	2008	2009	2010	2011	2012
17. 000$ Per Broadband Digital Loop Carriers	3.0	000$	3.0	3.1	3.1	3.1	3.2
18. % Change In Price of Broadband Digital Loop Carriers		%	1.0	1.0	1.0	1.0	1.0
19. # Broadband Digital Loop Carriers - Initial Investment and # Added Per Year	1.0	# ports	1.0	1.0	1.0	1.0	1.0
20. Total Costs For Broadband Digital Loop Carriers	3.000	000$	3.030	3.060	3.091	3.122	3.153

Source: Wintergreen Research, Inc.

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The number of broadband digital loop carriers purchased as part of the initial investment is 1.

The cost per broadband digital loop carrier is $3,000. Hence the total initial investment for broadband digital loop carriers in the distributed server is $3,000.

For years 2008 through 2012:

The cost of broadband digital loop carrier will increase by 1.0% every year. One additional broadband digital loop carrier will be needed every year. Hence, the total cost of additional broadband digital loop carriers in the distributed server will increase from $3,030 in 2008 to $3,153 in 2012.

FIGURE 5–13

TOTAL INITIAL AND ADDITIONAL QOS NETWORK COSTS IN DISTRIBUTED SYSTEM

21. Total QoS Additional Network Costs	Initial	Unit	2008	2009	2010	2011	2012
22. Total Network Costs for Distributed Quality of Services QoS System	288.0	000$	3.0	3.1	3.1	3.1	3.2

Source: Wintergreen Research, Inc.

The total QoS network costs is the sum total of the network QoS costs, network dedicated VoIP switch server costs, network VoIP special cabling costs and network broadband digital loop carrier costs. This value is $288,000 for the current year.

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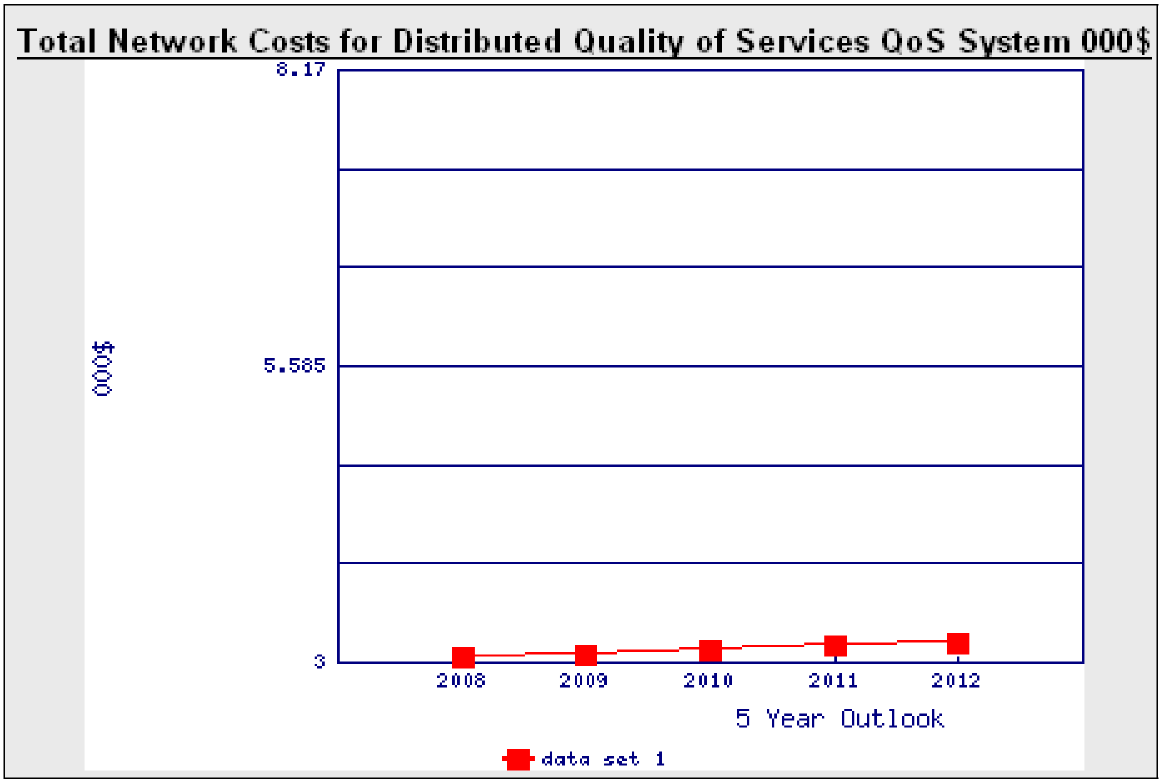
FIGURE 5–14

FIVE-YEAR OUTLOOK OF TOTAL ADDITIONAL NETWORK COSTS FOR DISTRIBUTED QUALITY OF SERVICES QOS SYSTEM



Source: Wintergreen Research, Inc.

The above graph shows the five-year outlook for additional network costs for distributed QoS system.

For years 2008 through 2012:

The additional QoS network costs increase from $3,000 to $3,200.

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5.5 Network and Quality of Service (QoS) On Mainframe

Costs of network and QoS VoIP systems on mainframe systems are being analyzed under the following sections:

- Network equipment and cabling costs
- Network QoS costs

5.5.1 Network Equipment And Cabling Costs In Mainframe Systems

For accuracy in calculations, the network equipment costs for mainframe systems are further subdivided into the following:

- Costs for mainframe routers
- Costs for mainframe switches

The network cabling costs are further subdivided into the following:

- Costs for cables
- Costs for associated connectors
- Costs for extenders
- Costs for repeaters
- Costs for transceivers

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- Costs for hubs
- Costs for testers
- Costs for Power over Ethernet
- Costs for media converters

All calculations made are for the current year, unless specified otherwise.

5.5.2 Network Costs For Mainframe Routers

FIGURE5-15

WORKING OUT THE NETWORK COSTS FOR MAINFRAME ROUTERS

2. Network Costs - Routers For Mainframe	Initial	Unit	2008	2009	2010	2011	2012
3. 000$ Per Router	160.0	000$	161.6	163.2	164.8	166.5	168.2
4. % Change In Price of Routers		%	1.0	1.0	1.0	1.0	1.0
5. # Routers - Initial Investment and # Added Per Year	0.001	# Routers	0.001	0.001	0.001	0.001	0.001
6. Total Cost For Routers	0.160	000$	0.162	0.163	0.165	0.166	0.168

Source: Wintergreen Research, Inc.

The number of mainframe routers purchased as part of the initial investment is 0.001, a fraction of the number of routers required for distributed system.

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The cost per router is $160,000. Hence the total initial investment for routers in the mainframe system is $160.

For years 2008 through 2012:

The price of mainframe routers will increase by 1.0% every year. The number of routers added to the mainframe system will be 0.001 every year. Hence, the total cost of additional routers will increase from $162 in 2008 to $168 in 2012. This is a negligible increase, compared to the huge increase in the additional router cost for distributed systems.

5.5.3 Network Costs For Mainframe Switches

FIGURE 5-16

WORKING OUT THE NETWORK COSTS FOR MAINFRAME SWITCHES

7. Network Costs - Switches - Mainframe	Initial	Unit	2008	2009	2010	2011	2012
8. 000$ Per Switch	90.0	000$	91.8	93.6	95.5	97.4	99.4
9. % Change In Price of Switches		%	2.0	2.0	2.0	2.0	2.0
10. # Switches - Initial Investment and # Added Per Year	0.001	# Switches	0.001	0.001	0.001	0.001	0.001
11. Total Cost For Switches	0.090	000$	0.092	0.094	0.096	0.097	0.099

Source: Wintergreen Research, Inc.

The number of switches purchased as part of the initial investment is 0.001, a fraction of the number needed in distributed systems.

The cost per switch is $90,000. Hence the total initial investment for switches in the mainframe system is $90.

For years 2008 through 2012:

The price of mainframe switches will increase by 2.0% every year. The number of switches added to the mainframe system will be 0.001 every year. Hence, the total cost of additional switches will increase from $92 in 2008 to $99 in 2012, which is clearly lesser than that in distributed systems.

5.5.4 Network Cabling Costs For Mainframe System

FIGURE 5-17

WORKING OUT THE NETWORK CABLING COSTS FOR MAINFRAME SYSTEM

12. Network Costs - Cabling - Mainframe	Initial	Unit	2008	2009	2010	2011	2012
13. 000$ Per Bundle of 100 Cables, And Associated Connectors, Extenders, Repeaters, Transceivers, Hubs, Testers, Power Over Ethernet, Transceivers, And Media Converters	95.0	000$	96.9	98.8	100.8	102.8	104.9
14. % Change In Price of Cabling		%	2.0	2.0	2.0	2.0	2.0
15. # Bundles - Initial Investment and # Added Per Year	0.140	# Bundles	0.001	0.001	0.001	0.001	0.001
16. Total Cost For Cabling	13.300	000$	0.097	0.099	0.101	0.103	0.105

Source: Wintergreen Research, Inc.

The number of cable bundles purchased as part of the initial investment is 0.140

The cost per a bundle of 100 cables is $95,000. Hence the total initial investment for cable bundles in the distributed server is $13,300.

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For years 2008 through 2012:

The price of mainframe cable bundles will increase by 2.0% every year. The number of cable bundles added to the mainframe system will be 0.001 every year. Hence, the total cost of cabling in the mainframe system will increase from $97 in 2008 to $105 in 2012.

5.5.5 Network Broadband Connectivity Costs For Mainframe System

FIGURE 5-18

WORKING OUT THE NETWORK BROADBAND COSTS FOR MAINFRAME SYSTEM

17. Network Costs - Broadband - Mainframe	Initial	Unit	2008	2009	2010	2011	2012
18. 000$ Per Broadband Connection	50.0	000$	51.0	52.0	53.1	54.1	55.2
19. % Change In Price of Broadband Connection		%	2.0	2.0	2.0	2.0	2.0
20. # Broadband Lines - Initial # Lines and # Broadband Connectivity Lines Per Year	0.0	# lines	0.001	0.001	0.001	0.001	0.000
21. Total Costs For Broadband	0.000	000$	0.051	0.052	0.053	0.054	0.000

Source: Wintergreen Research, Inc.

The number of broadband lines required as part of the initial investment is 0. The cost per broadband connection is $50,000. Hence the total initial investment for broadband lines in the mainframe system is 0.

For years 2008 through 2012: The cost of a broadband connectivity line will increase by 2.0% every year. Additional broadband lines required will increase by 0.001, 0.001, 0.001, 0.001 and 0 for the respective years. Hence the additional broadband connectivity cost in the mainframe system will increase from $51 in 2008 to $54 in 2011.

FIGURE 5-19

WORKING OUT THE TOTAL NETWORK COSTS FOR MAINFRAME SYSTEM

22. Total Network Costs	Initial	Unit	2008	2009	2010	2011	2012
23. Total Network Costs for Mainframe	13.6	000$	0.4	0.4	0.4	0.4	0.4

Source: Wintergreen Research, Inc.

The total networks costs for the mainframe system is the sum of the total costs for routers, switches, cabling and broadband connectivity for the mainframe system. For the current year, the total network cost for mainframe is $13,600.

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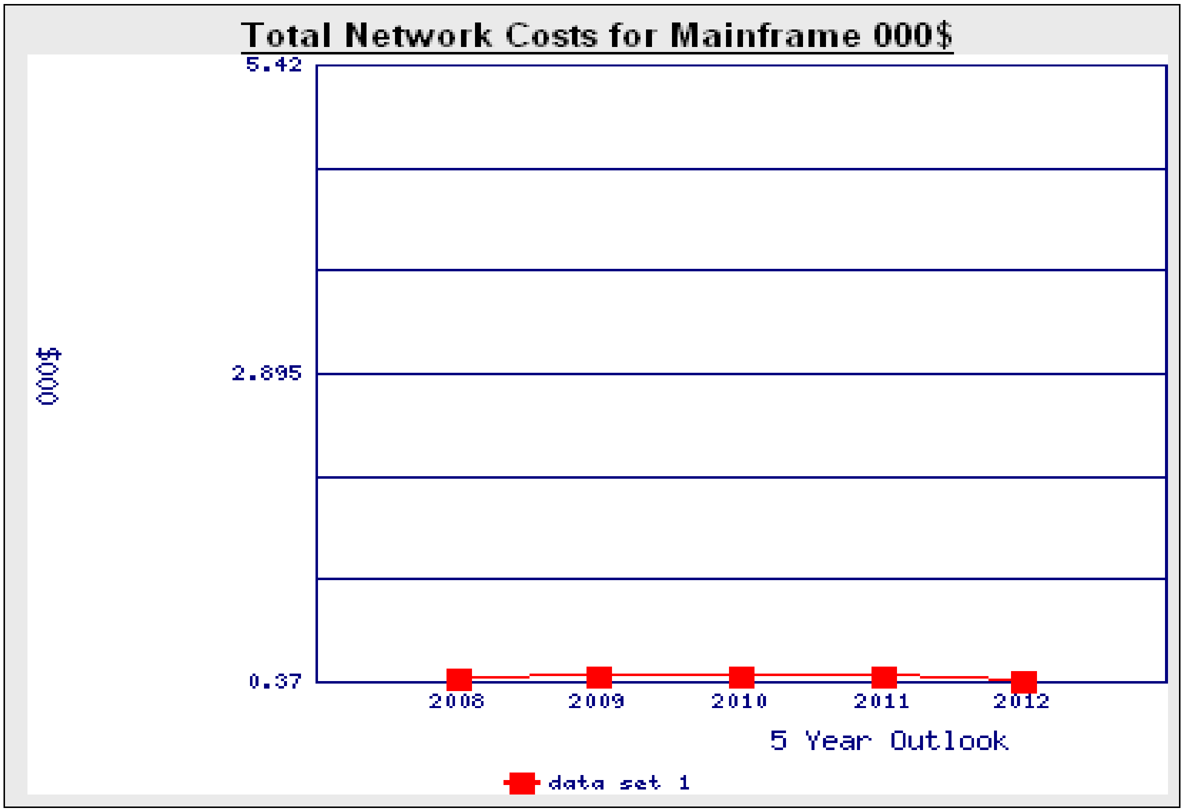
FIGURE 5–20

FIVE-YEAR OUTLOOK OF TOTAL ADDITIONAL NETWORK COSTS FOR MAINFRAME SYSTEM



Source: Wintergreen Research, Inc.

The above graph shows a five-year outlook of additional network costs for mainframe system.

For years 2008 through 2012:

The additional network costs will remain at $400.

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5.5.6 Network Quality of Service (QoS) VoIP Costs In Mainframe Servers

Analysis of network QoS costs in mainframe systems involve cost calculations of the following:

- Network QoS costs
- Network dedicated VoIP switch server costs
- Network VoIP special cabling costs
- Network broadband digital loop carrier costs

All calculations are for the current year, unless specified otherwise.

5.5.7 Network QoS Costs In Mainframe System

FIGURE 5–21

NETWORK QOS COSTS FOR MAINFRAME SYSTEM

1. Network Quality of Service (QoS) Costs Mainframe Servers	Initial	Unit	2008	2009	2010	2011	2012
2. 000$ Per Edge Router	3.000	000$	3.060	3.121	3.184	3.247	3.312
3. % Change In Price of Mainframe Edge Routers		%	2.0	2.0	2.0	2.0	2.0
4. # Edge Routers - Initial Investment and # Added Per Year	0.040	# Routers	0.007	0.006	0.005	0.004	0.003
5. Total Cost For Edge Routers	0.120	000$	0.021	0.019	0.016	0.013	0.010

Source: Wintergreen Research, Inc.

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The number of mainframe edge routers purchased as part of the initial investment is 0.040. The cost per edge router is $3000. Hence the total initial investment for edge routers in the mainframe system is $120.

For years 2008 through 2012: The cost of mainframe edge router will increase by 2% every year. The number of edge routers required to be added to the mainframe system will be 0.007, 0.006, 0.005, 0.004 and 0.003 for the respective years. Hence, the total cost of additional edge routers in the mainframe system will decrease from $21 in 2008 to $10 in 2012.

5.5.8 Network VoIP Switch Server Costs In Mainframe System

FIGURE 5–22

NETWORK VOIP SWITCH SERVER COSTS FOR MAINFRAME SYSTEM

6. Network Costs For Mainframe Dedicated VoIP Switch Servers	Initial	Unit	2008	2009	2010	2011	2012
7. 000$ Per Mainframe Dedicated VoIP Switch Servers	5.0	000$	5.1	5.2	5.3	5.4	5.5
8. % Change In Price of Mainframe Dedicated VoIP Switch Servers		%	2.0	2.0	2.0	2.0	2.0
9. # Mainframe Dedicated VoIP Switch Servers - Initial Investment and # Added Per Year	0.400	# Servers	0.007	0.006	0.005	0.004	0.003
10. Total Cost For Mainframe Dedicated VoIP Switch Servers	2.000	000$	0.036	0.031	0.027	0.022	0.017

Source: Wintergreen Research, Inc.

The number of dedicated VoIP switch servers purchased as part of the initial investment is 0.400. The cost per dedicated mainframe VoIP switch server is $5,000. Hence the total initial investment for dedicated VoIP switch in the mainframe server is $2,000.

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For years 2008 through 2012:

The cost of dedicated VoIP switch will increase by 2.0% every year. The number of dedicated VoIP switches required to be added to the mainframe system will be 0.007, 0.006, 0.005, 0.004 and 0.003 for the respective years. Hence, the total cost of additional dedicated VoIP switches in the mainframe system will decrease from 36 in 2008 to $17 in 2012.

5.5.9 Network VoIP Special Cabling Costs In Mainframe System

FIGURE 5–23

NETWORK VOIP SPECIAL CABLING COSTS FOR MAINFRAME SYSTEM

11. Network Costs for VoIP Special Cabling	Initial	Unit	2008	2009	2010	2011	2012
12. 000$ Per Bundle of 50 VoIP Special Cables	50.0	000$	51.5	53.0	54.6	56.3	58.0
13. % Change In Price of VoIP Special Cabling		%	3.0	3.0	3.0	3.0	3.0
14. # Bundles - Initial Investment and # Added Per Year	0.040	# Bundles	0.007	0.006	0.005	0.004	0.003
15. Total Cost For VoIP Special Cabling	2.000	000$	0.360	0.318	0.273	0.225	0.174

Source: Wintergreen Research, Inc.

The number of dedicated VoIP special cable bundles purchased as part of the initial investment is 0.040, which is a fraction of that needed for distributed systems. Each bundle consists of 50 special cables.

The cost per dedicated VoIP special cable bundle is $50,000. Hence the total initial investment for dedicated VoIP special cable bundles in the mainframe system is just $2,000.

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For years 2008 through 2012:

The cost of dedicated VoIP special cable bundle will increase by 3.0% every year. The number of dedicated VoIP special cable bundles required to be added to the mainframe system after the initial investment is 0.007, 0.006, 0.005, 0.004 and 0.003 for the respective years. Hence, the total cost of additional dedicated VoIP special cable bundles in the mainframe system will significantly reduce from $360 in year 2008 to $174 in year 2012.

5.5.10 Network Broadband Digital Loop Carrier Costs In Mainframe System

FIGURE 5–24

NETWORK BROADBAND DIGITAL LOOP CARRIER COSTS FOR MAINFRAME SYSTEM

16. Network Costs for Broadband Digital Loop Carriers	Initial	Unit	2008	2009	2010	2011	2012
17. 000$ Per Broadband Digital Loop Carriers	0.3	000$	0.3	0.3	0.3	0.3	0.4
18. % Change In Price of Broadband Digital Loop Carriers		%	2.0	2.0	3.0	6.0	8.0
19. # Broadband Digital Loop Carriers - Initial Investment and # Added Per Year	0.300	# ports	0.300	0.300	0.300	0.300	0.300
20. Total Costs For Broadband Digital Loop Carriers	0.090	000$	0.092	0.094	0.096	0.102	0.110

Source: Wintergreen Research, Inc.

The number of broadband digital loop carriers purchased as part of the initial investment is 0.3

The cost per broadband digital loop carrier is $300. Hence the total initial investment for broadband digital loop carriers in the mainframe system is $90, almost negligible compared to that in distributed systems.

For years 2008 through 2012:

The cost of broadband digital loop carrier will increase by 2%, 2%, 3%, 6% and 8% in the respective years. The number of additional broadband digital loop carriers required will be 0.3 every year. Hence, the total cost of additional broadband digital loop carriers in the mainframe system will increase from $92 in 2008 to $110 in 2012.

FIGURE 5–25

TOTAL INITIAL AND ADDITIONAL QOS NETWORK COSTS IN DISTRIBUTED SYSTEM

21. Total QoS Additional Network Costs	Initial	Unit	2008	2009	2010	2011	2012
22. Total Network Costs for Mainframe Quality of Services QoS System	4.210	000$	0.509	0.462	0.412	0.362	0.311

Source: Wintergreen Research, Inc.

The total QoS network costs is the sum total of the network QoS costs, network dedicated VoIP switch server costs, network VoIP special cabling costs and network broadband digital loop carrier costs. This value is $4,210 for the current year.

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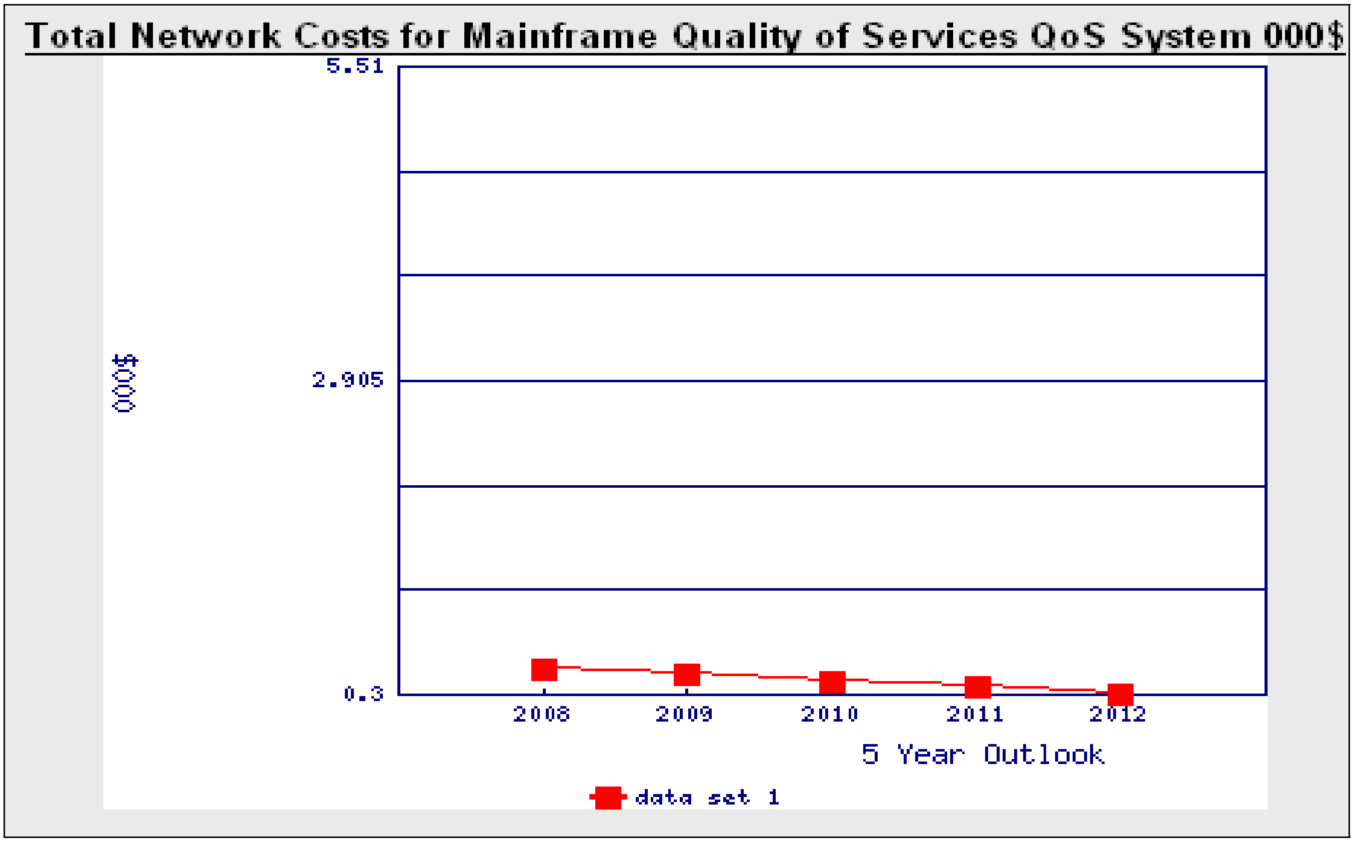
FIGURE 5–26

FIVE-YEAR OUTLOOK OF TOTAL ADDITIONAL NETWORK COSTS FOR MAINFRAME QUALITY OF SERVICES QOS SYSTEM



Source: Wintergreen Research, Inc.

The above graph shows the five-year outlook for additional network costs for mainframe QoS system.

For years 2008 through 2012:

The additional QoS network costs will decrease from $509 to $311.

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6. Security Cost Analysis -- Mainframe vs. Distributed Return on Investment (ROI)

6.1 External Attacks And Security Threats

External attacks and security threats are virtually unable to get through to any data in the mainframe. This unparalleled mainframe security capability results from the mainframe's architecture and complementary technologies such as identity and access management, which have always been an integral part of the mainframe ecosystem.

The function of every security system is to connect users to the system resources to which they are authorized. At the same time, the IT infrastructure must manage resources and users so that access to programs and data is protected and intrusion is detected across the entire enterprise. The challenge is to manage and maintain a consistent security strategy to allow resource protection without negatively impacting productivity.

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FIGURE 6-1

WORKING OUT THE SECURITY COST DIFFERENTIAL BETWEEN MAINFRAME AND DISTRIBUTED SYSTEMS

Summary Page: Security	Current Scenario: Scenario 1 Go Scenarios	Print		Calculate

1. Security Cost Analysis - Mainframe Versus Distributed System	Current	Unit	2008	2009	2010	2011	2012
2. Analyst Comments - Security							
3. Total Annual Security Costs - Distributed System	330.5	$000	340.4	350.7	361.2	372.0	383.2
4. Total Annual Security Costs - Mainframe	13.3	$000	13.7	14.1	14.5	14.9	15.4
5. Cost Differential	Total	Unit	2008	2009	2010	2011	2012
6. Security Cost Differential - Mainframe vs. Distributed System	317.3	$000	326.8	336.6	346.7	357.1	367.8

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Summary Page: Security	Current Scenario: Scenario 1 Go Scenarios	Print	Display Calc List	Calculate

1. Security Cost Analysis - Mainframe Versus Distributed System	Current	Unit	2008	2009	2010	2011	2012
2. Analyst Comments - Security							
3. Total Annual Security Costs - Distributed System	330.5	$000	340.4	350.7	361.2	372.0	383.2
4. Total Annual Security Costs - Mainframe	13.3	$000	13.7	14.1	14.5	14.9	15.4
5. Cost Differential	Total	Unit	2008	2009	2010	2011	2012
6. Security Cost Differential - Mainframe vs. Distributed System	317.3	$000	326.8	336.6	346.7	357.1	367.8

Source: Wintergreen Research, Inc.

The security concerns in distributed systems relate to vulnerabilities of security breaches from the network. Advances in mainframe encryption and rack F security features create a fundamental difference in quality and cost between the mainframe and distributed server environments. In mainframe systems the security is enhanced because much of the traffic does not go to the network, but is handled in the backplane. ROI analyzes the security cost differential between distributed and mainframe systems.

6.2 Analyst Comments – Security

TABLE 6-2

DISTRIBUTED SYSTEMS VULNERABILITIES AND MAINFRAME SECURITY

Distributed systems have vulnerabilities that need to be addressed specifically to achieve a secure system. It is expensive to develop and administer consistent security policies that work across server, data and network, across disparate application platforms and operating systems, according to business goals.
2. The mainframe provides centralized management of encryption keys, helping provide customers with better long-term management for data security. System z9 includes a built-in cryptography feature and an improved hashing algorithm (SHA-256) Cisco Self Defending

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TABLE 6-2 (Continued) DISTRIBUTED SYSTEMS VULNERABILITIES AND MAINFRAME SECURITY Network strategy complements the Intrusion Detection Services (IDS) of z/OS. z/OS IDS is designed to detect and defend against known attacks and new or previously unidentified attacks, using a policy-based approach. z/OS can recognize and report system activities indicative of a denial-of-service attack, which are designed to enable businesses to take action before system degradation occurs
3. IT data security relates to protecting data from Internet intrusion and virus protection. Storage security requirements of a large, geographical reach spread enterprises must consider mounting threats from cyber-terrorists, compliance regulations, and protecting data from hardware, software, intrusion (WORM, virus, hackers) and theft. It is necessary to secure data at all levels of the local and remote enterprise. Securing data includes protection from theft via encryption.

Source: Wintergreen Research, Inc.

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6.2.1 Providing Adequate Security

Providing adequate security also goes beyond technical matters to security protocols and human behavior. All the physical and logical security in the world won't help you if some authorized person gives the information away. Technical security must always be part of a complete security system that incorporates proven protocols and manual procedures.

There are a vast number of security protocols to protect against various scenarios, including eavesdropping, man-in-the-middle attacks, repudiation, and message alteration.

Technical security alone cannot provide appropriate security at an acceptable cost. Before implementing technical solutions, resolve two areas of security management. Managing the risk during the design and implementation stage, and the other involves managing the risk during operations.

Security cost analysis indicates that for one application analyzed, mainframe utilized 16 MIPs for the application and the prorated security costs were$13,300 vs. 14 servers for the distributed system, with costs for security at $332,000. The several thousand dollars difference in costs reflects the built in security of the mainframe in contrast to the fact that security must be added to servers, and that it must be added to each server separately.

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6.3 Distributed Systems Vulnerabilities

Distributed systems have vulnerabilities that need to be addressed specifically to achieve a secure system. It is expensive to develop and administer consistent security policies that work across server, data and network, across disparate application platforms and operating systems, according to business goals.

Given the abundance of information technology security issues that impact businesses - including identity theft, regulatory compliance concerns, and firewall intrusions, it is essential for a robust security solution.

6.4 System z9 Built On The IBM Mainframe 41-Year Heritage

The System z9 is built on the IBM mainframe's 41-year heritage as a secure-rich system. IBM mainframes are designed with advanced hardware security. Each system contains master encryption keys stored in a "tamper-resistant" package that is designed to zero-out data to prevent physical capture by an intruder.

The System z9 has the capabilities to allow consistent security policies across server, data and now the network, all according to business goals through centralized key management in z/OS and other built-in security features. By increasing secure transactions throughput (SSL), System z9 can improve responsiveness. Security is strengthened through enhanced encryption and hashing algorithms.

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The system helps to secure and control access to data and system resources, and is designed to respond automatically to network intrusions—from inside or outside. The System z9 provides advanced protection against internal and external risks with these new features:

6.4.1 Helping to Secure Data Transported to Alternate Locations –

The System z9, leveraging existing key management capabilities in z/OS and a planned new encryption solution, is intended to enable customers to encrypt data for more secure transport to partners, suppliers, and remote or archive sites across multiple server platforms. With clients and regulations increasingly focused on securing customer and business data, this technology will be designed to help prevent the security breaches caused by lost data tapes that have plagued financial services and e-commerce companies in recent months.

6.4.2 Advanced Encryption –

The mainframe provides centralized management of encryption keys, helping provide customers with better long-term management for data security. The System z9 now includes a built-in cryptography feature and an improved hashing algorithm (SHA-256). The z9 also now supports the open Advanced Encryption Standard. These cryptography advances are designed to improve performance, speed transactions and help lower processing costs.

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6.4.3 Faster secure online transactions –

New on the IBM System z9 is the ability to configure Crypto Express2 PCI-X adapters as accelerators, which helps with secure data transmission on the Internet through Secure Sockets Layer (SSL), a commonly-used Internet protocol. When both PCI-X adapters are configured as accelerators, the Crypto Express2 feature can perform up to 6,000 SSL handshakes per second. This represents, approximately, a three-time performance improvement compared to the PCICA feature or the current Crypto Express2 feature on z990, on a per card basis. This can help businesses conduct security-rich e-commerce transactions in less time.

6.4.4 Easier-to-deploy Internet Security for Mainframe Workloads –

As financial services companies, government agencies and manufacturers move away from relying on more expensive private networks and increasingly tap the Internet to expand their ecosystem of partners, they are looking to secure their mission-critical z/OS applications like CICS on the Internet. z/OS has a new function, application transparent transport layer security, which allows businesses to apply Internet-standard TLS or SSL encryption no anticipated changes to their core applications.

This feature can make it easier to deploy the mainframe's leading encryption for z/OS managed data and transactions traveling on the Internet to prevent outsiders from snooping data on the network.

6.4.5 Network-based Security with Cisco –

Cisco and IBM provide a comprehensive and complementary network security solution designed to extend security across the network, and enable secure processing from end-to-end. The Cisco Self Defending Network strategy complements the Intrusion Detection Services (IDS) of z/OS. z/OS IDS is designed to detect and defend against known attacks and new or previously unidentified attacks, using a policy-based approach. z/OS can recognize and report system activities indicative of a denial-of-service attack, which are designed to enable businesses to take action before system degradation occurs.

6.4.6 Security And Encryption Offerings In The IBM System Z9

The security and encryption offerings in the IBM system z9 are designed to provide an enterprise-wide solution to help companies secure their customer data within company walls as well as when it leaves their direct control. Centralized key management helps simplify customer security solutions, and is designed to provide a long-term capability for protecting data.

System z9 enables "Always On" reliability and availability across the network. New capacity back-up for specialty engines can extend the System z9's uptime capability designed to avoid planned outages for maintenance and upgrades. This builds on the mainframe legendary reliability.

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6.4.7 Available Memory In System Z9

With up to twice the available memory in System z9 as in z990, the System z9 is designed to support even larger-scale, secure transaction environments making it possible to use the same memory for spikes that may come at different times in different applications, preserving security the while.

The mainframe provides centralized management of encryption keys, helping provide customers with better long-term management for data security. System z9 includes a built-in cryptography feature and an improved hashing algorithm (SHA-256).

Open advanced encryption standard cryptography techniques are designed to improve performance, speed transactions and help lower processing costs.

6.4.8 Designs To Detect And Defend Against Attacks

Cisco self defending network strategy complements the intrusion detection services (IDS) of z/OS. z/OS IDS is designed to detect and defend against known attacks and new or previously unidentified attacks, using a policy-based approach. z/OS can recognize and report system activities indicative of a denial-of-service attack, which are designed to enable businesses to take action before system degradation occurs

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IT data security relates to protecting data from Internet intrusion and virus protection. Storage security requirements of a large, geographical reach spread enterprises must consider mounting threats from cyber-terrorists, compliance regulations, and protecting data from hardware, software, intrusion (WORM, virus, hackers) and theft.

It is necessary to secure data at all levels of the local and remote enterprise. Securing data includes protection from theft via encryption.

Leading retailers as well as governmental and financial institutions have historically selected the mainframe as a secure repository and transaction hub for their most critical data. As the Internet emerges as a significant channel and supply chain enabler, the secure repository is needed in these new applications. New workload on the mainframe depends of optimization of Internet software systems on the mainframe.

IBM System z a prominent financial institution with a business focused in the Nordic countries - is an example of an IBM client that has leveraged the System z9 mainframe security architecture.

6.4.9 Overlapping Investment

Overlapping investment is an issue. Policy management utilizes tools from portfolio management with application cycle practices. Companies can achieve 100% improvement by prioritizing transformation of the security policies. Allocation of security costs is not necessarily the same as actual portfolio security management.

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Security is impacted by accountability and deriving value from the business. Security management is an organization of governance and optimizing security systems.

Organizations need to figure out how to quantify security risk. The main benefit of security management is that it lets the business create a model of the security policies. Instead of creating fear and resistance to change, security management gives a good view of component business modeling that creates a map of the business security process

Security maps relate to management policies that provide control over the business in the context of connectivity. Securing a distributed environment will always require a combination of physical security and logical security (authentication, authorization, and encryption).

6.5 Security Cost Analysis for Distributed Systems

For distributed systems, there are no inbuilt security solutions. Hence, it is essential to purchase add-on hardware and software security solutions. Also, the solution must be selected such that it is easy to install, implement and use.

Analysis of security costs for distributed systems relates to the analysis of developer and software costs. A lot of the security that is inherent in the mainframe hardware and operating system must beaded to each server to attain a minimum level of protection against intrusion from the network. In contrast, the mainframe is highly secure and instances of intrusion do not exist or are extremely rare.

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TABLE 6-3

SECURITY COSTS ANALYSIS FOR DISTRIBUTED SYSTEMS

- Labor costs
- Software costs
- Hardware costs
- Physical security costs
- IT security incident labor costs
- Cost of lost business due to security incidents

Source: Wintergreen Research, Inc.

6.5.1 Labor Costs - Security Policy Declaration for Distributed Systems

Labor costs continue as key components of maintaining security policy definition and implementation in distributed server environments. Companies are plagued with a continuing vulnerability in distributed systems environments. Policy management is central to aligning security policy with what an enterprise needs.

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FIGURE 6-4

SECURITY LABOR COST ANALYSIS FOR DISTRIBUTED SYSTEMS

Security Cost Analysis For Distributed Systems (Dollars in Thousands)		
Labor Costs - Security Policy Declaration	Current	Unit
Annual Cost of Labor To Develop Security Policies	50.0	$000
Annual Cost of Labor To Implement LDAP or other Security Server	10.0	$000

Source: Wintergreen Research, Inc.

Labor costs for security policy declaration for distributed systems involve the following two components:

- Cost of labor to develop security policies
- Cost of labor to implement LDAP and other security servers

For the current year:

The cost of labor to develop security policies is $50,000 and the cost of labor to implement LDAP is $10,000.

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FIGURE 6-5

YEARLY GROWTH IN TOTAL SECURITY LABOR COST FOR DISTRIBUTED SYSTEMS

% Increase/Decrease In Security Policy Costs		%	3.0	3.0	3.0	3.0	3.0
Total Annual Cost of Labor to Implement Consistent Security and Identity Resolution Policies	60.0	$000	61.8	63.7	65.6	67.5	69.6

Source: Wintergreen Research, Inc.

Therefore the total costs of labor, to implement consistent security and identity resolution policies are $60,000.

The forecast of costs estimates that labor costs will increase at a rate of 3% per year.

In year 2012, the total annual cost of labor to implement consistent security and identity resolution policies will increase to $69,600.

6.5.2 Software Costs - E-Referral 14 Servers Security for Distributed Systems

Security on distributed systems is provided using the following types of software:

- Encryption security software
- Intrusion detection software

- Firewall security software
- Virus protection security software
- PKI security software

FIGURE 6-6

SECURITY SOFTWARE COST ANALYSIS FOR DISTRIBUTED SYSTEMS

7. Software Costs - E-Referral 14 Servers Security	Current	Unit
8. Cost Of Encryption Security Software	15.0	$000
9. Cost Of Intrusion Detection Security Software	3.0	$000
10. Cost Of Firewall Security Software	2.0	$000
11. Cost Of Virus Protection Security Software	1.4	$000
12. Cost Of PKI Security Software	5.0	$000

Source: Wintergreen Research, Inc.

For the current year:

In a distributed system, the additional security software costs are $15,000 for encryption software, $3,000 for intrusion detection software, $2,000 for firewall software, $1,400 for virus protection software and $5,000 for PKI software.

Distributed systems require investment of $26,400 for security software, in addition to the purchase price, whereas mainframe systems have inbuilt security software as part of the purchase price.

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FIGURE 6-7

YEARLY GROWTH IN TOTAL SECURITY SOFTWARE COST FOR DISTRIBUTED SYSTEMS

13. % Increase/Decrease In Security Software Costs		%	3.0	3.0	3.0	3.0	3.0
14. Total Cost Of Security Software	26.4	$000	27.2	28.0	28.8	29.7	30.6

Source: Wintergreen Research, Inc.

The security software costs are forecast to increase by 3% every year. The total cost of security software will thus increase to $30,600 in year 2012.

6.5.3 Hardware Costs – Security for Distributed Systems

Security on distributed systems is primarily provided using the following hardware devices or components:

- Security edge routers
- Security appliances

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FIGURE 6-8

SECURITY HARDWARE COST ANALYSIS FOR DISTRIBUTED SYSTEMS

15. Hardware Costs - Security	Current	Unit
16. Cost Of Security Edge Routers	7.0	$000
17. Cost Of Security Appliances	2.0	$000
18. % Increase/Decrease In Security Hardware Costs		%
19. Total Cost Of Security Hardware	9.0	$000

Source: Wintergreen Research, Inc.

For the current year:

In distributed systems, the additional hardware costs are $7,000 for security edge routers and $2,000 for security appliances. Distributed systems thus require an additional investment of $9,000 on hardware devices, for security, whereas most of these hardware devices are inbuilt and available as part of the mainframe racks during initial purchase.

FIGURE 6-9

YEARLY GROWTH IN TOTAL SECURITY HARDWARE COST FOR DISTRIBUTED SYSTEMS

18. % Increase/Decrease In Security Hardware Costs		%	3.0	3.0	3.0	3.0	3.0
19. Total Cost Of Security Hardware	9.0	$000	9.3	9.5	9.8	10.1	10.4

Source: Wintergreen Research, Inc.

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The security hardware costs are forecast to increase by 3% every year. The total cost of security hardware will thus increase to $10,400 in year 2012.

6.5.4 Physical Security Costs for Distributed Systems

Physical security costs include costs for physical security personnel and security guards, hired to guard the devices against physical threat. Physical security costs are related to the physical size of the floor space and the number of personnel required guarding the area. Since the involved devices are higher in number and spread over a larger area, distributed systems have a disadvantage of higher physical security costs.

FIGURE 6-10

PHYSICAL SECURITY COST ANALYSIS FOR DISTRIBUTED SYSTEMS

20. Physical Security Costs	Current	Unit
21. Annual Cost Of Physical Security Personnel (security guard(s) or other)	95.0	$000

Source: Wintergreen Research, Inc.

For the current year:

The cost of hiring and retaining physical security personnel, to keep the systems running, is $95,000.

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FIGURE 6-11

YEARLY GROWTH IN TOTAL PHYSICAL SECURITY COST FOR DISTRIBUTED SYSTEMS

22. % Increase/Decrease In Physical Security Personnel Costs		%	3.0	3.0	3.0	3.0	3.0
23. Total Cost Of Physical Security Personnel		$000	97.8	100.8	103.8	106.9	110.1

Source: Wintergreen Research, Inc.

The physical security costs are forecast to increase by 3% every year. The total cost of physical security will thus increase to $110,100 in year 2012.

6.5.5 IT Security Incident Labor Costs for Distributed Systems

All systems must be prepared to quickly and efficiently handle and resolve events of threat to IT security. In distributed systems, this necessitates hiring of skilled and experienced security technicians, since there is no inbuilt self-correcting mechanism in an event of IT security threat or failure.

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FIGURE 6-12

IT SECURITY INCIDENT LABOR COST ANALYSIS FOR DISTRIBUTED SYSTEMS

24. IT Security Incident Labor Costs	Current	Unit
25. Labor Cost Per Hour For Security Technicians to Resolve Specific Security Incidents	50.0	$
26. # Major Security Incidents Per Year	10.0	#
27. Average # Of Technician and Management Hours To Resolve a Security Incident	90.0	#

Source: Wintergreen Research, Inc.

For the current year:

Labor costs per hour, for security technicians to resolve specific security events are $50.

The number of major IT security incidents is 10. On an average, it takes 90 hours to resolve an IT security incident. The labor costs to resolve such security incidents are $110,100.

FIGURE 6-13

YEARLY GROWTH IN TOTAL IT SECURITY INCIDENT LABOR COST FOR DISTRIBUTED SYSTEMS

28. % Increase/Decrease In IT Security Incident Labor Costs		%	3.0	3.0	3.0	3.0	3.0
29. Total Annual Labor Costs To Resolve Specific Security Incidents	110.1	$000	113.4	116.8	120.3	124.0	127.7

Source: Wintergreen Research, Inc.

The IT security incident labor costs are forecast to increase by 3% every year. The total cost to resolve IT security incidents will thus increase to $127,700 in year 2012.

6.5.6 Cost of Lost Business Due To Security Incidents for Distributed Systems

IT security incidents lead to business loss for the duration of time that the system remains affected. E-referral business transaction is a major casualty in case of an IT security incident.

FIGURE 6-14

COST ANALYSIS OF BUSINESS LOST DUE TO SECURITY INCIDENTS FOR DISTRIBUTED SYSTEMS

30. Cost Of Lost Business Due To Security Incidents	Current	Unit
31. Total Annual Cost Of E-Referral Lost Business Due To Security Incidents	30.0	$000

Source: Wintergreen Research, Inc.

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Though security technicians are put to work on the issue immediately, the cost of E-referral lost business due to security incidents in distributed systems, in the current year is $30,000.

FIGURE 6-15

YEARLY GROWTH IN COST OF BUSINESS LOST DUE TO SECURITY INCIDENTS FOR DISTRIBUTED SYSTEMS

32. % Increase/Decrease In Cost of Lost Business Due to Security Incidents		%	3.0	3.0	3.0	3.0	3.0
33. Annual Cost Of Lost Business Due To Security Incidents		$000	30.9	31.8	32.8	33.8	34.8

Source: Wintergreen Research, Inc.

The cost of lost business due to IT security incidents are forecast to increase by 3% every year. The total cost of lost business due to IT security incidents will thus increase to $34,800 in 2012.

6.5.7 Total Security Costs for Distributed Systems

The total security costs for distributed systems is the sum total of the labor costs, software costs, hardware costs, physical security costs, IT security incident labor costs and cost of lost business due to security incidents.

FIGURE 6-16

YEARLY GROWTH IN TOTAL SECURITY COSTS FOR DISTRIBUTED SYSTEMS

34. Total Costs	Current	Unit	2008	2009	2010	2011	2012
35. Annual Cost Of Security - Distributed System	330.5	000$	340.4	350.7	361.2	372.0	383.2

Source: Wintergreen Research, Inc.

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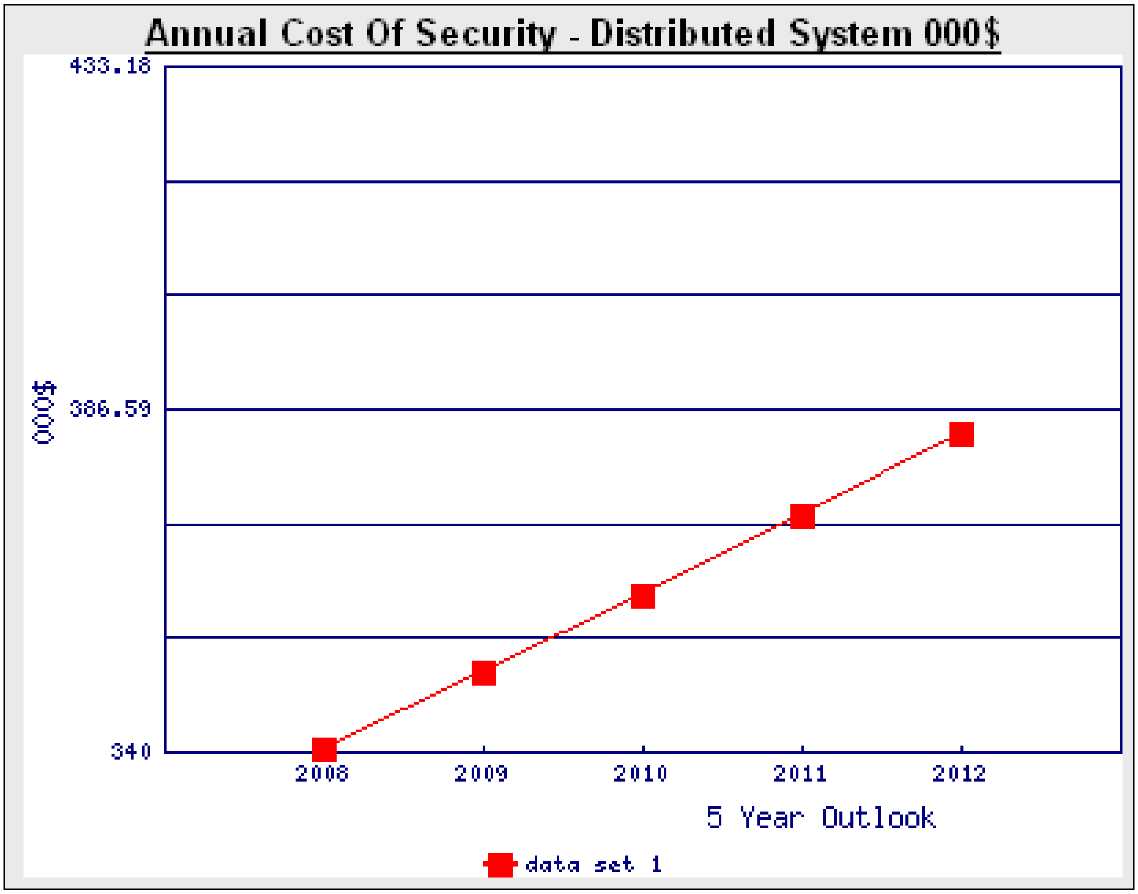
FIGURE 6-17

FIVE-YEAR OUTLOOK OF TOTAL SECURITY COSTS FOR DISTRIBUTED SYSTEMS



Source: Wintergreen Research, Inc.

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The above graph shows a five-year outlook for the total security costs for distributed systems. The sum total of security costs for distributed systems in the current year is $330,500. With a 3% increase in costs every year, the total security costs will increase to $383,200 in year 2012.

6.6 Security Cost Analysis for E-Referral on the Mainframe

There is a significant advantage to the overall mainframe security cost structure. This difference occurs because security is built into the mainframe operating systems, applications, and hardware while security for the distributed systems is added on with a range of different hardware and software modules. Mainframe encryption algorithms are more highly evolved and more secure than anything available on distributed servers.

The mainframe remains inherently more secure because of its bulletproof integration between the operating system, related middleware and the security server itself. That allows unmatched protection of your data against internal and external threats, and related loss during unexpected application outages.

Analysis of security costs for mainframe includes the following:

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TABLE 6-18

SECURITY COSTS ANALYSIS FOR MAINFRAME

- Labor costs
- Software costs
- Hardware costs
- Physical security costs
- IT security incident labor costs
- Cost of lost business due to security incidents

Source: Wintergreen Research, Inc.

6.6.1 Labor Costs - Security Policy Declaration for Mainframe

With centralized servers and consolidated security solutions in mainframe, the risks of multiple security domains are eliminated. This enables assignment of staffers to higher-level tasks, instead of security-related tasks.

FIGURE 6-19

SECURITY LABOR COST ANALYSIS FOR MAINFRAME SYSTEMS

2. Labor Costs - Security Policy Declaration	Current	Unit
3. Annual Cost of Labor To Develop Security Policies	5.0	$000
4. Annual Cost of Labor To Implement LDAP or other Security Server	1.0	$000

Source: Wintergreen Research, Inc.

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Labor costs for security policy declaration for mainframe involve the following two components:

- Cost of labor to develop security policies
- Cost of labor to implement LDAP and other security servers

For the current year:

The cost of labor to develop security policies is $5,000 and the cost of labor to implement LDAP is $1,000.

FIGURE 6-20

YEARLY TOTAL SECURITY LABOR COST FOR MAINFRAME SYSTEMS

5. % Increase/Decrease In Security Policy Costs		%	3.0	3.0	3.0	3.0	3.0
6. Total Annual Cost of Labor to Implement Consistent Security and Identity Resolution Policies	6.0	$000	6.2	6.4	6.6	6.8	7.0

Source: Wintergreen Research, Inc.

Therefore the total costs of labor, to implement consistent security and identity resolution policies are $6,000.

The forecast of costs estimates that labor costs will increase at a rate of 3% per year.

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In year 2012, the total annual cost of labor to implement consistent security and identity resolution policies will increase to $7,000. This is a fraction of the cost incurred in distributed systems.

6.6.2 Software Costs – Security for Mainframe

Security on mainframe systems is provided using the following types of inbuilt software:

- Encryption security software
- Intrusion detection software
- Firewall security software
- Virus protection security software
- PKI security software

FIGURE 6-21

SECURITY SOFTWARE COST ANALYSIS FOR MAINFRAME SYSTEMS

7. Software Costs - Security	Current	Unit
8. Cost Of Encryption Security Software	0.0	$000
9. Cost Of Intrusion Detection Security Software	0.0	$000
10. Cost Of Firewall Security Software	0.0	$000
11. Cost Of Virus Protection Security Software	0.0	$000
12. Cost Of PKI Security Software	0.0	$000
13. % Increase/Decrease In Security Software Costs		%
14. Total Cost Of Security Software	0.0	$000

Source: Wintergreen Research, Inc.

Since all the software is inbuilt and is available as part of the purchase price of the mainframe system, the security software costs are nil. With advancements in mainframe technology and improved features, the security software costs are bound to remain nil, in the years to come. In distributed systems, regardless of advancements and newer features, security software costs will continue to rise.

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6.6.3 Hardware Costs – Security for Mainframe

Security on mainframe systems is primarily provided using the following hardware devices or components:

- Security edge routers
- Security appliances

In mainframe systems, necessity for dedicated security appliances can be eliminated by the use of suitable processors within the mainframe itself. For example, Decru DataFort, a security appliance, can be eliminated by use of a cryptographic coprocessor (CC) within the mainframe. Examples of CC are PCIXCC or Crypto Express 2 available for the z9 system of IBM. All-in-one integrated security appliances are also gaining acceptance. Security edge routers form the major component of security hardware cost.

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FIGURE 6-22

SECURITY HARDWARE COST ANALYSIS FOR MAINFRAME SYSTEMS

15. Hardware Costs - Security	Current	Unit
16. Cost Of Security Edge Routers	7.0	$000
17. Cost Of Security Appliances	0.070	$000

Source: Wintergreen Research, Inc.

For the current year:
In mainframe systems, the additional hardware costs are $7,000 for security edge routers and $70 for security appliances.

FIGURE 6-23

YEARLY TOTAL SECURITY HARDWARE COST FOR MAINFRAME SYSTEMS

18. % Increase/Decrease In Security Hardware Costs		%	3.0	3.0	3.0	3.0	3.0
19. Total Cost Of Security Hardware	7.1	$000	7.3	7.5	7.7	8.0	8.2

Source: Wintergreen Research, Inc.

Mainframe systems thus require an additional investment of just $7,100 on hardware devices, as compared to $9,000 for distributed systems.

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The security hardware costs are forecast to increase by 3% every year. The total cost of security hardware will thus increase to $8,200 in year 2012.

6.6.4 Physical Security Costs for Mainframe

Not only do large numbers of distributed system components consume vast amounts of space and energy but, even more importantly, they need a lot of people to keep them running. Mainframe, on the other hand, with its integrated and centralized approach, enables reduction of physical security costs to a negligible amount.

FIGURE 6-24

PHYSICAL SECURITY COST ANALYSIS FOR MAINFRAME SYSTEMS

20. Physical Security Costs	Current	Unit	2008	2009	2010	2011	2012
21. Annual Cost Of Physical Security Personnel (security guard(s) or other)	0.095	$000					
22. % Increase/Decrease In Physical Security Personnel Costs		%	3.0	3.0	3.0	3.0	3.0
23. Total Cost Of Physical Security Personnel		$000	0.1	0.1	0.1	0.1	0.1

Source: Wintergreen Research, Inc.

For the current year:

The cost of hiring and retaining physical security personnel, to keep the systems running, is just $95. With a forecast of 3% increase in physical security costs every year, the total cost for physical security personnel will reach just $100 in year 2012.

6.6.5 IT Security Incident Labor Costs for Mainframe

In mainframe systems, due to inbuilt self-correcting mechanisms and newer technologies for monitoring security, the number of security incidents necessitating action by a trained security technician is negligible.

FIGURE 6-25

IT SECURITY INCIDENT LABOR COST ANALYSIS FOR MAINFRAME SYSTEMS

24. IT Security Incident Labor Costs	Current	Unit
25. Labor Cost Per Hour For Security Technicians to Resolve Specific Security Incidents	50.0	$
26. # Security Incidents Per Year	0.001	#
27. Average # Of Hours To Resolve a Security Incident	0.3	#

Source: Wintergreen Research, Inc.

For the current year:

In mainframe systems, labor costs per hour, for security technicians to resolve specific security events are $50.

The number of major IT security incidents is 0.001. On an average, it takes 0.3 hours to resolve an IT security incident.

FIGURE 6-26

YEARLY GROWTH IN TOTAL IT SECURITY INCIDENT LABOR COST FOR MAINFRAME SYSTEMS

28. % Increase/Decrease In IT Security Incident Labor Costs		%	3.0	3.0	3.0	3.0	3.0
29. Total Annual Labor Costs To Resolve Specific Security Incidents	0.1	$000	0.1	0.1	0.1	0.1	0.1

Source: Wintergreen Research, Inc.

The labor costs to resolve such security incidents are $100. A five-year forecast shows that this cost will remain the same.

6.6.6 Cost of Lost Business Due To Security Incidents for Mainframe

Unlike in distributed systems, mainframe systems, with negligible IT security incidents per year, boasts of nil cost of lost business due to IT security incidents.

FIGURE 6-27

YEARLY GROWTH IN COST OF BUSINESS LOST DUE TO SECURITY INCIDENTS FOR MAINFRAME SYSTEMS

30. Cost Of Lost Business Due To Security Incidents	Current	Unit	2008	2009	2010	2011	2012
31. Total Annual Cost Of Lost Business Due To Security Incidents	0.0	$000					
32. % Increase/Decrease In Cost of Lost Business Due to Security Incidents		%	3.0	3.0	3.0	3.0	3.0
33. Annual Cost Of Lost Business Due To Security Incidents		$000	0.0	0.0	0.0	0.0	0.0

Source: Wintergreen Research, Inc.

With only advancements in sight for mainframe systems, the cost of lost business due to security incidents is set to remain at zero.

6.6.7 Total Security Costs for Mainframe

The total security costs for mainframe is the sum total of the labor costs, software costs, hardware costs, physical security costs, IT security incident labor costs and cost of lost business due to security incidents.

FIGURE 6-28

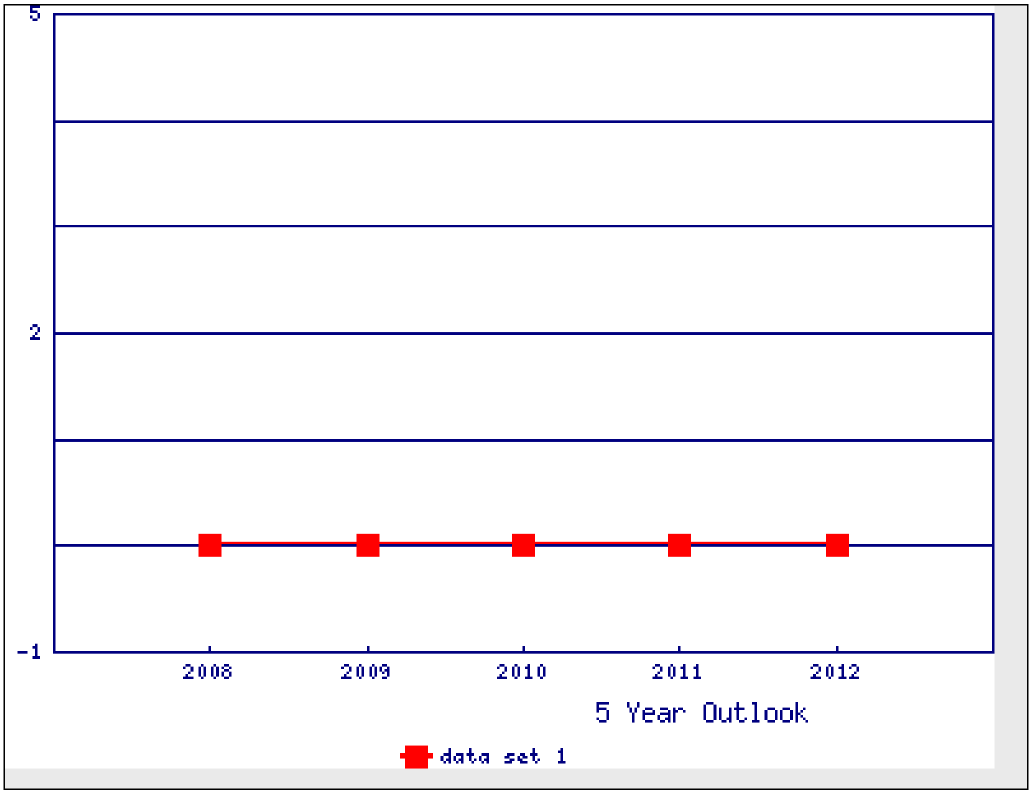
YEARLY GROWTH IN TOTAL SECURITY COSTS FOR MAINFRAME

34. Total Costs	Current	Unit	2008	2009	2010	2011	2012
35. Annual Cost Of Security - Mainframe	13.3	000$	13.7	14.1	14.5	14.9	15.4

Source: Wintergreen Research, Inc.

FIGURE 6-29

FIVE-YEAR OUTLOOK OF TOTAL SECURITY COSTS FOR MAINFRAME



The above graph shows a five-year outlook for the total security costs for mainframe systems. The sum total of security costs for mainframe, in the current year is $13,300. With a 3% increase in costs every year, the total security costs will increase to $15,400 in year 2012. This is a fraction of the security costs incurred with distributed systems.

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7. Software Cost Analysis -- Mainframe vs. Distributed Service Level Availability SLA Return on Investment (ROI)

7.1 SOA Foundation Architecture Addresses Flexible Response To Changing Market Conditions

The following chapter analyzes the software license and yearly maintenance costs giving a direct comparison for the mainframe and distributed systems. SOA is the big news here, creating automation of business process from the desktop and providing integration systems that provide flexible systems implementation. SOA holding the promise of process from desktop icons brings a revolution to business promising improved productivity.

SOA is a mainframe technology, providing vast returns on investment for the business, creating tremendous opportunities for growth and competitive advantage to enterprises that embrace the architecture of reusable components of code. Thus, the software model presented here that shows significant investment in SOA should be accompanied by an additional model that shows the business benefit anticipated to be realized from SOA investment. That model is not described here because it is industry specific and business specific and needs to be built in a customized manner.

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IBM has been a leader in SOA and in creating the ability to consolidate its integration modules with foundation architecture. Business integration foundation systems create a way to organize supporting modules. Application integration systems are evolving to support business flexibility by enabling integration of systems dynamically. Applications are being interconnected using integration to create cross-departmental processes. Processes are implemented in real time.

Business integration is positioned as middleware useful in the transformation of business process to make it more flexible and adaptive to change. It is used to leverage making legacy applications more flexible. EAI extends existing technology investment by providing tools and middleware for interconnecting systems.

Application server systems satisfy the concerns of customers to reach partners, channel and customers directly via the Internet. Application server middleware market is dominated by a number of large and well-established companies that have significant financial resources, large development staffs, and extensive marketing and distribution capabilities.

7.1.1 Services Oriented Architecture (SOA) Engine Core Process Market Driving Forces

IBM is the defacto industry standard market leader in SOA engine markets by virtue of its infrastructure middleware that provides the ability to consolidate integration modules with foundation architecture. IBM SOA is the software used in creating business integration foundation systems.

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SOA creates a way to organize automated process supporting modules. SOA systems are evolving to support business flexibility by enabling integration of systems dynamically. Applications are being interconnected using integration to create cross-departmental processes. Processes are implemented in real time.

Business integration is positioned as middleware useful in the transformation of business process to make it more flexible and adaptive to change. It is used to leverage making legacy applications more flexible. SOA extends existing technology investment by providing tools and middleware for interconnecting systems.

Mission critical messaging provides the base for application integration. Web services and Java based messaging do not manage the complexity of data structures that are encountered in even modest integration projects. The broker management of data structures is what integration is all about.

WebSphereMQ and Tibco Rendezvous become the core processes for SOA in this context. BEA has a strong broker capability.

7.1.2 WebSphereMQ and Tibco Transport Layer Achieve Mission Critical Functionality

The mature transport technologies have a strong customer base those supports and funds product enhancements. The newer transport technologies MSMQ, .Net, SOAP, and JMS are generally utilized as modules that are wrapped in the mature WebSphereMQ or Tibco transport layer to achieve mission critical functionality.

Rules engines permit systems to be developed that look at the content of a message to determine the basis of a route. A routing decision is made after the application process rules are addressed.

The improved systems capability and proven return on investment for Services Oriented Architecture markets represent the most compelling market driving forces. Companies that achieve faster time to market receive significant competitive advantage. Achieving competitive advantage is a central and compelling issue driving every enterprise to look at the advantages of enterprise application integration.

Enterprise networks represent the core business capability. Enterprise application connectivity is significant for internal IT departments. It supports connectivity to distributors, suppliers, partners, and customers. The ability to send information between disparate applications in real-time is relevant to every aspect of network computing.

SOA refers to integration projects inside the enterprise network with employees and over the Internet with partners. Services oriented architecture is the base for business process integration, the integration of information relevant to projects inside and beyond the borders of the enterprise.

Integration products support broad initiatives to integrate heterogeneous IT departments. Departments comprised of discrete target point solutions need to be interconnected in the broader IT management of information. Integration products are becoming more highly developed and less expensive. Portals shift the focus of integration to include integration initiatives beyond the enterprise.

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Vendors provide the overall architecture and individual workplace integration software for the enterprise, replacing internal hand coded solutions. Supply chain solutions that go across corporate boundaries relate to providing integration software that the technical capabilities needed to help clients to integrate different back-end distributed systems with a web-enabled front-end.

7.1.3 SOA Integration Of E-Business

The integration of e-business presents major technical challenges. Organizations have implemented various ERP enterprise applications to handle the core processes.

In an attempt to address business challenges, e-business integration provides transport and connectivity between disparate core business processes, e.g. order entry and shipping.

Integration complicates IT process applications implementation by managing the processes that are implemented as users create response to the market opportunity presented by the Internet market channels.

Services Oriented Architecture (SOA) technologies address the need to interconnect distributed islands of computing using mission critical transport to achieve master data management that gives a single view of data.

A metadata application server gives access based on transport. Leverage the value of information using SOA and information servers is able to access and make sense of data.

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Real time network communication of information implies that computing application resources are interconnected. Solutions have limitations in terms of time-to-market, cost, performance or flexibility.

No one SOA approach fully addresses the entire e-Business integration challenge. IBM has the most complete integration solution. IBM addresses the integration task with a WebSphere product set that includes an application server, a portal, an integration engine, brokers, and messaging capability. WebMethodsMQ is the foundation transport technology for this task implementation of integration.

Tibco is positioned with an integration broker that is fully functional. Tibco leverages its Rendezvous publish subscribe messaging suite.

Application server functionality is enhanced by integration capabilities from BEA. webMethods has developed services oriented architecture to complement its strong XML schema integration capabilities. Thus the market continues to be fragmented, with IBM and Tibco the only players dominating the market because they are SOA providers with compete product sets.

The SOA companies coming together with a common theme and marketing effort create an atmosphere of optimism about the opportunities for using the network to build new ways of doing business. Table 7-1 illustrates enterprise services oriented architecture market driving forces.

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TABLE 7-1

ENTERPRISE SERVICES ORIENTED ARCHITECTURE MARKET DRIVING FORCES

- Service oriented architecture
- On demand data access
- Meta data solutions
- Integration demands of e-Business
- Major technical challenges
- Need to address business challenges
- Need to adapt to market changes
- ERP enterprise applications handle the core processes
- e-Business IT process applications initiatives
- Need to leverage Internet market channels
- Need to interconnect distributed islands of computing
- Real time network communication of information

TABLE 7-1 (CONTINUED)

ENTERPRISE SERVICES ORIENTED ARCHITECTURE MARKET DRIVING FORCES

- Computing application resources interconnected
- Application solutions have limitations in terms of time-to-market, cost, performance or flexibility

Source: WinterGreen Research, Inc.

Implementation of systems automation depends on SOA. Integration projects permit businesses to achieve more attractive returns on existing investments. Point solutions are being replaced with modular integration projects that are implemented in stages. Services are evolving in the context of integration solutions.

SOA work frequently relates to integration of ERP. SAP, Siebel, Oracle / Peoplesoft, i2, and Ariba integrations are basic to SOA projects. Best-of-breed SOA vendors seek to control the ERP back-end of an enterprise. SOA vendors are positioning to assume more responsibility for the overall enterprise business process management. Heterogeneous application connectivity provides a primary market driving force.

Business infrastructure issues achieve market momentum because of the competitive advantage provided by integration projects. SOA integration investment is proved to provide competitive advantage.

If Coke implements a major SOA initiative, Pepsi is sure to follow. This is the driving force for SOA projects. Businesses run more efficiently when systems are interconnected.

The innovators and early adopters have achieved real competitive advantage by streamlining operations. Other companies in the same market segment need to change to achieve competitive advantage.

7.1.4 Market Driving Forces For Real Time Exchange of Information

Market driving forces for SOA are comprised of a number of direct and indirect factors impacting markets as companies seek to achieve the benefits of using the network to exchange information electronically. Supply chain and logistics systems have already been automated.

Product cycles that were ten years, have shrunk to one year or six months. This has brought massive changes. The conversion from analog to digital telecommunications switches took ten years. The conversion to all optical networks is being accomplished far more rapidly. This is in part due to the ability of partners to work together to coordinate ordering processes. A network carrier can place an order and have the consequences of that order flow back to the manufacturer of optical components within hours.

Just in time inventory control takes on new meaning in this context. Direct factors relate to the need for Services Oriented Architecturebetween every different type of enterprise resource planning (ERP) system.

Supply chains are automated using SOA technology.

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Electronic commerce needs SOA to function.

Business processes are automated

Partners can be interconnected

New customer service systems need SOA in order to be implemented. Indirect factors relate to the migration of existing products from separate market segments to being subsumed by SOA. File transfer, CTI, applications development, and workflow illustrate these segments.

Enterprise Services Oriented Architecture is occurring in the context of corporate adoption of best-of-breed SOA application strategies. Mergers, acquisitions, reorganizations are increasing. The driving force is the need to leverage economies of scale brought by the Internet.

A desire to develop closer links with customers, suppliers and partners is also evolving. These events all drive demand for SOA. Dynamically growing businesses must meld applications, databases, operating systems, and hardware platforms. Vendors fold applications seamlessly into networks supporting mainframes, client/server platforms, and PCs.

Companies trying to pick up the IT pieces following a merger or acquisition need SOA. Those involved in front office/back office integration and those

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working to comply with new regulations all face the need to implement integration. Table 7-2 illustrates SOA market driving forces.

This is the major driving force for SOA, the ability to communicate in real time depends on having the end points able to talk to each other. Our networks are heterogeneous. Our applications are heterogeneous. There is nothing homogeneous about the networks and IT centers. Everyone has every kind of platform and application imaginable. Legacy systems are complemented by open systems with a lot of other stuff mixed in.

This situation will never change in a global economy with healthy competitive markets. This evolution of real time computing is the primary market driver for SOA and ensures that markets will not go away.

Systems need to be able to be put in place more easily and at less cost for services for markets to further evolve. Systems need to evolve services oriented architectures in the context of a framework, an architecture for those capabilities to take hold in the markets. IT departments need to have control of the services that are developed by business analysts.

Table 7-2

SOA Market Driving Forces For Real Time Computing

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- Speed corporate adoption of web enabled applications
- Support Internet strategies
- Manage mergers, acquisitions and reorganizations
- Develop seamless links with customers, suppliers, distributors, and partners
- Fold applications seamlessly into networks
- Support mainframes, client/server platforms, and PCs
- Meld applications, databases, operating systems, and hardware platforms

- Integrate packaged ERP applications, such as PeopleSoft, SAP, S.W.I.F.T.
- Integrate packaged database applications, such as Oracle, DB2, Sybase, and Microsoft SQL Server
- Build interfaces to Scopus, Clarify, Vantive information management systems
- Extend investment in legacy applications

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Table 7-2 (Continued)

SOA Market Driving Forces For Real Time Computing

- Enable client/server and network computing
- Provide electronic commerce over the Internet
- Integrate open systems solutions with legacy applications

Source: WinterGreen Research, Inc.

7.2 SOA Market Shares

IBM is the leader in SOA markets.

7.2.1 SOA Process Component Segments By Vendor

IBM is the market leader in all SOA segments by a wide margin. This is a very significant market. Penetration is at 7%, most integration is accomplished by roll your own hand coded systems, but this is defiantly not efficient and does not provide efficient solutions.

Solutions are evolving as automated solutions are significantly better and provide return on investment. The mainframe is significantly more efficient than the server farms.

As new applications are moved onto the mainframe, the integration solutions will be implemented as automated solutions.

7.2.2 SOA Engine License Market Shares

IBM is the leader in the SOA engine license markets with 53% share in 2006. IBM is able to lead the markets because of its broad middleware infrastructure product line: application servers, portals, mission critical messaging, business process management (BPM), WebSphere ESB, WebSphere Broker ESB, and DataPower ESB.

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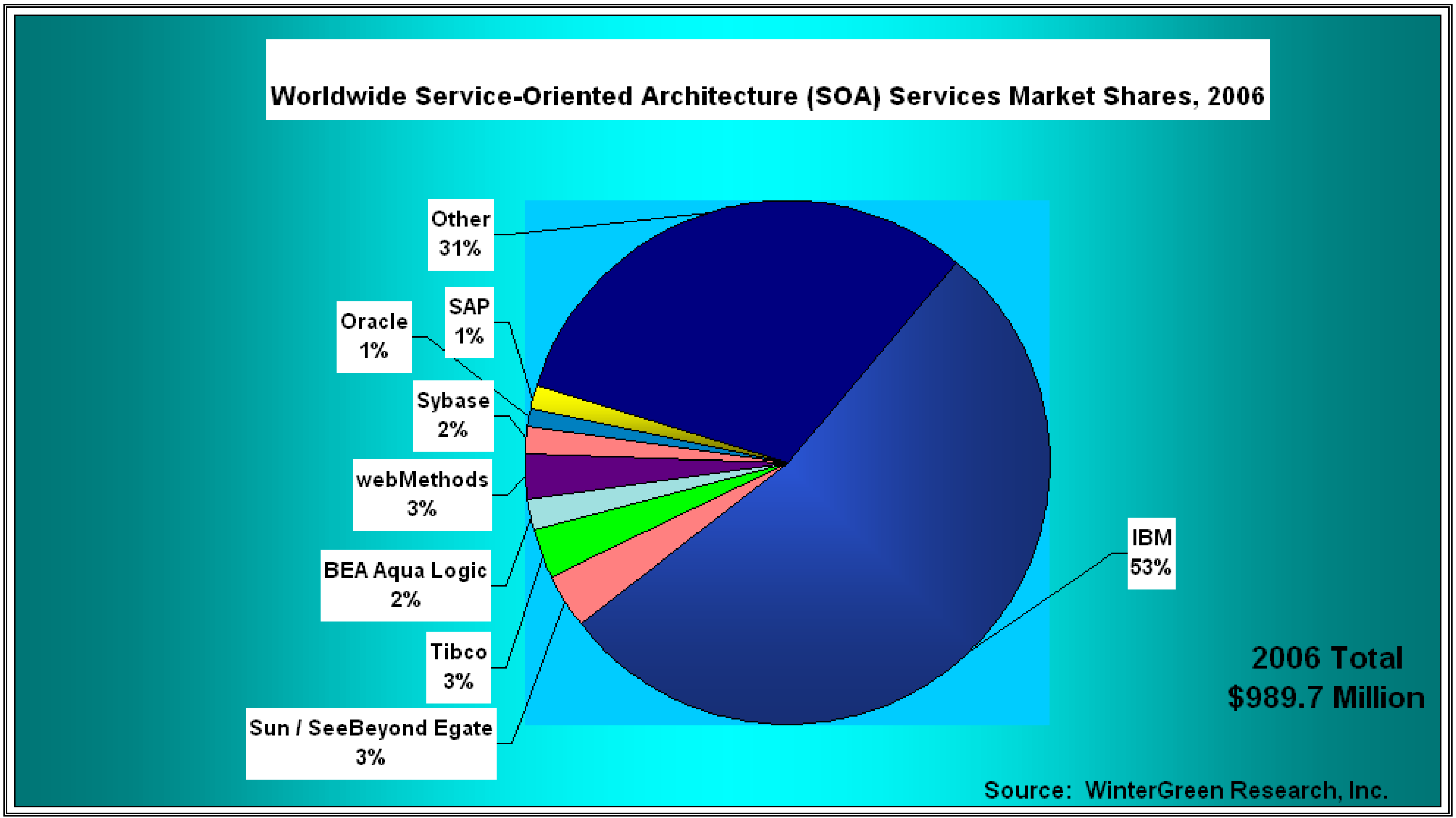
Figure 7-3

Worldwide Service-Oriented Architecture (SOA) Engine License Market Shares, 2006



The remainder of the market is split between multiple participants with Sun, Tibco, WebMethods, and BEA having measurable market share.

Knowledgeable workers use application servers to help focus energies on high-value activities, driving new efficiencies, spending as little time as possible seeking and wading through information. The systems are used to automate the processes responsive to Internet channel transactions.

An enterprise-wide application server is useful for displaying html pages dynamically and conducting business on the Internet. Suppliers improve sensing, analytic and workflow capabilities by radically streamlined the way customers access and act on information.

7.2.3 Mainframe Software License Costs

Mainframe software license costs are competitive with other platforms. License costs/unit of workload of IBM decreases as the workload increases. Five nines of availability is a significant operational aspect.

7.3 Analyst Comments

Services oriented applications are evolved from an architecture that is an IT data base engine that functions as a directory to manage scripts with header, date, user, and use information that supports broad enterprise access to information. SOA engines are designed to support reuse of adapters in a number of data centers. Access to information is constructed as a service. SOA containers implement process from an icon.

A SOA engine is positioned to permit users to reuse information assets. Information is best left where it is initially put.

SOA provides a flexible application framework for managing changing business needs. Service-oriented architecture is positioned to unlock the business value of an application portfolio.

Service-oriented architecture (SOA) is about the benefit of breaking down applications in a portfolio into discrete services. The aim is to streamline IT infrastructure. Service-oriented applications (SOA) are built from components that are designed to interconnect to existing applications to achieve an alignment of IT investments with business goals.

Service-oriented architecture (SOA) seeks to optimize IT spending. Business processes depend on the supporting technology aligned for efficiency to be achieved. Deploying applications as Web services in a service-oriented architecture (SOA) allows tight integration of business and technology.

7.3.1 Application Portfolio Management

Enhancing existing applications is impacted by the fixed to variable cost ratios. By moving overlap and identifying areas for reuse provides funds for new development.

The lifecycle of the applications depends on measurements and frameworks of applications. The call to get an application back up depends on being able to know what was happening to all the different applications running on the server when it went down and the different situations being handled by the server for each application when the server went down.

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This is different from the state of the hardware. Application owner, and application quality is indication of technical quality. Requirements management relates to customer satisfaction. Investment profile relates to solutions

Value functionality, quality of data, efficiency and agility are essential factors. A new application-based product needs to get to market quickly, even if the application architecture were of the monolithic variety; the tough part would be doing so while maintaining the level of service quality that clients expect. An application characterized by tightly coupled components tends to be brittle, in that it's hard to change one part without breaking another. Because SOA involves a high degree of abstraction that shields the developer of service-consuming programs from concerns about underlying system and data structures, changes can be made on the service-providing side without breaking consumer programs. You can change a database schema, change a program's language, and change a server platform - all without changing a thing in a service-consuming program.

7.3.2 SOA Enhances Quality Through Data Autonomy

SOA also enhances quality through data autonomy. Atomic-level services are grouped into service "nodes," and each service grouping has its own set of database tables (if the application utilizes a database - and note that the sets of tables "belonging" to different service nodes could be only logically separated, existing within one physical database). Here's the rule: If data in a table belonging to service grouping ABC is to be accessed, it must be accessed via a service that's part of service grouping ABC. This approach minimizes the number of programs that have to be changed in the event of a database schema change.

The conventional wisdom says that an organization can't achieve excellence in three areas at one time, referring to cost-efficiency, quality and agility. People will tell you that you can move fast and be the low-cost provider of service, but not if you want to be a quality leader; or, that you can get to market quickly and with high quality, but not without high costs. SOA has the potential to turn that piece of conventional wisdom on its head:

SOA can lead to somewhat increased server utilization, but it also facilitates the effective combination of disparate application- and data-serving platforms to deliver services, allowing an organization to truly use the right (and right-priced) tool for the right job. On top of that, server hardware and software acquisition costs are just one part of the expenses associated with a business application. There are also code maintenance and enhancement costs, and the technology abstraction that is a key aspect of SOA can really have a positive impact here.

As I mentioned, SOA makes an application less brittle. More of your code is insulated from the changes that come with the development of new services and the deployment of new server technology, so service-disrupting problems are less likely to occur as your organization responds to customer requirements.

7.3.3 Componentizing The Management Of Projects

Cost is looked at with respect to what is strategic and what is not a strategic. Strategic ranking creates a methodology for software decisions. Methods work is application portfolio input into decision making about what will get done and what will not get done.

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Quality management and cost ROI analysis work together. Prioritize and look at new demand. Governance is central to application portfolio management systems.

Componentizing the management of projects depends on understanding the assets that are available to the systems manager. To develop value depends on separating the cost structures and looking at allocations of people. Objectives need to be brought in line with costs. The management of assets depends on data from the general ledger that compares the aggregated information to the ROI analysis.

Aggregation of applications systems depends on portfolio management needs. The idea is that portfolio management requires real data and cannot rely on qualitative information.

Insight into discovery manger gives application information consolidated that is mapped to objects. Metrics are displayed on dashboards to look at need for corrective action or quarterly or annual basis to retire or enhance applications.

7.3.4 Defining ROI

ROI methods drive functionality for what is provided by the ROI tool. This is done to align with the interaction design that uses scenarios. Use cases drive the input into the ROI tool. This is a business based function. The needs of the business users relate to simplicity.

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Screenshots and dashboards provide architectural definition of the business problem. People want the products to market faster. Business goals and objects relate to key performance indicators. The quality of information is a factor. Quality of data and currency of data is an issue.

Application definition relates to understanding the business case. Identify business case, effort, cost and likelihood of delivering feeds into the business decision. Labor rates may come from SAP. Monetizing efforts and risk relates to monetizing the particular business objective. People identify variance in expected benefits. Provide likely and optimistic view. Capturing the benefits is a central aspect of monetizing the analysis.

Holding people accountable for deliverables is central to the process of monetizing risk. Enter 3 numbers need to pick a number to make a commitment. Can collect the numbers, but need to create a scenario that can be customized. Willingness to collect the numbers that profile a project.

Accommodate a control system that provides portfolio management.

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7.4 Distributed Systems Software Costs

FIGURE 7-4

WORKING OUT THE SOFTWARE COSTS FOR DISTRIBUTED SYSTEMS

3. Distributed Systems Software Costs	Current	Unit	2008	2009	2010	2011	2012
4. Application Server Software	10.5	000$	10.6	10.7	10.8	10.9	11.0
5. SOA Software	0.0	000$	0.0	0.0	0.0	0.0	0.0
6. Integration Software	0.0	000$	0.0	0.0	0.0	0.0	0.0
7. Database Software	38.5	000$	38.9	39.3	39.7	40.1	40.5
8. Mission Critical Messaging Software	0.0	000$	0.0	0.0	0.0	0.0	0.0
9. Operating System Software	33.6	000$	0.0	0.0	0.0	0.0	0.0
10. Total Software Costs - Distributed System	**82.6**	**000$**	**49.5**	**50.0**	**50.5**	**51.0**	**51.5**

Source: Wintergreen Research, Inc.

Analysis of software costs for distributed systems includes the following:

TABLE 7-5

SOFTWARE COSTS ANALYSIS FOR DISTRIBUTED SYSTEMS

- Application server software costs
- SOA software costs
- Integration software costs
- Database software costs
- Mission critical messaging software costs
- Operating system software costs

Source: Wintergreen Research, Inc.

All calculations are for the current year, unless specified otherwise.

7.4.1 Application Server Software

Application sever software is essential to the effective and efficient deployment, maintenance and load-balancing of distributed systems. Application server software in distributed systems must be highly scalable and load-tolerant.

FIGURE 7-6

CURRENT COST CALCULATION FOR APPLICATION SERVER SOFTWARE IN DISTRIBUTED SYSTEMS

1. Current Costs - Application Server Software - Distributed System	Current	Unit
2. License $ per Processor	500.0	$
3. # Of Processors per Server	3.0	#
4. License Cost per Server	1.5	000$
5. # Of Servers to be licensed - initial investment	7.0	#
6. Total License Costs - Initial Investment - Application Server Software - Distributed System	10.5	000$

Source: Wintergreen Research, Inc.

The application servers in distributed systems consist of several licensed processors that run the required application software. There are 3 processors per server. $500 is the cost of license per processor. There are 7 servers to be licensed initially, at a license cost of $1,500 per server. Hence, the total initial license cost for application server software for distributed systems is $10,500.

FIGURE 7–7

ESTIMATED TOTAL COSTS FOR APPLICATION SERVER SOFTWARE IN DISTRIBUTED SYSTEM

7. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
8. % Change In Ongoing License Costs		%	1.0	1.0	1.0	1.0	1.0
9. # of Servers to be licensed		#	7.0	7.0	7.0	7.0	7.0
10. Maintenance as a % of License Costs		%	15.0	15.0	15.0	15.0	15.0

11. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
12. License Cost Per Server - Application Server Software - Distributed System	1.5	000$	1.5	1.5	1.5	1.6	1.6
13. Total License Costs (for all Servers) - Application Server Software - Distributed System	10.5	000$	10.6	10.7	10.8	10.9	11.0
14. Annual Maintenance Costs - Application Server Software - Distributed System		000$	0.0	0.0	0.0	0.0	0.0
15. Total License And Maintenance Costs - Application Server Software - Distributed System (annual)	**10.5**	000$	**10.6**	**10.7**	**10.8**	**10.9**	**11.0**

Source: Wintergreen Research, Inc.

For years 2008 through 2012:

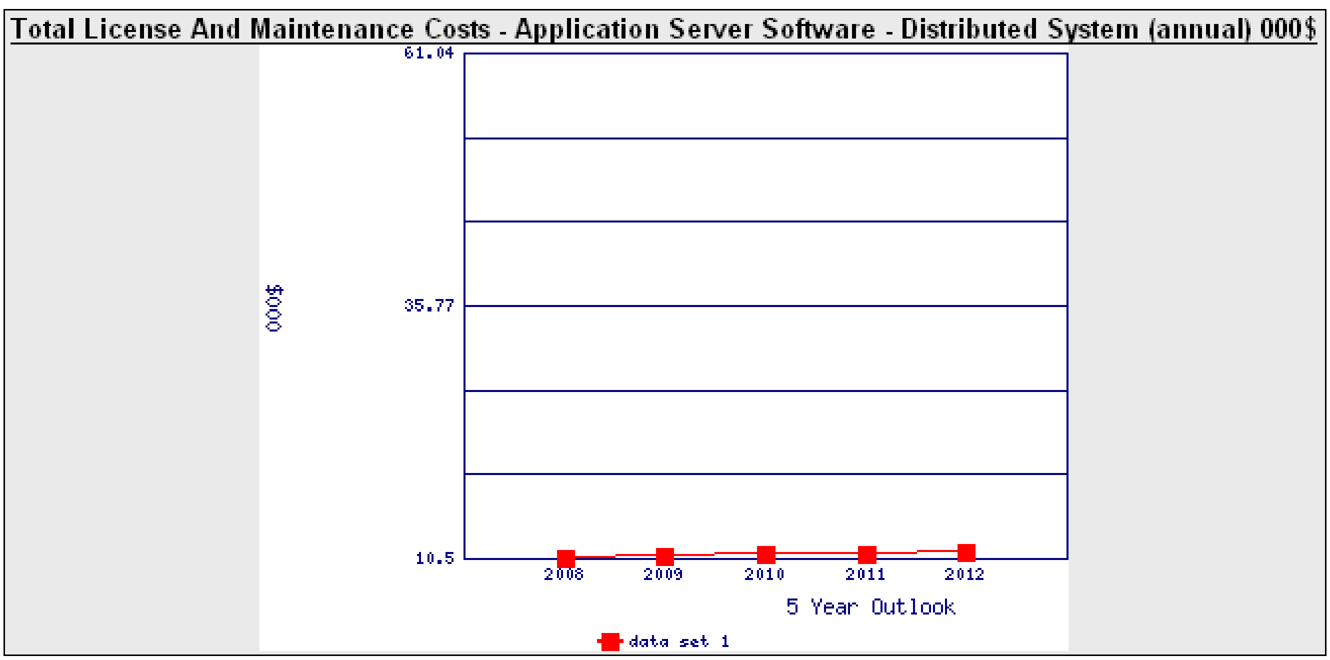
7 servers need to be licensed every year. 15% of the license cost is incurred for maintenance every year.

Increasing at a rate of 1% every year, the license cost per server is estimated to be $1,500, $1,500, $1,500, $1,600 and $1,600 for the respective years. Hence the license cost for all the 7 servers is $10,600, $10,700, $10,800, $10,900 and $11,000 for the respective years.

The annual maintenance cost for the application server software remains zero. Hence the sum total of the licensing cost and maintenance cost for application server software for distributed systems increases from $10,600 in 2008 to $11,000 in 2012.

FIGURE 7–8

FIVE-YEAR OUTLOOK OF TOTAL APPLICATION SERVER SOFTWARE COSTS FOR DISTRIBUTED SYSTEMS



Source: Wintergreen Research, Inc.

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See the graph above for a five-year outlook in the annual license and maintenance costs for application server software for distributed systems for years 2008 through 2012.

7.4.2 SOA Software

SOA enables a common way for services to communicate with each other. SOA software needs to be robust and secure, as it forms the basis of IT infrastructure in distributed systems.

FIGURE 7–9

CURRENT COST CALCULATION FOR SOA SOFTWARE IN DISTRIBUTED SYSTEM

1. Current Costs - SOA Software - Distributed System	Current	Unit
2. License $ per Processor	1,600.0	$
3. # Of Processors per Server	3.0	#
4. License Cost per Server	4.8	000$
5. # Of Servers to be licensed - initial investment	0.0	#
6. Total License Costs - Initial Investment - SOA Software - Distributed System	0.0	000$

Source: Wintergreen Research, Inc.

The SOA software in distributed systems runs on several servers. There are 3 processors per server. $1,600 is the cost of license per processor.

Since no server needs to be licensed initially, the total initial license cost for SOA software for distributed systems is 0 in this instance, but to the extent SOA is implemented on distributed servers, the analysis can be automated here.

FIGURE 7–10

ESTIMATED TOTAL COSTS FOR SOA SOFTWARE IN DISTRIBUTED SYSTEM

7. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
8. % Change In Ongoing License Costs		%	1.0	1.0	1.0	1.0	1.0
9. # of Servers to be licensed		#	0.0	0.0	0.0	0.0	0.0
10. Maintenance as a % of License Costs		%	15.0	15.0	15.0	15.0	15.0

11. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
12. License Cost Per Server - SOA Software - Distributed System	4.8	000$	4.8	4.9	4.9	5.0	5.0
13. Total License Costs (for all Servers) - SOA Software - Distributed System	0.0	000$	0.0	0.0	0.0	0.0	0.0
14. Annual Maintenance Costs - SOA Software - Distributed System		000$	0.0	0.0	0.0	0.0	0.0
15. Total License And Maintenance Costs - SOA Software - Distributed System (annual)	**0.0**	000$	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

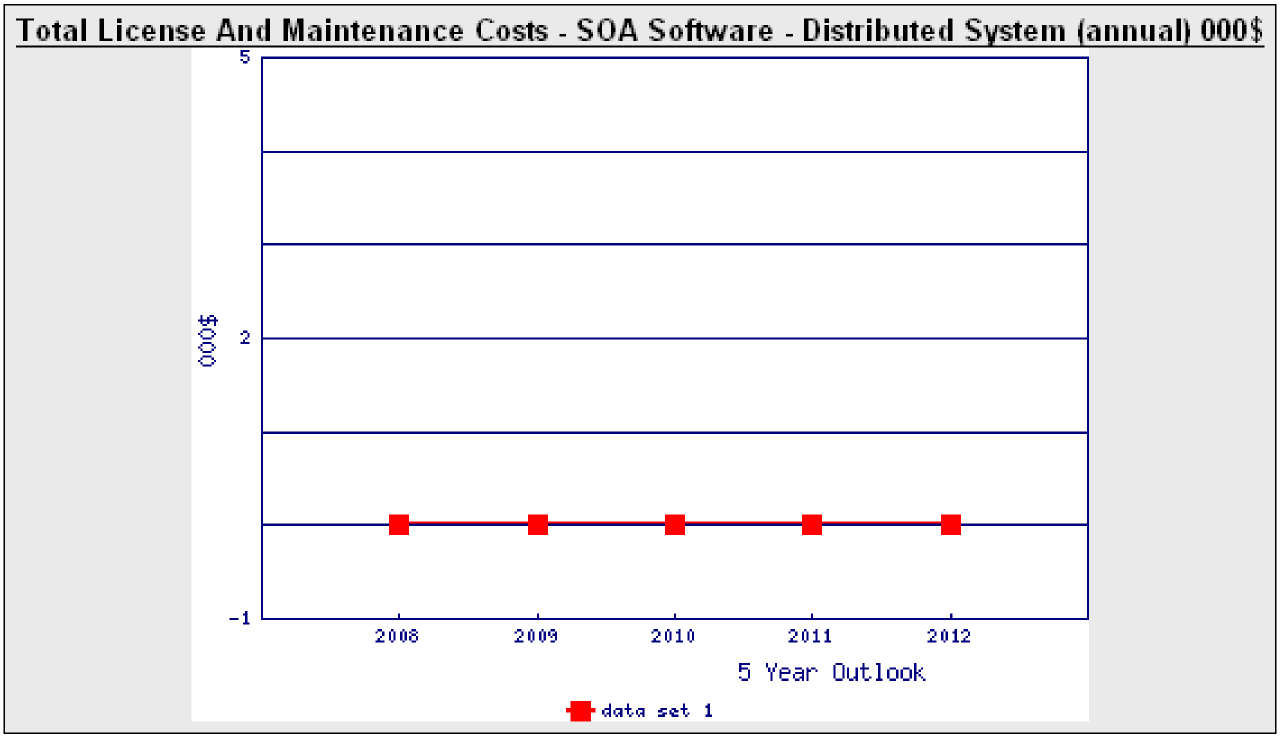
Source: Wintergreen Research, Inc.

For years 2008 through 2012:

Since no server needs to be licensed for the years being discussed, the licensing and maintenance costs for the SOA software for distributed systems remain 0.

FIGURE 7–11

FIVE-YEAR OUTLOOK OF TOTAL SOA SOFTWARE COSTS FOR DISTRIBUTED SYSTEMS



Source: Wintergreen Research, Inc.

See the graph above for a five-year outlook in the annual license and maintenance costs for SOA software for distributed systems, remaining 0, for the years 2008 through 2012.

7.4.3 Integration Software

Integration software provides a common framework for integrating incompatible and distributed systems, making it faster and easier to tie together applications and web services so you can integrate them into business processes that span the organization.

FIGURE 7–12

CURRENT COST CALCULATION FOR INTEGRATION SOFTWARE IN DISTRIBUTED SYSTEM

1. Current Costs - Integration Software - Distributed System	Current	Unit
2. License $ per Processor	5,000.0	$
3. # Of Processors per Server	3.0	#
4. License Cost per Server	15.0	000$
5. # Of Servers to be licensed - initial investment	0.0	#
6. Total License Costs - Initial Investment - Integration Software - Distributed System	0.0	000$

Source: Wintergreen Research, Inc.

The Integration software on distributed systems runs on several servers, each of which consists of 3 processors. $5,000 is the cost of license per processor. Since no server needs to be licensed initially, the total initial license cost for Integration software for distributed systems is 0.

FIGURE 7–13

ESTIMATED TOTAL COSTS FOR INTEGRATION SOFTWARE IN DISTRIBUTED SYSTEM

7. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
8. % Change In Ongoing License Costs		%	1.0	2.0	3.0	4.0	5.0
9. # of Servers to be licensed		#	0.0	0.0	0.0	0.0	0.0
10. Maintenance as a % of License Costs		%	5.0	1.0	2.0	3.0	4.0

11. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
12. License Cost Per Server - Integration Software - Distributed System	15.0	000$	15.2	15.5	15.9	16.6	17.4
13. Total License Costs (for all Servers) - Integration Software - Distributed System	0.0	000$	0.0	0.0	0.0	0.0	0.0
14. Annual Maintenance Costs - Integration Software - Distributed System		000$	0.0	0.0	0.0	0.0	0.0
15. Total License And Maintenance Costs - Integration Software - Distributed System (annual)	**0.0**	000$	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

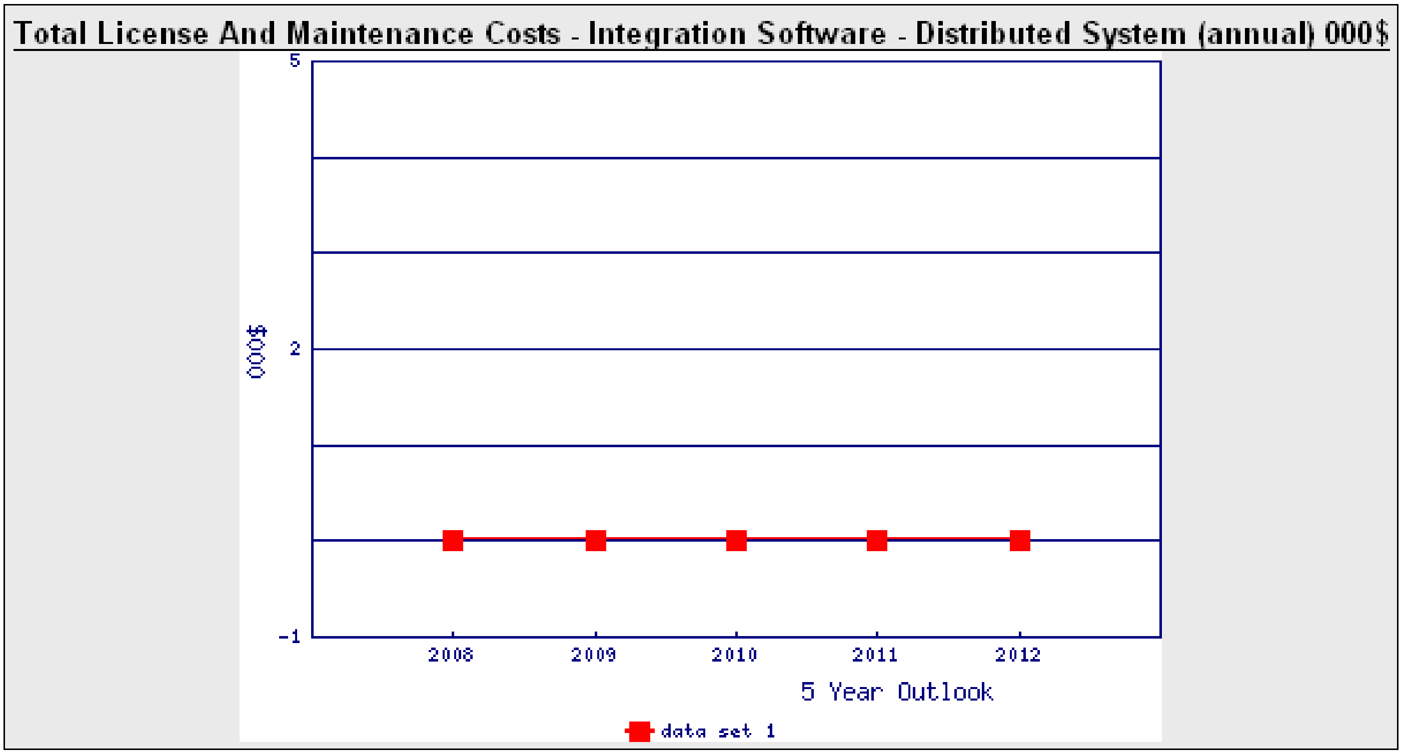
Source: Wintergreen Research, Inc.

For years 2008 through 2012:

Since no server needs to be licensed for the years being discussed, the licensing and maintenance costs for the Integration software for distributed systems remain 0.

FIGURE 7–14

FIVE-YEAR OUTLOOK OF TOTAL INTEGRATION SOFTWARE COSTS FOR DISTRIBUTED SYSTEMS



Source: Wintergreen Research, Inc.

See the graph above for a five-year outlook in the annual license and maintenance costs for Integration software for distributed systems, remaining 0, for the years 2008 through 2012.

7.4.4 Database Software

Database software is used to manage databases in distributed systems. It controls the organization, storage, management, and retrieval of data in a database.

FIGURE 7–15

CURRENT COST CALCULATION FOR DATABASE SOFTWARE IN DISTRIBUTED SYSTEM

1. Current Costs - Database Software - Distributed System	Current	Unit
2. License $ per Processor	1,100.0	$
3. # Of Processors per Server	5.0	#
4. License Cost per Server	5.5	000$
5. # Of Servers to be licensed - initial investment	7.0	#
6. Total License Costs - Initial Investment - Database Software - Distributed System	38.5	000$

Source: Wintergreen Research, Inc.

The database software in distributed systems runs on several servers, each of which consists of 5 processors. $1,100 is the cost of license per processor. There are 7 servers to be licensed initially, at a license cost of $5,500 per server. Hence, the total initial license cost for database software for distributed systems is $38,500.

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FIGURE 7–16

ESTIMATED TOTAL COSTS FOR DATABASE SOFTWARE IN DISTRIBUTED SYSTEM

7. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
8. % Change In Ongoing License Costs		%	1.0	1.0	1.0	1.0	1.0
9. # of Servers to be licensed		#	7.0	7.0	7.0	7.0	7.0
10. Maintenance as a % of License Costs		%	25.0	25.0	25.0	25.0	25.0

11. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
12. License Cost Per Server - Database Software - Distributed System	5.5	000$	5.6	5.6	5.7	5.7	5.8
13. Total License Costs (for all Servers) - Database Software - Distributed System	38.5	000$	38.9	39.3	39.7	40.1	40.5
14. Annual Maintenance Costs - Database Software - Distributed System		000$	0.0	0.0	0.0	0.0	0.0
15. Total License And Maintenance Costs - Database Software - Distributed System (annual)	**38.5**	**000$**	**38.9**	**39.3**	**39.7**	**40.1**	**40.5**

Source: Wintergreen Research, Inc.

For years 2008 through 2012:

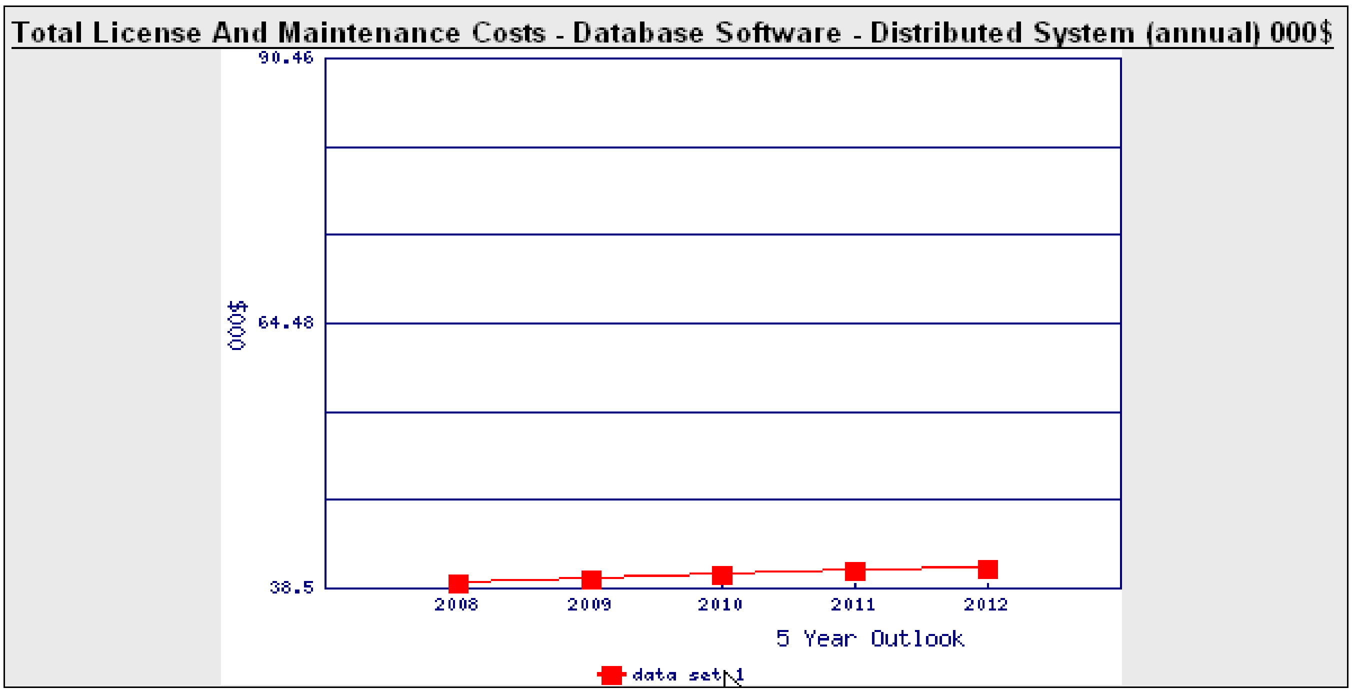
7 servers need to be licensed every year. 25% of the license cost is incurred for maintenance every year.

Increasing at a rate of 1% every year, the license cost per server for database software is estimated to be $5,600, $5,600, $5,700, $5,700 and $5,800 for the respective years. Hence the license cost for all the 7 servers is $38,900, $39,300, $39,700, $40,100 and $40,500 for the respective years.

The annual maintenance cost for the integration software remains zero. Hence the sum total of the licensing cost and maintenance cost for database software for distributed systems increases from $38,900 in 2008 to $40,500 in 2012.

FIGURE 7–17

FIVE-YEAR OUTLOOK OF TOTAL DATABASE SOFTWARE COSTS FOR DISTRIBUTED SYSTEMS



Source: Wintergreen Research, Inc.

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See the graph above for a five-year outlook in the annual license and maintenance costs for database software for distributed systems for years 2008 through 2012.

7.4.5 Mission Critical Messaging Software

Mission critical messaging software is central to transaction transport and network integration. This software is essential to the successful functioning of the system.

FIGURE 7–18

CURRENT COST CALCULATION FOR MISSION CRITICAL MESSAGING SOFTWARE IN DISTRIBUTED SYSTEM

1. Current Costs - Mission Critical Messaging Software - Distributed System	Current	Unit
2. License $ per Processor	1,300.0	$
3. # Of Processors per Server	3.0	#
4. License Cost per Server	3.9	000$
5. # Of Servers to be licensed - initial investment	0.0	#
6. Total License Costs - Initial Investment - Mission critical messaging Software - Distributed System	0.0	000$

Source: Wintergreen Research, Inc.

The mission critical messaging software in distributed systems runs on several servers, each of which consists of 3 processors. $1,300 is the cost of license per processor.

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Hence the license cost per server is $3,900. Since there are no servers to be licensed initially, the total initial license cost for mission critical messaging software for distributed systems is 0.

FIGURE 7–19

ESTIMATED TOTAL COSTS FOR MISSION CRITICAL MESSAGING SOFTWARE IN DISTRIBUTED SYSTEM

7. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
8. % Change In Ongoing License Costs		%	1.0	1.0	1.0	1.0	0.0
9. # of Servers to be licensed		#	0.0	0.0	0.0	0.0	15.0
10. Maintenance as a % of License Costs		%	15.0	15.0	15.0	15.0	3.9
11. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
12. License Cost Per Server - Mission critical messaging Software - Distributed System	3.9	000$	3.9	4.0	4.0	4.1	4.1
13. Total License Costs (for all Servers) - Mission critical messaging Software - Distributed System	0.0	000$	0.0	0.0	0.0	0.0	60.9
14. Annual Maintenance Costs - Mission critical messaging Software - Distributed System		000$	0.0	0.0	0.0	0.0	0.0
15. Total License And Maintenance Costs - Mission critical messaging Software - Distributed System (annual)	**0.0**	000$	**0.0**	**0.0**	**0.0**	**0.0**	**60.9**

Source: Wintergreen Research, Inc.

For years 2008 through 2012:

No server needs to be licensed for the years 2008, 2009, 2010 and 2011. 15 servers need to be licensed for the year 2012. The license cost increases by 1% every year. 15%, 15%, 15%, 15% and 3.9% of the license cost is incurred as maintenance cost for the respective years.

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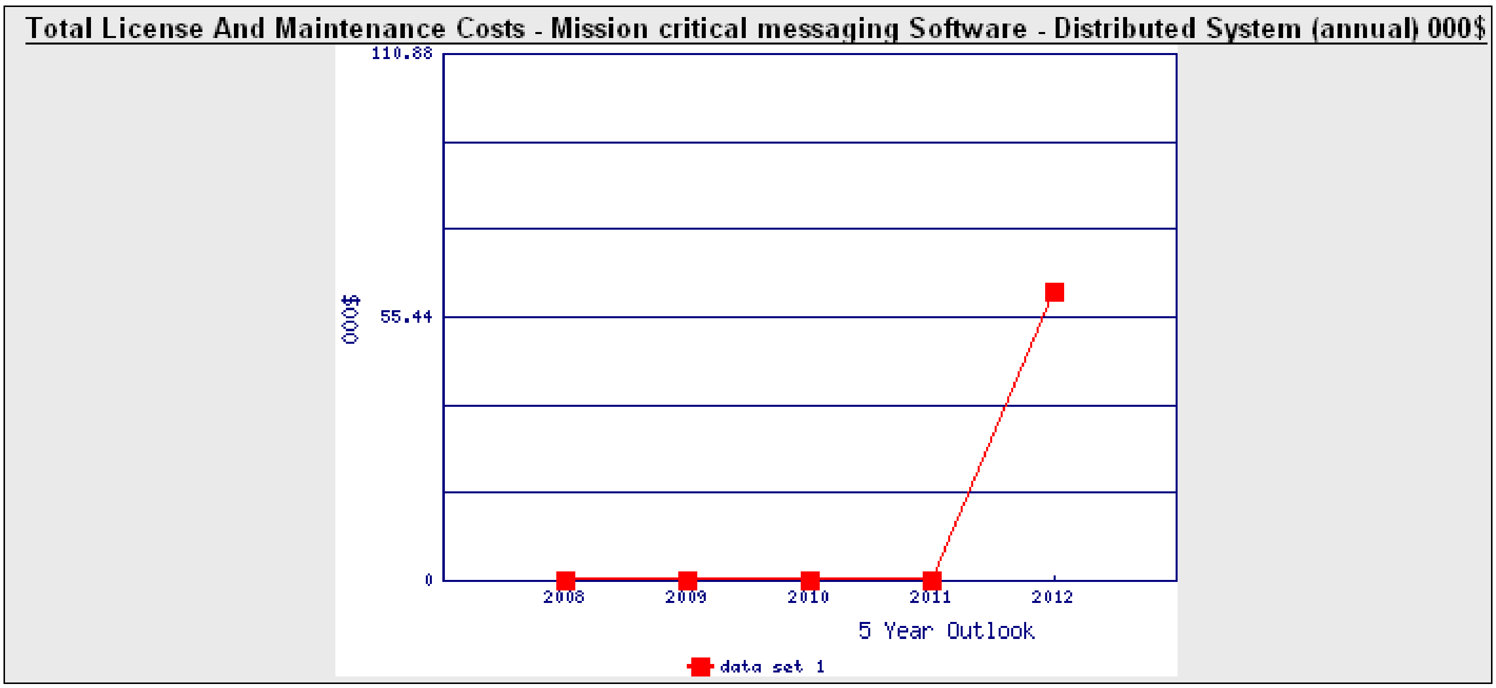
The licensing and maintenance costs for the mission critical messaging software for distributed systems remain 0 for the years 2008 through 2011, but peak to $60,900 in year 2012.

FIGURE 7–20

FIVE-YEAR OUTLOOK OF TOTAL MISSION CRITICAL MESSAGING SOFTWARE COSTS FOR DISTRIBUTED SYSTEMS



Source: Wintergreen Research, Inc.

See the graph above for a five-year outlook in the annual license and maintenance costs for mission critical messaging software for distributed systems for years 2008 through 2012.

7.4.6 Operating System Software

Operating system software for distributed systems enable efficient memory management, parallel processing and resource handling, in rapidly changing user environments.

FIGURE7–21

CURRENT COST CALCULATION FOR OPERATING SYSTEM SOFTWARE IN DISTRIBUTED SYSTEM

1. Current Costs - Operating System Software - Distributed System	Current	Unit
2. License $ per Processor	800.0	$
3. # Of Processors per Server	3.0	#
4. License Cost per Server	2.4	000$
5. # Of Servers to be licensed - initial investment	14.0	#
6. Total License Costs - Initial Investment - Operating System Software - Distributed System	33.6	000$

Source: Wintergreen Research, Inc.

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The operating system software in distributed systems runs on several servers, each of which consists of 3 processors. $800 is the cost of license per processor. There are 14 servers to be licensed initially, at a license cost of $2,400 per server. Hence, the total initial license cost for operating system software for distributed systems is $33,600.

Figure 7–22

Estimated Total Costs For Operating System Software In Distributed System

7. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
8. % Change In Ongoing License Costs		%	1.0	2.0	3.0	4.0	5.0
9. # of Servers to be licensed		#	0.0	0.0	0.0	0.0	0.0
10. Maintenance as a % of License Costs		%	15.0	15.0	15.0	15.0	15.0

11. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
12. License Cost Per Server - Operating System Software - Distributed System	2.4	000$	2.4	2.5	2.5	2.6	2.8
13. Total License Costs (for all Servers) - Operating System Software - Distributed System	33.6	000$	0.0	0.0	0.0	0.0	0.0
14. Annual Maintenance Costs - Operating System Software - Distributed System		000$	0.0	0.0	0.0	0.0	0.0
15. Total License And Maintenance Costs - Operating System Software - Distributed System (annual)	33.6	000$	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

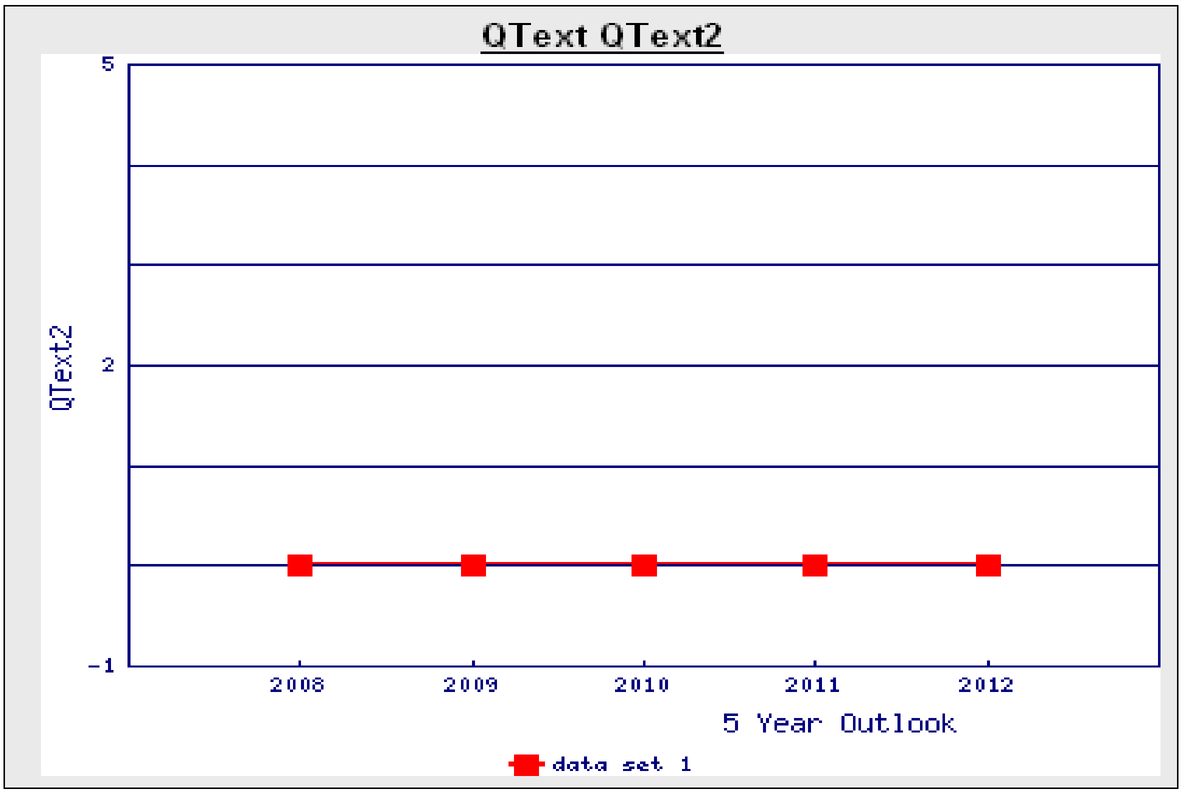
Source: Wintergreen Research, Inc.

For years 2008 through 2012:

Since no server needs to be licensed for the years being discussed, the licensing and maintenance costs for the operating system software for distributed systems remain 0.

FIGURE 7–23

FIVE-YEAR OUTLOOK OF TOTAL OPERATING SYSTEM SOFTWARE COSTS FOR DISTRIBUTED SYSTEMS



Source: Wintergreen Research, Inc.

See the graph above for a five-year outlook in the annual license and maintenance costs for operating system software for distributed systems, remaining 0, for the years 2008 through 2012.

7.5 Mainframe Software Costs

FIGURE 7-24

WORKING OUT THE SOFTWARE COSTS FOR DISTRIBUTED SYSTEMS

11. Mainframe Software Costs	Current	Unit	2008	2009	2010	2011	2012
12. Application Server Software	1.9	000$	1.9	1.9	1.9	2.0	2.0
13. SOA Software	22.8	000$	23.0	47.0	72.6	100.6	132.1
14. Integration Software	1.2	000$	1.2	2.5	3.8	5.3	7.0
15. Database Software	1.4	000$	5.4	5.4	5.5	5.5	5.6
16. Mission Critical Messaging Software	0.4	000$	0.0	0.0	0.0	0.0	0.0
17. Operating System Software	2.2	000$	8.2	8.4	8.6	9.0	9.4
18. Total Software Costs - Mainframe	**29.8**	**000$**	**39.7**	**65.2**	**92.4**	**122.4**	**156.0**

Source: Wintergreen Research, Inc.

Analysis of software costs for mainframe systems includes the following:

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TABLE 7-25

SOFTWARE COSTS ANALYSIS FOR MAINFRAME SYSTEMS

- Application server software costs
- SOA software costs
- Integration software costs
- Database software costs
- Mission critical messaging software costs
- Operating system software costs

Source: Wintergreen Research, Inc.

All calculations are for the current year, unless specified otherwise.

7.5.1 Application Server Software

Application server software is in-built into the mainframe system and hence the licensing and maintenance costs are negligible compared to that of distributed systems.

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FIGURE 7–26

CURRENT COST CALCULATION FOR APPLICATION MAINFRAME SOFTWARE IN MAINFRAME SYSTEM

1. Current Costs - Mainframe Application Server Software - System	Current	Unit
2. License $ per MIP Per Year	500.0	$
3. # Of MIPs per Mainframe	3.779	#
4. License Cost per Mainframe	1.9	000$
5. # Of Mainframes to be licensed - initial investment	1.0	#
6. Total License Costs - Initial Investment - Mainframe Application Server Software - System	1.9	000$

Source: Wintergreen Research, Inc.

The application servers in mainframe systems consist of several licensed MIPs that run the required application software. There are 3.799 MIPs per mainframe. $500 is the cost of license per MIP per year. Only 1 mainframe needs to be licensed initially, at a license cost of $1,900 per server. Hence, the total initial license cost for application mainframe software is $1,900.

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FIGURE 7–27

ESTIMATED TOTAL COSTS FOR APPLICATION MAINFRAME SOFTWARE IN MAINFRAME SYSTEM

7. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
8. % Change In Ongoing License Costs		%	1.0	1.0	1.0	1.0	1.0
9. # of Mainframes to be licensed		#	1.0	1.0	1.0	1.0	1.0
10. Maintenance as a % of License Costs		%	15.0	15.0	15.0	15.0	15.0
11. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
12. License Cost Per Mainframe - Application Server Software - System	1.9	000$	1.9	1.9	1.9	2.0	2.0
13. Total License Costs (for all Mainframes) - Application Mainframe Software - System	1.9	000$	1.9	1.9	1.9	2.0	2.0
14. Annual Maintenance Costs - Application Mainframe Software - System		000$	0.0	0.0	0.0	0.0	0.0
15. Total License And Maintenance Costs - Application Mainframe Software - System (annual)	**1.9**	000$	**1.9**	**1.9**	**1.9**	**2.0**	**2.0**

Source: Wintergreen Research, Inc.

For years 2008 through 2012:

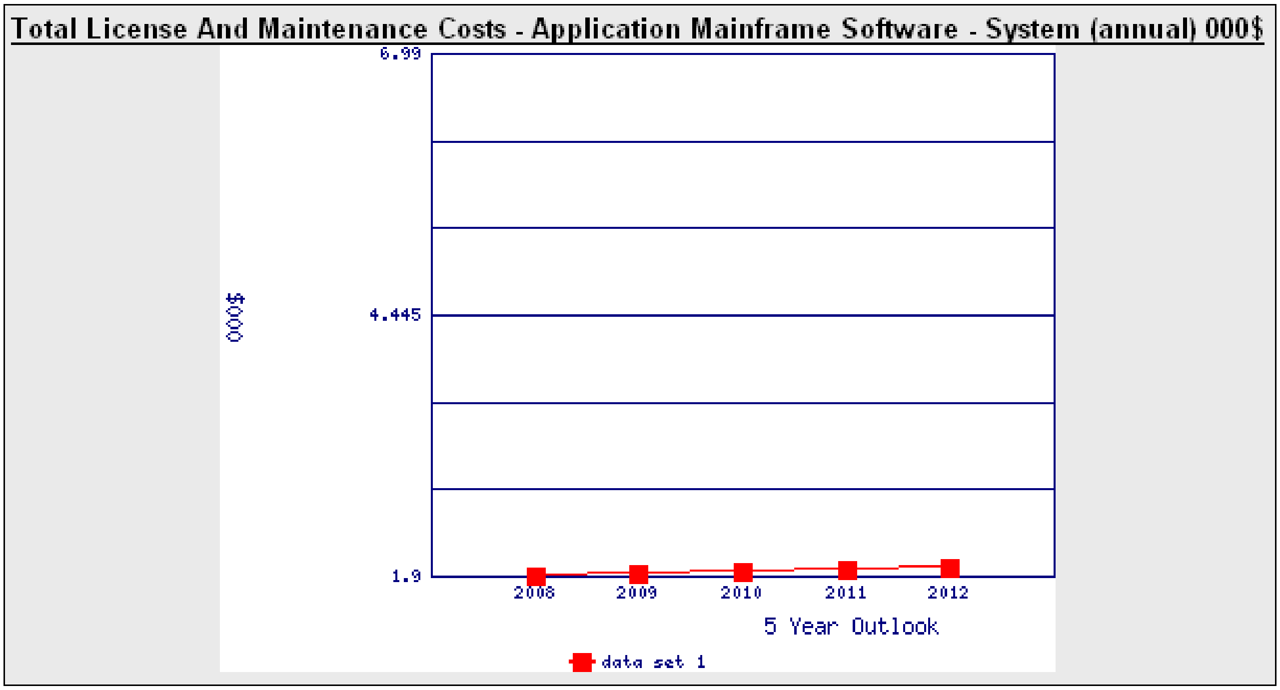
1 mainframe need to be licensed every year. 15% of the license cost is incurred for maintenance every year.

Increasing at a rate of 1% every year, the license cost per mainframe is estimated to be $1,900, $1,900, $1,900, $2,000 and $2,000 for the respective years. Hence the total license cost for all the entire mainframe system is $1,900, $1,900, $1,900, $2,000 and $2,000 for the respective years.

The annual maintenance cost for the application server software remains zero. Hence the sum total of the licensing cost and maintenance cost for the application mainframe software marginally increases from $1,900 in 2008 to $2,000 in 2012.

FIGURE 7–28

FIVE-YEAR OUTLOOK OF TOTAL APPLICATION MAINFRAME SOFTWARE COSTS FOR MAINFRAME SYSTEMS



Source: Wintergreen Research, Inc.

See the graph above for a five-year outlook in the annual license and maintenance costs for application mainframe software for mainframe systems, marginally increasing during the years 2008 through 2012.

7.5.2 SOA Software

Mainframe systems need to be further enhanced for improved SOA-enabled applications.

FIGURE 7–29

CURRENT COST CALCULATION FOR SOA SOFTWARE IN MAINFRAME SYSTEM

1. Current Costs - SOA Software - System	Current	Unit
2. License $ per Processor	6,000.0	$
3. # Of MIPs per Mainframe	3.799	#
4. License Cost per Mainframe	22.8	000$
5. # Of Mainframes to be licensed - initial investment	1.0	#
6. Total License Costs - Initial Investment - SOA Software - System	22.8	000$

Source: Wintergreen Research, Inc.

The SOA software in mainframe systems runs on several mainframes. There are 3.799 MIPs per mainframe. $6,000 is the cost of license per MIP. Since 1 mainframe needs to be licensed initially at a license cost of $22,800, the total initial license cost for SOA software for mainframe systems is $22,800.

FIGURE 7–30

ESTIMATED TOTAL COSTS FOR SOA SOFTWARE IN MAINFRAME SYSTEM

7. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
8. % Change In Ongoing License Costs		%	1.0	2.0	3.0	4.0	5.0
9. # of Mainframes to be licensed		#	1.0	2.0	3.0	4.0	5.0
10. Maintenance as a % of License Costs		%	5.0	1.0	2.0	3.0	4.0

11. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
12. License Cost Per Mainframe- SOA Software - System	22.8	000$	23.0	23.5	24.2	25.2	26.4
13. Total License Costs (for all Mainframes) - SOA Software - System	22.8	000$	23.0	47.0	72.6	100.6	132.1
14. Annual Maintenance Costs - SOA Software - System		000$	0.0	0.0	0.0	0.0	0.0
15. Total License And Maintenance Costs - SOA Software - System (annual)	**22.8**	**000$**	**23.0**	**47.0**	**72.6**	**100.6**	**132.1**

Source: Wintergreen Research, Inc.

For years 2008 through 2012:

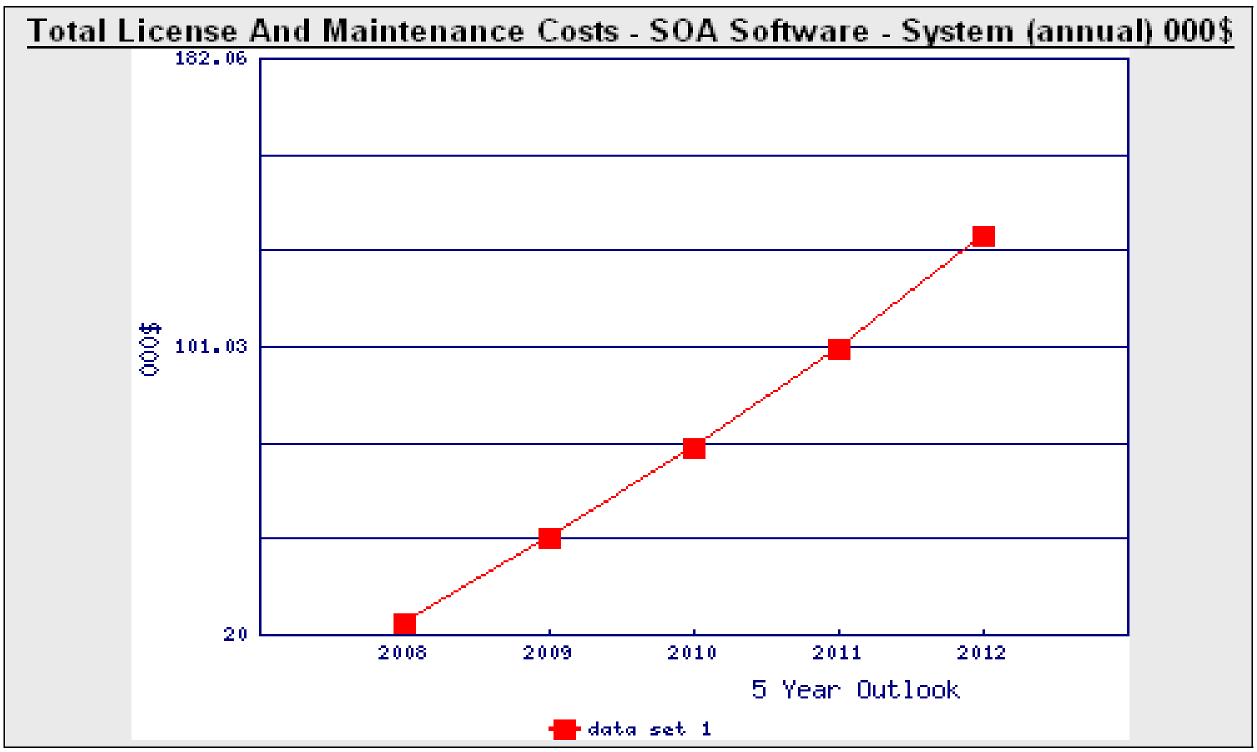
5%, 1%, 2%, 3%, and 4% of the license cost is incurred for maintenance for the respective years.

The license cost per mainframe for SOA software is estimated to increase by 1%, 2%, 3%, 4% and 5% for the respective years and is slated to be $1,900, $1,900, $1,900, $2,000 and $2,000 for the respective years. 1, 2, 3, 4 and 5 mainframes need to be licensed for the respective years. Hence the total license cost for all the entire mainframe system is $23,000, $23,500, $24,200, $25,200 and $26,400 for the respective years.

Since the annual maintenance cost for the SOA software for the mainframe system is 0, the sum total of the license costs and maintenance costs for SOA software for all mainframes is $23,000, $47,000, $72,600, $100,600 and $132,100 for the respective years.

FIGURE 7–31

FIVE-YEAR OUTLOOK OF TOTAL SOA SOFTWARE COSTS FOR MAINFRAME SYSTEMS



Source: Wintergreen Research, Inc.

See the graph above for a five-year outlook in the annual license and maintenance costs for SOA software for mainframe systems, sharply increasing during the years 2008 through 2012.

7.5.3 Integration Software

Mainframe systems are an integral part of most enterprises. These systems hold valuable data and processes that have evolved with the enterprise, and it is crucial that these assets be active participants in corporate technology infrastructures as part of an SOA strategy.

Incompatible legacy databases often reside in an enterprise as the result of a merger or acquisition. The introduction of open systems technologies has also resulted in incompatibilities making it difficult if not impossible to achieve real-time integration of data and processes across an enterprise. Ideal integration software solutions address these problems by exposing mainframe assets as reusable business services that can be assembled into new composite applications.

For example, TIBCO Mainframe Service Suite is a complete range of mainframe integration solutions that provides the framework for all mainframe technology and business processes that actively participate in enterprise-wide service architectures. It includes both on-host and off-host solutions.

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FIGURE 7–32

CURRENT COST CALCULATION FOR INTEGRATION SOFTWARE IN MAINFRAME SYSTEM

1. Current Costs - Integration Software - System	Current	Unit
2. License $ per Processor	6,000.0	$
3. # Of MIPs per Mainframe	0.2	#
4. License Cost per Mainframe	1.2	000$
5. # Of Mainframes to be licensed - initial investment	1.0	#
6. Total License Costs - Initial Investment - Integration Software - System	1.2	000$

Source: Wintergreen Research, Inc.

The integration software in mainframe systems runs on several mainframes. There are 0.2 MIP per mainframe. $6,000 is the cost of license per MIP. Since 1 mainframe needs to be licensed initially at a license cost of $1,200, the total initial license cost for integration software for mainframe systems is $1,200.

FIGURE 7–33

ESTIMATED TOTAL COSTS FOR INTEGRATION SOFTWARE IN MAINFRAME SYSTEM

7. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
8. % Change In Ongoing License Costs		%	1.0	2.0	3.0	4.0	5.0
9. # of Mainframes to be licensed		#	1.0	2.0	3.0	4.0	5.0
10. Maintenance as a % of License Costs		%	5.0	1.0	2.0	3.0	4.0

11. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
12. License Cost Per Mainframe- Integration Software - System	1.2	000$	1.2	1.2	1.3	1.3	1.4
13. Total License Costs (for all Mainframes) - Integration Software - System	1.2	000$	1.2	2.5	3.8	5.3	7.0
14. Annual Maintenance Costs - Integration Software - System		000$	0.0	0.0	0.0	0.0	0.0
15. Total License And Maintenance Costs - Integration Software - System (annual)	**1.2**	**000$**	**1.2**	**2.5**	**3.8**	**5.3**	**7.0**

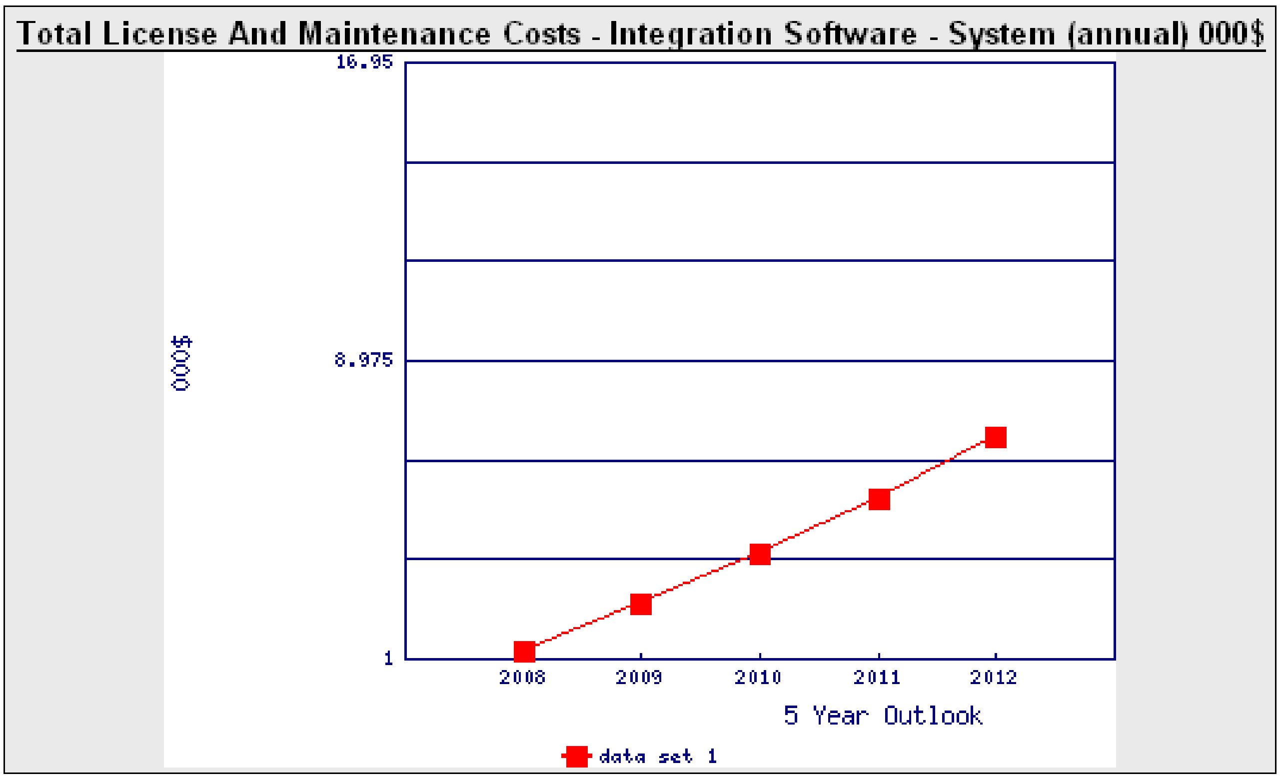
Source: Wintergreen Research, Inc.

For years 2008 through 2012: 5%, 1%, 2%, 3%, and 4% of the license cost is incurred for maintenance for the respective years. The license cost per mainframe for integration software is estimated to increase by 1%, 2%, 3%, 4% and 5% for the respective years and is slated to be $1,200, $1,200, $1,300, $1,300 and $1,400 for the respective years. 1, 2, 3, 4 and 5 mainframes need to be licensed for the respective years. Hence the total license cost for the integration software for the entire mainframe system is $1,200, $2,500, $3,800, $5,300 and $7,000 for the respective years.

Since the annual maintenance cost for the integration software for the mainframe system is 0, the sum total of the license costs and maintenance costs for integration software for all mainframes is $1,200, $2,500, $3,800, $5,300 and $7,000 for the respective years.

FIGURE 7–34

FIVE-YEAR OUTLOOK OF TOTAL INTEGRATION SOFTWARE COSTS FOR MAINFRAME SYSTEMS



Source: Wintergreen Research, Inc.

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See the graph above for a five-year outlook in the annual license and maintenance costs for integration software for mainframe systems, increasing during the years 2008 through 2012.

7.5.4 Database Software

The mainframe system has inbuilt database software that handles the organization, storage and retrieval of data effectively and efficiently. Hence, the cost of licensing and maintenance for database software in mainframe systems is negligible compared to that in distributed systems.

FIGURE 7–35

CURRENT COST CALCULATION FOR DATABASE SOFTWARE IN MAINFRAME SYSTEM

1. Current Costs - Database Software - System	Current	Unit
2. License $ per MIP	371.677	$
3. # Of MIPs per Mainframe	3.779	#
4. License Cost per Mainframe	1.405	000$
5. # Of MIPs to be licensed - initial investment	1.0	#
6. Total License Costs - Initial Investment - Database Software - System	1.4	000$

Source: Wintergreen Research, Inc.

The database software in mainframe systems runs on several mainframes. There are 3.799 MIPs per mainframe. $371.677 is the cost of license per MIP. Since 1 mainframe needs to be licensed initially at a license cost of approximately $1,400, the total initial license cost for database software for mainframe systems is $1,400.

FIGURE 7–36

ESTIMATED TOTAL COSTS FOR DATABASE SOFTWARE IN MAINFRAME SYSTEM

7. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
8. % Change In Ongoing License Costs		%	1.0	1.0	1.0	1.0	1.0
9. # of MIPs to be licensed		#	3.8	3.8	3.8	3.8	3.8
10. Maintenance as a % of License Costs		%	15.0	15.0	15.0	15.0	15.0

11. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
12. License Cost Per Mainframe- Database Software - System	1.4	000$	1.4	1.4	1.4	1.5	1.5
13. Total License Costs (for all Mainframes) - Database Software - System	1.4	000$	5.4	5.4	5.5	5.5	5.6
14. Annual Maintenance Costs - Database Software - System		000$	0.0	0.0	0.0	0.0	0.0
15. Total License And Maintenance Costs - Database Software - System (annual)	**1.4**	000$	**5.4**	**5.4**	**5.5**	**5.5**	**5.6**

Source: Wintergreen Research, Inc.

For years 2008 through 2012:

15% of the license cost is incurred for maintenance every year.

The license cost per mainframe for database software is estimated to increase by 1% every year and is slated to be $1,400, $1,400, $1,400, $1,500 and $1,500 for the respective years. 3.8 MIPs need to be licensed every year. Hence the total license cost for the database software for the entire mainframe system is $5,400, $5,400, $5,500, $5,500 and $5,600 for the respective years.

Since the annual maintenance cost for the database software for the mainframe system is 0, the sum total of the license costs and maintenance costs for database software for all mainframes is $5,400, $5,400, $5,500, $5,500 and $5,600 for the respective years.

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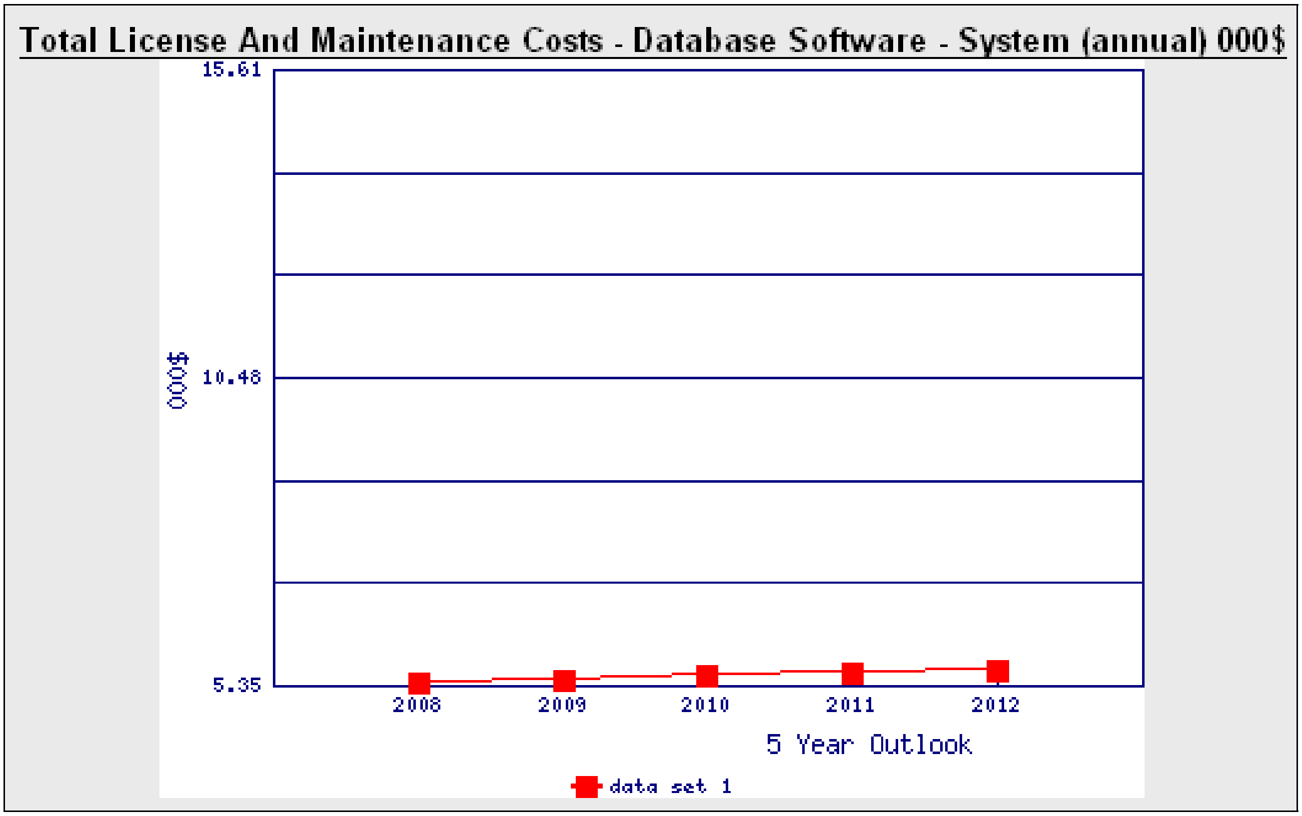
FIGURE 7–37

FIVE-YEAR OUTLOOK OF TOTAL DATABASE SOFTWARE COSTS FOR MAINFRAME SYSTEMS



Source: Wintergreen Research, Inc.

See the graph above for a five-year outlook in the annual license and maintenance costs for database software for mainframe systems, marginally increasing during the years 2008 through 2012.

7.5.5 Mission Critical Messaging Software

Mission critical software such as recovery tools are inbuilt in mainframe systems and hence do not contribute to additional expense.

FIGURE 7–38

CURRENT COST CALCULATION FOR MISSION CRITICAL MESSAGING SOFTWARE IN MAINFRAME SYSTEM

1. Current Costs - Mission Critical Messaging Software - System	Current	Unit
2. License $ per MIP	100.0	$
3. # Of MIPs per Mainframe	3.8	#
4. License Cost per Mainframe	0.4	000$
5. # Of Mainframes to be licensed - initial investment	1.0	#
6. Total License Costs - Initial Investment - Mission critical messaging Software - System	0.4	000$

Source: Wintergreen Research, Inc.

The mission critical messaging software in mainframe systems runs on several mainframes. There are 3.8 MIPs per mainframe. $100 is the cost of license per MIP. Since 1 mainframe needs to be licensed initially at a license cost of approximately $400, the total initial license cost for mission critical messaging software for mainframe systems is $400.

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FIGURE 7–39

ESTIMATED TOTAL COSTS FOR MISSION CRITICAL MESSAGING SOFTWARE IN MAINFRAME SYSTEM

7. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
8. % Change In Ongoing License Costs		%	1.0	1.0	1.0	1.0	1.0
9. # of MIPs to be licensed		#	0.0	0.0	0.0	0.0	0.0
10. Maintenance as a % of Original License Costs		%	5.0	1.0	2.0	3.0	4.0

11. Estimated Total Costs	Current	Unit	2008	2009	2010	2011	2012
12. License Cost Per Mainframe- Mission critical messaging Software - System	0.4	000$	0.4	0.4	0.4	0.4	0.4
13. Total License Costs (for all Mainframes) - Mission critical messaging Software - System	0.4	000$	0.0	0.0	0.0	0.0	0.0
14. Annual Maintenance Costs - Mission critical messaging Software - System		000$	0.0	0.0	0.0	0.0	0.0
15. Total License And Maintenance Costs - Mission critical messaging Software - System (annual)	**0.4**	000$	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Source: Wintergreen Research, Inc.

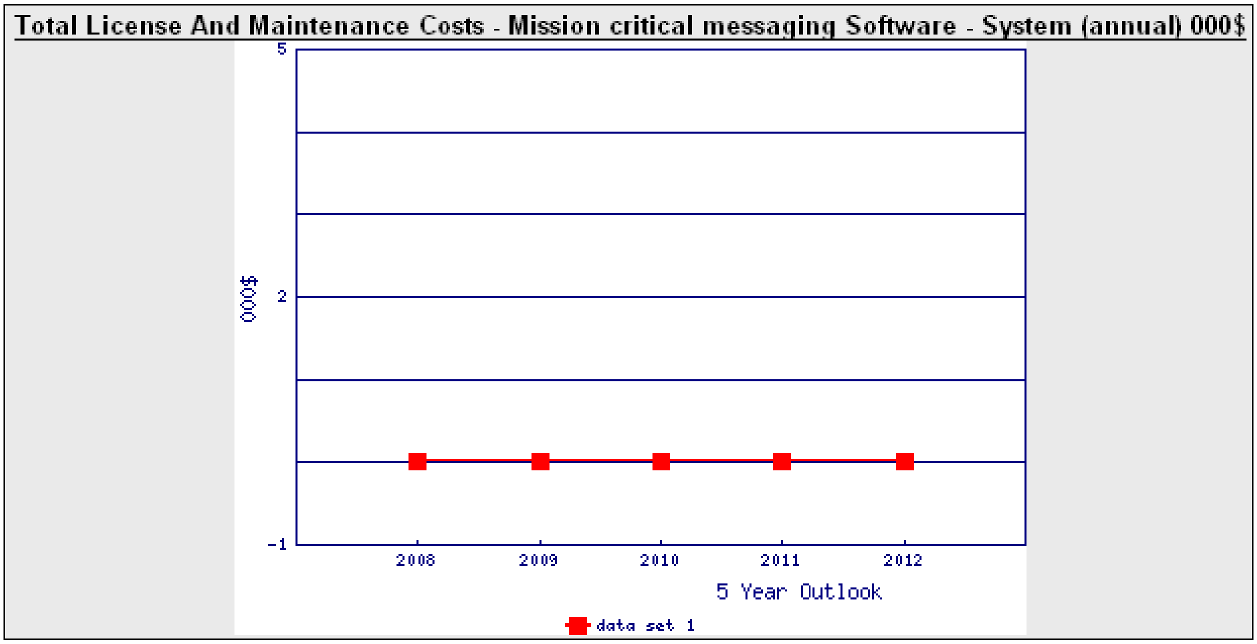
For years 2008 through 2012:

5%, 1%, 2%, 3% and 4% of the original license cost is incurred for maintenance for the respective years.

The license cost per mainframe for mission critical messaging software is estimated to increase by 1% every year and is slated to be $400 every year. But, since no MIP needs to be licensed for the years being discussed, the sum total of license costs and maintenance costs for mission critical messaging software for all mainframes is 0.

FIGURE 7–40

FIVE-YEAR OUTLOOK OF TOTAL MISSION CRITICAL MESSAGING SOFTWARE COSTS FOR MAINFRAME SYSTEMS



Source: Wintergreen Research, Inc.

See the graph above for a five-year outlook in the annual license and maintenance costs for mission critical messaging software for mainframe systems, remaining 0, for the years 2008 through 2012.

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7.5.6 Operating System Software

FIGURE 7–41

CURRENT COST CALCULATION FOR OPERATING SYSTEM SOFTWARE IN MAINFRAME SYSTEM

1. Current Costs - Operating System Software - Mainframe Z/OS	Current	Unit
2. License $ per MIP Per Year	570.0	$
3. # Of MIPs per Mainframe	3.779	#
4. License Cost per MIP	2.2	000$
5. # Of MIPs to be licensed - initial investment	1.0	#
6. Total License Costs - Initial Investment - Operating System Software - System	2.2	000$

Source: Wintergreen Research, Inc.

The operating system software in mainframe systems runs on several mainframes. There are 3.799 MIPs per mainframe. $570 is the cost of license per MIP per year. Since 1 mainframe needs to be licensed initially at a license cost of approximately $2,200, the total initial license cost for mission critical messaging software for mainframe systems is $2,200.

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FIGURE 7–42

ESTIMATED TOTAL COSTS FOR OPERATING SYSTEM SOFTWARE IN MAINFRAME SYSTEM

7. 5-Year Assumptions	Current	Unit	2008	2009	2010	2011	2012
8. % Change In Ongoing License Costs		%	1.0	2.0	3.0	4.0	5.0
9. # of MIPs to be licensed		#	3.8	3.8	3.8	3.8	3.8
10. Maintenance as a % of License Costs		%	15.0	15.0	15.0	15.0	15.0
11. Estimated Total Costs	**Current**	**Unit**	**2008**	**2009**	**2010**	**2011**	**2012**
12. License Cost Per Mainframe- Operating System Software - System	2.2	000$	2.2	2.2	2.3	2.4	2.5
13. Total License Costs (for all Mainframes) - Operating System Software - System	2.2	000$	8.3	8.4	8.7	9.0	9.5
14. Annual Maintenance Costs - Operating System Software - System		000$	0.0	0.0	0.0	0.0	0.0
15. Total License And Maintenance Costs - Operating System Software - E-Referral Mainframe (annual)	**2.2**	**000$**	**139.0**	**174.0**	**106.0**	**131.0**	**136.0**

Source: Wintergreen Research, Inc.

For years 2008 through 2012:

15% of the license cost is incurred for maintenance every year.

The license cost per mainframe for operating system software is estimated to increase by 1%, 2%, 3%, 4% and 5% for the respective years and is slated to be $2,200, $2,200, $2,300, $2,400 and $2,500 for the respective years.

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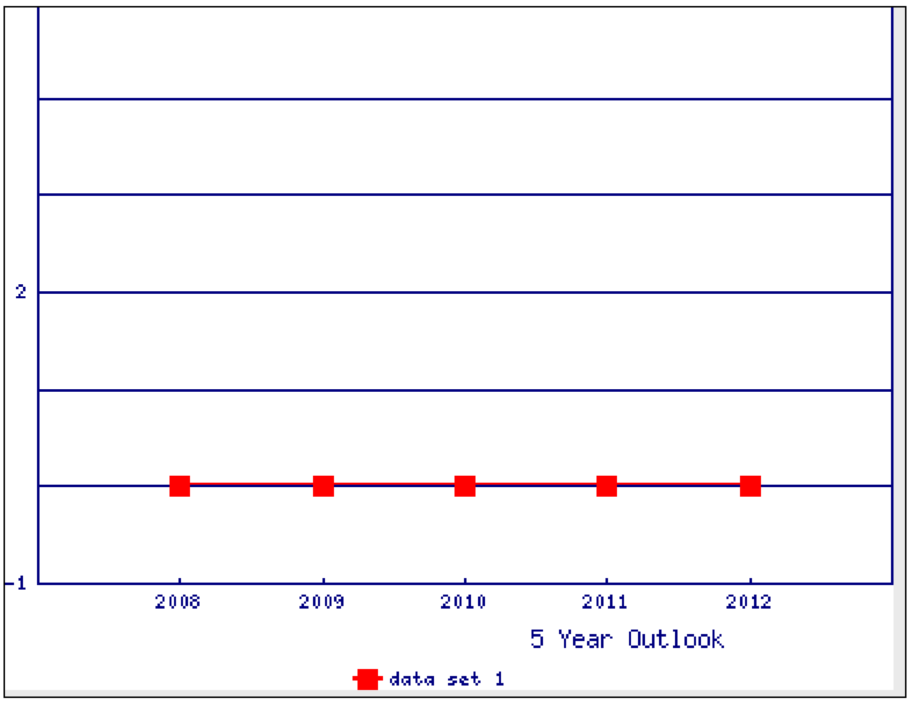
3.8 MIPs need to be licensed every year. Hence the total license cost for the operating system software for the entire mainframe system is $8,300, $8,400, $8,700, $9,000 and $9,500 for the respective years.

FIGURE 7–43

FIVE-YEAR OUTLOOK OF TOTAL OPERATING SYSTEM SOFTWARE COSTS FOR MAINFRAME SYSTEMS



Source: Wintergreen Research, Inc.

8. Infrastructure Cost Analysis -- Mainframe vs. Distributed Return on Investment (ROI)

8.1 Cost of Electricity Escalating

The mainframe is a significantly more efficient computing server when looked at from the perspective of the cost of electricity. Here there is a comparison of the cost application in a mainframe shared workload environment vs. running 13 separate distributed servers.

The costs of electricity are certain to escalate, creating an even more dramatic difference between the mainframe and distributed server systems. In some parts of the country particularly in the Southwest, they have simply run out of electricity. In other parts of the country, for example Seattle, the cost of electricity goes to $.52 per kilowatt-hour at peak hours of air conditioning use, considerably higher than the $.12 per kilowatt-hour used in this analysis. Thus market forces will surely force use of the mainframe as a green machine.

For one application, the cost of the distributed server is $118.3 thousand for power and floor space, while the cost of the mainframe is $96 for power and floor space.

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FIGURE 8-1

WORKING OUT THE INFRASTRUCTURE COST DIFFERENTIAL BETWEEN MAINFRAME AND DISTRIBUTED SYSTEMS

Summary Page: **Infrastructure**

Current Scenario: Scenario 1 | Go | Scenarios | Print | Calculate

1. Infrastructure - Mainframe Cost Analysis	Current	Unit	2008	2009	2010	2011	2012
2. Infrastructure Analyst Remarks							
3. Distributed Server Infrastructure Costs	118.290	000$	120.823	123.543	126.459	129.584	132.927
4. Mainframe Infrastructure Costs	0.096	000$	0.098	0.100	0.102	0.104	0.107
5. Cost Differential	**Total**	**Unit**	**2008**	**2009**	**2010**	**2011**	**2012**
6. Infrastructure Cost Differential -- Distributed System Vs. Mainframe	**118.2**	000$	**120.7**	**123.4**	**126.4**	**129.5**	**132.8**

ON-LINE VERSION

Summary Page: **Infrastructure**

Current Scenario: Scenario 1 | Go | Scenarios | Print | Display Calc List | Calculate

1. Infrastructure - Mainframe Cost Analysis	Current	Unit	2008	2009	2010	2011	2012
2. Infrastructure Analyst Remarks							
3. Distributed Server Infrastructure Costs	118.290	000$	120.823	123.543	126.459	129.584	132.927
4. Mainframe Infrastructure Costs	0.096	000$	0.098	0.100	0.102	0.104	0.107
5. Cost Differential	Total	Unit	2008	2009	2010	2011	2012
6. Infrastructure Cost Differential -- Distributed System Vs. Mainframe	**118.2**	000$	**120.7**	**123.4**	**126.4**	**129.5**	**132.8**

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8.2 Infrastructure Analyst Remarks

Infrastructure costs comprise the costs incurred for power, cooling, raised floor space, physical security for application server – distributed or mainframe. From the facility and infrastructure to the servers and other computer hardware, a company invests millions of dollars in a data center.

8.2.1 Data Center Construction Costs

Data center construction costs include those for site location, building type and the level of redundancy or fault tolerance required. In addition to server and storage redundancy, redundancy is needed for electrical and mechanical systems, including heating, ventilation, air conditioning, fire suppression and other systems.

The data center is the physical infrastructure consisting of all the facility equipment needed to provide power, cooling and physical protection of the IT equipment, but not the IT equipment itself.

Configuring file storage to be accessible by users across multiple platforms (Windows, Linux, UNIX, Mac) requires special attention and planning. When this flexibility is needed, complexity grows. This increases exposure to security threats.

Software solutions are very cost effective. The simplified management allows administrators to consolidate a number of servers without adding to the administrative overhead. A software solution can also emulate a distributed file system for overcoming capacity scalability limitations.

For a typical data center analysis, space is considered to be 60 square feet for the distributed server racks that sit side by side. Personnel access around the outside of the unit increase the calculation to 80 square feet per server. This is perhaps a modest calculation after including clearance for access.

$18 per square foot per month includes consideration of actual square footage, utility, water, taxes, insurance, electrical cables, and battery backup expenses. These may represent a factor that drives the cost considerable above $18 per square foot, but I am seeking to make sure these costs get counted somewhere.

The data center has a lot of special protections because without those, a flood, a power surge, or even a good stiff wind will take the servers down. The distributed servers are physically housed within a facility designed specifically to host the websites and application servers.

Redundancy in cooling is coupled with ten managed backup power generators. Backbone systems are available in the building via cross connect. Fire suppression includes a pre-action dry pipe system including VESDA (Very Early Smoke Detection Apparatus) or similar system with over 700 smoke detectors between the two facilities. The $18 per square foot includes an aspect of the following that are needed in a hardened data center:

8.2.2 Data Center Cost Metrics

Following are data center cost metrics for a sample IT department.

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TABLE 8-2

DATA CENTER COST METRICS

- # Fault tolerant electrical grid
- # 2000 amps of 480v input power
- # Main transfer switch
- # 500KVA Powerware UPS units with 90 batteries per unit
- # Standalone PDUs at each cabinet row
- # 1.5-megawatt generator (2200-gallon tank)
- # DataTrax monitoring software for all data center infrastructure
- # 1-megawatt generator (2000-gallon tank)
- # 22,000 sq. ft. facility
- # 18,000 sq. ft. of raised floor
- # 26-ton data air AC units
- # Very Early Smoke Detection Apparatus (VESDA)
- # Pre-action dry pipe sprinkler system
- # 220 smoke detectors in an integrated system
- # Simplex security badge entry/exit on all doors to facility
- # Earthquake protection for the building

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The $18 per square foot includes an aspect of the following that are needed in a hardened data center: In the context of these metrics, the smaller footprint of the mainframe provides significant advantage mainframe.

A significant aspect of the $ per square foot is the consideration of the network architecture in the distributed systems that utilizes the enterprise grade routing and switching engines like what is offered by Juniper and Cisco.

Whereas the exchange of information, the failover and load balancing depends on the network in the data center for distributed systems, the mainframe is able to make memory look like the network when the servers are implemented as virtual images on the mainframe. The virtual Linux images are able to exchange information through dynamic allocation of memory, leveraging the failover and load balancing of WebSphere via dynamic memory allocation in the z/VM environment.

8.2.3 Aspect Of The $ Per Square Foot

A significant aspect of the $ per square foot is the consideration of the network architecture in the distributed systems that utilizes the enterprise grade routing and switching engines like what is offered by Juniper and Cisco. Whereas the exchange of information, the failover and load balancing depends on the network in the data center for distributed systems, the mainframe is able to make memory look like the network when the servers are implemented as virtual images on the mainframe. The virtual Linux images are able to exchange information through dynamic allocation of memory, leveraging the failover and load balancing of WebSphere via dynamic memory allocation in the Zvm environment.

Typically Juniper M20 routers are used as border routers, Cisco 6500 series switches in the distribution layer and Cisco 6500 switches in the aggregation layers, and Cisco 3500 and 2900 series switches at the customer layer. Networks are fully meshed and redundant with 11 backbone providers.

8.2.4 Network Building Fiber

Network building fiber is used to interconnect routers. Systems interconnected include.

* Cisco Certified Network
* Cisco 6500 series distribution routing switched
* Cisco 6500 series aggregation switches for customer access
* Juniper M20 border routers
* 100% uptime SLA utilizing HSRP/BGP

Systems achieve additional security, reliability, and redundancy by using the mainframe. The cost per square foot for a distributed server in the professionally managed commercial data center is $18 per square foot per month. Comparing distributed servers to hosting solutions to typical mainframe data center costs provides a compelling story for the mainframe.

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Space Calculation for Distributed Servers

$18 per square foot per month *

116 servers =$2,088 per month for servers per square foot

* 12 months =$25,056 per year for one square foot

80 square feet per server =$2,004,480

8.2.5 Shift To Virtualization

The servers normal capacity use significant power so that power is not an issue for performance limitations. File server consolidation through virtualization is fast becoming a critical initiative in large enterprise organizations around the world. Costs of power and floor space are significant aspects of this shift to virtualization. The mainframe is the most efficient virtualization system.

With consolidation, users can improve resource utilization, simplify infrastructure management and reduce capital and operating cost, all while increasing ROI (Return on Investment).

Virtualization technologies can help by allowing consolidation of Windows and UNIX servers while preserving end user access patterns and accessibility expectations. With a little careful planning, smooth and eventless migration from real to a virtual world is possible.

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Virtualization technologies can help by allowing consolidation of Windows and UNIX servers while preserving end user access patterns and accessibility expectations. Planning is needed to create a smooth and eventless migration from real to a virtual world is possible.

8.3 Distributed Server Infrastructure Costs

The infrastructure cost analysis for distributed server involves a study of the power consumption, server electrical power costs, computer electrical power costs, air conditioning power costs and floor space infrastructure costs.

The server electrical power costs must be calculated for each set of servers. Not all server sets are necessarily active at all times. Also, not all server sets are necessarily populated with servers. The number of server sets and the number of servers in each set depends on the application in which it is employed.

The cost analysis presented below considers a data center distributed system with four sets of servers. Unless otherwise mentioned, the calculations made, are for the current year.

FIGURE 8–3

INFRASTRUCTURE SERVER SET 1: ELECTRICAL POWER COST ANALYSIS FOR DISTRIBUTED SYSTEM DATA CENTER

3. Data Center Infrastructure Server Electricity Analysis (Set 1)	Current	Unit
4. Watts of Power Used Per Processor, Including External Memory, And Ram (Set 1) (Processor Power Draw Rating)	233.0	# Watts
5. Number of Processors per Server (Set 1)	2.0	# Processors
6. Number of Servers (Set 1)	0.0	# Servers
7. Power Used By This Set Of Servers (Set 1) in Watts	0.0	# Watts
8. Unit Conversation - Watts to Kilowatts	1,000.0	#
9. 000$ - Power Used By This Set Of Servers (Set 1) in Kilowatts	0.000	# Kilowatts
10. Cost per Kilowatt (Set 1)	0.120	$ per kW/hr
11. $ - Cost For Power For One Hour for Servers In Kilowatts (Set 1)	0.000	$
12. Unit Conversation - $ to 000$	1,000.0	#
13. 000$ - Cost For Power For One Hour for Servers In Kilowatts (Set 1)	0.000	000$
14. Number of Operational Hours Per Year (Set 1)	8,760.0	# hr per yr
15. 000$ - Cost For Server Electrical Power For One Year (Set 1)	**0.000**	000$

Source: Wintergreen Research, Inc.

For Server Set 1:

In the data center application being analyzed, Server Set 1 does not have any server. Hence the cost of server electrical power for Set 1 is zero but if the data center had a different type of server that would be analyzed here. .

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FIGURE 8–4

INFRASTRUCTURE SERVER SET 2: ELECTRICAL POWER COST ANALYSIS FOR DISTRIBUTED SYSTEM DATA CENTER

16. Data Center Infrastructure Server Electricity Analysis (Set 2)	Current	Unit
17. Watts of Power Used Per Processor, Including External Memory, And Ram (Processor Power Draw Rating) (Set 2)	465.0	# watts
18. Number of Processors per Server (Set 2)	3.0	# Processors
19. Number of Servers (Set 2)	14.0	# Servers
20. Power Used By This Set Of Servers (Set 2) in Watts	19,530.0	# Watts
21. Unit Conversation - Watts to Kilowatts	1,000.0	#
22. 000$ - Power Used By This Set Of Servers (Set 2) in Kilowatts	19.530	# Kilowatts
23. Cost per Kilowatt (Set 2)	0.120	$ per kW/hr
24. $ - Cost For Power For One Hour for Servers In Kilowatts (Set 2)	2.344	$
25. Unit Conversation - $ to 000$	1,000.0	#
26. 000$ - Cost For Power For One Hour for Servers In Kilowatts (Set 2)	0.002	000$
27. Number of Operational Hours Per Year (Set 2)	8,760.0	# hr per yr
28. 000$ - Cost For Server Electrical Power For One Year (Set 2)	**20.530**	000$

Source: Wintergreen Research, Inc.

For Server Set 2:

In the data center application being analyzed, Server Set 2 has 14 servers and 3 processors per server. The power consumption per processor is 465 Watts (W). Hence, the power consumption of all the servers in Set 2 is 19.530 Kilowatts (kW).

The cost of power per kW/hour is $0.120

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Hence the cost of power consumption of servers in Set 2, for one hour is $0.002. Server Set 2 operates for 8,760 hours in a year. Thus the cost of electrical power for Server Set 2 for one year is approximately $20,500.

FIGURE 8–5

INFRASTRUCTURE SERVER SET 3: ELECTRICAL POWER COST ANALYSIS FOR DISTRIBUTED SYSTEM DATA CENTER

29. Data Center Infrastructure Server Electricity Analysis, (Set 3 of servers)	Current	Unit
30. Watts of Power Used Per Processor, Including External Memory, And Ram (Processor Power Draw Rating) (Set 3)	530.0	# watts
31. Number of Processors per Server (Set 3)	6.0	# Processors
32. Number of Servers (Set 3)	0.0	# Servers
33. Power Used By This Set Of Servers (Set 3) in Watts	0.0	# Watts
34. Unit Conversation - Watts to Kilowatts	1,000.0	#
35. 000$ - Power Used By This Set Of Servers (Set 3) in Kilowatts	0.000	# Kilowatts
36. Cost per Kilowatt (Set 3)	0.120	$ per kW/hr
37. $ - Cost For Power For One Hour for Servers In Kilowatts (Set 3)	0.0	$
38. Unit Conversation - $ to 000$	1,000.0	#
39. 000$ - Cost For Power For One Hour for Servers In Kilowatts (Set 3)	0.000	000$
40. Number of Operational Hours Per Year (Set 3)	8,760.0	# hr per yr
41. 000$ - Cost For Server Electrical Power For One Year (Set 3)	**0.000**	000$

Source: Wintergreen Research, Inc.

For Server Set 3:

In the data center application being analyzed, Server Set 3 does not have any server. Hence the cost of server electrical power for Set 3 is zero but if the data center had a different type of server that would be analyzed here. .

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FIGURE 8–6

INFRASTRUCTURE SERVER SET 4: ELECTRICAL POWER COST ANALYSIS FOR DISTRIBUTED SYSTEM DATA CENTER

42. Data Center Infrastructure Server Electricity Analysis (Set 4 of Servers)	Current	Unit
43. Watts of Power Used Per Processor, Including External Memory, And Ram (Processor Power Draw Rating) (Set 4)	633.0	# watts
44. Number of Processors per Server (Set 4)	8.0	# Processors
45. Number of Servers (Set 4)	0.0	# Servers
46. Power Used By This Set Of Servers (Set 4) in Watts	0.0	# Watts
47. Unit Conversation - Watts to Kilowatts	1,000.0	#
48. 000$ - Power Used By This Set Of Servers (Set 4) in Kilowatts	0.000	# Kilowatts
49. Cost per Kilowatt (Set 4)	0.120	$ per kWhr
50. $ - Cost For Power For One Hour for Servers In Kilowatts (Set 4)	0.000	$
51. Unit Conversation - $ to 000$	1,000.0	#
52. 000$ - Cost For Power For One Hour for Servers In Kilowatts (Set 4)	0.000	000$
53. Number of Operational Hours Per Year (Set 4)	8,760.0	# hr per yr
54. 000$ - Cost For Server Electrical Power For One Year (Set 4)	**0.000**	000$

Source: Wintergreen Research, Inc.

For Server Set 4:

In the data center application being analyzed, Server Set 4 does not have any server. Hence the cost of server electrical power for Set 4 is zero but if the data center had a different type of server that would be analyzed here. .

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FIGURE 8–7

TOTAL INFRASTRUCTURE SERVER ELECTRICAL POWER COST ANALYSIS FOR DISTRIBUTED SYSTEM DATA CENTER

55. Data Center Infrastructure Server Power Electricity Costs As A Function of Server Power Consumption	Current	Unit
56. 000$ - Cost For Server Electrical Power For One Year (Set 1 to 4)	20.5	000$

Source: Wintergreen Research, Inc.

The total cost of infrastructure server electrical power for the distributed system data center application is the sum of the electrical power cost for Server Set 1, 2, 3 and 4. This totals to $20,500.

FIGURE 8–8

INFRASTRUCTURE AIR-CONDITIONING POWER COST ANALYSIS FOR DISTRIBUTED SYSTEM DATA CENTER

57. Data Center Infrastructure Air conditioning Costs For Power Per Year Is Twice Costs for Server Power Electricity Costs	Current	Unit
58. Multiplier of Server Costs For Power Per Year For Air Conditioning	2.0	#
59. 000$ - Cost For Power For Air Conditioning For Distributed Server	41.1	000$

Source: Wintergreen Research, Inc.

For the data center application being analyzed, the cost of power for infrastructure air-conditioning is twice the server power electricity costs. This totals to $41,100.

FIGURE 8–9

SUM OF INFRASTRUCTURE SERVER ELECTRICAL POWER AND AIR-CONDITIONING POWER COST ANALYSIS FOR DISTRIBUTED SYSTEM DATA CENTER

60. Data Center Infrastructure Electricity Power and Air conditioning Costs Per Year	Current	Unit
61. 000$ - Cost For Power and Air Conditioning For Distributed Servers	61.6	000$

Source: Wintergreen Research, Inc.

The sum of the power costs for infrastructure server and air-conditioning for the distributed system data center application is $61,600.

FIGURE 8–10

ALTERNATE METHOD TO DETERMINE SUM OF INFRASTRUCTURE SERVER ELECTRICAL POWER AND AIR-CONDITIONING POWER COST ANALYSIS FOR DISTRIBUTED SYSTEM DATA CENTER

62. Alternate Method to Determine Data Center Infrastructure Electricity Costs (Crosscheck only - Numbers Not Included in Total)	Current	Unit
63. Costs For Power Per Year In Entire Building	1,800.0	000$
64. % Of Total Electricity Consumed By Distributed System Data Center For Computer And Air Conditioning Power Per Year	75.0	%
65. Costs For Computer And Air Conditioning Electricity Power Per Year In Distributed System Data Center	**1,350.0**	000$

Source: Wintergreen Research, Inc.

FIGURE 8–11

FLOOR SPACE INFRASTRUCTURE

66. Data Center Floor Space Infrastructure Costs	Current	Unit
67. $ Per Square Foot (Fully Loaded Cost)	18.0	$/sq ft
68. # Square Feet Per Server (Including Peripherals, Routers, and Cables)	225.0	#/sq ft
69. # Servers Included in Set 1 to Set 4 above	14.0	#
70. Costs For Floor Space Distributed System Data Center	56.7	000$

Source: Wintergreen Research, Inc.

Each server in the distributed system data center occupies 225 square feet. This area takes into account, the peripherals, router and cables in addition to the area occupied by the actual server equipment. The cost per square foot of fully equipped area is $18. With 14 servers in the data center application, the total cost of floor space is $56,700.

FIGURE 8–12

SUM OF POWER COSTS AND FLOOR SPACE COSTS FOR DISTRIBUTED SYSTEM DATA CENTER

71. Distributed Server Infrastructure Costs	Current	Unit
72. Costs For Power (Set 1 to Set 4) And Floor Space	118.3	000$

Source: Wintergreen Research, Inc.

The total costs for the distributed system data center is the sum of the power costs and the floor space costs. This totals to $118,300.

FIGURE 8–13

YEARLY GROWTH RATE FOR POWER COSTS AND FLOOR SPACE COSTS FOR DISTRIBUTED SYSTEM DATA CENTER

73. Distributed Server Infrastructure Costs Growth Rate	Current	Unit	2008	2009	2010	2011	2012
74. Growth Rate of Distributed System Power Costs(%)		%	3.1	3.2	3.3	3.4	3.5
75. % Growth In $ Per Square Foot Prices Data Center		%	1.1	1.2	1.3	1.4	1.5

Source: Wintergreen Research, Inc.

For years 2008 through 2012: The cost of power will increase by 3.1%, 3.2%, 3.3%, 3.4% and 3.5% for the respective years. The cost per square foot of floor space will increase by 1.1%, 1.2%, 1.3%, 1.4% and 1.5% for the respective years.

FIGURE 8–14

INCREASE IN POWER COSTS AND FLOOR SPACE COSTS FOR DISTRIBUTED SYSTEM DATA CENTER IN THE NEXT FIVE YEARS

76. Distributed Server Infrastructure Costs	Current	Unit	2008	2009	2010	2011	2012
77. Costs For Computer And Air Conditioning Electricity Power Per Year In Distributed System Data Center	61.6	000$	63.5	65.5	67.7	70.0	72.4
78. Cost Of Distributed System Data Center Floor Space In Building	56.7	000$	57.3	58.0	58.8	59.6	60.5
79. Total Distributed Server Infrastructure Costs	Current	Unit	2008	2009	2010	2011	2012
80. Costs For Computer And Air Conditioning Power And Floor Space Per Year In Distributed System Data Center	118.3	000$	120.8	123.5	126.5	129.6	132.9

Source: Wintergreen Research, Inc.

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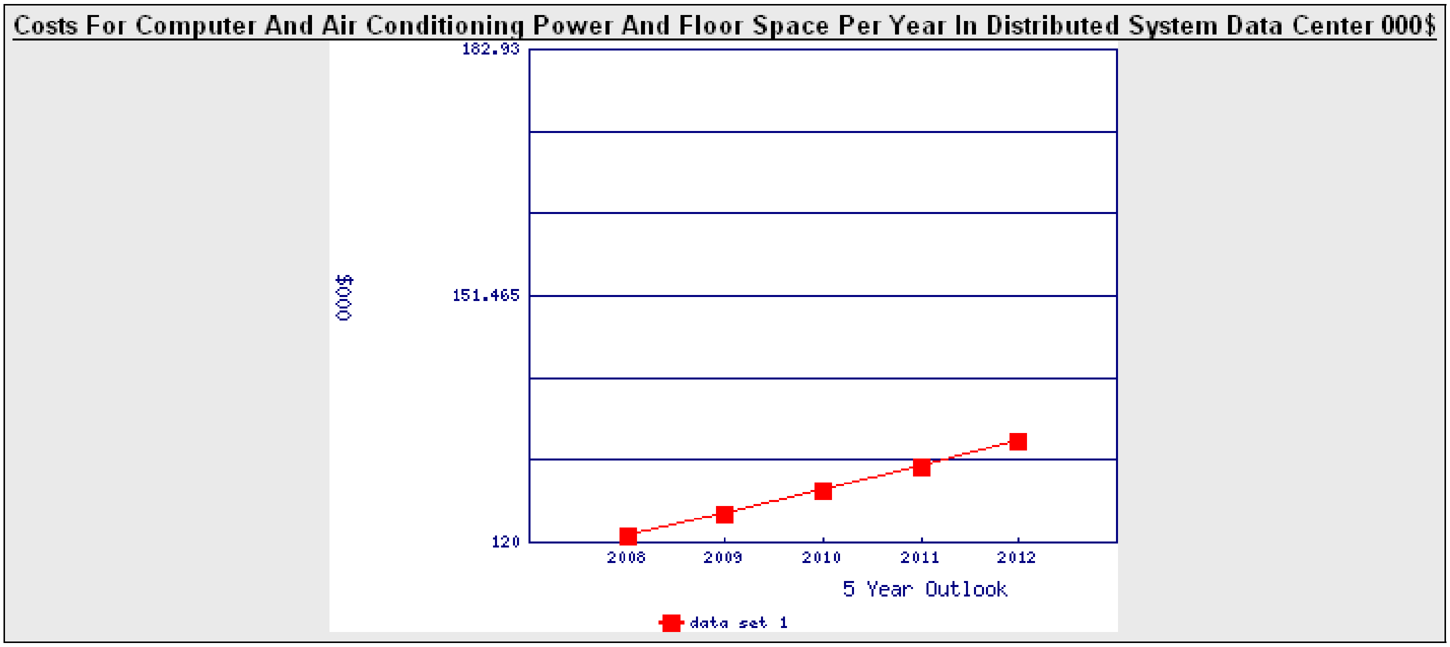
Given the rate of growth in power and floor space costs, the total costs of power and floor space for the distributed system data center will increase to $132,900 in 2012 from the current $118,300.

FIGURE 8–15

GRAPH OF FIVE-YEAR OUTLOOK IN POWER COSTS AND FLOOR SPACE COSTS FOR DISTRIBUTED SYSTEM DATA CENTER



Source: Wintergreen Research, Inc.

The above graph depicts the five-year outlook in growth of costs of power and floor space for the distributed system data center.

8.4 Mainframe Infrastructure Costs

The infrastructure cost analysis for mainframe system involves a study of the number of runtime MIPs utilized by the application and hence the cost of power used by the mainframe, air-conditioning power costs and floor space infrastructure costs.

Since the server in a mainframe system is centralized, the analysis is simpler than that for distributed systems with multiple server sets.

The cost analysis presented below considers an E-Applicationapplication for mainframe data center. Unless otherwise mentioned, the calculations made, are for the current year.

FIGURE 8–16

ANALYSIS OF OPERATION HOURS OF E-APPLICATION FOR MAINFRAME SYSTEM

2. Data Center Infrastructure Mainframe Electricity Analysis	Current	Unit
3. # of Runtime MIPS Utilized by this application	16.0	# MIPs
4. Mainframe Runtime MIPS Analysis For E-Referral Application Full Capacity or Near Full Capacity	Current	Unit
5. # of Hours Per Day Used	8.0	# hours
6. # of Days Per Week	5.0	# days
7. # of Weeks Per Year	52.0	# weeks
8. # Mainframe Application E-Referral Runtime Operational Hours Per Year	**2,080.0**	hrs

Source: Wintergreen Research, Inc.

The E-Application being analyzed utilizes 16 runtime MIPs. In full-capacity utilization, the application operates for 8 hours per day, 5 days per week and 52 weeks per year. This totals to 2,080 hours of operation.

FIGURE 8-17

OPERATIONAL HOURS OF THE MAINFRAME SYSTEM APPLICATION

9. Mainframe Allocated MIPS Analysis For E-Referral Application -- Illustrates Workload Sharing Impact Assuming 90% Utilization Of Mainframe	Current	Unit
10. Total # Operational Hours Per Year	8,760.0	hrs
11. Mainframe E-Referral Application Allocated MIPs Percent -- Runtime Operational Hours Per Year as a % of Total Operational Hours	23.7	% hrs

Source: Wintergreen Research, Inc.

The application runs for 8,760 hours in a year.

FIGURE 8-18

MIPS ALLOCATION FOR THE MAINFRAME APPLICATION

12. Allocated Mainframe MIPs (# of Runtime MIPs times % of Time Run time Used)	3.799	# MIPS

Source: Wintergreen Research, Inc.

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Number of MIPs allocated for the E-Application mainframe application is 3.799

FIGURE 8–19

COST ANALYSIS OF POWER CONSUMED BY THE E-APPLICATION FOR MAINFRAME SYSTEM

13. # Mainframe watts Per MIPS Analysis	Current	Unit
14. Number of MIPs In the Mainframe	2,600.0	# MIPs
15. Power Used by Mainframe	12,100.0	# watts
16. # Watts Per MIP	4.654	# watts
17. Number of Watts Consumed By Allocated MIPS Utilized By This Application (Considering Workload Offset For ROI Calculation)	17.680	# watts
18. Unit Conversation - Watts to Kilowatts	1,000.0	#
19. 000$ - Power Used By Mainframe in Kilowatts	0.018	# Kilowatts
20. Cost per Kilowatt	0.120	$ per kW/hr
21. $ - Cost For Power For One E-Referral Application Running For One Hour on Mainframe In Kilowatts	0.002	$
22. Unit Conversation - $ to 000$	1,000.0	#
23. 000$ - Cost For Power For One Hour for Mainframe In Kilowatts	0.000	000$
24. Number of Operational Hours Per Year	8,760.0	# hr per yr
25. 000$ - Cost For Mainframe Electrical Power For One Year	0.019	000$

Source: Wintergreen Research, Inc.

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The power consumption per MIP is 4.654 Watts. Hence the total power consumption by the MIPs allocated for the application is 0.018 kW. This is the power consumption of the mainframe system.

The cost of power consumed is $0.120 kW/hour. Hence the total power consumption cost for the mainframe for one hour is almost zero. This translates to a power consumption cost of $19 per year.

FIGURE 8-20

COST ANALYSIS FOR AIR-CONDITIONING FOR THE E-APPLICATION FOR MAINFRAME SYSTEM

26. Data Center Infrastructure Air conditioning Costs	Current	Unit
27. Multiplier of Mainframe Power Costs	1.0	#
28. 000$ - Costs For Air Conditioning	**0.019**	000$
29. 000$ - Power and Air Conditioning Costs	**0.037**	000$

Source: Wintergreen Research, Inc.

The cost of air-conditioning for the mainframe data center is equal to the power costs. Hence the total costs of air-conditioning and power consumption is $37 per year.

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FIGURE 8-21

ALTERNATE METHOD FOR FOR THE E-APPLICATION FOR MAINFRAME SYSTEM

30. Alternate Method to Determine Mainframe Data Center Infrastructure Electricity Costs (Crosscheck only - Numbers Not Included in Total)	Current	Unit
31. Costs For Power Per Year In Entire Building	1,800.0	000$
32. % Of Total Electricity Consumed By Mainframe Data Center For Computer And Air Conditioning Power Per Year	0.002	%
33. Costs For Computer And Air Conditioning Power Per Year In Mainframe Data Center	**0.036**	000$
34. Allocated Mainframe MIPs	3.799	# MIPS
35. Number of MIPs In the Mainframe	2,600.0	# MIPs
36. Allocated Mainframe MIPs As A % of Total Mainframe MIPs	**0.146**	% MIPS
37. Mainframe Power Consumed by Application E-Referral	**2.630**	000$

Source: Wintergreen Research, Inc.

FIGURE 8-22

COST ANALYSIS FOR INFRASTRUCTURE FLOOR SPACE FOR THE E-APPLICATION FOR MAINFRAME SYSTEM

38. Mainframe Data Center Floor Space Infrastructure Costs	Current	Unit
39. $ Per Square Foot (Fully Loaded Cost)	18.0	$/sq ft
40. # Square Feet Per Mainframe (Including Peripherals, Routers, and Cables)	225.0	#/sq ft
41. Costs For Floor Space Mainframe Data Center	40.500	000$
42. % Total MIPs Allocated to Application E-Referral	0.146	%
43. Costs For Allocated Floor Space Mainframe Data Center	0.059	000$

Source: Wintergreen Research, Inc.

The floor space occupied by the mainframe, including peripherals, routers and cables is 225 sq ft. At a cost of $18 per sq ft for fully equipped floor space, the cost of floor space for the entire application is $40,500.

0.146% of the total MIPs are allocated for the E-Application. Hence the allocated floor space cost for the mainframe data center is $59.

FIGURE 8–23

SUM OF POWER COSTS AND FLOOR SPACE COSTS FOR MAINFRAME SYSTEM APPLICATION

44. Mainframe Infrastructure Costs	Current	Unit
45. Costs For Power, Air Conditioning, And Floor Space	0.096	000$

Source: Wintergreen Research, Inc.

The sum total of the power, air-conditioning and floor space costs equal $96.

FIGURE 8-24

GROWTH RATE ANALYSIS OF MAINFRAME INFRASTRUCTURE COSTS

46. Mainframe Infrastructure Costs Growth Rate	Current	Unit	2008	2009	2010	2011	2012
47. Growth Rate of Mainframe Power Costs(%)		%	3.1	3.2	3.3	3.4	3.5
48. % Growth In $ Per Square Foot Prices Data Center		%	1.1	1.2	1.3	1.4	1.5

Source: Wintergreen Research, Inc.

For years 2008 through 2012: The mainframe power costs will increase by 3.1%, 3.2%, 3.3%, 3.4% and 3.5% for the respective years. The price per square foot of floor space will increase by 1.1%, 1.2%, 1.3%, 1.4% and 1.5% for the respective years.

FIGURE 8–25

INCREASE IN POWER COSTS AND FLOOR SPACE COSTS FOR MAINFRAME SYSTEM APPLICATION IN THE NEXT FIVE YEARS

49. Mainframe Infrastructure Costs	Current	Unit	2008	2009	2010	2011	2012
50. Costs For Computer And Air Conditioning Electricity Power Per Year In Mainframe Data Center	0.037	000$	0.038	0.040	0.041	0.042	0.044
51. Cost Of Mainframe Data Center Floor Space In Building	0.059	000$	0.060	0.061	0.061	0.062	0.063
52. Total Mainframe Infrastructure Costs	Current	Unit	2008	2009	2010	2011	2012
53. Costs For Computer And Air Conditioning Power And Floor Space Per Year In Mainframe Data Center	0.096	000$	0.098	0.100	0.102	0.104	0.107

Source: Wintergreen Research, Inc.

Given the rate of growth in power and floor space costs, the total costs of power and floor space for the mainframe system data center will increase to $107 in 2012, from the current $96.

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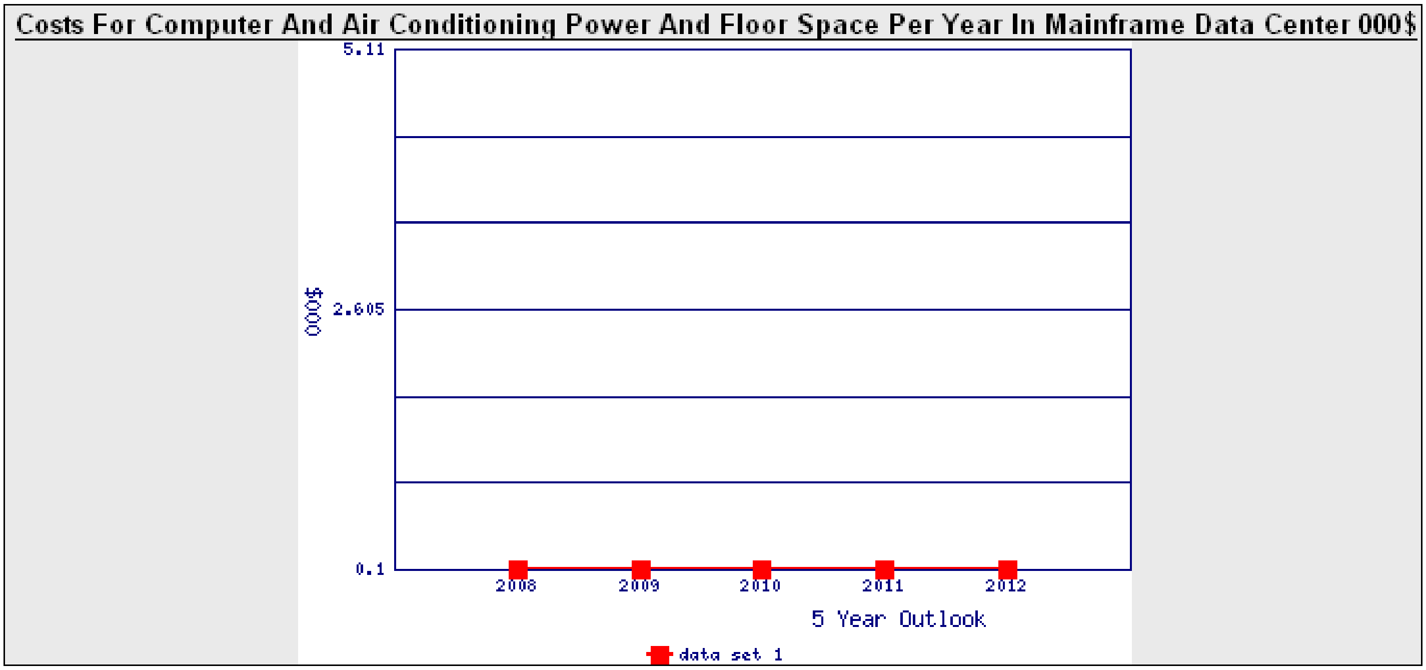
FIGURE 8–26

GRAPH OF FIVE-YEAR OUTLOOK IN POWER COSTS AND FLOOR SPACE COSTS FOR MAINFRAME SYSTEM APPLICATION



Source: Wintergreen Research, Inc.

The above graph depicts the five-year outlook in growth of costs of power and floor space for the mainframe system data center application. This is just a fraction of the costs incurred in distributed system data center application.