



SteelEye® Technology®

V01

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SteelEye Business Continuity

“Our mission is to eliminate IT downtime !

**...by delivering best-in-class software technology
providing integrated application availability and data
replication solutions at a fraction of the cost and
complexity of conventional and proprietary systems”**

Introduction to SteelEye Technology

- Founded 1999
- Scalable business continuity and disaster recovery solutions
- SteelEye LifeKeeper family of integrated, scalable products
 - Data and disk replication
 - High availability clustering
- Proven technology
 - Over 4,000 licenses sold worldwide
 - Originally developed by AT&T Bell Labs
 - Rich, stable code-base - over a decade of development
 - 11 patents held and 6 applications in process
- Focus on Linux and Windows
- World-class expertise in High Availability Clustering
 - SteelEye branded services
 - Significant contributor to Open Source movement
- Strategic relationships with IBM and SAP

SteelEye LifeKeeper Solutions

- LifeKeeper Data Replication
 - High performance block-level data replication
 - 'Change-level' synchronization enhances performance, reduces system overhead
 - Synchronous or asynchronous replication
- LifeKeeper High Availability Clustering
 - Integrated monitoring, failover and failback
 - Application-centric clustering
 - *Support for wide range of applications and databases*
 - *Simplified implementation and management reduce TCO*
 - Integrated with LifeKeeper Data Replication
- LifeKeeper Disaster Recovery
 - Integrated 'stretch-cluster' solution
 - Disaster recovery across campuses or continents
 - Sophisticated architecture to accommodate complex scenarios

SteelEye LifeKeeper Solution Differentiators

- Proven solutions and expertise
 - ATT/NCR heritage
 - Enterprise customers
- Complete solutions out of the box
 - Including: DB2, Exchange, mySAP, Oracle, SQL Server, NFS, Samba, MySQL, Sendmail, print services ... etc
- Integrated and scalable solutions
 - Enables incremental deployment – from LAN to WAN
- Significant reduction in complexity, increase in flexibility
 - Resource-driven architecture vs conventional quorate approach
 - Non-intrusive, no application reengineering
- Easy to implement and deploy
 - Script-based, no coding, customizable templates speed deployment
 - Low cost of ownership
- Enables use of standard, lower-cost editions of software
 - OS, database and applications
- Single management platform for Intel servers
 - Linux and Windows

Global 2000 Customers Representative Selection





- Lenzing AG
 - Austria, manufacturing
 - Prohibitive cost of upgrade on RISC
 - IBM xSeries LifeKeeper, Oracle on Linux



- Vedes
 - Germany, toy distribution and retailing
 - ERP systems expansion/migration – Windows to Linux
 - IBM xSeries, LifeKeeper, mySAP, on Linux



- Foster Farms
 - United States, food industry
 - Poultry Inventory, Packaging and Shipping Operation
 - IBM xSeries 235 w/ServerRAID 5i (replicated storage) on Linux



SteelEye and IBM

The SteelEye / IBM Relationship

- SteelEye solutions available worldwide through IBM
- Certification of hardware with SteelEye LifeKeeper solutions
 - Includes all xSeries Servers and BladeCenter Servers
 - Storage: ServeRAID, FASTT – includes Multipath support, and ESS
 - ServerProven, ClusterProven and StorageProven
- Certification of DB2 UDB with SteelEye LifeKeeper solutions
 - Includes v7.2 and v8.1
 - DB2 Stinger in process
- Pre-sales support from SteelEye
- SteelEye LifeKeeper installed in IBM labs worldwide
- Access to SteelEye Sales Teams and Support Organization
- Rational ClearCase and Lotus Domino HA Solutions
- Joint Marketing Activities
 - Conferences, roadshows, case studies, press releases



IBM Hardware Compatibility Matrix

▶ Current xSeries Servers

- ▶ x205, x225, x235, x255
- ▶ x306, x335, x345, x365
- ▶ x445
- ▶ x450
- ▶ x336, x346
- ▶ eServer 325
- ▶ Blade Center
 - ▶ *HS20*
 - ▶ *HS40*

▶ Older xSeries Servers

- ▶ Netfinity Models
- ▶ x200, x220, x240, x250, x300, X305, x330, x342, x350, x360, x370, x440

▶ Storage Options

- ▶ ESS *
 - ▶ FASTT
 - ▶ *200**
 - ▶ *500**
 - ▶ *600*
 - ▶ *700*
 - ▶ *900*
 - ▶ ServeRAID
 - ▶ *4Mx*
 - ▶ *4Lx*
 - ▶ *4H*
 - ▶ *6M*
 - ▶ *EXP 300 and EXP 400*
- } RDAC for multi-path

* Single Path only

SteelEye LifeKeeper Products – Available through IBM

Linux

- LifeKeeper for Linux Core
- LifeKeeper Data Replication– LAN
- LifeKeeper Data Replication– WAN
- Apache Web Server Application Recovery
- Sendmail Application Recovery Kit
- Informix Application Recovery Kit
- Oracle Application Recovery kit
- DB2 Application Recovery kit
- Sybase Application Recovery kit
- MySQL Application Recovery kit
- PostgreSQL Application Recovery kit
- NFS Server Application Recovery Kit
- Print Services Application Recovery Kit
- Samba Application Recovery Kit
- Network Attached Storage Application Recovery kit
- Logical Volume Manager Recovery kit
- Software Developers Kit
- LifeKeeper for mySAP/Oracle Solution
- LifeKeeper for mySAP/SAP DB Solution
- LifeKeeper for mySAP/DB2 Solution
- LifeKeeper for Sendmail SAMS Solution

Windows

- LifeKeeper for Windows Core
- LifeKeeper Exchange 2000/2003 Solution – LAN
- LifeKeeper Exchange 2000/2003 Solution –WAN
- LifeKeeper Data Replication for Windows
- MS IIS 5.0 Web Server Application Recovery Kit
- SQL Server Application Recovery Kit
- DB2 Application Recovery kit
- Oracle Application Recovery Kit



SteelEye LifeKeeper

The Value of Availability

Availability Measures

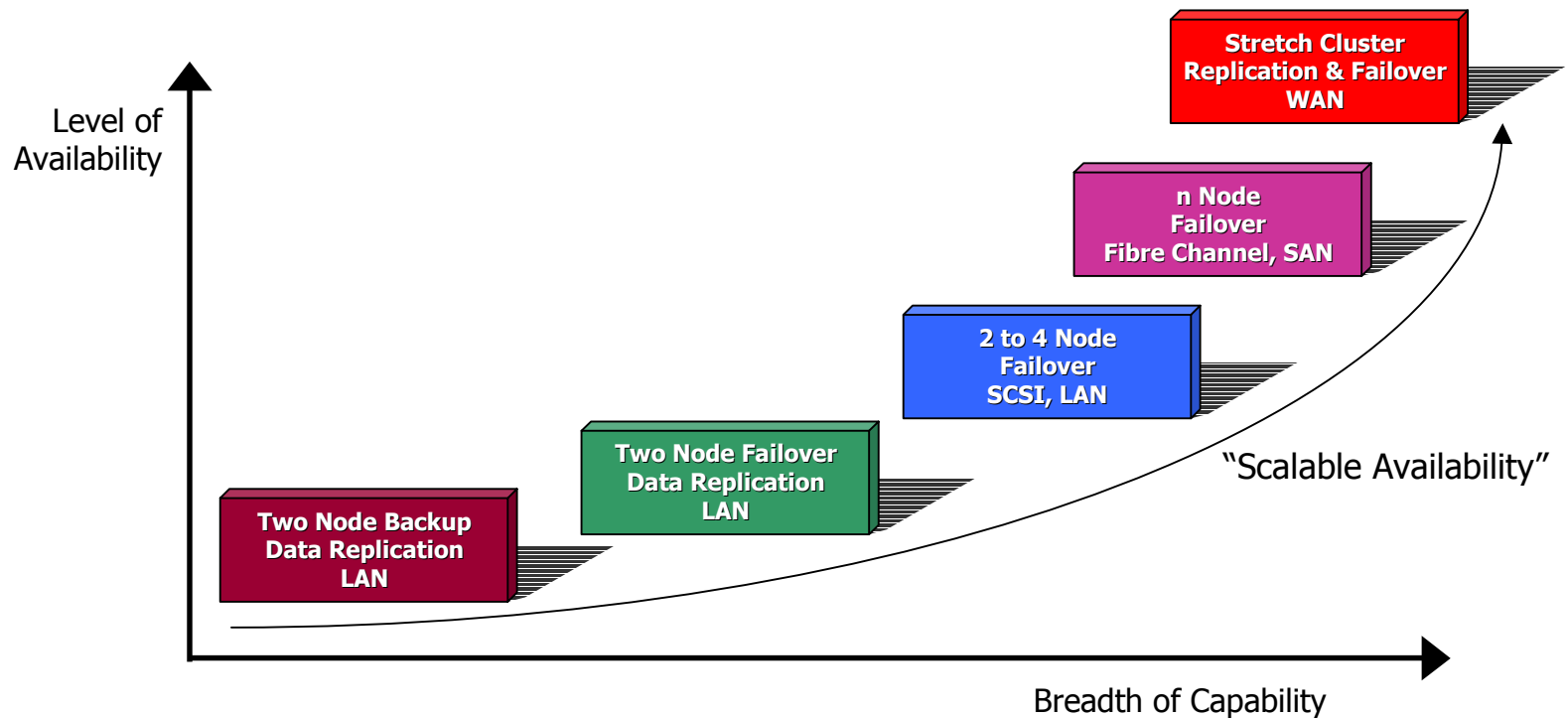
- 90% >1 month outage time per year
- 99% just under 4 days outage time per year
- 99.9% just under 9 hours outage time per year
- 99.99% 53 minutes outage time per year [Fault Resilient]
- 99.999% 8 minutes outage time per year [Fault Resilient]
- 99.9999% 30 seconds outage time per year [Fault Tolerant]
- 99.99999% about 3 seconds outage time per year [Fault Tolerant]

Fault Resilient versus Fault Tolerant

- Much less expensive to implement
 - Can be built with commodity components
- Best solution for vast majority of implementations

SteelEye Delivers Scalable Availability

- Choice of protection based upon availability needs
 - Different between organizations
 - Different between applications
 - Requirements will evolve over time



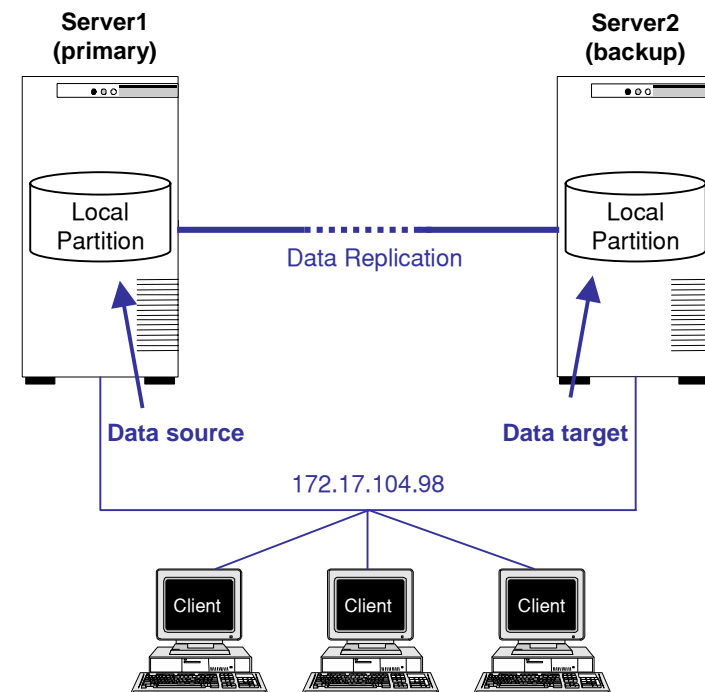
LifeKeeper Benefits

- SteelEye LifeKeeper is best-in-class software technology
 - Delivering **integrated** application availability and data replication solutions
 - **Removing the complexity** and high cost typically associated with high availability
 - **Proven** industrial-strength reliability
 - **No changes** to your application environment required
- Powerful application-centric business continuity and disaster recovery solutions
 - Leveraging the compelling price/performance of Intel servers
 - Availability without the complexity – reduced time to protection
 - **Design, implement and deploy in days** not weeks or months as with earlier generations of high availability solutions on RISC/Unix platforms
 - Complete, integrated, certified application-centric solutions
 - Protection for branded applications and databases available **off-the-shelf**
 - Support of Linux and Windows operating system platforms

Two Node Replication Within a LAN

Entry-Level Configuration

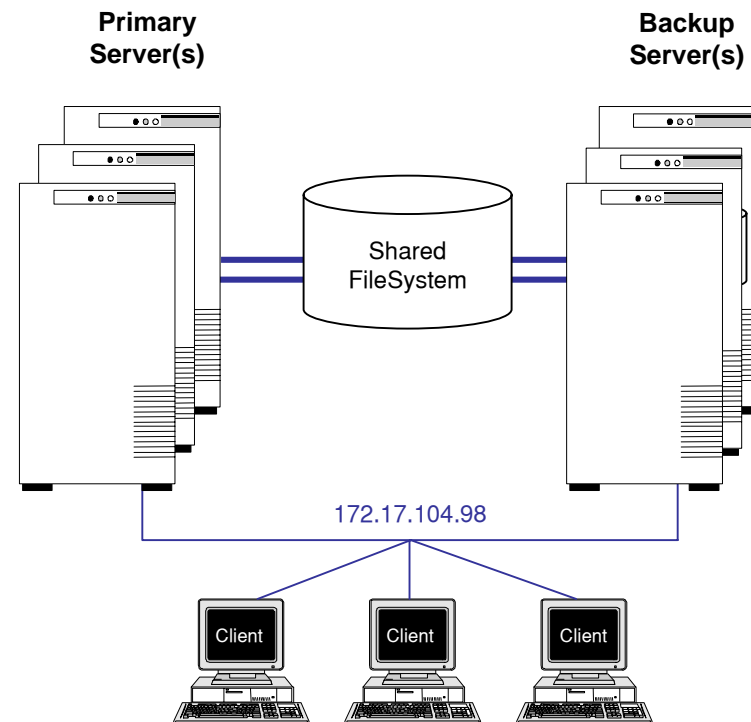
- Lowest cost of entry
- No shared storage required
- Local dedicated access to application data
- Automated data replication
 - Synchronous or asynchronous
 - Disk-to-disk back-up



2 to 4-Node Shared SCSI within LAN
n-Node Shared Fiber Channel within SAN
Network Attached Storage

Shared storage configuration

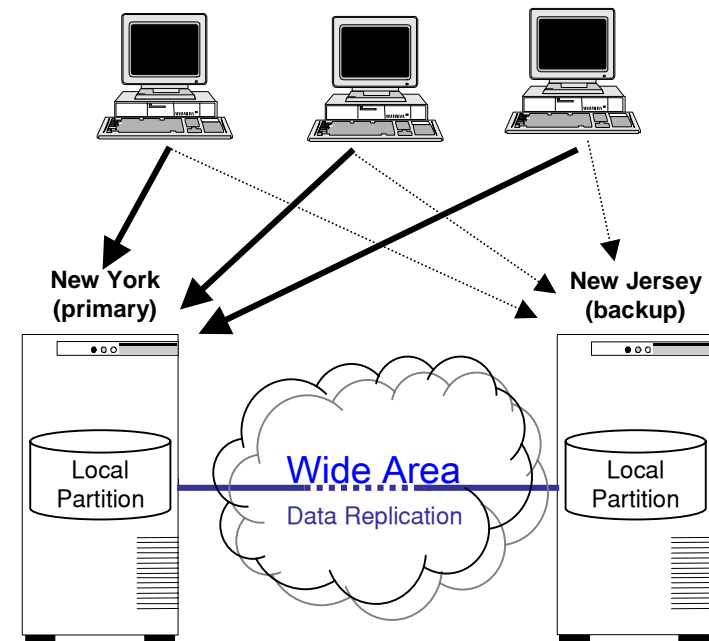
- Shared SCSI, FC or NAS allows building of larger clusters
- Single write of data speeds processing versus replication
- Multi-path access to shared storage removes potential single points of failure



Stretch Cluster for Disaster Recovery

Highest Levels of Availability

- Asynchronous data replication across geographies
- Failover can be either automated or require human intervention
- Client redirection across subnets to provide as seamless as possible recovery
- Bandwidth between sites and rate of data change are critical considerations



SteelEye LifeKeeper for Linux

- Distributions



redhat



MIRACLE

Red Flag

- Scalable Configurations

- 2 node LAN data replication for continuous data backup at low cost
- 2 node LAN failover cluster using LifeKeeper Data Replication
- 2 to 4 node using Direct Attach SCSI,
- 2 to 32 node using Fiber Channel SAN
- 2 to 32 node using Network Attached Storage
- 2 node stretch cluster for Disaster Recovery

- Simple to build, deploy, administer cluster

- Wizard-driven cluster configuration
- JAVA GUI allows remote administration
- SNMP Traps integrate with systems management console
- Full CLI available for use if needed

SteelEye LifeKeeper for Linux

- Widest selection of developed and certified protection, including

Services

- Apache
- Samba
- NFS
- Others via Gen App

Databases

- Oracle
- DB2
- MySQL
- PostgreSQL
- Informix
- SAPDB/MaxDB
- Sybase

Applications

- mySAP, Sendmail/SAMS, ClearCase, Lotus Domino
- Various 3rd party providers: WebCT, Versaterm
- Any Custom Application via LifeKeeper SDK
- Any third-party application via LifeKeeper SDK

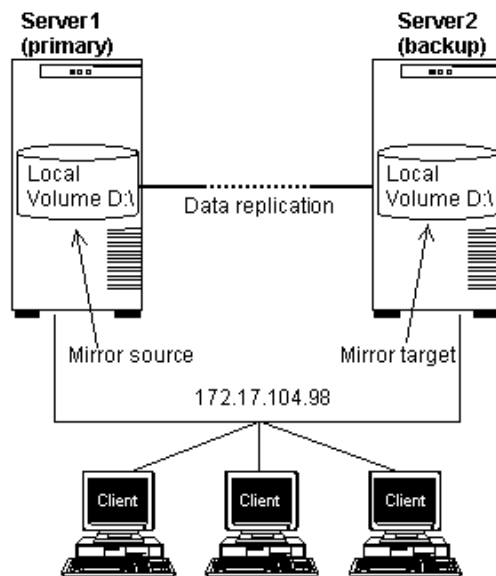
SteelEye LifeKeeper for Windows Server

- Operating Platforms – all flavors of



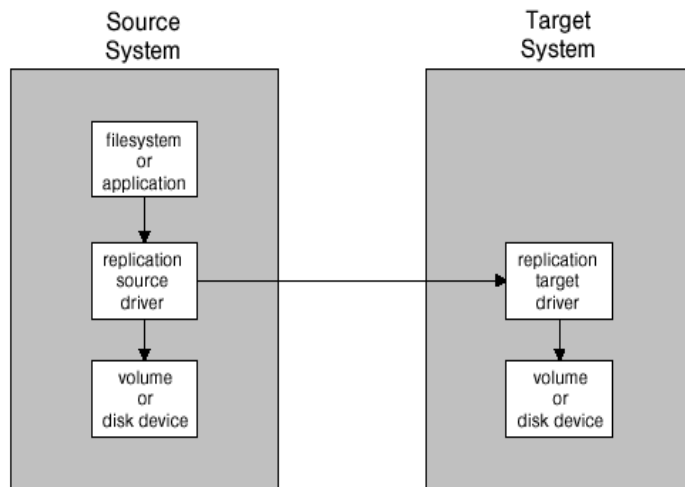
- Scalable Configurations
 - Realtime replication of data for continuous backup
 - Two-node LAN cluster using LifeKeeper Data Replication
 - Shared Storage: Direct Attach SCSI, N-node Fiber Channel SAN
 - Stretch cluster for Disaster Recovery
- Simple to build, deploy, administer cluster
 - Common Interface with Linux Solution
- Application Resources Protected off-the-shelf
 - Databases: SQL Server7 and 2000, Oracle 8i/9i, DB2 UDB
 - Applications: Exchange 5.5, Exchange 2000, and 2003
 - Services: IIS, Print Services, IP, LAN Manager, Volume
 - Custom/Package Applications via LifeKeeper SDK

LifeKeeper Data Replication



- Real-time data protection
- Enhances & complements existing backup solutions
 - More current copy of data
 - Faster recovery
 - Reduces cost of backup infrastructure
- Allows building of Application Availability cluster without requirement for shared storage
- Lowers cost as a barrier to deployment
 - No shared storage to purchase, maintain
- Best solution for disk-disk-tape backup
- Lays foundation for building a Stretch Cluster for Disaster Recovery

LifeKeeper Data Replication Architecture



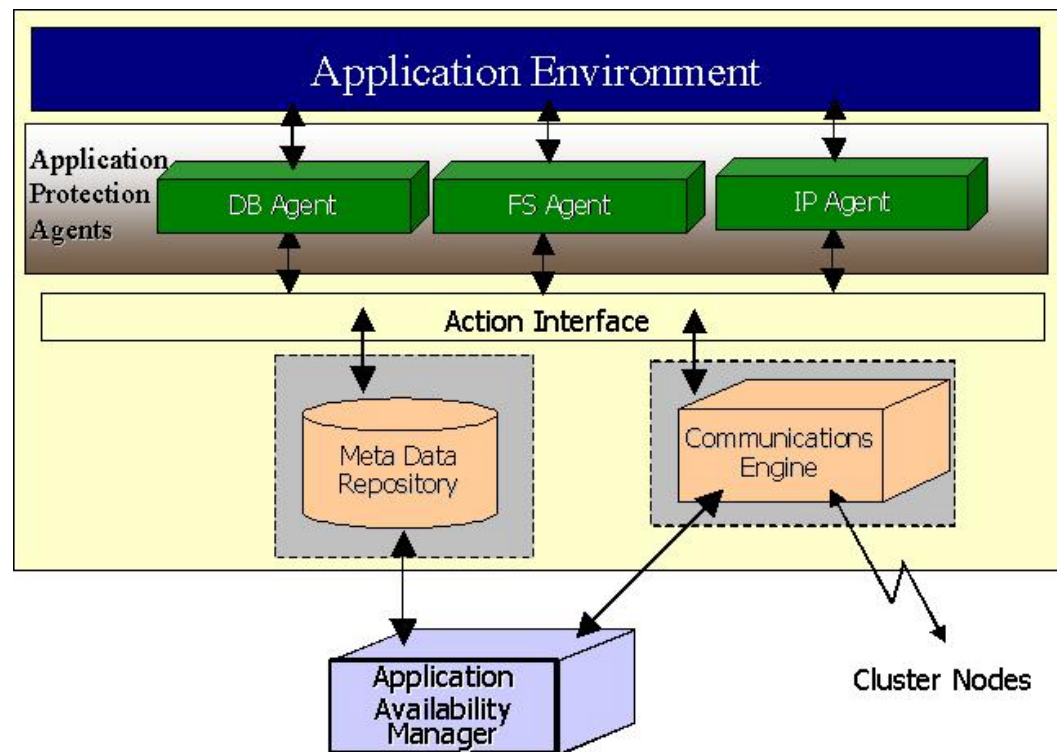
Windows: Implemented as standard filter driver

Linux: Implemented using standard md/nbd drivers

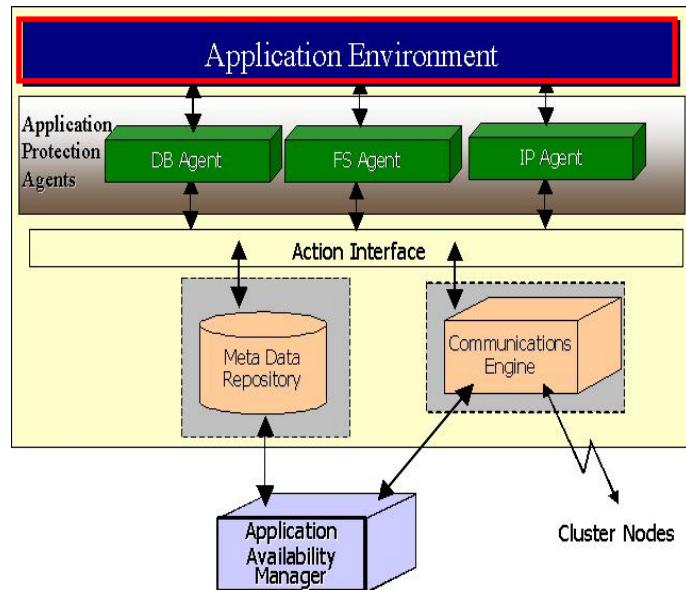
Both have SteelEye management interface and integration with LifeKeeper HA clustering

- Block-Level Volume Replication
 - Superior to File-based replication schemes
 - No issue with in-use files
 - No issue with missing files
 - More secure – replication and protection of storage permissions; target volume locked
 - Low system resource burden
- Replicates and transmits writes to local data volume
- Maintains write-order integrity to ensure data consistency
- Synchronous, Asynchronous, or Periodic Mirrors can be defined
- Persistent Intent Log optimizes resynchronization following any failure condition while in asynchronous mode
- Integration with LifeKeeper clustering

LifeKeeper High Availability Cluster Architecture



Application Environment

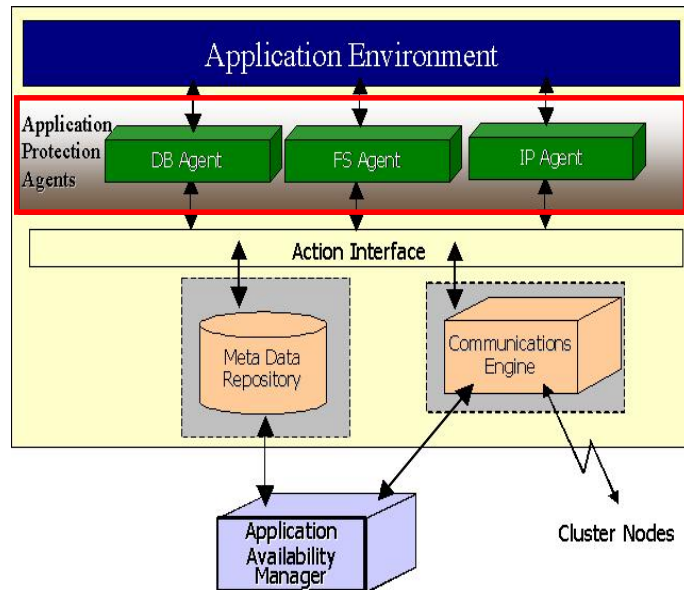


- Your application running in your standard configuration
 - No modifications required other than ensuring that the data required by the application is available to all nodes in the cluster
 - No special versions of Linux or Application required
 - No requirement that hardware in cluster be identical

- End-to-end application environment is virtualized
 - Client connection points, application sources, data sources and all interconnects
 - IP Address
 - Application Instances
 - OS Services
 - Data Volume
 - Mirrored Replica
 - Shared SCSI or Fiber
 - Network Attached Storage
 - Any dependent services or resources

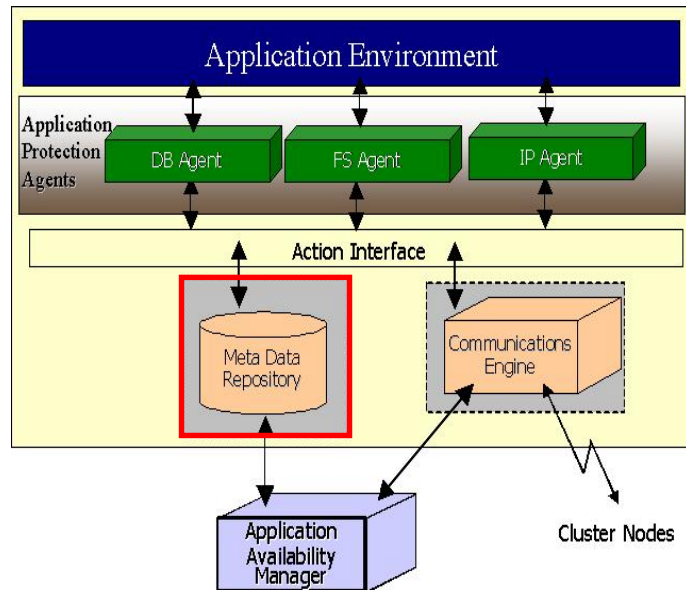
- Virtual environment mapped onto physical resources as needed to ensure Quality of Service

Application Protection Agents



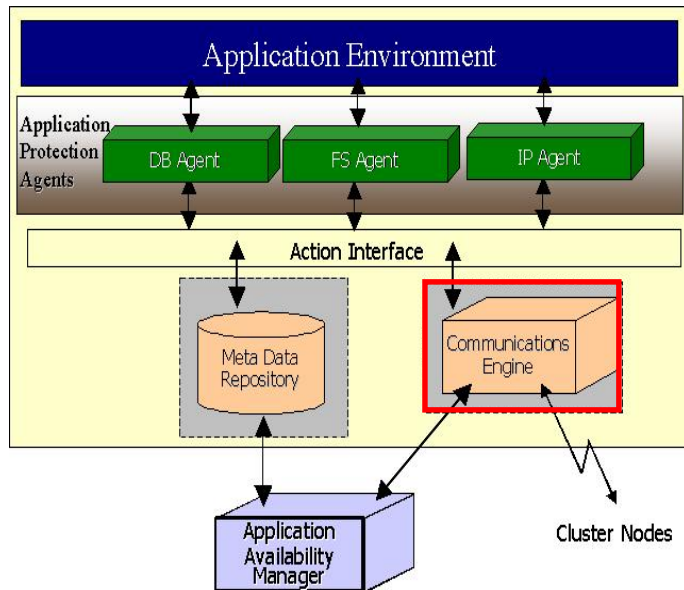
- Monitoring of application environment is accomplished via Application Protection Agents
- Each Agent contains specialized code unique to the component (resource) it is protecting
 - Monitor health of resource
 - 2 levels of checking provide for optimal balance between system resource utilization and timely detection of problems
 - Alert LifeKeeper system of events detected
 - Restore resource to working status
 - Within node (Local Recovery)
 - Across nodes (Remote Recovery)
- Script-based to ease field customization
 - Site specific error conditions to be monitored
 - SDK to support development of Agents for custom application

MetaData Repository



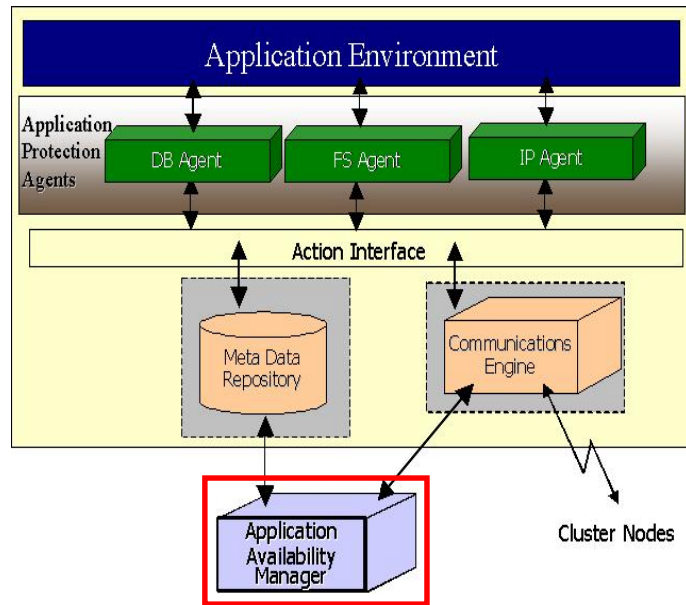
- Holds local copy of Cluster MetaData
 - Cluster Membership
 - Dependencies and Equivalencies
 - Recovery Policies
 - Status of Cluster Resources
- Updated real-time as cluster events dictate via light-weight peer-to-peer protocol
- Cached in memory and stored on system disk
- Decentralized MetaData store supports lower latency cluster operations and removes need for separate quorum device

Communications Engine



- Handles all communication services
 - Inter-process within a system
 - Across system boundaries
- Heartbeats used for system-level health monitoring
 - TCP or Serial
 - Configurable in interval between heartbeats and number that must be missed prior to marking down
 - Dual heartbeat paths always recommended
- MetaData updates between cluster nodes
- Resource Recovery initiation
- SNMP Alerts to Enterprise Management Systems
- All communication between LifeKeeper nodes is standard sockets-based and connection oriented

Application Availability Manager

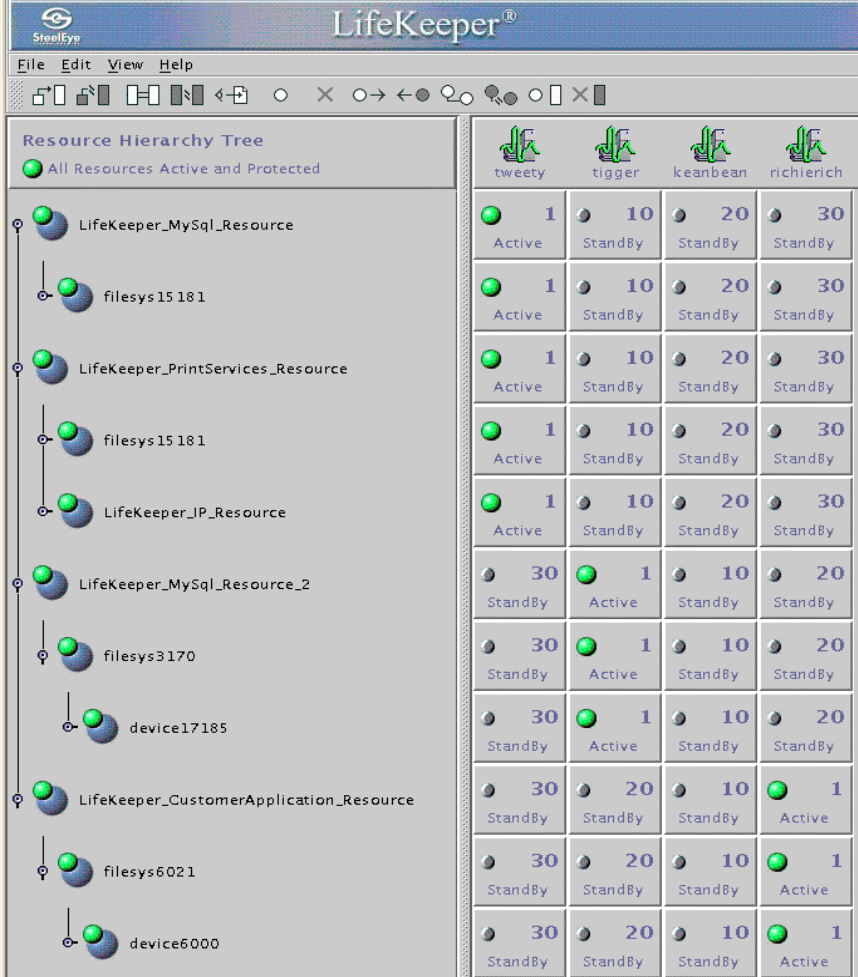


- Configure, Monitor, Administer the LifeKeeper Cluster
- Client/Server application developed using JAVA technology can be invoked as both a stand-alone JAVA application and as a JAVA applet within a browser
- Both Linux and Windows clusters can be managed from single console window
- Wizard-driven interface with auto-discovery and default choice population simplifies initial cluster construction

Highly Manageable and Flexible

RADICAL EASE-OF-USE:

- ▶ Centralized management interface across Linux and Windows
- ▶ Wizard-driven deployment
- ▶ Automated reliability policies
- ▶ Intuitive Java GUI
- ▶ SNMP alerts to Enterprise Management Station



The screenshot displays the LifeKeeper management interface. On the left, a 'Resource Hierarchy Tree' shows a tree structure of resources, including 'LifeKeeper_MySql_Resource', 'filesys 15 181', 'LifeKeeper_PrintServices_Resource', 'LifeKeeper_IP_Resource', 'LifeKeeper_MySql_Resource_2', 'filesys3170', 'device17185', 'LifeKeeper_CustomerApplication_Resource', 'filesys6021', and 'device6000'. On the right, a status table provides a detailed view of the resources, showing their status (Active or StandBy) and the number of instances for each of four nodes: tweety, tigger, keanbean, and richierich.

Resource	tweety	tigger	keanbean	richierich
LifeKeeper_MySql_Resource	1 Active	10 StandBy	20 StandBy	30 StandBy
filesys 15 181	1 Active	10 StandBy	20 StandBy	30 StandBy
LifeKeeper_PrintServices_Resource	1 Active	10 StandBy	20 StandBy	30 StandBy
filesys 15 181	1 Active	10 StandBy	20 StandBy	30 StandBy
LifeKeeper_IP_Resource	1 Active	10 StandBy	20 StandBy	30 StandBy
LifeKeeper_MySql_Resource_2	30 StandBy	1 Active	10 StandBy	20 StandBy
filesys3170	30 StandBy	1 Active	10 StandBy	20 StandBy
device17185	30 StandBy	1 Active	10 StandBy	20 StandBy
LifeKeeper_CustomerApplication_Resource	30 StandBy	20 StandBy	10 StandBy	1 Active
filesys6021	30 StandBy	20 StandBy	10 StandBy	1 Active
device6000	30 StandBy	20 StandBy	10 StandBy	1 Active

Storage Configurations Shared Storage

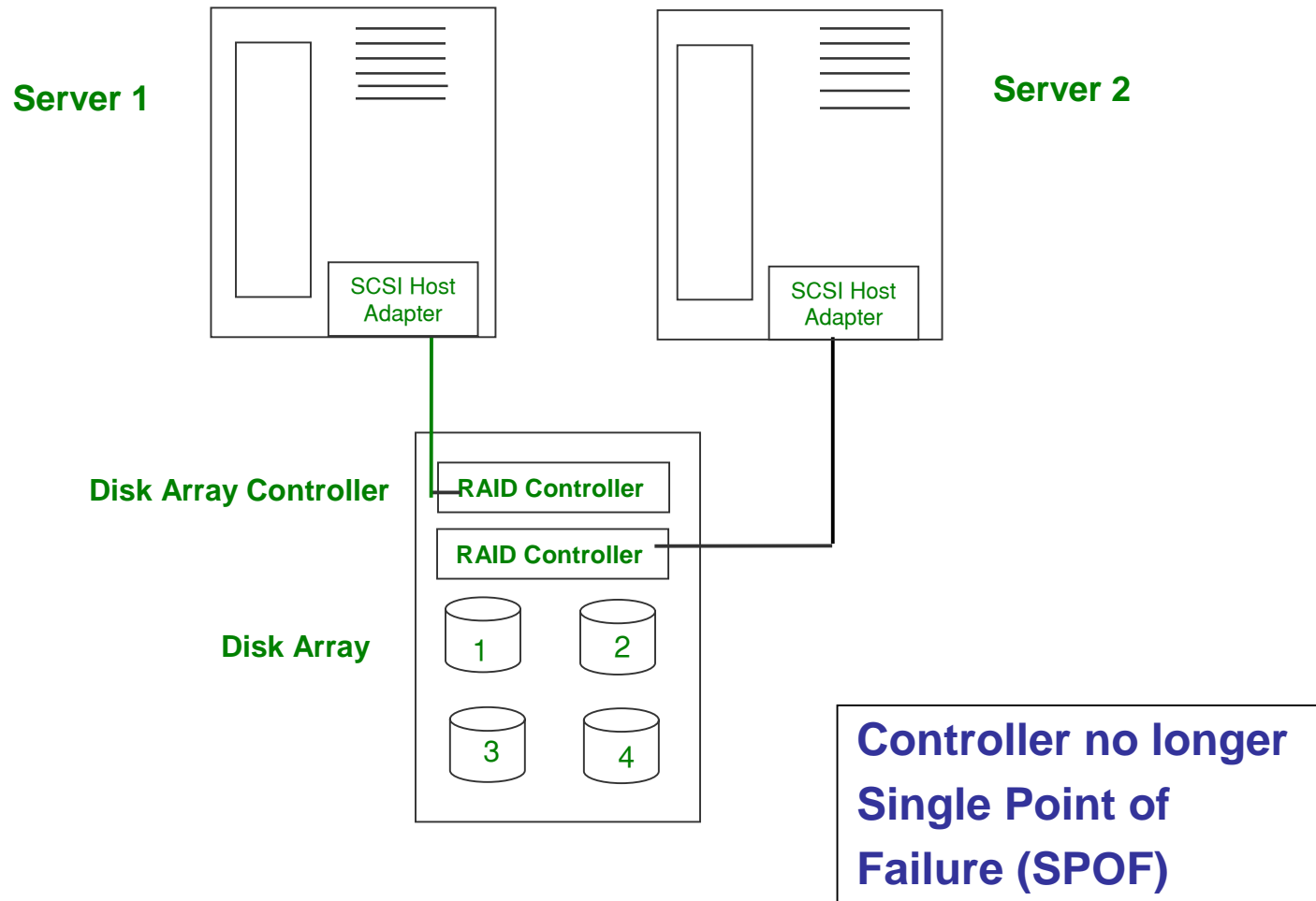
Shared Storage

- Direct Attached SCSI:
 - **Number of servers in cluster based on limitations of the ports on the SCSI enclosure (typically = 2 though there are quad-ported SCSI RAID enclosures, no LifeKeeper limitation)**
 - **Avoid Host-based RAID adapters except IBM ServeRAID**
- Fibre Channel:
 - **LifeKeeper uses SCSI protocol over a Fibre Channel interconnect**
 - **Support for 32 servers in a cluster**
- Network Attached

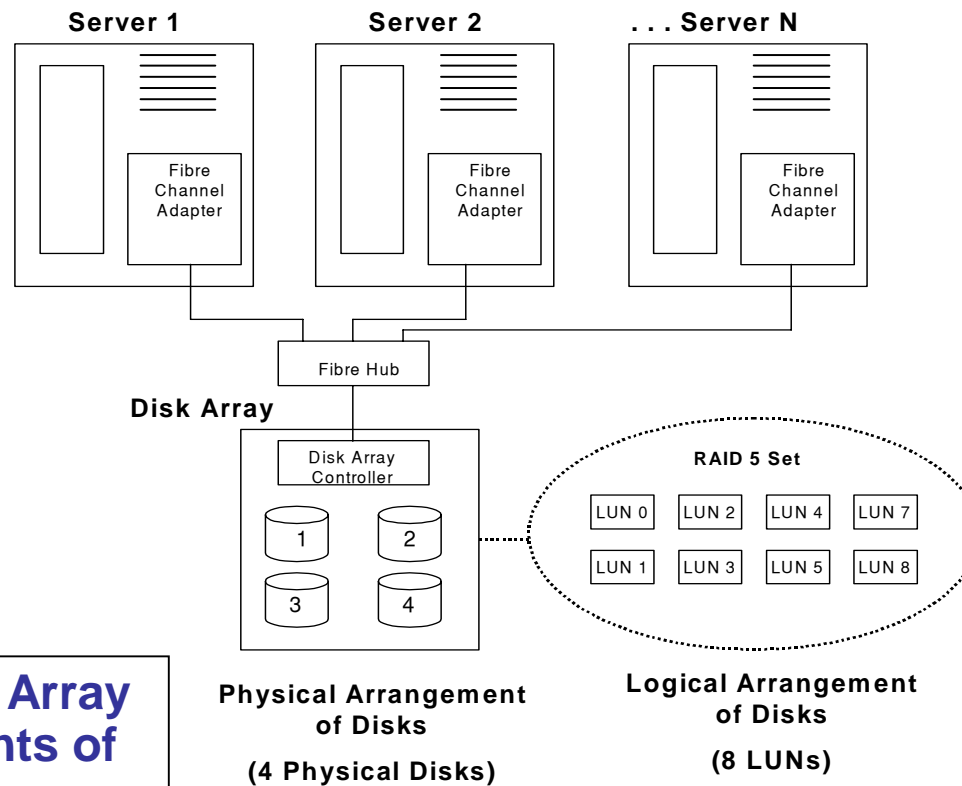
LifeKeeper...

- Prevents more than one resource from accessing the data at one time (IO Fencing)
- Locks shared resources at the LUN level using SCSI Reservations.
- Locks each LUN as a single disk, regardless of the physical location of the LUN.

Storage Configurations ServeRAID with EXP Storage

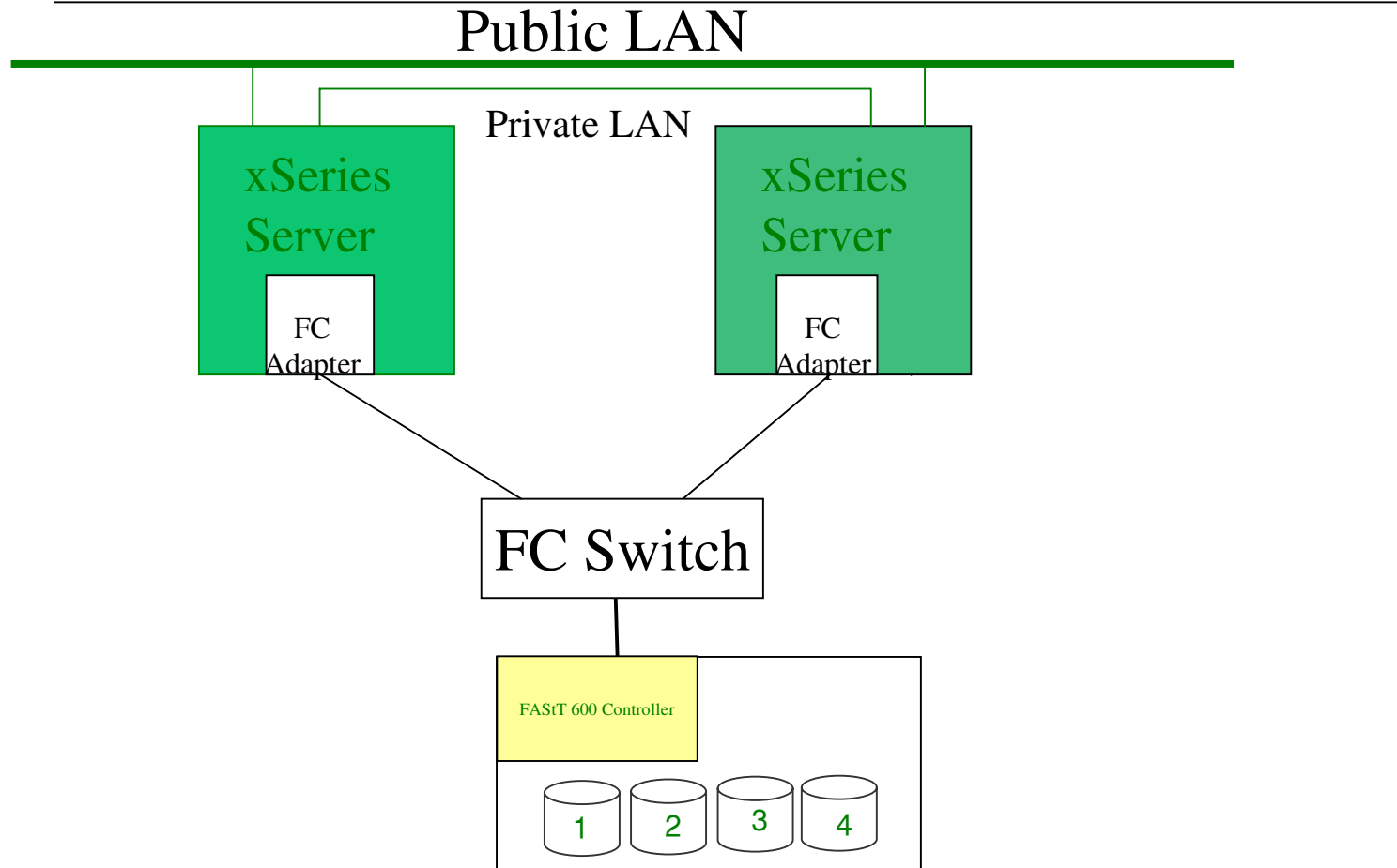


Storage Configurations Shared Fibre



FC Hub/Switch and Disk Array Controller are Single Points of Failure

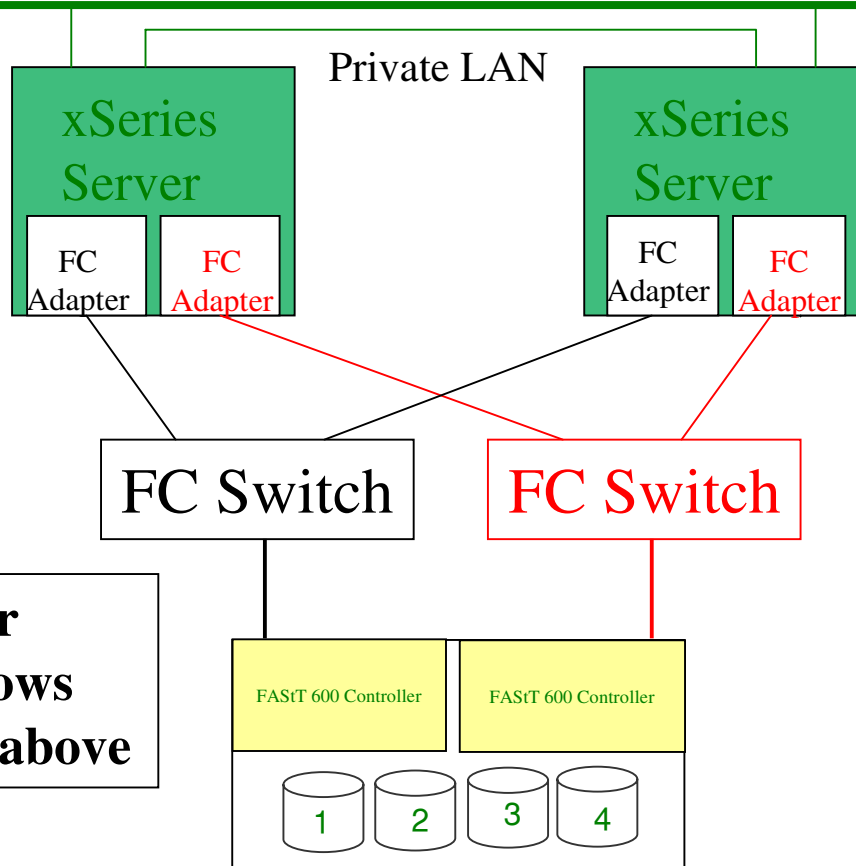
Storage Configurations Single Path Fibre



2 Node Single Path Configuration with IBM FAStT Fibre

Storage Configurations Dual Path Fibre

Public LAN



**Uses RDAC for
Linux and Windows
On FASTT 600 and above**

2 Node Multi-Path Configuration with IBM FASTT

Introducing LifeKeeper High Availability Clustering v4.5

- **ia64/x86-64 Support (64-bit Support)**
- Java 1.4 Support
- Latest kernel Support
 - SLES 8 SP3 2.4.21-215
 - RHEL 3.0 U2 2.4.21-15.EL
 - RHEL 2.1 U4 2.4.9-e.40 (32-bit only)
- MaxDB Support in SAP DB Recovery Kit
- Support for x86 and ia64 SAP kernels
 - SLES 8 - 2.4.21-190 (x86)
 - RHEL 3 - 2.4.21.9.0.1.EL (x86)
 - SLES 8 2.4.21-144 (ia64)
- Sybase Kit supports Symbolic Links to RUN_* Scripts



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