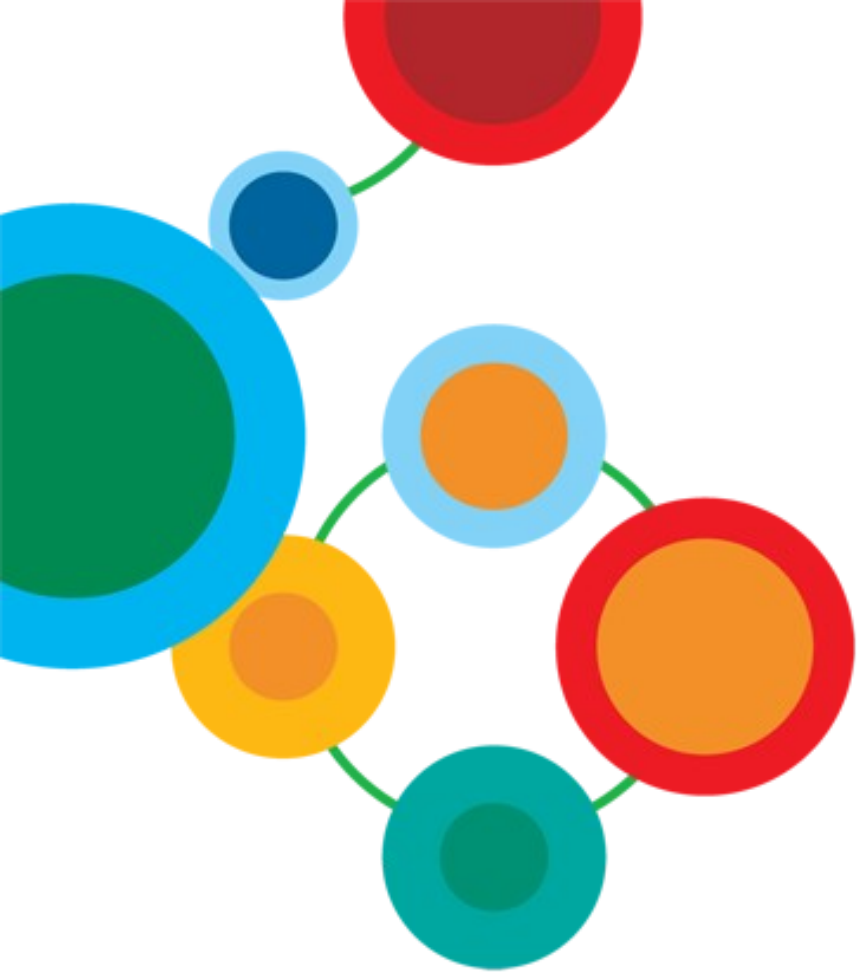

Building Highly Available Systems with IMS DB

Session Number 1243

Greg Vance, IBM

IBM Software

Information On Demand 2011

Please Note:

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Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput or performance that any user will experience will vary depending upon many factors, including considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve results similar to those stated here.

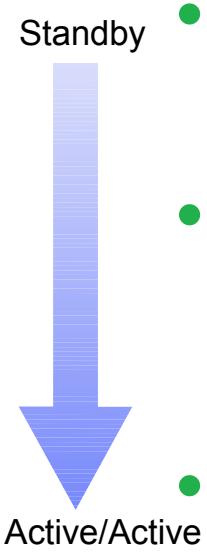
Agenda

- Background
- IMS 11 Enhancements
- IMS 12 Enhancements
- GDPS Active/Active Sites and IMS Replication

IMS Commitment to Availability and Resiliency

How Much Interruption can a Business Tolerate?

Ensuring Business Continuity:



- Disaster Recovery
  - Restore business after an unplanned outage
- High-Availability
  - Meet Service Availability objectives e.g., 99.9% availability or 8.8 hours of down-time a year
- Continuous Availability
  - No downtime (planned or not)

Cost of Downtime by Industry	
Industry Sector	Loss per Hour
Financial	**$8,213,470**
Telecommunications	**$4,611,604**
Information Technology	**$3,316,058**
Insurance	**$2,582,382**
Pharmaceuticals	**$2,058,710**
Energy	**$1,468,798**
Transportation	**$1,463,128**
Banking	**$1,145,129**
Chemicals	**$1,071,404**
Consumer Products	**$989,795**

Source: Robert Frances Group 2006, "Picking up the value of PKI: Leveraging z/OS for Improving Manageability, Reliability, and Total Cost of Ownership of PKI and Digital Certificates."

Global Enterprises that operate across time-zones no longer have any 'off-hours' window.
Continuous Availability is required.

What is the cost of 1 hour of downtime during core business hours?

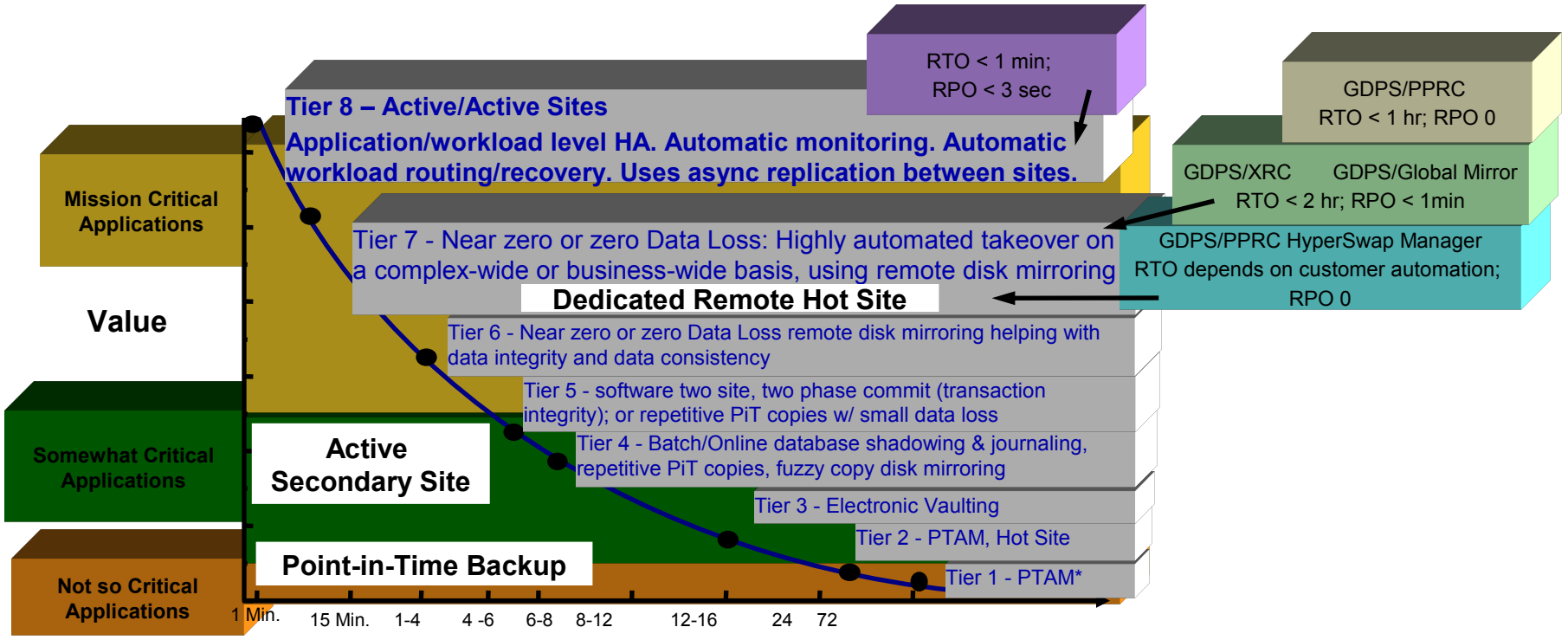
Business Continuity

- The top Causes of Business Interruption:
  - Planned Maintenance
    - System and Software Upgrades or Reconfiguration
    - Database Administration
  - Component Failure
    - Caused by Operator Errors, Software defects, Disk Failure, Subsystems, Hardware, Power Grid
    - Data is recoverable.
    - But, changes might be stranded until component is restored
  - Disaster
    - Flood, Earthquake, Fire, …, Loss of a site
    - Data is not recoverable

Establishing the Objectives:

- *Recovery Time* Objective (RTO) = How much time is needed to restore business operations?
- *Recovery Point* Objective (RPO) = How much data could we afford to *lose*?

Tiers of disaster recovery



Tiers based on Share Group 1992
*PTAM = Pickup Truck Access Method

Best D/R practice is blend tiers of solutions in order to maximize application coverage at lowest possible cost . One size, one technology, or one methodology does not fit all applications

IMS Resilience and Availability

- Reducing planned outages
  - Extended dynamic commands, enabling change without outages
- Recovering quickly from unplanned outages
  - Tools for autonomic tuning and responses to system conditions.
- Enhanced recovery and additional reliability, diagnostics, and performance improvements

Scaling Resiliency/Availability

- Single IMS
  - DB Recovery
  - Emergency Restart
  - Dataset redundancy (e.g pair/spare)
  - Reduce abends
  - Storm Drain
- Single Site (IMSPlex)
  - Shared Queues
  - XRF
  - Storm Drain
  - Data sharing
- Multi Site
  - XRC/PPRC
  - RSR

IMS: 40+ years of Investment Protection and Continuous Improvement

IMS 9

- HALDB On-line reorg
- Improved RACF security
- Reduced Installation and Sysgen effort
- Enhanced IMS log analysis, restart. recoverability

End of Service Nov 7, 2010

IMS 10

- Dynamic Resource Definition
- Improved Operations management, audit trail
- Enhanced installation, serviceability, recoverability, utilities

End of Service Nov 12, 2012

IMS 11

- Optimized DB Connectivity for Ultra-High Availability and Resilience
- New Commands and User Exit Management to Facilitate Operations and Heighten Availability
- Secured Investment

GA Oct 30, 2009

IMS 12

- Improved Operations management, audit trail
- Improved Full Function and Fast Path buffer pool management
- Improved Scalability

GA Oct 28, 2011

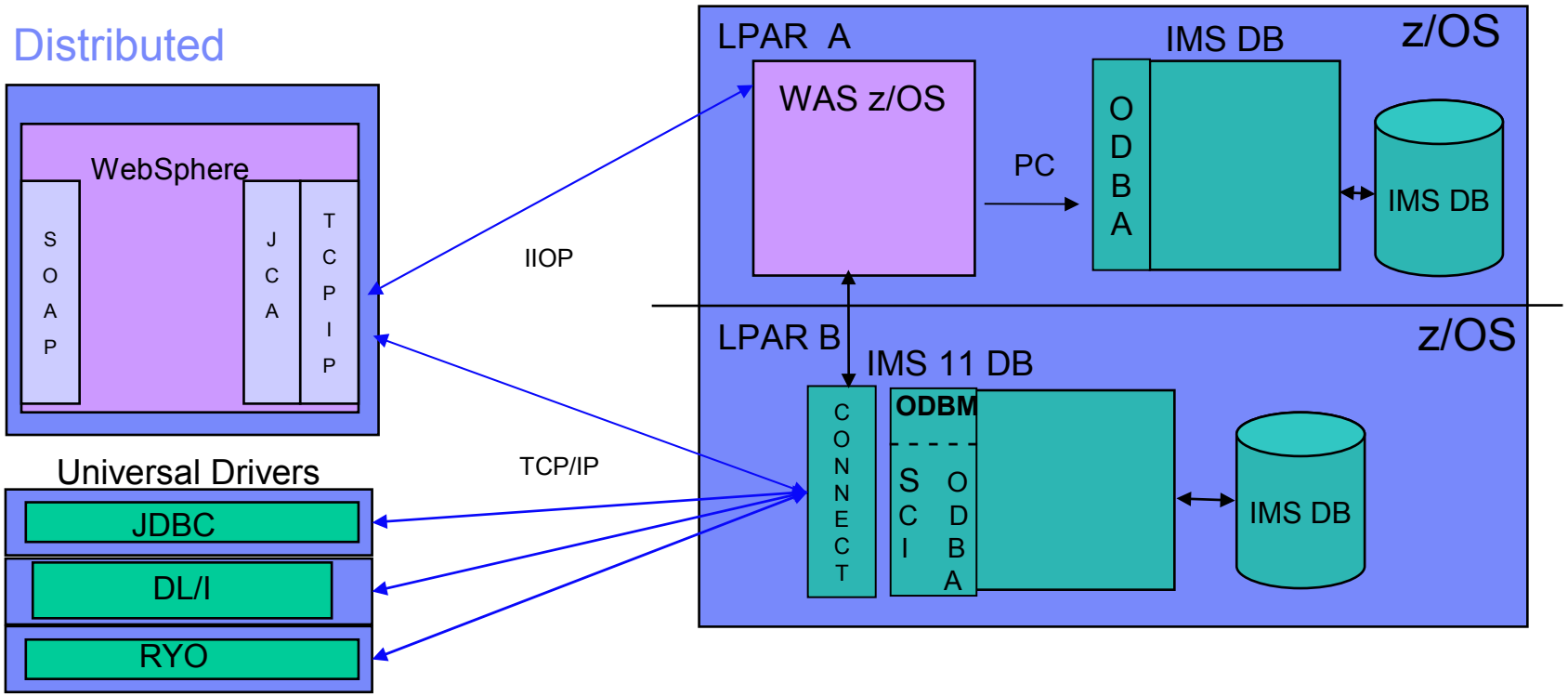
Agenda

- Background
- **IMS 11 Enhancements**
- IMS 12 Enhancements
- GDPS Active/Active Sites and IMS Replication

IMS 11 Database Server Enhances Availability and Reliance

- Business Flexibility: Eased Integration and Simplified Data Access
  - Direct, Distributed Access to IMS Data optimizes Connectivity for Ultra-High Availability and Resilience
- Simplification: Streamlined Installation and Management
  - New Commands and User Exit Management to Facilitate Operations and Heighten Availability
  - Advanced Syntax Checking for Rapid Installation
- Efficient Growth: Available, Reliable and Secure
  - 64-bit storage Use for Ultra-High Availability
  - and Overall Systems Performance
  - Secured Investment

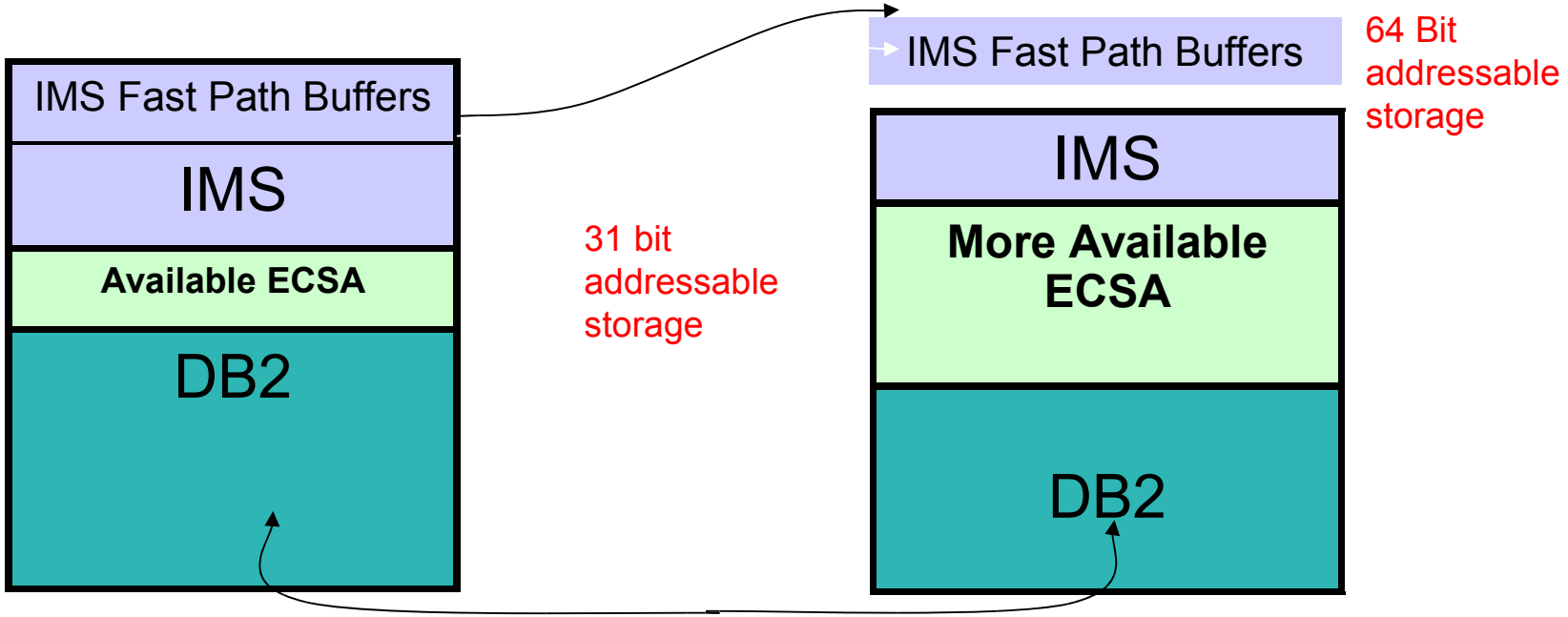
IMS 11: Business Flexibility and Enabling Resilience – with IMS Open Database support



Addressing businesses that rely on data stored in IMS that want:

- Direct, distributed access to IMS DB with language independent interfaces
- Ultra-high Availability through isolation of open IMS DB access components
- Broad Integration and Application Development, using standard, state of the art tooling
- Cost efficiencies, application growth, and resilience

IMS 11: Supporting Growth with Optimized Systems for Ultra High Availability



Addressing businesses with system storage constraints that want:

- Ultra high availability and overall system performance
  - Fast Path 64-bit Buffer manager loading data buffers into 64-bit storage
    - ECSA is being heavily used and many customer are running out of ECSA, causing system performance issues
    - Moving IMS Fast Path buffers to 64-bit storage frees up valuable ECSA
  - Application Control Block library loading ACB members into 64 bit storage
  - 64 bit storage used for tracking elements reduces use of Local System Queue Area

Simplifying Manageability for Availability and Resilience with IMS Tools for IMS 11/12 users

- Solution
  - IMS Database Solution Pack
  - IMS Fast Path Solution Pack
  - IMS Recovery Solution Pack
  - IMS Performance Solution Pack
  - IMS Configuration Manager
  - IMS Recovery Expert 2.1
- Value
  - Eliminate application downtime
  - Simplify change management for faster time to market
  - Improve/automate backup and recovery

= Faster ROI

Agenda

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- **IMS 12 Enhancements**
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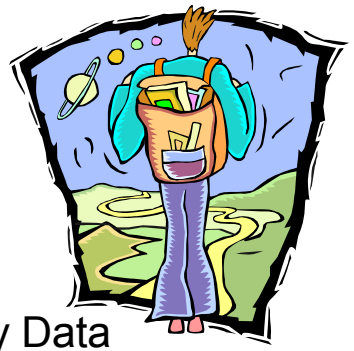
Continuing the Journey with IMS 12 DB … For Resilience, and Availability



APPLICATIONS

Business Challenge: Business Flexibility: Ease Integration and Simplify Data Access for Enriched data availability and resilience

Benefit/Solution: Extend open access and reuse of IMS data with Technological advancements, Industry Standard Tools/Interfaces, Expanded IMS Development Tools/Support to Modernize, Speed Deployment, Lower Costs, and Ease Use

OPERATIONS

Business Challenge: Simplification: Streamline Installation and Management

Benefit/Solution: Simplify Interfaces to Ease Operations, Heighten Availability, and Increase Productivity in managing data

- Dynamic Definitions and Simplified Interfaces
- Better Problem Analysis and Enhanced RAS

Business Challenge: Growth Enablement/Reduced Costs: Ensuring inhibitors to Reliability, security and Availability

Benefit/Solution: Autonomic Response, Recovery, and Tuning, Reduce Planned Outages, Expand Reliability, Diagnostics, to Ensure Resilience and Availability

- 64-bit Fast Path Buffer Manager support
- DB Recovery Control >32K buffer and additional Command enhancements
- Full Function (FF) Dynamic DB Buffer Pool, Enhanced Batch availability, Constraint Relief
- Fast Path (FP) Secondary Index Enablement

IMS 12 DB Resilience and Availability Highlights

Database Management

Full Function Database
- Extended Addressability Support (EAV) Support
- FF Dynamic DB Buffers
- FF DB Storage Enhancement
- Additional FF Enhancements

Fast Path
- FP Buffer Manager 64 bit Enhancements
- FP DEDB Secondary Index Enablement
- Additional FP Enhancements

DBRC
- DBRC Enhancements
- Migration/Coexistence

Systems Management

- IMS Repository and Usage for DRD Resources

- IMPORT Command Enhancement

- Logger Enhancements

- Syntax Checker Enhancements

- Extended Addressability Support (EAV) Support

Extended Address Volume Support

- Solution
  - Provide support for Extended Address Volumes for non-VSAM data sets (z/OS 1.12 and above) to satisfy growing DASD storage requirements.
  - Provide support for EAV for the following non-VSAM data sets:
    - Full Function Overflow Sequential Access Method (OSAM) data sets
    - IMS Online Log Data Sets (OLDS)
    - IMS Log Write Ahead Data Sets (WADS)
- Value
  - Provide relief to customers running out of z/OS addressable disk storage and alleviate disk storage constraints providing customers
  - with greater scalability to grow their business and ensure data availability

Full Function Dynamic Database Buffer Pools

- Solution
  - Provide for dynamic change to an OSAM or VSAM buffer pool without recycling IMS systems to pick up the change
  - Commands are used to Add, Change, or Delete FF Database Buffer Pools
  - Increase VSAM buffer pool limit

- Value
  - For buffer pool management, eliminate systems down time and improve systems availabilities
  - Flexibility with the ability to adjust DB buffers to business needs
  - Availability by being able to adjust DB buffers without stopping IMS

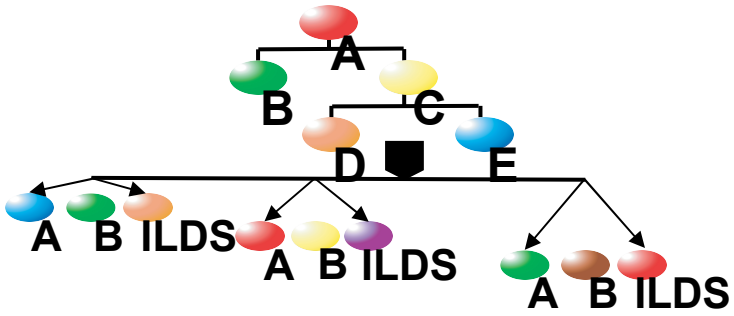
Full Function DB Storage Enhancement

- Solution
  - Storage for FF DB pools obtained in 31 bit virtual, backed by 64-bit real storage for DB Work pool, DMB pool, PSB CSA pool, DLI PSB pool, and PSB Work pool

- Value
  - Could reduce use of 31-bit fixed real frames, relieves 31-bit real storage constraint, and improve performance in managing PSBs in the pool
  - Customers with large Database pools who previously could not page fix these pools due to storage constraints may now be able to page fix due to an increase in available real storage

Additional Full Function Database Enhancements

- Solution
  - Display status of randomizers and partition selection exit routines
  - **Add diagnostic message for abend U3310 for long lock situation**
  - Save RACF user id in log type 9904 for batch jobs
  - **Improve reporting on batch U3303 and ABENDU0080 for open/close/EOV error**
  - **DLI Batch jobs will wait. not terminate, in the event of a Coupling Facility Switch**
  - HALDB Partition reuse
  - **Improve use of local DMB numbers**
  - Message DFS993I sent to system console



- Value
  - Scalability by reusing unused local DMB numbers
  - Serviceability by providing additional information
  - Availability by reuse of DMB numbers and eliminating of some hangs
  - Enhance the availability and usability for HALDB, OLR and batch users of IMS.

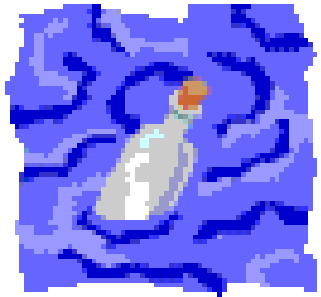
Fast Path 64-bit Enhancements

- Solution
  - FP subpools made more dynamic
    - Compression and pre-expansion
    - Resizing and cleanup
  - **Additional FP buffers are moved from ECSA to 64-bit storage**
  - Query Pool Type (FPBP64) command enhancements

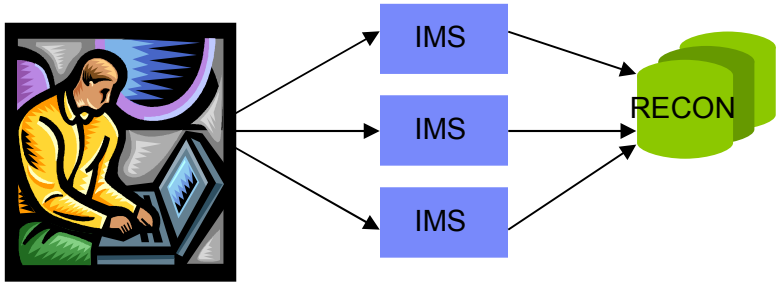
- Value
  - Reduce ECSA usage
  - Smarter usage of subpools

Additional Fast Path Enhancements

- Solution
  - **Issues messages to help Identify failing IMS data sharing systems for subsystem resource synchronization requests sent by a data sharing partner IMS system**
  - Optionally log the entire segment in 5950 record
  - Skip 9904 DLET record, or before image for 9904 REPL record
- Value
  - User can determine which IMS is non-responsive - Quicker response to a system hang
  - Can use full segment logging for disaster recovery tracking
  - Optional log reduction for 9904 data capture log records



DBRC Enhancements



- Solution
  - Remove the 32K output buffer constraint for DBRC LIST commands entered through the OM API.
  - Enhance the following DBRC commands:
    - **CLEANUP.RECON**
    - LIST.HISTORY
    - NOTIFY and CHANGE commands for IC, REORG, RECOV, and CA
    - INIT.CA
    - INIT.CAGRP, CHANGE.CAGRP
    - GENJCL
  - Add user data fields to the DBDS recovery records (IC, RECOV, REORG, and CA)
- Value
  - Improve the reliability, availability, maintainability, serviceability, and usability of DBRC and the RECON data sets.

IMS Repository and Usage for Dynamic Resource Definition (DRD) Resources

- Solution
  - Simplifies IMSPlex DRD resource management
  - **Provides a single centralized store for the DRD resource definitions**
    - Usage of IMS repository is optional. DRD users can continue to use RDDS instead of the repository.
  - Allows DRD resource definition changes to be made in repository and rolled to one or more active IMS systems
- Value
  - Simplified management of DRD resource definitions, reducing skills requirements
  - Eliminates the need for managing multiple Resource Definition Data Sets (RDDS) for each IMS

Agenda

- Background
- IMS 11 Enhancements
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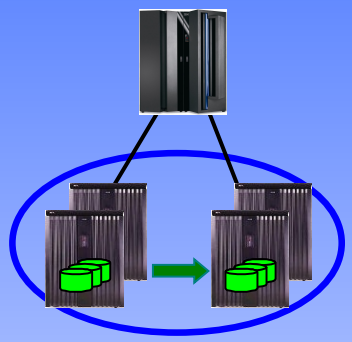
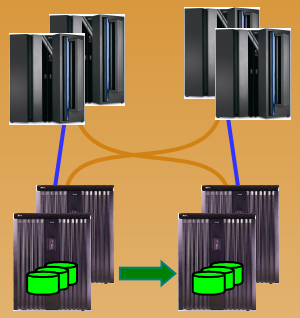
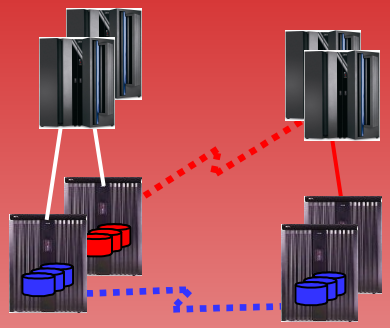
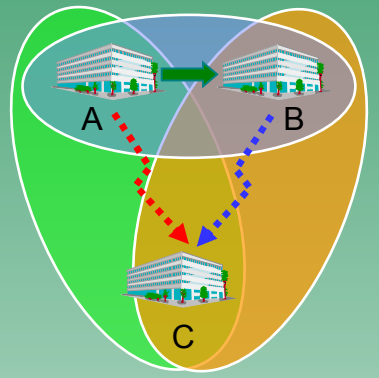
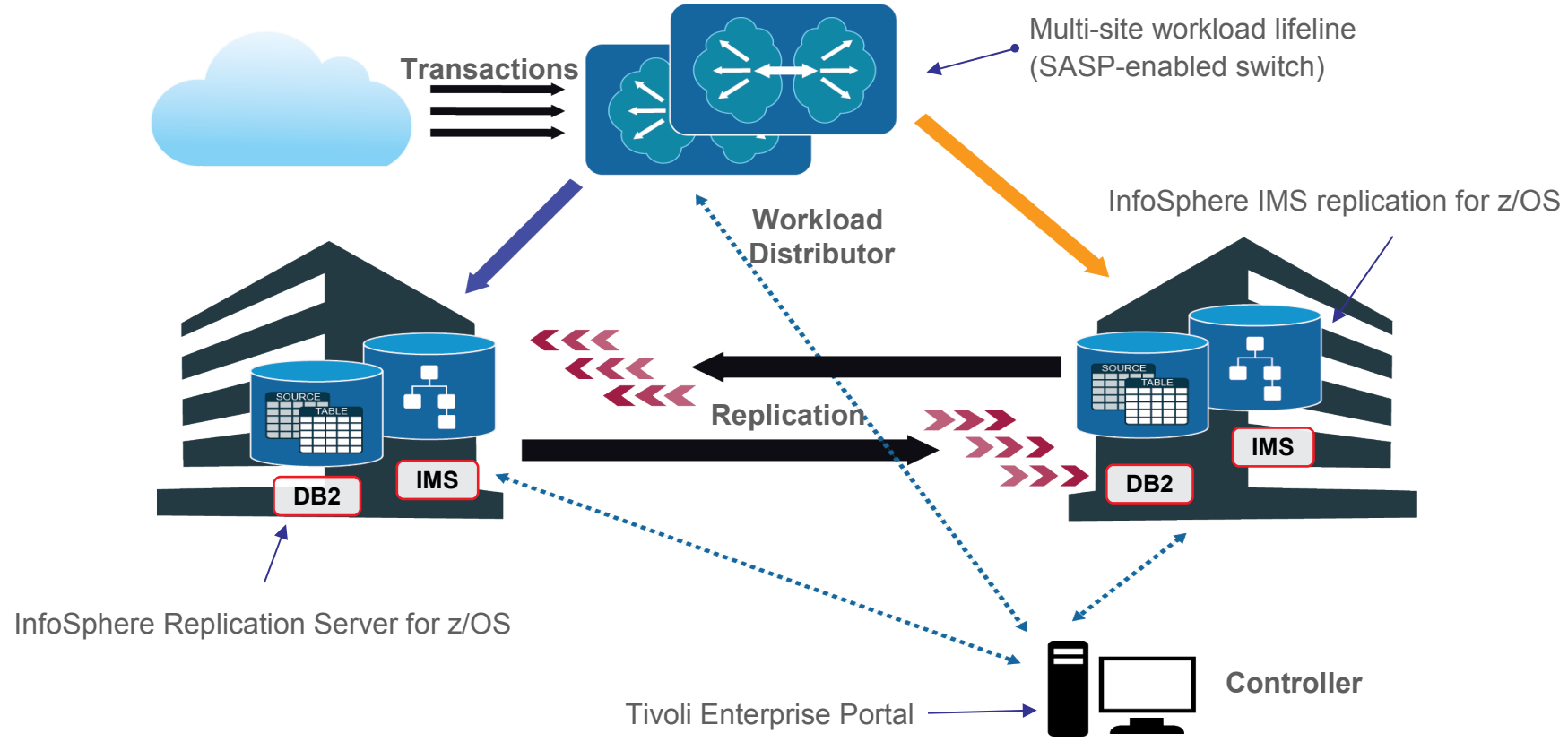
What are customers doing today ?

Continuous Availability of Data within a Data Center	Continuous Availability / Disaster Recovery within a Metropolitan Region	Disaster Recovery at Extended Distance	Continuous Availability Regionally and Disaster Recovery Extended Distance
Single Data Center **Applications remain active** **Continuous access to data in the event of a storage subsystem outage**	**Two Data Centers** **Systems remain active** **Multi-site workloads can withstand site and/or storage failures**	**Two Data Centers** **Rapid Systems Disaster Recovery with "seconds" of Data Loss** **Disaster recovery for out of region interruptions**	**Three Data Centers** **High availability for site disasters** **Disaster recovery for regional disasters**
			
GDPS/HyperSwap Mgr **RPO=0 & RTO=0**	**GDPS/PPRC** **RPO=0 & RTO<1 hr**	**GDPS/GM & GDPS/XRC** **RPO secs & RTO <1 hr**	**GDPS/MGM & GDPS/MzGM**

RPO – Recovery Point Objective
RTO – Recovery Time Objective

Active/Active Sites concept

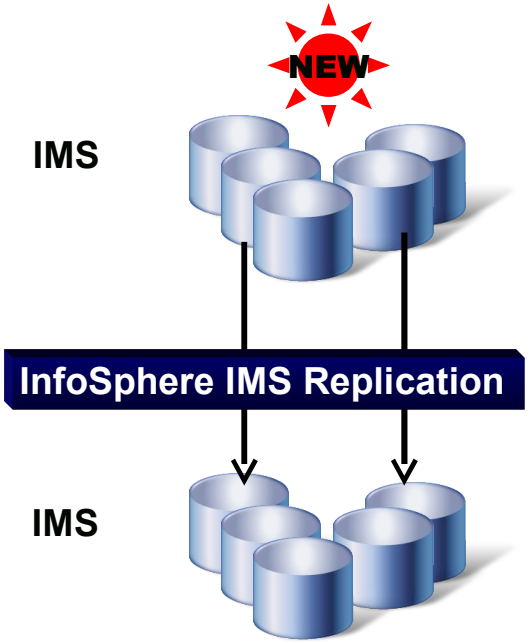


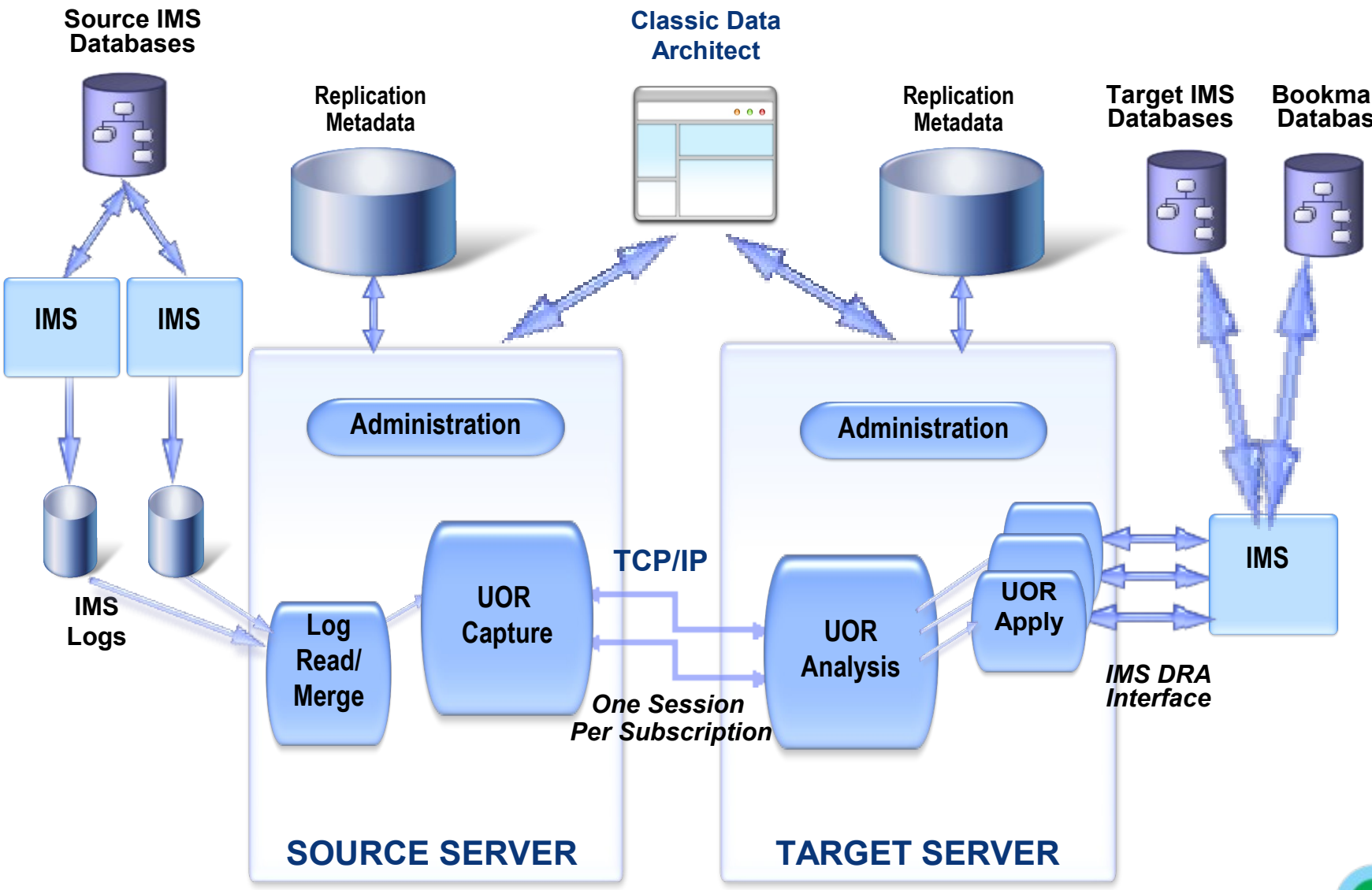
Two or more sites, separated by unlimited distances, running the same applications having the same data to provide:

- Cross-site Workload Balancing
- Continuous Availability
- Disaster Recovery
- Asynchronous Software replication

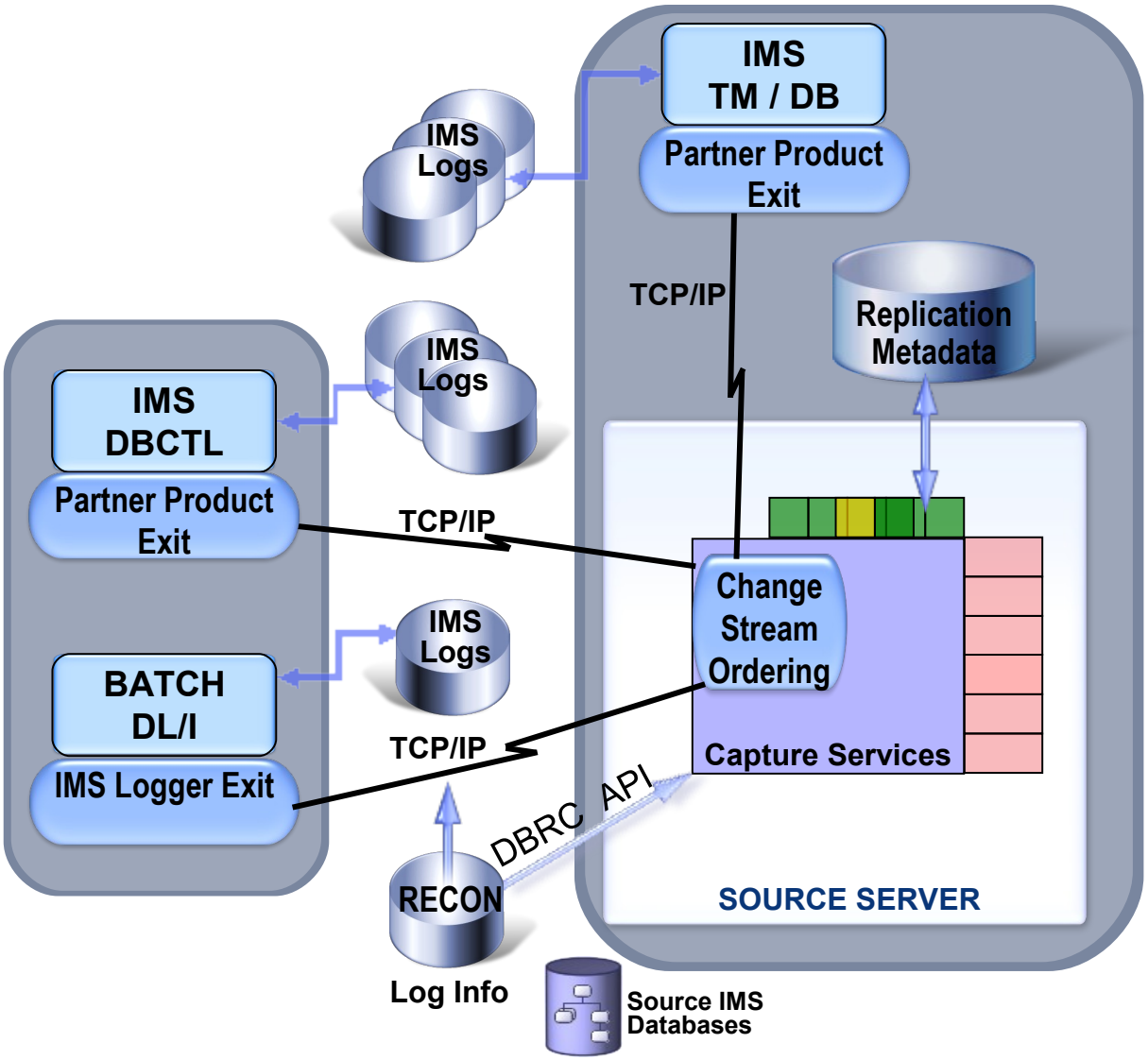
IMS Software-Based Data Mirroring
InfoSphere IMS Replication

- Unidirectional Replication of IMS data
  - All or nothing at DB level
  - Conflicts will be detected
    - Manual resolution will be required
  - External initial load of target DB
  - Basic replication monitoring
- IMS “Capture”
  - DB/TM, DBCTL, Batch DL/I
  - Capture x’99’ log records
    - Increase in log volume due to change data capture records
- IMS “Apply”
  - Uses IMS Database Resource Adapter interface
  - Serialization based on resources updated by unit of recovery
  - Uses bookmark DB for restart support
- Administration via Classic Data Architect & z/OS console commands



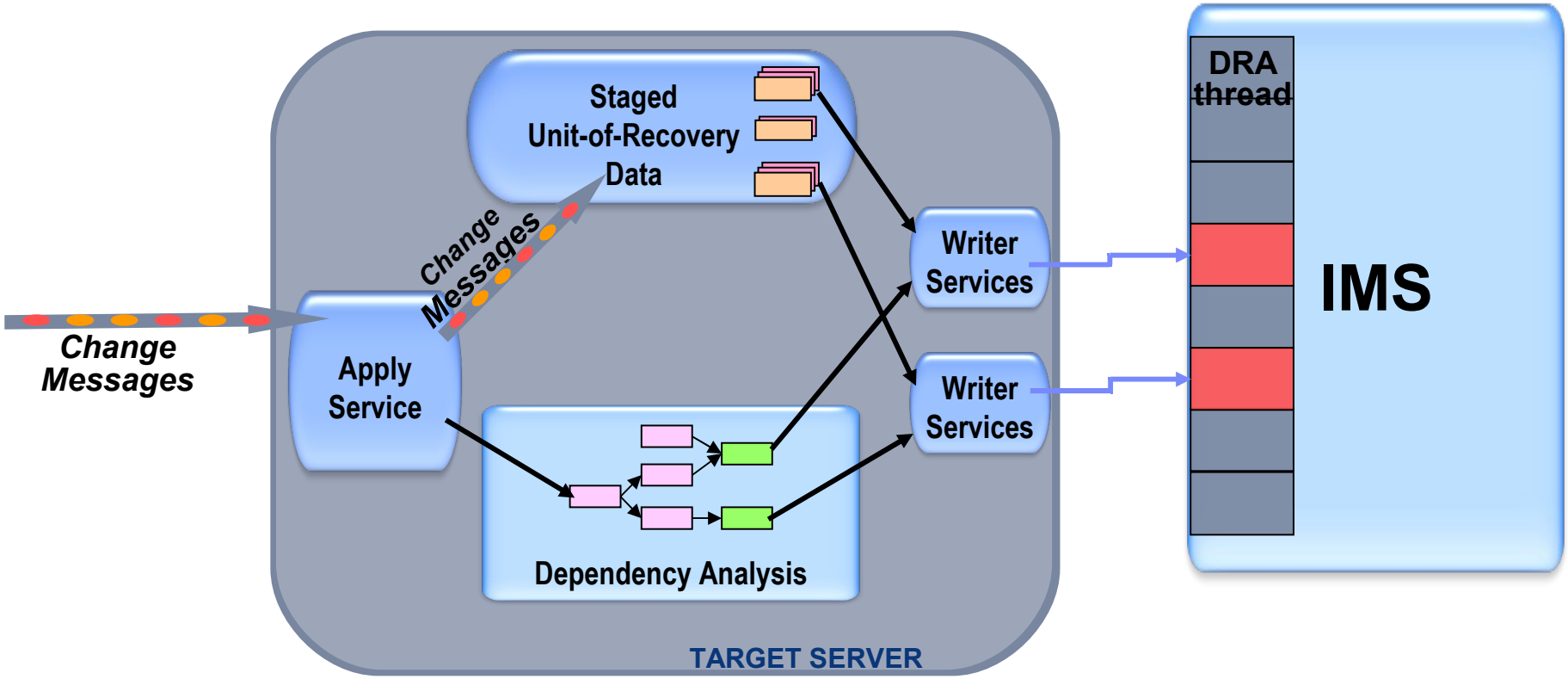

Source IMS Databases
Classic Data Architect
Replication Metadata
Replication Metadata
Target IMS Databases
Bookmark Database
IMS
IMS
Administration
Administration
IMS Logs
Log Read/ Merge
UOR Capture
TCP/IP
UOR Analysis
UOR Apply
IMS
IMS DRA Interface
One Session Per Subscription
SOURCE SERVER
TARGET SERVER

Some Data Capture Details



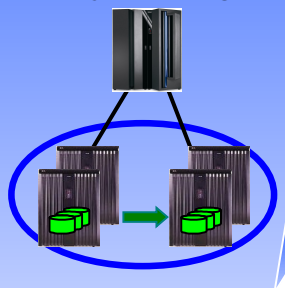
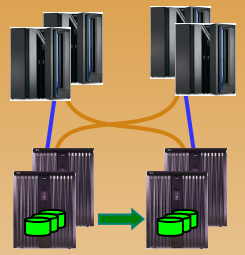
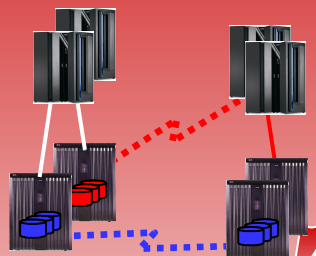
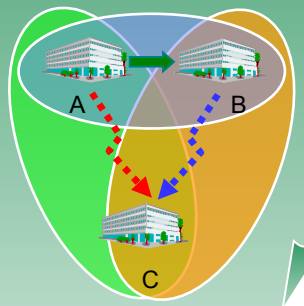
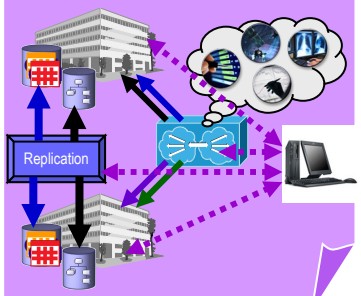
- User exits to notify server of new IMS instance
- Merge Waits for Batch DL/I to complete
- Idle IMS regions can slow processing

Some Apply processing details



- Parallelism based on dependency analysis within a subscription
- Database and root key used for analysis
- Conflict detection and adaptive apply
- Transactional consistency vs. Parallelism

The GDPS " Family "

Continuous Availability of Data within a Data Center	Continuous Availability w/ Disaster Recovery within a Metropolitan Region	Disaster Recovery at Extended Distance	Regional Continuous Availability w/ Disaster Recovery @ Extended Distance	Continuous Availability, Disaster Recovery, and Cross-site Workload Balancing at Extended Distance
GDPS/HyperSwap Mgr RPO = 0 / RTO = 0	**GDPS/PPRC** RPO = 0 / RTO <1hr (>20 km) RPO = 0 / RTO = 0 (<20 km)	**GDPS/GM & GDPS/XRC** RPO secs / RTO <1 hr	**GDPS/MGM & GDPS/MzGM**	**GDPS Active-Active Sites** RPO seconds / RTO seconds
Single Data Center Applications remain active Continuous access to data in the event of a storage subsystem outage	Multi-site workloads can withstand site and/or storage failures	**Two Data Centers** Rapid Systems Disaster Recovery with "seconds" of Data Loss Disaster recovery for out of region interruptions	**Three Data Centers** High availability for site disasters Disaster recovery for regional disasters	**Two or More Data Centers** All sites active
				
Components				
Tivoli – NetView, SAz System z, DS8K, PPRC GDPS control code, Services	**Tivoli** – NV, SAz, SA-MP, AppMan System z, DS8K, VTS, PPRC GDPS control code, Services	**Tivoli** – NV, SAz System z, DS8K, Global Mirror, XRC GDPS control code, Services	**Tivoli** – NV, SAz System z, DS8K, MGM, MzGM GDPS control code, Services	**Tivoli** – SA, NetView Multi-site Workload Lifelife DB2 &IMS replication System z, DS8K, Global Copy GDPS control code, Services

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