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Database Storage Management Techniques and Technology for High Availability

Paul Tsien
Product Manager
Systems Technology Group

Oracle, High Availability, and Storage

- Recent trends
 - “Everything” is on the Web and “everything” needs to be stored somewhere
 - Every business is eBusiness
 - eCommerce (B2B, B2C) is everywhere, all transactions need to be stored somewhere
 - 7x24 is becoming a must, data is being generated continuously
 - Storage is hot!

Why High Availability Is Important?

Time to lose a customer on
the internet

30 Seconds

All customers will become
internet customers

E-business cost of downtime
per second

\$1800

All businesses will
become E-businesses

Why Storage Is Important?

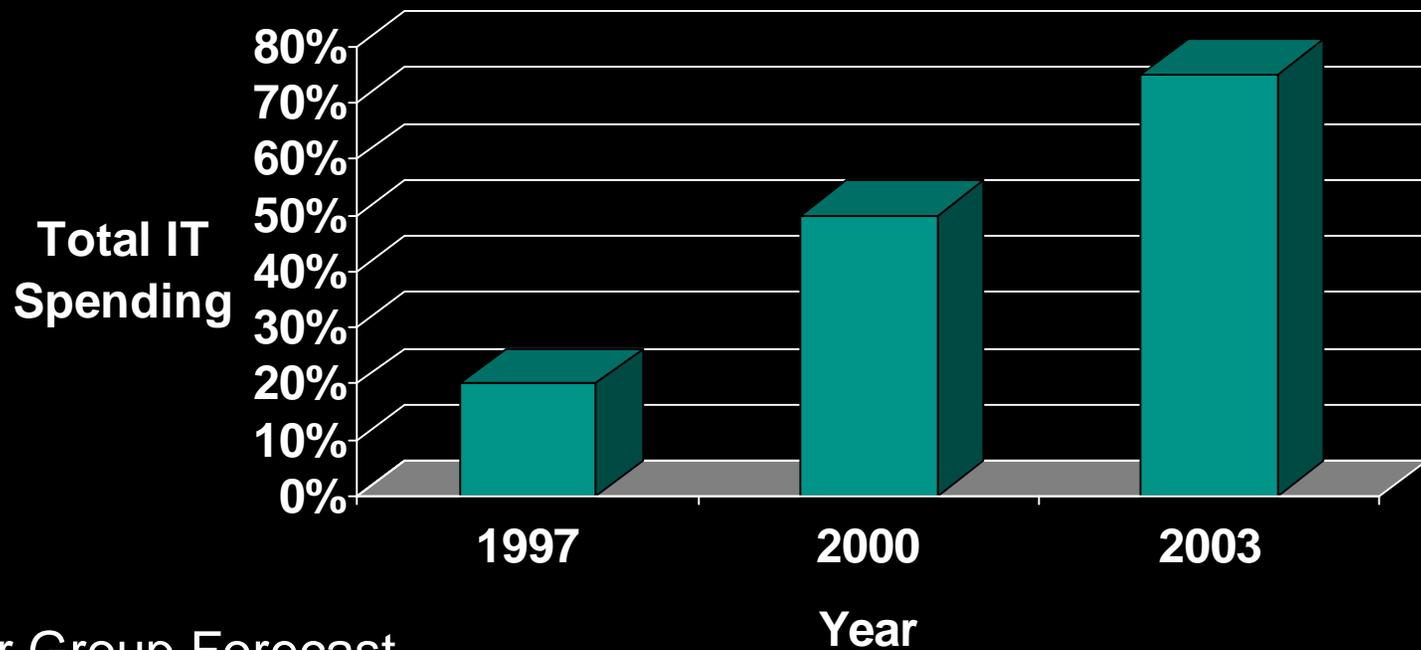
**Database cannot exist without
storage**

**Database Resides On
Storage!**

**Managing data and storage is what
Oracle does**

Storage Spending Is Growing Fast!

Storage Spending



Gartner Group Forecast

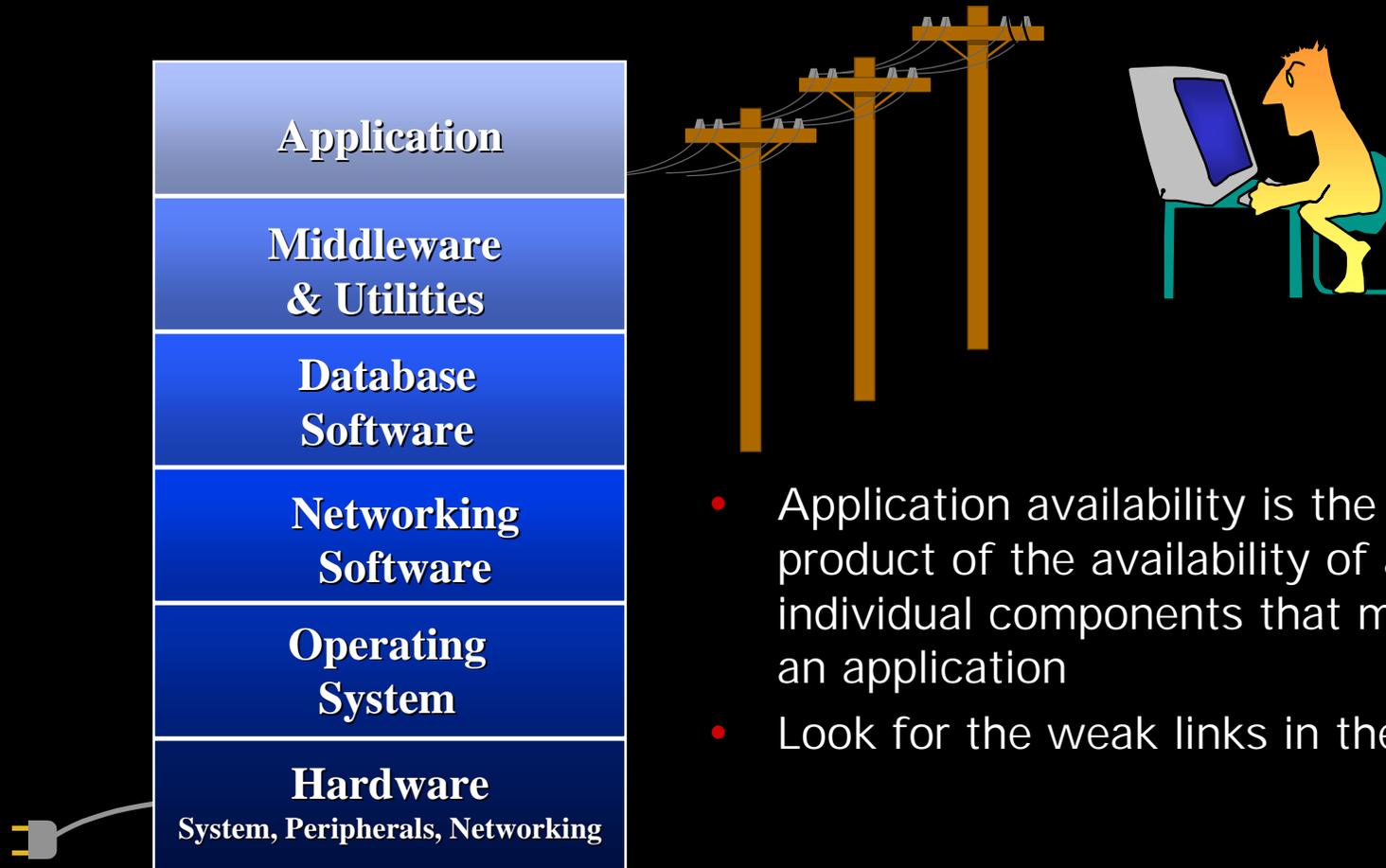
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Hardware and software can
be replaced!

Data is Irreplaceable!

Customer information,
sales records, etc.

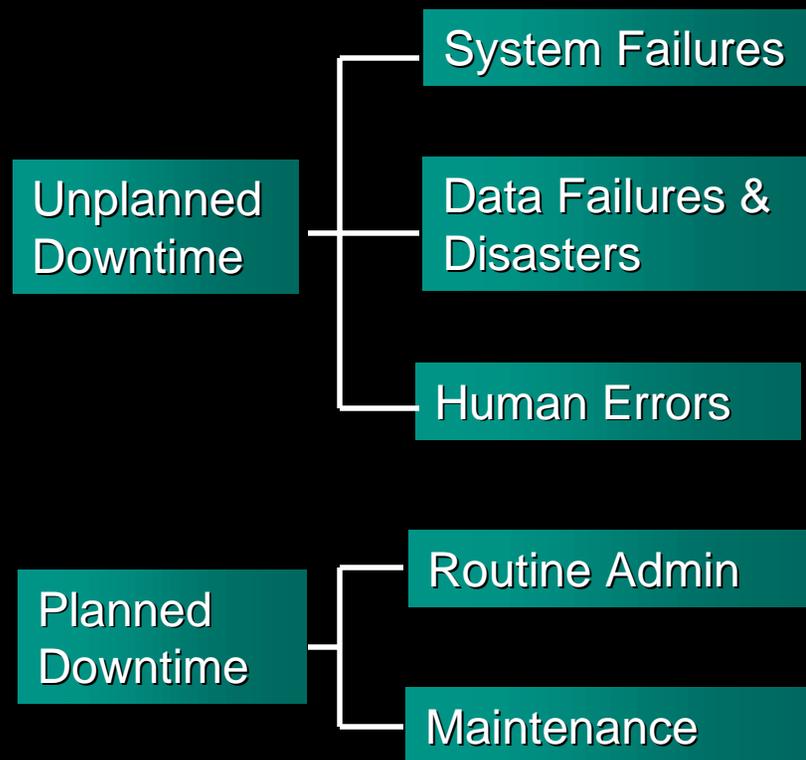
Application versus Component Availability



- Application availability is the product of the availability of all the individual components that make up an application
- Look for the weak links in the chain

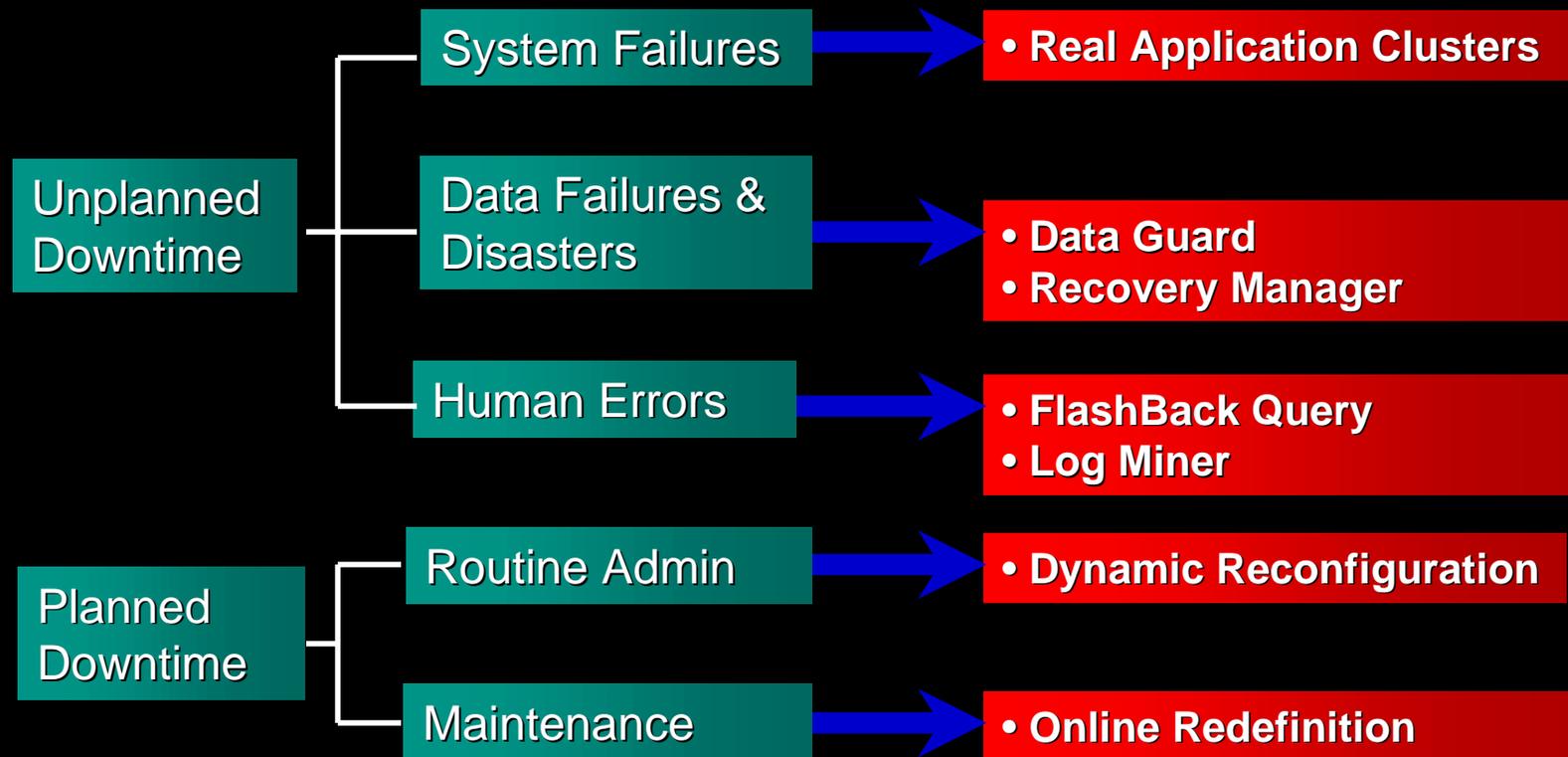
Oracle9i - Architected for Continuous Data Availability

- Causes of downtime



Oracle9i - Architected for Continuous Data Availability

- Oracle9i handles ALL causes of downtime



Oracle and Storage

- Storage was simple in the past
- Oracle deals with storage primarily from file perspective
 - Files system
 - Raw Partition
- Mostly SCSI direct attached disks (JBOD/disk array) or tape drives
- Oracle does not certify storage

Storage Is More Complex Now

- Sophisticated RAID systems with large amount of cache
- Storage appliances
- Fibre Channel, iSCSI, InfiniBand technologies
- Advanced volume managers and file systems
- Solid state disks
- Intelligence and cache are built into subsystems, controllers, hubs, switches or even disks

Storage Is Becoming More Independent and Autonomous

- Computing environment is heterogeneous
- Network Attached Storage (NAS)
- Storage Area Network (SAN)
- Storage Virtualization
- Storage as utility

Oracle And The New Storage Environment

- Oracle is working with industry standard organizations and leading storage vendors to deliver the best database/storage solutions in the industry!
 - Data integrity and availability
 - Interoperability
 - Performance
- Compaq, EMC, Hitachi, HP, IBM, NetApp, Sun, VERITAS, etc.

Oracle Storage Objectives

- Deliver world class database/storage solutions!
- Leverage Oracle's storage and I/O knowledge to enhance combined Oracle/storage solutions
 - Only Oracle knows how data will be accessed
 - ODM, OMF, BMR, etc.
- Use partners' storage technologies to complement Oracle capabilities
 - Remote mirroring, server-less backup, etc.
- Make storage management simple and easy
- Make Oracle and storage integration simple and easy
- Recommend and validate storage configurations

Oracle Storage Initiatives

- Oracle storage technology requirements
- Oracle storage management features
- Oracle storage APIs
- Oracle storage programs
- Oracle storage configuration projects

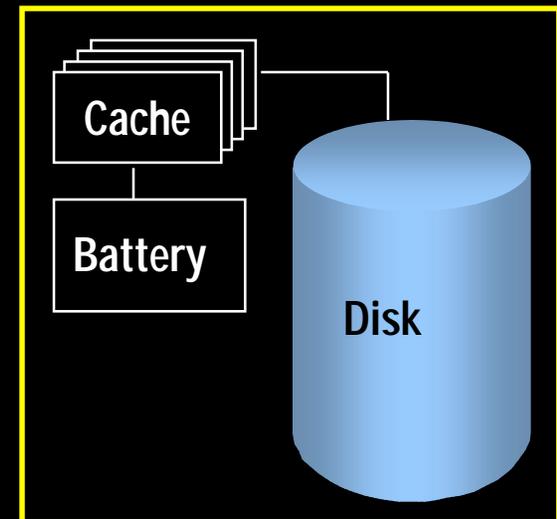
Oracle Storage Technology Requirements

- Cache and Non-Volatile RAM (NVRAM)
- Write ordering
- Atomic writes
- Other requirements

Oracle Storage Technology Requirements - Cache and Non-Volatile RAM (NVRAM)

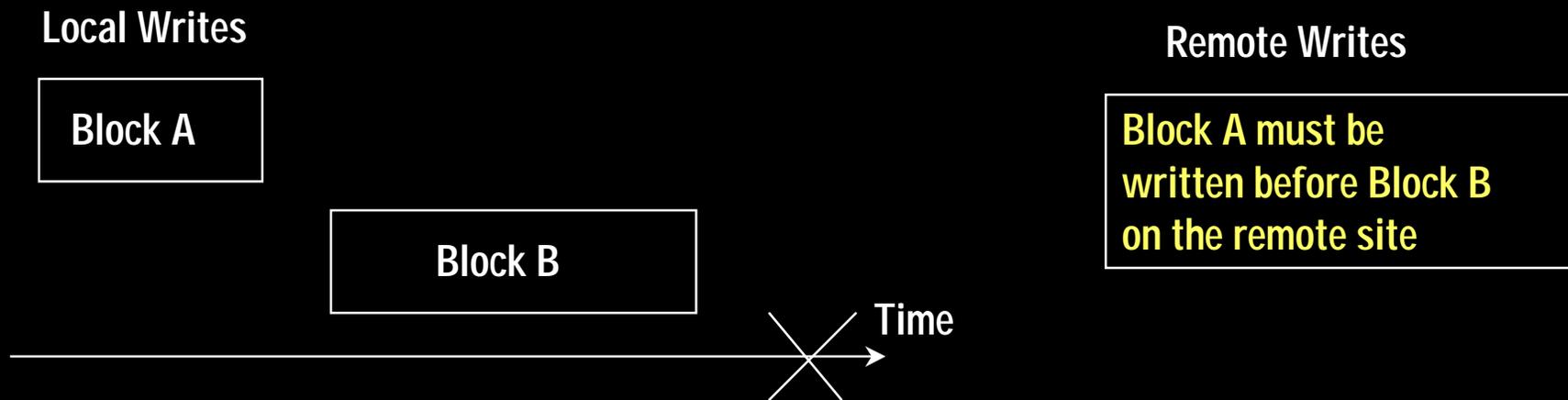
- Oracle treats storage subsystem cache and NVRAM as persistent (as part of the disk)
- If content of cache or NVRAM is lost, all storage associated with that cache or NVRAM must be considered lost
 - Battery failure
 - Accidental cache board swap
 - Software corruption of cache
 - Unlikely but they do happen!

Storage Subsystem



Oracle Storage Technology Requirements - Write Ordering

- In the database remote mirroring case, Oracle write order must be maintained (across multiple logical volumes and physical boxes)
- For example remote log write must happen before remote data write



Oracle Storage Technology Requirements -Atomic Writes

- Oracle requires 512 byte (a physical sector) atomic writes
- Size of an Oracle log block
- For example, after a power failure, Oracle needs the log for recovery
- Not a problem for direct attached storage

Oracle Storage Technology Requirements - Others

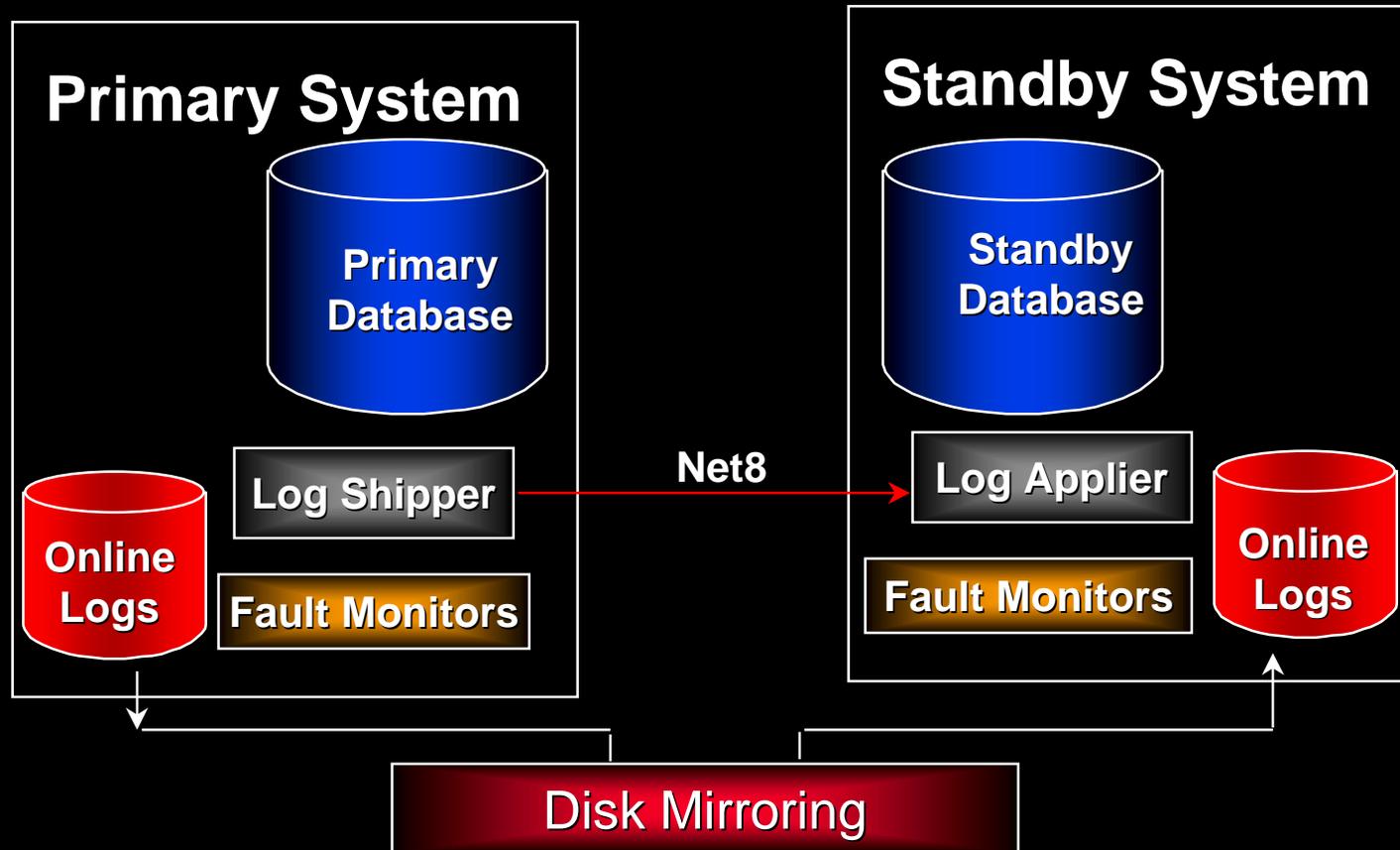
- Many implementation requirements
 - Oracle must be in hot backup mode for fuzzy backup
 - Can not use NFS client cache with OPS (no stale cache)
 - Async I/O implementation needs to be robust
 - Etc.

Oracle Storage Management Features

- Oracle Data Guard
- Oracle Managed Files
- Recovery Manager (RMAN)
- Oracle level storage management features
 - Automatic space management features
 - Online data reorganization and redefinition
 - Oracle Enterprise Manager (OEM)



Oracle Storage Management Features - Zero Data Loss with Oracle8i Data Guard



Oracle8i Data Guard maintains complete copy of Primary Database

Oracle Storage Management Features

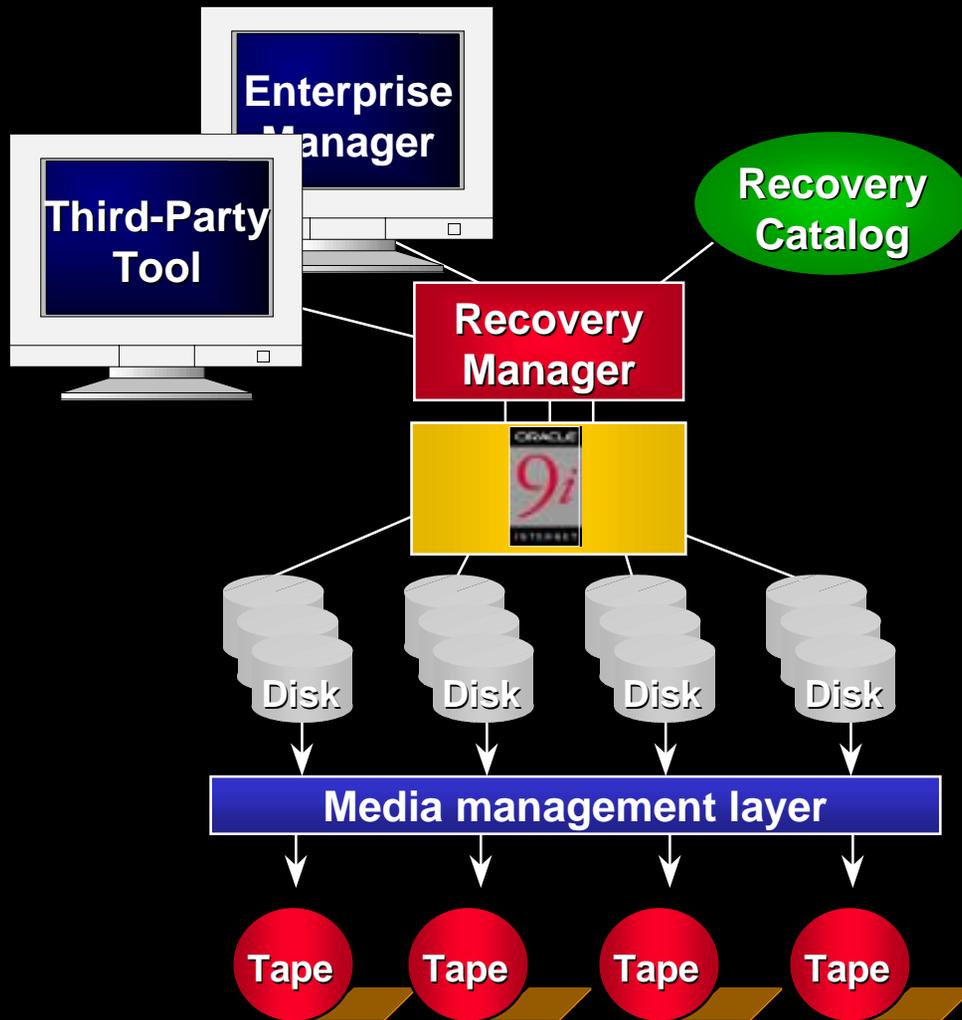


- Oracle Managed Files (OMF)

- Simplifies the administration of Oracle databases files
- Administrators specifies in terms of database objects
- Oracle automatically creates and deletes files as required
- Administrators can specify different locations for data files and online redo log/control files
- Third party applications need not embed OS specific file names in their scripts

Oracle Storage Management Features

Recovery Manager (RMAN)



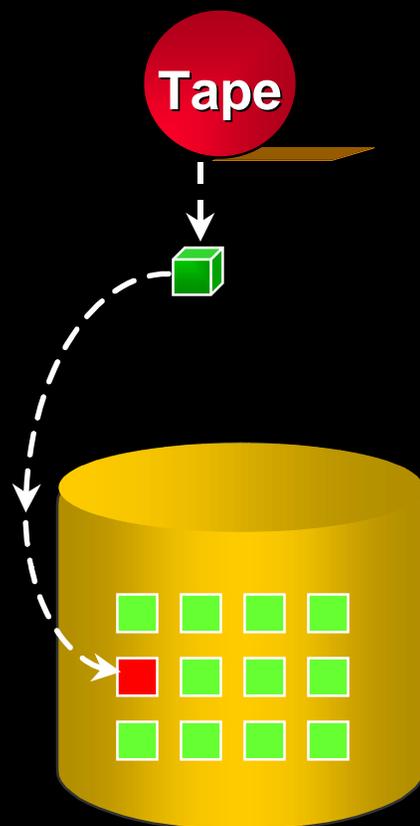
• Recovery Manager is a tool that:

- Manages the backup, restore, and recovery process
- Creates and maintains backup policies
- Catalogs all backup and recovery activities
- Many optimizations for improved availability and performance

Oracle Storage Management Features



- Block Media Recovery



- Increased data availability
 - Datafile remains online
 - Only blocks requiring recovery are inaccessible
 - Maximize data availability
- Reduce mean time to recover
 - Selectively restore and recover damaged blocks
 - Minimal I/O needed with redo only applied to damaged blocks
- Managed by Recovery Manager

Oracle Storage Management Features



- Automatic Space Management

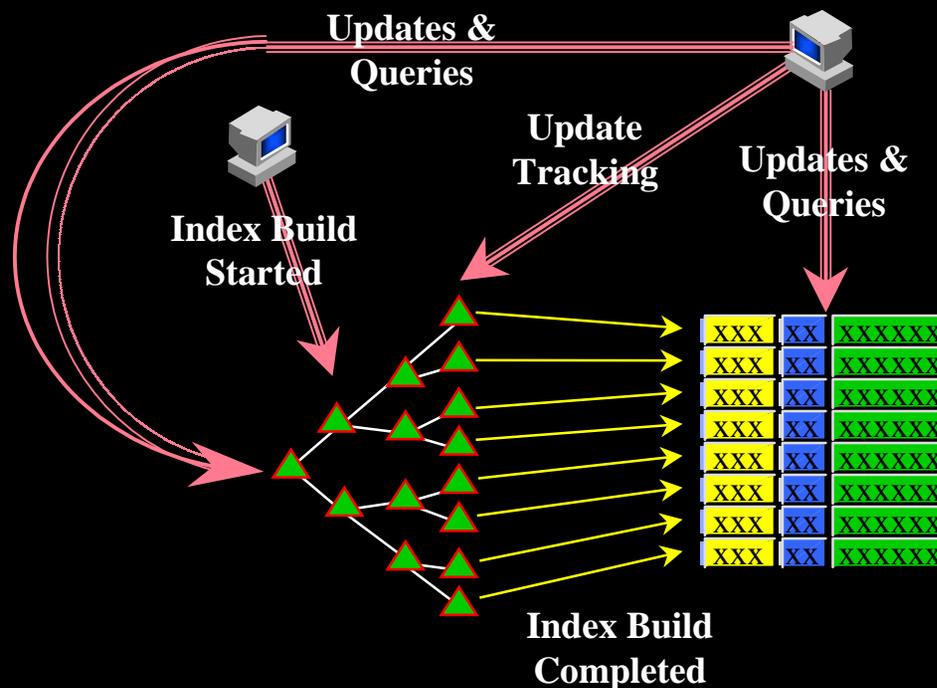
- Oracle manages space automatically with locally managed tablespaces (inter-segments)
 - Ease of use, elimination of fragmentation
- Automatic segment space management (intra-segments)
 - Dynamic space affinity to instances
- Automatic undo management

Oracle Storage Management Features

- Online Reorganization

- Unlimited Online Index Operations

- Create new index for any type of table or index
 - Secondary indexes on IOTs
 - Reverse Key, functional, compressed indexes
- Move or reorg existing index
- Move or reorg existing Index Organized Table

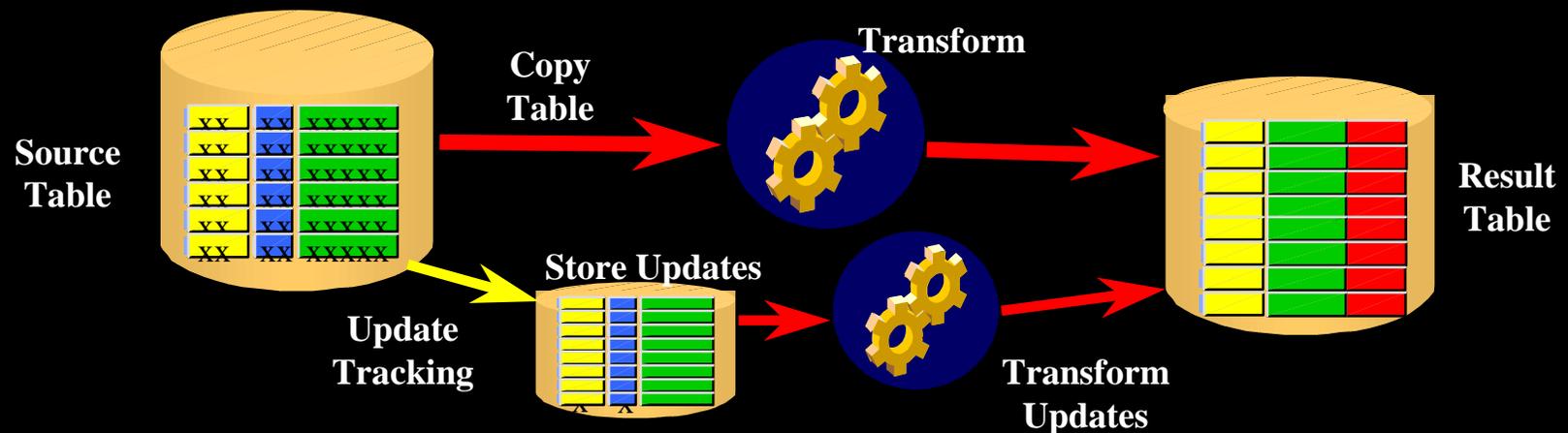


Oracle Storage Management Features



Online Table Redefinition

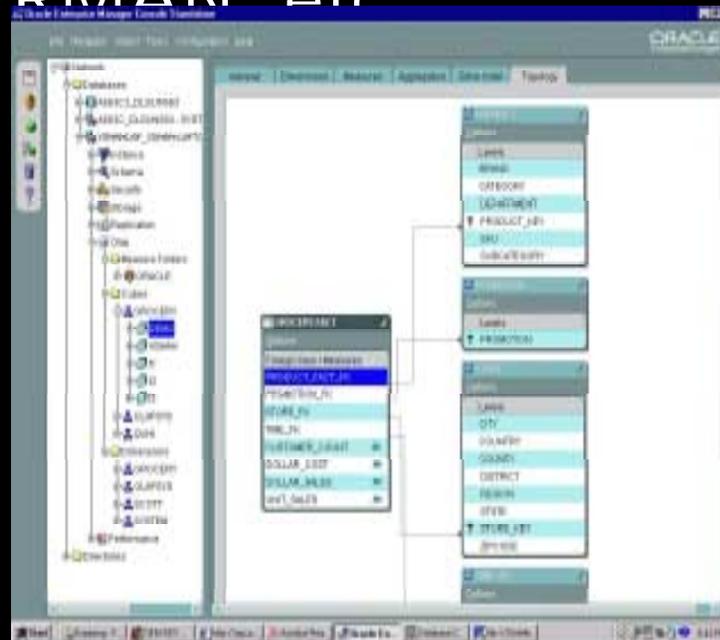
- Reducing planned outages
 - Table contents are copied to a new table
 - Eliminates fragmentation
 - Change location, table type, partitioning, parameters
 - Contents can be transformed as they are copied
 - Allows changes to columns, types, sizes, etc.
 - Updates and Queries can continue uninterrupted



Oracle Storage Management Features

- Oracle Enterprise Manager (OEM)

- Oracle GUI front end to space management, storage management, Data Guard, RMAN, etc



Oracle Storage Management Features

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Other

- HSM support
 - Read_only_open_delayed option
- Read-only tablespaces
 - Can be on WORM or CD-ROM
- Partitioning
 - Improve performance, availability and recoverability

Oracle Storage Management Features

- Other

- Transportable tablespaces
 - Mechanism to quickly move a tablespace from one Oracle database to another
 - Auto parts branch store receiving monthly catalog as CDs
- Heterogeneous data transfer
 - Import/Export
 - Replication

Oracle Storage APIs

- Media Management/Proxy Copy API
- Oracle Mirror Resilvering
- Oracle Disk Manager (ODM)
- Other Storage APIs

Oracle Storage APIs - Media Management/Proxy Copy API

- Also known as System Backup to Tape (SBT) API
- Defines the interface between Oracle's software (i.e. RMAN) and non-Oracle media management software packages
- API defines functions including:
 - Create backup files
 - Write to and read from backup media
 - Search and remove backup files
 - Server-less backup

Oracle Storage APIs - Oracle Mirror Resilvering

- Use for software disk mirroring
- How to recover mirror inconsistency? (For example, after a power failure)
- OS may need to copy the whole mirror
- Catch up of a large mirror may take a long time
- Leverage Oracle redo log to speed up resilvering of data files



Oracle Storage APIs - Oracle Disk Manager (ODM)

- Special interface from Oracle to 'files'
 - Raw performance with file system manageability
- Reduce system overhead by not requiring file open per each Oracle process
- Special locking modes prevent errors
- Batched async I/O issue and completion
- Allows dynamic resizing of files
- Can pass usage hints, priorities
- Automatic generation of unique file name - OMF
- Support Oracle mirror resilvering

Oracle Storage Programs

- Back Solutions Program (BSP)
- Oracle Storage Compatibility Program (OSCP)
- Other Storage Programs

Oracle Storage Programs - Backup Solutions Program (BSP)

- Recovery Manager - RMAN
 - Oracle's integrated backup and recovery tool
 - SBT interface - interface to tertiary storage
 - Proxy Copy - server-less backup
 - Oracle provides SDK to certify backup product interoperability with RMAN
 - Enterprise backup integration with RMAN
 - Web page of supported configurations

Oracle Storage Programs - Oracle Storage Compatibility Program (OSCP)

- Validate Compatibility of “Specialized” storage solutions with Oracle
 - Oracle over NFS - NAS
 - Remote Mirroring - primarily for log files
 - Snapshot technologies
- Process - architecture review, test kit, usage guide, web page of supported configurations
- A validation program only
 - Vendors self-test Oracle supplied OSCP test suites

Oracle Storage Configuration Projects

- Standard storage configuration
 - Stripe And Mirror Everywhere (SAME)
- High availability standard configuration and validation
 - Oracle Parallel Fail Safe (OPFS)
 - HP Server with HP SureStore XP or EMC disk array
 - Oracle8i Data Guard
 - Push button remote fail over and fail back to protect against corruptions, human errors and disasters

Standard Storage Configuration - SAME

- Standard methodology for configuring storage for Oracle databases
 - Optimal storage configuration made easy
- S.A.M.E. = Stripe And Mirror Everything
 - Specific details and methodology described in white paper
- Storage subsystem improvements can enable wide spread usage of the SAME
- Joint testing and white paper on specific storage stacks

Summary

- Oracle and partners continue to deliver world class database/storage solutions!
 - Oracle storage technology requirements
 - Oracle storage management features
 - Oracle storage APIs
 - Oracle storage programs
 - Oracle storage configuration projects

Useful URLs

- Oracle high availability and storage management technical white papers
 - <http://technet.oracle.com/deploy/availability/>
- Oracle Storage Compatibility Program (OSCP)
 - <http://www.oracle.com/ip/deploy/database/storage/>
- Oracle Backup Products
 - <http://www.oracle.com/ip/deploy/database/features/recovery/index.html?content.html>

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