PA102 – High Availability for SAP Solutions

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Learning Objectives

As a result of this lecture, you will be able to:

- Identify single points of failure (SPOF) within your SAP system and know measure to eliminate them
- Know high availability options for databases
- Understand the basic principle of a fail-over cluster
- Know basics about recovery / disaster recovery
- Know reasons for planned downtimes and SAP's approach to decrease them
- Know built-in load balancing facilities to make use of redundant components
- Know high availability configurations for SAP NetWeaver
- Find detailed information provided by SAP about high availability

Agenda

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Causes for Downtimes and Measures

Unplanned Downtime	Planned Downtime

Unplanned Downtime

HW, OS failures, disasters 20%

application failures 40%

operator errors 40%
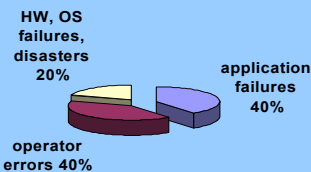
Source: Gartner Group

Planned Downtime
- ■ System and infrastructure maintenance
- ■ Patches, upgrades, transports
- ■ ...

■ Hardware, OS, environment failures, disaster impact to be avoided by *eliminating Single Points of Failure* (SPOF)

■ "Human errors" (= 80% of downtime causes) to be addressed by *ease of system management* and with improved *change* and *problem management processes*

■ To be avoided with scalable components which enable rolling maintenance

■ Improved upgrade processes

■ Proven correction and transport system

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Agenda

Overview

How to avoid unplanned downtimes
- **Overview**
- **Points to be protected for SAP Web AS**
- **High availability for databases**
- **Clustering**
- **Standalone enqueue service**
- **High availability for SAP Web Application Server Java**

Recovery

How to decrease planned downtimes

High availability configurations for SAP NetWeaver
- **SAP Enterprise Portal**
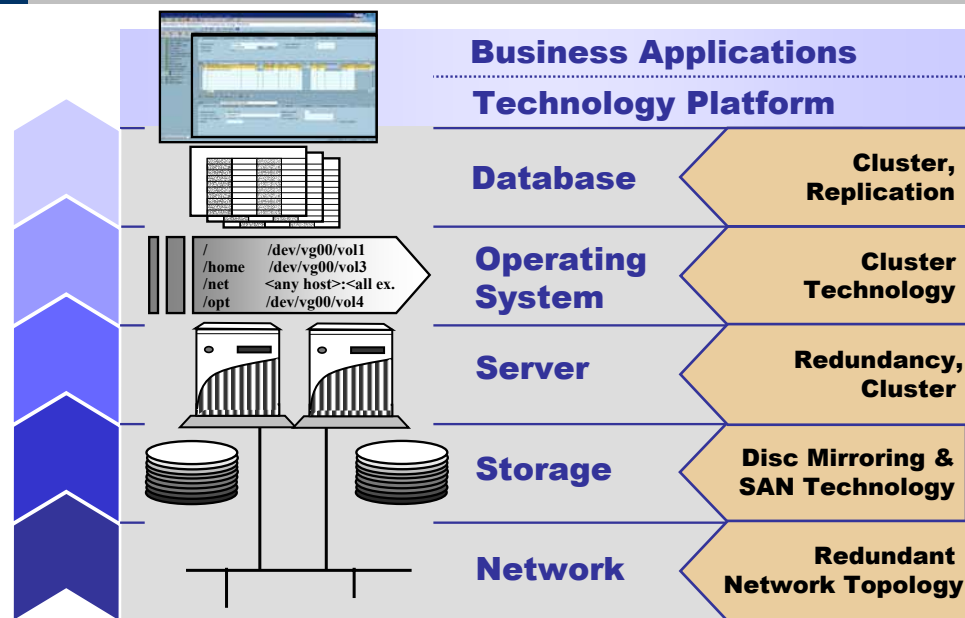- **SAP Exchange Infrastructure**

Summary

Protecting Against Unplanned Downtime

Business Applications

Technology Platform

Database	Cluster, Replication
Operating System	Cluster Technology
Server	Redundancy, Cluster
Storage	Disc Mirroring & SAN Technology
Network	Redundant Network Topology

```
/        /dev/vg00/vol1
/home    /dev/vg00/vol3
/net     <any host>:<all ex.
/opt     /dev/vg00/vol4
```
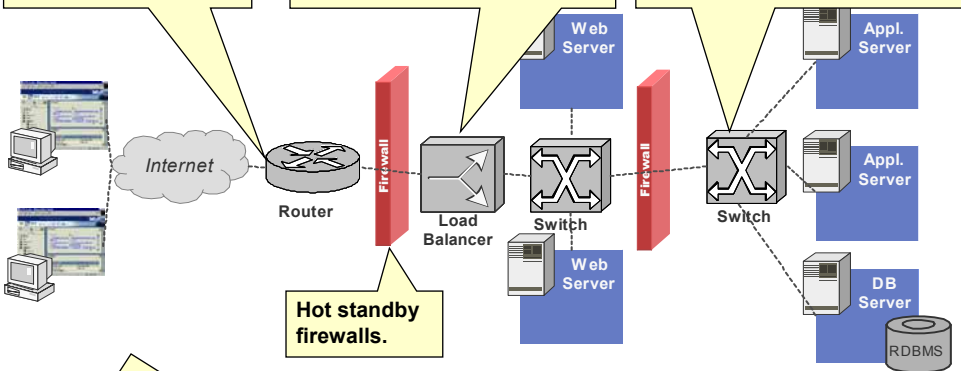
Network

Redundant network provider connections. Redundant routers.

Load balancing to access redundant servers. Load balancer has to be redundant.

**Redundant switches. Redundant network access for servers (cluster might be required).**

Web Server

Appl. Server

Internet

Router

Firewall

Load Balancer

Switch

Web Server

Firewall

Switch

Appl. Server

DB Server

RDBMS

Hot standby firewalls.

Further network related services to be considered: DNS, Mail, Directory Server, Domain Controller, …

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Storage Area Networks / Network Attached Storage

FCS

SCSI Protocol

SAN

NAS Gateway
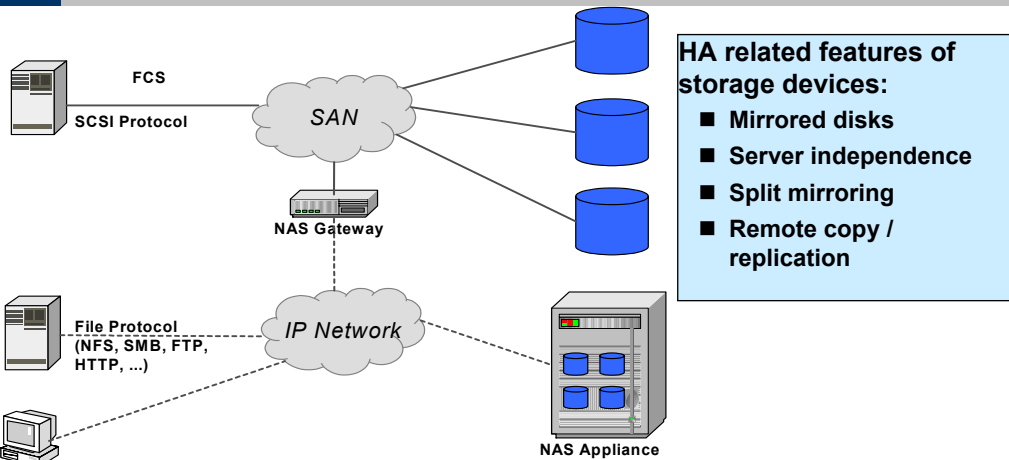
HA related features of storage devices:

- **Mirrored disks**
- **Server independence**
- **Split mirroring**
- **Remote copy / replication**

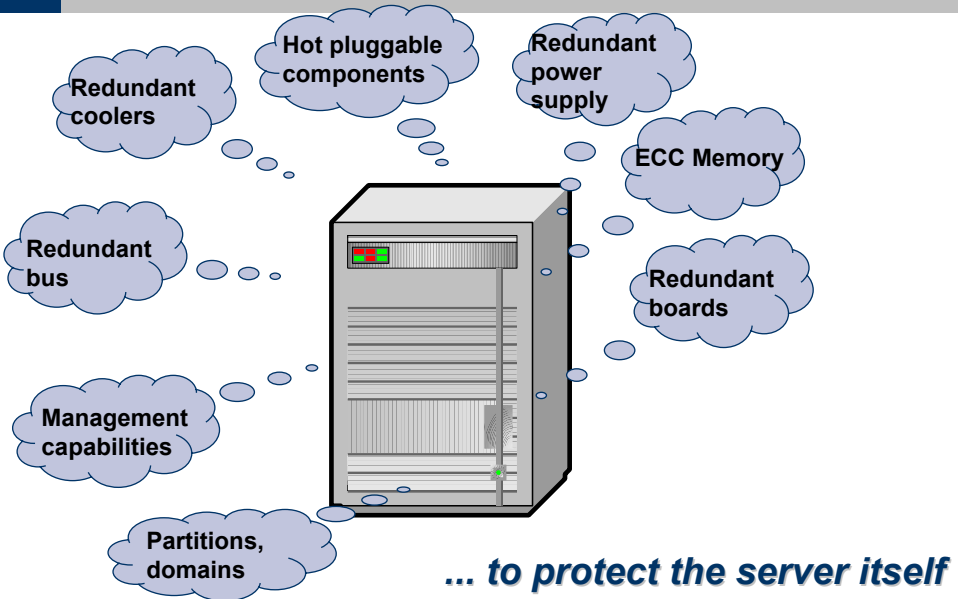File Protocol (NFS, SMB, FTP, HTTP, ...)

IP Network

NAS Appliance

RAID (redundant array of inexpensive/independent disks) is used to protect the disks itself, e.g.:

- **RAID 1 – mirroring and duplexing**
- **RAID 5 – independent data disks with distributed parity blocks**
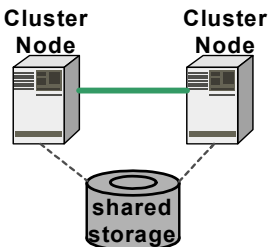
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High Availability Features for Server Hardware

Hot pluggable components

Redundant coolers

Redundant power supply

ECC Memory

Redundant bus

Redundant boards

Management capabilities

Partitions, domains

... to protect the server itself

Overview of HA Options for Databases

One Database

Cluster Node   Cluster Node

shared storage

Two Databases

DB

Replication

Standby DB

- ■ Clustering alternatives: „shared nothing" vs. „shared everything"
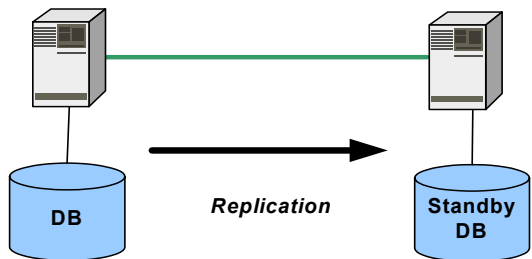
- ■ Replication on database level
- ■ Replication on storage level

- ■ Combination of the options

Oracle 9i Real Application Cluster

Oracle9i provides a scalable, high availability architecture that provides transparent client fail-over capability

- **Little or no user downtime**
- **Applications and users are automatically and transparently reconnected to another system**
- **Queries continue uninterrupted**

If a node fails, users will be migrated.
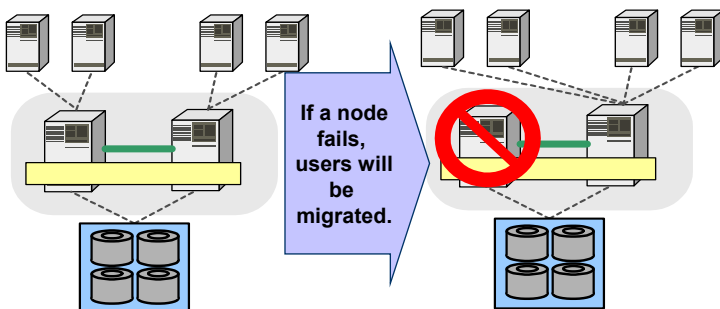
Highly available shared file system required for software and data files

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Failover Cluster Example:
MSCS Setup for SAP Systems

One node runs the database, the other node runs the central instance.

The applications are accessed via virtual IP addresses and host names.

SAP	10.0.0.6
Cluster	10.0.0.5
Node A	10.0.0.3

Public Network

DB	10.0.0.7
Node B	10.0.0.4

Cluster Node A

OS DB Exe.

Cluster SW

CI

10.0.0.1

Cluster Interconnect (Heartbeat)

10.0.0.2

Cluster SW

DB

Cluster Node B

OS DB Exe.

Currently owns

Quorum disk

Data

SAP

Logs

Shared Disk Storage

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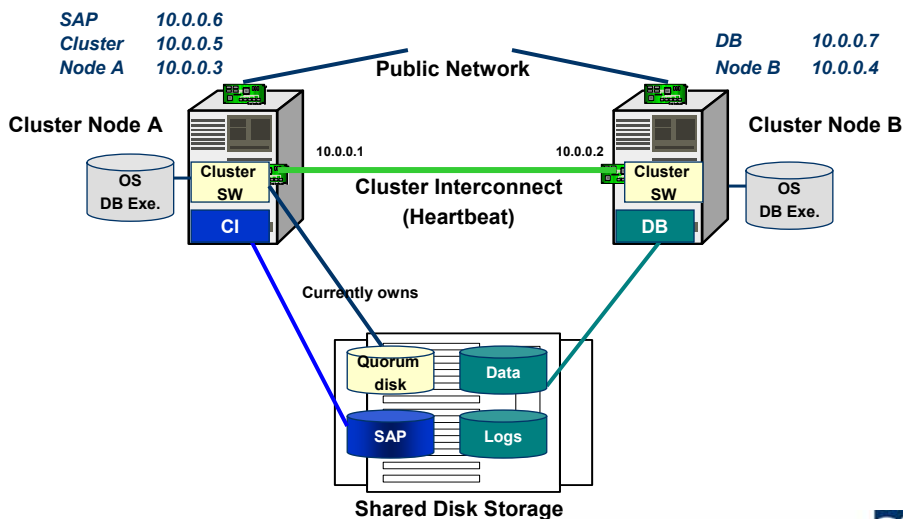
Scenario: Complete Failure of the CI node

1.
The CI node fails.

2.
The cluster SW detects the failure.

Cluster   10.0.0.5
SAP   10.0.0.6
DB   10.0.0.7
Node B   10.0.0.4

Node A   10.0.0.3

Public Network

Cluster Node A

Cluster Node B

OS
DB Exe.

Cluster SW

10.0.0.1

10.0.0.2

Cluster SW

Cluster Interconnect (Heartbeat)

DB

CI

OS
DB Exe.

Currently owns

Quorum disk

Data

SAP

Logs

3.
Node B is configured with the virtual address of the cluster and the CI and gets access to the required disks. Then the CI will be restarted.

Shared Disk Storage

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Scenario: Complete Failure of the DB node

2.
The cluster SW detects the failure.

1.
The DB node fails.

DB   10.0.0.7
SAP   10.0.0.6
Cluster   10.0.0.5
Node A   10.0.0.3

DB   10.0.0.7
Node B   10.0.0.4

Public Network

Cluster Node A

Cluster Node B

OS
DB Exe.

Cluster SW

10.0.0.1

10.0.0.2

Cluster SW

Cluster Interconnect (Heartbeat)

CI

DB

OS
DB Exe.

Currently owns

Quorum disk

Data

SAP

Logs

4.
The application servers can automatically reconnect to the new DB host (using the virtual IP address).

3.
Node A is configured with the virtual address of the DB and gets access to the required disks. Then the DB will be restarted.

Shared Disk Storage

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Cluster – Summary

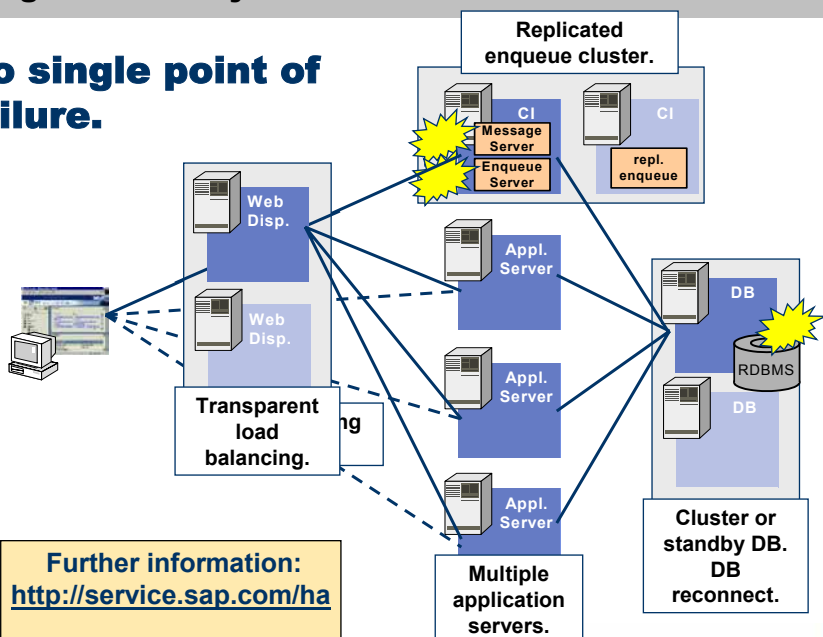| What a cluster provides…	Where a cluster does not help…
■ Mask server hardware failures ■ Mask OS errors on one node ■ Automatic restarts ■ Automatic failure detection	■ Move running applications without disturbance (only stop/restart) ■ (Disaster recovery - …requires two locations) ■ HA for horizontally scalable components (e.g. SAP application servers) ■ HA for disks (RAID required) ■ Logical data corruptions ■ Physical corruption of files ■ Having good knowledge in system administration

SAP recommends clustering for HA purposes.

No certification of cluster software by SAP.

Cluster software has to be supported by the respective vendor. (Exception: MSCS support by SAP)

High Availability for SAP Web AS

No single point of failure.

Replicated enqueue cluster.

CI — Message Server, Enqueue Server

CI — repl. enqueue

Web Disp.

Web Disp.

Transparent load balancing.

Appl. Server

Appl. Server

Appl. Server

Multiple application servers.

DB

RDBMS

DB

Cluster or standby DB. DB reconnect.

Further information:
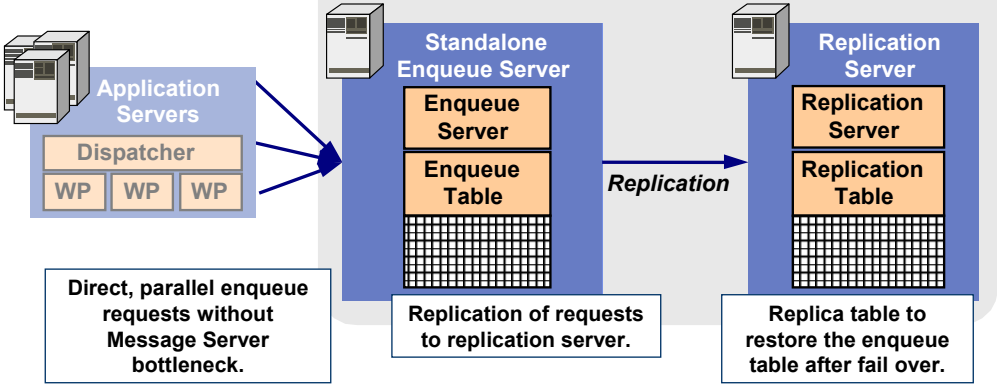**http://service.sap.com/ha**

Standalone Enqueue Service with Replication

Ready for pilot use. Requires 4.6D or 6.20 kernel.

Error detection and fail over by industry standard cluster solutions.

Failover cluster

Application Servers

Dispatcher

| WP | WP | WP |

Standalone Enqueue Server

Enqueue Server

Enqueue Table

Replication

Replication Server

Replication Server

Replication Table

Direct, parallel enqueue requests without Message Server bottleneck.

Replication of requests to replication server.

Replica table to restore the enqueue table after fail over.

For details on the availability of the standalone enqueue service check SAP Note 524816.

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SAP Web AS Java 6.20: Cluster Architecture

- **Deployment to all J2EE Engines in a cluster group**

- **Distributed configuration database (for JNDI and security settings)**

- **Transparent fail-over for stateless JSPs/servlets (no state synchronization)**

- **No transparent fail-over for stateful conversation**
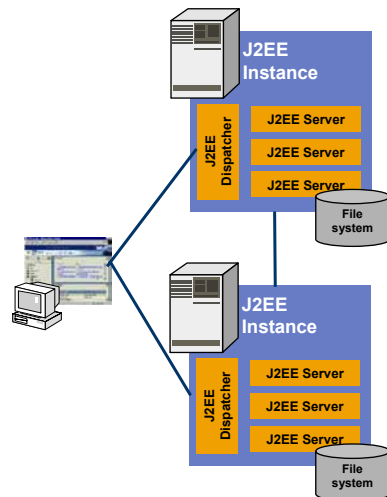
J2EE Instance

J2EE Dispatcher

| J2EE Server |
| J2EE Server |
| J2EE Server |

File system

J2EE Instance

J2EE Dispatcher

| J2EE Server |
| J2EE Server |
| J2EE Server |

File system

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SAP Web AS Java 6.30: New Cluster Architecture
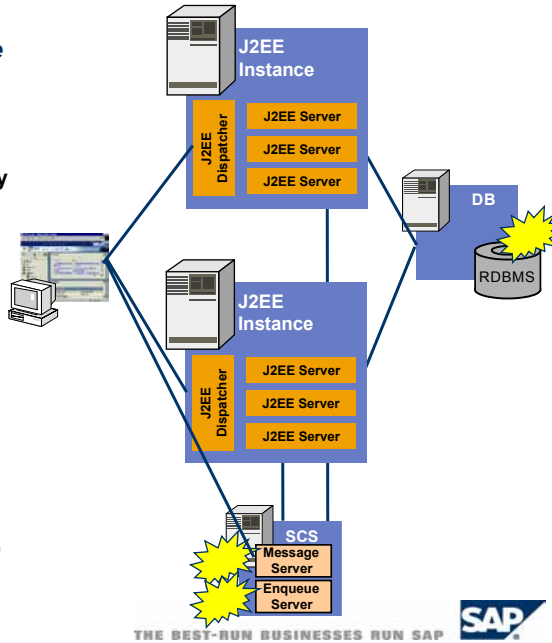
Design goals for the new Architecture

- **Better Scalability**
- **Better Performance**
- **Better Manageability**
- **Reuse of robust SAP base technology**
- **Better Integration with SAP Web AS ABAP**

New Cluster Components

- **SAP Central Services Instance (SCS)**
  - ◆ **Message Server**
  - ◆ **Standalone Enqueue Server**
- **J2EE Central Database**

New HA Feature

- **HTTP session failover (configuration option per application)**

J2EE Instance

J2EE Dispatcher

J2EE Server
J2EE Server
J2EE Server

DB
RDBMS

J2EE Instance

J2EE Dispatcher

J2EE Server
J2EE Server
J2EE Server

SCS
Message Server
Enqueue Server

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How to avoid unplanned downtimes

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Recovery

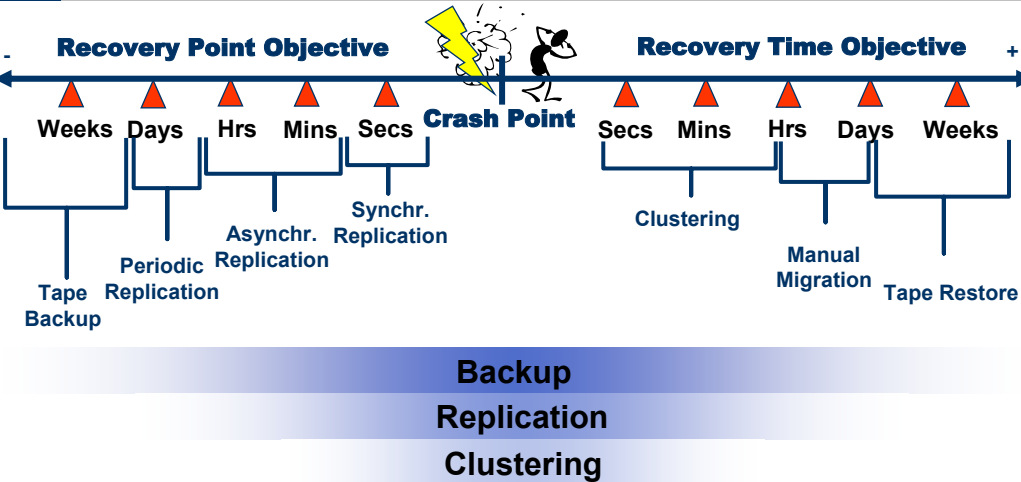**How to decrease planned downtimes**

High availability configurations for SAP NetWeaver

- **SAP Enterprise Portal**
- **SAP Exchange Infrastructure**

Summary

Overview of Recovery Technology

- Recovery Point Objective | **Recovery Time Objective** **+**

Weeks | Days | Hrs | Mins | Secs | **Crash Point** | Secs | Mins | Hrs | Days | Weeks

Synchr. Replication

Asynchr. Replication

Periodic Replication

Tape Backup

Clustering

Manual Migration

Tape Restore

Backup

Replication

Clustering

| To which point-in-time can I perform a recovery? | | Who long do I need for recovery? |

Backup / Restore in a System Landscape

Backup & restore of a single system component

- Prevent data loss
- Ensure recovery to current point in time (point of failure)
- Ensure data consistency between systems
- No impact on production systems caused by backup
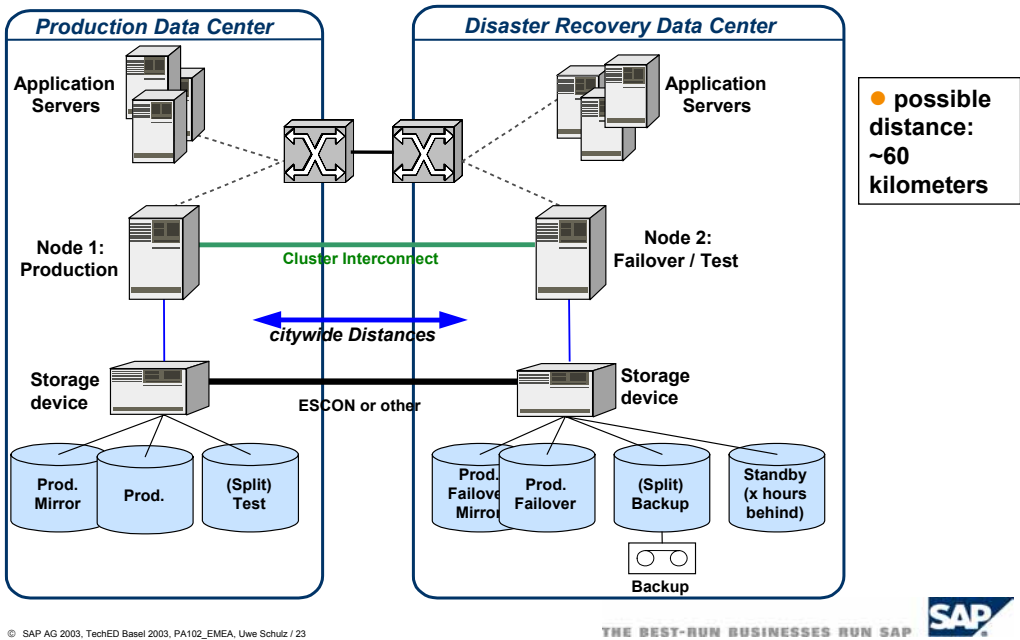- Fast backup/restore/recovery
- Easy handling

> **Further information:**
> **http://service.sap.com/atg**
>
> → **Backup & Restore**

Consistent backup & restore of the complete system landscape

- Synchronization points
- Consistent system copies
- (not easy to achieve)

Disaster Recovery – Sample Configuration

Production Data Center

Application Servers

Node 1: Production

Cluster Interconnect

Storage device

ESCON or other

citywide Distances

Prod. Mirror · Prod. · (Split) Test

Disaster Recovery Data Center

Application Servers

Node 2: Failover / Test

Storage device

Prod. Failover Mirror · Prod. Failover · (Split) Backup · Standby (x hours behind)

Backup

- possible distance: ~60 kilometers

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High availability configurations for SAP NetWeaver
- SAP Enterprise Portal
- SAP Exchange Infrastructure

Summary

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## Planned Downtime

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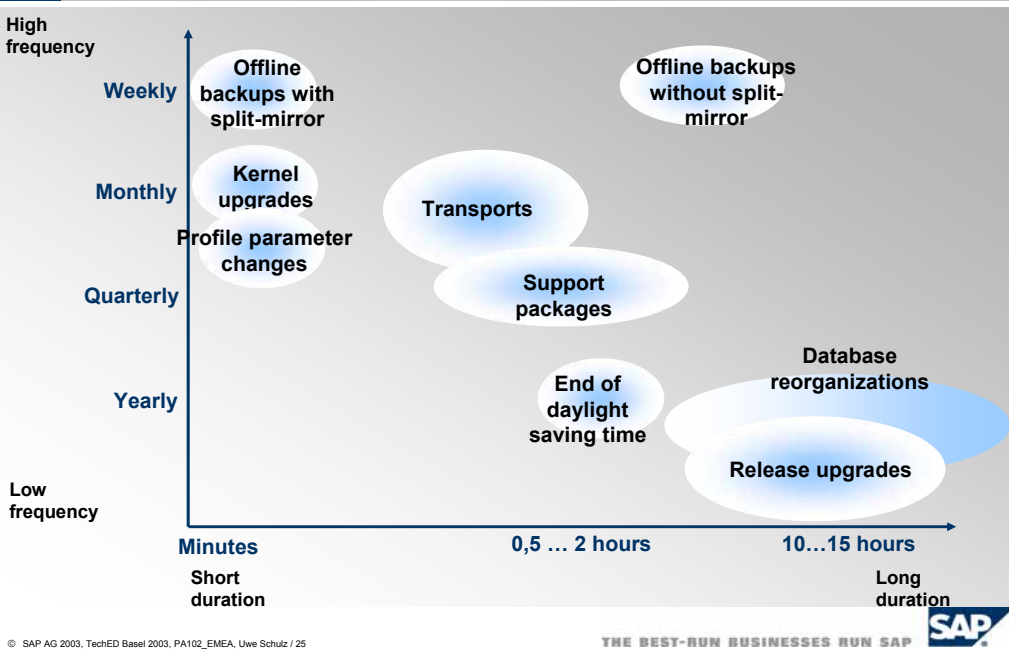
Parameter Changes / Operation Modes

Profile Parameter Changes

- Profile parameters to configure SAP instances
- Held in shared memory since Rel 4.0 (which enables online changes)
- A lot of profile parameters can be changed online (e.g. timer values) – some changes require downtime (e.g. memory parameter)
- List of parameters to be changed online: note 102428

Operation Mode Changes

- Type of work processes can be changed dynamically, e.g. to adjust different work profiles (e.g. day vs. night – dialog vs. batch)
- Number of work processes is not changed
- Switch manual or scheduled without disturbance of current work

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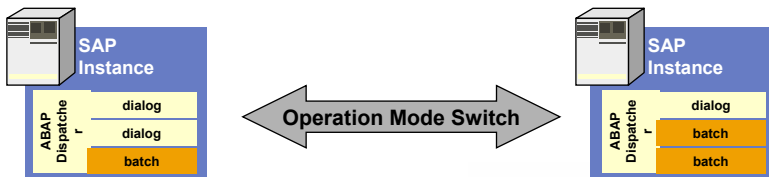
SAP Web AS 6.10: "Soft Shutdown"

Instance can be set to status "passive" with TA/command SMMS.

The application server can *continue to process received requests* or create requests itself.

However, no new requests will be sent to the server.

The purpose of this state is to "logically" remove a server that has to be stopped during productive operation of the system.

The server finishes processing its existing requests, but *does not accept any new requests* and can be terminated without having to interrupt any relevant requests such as updates or batch jobs.

This state can be changed to the "active" state.

Benefit:
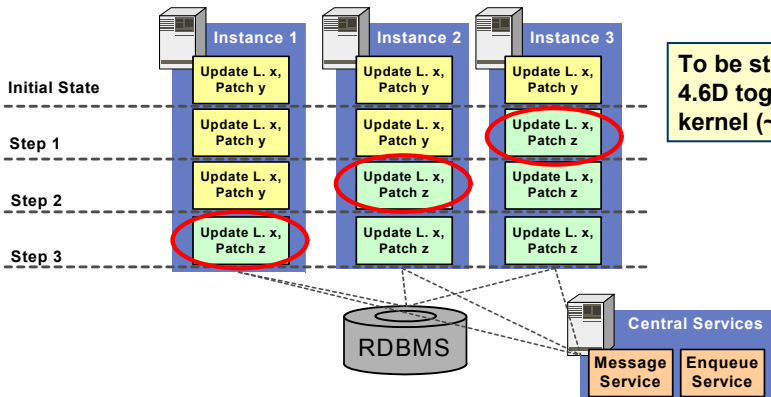**Instance can be taken out of operation without disturbing users.**

THE BEST-RUN BUSINESSES RUN SAP **SAP**

Applying Support Packages with Minimal Downtime

Uptime		Downtime	Uptime
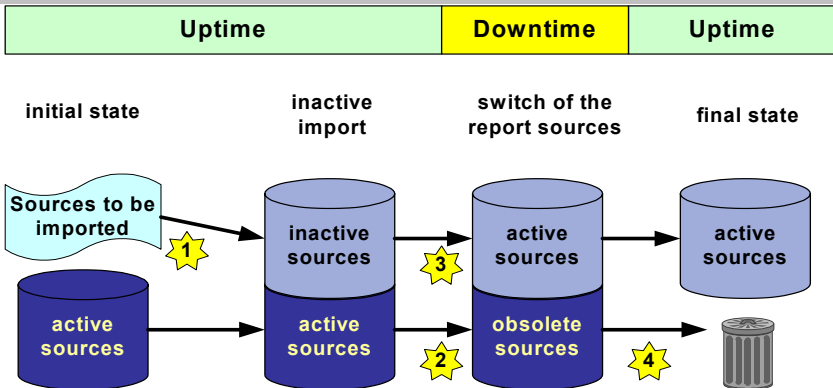
- **4.6D: support package shadow import**
- **Uptime: Parallel import of new sources**
- **Downtime: DDIC import, main import, switch of sources to active state**
- **Benefit: All report sources (main part of SP) can be imported during uptime**
- **Downtime decreased! (saved up to 70% with report sources)**

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Rolling Kernel Upgrades

planned

	Instance 1	Instance 2	Instance 3
Initial State	Update L. x, Patch y	Update L. x, Patch y	Update L. x, Patch y
Step 1	Update L. x, Patch y	Update L. x, Patch y	Update L. x, Patch z
Step 2	Update L. x, Patch y	Update L. x, Patch z	Update L. x, Patch z
Step 3	Update L. x, Patch z	Update L. x, Patch z	Update L. x, Patch z

RDBMS

Central Services
- Message Service
- Enqueue Service

To be started with kernel 4.6D together with EXT kernel (~Q4/2003).

Prerequisites:

- **Application servers may not impose SPOF (requires standalone / replicated enqueue)**
- **Only switch of compatible kernels**
- **Different kernels only for short time**

Not all instances have to be stopped at once – System remains online.

Soft shutdown to minimize disturbance.

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Database Reorganization

- **Reorganization of DB objects (tablespaces, indices, tables) might be useful**
- **Causes:**
  - **Tablespace overflow (Measure: Increase tablespace in time)**
  - **DB file fragmentation (Consider: downtime vs. space saving)**
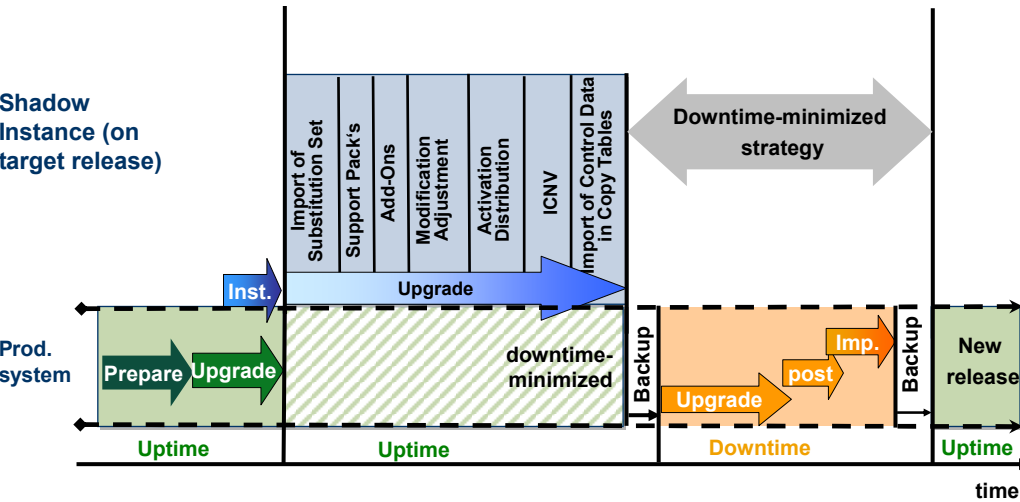 - **Index fragmentation (Consider: downtime vs. performance increase)**

- **Goals (performance increase, space saving) have to be considered vs. downtime**
- **New DB releases lower the need for reorganization**
- **Performance gain after DB file reorganization not always evident**
- **DB reorganization requires downtime (might be long!)**

- **SAP recommendations:**
  - **Avoid reorganization if possible**
  - **Correct configuration**
  - **Proper monitoring**
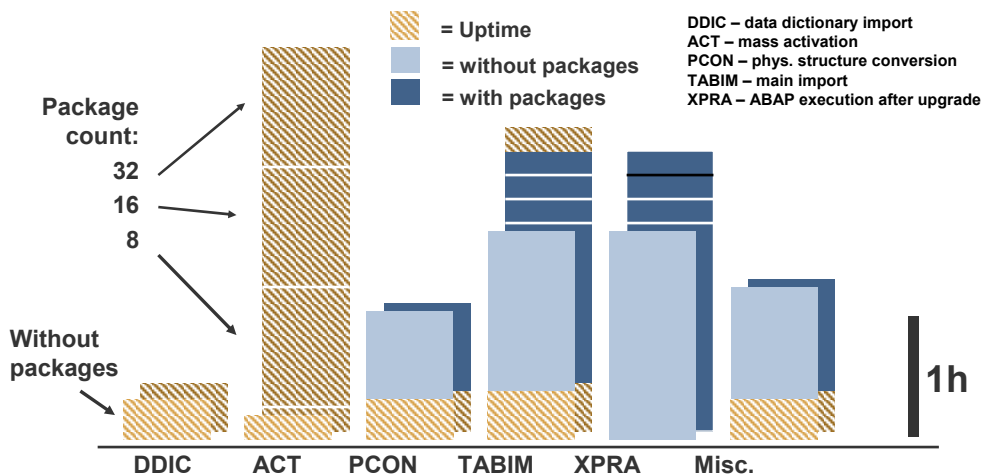 - **Documentation: SAP Help**

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New Upgrade Procedure: System Switch Upgrade (from Rel. 6.x)

Shadow Instance (on target release)

Import of Substitution Set | Support Pack's | Add-Ons | Modification Adjustment | Activation Distribution | ICNV | Import of Control Data in Copy Tables

Inst. — Upgrade

Downtime-minimized strategy

Prod. system

Prepare → Upgrade — downtime-minimized — Backup — Upgrade → post → Imp. — Backup — **New release**

Uptime | Uptime | Downtime | Uptime

time

Beside the downtime-minimized strategy, there is a resource-minimized strategy.

Downtime with System Switch Upgrade

No downtime extension caused by included Support Packages/Add-Ons

= Uptime
= without packages
= with packages

DDIC – data dictionary import
ACT – mass activation
PCON – phys. structure conversion
TABIM – main import
XPRA – ABAP execution after upgrade

Package count:

32
16
8

Without packages

1h

DDIC | ACT | PCON | TABIM | XPRA | Misc.

SM207 – Upgrade with acceptable Downtime
10/02/03 – 12.00-13.00

SM261 – System Switch Upgrade – Monitoring and Troubleshooting
10/01/03 – 14.00-18.00

Outlook: End of Daylight Saving Time
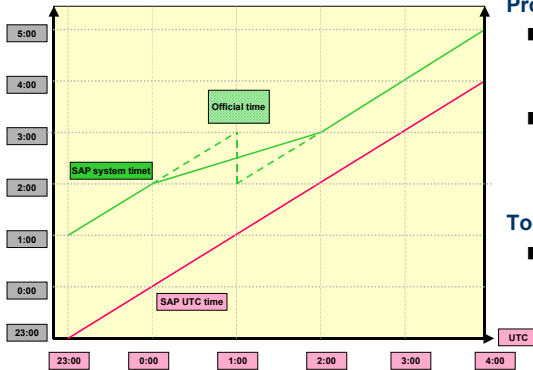
Problem

- **Switch back from daylight saving time to normal time causes „double hour" with non-unique time stamps**
- **Problems (e.g. with batch jobs or generation of reports) might occur**

Today

- **SAP recommends to turn off the system during this time (that means 1..2 h planned downtime!)**

- **The new way:** *Save time continuity by stretching system time in „double hour"*

- **For SAP Web AS 6.40 (with downward compatible kernel availability for all 6.x based systems)**

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How to decrease planned downtimes

High availability configurations for SAP NetWeaver

- **SAP Enterprise Portal**
- **SAP Exchange Infrastructure**

Summary

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SAP NetWeaver: High Availability for SAP Enterprise Portal 6.0

- *Database* – **to be protected with** *cluster*
- *Global file system* – **to be protected with** *cluster*
- *Portal application* **on top of SAP J2EE Engine** – *multiple servers*
- **Access to multiple servers via** *load balancer*

Portal Server
- J2EE Dispatcher
- J2EEServer
- J2EEServer
- J2EEServer

Portal Server
- J2EE Dispatcher
- J2EEServer
- J2EEServer
- J2EEServer

Portal Server
- J2EE Dispatcher
- J2EEServer
- J2EEServer
- J2EEServer

Load Balancer

Cluster
- DB Server
- RDBMS
- File System
- Spare Server
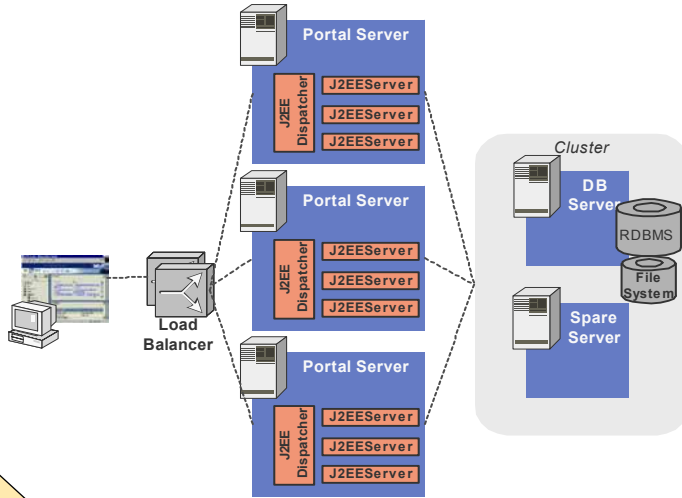
PRTL201 – Technical Infrastructure of SAP Enterprise Portal 6.0
09/30/03 – 14.00-18.00

HA example for SAP EP6.0, based on SAP J2EE Engine 6.20

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SAP NetWeaver: High Availability for SAP Exchange Infrastructure 2.0

BPI102 – SAP Exchange Infrastructure – Process Centric Collaboration
09/30/03 – 16.00-17.00
10/01/03 – 17.00-18.00

Mapping Server
- J2EE Dispatcher
- J2EEServer
- J2EEServer
- J2EEServer

Integration Server
- Dispatcher
- WorkProcess
- WorkProcess
- WorkProcess

J2EE Cluster

Mapping Server
- J2EE Dispatcher
- J2EEServer
- J2EEServer
- J2EEServer

J2EE Cluster

Cluster
- DB Server
- File System
- RDBMS
- Central Instance
  - Enqueue Service
  - Message Service
  - Dispatcher
  - WorkProcess
  - WorkProcess
  - WorkProcess

HA example for SAP XI2.0, based on SAP J2EE Engine 6.20

- *Integration server*: **ABAP based** – *DB and CI* **to be protected with** *cluster*
- *Mapping server*: **J2EE based** – *J2EE cluster*
- **XI Integration Directory, Repository, System Landscape Directory – no SPOFs at runtime**

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- **SAP Enterprise Portal**
- **SAP Exchange Infrastructure**

Summary

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Summary

Eliminate Single Points of Failure using redundant components to avoid unplanned downtimes

All critical system components of SAP Web AS can be protected

Consider recovery / disaster recovery

Planned downtime can be reduced by several measures

SAP makes continuous improvements to decrease planned downtimes

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Further Information

➔ **SAP Service Marketplace:**
http://service.sap.com/ha
http://service.sap.com/upgrade
http://service.sap.com/netweaver

➔ **Related Workshops/Lectures at SAP TechEd 2003**
See hints in the slides.

Questions?

Q&A

**Please complete your session evaluation and
drop it in the box on your way out.**

Thank You !

The SAP TechEd '03 Basel Team

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