High Availability for SAP on Windows Server 2003

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Agenda

- Introduction to High Availability and SAP in the Microsoft area
- SAP components, solution stack and HA examples
- Microsoft Cluster and SAP certified HP servers and disk subsystems
- Summary and Q&A

Introduction to High Availability

- 7 x 24 availability becomes more and more important for every enterprise irrespective their size
- Nearly all business critical processes are processed electronically
- Customers, business partners and employees depend on the availability of the infrastructure supporting their business processes.
- SAP and HP supporting this trends and provides technologies to achieve HA in the SAP area.

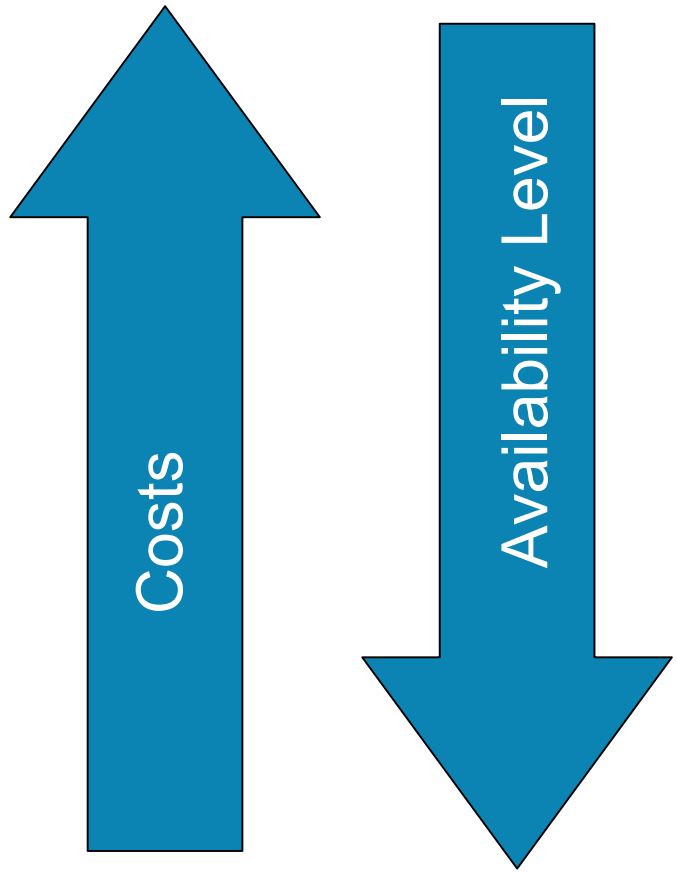
The implementation of HA technologies for SAP applications is critical and provides following benefits:

- Protect mission critical processes and data
- Minimize unplanned downtime
- Maximize efficiency and revenue

Introduction to High Availability

3 levels of availability:

- Fault prevention — Ability to prevent failure
- Fault /disaster tolerance — Ability to prevent problems from impacting users and operations
- Rapid recovery — Ability to quickly recover from problems



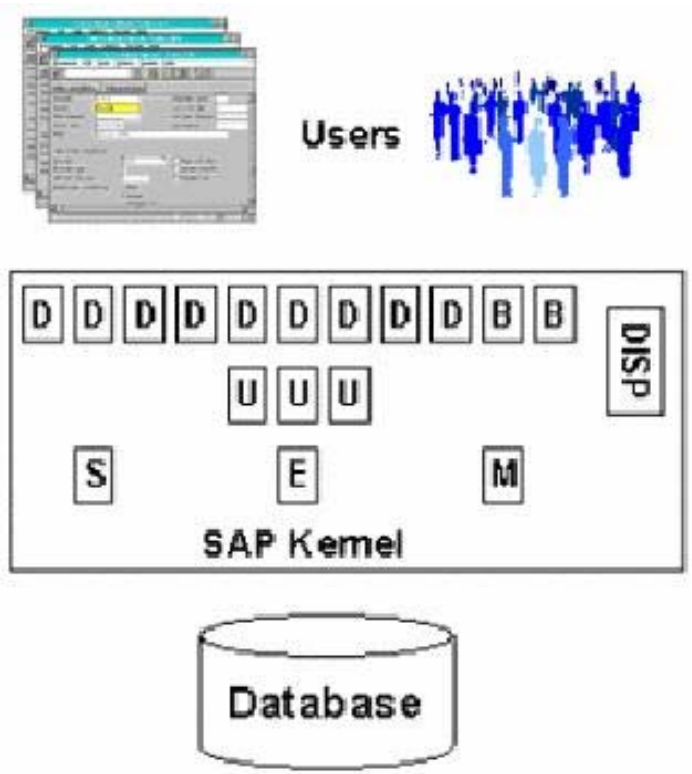
Introduction to High Availability

Elements for achieving high availability and to protect the "SAP dependency chain":

- Hardware:
  - Redundant devices
  - Ongoing system diagnostics for rapid recovery
  - Online serviceability
  - Hardware RAID protection and replication
- Software:
  - Database replication
  - Clustering of applications for rapid recovery
- Operation:
  - System management
  - Solid backup and restore strategy
  - Operatore handbook / documented procedures

Introduction to SAP

SAP R/3 process architecture:

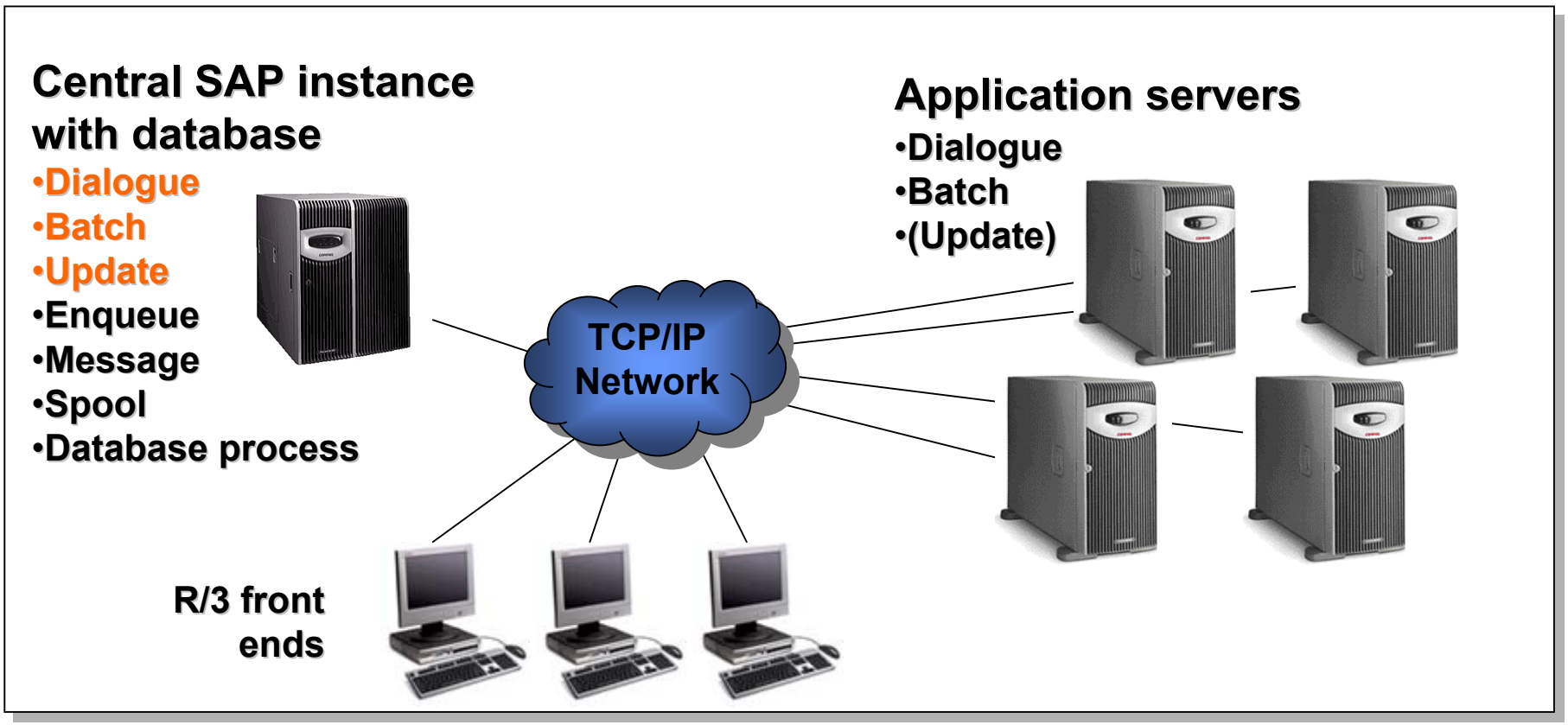


R/3 Processes:

- Dispatcher / Transaction Monitor
- Dialog / Interactive processing
- Batch / Off-line processing
- Update / Changes to the database
- Enqueue / Database lock manager
- Spool / Print subsystem
- Message / Inter-process communication

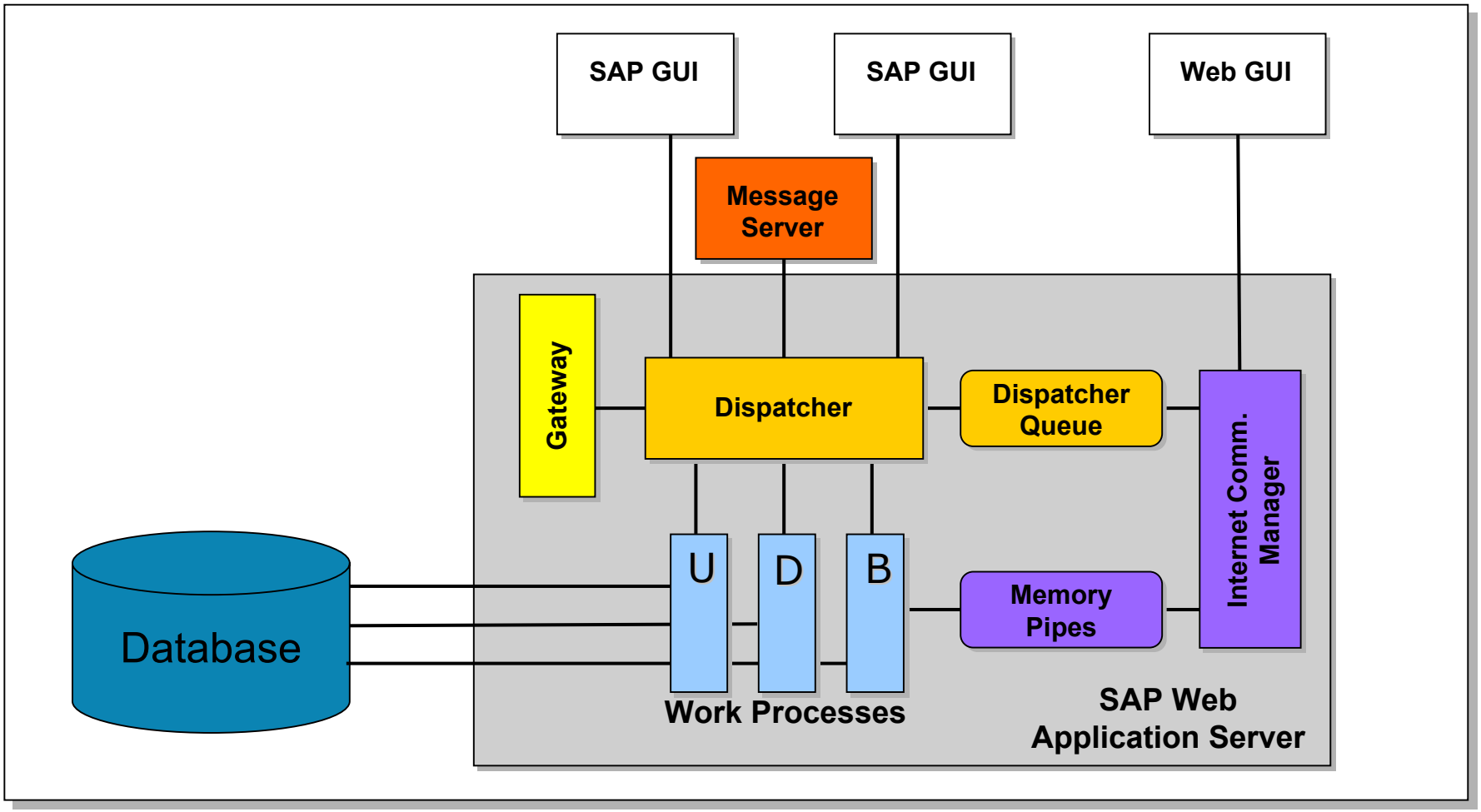
Introduction to SAP

R/3 supports a three-layer client/server architecture:



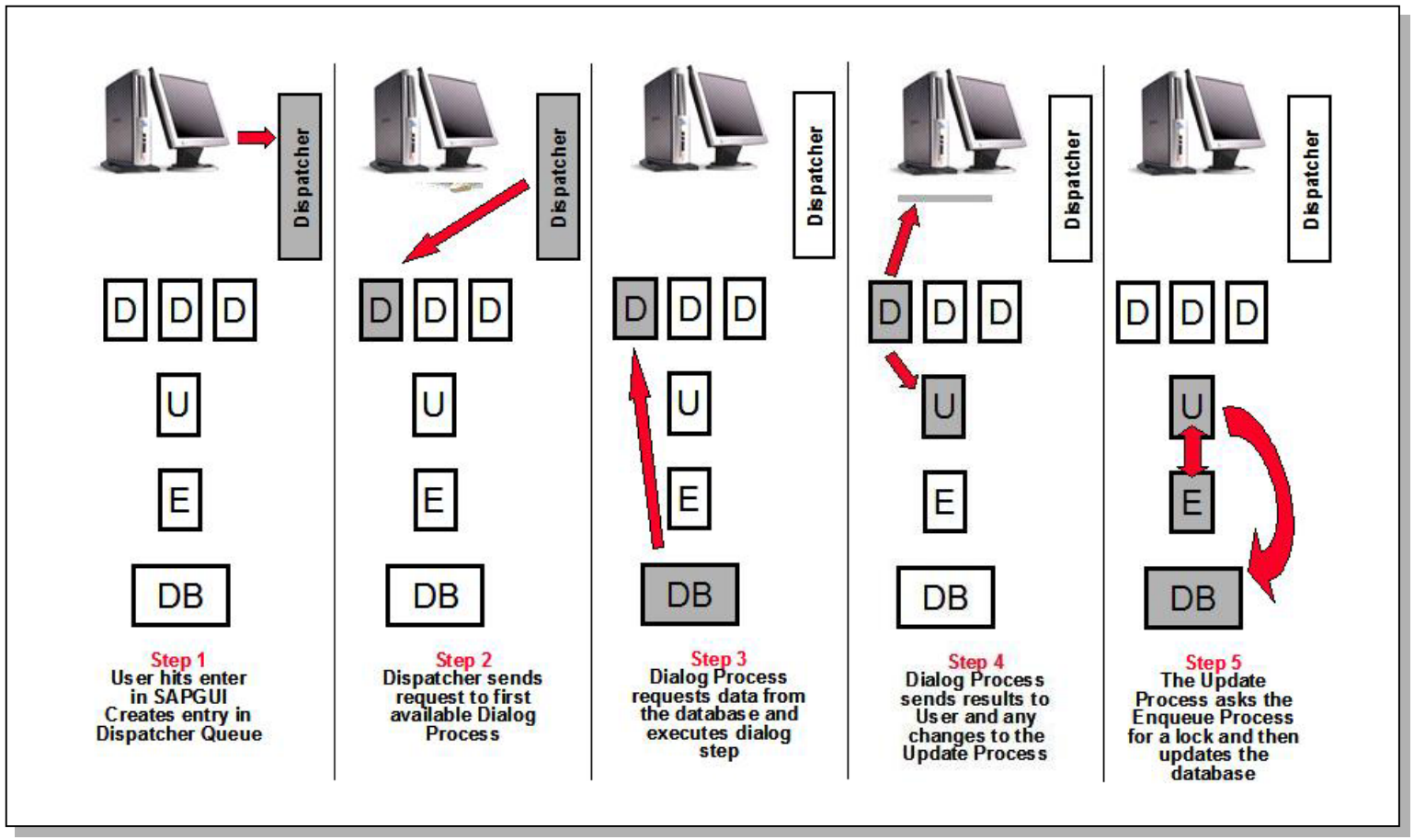
Introduction to SAP

SAP Web Application Server Architecture (6.20)



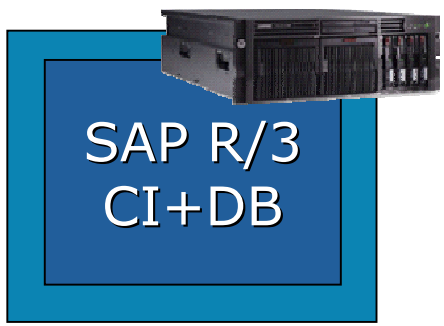
Introduction to SAP

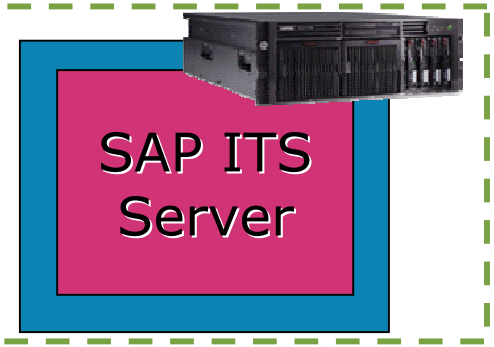
The flow of information within an R/3 system :

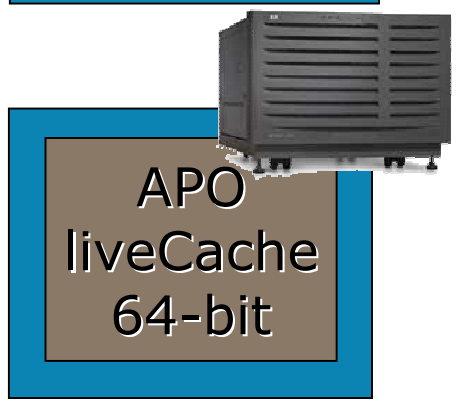


Introduction to SAP

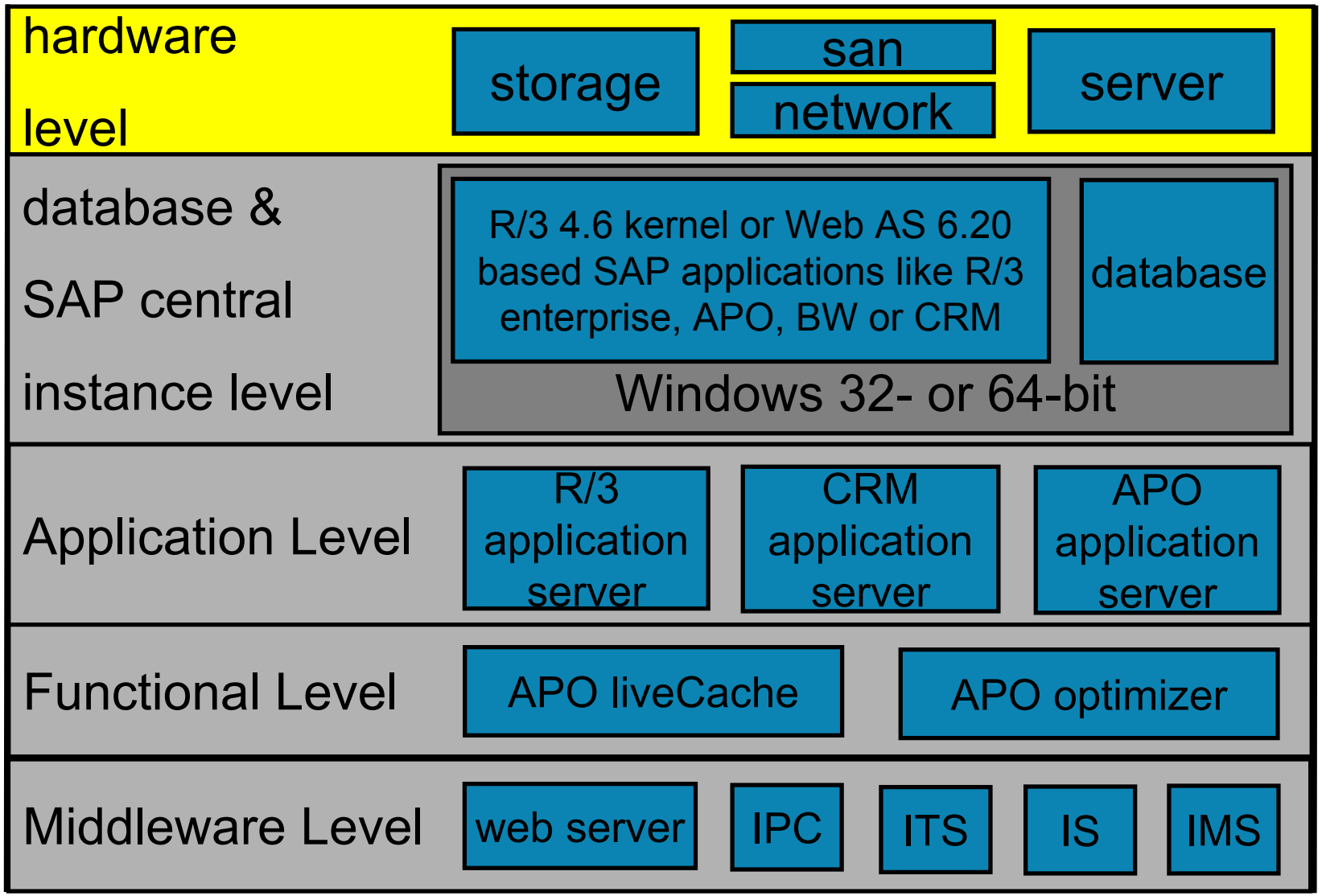
Typical SAP R/3 APO 3-tier landscape:





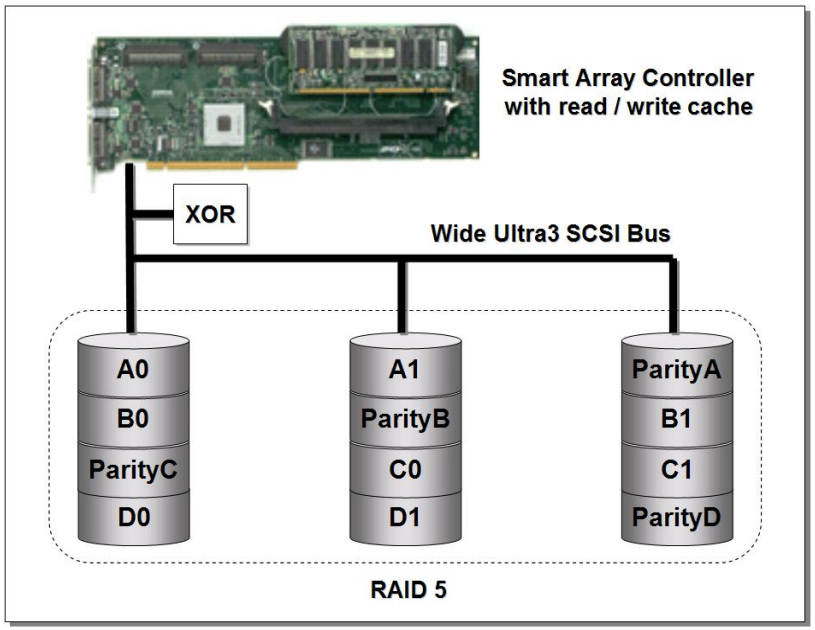


SAP components and solution stack

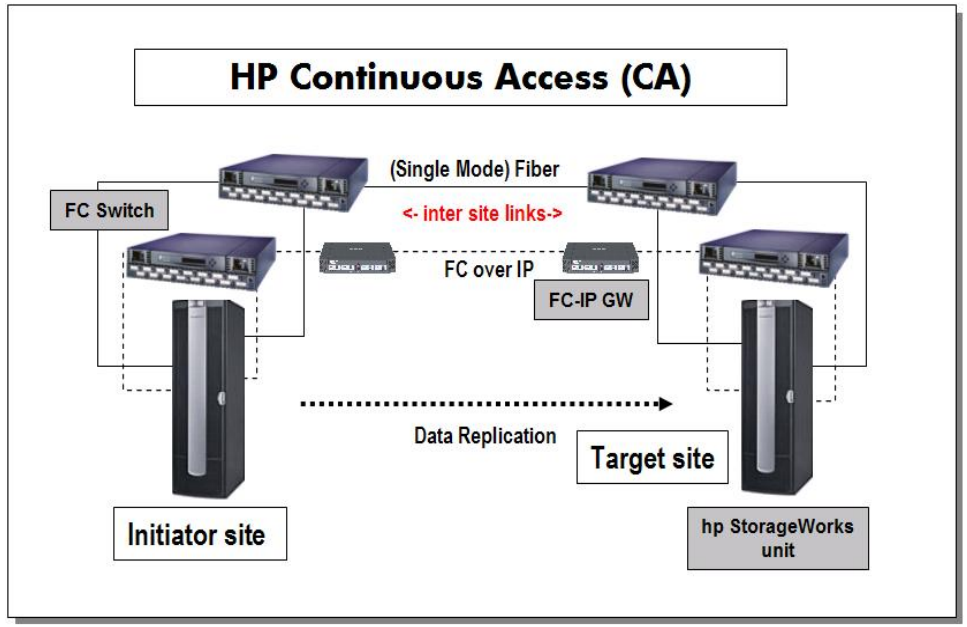


SAP components and solution stack

HA on the hardware level (storage):



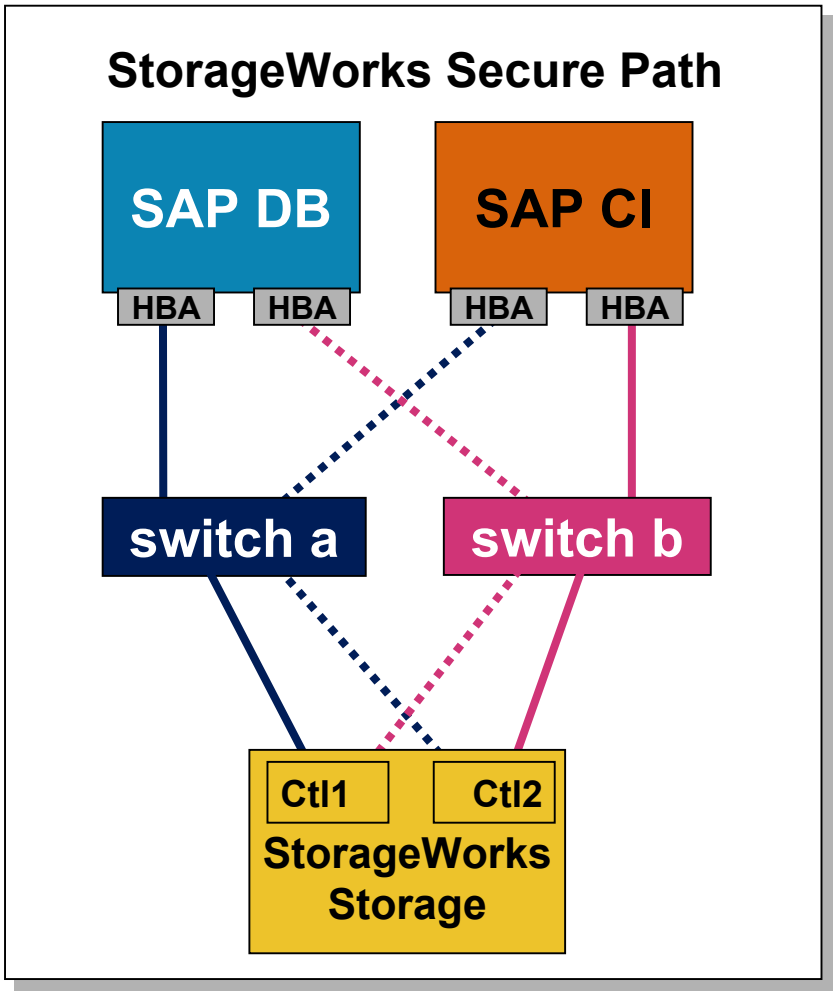
hardware RAID

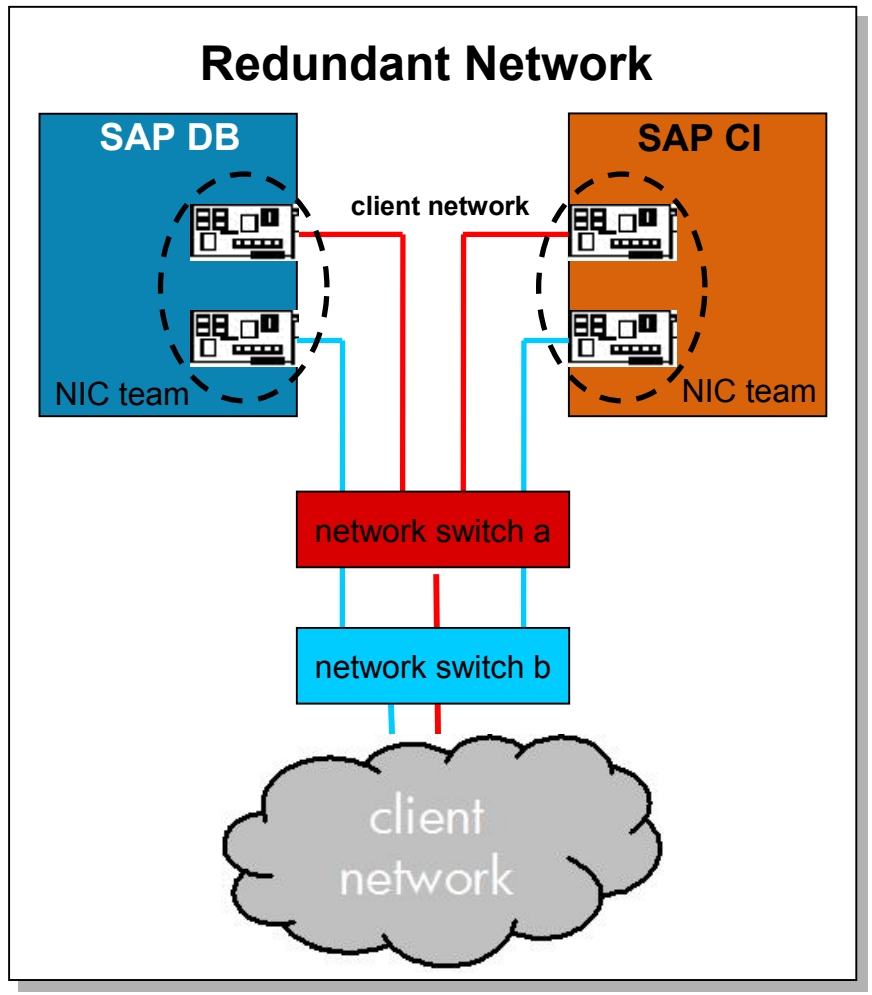


storage / data replication

SAP components and solution stack

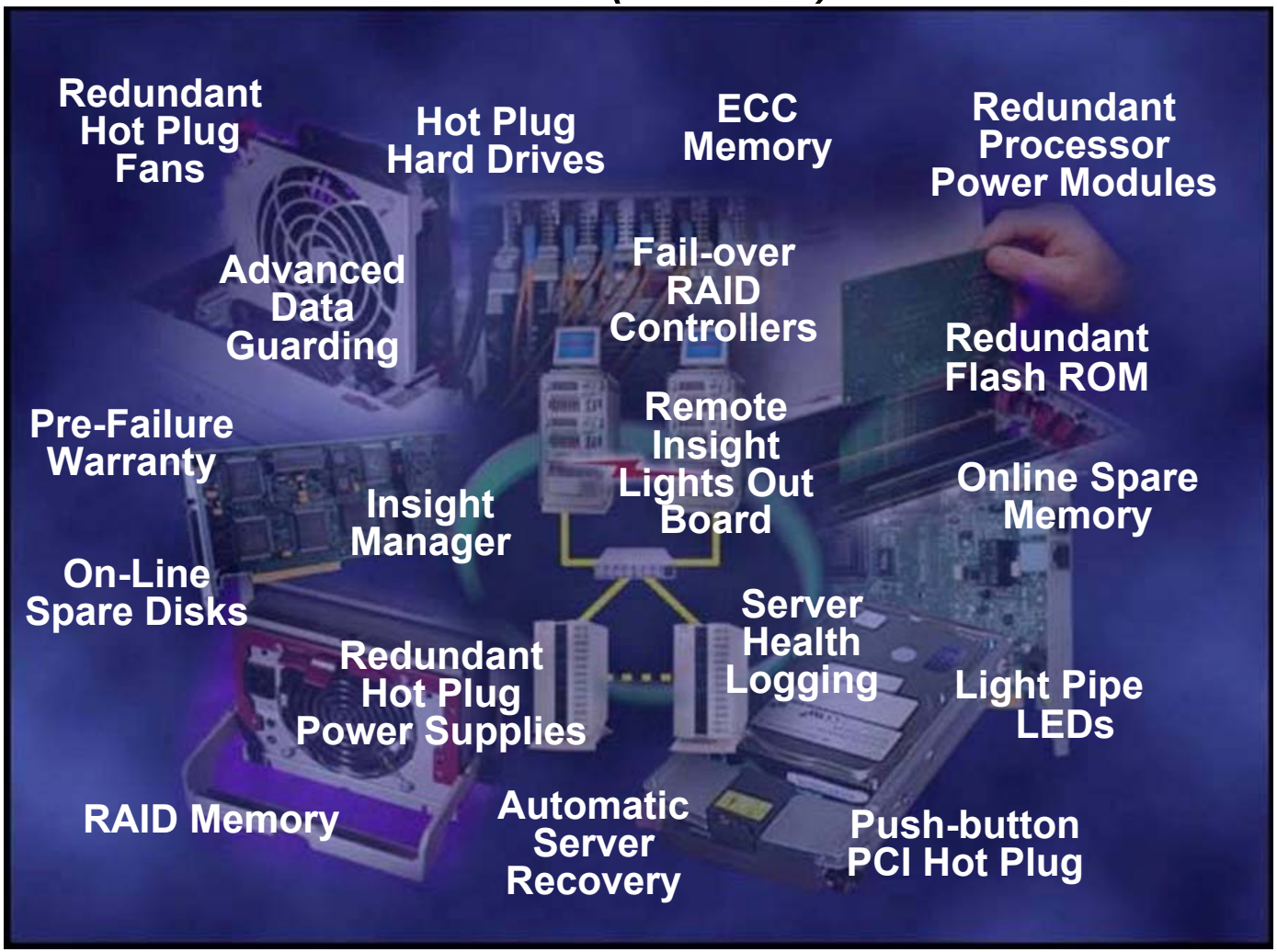
HA on the hardware level (SAN and Network):



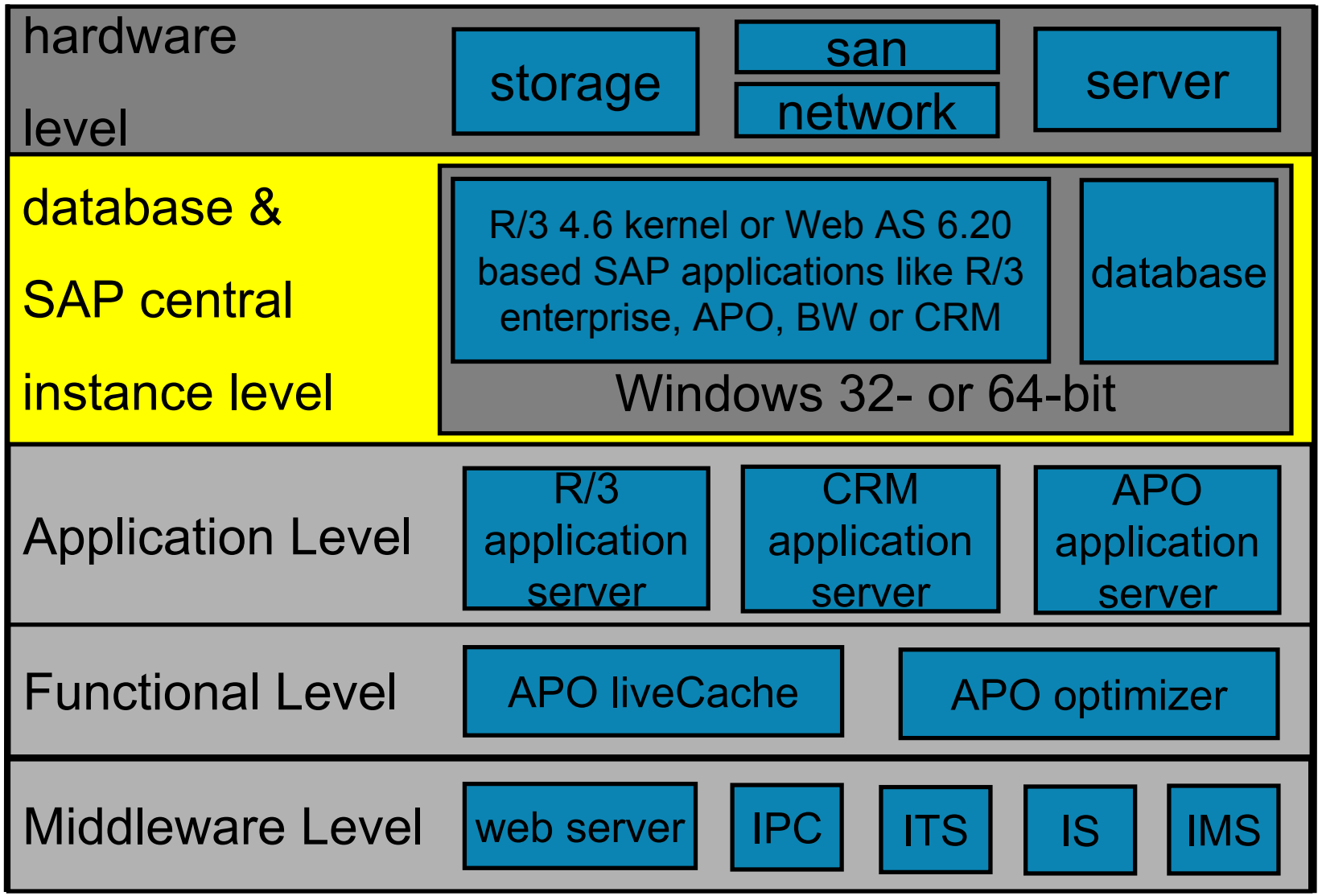


SAP components and solution stack

HA on the hardware level (server):



SAP components and solution stack



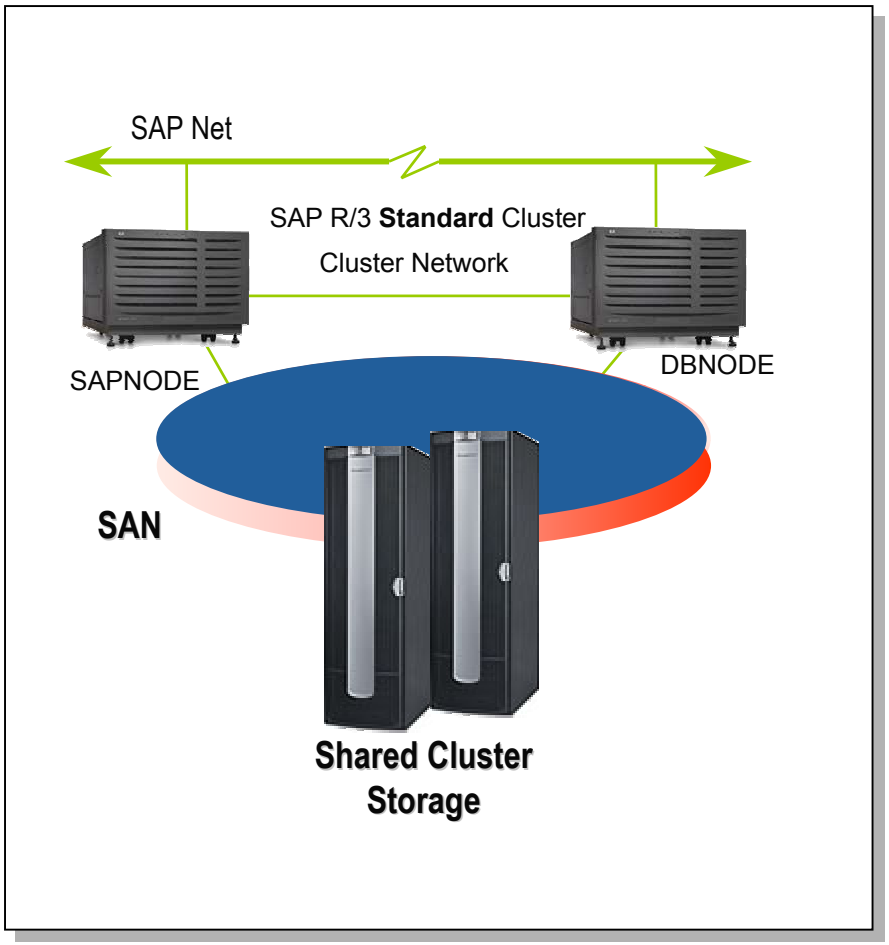
SAP components and solution stack

SAP relevant Windows Server 2003 high availability features:

- **Server Clusters (MSCS)**
  - Server clusters provide high availability via failover and restart mechanism for mission-critical applications such as SAP R/3 or APO.
- **Network Load Balancing (NLB)**
  - NLB service load balances incoming IP traffic across clusters. Network Load Balancing enhances both the availability and scalability of Internet services such as SAP ITS and Web AS.
- Component Load Balancing
  - Provides dynamic load balancing of middle-tier application components that use COM+.

SAP components and solution stack

Review: Windows Server 2003 Cluster Service:



MSCS performs critical functions:

- Sends and receives heartbeat signals between cluster nodes to verify resource availability
- Monitors the state of each cluster node and synchronizes status information
- Controls access to logical volumes on the shared storage subsystem
- Automatically initiates and completes failover and fail back events in response to failures
- Monitors cluster-aware applications and initiates application failover when a failure occurs

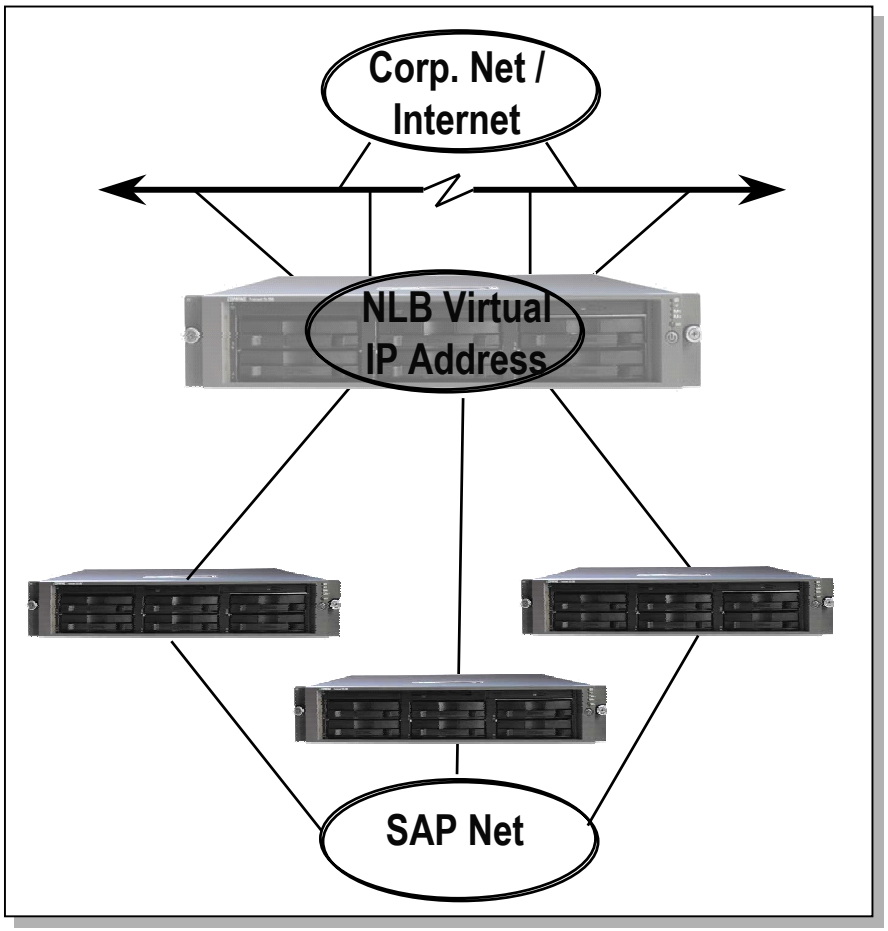
SAP components and solution stack

New Windows Server 2003 cluster features:

- 64-Bit support
- Larger Clusters
- Majority Node Set (MNS) clusters
- Storage Abstraction
- Backup and Restore
- Scripting
- Resize Clustered Disks
- Storage Area Networks

SAP components and solution stack

Review: Windows Server 2003 Network Load Balancing:

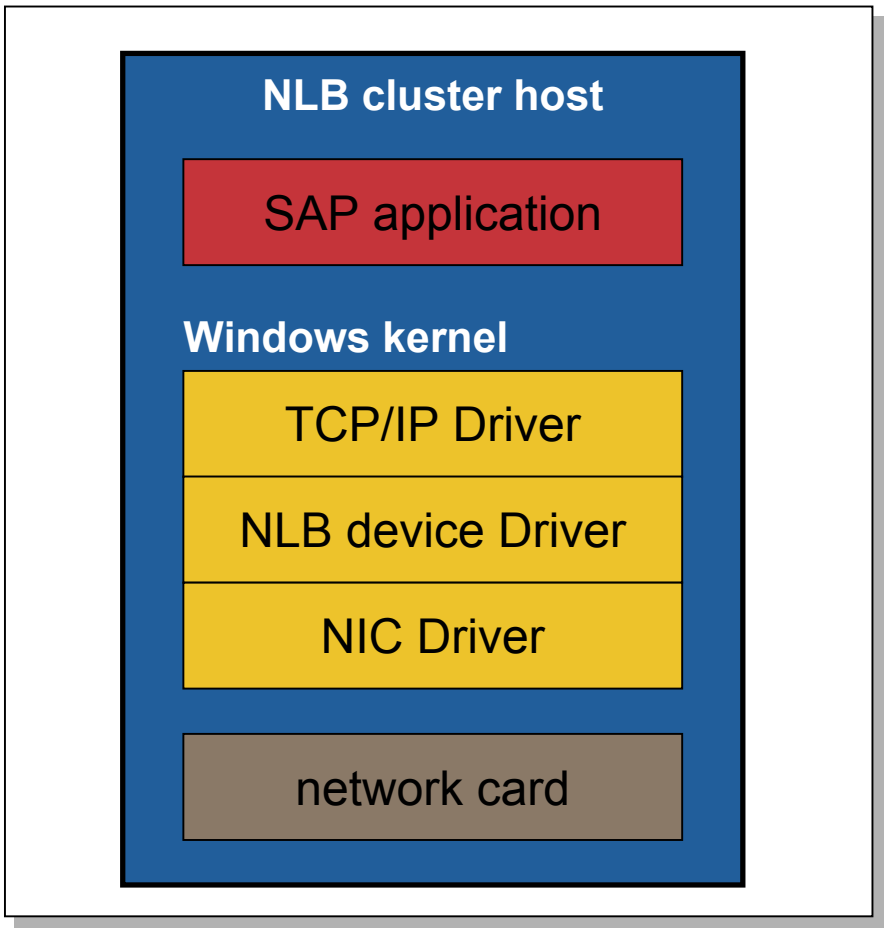


Network Load Balancing (NLB)

- NLB is a standard feature in Windows since Windows 2000
- NLB increases the network availability and load balances network traffic across up to 32 nodes
- New: network load balancing (NLB) manager
- New feature called virtual clusters provides per-IP port rules

SAP components and solution stack

Review: Windows Server 2003 NLB – Technical Implementation:



Network Load Balancing (NLB)

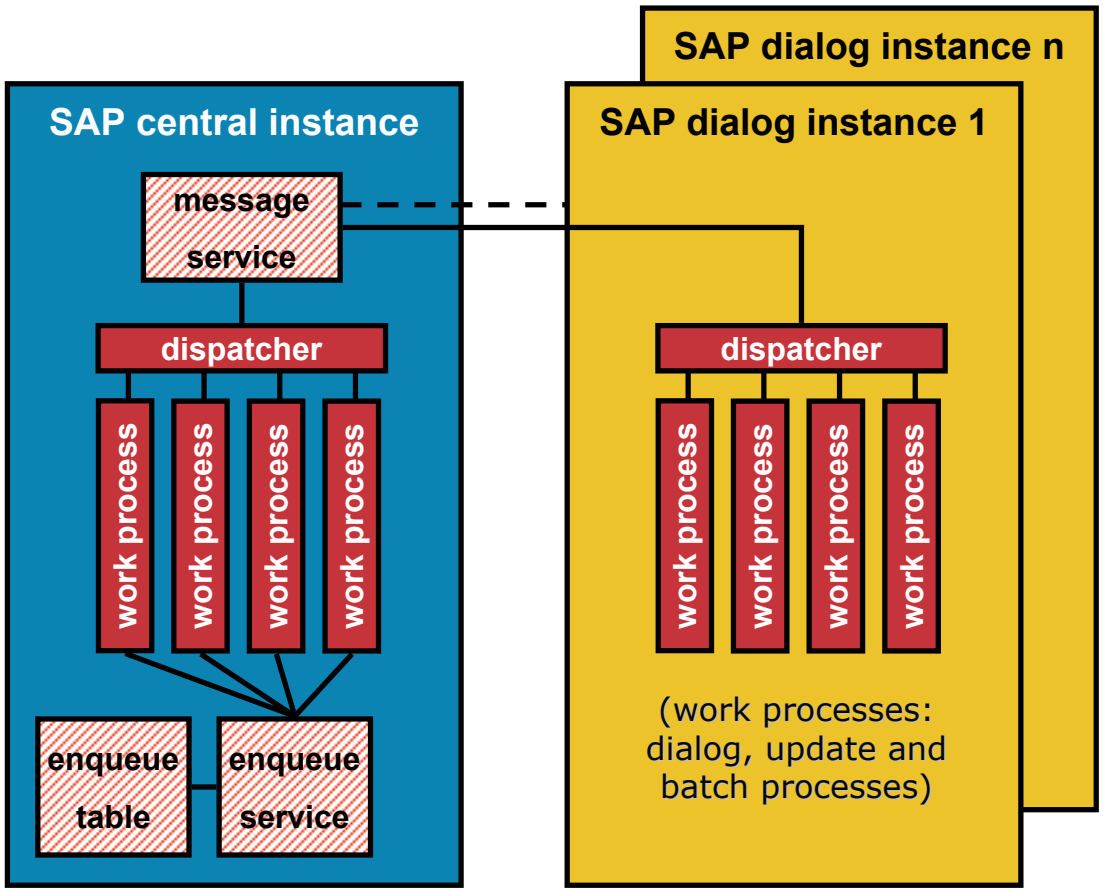
- Implemented as Driver for Network Card
- Uses Driver of the Network Card
- Filters incoming TCP and UDP packets.
- Distributed protocol is used
- to assign which client is served by which host
- to observe if a host has failed
- No other control data is needed.

Agenda

- Introduction to High Availability and SAP in the Microsoft area
- **SAP components, solution stack and HA examples**
- Microsoft Cluster and SAP certified HP servers and disk subsystems
- Summary and Q&A

SAP components and solution stack

Why is it important to protect the SAP central instance and why use Microsoft clustering for it?



SAP components and solution stack

Why is it important to protect the SAP central instance and why use Microsoft clustering for it?

- SAP currently supports only the Microsoft cluster service in the Windows area.
- SAP provides the needed cluster resource DLLs to make SAP cluster aware.
- The cluster implementation of R/3 is transparent for R/3. R/3 is not affected by these extensions
- SAP OSS note „Availability of R/3 on Microsoft Cluster Server“ number 106275 for more details!

SAP components and solution stack

SAP R/3 kernel cluster support and implementation (SAP 4.6 and 4.7):

- The cluster extensions are available for Windows 32-bit (NT 4.0, W2K & W2K3) and Windows 64-bit (W2K3)
- It is not supported nor possible to use the 32-bit dll‘s on the 64-bit platform!
- Every existing SAP installation that is based on R/3 kernel 3.1I or later can get clustered.
- SAP supports a configuration based on a homogeneous cluster configurations
- Hardware must be sized for the load of the database and central instance processes.

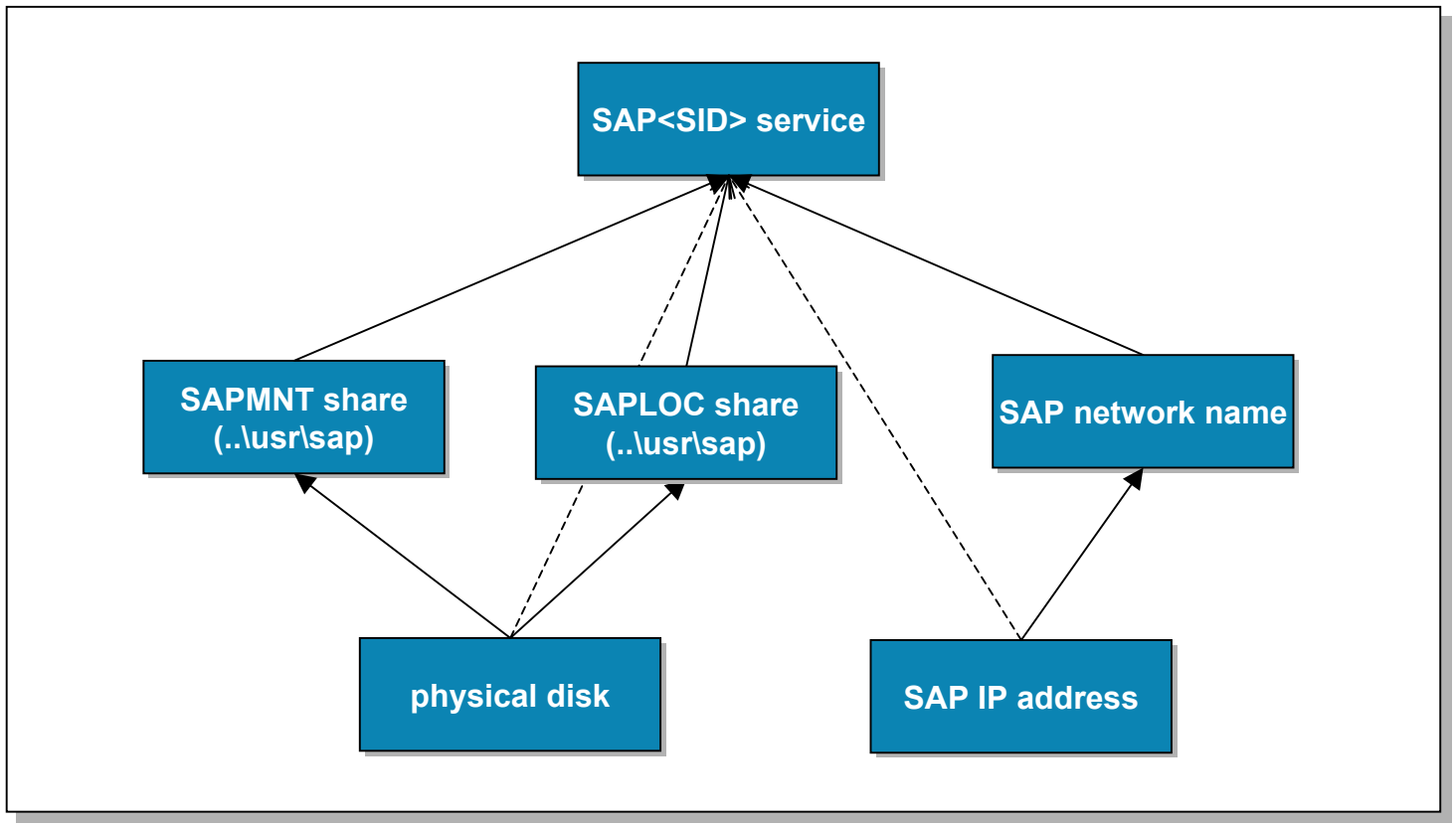
SAP components and solution stack

SAP R/3 kernel cluster support and implementation (SAP 4.6 and 4.7):

- Which DLL‘s are used?
  - SAP resource DLL (saprc.dll) for starting and stopping functions and status checking
  - a resource DLL (saprcex.dll) that enables the cluster administrator to manage the SAP cluster resource
- How is it implemented?
  - A special cluster resource group gets created. This cluster group contains all SAP resources that are needed by the SAP central instance. These resources are:
    - the physical disk where the SAP binaries are stored
    - the IP address and network name
    - the SAP shares sapmnt and saploc
    - the SAP service itself

SAP components and solution stack

SAP R/3 kernel cluster support and implementation (cluster dependencies SAP 4.6 and 4.7):



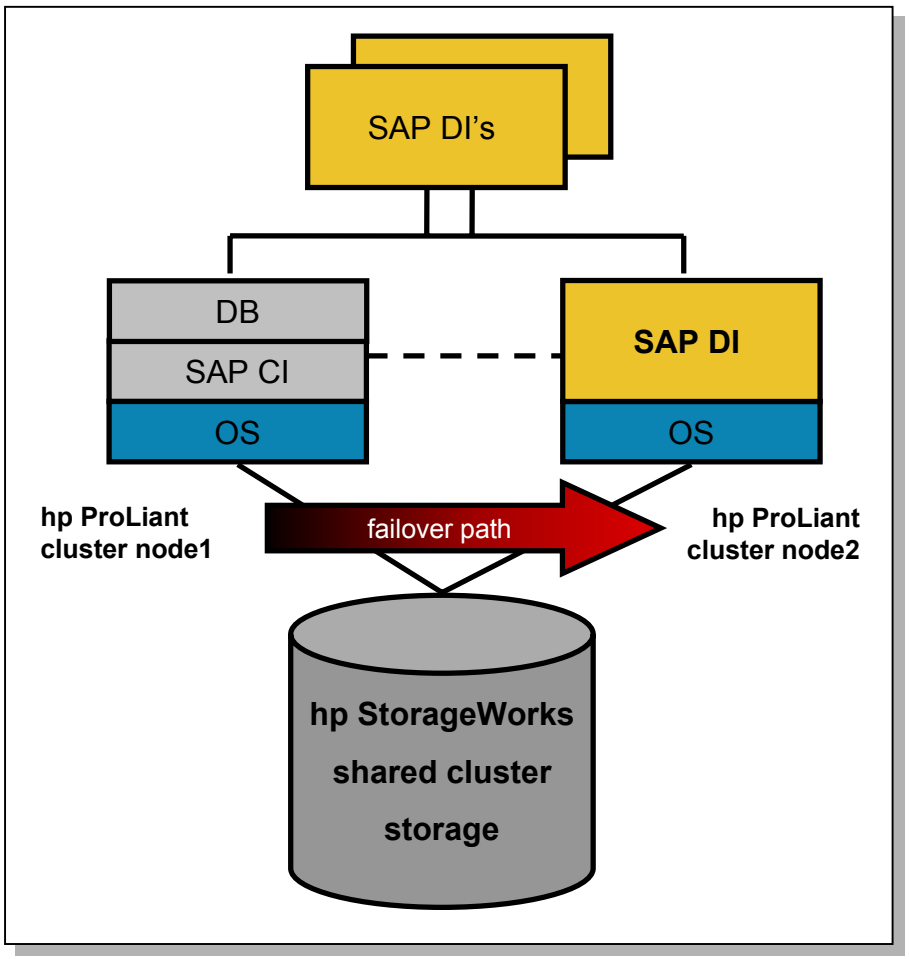
SAP components and solution stack

SAP R/3 kernel cluster support and implementation (SAP 4.6 and 4.7):

- SAP officially supports only so-called homogeneous 2-node cluster installations within a Microsoft cluster, where the cluster nodes are sized for the load of the database and the central instance.
- Distribution of the SAP central instance (CI) and database (DB) across the two cluster nodes is the only supported configuration.
- The problem of such a configuration is that the hardware is **underutilized**, since the nodes must be sized for the load of the central instance and the database!
- **HP supports** the installation of an additional SAP dialog instance within such a configuration. An integration white paper for this is available upon request.

SAP components and solution stack

SAP R/3 kernel cluster support and implementation (HP supported cluster configuration):



Failover clusters protect the following components:

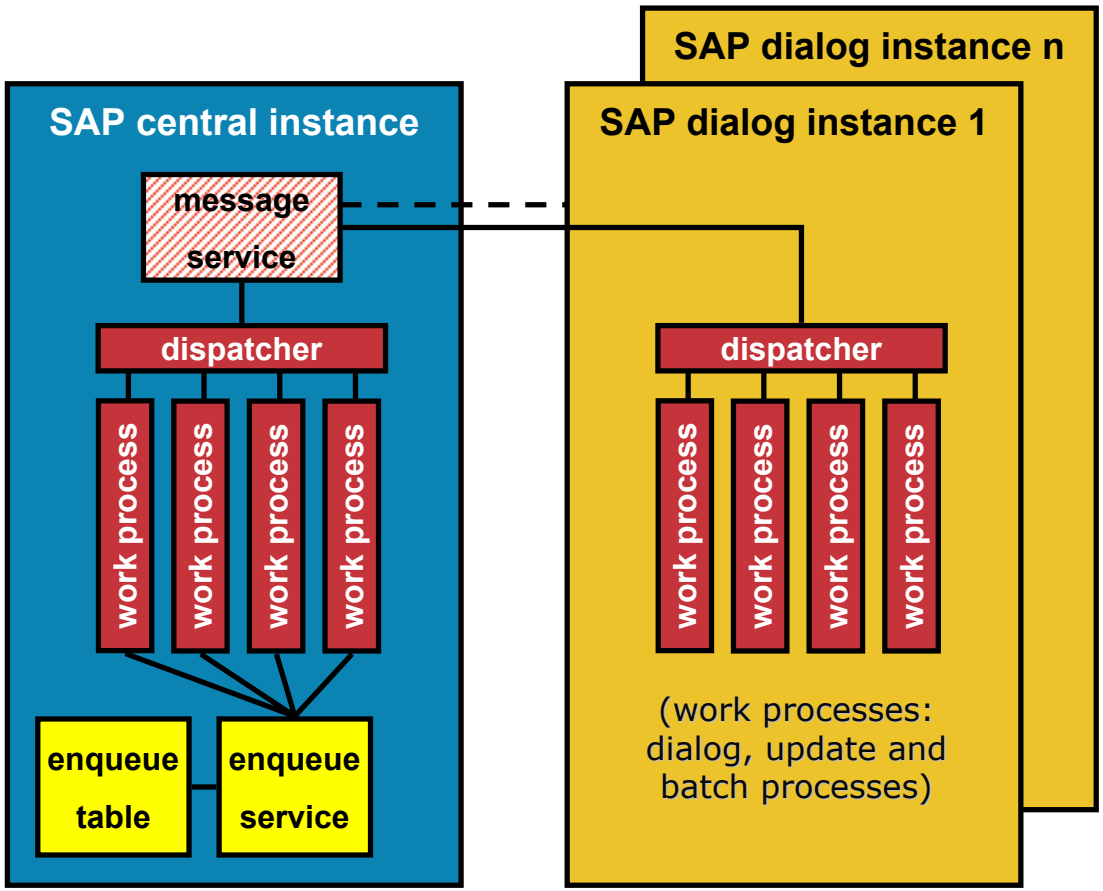
- network access
- SAP central instance
- SAP executables and binaries
- HP's implementation supports a dialog instance within the cluster

Limitations of a failover cluster:

- Not lock-step/fault-tolerant
- Not able to "move" running applications
- Not able to recover shared state between client and server

SAP components and solution stack

SAP replicated enqueue service: status and availability



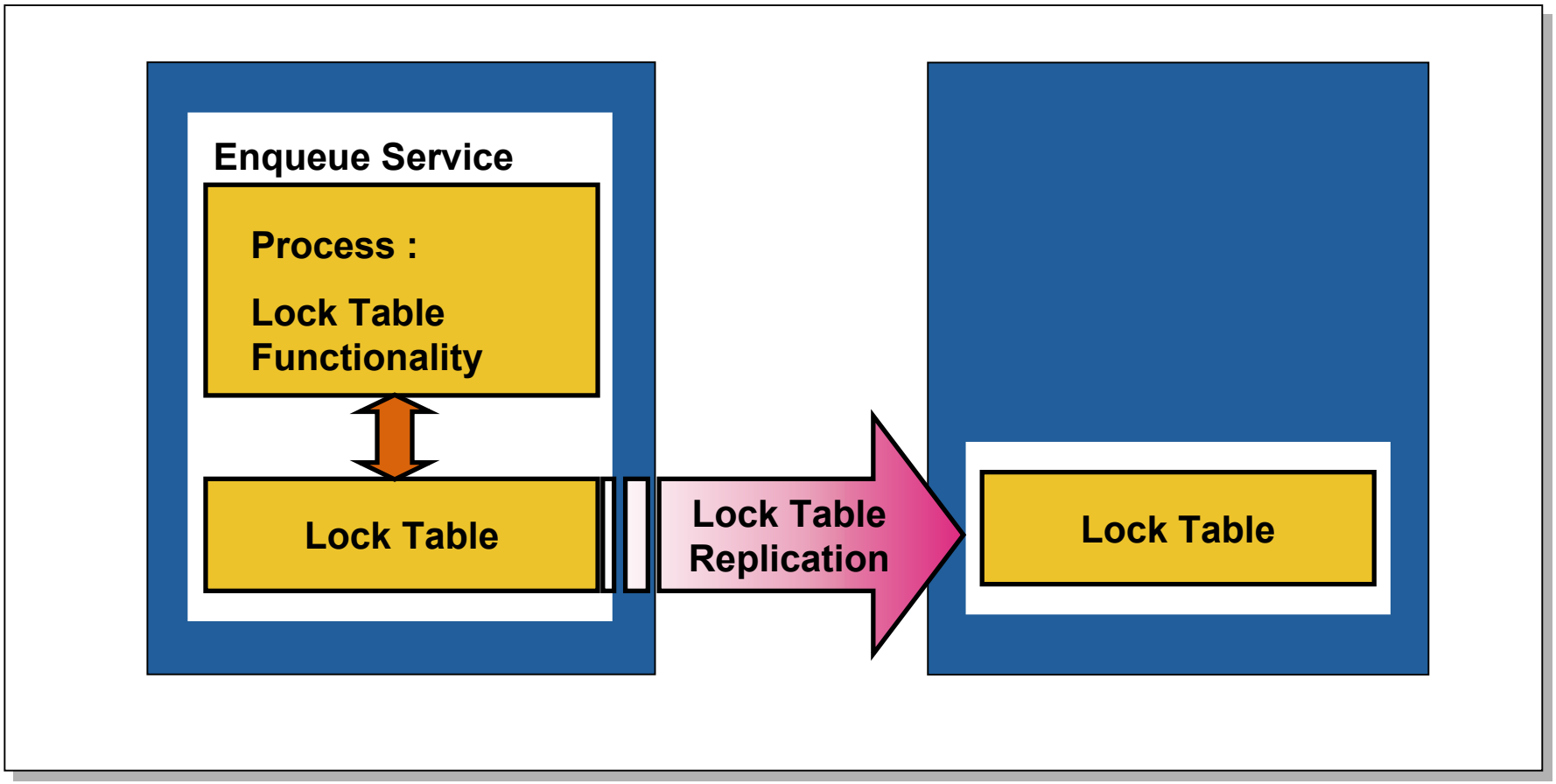
SAP components and solution stack

SAP replicated enqueue service: status and availability

- Enqueue service is a **single point of failure!**
- The cluster service can not protect the enqueue service status (lock table), it can only re-start the enqueue service on the other node.
- All transactions and status information locked are lost!
- A replicated enqueue service replicated the lock table to an other server and protects therefore the status information.
- Will be a standard component of SAP with WAS server version 6.40 (new Enqueue lock handler design).
- Today available for SAP 4.6 or less from HP, product name **HP Somersault**!

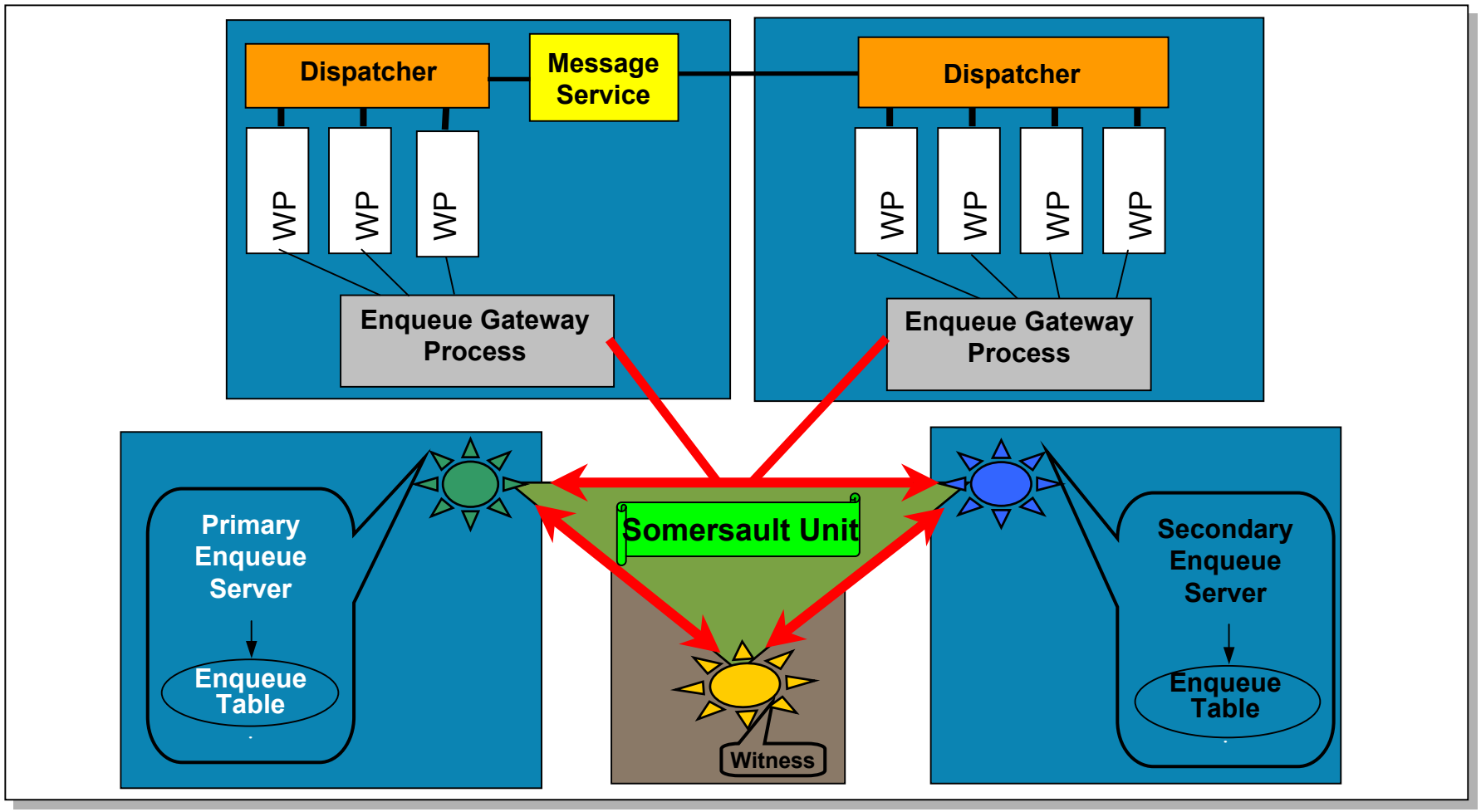
SAP components and solution stack

SAP replicated enqueue service: status and availability – "lock table" replication



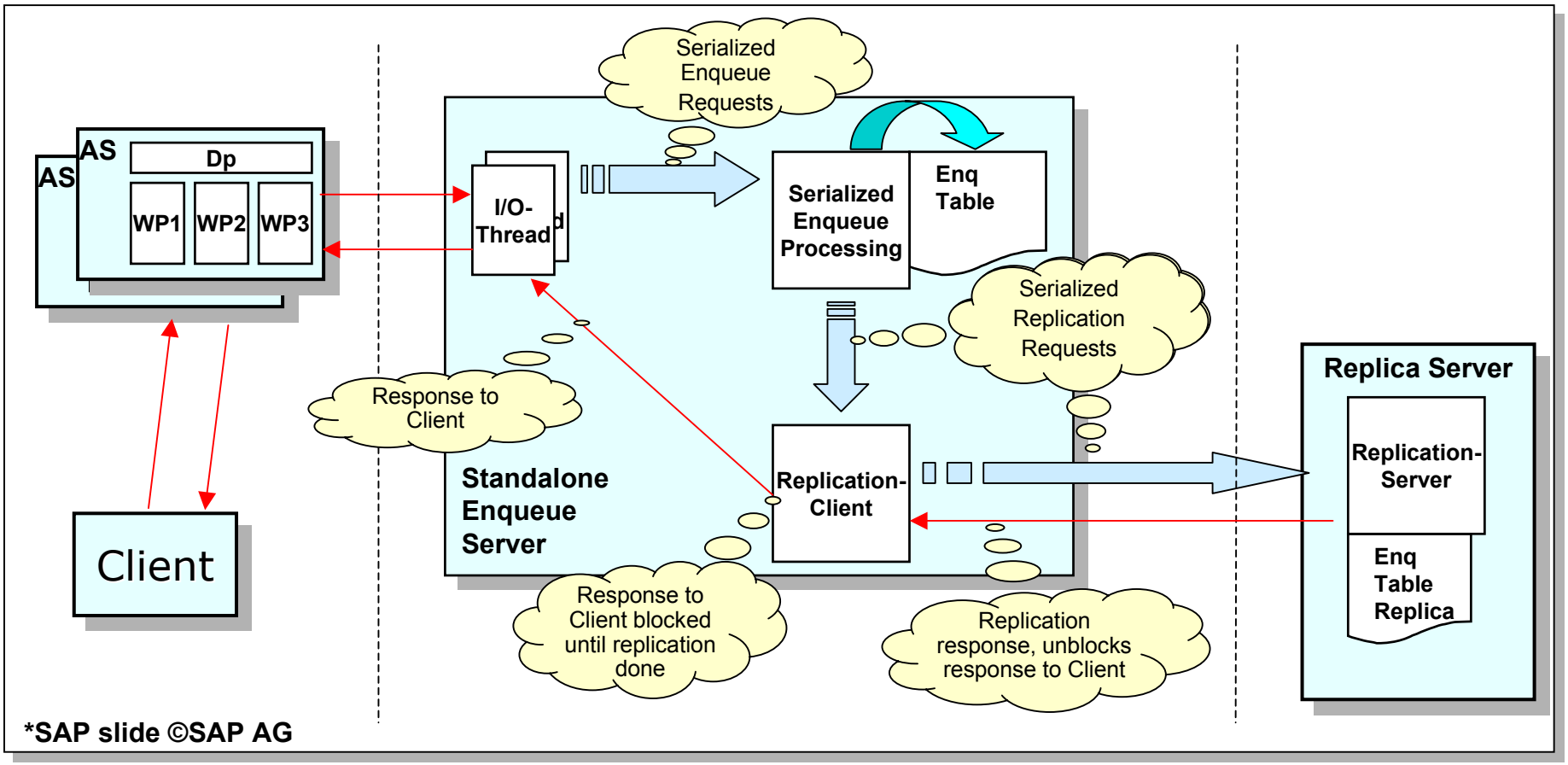
SAP components and solution stack

SAP replicated enqueue service: status and availability – HP Somersault



SAP components and solution stack

*Database high availability features: specifics and SAP support status – New SAP Enqueue Lock Handler Design**



SAP components and solution stack

High Availability Database solutions for SAP:

- Clustered Databases
- Parallel Databases
- Database Replication
  - Standby Databases (Log Shipping)
  - Hardware Replicated Databases (via HP CA)

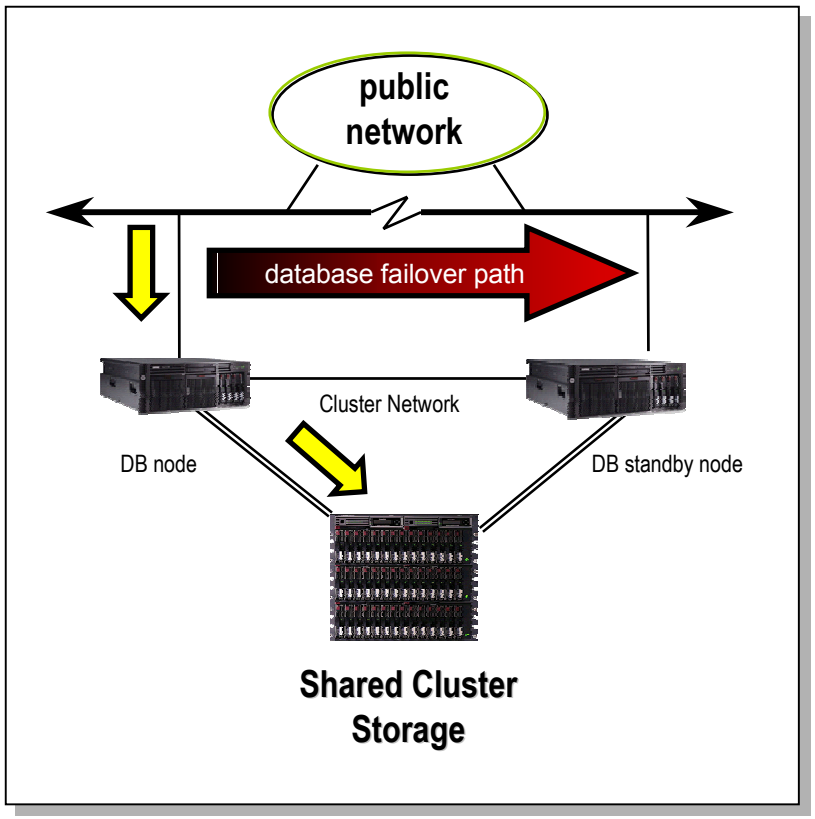
SAP components and solution stack

HP Supported Database solutions for SAP:

database feature	Microsoft SQL 2000	Oracle ≥8.1.6	Oracle 9.2	SAP DB
SAP 4.6x support	☑	☑	☑	☑
SAP 4.7 with web as 6.20 support	☑	☑	☑	☑
Windows Server 2003 general support	☑	☒	☑*	☑
Windows Server 2003 32-bit cluster support	☑	☑ (with FailSafe)	☑ (with RAC or FailSafe)	☑
Windows Server 2003 64-bit cluster support	☑	☒	☑ (with RAC or FailSafe)	☑**
parallel databases	☒	☒	☑***	☒
database replication (software level)	☑	☑	☑	☑
database replication (hardware level)	☑	☑	☑	☑

SAP components and solution stack

Database failover cluster support:



Failover clusters protect the following components:

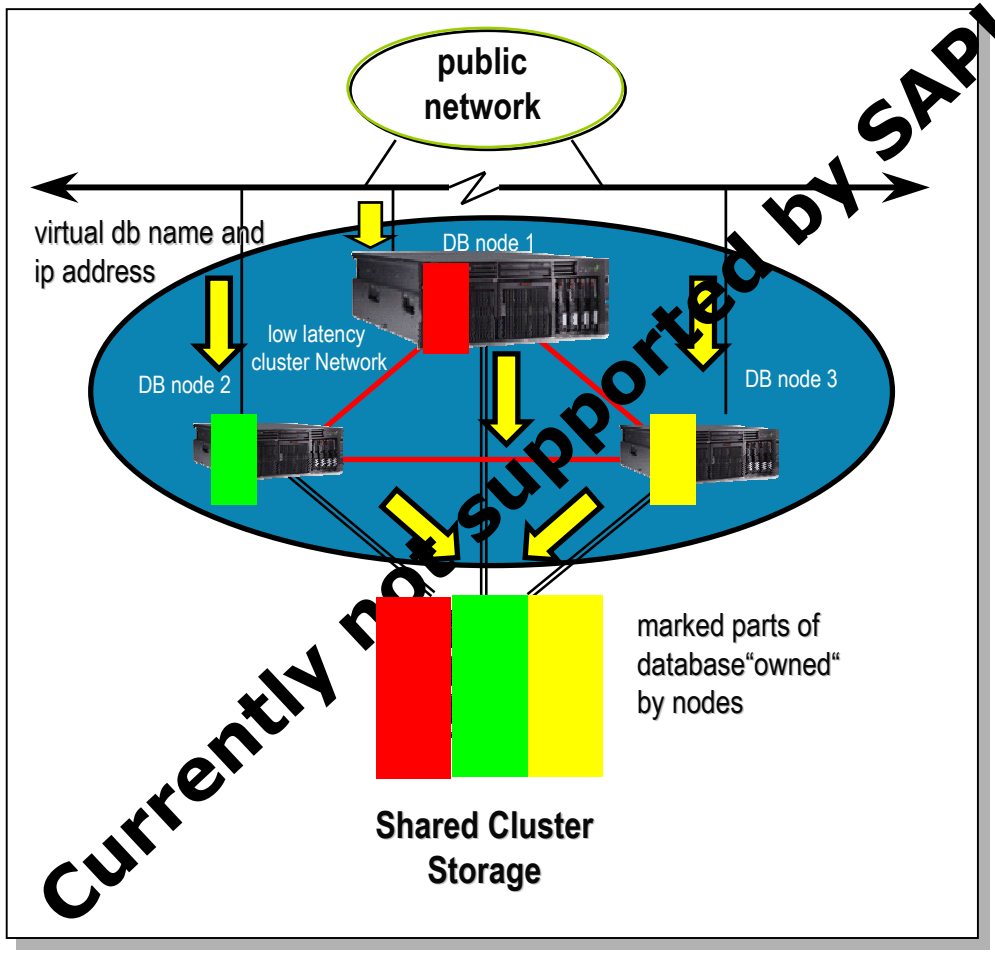
- network access
- database software
- database data and log files (crash recovery)

Limitations of a failover cluster:

- Not lock-step/fault-tolerant
- Not able to “move” running applications
- Not able to recover shared state between client and server (for example, database transaction)

SAP components and solution stack

Parallel Database Clusters:

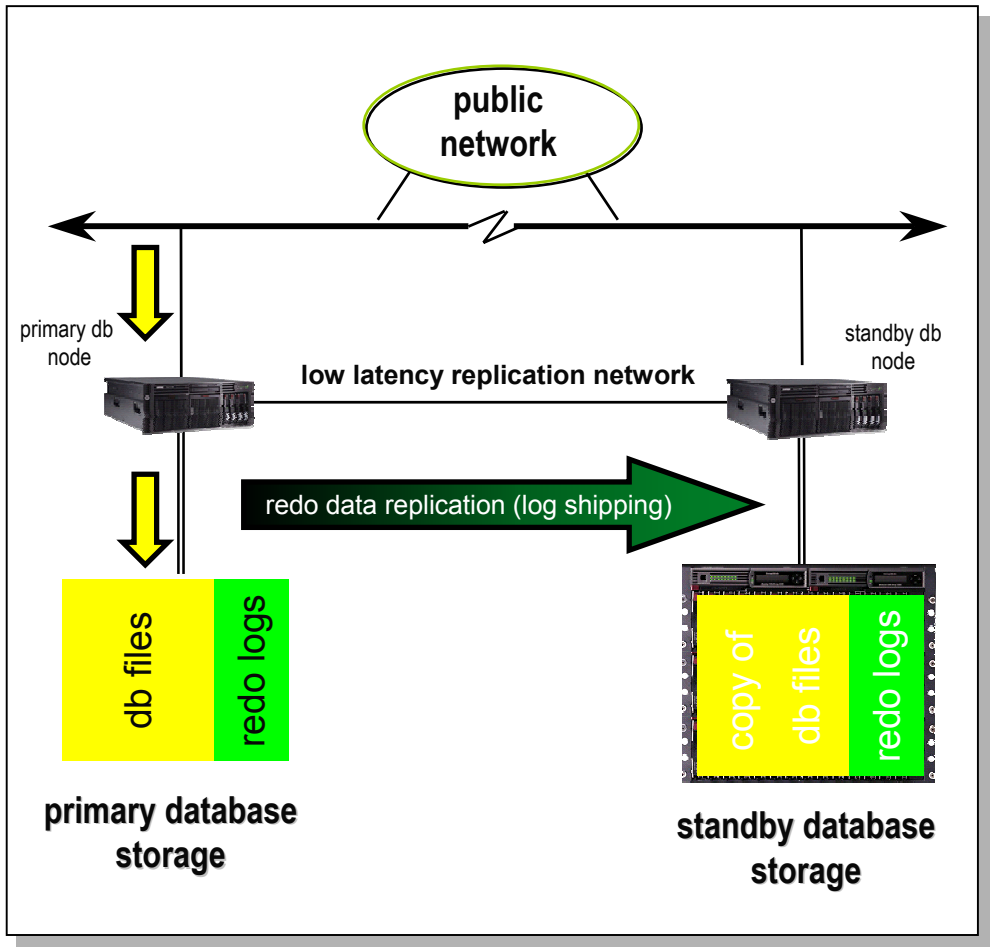


Additional benefits of a parallel database cluster:

- Provides near continuous access to data with minimal interruption by hardware and software component failures
- Allows the addition of nodes to the cluster to increase processing capabilities without the need to redistribute data or alter the user application.

SAP components and solution stack

Database Replication – Software Level:

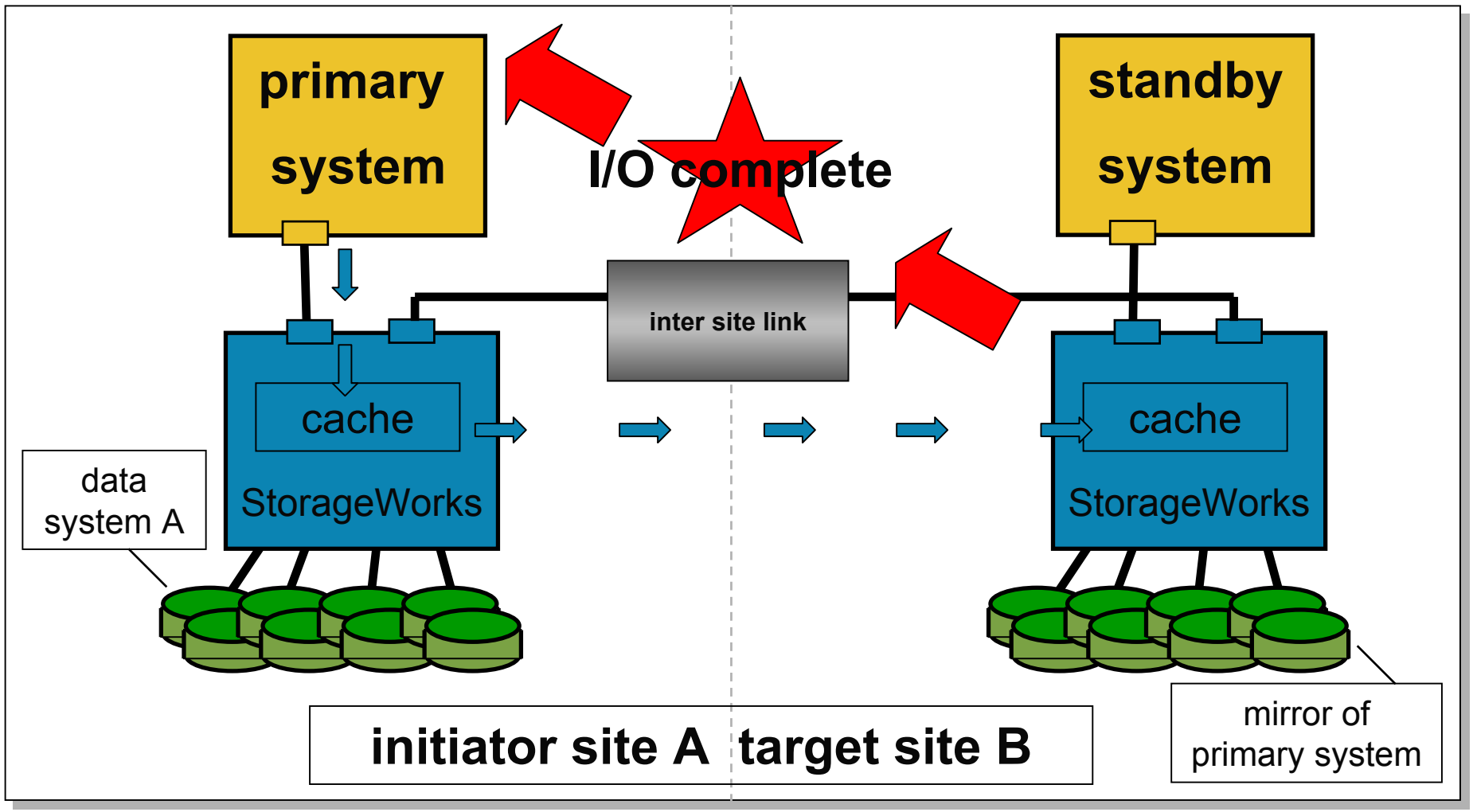


Log-Shipping Database:

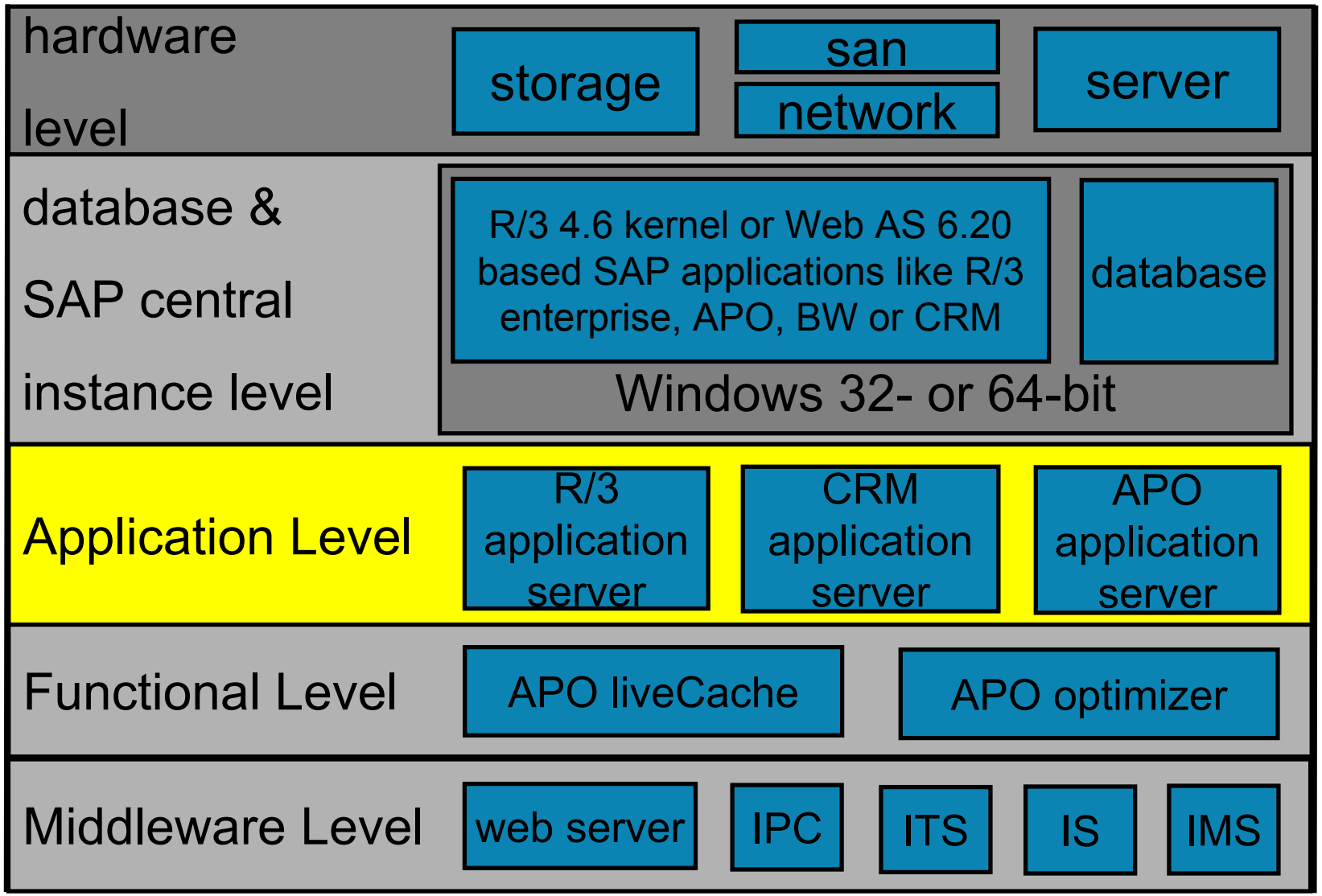
- Provides a 2nd copy of the database
- Replica can get used as near line backup
- Protects against logical database errors like data corruption and accidental data deletion
- Failure recovery is slower as with a failover cluster, but provides additional benefits.

SAP components and solution stack

Database Replication – Hardware Level:

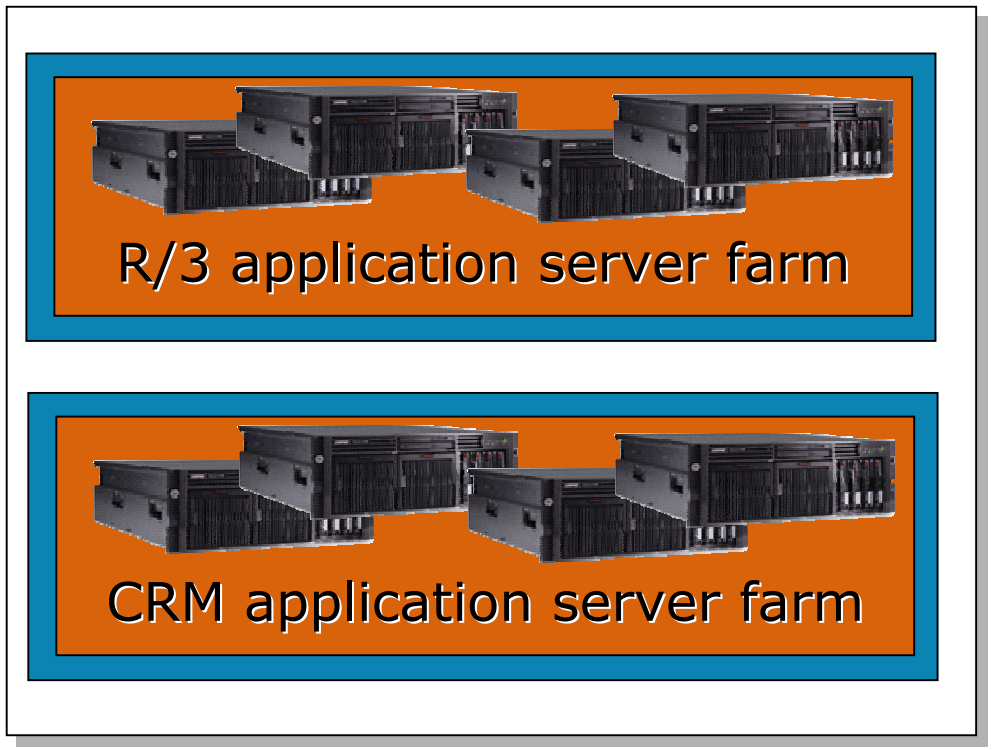


SAP components and solution stack



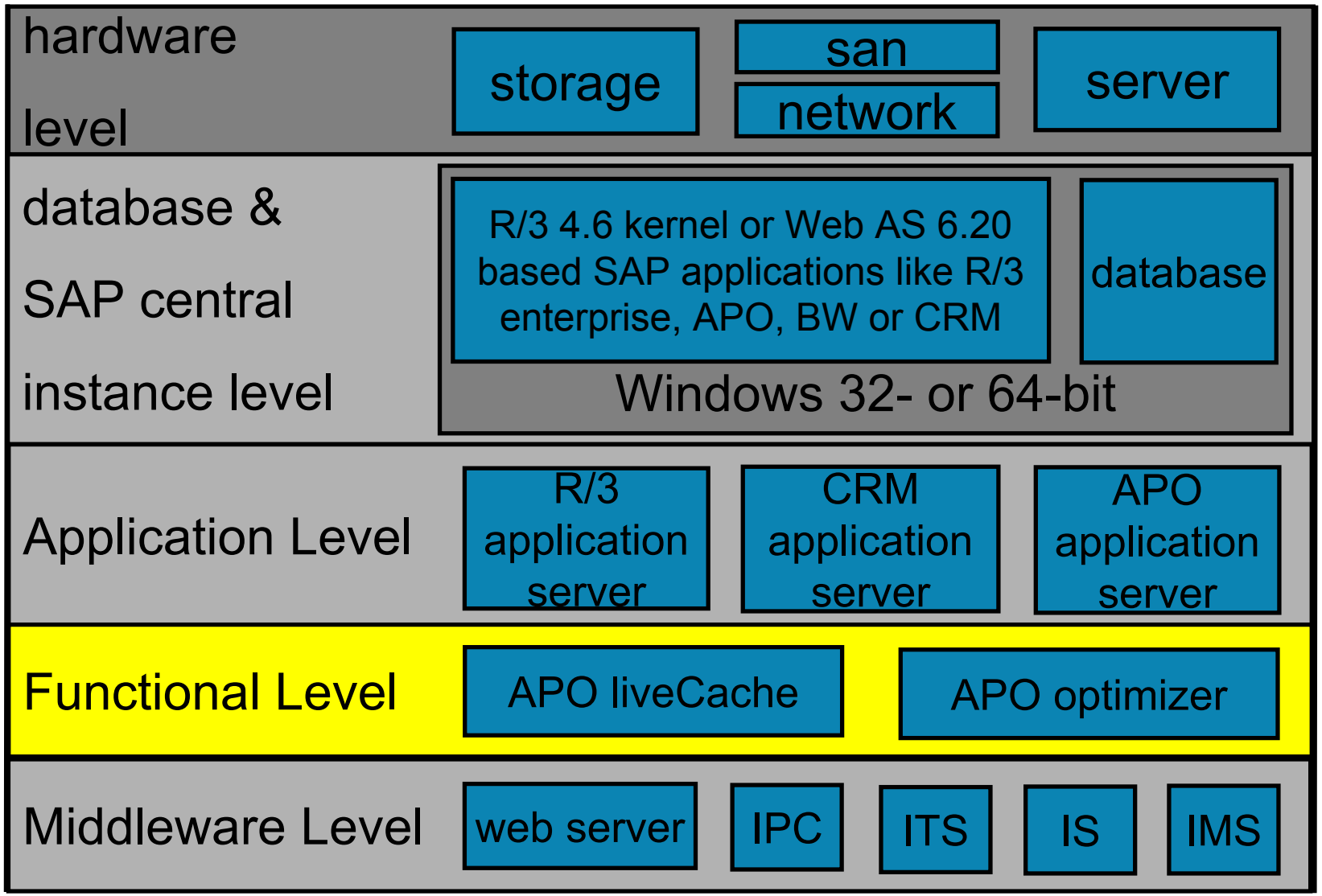
SAP components and solution stack

High Availability on the Application Server Level:



- SAP application server systems can from so-called application server log-on-groups – NSPOF!
- The CI message service assigns a user automatically the next free application server when he uses the log on group
- Application servers automatically re-connect after failures
- User state is lost after a failure

SAP components and solution stack



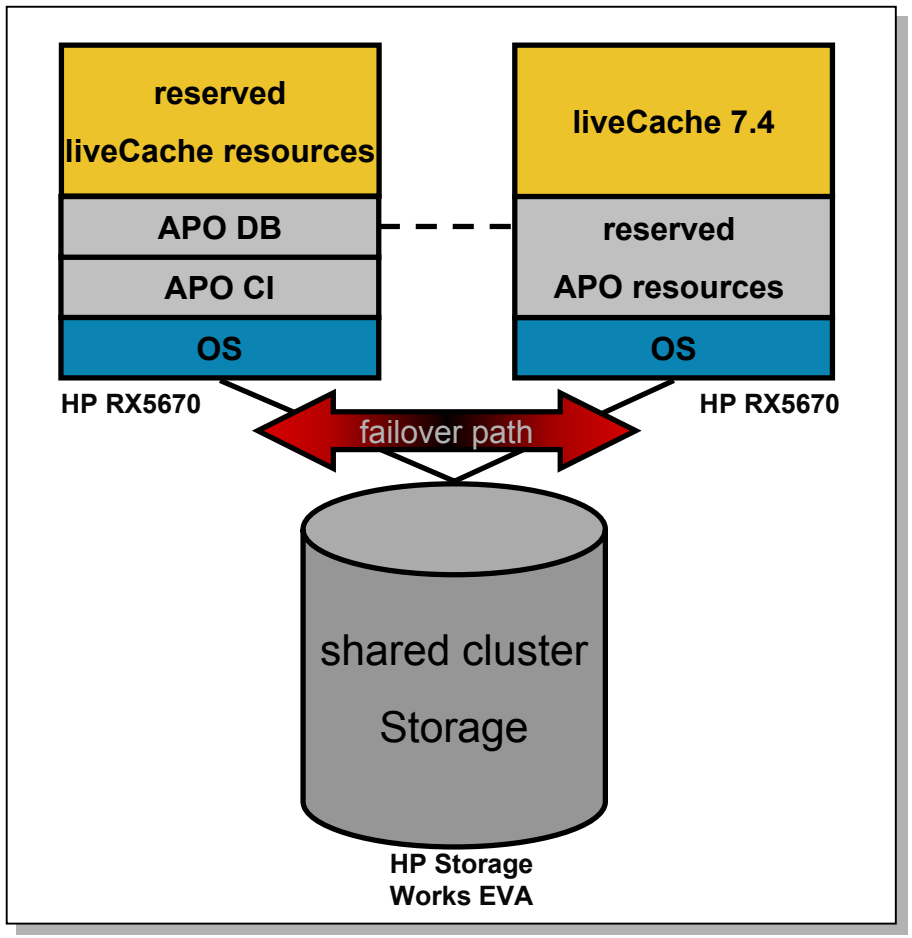
SAP components and solution stack

High Availability on the Functional Level (example APO):

- SAP APO has additional software components that must also get protected against failures.
- APO Optimizer:
  - Is an optional component and used to optimize planning results and to reduce the time needed for this runs.
- liveCache 7.4
  - Is required for every APO installation. The APO data are distributed between the APO database and the liveCache. The liveCache data are normally loaded completely into the memory of the database host. Windows 64-bit is the 1st operating system from Microsoft that fulfills the memory demands of liveCache.

SAP components and solution stack

High Availability on the Functional Level (example APO):



- "Standard" failover cluster solution for liveCache 7.4
- Unlike the standard R/3 cluster configuration the APO CI and DB are running on the same node.
- The liveCache database runs on the 2nd node.
- System resources must be reserved for the failover case.

Pros:

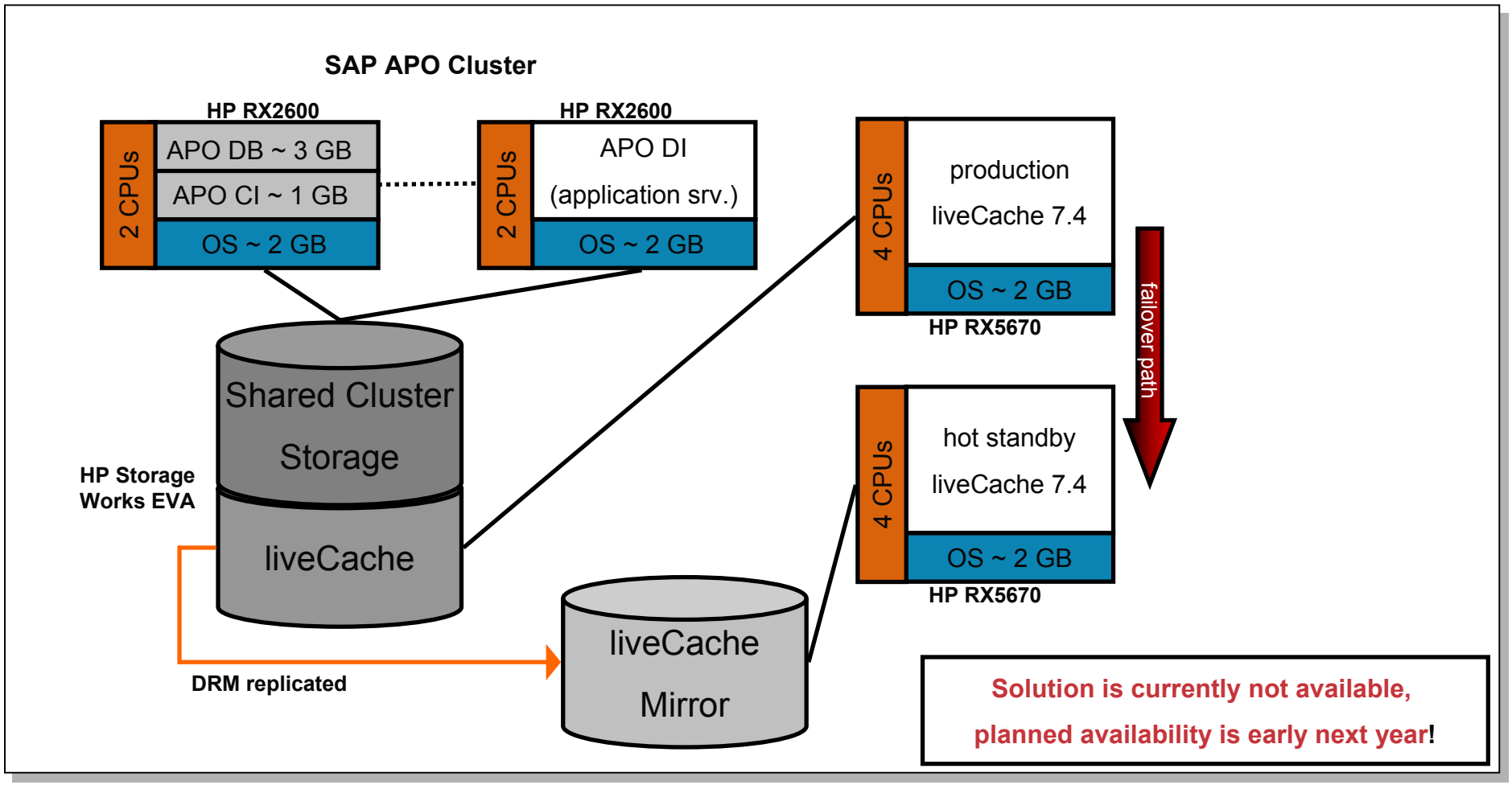
- System resources of all nodes are used
- APO and liveCache are fully protected against OS, application and hardware failures.
- liveCache database is only affected by failures on of the LC node

Cons:

- liveCache database must get loaded into memory after a failover -> cache hit rate is low, LC performance is low
- APO DB and CI may be affected by the LC instance -> processes running on the CI are slower.

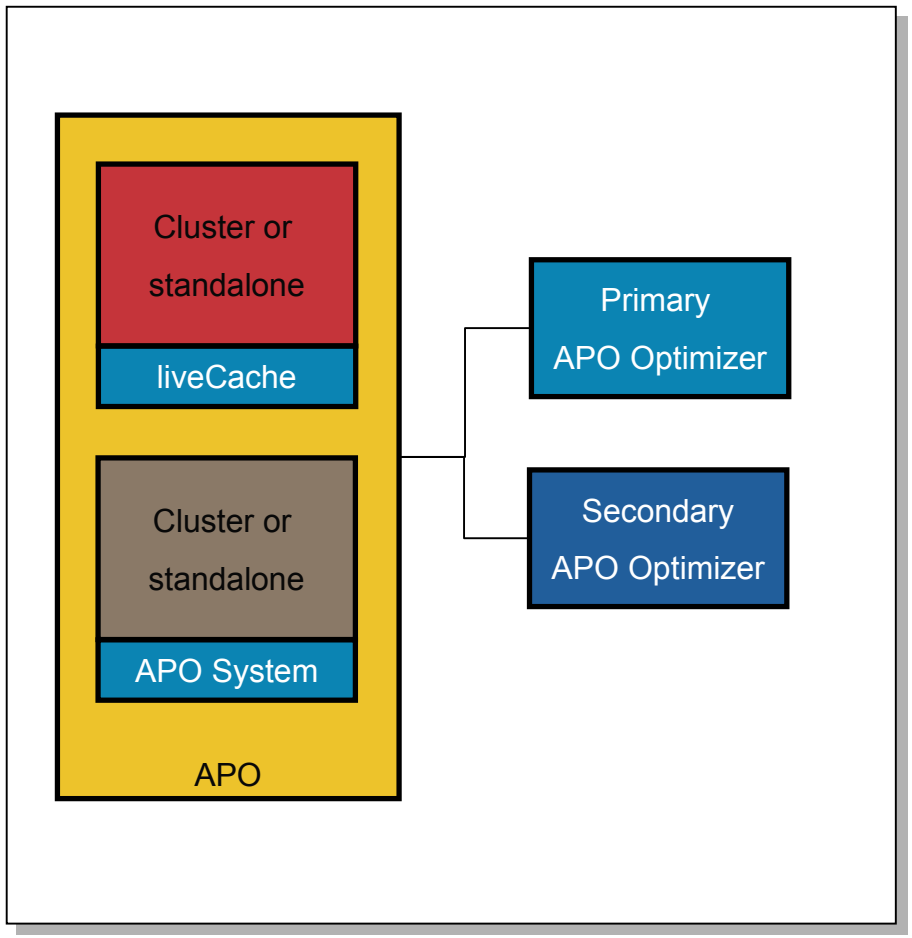
SAP components and solution stack

High Availability on the Functional Level (example APO):



SAP components and solution stack

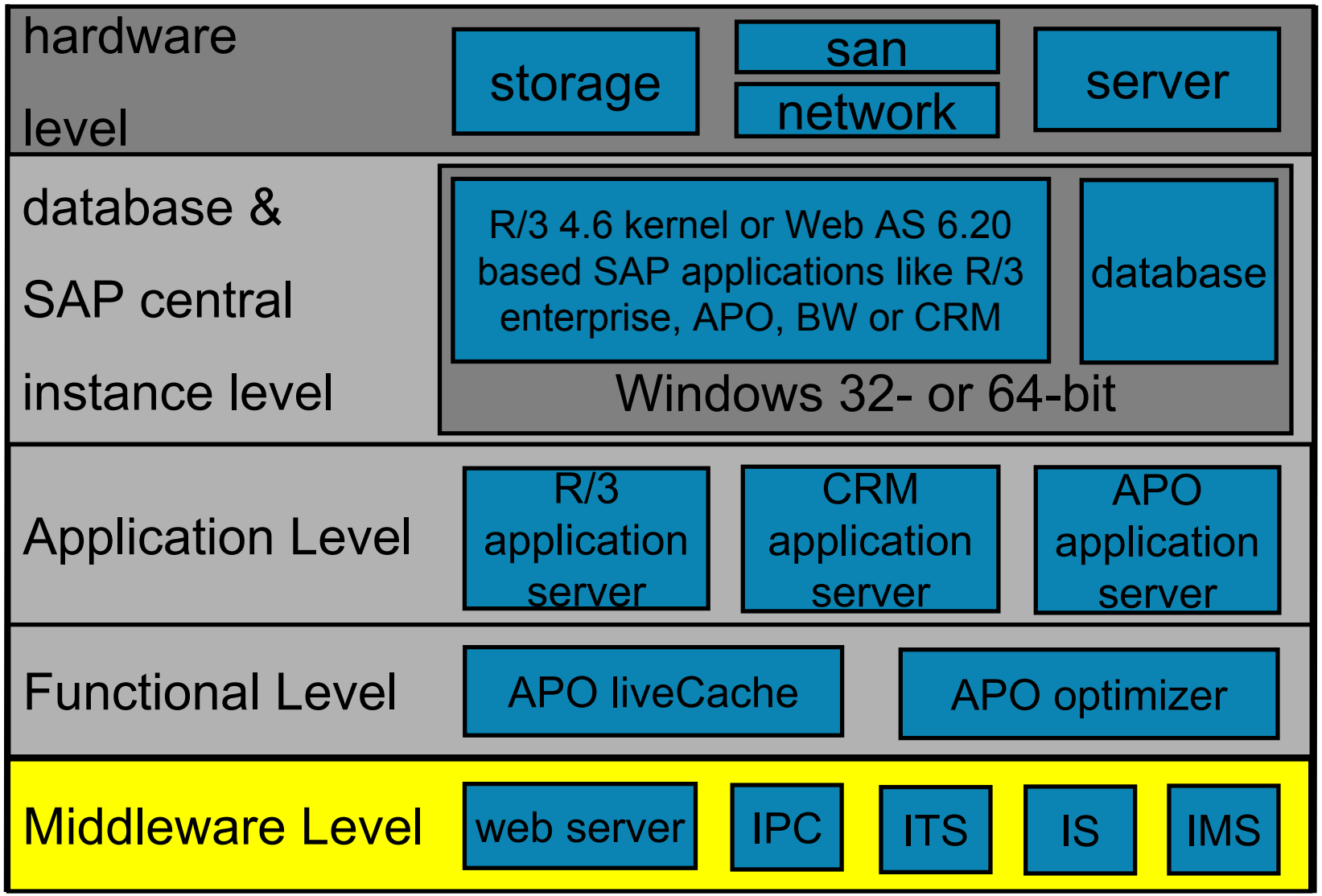
High Availability on the Functional Level (example APO):



APO Optimizer:

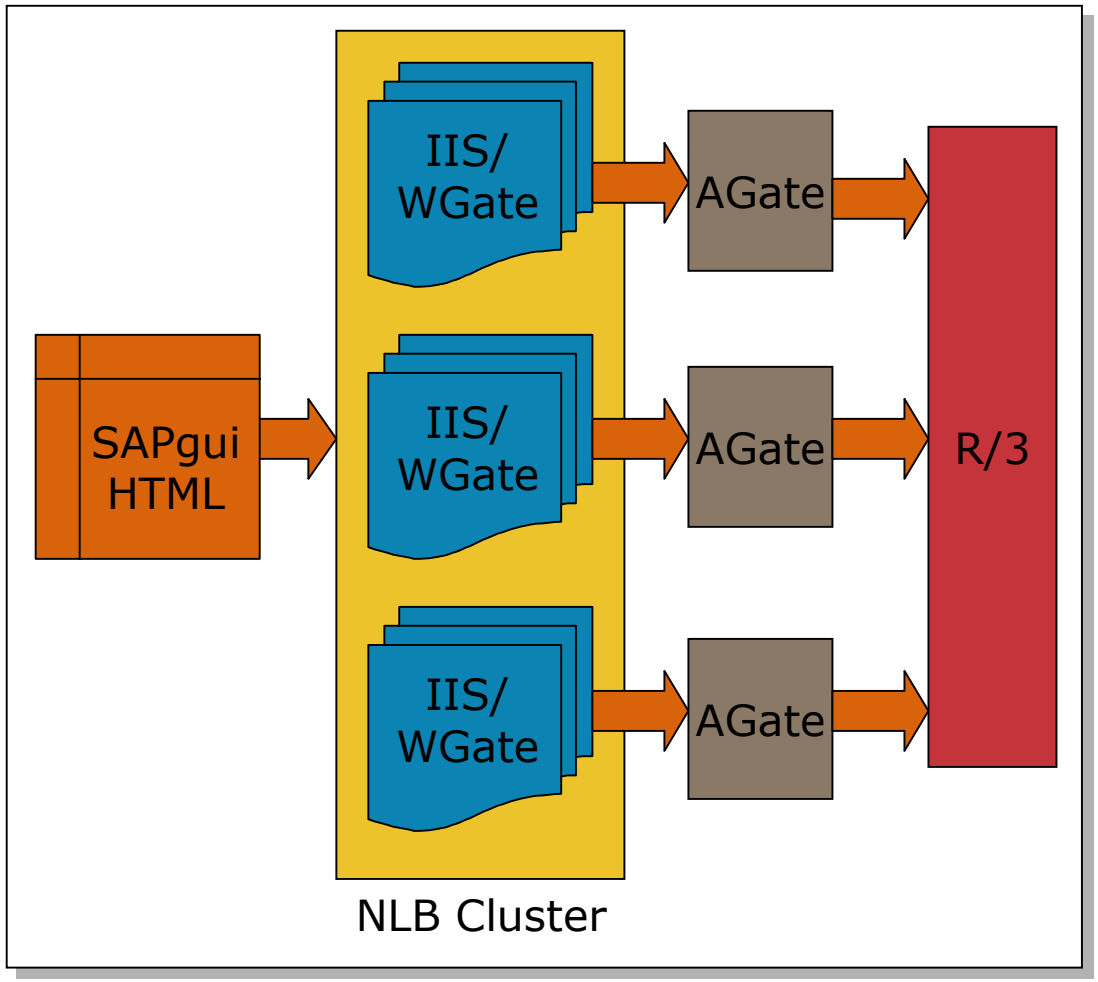
- No Single Point of Failure!
- Can get installed multiple times
- Is supported to run on a cluster, but the cluster service is not required and does not provide additional benefits compared to the standby configuration
- Standby optimizer server can get used during normal operation

SAP components and solution stack



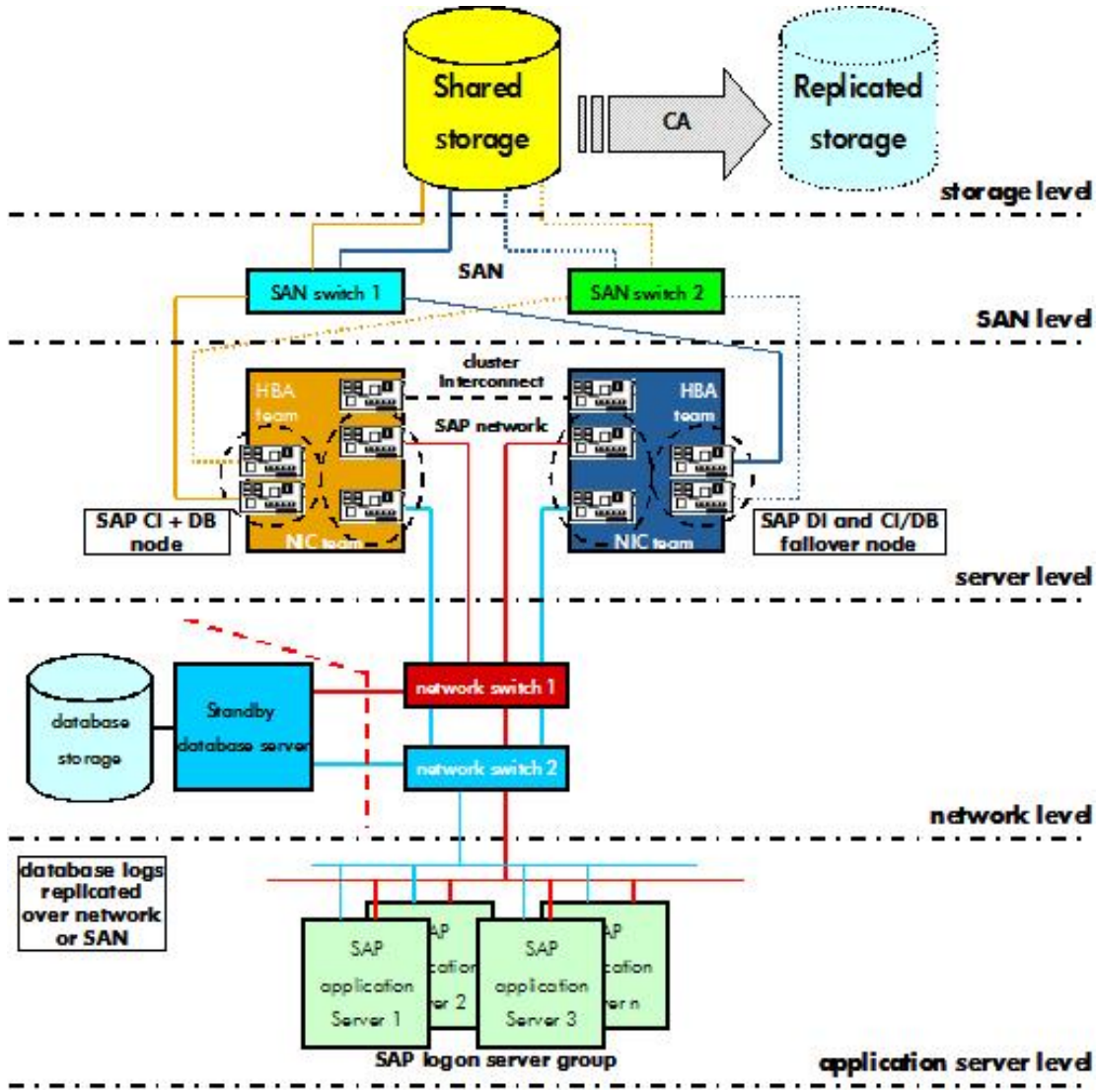
SAP components and solution stack

High Availability on the Middleware Level (example ITS):

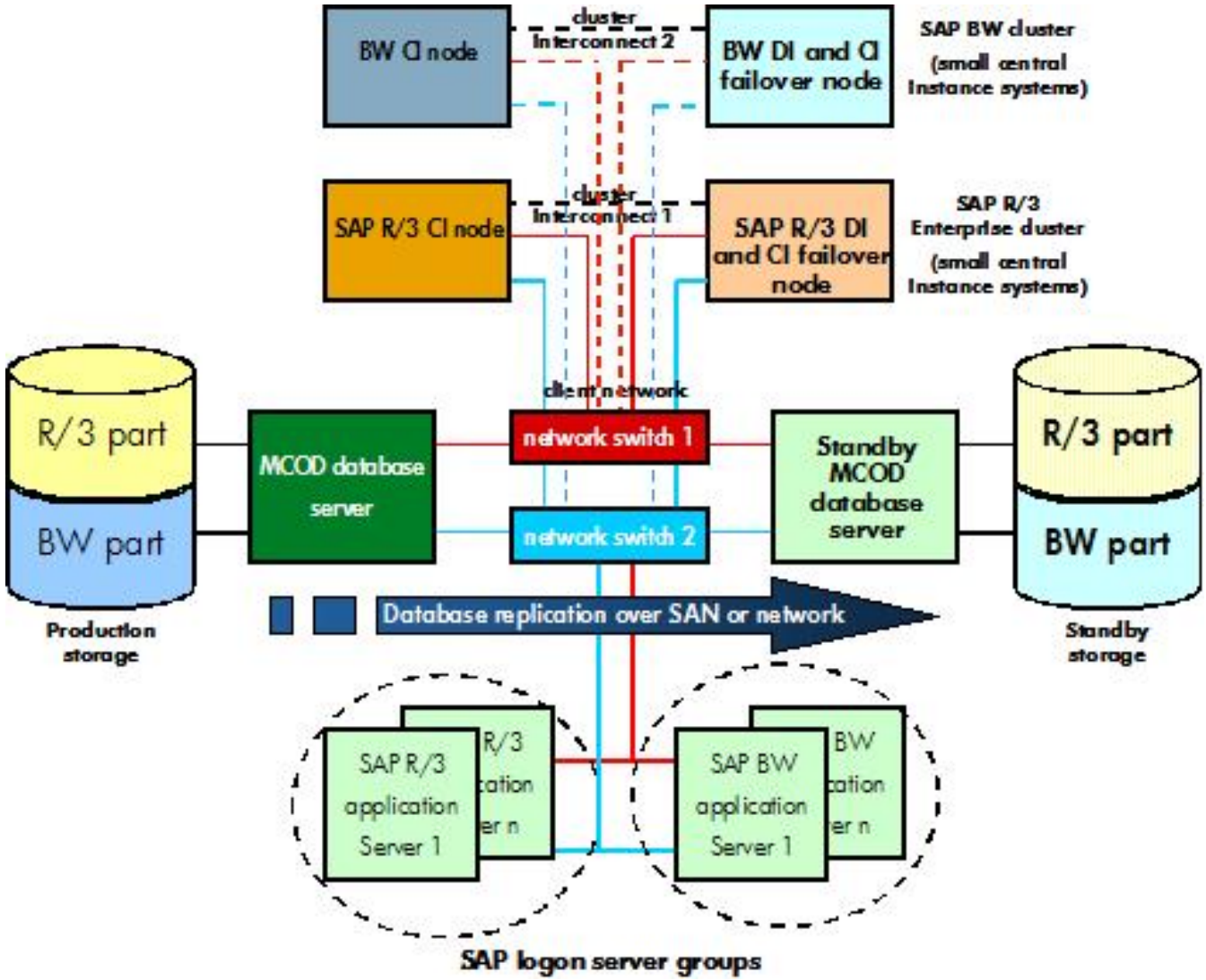


- ITS web servers are running on a NLB cluster
- With Network Load Balancing ITS is protected against failures -> NSPOF
- A “watchdog” for ITS checks regularly the status and availability of all ITS nodes and removes a faulty ITS server from the NLB cluster

SAP HA solution example 1



SAP HA solution example 2



Agenda

- Introduction to High Availability and SAP in the Microsoft area
- SAP components, solution stack and HA examples
- **Microsoft Cluster and SAP certified HP servers and disk subsystems**
- Summary and Q&A

Microsoft Cluster and SAP certified HP servers and disk subsystems

- **Only SAP certified HP server systems are supported!**
- **Only Fibre Channel based storage is supported in the SAP area!**
- **Deployment flexibility with HP cluster kits**
  - HA/F100
  - HA/F200
  - HA/F500 for Enterprise Virtual Array
- **Only Microsoft Cluster Service „clustered“ systems are supported!**
- **SAP and Microsoft certification web sites**
  - http://www.microsoft.com/hcl/
  - http://www.addon.de/fcert.htm

SAP components and solution stack

Microsoft Cluster and SAP Certified HP Server Systems:

Density Line:

- DL360
- DL380
- DL580
- DL560
- DL760

HP Blades:

- BL20p G2
- BL40p

HP Itanium:

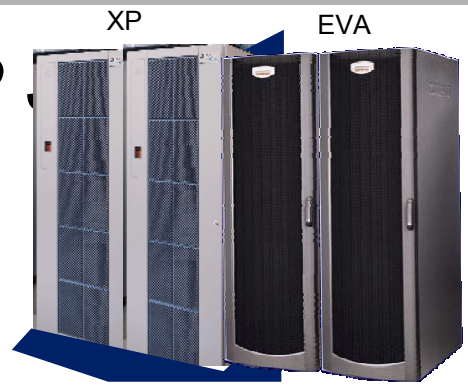
- RX5670
- RX2600

ML (Media) Line:

- ML370
- ML530
- ML570
- ML750

SAP components and solution stack

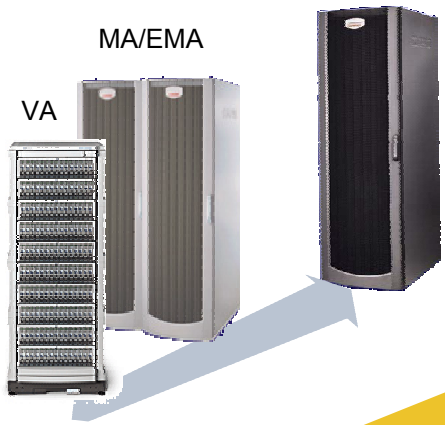
Microsoft Cluster and SAP Certified HP Systems:



EVA-based midrange

MA/EMA

VA



VA7100

MSA1000

<u>business entry</u>
- SCSI and FC
- investment protection: DAS to SAN (DtS)
- moderate scalability
- price sensitive
- faster life cycles

<u>business midrange</u>
- scalable modularity
- heterogeneous
- ease of administration
- price/performance
- moderate functionality

<u>business enterprise</u>
- monolithic or modular
- high connectivity
- high scalability
- high efficiency
- lower TCO
- lower high-end entry price points
- highest disaster tolerance solutions
- universal connectivity and heterogeneity

Agenda

- Introduction to High Availability and SAP in the Microsoft area
- SAP components, solution stack and HA examples
- Microsoft Cluster and SAP certified HP servers and disk subsystems
- **Summary and Q&A**

Summary and Q&A

- Microsoft Windows based SAP systems are well suited for the enterprise!
- The database vendors support high availability with their products!
- SAP supports only MSCS clustering in the MS area!
- Use the right technology for the different SAP solution stack level!
- Clustering alone does not solve your continuance and availability problem!
- HP provides the right server and storage platform for Windows 2003 64-bit and SAP.
- Several HP whitepapers for SAP and HA are available from HP

  (e.g. http://esp.rose.hp.com:2000/nav24/cons/fis/eis/Presentations/090017ad815c84fa/)

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