SQLdays konferenz

Failure is not an Option
SQL Server HADR in der Praxis

=tg= Thomas Grohser

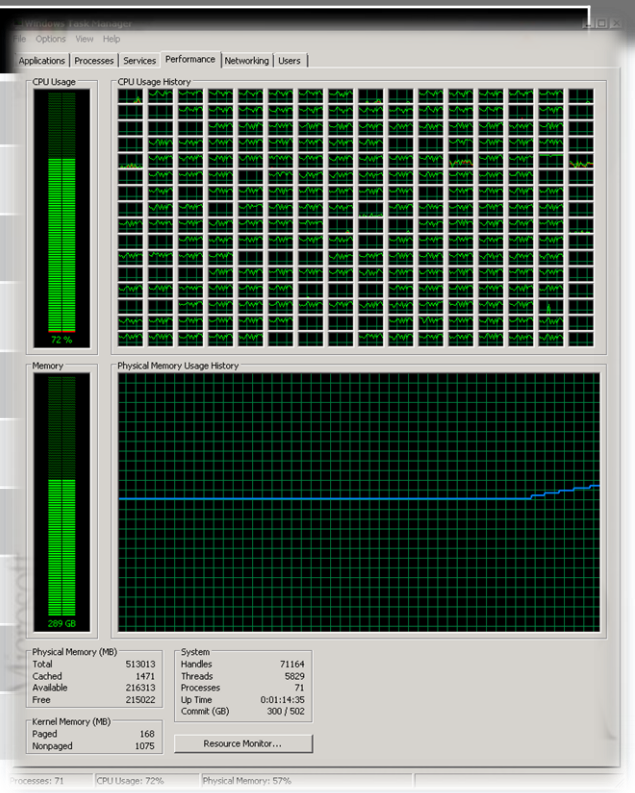
tg@grohser.com

Veranstalter:

ppedv

select * from =tg=

@@Version	Remark
SQL 4.21	First SQL Server ever used (1994)
SQL 6.0	First Log Shipping with failover
SQL 6.5	First SQL Server Cluster (NT4.0 + Wolfpack)
SQL 7.0	2+ billion rows / month in a single Table
SQL 2000	938 days with 100% availability
SQL 2000 IA64	First SQL Server on Itanium IA64
SQL 2005 IA64	First OLTP long distance database mirroring
SQL 2008 IA64	First Replication into mirrored databases
SQL 2008R2 IA64	First 256 CPUs & >500.000 STMT/sec
SQL 11 (Denali)	Can't wait to push the limits even further



Thomas Grohser, SQL Server MVP, bwin Interactive Entertainment AG

Focus on SQL Server Infrastructure Architecture and Implementation

Close Relationship with Microsoft

- SQLCAT (SQL Server Customer Advisory Team)
- SCAN (SQL Server Customer Advisory Network)
- TAP (Technology Adoption Program SQL2008R2 and SQL11)

Active PASS member and PASS Summit Speaker

MVP Microsoft Most Valuable Professional

SQL CAT

PASS PROFESSIONAL ASSOCIATION FOR SQL SERVER

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World's biggest publicly listed online gaming platform

World's **leading provider** of online Sports Betting

One of the largest **Poker networks**

Comprehensive range of **Payment Service Providing**

Integrated gaming portal - **22 languages,**
25 core markets

Gross gaming revenues 2008 (GGR):
EUR **421 million**

More than **20 million registered customers**

1,500 employees

bwin builds on the strengths of the web in order to **tie up responsibility and gaming**

15 million page views and up to **980,000 users a day**

Failure is not an option
Agenda

- **The Mission**
- **The Solution**
  - Standardizing
  - Zero data loss
  - High availability
  - Scale up
- **The Details**
  - SQL Server logins
  - SQL Server jobs
  - Log Shipping
  - Partner databases
  - Replication

24x7 OLTP Database Management for VLDB

Failure is not an option
The Mission

- **VLDB – A database that needs attention it's not size alone**
- **SLA**
  - Zero data loss & 100% transactional consistency on financial transactions
  - 99.99x% availability @ 24 x 7
  - 450.000+ SQL Statements per second
  - Assumed worst case scenario: full datacenter failure with complete data loss within the datacenter
- **Budget: unlimited** (not kidding)

Failure is not an option
The Solution

- **Standardize everything**
- **Work by the book**
- **Have some clever guys at hand**

if the book runs out of pages

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Standardizing

- **Operating System**
  - Version, Edition, Service Pack, Patch Level
- **File System and Disks**

Failure is not an option
File System Example

- C:\
- C:\Windows
- C:\Install
- C:\SQL01
- C:\SQL01\BIN
- C:\SQL01\TEMPLOG01
- C:\SQL01\TEMPDATA01
- C:\SQL01\LOG01
- C:\SQL01\LOG02
- C:\SQL01\DATA01
- C:\SQL01\DATA02
- C:\SQL01\DATA03
- C:\SQL01\DATA04

Failure is not an option
File System expansion

- C:\
- C:\Windows
- C:\Install
- C:\SQL01
- C:\SQL01\BIN
- C:\SQL01\TEMPLOG01
- C:\SQL01\TEMPDATA01
- C:\SQL01\LOG01
- C:\SQL01\LOG02
- C:\SQL01\DATA01
- C:\SQL01\DATA02
- C:\SQL01\DATA03
- C:\SQL01\DATA04

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File System settings

- Stripesize 64/128/256 kB
  depending on storage
- Partition alignment 64/128 kB
  depending on storage
- Cluster size 64 kB
- 100% write cache
- 0% read cache

Failure is not an option
Standardizing

- **Operating System**
  - Version, Edition, Service Pack, Patch Level
- **File System and Disks**
- **SQL Server**
  - Version, Edition, Service Pack, Patch Level
- **Network**
  - Separate network for data and backup
  - IP Schema
- **Documentation, Documentation, ….**

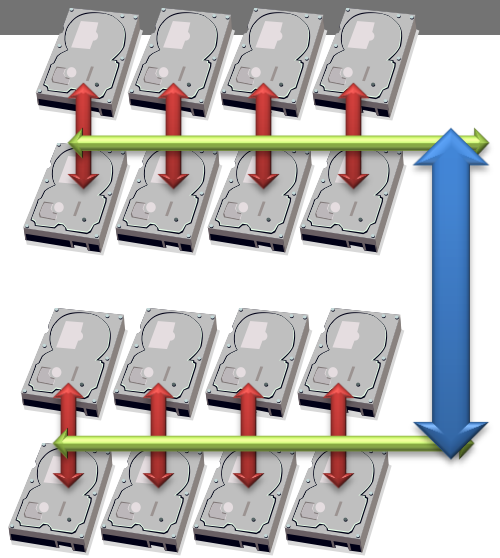
Failure is not an option
Zero data loss

- Redundant NIC
- Redundant Power Supply
- Data files on SAN
  (RAID 1/0 Multipath/2 Fabrics)
- Transaction log files on RAID 101

Failure is not an option
RAID 101

RAID Controller

RAID Controller



HW RAID 1

HW RAID 0

SW RAID 1

Failure is not an option
Zero data loss

- Redundant NIC
- Redundant Power Supply
- Data files on SAN
  - (RAID 1/0 Multipath/2 Fabrics)
- Transaction log files on RAID 101

Availability: 0,00%
Data loss: 100,00%

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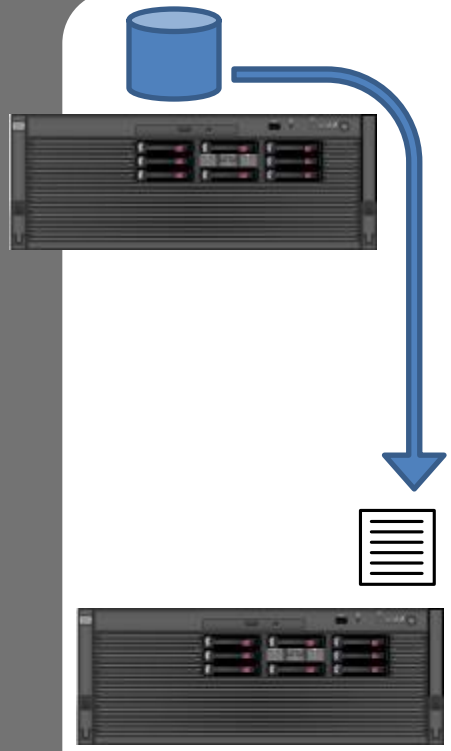
Failure is not an option
Zero data loss



- Full backup every 24 h

Availability: 0,00%

Data loss: 100,00%

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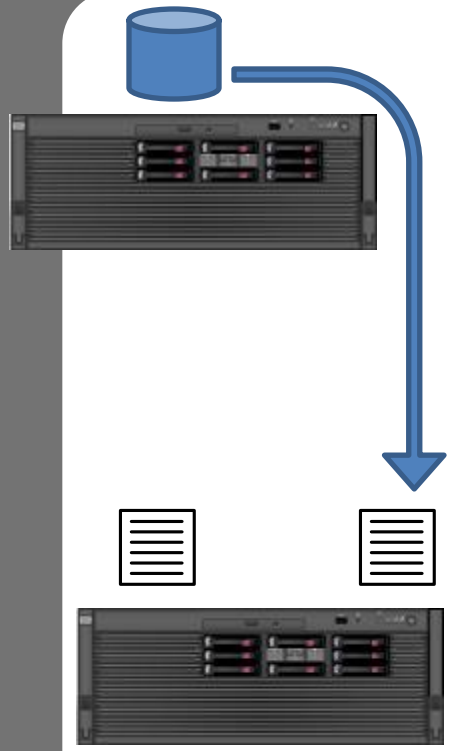
Failure is not an option
Zero data loss



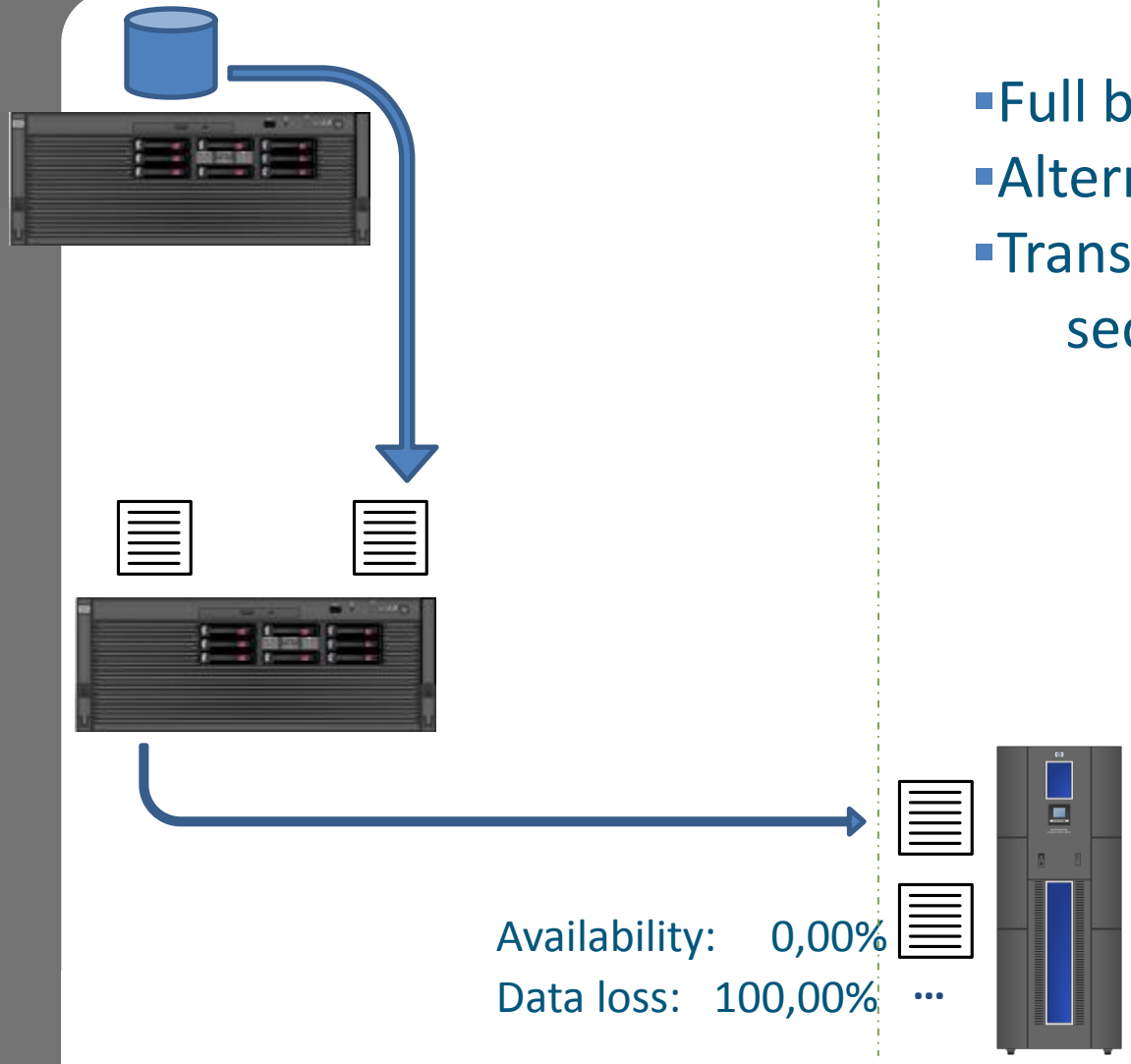
- Full backup every 24 h
- Alternating files

Availability: 0,00%

Data loss: 100,00%

SQLdays konferenz

Failure is not an option
Zero data loss



- Full backup every 24 h
- Alternating files
- Transfer of files to tape in second location

Availability: 0,00%

Data loss: 100,00%

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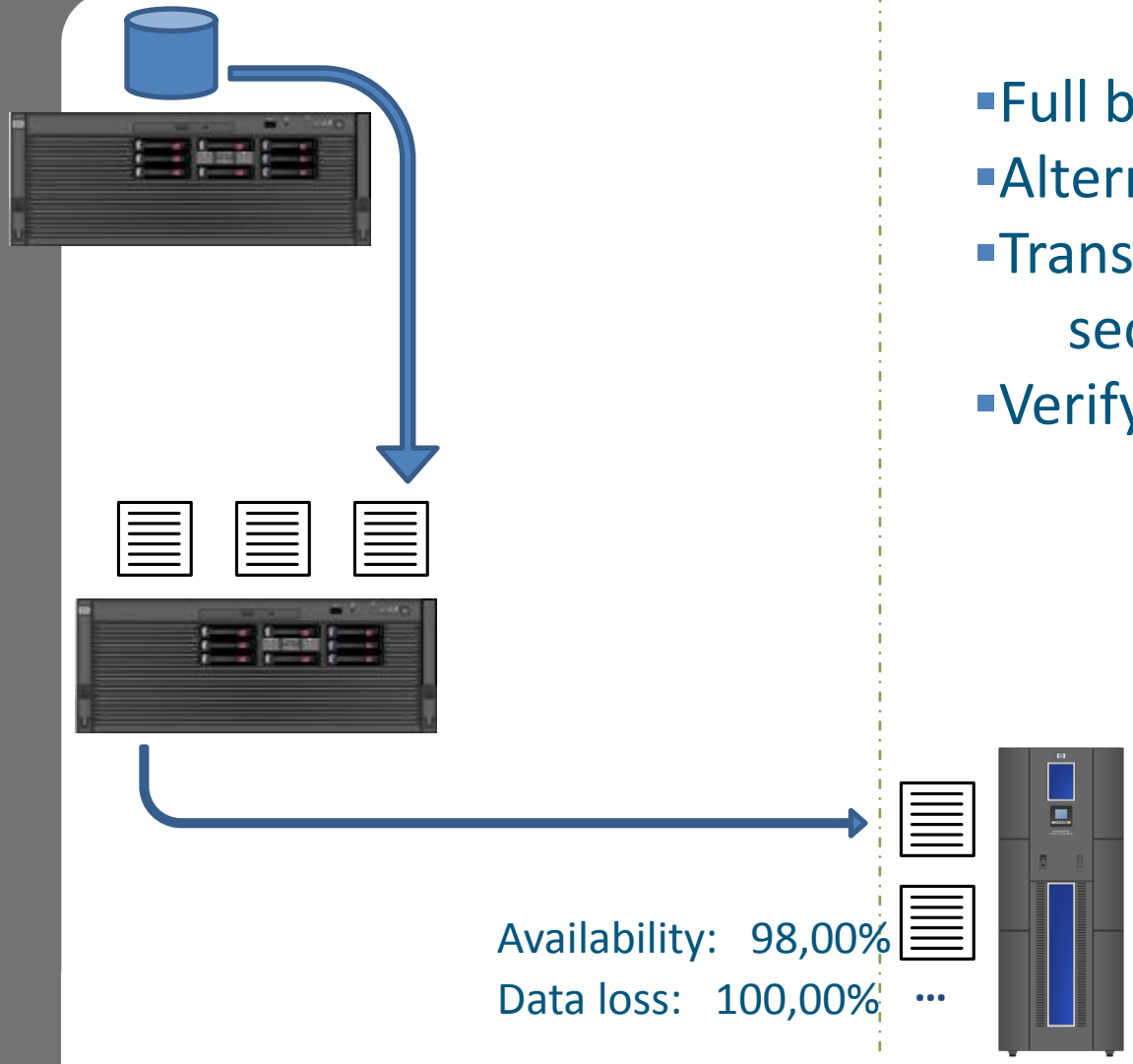
Failure is not an option
Zero data loss



- Full backup every 24 h
- Alternating files
- Transfer of files to tape in second location
- Verify of backups (daily)

Availability: 98,00%

Data loss: 100,00%

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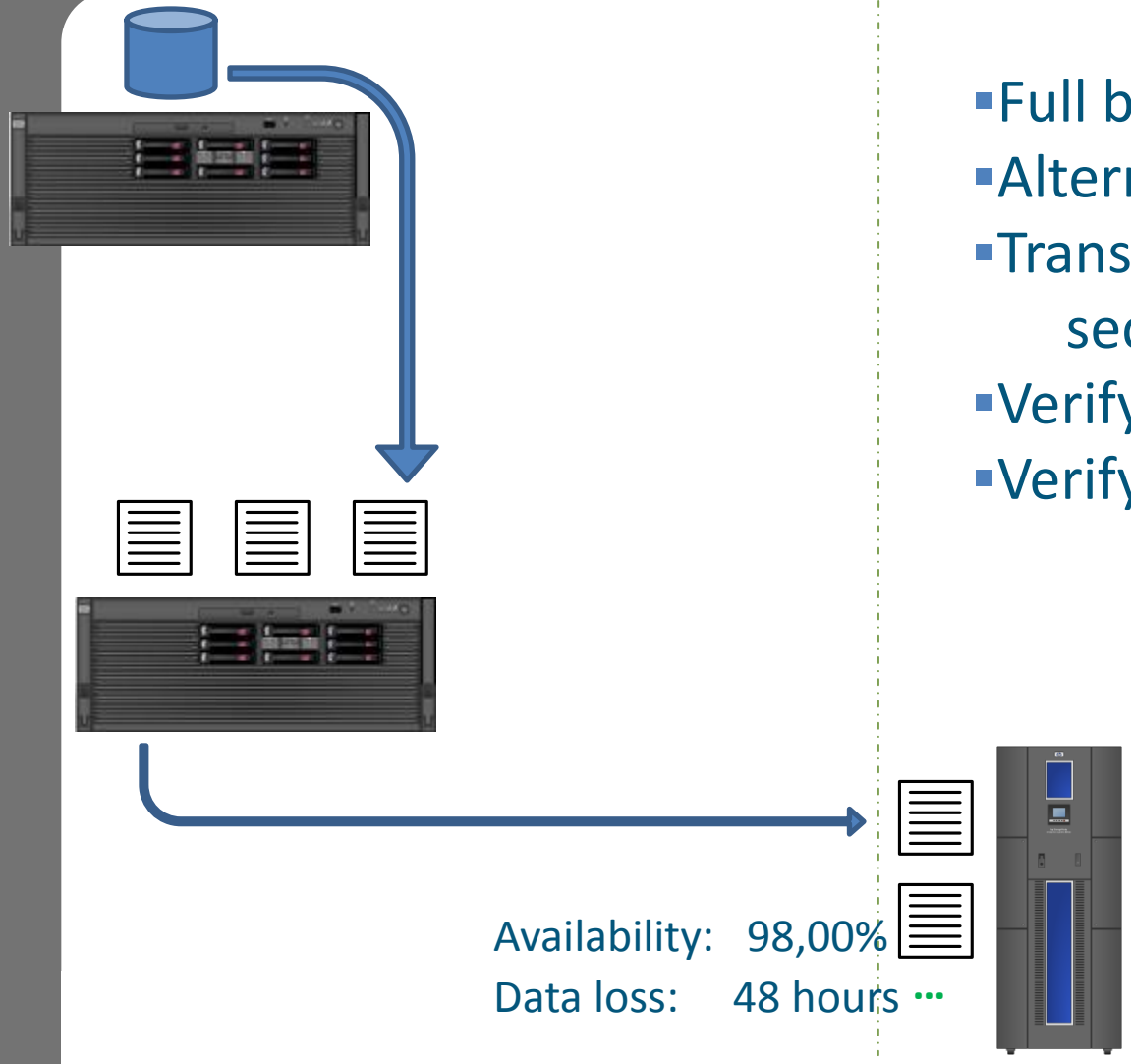
Failure is not an option
Zero data loss



- Full backup every 24 h
- Alternating files
- Transfer of files to tape in second location
- Verify of backups (daily)
- Verify of tapes

Availability: 98,00%

Data loss: 48 hours …

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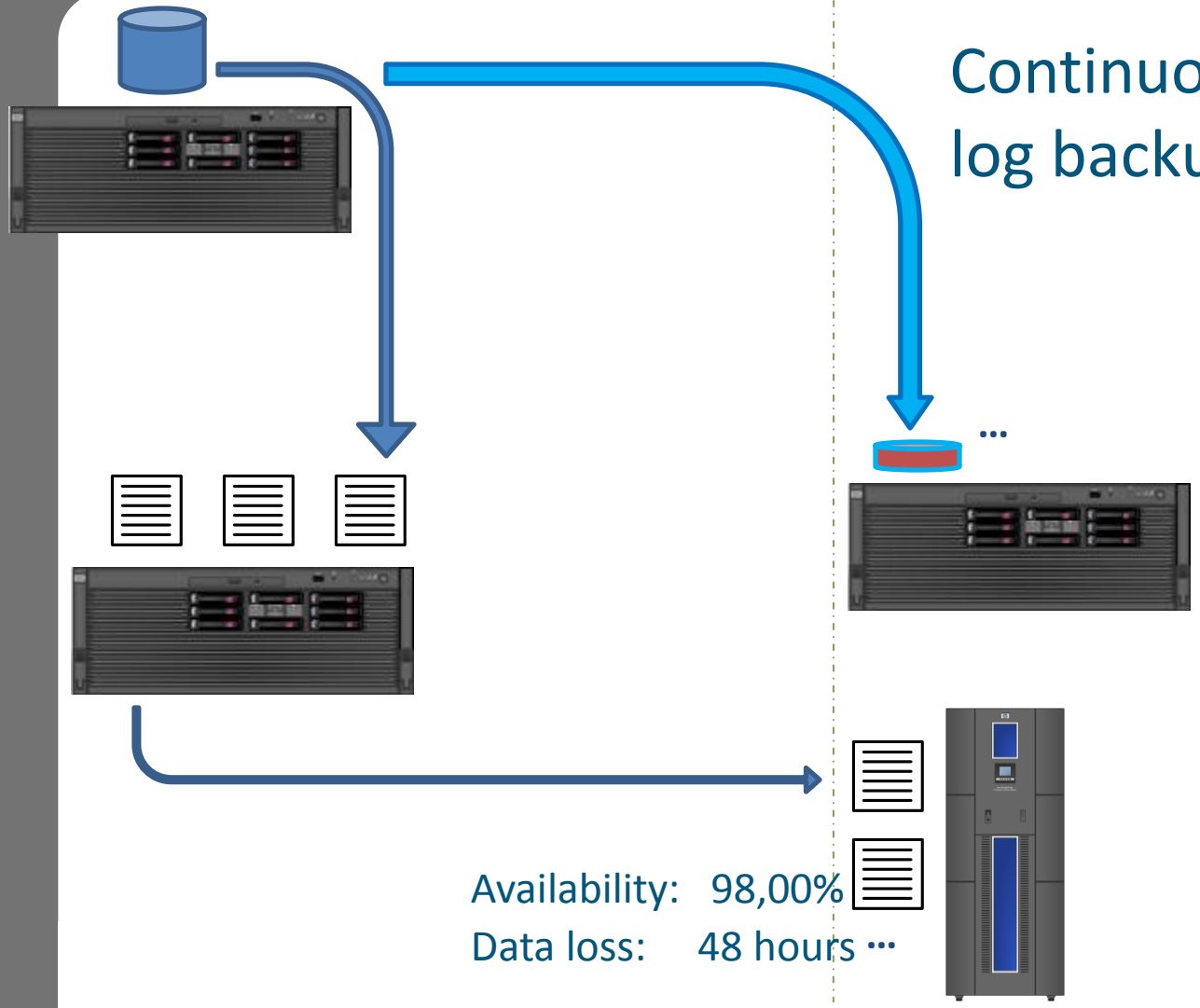
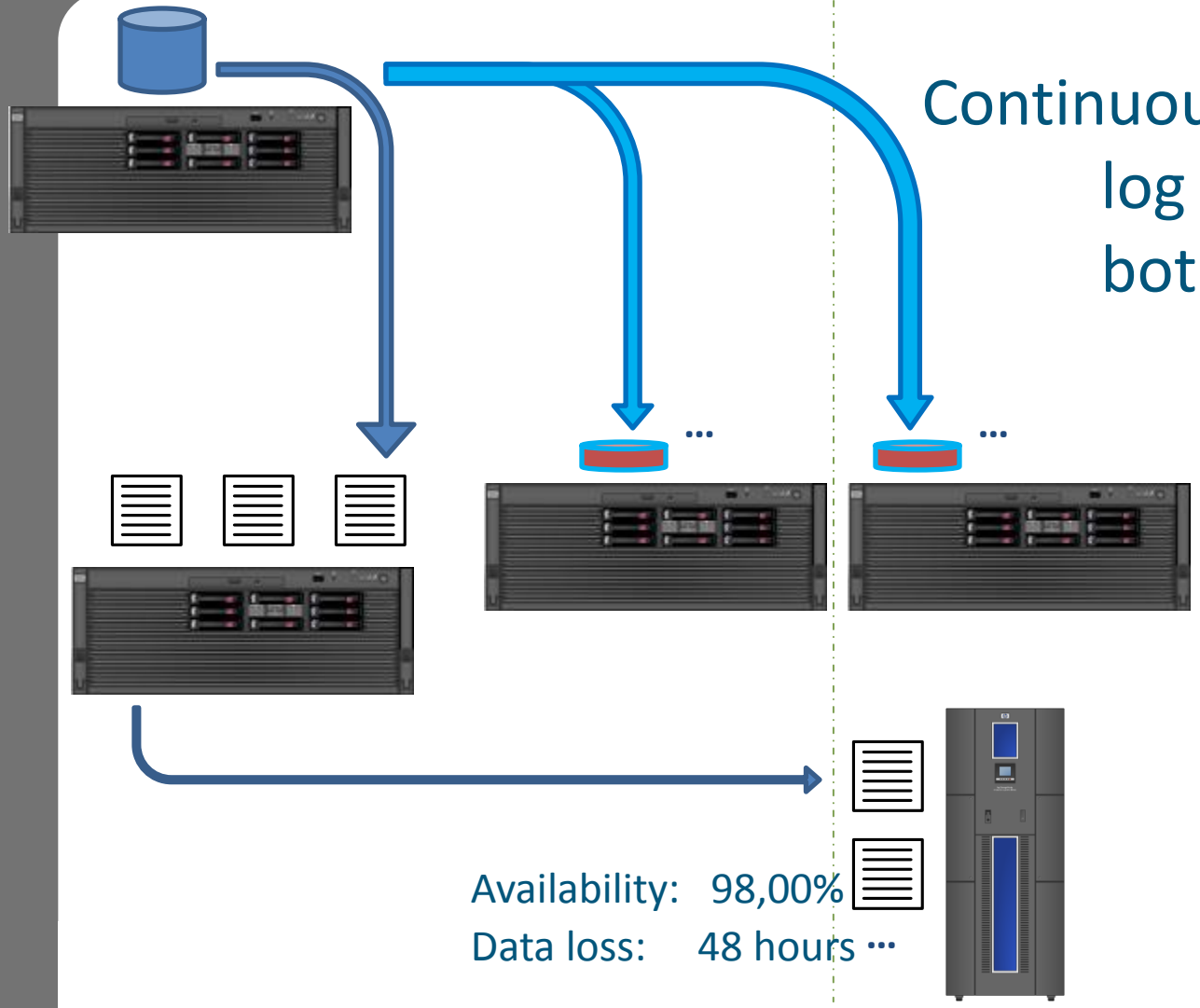
Failure is not an option
Zero data loss



Failure is not an option
Zero data loss

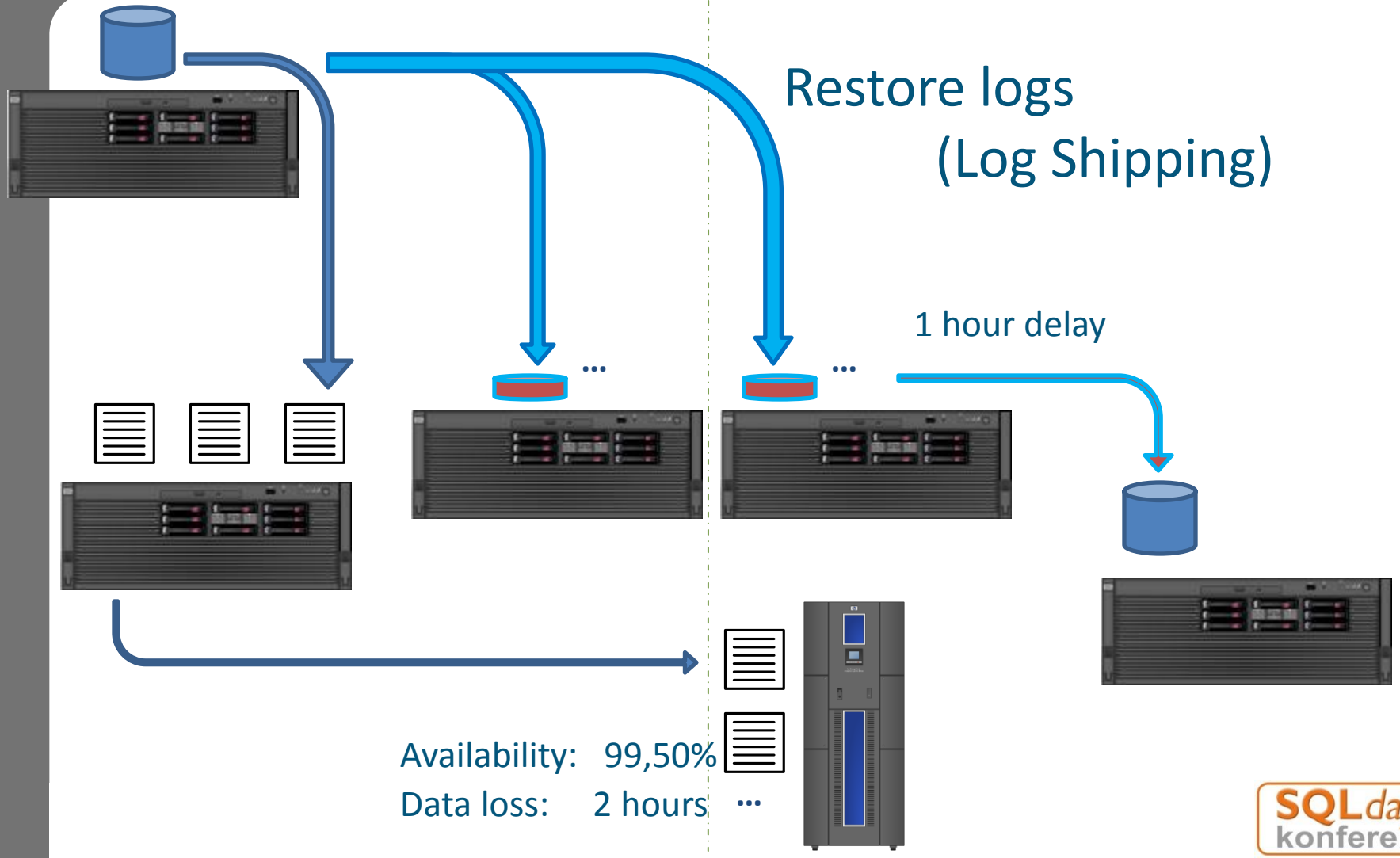


Continuous Transaction log backups to both locations

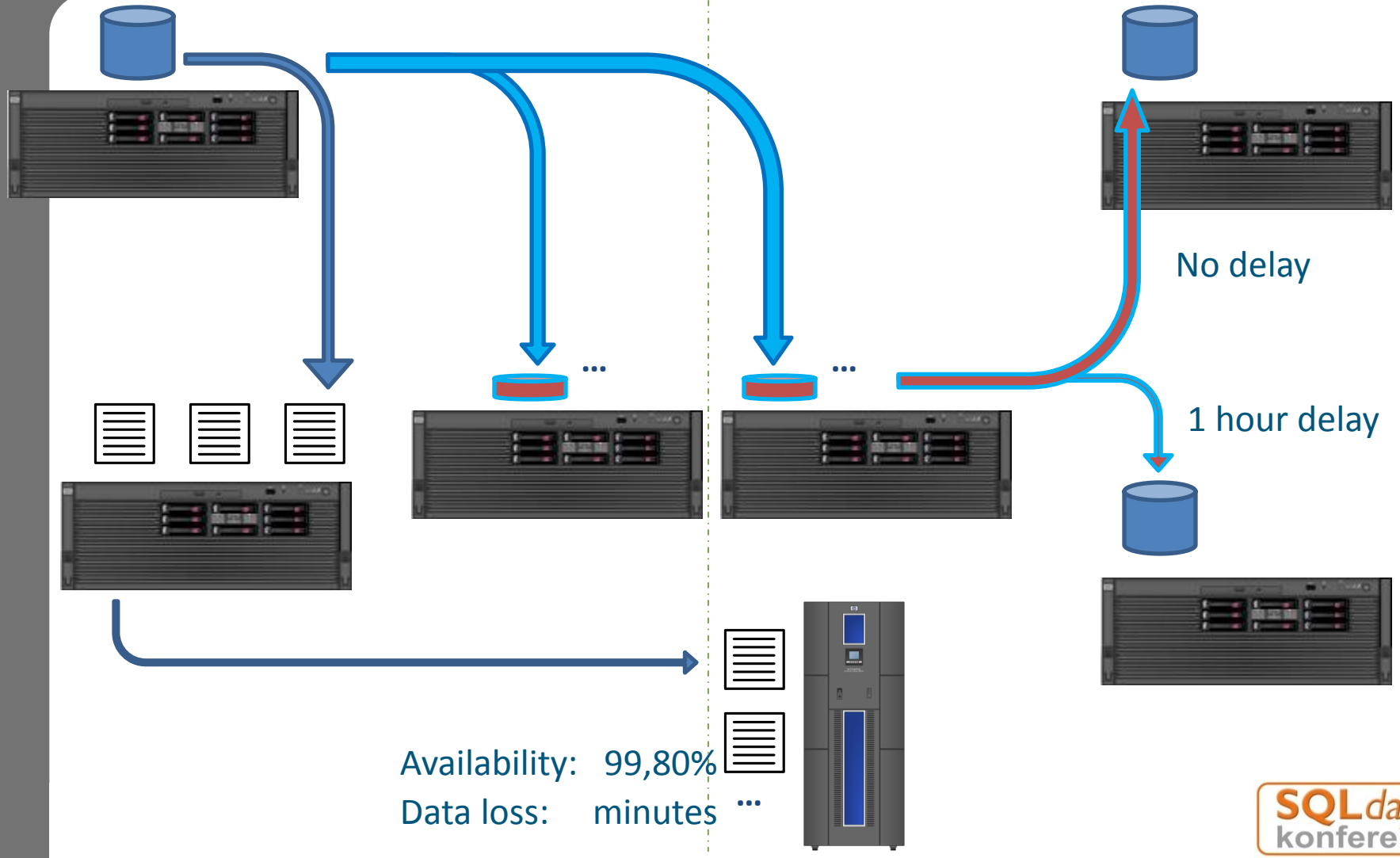
Availability: 98,00%

Data loss: 48 hours …

Failure is not an option
Zero data loss



Failure is not an option
Zero data loss



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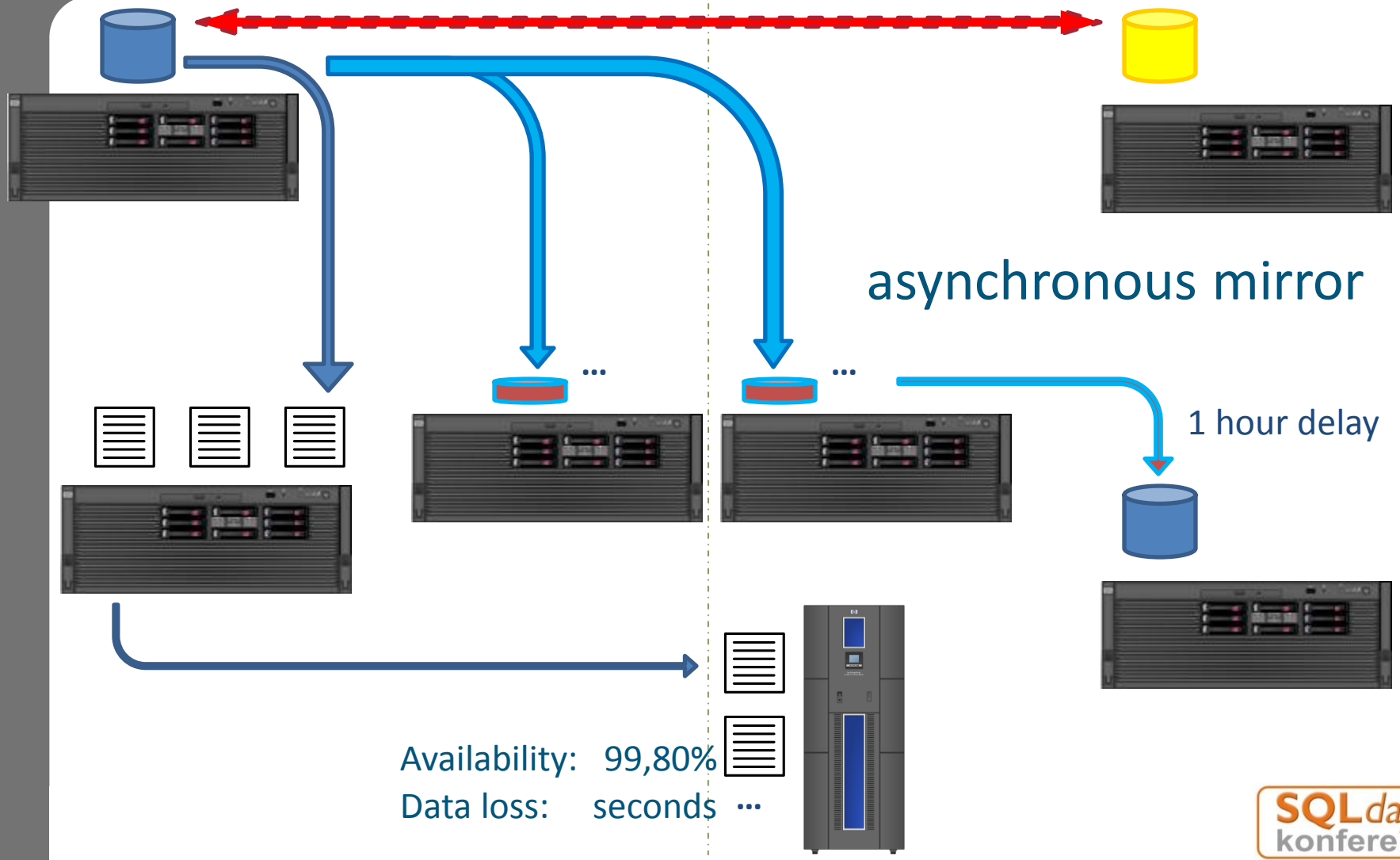
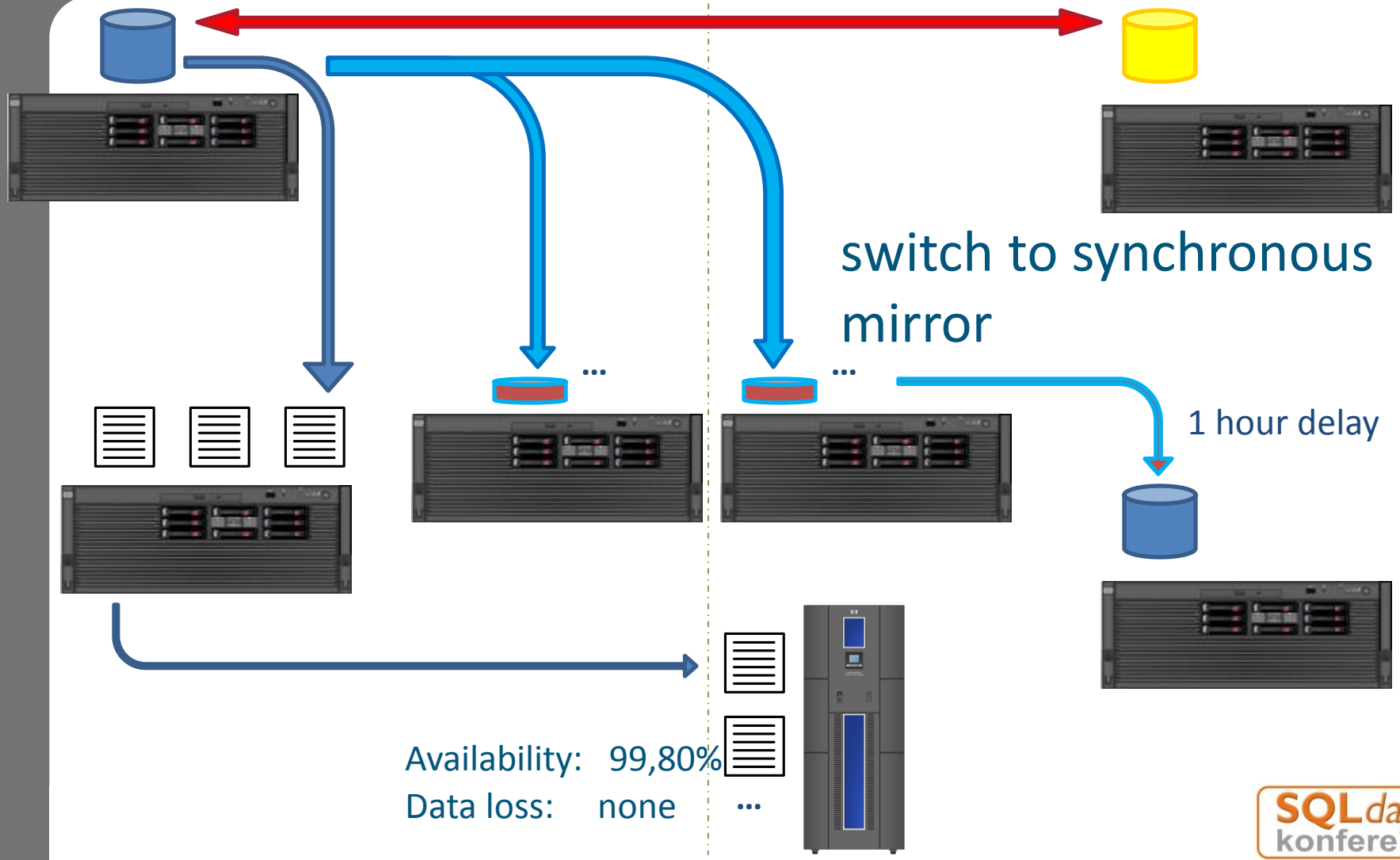
Failure is not an option
Zero data loss

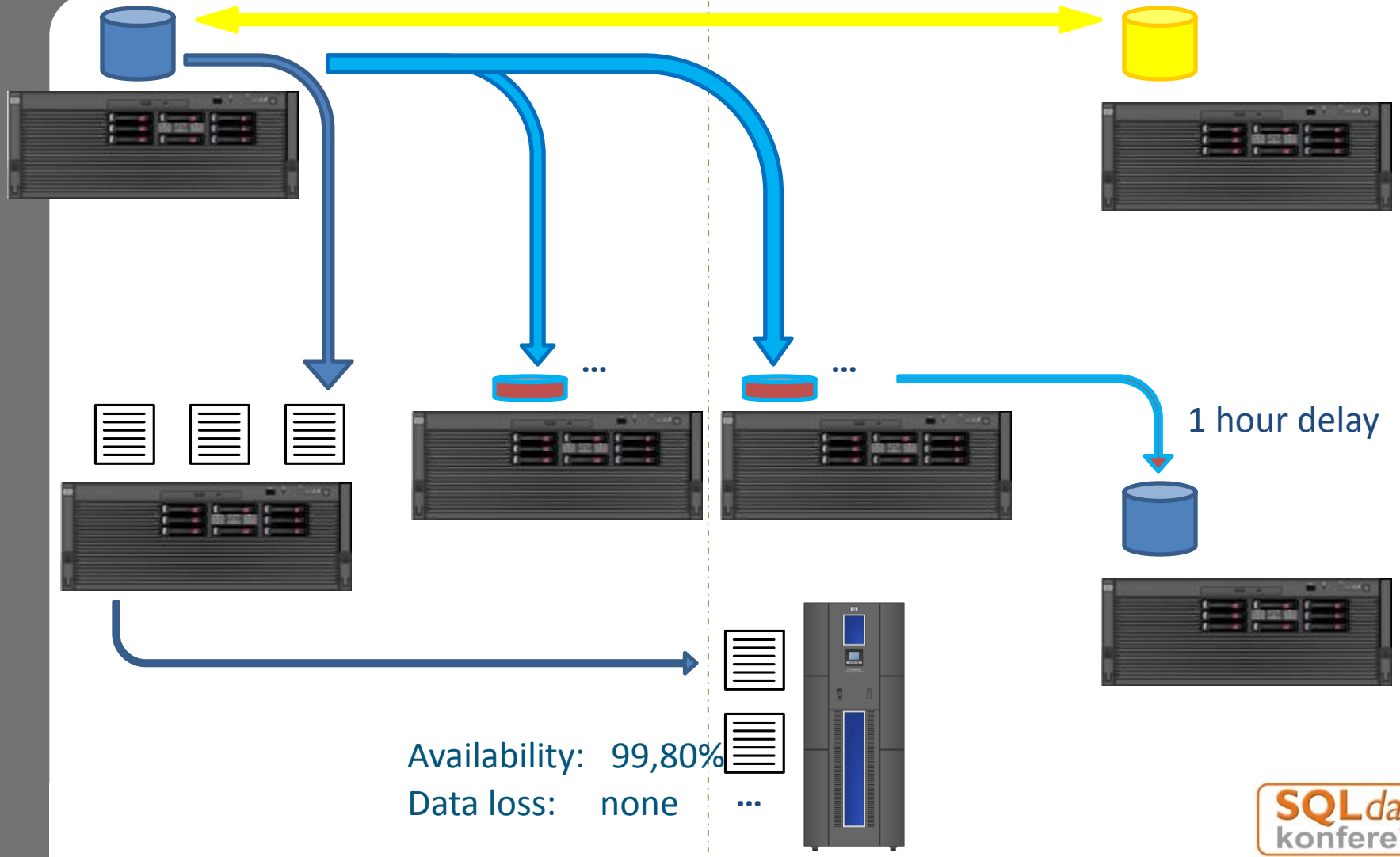


SQLdays konferenz

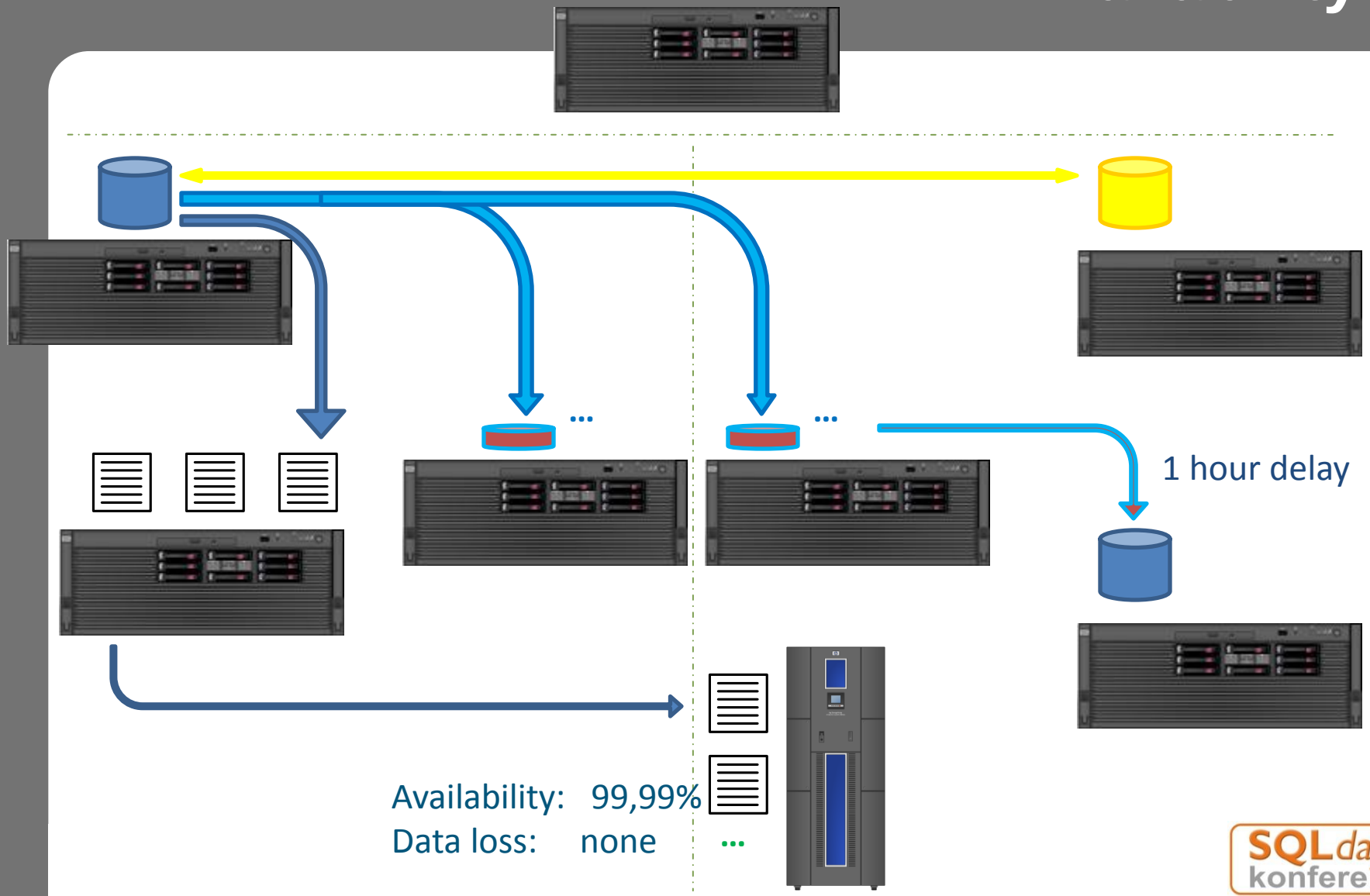
Failure is not an option
Zero data loss



Failure is not an option
Availability



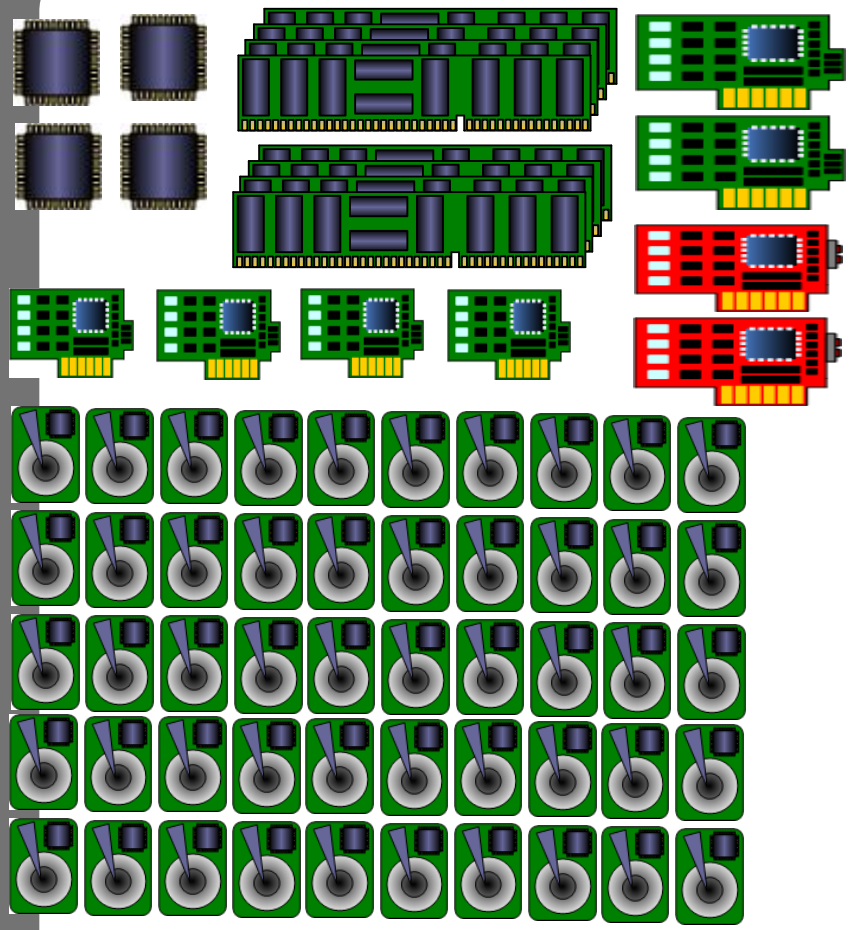
Failure is not an option
Availability



Failure is not an option
Scale Up

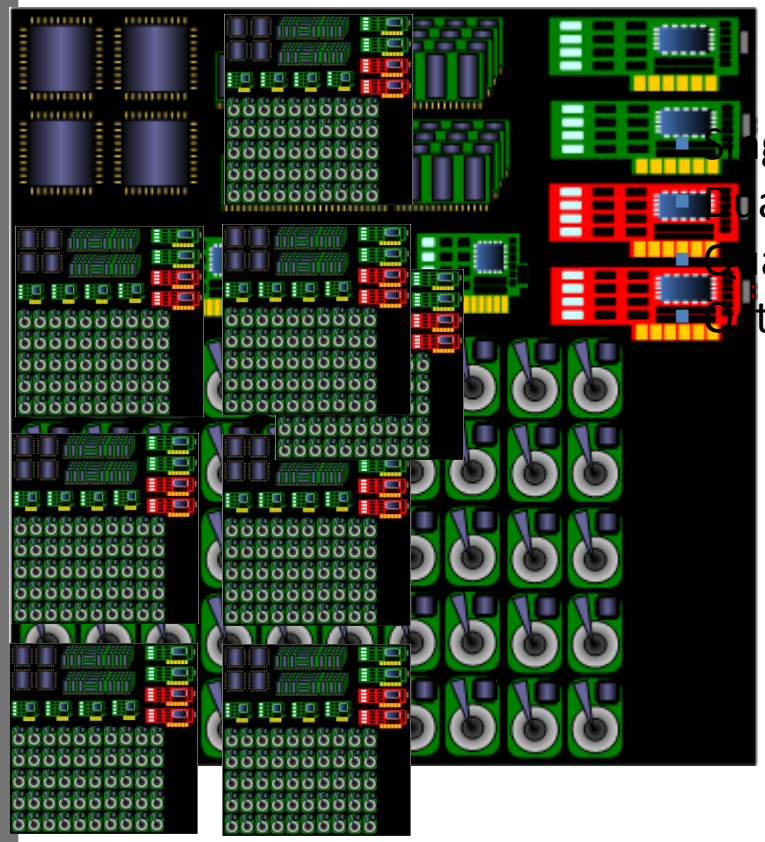
- Selected CPU IA64 / Itanium 2
- Selected server/memory architecture SMP / NUMA
- SQL Server 2008 Enterprise Edition
- Windows Server 2008 R2 for Itanium-Based Systems

Failure is not an option
Scale Up – Single NUMA node



- 4 x Dual Core ITANIUM 2 CPUs
  24 MB cache each
- 64 GB memory
- 4 x dual port 1 Gb/s network card
- 2 x dual port HBA (4Gb/s)
- 2 x P800 RAID controller
- 50 x 72 GB 15kRPM SAS disks
- SAN storage as needed
  n x 512GB (on 64 spindles each)

Failure is not an option
Scale Up



	cores	GB	disks	NIC	HBA
Single	8	64	50	8	4
Dual	16	128	100	16	8
Quad	32	256	200	32	16
Octal	64	512	400	64	32

Almost linear scaling

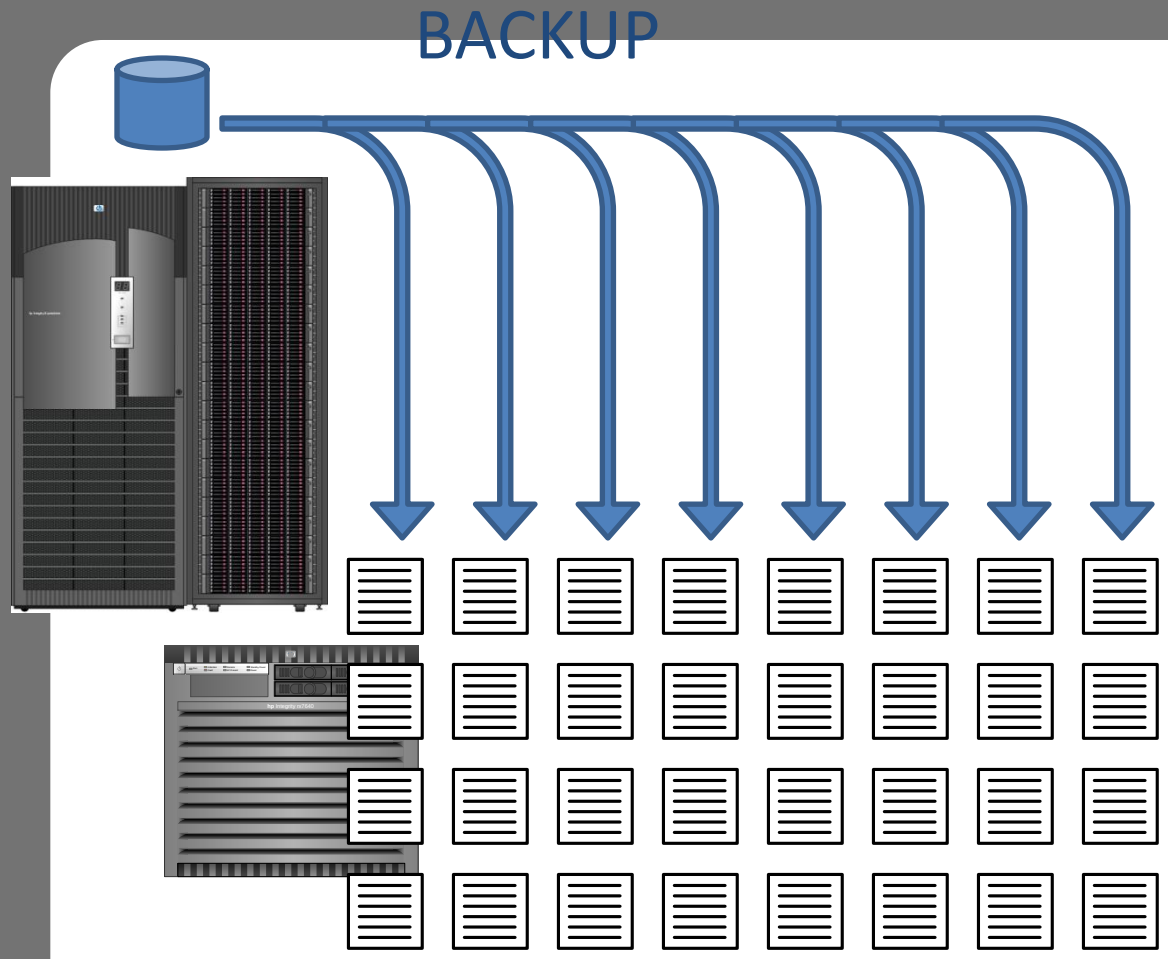
Failure is not an option
Scale Up

- **1 NUMA Node Server**
  - 2 x NUMA node basic configuration

  plus
  - 2 x P600 (512MB cache)
  - 16 x 72 GB 15kRPM SAS disks
- **2 NUMA Node Server**
  - 2 x NUMA node basic configuration
- **4/8/16 NUMA Node Server**
  - 4/8/16 x NUMA node basic configuration

  plus
  - 2 x single port 10 GE network card

Failure is not an option
Scale Up



- Use eight parallel one GB/s sec network interface cards (one physical network, eight subnets)
- Use 32 parallel backup files each on a separate set of spindles with aligned partitions
- Transfer four files per network interface card

Failure is not an option
Scale Up

SQL Server	IP Address	Network Mask
Network Card 1	192.168.1.2	255.255.255.0
Network Card 2	192.168.2.2	255.255.255.0

File Server	IP Address	Network Mask
Network Card 1	192.168.1.1	255.255.255.0
Network Card 2	192.168.2.1	255.255.255.0

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Failure is not an option
Scale Up

```
BACKUP DATABASE  MyVLDB
  TO
    DISK='\\192.168.1.1\backup\MyVLDB_1
  .bak',
    DISK='\\192.168.2.1\backup\MyVLDB_2
  .bak'
WITH
    BLOCKSIZE = 8192
```

- Use Jumbo Frames if you can (+100%) with about 9016 bytes frame size

Failure is not an option
The Details

- Mirroring (not yet) as simple to manage as clustering

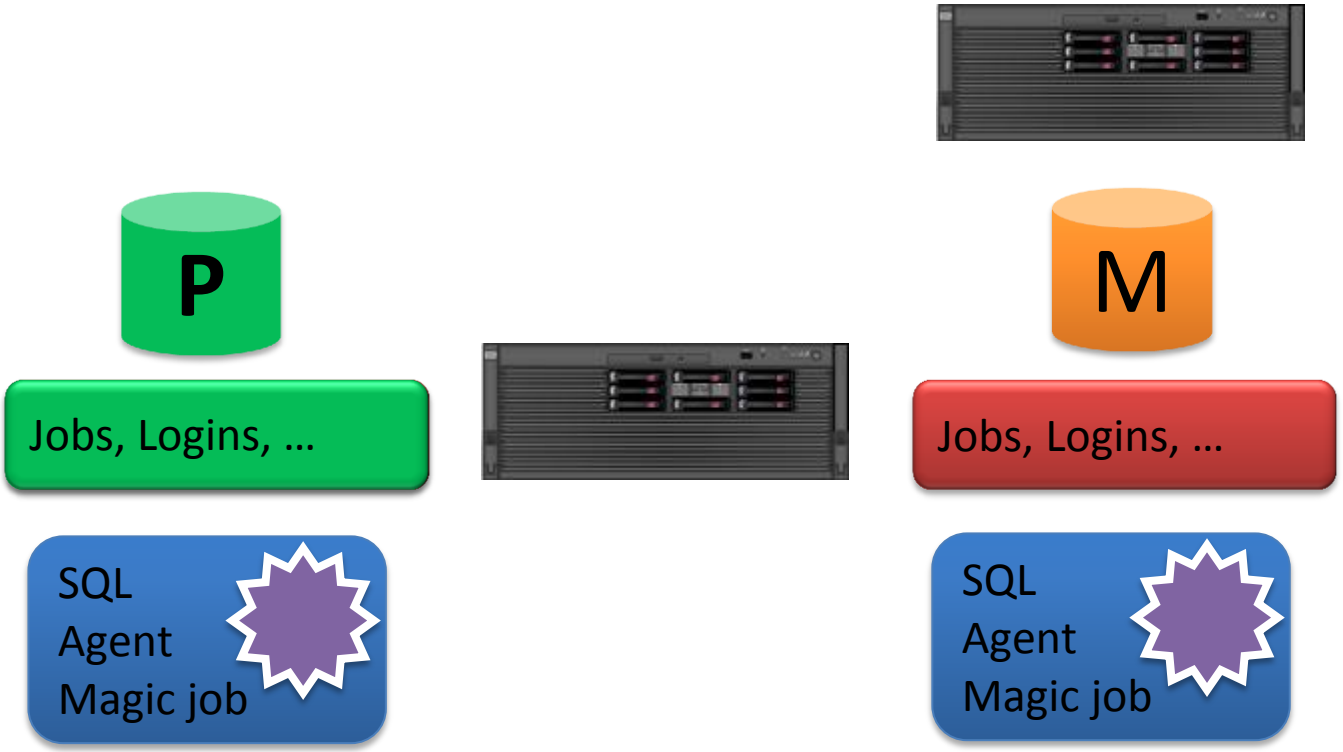
- SQL Server logins
- SQL Server jobs
- Log Shipping
- Replication
- Partner databases

Failure is not an option
Miracle Job

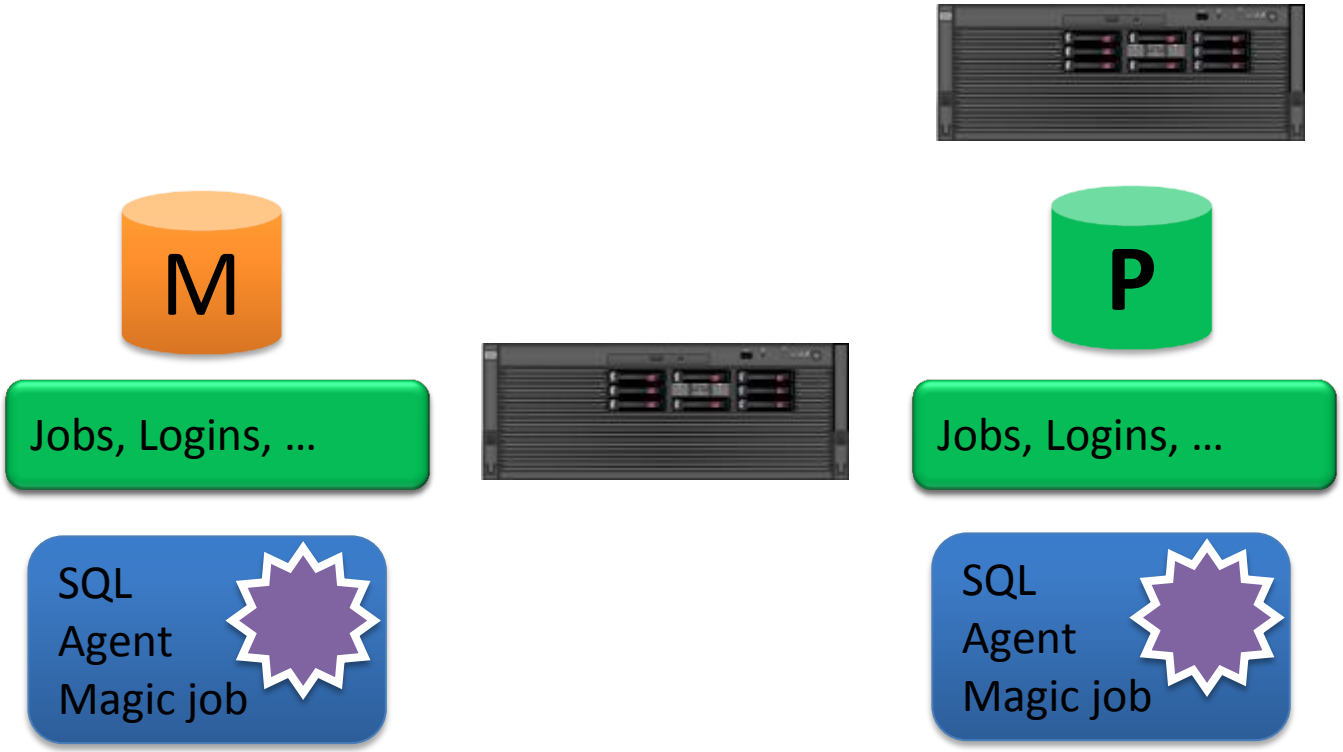
On both the principal and the mirror server:

- **Create a helper job (e.g.: Manage Mirrors)**
  with a schedule to run it once every minute
- **Create a helper database (e.g.: admin)**
  to store info like the last state of a database

Failure is not an option
Miracle Job



Failure is not an option
Miracle Job



Failure is not an option
Miracle Job

```
USE Admin;
GO
CREATE SCHEMA FailoverHandler;
GO
CREATE TABLE FailoverHandler.DBStatus
(
  database_id              int,
  lastStatus               varchar(16),
  lastStatusUpdateUTC      datetime
);
```

Failure is not an option
Miracle Job

```
CREATE PROC AutoFailoverHandler.CleanupDB  @dbID as int
AS BEGIN
     DECLARE @currentStatus AS varchar(16) =
       (SELECT state_desc FROM sys.databases WHERE database_id = @dbID);
     DECLARE @lastStatus AS varchar(16) =
       (SELECT isnull((SELECT lastStatus FROM
   Admin.FailoverHandler.DBStatus
           WHERE database_id = @dbID
     AND lastStatusUpdateUTC>dateadd(minute,-5,GetUTCdate())),'N/A'));
   IF (@lastStatus <> @currentStatus)
   BEGIN
        -- Here we place the stuff to update
   END
   UPDATE FailoverHandler.DBStatus
      SET lastStatus = @currentStatus,lastStatusUpdateUTC=GetUTCDate()
      WHERE database_id = @dbID;
END
```

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Failure is not an option
Miracle Job

- Execute the stored procedure for each mirrored database in a job step in our helper job on each server

```
EXEC AutoFailoverHandler.CleanupDB
     @dbID = db_id('myVLDB')
EXEC AutoFailoverHandler.CleanupDB
     @dbID = db_id('myOtherVLDB')
```

Failure is not an option
SQL Server logins

- Windows integrated logins must just be created on the mirror server, they use the Windows SID to map to the Database User.

- For each user / login pair where the login is a SQL Server login map the user with the login using

```
exec sp_change_users_login
```

Failure is not an option
SQL Server logins - Code

```
DECLARE @user AS TABLE (username sysname);
DECLARE @username as sysname;
INSERT INTO @user
    SELECT u.name as username
   FROM sys.sysusers u
      left outer join sys.syslogins l ON (u.sid = l.sid)
   WHERE u.islogin = 1 AND u.isntname <> 1 and u.isntgroup <> 1
                and u.hasdbaccess = 1 AND l.sid is null;
WHILE ((SELECT COUNT(*) FROM @USER) > 0)
BEGIN
   SET @username = (SELECT TOP(1) username from @user);
   EXEC sp_change_users_login
        @Action = ''Auto_Fix'', @UserNamePattern = @username;
   DELETE FROM @user where username = @username
END
```

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Failure is not an option SQL Server jobs

- Have a first job step that checks if the database is online
- Check in every step
- Enable / Disable with

```
EXECUTE msdb.dbo.sp_update_job
        @job_id = @jobID,
        @enabled = 1;
```

- Special care must be taken for jobs that job starts when the server starts and therefore must start with database (used for forever running jobs)

Failure is not an option
SQL Server jobs

```
DECLARE @jobID as uniqueidentifier
WHILE 1=1
    BEGIN
    SET @jobID = (SELECT TOP(1) job_id from msdb.dbo.sysjobs
   WHERE name like '%#MyDBName' and [enabled] = 0);
    IF (@jobID IS NULL) BREAK;
    EXECUTE msdb.dbo.sp_update_job @job_id=@jobID, @enabled=1;

    IF ((SELECT freq_type FROM msdb.dbo.sysjobs j
        inner join msdb.dbo.sysjobschedules js ON
   (j.job_id=js.Job_id)
   inner join msdb.dbo.sysschedules s ON (js.schedule_id =
                                          s.schedule_id)
       WHERE j.job_id = @jobID) = 64)
        EXECUTE msdb.dbo.sp_start_job @job_id = @jobID;
END
```

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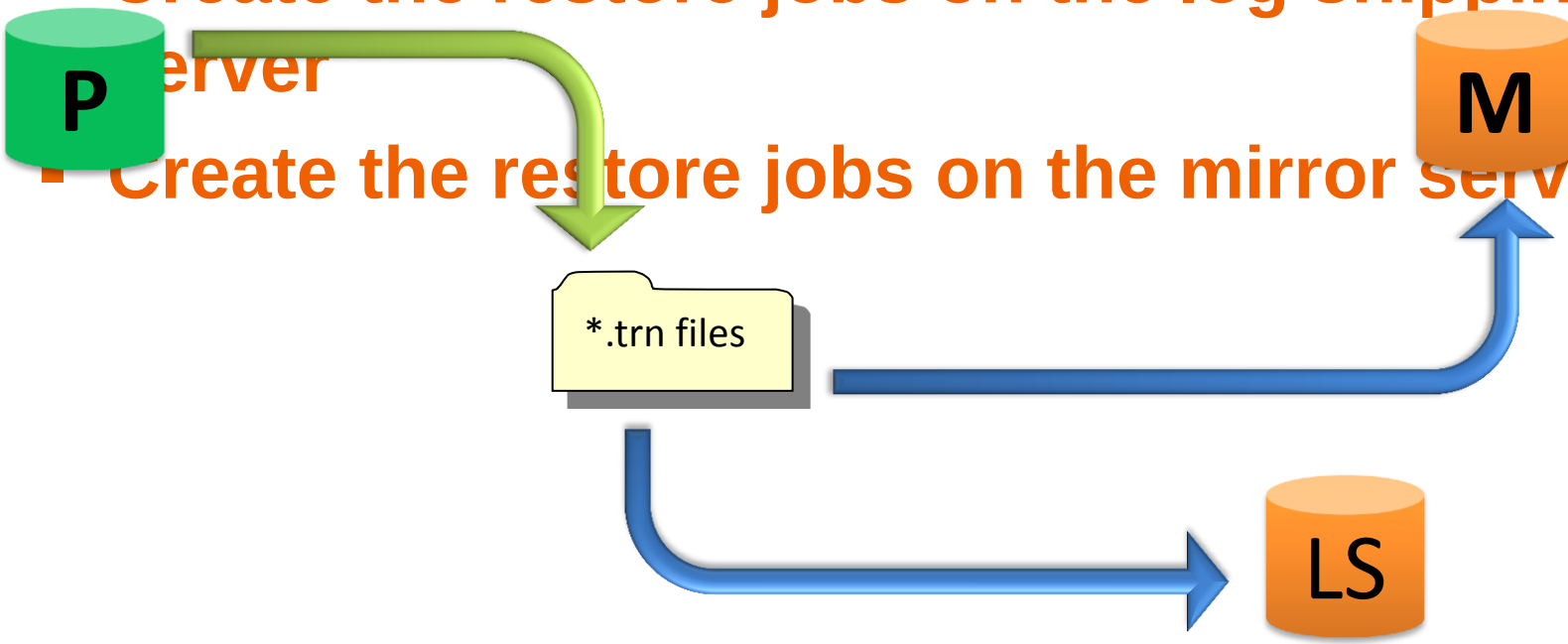
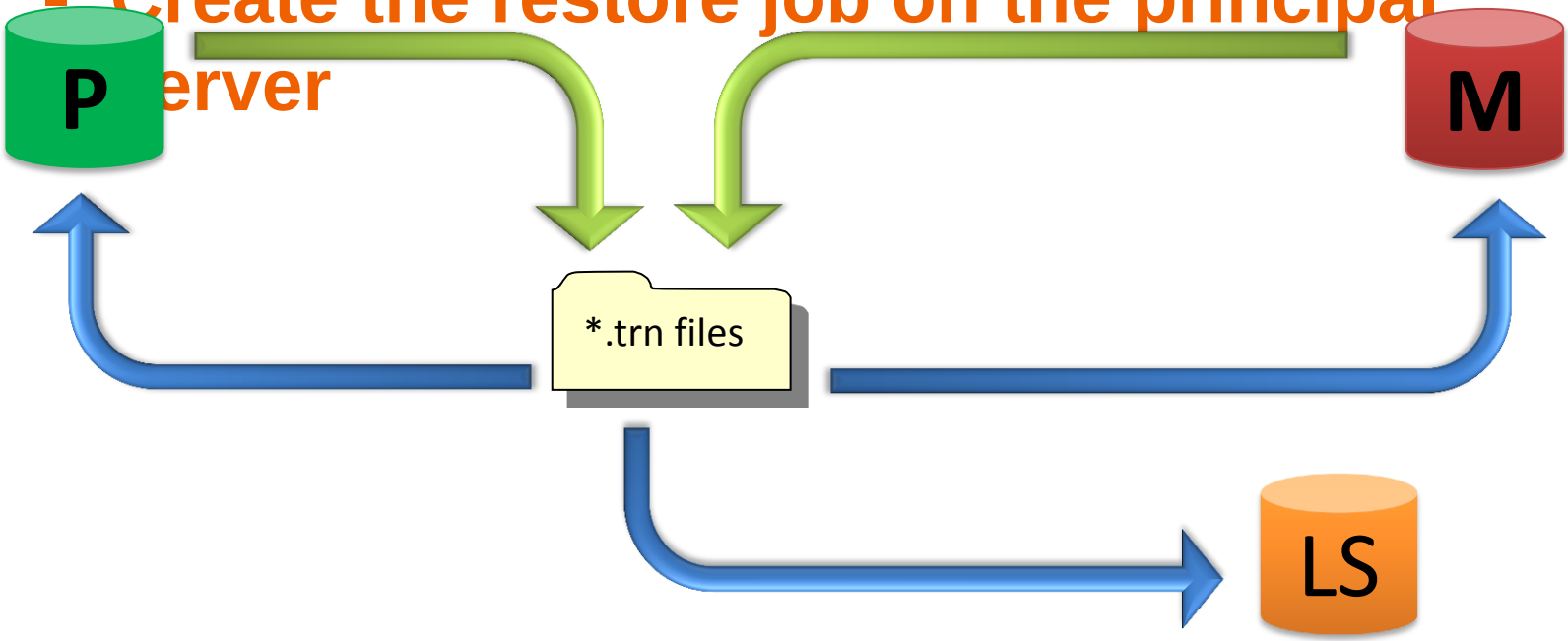
Failure is not an option
Log Shipping

- Create the backup jobs on the principal server
- Create the restore jobs on the log shipping server
- Create the restore jobs on the mirror server



Failure is not an option
Log Shipping

- Failover the database
- Create the backup job on the mirror server
- Create the restore job on the principal server



Failure is not an option
Partner databases

- Partner databases are a databases that must be online on the same server
- Therefore if one database fails over to the mirror all others must failover too
- No problem if the server fails, because all db's will failover
- Otherwise we must help a little with

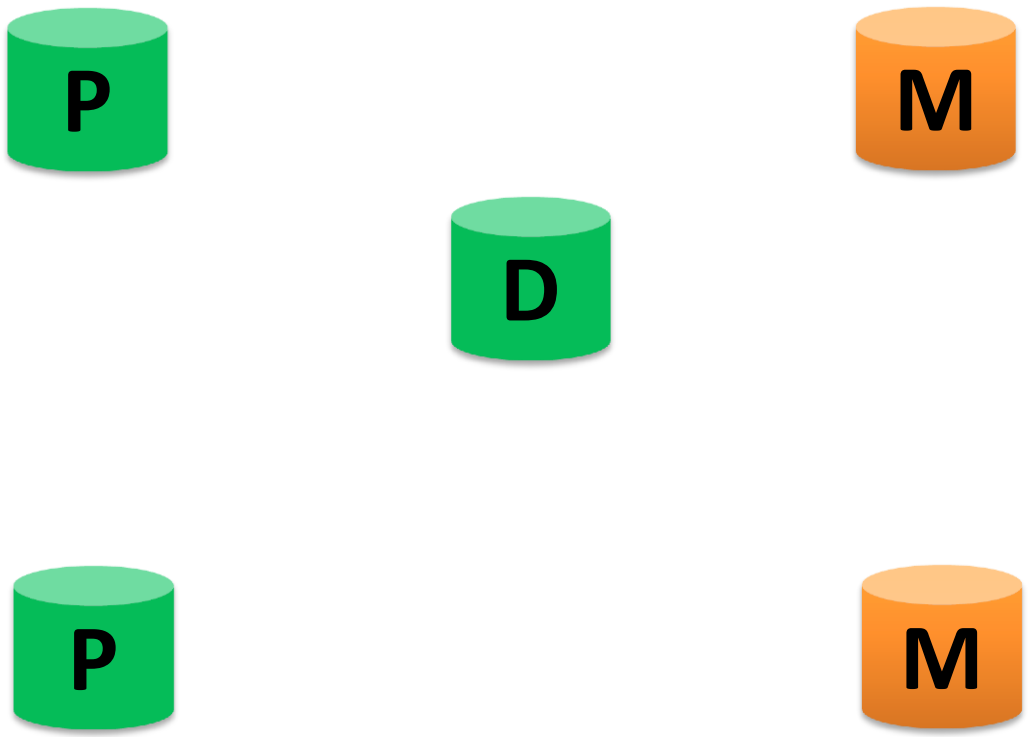
```
ALTER DATABASE myOtherDB SET PARTNER
FAILOVER
```

- The code can be found in the demo scripts

Failure is not an option
Replication

- **Transactional Replication**
  - from a mirrored publisher database
    (2005 and 2008/2008R2 supported)
    (distributor must be 2008/2008R2)
  - into a mirrored subscriber database
    (2005 and 2008/2008R2 possible)
    (distributor can be 2005 or 2008)

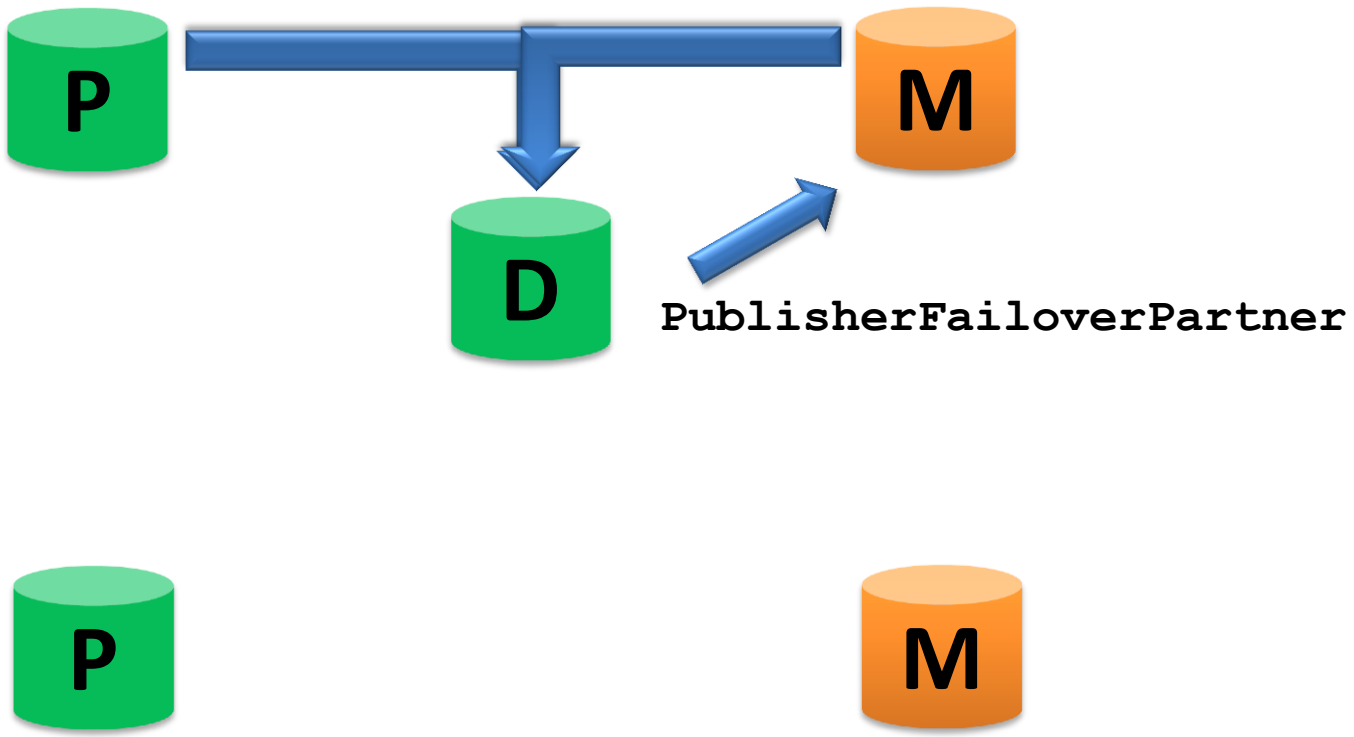
Failure is not an option
Replication



Failure is not an option
Replication

- **Publishing from a mirrored database (2005, 2008 or 2008R2)**
  - Publisher : Create the publication as always
  - Distributor (2008): In the Agent Profile you must add a
    `-PublisherFailoverPartner`

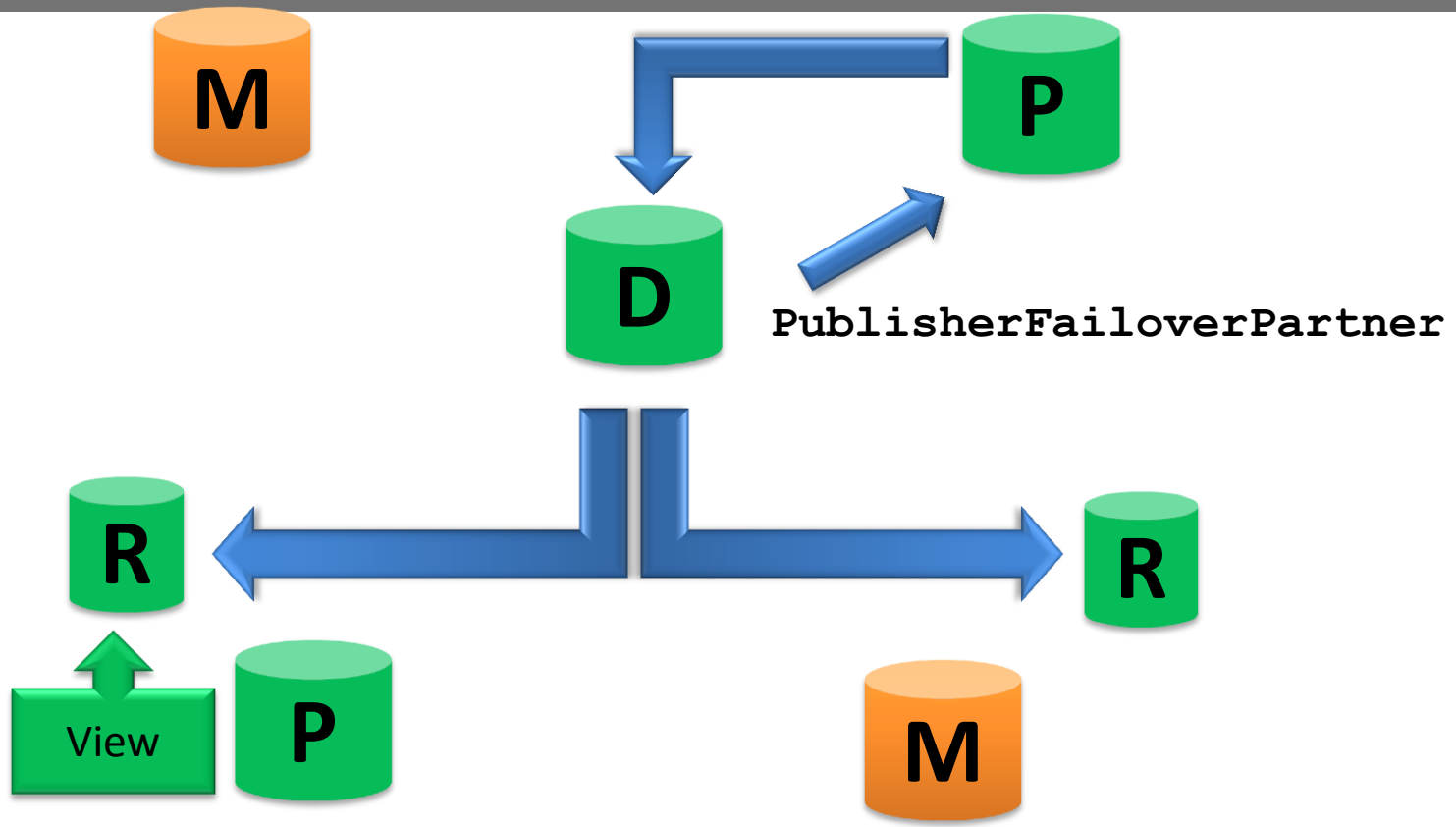
Failure is not an option
Replication



Failure is not an option
Replication

- **Subscribing into a mirrored database (2005 or 2008)**
  - Publisher /Distributor: Create the publication as always
  - Subscriber:
    - Create a helper database on each server (principal and mirror)
      (same name)
    - Create two subscription one into each of the helper databases
    - On principal database create a view to the replicated data

Failure is not an option
Replication




```
Use P;
CREATE VIEW dbo.MyTable as
                SELECT * FROM R.dbo.MyTable;
```

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Failure is not an option Replication

- **Subscriber: Alternative method:**
  - Implement reinitialize form LSN
    - White paper from Gopal Ashok (Microsoft Corporation) and

      Paul S. Randal (SQLskills.com)

http://download.microsoft.com/download/d/9/4/d948f981-926e-40fa-a026-5bfcf076d9b9/ReplicationAndDBM.docx

Failure is not an option
Call to action

- **Establish a SLA**
- **Standardize your environment**
- **Use your knowledge to build**
  - Reliable
  - Highly Available
  - Extreme performing

SQL Server

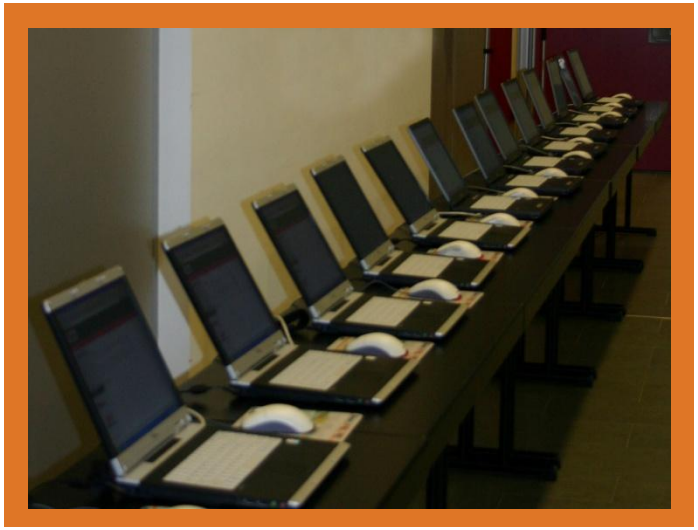
Solutions

fulfilling the SLA

FRAGEN ?

SQLdays konferenz

Hat Ihnen mein Vortrag gefallen?



Ich freue mich auf Ihr Feedback!

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  - .NET, Visual Studio, SharePoint & more!

  www.VSone.de

- **Trainings und Events der ppedv**
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VIELEN DANK!

=tg= Thomas Grohser

Veranstalter:

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