Backup and DR

Security level:

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Why Is Business Continuity Important?

Consider the following example. Assume as a senior executive you need to handle the following incidents:

1. Trading data is damaged due to human error (securities).
2. All insurance policies are lost due to a power failure (insurance).
3. A year's worth of geological is lost due to malicious actors (oil exploration).
4. Medical records are unusable due to damage to the tape library (healthcare).

...

All of these incidents impair business, including data loss, downtime, and impacts to brand image. What is the solution?

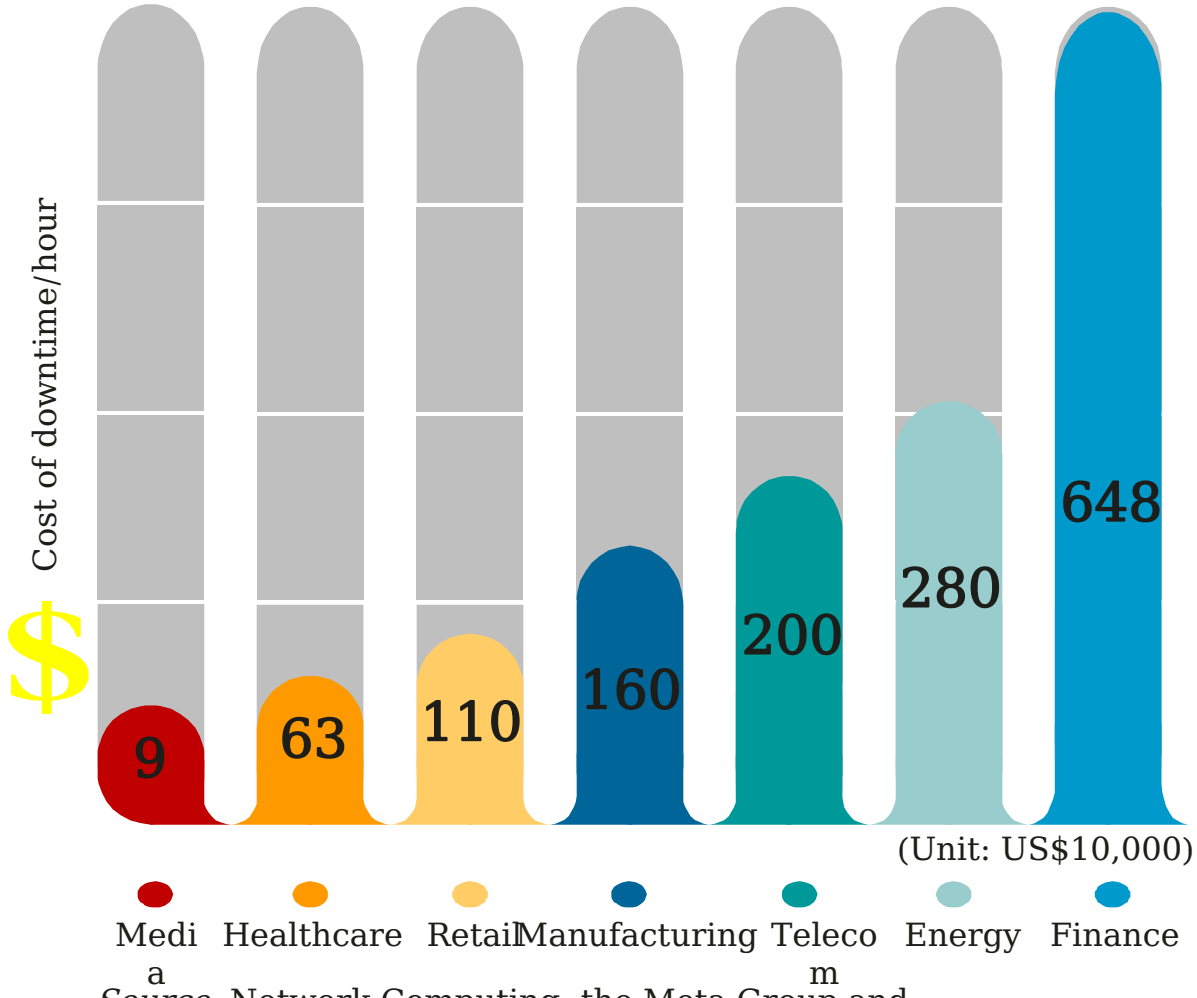
The Necessity of DR – Direct Benefits

Amazon
Two breakdowns
The amount of Loss ($)
7,000,000

Apple
iCloud storage breakdown
The number of affected users
3,000,000

Google
Full breakdown
Global traffic decrease in 5 minutes
40%

Source: Huawei MI



Source: Network Computing, the Meta Group and Contingency Planning Research

From conventional DCs to cloud environments, downtime resulting from a disaster (natural, human-error, equipment failure, or cyber threat) can cause financial and reputational repercussions. Customers require 24/7 business continuity and data protection.

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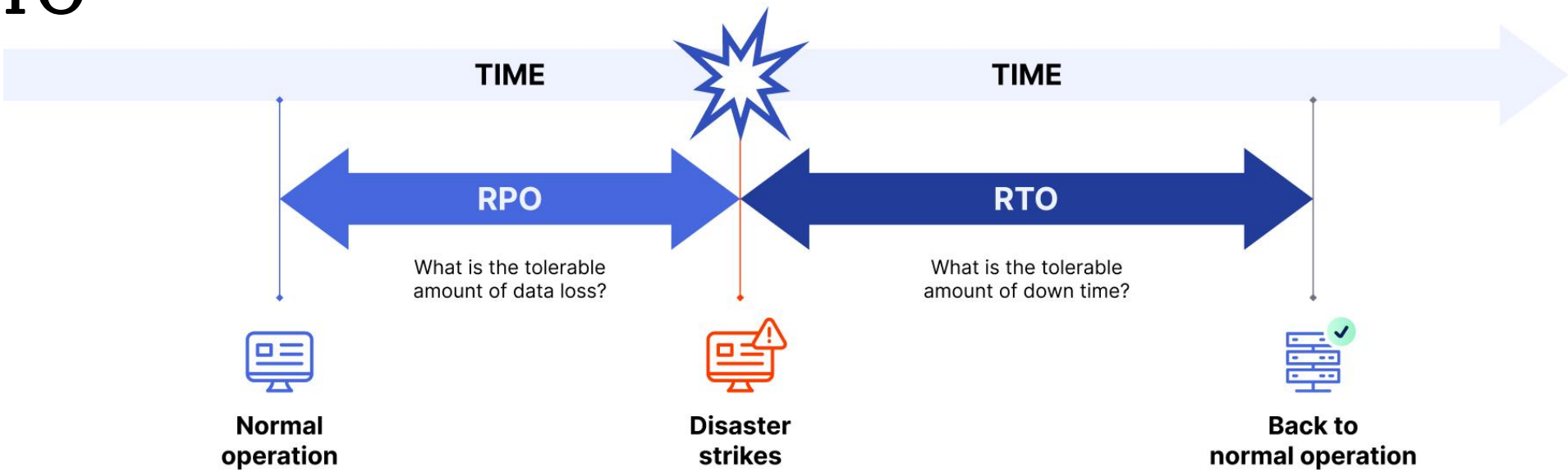
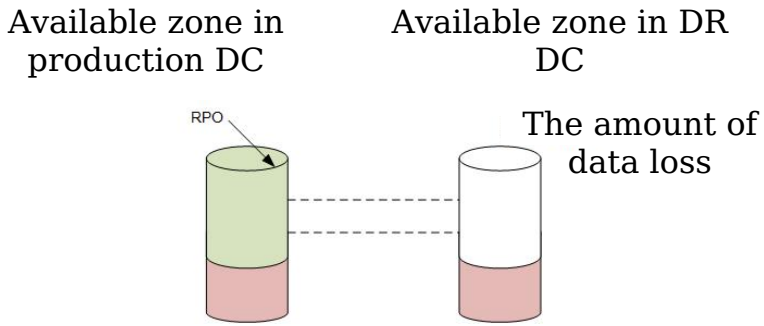
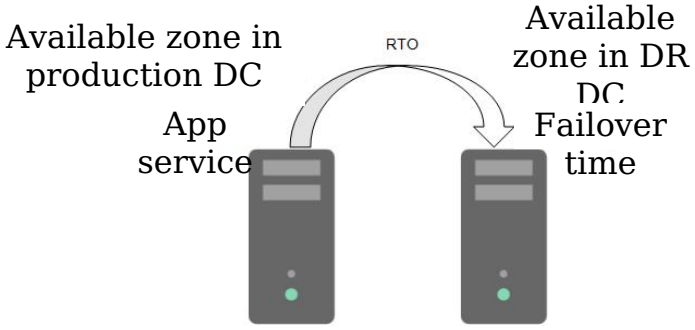
Key Parameters Used to Measure Business Continuity – RPO and RTO



The recovery point objective (RPO) is the amount of data loss that an enterprise can tolerate losing. This threshold is typically represented by a time value.



The recovery time objective (RTO) is the maximum length of a time it should take to restore systems to normal conditions in order to avoid further or unacceptable consequences caused by downtime.



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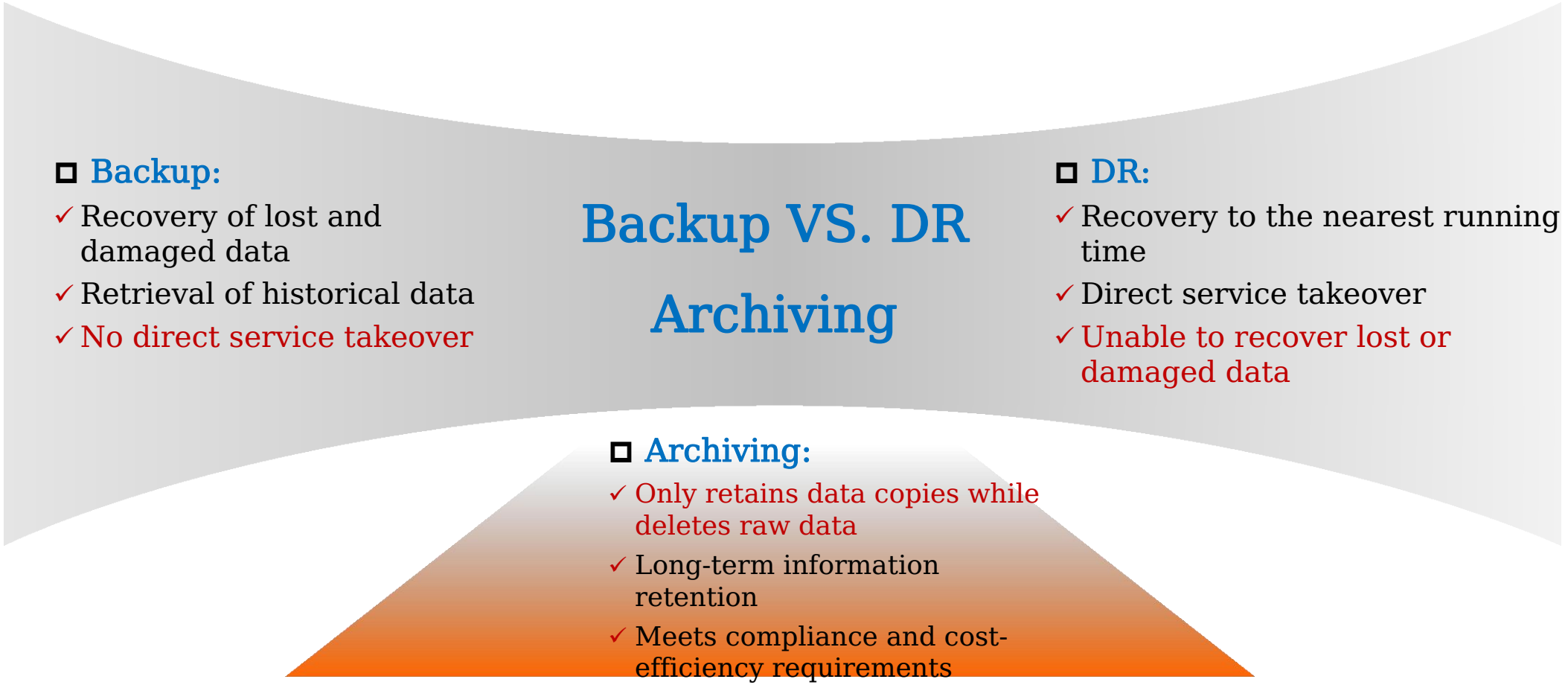
Two Major Standards of DR Construction

RPO: the amount of data loss caused by downtime | RTO: the time period of downtime

Information Security Technology – Disaster Recovery Specifications for Information Systems (China)	IBM's SHARE 78 Seven Levels of Disaster Recovery (International)	RPO	RTO	Technical Requirements of the Classified Protection of Cybersecurity 2.0 (China)
Tier 6 – Zero data loss and services are automatically started	**Tier 7** – Zero data loss and services are automatically started	0	< 15 min	**Level 4** Local backup + remote backup + local high availability (HA) + remote service HA
Tier 5 – Zero data loss	**Tier 6** – Zero data loss	0–30 min	< 2 hours	
Tier 4 – Electronic transmission and full device support	**Tier 5** – Real-time status update in the DR DC	2–12 hours	< 24 hours	**Level 3** Local backup + remote real-time backup + local service HA
	Tier 4 – Active DR DC	2–24 hours	< 24 hours	
Tier 3 – Electronic transmission and partial device support	**Tier 3** – Electronic vaulting	12–24 hours	24 hours	**Level 2** Local backup + remote periodic backup
Tier 2 – Backup site support	**Tier 2** – PTAM + hot site	24 hours to several days	24 hours to several days	
Tier 1 – Basic support	**Tier 1** – PTAM	Several days	Several days	**Level 1** Local backup
	Tier 0 – No off-site data	Several days	Several days	

Differences Between Backup, DR, and Archiving



Backup provides data recovery, DR focuses on business continuity, and archiving meets regulatory compliance.

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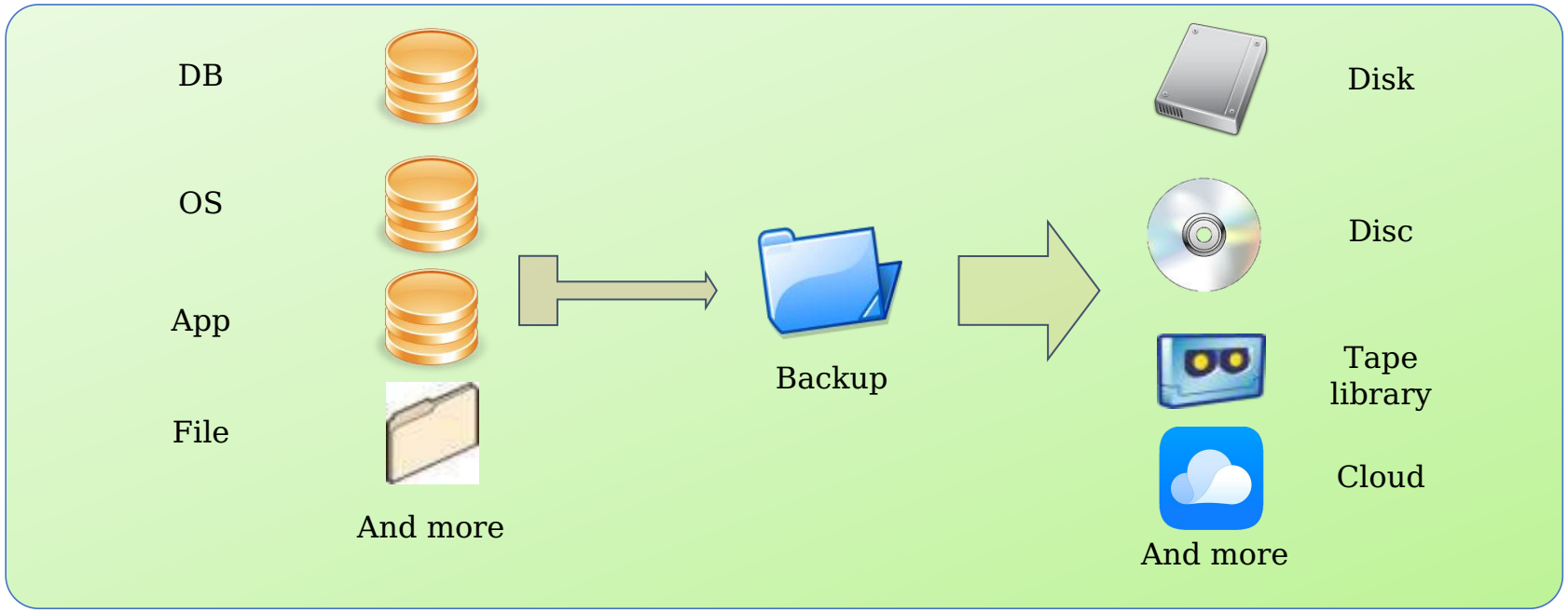
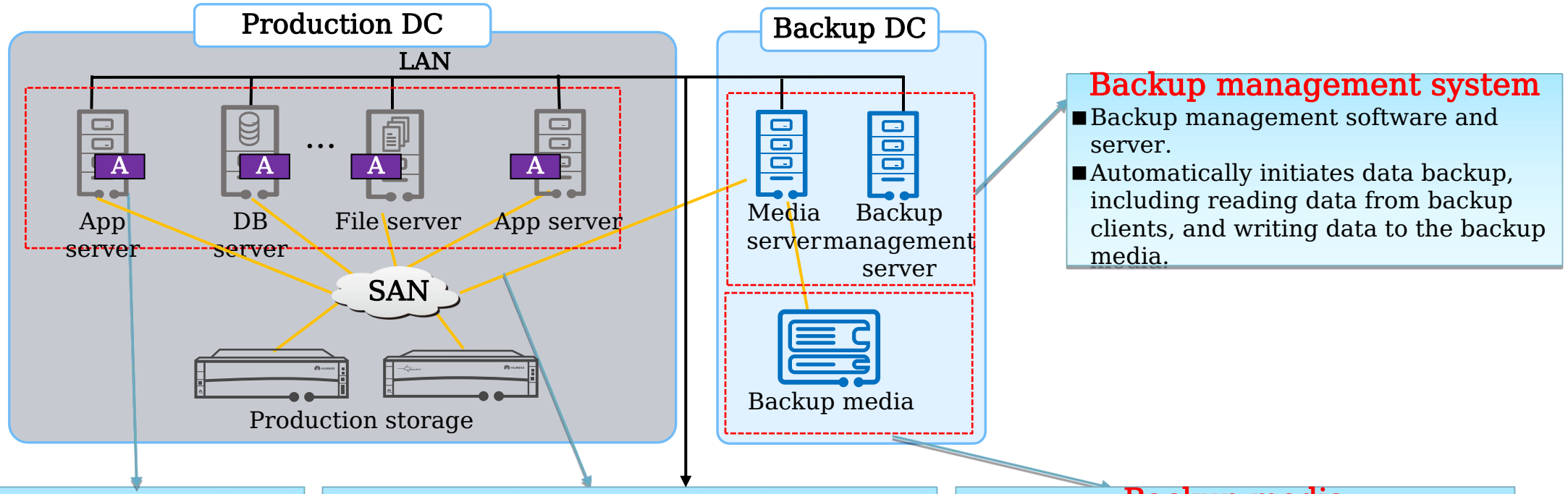
Basic Concepts of Backup

Definition:

A backup is an additional copy of production data used to recover lost or damaged data. With ever-increasing data volumes, organizations need an efficient and cost-effective backup method to meet service and regulatory requirements on data storage, retention, and availability.



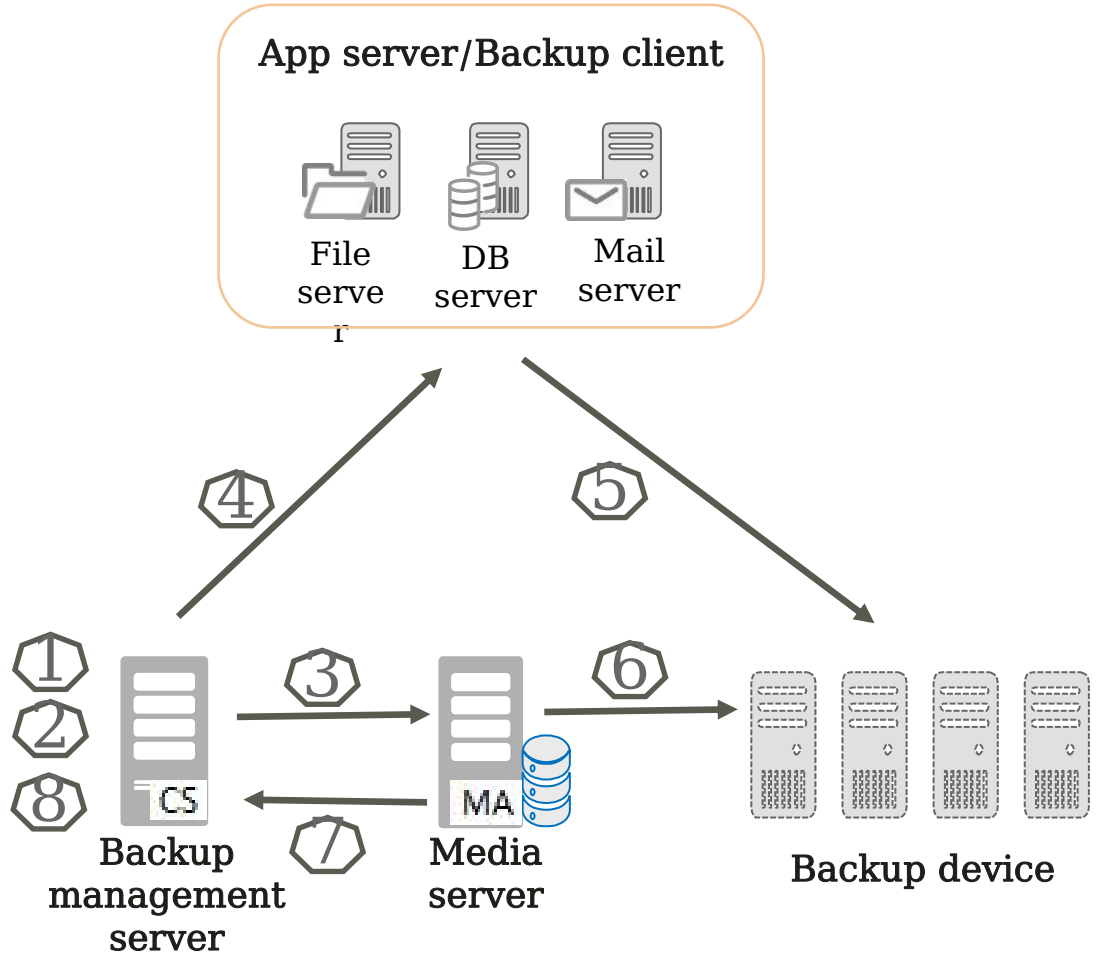
Components of a Backup System



- **Centralized backup solution:** The backup media servers (running backup software) are separated from the backup media, that is, storage and computing are decoupled.
- **All-in-one backup solution:** integrates backup software, media servers, and backup media, also known as coupled storage.

Data Backup Process

When data backup is initiated, important network communication takes place between the components of the backup infrastructure. This operation is initiated either by the backup management server or the client.



1. The backup management server starts the periodic backup.
2. The backup management server retrieves backup-related information from the backup directory.
3. The backup management server notifies the media server to load backup media.
4. The backup management server notifies the backup client and the latter sends the data that needs to be backed up to the storage node.
5. The backup client sends the data to the storage node and updates the backup directory on the backup management server.
6. The media server sends data to the backup device.
7. The media server sends metadata and backup information to the backup management server.
8. The backup management server updates the backup directory.

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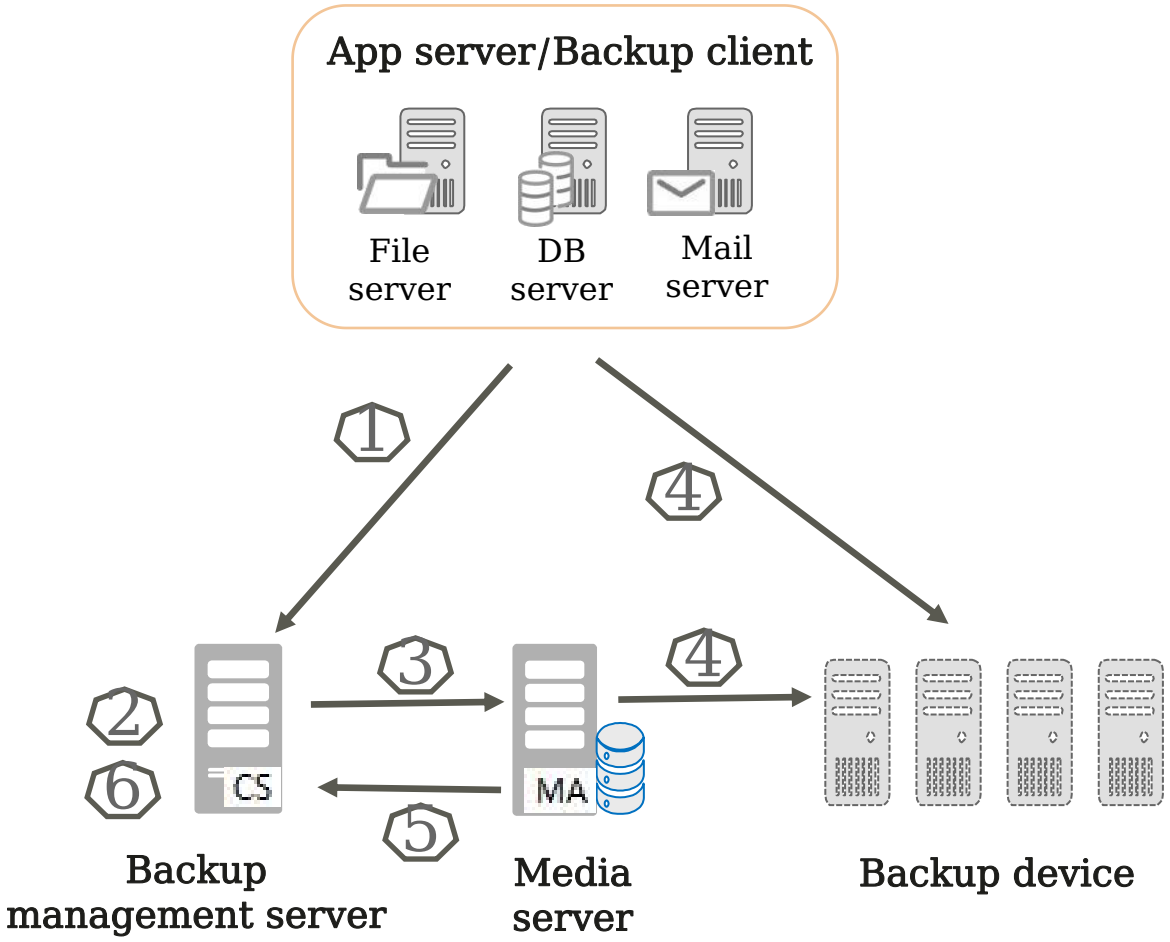
Data Recovery Process

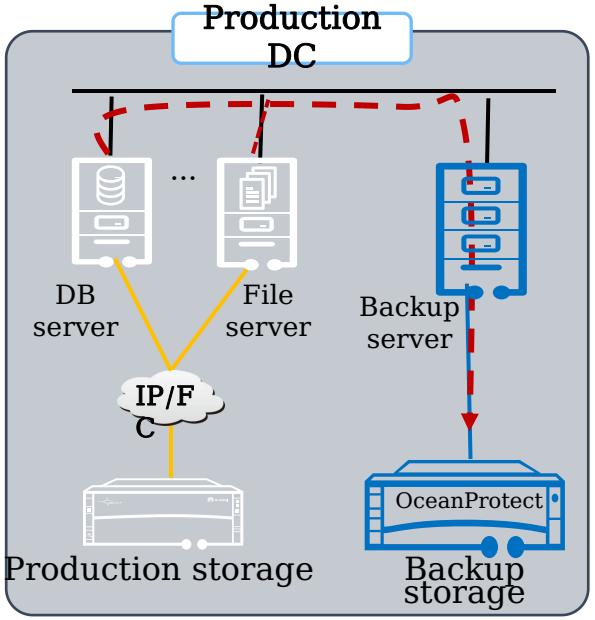
Once receiving a recovery request, the administrator can find the list of backed up clients in the recovery application.



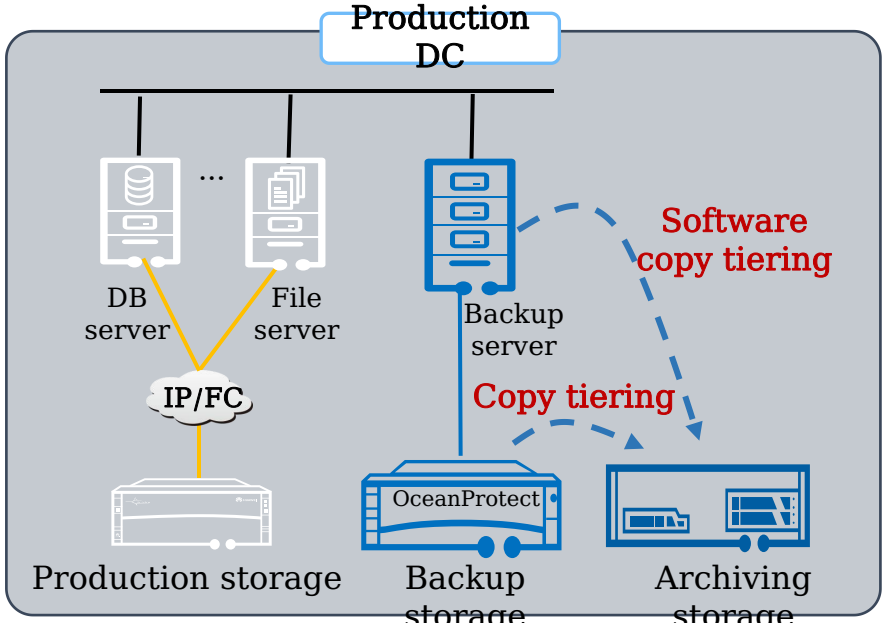
1. The backup client sends a data recovery request to the backup management server.
2. The backup management server scans the backup directory to identify the data to be recovered and the target clients that will receive the data.
3. The backup management server notifies the media server to load backup media on the backup device.
4. The media server reads the data and sends it to the backup client.
5. The media server sends the recovery metadata to the backup management server.
6. The backup management server updates the backup directory.

Three Typical Scenarios of the Backup Solution

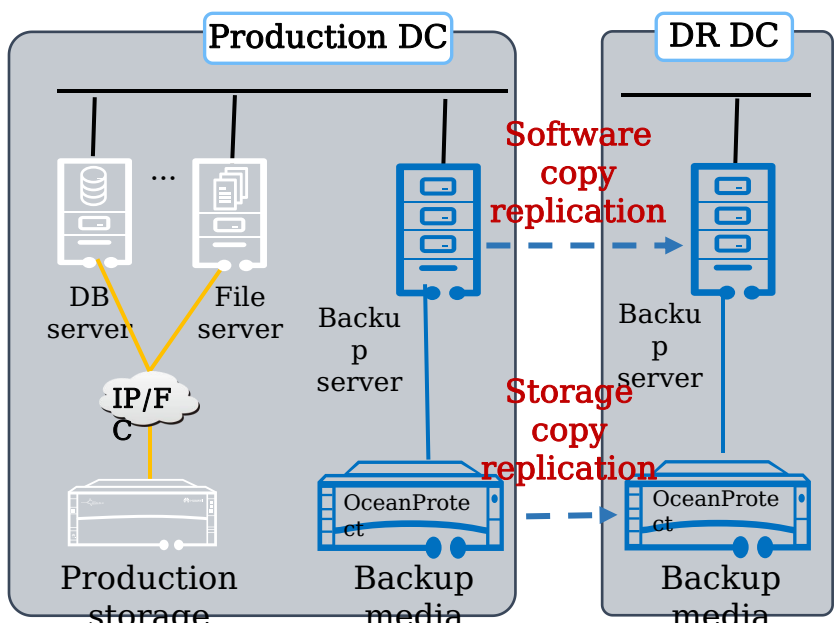
Local backup



Copy archiving



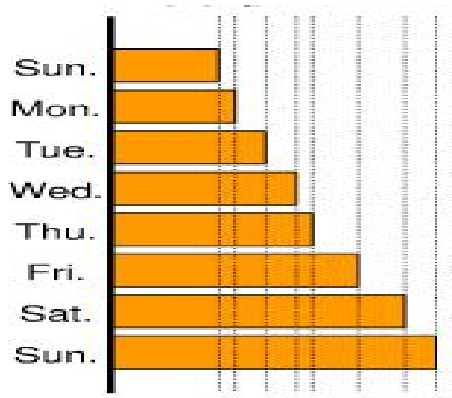
Copy replication



Category	Local Backup	Copy Archiving	Copy Replication
Solution Description	Data in the production system is replicated and transmitted to the backup system over a network, with multiple historical copies retained.	The backup system tiers copies and transmits them from level-1 backup storage to level-2 archiving storage.	The backup system replicates local copies to the DR DC, implementing remote redundancy of multi-copy data.
Main Feature	Local data backup and copy management	Hot and cold data tiering, long-term data retention, and compliance of policies and regulations	Remote data DR, multiple copies in multiple DCs, and compliance of policies and regulations
Backup Technology	Direct application backup and software backup	Software tiering and storage tiering	Software/Storage-level replication technology
Backup Media	High-performance and high-deduplication ratio featured storage media	High-performance and high-deduplication ratio featured storage media and large-capacity and low-cost archiving media	Homogeneous software or storage

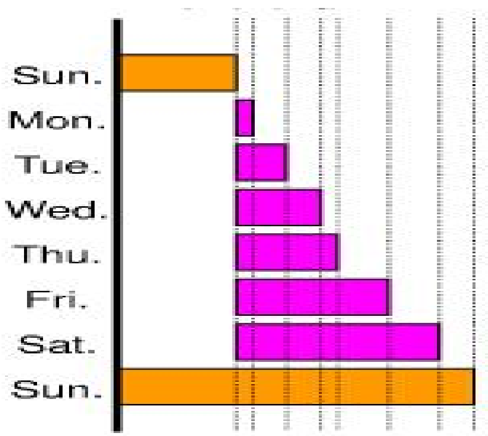
Common Backup Types

Full backup



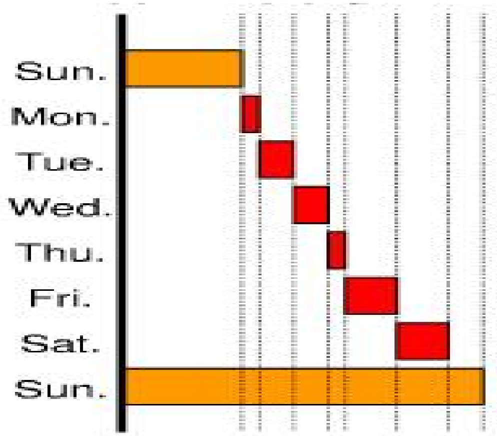
✓Full backup every day

Differential backup



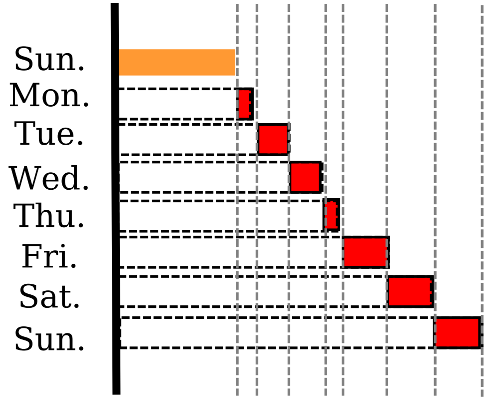
- ✓ Full backup once a week
- ✓ Daily backup of changes from the last full backup in the rest of the week

Incremental backup



- ✓ Full backup once a week
- ✓ Daily backup of the change compared with last backup in the rest of the week

Synthetic full backup (Forever incremental backup)



- ✓ One-time full backup
- ✓ Daily backup of the change compared with last backup

Recommended scenarios

Full backup:
- ✓ Core applications
- ✓ Small data volume (less than 1 TB)

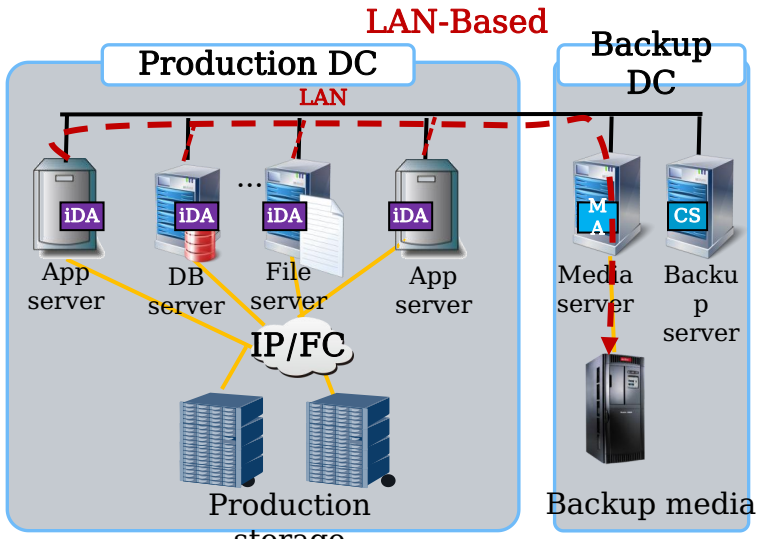
Differential backup:
- ✓ Important businesses
- ✓ Medium data volume (less than dozens of TB)

Incremental backup:
- ✓ Important businesses
- ✓ Medium data volume (less than dozens of TB)

Synthetic full backup:
- ✓ General businesses
- ✓ Large amount of data (around hundreds of TB or even PB) with hundreds of millions of small files

Typical Backup Networking

LAN-Based

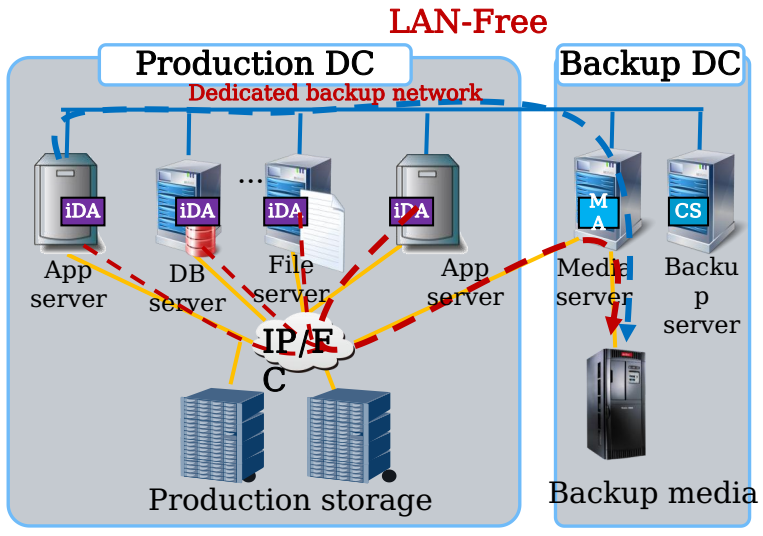


Description

- Backup data streams are transmitted over the existing LAN.

- **Pros:**
  - Makes full use of the existing network, reducing investment
- **Cons:**
  - Occupies the existing service network bandwidth
  - Limited backup performance
  - Impact on host applications

LAN-Free

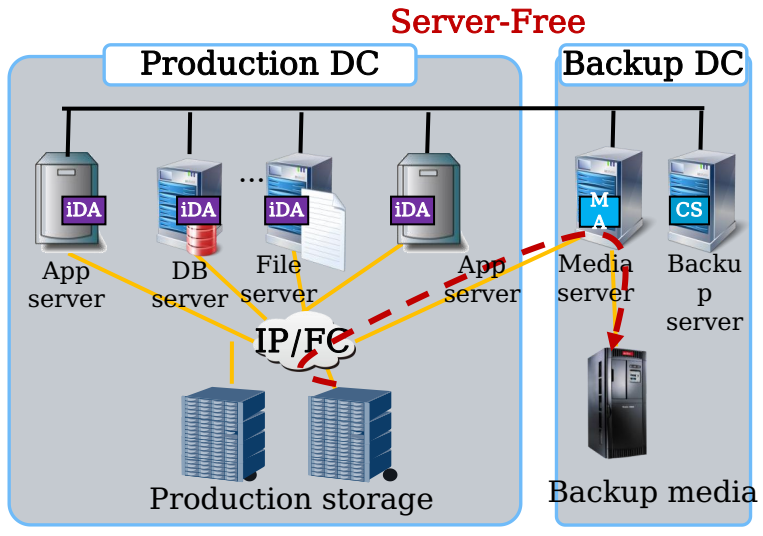


Description

- Backup data streams are transmitted over a SAN or a dedicated backup network.

- **Pros:**
  - Minimal impact on the existing service network
  - High backup performance
- **Cons:**
  - Increased investment in the network
  - High requirements on backup devices
  - Impact on host applications

Server-Free

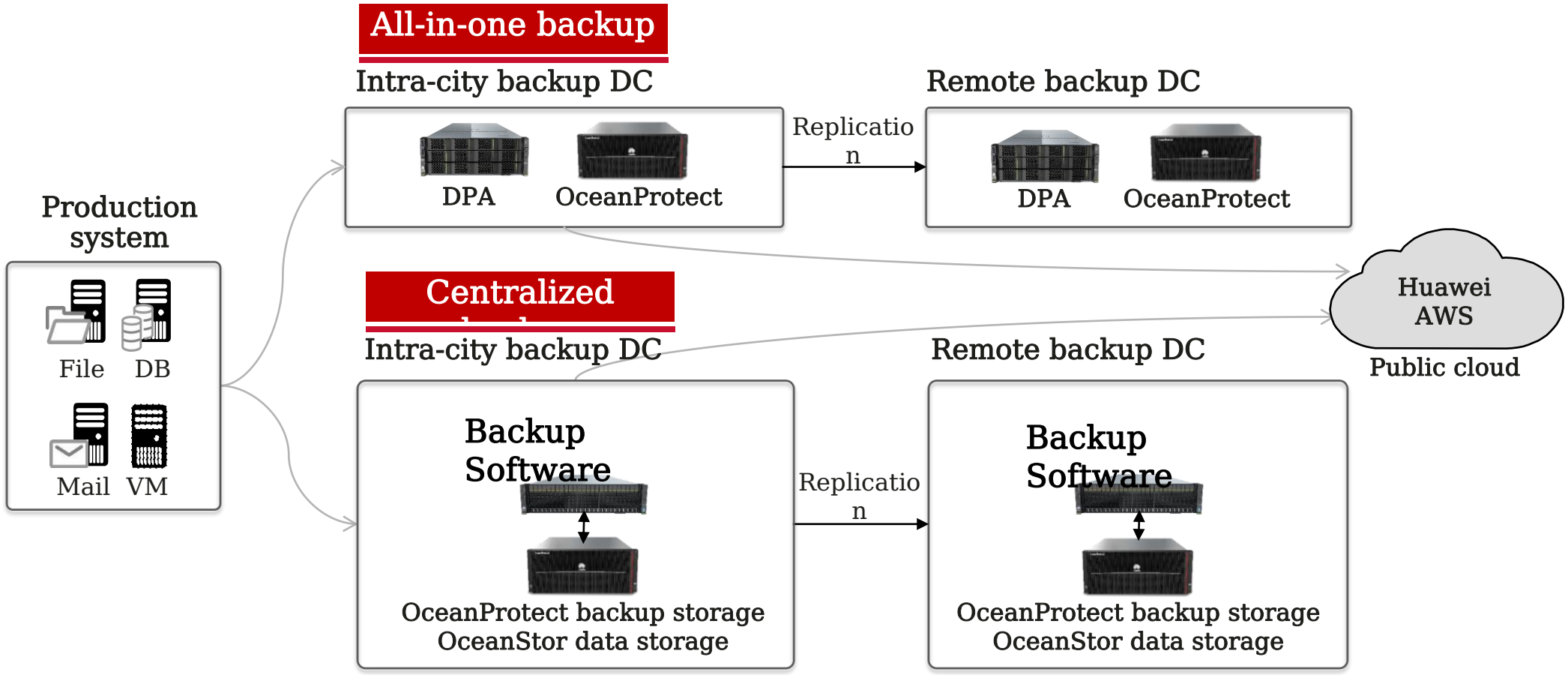


Description

- Backup data streams are transmitted directly through the media server over an independent SAN.

- **Pros:**
  - Minimal impact on service hosts
  - Minimal impact on the existing service network
  - High backup performance, depending on the SAN
- **Cons:**
  - Increased investment in the network
  - High requirements on backup devices

Overview of Huawei Backup Solution



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What Is Disaster Recovery?

Disaster recovery (DR) is the coordinated plan to restore and recover systems, data, and the infrastructure from an event that disrupts business operations. It is the process of restoring a data copy and applying logs or other necessary processes to that copy to bring it to a point of consistency. After all recovery efforts are completed, the data is validated to ensure that it is correct.

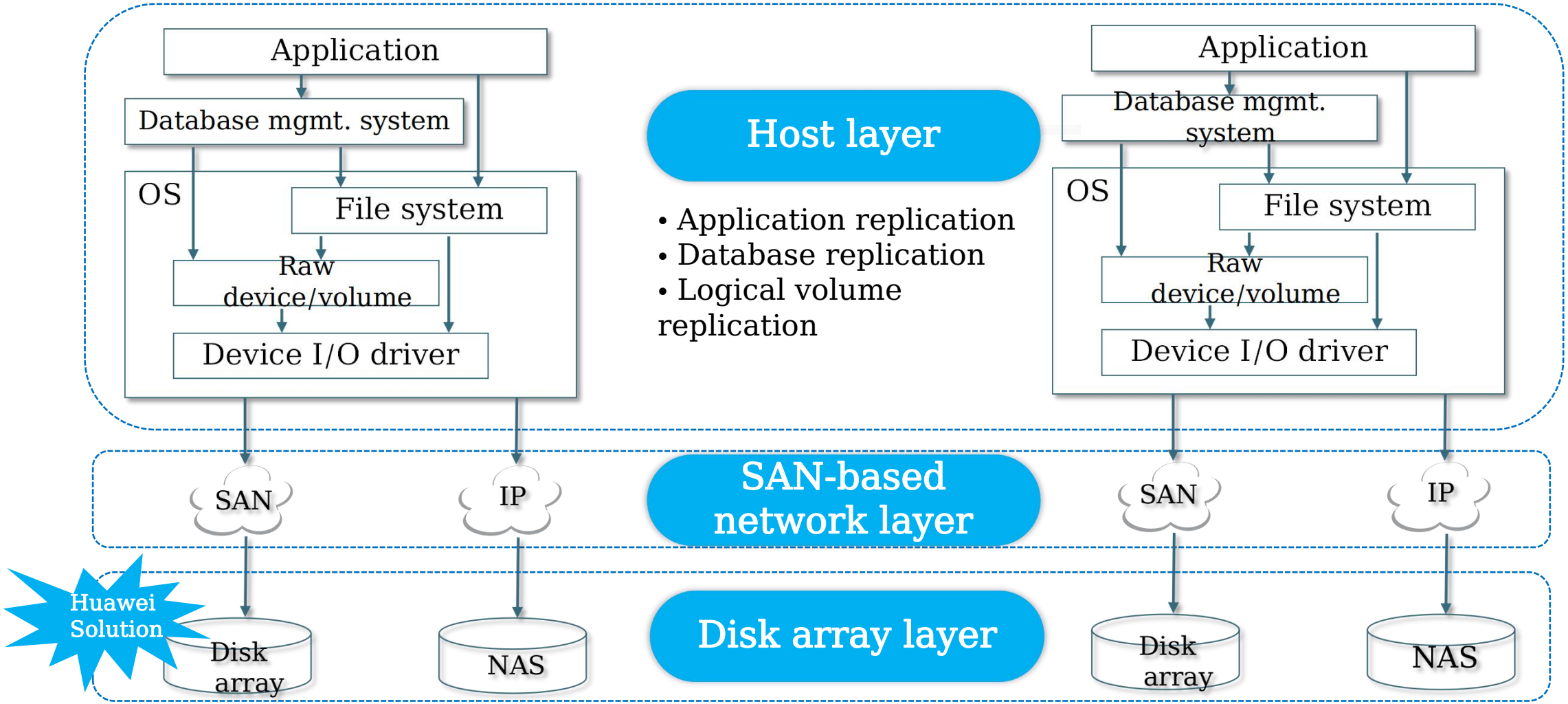
Power failure

Viruses outbreak

Fire

Device failure

Major Disaster Recovery Technologies



DR Implementation in the Industry

Host layer: Typical replication software includes Oracle Data Guard, Veritas VVR, DSG, and Quest

Pros	Data replication is implemented on hosts without compatibility issues for underlying devices. During database replication, the DR center takes over certain workload from the production center.
Cons	Database replication can run on only single-type databases. Host-layer replication occupies certain host resources, affecting the application system. Host-based data replication is complex and usually requires system reconstruction.

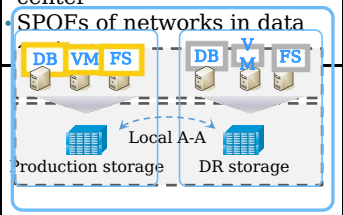
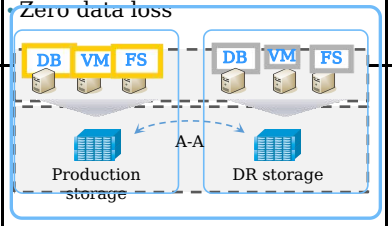
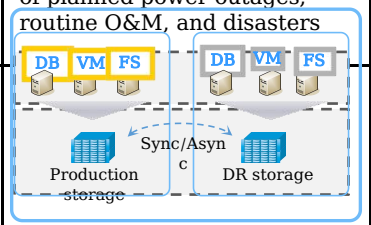
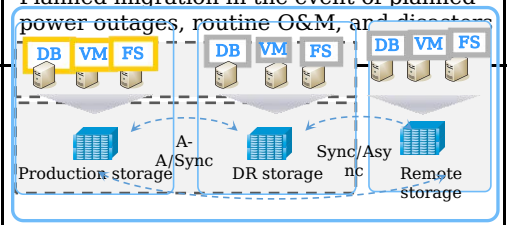
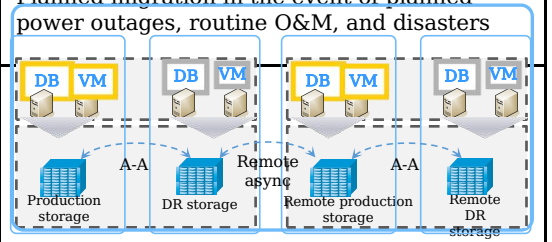
Network layer: Typical gateway devices include EMC VPLEX and IBM SVC

Pros	Broad compatibility enables integration of different backend heterogeneous SAN storage resources. Simultaneous disaster recovery for multiple SAN arrays without one-to-one mapping. Extendable disaster recovery platform. No extra investment required even with additional hosts and arrays.
Cons	High initial investment and few solution vendors. Complex gateway networking increases latency.

Storage array layer: Arrays that support dual-write or mirroring, such as Huawei storage series

Pros	Data replication does not affect the host application system and the DR architecture is easy to deploy. If the production arrays fail, applications can be switched to the DR arrays with minimal downtime. Data replication runs on the underlying array, eliminating fees incurred by host licenses.
Cons	Storage arrays at both sites must be provided by the same vendor, with only certain vendors (such as Huawei) providing heterogeneous solutions. Certain solutions don't support real-time remote data access (Huawei SAN active-active architecture is an exception), requiring data volume improvement or snapshots.

Overview of Huawei Flash Storage Disaster Recovery Solution

	Local High Availability Solution	Active-Active Data Center Solution	Active-Passive DR Solution	Geo-Redundant 3DC DR Solution	Geo-Redundant 4DC DR Solution (SAN Storage 6.1.6)
Service application	• Financial core production systems (class A and B) • HIS and PACS • Core system of the carrier's BSS domain • Core manufacturing system • University information system	• Financial core production systems (class A and B) • HIS and PACS • Core system of the carrier's BSS domain • Core manufacturing system • University information system	• Financial core production systems (classes A, B, C, and D) • HIS and PACS • Core system of the carrier's BSS domain • Core manufacturing system	• Financial core production systems (class A and B) • HIS • Core system of the carrier's BSS domain • Core manufacturing system	• Financial core production systems (class A and B) • Core manufacturing system
Fault protection	• Single point of failure (SPOF) of components (network adapter, controller, and storage device) in a data center • SPOFs of networks in data	• Failure of apps, storage devices, or an entire data center • Zero service disruption • Zero data loss	• Quick recovery in the event of power outage, fire, or flood • Planned migration in the event of planned power outages, routine O&M, and disasters	• Rapid recovery in the event of large-scale or regional disasters such as earthquakes, fires, and floods • Planned migration in the event of planned power outages, routine O&M, and disasters	• Rapid recovery in the event of large-scale or regional disasters such as earthquakes, fires, and floods • Planned migration in the event of planned power outages, routine O&M, and disasters
Solution topology					
Distance (from production to DR storage)	Different cabinets in the same equipment room or at the same site	Intra-city (< 100 km)	Intra-city or remote data center (synchronous replication: < 100 km; asynchronous replication: < 3000 km)	Intra-city or remote data center (synchronous replication: < 100 km; asynchronous replication: < 3000 km)	Intra-city active-active (< 100 km); remote asynchronous replication (< 3000 km)
RPO	0 (local active-active)	0 (intra-city active-active)	0 (synchronous) minutes (asynchronous)	0 (active-active/synchronous) minutes (asynchronous)	0 (intra-city active-active) minutes (remote)
RTO	≈ 0	≈ 0	Minutes	Minutes or hours	≈ 0 (intra-city) minutes (remote)
Storage + Optical Connection Coordination (SOCC)	N/A	Implemented in Version 6.1.6	Implemented in Version 6.1.6	Implemented in Version 6.1.6	Implemented in Version 6.1.6
Deployment cost	Low	High	Medium	High	High

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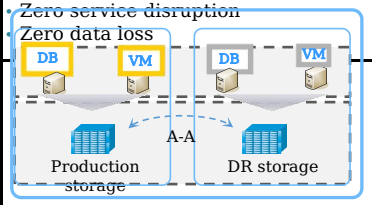
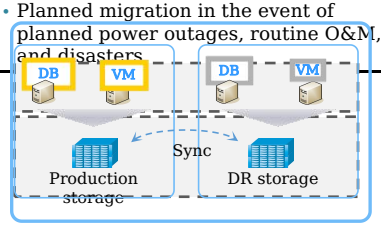
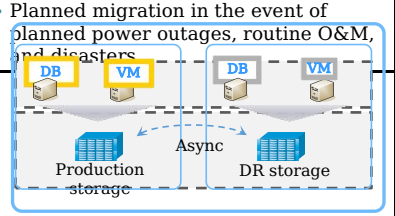
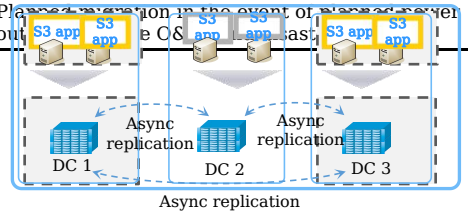
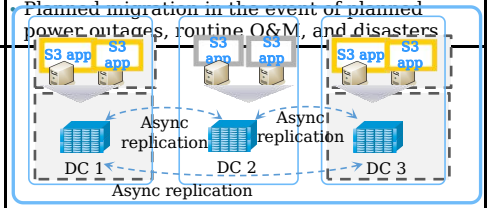
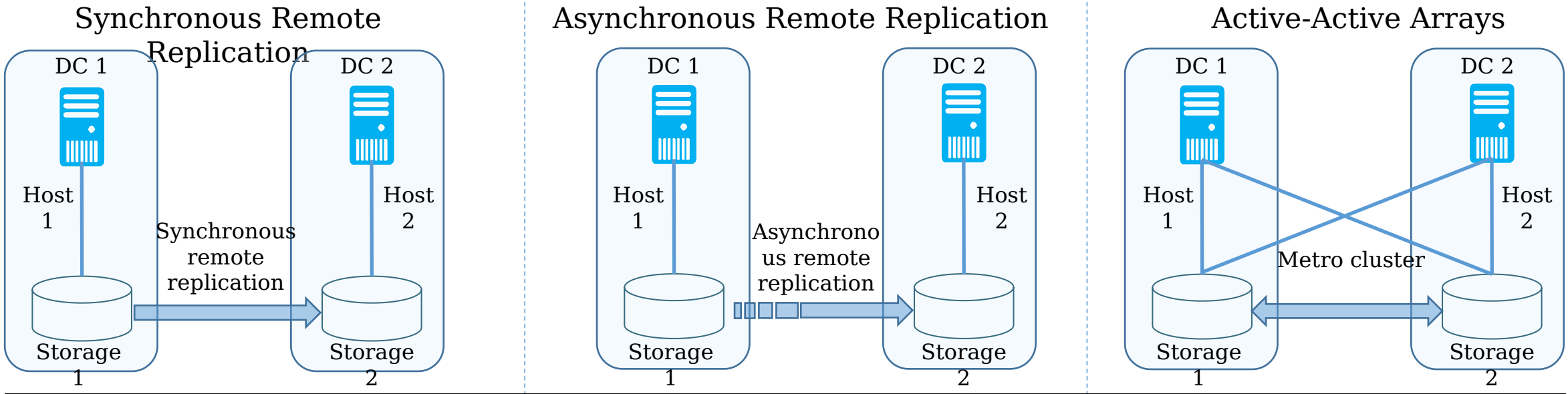
Overview of Huawei Scale-Out Storage Disaster Recovery Solution

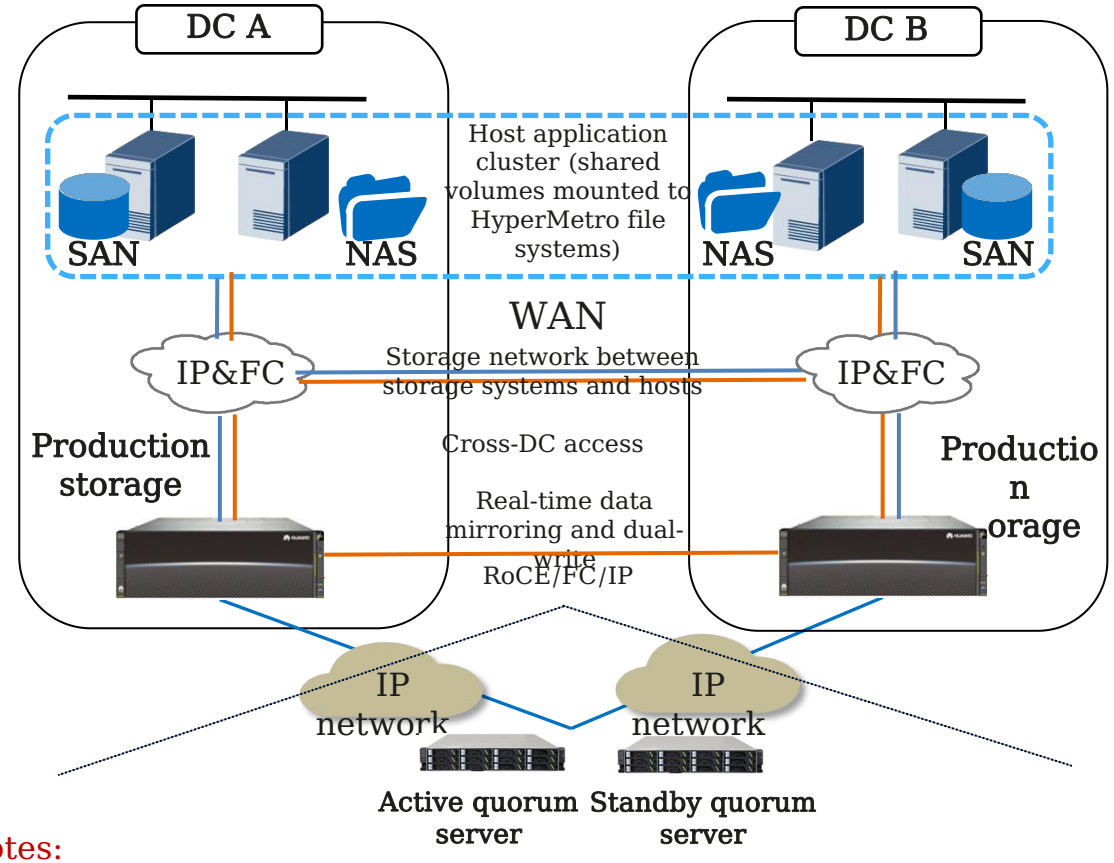
	HyperMetro Active-Active Data Center Solution (Scale-Out Block Storage)	HyperReplication Synchronous Replication–Based DR Solution (Scale-Out Block Storage)	HyperReplication Asynchronous Replication-Based DR Solution (Block/File/Object/HDFS)	HyperGeoMetro Geo-Redundant Multi-DC Solution (Object Storage)	HyperGeoEC Geo-Redundant Multi-DC Solution (Object Storage)
Service application	• Financial database system • Financial VM system • Financial new scale-out core system • Government cloud • Smart city • Public safety policing cloud and policing big data	• Financial database system • Financial VM system • Financial new scale-out core system • Government cloud • Smart city • Public safety policing cloud and policing big data	• Financial document image & dual-recording system • Financial database & VM system • Manufacturing content (email, etc.) management system • Government data archiving system • Financial new scale-out core system • Smart city • Public safety policing cloud and policing big data	• Financial document image system • Financial dual-recording system • Financial data exchange system • Manufacturing content (email, etc.) management system • MSP enterprise 2B service	• Financial log data archiving system • Scientific research data archiving system • Government tax data archiving system • Unstructured data (email, etc.) archiving system
Fault protection	• Failure of applications, storage devices, or an entire data center • Zero service disruption • Zero data loss	• Quick service recovery in the event of power failure, fire, or flood • Planned migration in the event of planned power outages, routine O&M, and disasters	• Quick service recovery in the event of power failure, fire, or flood • Planned migration in the event of planned power outages, routine O&M, and disasters	• Rapid recovery in the event of large-scale or regional disasters such as earthquakes, fires, and floods • Planned migration in the event of planned power outages, routine O&M, and disasters	• Rapid recovery in the event of large-scale or regional disasters such as earthquakes, fires, and floods • Planned migration in the event of planned power outages, routine O&M, and disasters
Solution topology					
Distance (from production to DR storage)	Intra-city (< 100 km)	Intra-city (< 300 km)	Asynchronous replication (< 3000 km)	Asynchronous replication (< 3000 km)	Remote asynchronous replication (< 3000 km)
RPO	0 (intra-city active-active)	0	Seconds to minutes	> 0 (seconds, depending on cross-site network bandwidth, latency, and frontend service pressure)	> 0 (seconds, depending on cross-site network bandwidth, latency, and frontend service pressure)
RTO	≈ 0	Minutes	Minutes	Minutes (depending on load balancer)	Minutes (depending on load balancer)
Deployment cost	Medium	Medium	Medium	High	Low

Synchronous/Asynchronous Remote Replication and Active-Active Arrays



	Synchronous Remote Replication	Asynchronous Remote Replication	Active-Active Array
Architecture	A-P	A-P	A-A
RPO	RPO = 0	RPO > 0	RPO = 0
RTO	RTO > 0	RTO > 0	RTO ≈ 0
Distance	< 100 km	< 3000 km	< 100 km
Bandwidth	≥ Peak-hour bandwidth (at least 64 Mbit/s)	≥ Changed data volume during peak hours/Replication period (at least 10 Mbit/s)	≥ Peak-hour bandwidth (at least 64 Mbit/s)

Integrated SAN and NAS A-A Solution



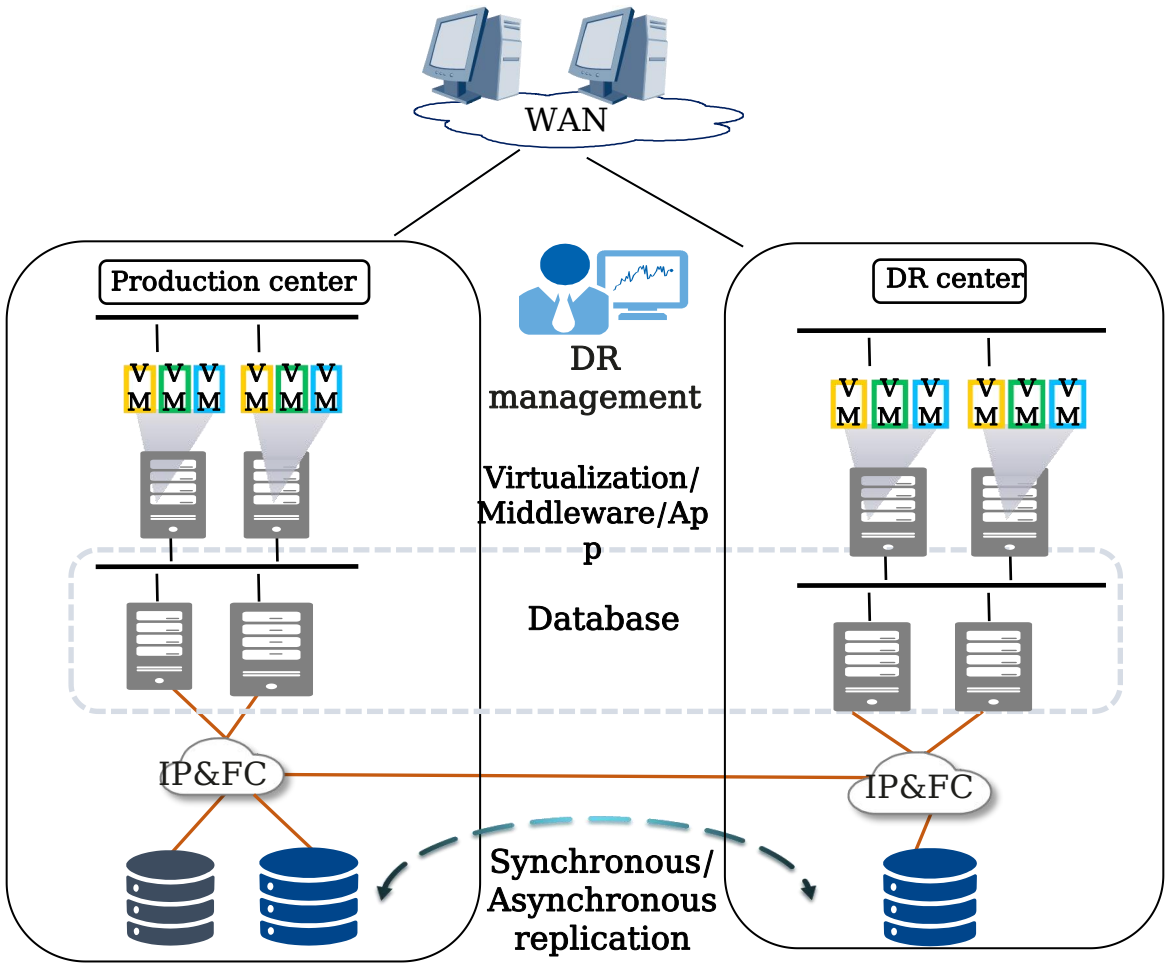
Notes:

1. The frontend of NAS HyperMetro supports only IP networks and not support Fibre Channel networks.
2. For HyperMetro, RTO is close to 0 and this is because HyperMetro arbitration needs time if a site is faulty.

Solution and Technologies

- High-reliability service-level A-A architecture ensures zero data loss or interruption in case a DC is down (RPO = 0, RTO ≈ 0).
- Concurrent and balanced workloads at both sites ensure user's access to the closest resources.
- No gateway, streamlining networking (cost and latency) for 30% higher performance.
- Dual arbitration mechanism with quorum server and static priority improves system reliability.
- Optimized storage protocol, with fewer cross-site write interactions (2 to 1) to boost A-A performance by 25%.
- Cross-site RoCE communication supports RDMA to slash latency and protocol stack processing overheads, while boosting bandwidth.
- Optimized storage, databases, virtualization, network, and transmission ensure consistent service experience between local and remote site (100 km).
- Scalability to geo-redundant 3DC DR solutions without service interruption.

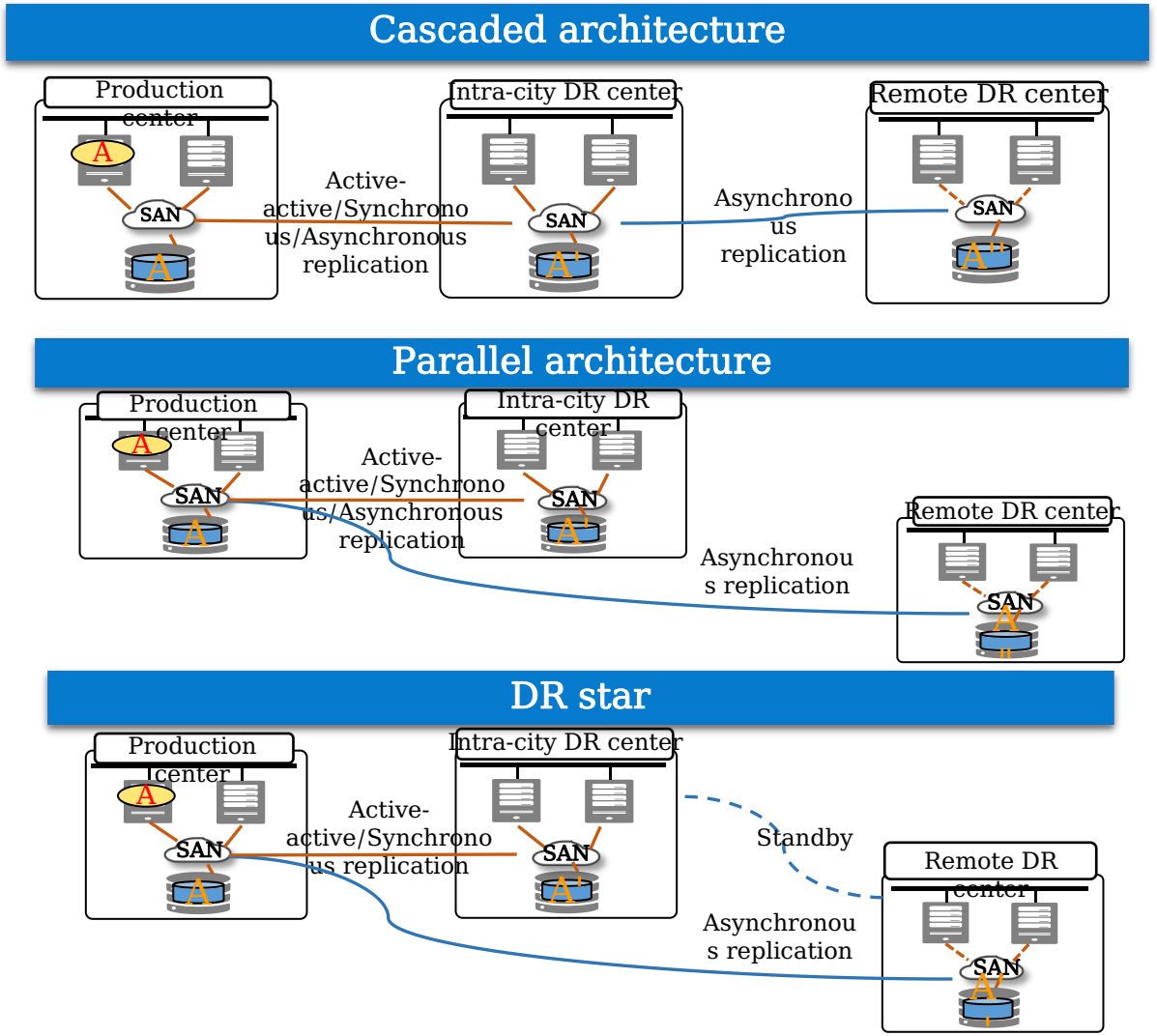
Active-Passive DR Solution



Solution and Technologies

- Integrated SAN and NAS active-passive DR solution ensures the consistency of databases and files.
- Heterogeneous storage resource consolidation in the production center improves the utilization of the existing storage arrays while avoiding storage vendor lock-in for DR system construction.
- Supports interconnection across high-end, mid-range, and entry-level storage systems, and heterogeneous server virtualization, reducing investment on devices in the DR center.
- I/O-based data replication, RPO ≈ 0.
- Automatic or manual switchover between synchronous and asynchronous replications, cutting down the impact of link jitter on services.
- Supports synchronous and asynchronous replication of VMware vVols 2.0.
- Dedicated DR management software delivers visualized DR management and one-click DR drill and recovery.

Geo-Redundant 3DC DR Solution



Solution and Technologies

- **Resilient design** with 3 copies and larger DR scope.
- **Smooth expansion** from two to three (cascaded) data centers, with flexible parallel deployment and **multi-copy DR**.
- **Supports the 3DC DR star**, ensuring uninterrupted data replication in the event of a DC failure.
- **Replication interoperability among high-end, mid-range, and entry-level storage arrays**, with mix-and-match selection for DR center devices to increase ROI.
- **Visualized management of DR services and topologies**, including one-click DR drill and failover to simplify the management and maintenance.

Thank you.

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