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SQL Server High Availability (HA) topic that's widely used in real-world environments. Let's go through **SQL Server Log Shipping** thoroughly, covering:

1. **Prerequisites**
2. **Architecture & Setup Flow**
3. **Real-Time Use Cases**
4. **Advantages**
5. **Disadvantages**
6. **Common Issues and Resolutions**

🧩 1. Prerequisites for Log Shipping

Before configuring **Log Shipping**, certain requirements must be met at both the SQL Server and infrastructure levels.

🔷 A. SQL Server & Database Requirements

Requirement	Description
Edition	Supported in **Enterprise, Standard, Web, and Developer** editions of SQL Server.
Database Recovery Model	The **database must use the FULL or BULK-LOGGED** recovery model (not SIMPLE).
Initial Full Backup	A **full backup** of the primary database must be taken and restored (WITH NORECOVERY) on the secondary server.
Same Database Name	Primary and secondary databases **must have identical names**.
SQL Server Agent	Must be running on both **Primary and Secondary servers**, since jobs are agent-driven.
Shared Folder / Network Path	The **transaction log backups** must be accessible by both servers via a **shared folder** (UNC path, e.g. \\PrimaryServer\LogShipShare).
Sufficient Disk Space	For storing log backups on primary and for restore operations on secondary.
Security Permissions	The SQL Server Agent service account on the secondary must have **read** permission to the shared folder.
Time Synchronization	Both servers' clocks must be synced (important for monitoring).
Database Compatibility	Both primary and secondary servers must have **compatible SQL Server versions** (equal or higher on secondary).

⚙️ 2. Log Shipping Architecture & Process Flow

Architecture Components:

1. **Primary Server (Source)** — The live production database.
2. **Secondary Server (Target)** — The standby copy.
3. **Monitor Server (Optional)** — Tracks and alerts if log shipping fails or delays.

Log Shipping Jobs (3 main jobs):

Job	Runs On	Description
Backup Job	Primary	Backs up the transaction log at defined intervals (e.g., every 5 mins).
Copy Job	Secondary	Copies the .trn files from shared folder to local folder.
Restore Job	Secondary	Restores log backups in sequence using RESTORE LOG ... WITH NORECOVERY or STANDBY.

Data Flow Summary:

Primary DB (Log Backup) → Shared Folder → Secondary DB (Copy + Restore)

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Modes of Restore on Secondary:

- NORECOVERY → DB is **non-readable** (used for DR failover only)
- STANDBY → DB is **readable** (used for reporting)

💼 3. Real-Time Use Cases

Scenario	Description
Disaster Recovery (DR)	Commonly used to maintain a warm standby copy of the production database in a remote data center or cloud VM.
Reporting Server	Secondary in STANDBY mode is used for **read-only queries**, reducing load on the primary.
Migration Testing	Used to maintain a **near-real-time copy** of production for testing new queries or configurations.
Data Archival	Historical log backups can be retained and archived for auditing or compliance.
Low-Cost HA Solution	Ideal for smaller organizations needing HA/DR without investing in AlwaysOn or Clustering.

✅ 4. Advantages

Advantage	Explanation
Simple & Reliable	Log shipping uses standard backup/restore operations, easy to configure and troubleshoot.
Low Cost	No shared storage or expensive clustering; works with SQL Server Standard edition.
Supports Multiple Secondaries	One primary can ship logs to multiple secondary servers.
Flexible Schedule	Backup frequency can be tuned (e.g., every 1–15 minutes).
DR & Reporting	DR protection and read-only reporting via STANDBY mode.
Independent Servers	Servers don't share storage; can be geographically separated.

⚠️ 5. Disadvantages / Limitations

Limitation	Description
Manual Failover	No automatic failover mechanism (manual intervention needed).
Data Loss Possibility	If last log backup hasn't been shipped/restored before failure, data loss may occur.
Latency	Secondary is **not real-time**, it's delayed by the log backup/restore frequency.
No Automatic Re-synchronization	If log chain breaks, you must reinitialize the secondary.
Single Direction	Log shipping works **one-way** (no bi-directional replication).
Maintenance Overhead	Requires monitoring jobs and cleanup of old log backups.

🧯 6. Common Issues & Resolutions

Issue	Root Cause	Resolution
Copy Job Fails	Network path or permission issue.	Ensure SQL Agent account on secondary has **read access** to shared folder; verify UNC path.
Restore Job Fails	Missing or skipped log backup file.	Check for missing .trn file; reinitialize log shipping if log chain is broken.
Log Backup Fails	Database not in FULL recovery model or disk full.	Set recovery model to FULL; free up space.

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Issue	Root Cause	Resolution
Log Shipping Monitor Alerts (Latency)	Backup, copy, or restore delays beyond threshold.	Investigate job history and system performance; adjust schedule.
Secondary Database Out of Sync	Backup/copy/restore job stopped or skipped.	Resume jobs; ensure log backups are sequentially restored.
Secondary Database in "Restoring" State	This is normal for NORECOVERY mode.	To make it readable, configure in STANDBY mode.
Transaction Log Chain Broken	Manual log backup not part of Log Shipping job.	Always take log backups through Log Shipping job only.
High Disk Usage	Old log backups not deleted.	Configure file retention or manual cleanup.
Monitoring Server Unreachable	Monitor SQL Agent offline or connection issue.	Reconfigure monitor server or fix network connectivity.

🧠 Pro Tips

- Always **exclude Log Shipping folders** from antivirus scanning to avoid copy delays.
- Use **Monitor Server** for automated alerting on lag thresholds.
- Schedule **log backups** every 5–15 minutes in production for near-real-time DR.
- Combine with **Database Mirroring / AlwaysOn** for hybrid HA/DR strategy.