SQL Server Cluster OverView

Detailed overview of SQL Server clustering, covering various aspects such as types, components, prerequisites, and features:

Aspect	Details
Feature	SQL Server Clustering
Types of Clusters	- **Failover Cluster Instance (FCI)**: Provides high availability by running SQL Server instances on multiple nodes with shared storage.
	- **Always On Availability Groups**: Provides high availability and disaster recovery at the database level without requiring shared storage.
Editions	- **Enterprise Edition**: Full support for both Failover Cluster Instances and Always On Availability Groups.
	- **Standard Edition**: Supports Failover Cluster Instances with two nodes and Basic Availability Groups (limited to 1 database and 2 replicas).
Components	- **Cluster Nodes**: Servers participating in the cluster, each running Windows Server and SQL Server.
	- **Shared Storage (FCI)**: SAN, iSCSI, or Storage Spaces Direct (S2D) providing a shared disk accessible by all cluster nodes.
	- **Cluster Network**: Networks connecting the nodes and storage, including private (heartbeat) and public (client) networks.
	- **Quorum**: Mechanism ensuring cluster reliability and preventing split-brain scenarios, typically using a disk witness, file share witness, or cloud witness.
	- **Virtual Network Name (VNN)**: A network name for the cluster that clients connect to, automatically redirecting to the active node.
	- **Cluster Resources**: Includes the SQL Server instance, shared disks, and IP addresses managed by the cluster.

Prerequisites	- **Windows Server Failover Clustering (WSFC)**: Must be configured and validated before setting up SQL Server clustering.
	- **Domain Membership**: All cluster nodes must belong to the same Windows domain or trusted domains.
	- **Shared Storage**: Required for Failover Cluster Instances, with disks accessible by all nodes.
	- **Networking**: At least two network interfaces per node (one for public access, one for private/heartbeat communication).
	- **SQL Server Installation**: SQL Server must be installed with the Failover Cluster option selected.
High Availability Features	- **Automatic Failover (FCI)**: If the active node fails, another node automatically takes over, ensuring high availability.
	- **Manual Failover**: Administrators can manually trigger a failover to another node.
	- **Shared Disk Access (FCI)**: All nodes have access to the same data, ensuring consistency during failovers.
	- **Rolling Upgrades**: Allows upgrading nodes one at a time, minimizing downtime during maintenance.
	- **Heartbeat Mechanism**: Constant monitoring between nodes to detect failures and trigger failovers.
	- **Quorum Models**: Configure quorum to ensure cluster reliability, including Node Majority, Node and Disk Majority, and Node and File Share Majority.
Disaster Recovery (DR) Features	- **Multi-Subnet Clustering**: Support for clusters spread across different geographic locations for disaster recovery.
	- **Geographically Dispersed Clusters**: Configurations that provide both high availability and disaster recovery by spanning multiple sites.

Monitoring and Management	- **Failover Cluster Manager**: Tool for managing and monitoring the cluster, including nodes, resources, and failover processes.
	- **SQL Server Management Studio (SSMS)**: Used to manage the SQL Server instances within the cluster.
	- **Dynamic Management Views (DMVs)**: Used for monitoring cluster performance and health (`sys.dm_hadr_*` for Availability Groups, etc.).
	- **Event Logs and Cluster Logs**: Monitor and troubleshoot issues using logs stored on each node and in the cluster logs.
Networking	- **Public Network**: Used by clients to connect to SQL Server.
	- **Private Network (Heartbeat)**: Used for communication between cluster nodes to monitor their status.
	- **Virtual IP Address (VIP)**: The IP address associated with the cluster's VNN, directing client connections to the active node.

Security	- **Encryption**: SQL Server supports SSL/TLS encryption for data in transit between clients and the cluster.
	- **Kerberos Authentication**: Used for secure communication between the cluster nodes and between clients and the cluster.
	- **Active Directory Integration**: Ensures that all cluster nodes and resources are securely registered and managed within the AD domain.
Use Cases	- **High Availability**: Ensures that SQL Server services remain available even in the event of hardware failures or maintenance.
	- **Disaster Recovery**: Provides options for recovering SQL Server services across different geographic locations.
	- **Load Balancing (Always On AGs)**: Distributes read-only workloads across multiple replicas to balance the load.

Limitations	- **Standard Edition Limits**: Supports only two nodes in Failover Cluster Instances and Basic Availability Groups with limited features.
	- **Shared Storage Requirement (FCI)**: Requires shared storage accessible by all nodes, which can be a single point of failure if not properly configured.
	- **Complexity**: SQL Server clustering can be complex to set up and manage, especially when integrating with Always On Availability Groups or multi-subnet clusters.
Licensing	- **Enterprise Edition**: Required for full support of multi-node clustering and Always On Availability Groups.
	- **Standard Edition**: Supports up to two nodes in a Failover Cluster Instance and limited Availability Group features.

This table provides a comprehensive overview of SQL Server clustering, summarizing the key components, features, prerequisites, and considerations. It serves as a quick reference for understanding and planning SQL Server clustering in an enterprise environment.