Assignment

Unit - 1

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Topologies Supporting Scalability

Mesh Topology (fabric): Highly scalable, device connect via switches allowing dynamic pathing, minimal bottlenecks, and easy addition / removal of nodes.

Hierarchical (Tree): Scales well logically; core / distribution / access layer manage traffic flow efficiently, supporting large networks.

Hyper-converged Infrastructure (HCI): Scales "out" by adding identical nodes; integrates compute, storage, and networking, simplifying managment and scaling resources linearly.

Clustered NAS: Scales capacity and performance by adding nodes to a single namespace, distributes local and metadata across controllers.

Object Storage Architecture: Scales massively 'out' using flat namespace, data and metadata distributed across many nodes, ideal for unstructured data.

b) SAN vs NAS Comparison Over Media

SNo.	Aspect	SAN (Block Storage)	NAS (file storage)
1	Primary media	Fiber channal optics (or) ethernet cable	Standard ethernet (Cat 6/6A, Fiber)
2	Cabling	Specialized (Fc cables)	Commodity (RJ45 copper)
3.	Signal Integrity	Requires lossless fabric (fc / NVMe-of)	Tolerats packet loss (TCP/IP recovery)
4	Latency	Microseconds (fc / NVMe-of)	Milliseconds.
5	Max distance	Fc: 10km + (SMF), iSCSI: IP network limits	Limited by LAN/WAN.
6.	Noice Susceptibility	low (optical fc), copper requires EMI shielding	High (Ethernet copper), fiber immune.
7.	Throughput	16GFC/32GFC/64GFC, 100GBE iSCSI.	10GbE/25GbE/100GbE
8.	Protocal translation	SCSI encapsulated over ~~fc/fo~~ FC/FCoE/iSCSI	NFS/SMB natively over TCP/IP.

c) Recommended Media for Internal Data Flow:

- NVMe-oF over Fabrics: Best for high-speed, low latency internal data.
- Optical Fiber (100G+): Ideal for backbone; supports long distance, EMI-free.
- Direct-Attach Copper (DAC): Cost-effective for short distance (<7m).
- InfiniBand: Ultra-low latency, suited for HPC/AI clusters.
- 25/100 GbE Ethernet Balanced cost/performance, ubiquitous
- Avoid HDDs/SSDs for transit: use flash/NVMe for storage, not transport media.
- RDMA Support Use RoCE (Ethernet) or InfiniBand for zero copy data transfer.
- Future-Proof: Prioritize media supporting 200/400 Gbps standards.

d) Role of physical layer in Storage Replication.

- Signal transmitission: Converts data bits into electrical optical signals.
- Media Integrity: Ensure cables (fiber./copper) maintain Signal quality.
- ~~Error~~ Encoding schemes: Uses 64b/66b (Ethernet) or 8b/10b (fc) for ~~error~~ ~~dection~~ dectection.
- Synchronization: Aligns clock cycles between source / traget devices.
- Distance Limits: Dictates max replication distance (eg copper: 100m, fiber: km+).
- Bandwidth caps: Defines max throughput (eg, 100 Gbps fiber).
- Error Handling: Detects physical-layers errors (eg, signed attenuation).
- Protocal translation: Interfaces with data link layer (eg, FC to DWDM optics).