

Computing Infrastructure

 POLITECNICO DI MILANO

Storage: the trends

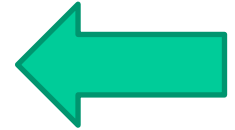


The topics of the course: what are we going to see today?



A. HW Infrastructures:

- **System-level**: Computing Infrastructures and Data Center Architectures, Rack/Structure;
- **Node-level**: Server (computation, HW accelerators), **Storage (Type, technology)**, Networking (architecture and technology);
- **Building-level**: Cooling systems, power supply, failure recovery



B. SW Infrastructures:

- **Virtualization**: Process/System VM, Virtualization Mechanisms (Hypervisor, Para/Full virtualization)
- **Computing Architectures**: Cloud Computing (types, characteristics), Edge/Fog Computing, X-as-a service
- **Machine and deep learning-as-a-service**

C. Methods:

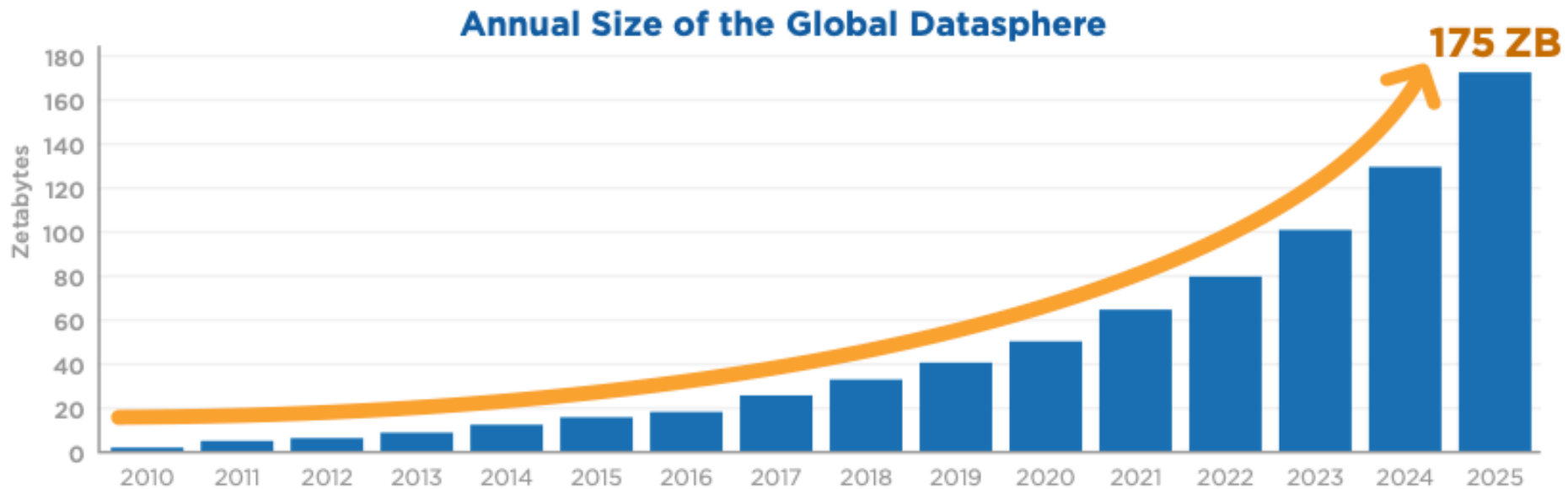
- **Reliability and availability of datacenters** (definition, fundamental laws, RBDs)
- **Disk performance** (Type, Performance, RAID)
- **Scalability and performance of datacenters** (definitions, fundamental laws, queuing network theory)



Some Trends...



- Data-driven world
 - 80s-90s data was primarily generated by humans
 - Nowadays machines generate data at an unprecedented rate
 - Not only Media (image/video/audio/socialmedia) as big-data source
 - Sensors, surveillance cameras, digital medical imaging devices...
 - Industry4.0 and AI



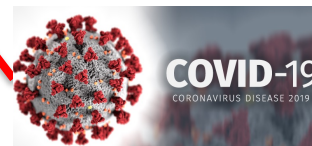
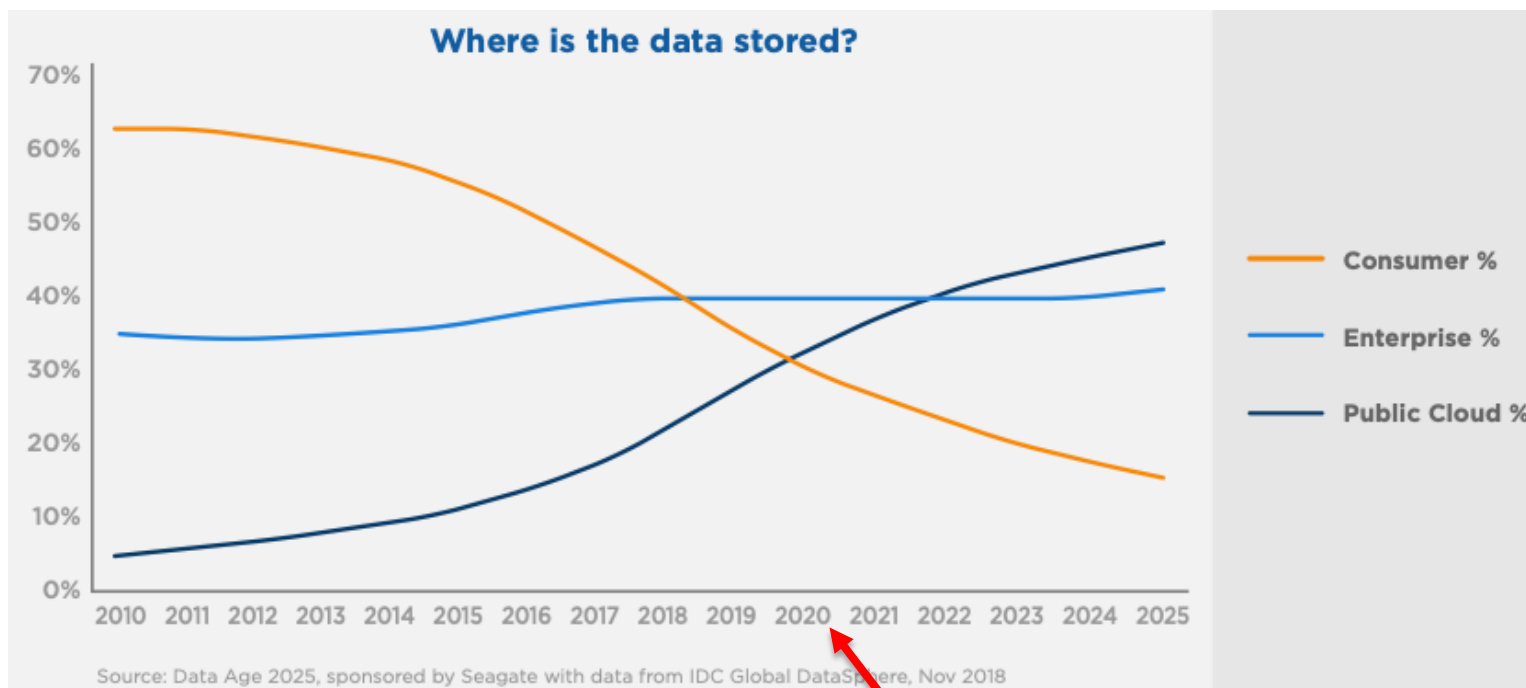
Source: Data Age 2025, sponsored by Seagate with data from IDC Global DataSphere, Nov 2018



Some More Trends...



- The growth favors the centralized storage strategy
 - Limiting redundant data
 - Automating replication & backup
 - Reducing management costs

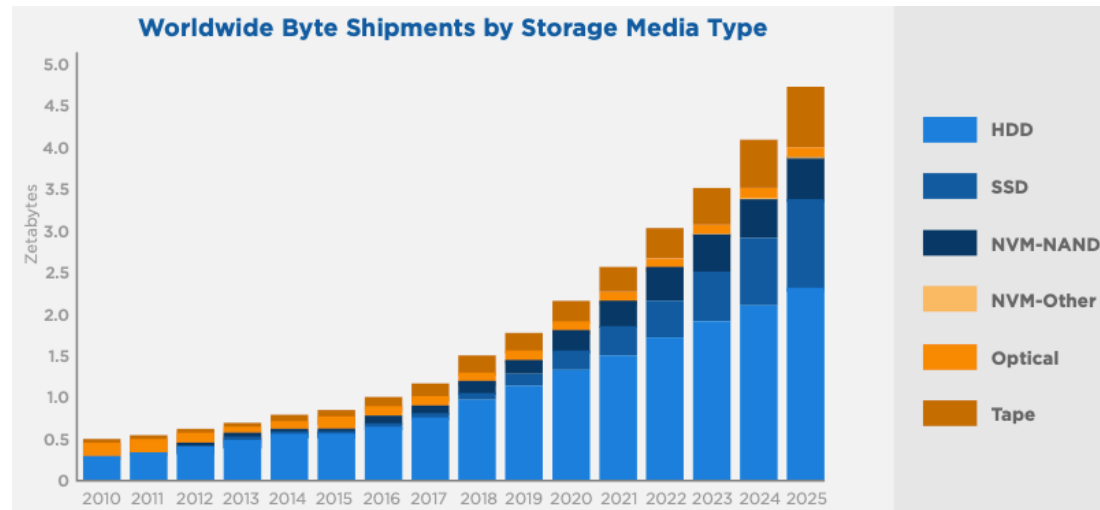




Storage Technologies



- Storage technology is dominated by HDDs
 - Magnetic disks with mechanical interactions
- «Recent» technology advancement brought SSDs
 - No mechanical or moving parts
 - Built out of transistors (NAND flash-based devices)
- NVMe - Non-Volatile Memory Express
 - Latest industry-standard to run PCIe SSDs
- Tapes ... *will never die*





Amazon S3 vs. Glacier

- Same durability (11 nines), different performance in data retrieval



S3 Standard - General purpose storage for any type of data, typically used for frequently accessed data

First 50 TB / Month	\$0.023 per GB
Next 450 TB / Month	\$0.022 per GB
Over 500 TB / Month	\$0.021 per GB

S3 Glacier Flexible Retrieval (Formerly S3 Glacier)*** - For long-term backups and archives with retrieval option from 1 minute to 12 hours

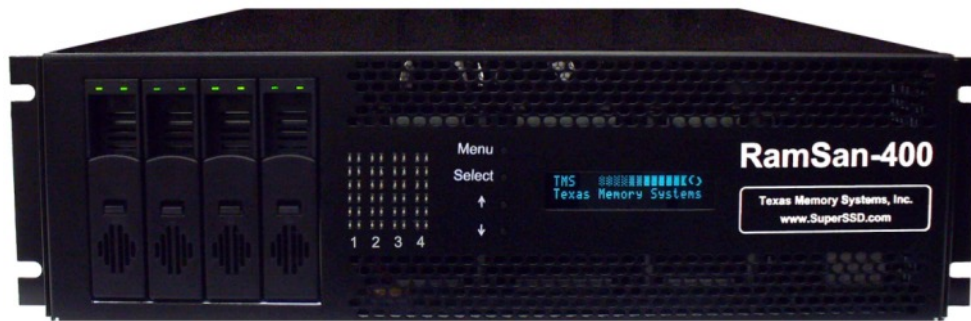
All Storage / Month	\$0.0036 per GB
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S3 Glacier Deep Archive*** - For long-term data archiving that is accessed once or twice in a year and can be restored within 12 hours

All Storage / Month	\$0.00099 per GB
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Hybrid solutions (HDD + SSD)



Some large storage servers use SSD as a cache for several HDD. Some mainboards of the latest generation have the same feature: they combine a small SSD with a large HDD to have a faster disk.



Some HDD manufacturers produce Solid State *Hybrid Disks* (SSHD) that combine a small SSD with a large HDD in a single unit.

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A server for a datacenter: an example



An example of Server for a Datacenter



E4
COMPUTER
ENGINEERING

Descrizione

RB120: Server 1U Dual Socket Intel GPU – 2 bays SAS/SATA + 2 internal

1 x 1U – 2 x SAS/SATA – Ridondante 2000W

1U Rackmount Black Chassis. 2000W Redundant Power Supplies.
43mm (H) x 437mm (W) x 894mm (D). N. 2 Hot-swap 2.5" SAS/SATA drive bays, n. 2 Internal 2.5" drive bays.

1 x Dual Xeon Scalable – C621 – Server GPU

Proprietary Motherboard. Intel® C621 chipset. Dual Socket P (FCLGA3647). Support up to 165W TDP. N. 12 DIMM Slots supported
Memory Types: 2666/2400/2133MHz RDIMM, LRDIMM and 3DS ECC LRDIMM modules. Optimal memory configuration: Six memory channels per CPU.

2 x Xeon 8-Core 4110 2,1Ghz 11MB

Intel® Xeon® Silver 4110 Processor. 8Cores. 16Threads. FCLGA3647 Socket. 11MB L3. 2,1Ghz Base Frequency. 85W max. TDP. DDR4-2400 Memory type.

6 x DDR4-2666 Reg. ECC 16 GB module

Full brand memory, tested and certified by manufacturer for thorough compatibility with proposed system. The real operating speed depends on the processor's model and on the number of the installed modules. Better performances are achieved through a proper channel configuration.

1 x Intel C621 SATA III 4 ports

1 x SEAGATE 2TB 2,5" SATA III 7.200RPM

Seagate Enterprise Capacity hard disk drive. Form factor: 2,5". Capacity: 2TB. Interface: 512N SATA 6Gb/s. Buffer: 128MB. Rotational Speed: 7200RPM. Max. Sustained Transfer Rate (MB/s): 136MB/. 2Million-hour MTBF.

1 x Intel S4500 240GB 2,5" SSD SATA III

Intel® SSD DC S4500 Series. Sequential Read (up to): 500MB/s. Sequential Write (up to): 190MB/s. Random Read (100% Span): 69000 IOPS. Random Write (100% Span): 16000 IOPS. Endurance Rating (Lifetime Writes): 0.62 PBW.

1 x Backplane 2 bays SAS/SATA