

Infrastructure Architecture



Joseph Anthony

@ansolabs | www.ansolabs.net

Module Focus

Data Centers

Servers

Networking

Storage

End User Devices

Industry Trends

Lets Focus On..

Data Centers

Servers

Networking

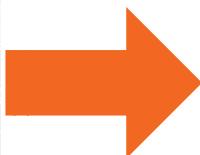
Storage

End User Devices

Industry Trends



NASA Computer Room (Early 1960s)



Server Floor

Google Data Centre (Lenoir, NC)

Key Data Centre Building Blocks

Racks

Cabling & Patching

Power Supply

Environment Control Systems

Fire Suppression

Layout and Physical Structure

Racks

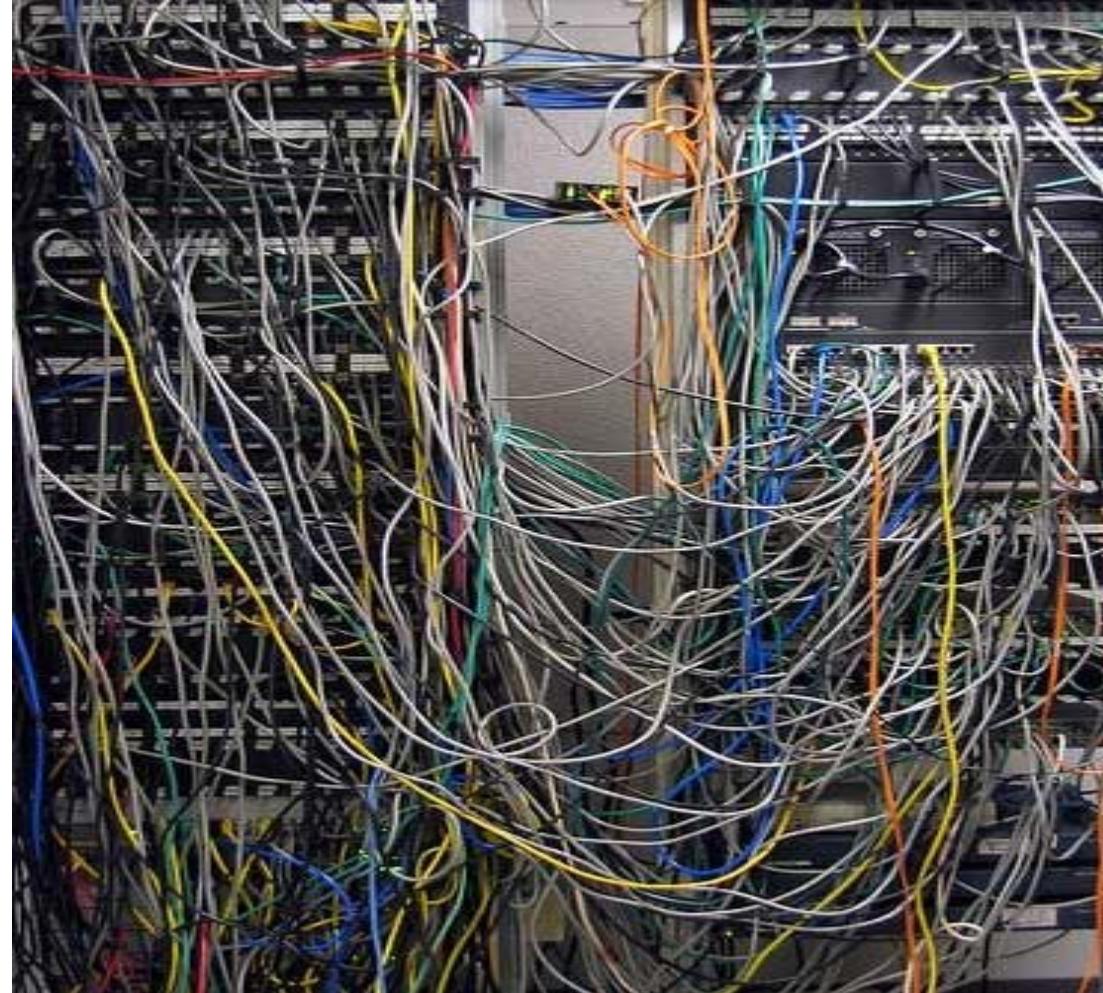


Standardized enclosures that house IT infrastructure - usually 19 inches wide

Rack-mountable equipment are designed specifically to be placed on the racks

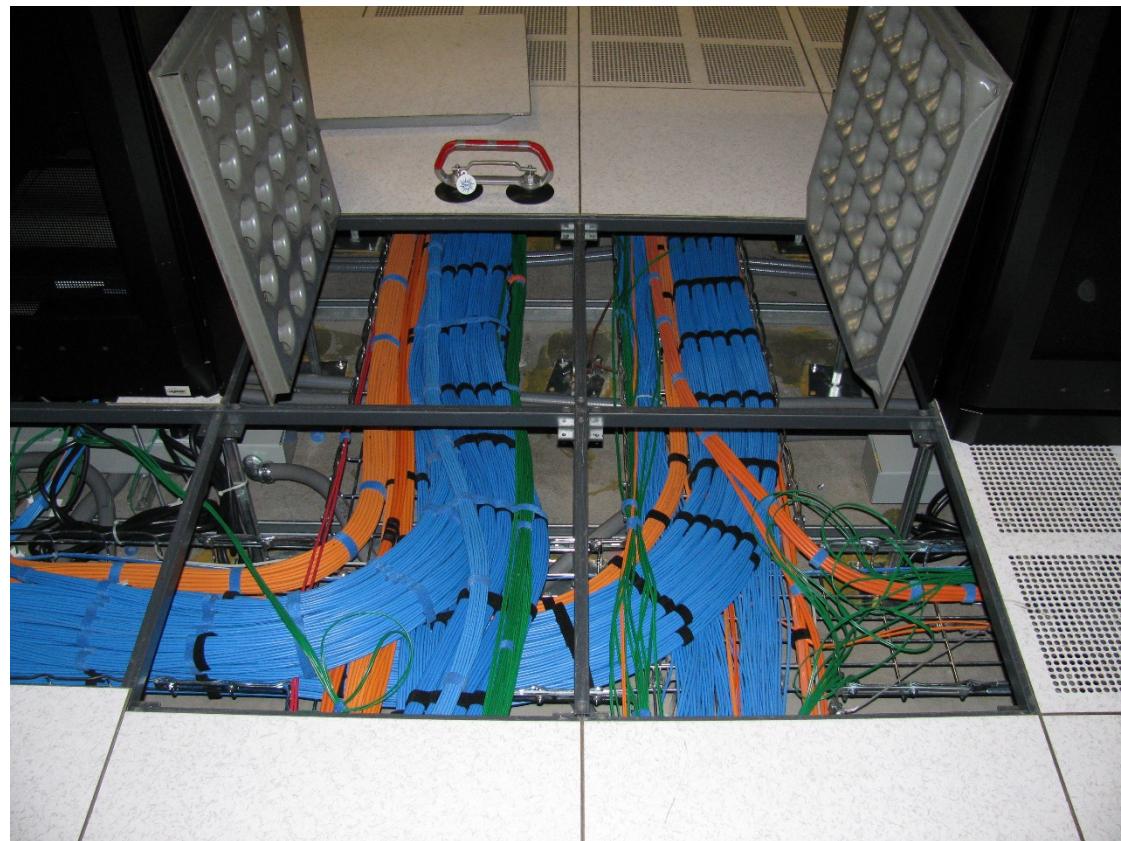
Front panel is 19 inches or 49 cm wide
Their height is measured in multiples of "Rack Units" denoted by letter 'U' (1.752 inches or 44.5 mm)
Industry standard rack is 42 U high

Cabling



Lack of discipline leads to spaghetti cabling

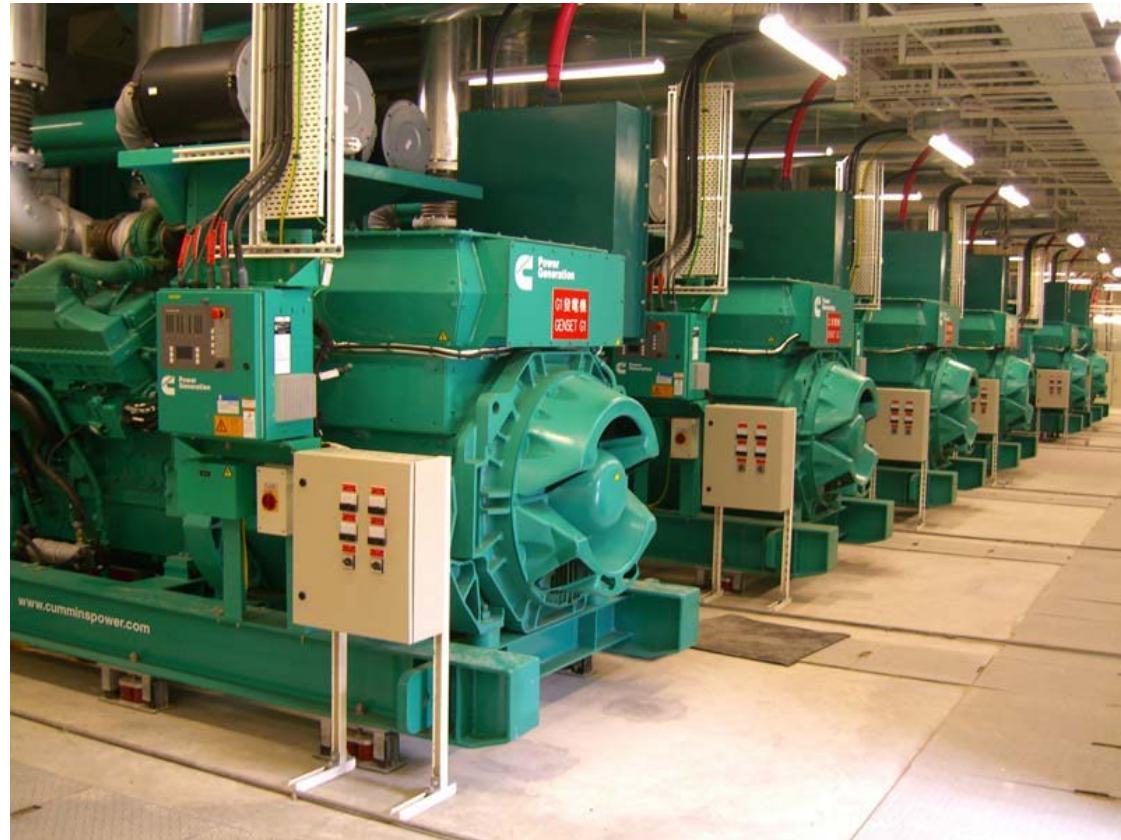
Standard Cabling -TIA 942



The Telecom Industry Association's
Telecommunications Infrastructure
Standard (TIA 942)

Adhering to standards enables
Standard and consistent nomenclature
Failsafe operation
Reliability
Expandability & Scalability
Robust protections

Power Supply



Foundational infrastructure capability supported by a Data Centre

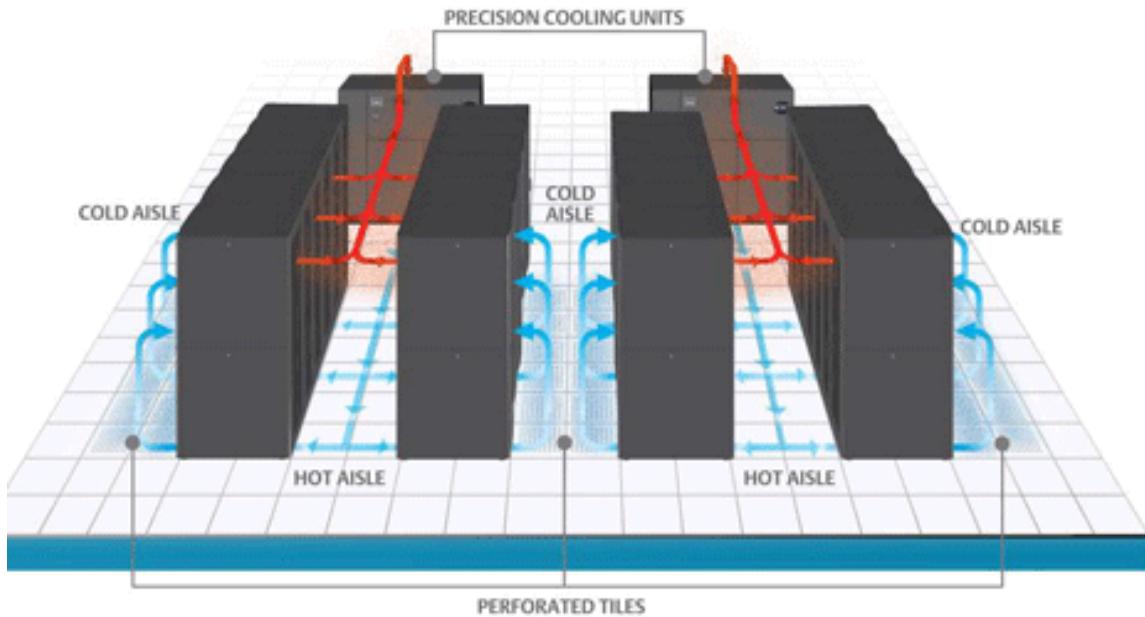
Represents one of the highest operating expense

Power density and quality of power supplied are important considerations

Data centers use a combination of:
**Redundant utility power sources,
Uninterrupted Power Supply (UPS) and
Backing power generators**

Backup Power Generators for Data Centre (<http://bit.ly/1CyskOF>)

Environment Control System



Heat - 90% of all power used by the IT equipment are converted into heat

Humidity and dust control are other problems

Data centers use a combination of :
Precision cooling,
Air quality control systems,
Limited manual access policies

Fire Suppression



Fire prevention involves
Prevention of equipment and cable overheating
Use of physical firewall
Use of fire resistant materials

Fire detection involves
Deploying heat and fire detection systems

Fire suppression involves
Reducing oxygen levels
Deploying water sprinklers

Layout & Structure

Equipment density is a key consideration
Preventing intrusion and fire are important too
So is serviceability and enabling human access

Lets Focus On ..

Data Centers

Severs

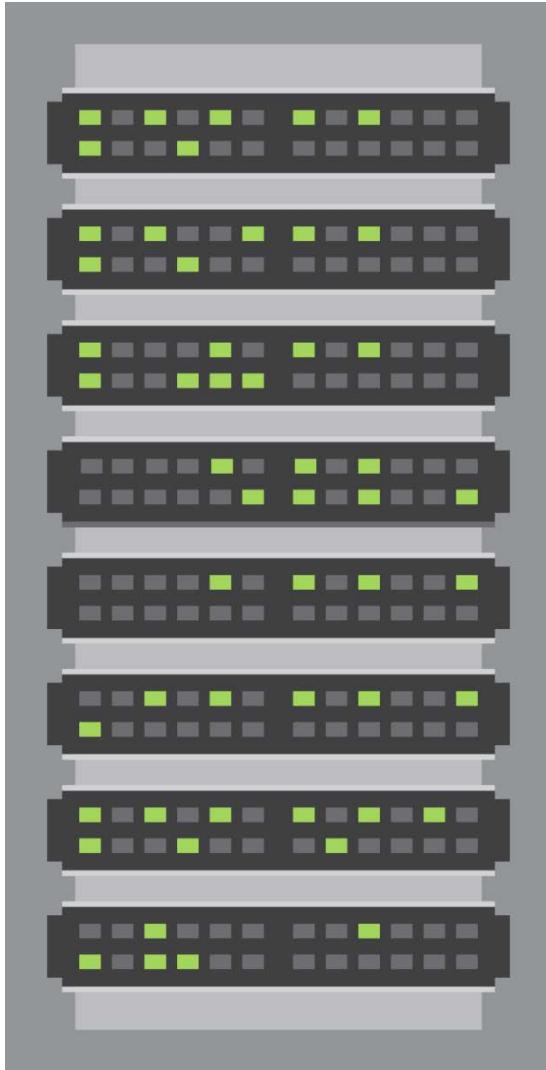
Networking

Storage

End User Devices

Industry Trends

Server Building Blocks



CPU

Memory

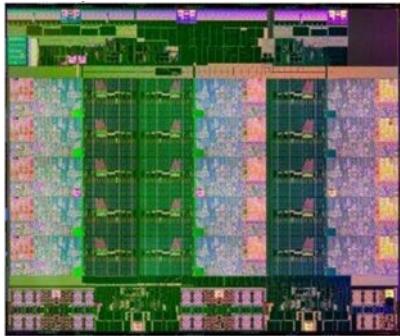
Buses & Interfaces

Network connectivity

Internal Power Supply

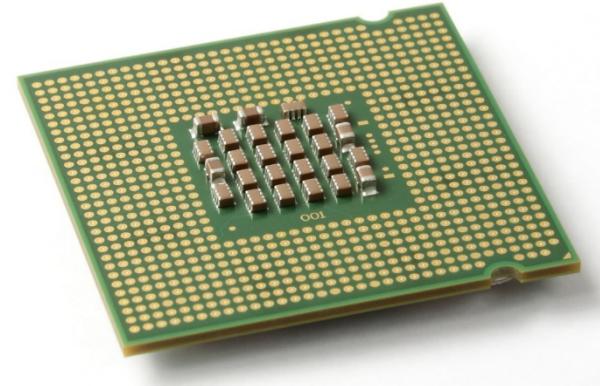
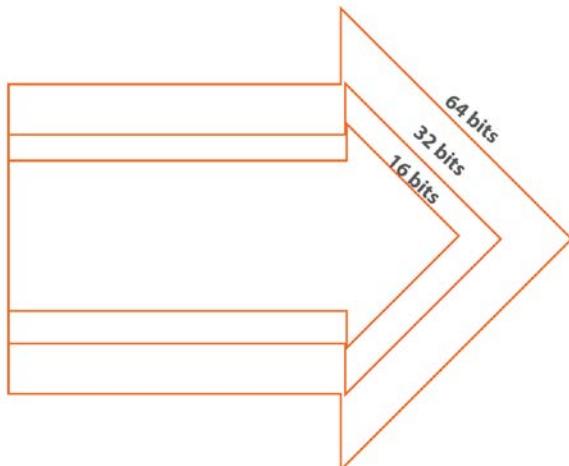
CPU – Central Processing Unit

Intel Xeon E7 Ivy Town Die

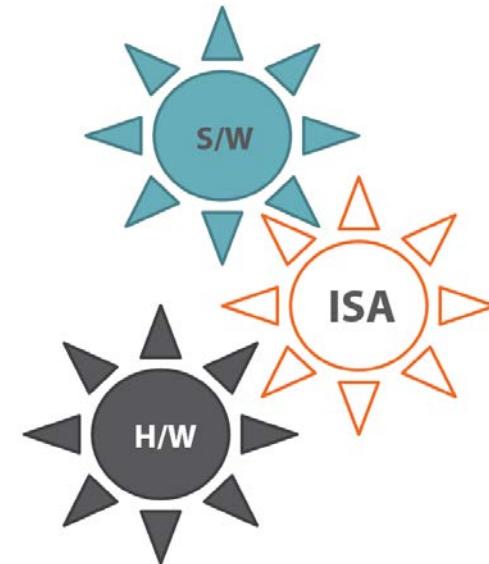


<http://bit.ly/13RvWfK>

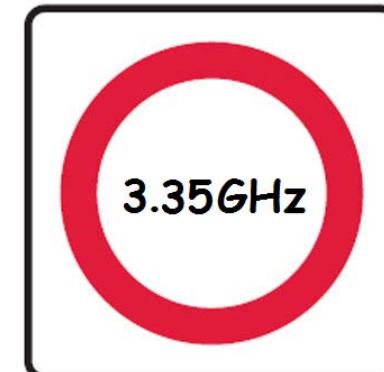
Word size impacts data throughput



Instruction Set Architecture (ISA) abstracts hardware



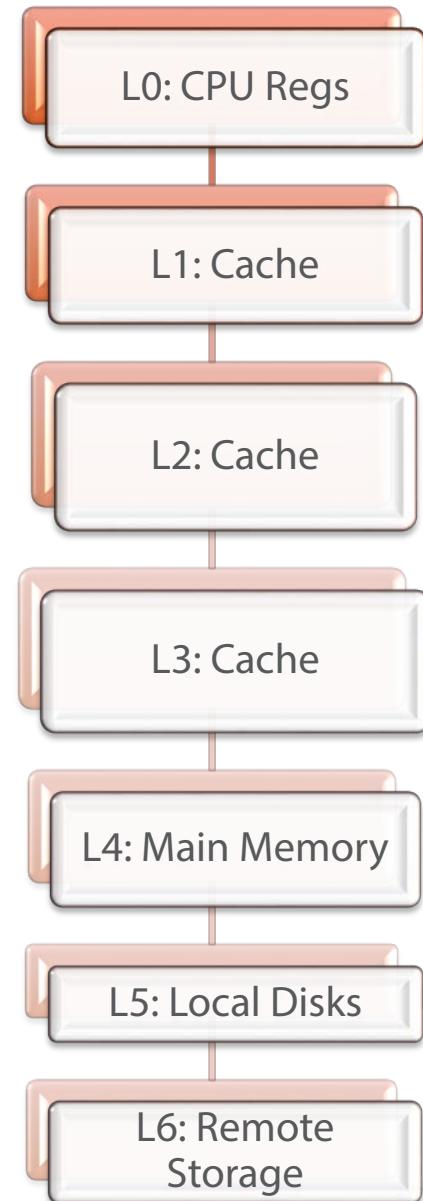
Clock-speed indicates – CPU cycles per second



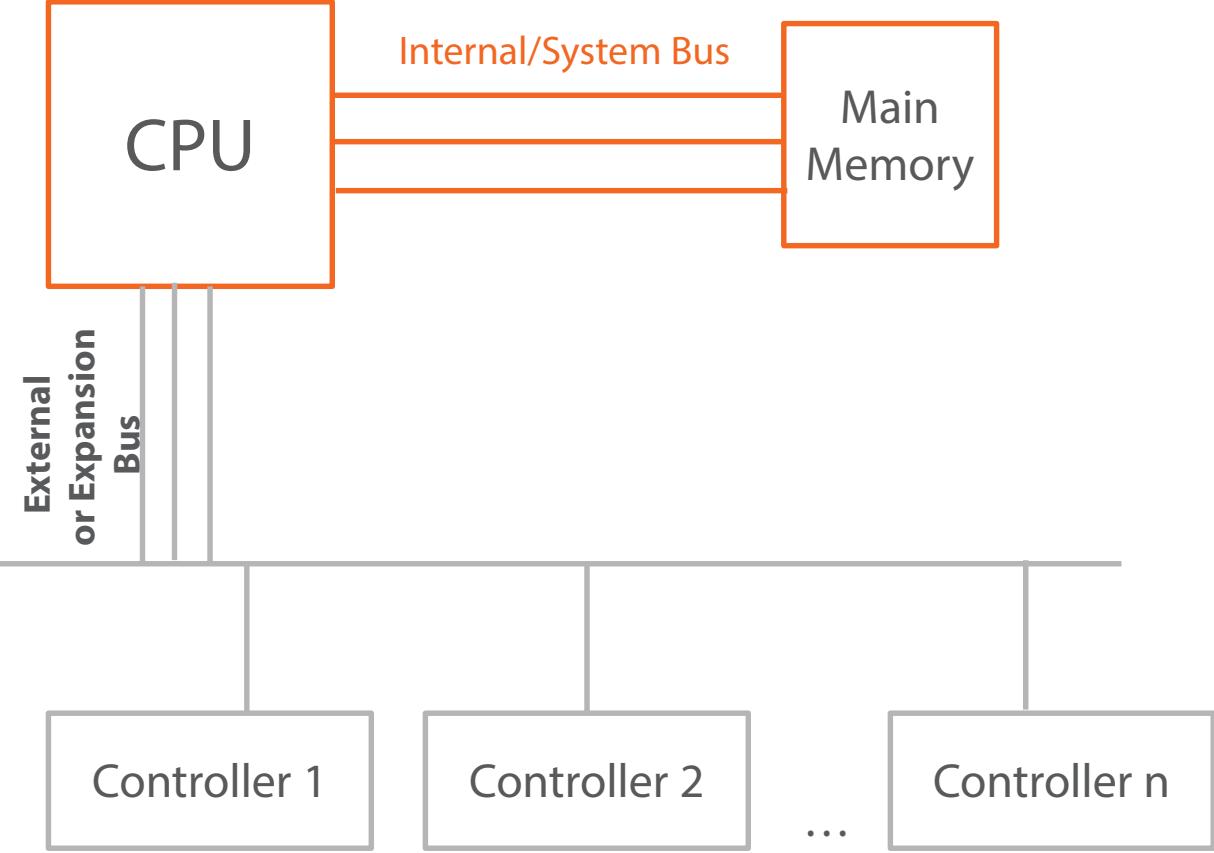
Memory



Memory Hierarchy



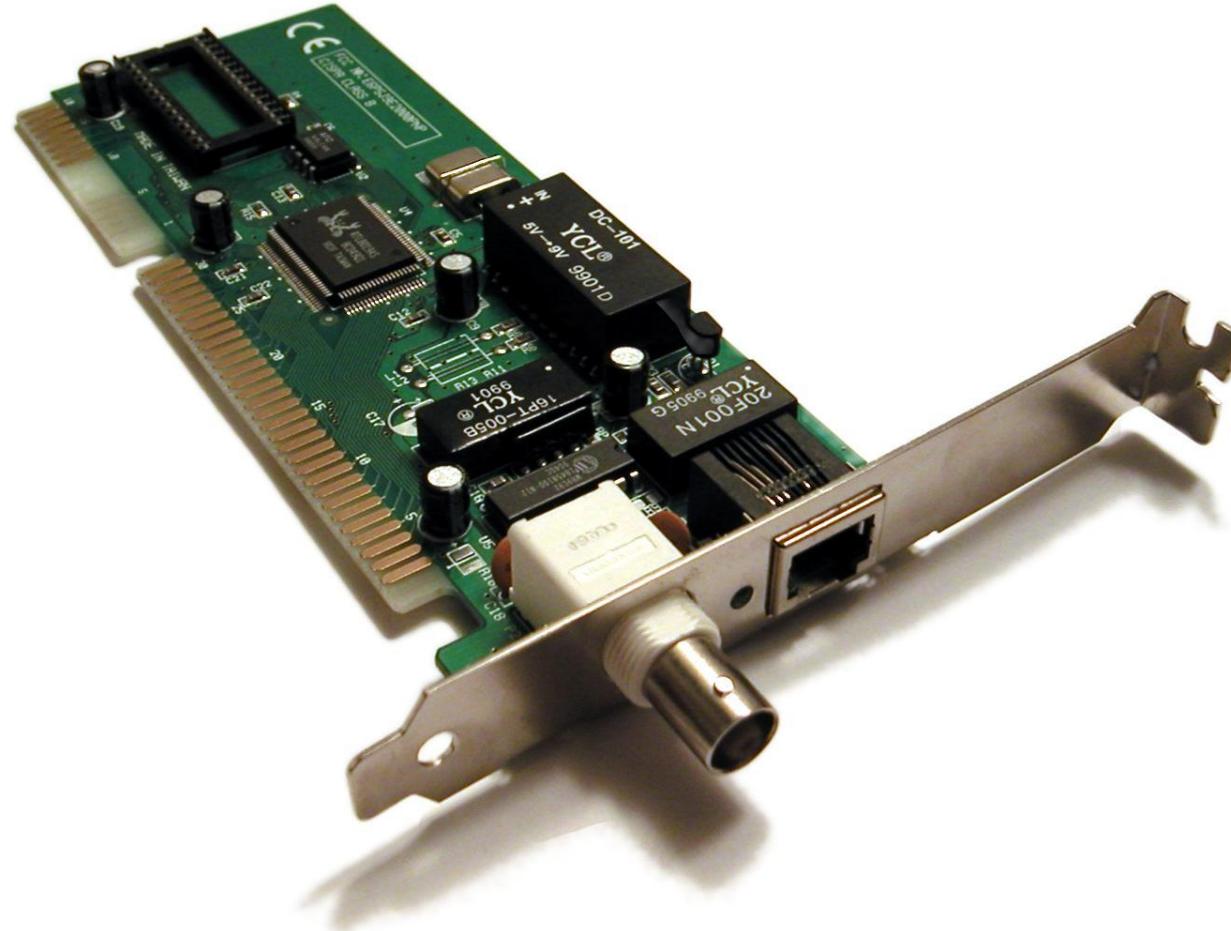
Buses & Interfaces



External Interfaces



Network Interface Card



Internal Power Supply



Server Marketplace – 4 Broad Categories



AMD

X86 - based

IBM

UNISYS

BULL

Mainframe

SPARC

POWER8

Mid-Range



SoC - based

Lets Focus On ..

Data Centers

Severs

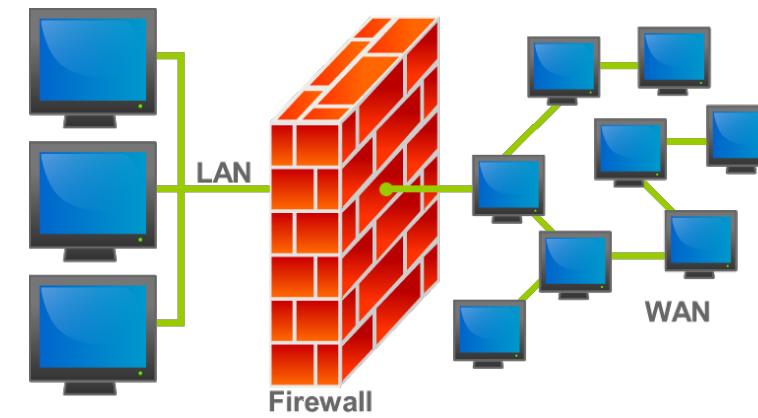
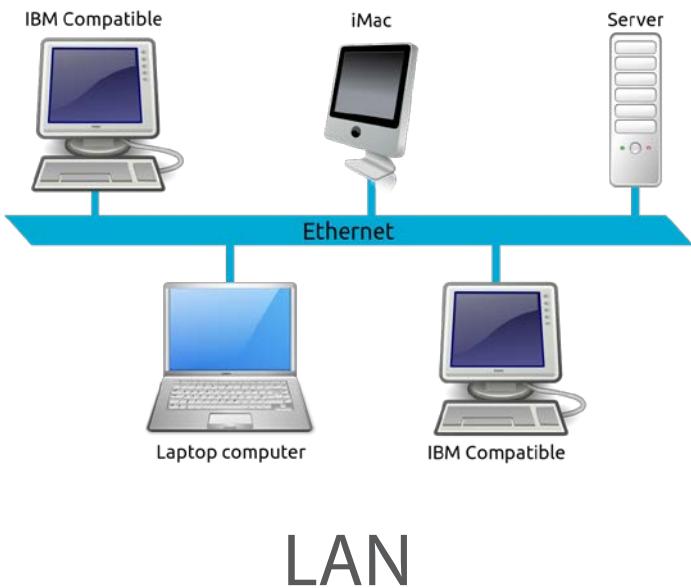
Networking

Storage

End User Devices

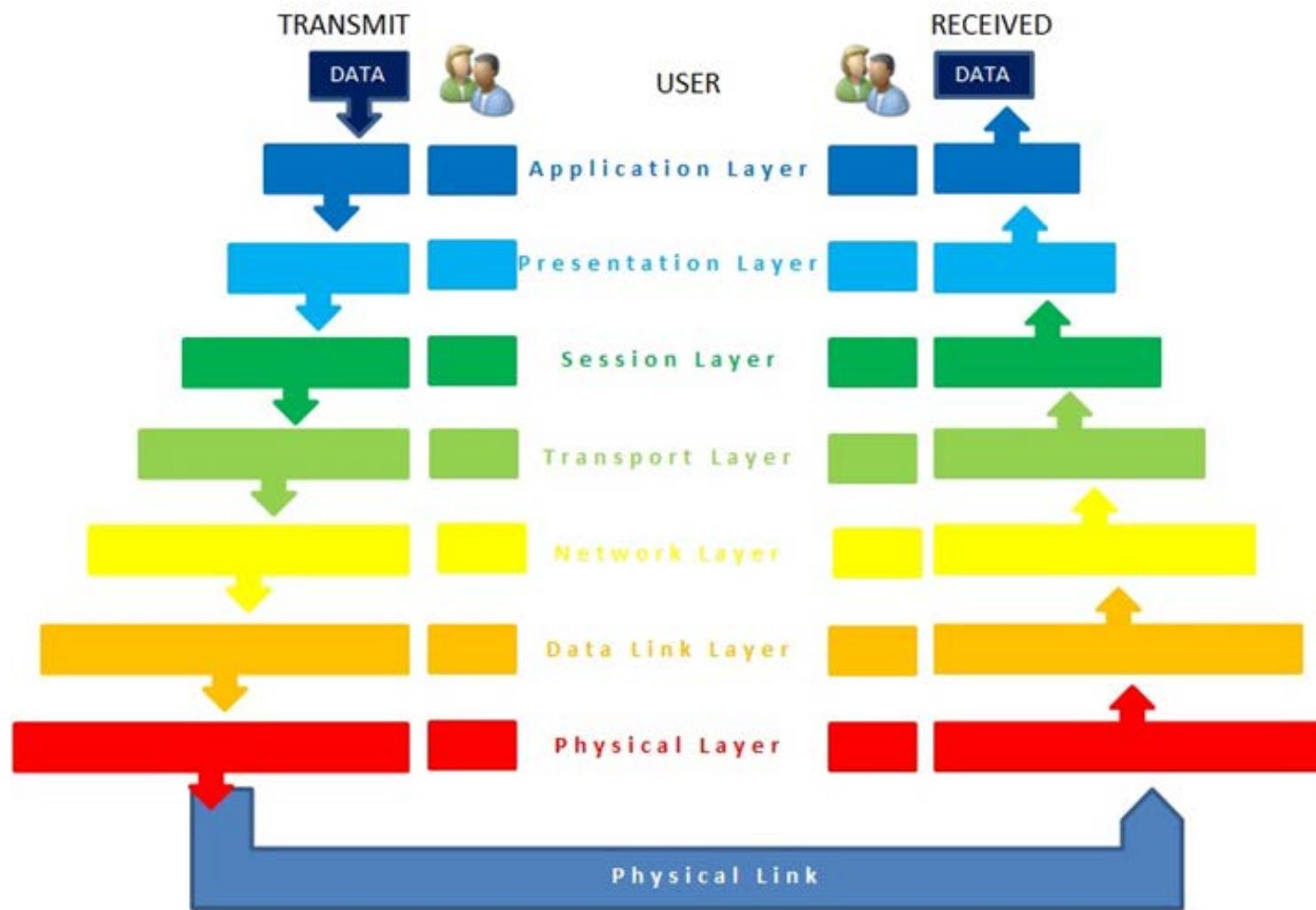
Industry Trends

Computer Networks – Broad Classification

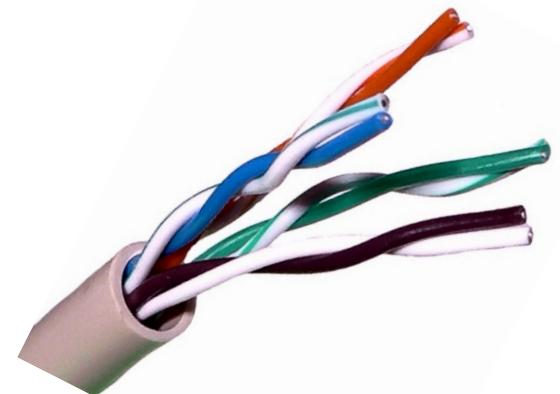


OSI Reference Model

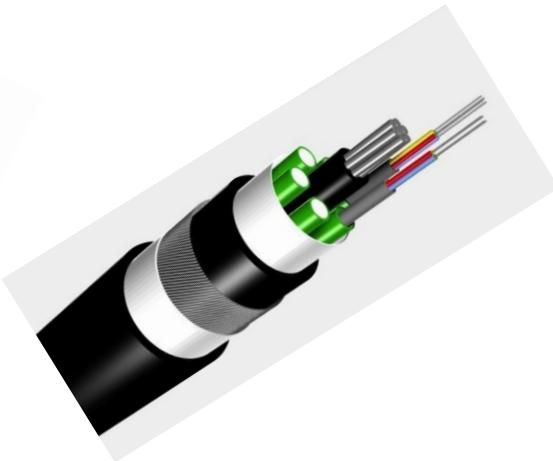
7 Layers of the OSI Model



Physical Link



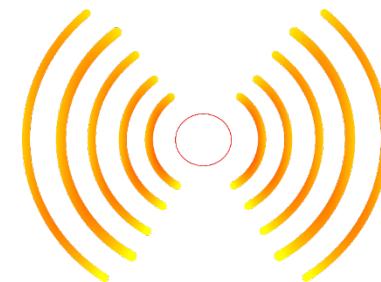
Twisted-pair cable



Fiber Optic cable



Co-axial cable



Radio/ Micro Wave



Satellite
Communication

Physical Layer

OSI

Application

Presentation

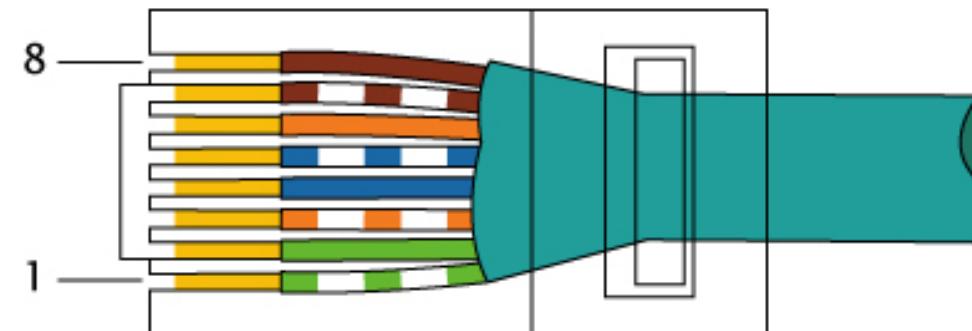
Session

Transport

Network

Data Link Layer

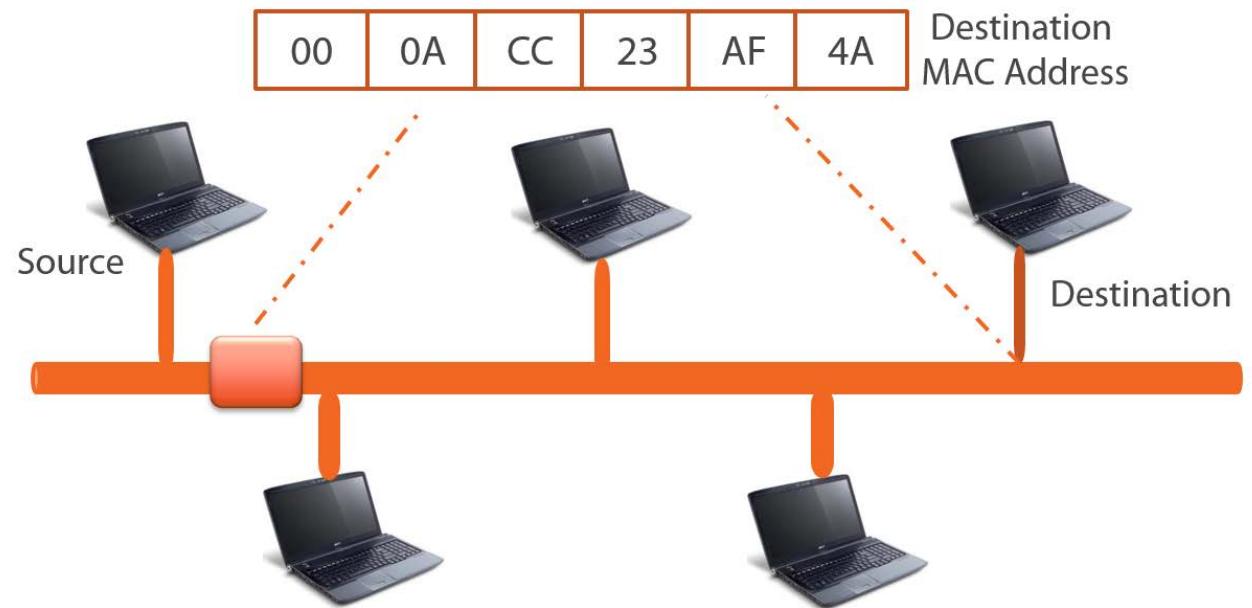
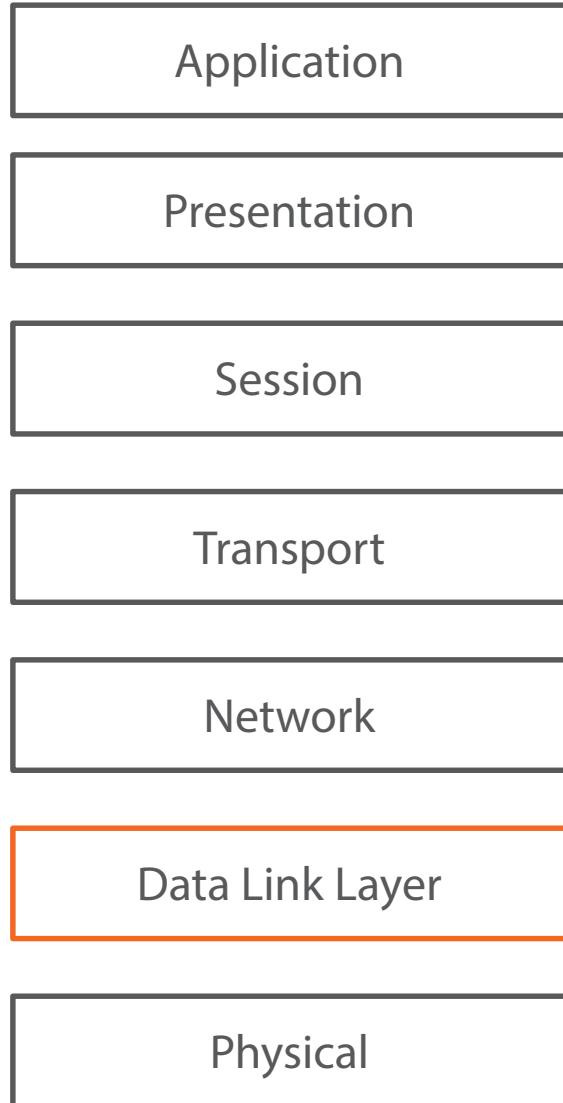
Physical



EIA/TIA-568A

Data Link Layer

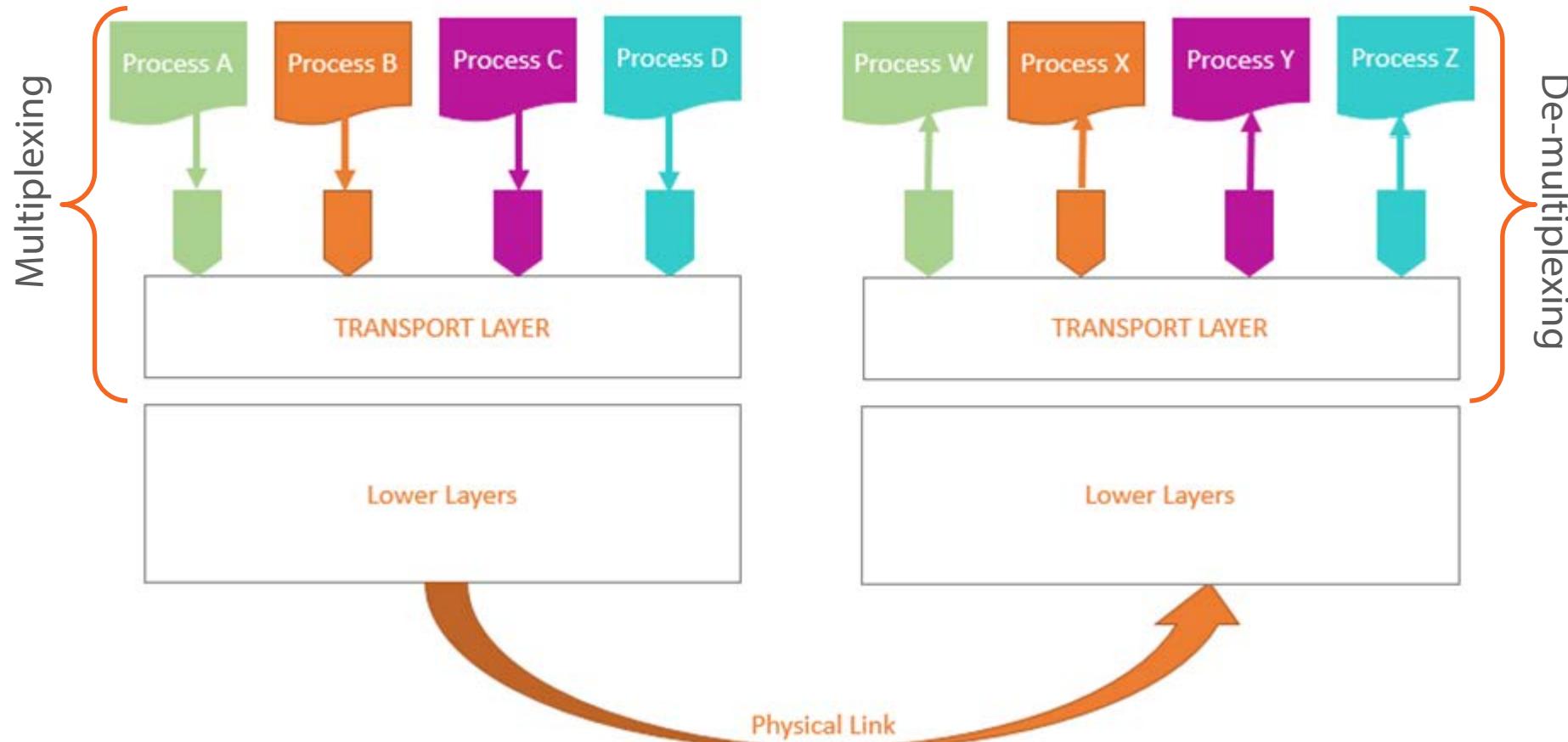
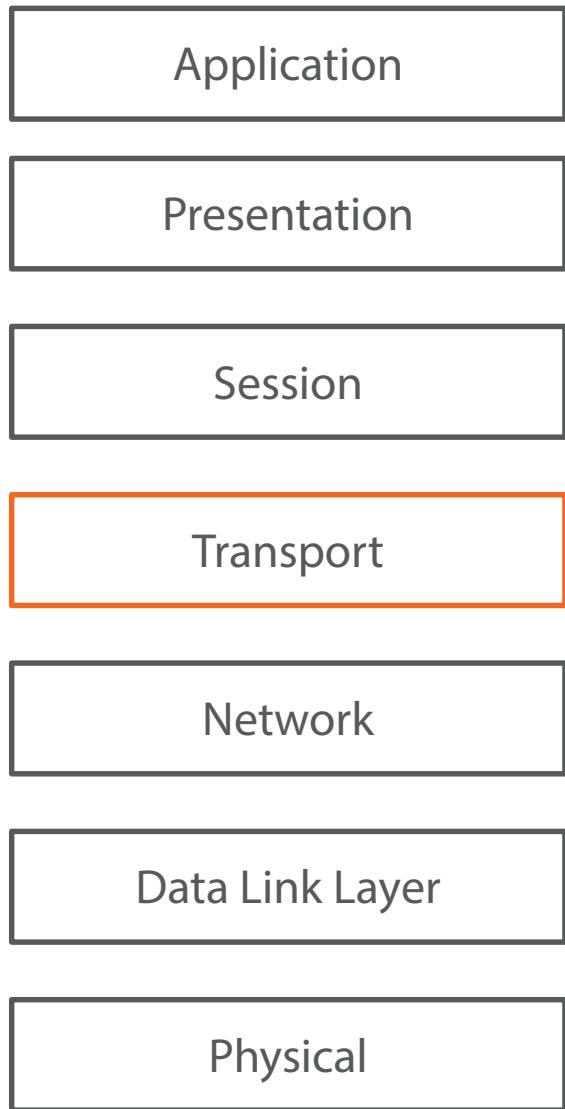
OSI



Switches divide
the network into
multiple collision
domains

Transport Layer

OSI



Network Layer

OSI

Application

Presentation

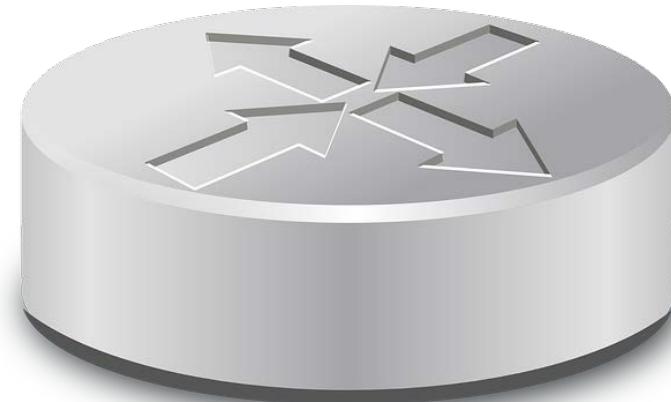
Session

Transport

Network

Data Link Layer

Physical



Network Router

Session - Presentation and Application Layers

OSI

Application

Presentation

Session

Transport

Network

Data Link Layer

Physical

Session

- Helps establish persistent logical links between applications over the network
- Enables exchange of data at application level

Presentation

- Protocols in this layer are concerned with the presentation of data to application
- Examples : SSL, Audio/ Video/ image Codecs, Compression protocols

Application

- Top most layer of OSI model abstracting rest of the stack
- Familiar examples: HTTP, SMTP, DHCP, FTP, SNMP and IRC

Lets Focus On ..

Data Centers

Severs

Networking

Storage

End User Devices

Industry Trends

Storage Building Blocks



Storage Media

Storage Interface Protocols

Storage Networks

Storage Optimization
Technologies

Storage Media



Random Access Storage



Sequential Storage

Hard Disk



Electro-mechanical disk drive



Solid state drive

Sequential Storage



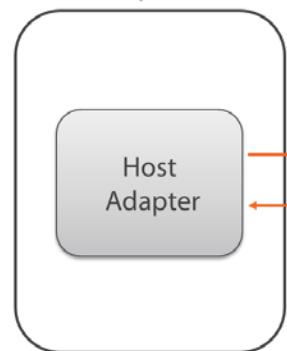
Magnetic Tapes



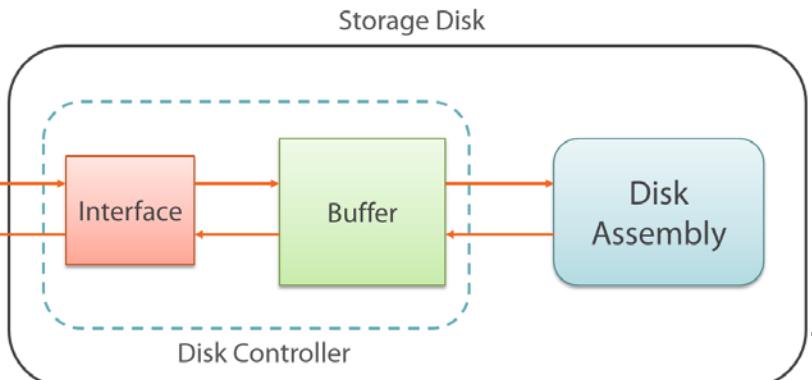
Scalable Tape Library

Storage Interface Protocols

Host (Compute Server)



Storage Disk



Interface protocols are implemented across host adapters, disk controllers and other storage network components

Low-end/
slow storage

SATA – Serial Advanced Technology Attachment

SCSI – Small Computer Systems Interface

SAS – Serial Attached SCSI

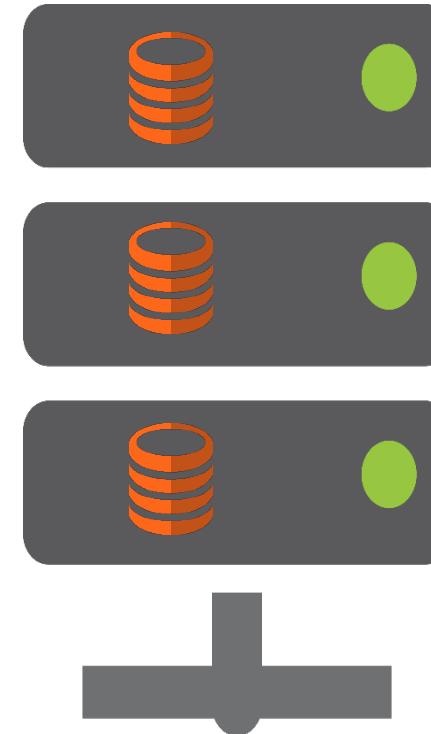
FC – Fiber Channel

High-end/ High
performance storage

Storage Networks

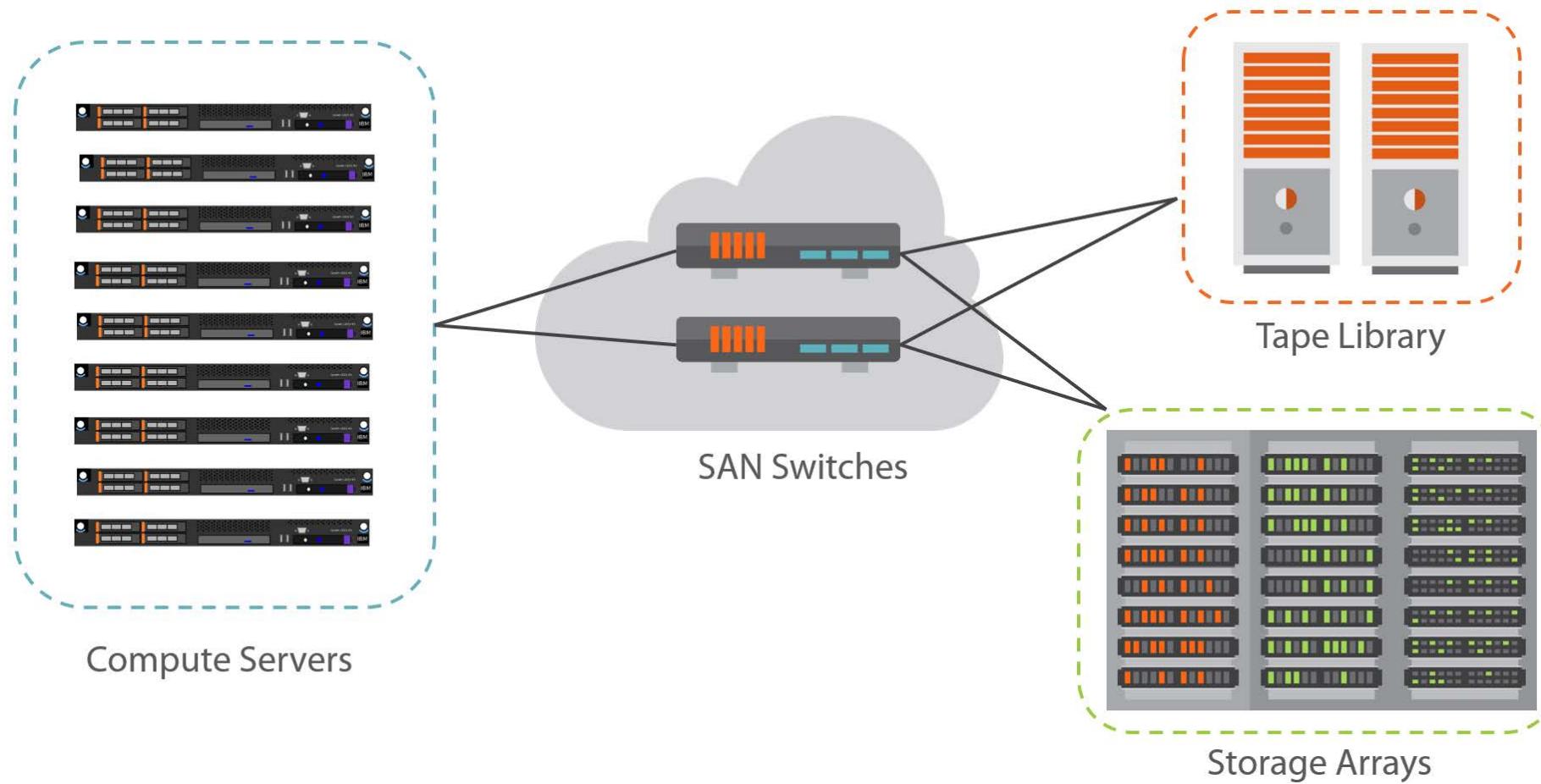


Storage Area Network (SAN)

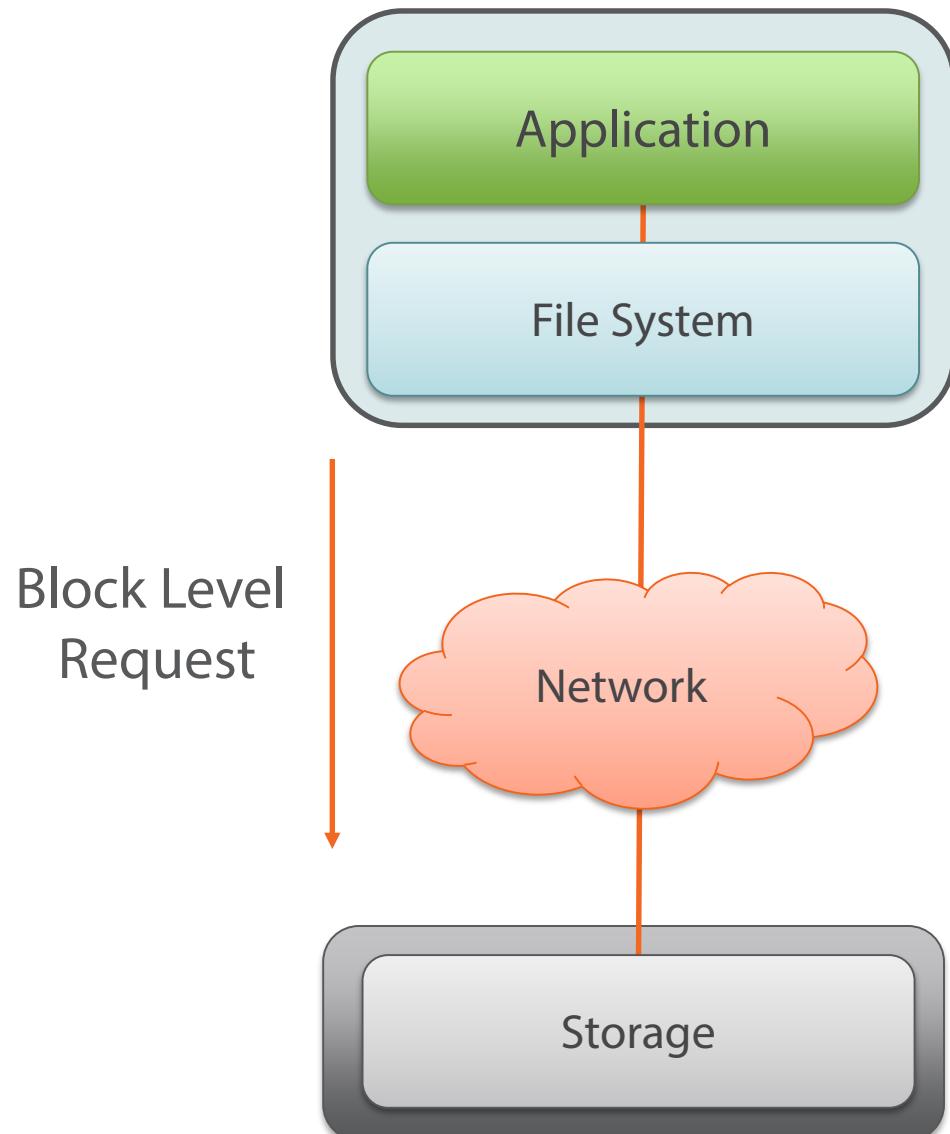


Network Attached Storage (NAS)

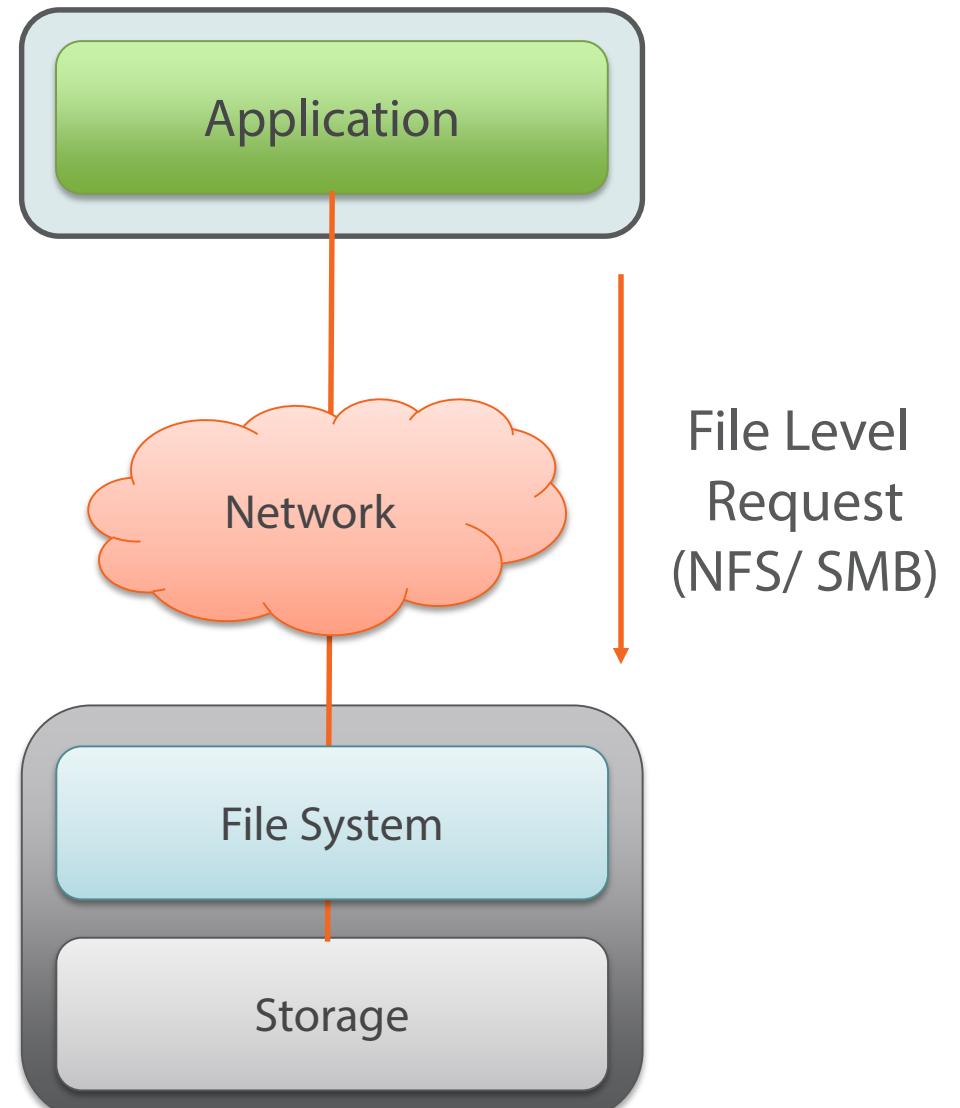
Storage Area Network



SAN vs. NAS



SAN - Block Level Access



NAS- File Level Access

Optimization Techniques

Availability and resilience improved using RAID techniques

Replication supports disaster recovery and business continuity

Snapshot and cloning used for efficient backups

Block-level deduplication, compression and thin-provisioning maximize storage density

Lets Focus On ..

Data Centers

Severs

Networking

Storage

End User Devices

Industry Trends

End User Devices



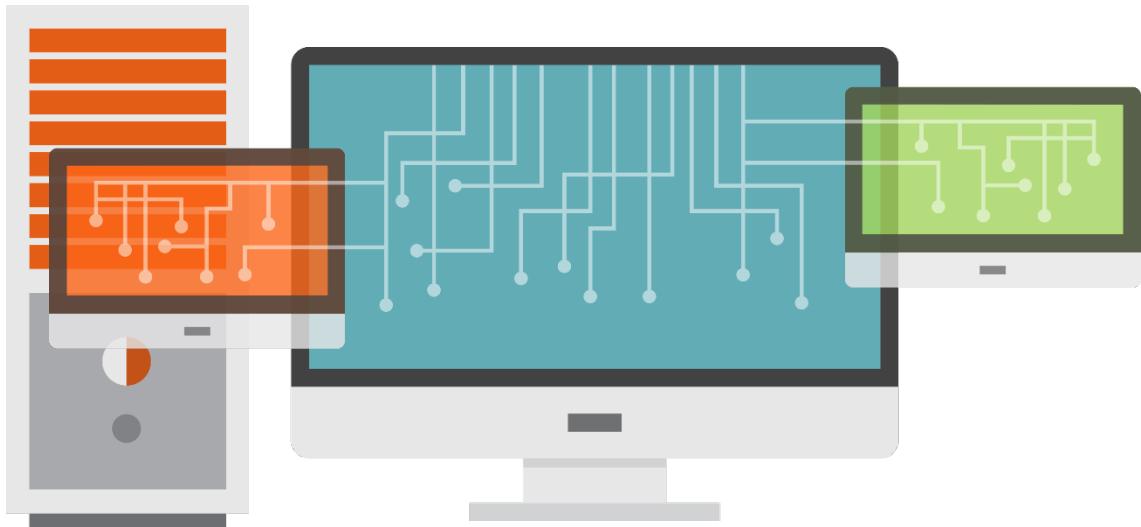
Workstations

(Desktops and Laptops)

Tablets and Mobile Devices

Virtualization
(Desktop and Application)

Workstations



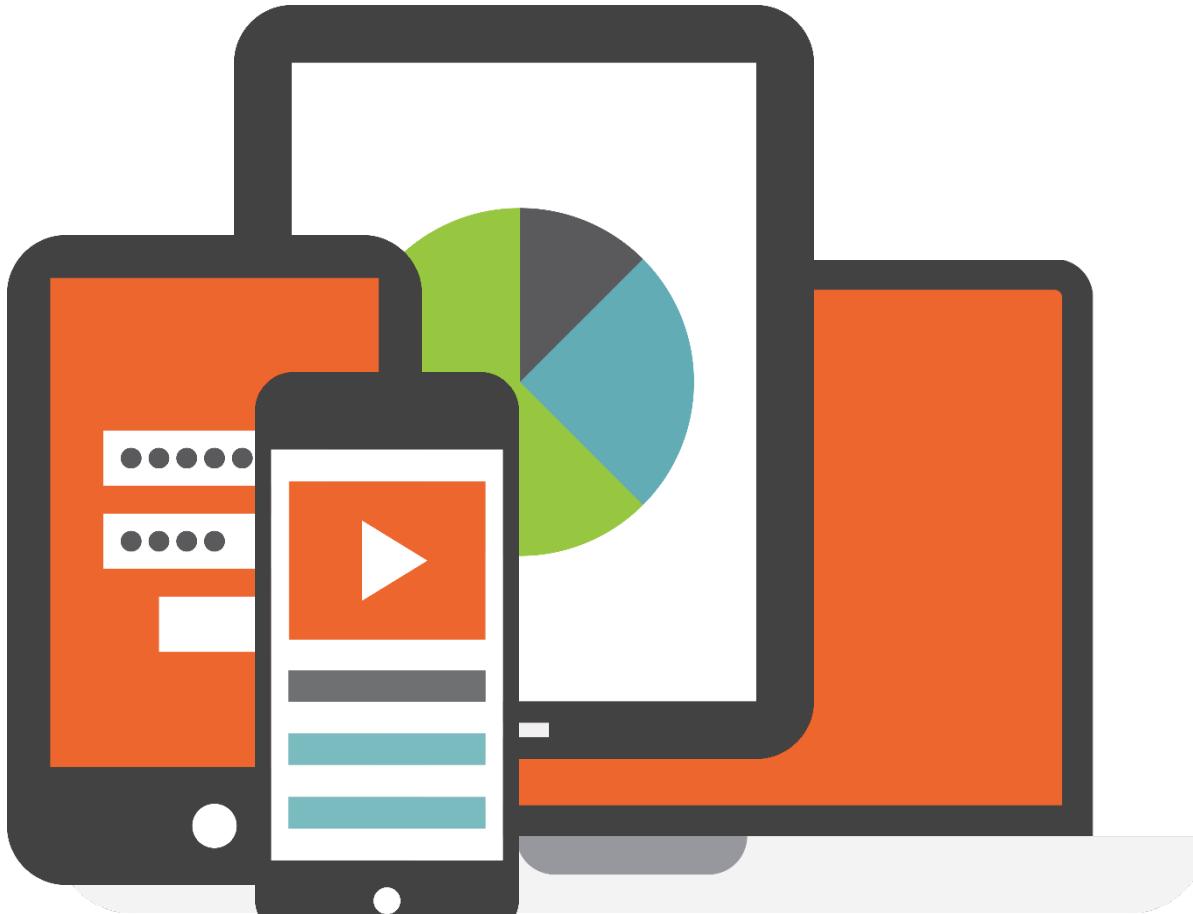
Primary end-user workstation within enterprise is predominantly an x86 based workstation

About 90% of them run on a version of Microsoft Windows as of March 2015

Typically laptops are considered a higher risk category than desktops

Laptops are more vulnerable to
cyber attacks
physical damages
being lost or stolen

Bring Your Own Devices (BYOD)



Influx of employee owned personal mobile devices in their environment further adds to the complexity

Many devices are not actively managed by the enterprise

Positives:

Productive and motivated employees

Negatives:

Exposure to security risks increases dramatically

Merging Twin Priorities



Urgent need for managing and securing all devices used for accessing and working on enterprise data and information

Mitigate risks, enforce compliance, manage costs and complexity

Achieve this without intruding into employee's freedom of device choice and flexibility

Vision & Outlook

Many enterprises have embraced the vision of “working from anywhere and on any device”

Many others have taken first step to introduce mobility to augment a primarily desktop and laptop centric environment

Enterprise Technologies to Architect End-User Computing Environment

User / Devices Management and Configuration Products

Environments based on pre-configured images

Register personal devices with IT
Access corporate resource on premise and over internet

Setup access policies

Continuous access to devices for servicing and management

Granular control of access

Encryption of data

Selective wiping of corporate data

Airwatch (a VMware company), Citrix, IBM, Good Technology and Microsoft

Application delivery technologies/ tools

Apps installed from public app stores

Enterprise-specific app stores hosted privately

Zero footprint virtualized applications

Virtual desktop infrastructure

Desktop as a Service

Cloud-hosted or on premise web-based applications

Identity & Access Management



Single user identity across enterprise resources on premise and in cloud

Federation, single and same sign-on

Multi-factor user authentication and device authentication

Granular and dynamic authorizations

Microsoft, Oracle, IBM, Octa and Ping Identity are dominant vendors

Lets Focus On ..

Data Centers

Severs

Networking

Storage

End User Devices

Industry Trends

Demands on Modern IT Infrastructure Teams Are Multifold

Achieve more within ever shrinking time-frame and budgets

Enterprises need flexible and agile IT infrastructure

Uptake of web-scale IT in a big way is predicted in the near future



What Is Web-scale IT?

Architectural response to modern business demands on IT infrastructure

Recognizes that traditional lead-times of weeks and months are not viable anymore

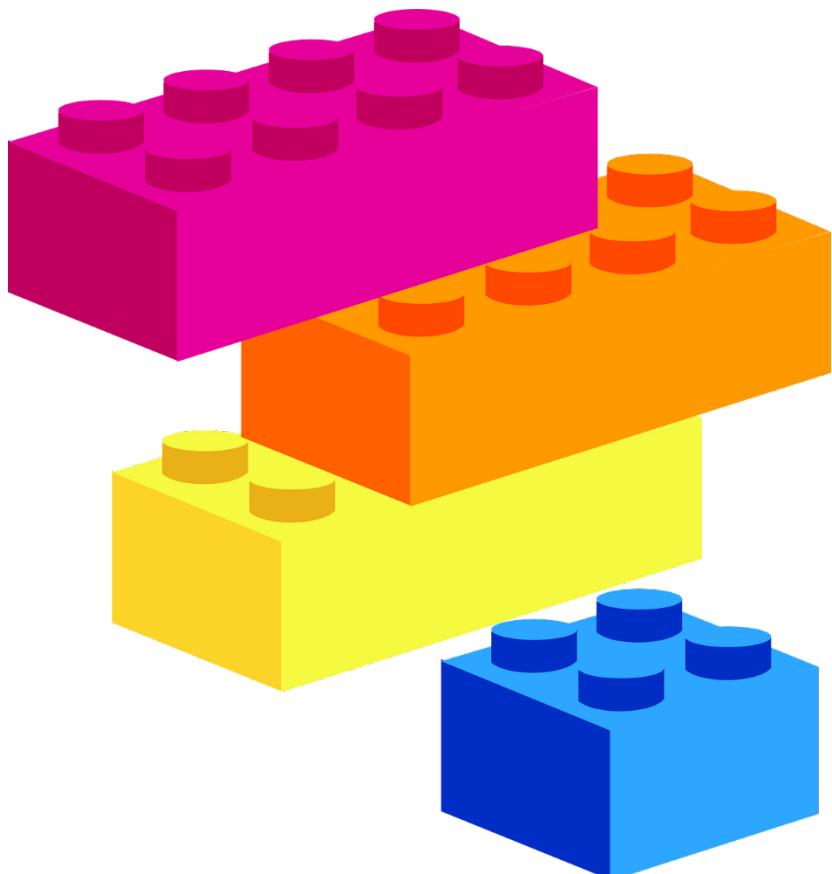
Emulates the architectural approaches used by large cloud and web-based enterprises

Intent is to dramatically increase the speed and agility within enterprise IT infrastructure space

Gartner predicts that by 2017 about 50% of worlds enterprises will embrace web-scale IT



Combination of Technologies and Products



Virtualization

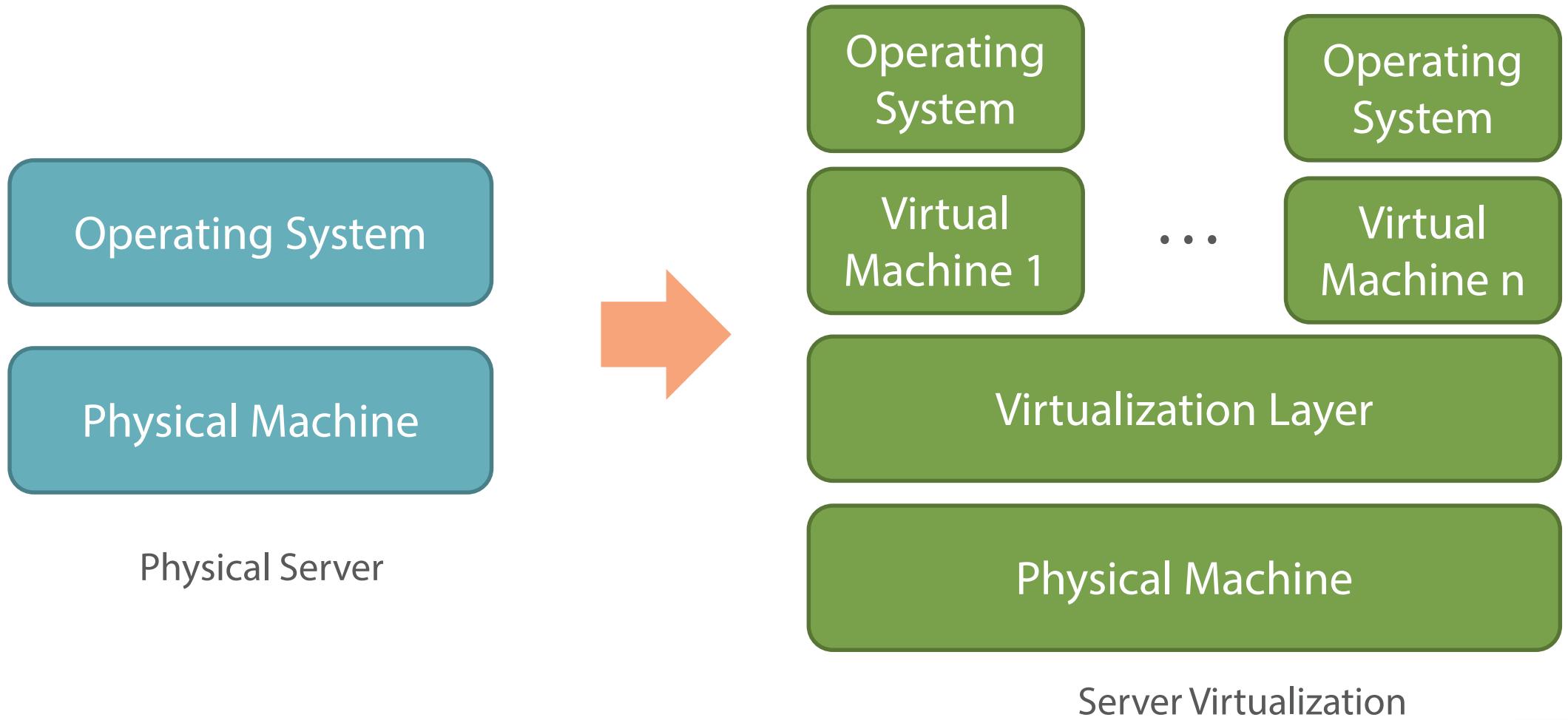
Convergence, Hyper-convergence & SDDC

Hybrid Cloud

Virtualization

A layer of software abstraction built over the physical resource that facilitates a level of indirection that then affords greater flexibility in how the resource is utilized

Server Virtualization



Server Virtualization - Advantages



- Consolidate underutilized physical servers
- Flexibility in creating, configuring and repurposing servers
- Move virtual machines between physical servers without downtime
- Load balancing, lock-stepping, conserving power based on actual usage
- Simplified management – enabling single admin managing >1000 virtual machines

VMware, Citrix and Microsoft are major vendors

Storage Virtualization

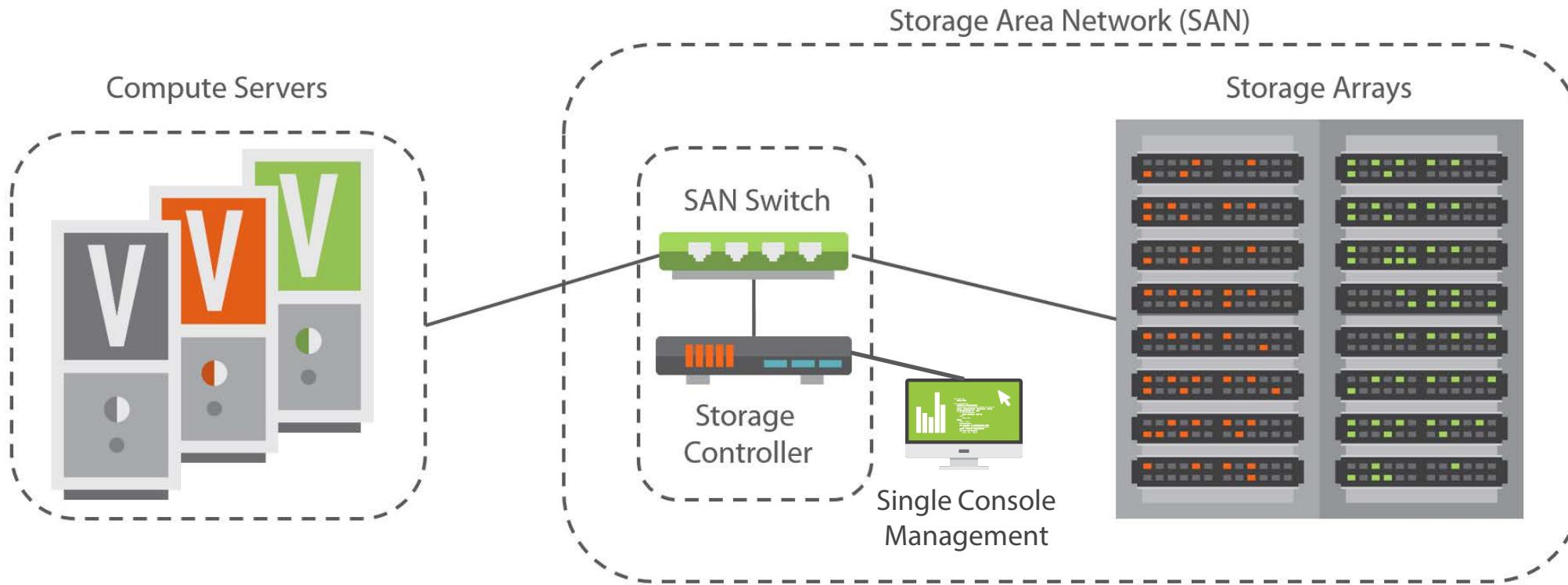


Storage virtualization is the virtualization of the storage arrays using a storage controller

Storage controller can be a virtualization appliance or software

Storage controller aggregates the physical storage arrays in a pool and creates a logical storage

Storage Virtualization - Advantages



Single console management of diverse technologies

Greatly improved capacity utilization

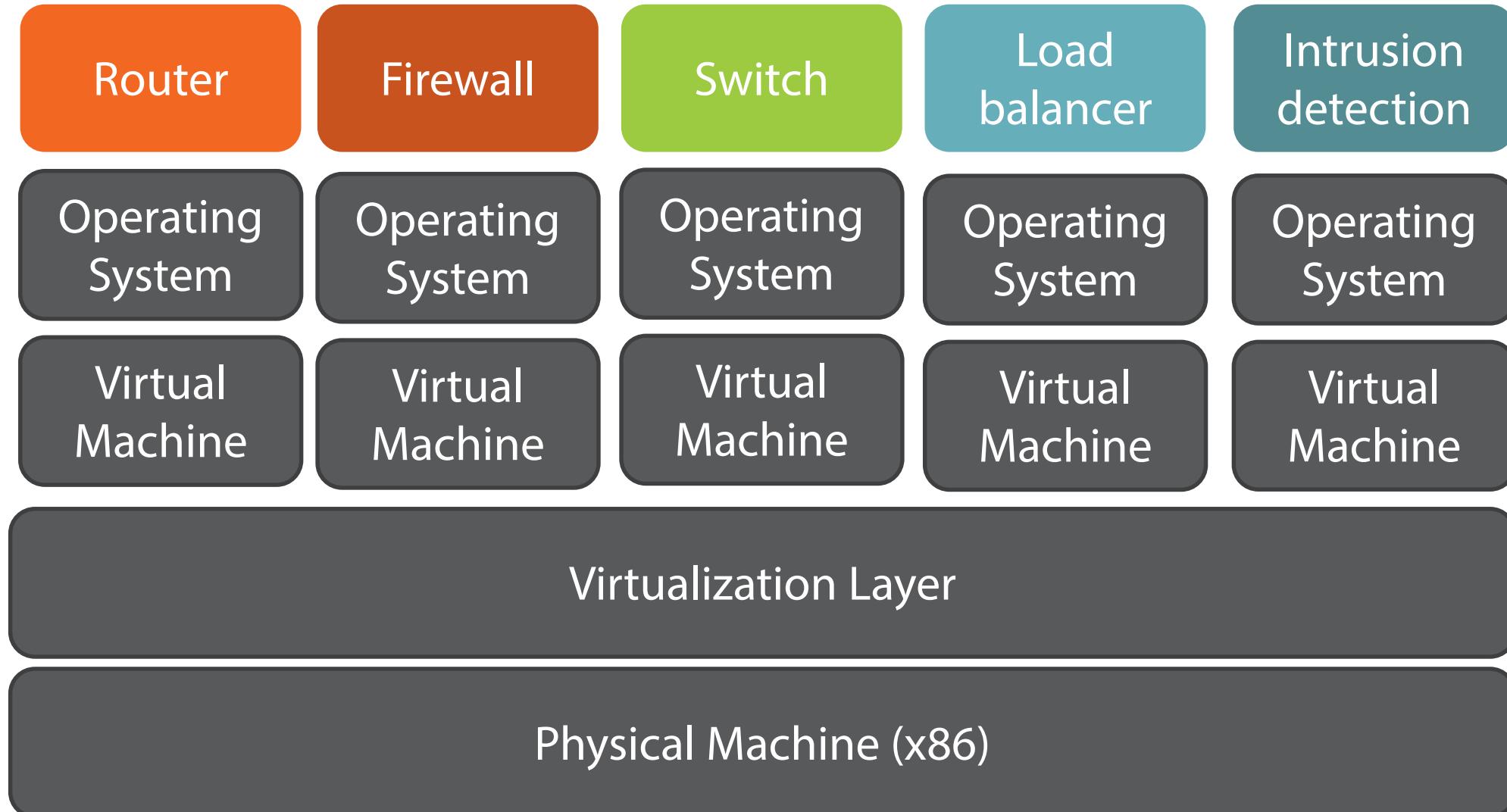
High-speed in-band caches

Flexible data migration, dynamic tiered storage

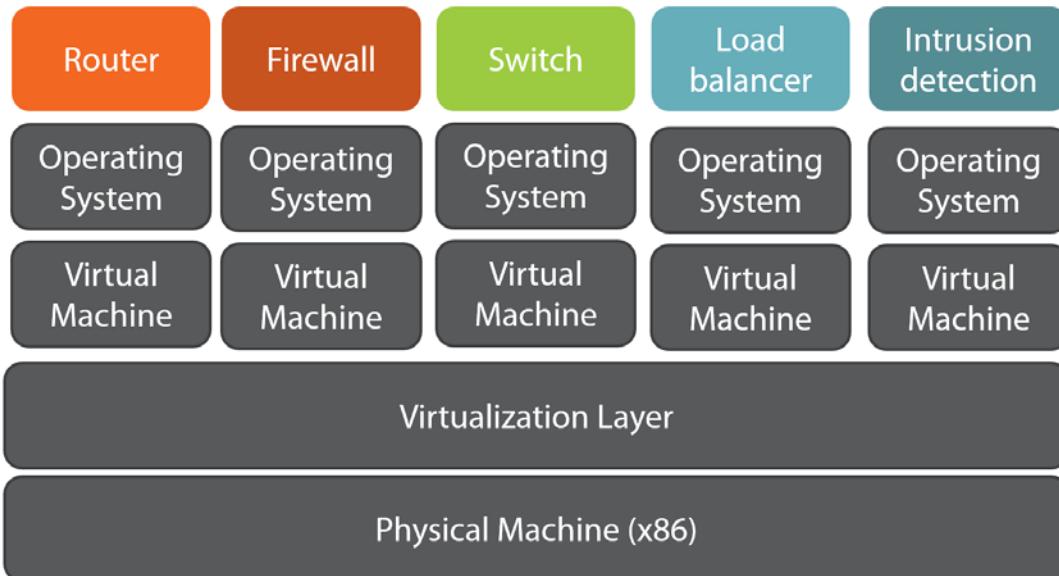
And other strategies for holistic optimization

DataCore, EMC, IBM, FalconStore and NetApp are some vendors

Network Functions Virtualization (NFV)



NFV - Advantages



Large scale consolidation of physical network devices and appliances

Reduced investment in network infrastructure

Reduced ongoing operating costs

Biggest benefits though are:

network infrastructure agility and flexibility to repurpose and reuse investments

Converged IT Infrastructure

Traditional IT Infrastructure Is Organized Into Silos

Changes require coordination, planning and are error prone

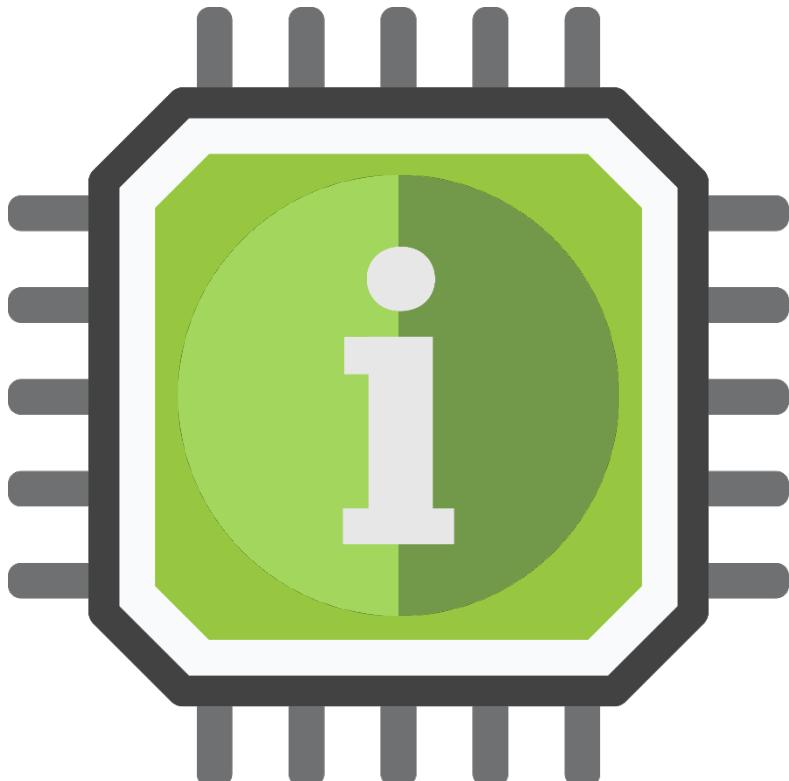
Leads to delays in the order of weeks and months

These impact business agility

Enterprises are keen to converge infrastructure to support greater agility



Converged/ Hyper-converged Infrastructure



First generation converged solutions typically converged

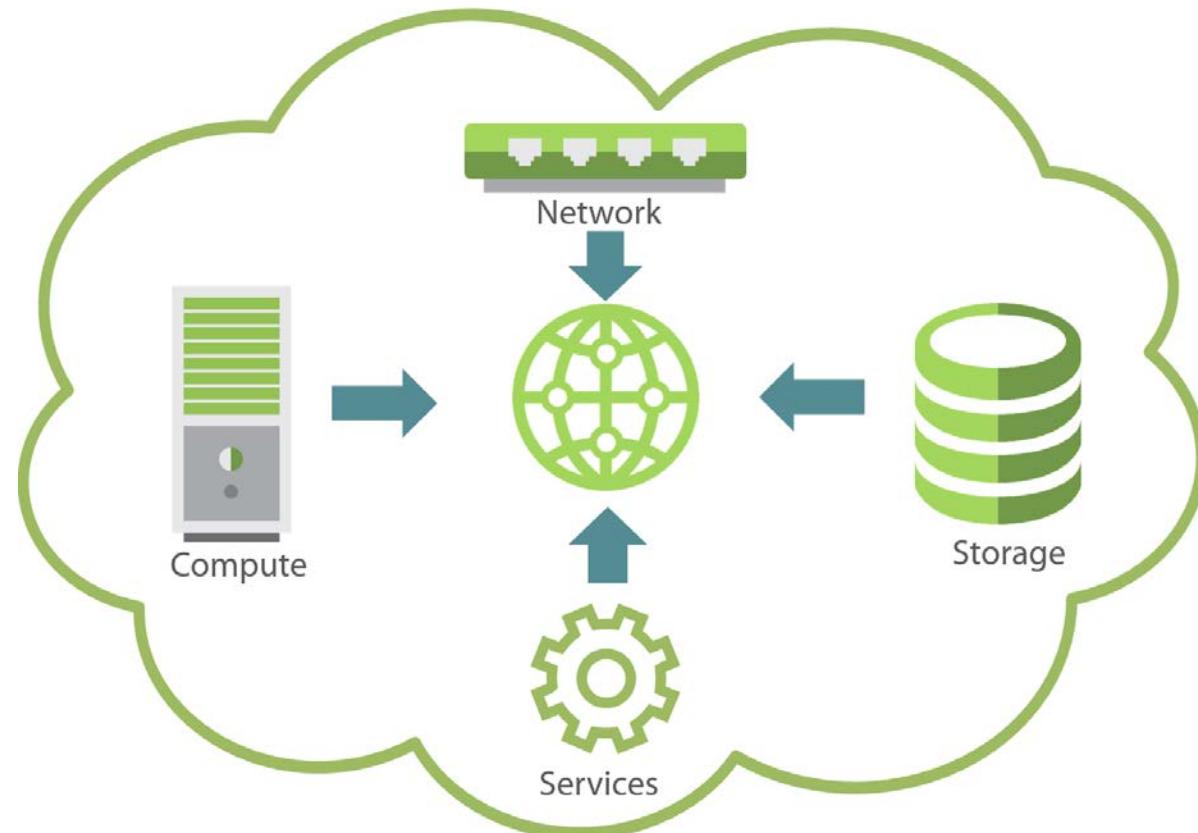
storage and compute servers or network and storage layers

Hyper-converged infrastructure software implementation

is built into the hyper-visors layer itself or a layer on top of standard hypervisors

Consolidates multiple infrastructure resources into a single elastic stack of x86 servers

Hyper-converged Infrastructure



The hyper-converged infrastructure offerings in the market takes one of two forms,

- As a reference architecture
- As a pre-fabricated appliance

Hyper-convergence products and architectures consolidate many services

- Data de-duplication
- Data backup and replication
- SSD cache arrays
- WAN optimization
- Public-cloud gateways etc.

Combine all of these with vastly simplified management

Software Defined Data Center

Software Defined Data Center (SDDC)



Abstraction, pooling, and policy-driven automation of most resources

SDDC is hyper-convergence combined with policy driven automation

SDDC enables the IT as a service (ITaaS) model within the enterprise data center

Moving away from static, over-provisioned, inflexible and siloed infrastructure

Towards automated, orchestrated resources optimized to business demands

VCE, NetApp, HP, Dell, IBM, Simplivity and Nutanix are major vendors

Are Enterprises Moving To Cloud?

Enterprises are already in a big way embracing cloud

They are reaping the economies of scale offered by
the public cloud providers

They are not willing to entirely move their IT
infrastructure into the public cloud

Virtualization, convergence and SDDC enables the
possibility of extending the elasticity of the cloud to
the enterprise data centre seamlessly – Hybrid cloud

To Summarize

Data Centers

Servers

Storage

Networking

End User Devices

Web-scale IT