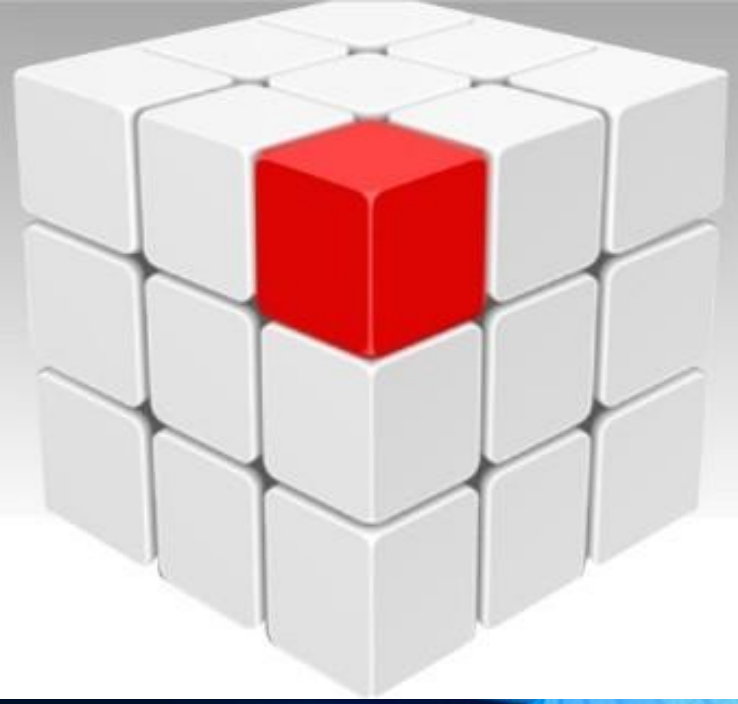
Integrated Solutions For High Performance Computing Systems



# Cluster Overview

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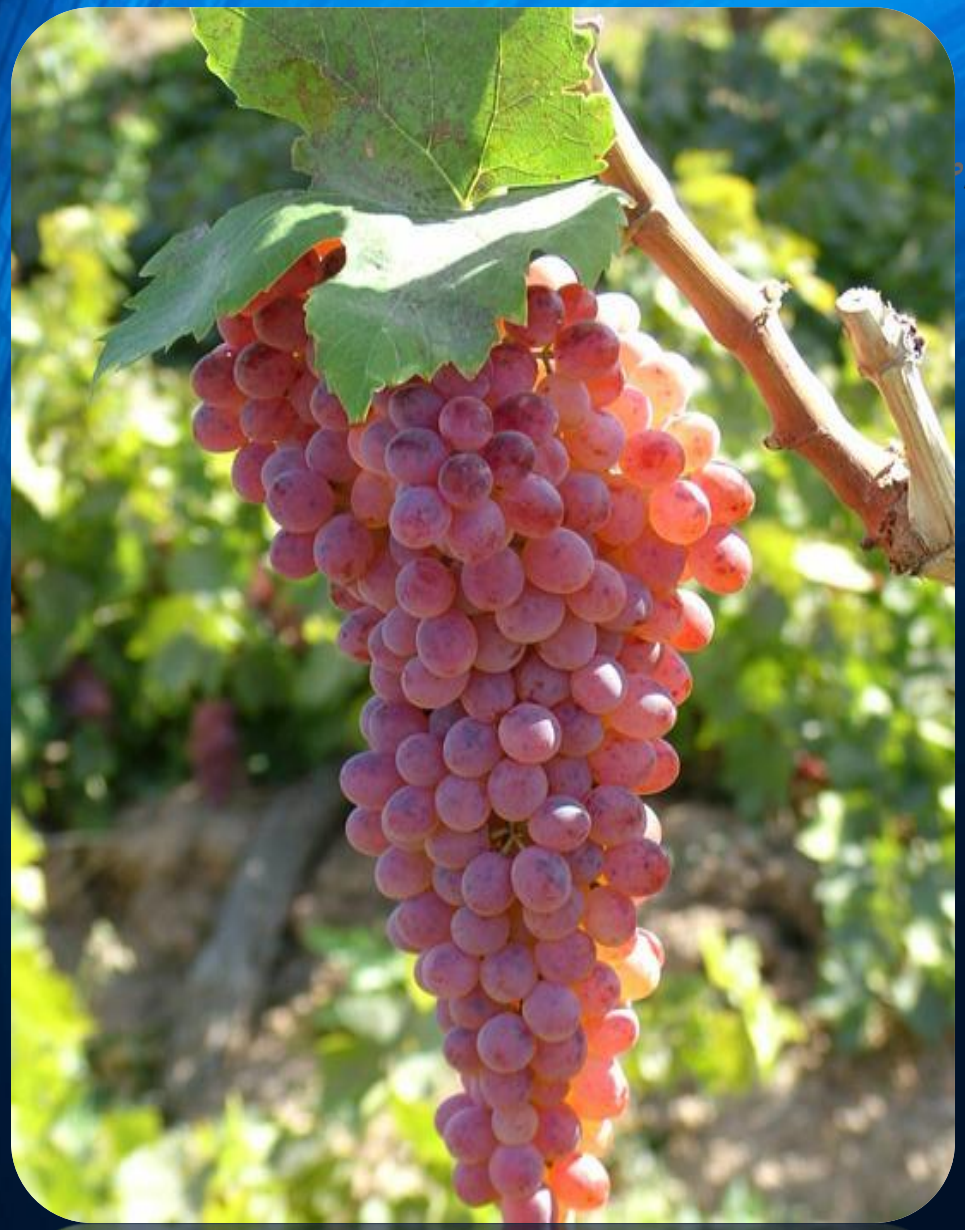
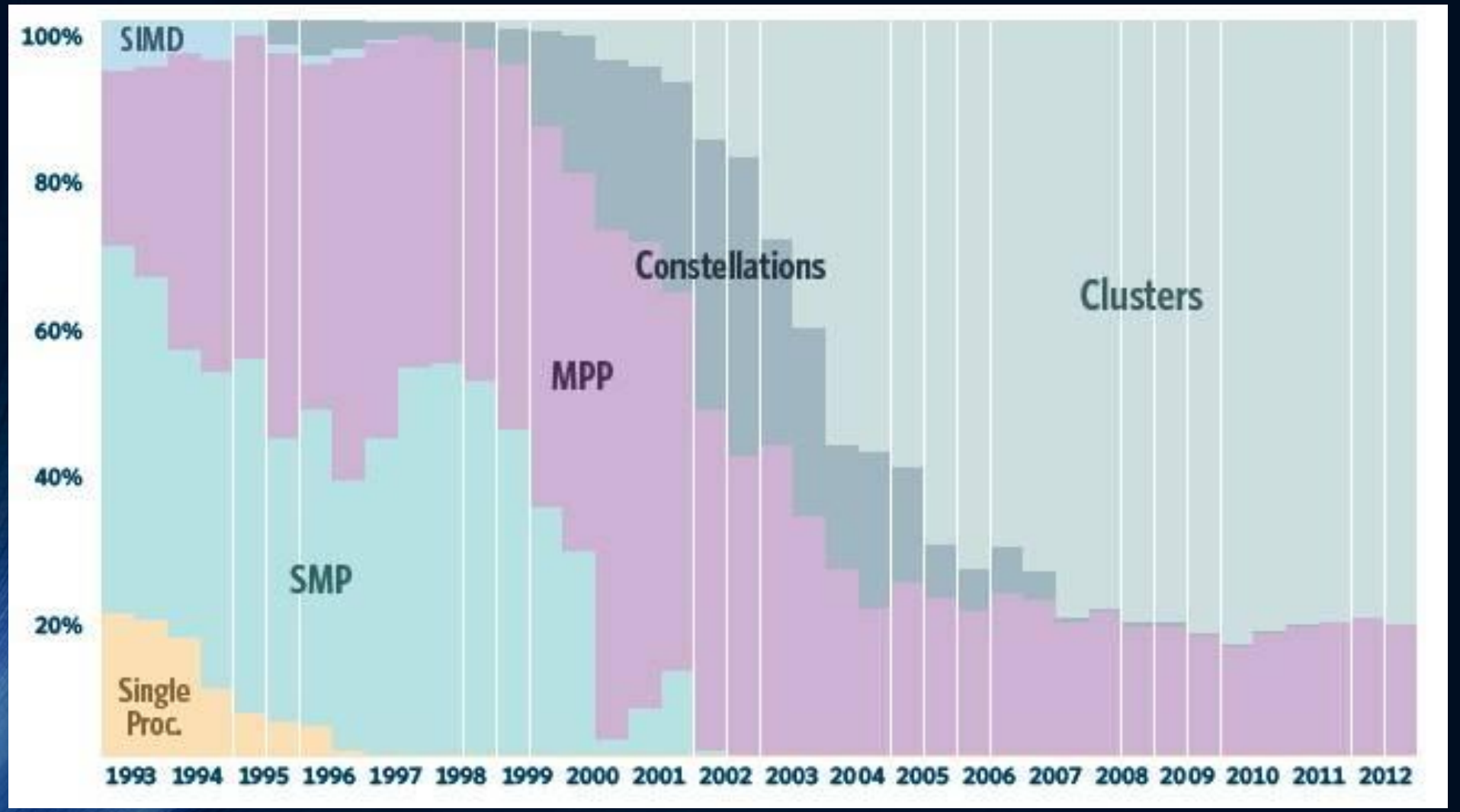
# Agenda

- Computing resources concepts
  - ✓ Server
  - ✓ Cluster
  - ✓ High Performance Computing (HPC)
  - ✓ Grid
  - ✓ Cloud

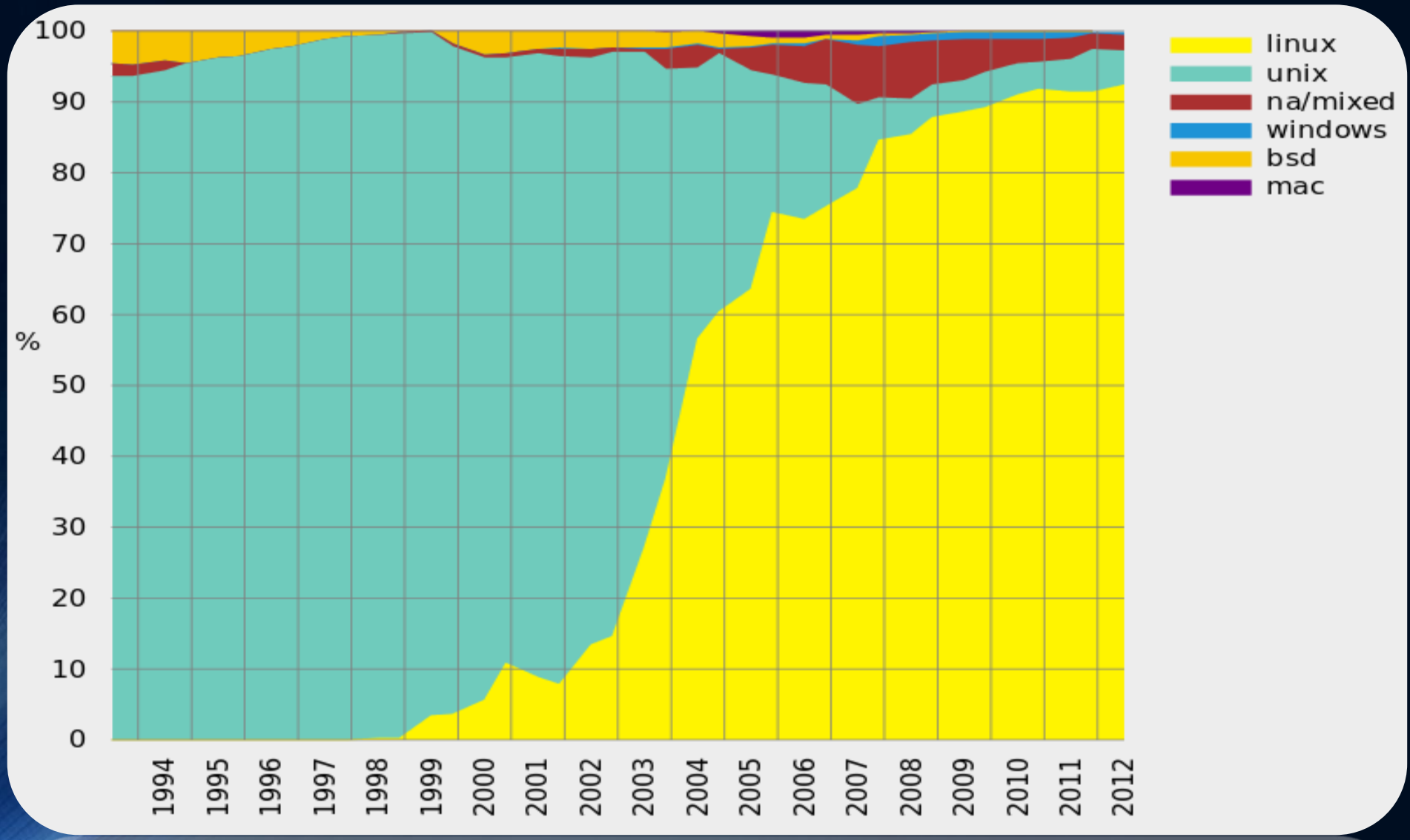


# The cluster

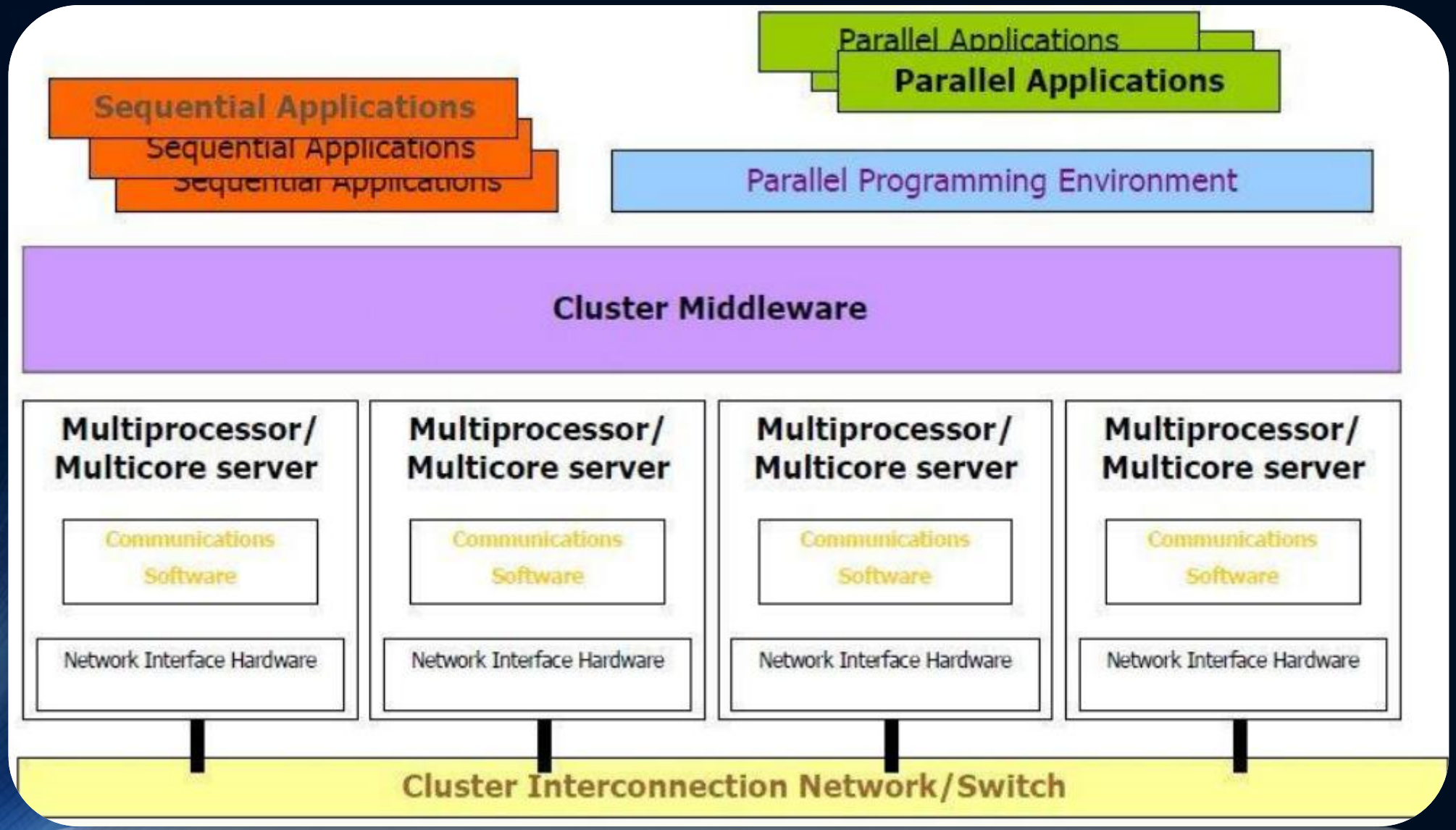
# Evolution of cluster architectures in top500



# Evolution of operating systems in top500



# Cluster architecture (1)



# Cluster architecture (2)



- Servers are the nodes (cluster components of different nature: login nodes, computing nodes, service nodes…)
- Nodes are connected using a network
  - ✓ Topology
- Interconnection characteristics
  - ✓ Latency: Initialization time before data can be sent
    - How much does it take to open the channel ?
  - ✓ Per-link Peak Bandwidth: Maximum data transmission rate (varies with packet size)
    - How wide is my channel ?
  - ✓ Bisection Bandwidth:
    - Bandwidth available if one half of nodes try communicating with the other half simultaneously.

# Cluster networks



- HIGH SPEED NETWORK
  - parallel computation
    - Low latency /high bandwidth
    - Usual choices: Myrinet / Infiniband…
- I/O NETWORK
  - I/O requests (NFS and/or parallel FS)
    - latency not fundamental/ good bandwidth
- Management network
  - Management traffic
    - Any standard network (fast ethernet OK)

# Servers and clusters



- Local resources
  - ✓ Price/performance when compared with a dedicated parallel supercomputer
  - ✓ Great opportunity for low budget institution
  - ✓ Flexibility: many ad hoc solution for different problems…
  - ✓ Open Technology
- Complex to build and maintain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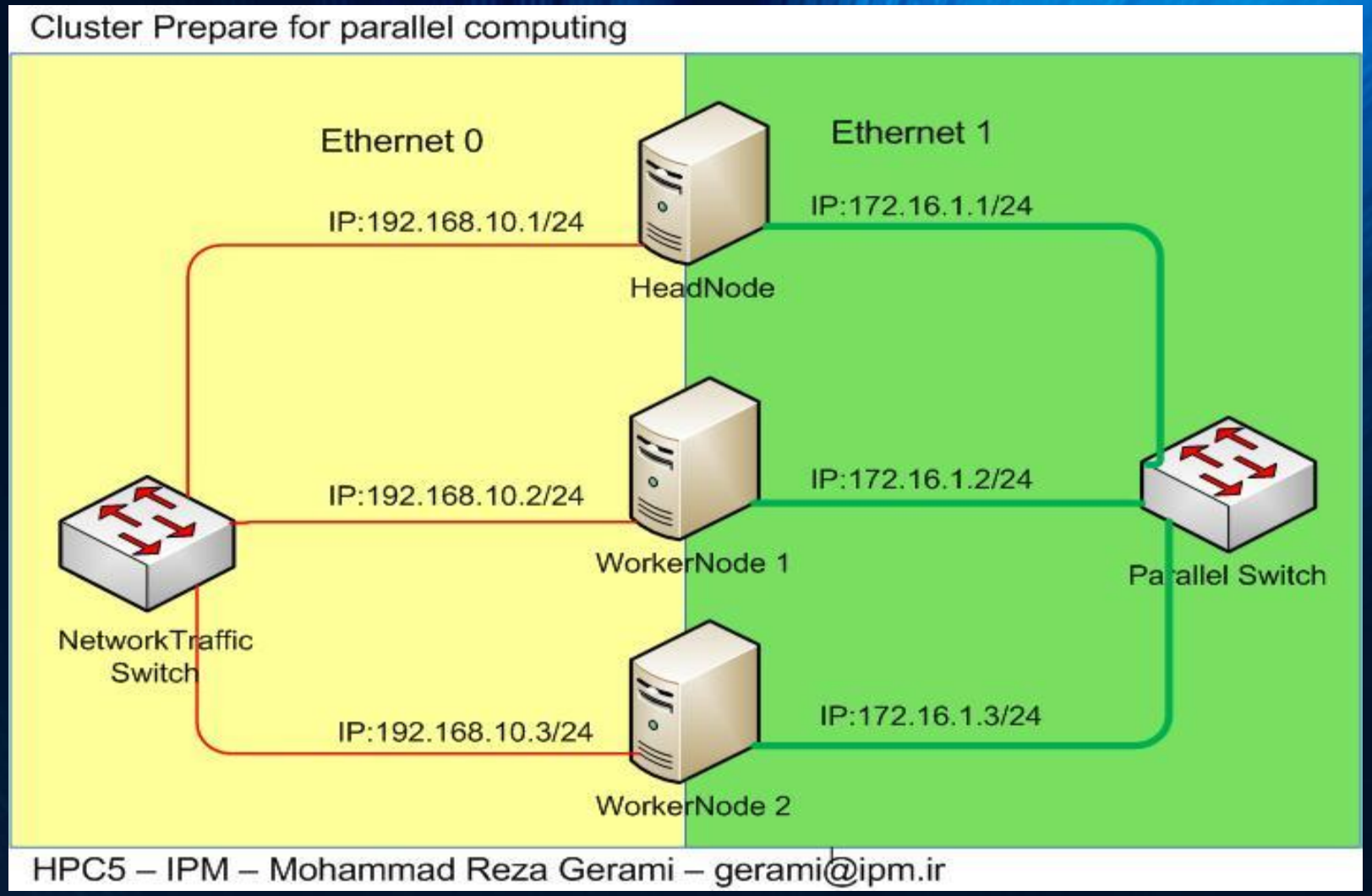
# Network and Topology





# OS installation



- Linux
  - ✓CentOS
  - ✓Network Configuration
  - ✓NFS (Sharing) Configuration
  - ✓SSH Password Less
  - ✓NTP Configuration
  - ✓Service Configuration

# Network Configuration => Ipaddress Ethernet 1

vi /etc/sysconfig/network-scripts/ifcfg-eth1

DEVICE=eth1

ONBOOT=yes

IPADDR=172.16.1.1

NETMASK=255.255.255.0

#GATEWAY=172.16.1.1  if you have a gateway for other network or internet

TYPE=Ethernet

# Network Configuration => Ipaddress Ethernet 0

vi /etc/sysconfig/network-scripts/ifcfg-eth0

DEVICE=eth0

ONBOOT=yes

IPADDR=192.168.10.1

NETMASK=255.255.255.0

#GATEWAY=192.168.10.1  if you have a gateway for other network or internet

TYPE=Ethernet

# Network Configuration =>DNS

vi /etc/resolv.conf

#nameserver [your dns ip ]

nameserver 4.2.2.4

# Network Configuration

vi /etc/hosts

```
127.0.0.1       localhost.localdomain localhost
172.16.1.1      headnode.test.com    headnode
172.16.1.2      wn1.test.com         wn1
172.16.1.3      wn2.test.com         wn2
```

# NFS (Sharing) Configuration



#Head Node ( with ip addres 172.16.1.1)

mkdir -p /opt/share

vi /etc/exports

/opt/share 172.16.1.1/24(rw,sync,no_root_squash,nohide,no_wdelay)

/home 172.16.1.1/24(rw,sync,no_root_squash,nohide,no_wdelay)

#Workers Nodes

mkdir -p /opt/share

vi /etc/fstab

172.16.1.1/opt/share /opt/share nfs rw,sync 0 0

172.16.1.1:/home /home nfs rw,sync 0 0

# NFS (Sharing) Configuration



#Head Node

service portmap restart

service nfs restart

#Workers Nodes

service portmap restart

service nfs restart

mount –a

mount -l

# SSH Passwordless environment for the superuser



```
#cd ~/.ssh

rm -f *

ssh 127.0.0.1

ssh-keygen -t dsa -N ""

cat /root/.ssh/id_dsa.pub >> /root/.ssh/authorized_keys

chmod -R u+rwX,go= /root/.ssh/

#Copy  id_dsa.pub & authorized_keys to all nodes:

#/etc/hosts Must be Equal in all nodes:

scp /etc/hosts wn1:/etc/

scp -r /root/.ssh/ wn1:/root/

/etc/init.d/sshd   restart
```

# NTP Configuration

vi /etc/ntp.conf

#you can delete all time servers and add

server time.apple.com

then

service ntpd stop

ntpdate -b time.apple.com

service ntpd start

# Services Configuration

chkconfig portmap on

chkconfig ntpd on

chkconfig iptables off

/etc/init.d/iptables stop

# Test

ssh wn1

#you must be ssh to wn1 without any password

ssh wn2

That’s it, Enjoy

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Thanks for your attention

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