IP Router Architecture

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ISPs categories:

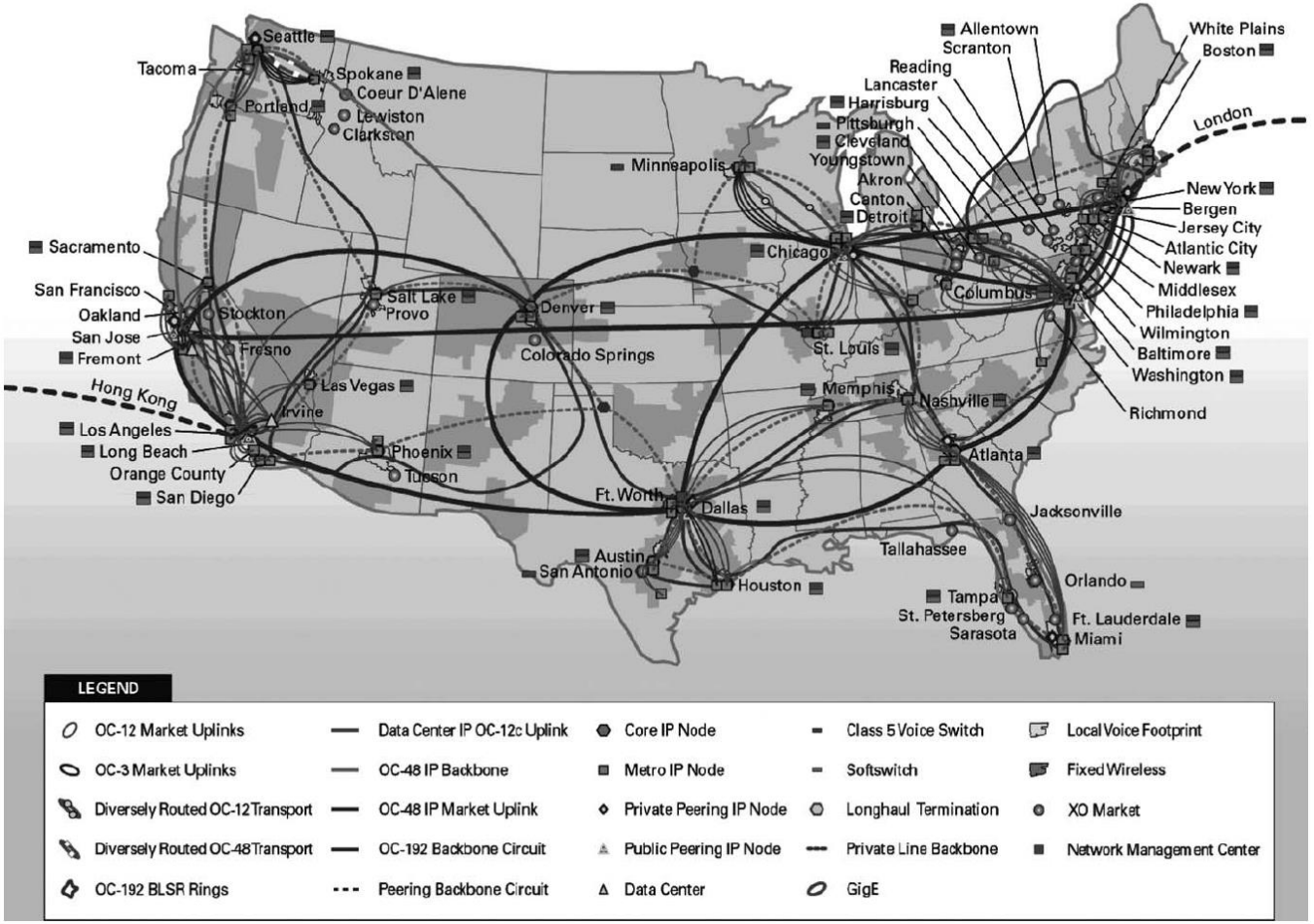
Internet Service Providers (ISPs) categories:

- **Tier-1 ISPs:** Major telecommunication companies whose high-speed global networks form the Internet backbone.
  (such as UUNet, Sprint, Qwest, XO Network, and AT&T)

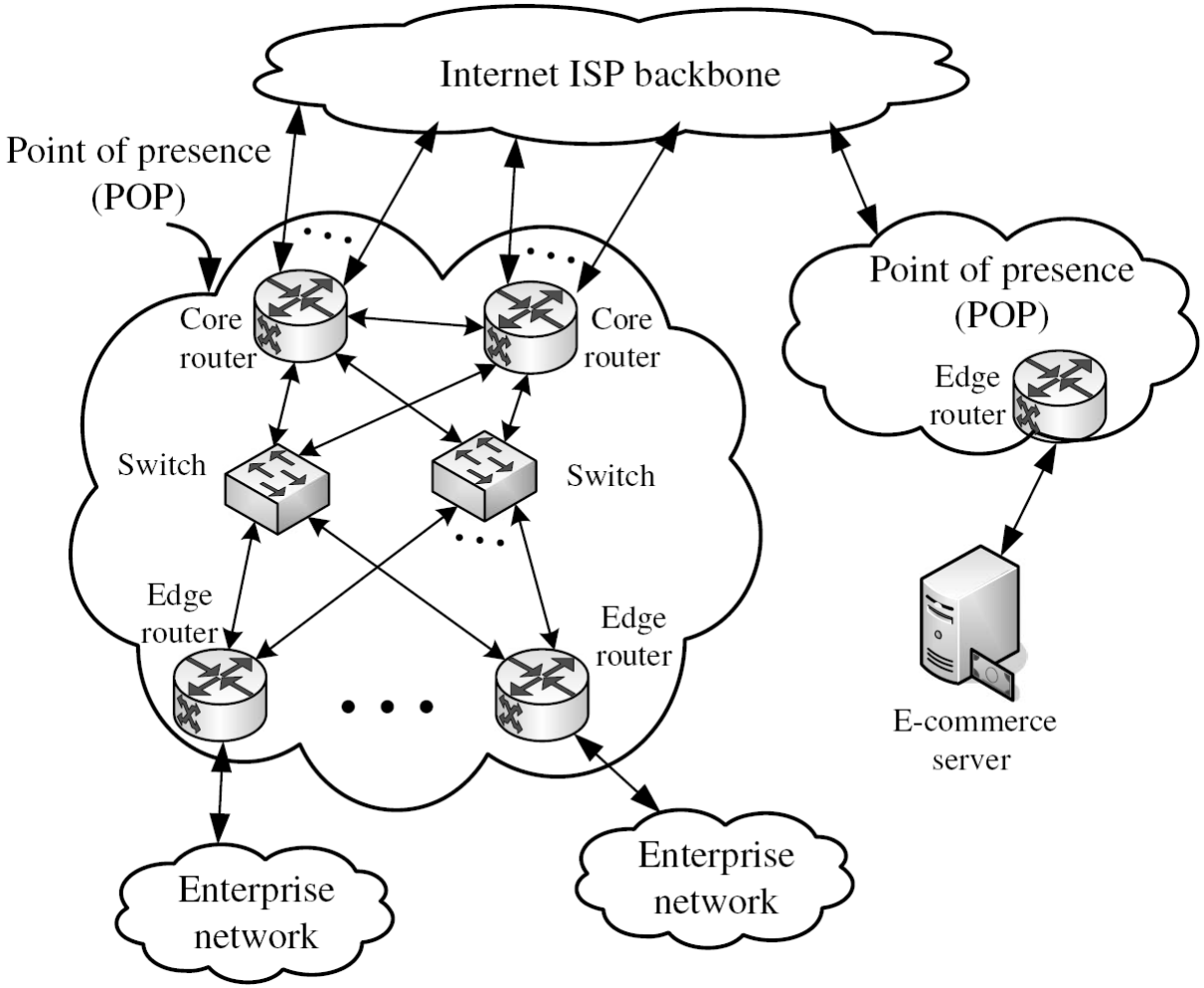
Tier-2 ISPs: Smaller than tier-1 ISP which buy the network capacity from other providers.
(such as America Online and Broadwing.)

- **Tier-3 ISPs:** Regional service providers.
  (such as Verizon and RCN)

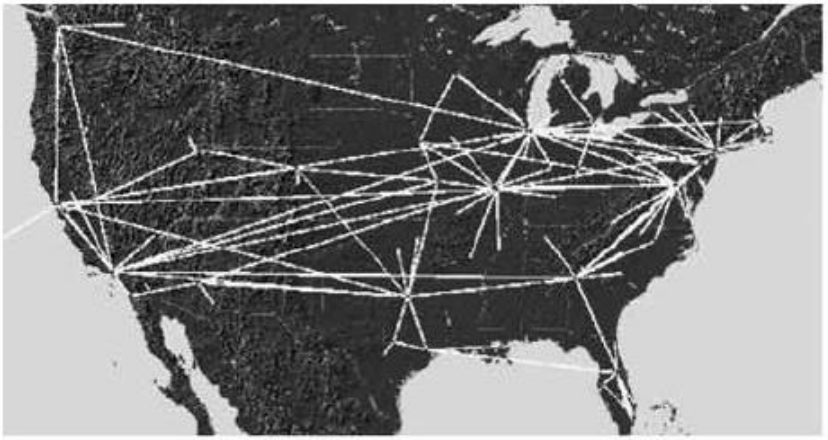
Network map of a Tier-1 ISP, XO Network



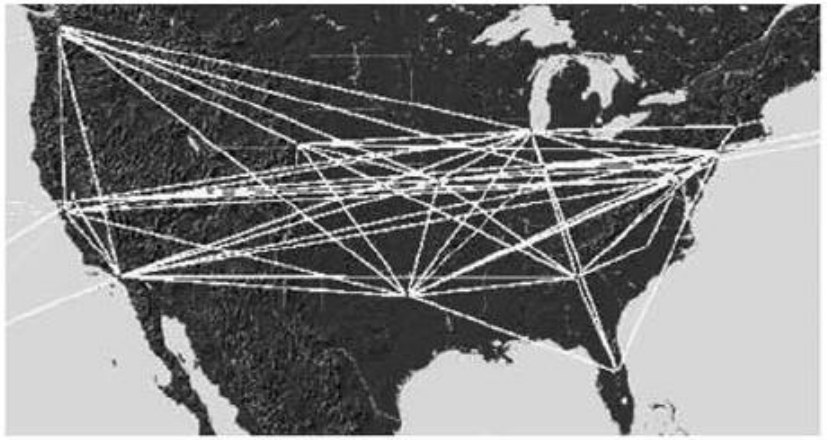
Point of presence (POP):



Three distinct backbone design paradigms of Tier-1 ISPs.



AT&T



Sprint

Level 3 national network infrastructure

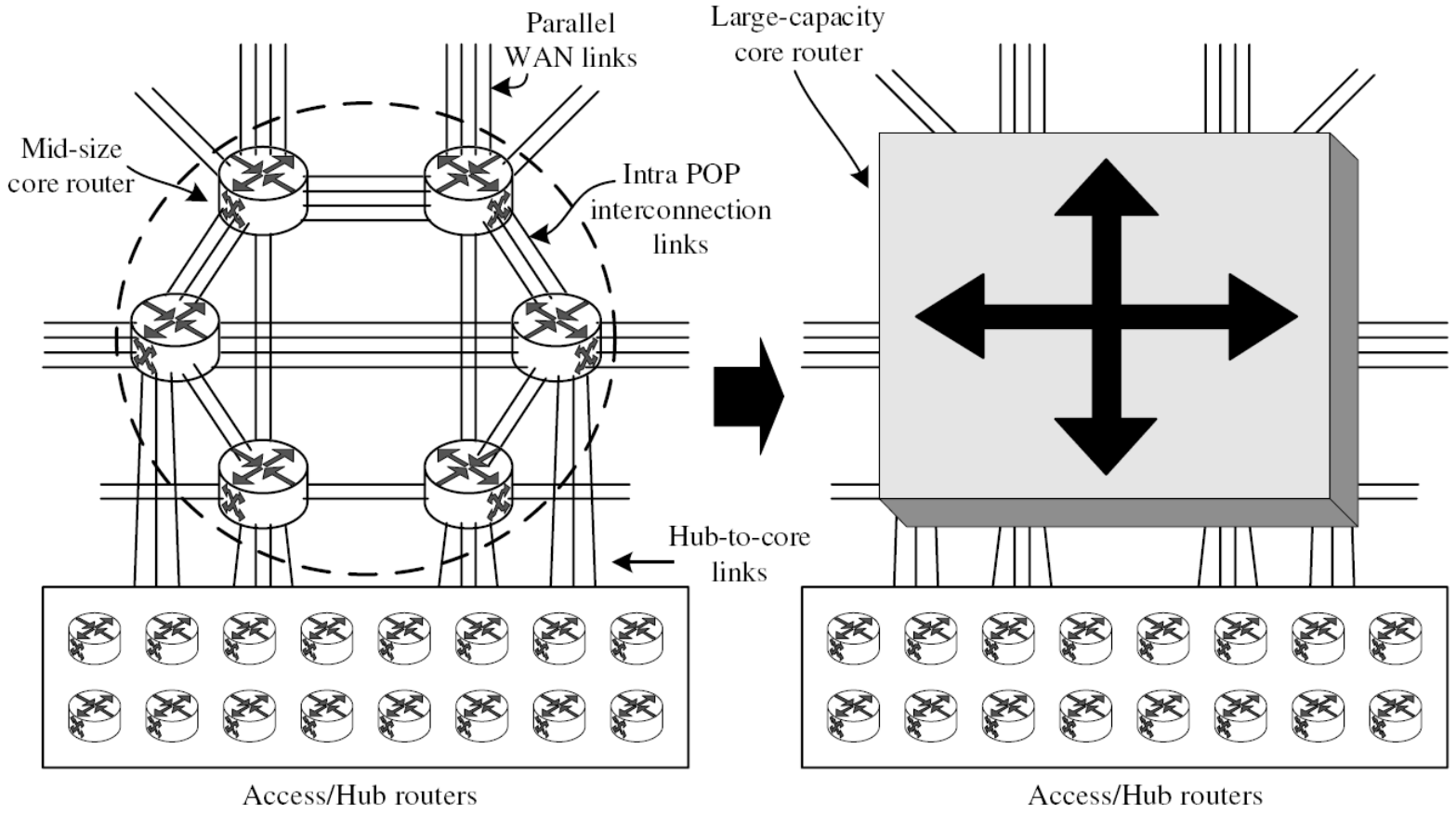
Routers in the Market

Popular Enterprise, Edge, and Core Routers in the Market

Model	Capacity[a]	Memory	Power	Features
Cisco 7200	–	256 MB	370 W	QoS, MPLS, Aggregation
Cisco 7600	720 Gbps	1 GB	–	QoS, MPLS, Shaping
Cisco 10000	51.2 Gbps	–	1200 W	QoS, MPLS
Cisco 12000	1.28 Tbps	4 GB	4706 W	MPLS, Peering
Juniper M-320	320 Gbps	2 GB	3150 W	MPLS, QoS, VPN
Cisco CRS	92 Tbps	4 GB	16,560 W	MPLS, Qos, Peering
Juniper TX/T-640	2.5 Tbps/640 Gbps	2 GB	4550 W/6500 W	MPLS, QoS, Peering

[a]Note that the listed capacity is the combination of ingress and egress capacities.

Replacing a Cluster of Mid-size Routers with Large-Capacity Scalable Routers



Function of IP Routers

IP routers' functions can be classified into two categories:

- **Datapath functions**

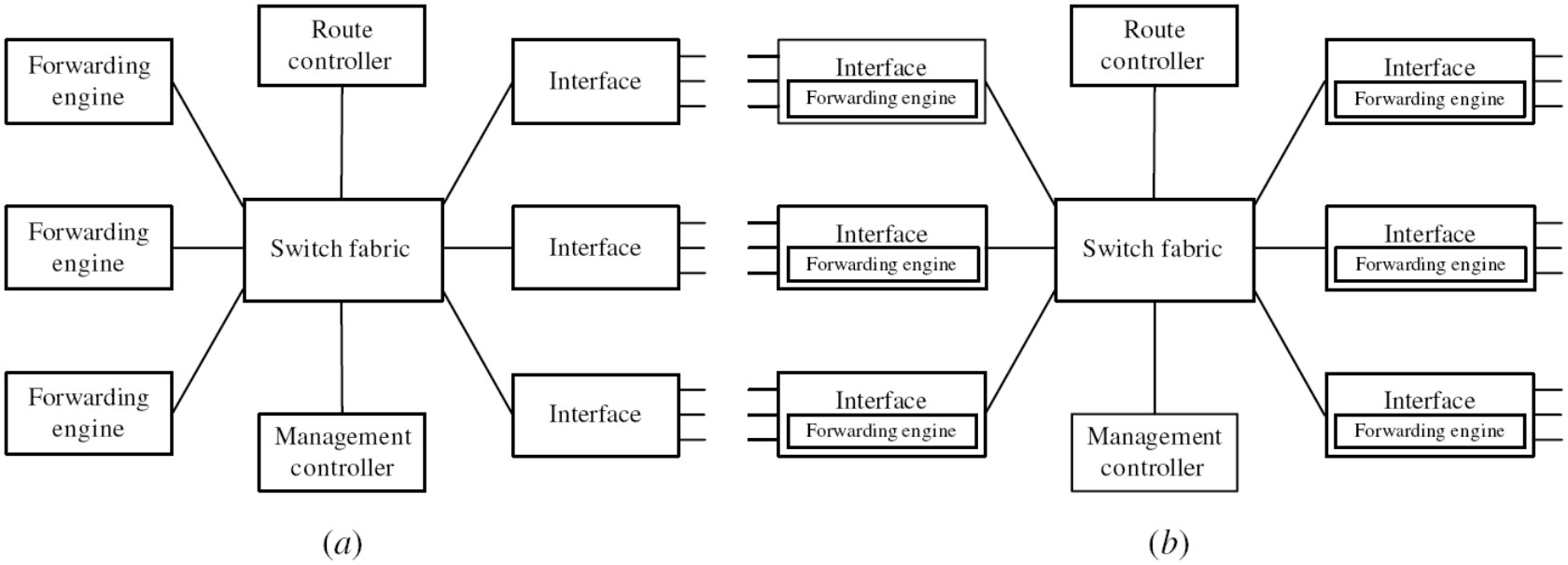
  The datapath functions such as forwarding decision, forwarding through the backplane, and output link scheduling are performed on every datagram that passes through the router.

- **Control plane functions**

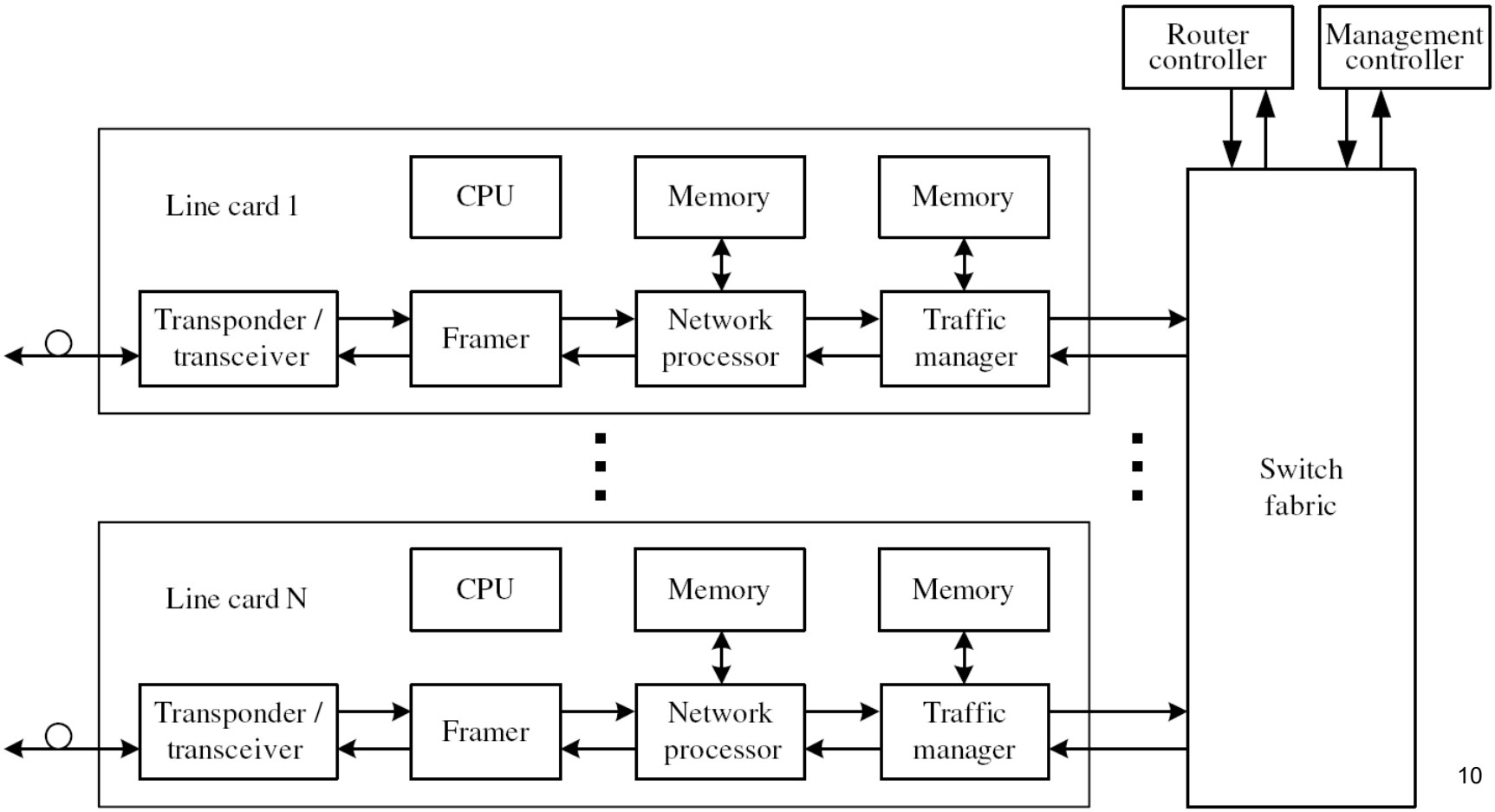
  The control plane functions include the system configuration, management, and exchange of routing table information. These are performed relatively infrequently.

Router Architectures

Router architectures generally fall into two categories: centralized (Fig. *a*) and Distributed (Fig. *b*).



Typical Router Architecture



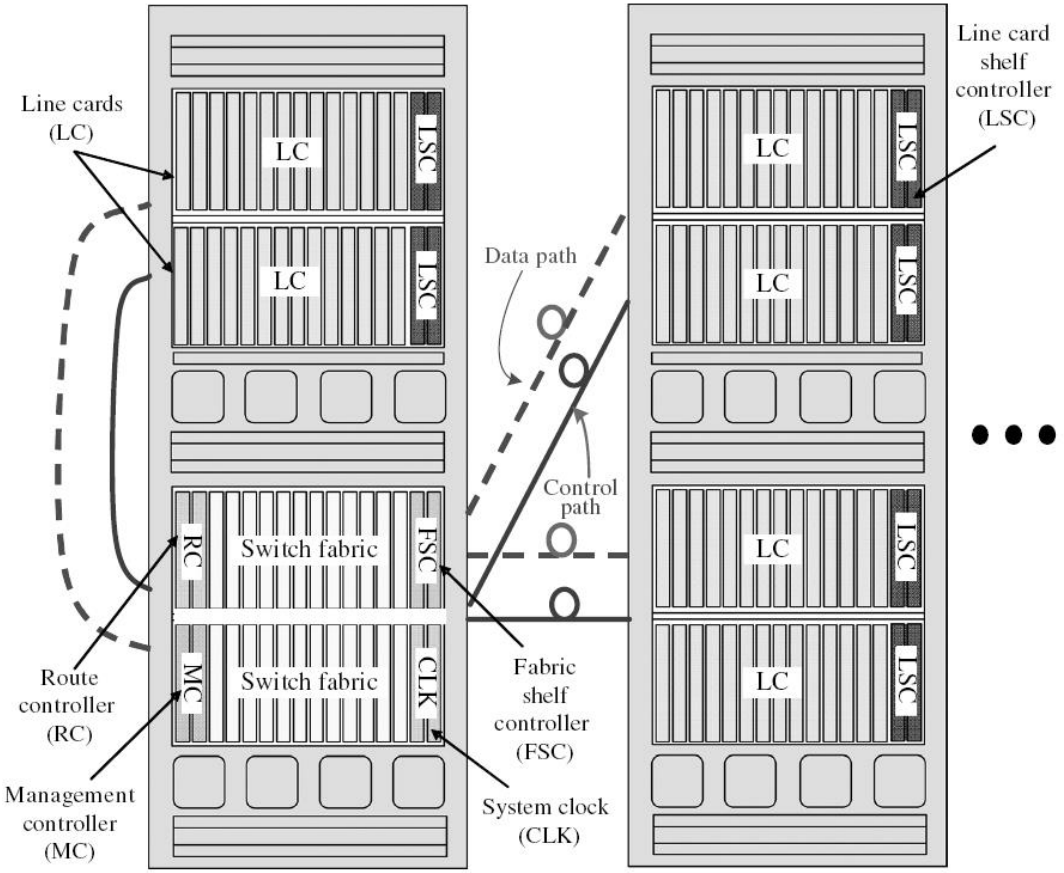
Line Card Components

Components of a Line Card:

- **Transponder,**
- **Framer,**
- **Network Processor (NP),**
- **Traffic Manager (TM), And**
- **Central Processing Unit (CPU).**

Multi-Rack Router System

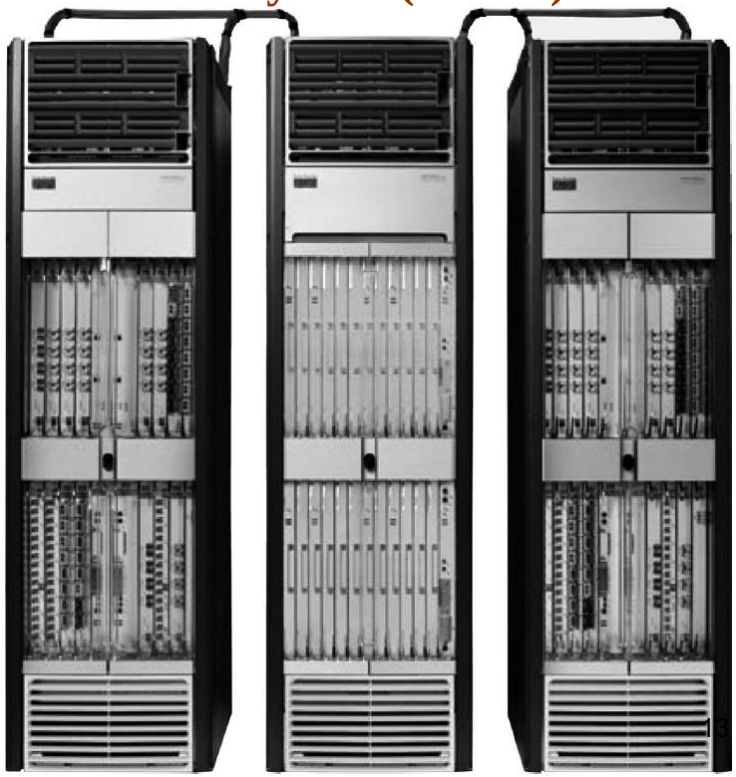
Multi-rack router system



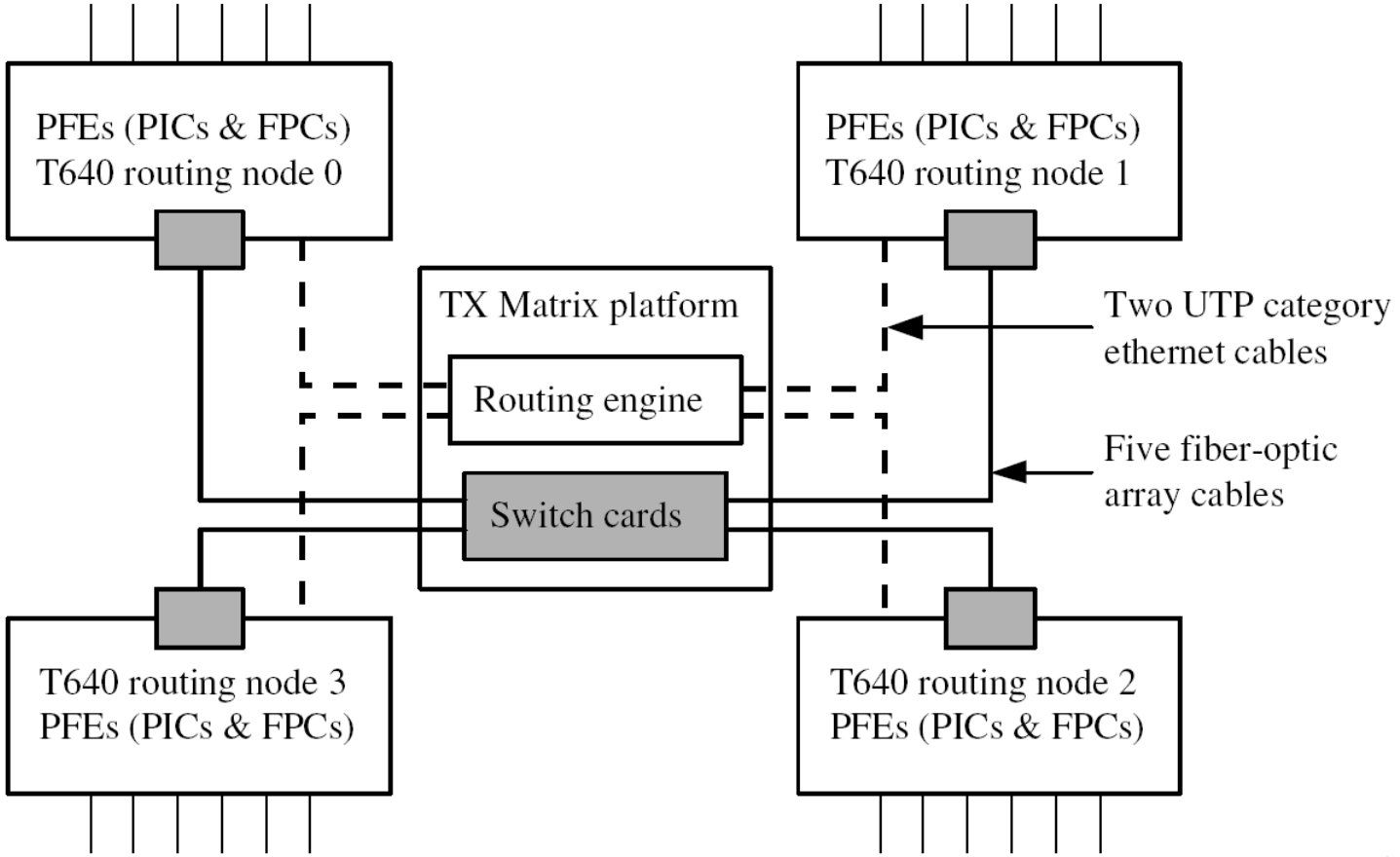
Commercial Core Router Examples:

Juniper Network's T640 TX-Matrix

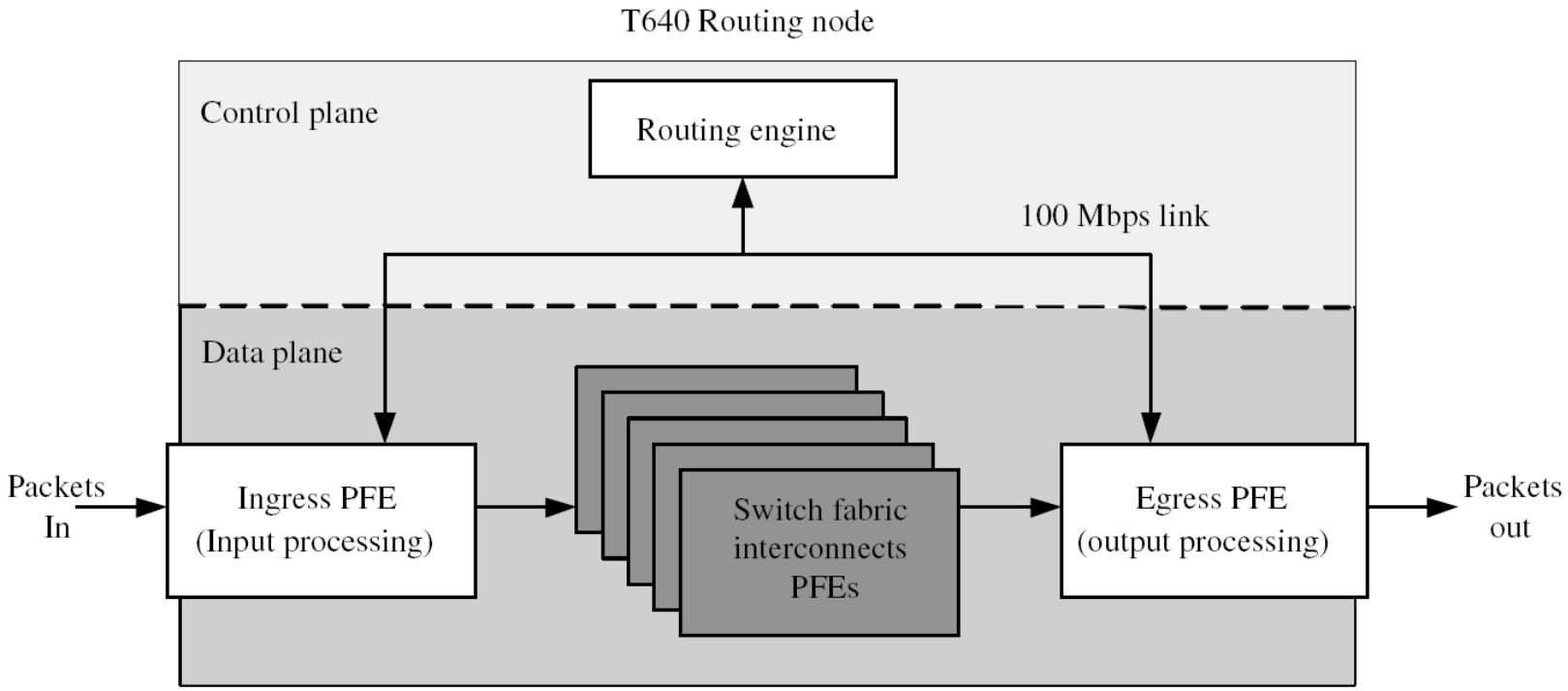
Cisco System's Carrier Routing System (CRS-1)



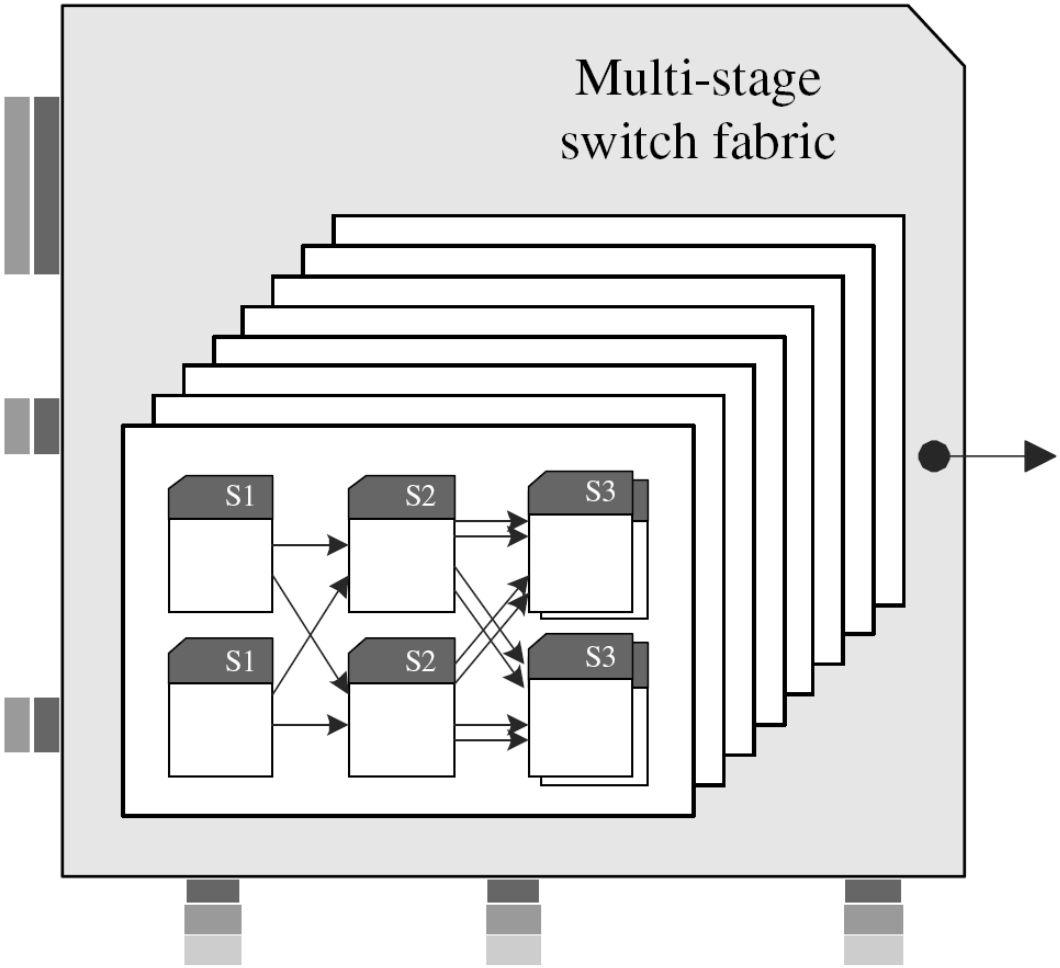
Juniper Network's T640 TX-Matrix



T640 Routing Node



Cisco System's Carrier Routing System (CRS-1)



Design of Core Routers

Design goals of core routers generally fall into the following ategories:

- ***Packet Forwarding Performance,***
- ***Scalability,***
- ***Bandwidth Density,***
- ***Service Delivery Features,***
- ***Availability,***
- ***Security,***

Router/Switch Design Issues

- ***Memory Speed,***
- ***Packet Arbitration,***
- ***QoS Control,***
- ***Optical Interconnection,***
- ***Power Consumption,***
- ***Flexibility,***

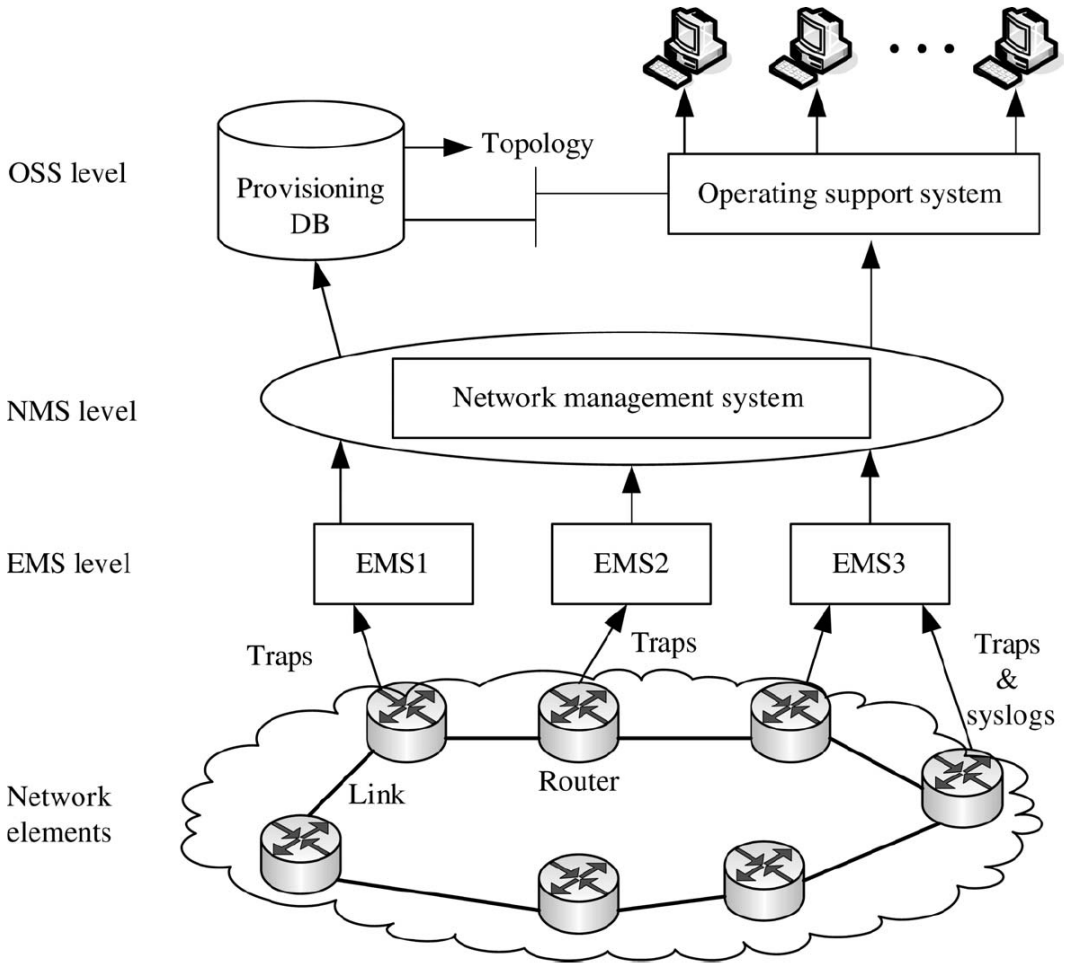
IP Network Management

Network Management System Functionalities: (FCAPS)

- ***Fault Management (FM),***
- ***Configuration Management (CM),***
- ***Accounting Management (AM),***
- ***Performance Management (PM),***
- ***Security Management (SM).***

Network Management Architecture

NMS Architecture



EMS Architecture