

Router Architectures

An overview of router architectures.

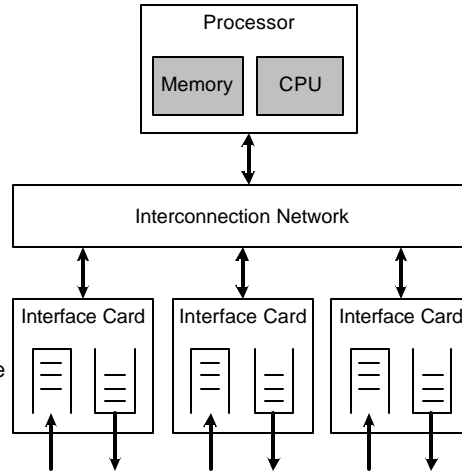
Introduction

What is a Packet Switch?

- Basic Architectural Components
- Some Example Packet Switches
- The Evolution of IP Routers

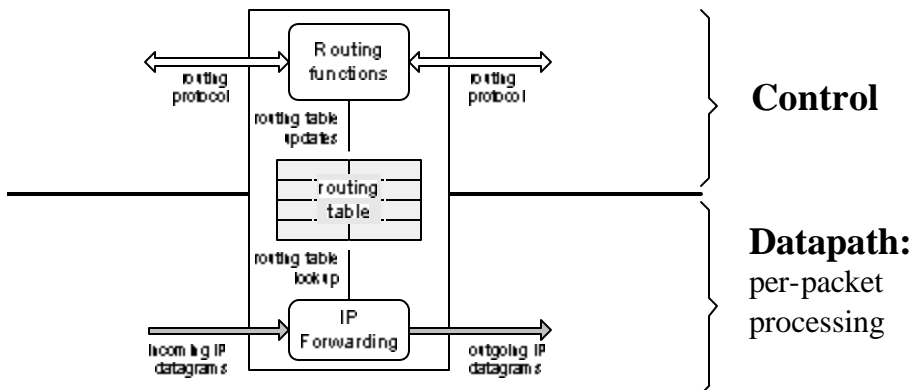
Router Components

- Hardware components of a router:
 - Network interfaces
 - Interconnection network
 - Processor with a memory and CPU
- **PC router:**
 - interconnection network is the (PCI) bus and interface cards are NICs
 - All forwarding and routing is done on central processor
- **Commercial routers:**
 - Interconnection network and interface cards are sophisticated
 - Processor is only responsible for control functions (**route processor**)
 - Almost all forwarding is done on interface cards



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Functional Components



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Routing and Forwarding

Routing functions include:

- route calculation
- maintenance of the routing table
- execution of routing protocols
- On commercial routers handled by a single general purpose processor, called *route processor*

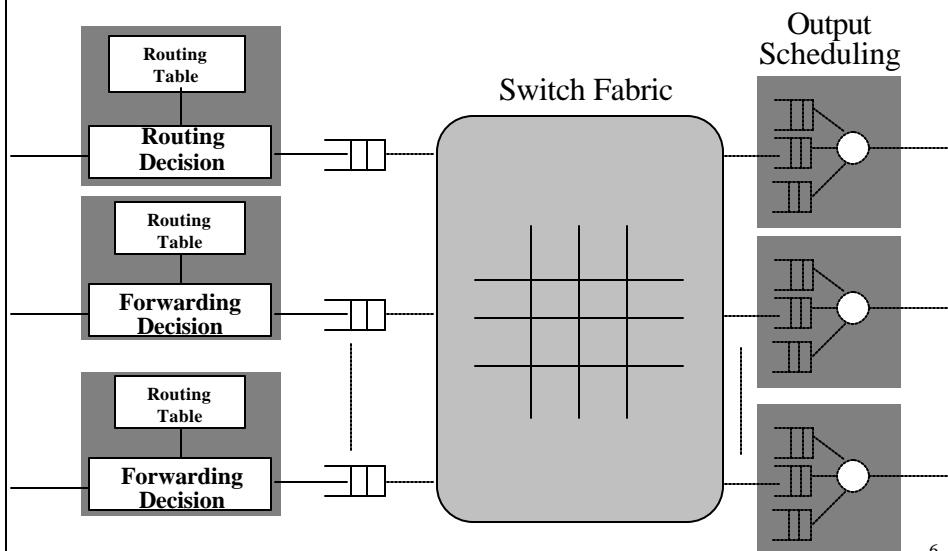
IP forwarding is per-packet processing

- On high-end commercial routers, IP forwarding is distributed
- Most work is done on the interface cards

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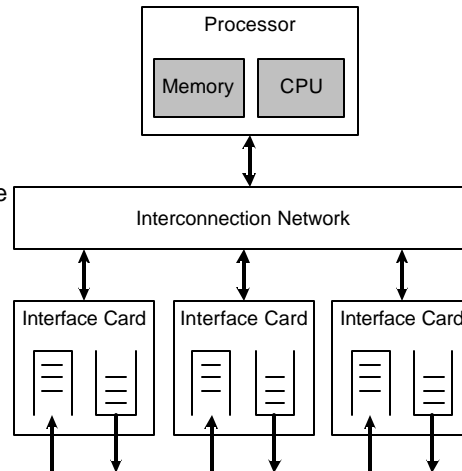
Basic Architectural Components

Per-packet processing



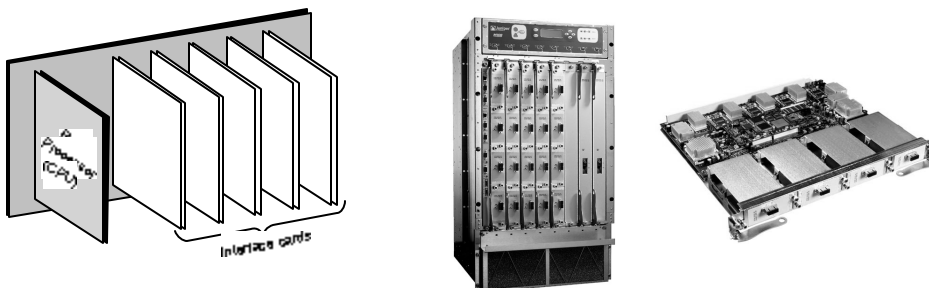
Router Components

- **On a PC router:**
 - interconnection network is the (PCI) bus
 - Interface cards are NICs (e.g., Ethernet cards)
 - All forwarding and routing is done on central processor
- **On Commercial routers:**
 - Interconnection network and interface cards can be sophisticated
 - Central processor is the route processor (only responsible for **control functions**)



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Slotted Chassis



- Large routers are built as a slotted chassis
 - Interface cards are inserted in the slots
 - Route processor is also inserted as a slot
- This simplifies repairs and upgrades of components

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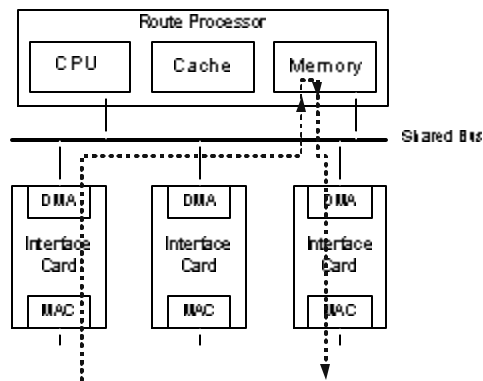
Evolution of Router Architectures

- Early routers were essentially general purpose computers
- Today, high-performance routers resemble supercomputers
 - Exploit parallelism
 - Special hardware components
- Until 1980s (1st generation): standard computer
- Early 1990s (2nd generation): delegate to interfaces
- Late 1990s (3rd generation): Distributed architecture
- Today: Distributed over multiple racks

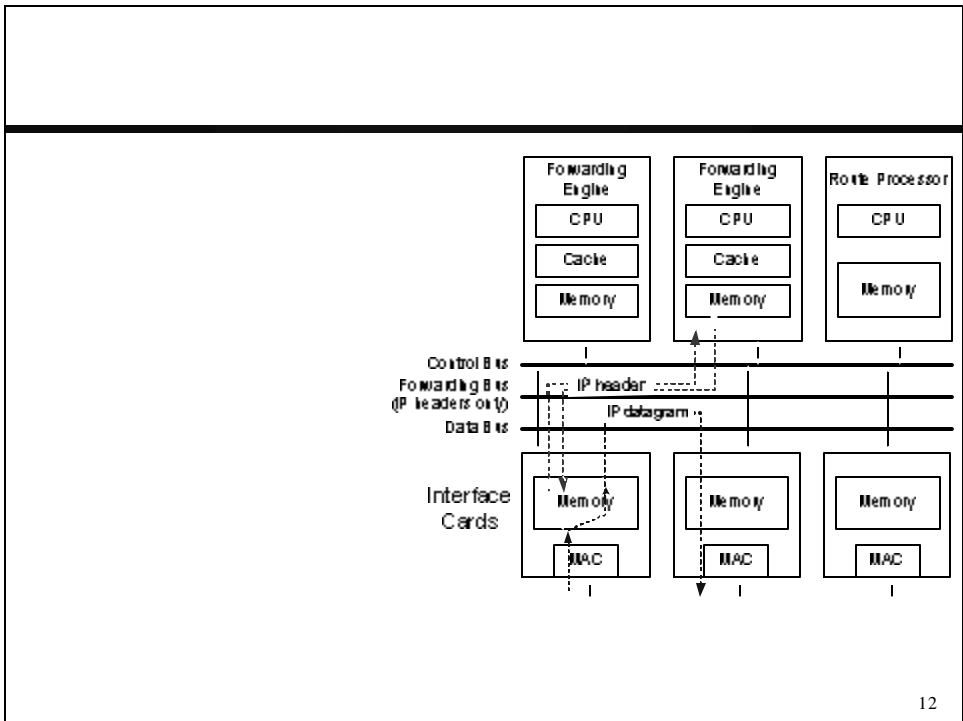
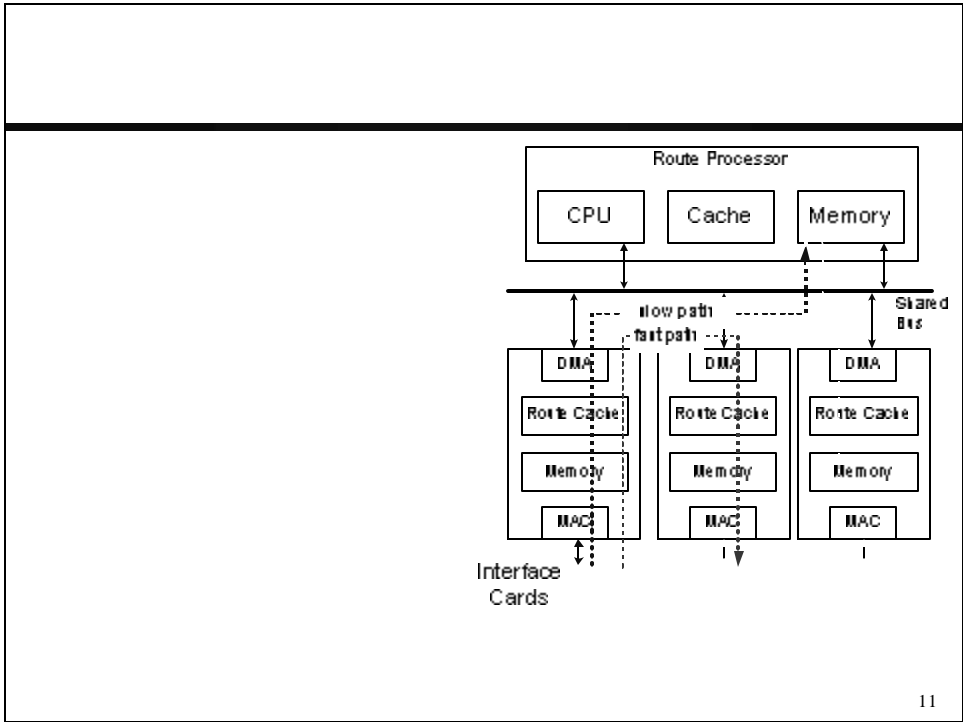
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1st Generation Routers

- This architecture is still used in low end routers
- Arriving packets are copied to main memory via direct memory access (DMA)
- Interconnection network is a backplane (shared bus)
- All IP forwarding functions are performed in the central processor.
- Routing cache at processor can accelerate the routing table lookup.
- Drawbacks:
 - Forwarding Performance is limited by CPU
 - Capacity of shared bus limits the number of interface cards that can be connected



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3rd Generation Architecture

- Interconnection network is a switch fabric (e.g., a crossbar switch)
- **Distributed architecture:**
 - Interface cards operate independent of each other
 - No centralized processing for IP forwarding
- These routers can be scaled to many hundred interface cards and to aggregate capacity of > 1 Terabit per second

