



Computer Networks

Switching and Routing: Part-1

*Summary of Differences Between
L-2 Switches, Routers (L-3) and L-3 Switches*
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Based on: "Lecture Notes in Computer Networks"

1. Bridges and Layer-2 Switches

- Bridges and Layer-2 switches divide the network into segments or micro-segments (apart from helping in Layer-2 protocol translation, management, security etc.)
- In effect, we can say that
 - Layer-2 Switches / Bridges separate collision domains
 - Layer-2 Switches / Bridges can carry out protocol translations

2. Routers (Layer-3)

- Routers are Layer-3 devices who handle Layer-3 packet routing within and outside the local network / internetwork and therefore effectively separate broadcast domains which end at its different network interfaces each of which carries a separate Subnet-identifier / Subnet-address (apart from Layer-3 protocol translation, monitoring, security and management)
- Thus, in effect, we can say that:
 - Routers Separate broadcast domains (each of such broadcast domains which end at its different network interfaces each of which carries a separate Subnet-identifier / Subnet-address)
 - Routers can carry out interior routing and / or exterior routing, depending upon their location in the network
 - Routers can carry out protocol translations (in terms of protocol-specific packet formats as well as in terms of allowing appropriately formatted selective data specific to routing protocols they may support).

3. Layer-3 Switches

- Layer-3 switches are devices which can handle all functionalities of Layer-2 Switches as well as fast (often based on header/tag/label switching) Layer-3 packet routing within but not outside the local network / internetwork; and therefore, effectively separate broadcast domains which end at its different LAN interfaces each of which carries a separate Subnet-identifier / Subnet-address (apart from optional Layer-3 protocol translation, monitoring, security and management)
- Thus, in effect, we can say that:
 - L-3 Switches Separate broadcast domains (each of such broadcast domains which end at its different LAN interfaces each of which carries a separate Subnet-identifier / Subnet-address)
 - L-3 Switches can carry out fast interior routing / packet-switching often based on header/tag/label switching
 - Layer-3 Switches, optionally, can carry out protocol translations (in terms of protocol-specific packet formats).

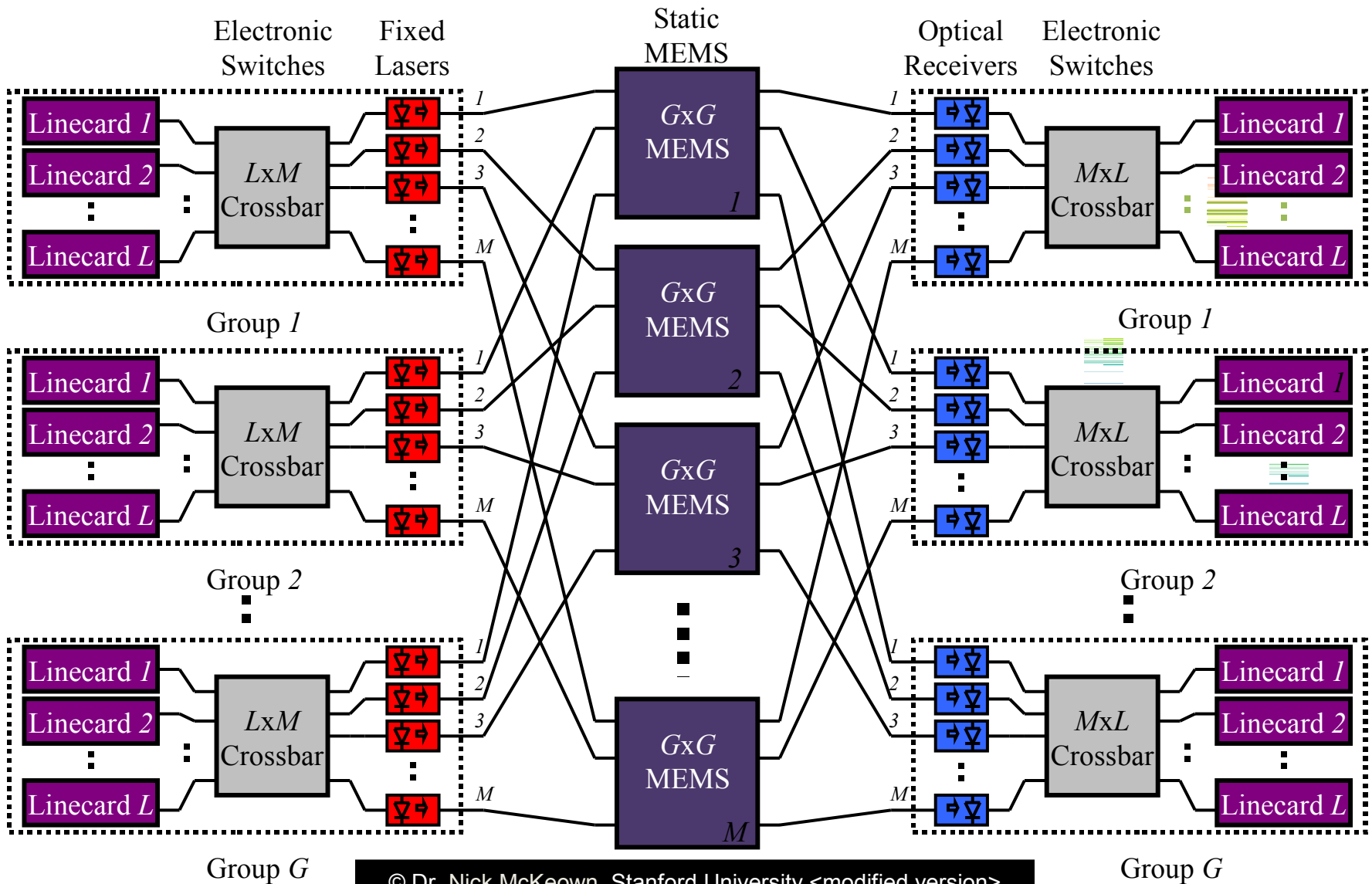
Inside a Layer-2 Switch

- Elements of a Layer-2 Switch
 - Processors (Front-end Processors on Line Cards) for Frame Routing (*These are specialized network nodes optimized for functions like switching / routing / forwarding / provisioning etc.*)
 - Multiple Buffers for Multiple Queues
 - Switching Fabric (*A Switching Fabric is a set of switching elements and links capable of transferring a Frame from any input port to any output port. This applies to what are known as 3rd and higher Generation switches.*)
 - I/P Line Controllers (ILC)
 - O/P Line Controllers (OLC)

Inside a Switch Fabric (3rd Gen.)

- A Switch Fabric is a set of switching elements and links capable of transferring a data unit from any input port to any output port.
 - Types of a Switch Fabric
 - Crossbar Fabrics
 - Broadcast Fabrics
 - Switching Element based Fabrics
 - Banyan Fabrics
 - Sorting & Merging Fabrics
 - Batcher-Banyan Fabrics
- And, other types are emerging ...

An Example of a Hybrid Switching Fabric



Frame Switching in L-2 Switches

(old & new)

- Frame Switching: <Size: Fixed / Variable> *Original style was Bridge style*
 - Store-in-entirety first and forward later
 - All nodes on each side form their respective collision domains

- Frame Routing and / or Switching: <Size: Fixed / Variable> *Current style*
 - Store header first and begin switching without waiting for payload's arrival
 - Uses no or smaller collision domains, where applicable

Some Common Multi-layer Switches from Cisco...

Cisco Catalyst 3750 Series Switches



© Cisco, Inc.

Cisco Catalyst 4500 Series of Switches

(Used in several places at BITS as Distribution Switches)



Cisco Catalyst 6500 Series of Switches

Cisco Catalyst 6500 Series
Switches

(One of these is OUR Core
Switch located in the IPC
System Room at BITS)



Features of the Cisco 6500 Switch

- Cisco Catalyst 6500 Series Switch (BITS has 6513) offers:
 - high availability
 - integrated security
 - support for converged applications that includes:
 - high-density 802.3af Power over Ethernet with intelligent power management, advanced IP multicast, and Quality of Service features
 - embedded real-time monitoring of VoIP call quality;
 - the Cisco Communication Media Module, which allows to connect TDM and analog devices to the IP network
 - a wireless LAN services module to simplify deployment and management of WLAN infrastructure
 - an Application-Oriented Networking (AON) Module to provide message-level routing, visibility, and security.
 - Scalability
 - investment protection to a certain extent through several daughter-card options for incremental upgrades and backward compatibility

Source: Cisco, Inc. Modified and edited for instruction

Inside Cisco 6500 Switch

- Scalability and Flexibility:
 - The Catalyst 6500 Series currently supports:
 - up to 288 Class 3 (15.4W) Power over Ethernet (PoE) devices
 - up to 1152 10/100-Mbps, 576 10/100/1000-Mbps, or 32 10-Gbps Ethernet ports in a single chassis, and
 - system scalability up to 720 Gbps, providing 40 Gbps/slot (half-duplex)
 - Additional choices include 3, 4, 6, 9, and 13-slot chassis options and several WAN interface module options.

Any question please?

Thank you for your kind attention!

For further details, you may contact at:

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Short List of Reading Materials

- *Larry L. Peterson & Bruce S. Davie: Computer Networks: A Systems Approach, Fourth Edition, Morgan Kaufmann / Elsevier, New Delhi, 2007. <System design approach>*
- *A. S. Tanenbaum: Computer Networks, Fourth Edition, Pearson Education, New Delhi, 2003. <Conceptual Approach>*
- *S. Keshav: Computer Networking: An Engineering Approach, Pearson Education, New Delhi, 1997.*
- *IEEE802.1ag-2007 IEEE Standard for LAN/MAN — Virtual Bridged LANs — Amendment 5: Connectivity Fault Management*