Lecture 1

COMPUTER NETWORKS

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OBJECTIVES

- Explain basic networking concepts
- Describe networking functions
- Explain how networks are classified.
- Explain various networking equipment

What is a network?

Network is life

- Homes
- Business
- Social
- Culture
- All over …

Network jargon:

- Bits
- Protocols
- Media
- LAN
- Packets
- Topology
- Configuration
- Downtime
- Uptime
- Domain
- Addresses

Protocol Concepts

- Protocols are sets of rules.
- What do you want to do? (Application)
- Where are you going? (Addressing)
- How do you get there? (Media types)
- Did you get there? (Acknowledgments, Error checking)

Best Effort

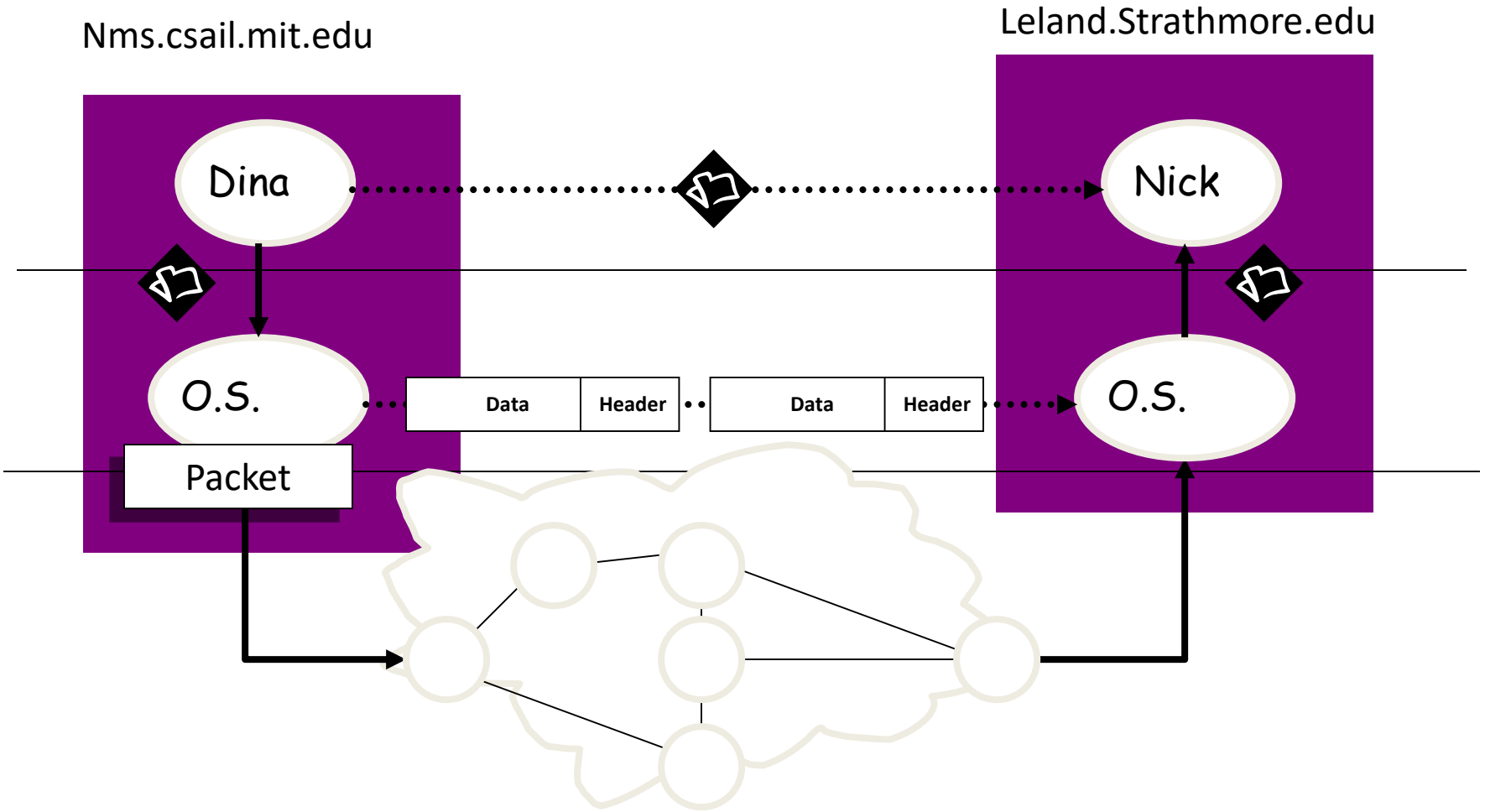
No Guarantees:

- Variable Delay (jitter)
- Variable rate
- Packet loss
- Duplicates
- Reordering
- (notes also state maximum packet length)

Intranet and Internet Specifications

- ***Intranet:*** An intranet is a private network that is contained within an enterprise. It may consist of many interlinked local area networks and also use leased lines in the wide area network.
- An intranet uses TCP/IP, HTTP, and other Internet protocols and in general looks like a private version of the Internet. With tunneling, companies can send private messages through the public network, using the public network with special encryption/decryption and other security safeguards to connect one part of their intranet to another.
- ***Internet:*** is a worldwide system of computer networks - a network of networks in which users at any one computer can, if they have permission, get information from any other computer (and sometimes talk directly to users at other computers).

The Internet



Characteristics of the Internet

- Each packet is individually routed
- No time guarantee for delivery
- No guarantee of delivery in sequence
- No guarantee of delivery at all!
  - Things get lost
  - Acknowledgements
  - Retransmission
    - How to determine when to retransmit? Timeout?
- If packet is re-transmitted too soon → duplicate

Client and Server computer role in networking

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- **Server** computer is a core component of the network, providing a link to the resources necessary to perform any task.
- A server computer provides a link to the resources necessary to perform any task.
- The link it provides could be to a resource existing on the server itself or a resource on a client computer.
- **Client** computers normally request and receive information over the network *client. Client* computers also depends primarily on the central server for processing activities

Client/Server Networking

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- In this design, a small number of computers are designated as centralized *servers* and given the task of providing services to a larger number of user machines called *clients*

Circuit Switching

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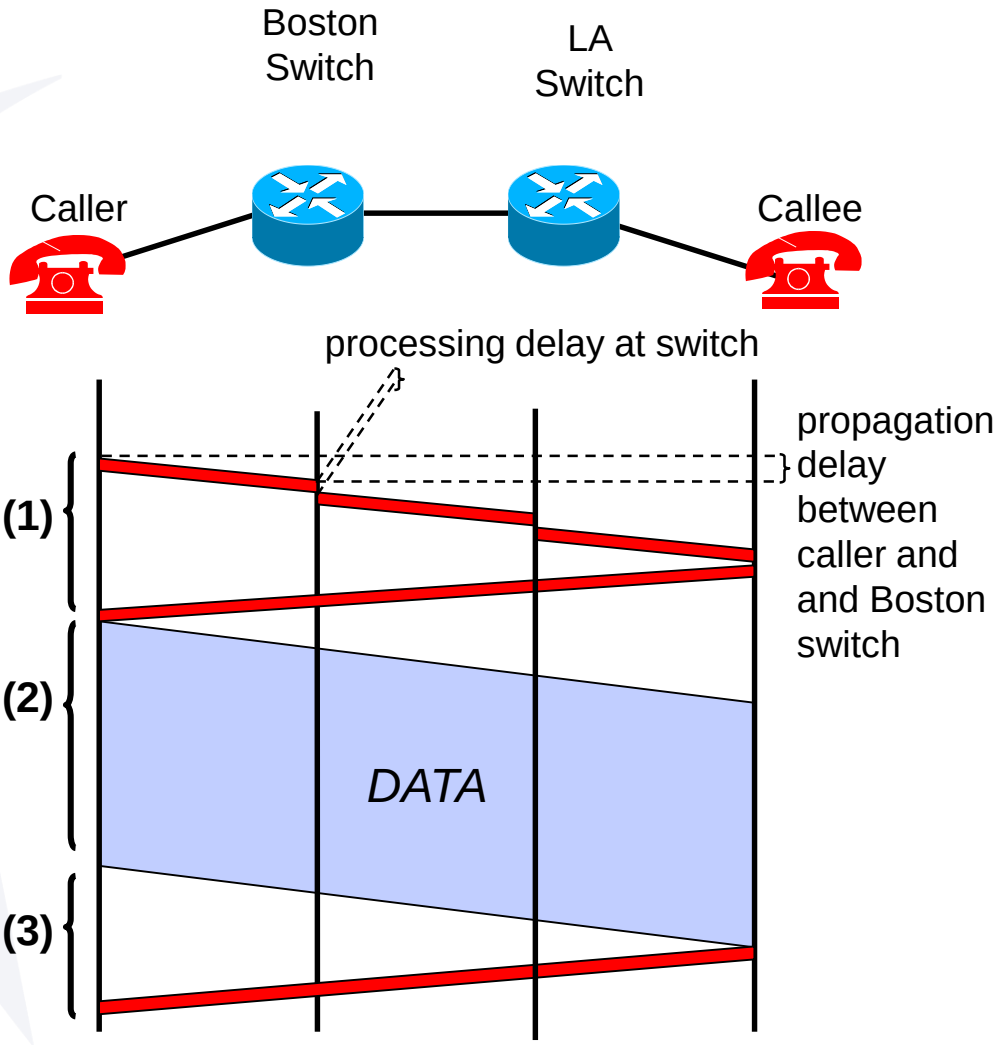
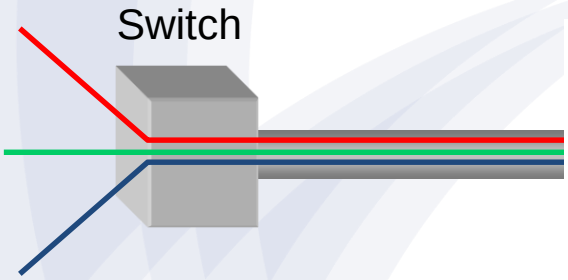
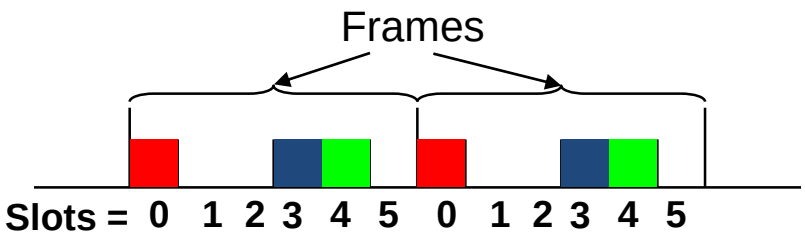
- It's the method used by the telephone network
- A call has three phases:
  1. Establish circuit from end-to-end ("dialing"),
  2. Communicate,
  3. Close circuit ("tear down").
- If circuit not available: "busy signal"



Circuit Switching: Multiplexing/Demultiplexing





One way for sharing a circuit is TDM:

- Time divided into frames and frames divided into slots
- Relative slot position inside a frame determines which conversation the data belongs to
  - E.g., slot 0 belongs to the red conversation
- Need synchronization between sender and receiver

Circuit Switching

- Assume link capacity is C bits/sec
- Each communication requires R bits/sec
- #slots = C/R
- Maximum number of concurrent communications is C/R
- What happens if we have more than C/R communications?
- What happens if the a communication sends less/more than R bits/sec?

→ Design is unsuitable for computer networks where transfers have variable rate (bursty)

Internet Traffic Is Bursty

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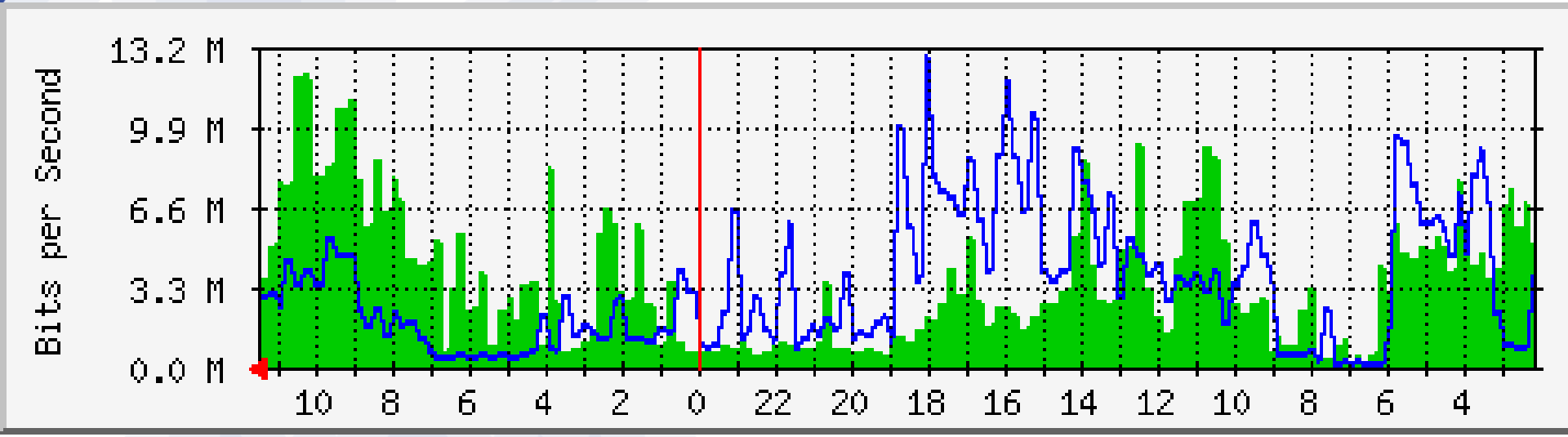
Daily traffic at an institution router



Max In:12.2Mb/s Avg. In: 2.5Mb/s

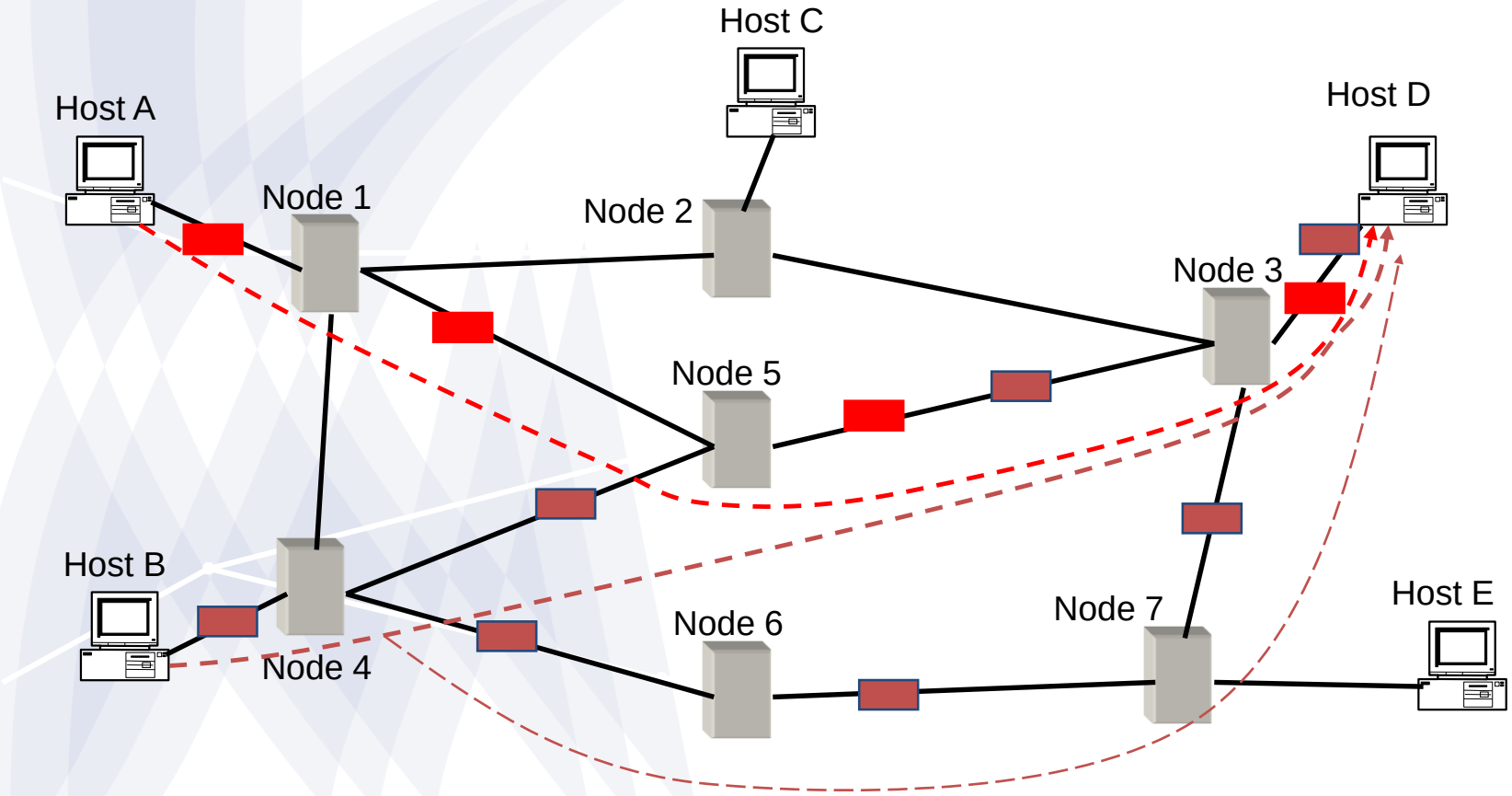
Max Out: 12.8Mb/s Avg. Out: 3.4 Mb/s

Queues introduce

- Variable Delay
  - Delay = Queuing delay + propagation delay + transmission delay + processing delay
- Losses
  - When packets arrive to a full queue/buffer they are dropped

Packet switching also show reordering

Packets in a flow may not follow the same path (depends on routing as we will see later) → packets may be reordered



Functions of a network

1. Communication – email, mobile, chat, social media
2. Decision making – information systems
3. Monitor –surveillance, time logging, illegal activities.
4. Security – forensics –Government
5. Resource sharing – network printer, files etc
6. System auditing

Network resources

A resource may be:

- A file
- A folder
- A printer
- A disk drive
- Or just about anything else that exists on a computer.

Networking equipment

1. Computers – nodes/clients
2. Router – connect to other networks, gateway, DNS, DHCP, proxy
3. Hub – connect machines to the network.
4. switch – Intelligent – mac address, security, scalability.
4. Media/Cables – wireless and physical cables
5. MODEM – Modulator Demodulator – convert analog signals to digital signal and vice versa
7. Firewalls – filter traffic using set criteria

Hardware, Software and Networks Peripherals (device)

- Network Interface Card (NIC)
- Repeater
- Hub
- Bridge
- Routers
- Switch

Types of networks

Classification:

1. Geographically – LAN, MAN, WAN, PAN
2. Ownership – private/public
3. Infrastructure – client/server, thin client, peer-to-peer, SAN, cloud
4. Topology – star, mesh, ring, bus
5. Size – internet, intranet, extranet
6. Representation – Physical, logical

Qualities of network

1. Maintainability
2. Manageability
3. Scalability
4. Security
5. Fault tolerance
6. Quality of Service (Qos)
7. Sustainability (trajectory…)

Advantages of networking

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- Connectivity and Communication
- Data Sharing
- Hardware Sharing
- Internet Access
- Internet Access Sharing
- Data Security and Management
- Performance Enhancement and Balancing

The Disadvantages (Costs) of Networking

- Network Hardware, Software and Setup Costs
- Hardware and Software Management and Administration Costs
- Undesirable Sharing
- Illegal or Undesirable Behavior
- Data Security Concerns

Summary

- Networking definition.
- Why networks.
- Networking hardware/equipment.
- Criteria: networks classification.
- Basic networking concepts.

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