# ECSE-4730: Computer Communications Networks (CCN): Introduction 

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- Syllabus, administratrivia
- Why is networking interesting ?
- Simple network (2 users): issues
- N-user network: issues
- Scalable network of heterogeneous networks: issues
- Laundry list of issues for the course to address


## Why is networking interesting ?

- Today's economy
- manufacturing, distributing, and retailing atoms
- but also
$\square$ publishing
-banking
- film making....
- main 'product' is creation and dissemination of information - part of the 'information economy'
- Future economy likely to be dominated by information e.g. smart shoes and wireless tags on groceries
- Computers "manipulate" information
- Networking creates "access" to information


## Information

- A representation of knowledge
- "Information exists only when you learn something that was not known before"
- Shannon's theory: allows us to quantify information
- Can represent information in two ways
- analog (atoms)
- digital (bits)
- Digital is better
- computers manipulate digital information
- infinitely replicable
$\square$ networks can move bits everywhere, cheaply, and with good performance characteristics


## What's a network ?

- \#1: A medium which allows information exchange between a population of users or applications
- \#2: Defined recursively as two or more nodes connected by a physical link, or by two or more networks connected by one or more nodes.


## Which one is correct?

## Network provides connectivity...

- Building Blocks
- links: coax cable, optical fiber...
$\square$ nodes: general-purpose workstations...
- Direct Links
$\square$ point-to-point
$\square$ multiple access

(b)




## So, what is "connectivity"?

- Direct or indirect "access" to every other node in the network
- Access is not the same as having a pt-pt link
- What you get is a "virtual channel" between nodes, which does not necessarily have the same performance characteristics of a physical link.
- For example, a virtual channel may minimally provide only "best-effort connectivity on a packet-by-packet basis" whereas a link provides an 'always-connected, fixed bandwidth, fixed delay and near zero-jitter" channel.
- Just connectivity may not be enough for some applications. They might need more services to make the channel look meaningful to them...


## Issues in a point-to-point network ...



- Physical layer: coding, modulation etc
- Link layer: framing, protocol multiplexing, error recovery, flow control...
- No need for protocol flab like addressing, names, routers, hubs etc


## Connecting N users: Directly ...

Bus: broadcast, collisions, media access control

- Full mesh: Cost, simplicity
 Bus


Full mesh

## Connecting N users: Indirectly ..

- Star: One-hop path to any node, reliability, forwarding function
- Tree: Minimal links, multiple hop-paths, distributed load
- Ring: Reliability to link failure, near-minimal links etc
- Hybrid
- All these topologies ("multi-access networks") assume a single physical network, not a network of networks


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## Multi-access networks (contd)

- Topology issues: Cost, reliability, manageability, deployability, scalability, software complexity
- Medium Access Protocols:
- ALOHA
- CSMA/CD (Ethernet)
- Token Ring
- Wireless
- New concepts: address, forwarding (and forwarding table), bridge, switch, hub, token, medium access control (MAC) protocols


## Inter-networks: networks of networks

- Internetworking involves two fundamental problems: heterogeneity and scale
- Concepts: translation, routing, address \& name resolution, address allocation/admin., networking management etc
- Introduction given in this course.
- Covered in more detail in "Internet Protocols"


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## Application networks

- Problem: how to run applications over this flaky cloud which can provide '"virtual' point-to-point connectivity, without destabilizing it?
- Ans: Transport protocols for reliability (TCP), Simple muxing (UDP), multimedia transmission (RTP) etc
- Concepts: more reliability concepts, congestion control
- Introduction in this course.
- More detail about protocols in "Internet Protocols"
- Application level issues (API, client/server etc) covered in "Network Programming"
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## Laundry List of Problems in Networking

- Topologies
- Framing
- Error control
- Flow control
- Multiple access
- How to share a wire
- Switching, bridging, routing
- Naming, addressing
- Congestion control, traffic management
- Reliability


## Perspective

- Network users: services that their applications need, e.g., guarantee that each message it sends will be delivered without error within a certain amount of time
- Network designers: cost-effective design e.g., that network resources are efficiently utilized and fairly allocated to different users
- Network providers: system that is easy to administer and manage e.g., that faults can be easily isolated and it is easy to account for usage

- Admin junk ...

Networks, connectivity, topologies..
$\square$ Laundry list of networking problems which we will learn how to solve in the course...

