



University of
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Amherst

ECE697AA – Lecture 24

Next-Generation Internet

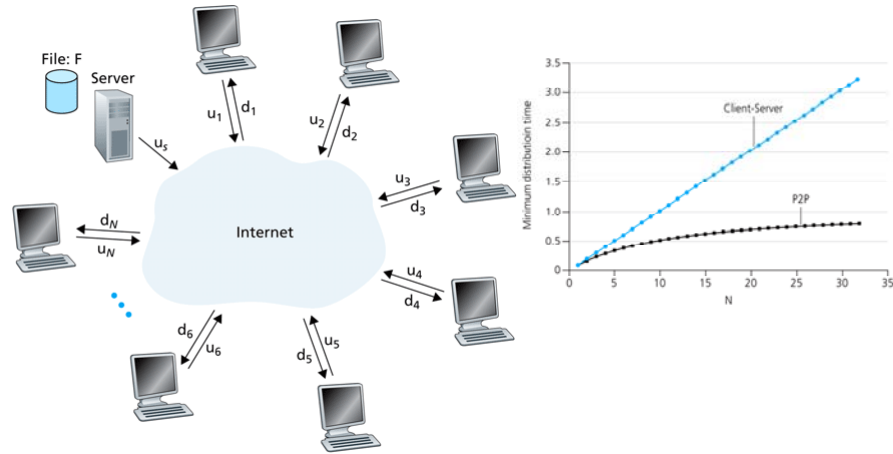
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12/05/08

Extensions to Internet

- IP networks
 - Limited feature set
 - Difficult to extend functionality
 - Client-server paradigm
- Other networking concepts
 - Peer-to-peer
 - Content distribution / content-addressable networks
 - Sensor networks
 - Capabilities-based networks
- Technology drivers
 - Wireless networks
 - Optical core
 - Programmability in data path
 - Network virtualization
- Next-generation networks

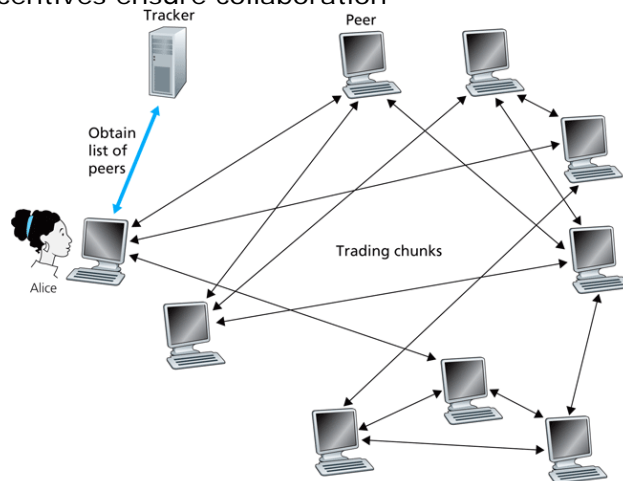
Peer-to-Peer Networks

- File distribution problem
 - Fastest if all nodes participate



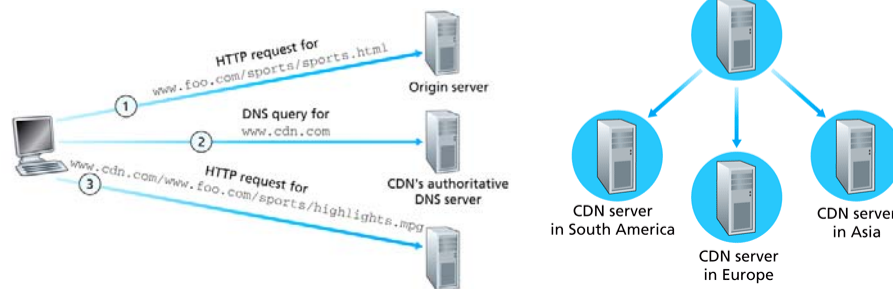
Peer-to-Peer Networks

- Chunks obtained from multiple nodes
 - Tracker keeps index of files
 - Incentives ensure collaboration



Content Distribution Networks

- “Push” of content closer to customer
 - Reduces access time
- Customer needs to access “nearest” CDN server
 - Implemented via DNS redirects

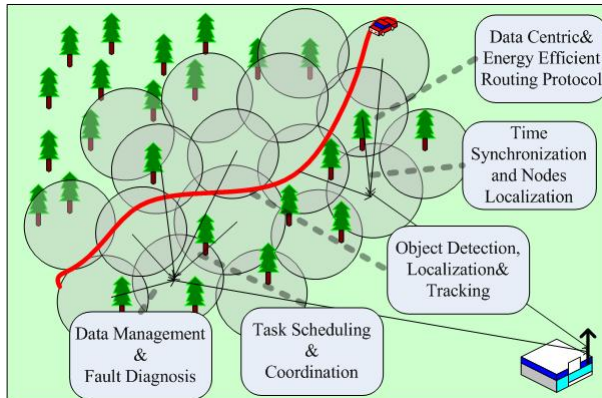


Content-Addressable Networks

- Combination of storage and communication
- Reference information by identifier
 - Request information from network
 - No explicit data transfer
- Network retrieves content via other mechanisms
 - Typically via P2P overlay network

Sensor Networks

- Large number of simple sensors
 - Networked via wireless
- Routing of data instead of connection
 - Queries, aggregation, etc.



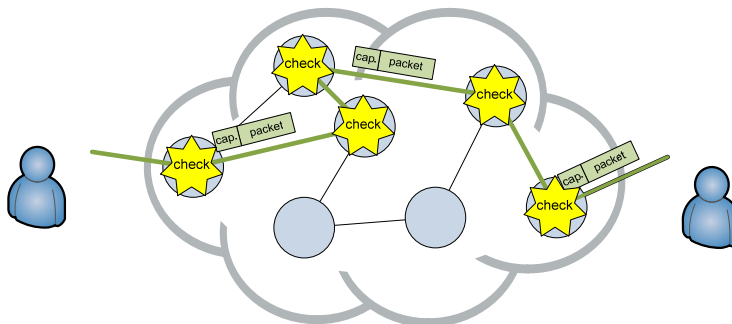
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Capabilities-Based Networks

- Off-by-default network
 - Explicit permission to establish connection
 - Defense against DoS attacks
- “Capability” indicates permission
 - Router(s) check capabilities



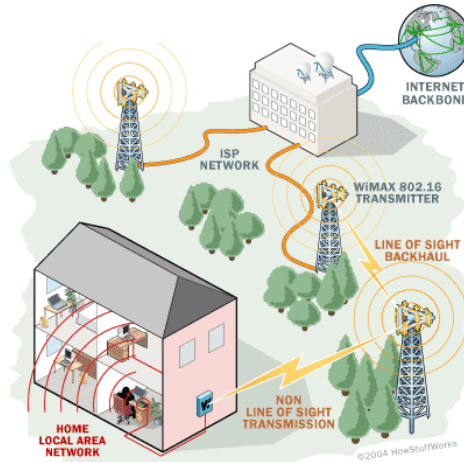
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Wireless Networks

- Large-scale deployment of wireless networks
 - For mobile devices
 - For general network access



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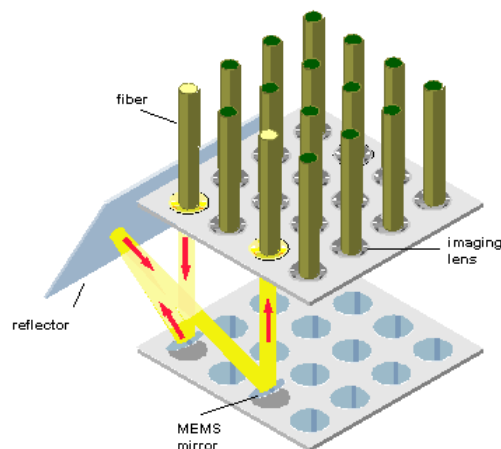
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Optical Core Networks

- All-optical networks
 - Incredible bandwidth in single wavelength
 - Switching of light paths
- Challenges
 - Connection setup
 - Control much slower than data
 - Management of wavelengths

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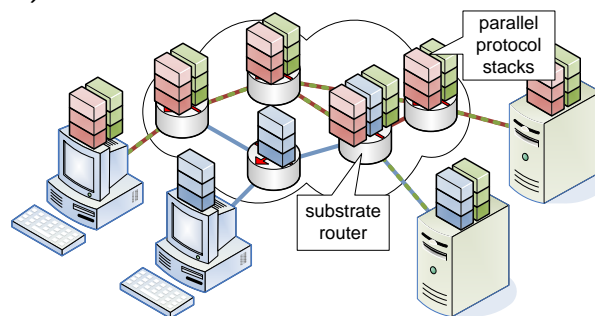
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Programmability in Data Path

- Active networks
 - Programmability by end-system
 - Code carried with packet
 - Very powerful and very difficult to control
 - » Programming abstractions
 - » Process isolation
 - » Resource consumption
 - Example applications
 - » Active reliable multicast
 - » Queue management for video
 - » Traffic merging (audio bridge)
- Programmable router system
 - Predetermined processing functions
 - User/administrator select from functions
- “Network services”
 - General concept of processing in data path

Network Virtualization

- No single network fits all purposes
 - Often conflicting optimizations
- Virtualization of router system
 - Common hardware (“substrate”)
 - Coexistence of multiple networks
 - Specialized networks deployed as separate protocol stacks (“slices”)



Next-Generation Network

- Many new paradigms and technologies
- Currently area of intense research
 - NSF FIND and NSF GENI projects
 - Some level of industry interest
- Exciting time to be networking researcher
 - “Clean slate approach” allow creative ideas
 - Overlap with many interesting technologies and application domains