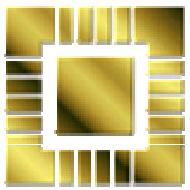

Electronics and Computer Science
University of Southampton

CM214-COMP2008
Data Communications and Networks

Ethernet

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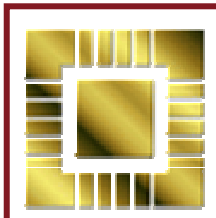
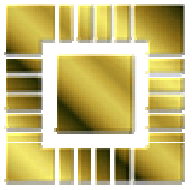


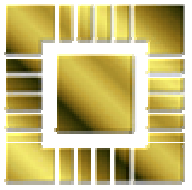
Objectives

- To understand how Ethernet works
- To discuss various Ethernet network topologies
  - And Ethernet hardware components
- (Peterson & Davie, Section 2.6)



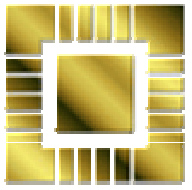
Ethernet History

- In the 1960's the University of Hawaii has facilities on various islands that needed connections to the mainframe
- Developed a "packet radio" system, ALOHA
- Transmitted packets of data over a shared frequency band
- Developed into Ethernet by Xerox PARC in the 1970's



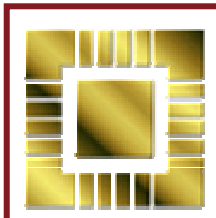
Ethernet Cabling

- Works in the same way as ALOHA but over a shared cable, not air
  - Cable is a broadcast medium
  - Needs termination to avoid echoes
  - Segments (below) can be joined by repeaters (≤4)
- Cabling options
  - 10base5 – thick yellow co-ax (500m)
  - 10base2 – thin black co-ax (200m)
  - 10baseT – unshielded, twisted pair, any colour you like(!), (100m)



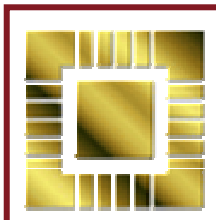
Ethernet Transmission

- Ethernet is a CSMA/CD network
  - Carrier sense, multiple access with collision detection
- Can sense when the medium is currently in use
  - And hence does not transmit
- Can detect collisions with its own transmissions
  - By listening to what is on the medium

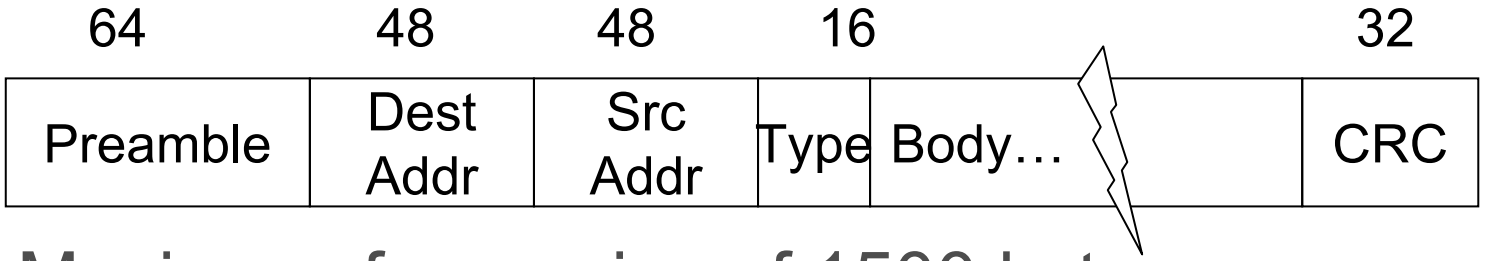


Ethernet Addressing

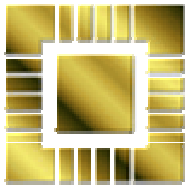
- Every host on the Ethernet must have a unique address
  - Because it is a broadcast medium, all hosts receive all messages
- Achieved by building every Ethernet adaptor with a different address
  - From a 48 bit address space
  - MAC Address, e.g. 08:12:CA:E4:B3:17



Ethernet Packets

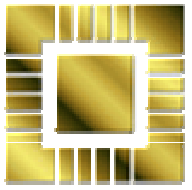


- Maximum frame size of 1500 bytes
  - Minimum frame size of 64 bytes
- Addressing scheme also allows for
  - Broadcast frames (to all hosts)
  - Multicast frames (to a group of hosts)
- Hosts can also be “promiscuous”
  - Will receive all frames (sent to any host)



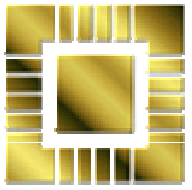
Transmission Algorithm

- Although hosts listen before transmitting, two (or more) may start transmitting at the same time
- Detected by listening to medium
- If a collision detected, send jamming sequence
  - Then wait for a while and try again
  - "Random exponential back-off"



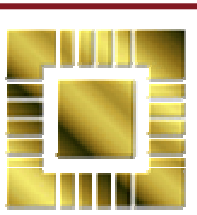
Propagation Delay

- A single Ethernet could be 2500M long
  - 5 x 500m segments, 4 repeaters
  - Round trip delay is 51.μS
  - 512 bits at 10Mbps
- Hence requirement for minimum frame size of 64 bytes
  - To allow a frame to propagate over entire Ethernet during transmission time
  - So collisions can be detected



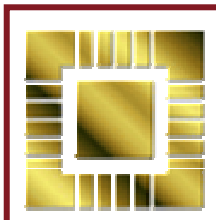
Ethernet Topologies

- 10base5 & 10base2, shared segments connected by repeaters
- 10baseT
  - Crossover cable to connect two hosts
  - Or connect hosts to a hub
    - Still a broadcast medium
  - Crossover cable to connect hubs
  - Hubs are “passive” devices



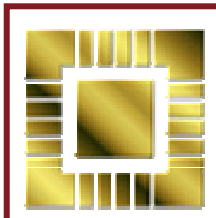
Congestion

- Ethernet performance declines dramatically with increasing traffic
  - Many more collisions
- Maximum utilisation of a shared segment ≈ 70%
- Performance (throughput) starts to tail off at ≈ 30%



Switched Ethernet

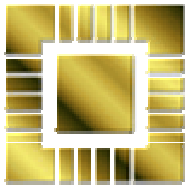
- One approach to congestion is give every host its “own” segment
- Connect all segments to a switch, which routes frames
- Switch is a hardware device
- Implements a “star” topology
- Switches can become congested
  - But only at much higher loads



Ethernet Developments

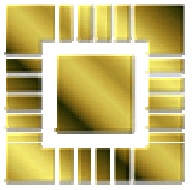
- Most Ethernet adapters are now switchable (automatically) between 10Mbps and 100Mbps

- Gigabit Ethernet also available
  - Similar technology
  - Normally used in switched environments



Other Networking

- Ethernet is by far the most common form of networking
- There are others
  - Token Ring
  - FDDI
  - Wireless
  - Infra-red



Summary

- Ethernet is a broadcast technology, with collision detection
- Simple framing scheme
- Universal unique addressing
- Implemented as shared segments
- Or switched environments
  - Still using same transmission scheme
- Ubiquitous, but not the only solution