

**CS 4/54201  
Computer**

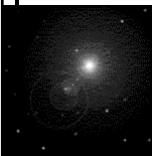
**Communication  
Network**



**Kent State  
University**

Dept. of Computer Science

[www.mcs.kent.edu/~javed/class-NET06F/](http://www.mcs.kent.edu/~javed/class-NET06F/)



A Course on Networking and  
Computer Communication

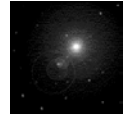
# INTERNETWORKING

## SCALING OF NETWORKS

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### Problems of Scaling

- Distance Limitation
- Technological Heterogeneity

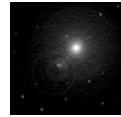


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## Extending LANs

- Why LANs are distance limited?
  - Signal loss at physical level
  - Coordination at logical level
- Engineers have developed a variety of ways to extend LAN connectivity.
- Most extension mechanisms use standard interface hardware and insert additional hardware components that can extend signals at longer distances.
- Fiber optic extensions, repeaters, bridges or switches and hubs can be used for extending LANs.

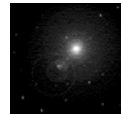


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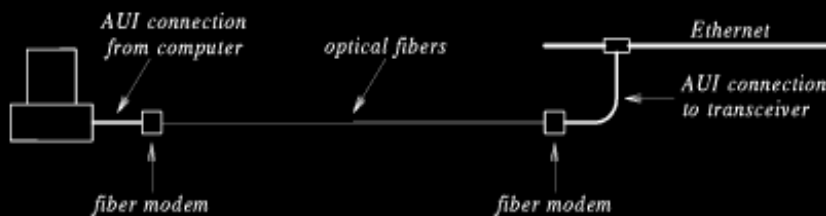
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## Fiber Modems

- The simplest LAN extension mechanism uses optical fibers and a pair of fiber modems extend the connection between a computer and a trans-receiver. Fibers have low delayed and high bandwidth.

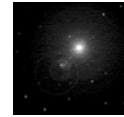
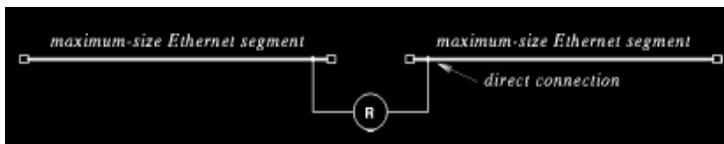


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# Repeaters

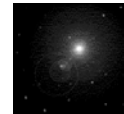
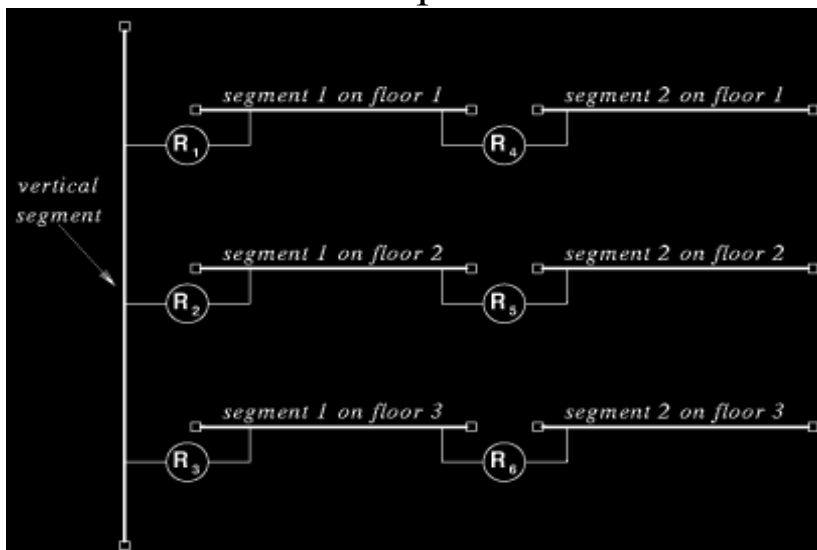
- Repeaters connects a pair of cables and is an analog device.
- Its main job is to repeats every signal that it hears on one side to the other.



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# Extended Ethernet LAN with Repeaters



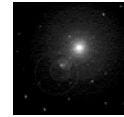
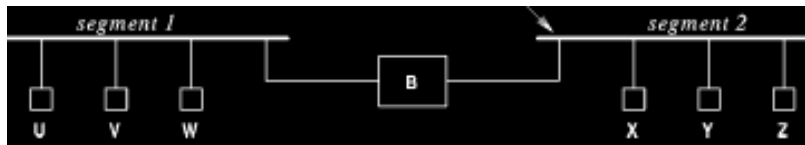
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Repeater  
repeats  
everything,  
collision,  
noise, even  
thunderstorm!

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# Bridges

- Bridges also connects two networks,
  - but they understand frame format.
  - Has a separate HW address.
  - Can talk to each other.
- Listens to both the networks in promiscuous mode and can copy every frame it receives intact to the other network.
- Thus two LANs can work as one LAN.
- Computers would not know on which segment they are in.

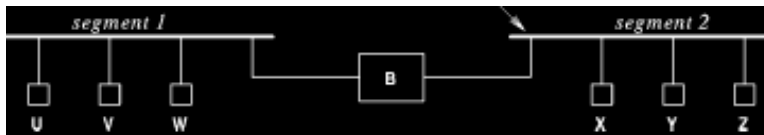


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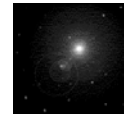
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# Bridges

- Bridges can also perform frame filtering.
  - It looks into hardware address in the frames.
  - Relays the frames only if it is for a computer in other segment.



Event	Segment 1 List	Segment 2 List
Bridge boots	-	-
U sends to V	U	-
V sends to U	U, V	-
Z broadcasts	U, V	Z
Y sends to V	U, V	Z, Y
Y sends to X	U, V	Z, Y
X sends to W	U, V	Z, Y, X
W sends to Z	U, V, W	Z, Y, X



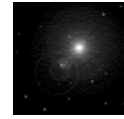
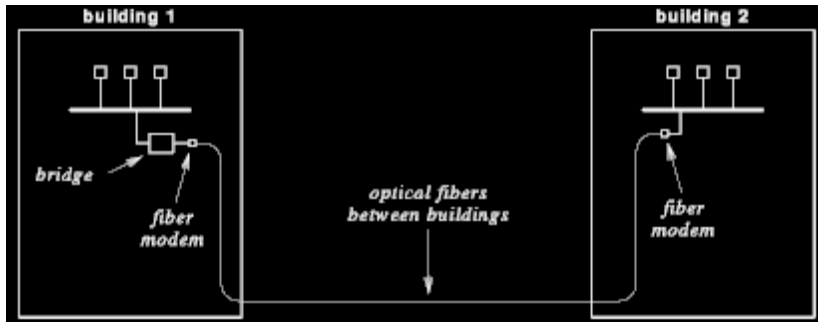
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How do they know which computer is in which side?

How Bridges know about the computer which did not talk?

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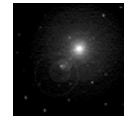
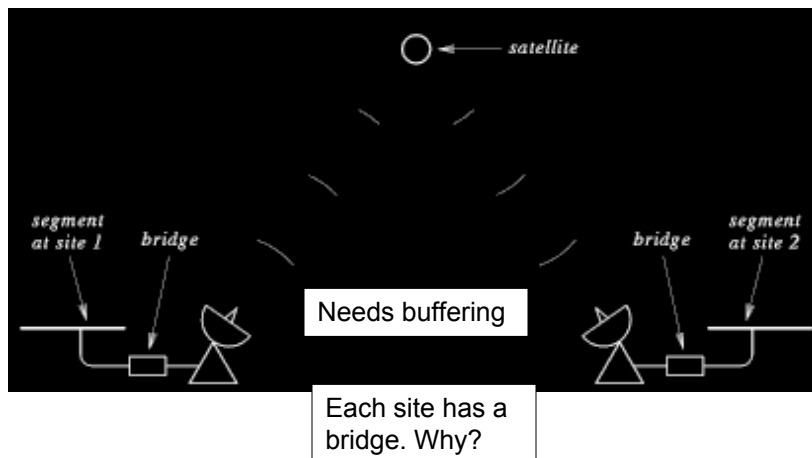
## Bridging Between Buildings



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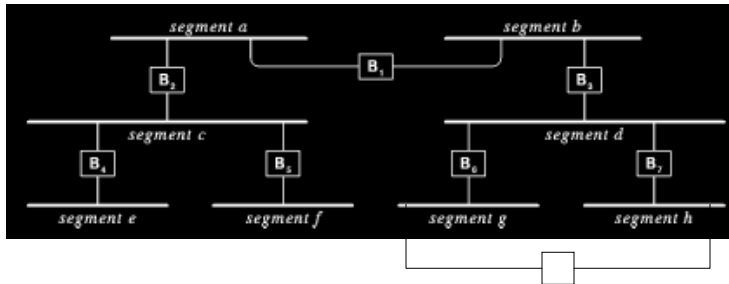
## Bridging Across Long Distance



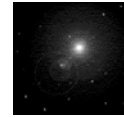
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## Cycle of Bridges



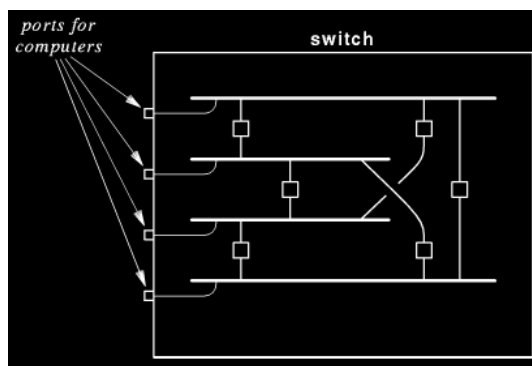
- Parallelism
- How computers should be distributed at two segments?
- Each Bridge connects only two networks.



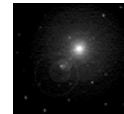
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## Switching



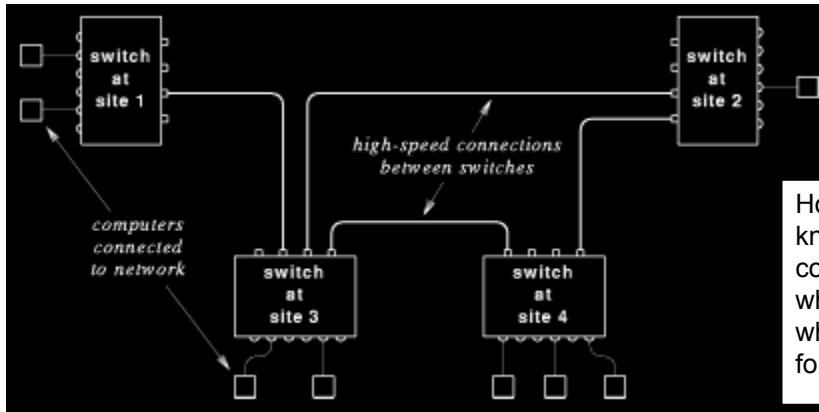
Computers can communicate in parallel. But costly.  
Thus a combination of Switch & Hub is used.



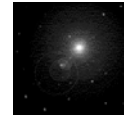
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## WANs with Packet Switches



- Computers now talk in parallel.
- Switches does store and forward.

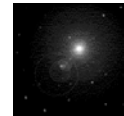


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## Problem of Scale: WANs

- The techniques shown in last few slides show how the distance limitation of LANs be extended.
- But, they do not solve the problem of Scale. What if we have too many computers scattered across long distances, at different places?



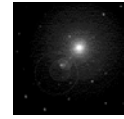
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# Internetworking

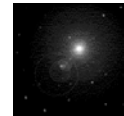
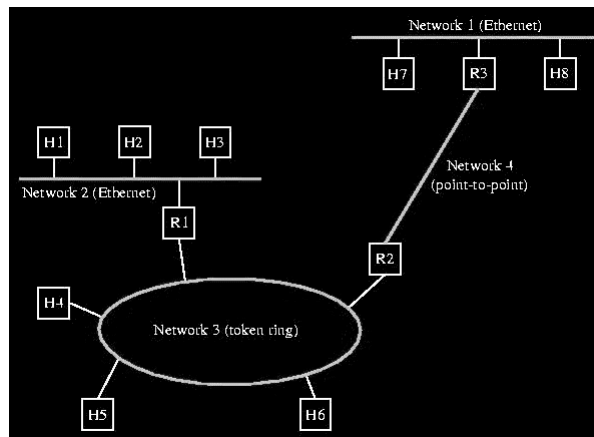
- Global Addressing
- Packetization
- Distributed Routing



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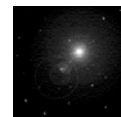
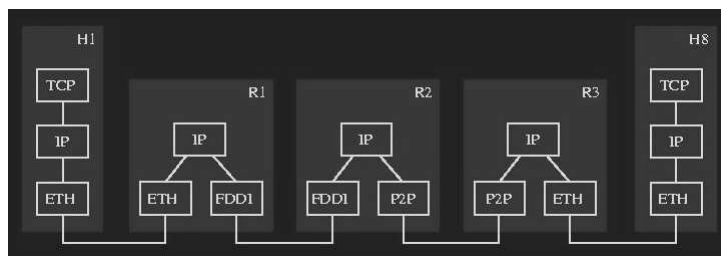
# Internet Connectivity



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# TCP/IP Protocol Stack



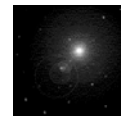
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# Summary

- LAN technology can connect a community of computers.
- Solution to Distance Limitation
  - Repeaters & Bridges.
- Solution to Scale Limitation
  - Packet switch for connection scaling.
  - Distributed Hierarchical Routing

10s of thousands of computers can be connected with the above Networking Infrastructure!



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# NEXT CLASS

## IP4