
Performance Evaluation of Educational Workstation LAN Systems

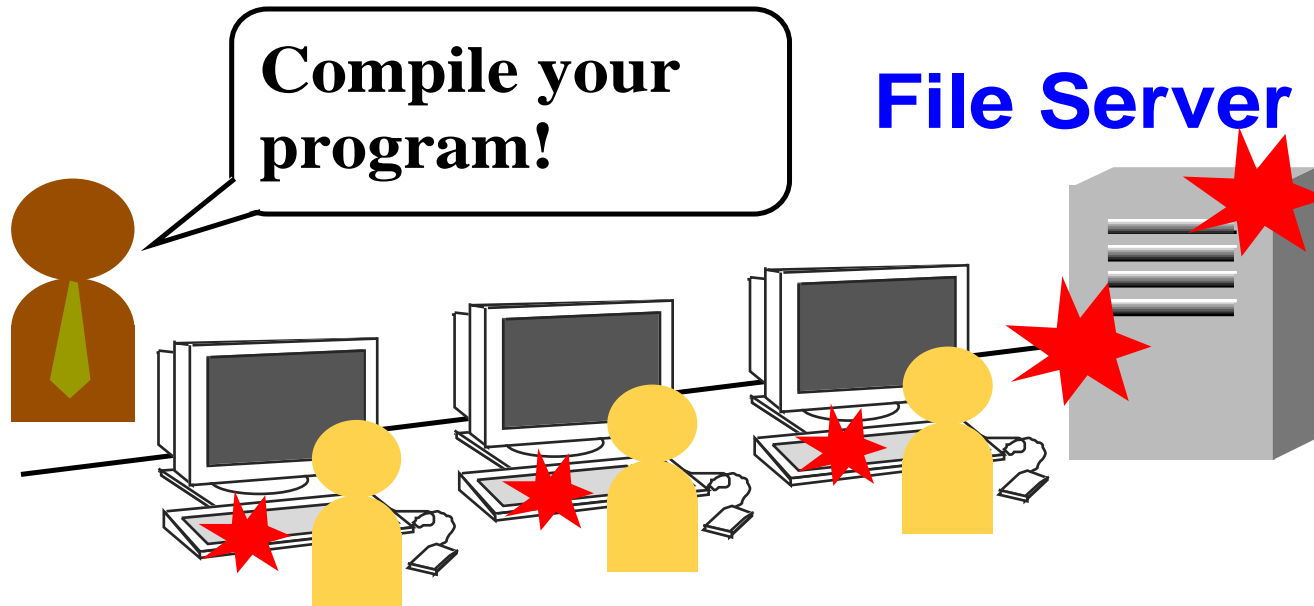
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Concentrated Educational Workstation Systems

- ◆ **Many Registered Users**
- ◆ **Many Users at a Time**
- ◆ **Many Workstations**
- ◆ **Same Working Environment at All Workstations**
- ◆ **Easy to Maintenance**

"Ready Go!" Situation

- ◆ Momentary High Load to the LAN
- ◆ Long Response Time



Approach

- ◆ **Detailed Network Simulator**

- Ethernet CSMA/CD, Propagation Delay
- TCP / NFS Retransmission Strategies

- ◆ **Users' Behavior Model**

- “Ready Go!” Situation
- Based on Measurements in an Educational System

Related Works

◆ Performance Evaluation of LANs

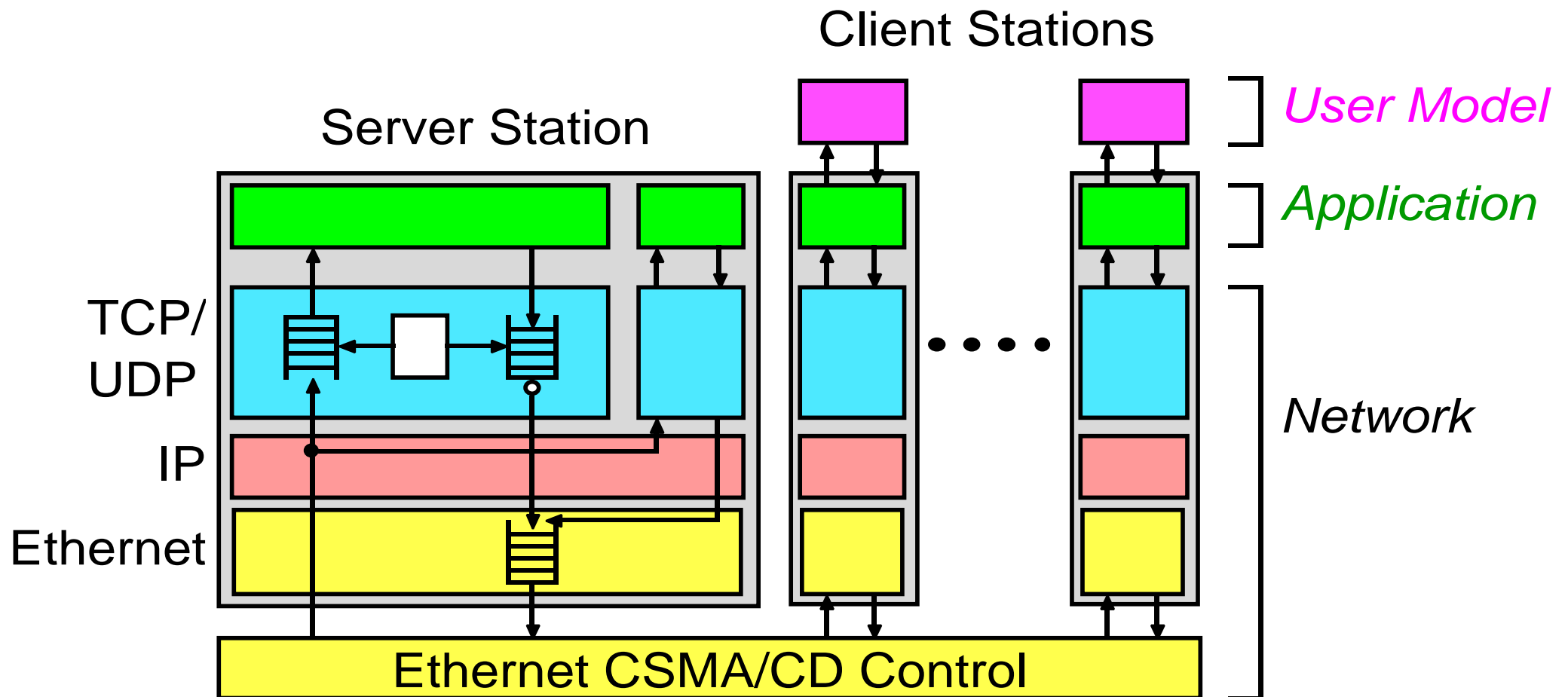
- Gigabit Ethernet [Molle 97]
 - » **Only under MAC Layer (Ethernet)**
- Packet Length Distribution in Practical LAN [Ishida 94]

Yet to be Achieved

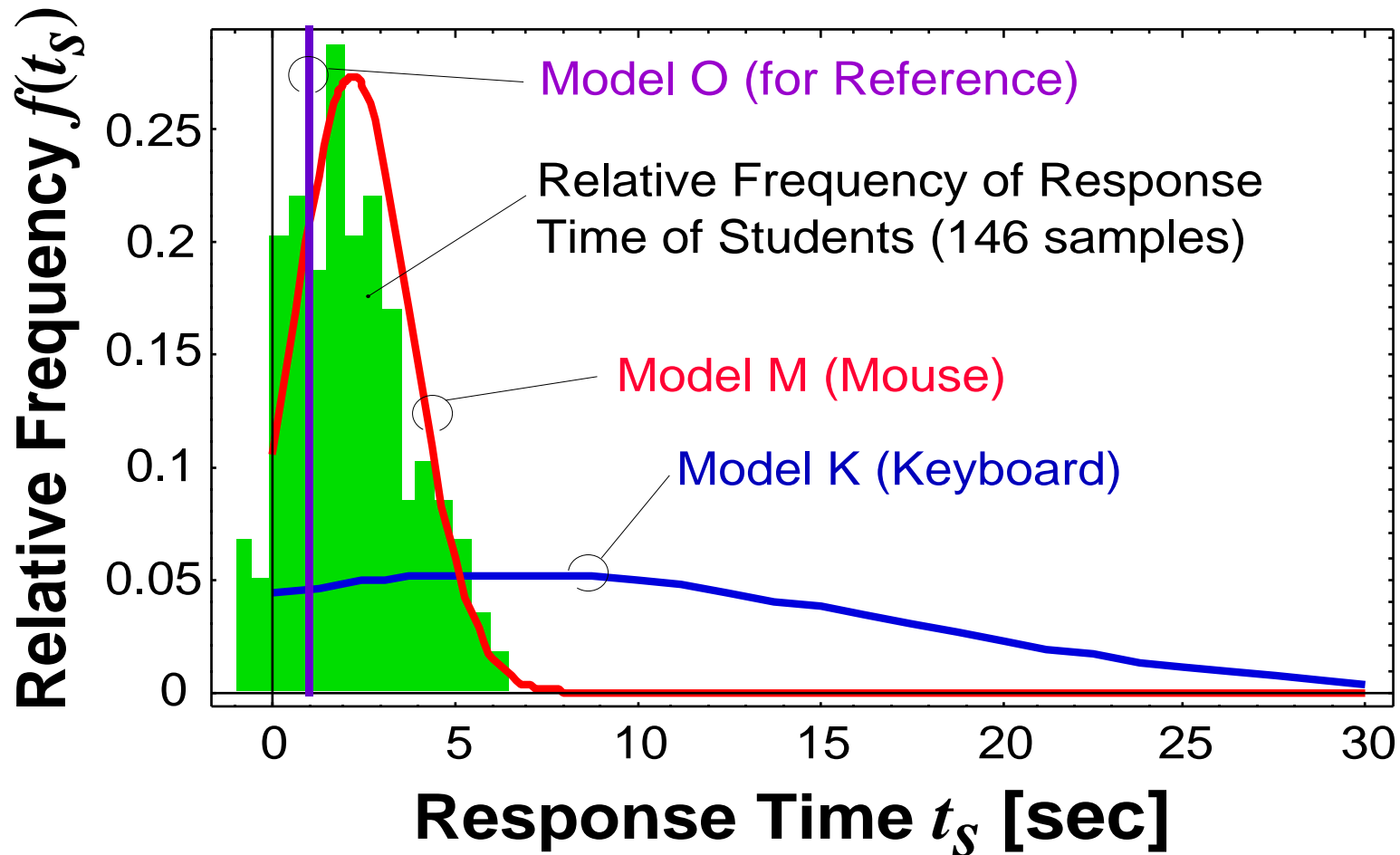
- Educational Systems (“Ready Go!” Situation)
- Total Analysis from 1st Layer to 7th Layer

Network Simulator

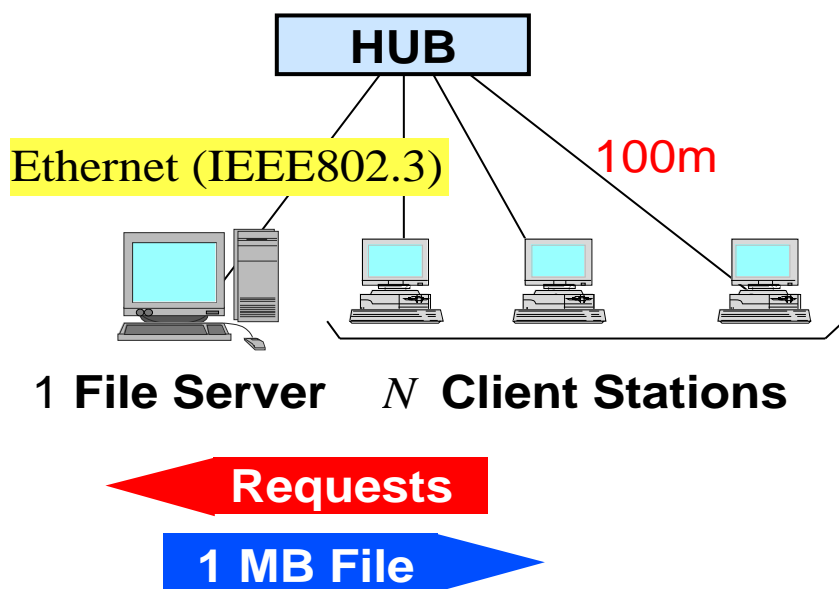
SimNET



Users' Behavior Model

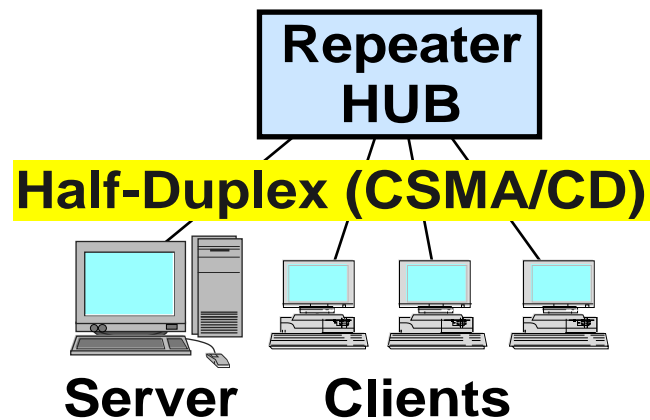


Simulation

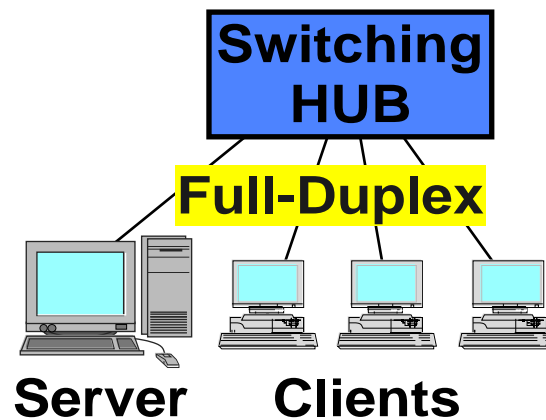


- ◆ NFS (SunOS 4.1), FTP
- ◆ TCP(BSD 4.3Tahoe), UDP/IP
- ◆ Ethernet
 - 10BASE-T (10Mbps)
 - 100BASE-TX (100Mbps)
 - 1000BASE-T (1Gbps)
 - » with Carrier Extension & Frame Bursting

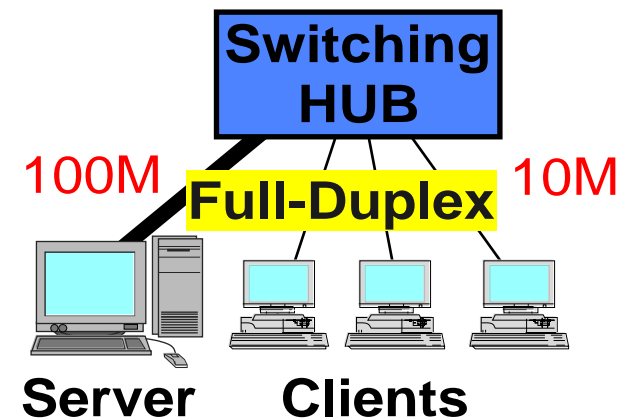
Network Topologies



(a) Shared-10M
Shared-100M
Shared-1G



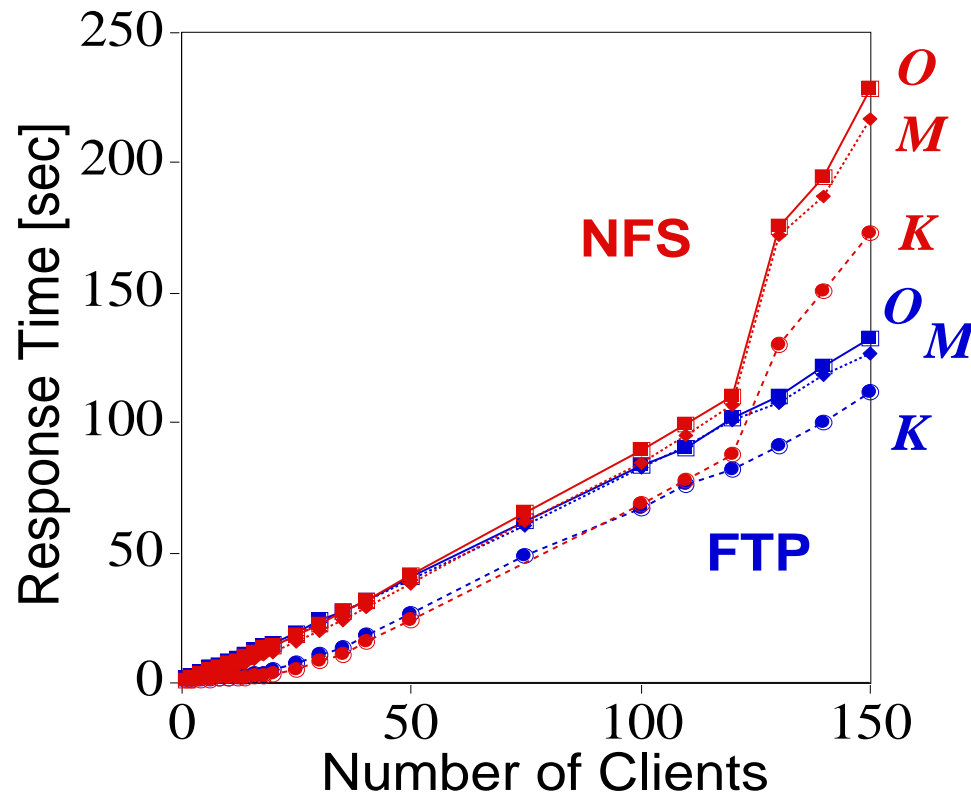
(b) Switching-10M
Switching-100M



(c) BigPipe-10M/100M

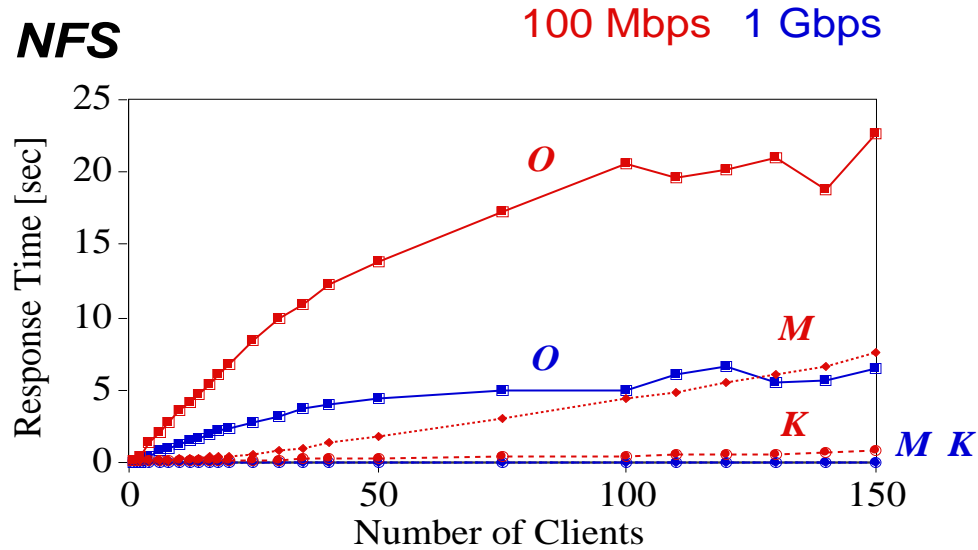
Simulation Results: 10Mbps (Shared)

10BASE-T



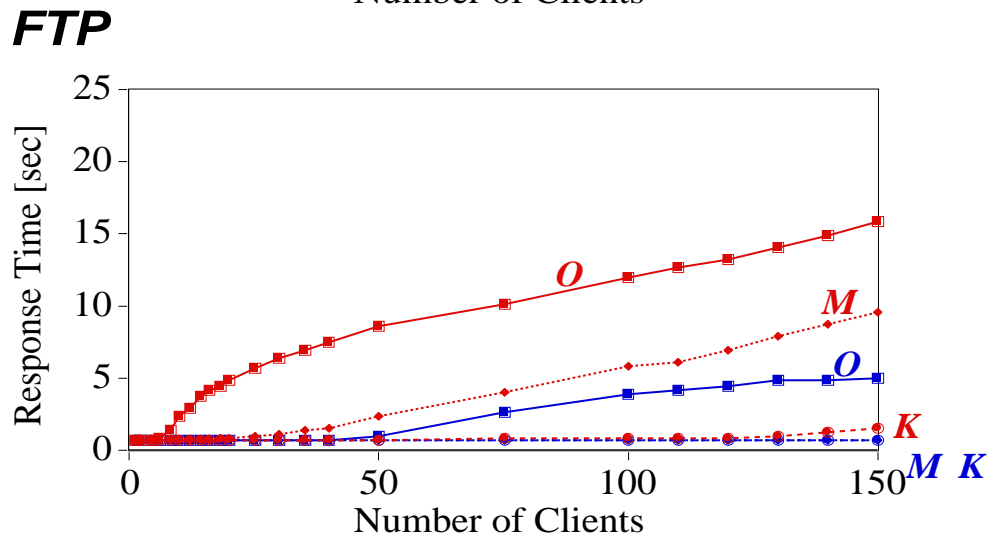
- ◆ **Rapid Increase at**
 - N = 10 (Model M)
 - N = 20 (Model K)
- ◆ **Response Time Explosion at N > 120 (NFS)**
 - NFS time-out

Simulation Results: 100Mbps & 1Gbps (Shared)



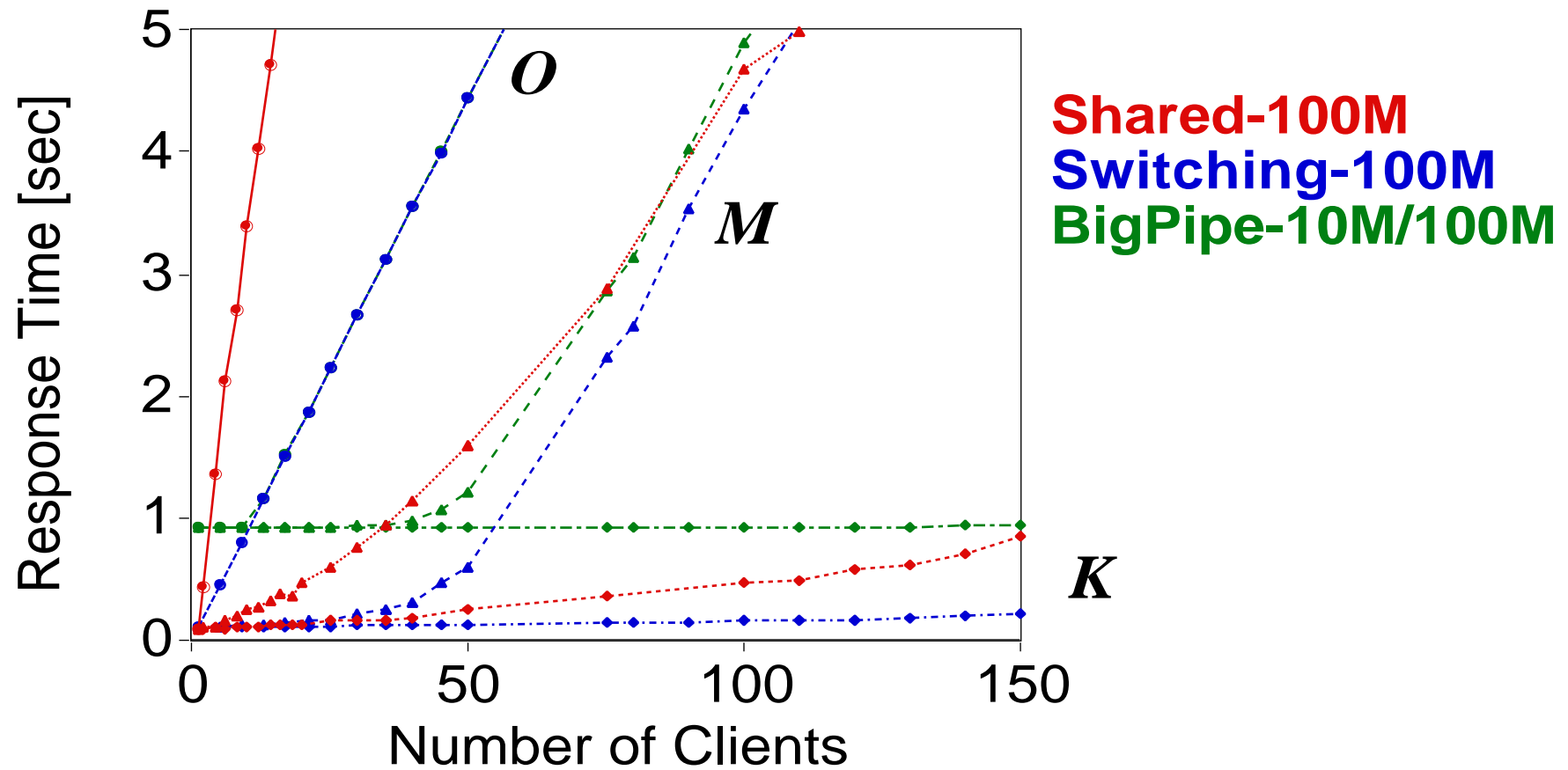
◆ Suitable Numbers of Clients

- $N < 50$
(100 BASE-TX)
- $N > 150$
(1000BASE-T)



Simulation Results: Switch & BigPipe

NFS

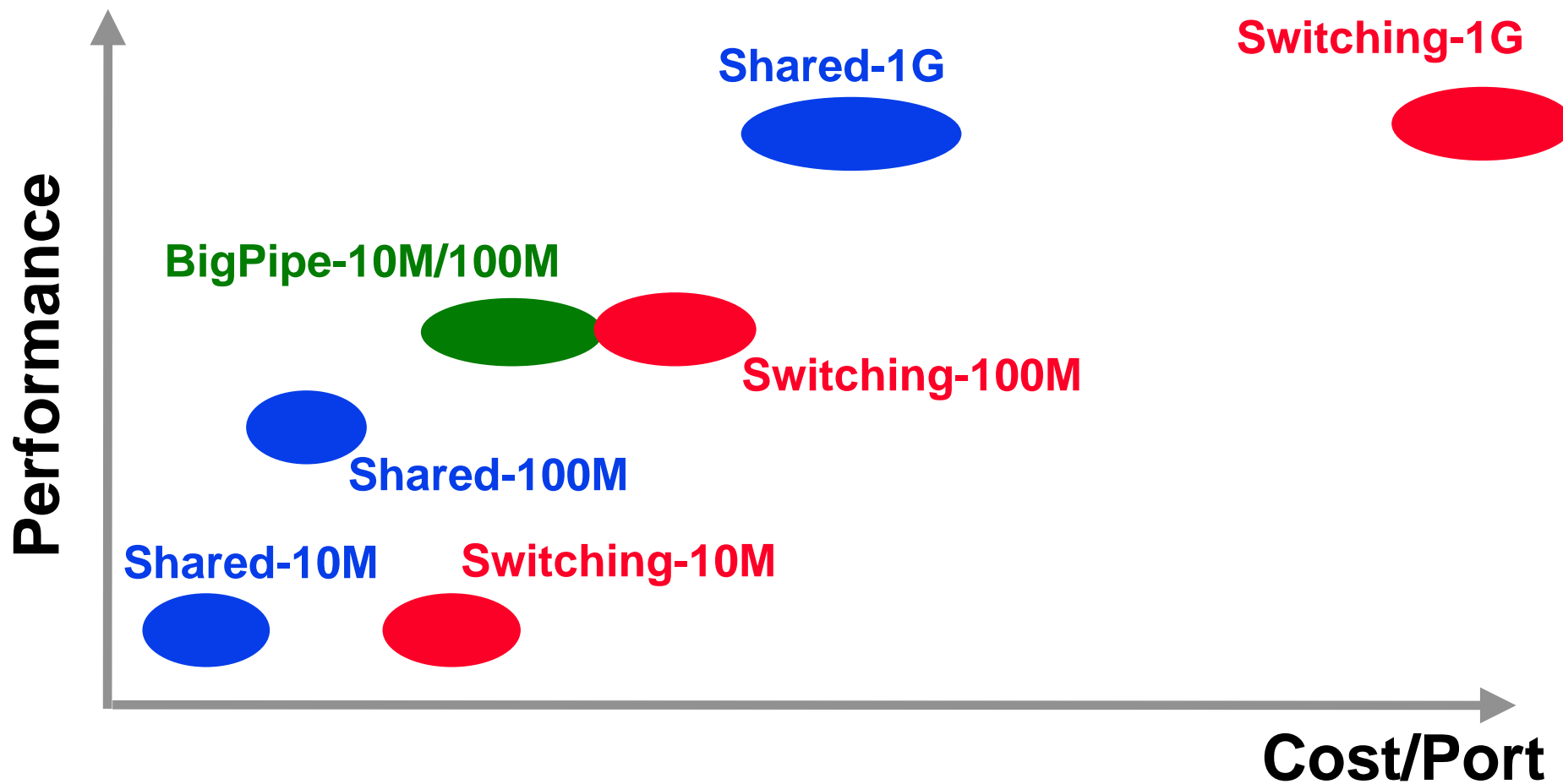


Proper Number of Clients

- Response Time < 1 sec
- No rapid increasing of response time

	Mouse Operation	Keyboard Operation
Shared-10M	< 10	< 20
Switching-10M	< 10	< 20
Shared-100M	< 30	< 150
Switching-100M	< 50	> 150
BigPipe-10M/100M	< 50	> 150
Shared-1G	> 150	> 150

Cost and Performance



Conclusion

- ◆ **Suitable Design for Educational Workstation LAN Systems**

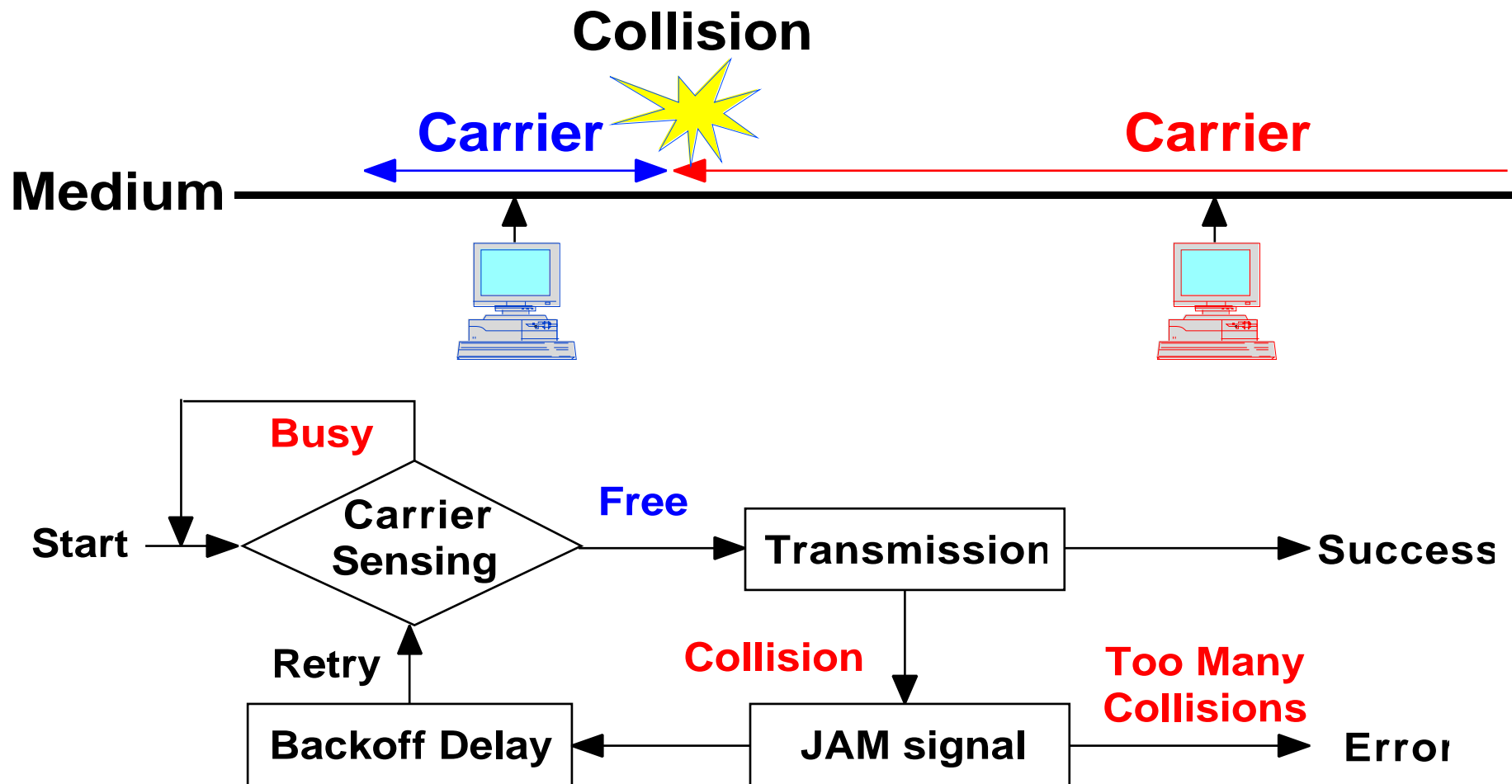
obtained by

- Detailed Network Simulation
- Users' Behavior Models

- ◆ **Future Studies**

- Other Network Topologies
- Consideration of the Performance of Servers
- Multimedia Data Transmission

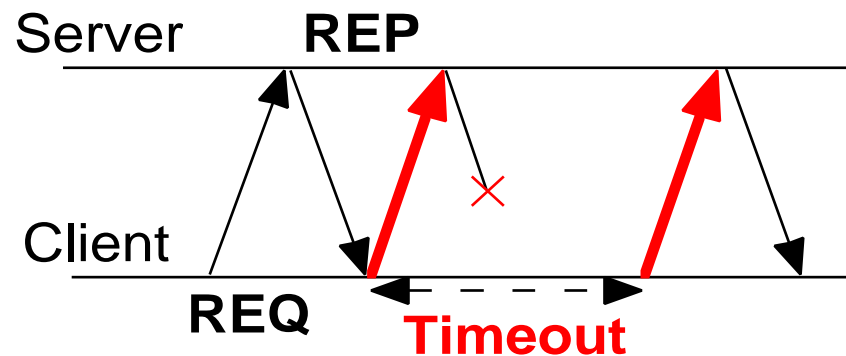
CSMA/CD Algorithm



Application Models

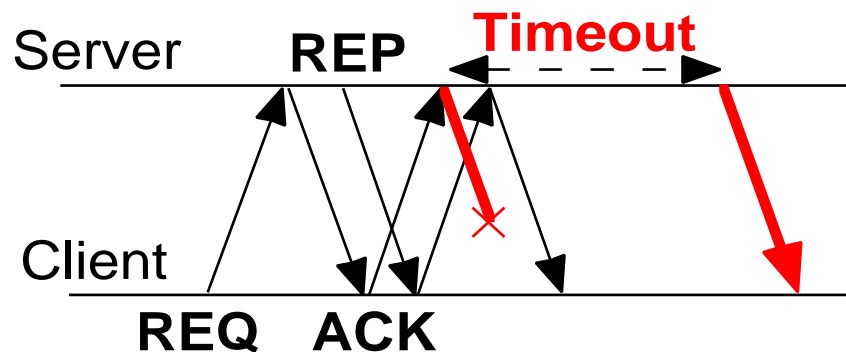
◆ NFS

- Simple Time-out and Retry

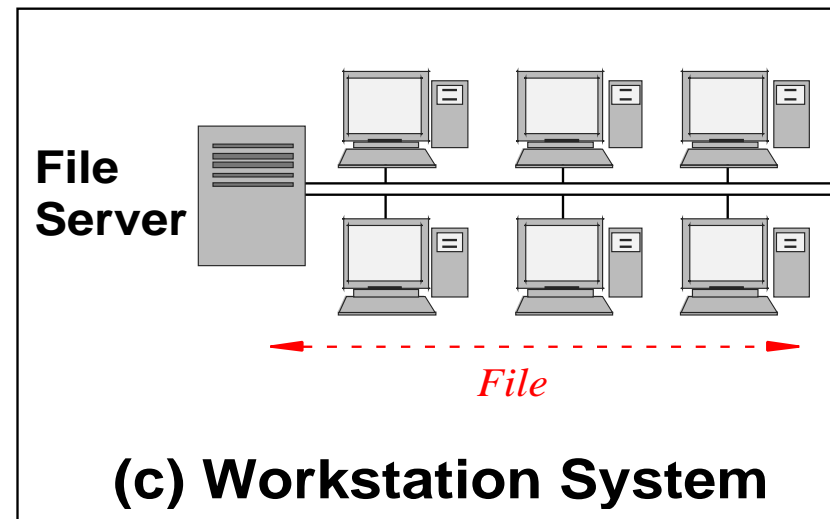
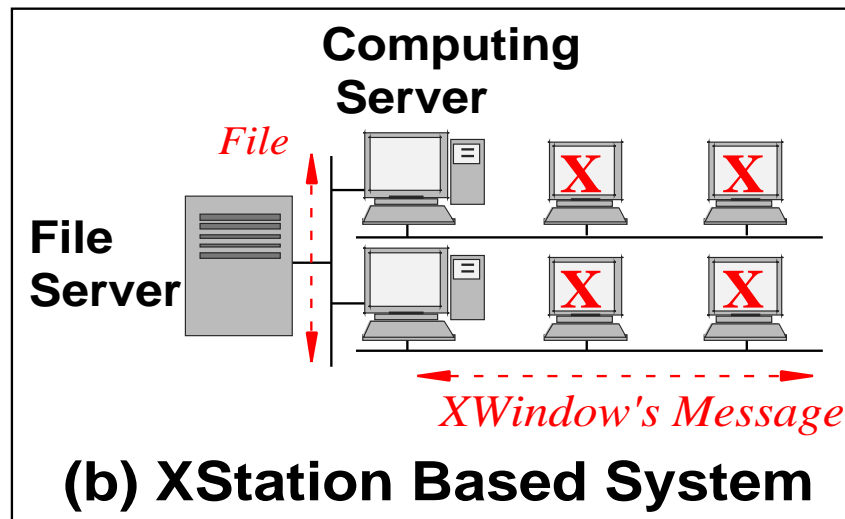
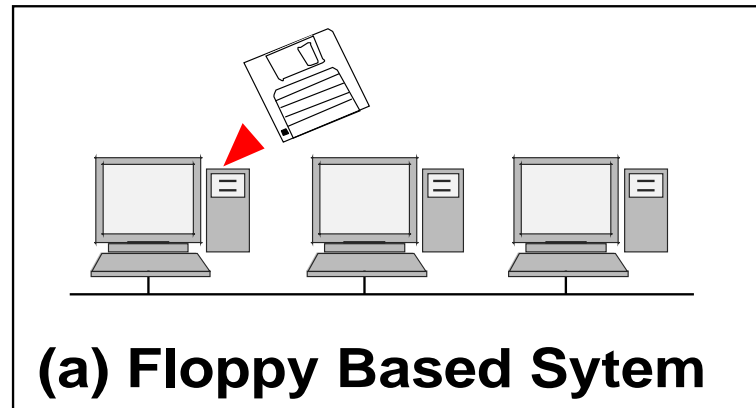


◆ FTP

- Works on TCP
- Reliability is offered by TCP

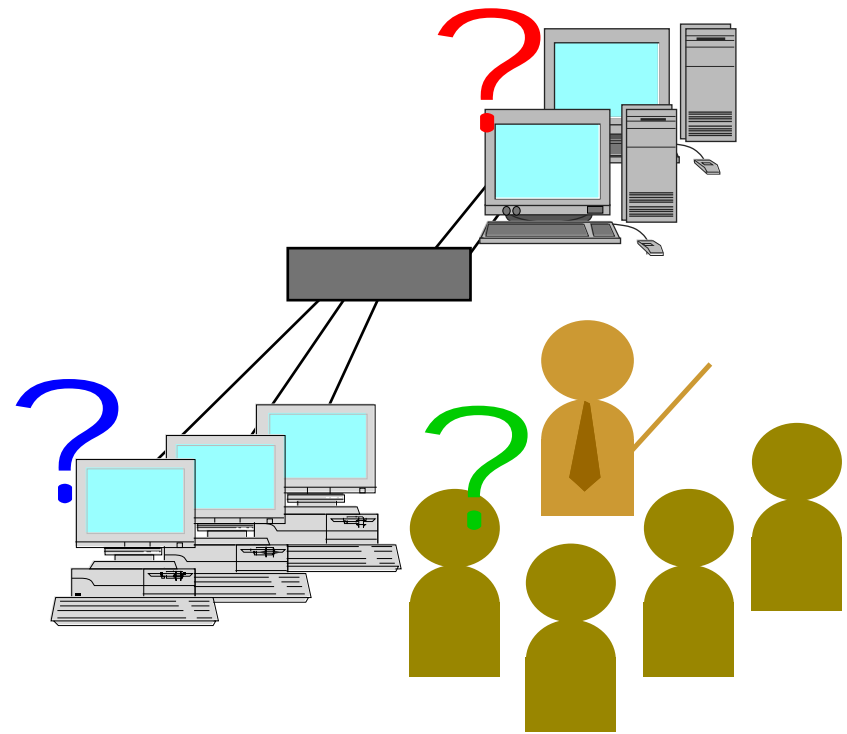


Examples of Educational Systems



Problems in Designing Networks

- ◆ How many stations are suitable for an Ethernet collision domain?
- ◆ How many stations are suitable for a file server?
- ◆ How do students behave in educational computer systems?



SimNET

Supports...

- ◆ **Cable and HUB Delay on Ethernet**
- ◆ **CSMA/CD algorithm**
- ◆ **All Packet Transmissions**
- ◆ **Retransmission Strategies**
- ◆ **User Actions**