
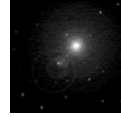


CS 4/54201 Computer	Kent State University Dept. of Computer Science www.mcs.kent.edu/~javed/class-NET06F/
Communication Network	

	A Course on Networking and Computer Communication

Class Mechanics

- Internet Engineering (Fall 2007)
 - Internet Technology (addressing, routing, management)
 - HTTP 1.1
 - Information Sharing (document session)
 - Network Programming
 - Web Server and Web Browser Design
 - Transoceanic Cache and Internet Performance
- Peer-to-Peer Networking (Spring 2007)
 - Architecture of major P2P systems
 - Theory complex network
 - Distributed Hashing
 - Search & Routing in P2P
 - Event Routing
 - Security & Scalability

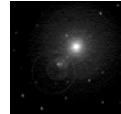


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Class Mechanics

- DO NOT Email be the Home Works
 - Email to TA: wchantam@cs.kent.edu
- Project#1 Due today: Submit your ZIP file to TA
- Midterm Monday OCT 23 rd
- But FlexFormat Midterm on Friday:
- Signup for exam Slot
- Midterm Exam
 - Open Book
 - 4 questions
 - Answer any three
 - 1 true/ false.



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Slot1:Th

Slot2:Fr

Slot3:Fr

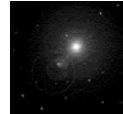
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FORWARDING

5

Packet Switching

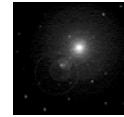
- All machines are not connected directly
- Limiting Reasons:
 - Number of Nodes.
 - Length of Links.



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Packet Switch

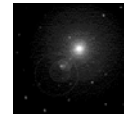
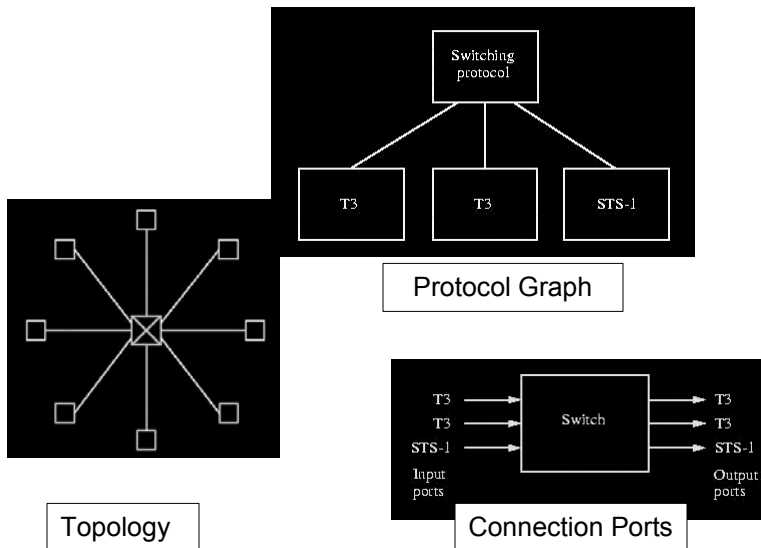
- Packet switch is a device which connects links logically. Upon receiving a packet from one link, it generates a new packet (perhaps with some logical modification of the original one) and transmits it towards its final destination.



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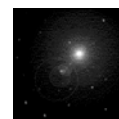
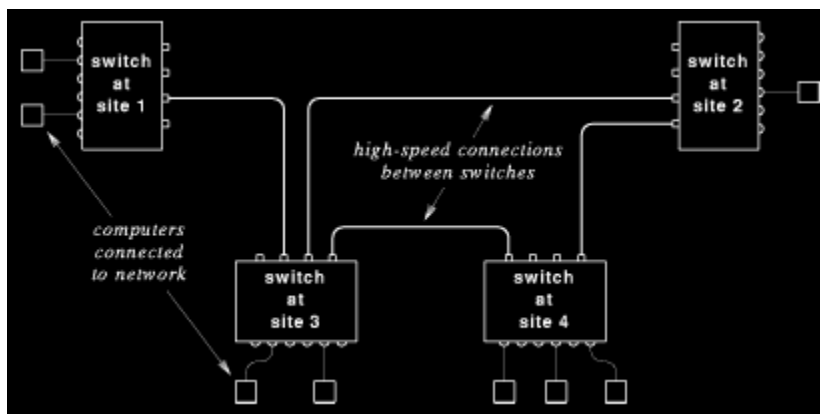
Switch



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WANs with Packet Switches



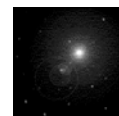
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Advantages of Switching

- Nodes can be connected using simple point-to-point links.
- Although a single switch has fixed number of input and output, but large networks can be built using many interconnected switches.
- Adding new host to a network by connecting it to the switch does not mean that the hosts already connected will get worse performance.

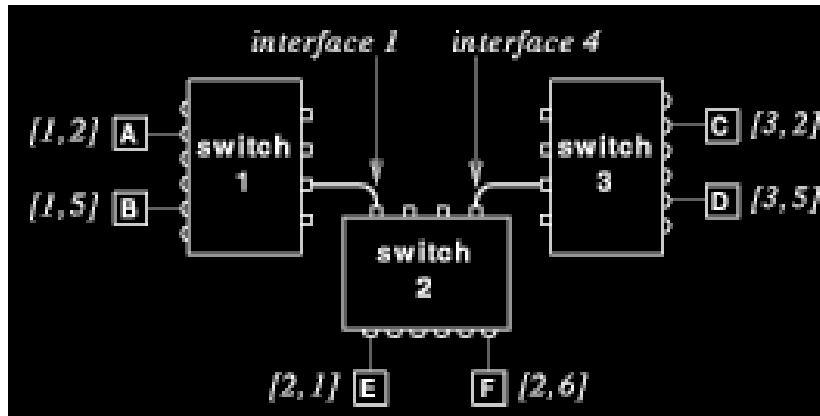


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WANs with Packet Switches



Forwarding and Routing

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How do they know which computer is where and where to forward?

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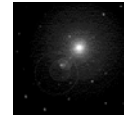
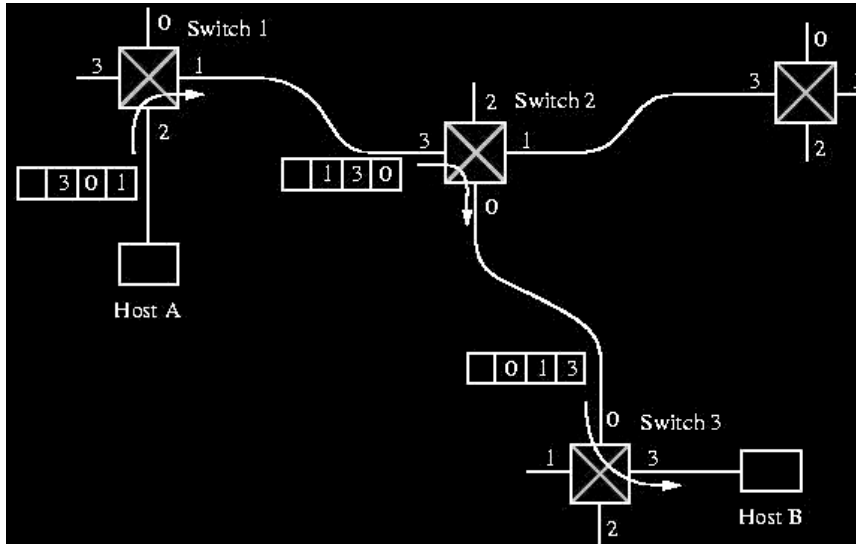
Source Route based Forwarding

- Each packet contains enough information to find its path.
- The source knows the entire path.
- The source of the packet lists all the output port numbers along the path in the packet header.
- Each switch looks into the packet header and forwards it to the designated output port.

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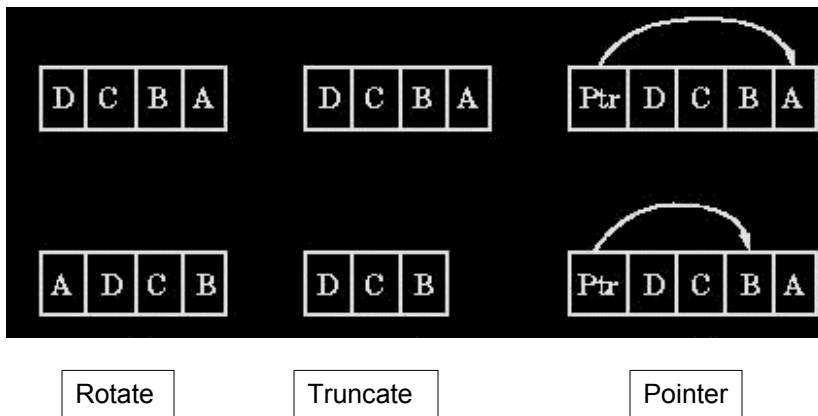
Example of Source Routing



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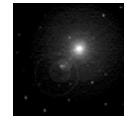
What to do with the Header?



Rotate

Truncate

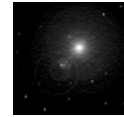
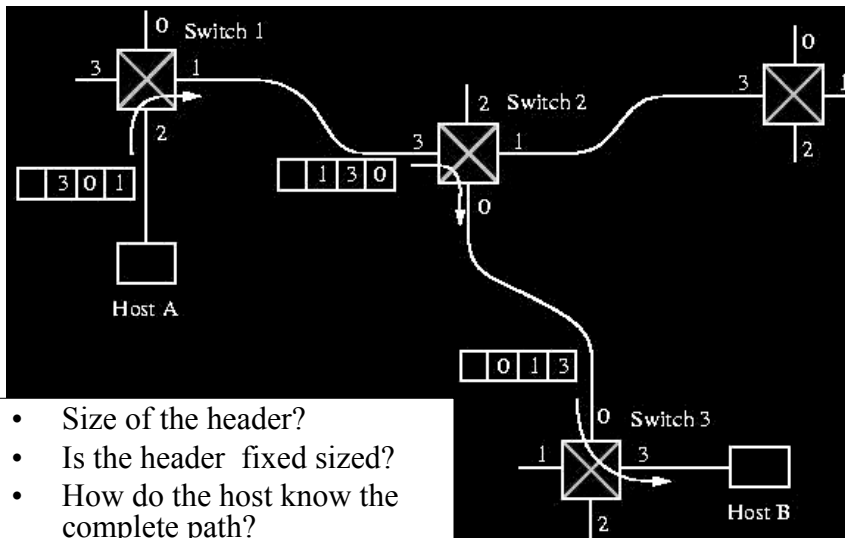
Pointer



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Advantages and Disadvantages

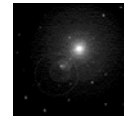


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Virtual Circuit Switching

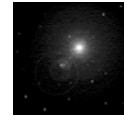
- This is a connection-oriented model.
- The first step is to set up a virtual connection from the source to host.
- Once the connection is established, all switch on the way can determine the destination of a packet by looking at the small identifier of the packet.



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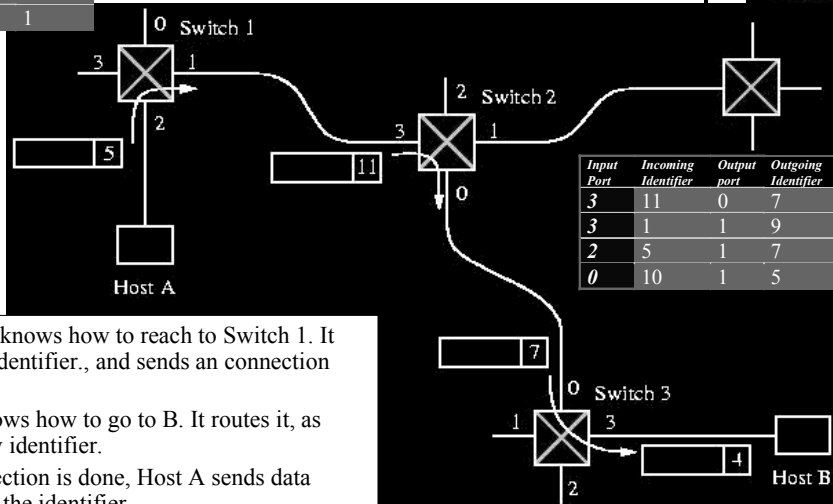
Quiz



- 203: Explain True or False. In the source based routing Maximum diameter of the network will determine the packet size.

Input Port	Incoming Identifier	Output port	Outgoing Identifier
2	1	2	4
2	4	0	3
2	5	1	11
2	7	1	1

Example of VC



- Host A only knows how to reach to Switch 1. It appends an identifier., and sends an connection request.
- Switch 1 knows how to go to B. It routes it, as selects a new identifier.
- Once, connection is done, Host A sends data packets with the identifier
- When done, host A sends a tear down request....

Example of VC

Input Port	Incoming Identifier	Output port	Outgoing Identifier
2	1	2	4
2	4	0	3
2	5	1	11
2	7	1	1

Input Port	Incoming Identifier	Output port	Outgoing Identifier
3	11	0	7
3	1	1	9
2	5	1	7
0	10	1	5

- Communication Delay?
- Packet Size? (connection request packet vs. data packet)
- What if the connection is accidentally broken?
- How the switches decides about the way out?

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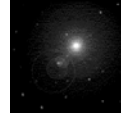
Quiz

- 201: If the identifier of packet from host A in last example was 7, not 5 where it will be routed?

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Advantages of VC

- More thing can be done while setting up connections:
 - There is really a route..
 - Every body on the way can allocate buffer for a connection.
 - A QOS can be ensured.
- In X.25:
 - buffers are allocated.
 - Sliding-window protocol is run between each pair of nodes along the VC.
 - The circuit is rejected by a given node if not enough buffer is available.

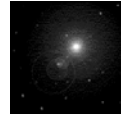


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Datagram Forwarding

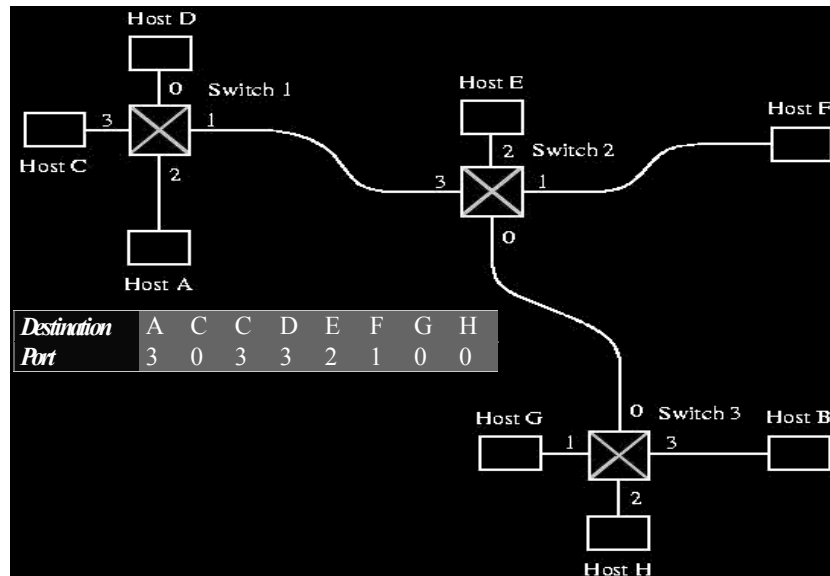
- In this model, there is no need to setup a connection.
- Each packet contains just enough information to get to the destination (what is it?)
- Each switch decides how to forward it towards the destination.



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Example of Datagram Forwarding



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Characteristics of Datagram Forwarding

- No round trip delay.
- But large tables.
- While sending, no way of knowing if the connection is there.
- Failure of one switch may not have any effect on communication.
- Every packet must carry the destination address. The over head is higher than connection-oriented model.
- No obvious way of setting up QOS.

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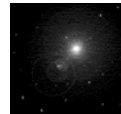
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Routing Algorithms

25

Routing

- How do the nodes, or switches find out about the network topology?
- Forwarding vs. Routing:
 - Forwarding consists of taking a packet, looking at its header or destination address, consulting a table, and sending the packet in the direction determined by the table.
 - Routing is the process by which the tables are built, and is a topic to which people can devote an entire career.
 - The basic objective is to find the lowest cost path between two nodes in the network.
- Generally networks are large and dynamic. Thus static approaches do not work.

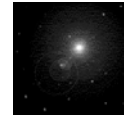


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Quiz

- 202: Datagram forwarding vs. Virtual Circuit, which one will you use for short communication (say only 10 byte communication). Explain why?



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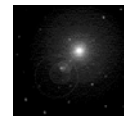
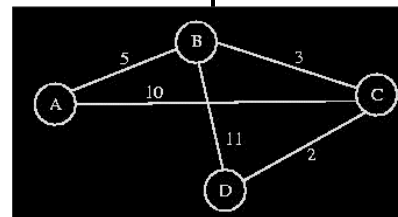
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Computing Shortest Path (Dijkstra's Algorithm)

$W[i][j]$ =link cost between node i and j . /*Collected from link states*/
 $S[i]$ =all nodes except source; /*A list of target nodes*/
 $R[i]$ = source for all connected nodes otherwise $R[i]=\text{zero}$. /*Next hops*/
 $D[i]=W[\text{source}][i]$ for connected nodes otherwise $D[i]=\text{infinity}$.

```
while( set S is not empty) {  
  choose a node u from S which is closest to source;  
  if ( $D[u]=\text{infinity}$ ) no path in S, exit;  
  delete u from S;  
  for each v such that  $W[u][v]$  is an edge {  
    if (v is still in S) {  
       $c=D[u]+W[u][v]$ ;  
      if ( $c < D[v]$ ) {  
         $R[v]=R[u]$ ;  
         $D[v]=c$ ;  
      }  
    }  
  }  
}
```

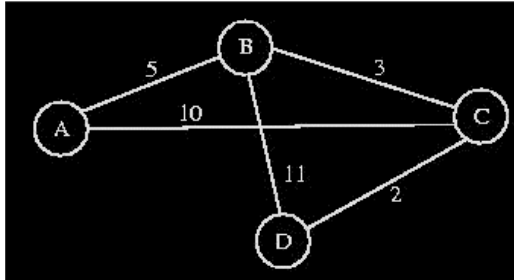
}}}}



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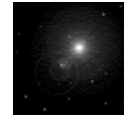
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Example routing table for node D



Quiz: 204: If distance BD is 3 instead of 11 which node will be picked in the confirmed list after D?

CONFIRMED	TETATIVE
(D,0,-)	
(D,0,-)	(B,11,B) (C,2,C)
(D,0,-) (C,2,C)	(B,11,B)
(D,0,-) (C,2,C)	(B,5,C) (A,12,C)
(D,0,-) (C,2,C) (B,5,C)	(A,12,C)
(D,0,-) (C,2,C) (B,5,C)	(A,10,C)
(D,0,-) (C,2,C) (B,5,C) (A,10,C)	



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