Small Review

What is the difference between circuit switching and packet switching?

What is the difference between connection-oriented and connectionless services?

What is the difference between circuit switching and connection-oriented service?

The Network Core

mesh of interconnected routers

the fundamental question: how is data transferred

through net?

- circuit switching: dedicated circuit per call: telephone net
- packet-switching: data sent thru net in discrete "chunks"



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Network Core: Circuit Switching

network resources (e.g., bandwidth) divided into "pieces" pieces allocated to calls resource piece *idle* if not used by owning call (*no sharing*)

- dividing link bandwidth into "pieces"
 - frequency division
 - time division









Packet switching versus circuit switching

Is packet switching a "slam dunk winner?"

Great for bursty data • resource sharing

simpler, no call setup

More resilient to failures Excessive congestion: packet delay and loss • protocols needed for reliable data transfer, congestion control Q: How to provide circuit-like behavior?

- bandwidth guarantees needed for audio/video apps
- still an unsolved problem
- Overprovisioning often used



Packet-switched networks: forwarding

<u>Goal:</u> move packets through routers from source to destination

• we'll study several path selection (i.e. routing) algorithms

datagram network:

- · destination address in packet determines next hop
- routes may change during session
- analogy: driving, asking directions

virtual circuit network:

- each packet carries tag (virtual circuit ID), tag determines next hop
- fixed path determined at *call setup time*, remains fixed through call
- routers maintain per-call state

Internet structure: network of networks

roughly hierarchical

at center: "tier-I" ISPs (e.g., UUNet, BBN/Genuity, Sprint,

- AT&T), national/international coverage
- treat each other as equals

























Packet loss

queue (aka buffer) preceding link in buffer has finite capacity when packet arrives to full queue, packet is dropped (aka lost) lost packet may be retransmitted by previous node, by source end system, or not retransmitted at all







