Lecture 10 (Introduction to Network Layer)

1 Router

1. Input port
2. Output port
3. Switching
4. Buffer management
5. Scheduling

2 Internet Protocol (IP)

1. Datagram format
2. Addressing
3. Network address translation
4. IPv6 is the new version

3 Generalised Forwarding - Software Defined Networking

1. Match+action
2. OpenFlow - match+action in action

4 Network Layer Services and Protocol

1. Takes data from transport layer and transmits it to the destination
2. Present in all points on the network (unlike transport layer which is only present at the ends)
3. Routers examine the header field in all IP datagrams and move them from input port to the output port

5 Functions of Network Layer

1. Forwarding data from router's input link to appropriate router's output link
2. Routing

6   Data Plane

1. It is a local, per-router function
2. It determines how datagram arriving on input port is forwarded to output port

7   Control Plane

1. Network-wide logic
2. Determines how datagram is routed and prevents loops
3. Two approaches exist:
    i. Traditional routing algorithms (implemented in routers)
    ii. SDNs (implemented in remote servers)

7.1   Per-Router Control Plane

Forwarding table is maintained which decides the next router to send the data to

7.2   SDN

Remote controller computes and supplies the routing table to the routers

8   Access Networks

If access network is "switched":

1. Similar to a packet-switched network (or)
2. Layer 2 connectivity

If it is "shared", sharing of data needs to be figured out: wireless or cable

9   What Should be the Promises given by Network Layer?

Points to ponder are:

1. Delivery within a timeout
2. In-order delivery
3. Minimum bandwidth for a "flow"
4. Spacing between packets is maintained

10   What is Actually Promised?

Service model is "best-effort":

1. No bandwidth guarantee

2. Loss is possible
3. Ordering can change
4. No guarantee on timing

11   Comparison

Network architecture	Service Model	Bandwidth	Loss	Order	Timing
Internet	best effort	none	no	no	no
ATM	constant bitrate	constant rate	yes	yes	yes
ATM	available bitrate	guaranteed minimum	no	yes	no
Internet	Intserv Guaranteed	yes	yes	yes	yes
Internet	Diffserv	possible	possibly	possibly	no

12   Features about Best Effort

1. Simplicity
2. Sufficient provisioning of bandwidth is "good enough" for "most of the time"
3. CDN-like implementations helped
4. Congestion control of elastic services allows best effort to work