Virtual Circuit and Datagram Networks

Transport layer provides ← UDP — Connectionless Service
TCP — Connection oriented Service

Similarly Network layer provides Connectionless and Connection Serv.

Network connection service begins with handshake between the source and destination hosts and Connectionless service does not have an handshaking preliminaries.

Difference between N/L & T/L

	N L	T L
1	Services are host-to-host Services provided by the network layer to transport layer	Services are process to process Services provided by the transport layer to the application layer
2	In all major computer NW architecture, the network layer provides either a Connectionless or Connection Service but not both Connection Service are called Virtual-circuit (VC) networks Networks which provide Connectionless Service are called datagram Networks	Both

3. the transport layer connection-oriented service is implemented at the edge of the network in the end system

Network-layer connection service is implemented in the routers in the network core as well as in the end systems

Virtual-Circuit Networks.

ATM & Frame-relay are V-C Networks.

How V-C can be established in a Computer Network

A V-C consists of

(i) A path between source & destination hosts (a series of links & routers)

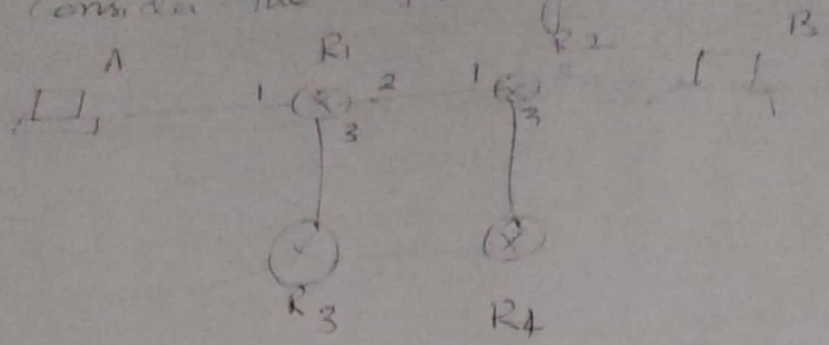
(2) VC numbers one no for each link along the path

(3) Entries in the forwarding table in each router along the path

⇒ A packet belonging to a virtual circuit will car a VC number in its header.

⇒ A virtual circuit may have a different VC no on each link, so each intervening router m replace the VC number of each traversing packet with a new VC number. The new VC numb is obtained from the forwarding table.

Consider the following network



the no's 1, 2, 3 in the Router R1 are the link interf
Nos.

Assume A requests the network to establish a VC betw
itself and Host B. and it chooses the path
A – R1 – R2 – B, and assign VC number 12, 22 &
to the links in the path for the VC.

In this case when a packet in this VC leav
host A, the value in the VC number field in
the pckt header is 12 when it leaves R1
the value is 22 and when it leave R2 the valu
32.

For a VC network, each routers forwarding table
includes Vc number translation

e.g

Incoming Interface	Incoming VC#	outgoing Interface	outgoing VC#
1	12	2	22
2	63	1	18

When ever a new VC is established across a router an entry is added to the forwarding table.

Similarly whenever a VC terminates the appropriate entries in each table along its path are removed.

Why a pkt does not keep the same VC No on each of the links along its route

⇒ Replacing the no from link to link reduces the length of the VC field in the packet header.

⇒ VC setup is considerably simplified by permitting a different VC no at each link along the path of the VC.

⇒ with multiple VC no's each link in the path can Choose a VC number independently of the VC no's chosen at other links along the path.

⇒ If a common VC no were required for all links along the path, the routers would have to exchange and process a substantial no of messages to agree on a common VC no to be used for a connection.

→ In a VC network, the network routers must maintain connection state information for the ongoing connections

→ Each time a new connection is established across a router, a new connection entry must be added to the router's forwarding table.

→ Each time a connection is released an entry must be removed from the table.

There are 3 identifiable phases in a VC

→ VC setup
→ Data transfer
→ VC teardown

① → During setup phase the sending transport layer contacts the network layer, specifies the receiver address and waits for the network to set up the VC.

→ the network layer determines the path between sender and receiver ie the series of links routers through which all packets of the VC will travel

→ the VC no for each link along the path is also determined by the network layer.

→ the entries in the forwarding table in each router is also added by the N/w layer

→ During VC setup the N/w layer also reserves the resources along the path of the VC.

2) Once the VC is established, packets can begin to flow along the VC. Fig 4.4

3) this is initiated when the sender (or receiver) informs the network layer of its desire to terminate VC. The N/w layer then inform the end systems in the other side of the network of the call termination and update the forwarding tables in each of the routers on the path to indicate VC no longer exists.

the diffn between VC setup at the network layer and Connection setup at the transport layer

→ Connection set up at the transport layer involves only the two end systems. The two end systems alone determine the parameters (seq no & Ack no) of their transport layer Connection

~~→ In VC setup network~~ In VC setup, routers along the path between the two end systems are involved in the VC setup and each router is fully aware of all the VC's passing through it.

→ the messages that the end systems send into the network to initiate or terminate a VC and the messages passed between the routers to set up the VC are known as signaling messages and the protocols used to exchange these messages are called Signaling protocols

Datagram Networks

In a datagram Network each time an end system wants to send a packet, it stamps the pkt with the address of the destination end system and then pops the pkt into the network.

→ When a pkt is transmitted from source to destination it passes through a series of routers

→ Each router has a forwarding table that maps destination address to link interfaces.

→ when a pkt arrives at the router, the router uses the packets destination address to look up the appropriate output link interface in the forwarding tab

→ the router then intentionally forwards the packet to that output link interface

e.g

Suppose the destination addresses are 32 bits [ie the length of destination address in an Ip datagram].

Destination Address	Link Interface
11001000 00010111 00010000 00000000 through 11001000 00010111 00010111 11111111	0
⋮	1
	2
Otherwise	3

It is not necessary to have 4 billion entries in the routers forwarding table. We can have as follows

prefix Match	Link Interface
11001000 00010111 00010	0
11001000 00010111 00011000	1
11001000 00010111 00011	2
Otherwise	3

the router matches a prefix of the packets destination address with the entries in the table.
When there are multiple matches the router uses the longest prefix matching rule.

→ routers in datagram network maintain no connection state information and forwarding state information in their forwarding tables.

→ In a datagram the forwarding tables are modified by the routing algorithm which updates the forwarding table every one to five mts or so.

→ In a VC network, the forwarding table in a router is modified whenever a new connection is set through the router or whenever a connection is torn down.

→ forwarding tables in a datagram can be modified at any time and series of pkts sent from one end system to another may follow different paths through the network and arrive at different pts which can cause out of order packets arrival.