Module III

Network layer - Routing

Network Layer (Layer-3)

Network layer is responsible for the source to destination (end to end) delivery of a packet across multiple network links. to achieve this goal, layer must know topology of the communication Network, choose appropriate path for data delivery and avoid overloading in the Network link.

* Important duties of Network layers.
  1) Internetworking
  2) Logical Addressing
  3) Routing
  4) Packetizing
  5) Fragmenting.

* Networ Layer provide two type of services to upper layer,
  1) Connection-Oriented Network service.
  2) Connection less Network service.

* There is a two type of subnet in Network layer.
  1) virtual circuit subnet
  2) Datagram subnet

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Routing

Routing means selecting the best path for sending a packet from one point to another (end to end) when more than one path is available in the network.

* Routing in the network is implimented by the use of routing algorithms. The routing algorithms are part of Network softwars.
* the process of delivery of arrived packet to the out going line by the use of routing table in routing device is called forwarding
* properties of routing algorithms are,
  1) correctness
  2) Robustness (strong)
  3) stability
  4) Fairness
  5) Optimality (Best)
* Routing algorithms are classified into two.
  1) Non adaptive algorithm (static algorithm)
  2) adaptive algorithm (Dynamic algorithm)

* The routing decision is not based on the measurment of current traffic and topology is called non-adaptive algorithm (static routing). In this type routing decision can't be changed, if there is any change in topology or traffic.

* The routing decision can be changed, if there is any change in topology or traffic is called adaptive algorithm (dynamic algorithm)

* The important Examples of static algorithms are,
  1) Shortest path routing algorithm
  2) Fooding algorithm.
  3) Flow based routing algorithm.

Shortest path routing algorithm.

Shortest path routing algorithm is a simple and easly understandable algorithm. To choose optimum route between two node(routers) the algorithm just find the shortest path between the nodes.

Number of hops and geographical distance in kilometers are comonly used for measuring the path length, also some other metric like Bandwidth, average traffic, communication cost, mean queue length and measured delay may also used.

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* Commonly used shortest path routing algorithms are
  1) Dijkstra algorithm.
  2) Bellman-Ford algorithm.

Dijkstra algorithm

Dijkstra's shortest path algorithm creates a shortes path ~~betwee~~ tree from a Network graph., Shortest path tree is a tree in which the path between a node and every other node is shortest.

* In this algorithm, the nodes in the network divided into two.
  1) Tentative (not fixed)
  2) permanent.

* Algorithm find the neighbour of a current node, make them to tentative list, examin them, and if they pass the criteria (shortest path) make them permanent.

* the tentative list is empty, the algorithm will stop.

Flooding

In this static algorithm every incoming packets are sent out through every outgoing lines enept the line on which it has arrived.

* The disadvantage of flooding is generation of large number of duplicate packets.

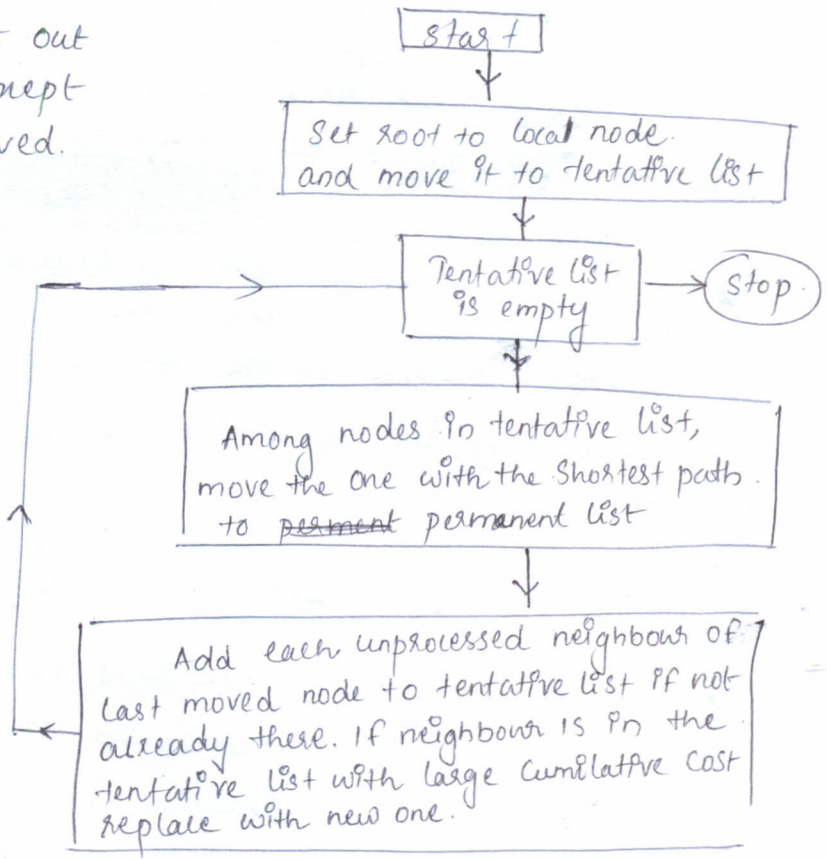
* The generation of duplicate packets number can reduced by various methods. The technique used for damp the process of generation of duplicate packet is called damping techniques.

* Important damping techniques are
  1) use of a hop counter
  2) keep a track of which packet have been flooded
  3) Selective flooding.

* Characteristics of flooding are
  1) Delivery of packet is guaranteed.
  2) One of the copy will arrive by the quikest and shortest path.

- Due to this characteristics flooding is applicable in Milatary applications.

Dijkstra algorithm



Dynamic Routing Algorithms.

Dynamic routing algorithm change the routing path as the network traffic load or topology changes.

* popular dynamic (adaptive) routing algorithms are Distance-vector routing algorithm and Link state routing algorithm. Both algorithms are suitable for the packet switched network.

In distance vector routing, a node tells its neighbours abouts its distance to every other node in the network. and in link state routing a node tells every other node in the network, its distance to its neighbours. (cost)

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Distance Vector Routing Algorithm.

In this algorithm, each router maintains a routing table called vector, giving the best known distance to each distination and the information about which line to be used to reach there. The algorithm some times called Distributed Bellman-Ford routing algorithm or Ford-Fulkerson algorithm.

* The vector has two parts, the first part shows the prefered outgoing line to be used to reach the destination & second part gives an estimate metric to the destination. (metric - distance metric)
* matric may be calculated by the use of distance, que length or delay.
* A router periodically sends a copy of its distance vector to all its neighbours for updating the vector of neighbours.
* There is 3-stages for distance vector routing algorithm.
  1) Intialization of vector.
  2) Shearing of vector
  3) updating the vector.

Intialization :- At the beginning, each node know only the distance between itself and immediate neighbours. The distance for any ~~no~~ entry that is not a neighbour is marked as infinity.

Shearing :- Each node shere its routing table (vector) with its immediate neighbours periodically and when there is change.

updating :- updating of node vector by the use of shared neighbour vector.

* Shearing and updating are two type.
  1) Periodic update,
     Shearing of vector, Periodicaly every 30sec.
  2) Triggered update,
     Shearing of vector only when there is change in metric or topology.

Draw balks of DV algorithm

1) Slowness of find current route, this slowness is due to count-to-infinity problem, and it is solved by split horizon algorithm
2) This algorithm does not take the line Band width into consideration when choosing route. This problem can over come by replace the algorithm with link state algorithm.

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Link State Routing

Link state routing algorithm is used to overcome the drawbacks of distance vector algorithm.

The idea behaind the algorithm can be stated as five part.

1) Discover its neighbours and learn their network address.
2) Measure the delay or cost to each of its neighbours
3) Construct a packet (link state packet) telling the network address and delay of all neighbours.
4) Send this packet to all other routers using flooding algorithm.
5) Compute shortest path to every other nodes.

* Dijkstra's algorithm can be run to find the shortest path to every other node.
* Link state packet (LSP) can carry a large amount of information. The minimum amount of informations are,
  1) Node identity
  2) Sequence number
  3) List of links.
  4) age.
* LSPs are generated on two occasions, when there is a change in topology of the network and on a periodic basis.

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* Routing
  - Unicast Routing
  - Multicast Routing
* Routing Protocols
  - Interior protocols (Intradomain) < RIP, OSPF
  - Exterior protocols (Interdomain) – BGP

the routing inside an Autonomos system is called Interior routing, the protocol used for interior routing is called interior routing protocols.

Eg:- RIP (Routing information protocol)
~~BGP~~ OSPF (Open shortest path first protocol)

Routing between Autonomos system is called Exterior ~~protocol~~ routing, the protocol used for Exterior routing is called Exterior routing protocol

Eg:- BGP (Border Gateway protocol)

RIP

Routing information protocol is a interior protocol, it is based on distance vector routing.

* ~~Implem~~ Implementation of RIP with following considerations.
  1) The router have a routing table, network donot
  2) destination in a routing table is a network.

3) The metric used in RIP is Hop Count
4) RIP cannot have more than 15 count.
5) the next hop column in routing table define the address of router to which the packet is to sent to reach its destination.

* Routing table updation in RIP is done by the use of RIP response message and updation is done by RIP routing table updation algorithm.

Routing table of RIP

Destination	Hop count	Next route	Other information

* RIP message can be classified in to two.
  1) Message that deliver routing information.
  2) Message that request routing information.

* RIP have two versions, RIP version 1 & RIP version 2.

OSPF

Open shortest path first protocol is an intradomain routing protocol based on link state routing. In this protocol an autonomos system is divided into areas.

Special routers are used in the borders of area to connect different area is called Area border routers, A special area inside an atonomus system is called back bone, router inside the back bone area is called back bone routers and all the area inside an atonomous system should be connected to backbone.

* OSPF terminology connections are called a link, there is 4 type of link.
  1) point-to-point link.
  2) Transient link (connect two routers without any other host)
  3) Stub link
  4) Virtual link.

Transient link :- A network with several routers attached to it.
Stub link :- a network that is connected to only one router.
Virtual link :- is created between two routers when the link between them is broken.

- OSPF packets
  - Hello.
  - Database description
  - Link state request
  - Link state update
    - Router link
    - Network Link
    - Summary link to Network
    - Summary link to AS boundary router
    - Extra link
  - Link state acknowledgement

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Routing for Mobile Hosts.

Routing for mobile hosts deal with the routing of information to a portable computers(nodes), for routing to this mobile host the network should find it.

OSPF packet

Version	Type	Message length.
Soure router IP address.		
Area identifier.		
Checksum	Authentication type	
Authentication.		

* Type of nodes present in a network.

1) Stationary host
   - Immovable host, they are connected by wired medium.

2) Migratory host
   - Stationary hosts, who can move from one fixed site to other.

3) Roming host
   - host can move and maintain connection anywhere.

4) Mobile host
   - host in mobile nature (either of Migration host and Roming host)

* All the host are assumed to have a perment home location, they never change and also have a permanent home address. In mobile host routing a packet can sent to a mobile node(host) using their home address. If the mobile node is at out of home location.

* In the mobile host routing, the world is divides geographically into small units called areas. Each area has one or more foreign agent and Home agent

Foreig agent are processes and keep track all mobil hosts visiting in the area and Home agent track all the hosts whose home is in that area, but who are currently visiting another area.

* when a new mobile host enter in an area, the host must registes itself with the foreign agent there.

Registration procedure include registering the mobile host with foreign agent and advertising this information to its home agent to inform, your mobile host is here.

* when a packet is sent to mobile host, first the packet sent to the home agent through LAN, home agent look up the mobile host new location address and forward the packet to foreign agent or sent the new location address to source for sent the packet to mobile host using that new address.

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