ELEC 3500

Tutorial - 9 (Solution)

9-1 Selection of protocols is determined by three main factors: Policy, Scale and Performance.

Policy: Among autonomous systems (ASs), policy issues dominate. It is possible that traffic originating in a given AS may not be able to pass through another specific AS. Similarly, a given AS may want to control what transit traffic it carries between other ASs. Within an AS, everything is normally under the same administrative control and thus policy issues a much less important role in choosing routes within an AS.

Scale: The ability of a routing algorithm and its data structures to scale to handle routing to/among large number of networks is a critical inter-AS routing issue. Within an AS, scability is less of a concern. If a single administrative domain becomes too large then it is alway possible to divide it into two ASs, and perform inter-AS routing between the two new ASs.

Performance: Inter-AS routing is policy oriented, the quality of the routes used is often of secondary concern. In many cases among ASs there is not even notion of costs other than hop count is associated with routes. Within a single AS, policy concerns aire of less importance, allowing routes to focus more on the level of performance realised on a route.

9-2: An area in an OSPF AS is refer to a set of routers, in which each router broadcasts its link state to all other routers in the same set. An OSPF AS can be configured hierarchically into multiple areas, with each area running its own OSPF link-state routing algorithm.

Within each area, one or more area border routers are responsible for routing packets outside the area. The concept of area is introduced for scalability reason, i.e. build a hierarchical routing for a large scale OSPF AS, and an area is an important building block in hierarchical routing.

9-3: Routers use the AS-PATH attribute to detect and prevent looping advertisements; they also use it in choosing among multiple paths to the same prefix. The NEXT-HOP attribute indicates the IP address of the first router along an advertised path to a given prefix. When configuring its forwarding table, a router uses the NEXT-HOP attribute.

9-4:
(a) eBGP : Because in different AS
(b) iBGP : Learns via the internal routers 3c.
(c) eBGP
(d) iBGP

9-5 Packet transmission time $X = \frac{L}{R}$

if $d_{prop} < X$

In this case the packet transmission goes for a long period. If no carrier sensing or a channel sensing technique is used; a collision will happen because a new packet could interfer with the current transmission

In case of a CSMA collision can still happen but overall efficiency will be better.

9.6 Maximum normalised throughput of the ALOHA protocol is 0.184.

Maximum throughput in bits/sec $R_{th} = R \times \eta_{ALOHA}$

$\Rightarrow R_{th} = 56 \times 10^3 \times 0.184 = 10,304$ bits/sec

$= 10.304$ kbits/sec

Maximum throughput in packets/sec =

$\Rightarrow R_{th,pac} = \frac{10304}{1000} = 10.304 \simeq 10$ packets.

9-7 Slots are empty only when no packets arrive in a particular slot which is given by:

$P[k \text{ transmissions in a slot time } T \text{ sec}] = \frac{G^k}{k!} e^{-G}$

with $k = 0$; i.e. no arrival

$P[0] = \frac{1^0}{0!} e^{-1} = 0.368$

9-8: $R = 1$ Mbits/sec, $L = 100$ byte

$\lambda = 100$ packets/sec

$\lambda_{total} = 4 \times 100 = 400$ packets/sec

System capacity in Packets/$\mu_p = \frac{1 \times 10^6}{100 \times 8} = 1250$ packets/sec.

Normalised arrival load $G = \frac{\lambda_{total}}{\mu_p}$

$\Rightarrow G = \frac{400}{1250} = 0.32$

Normalised Throughput of the SALOHA protocol is given by $S = Ge^{-G} = 0.32 e^{-0.32} = 0.32 \times 0.726$

$= 0.232$

Link throughput in bits/sec $R_{th} = RS = 1 \times 10^6 \times 0.232$

$= 232$ kbits/sec.

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