

Computer Networks

20 Revision Questions – GATE CS

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Attempt all 20 on paper first. Numerical questions need working shown, not just a final answer. The answer key with full solutions is on the last two pages – don't peek early.

Questions

1. [**IP Addressing**] How many usable host addresses are available on the subnet 172.16.0.0/20?
2. [**Subnetting – VLSM**] You are given 10.0.0.0/24 and must carve out three subnets needing 100, 50, and 20 hosts respectively. What subnet mask (in CIDR form) should be used for the 50-host subnet?
3. [**CIDR Aggregation**] Two address blocks, 15.16.0.0/22 and 15.16.4.0/22, are advertised by the same router. Can they be aggregated into a single route? If yes, give the aggregated CIDR block.
4. [**CRC**] A sender wants to transmit the message 1010111 using the generator polynomial represented by the bit pattern 1011. Compute the complete bit string that is actually transmitted (message + CRC remainder), showing the division.
5. [**CRC – Concept**] A CRC scheme uses a generator polynomial of degree r . What is the longest burst error length that is *guaranteed* to always be detected?
6. [**Topology**] In a full-mesh topology with $n = 6$ nodes, where every node has a direct link to every other node, how many physical links are required in total?
7. [**Flooding**] In pure flooding, every incoming packet is forwarded out of every interface except the one it arrived on. Name **two** distinct mechanisms used in practice to stop such packets from circulating forever.
8. [**TTL**] A host sends an IP packet with TTL = 4. Each router along the path decrements TTL by 1 before forwarding, and discards the packet outright (without forwarding) if the decremented value reaches 0. What is the maximum number of routers this packet can reach before it is finally discarded?
9. [**Routing Protocols**] State **two** key differences between Distance Vector routing and Link State routing (in terms of what information is exchanged and how the shortest path is computed).
10. [**Distance Vector**] Explain briefly why the "count-to-infinity" problem occurs in distance vector routing, and name one standard technique used to mitigate it.

11. [**MAC – CSMA/CD**] A 1 km broadcast LAN has a bandwidth of 10^8 bps and uses CSMA/CD. The signal propagates at 2×10^8 m/s. What is the minimum frame size (in bits) required for reliable collision detection?
12. [**MAC – ALOHA**] What is the maximum theoretical channel utilization (throughput) of **pure ALOHA**? Give the numeric value as a fraction/percentage.
13. [**MAC – ALOHA**] What is the maximum theoretical channel utilization of **slotted ALOHA**, and why is it higher than pure ALOHA?
14. [**Sliding Window**] A link has frame transmission time $T_t = 1$ ms and one-way propagation delay $T_p = 20$ ms. Using a sliding window protocol with window size $W = 10$, what is the link utilization (efficiency)?
15. [**Framing – Bit Stuffing**] Using the standard HDLC rule (insert a 0 after any five consecutive 1's), what is the bit-stuffed output for the data stream 110111110111110?
16. [**Encoding**] A link uses Manchester encoding to achieve a data rate of 10 Mbps. What baud rate (signal transitions per second) does the physical layer need to support?
17. [**Topology**] Compare star and bus topologies in terms of the effect of a single point of failure. Which failure is more catastrophic in each case?
18. [**Subnetting**] Find the network address and broadcast address for the host 172.16.28.9/20.
19. [**Flooding**] What is the key difference between *pure flooding* and *selective flooding*?
20. [**Routing – Longest Prefix Match**] A router has the following entries: 172.20.0.0/16 and 172.20.128.0/18, plus a default route. Which entry is used to forward a packet addressed to 172.20.130.5, and why?

Answer Key with Solutions

1. $/20 \Rightarrow$ host bits = 12. Usable hosts = $2^{12} - 2 = \mathbf{4094}$.
2. Need $2^h - 2 \geq 50 \Rightarrow h = 6$ ($2^6 - 2 = 62 \geq 50$). Mask = $/\mathbf{26}$ (255.255.255.192).
3. **Yes.** Together they span 15.16.0.0 – 15.16.7.255 (8 addresses in the 3rd octet = 2^3), which is exactly the range covered by a single $/21$. **Aggregate: 15.16.0.0/21.**
4. Generator 1011 has degree $r = 3$; append 3 zeros to the message: 1010111000 (10 bits). Performing mod-2 (XOR) division of 1010111000 by 1011 gives remainder 111. **Transmitted string = 1010111 + 111 = 101011111.**
5. A CRC with generator degree r is **guaranteed** to detect any burst error of length $\leq r$. (Longer bursts are detected with high probability but not guaranteed.)
6. Full mesh needs $\frac{n(n-1)}{2} = \frac{6 \times 5}{2} = \mathbf{15}$ links.
7. Any two of: (a) **TTL / hop-count field** – packet dropped once the counter expires; (b) **sequence numbers per source** – each node remembers packets it has already flooded and doesn't re-forward duplicates; (c) reverse-path forwarding / spanning-tree-restricted flooding to avoid true loops altogether.
8. TTL= 4 decremented at each router: R1→3 (forwarded), R2→2 (forwarded), R3→1 (forwarded), R4→0 → **discarded here**. So the packet reaches (is processed by) a maximum of **4 routers**, being successfully forwarded past only the first 3.
9. Any two of: (a) DV exchanges the *entire routing table* (distance estimates) with immediate neighbours only; LS floods *link-state information* (its own link costs) to *every* router in the area. (b) DV computes shortest paths using the distributed Bellman-Ford algorithm; LS has every router independently run Dijkstra's algorithm on a complete topology map. (c) DV converges slower and is prone to count-to-infinity; LS converges faster but needs more memory/computation per router.
10. It happens because a router's advertised distance to a destination may itself be derived (indirectly, through several hops) from the very route that just failed – neighbours keep telling each other slightly-worse-but-still-finite distances, so the "cost" creeps up 1 step at a time instead of immediately reflecting the failure. **Mitigation:** split horizon (with poison reverse), hold-down timers, or capping "infinity" at a small value (e.g. 16 in RIP).
11. $T_p = \frac{1000}{2 \times 10^8} = 5 \mu s$. Minimum frame = $2T_p \times \text{Bandwidth} = 2 \times 5 \times 10^{-6} \times 10^8 = \mathbf{1000 \text{ bits}}$ (125 bytes).
12. Pure ALOHA max throughput = $\frac{1}{2e} \approx \mathbf{18.4\%}$.
13. Slotted ALOHA max throughput = $\frac{1}{e} \approx \mathbf{36.8\%}$ – double that of pure ALOHA, because slotting forces all transmissions to align to slot boundaries, which halves the vulnerable period during which a collision can occur.
14. $a = T_p/T_t = 20$. Efficiency = $\frac{W}{1+2a} = \frac{10}{1+40} = \frac{10}{41} \approx \mathbf{24.4\%}$.

15. Original: 110111110111110. Each run of five consecutive 1's gets a 0 inserted immediately after it: 11+0+111110+0+111110+0 **Stuffed output: 11011111001111100** (17 bits – 2 stuff bits added to the original 15).
16. Manchester encoding needs **one full signal transition per data bit**, so baud rate = $2 \times$ bit rate = **20 Mbaud**.
17. **Star:** failure of the central hub/switch brings down the *entire* network (single point of failure for everyone); failure of one node's own link only isolates that one node. **Bus:** failure of the shared backbone cable itself splits/kills the whole network; but there's no central device to fail, so a single node's transceiver failing doesn't affect others unless it damages the shared medium.
18. $/20 \Rightarrow$ block size in the 3rd octet = $2^{(24-20)} = 16$. Multiples of 16 near 28: 16, 32; so $28 \in [16, 31]$. **Network address: 172.16.16.0; Broadcast address: 172.16.31.255.**
19. **Pure flooding** forwards every packet out of *all* interfaces except the incoming one (maximum redundancy, maximum traffic). **Selective flooding** forwards only out of interfaces that are roughly "in the right general direction" toward the destination, cutting down unnecessary traffic while keeping most of flooding's robustness.
20. Both entries match 172.20.130.5 (since it falls inside both the /16 and the /18 ranges). By the **Longest Prefix Match** rule, the router picks the more specific route: **172.20.128.0/18** (covers 172.20.128.0–172.20.191.255, which includes .130.5).

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