

ECSE-6600: Internet Protocols

Informal Quiz #01: SOLUTIONS

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Review of Networking Concepts (I): Informal Quiz SOLUTIONS

For each T/F question:

Replace the appropriate box with a tick ✓
(cut-and-paste the tick from here: ✓).

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Review of Networking Concepts (I)

- T F
- ✓ Connectivity implies a direct point-to-point physical link between any pair of end-system hosts.
 - ✓ A performance tradeoff is usually made to achieve “connectivity” instead of having direct point-to-point physical links between end-hosts
 - ✓ The difference between the network edge and the network core is that the network edge focuses only on packet forward and leaves other value-added functions to the network core.
 - ✓ Layering provides both modularity and support for evolution while holding interfaces constant.
 - ✓ The logical communication view provided by layering is that each layer communicates with its remote peer layer.
 - ✓ The Internet has a loose tiered hierarchical structure of ISPs.
 - ✓ Best-effort service offers the best possible combination of performance characteristics: defined capacity, delay and jitter.
 - ✓ The physical layer that transmits bits uses protocol concepts like “switches”, “packets” etc
 - ✓ SLIP is a bare-bones link-layer protocol designed specifically for IP: it cannot support any other layer 3 protocol
 - ✓ PPP shares one big drawback of SLIP, I.e., it cannot support multi-protocol encapsulation.
 - ✓ The minimum link speed supported by PPP is 28 kbps

Review of Networking Concepts: Contd...

T F

- A checksum is used in link-layers to both detect and correct errors at the destination node
- A duplicate acknowledgement indicates that a packet was incorrectly received (or is missing)
- ACKs and NAKs are required for providing reliability over an error-free channel
- MAC protocols are needed for point-to-point communications over a direct, unshared physical link between two hosts.
- Stop-and-wait uses a 1-bit sequence number
- Stop-and-wait and window-based protocols use timers (and timeouts) both at the sender and receiver (I.e. in both directions)
- Stop-and-wait protocol can only correct for packet errors and cannot compensate for bit-errors, especially in the reverse direction
- Ethernet uses a form of stop-and-wait in its CSMA/CD protocol
- ARQ (retransmission-based reliability) is generally not preferred in data networking protocols: FEC is preferred.
- Error correction is easier than error detection.
- Explicit NAKs are essential in any retransmission-based reliability scheme
- Stop-and-wait is quite efficient if the transmission time of packets is very large compared to propagation times (eg: low-speed LANs)
- Sliding window protocols can never attain a utilization of 100%

Review of Networking Concepts: Contd...

T F

- ✓ Go-back-N refers to the selective retransmission of the Nth earlier packet in the window.
- ✓ MAC protocols are essentially distributed multiplexing schemes.
- ✓ Token ring is essentially distributed, randomized FIFO multiplexing.
- ✓ FDM involves chopping up the input traffic into frequency bands.
- ✓ Statistical multiplexing is most useful to analyze the case when we have fixed (I.e. constant) demand, and fixed capacity
- ✓ It is possible to operate a statistically multiplexed system forever with average demand exceeding average capacity
- ✓ The problem of congestion control is to dynamically detect overload and adapt demand to maintain stability.
- ✓ In a zero-sum-game (or a tradeoff), you can indefinitely gain something for nothing
- ✓ The correct way to design a tradeoff is to spend the cheap resource and optimize the expensive resource.
- ✓ Circuit switching requires headers in each packet for its operation
- ✓ Statistical multiplexing imposes both tangible and intangible costs on users in pursuit of economical sizing of capacity to meet demand.
- ✓ Direct connectivity is a scalable strategy for building the Internet.

Review of Networking Concepts: Contd...

T F

- ✓ The primary source of limits to scalability is some form of resource usage inefficiency.
- ✓ Amdahl's law bounds the maximum expected improvement to an overall system when only a part of the system is improved.
- ✓ In networking, the "filtering" function is performed by specialized nodes called "switches", "bridges", "routers" etc
- ✓ Forwarding implies sending packets on a filtered subset of links
- ✓ A virtual resource (eg: virtual circuit, virtual memory) can be constructed through the combination of a multiplexed physical resource and the concept of indirection
- ✓ Packets, slots, tokens, forwarding tables are examples of "indirection" mechanisms in networks to create an end-to-end virtual link abstraction
- ✓ Token ring is an example of a random access MAC protocol
- ✓ CSMA is an example of a random access MAC protocol
- ✓ Ethernet is essentially a distributed round-robin multiplexing protocol
- ✓ Hub is a layer 2 device
- ✓ A bridge is a layer 2 device that connects two collision domains in Ethernet
- ✓ A bridge has more efficient filtering capabilities compared to a router, I.e., bridged networks are more scalable than routed networks
- ✓ A switch has a "fabric" that allows multiple parallel forwarding paths between ports. A switch can operate at layer 2 or layer 3.

Review of Networking Concepts: Contd...

- ✓ A router demarcates a broadcast domain in Ethernet
- ✓ Flat addresses (eg: Ethernet) do not explicitly acknowledge the possibility of indirect connectivity: it assumes all nodes are directly connected to each other. This fundamentally limits scalability.
- ✓ Token passing and polling are two examples of “taking turns” method of MAC layer protocol design
- ✓ The internet looks like a virtual “switch” between end-hosts, I.e. it provides filtering and forwarding services on a large-scale.
- ✓ Address hierarchy in IP is targeted at solving the heterogeneity problem of internetworking.
- ✓ Circuit switched network design is well-matched to applications whose traffic is constant and they require strict bounds on network performance
- ✓ Since there are no “headers” in circuit-switched information, all meta-data for the purposes of forwarding decisions is inferred from timing
- ✓ Circuit switching divides up the network resources (eg: link bandwidth) *a priori* whereas packet switching divides up the information to be transmitted *a priori*.
- ✓ Packets need “headers” because relative timing (between packets) is perfect in packet-switched networks
- ✓ Packet switching uses the concept of a packet queue (I.e. store-and-forward), a concept that trades off packet delay (and loss) for increased link utilization
- ✓ Link and router/switch resources are statistically multiplexed in packet-switched networks

Review of Networking Concepts: Contd...

T F

- ✓ ARP and DNS resolution are examples of indirection operations.
- ✓ Virtualization refers to the software abstractions of the physical resource created through a combination of multiplexing and indirection.
- ✓ Overload in statistically multiplexed packet-switched networks is handled through a demand-management procedure called congestion control
- ✓ Temporal multiplexing refers to the mode of sharing where a resource is split up a priori (I.e. ahead of time) and pre-assigned to users; therefore there is no queuing at the resource
- ✓ Packet switching allows both modes of statistical multiplexing gains: temporal and spatial: hence it is potentially more efficient than circuit-switching.
- ✓ The purpose of hierarchical structuring of host addresses is to make the address carry more information: information about the end-hosts as well as information about the network to which the end-host belongs.
- ✓ Flat (unstructured) addresses lead to inherently un-scalable network designs
- ✓ The congestion control problem is difficult because it is a distributed problem with incomplete & time-delayed information about capacity/load imbalances

PRE-REQUISITIES

Informal Quiz: Prerequisites

T F (True or False)

- Datalink refers to the 3rd layer in the ISO/OSI reference model
- If peak rate = 10 Mbps, Avg rate = 2 Mbps and Service rate = 4 Mbps, multiplexing gain = 2.
- An even parity bit value for the 8-bit string 01101010 is 0.
- Packet forwarding is a control-plane function and routing is a data-plane function.
- Bridges and switches in Ethernet allow separation of collision domains, and reduce the degree of sharing of the physical media.
- Finding path from one node to another in a large network is a transport layer function.
- It is impossible to send 3000 bits/second through a wire which has a bandwidth of 1000 Hz.
- Randomness (in service and arrival) is what causes queuing at buffers.
- Little's law which relates expected queuing delay $E(T)$ and expected # in the system $E(n)$ is applicable only to M/M/1 queues.
- Little's law also holds for *instantaneous* (as opposed to average) queuing delay and instantaneous number in the system

Pre-requisites (Continued)

- ✓ Bit stuffing is used so that framing characters do not occur in the frame payload.
- ✓ CRC is based upon the idea that it is highly unlikely for an uncorrupted packet to be perfectly divisible by the CRC polynomial.
- ✓ Random access MAC protocols tend to perform very well at low loads in terms of channel multiplexing; but suffer from high delay at high loads.
- ✓ “Taking turns” or token-based protocols like token-ring offer a best of both partitioning and random access worlds.
- ✓ For long delay paths, on-off flow control is better than window flow control.
- ✓ Ethernet uses a CSMA/CD access method.
- ✓ The packets sent in a connection-oriented network are called datagrams.
- ✓ The distance-vector protocol involves checking neighbors’ distance vectors and updating its own distance vector.
- ✓ Address structure is required to recognize whether the destination is one-hop or multiple-hops away.