Informal Quiz 2

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Multicast

T  F
☐ ☐ Multicast is useful for one-to-many data-delivery applications where the receivers are interested in receiving the same information at roughly the same time.
☐ ☐ Multicast only saves bandwidth, and does not save on operating system resources like processes/threads etc.
☐ ☐ Multicast is superior to replicated unicast, in that the sender does not necessarily need to maintain state or process control traffic for each receiver, and does not duplicate transmissions on shared links to other receivers
☐ ☐ IP multicast places the relaying function at the network layer, whereas application multicast places it at the application layer.
☐ ☐ Application level multicast may be inefficient in terms of bandwidth usage, and may not be scalable in terms of the routing algorithms (i.e. tree maintainence) used
☐ ☐ The original IP multicast model uses a “closed” group model, and allows only limited size and dynamism in terms of group membership
☐ ☐ The original IP multicast model assumes that senders know the set of receivers.

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☐ ☐ The original IP multicast is very simple from the perspective of the source, because it just uses the group address as the destination address

☐ ☐ The address resolution part of IP multicast (to get a link level multicast address) is more complex than ARP (used for unicast)

☐ ☐ The simple address resolution allows receivers to easily listen to ongoing multicast transmissions to the group on their subnets

☐ ☐ Besides address resolution, receivers explicitly try to join multicast groups using the IGMP procedure

☐ ☐ An IP multicast routing tree is built and maintained using the combination of IGMP (at the leaves) and a routing protocol

☐ ☐ TTL scoping allows both nested and overlapping scopes

☐ ☐ A packet addressed to 225.13.40.3 will not leave the site (or administrative domain)

☐ ☐ In IGMP, the querier sends a membership query to every group address separately

☐ ☐ In IGMP, all members of the group respond to the membership query.

☐ ☐ In IGMP, the membership report is broadcast to all nodes on the subnet.
Multicast (contd)

- On Ethernet-based broadcast domains (even if switches are used), even though multicast restricts the number of receivers interrupted by multicast transmissions, such transmissions are flooded to all collision domains and eats up link and network bandwidth just like broadcast.

- IGMPv2 allows receivers to join a list of source-specific groups, i.e. a list of (S,G) pairs.

- IGMPv2 requires explicit leave group messages, and reduces leave-latency and tree-prune latencies.

- A multicast routing protocol builds unicast paths from the source to every destination in the multicast group.

- A multicast routing protocol has to actively discover the existence of new receivers or sources and connect them through one or more distribution trees.

- The anonymity, open/dynamic group semantics of the original IP multicast model dramatically simplifies IP multicast routing.

- PIM-SM uses a flood and prune approach of multicast routing.
Multicast (contd)

- Scalability in multicast routing is typically achieved by using shared trees and not requiring off-tree state.
- DVMRP and MOSPF is a data-driven routing approach (i.e. they compute the trees only when the data actually shows up).
- Explicit join refers to the sources explicitly searching for a (S,G) based distribution tree and joining with it.
- DVMRP performs (among other things) a reverse path check before forwarding packets.
- RPM refers to the combination of a reverse path check for the current node, a reverse path check for the child node, truncation of leaves which do not have receivers, and on-demand pruning of branches (i.e. multiple router hops) which do not have receivers.
- DVMRP keeps (S,G) state in routers even after pruning, to allow the possibility of grafting.
- The MBONE (which used DVMRP) was suitable for a large number of multi-way, highly interactive videoconferences.
- PIM is a multicast routing protocol that is tied to RIP and OSPF as its underlying unicast routing protocols.
- Reliable multicast transport protocols try to optimize reverse control traffic and retransmission traffic so that the efficiency benefits of multicast are not lost.
- Source-based trees are efficient in terms of the state maintained in routers.
Multicast (contd)

- Shared trees are efficient in terms of routes from sources to destinations.
- The MSDP protocol works across domains and solves the problem of discovering the rendezvous point (RP) in the source-domain.
- The MASC protocol assigns group addresses randomly to groups all over the Internet.
- RTP does not provide acks or NAKs, and therefore is not a reliable multicast transport protocol.
- Implosion refers to the inefficient transfer of packets and retransmissions from sources to group receivers.
- Subcasting would solve the ack or NAK implosion problem.
- All reliable multicast protocols use the temporal redundancy scheme (similar to TCP).
- Multi-rate multicast congestion control schemes usually involve sending congestion indications back to the source which controls the transmission rate.
- Single-rate multicast congestion control schemes have to solve the problems of drop-to-zero and TCP friendliness.
- The SSM paradigm solves access control, source-discovery and address allocation problems elegantly compared to the original IP multicast model.
- Application-level multicast is useful for small groups.
- Application-level multicast builds overlay trees on top of overlay meshes based upon performance measures of point-to-point links of the mesh.
OAM: ICMP, SNMP, BOOTP etc

- ICMP uses IP to forward its error information
- The ping tool uses the timestamp request/response feature of ICMP
- PathMTU discovery is based upon the fragmentation required error messages of ICMP
- Traceroute uses the record route IP option field to discover routes
- SNMP is designed to fetch any subtree in a MIB in a single transaction
- The “SEQUENCE OF” constructor in ASN.1 syntax is used to define the equivalent of a “struct” in the C language.
- SNMP is only the message exchange protocol for network management.
- RMON defines both a new MIB and a new protocol
- BOOTP extends RARP functionality and makes it independent of the link layer technology.
- The key difference between BOOTP and DHCP is that the latter can lease out addresses dynamically and for short periods
- The NAT function does not touch transport or higher layers.
- NAT, DHCP, subnetting and CIDR together allow better multiplexing of the IPv4 address space
- RSIP is like NAT, except that the end-system is directly allocated a public address temporarily, i.e., the function is not transparent.
IPv6

T  F
☐  ☐  IPv6 is merely IPv4 with larger (128-bit) addresses
☐  ☐  Aggregatable global unicast addresses in IPv6 allow better routing scalability because aggregation is based on topology defined by providers
☐  ☐  Link local addresses, multicast and neighbor discovery are key components in IPv6 which allow plug-and-play.
☐  ☐  Flow classification cannot be done when the authentication header is used.
☐  ☐  The scoping of multicast transmission is not a part of the IPv6 address.
☐  ☐  Neighbor discovery captures IGMP functionality
☐  ☐  The H ratio is usually 0.3 when networks expand their address spaces
☐  ☐  The 128 bit address space in IPv6 simplifies auto-configuration, network renumbering and routing
☐  ☐  The growth of wireless IP devices and peer-to-peer applications appear to be principal drivers for IPv6 today.
☐  ☐  Neighbor discovery generalizes the ARP functionality, and allows multiple default routers and multiple prefixes per interface.
☐  ☐  IPv6’s prefix lifetime and multiple addresses per interface features simplify renumbering of an AS, as it transitions from one provider to another.
☐  ☐  The 6-to-4 transition scheme views IPv4 as a link (i.e. subnet) of IPv6, and allows automated tunneling

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Given a constant set of resources, the bandwidth and delay allocations is a zero-sum game irrespective of the scheduling approaches chosen.

QoS, broadly speaking, is a spectrum of performance capabilities (specified or measured) ranging from best-effort to that of a leased line.

A FIFO service discipline can provide isolation between flows.

Signaling is an example of a data-plane QoS mechanism.

Scheduling refers to the choice of packet to transmit, whereas buffer management refers to the decision to enqueue or drop a particular packet.

A token bucket bounds the characteristics of inbound traffic into a QoS network (i.e. creates a predictable traffic envelope).

An arrival curve and service curves are cumulative functions of the number of bits arrived or serviced at a network element respectively.

Arrival and service curves are useful to understand QoS performance parameters such as the worst case delay, buffer requirements, average service rates etc.

Priority queuing provides service isolation only for the highest priority flow, whereas round robin provides isolation for every flow.

A delay guarantee can be provided by only using WFQ at the routers.

Service isolation and differentiation still does not guarantee avoidance of congestion collapse (which is an end-to-end problem).
QoS (contd)

- RED (the buffer management scheme) can provide service isolation between a mix of TCP and UDP flows.
- Virtual time refers to the service that backlogged flow with weight = 1 would receive in a GPS scheduler.
- In a work-conserving GPS scheduler, every flow receives the same normalized service (service normalized by weights), which is also equal to the normalized average service (total service normalized by sum of weights).
- Int-serv is an example of a stateless QoS architecture.
- Diffserv is an example of a stateless QoS architecture.
- Admission control is a function performed in the data-plane.
- RSVP provides QoS routing capabilities.
- RSVP PATH messages are used to identify the reverse path from receivers to any sender.
- RSVP provides signaling for both unicast and multicast flows.
- In the differentiated services model, interior routers must handle fine-grained signaling and policy functionality.
- Differentiated services would provide better-than-best-effort service in a scalable manner.
QoS, Router Design

- Differentiated services architecture fully specifies the service semantics in a manner similar to int-serv’s guaranteed and controlled load services.
- The expedited forwarding PHB in diff-serv can be used to create a guaranteed bandwidth, low jitter service.
- The DPS approach moves state from the edge to the core of the network.
- The DPS approach or edge-based closed-loop building blocks can be used to compose QoS services over multiple autonomous systems.
- One reason TCP is not suitable for video is because it can’t handle multicast.
- RTP provides useful transport functions for multimedia applications, but the network services are provided by RSVP, integrated services and differentiated services.
- H.323 provides call control and codecs in addition to RTP.
- A content delivery network is like a reverse cache, paid for by the content provider to bring content close to the user, and hence impact performance.
- The trie data structure for IP forwarding lookup facilitates binary search in terms of prefix length.
- An overwhelmingly large number of prefixes in the global routing mesh are between 16 and 24 bits long.
### Multicast (solns)

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