ECSE-6660: Broadband Networks

Homework 2
Please Submit Online in the WebCT dropbox
Deadline: 19th Feb (non-tape-delayed)
Feb 26th (tape-delayed)
I. Reading Assignment & Quick Questions (100%)

Reading assignments count for a substantial part of homework credit

Carefully review slide sets 3, 4, 5; Read Chapter 4, 15 of S. Keshav’s book, and Chap 6, 13, Secs: 10.1/10.2 of Ramaswami/Sivarajan.

Then answer the following quick true/false questions that test your knowledge. Please submit the electronic version of this powerpoint file with your answers. (Cut-and-paste the tick (√) over the appropriate boxes on the left)

[60 questions; 5/3 points per question]

T  F

☐  ☐  ”Switched” services offer the capability to “dial-up” a data service between two points

☐  ☐  Switched services usually offer distance-sensitive pricing plans just like T-carrier services

☐  ☐  Signaling and path-pinning is an important commonality between the “virtual-circuit” and “circuit-switched” network architectures

☐  ☐  The data-plane “labels” used in virtual circuits have a global meaning, i.e. they represent identifiers that can be interpreted in the same way by any node in the network
QoS capabilities are mandatory in virtual-circuit based networks.

X.25 uses a connectionless packet-switching approach and does not nail down paths before transmitting data.

X.25 is an example of a heavyweight protocol design where similar functions are found in multiple layers.

The internet architecture tends to “couple” a variety of protocol design issues (e.g., combines QoS with routing with signaling etc).

The difference between “connection-oriented” (e.g., TCP) and “virtual circuit” (e.g., frame relay or ATM) method is that the former only establishes an end-to-end state association, whereas the latter establishes state at nodes along the path.

X.25’s link layer (LAP-B) is derived from HDLC.

X.25 uses LAP-B and ISDN uses LAP-D, both of which are derived from HDLC.

LAP-B uses the balanced configuration mode of HDLC where both nodes can act as a transmitter or receiver.

X.25 “sets-up” a link before transmitting packets similar to how telephony would “setup” an end-to-end circuit before transmitting.

Frame relay dramatically simplifies the link layer equivalent of X.25.

Frame relay & frame switching implement LAP-F control protocol at all nodes.

The PRI service of ISDN offers 128 kbps and a D-control channel.

ISDN, like SONET, offers both channelized and concatenated channels.
ISDN extends the concept of digital modulation, digital transmission and common channel signaling all the way to the home.

X.25 and frame relay offer a significant cost advantage over leased lines, but offer reduced or no QoS guarantees; and a packet-switching service instead of a circuit-switching service.

Frame relay uses one control VC for all its data VCs; X.25 uses in-band control signaling leading to a complex frame format.

The CIR parameter of frame relay represents the maximum rate at which a user may transmit; all packets above this rate are dropped.

A user may transmit an unbounded number of simultaneous frames at the rate PIR.

The DE bit if set does not guarantee that the packet will be dropped, but assigns it a higher effective drop probability during congestion.

The frame-relay receiver responds to FECN bit settings by reducing its transmission rate.

In BECN, an intermediate relay device could immediately inform the source about congestion rather than mark a bit on a forward-going packet.

ATM networks were designed to offer the best of the two worlds of telephony (eg: reliability, QoS) and data networking (lower cost, flexibility, statistical multiplexing gains).

ATM uses variable sized packets.

The 53-byte cell is an efficient way to packetize data.

The term UNI refers to the user-to-network interface.

PNNI is an example of a network-to-network interface protocol.

One of the important functions of AAL is segmentation-and-reassembly (SAR).

ATM’s HEC field serves dual-use as a cell-boundary-synchronization hook and for header error detection.
A signaling protocol fundamentally maps global addresses (and path specifications) to local labels (it may optionally reserve resources).

An SVC is an example of an “on-demand” or “dial-up” virtual circuit, whereas a PVC is a more permanent VC.

ATM switches swap incoming labels with outgoing labels on ATM cells (unlike IP routers which do not change the IP address fields on IP packets).

Fixed sized cells tend to reduce average queuing delay in underloaded, bursty systems and also make it easier to build fast switches.

The CBR service is most useful for variable-bit-rate, adaptive data transport.

The key difference between GFR and UBR is that the former allows the minimum frame rates (instead of minimum cell rates) and emulates an equivalent of a frame-relay VC.

ABR provides a feedback-based traffic management feature that is not available in UBR.

In a signaled architecture, routing is used to guide the signaling call.

PNNI does not support QoS routing.

ATM uses a 20-byte global address during the signaling phase and 4-byte labels in the data-plane (i.e. in cells).

Ethernet uses flat addresses whereas IP and ATM use hierarchical addressing.

Unlike IP routing ATM also allows peer-group IDs to be encoded within the ATM address.

Like IP, ATM uses hop-by-hop routing and avoids the use of source-routing.

A DTL is a stack-like mechanism to specify a source-route in PNNI.
A node at the lowest level of the PNNI hierarchy can see only the internal topology of the peer group it is in.

Call admission control (CAC) is needed only if QoS is required.

Crank-back is a process where the signaling can backtrack to a prior node if CAC fails at a node.

ATM traffic management offers a combination of both open-loop and closed-loop mechanisms.

GCRA is implemented using leaky buckets and is an example of a traffic shaping method.

ATM inter-networking can happen at the link-layer (LANE), network layer (RFC 1577, MPOA, NHRP).

A fundamental problem in IP-over-ATM inter-networking is how to do address resolution (i.e., IP address to ATM address mapping) and the answer is usually a server-based approach.

ATM LANE offers virtual LAN capabilities.

RFC 1577 specifies packet encapsulation and RFC 1483 specifies address resolution methods.

The problem with RFC 1577 LIS structure is that two hosts on the same ATM network, but different LIS’es will need to go through (a potentially slow) router to communicate.

NHRP allows servers to relay address-resolution across LIS’es.

MPOA attempts to integrate the benefits of LANE and NHRP.

MPLS solves both the data-plane and control-plane IP-over-ATM mapping woes by abandoning the overlay model in favor of a hybrid mapping model.

A key problem in traffic engineering is to define traffic aggregates and then map them to an explicitly setup path.