Glossary, v1.0

AAL5 – ATM Adaptation Layer 5: A particular version of the layer that converts packets into cells. This version uses error correction on a packet basis rather than per cell.

application layer: The topmost layer of the OSI network architecture. This is a catch-all layer that provides the user's interface to the network.

ATM – Asynchronous Transfer Mode: (as opposed to Synchronous Transfer Mode, STM), communication standard based on small fixed-size cells that allow several streams to be multiplexed efficiently.

back pressure: The use of congestion all the way back to the sender to limit injection, which provides essentially zero flow control.

bisection bandwidth: The bandwidth across the minimum cut that divides the processors into two equal-sized groups. It is a good measure of a network's ability to handle random traffic from all nodes simultaneously.

bit stuffing: The injection of extra bits into a data stream either to differentiate flags from data (like the use of the backslash in Unix), or to transport on top of a slightly higher-rate signal.

bridge: Similar to a gateway, but connects two LANs at the MAC layer rather than at the internet layer. While a gateway connects any two networks, a bridge typically connects two ethernets by snooping on one and broadcasting on the other (and vice versa). A bridge allows the two halves to operate simultaneously, thus increasing bandwidth.

butterfly: An indirect network in which packets flow through a fixed number stages that essentially sort the packets to their correct destination.

circuit-switching (also circuit-switched routing): The use a long-term fixed-rate connection for communication. The path is locked down for the life of the connection and each link allocates the full bandwidth all of the time. Because this wastes bandwidth when the traffic is sparse, packet-switching schemes are now standard. The best-known circuit-switched system is the traditional copper-based phone system, in which each call literally has a complete electrical connection from end to end for the lifetime of the call.

data-link control layer: The second layer of the OSI architecture, it converts the unreliable bit stream of the physical layer into a sequence of frames that are either reliable or include error detection (see Figure 1).

datagram network: A network without connections: each packet is routed individually.

datagram service: A network in which packets can appear out of order, may be dropped, and in which no connections are required; also called *connectionless service*. Datagram networks usually provide datagram service. The alternative is *virtual-circuit service*.

delay jitter: A metric of burstiness that is defined as the difference between the minimum and maximum interarrival times for a connection. This differs from *jitter* in that it is a worst-case bound rather than a statistical guarantee. This distinction is not really in the literature, and in fact there are other definitions as well.

dilated butterfly: A butterfly in which each logical edge, typically the up and down edges, are replaced by a pair of edges. This doubles the number of wires (and pins), but increases the fault tolerance and performance of the network.

Handout 2: Glossary, v1.0

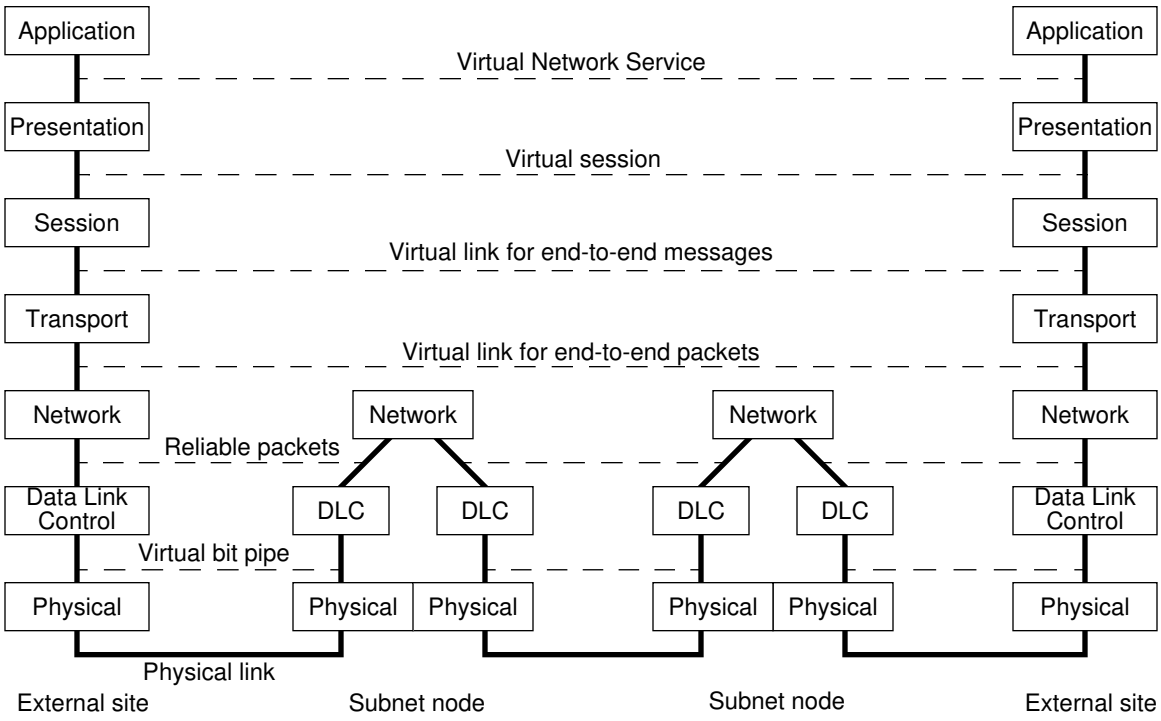

Figure 1: Seven-layer OSI Network Architecture

Each layer presents a virtual communication link, shown as a dashed line, that provides increasing semantic guarantees. Although no real system uses this structure, it is basis of comparison for all real network architectures. The thick black line traces the path of the end-to-end data. This figure is essentially taken from [BG92].

direct network: A network in which the packets move directly toward their target; the common direct network is the k-ary n-cube, which includes meshes and tori.

DLC: see data-link control layer.

framing: Delineating frames in a bitstream, usually by either special markers or by specifying the length of the frame.

gateway: Connects two networks using the internetwork protocol (IP). Gateways appear as nodes on both networks.

indirect network: A network in which packets move through routers that are not processors and that may not be physically closer to the target. The primary examples are fat trees, butterflies, and multibutterflies.

internet layer: The part of the network layer that connects different subnets and hides the subnet structure from higher layers. The internet protocol (IP) is the standard implementation for this layer.

jitter: In general, the amount of variance in the interarrival times for packets in a connection. Normally defined as the ratio of the variance of the interarrival times to the mean interarrival time, but sometimes defined as the ratio of the standard deviation to the mean. Because jitter assumes a normal distribution (with infinite tails) there is no strict bound on the worst-case interarrival time. See *delay jitter*.

LAPB: A particular data-link control standard, originally used for connecting an external site to a subnet.

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MAC layer – medium access control layer: This layer controls access to shared media such as a bus or ethernet and is usually considered part of the DLC layer.

metabutterfly: A variant of the multibutterfly that restricts the random wiring to ensure that the network remains scalable and practical, while maintaining the same performance and fault tolerance. See CBLK94.

multibutterfly: A version of the butterfly that uses random wiring to increase the fault tolerance and performance. Like the dilated butterfly, it uses twice as many wires as a regular butterfly. Random wiring leads to *much* better performance and fault tolerance than the dilated butterfly, but leads to networks that are difficult to build in practice. See LM92.

network layer: The third layer in the OSI architecture, it is responsible for routing packets and determining the route for connections. It also handles flow control. The resulting service may or may not be reliable and may or may not preserve order.

OSI – Open System Interconnection: Normally refers to the CCITT standard layering for networks; see Figure 1.

physical layer: The bottom layer of the OSI layering. This layer provides an pipe of unreliable bits between two nodes; it hides details regarding initialization, signaling, and digital to analog conversion. The best known physical layer is the RS-232C standard. See Figure 1.

plesiochronous: Communication in which the implicit clock is recovered from the data. This typically assumes that both sides are running at nearly the same frequency, but that there may be some variation in rate and phase. The alternative is to use an external clock that is shared by both ends, which is common in multiprocessors, but impractical for larger networks.

presentation layer: The second highest level of the OSI structure, this layer handles data encryption, compression, and format conversion. Format conversion could be simple things like translating newlines or more involved manipulations such as strided access or floating-point format conversion.

QOS – quality of service: A set of guarantees that the network provides to the client. These are typically used to ensure smooth audio and video. A typical contract would promise a particular level of reliability or jitter in response to a given load or input burstiness.

router: same as a switch; handles the routing of packets through a multiprocessor network. Sometimes used to describe the gateways between an ethernet and a WAN.

session layer: Part of the OSI architecture, this layer handles the endpoint issues involved in setting up a connection, including finding the receivers address and determining access rights.

SONET – Synchronous Optical Network, see [BC89]: A family of optical signaling standards; STS-n carries $51.84 \times n$ Mb/s by multiplexing n basic channels, which leads to the common ATM rates of 155.52 Mb/s (STS-3) and 622.08 Mb/s (STS-12).

store-and-forward routing: The basic packet-switching scheme in which data travels in packets hop by hop. Each nodes stores a packet completely before forwarding any of it to the next node, which simplifies error detection/correction and provides freedom from deadlock.

torus: A mesh with wrap-around connections, so that the network looks the same from all points, i.e. there are no corners or edges.

transport layer: The layer in the OSI network architecture responsible for breaking messages into packets, multiplexing multiple channels onto one network connection, and ensuring reliable end-to-end communication (when needed). It often handles end-to-end flow control as well.

virtual cut-through routing: Similar to store-and-forward routing except that a packet may move forward before all of the packet has arrived at the current node, which reduces latency by pipelining the over-

head at each hop. To avoid deadlock, each node must ensure sufficient storage for all accepted packets.

worm-hole routing: Similar to virtual cut-through routing, except that internal nodes do not have sufficient storage for entire packets. Thus a packet typically covers several nodes simultaneously and can easily introduce deadlock. There are several schemes for avoiding deadlock [BC93].