

## Lab 7 – Tutorial 3 WAN Technologies

### 1. What differentiates a WAN from a LAN?

- A LAN (local area network) is a group of computers and network devices connected together usually within the same building.
- A WAN differentiates from LAN when several LANs are connected, and is not restricted to a geographical location.

### 2. Explain one of common WAN device and what is its purpose?

- A Router provides internetworking between the LANs, and WAN access interface ports that are used to connect to the service provider network. These interfaces may be serial connections or other WAN interfaces. With some types of WAN interfaces, an external device such as a DSU/CSU or modem (Analogue, Cable, or DSL) is required to connect the router to the local point of presence (POP) of the service provider.

### 3. Which organizations produce WAN standards and what do they standardize?

- Telecommunications Industry Association (TIA) standardize telecommunications standards for telecommunications cabling infrastructure in user-owned buildings.
- Electronic Industries Alliance (EIA) developed standards to ensure the equipment of different manufacturers was compatible and interchangeable.
- International Organization for Standardization (ISO) develops and publishes worldwide technical, industrial and commercial standards.
- Institute of Electrical and Electronics Engineers (IEEE) develop standards to help make sure internet services and technologies follow a set of recommended practices so network devices can all work together smoothly

#### 4. Explain and provide an example ALL available WAN link options

##### Dialup

- A dialup connection can be used to access the Internet by connecting a computer to a modem, connecting the modem to an analog phone line, and dialing in to a service provider.
- For example Canada modems are limited to 48.0Kbps upload speed.

##### ISDN

- SDN is a digital technology that supports multiple 64Kbps channels on a single connection.
- BRI circuit consists of two 64Kbps bearer (B) channels and one 16Kbps delta (D) channel. For example, one channel is used as a TCP/IP connection to a location while the other channel is used to send a fax to a remote location.

##### DSL

- Digital Subscriber Line (DSL) is a group of technologies that provide high-speed data transmission over existing telephone wiring.
- Asymmetric DSL (ADSL) is the most popular variant. It include a channel for analog voice conversations, a channel for uploads, and a channel for downloads.

##### PPP

- Point-to-Point Protocol (PPP) is a common Layer 2 protocol used on dedicated leased lines. It can carry multiple Layer 3 protocols, such as IPv4 and IPv6.
- PPP multilink allows multiple interfaces to be combined into one logical interface.

##### Broadband Cable

- Broadband cable is an always-on Internet access method available in areas that have digital cable television. Connectivity is achieved by using a device called a cable modem. It has a coaxial connection for connecting to the provider's outlet and an unshielded twisted-pair (UTP) connection for connecting directly to a system or to a hub, switch, or router.

## Satellite

- Areas without WAN connectivity can connect to the Internet or to a remote office using satellite communications, where a transmission is bounced off of a satellite, received by a satellite ground station, and then sent to its destination using either another satellite hop or a wired WAN connection.
- A two-way satellite system, provides data paths for both upstream and downstream data.

## WiMAX

- WiMAX (Worldwide Interoperability for Microwave Access) provides wireless Internet broadband access to fixed locations (as an alternative to technologies such as DSL or cable).
- WiMAX is a popular choice for connecting cell towers in cellular networks.

## Cellular Technologies

- Some cellular phone technologies (for example, Long-Term Evolution [LTE], which supports a 100Mbps data rate to mobile devices and a 1Gbps data rate for stationary devices) can be used to connect a mobile device to the Internet.

## SONET

- Synchronous Optical Network (SONET) is a fiber-optic WAN technology that delivers voice, data, and video at speeds starting at 51.84Mbps.
- SONET is classified into various Optical Carrier (OCx) levels.

## Dedicated Leased Lines

- A dedicated leased line is typically a point-to-point digital circuit interconnecting two sites.
- WAN technologies commonly used with dedicated leased lines including T1, T3, E1, and E3.

## Frame Relay

- Frame Relay sites are interconnected using virtual circuits (VCs).
- Frame Relay shares a service provider's bandwidth with other customers of its service provider.

## ATM

- ATM is a Layer 2 technology that uses VCs. However, ATM uses a fixed-length frame, called a cell, which includes 48 bytes of data and a 5-byte header.

## MPLS

- Multiprotocol Label Switching (MPLS) can accommodate both Frame Relay and ATM on the same backbone.
- It does this by inserting a 32-bit header between the Layer 2 and Layer 3 headers.

## Metro Ethernet

- Metro Ethernet is simply Ethernet technology extended into the metropolitan area network (MAN).
- The customer connects to the service provider through an Ethernet connection (using an RJ-45 connector).

5. What are the differences between circuit switching and packet switching?

- Packet Switching is connectionless, whereas Circuit Switching is connection-oriented
- Packet switching is defined as the connectionless network where the messages are divided and grouped together known as a packet. Each packet is routed from the source to the destination as individual packets. The actual data in these packets are carried by the payload. When the packet arrives at the destination, it is the responsibility of the destination to put these packets in the right order.
- Circuit switching is defined as the method of switching which is used for establishing a dedicated communication path between the sender and the receiver. The link which is established between the sender and the receiver is in the physical form. Analog telephone network is a well-known example of circuit switching. Bandwidth is also fixed in this type of switching.

6. Which topologies are commonly deployed in a WAN and what are the advantages and limitation of each?

#### Ring Topology

- Ring topology connects each device to the ones on either side of them, when data is transmitted, the packets also travel along the circle, moving through each of the intermediate nodes until they arrive at their destination.
- Ring networks are usually easy to implement, and require minimal cabling to connect all the nodes on a network together.
- However, they can be vulnerable to failure, as a technical fault on the cabling ring can cause the whole network to stop working.

#### Point-to-Point Topology

- Point-to-Point topology connects one site to the other as if connected directly which is also called as Leased lines. They are leased from a Service Provider based on required bandwidth and the distance between the two sites.
- Point-to-Point topology is easy to visualize and set up as data travels in a single direction and back.
- However, setting up this topology is expensive and if either of the nodes stop working, information cannot be sent across the network.

7. Three-Layer Design Model is a common approach used to improve the capability of the network. Describe all components in the Three-Layer Design Model.

#### Access layer

- Controls user and workgroup access to the resources on the network. This layer usually incorporates Layer 2 switches and access points that provide connectivity between workstations and servers. You can manage access control and policy, create separate collision domains, and implement port security at this layer.

#### Distribution

- Serves as the communication point between the access layer and the core. Its primary functions are to provide routing, filtering, and WAN access and to determine how packets can access the core. This layer determines the fastest way that network service requests are accessed – for example, how a file request is forwarded to a server – and, if necessary, forwards the request to the core layer. This layer usually consists of routers and multilayer switches.

#### Core

- Also referred to as the network backbone, this layer is responsible for transporting large amounts of traffic quickly. The core layer provides interconnectivity between distribution layer devices it usually consists of high speed devices, like high end routers and switches with redundant links.