

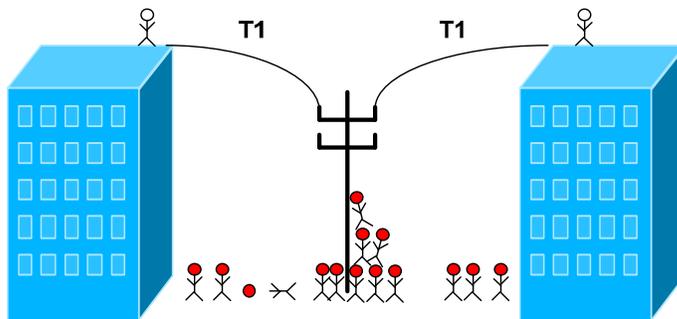
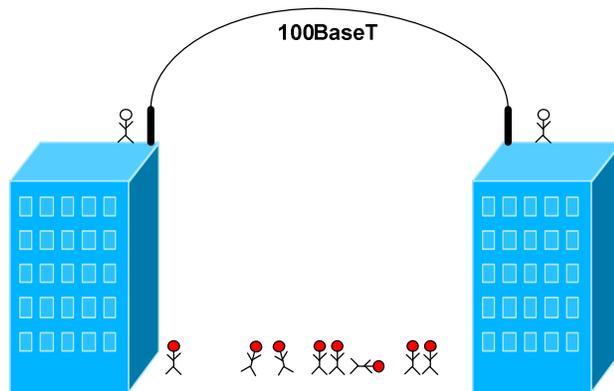
- Basic WAN Concepts -

What is a WAN?

There are two prevailing definitions of a **Wide Area Network (WAN)**. The **book definition** of a WAN is a network that spans large geographical locations, usually to interconnect multiple Local Area Networks (LANs).

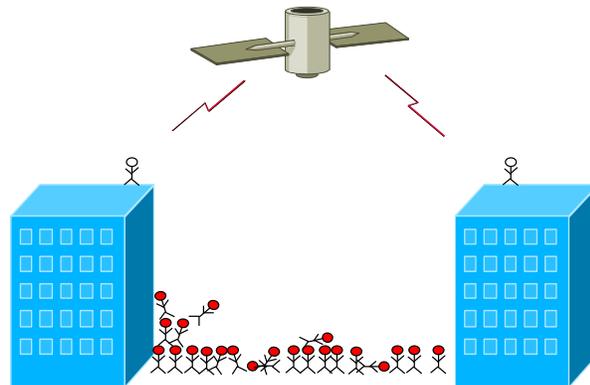
The **practical definition** of a WAN is a network that traverses a public network or commercial carrier, using one of several WAN **technologies**.

Consider the following example. A connection between two buildings using Ethernet as a medium would generally be considered a **LAN**. However, this is because of the *technology* used, and not the *zombie-infested distance* between the two buildings.



A connection between the *same* two buildings, using a dedicated T1 line as a medium, would generally be considered a **WAN**.

Remember, the difference is the *technology* used. A variety of WAN technologies exist, each operating at both the **Physical** and **Data-link** layers of the OSI models. Higher-layer protocols such as IP are **encapsulated** when sent across the WAN link.



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WAN Connection Types

WANs are generally grouped into three separate **connection types**:

- Point-to-Point technologies
- Circuit-switched technologies
- Packet-switched technologies

Point-to-Point technologies (often called **dedicated** or **leased lines**) are usually the most expensive form of WAN technology. Point-to-Point technologies are *leased* from a service provider, and provide *guaranteed* bandwidth from location to another (hence point-to-point). Cost is determined by the *distance* of the connection, and the amount of *bandwidth* allocated.

Generally, point-to-point links require **no call-setup**, and the connection is usually **always on**. Examples of point-to-point technologies include:

- T1 lines
- T3 lines

Circuit-Switched technologies **require call-setup** to occur before information can be transferred. The session is usually torn down once data transfer is complete (this is identified as an **On-Demand Circuit**). Circuit-switched lines are generally low-speed compared to point-to-point lines.

Examples of circuit-switched technologies include:

- Dial-up
- ISDN

Packet-Switched technologies share a common infrastructure between all the provider's subscribers. Thus, bandwidth *is* not guaranteed, but is instead allocated on a **best effort** basis. Packet-switched technologies are ill-suited for applications that require consistent bandwidth, but are considerably less expensive than dedicated point-to-point lines.

Examples of packet-switched technologies include:

- Frame-Relay
- X25

(Reference: http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito_doc/introwan.htm
http://www.ciscopress.com/content/images/chap01_1587051486/elementLinks/1587051486content.pdf)

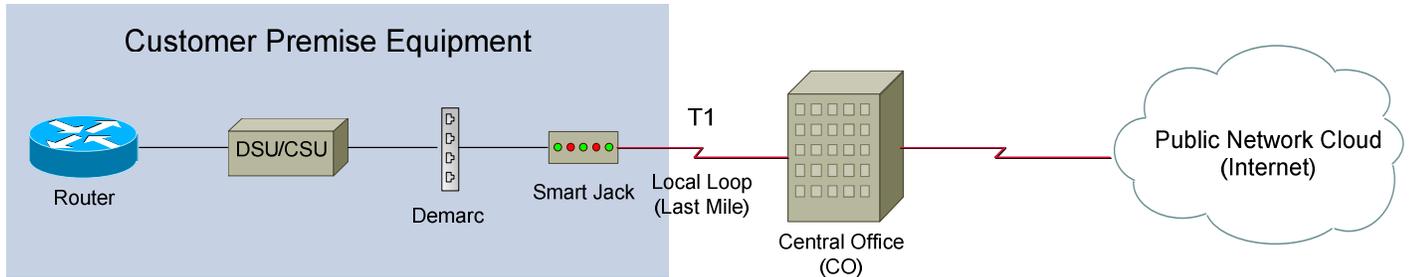
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Common WAN Terms

A wide variety of hardware is used with WANs. Equipment that is housed at the subscriber is referred to as **Customer Premise Equipment (CPE)**.



The above example demonstrates the basic equipment required for a T1 line.

A **CSU/DSU (Channelized Service Unit/Data Service Unit)** provides the clocking and channelization for T1 or T3 technology. The CSU/DSU converts the signal for use on an Ethernet (or other LAN technology) network. If a WAN technology other than a T1 line is used, a different device will be required. Examples include (but are no limited to):

- ISDN – a **terminal adapter**
- Dialup – a **modem**

The **Demarc** (short for demarcation) refers to the point of last responsibility for the service provider. All equipment on the Customer Premises side of the Demarc is the customer's responsibility to maintain. The Demarc is not *always* physically labeled or identifiable. Occasionally, a two-port or four-port patch-panel will be used as a physical Demarc.

The **Smart Jack** physically terminates the T1 line. If there is a connectivity issue, the provider will perform a ping test to the smart jack. If communication to the smart jack is successful, the provider will assume the issue resides on the customer's side of responsibility. The smart jack is often locked in a glass enclosure, and labeled with the T1's circuit number.

The **Local Loop** (or Last Mile) refers to the physical line connecting from the Customer Premises to the provider's nearest **Central Office (CO)**.

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WAN Encapsulation

Recall that WAN technologies operate at both **Physical** and **Data-link** layers of the OSI models, and that higher-layer protocols such as IP are **encapsulated** when sent across the WAN link.

A WAN is usually terminated on a Cisco device's serial interface. Serial interfaces support a wide variety of **WAN encapsulation types**, which must be manually specified.

By default, a serial interface will utilize **HDLC** for encapsulation. Other supported encapsulation types include:

- SDLC
- PPP
- LAPB
- Frame-Relay
- X.25
- ATM

Regardless of the WAN encapsulation used, it must **identical** on both sides of a point-to-point link.

Each encapsulation type is described in detail in separate guides.

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