

Wide Area Networks

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Table 1: An incomplete list of networks types

Category	Abbreviation	Distance
<i>Local Area Network</i>	LAN	few kilometers
<i>Metropolitan Area Network</i>	MAN	hundreds of kilometers
<i>Wide Area Network</i>	WAN	thousands and more kilometers

1 Introduction

This document offers a short explanation of *Wide Area Networks*(WAN) and their communication methods. Section 2 gives an overview of networks in general. After that the focus is shifted in section 3 to WAN and the typical types of connections between nodes.

2 Networks in General

This section gives a general description of networks.

A computer network is the infrastructure that allows two or more computers (called hosts) to communicate with each other. The network achieves this by providing a set of rules for communication, called protocols, which should be observed by all participating hosts. The need for a protocol should be obvious: it allows different computers from different vendors and with different operating characteristics to ‘speak the same language’.[1]

Depending on the distance a network covers it can fall into one of the categories depicted in Table 1. Those are by far not exhaustive but give the most important types.

Every category of networks utilises different ways to communicate and therefore different hardware and protocols. An exception to that rule are *Metropolitan* and *Wide Area Networks* as they have a similar setup and only differ on the distance they cover.

3 Communication Methods

The following paragraphs give a short overview about different ways to communicate over a WAN.

There are two ways of communicating between network nodes either by using broadcasts which reach every node in the network or by using a point to (multi-)point link. The first one is normally not used in WAN as it has the disadvantage that every node receives every information sent and therefore needs to handle data it may not need, want or even should not get. The other one can be further divide into circuit-switching and packet-switching which both will be explained closer in the following.

3.1 Circuit-Switching

At the beginning of the communication a preplanned path is established between both participants. This path consists of intermediate network nodes and their links and is only released at the end of the data-transfer. Normally those nodes and links allow more than one connection to take place, nevertheless they are hardware-wise only capable of a certain amount of circuits after that new ones have to wait for old ones to finish. The data itself is sent as a continuous stream of bits and therefore has no noticeable delay. This method is mostly used for telephone networks where even short delays are unwanted or for long connections with large amounts of data. There exists a slight variation of circuit-switching the so called leased-line.

In a leased-line both nodes are permanently connected and the only ones to use that connection. It allows a very secure, stable but expensive way of transporting information as there are no intermediate nodes which means that there are less sources for errors.

Circuit-switching offers a fixed amount of bandwidth which in some cases may not be used completely. For instance a computer may stop sending data because some processing needs to be done first. In the meantime the nodes and the links could be used for a communication between different (new) participants. Packet-switching, which will be described next, offers a way to avoid that issue.

3.2 Packet-Switching

This method separates the data into smaller segments with limited size, so called packets, which are sent individually through the network. Packet-switching can be further categorized into “connection-oriented” and “connectionless”.

3.2.1 Connection-Oriented

Before packets are sent, a virtual circuit is made between the two parties by sending a request-packet which informs all intermediate nodes of the communication path. This circuit is, unlike one from circuit-switching, only existing theoretically and does not block a node when no bandwidth is needed. Every subsequent packet has a virtual circuit identifier which tells the nodes to which circuit it belongs and through that the nodes know how to route that packet. As a result the only limit to the amount of circuits a node can be part of is the amount of virtual circuit identifier/destination - pairs it can save. This method ensures that all packets are received in the right sequence and there is only error handling needed if one of them is somehow lost.

3.2.2 Connectionless

Packets, in this case called datagrams, are sent independently of each other. They are given an address-header with all needed information to get to their destination and are then sent to an intermediate node that can handle them.

There they are temporarily stored until the next node is ready and send again. That procedure is repeated until they reach their destination. As a result two packets that have the same destination can be routed completely different and may even arrive in the wrong sequence or not at all. The network itself does not handle any of those cases - the network user has to do that. The big advantage of this method is, however, that congestions can be easily avoided as then the packet just takes a different path.

4 Conclusion

Finding the best method for establishing a connection between two *Wide Area Network* nodes involves thinking about the main advantages and disadvantages of them and comparing those with the specification of the connection. Whilst circuit-switching may seem favorable for instance for phone-calls because of being stable, the inflexibility it has through the limited amount of possible circuits and the bandwidth not being used completely may lead in other cases to packet-switching being the preferable option. Using a mobile game on a smart-phone is a good example as the phone and the server may want to stay connected for further data-exchange but both of them may stop sending data for a while to process and therefore would block a circuit that could be used otherwise.

References

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