Module 9

Digital Switching

Version 1 ECE , IIT Kharagpur

Lesson

29

Space Switching

9.1.1. INTRODUCTION

The basic communication network is the telephone network. It normally is multistage in the sense that the network is formed with several switching exchanges following some hierarchical structure. A standard telephone network is shown below.

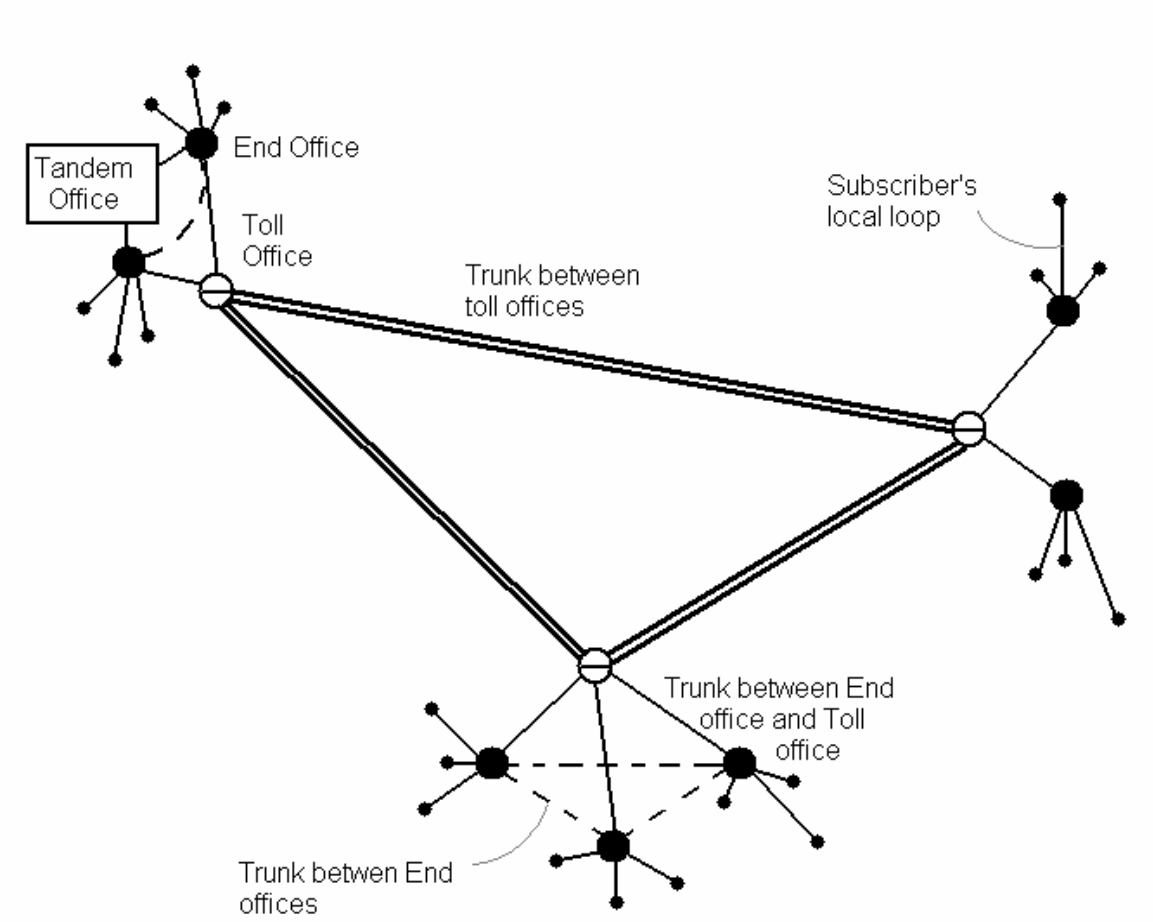

Figure 1 Standard telephone network structure

The subscriber loop is that part of the network which connects the user to the network.

Subscriber loop may be

- Original copper wire
- Fiber in the loop (FITL)
- Wireless in Local loop (WLL)

For uncompressed data rate of up to 64kbps, telephone network provides best QoS among data networks. Video can be of varying bit rate. But telephone network is of fixed bit rate, so it can support fixed data rate video. It can support anything with best QoS. The only concern is that cost will be more for less efficiency. So the telephone network are called telecommunication network.

☞In the hierarchical structure of the telephone networks, if the number of switches decrease then the transmission distance increases, and vice-versa.

Correspondence with OSI layers

In telephone network, upper three layers are in human brain as application is only voice and hence human controlled. So transport layer is not required as there are no multiple applications in application layer, and also the person will perform flow control etc. no storage is really required for finding the path. Network layer may be required to some extent (addressing by dialing). Data link layer has not much significance as no framing is required in network we need the routing functions. The routing is done using the telephone number that we dial for setting up the path so only physical layer is required.

MISSED ONE LECTURE (ON BASIC TELEPHONE EXCHANGE)

9.1.2 CONCEPTS OF SPACE SWITCHING

☞*GRADE OF SERVICE*

A SMALLER NUMBER OF SWITCHES ARE TO BE ACCESSED BY A LARGE NUMBER OF SWITCHES. SO SHARING OF THE SWITCHES IS VERY IMPORTANT. A USER MIGHT USE THE SWITCH ONLY FOR A SMALL AMOUNT OF TIME. AS IN NORMAL VOICE COMMUNICATION BETWEEN TWO PARTIES, A PERSON NORMALLY SPEAKS FOR 40% OF THE TIME. A

SINGLE SWITCH WILL SERVE BOTH THE USERS AT TWO ENDS. THUS EXPERIMENTALLY AVERAGE TRAFFIC MAY BE 20 TO 25%. SO THE NUMBER OF CROSS POINTS IS ONLY 25% OF THE NUMBER OF USERS. WITH THIS SCHEME WHEN THE 26TH CALL IN A HUNDRED-LINE SYSTEM ARRIVES IT WILL HAVE TO WAIT UNTIL A SWITCH BECOMES FREE. THIS BLOCKING IS REFERRED TO AS THE GRADE OF SERVICE IN TELEPHONE COMMUNICATION SYSTEM.

☞*TODAY IN ALL COMMUNICATION QOS IS IMPORTANT. IN CIRCUIT SWITCHING MODELS USED PREVIOUSLY A DEDICATED PATH BETWEEN USERS WAS ESTABLISHED, SO THE QOS COULD NEVER DEGRADE. THUS RELIABILITY WAS NOT A PROBLEM, ACCESSIBILITY WAS. THE MEASURE OF ACCESSIBILITY IS DEFINED AS GRADE OF SERVICE (GOS).*

The delay jitter in IP creates problems and results in degradation of QoS for voice and video traffic, but not for data traffic. Wireless communication additionally is very hazardous in maintaining QoS. Demand for everything on wireless requires amalgamation of all media, services, and technologies where QoS is very important.

Blocking

As we use a lower number of cross points for serving a larger number of users an incoming call may be blocked due to unavailability of a cross point. This reduces the GoS. This blocking process being random, it is quantified by Probability of Blocking -- P_b, which should be as small as possible. However reducing P_b implies providing higher number of cross points, which results in a higher cost.

9.1.3 DIGITIZATION OF THE TELEPHONE NETWORK

During digitization first the trunk exchange was made digital i.e. convert from analog FDM to digital TDM. We use a trans-multiplexer that converts 600 FDM channels to TDM channels. The ADCs were not placed in the Terminal equipment nor at the Local exchange as this would have increased the cost of the network. The ADCs were instead placed at the inputs of the Trunk exchanges where traffic from Local exchange come in. Multiplexing and switching is done digitally at the Trunk exchange. The trunk exchange output is anyway going through a digital line. So the form the local exchange side of the trunk exchange onwards the network is digital.

In another structure the ADC are used in local exchange. Multiplexing and switching is done digitally there. Switching is performed on 32-channel (or more) PCM data and then transmission is also digital. So from the output side of the local exchange the network becomes digital. This is called integration of switching and transmission. Using ADCs for a number of channels instead of individual ones helped in reducing the ADC cost as well as memory cost.

Later on subscriber side of the local exchange was also digitised using ADCs. So apart from the subscriber telephone sets and the associated copper line the whole network becomes digital. As digital phones are very costly, so users preferred to continue with the analog phones. The digitization is done at the port where the user telephone line is connected at the exchange.

☞*NOW-A-DAYS YOU CAN HAVE EITHER A DIGITAL PHONE CONNECTED DIRECTLY TO A DIGITAL PORT WITH 64KBPS BIT RATE, OR AN ANALOG PHONE CONNECTED THROUGH AN ADC. ALL DIGITAL EXCHANGES NOW PROVIDE BOTH OF THESE FACILITIES. A DIGITAL COMPUTER IS CONNECTED THROUGH AN ANALOG LINE (AN ANALOG PORT) USING A MODEM AT THE CUSTOMER PREMISES*

With conventional 0.4 mm wire the distance will be limited for digital lines. The loop wire width should be at least 0.6 mm. with 64 kbps data rate the capacity of upto 1 Mbps, is grossly underutilized, though.

☞*OFDM AND SOME OTHER TECHNIQUES ARE*

Objective Questions

29.01

Subjective Questions

29.11

Level 2 Questions

29.21