

**Project**

**Report on Telephone Network (A Networking Technology)**

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## **Telephone Network**

Networking technologies are technologies which focus on basic needs of getting networked. Without a series of network we cannot transfer data or communication from one point to another. A network is defined as group of devices which are intend to be connected to each other. Upon which transfer of information can be carried out. Each set of devices set on network can be thought of as node, with each node having its unique code and address.

For the purpose of this paper, we have chosen telephone network technologies.

Telephone network has been the oldest known networking technologies invented by humans and for the benefit of wide range of public. Earlier telephone networks were used to use morse code for receiving and sending information in the form of codes. Later newer developments created better technologies through which voice messaging was possible to transverse from one point to another over big web of networks interconnected with each other.

Before the invention of electromagnetic telephone system, mechanical acoustic telephones were used for transmitting voice messages for distance impossible for human voice transfer. Advances in technologies have a long way since the invention of mechanical acoustic telephones.

The network of wide range in telephone technologies can be dated to year 1876. The figure 1, clearly explains the very first telephonic network established for public use.

# Telephone Networks

- Starting in 1876, the public switched telephone network (PSTN) has become a global infrastructure for voice communications

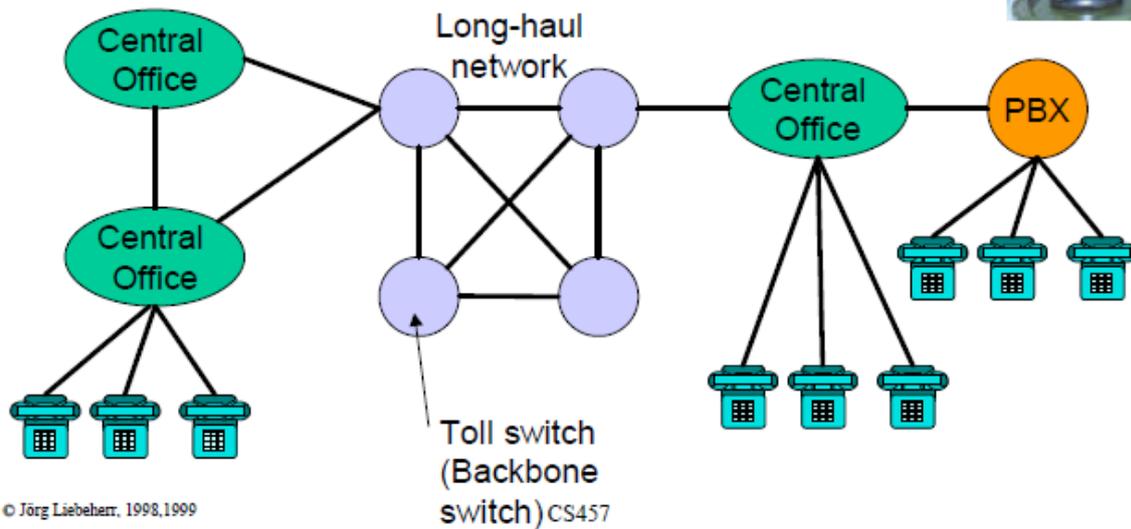
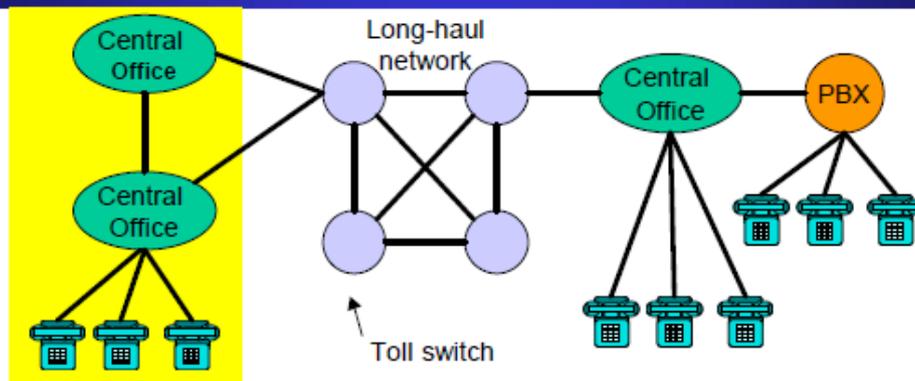


Figure 1

As described in the figure 1, there used to be central office which used to control the voice messages over long haul network and used to transmit the message from one node to another, then to another node.

## Central Office and Local Loop



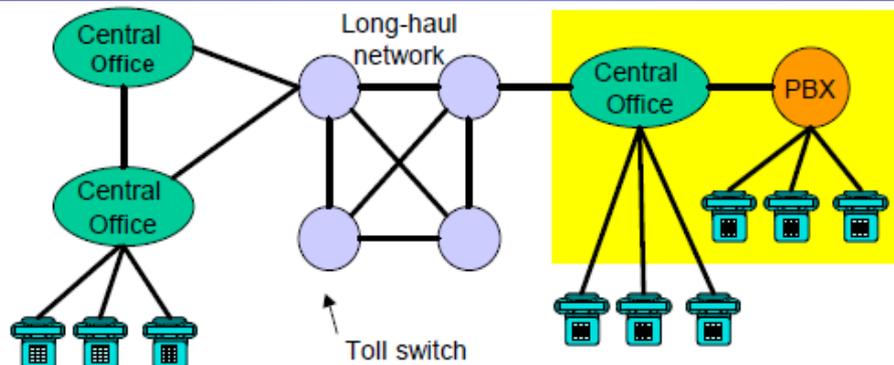
- Each phone user (**subscriber**) has a direct connection to a switch in the central office. This is called the **local loop**
- The local loop has a length of 1 - 10 km
- The switches in the central office are called (**local**) **exchange**
- A company which provides local telephone service is called a **local exchange carrier** or **LEC** (e.g., Bell Atlantic)

**Figure 2**

Figure 2 clearly mentions the importance of central office and local loop for transferring of messages. Each phone user or known as subscriber used to have direct connection to a switch in the central office. This was called local loop. Each local loop had the length in range between 1 to 10 km. The switches in the central office were called local exchange. Any service provider which used to provide local services was called local exchange carrier or in other words LEC.

Figure 3 below describes another characteristic of telephone network, i.e. PBX. Or in other words, Private branch exchange.

## PBX



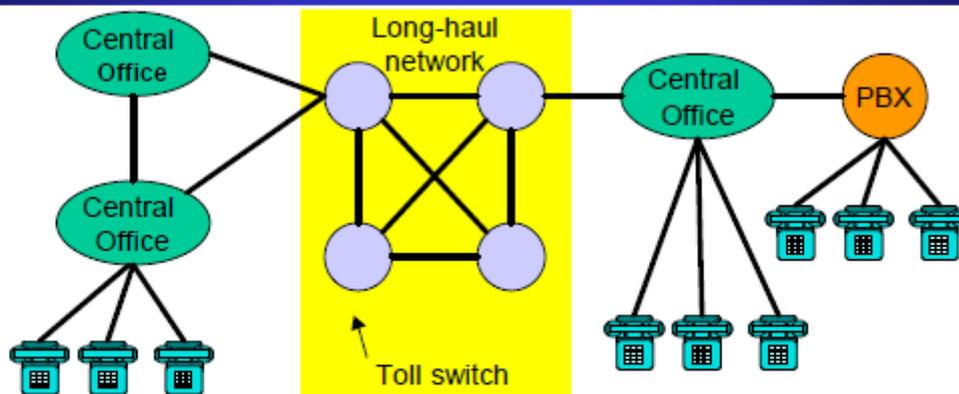
- A **PBX (Private Branch Exchange)** is a telephone system within an enterprise that switches calls within the enterprise on local lines, while allowing all users to share a certain number of external lines to the central office
- The main purpose of a PBX is to save the cost of requiring a line for each user to the telephone company's central office.

Figure 3

The Private Branch exchange was the telephone system with in the enterprise that switches calls within the enterprise on local lines, while allowing each of the users to share a number of external lines to the central office.

Figure 4 describes the long haul network in brief,

# The long-haul network



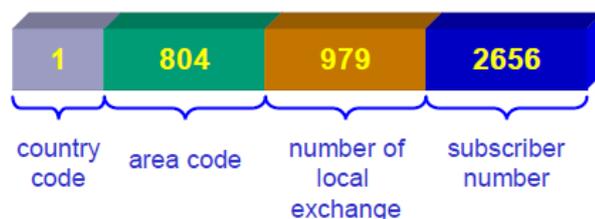
- Toll or backbone switches provide long-distance connectivity over long-distance trunks
- There are only about 500 toll switches in the United States. Each toll switch can run more than 100,000 simultaneous phone calls

Figure 4

Further characteristics of the telephone network has been described in figure 5, as mentioned below,

## Addressing and Routing

- Each subscriber has an address (telephone number)
- Addresses are hierarchical
- **Example:** Domino's Pizza in downtown Charlottesville



- One point here which is need
- The information contained in a telephone address is exploited when establishing a route from caller to callee

Figure 5

to be understood is, How voice used to be transferred.

A figure 6 describes the working as mentioned below,

- Voice can be transmitted in two ways:
  - **Analog voice transmission:** Each voice channel is allocated a bandwidth of 3.5 kHz
  - **Digital voice transmission:** Analog voice stream is converted in a digital stream:
    - Standard scheme for a voice call: Obtain 8000 samples per second, each with length 8 bit

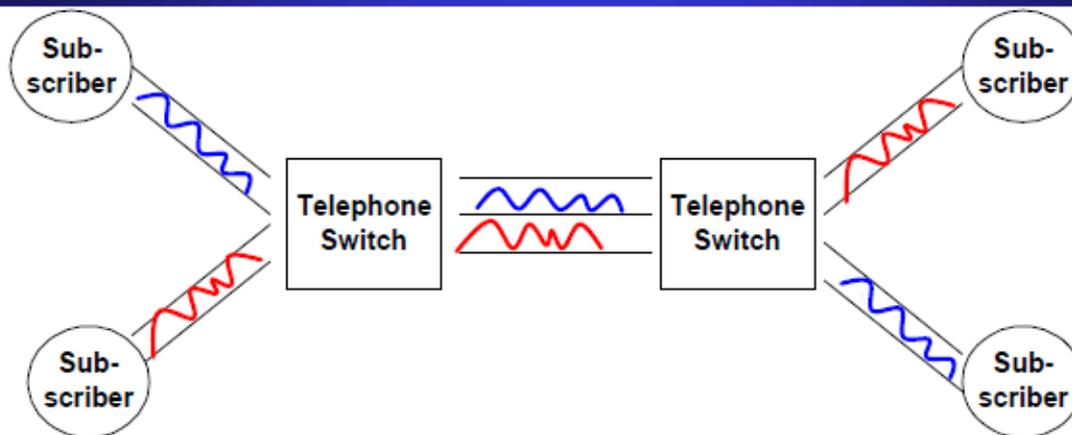
Figure 6

- **Until 1960s:**
  - Entire telephone network is analog
- **Today:**
  - The local loop is analog.
  - The rest of the network is digital.
- **When do we get an all digital network?**
  - This is ISDN
  - It is available since many years, but no one seems to want it, at least in the US. ISDN is in wide-spread use in Europe.

Figure 7

As it has been clearly described in Figure 6 and Figure 7 upon how voice used to be transmitted another characteristic's of the telephon netwrk is described in figure 8 below,

## All analog telephone network

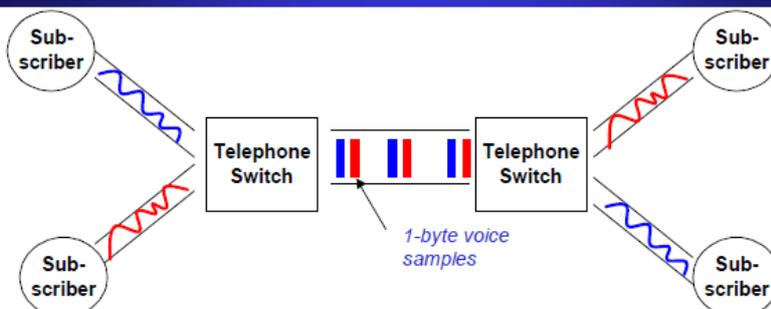


- The telephone switch bundles (multiplexes) multiple voice calls on a high-bandwidth link
- Each call receives a fixed bandwidth. The frequency of each call is shifted, so that multiple calls do not interfere. This is called **Frequency-Division-Multiplexing (FDM)**.

Figure 8

Figure 9 describes the telephonic network in little detail,

## Analog local loop / digital network



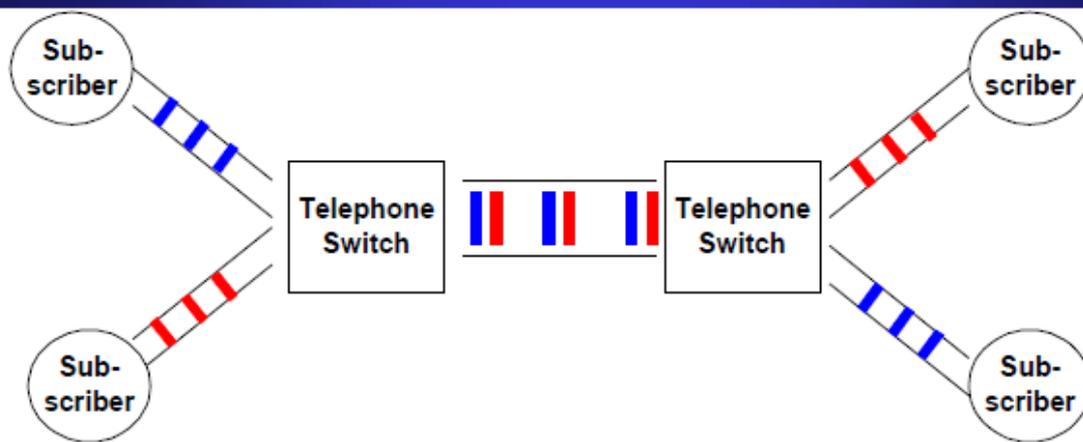
- The first telephone switch digitizes a voice call (8000 8-bit samples per second)
- Switch bundles multiple calls, by interleaving samples in time. Each call receives one 1-byte slot every 125  $\mu$ s
- This is called **Time-Division-Multiplexing (TDM)**.

Figure 9

Figure 10 mentions the characteristics of all digital network,

## All digital telephone network

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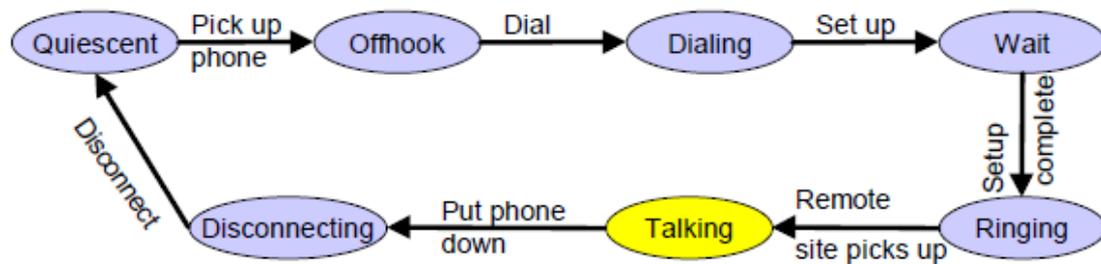
- The telephone at the subscriber digitizes voice and sends one 8-bit samples every  $125 \mu\text{s}$

Figure 10

Figure 11, mentions the concept of signaling over telephonic network,

# Signaling

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- **Signaling** refers to the control functions performed to setup a phone call
- Signaling between users and the local exchange in the central office is quite simple: dial-tone, punch numbers, put phone down, etc.
- Signaling between exchanges is more complicated and is done via a separate network, which uses packet switching

Figure 11 (Network Technologies, 2017)

## Importance of Telephonic network

Telephonic network has been in place before the invent of internet. Telephonic networks have advanced to present generation of mobile technologies, which use even today the loop technologies in their technologies to converse messages from one node to another. With the invent of smart phones and iPADS and tablets, the penetration of telephonic technologies have been in huge numbers.

Telephonic networks have completely transformed the way people now execute their business operations on the day to day basis. The technologies in telephone segments have advanced and even use more advanced platforms which has made the service stronger and secure in nature. Keeping track of unwanted events as they come up by using the

advancement in technologies in unlawful manner, many security providers have come up building yet another service segment which the companies now tap to earn money.

Advancement in telephonic networks have risen to a new level of security and privacy which ensures the public of user safety features by the service providers.

**Marketing agencies tap the potential of telephone network for the benefit of their business and to flourish by providing better services by reaching as close to the clients as possible by just sitting in their head offices.**

### **Future trends**

Internet has spread like never before these days, which is also one of the networking technologies, but it cannot replace the advantages which the telephonic networks provides to its users and public in a holistic manner (<https://www.nap.edu>, 2017).

### **References**

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2. The importance of telecommunications and telecommunications research. (2017). Accessed from: <https://www.nap.edu/read/11711/chapter/3> (Accessed on: 27.03.2017).