

ADVANCED ELECTRONIC COMM. SYSTEMS

LECTURE 1

INTR_TELECOMMUNICATION SYSTEMS

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COURSE INFO

Title	Advanced Electronic Comm. Systems
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References	Multiple references will be used
Assessment (100)	1. Final Term Exam (60) 2. Mid Term Exam (14) 3. Oral (10) 4. Section Work (8) 5. Lecture Work (8)

MAIN TOPICS

Introduction on Telecommunication systems

Basics of Satellite Communications

Recent Trends in Communication Systems
(Student Reports)

REFERENCES

L.Frenzel - Principles of electronic communication systems- 4th edition

Wayne Tomasi - Advanced Electronic Communications Systems- 6th edition

Recent Scientific Research Papers

MAIN ASSIGNMENT OF THIS COURSE

Presentation _Applications _ Cloud Computing

- Please send me group names (with one leader for each group) and the topic selection within two weeks from now.

Communications

- **Communications**

Transfer of information from one place to another.
Should be efficient, reliable and secured.

“A communication system is a process of **conveying information** from a source to a destination”

- **Communication system**

Components/subsystems act together to accomplish information transfer/exchange

“An electronic communication system is transferring information using an electrical field as a **mean of signal**”

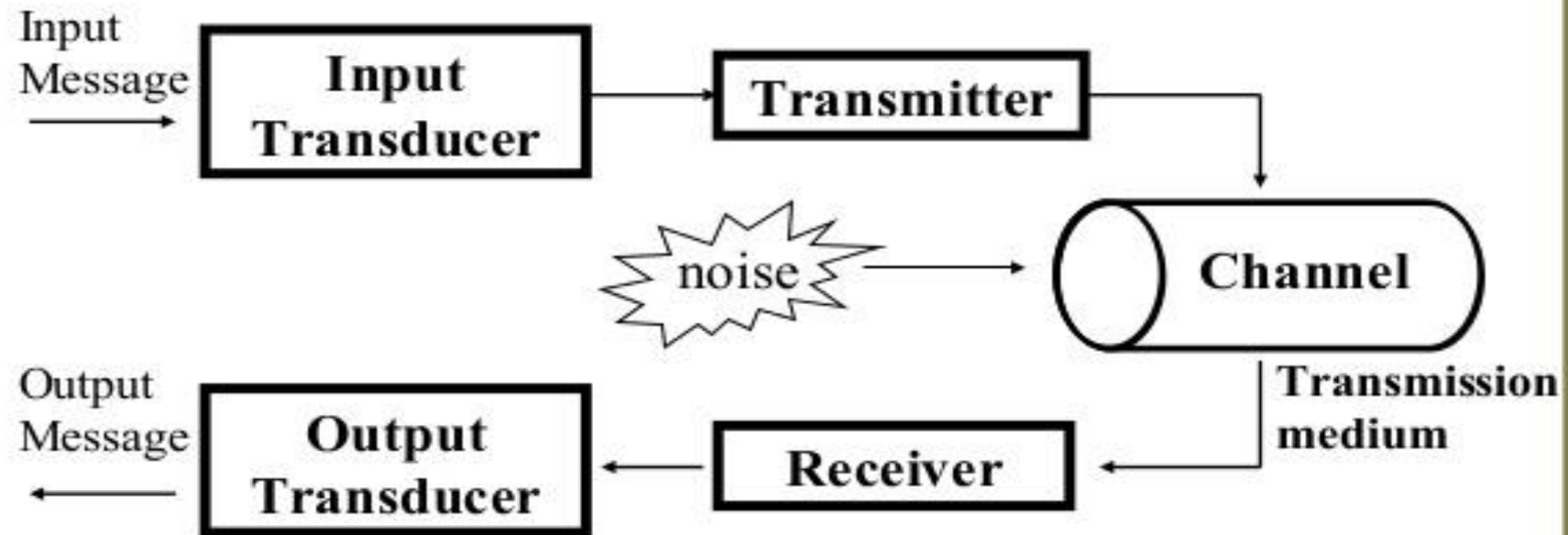
Requirements

- **Rate of information transfer**
 - The rate of information transfer is defined as the **amount of information** that must be communicated from source to destination.
 - It will determine the **physical form and technique** used to transmit and receive information and therefore determines the way the system is designed and constructed.
- **Purity of signal received**
 - The **received signal** must be the same as the **transmitted signal**.

Requirements

- **Simplicity of the system**
 - Any communication system must be **convenient** in order to be effective and efficient and easy to use
- **Reliability**
 - Users must be able to **depend** on a communication system. It must work when needed and transmit and receive information without errors or with an acceptable error.

Elements of Communication system



Elements of Communication system

- **Input Transducer**

To **convert the message** to a form suitable for the particular type of communication system.

Eg: Speech waves are converted to voltage variation by a microphone.



- **Transmitter**

Processes the input signal → to produce a transmitted signal that suited the characteristic of **transmission channel**.

eg: modulation, coding

Other functions performed:

Amplification, filtering

Elements of Communication system

- **Channel (Transmission medium)**

A medium that bridges the distance from source to destination.
eg: Atmosphere (free space), coaxial cable, fiber optic, waveguide

Signal undergoes degradation from noise, interference and distortion.

- Transmission systems can be evaluated according to five (5) main criteria:

- Capacity

- Performance

- Distance

- Security

- Cost which include installation, operation and maintenance

Elements of Communication system

- **Receiver**

To **extract the desired signal** from the output channel and to convert it to a form suitable for the output transducer.

eg: Demodulation, decoding

Other functions performed:

Amplification, filtering.

- **Output Transducer**

Converts the electrical signal at its input into a form desired by the system used.

Eg: Loudspeaker, PC and tape-recorders.

Losses in Communication System

Various unwanted undesirable effect crop up in transmissions

- **Attenuation**

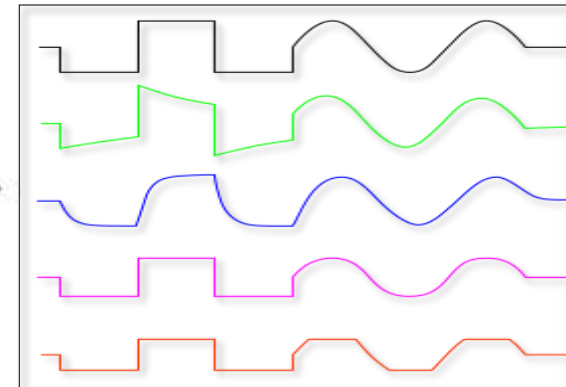
- Reduces signal strength at the receiver

- **Distortion**

- Waveform perturbation caused by imperfect response of the system to the desired signal itself
- It is the alteration of the original **shape** (or other characteristic). Ex. an amplifier is overdriven—causing **clipping** or **slew rate** distortion

- **Interference**

- Contamination by extraneous signals from human sources



**Harmonic distortion,
Phase distortion,
Amplitude distortion**

Historical Development

<u>Year</u>	<u>Events</u>
1844	Telegraph
1876	Telephone
1904	AM Radio
1923	Television
1936	FM Radio
1962	Satellite
1966	Optical links using laser and fiber optics
1972	Cellular Telephone

Historical Development

<u>Year</u>	<u>Events</u>
1975	First digital telephone switch
1975	Wideband communication system (cable TV etc)
1980	Compact disc is developed by Philip & Sony
1981	FCC adopts rules for commercial cellular telephone
1982	Internet is used to replace ARPANET
1985	Fax machines widely available in offices
1989	First SONET standard optical fiber products released
1990	WWW becomes part of the internet
1990-2000	Digital communication system (ISDN, BISDN, HDTV, handheld computers, digital cellular etc Global telecom system

Limitation in a Communication System

There are two categories of limitations:

- Technological constraint
 - Equipment ability
 - Economy and cost factor
 - National and international law and agreement as well as standardization (such as ITU etc)
 - Interaction with existing system
- Physical constraint
 - Bandwidth
 - The difference between the upper frequency and lower frequency of the signal or the equipment operation range
 - Noise
 - Any unwanted electrical energy present in the usable passband of a communication circuit

International Telecommunication Union ITU coordinates the shared global use of the **radio spectrum**, promotes international cooperation in assigning **satellite orbits**, works to improve telecommunication infrastructure in the developing world, and assists in the development and **coordination** of worldwide **technical standards**.



CHAPTER 18

Telecommunication Systems

Telecommunication Systems

Ref: L.Frenzel - Principles of electronic communication systems

Topics:

- Telephone System
- Facsimile
- Telephone IP

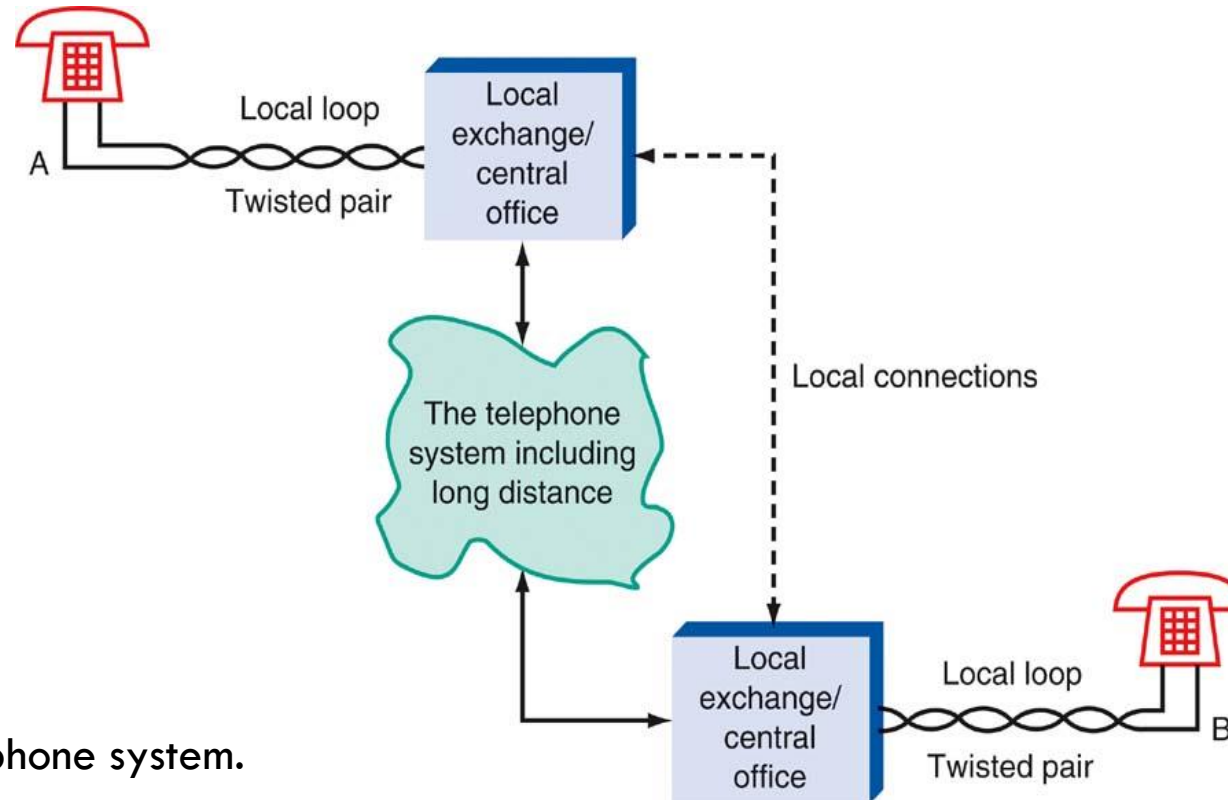
Telephone System

- The **telephone system** is the **largest** and most **complex electronic communication system**.
- The primary purpose of the telephone system is to **provide voice communication**. It is also widely used for many other purposes including **facsimile transmission** and **computer data transmission**.
- Telephone system is termed as **Public Switched Telephone Network (PSTN)**, which is based on the principles of **circuit switching** that can connect any two telephones.
- **Old system** of PSTN is called **Plain Old Telephone Service (POTS)**,

Telephone System

Central Office (CO) or Local Exchange

- CO is the facility to which your telephone is directly connected by a **twisted-pair cable**.
- The two-wire, twisted-pair connection between the telephone and central office is referred to as the **local loop** or **subscriber loop**. **10,000 telephone lines** can be connected to a single central office.

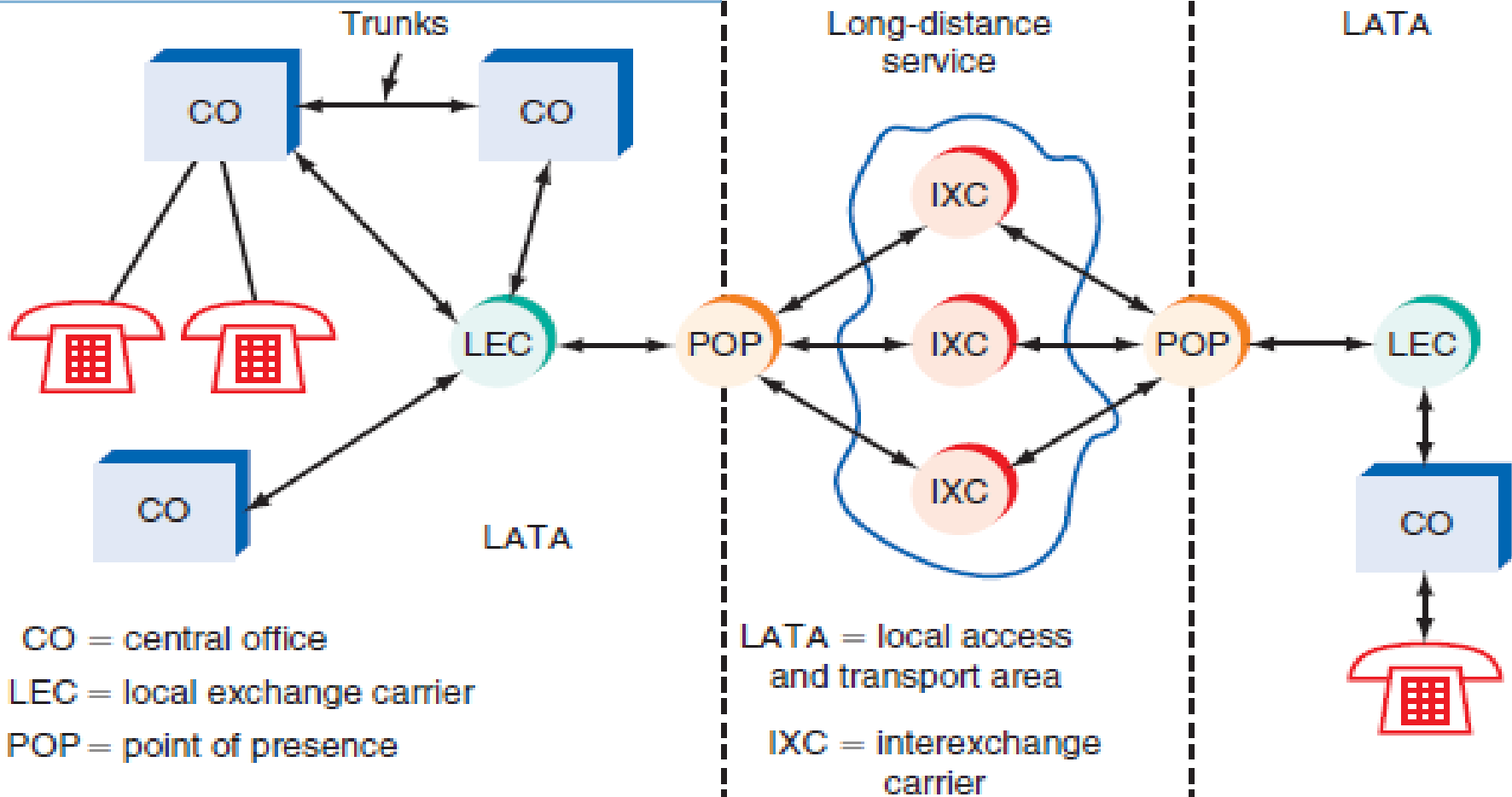


The basic telephone system.

Telephone System

Telephone System Hierarchy

coaxial, fiber-optic cable, or microwave radio links



Organization of the telephone system in the United States.

Telephone System

- Each **geographic area** is assigned to one of the regional operating companies (local exchange carriers, or local exchange companies (**LECs**)).
- The LECs provide “Local” telephone services to designated geographic areas referred to **as local access and transport areas (LATAs)**.
- Long-distance service is provided by long-distance carriers known as **interexchange carriers (IXCs)**.
- The **links** between **LATAs** within a region must be made through an **IXC**.
- Each LATA contains a serving, or **point-of-presence (POP)**, office that is used to provide the interconnections to the IXCs.

Telephone System

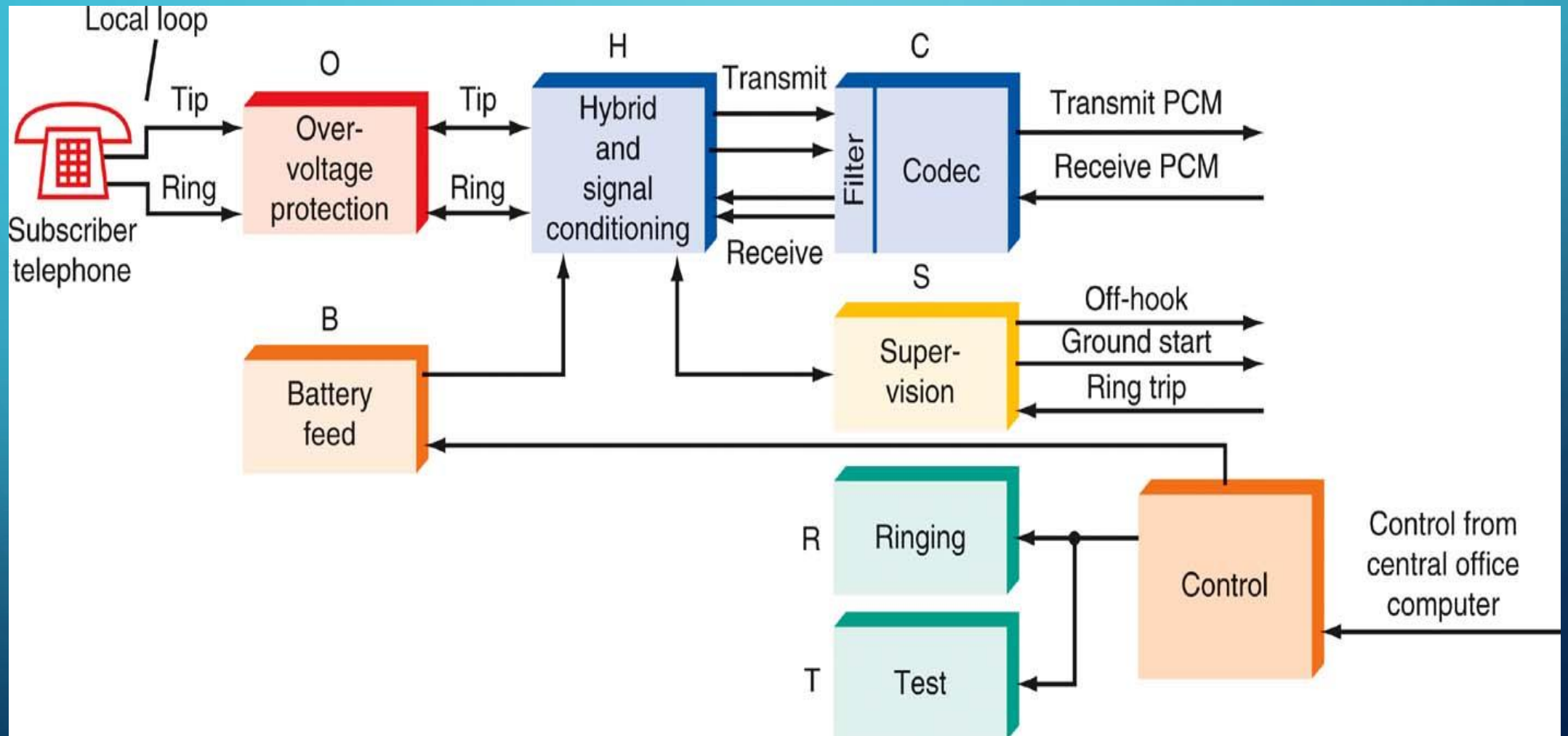
Subscriber Interface

- Each telephone connected to the central office is provided with a **group of basic circuits** that **power** the telephone and provide all the basic functions, such as **ringing, dial tone, and dialing supervision**.
- These circuits are collectively referred to as **the subscriber interface** or the subscriber line interface circuit (**SLIC**).
- In older COs, the SLIC used **discrete components**. Today, most functions of the SLIC are implemented by **ICs**.

The SLIC provide 7 functions generally referred to as BORSCHT: (**B**attery, **O**vervoltage protection, **R**inging, **S**upervision, **C**oding, **H**ybrid, and **T**est)

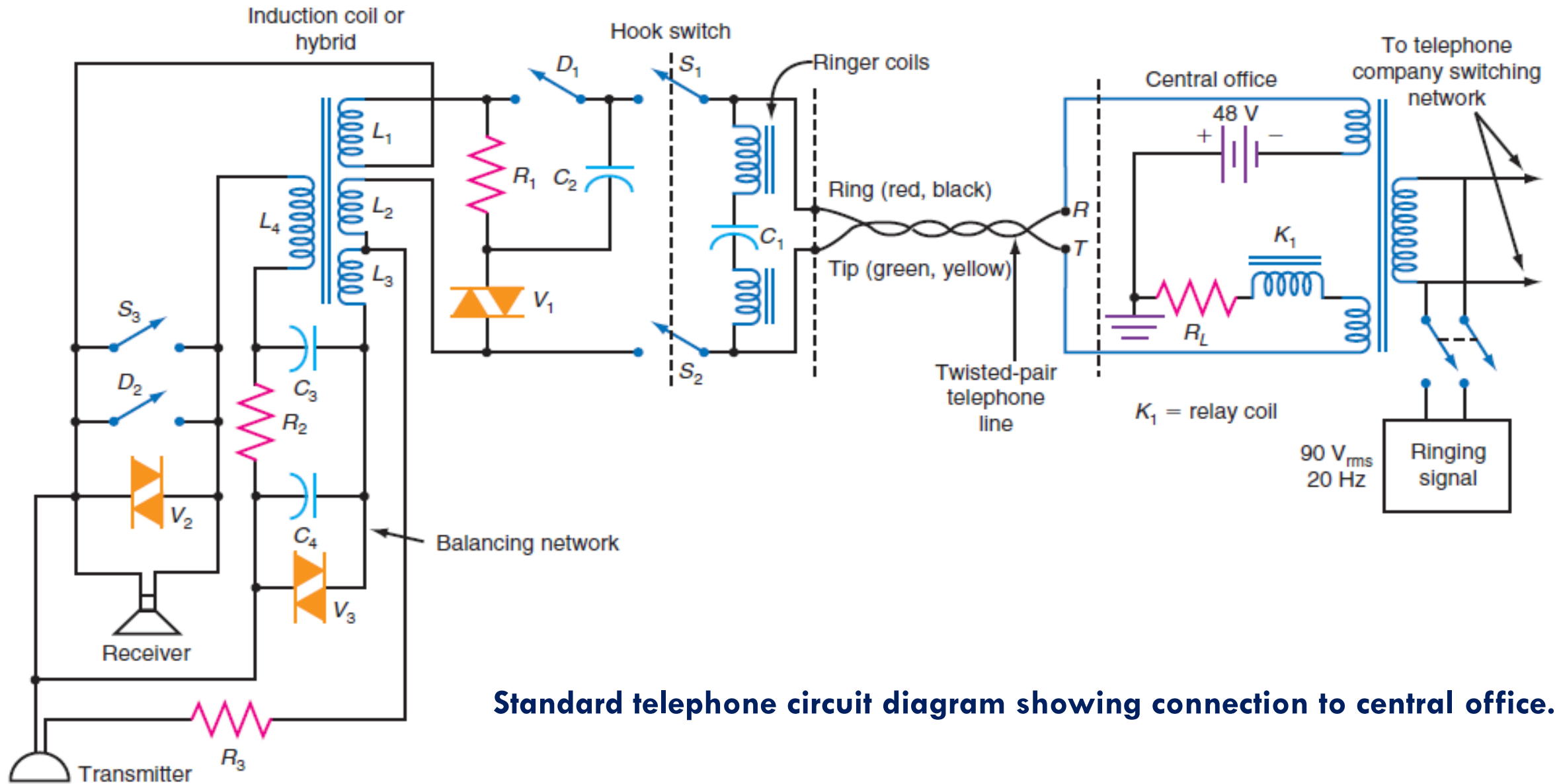
Telephone System

Subscriber Interface



BORSCHT functions in the subscriber line interface at the central office

Telephone System



Standard telephone circuit diagram showing connection to central office.

Telephone System

SLIC BORSCHT functions

Battery:

- CO provides - 48 V DC for on hook case (disconnected) , and drops to 6V for off hook.

Overvoltage protection:

- Protect the SLIC circuits from electrical damage

Ringng:

- CO supplied 90- Vrms ac Signal at about 20 Hz. It is done by closing relay contacts that connect the ringing signal to the line [a bell or an electronic oscillator connected to a speaker]

Supervision:

- monitor local loop conditions by a sensing circuit. (Ex. Recognize off-hook state, the ringing signal can be disconnected then connect dial tone, and a busy signal if the called number is not available.

Coding:

- A/D and D/A conversion

Hybrid

- (two-wire to four-wire vise versa), is a special transformer provides simultaneous two-way conversations on a single pair of wires..

Test:

- check the status and quality of subscriber lines, the phone company puts special test tones on the local loop and receives resulting tones in return.

Telephone System

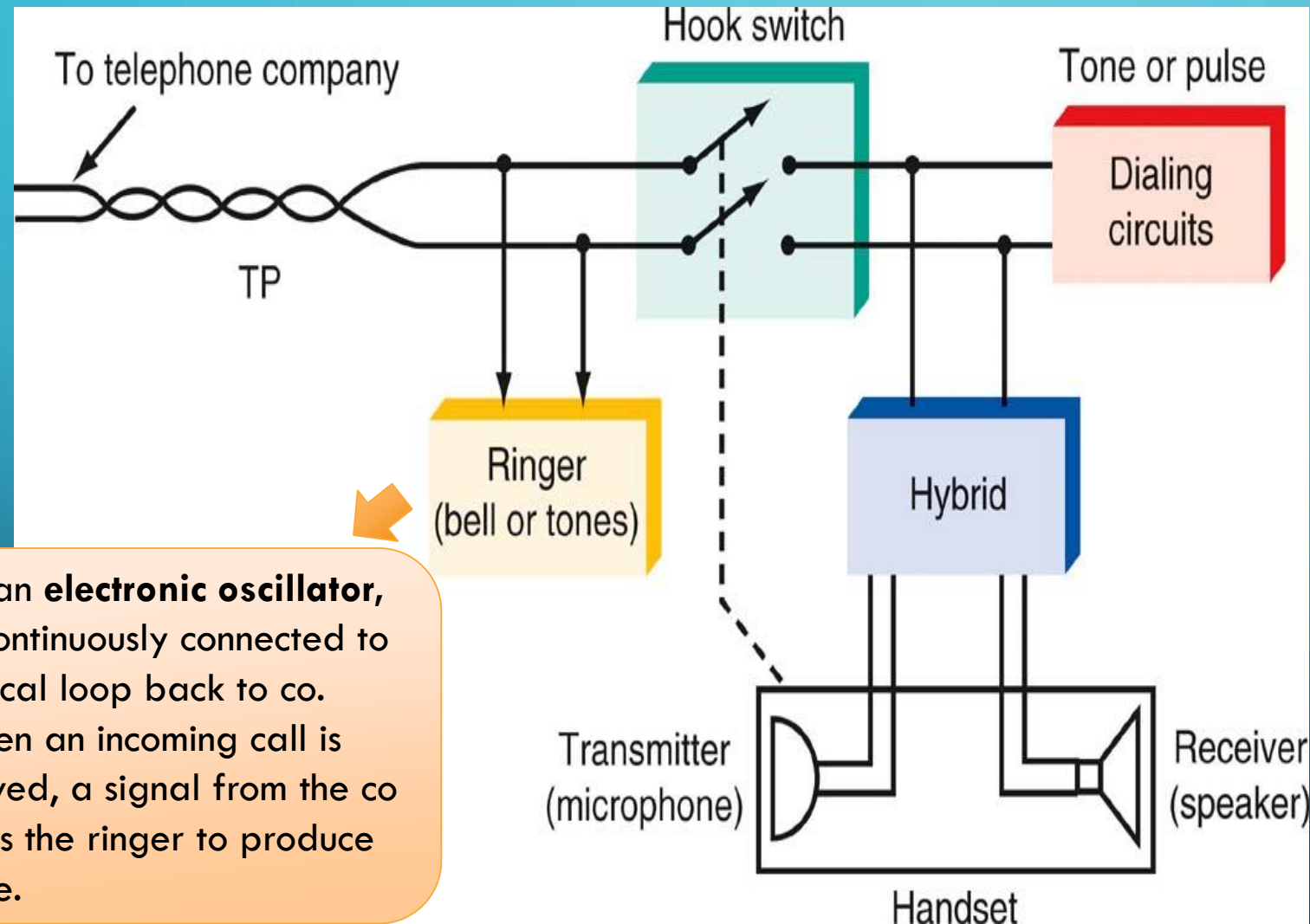
Telephone Set

- A basic telephone or telephone set is an **analog baseband transceiver**.
- It has a **handset** which contains a **microphone and a speaker**, better known as a **transmitter and a receiver**. It also contains a ringer and a dialing mechanism.

The advanced electronic telephones have other features such as **hold, speaker phone, call waiting, and caller ID**.

Telephone System

Basic Telephone Set

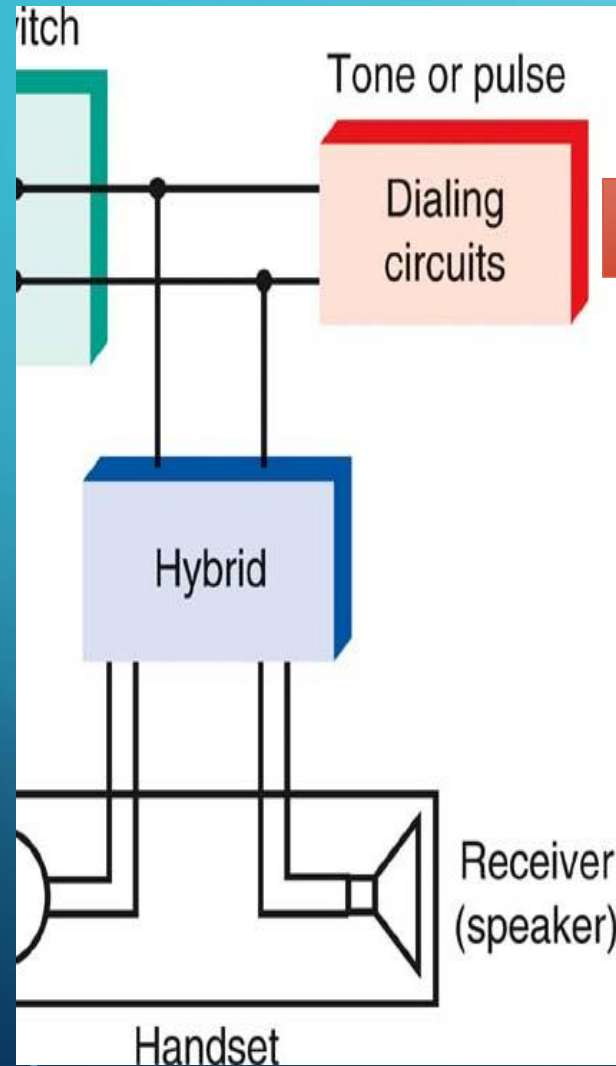


- Or an **electronic oscillator**, It is continuously connected to the local loop back to co.
- When an incoming call is received, a signal from the co causes the ringer to produce a tone.

- A **switch hook** is a **double-pole mechanical switch** that is usually **controlled** by a mechanism actuated by the **telephone handset**.
- When the **handset** is “**on the hook**,” the hook switch **is open**, thereby **isolating** all the **telephone circuitry** from the **central office local loop**.
- When a **call is** to be made or to be received, the handset **is taken off** the hook, **closing the switch** and **connecting** the **telephone circuitry** to the **local loop**.

Telephone System

Basic Telephone Set



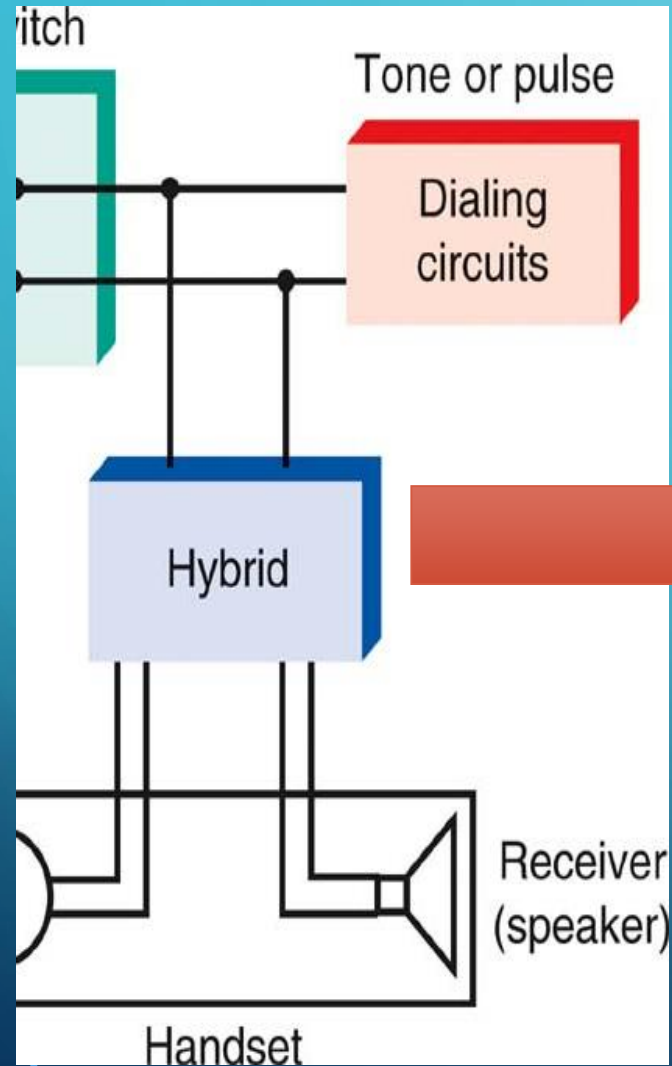
The *dialing circuits* provide a way for entering the telephone number to be called.

- **In older telephones**, a pulse dialing system was used. A rotary dial connected to a switch produced a number of on/off pulses corresponding to the digit dialed.
- These on/off pulses formed a binary code for signaling the co.

In modern telephones, a tone dialing system is used. Known as the dual-tone multifrequency (DTMF) system, this dialing method uses a number of pushbuttons that generate pairs of audio tones that indicate the digits called.

Telephone System

Basic Telephone Set



- The hybrid circuit is a special transformer used to convert signals from the four wires from the transmitter and receiver to a signal suitable for a single two-line pair to the local loop.
- The hybrid permits full duplex, i.e., simultaneous send and receive, analog communication on the two-wire line.

Telephone System

Private Telephone System

- For companies or large organizations with many employees, it is **not economical nor efficient** to use a remote CO for intercompany comm. with **separate** local loop connection for each telephone.
- This problem is solved by the use of **private telephone systems** within a company or organization.
- Private telephone systems provide **telephone service among the telephones in the organization** and **provide one or more local loop connections to the central office.**

Private Telephone System

- The two basic types of private telephone systems are known as:
 1. Key systems
 2. Private branch exchanges (PBX).

Key Systems:

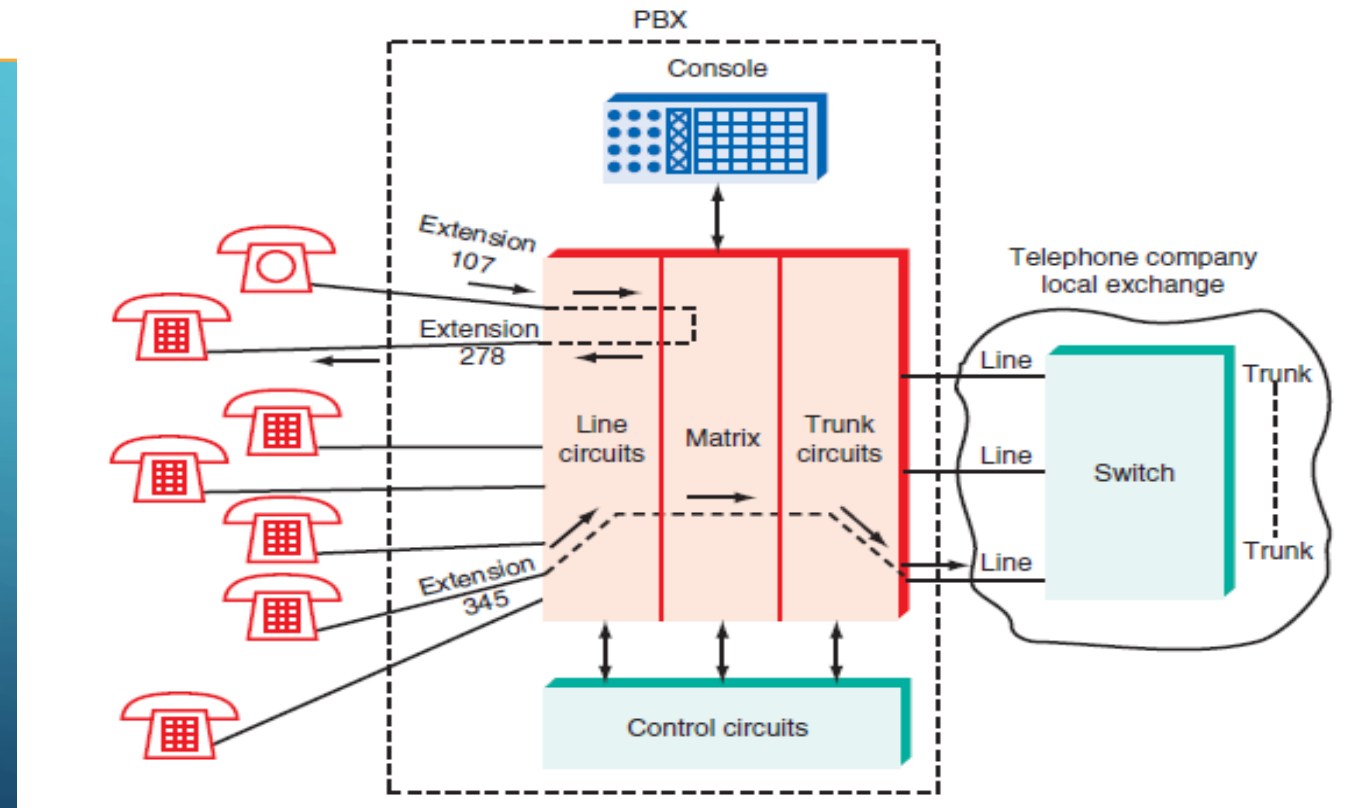
are small telephone systems designed to **serve 2–50** user telephones within an organization.

- Simple key telephone systems are made up of the **individual telephone units** called **stations**, all of which are connected to **a central answering station**.
- The central answering station is connected to one or more local loop lines, or trunks, back to the local exchange.

Private Telephone System

Private Branch Exchange(PBX)

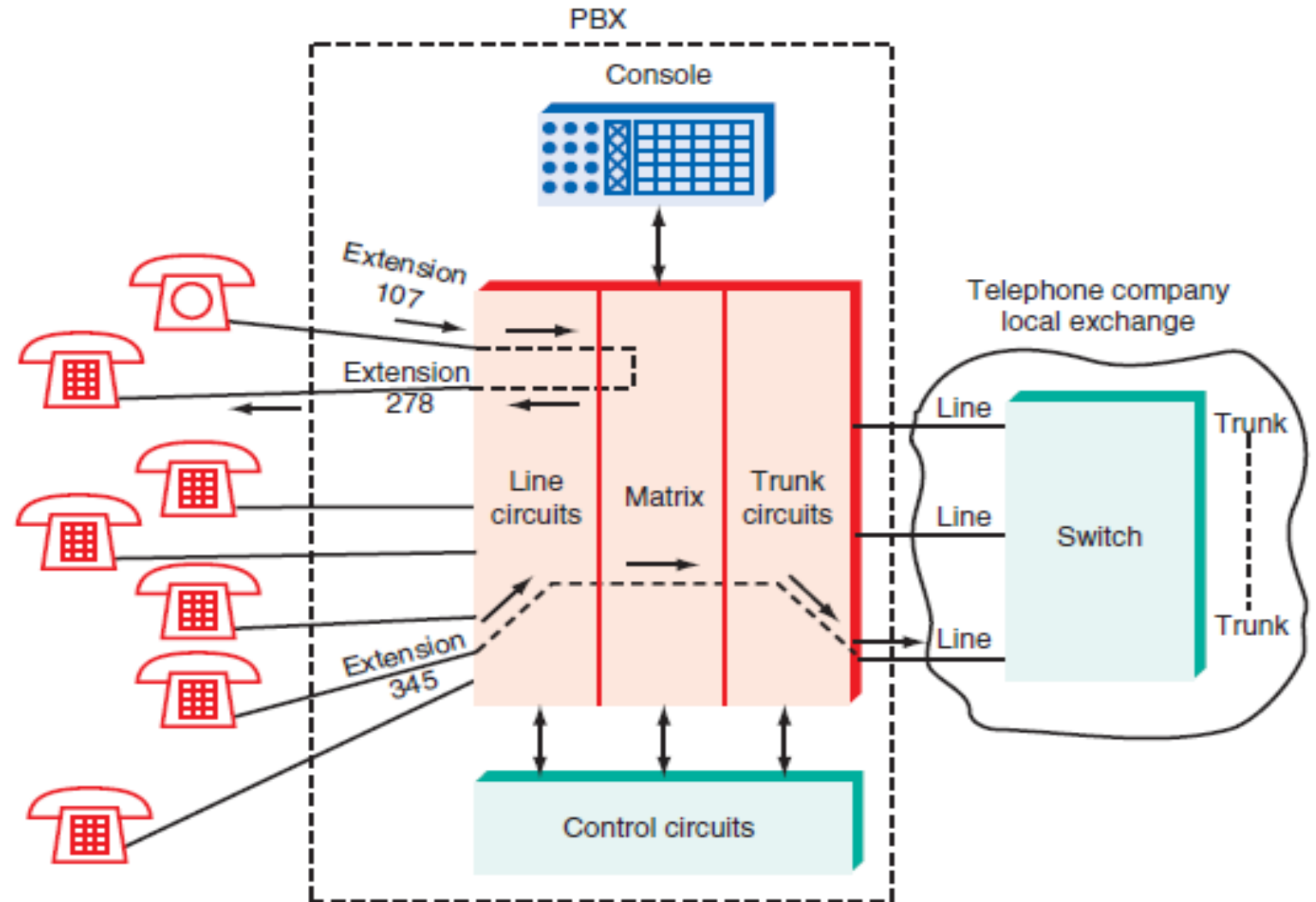
- A PBX is a **miniature complete telephone system**. It can handle **thousands of individual telephones** within **large organizations**.
- These systems may be referred to as **private automatic branch exchanges (PABXs)** or **computer branch exchanges. (CBXs)**



Private Telephone System

Private Branch Exchange(PBX)

- PBX is made up of **line circuits** that are similar to the **SLICs**.
- The **matrix** is **electronic switch** that connects any phone to any other phone in the system.
- The **trunk circuits** interface to the local loop lines to the Co.



Telephone System

Private Branch Exchange (PBX)

- PBX provides baseband interconnections to all the telephones in an organization.
- The PBX offers the advantages of **efficiency and cost reduction** when many telephones are required.
- The modern PBX is usually **fully automated** by **computer control** rather than **an operator to receive and route calls** that used in the old PBX.

- **An alternative to PBX** is **Centrex**: this service performs the function of a PBX but uses **special equipment** and **special trunk lines**.
- **Its advantage over a standard PBX** is that the **high initial cost of PBX equipment** can be avoided by **leasing the Centrex equipment** from the telephone company.

Today, as more companies adopt *VoIP systems*, the older style **PBX** systems are **gradually disappearing** in favor of an equivalent system that uses VoIP standards.

