# Unit 4
# Lecture 2
# Signaling

# Table of Contents

# Introduction

- Signaling Systems are as essential as switching systems and transmitted systems. For a multilink connection, it is necessary to send signals in both directions between the caller and the originating exchange , between the called customer and the terminating exchange and between exchanges.
- Signaling Systems must be compatible with the switching systems in a network. They must be able to transmit all the signals required to operate the switches. They must also be compatible with the transmission systems in the network in order to reach the exchanges that they control.
- Thus, the design of signaling systems is directly influenced by both switching and transmission requirements and the evolution of signaling has followed developments in switching and transmission.

- Transmitted signals may be either continuous signals or pulse signals. A pulse may be either a single pulse or a coded group of pulses.
- Transmitted signals may be either unacknowledged signals or acknowledged signals. When an acknowledgment signal is returned, it confirms receipt of the signal that was sent. Acknowledgment may be continuous or pulse signals.
- If pulse signalling is used, a signal may be repeated until it is acknowledged.
- When continuous signalling is used, a signal is sent until the acknowledgment is received and the signal persists until the original signal has been removed. This is called compelled signalling.

- Exchanges send signal over the same circuits in the network as the connections which they control. This is known as channel-associated signalling.
- For a simple telephone call only the following basic signals are required between exchanges :
  - Call request or seize
  - Address signal
  - Answer
  - Clear signals
- Signals generated by the central processor in one exchange and sent to the processor over a separate data channel is known as common-channel signalling (CCS).

# Customer line signalling

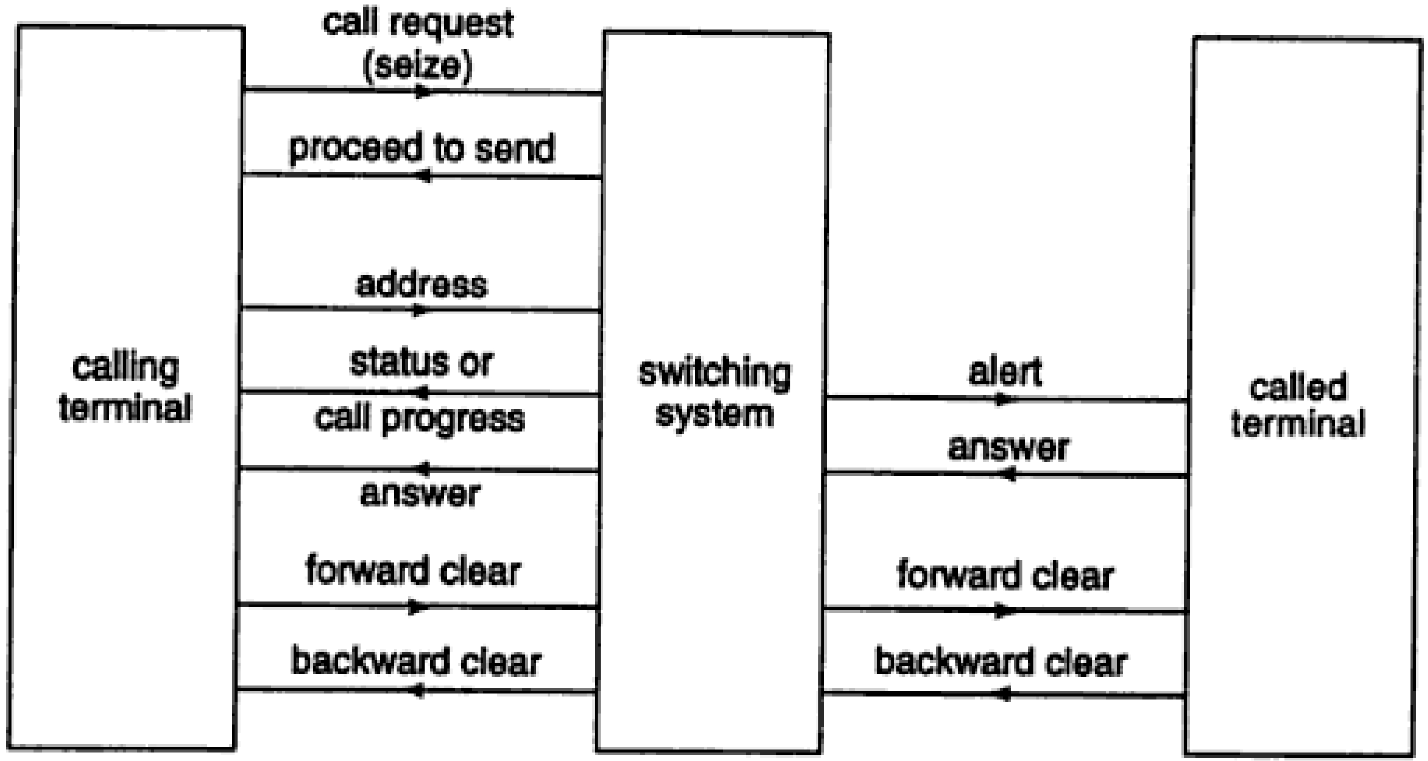
- In a local telephone network loop/disconnect signalling is used for sending customers call and clear signals to the exchange.
- Since there is a minimum line current that the exchange can detect, there is a maximum permissible line resistance.
- This limits the maximum length of line and the size of the area served by the exchange.
- In addition to being limited by DC resistance, the length of lines is also limited by permissible attenuation at voice frequencies.
- Ideally both limits be the same.

| Hz / Hz | 1209 | 1336 | 1477 | 1633 |
|---|---|---|---|---|
| 697 | Digit 1 | 2 | 3 | Spare |
| 770 | 4 | 5 | 6 | Spare |
| 852 | 7 | 8 | 9 | Spare |
| 941 | * | 0 | # | Spare |

Frequency coding used by pushbutton (keyphone or touch tone) telephone sets.

When dial telephones are used, customers send address information by decadic pulsing. For each digit, the dial makes and breaks the circuit to send a train of up to 10 loop/disconnect pulses at approximately 10 pulses per second. The exchange is able to detect the end of each pulse train because the minimum pause between digits (e.g. 400 ms to 500 ms) results in a loop state significantly longer than the 'makes' during pulsing (e.g. 33 ms.)

A relay circuit to receive dial pulses[2] was required in every selector in a Strowger exchange. However, the introduction of registers reduced the number of dial-pulse receivers needed, so these could be more complex. This led to the introduction of push-button telephones, which send voice-frequency pulses and thus provide faster signalling.



*Signals transmitted for a local call*

**Call between two customers on the same exchange require a number of actions to be performed in response to signals as shown**.

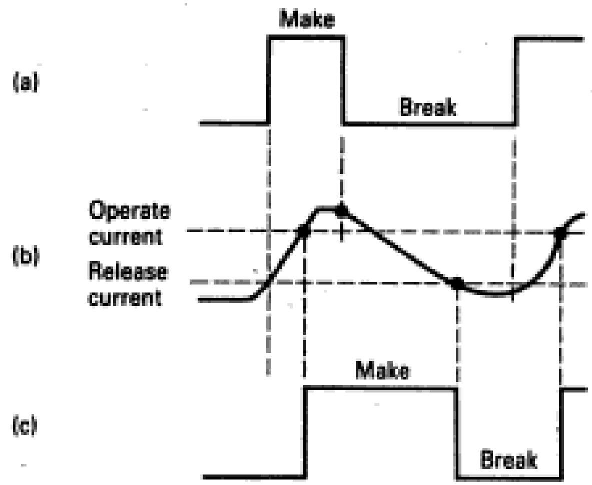
# Customer line signalling (Cont.)

In addition to the digits '1' to '0', the telephone keypad has buttons with the symbols '*' and '#'. These are used by SPC exchanges for facilities that are under the control of customers. For example, a customer who wishes incoming calls to be diverted to another telephone may key '*', followed by the appropriate instruction digits, before leaving. On returning, an instruction prefixed by '#' is keyed to remove the call diversion.

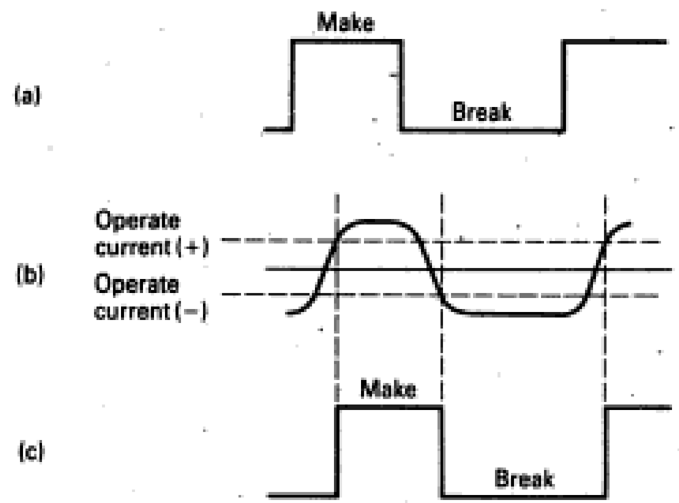
When a line serves a payphone additional signals must be transmitted for coin collection and return. For example, the exchange can make a polarity reversal for coin collection and apply a higher voltage for coin return. Some coin boxes require a coin to be inserted before dial tone is sent. These use a *ground start signal* instead of a loop seize signal. An earth is applied to the negative (R) wire of the line. A ground start signal may also be used to call a PBX from the main exchange. Otherwise, the line could be seized by an outgoing call from the PBX before the first burst of ringing current from the main exchange.

# AF junctions and trunk circuits

- When address information is sent between exchanges by loop/disconnect pulsing over a long line, distortion of the pulses can cause errors in the received information. The capacitance of the line causes a slow decay of the pulse waveform, so the output break from the receiving relay is shorter than that originally sent.
- On a multilink connection, when all the switches are directly controlled by the originating exchange, the distortion is cumulative.
- The non symmetrical waveform shown in figure ahead occurs with loop/disconnect pulsing because the sending impedance of the circuit is zero in the loop state and infinite in the disconnect state.
- Long distance direct current (LDDC) signalling system were therefore designed which obtain symmetrical waveforms by using double – current working.



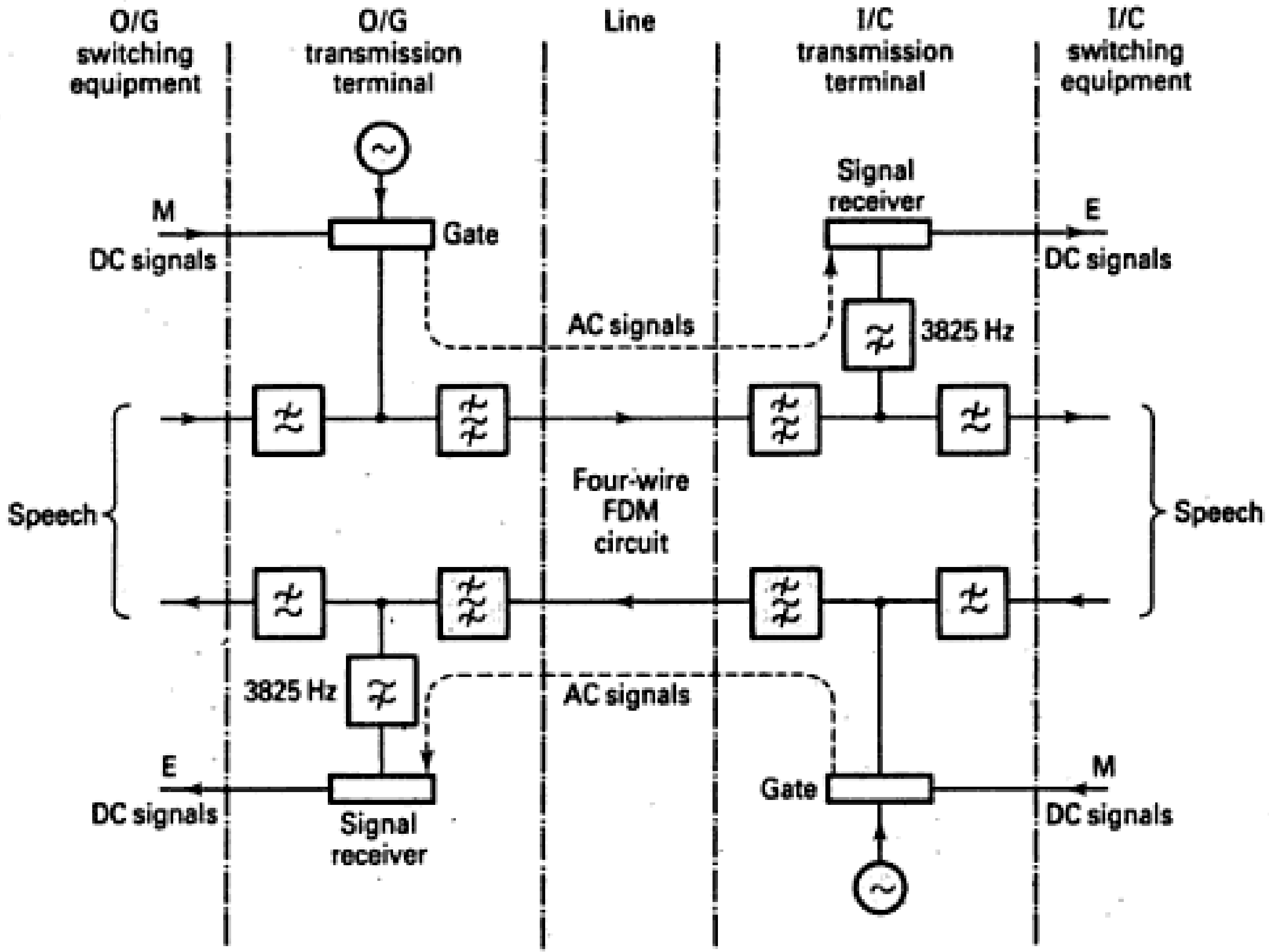

Distortion of loop/disconnect pulses caused by distributed capacitance of a long line. (a) Input pulse at sending end. (b) Arrival current waveform. (c) Output pulse from receiving relay.



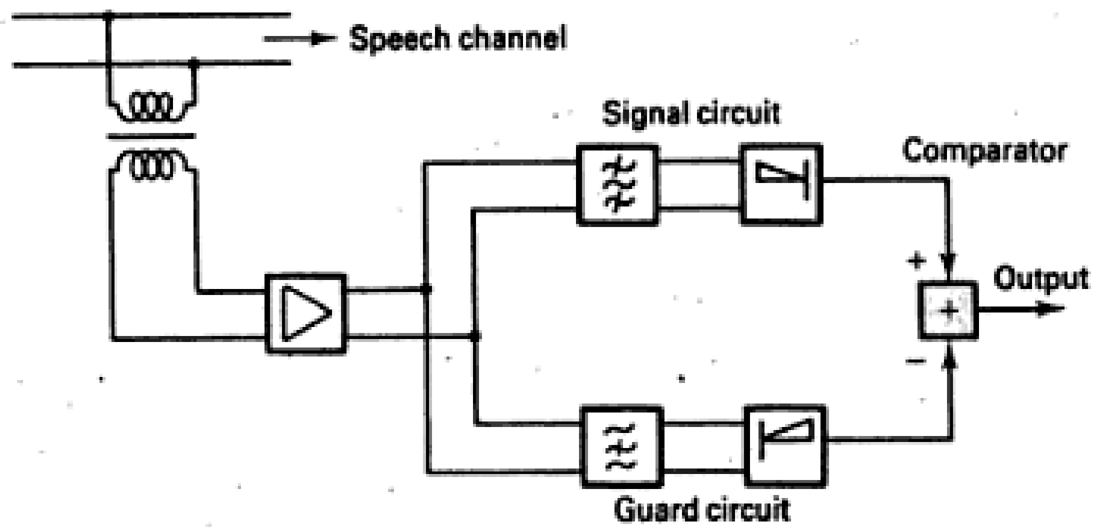

Pulsing by current reversals (double current working). (a) Input pulse at sending end. (b) Arrival current waveform. (c)Output pulse from receiving polarized relay.

# FDM Carrier Systems

- In FDM systems the carriers are spaced at intervals of 4KHz and the baseband is from 300Hz to 3.4 KHz. By using channel filters with a sharp cut off it is possible to insert a narrow band signalling channel above the speech band. Signal frequencies of 3.7 KHz and 3.85 KHz have been used. This is known as **outband signalling.**
- A “DC signal” on the output lead M at one terminal causes the signal frequency to be sent over the transmission channel. This is detected at the other terminal to give a corresponding DC signal on the output lead E.
- If the repeater station containing the FDM channeling equipment is adjacent to the switching equipment, it is simpler for the latter to send and receive signals over separate A and M wires than to extract them from and re insert them into the speech circuit.




Outband signalling system.




Block schematic diagram of voice-frequency receiver.

1. A signal frequency is chosen at which the energy in speech is low (i.e. above 2 kHz). For example, 2280 Hz is used in the UK[1] and 2600 Hz in North America.[5]
2. The durations of signals are made longer than the period for which the speech frequency is likely to persist in speech (e.g. ≥ 50 ms).
3. Use is made of the fact that the signal frequency is unlikely to be produced in speech without other frequencies also being present.

A block diagram of a VF receiver is shown in Figure 8.7. In order to make use of measure (3), the receiver contains a signal circuit with a band-pass filter to accept the signal frequency and a guard circuit with a band-stop filter to accept all other frequencies and reject the signal frequency. The outputs of both circuits are rectified and compared. If the output from the signal circuit exceeds that from the guard circuit, the receiver operates; if the output from the guard circuit exceeds that from the signal circuit, the receiver gives no output signal.

To avoid interfering with speech, VF signals must not be transmitted while a conversation is in progress. To avoid this, two signalling methods have been employed:

- Tone-on-idle signalling
- Pulse signalling.

Tone-on-idle signalling has been extensively used in North America.[5] In principle, it is very simple. An idle four-wire circuit transmits tone continuously in both directions and this is switched off in one direction by the forward seize and in the other by the backward answer. Clear signals switch on the signalling tone again. In practice, however, there are complications. Since the tone is present on every idle circuit, it must be transmitted at a low level to avoid overloading the FDM system. Also, the receiver must guard against short interruptions of the tone causing false seizures.