

Public Switched Telephone Network

This lecture describes the public switched telephone network (PSTN), the oldest access technology.

After this lecture you should be able to: define the terms introduced in the lecture, describe the POTS services provided by the CO and describe the various in-band signalling techniques.

Introduction

Although cellular phones and internet-based telephony are growing in popularity, the most people still subscribe to conventional wired telephone service (“landlines”).

The PSTN provides what is often called “plain old telephone service” (POTS). The PSTN allows its users (“subscribers”) to place and receive phone calls to and from any of about 7 billion mobile phones and about 1 billion fixed telephone lines.

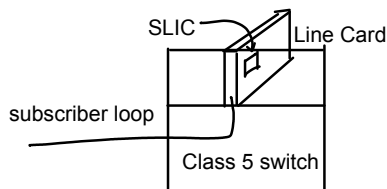
The focus of this lecture is on the physical interface between the subscriber’s phone and the central office. Telephony switching technologies and numbering plans will be covered in future lectures.

The PSTN interface is designed to carry an analog speech signal with frequency components from about 300 to 3400 Hz. It is also used with voice-band modems for data and fax.

The POTS service is supplied using differential signalling over one twisted pair “loop” per subscriber. One wire is labelled ‘tip’ and the other ‘ring’.

POTS Services Provided by CO

The PSTN interface on the CO side is provided by a “line card” that contains the required interface electronics. These are usually integrated into an IC called a Subscriber Line Interface Circuit (SLIC).



The SLIC provides a set of services that are often referred to by the acronym BORSCHT, which stands for:

- **Battery:** supplies -48V (relative to ground) and 0V on ring. This allows the CO to detect when the subscriber “seizes” the line by going off-hook.
- **Overload protection:** the interface protects against contact with power lines or transient overvoltages (e.g. nearby lightning strikes).
- **Ringling:** the CO notifies the subscriber of an incoming call by placing a 40–90 VAC signal on the line
- **Supervision:** the CO detects when the phone goes on- or off-hook to begin or end a call
- **Coding:** the line card converts the analog audio signal to/from digital a sampled digitized form since modern PSTN switches and trunks are digital
- **Hybrid:** the two directions, transmit and receive, are present simultaneously on the 2-wire pair but must be separated for transmission over the network
- **Testing:** for diagnostic purposes the loop voltage and current can be measured and the transmit output can be looped back to the receive input

Signalling

Signalling is the transfer of control information necessary to manage a communication link. PSTN signalling between the CO and subscriber is mostly analog.

Since there is only one pair between the CO and the subscriber, signalling must be done over the same pair that is used to carry the call. This is called in-band signalling. Most other PSTN signalling is done over dedicated channels that carry control between switches. This is called Common Channel Signalling (CCS).

We will study these signalling techniques in more detail in later lectures.

Hook State

When the phone is not in use it appears as an open circuit at DC. When the subscriber picks up the handset a

“hook switch” connects the line to the speaker and microphone. This causes loop current to flow. This indicates that the subscriber wants to place or answer a call.

Ringing

The CO places an AC voltage on the line to indicate an incoming call. The ringer is AC-coupled and generates a sound in response to the ringing voltage.

Call Progress Tones

When the phone is off-hook the CO can transmit various tones to indicate the status of a call. These include:

- dial tone: the user can start to dial
- ring-back: the phone at the remote end is ringing
- busy: the phone at the remote end is off-hook (possibly due to a call in progress)
- other: various other tones indicate problems with the network (all trunks busy, no such number, toll call, etc)

Dialing

The subscriber transmits the phone number of the desired party using either pulses or dual-tone multi-frequency (DTMF) signalling.

Calling Party ID

The phone number of the calling party can be transmitted using digital modulation; typically between the first and second rings.