October 2, 2021

What exactly is a telephone circuit?

At its most basic form, it is simply a pair of wires running between two points. The earliest telephone circuits were just that – a pair of wires stretched between two telephone devices that provided a purely metallic signal path. These circuits didn't care if the current was AC or DC. They didn't care much about the voltage. The only real limit was the current-carrying capacity of the wire. Most telephone companies were still happy to lease you a private line with these exact properties as recently as the mid-1990's. When I ran a 911 communication center, we used these for alarm circuits, dedicated point-to-point telephone circuits, and remote-control links for the radio communication system.

The telephones used with this simplest of circuits had to provide their own electrical power for both the "talk battery" and "ring generator" functions. In the classic wooden wall-mount telephones, talk current was provided by one or more dry-cell batteries; the ring signal (alternating current at 20-30 Hz at up to 100 volts) was generated using a hand-cranked magneto.

Figure 1-Dry Cell Batteries for Telephone Use

Figure 2- A Four-Bar Magneto for Generating Ring Current

Generally, the telephone instrument (including the local talk-batteries, magneto, ringer, receiver and transmitter) was packaged in a wall-mount cabinet with the distinctive look of 19th century electrical equipment.

Figure 3 - A Wall-Mount Telephone

So, in order to connect two telephone instruments together, we use our open-wire pair to construct the following circuit:

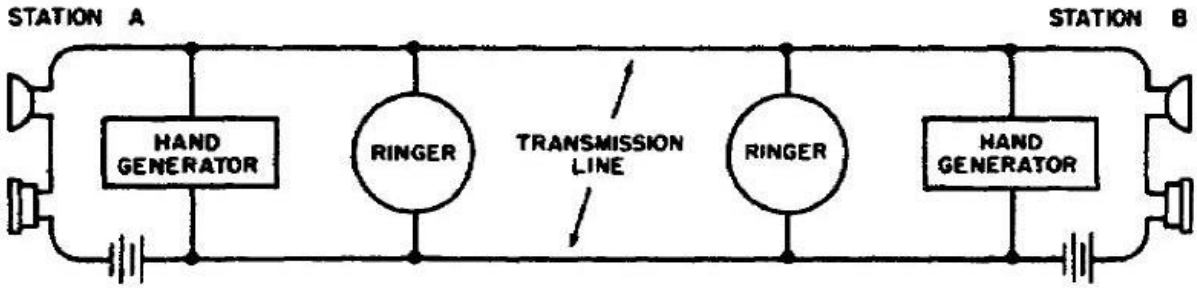


Figure 4 - A Basic Point-to-Point Telephone Circuit

The following linked video demonstrates how a simple telephone circuit like this works. I'm also working on implementing line supervision and pulse dialing, so the video mentions things like "loop start" that I'll get into somewhat later in the Retrochallenge.

Figure 5-Simple Common-Battery Telephone Circuit
(Video URL is: https://youtu.be/M2IDkqnPac0)

With very few improvements, this extremely simple circuit is still in wide-spread use. There are many applications where a dedicated point-to-point telephone is all that is

needed; consider the intercoms found in private homes, military field telephones, "courtesy" phones for hailing a taxicab, the emergency phones found in elevators, and even the telephones used in jails and prisons to allow visitors to speak with inmates while preventing physical contact.

Using a few odds-and-ends, it's quite easy to wire up a ring-down circuit that implements such modern amenities as a dial-tone, call-progress tones, standard ringing cadence, and supervision to stop ringing the remote telephone when answered. This circuit also implements CPC (calling party control) disconnect, which we'll address much later when talking about things like switching, supervision, and other esoteric subjects of telephony.

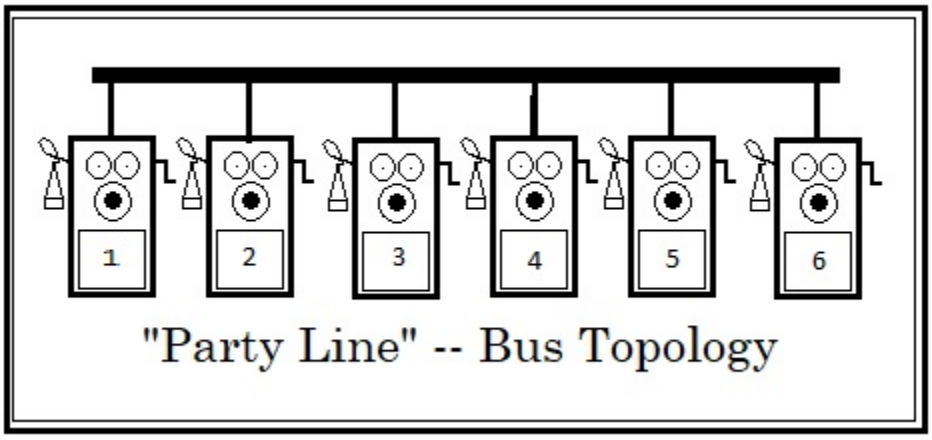
Figure 6-Demonstration of a Simple Ringdown Telephone Circuit
(Video URL is: https://youtu.be/GG2TglMjjS4)

In my days as the supervisor of a 911 center, we used dedicated circuits like these to communicate with other communication centers, the local prison, hospitals, and the state police. There were dedicated phone lines connected to public callboxes, fire stations, and even the front door to our building. Each station rang-in to our telephone system on a dedicated line, ensuring that we knew precisely where each incoming call was originating.

The problem with this system is that, in order to function, each line needs a dedicated telephone instrument at each end of the circuit. Further, each telephone instrument can communicate only with the matching set at the other end of the line. If you need

to communicate with more than one particular station, a little more wiring is going to be needed.

One solution, commonly used in mines, on the railroad, and in public-safety applications was a “party line” where multiple stations were connected to the same transmission line, creating a “bus” network topology. Coded ring signals were devised to differentiate between called parties: one ring for station #1, two rings for station #2 and so forth. The transmission line could still only accommodate a single conversation, but likewise that conversation might include more than the two parties on a typical private line. A simple “all call” designation might be coded as simply as the enumerated ring codes listed above. One circuit I used implemented an “all call” as a “short-long-short” coded ring but many such arrangements were possible.



Next, we’ll address some topics in manual telephone switching with a look forward at automatic and semi-automatic telephone switching.

-- Paleoferrosaurus