Loop Start or Ground Start?

by Dean K. Wilson, P.E.

Question: The new telephone system installed in our office building has "telephone voice mail." To signal a user that he or she has a message waiting in his or her telephone voice mail box, the system produces an interrupted dial tone. We plan to install a new fire alarm system throughout the building. We also plan to connect this new system to a remote supervising station using a Digital Alarm Communicator System. If we connect a Digital Alarm Communicator Transmitter to one of these lines, how will the DACT be able to recognize dial tone when telephone voice mail causes an interrupted dial tone?

Answer: The telephone system you describe appears to be one of the modern, digital private branch exchange (PBX) systems, manufactured by such highly-respected telecommunications companies as Northern Telecom or Lucent Technologies. This system consists of a digital private branch exchange electronic telecommunications switch located in one of the equipment rooms in your building. The telephone lines that serve all the telephones throughout your building terminate in that equipment room. The PBX switch controls those lines and provides the many features associated with your state-of-the-art telephone system.

In addition to the large number of internal telephone lines running throughout your building, the telephone company utility that provides service to your building has connected a certain number

of incoming telephone trunk lines. These circuits extend to your building from the nearest telephone company wire center. The telephone company utility has also connected a certain number of outgoing telephone trunk lines. These circuits also extend to your building from the nearest telephone company wire center.

When someone dials your telephone number, a main telecommunications switch in a telephone company wire center directs the call to the PBX switch in your building. The PBX switch, in turn, directs the call to your telephone extension. If you do not answer within a designated number of rings, or if another call already has you on the line, the PBX switch will transfer the new caller to your telephone voice mail. When the caller leaves you a message, the PBX switch creates the interrupted dial tone to let you know a message waits in your telephone voice mailbox.

NFPA 72-1996, *National Fire Alarm Code*, does not permit Digital Alarm Communicator Transmitters or Digital Alarm Communicator Receivers to connect to the type of telephone trunk lines that providing incoming and outgoing telephone service to your building.

Subsection 4-5.3.2.1.1 requires:

> 4-5.3.2.1.1 A DACT shall be connected to the public switched telephone network upstream of any private telephone system at the protected premises. In addition, the connections to the public switched telephone network shall be under the control of the subscriber for whom service is being provided by the supervising station fire alarm system, and special attention shall be required to ensure that this connection is made only to a loop start telephone circuit and not to a ground start telephone circuit.

Notice that this subsection requires that the fire alarm system installer must connect the DACT directly to the public switched telephone network, and particularly to a “loop start”

telephone line. This requirement prohibits the connection to a line downstream PBX because such a line does not serve as a direct path to the public switched telephone network. Further, quite typically the incoming and outgoing trunk lines that serve the PBX are “ground start” lines.

A “loop start” telephone line has voltage present on the line at all times (nominally 48 VDC). The telephone company calls this voltage “central office battery.” By monitoring the presence of this voltage, the DACT complies with the requirement of subsection 4-5.3.2.1.6.2(a). In effect, the DACT monitors the integrity of each of its telephone line connections between the protected premises and the first telephone company wire center. When a caller lifts a telephone handset to make a call, the change in loop resistance signals the telephone company wire center to supply dial tone.

A “ground start” telephone line does not have voltage present on the line at all times. Thus, the DACT cannot monitor the integrity of such a “ground start” line. In actual practice, when a caller uses the PBX to dial an “outside” telephone call, the PBX switch signals the telephone company wire center to supply dial tone by momentarily grounding one side of the telephone circuit. This action gives the type of line the name “ground start.”

Today, system designers do not have to limit designs only to systems that use telephone lines. Modern technology presents a variety of options for transmission of signals from a Digital Alarm Communicator Transmitter. The *National Fire Alarm Code* includes these technologies:

> 4-5.3.2.1.6.1 A DACT shall employ one of the following combinations of transmission channels:
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> (a) Two telephone lines (numbers);
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> (b) One telephone line (number) and one cellular telephone connection;
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> (c) One telephone line (number) and a one-way radio system;

(d) One telephone line (number) equipped with a derived local channel;

(e) One telephone line (number) and a one-way private radio alarm system;

(f) One telephone line (number) and a private microwave radio system;

(g) One telephone line (number) and a two-way RF multiplex system.

4-5.3.2.1.6.2 The following requirements shall apply to all combinations in 4-5.3.2.1.6.1:

(a) Both channels shall be supervised in a manner appropriate for the means of transmission employed.

(b) Both channels shall be tested at intervals not exceeding 24 hours.

Exception No. 1: For public cellular telephone service, a verification (test) signal shall be transmitted at least monthly.

Exception No. 2: Where two telephone lines (numbers) are used, it shall be permitted, until June 1, 1998, to test the primary telephone line (number) at 24-hour intervals without testing the secondary line (number). After June 1, 1998, where two telephone lines (numbers) are used, it shall be permitted to test each telephone line (number) at alternating 24-hour intervals.

(c) The failure of either channel shall send a trouble signal on the other channel within 4 minutes.

(d) When one transmission channel has failed, all status change signals shall be sent over the other channel.

Exception: Where used in combination with a DACT, a derived local channel shall not be required to send status change signals other than those indicating that adverse conditions exist on the telephone line (number).

(e) The primary channel shall be capable of delivering an indication to the DACT that the message has been received by the supervising station.

(f) The first attempt to send a status change signal shall utilize the primary channel.

Exception: Where the primary channel is known to have failed.

(g) Simultaneous transmission over both channels shall be permitted.

(h) Failure of telephone lines (numbers) or cellular service shall be annunciated locally.

These varied technologies open opportunities to apply clever and creative solutions in solving specific fire protection problems at various facilities. With this increase in the tools

available to the designer of fire alarm systems, the designer and the installer must make certain they carefully observe the subtleties of the requirements contained in these subsections of the *National Fire Alarm Code.* If they fail to do this, problems with the transmission technologies could render a Digital Alarm Communicator System inoperable. Such a failure might not signal its out of service condition to the remote supervising station.

Even worse, fire alarm signals might not reach the remote supervising station. Without a properly communicated signal, the operators at the remote supervising station would not know to dispatch the emergency responders.

Once again, the requirements of NFPA 72, 1996, *National Fire Alarm Code*, serve as a benchmark of quality. By comparing the performance of a proposed fire alarm system to the requirements of the *Code, designers and installers can make certain the system will function as the building owner or occupant intends. This will allow the fire alarm system to provide genuine protection, and not simply give a false sense of security.*

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