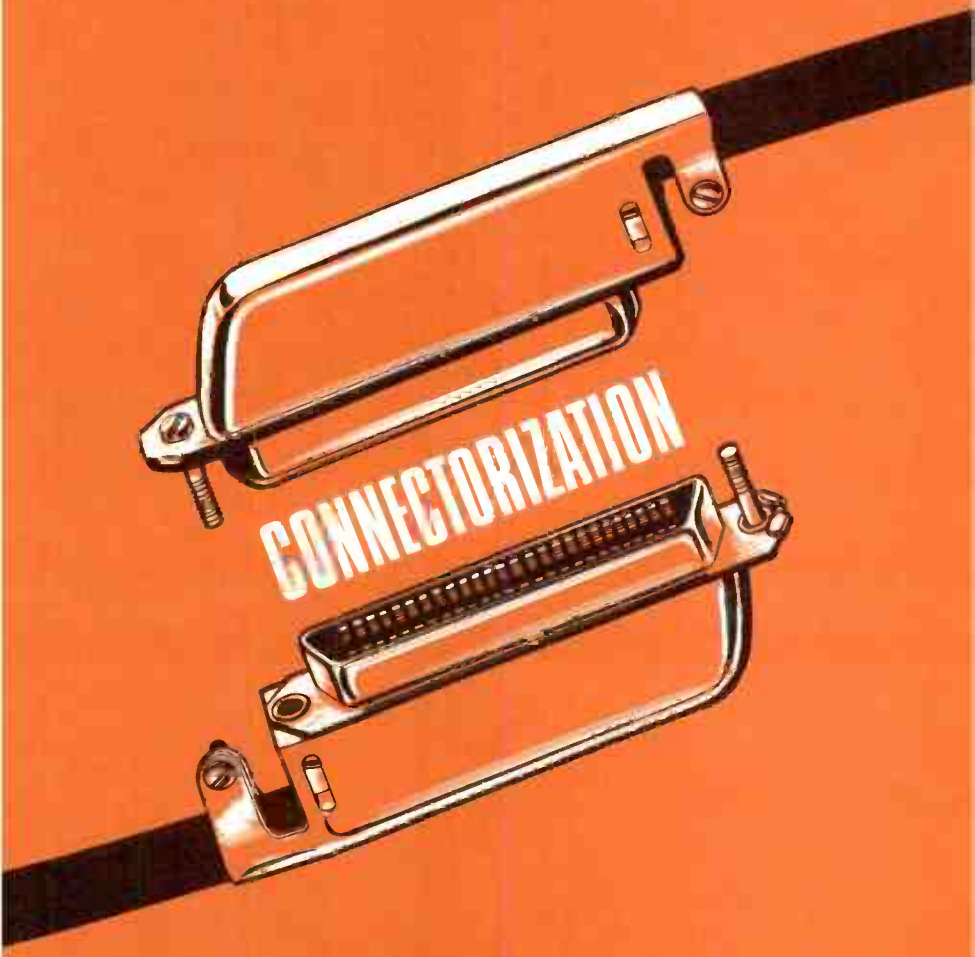
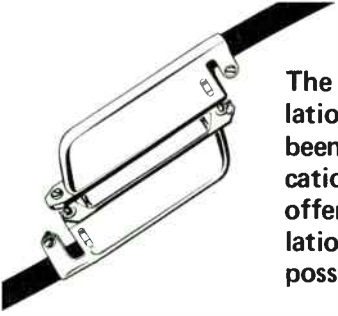
GTE LENKURT

DEMODULATOR

JULY 1973





The tedious wiring procedure involved in the installation of new central office equipment has long been considered a way of life by the telecommunications industry. Connectorized equipment now offers a greatly reduced wiring task, a faster installation period, and a considerable reduction in the possibility of wiring errors.

The central office of a telephone company contains the necessary equipment to complete communications circuits between subscribers. Some of this equipment may include carrier, multiplex and microwave terminals, signaling equipment, jackfields, and other associated assemblies. Each piece of equipment requires a number of per-channel connections to other equipment, usually by way of a distributing frame. The distributing frame is a structure where the permanent wires of a central office are terminated; its function is to enable the placing of semi-permanent cross-connections to permanent equipment.

The necessary individual connections required to establish a working system may run into the thousands and will require many man-hours of installation and testing time. The possibility of wiring errors in such an installation is high, and valuable time is often wasted in tracing down the source of a wiring problem. Figure 1 shows a possible layout of a central office for one voice channel, as associated with a GTE Lenkurt 46A multiplex system; each "X" marks a point where there must be a connection to a distributing frame. If the number of connections for the voice channel shown in Figure 1 are multiplied by the hundreds of voice channels that typify an average central office, it becomes apparent that even the addition of a new terminal of equipment infers extensive time requirements in

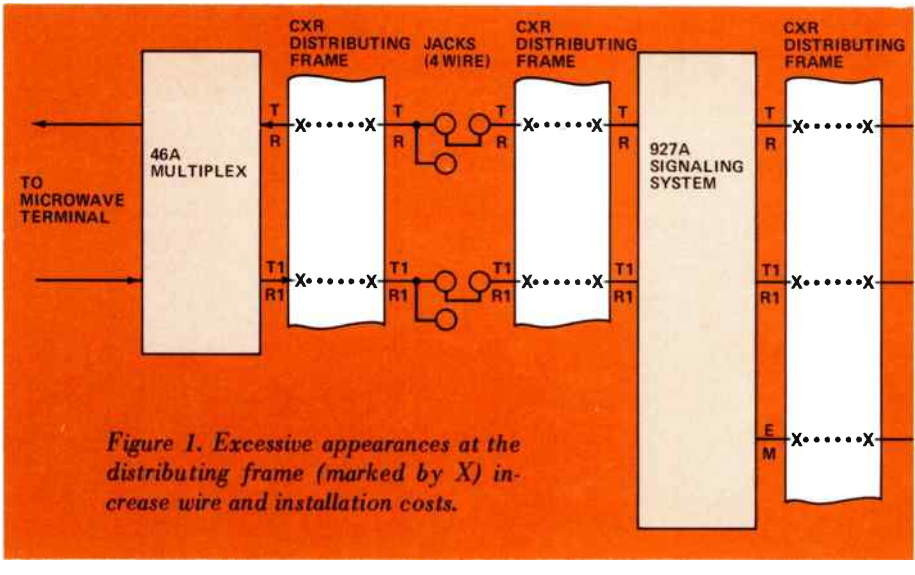


Figure 1. Excessive appearances at the distributing frame (marked by X) increase wire and installation costs.

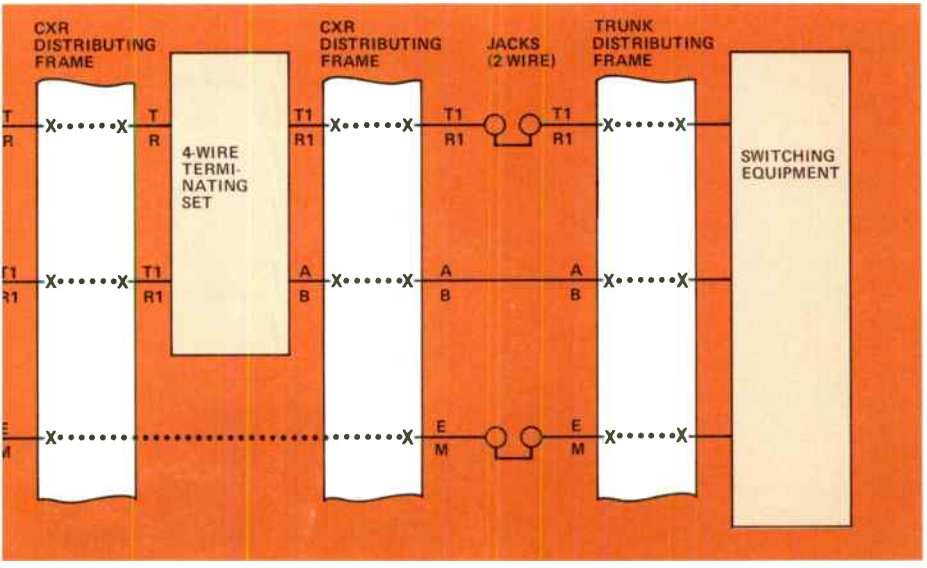
both installation and testing. The development of more sophisticated and compact telecommunications equipment means the presence of integrated circuits, transistors, and other complex and delicate components that can be destroyed as a result of a wiring error. The wrong voltage on the wrong pin may cause many hours of trouble shooting and wasted time.

Simplification – The First Attempts

One of the first methods used in an attempt to simplify the central office installation procedure was to provide cable stubs of an approximate length, prewired to carrier and multiplex channel equipment drop points. This method was further refined by the addition of terminal blocks at the end of the multipair cable stubs. The necessary length of the cable was specified by the customer and determined through measurements in the telephone office – from the carrier or multiplex equipment, up the racks, through the overhead ducts, and down to the terminations on the main distributing frame. The length of the cables – sometimes 200 feet – *did* present a shipping problem, since coils of cable had to be formed into large shipping crates alongside the equipment racks. When installed, slack in the cable presented a disordered appearance and took up excessive space in the overhead ducts. But this was still an improvement over manual on-site wiring.

Connectorization

The most recent development in the simplification of central office equipment installation is connectorization. The basic principle used by GTE Lenkurt in its connectorization schemes is relatively simple, and relies on the direction of connection. In a signaling system, for example, the line side of the equipment (the side toward the carrier) has female connectors; the drop side (the side toward the switch) has males. Also, pin assignments are standardized. Connector assignments are made by means of "key" telephone connectors (50 pin microribbon type) such as are commonly found in



business-office telephones. Such telephone instruments have six button keys to provide call holding, multiline pickup, signaling, and intercommunication. The term "connector" is often used to designate a female connecting device while "plug" designates a male connecting device. For simplicity, this article will use connector in the neuter sense, where it isn't essential that gender be specified. A key connector pin layout appears as shown in Figure 2. Each plug has 50 pins, with pins 25 and 50 generally left as spares. A twelve channel system requiring two wires per channel could, for example, be brought to the plug on the pins required for circuits 1 through 12. An additional 12-channel system could be placed on the remaining pins. Each channel has its own pair of colors, which remain consistent throughout the installation.

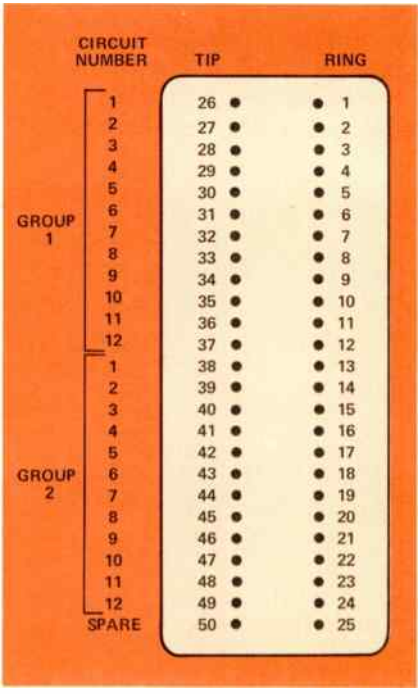


Figure 2. One 50-pin connector can accommodate two 12-channel systems.

Figure 3 shows one channel of a fully connectorized GTE Lenkurt 46A3 multiplex system with 11A signaling. A comparison between the system shown in Figure 1 and that shown in Figure 3 reveals the need of far fewer interfaces for the connectorized system. This has been accomplished, in part, by the dedication of specific shelf positions to specific pins on the connector. The dotted lines in Figure 1 indicate jumpers or cross connections, which are semipermanent connections that may be changed for equipment rearrangement purposes. This means that any carrier channel can be assigned to any signaling equipment, to any 4-wire jack, etc.; there is any number of possible assignments.

Connectorization, along with universal signaling systems such as the GTE Lenkurt 11A, have made it possible to significantly reduce the number of appearances required at the distributing frame. The fully connectorized system of Figure 3 shows that a particular carrier channel is assigned to a particular set of jacks, which will be assigned to a particular terminal point on the 11A, which is assigned to another particular set of jacks, which is then cross-connectable only in terms of a trunk. Variations in circuit arrangement are accomplished in the connectorized system by changing interface types in the 11A signaling system, instead of changing cross-connections at the distributing frame, as is presently done.

Connectorization moves much of the installation chore out of the field and into the factory. Connections are made in the factory under ideal conditions where there are testing capabilities that permit testing of a complete system. Instead of requiring field connections of individual wires to many drop points on the equipment – in some cases as many as 10 leads per channel – connections are performed

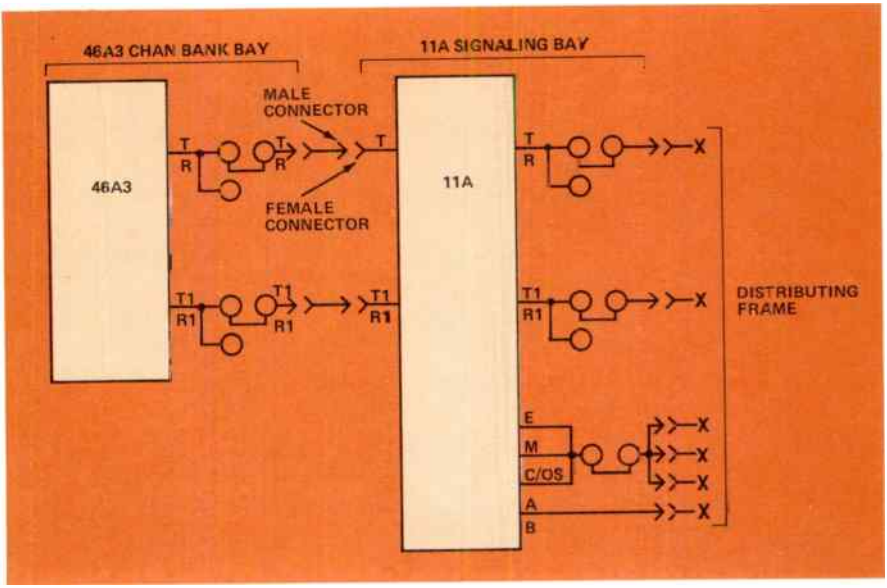


Figure 3. A fully connectorized system has a minimum of appearances at the distributing frame.

by snapping factory-wired, 50-pin connector sockets together. For this purpose, jacketed cables in standard lengths of up to 300 feet are available with connectors on one or both ends, as required. In the field, most of the connections that need to be made are from a connector to the distributing frame. Figure 4 shows a connectorized rack of equipment ready for shipment.

Connectorization For PCM

PCM systems such as the GTE Lenkurt 9002A D2-type cable carrier have also been fully connectorized. Figure 5 shows the necessary leads per channel that must be connected on a D2-type system. The T and R leads are the transmit pair, T1 and R1 are the 4-wire receive or 2-wire transmit and receive pair, E and F are the receive signaling leads, M is the transmit signaling lead, C/OS is the trunk control lead, and A and B are the talking battery leads. Since these ten leads constitute one channel, the normal 24-channel PCM terminal will require that 240 connections be made for the full complement of equipment – a time-consuming task in the field, but avoidable through connectorization, and with the added benefit of factory testing to reduce the possibility of wiring errors.

More Advantages

Because connectorized equipment is essentially fully wired prior to shipment (a few HF, power, alarm and ground wires remain to be made in the field), the initial savings in installation and testing costs are significant. The ribbon type connectors used in connectorization are of proven reliability – there are more than 100 million in use today, and experience has shown that their failure rates are extremely low.

Wiring errors during initial equipment installation are a major factor responsible for premature failure of delicate electronic modules. Many of these errors can be eliminated by more accurate factory wiring procedures.

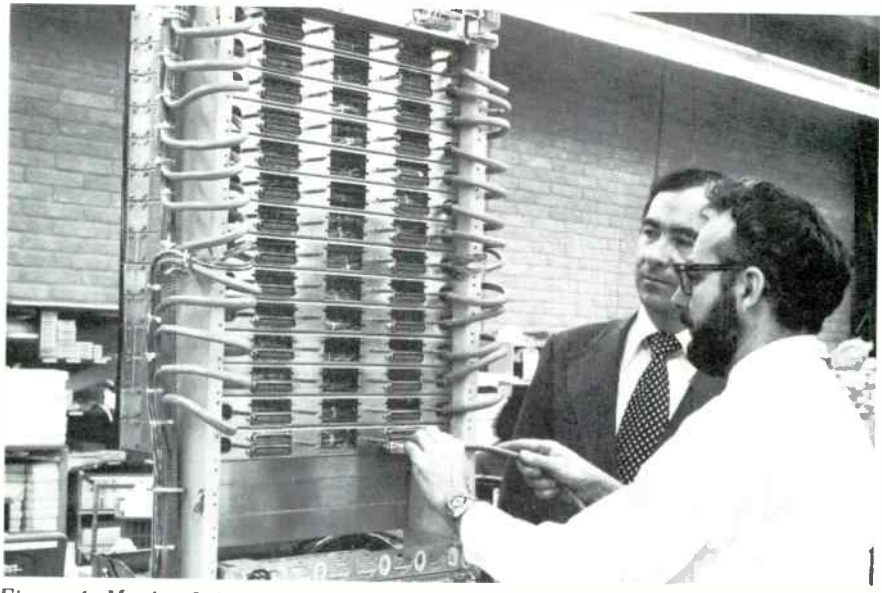


Figure 4. Much of the wire-by-wire connecting is eliminated by using connectorized terminals.

Even automatic testing techniques are being perfected that can reduce the wire-by-wire continuity checks of a typical 144-channel carrier equipment assembly from four hours to less than 15 minutes.

Another important use for connectorization is in the wiring of jackfields that are used for the patching and testing of telephone circuits (see Figure 6). In the field, this is usually a tedious and time-consuming wiring task, but factory connectorized jackfields significantly simplify the installation process. For example, in an equipment bay for up to 300 channels of type 46A multiplex equipment, complete with factory-installed jacks, all intra-bay channel-drop connections to the jackfield are completed at the factory, and external leads are terminated in connectors for extension by plug-ended cables (see Figure 6). If terminals blocks on the distributing frame are also equipped with connectors, on site installation procedures are reduced to the simple snapping together of connectors, once the cable is run through ducts. Prewiring from the distributing frame is possible with connectorization, and it is practical to do

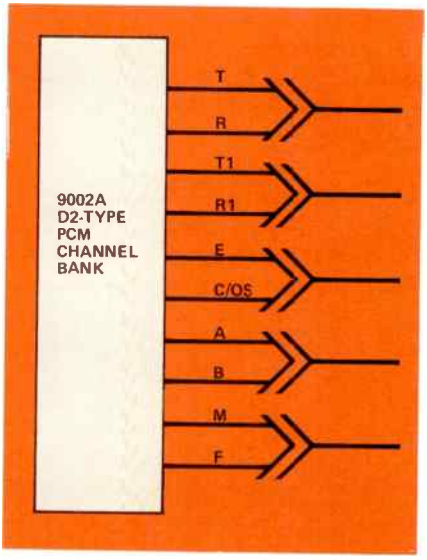


Figure 5. A D2-type PCM channel bank requires 10 connections per channel.

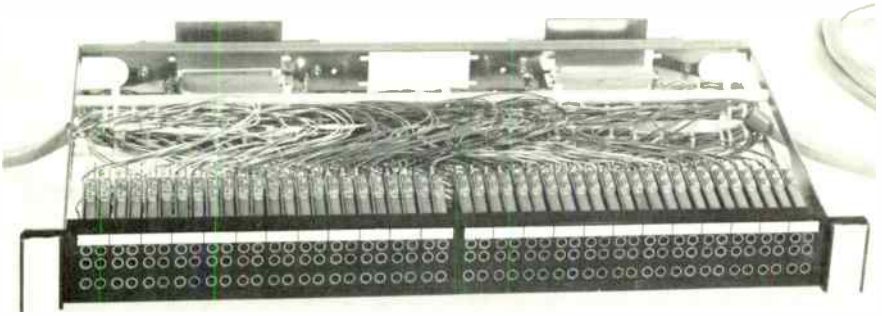


Figure 6. The task of jackfield wiring is moved from the field to the factory with connectorization.

much of the preliminary installation work in advance of receiving the carrier or multiplex equipment.

Jacks are used for testing a channel to determine if it is working properly and to reroute facilities when a temporary arrangement is necessary, such as when an important person, like a government official, for example, is briefly visiting an area. Public toll circuits must be attached to provide him with special circuits to the Capitol. Such temporary special service arrangements are usually made from the patching bays rather than by interconnection.

Lower Cable Costs

In lessening the number of trips to the distributing frame, the expense of actual physical cable is greatly reduced. A trip from a carrier terminal to a distributing frame may require from 50 to perhaps 200 feet of cable. The system in Figure 1 would require something in the neighborhood of 1500 pair feet of wire per circuit (if each trip to the distributing frame were 50 feet), while the connectorized system shown in Figure 3 would require only 300 pair feet of wire per circuit. This constitutes a reduction in cable requirements of 5:1, and implies an economic savings as well as conservation of space and a weight reduction in the overhead ducts.

The results of connectorization as a time-saving device are also impressive. Regular hard wiring time has been reduced an average of 75% through connectorization of telecommunications equipment. Where it once took about 24 man-hours to wire 48 circuits of miniature jacks in the field, with about one-fourth the time allotted to running and terminating cable at a main distributing frame, the process now consists of snapping and locking connectors, and running and terminating the cable as before — a time savings of 75 per cent.

Connectorization offers a new approach to equipment installation, which basically employs two concepts: (1) specific circuits in one piece of equipment are dedicated to specific circuits in associated equipment. (2) the dedication of specific circuits is realized and maintained by the use of connectored cables.

Connectorization is a logical and practical approach to telecommunications equipment installation. And, it can be applied to installation of new equipment in existing offices as well as to a completely new installation.

GTE LENKURT
1105 COUNTY ROAD
SAN CARLOS, CALIFORNIA 94070

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