

Lineless Extension Telephone In Exploratory Development

News of Telephone Set Development

An experimental lineless extension telephone, a battery-operated portable unit that performs the major functions of a regular telephone set, is being developed at the Telephone Studies Laboratory. The unit connects with the telephone network via a radio link to a fixed station which, in turn, is connected to a telephone line or extension line.

Unlike push-to-talk walkie-talkies, the cordless telephone provides simultaneous two-way conversation, as well as supervision (connecting and disconnecting), dialing, and ringing. Designed to be carried on a belt or in an overcoat pocket, the portable telephone now has a range of from 100 to 1500 feet from the fixed station, depending upon the radio frequency environment.

The 31-ounce, 9-inch long unit is presently designed as a one-piece, dial-in-handset telephone, somewhat like the Bell System's TRIMLINE® set. Eventual commercial models may be substantially smaller and lighter. Mounted on the deck, or front, of the present unit are the dial, a switch which performs the function of a switch hook in a regular telephone set, an "on-off" battery switch, and the earpiece and mouthpiece. A collapsible whip antenna is included in the design to extend the range of operation.

The user would be able to make a call, for example, from a construction site, or from the floor of a convention hall, or in other situations that require temporary telephone service, particularly if mobility is needed or if running telephone wire would be diffi-

cult. In making a call, the user extends the whip antenna on the portable unit and moves the switch to the "talk" position. This sends a signal to the fixed station which activates the station transmitter, and a connection is established from the lineless telephone, through the fixed station, to the central office. Central office equipment sends out a dial tone which is relayed by the fixed station to the portable telephone, and dialing can begin.

Dialing the lineless portable unit sends tone pulses to the fixed station. There they are translated into the conventional dc line current pulses used in the telephone network. Once the call is connected, two-way conversation takes place as with an ordinary telephone.

When a call is made to a lineless set, a signal transmitted from the fixed station activates the telephone's electromagnetic sounder causing a ringing tone. The person called extends the antenna and turns the switch to the "talk" position, which enables the telephone to be used for two-way conversations. To "hang up," the user turns the switch to off, which sends a positive disconnect signal to the fixed station. A positive disconnect signal is provided, rather than merely cutting off the connection as in wire-connected telephone systems, to prevent inadvertent disconnections in case of a momentarily low signal caused by shielding, such as metal in walls and buildings. The lineless set uses a narrow band FM transmission system. It now operates in the 35 to 43 MHz mobile highway band under an FCC experimental license.

The two-tone gray, portable telephone unit contains a transmitter, receiver, ringer, antenna system, signaling circuits, and rechargeable nickel-cadmium batteries. Many of the passive components are packaged into units which, together with integrated circuits, reduce size and interconnection requirements.

The fixed station, which can be mounted on a wall, consists of an antenna mounted on a box containing all radio and antenna circuitry, which fits into a larger box containing the power system transformer and network circuit boards. The antenna box is connected to the larger box by wires carrying only low voltage dc and audio signals. Where a suitable antenna location is not convenient to a power outlet, the antenna box can be mounted as much as 100 feet from the rest of the fixed station.

The antenna coupling network, called a "diplexer," separates the transmitting channel from the receiving channel by means of tuned circuits. This permits full duplex operation, or simultaneous two-way conversation, on a single antenna without interaction between the transmitter and the receiver in either the fixed station or the portable unit.

The fixed station is able to produce ringing in the lineless telephone at the usual range (currently 100 to 1500 feet) even with the 18-inch whip antenna of the portable unit in a collapsed position. The gain with the antenna collapsed is about 10 db less than with the antenna extended. Where a 10 db additional path loss can be tolerated, the portable telephone can be

used with the whip antenna collapsed for voice communication, as well as for ringing.

The miniature receiver in the lineless telephone measures 2.5 inches by 0.5 inches by 2 inches, and weighs 73 grams, or approximately 2.6 ounces. It was initially designed for use only in the portable unit. Due to its favorable performance, however, the same receiver was chosen for use in the fixed station even though minaturization was not necessary. The receiver employs a quartz-crystal RF filter and a ceramic IF filter. These two devices do the job of many space-consuming discrete components.

The transmitters in both the fixed station and the portable unit use a form of frequency modulation in which the frequency of a crystal-controlled oscillator is varied by means of a varactor diode. This scheme requires only one stage of frequency multiplication to reach the desired transmitting frequency, resulting in a very simple and compact transmitter. The radio channels from the portable telephones to the fixed station are in the 43 MHz mobile highway band, and the channels from the fixed stations to the portable sets are in the 35 MHz mobile highway band.

Audio frequency amplifiers in the portable and fixed station provide the necessary gain and power for transmission and signaling functions. Negative feedback is used to control the input and output impedances, stabilize gain, and reduce temperature effects.

The speech and signaling circuits in the fixed station are assembled on conventional printed circuit boards, which contain all components except for large elements such as the power transformer.

As an exploratory development, the present model of the lineless telephone is intended primarily for technical field trial evaluation. Trials will be conducted by the New England Telephone and Telegraph Company in the Boston area, and by the Mountain States Telephone and Telegraph Company in the Phoenix area.



C. E. Paul dials a number on an experimental lineless telephone. The unit, which provides simultaneous two-way conversation, connects with the telephone network via a radio link to a fixed station connection to a telephone or extension line.



John C. Sullivan of Bell Telephone Laboratories, Holmdel, New Jersey, checks the 4½-foot whip antenna of the fixed station used with the experimental lineless telephone. The fixed station, normally mounted on a wall, is connected to a telephone line or extension line, and to a power outlet. It operates with the battery-operated portable telephone via a radio link. Together, the fixed station and the portable telephone perform the normal functions of a regular telephone set.