

RECOMMENDATION ITU-R M.1033-1

**TECHNICAL AND OPERATIONAL CHARACTERISTICS OF CORDLESS TELEPHONES
AND CORDLESS TELECOMMUNICATION SYSTEMS**

(Question ITU-R 114/8)

(1994-1997)

Summary

This Recommendation provides the objectives and technical and operational characteristics for cordless telephones and cordless telecommunication systems. By summarizing and comparing the characteristics and providing associated references, the Recommendation provides guidance for administrations evaluating various cordless systems for their intended application.

The ITU Radiocommunication Assembly,

considering

- a) that new land mobile services, such as cordless telephones and cordless telecommunication systems providing communications in areas limited to a few hundred metres radius are becoming available to a large public;
- b) that in the longer term, Future Public Land Mobile Telecommunication Systems (FPLMTS) Recommendations will encompass future needs supported by digital cordless systems; however, in the interim, a Recommendation should include digital cordless systems;
- c) that these services can use consumer-type devices which may create difficulties to administrations, and may be misused;
- d) that the utilization of the radio spectrum should be as economical as possible and that the use of multi-channel access techniques conserves frequency spectrum;
- e) that highly flexible and economical systems can be achieved without using a central controller for setting up control of the radio path;
- f) that the widespread and increasing use of these equipments and the characteristics of their utilization may create operational problems;
- g) that certain administrations are encountering problems of mutual interference and inadvertent interaction between "cordless telephone" systems;
- h) that a number of systems have already been adopted by a wide range of administrations and can form the basis for a Recommendation,

recommends

that cordless telephones and cordless telecommunication systems (cordless systems) should conform to the following objectives and technical and operational characteristics:

1 General objectives

Cordless systems should be designed with the following minimum basic objectives:

- that the radio spectrum be used efficiently;
- that a system of high subscriber capacity be realized;
- that simple and miniature circuits be used to ensure that the weight and size of the equipment are comparable with ordinary telephones;
- that it can be provided economically and the cost of equipment can be reduced to be acceptable for a mass market;

- that the system provide good quality for public communication and that a flexible system of operation can be provided that does not require complicated frequency management;
- that the system provide as far as possible normal telephone features;
- that the system provide security of call charges.

2 Operational and management objectives

Cordless systems should allow operation and management procedures which ensure that:

- in system operation, it is only necessary to manage the number of cordless systems within the area determined by the distance at which interference occurs, while taking into account the subscriber capacity which is determined by the number of channels and the channel traffic;
- flexible operation can be provided, so as to permit the use of a greater number of portable sets than the subscriber capacity per zone, if the number of cordless sets in use in the adjacent zone is small.

3 Access techniques

Cordless systems should include the use of multi-channel techniques and appropriate protocols which do not require the use of a central controller for the detection of idle channels.

These techniques, also called self-trunking or dynamic channel selection, may employ FDMA-FDD, FDMA-TDD, as well as multi-carrier TDMA-TDD. Depending on the application the access technique should allow also in-call handover.

4 Features and areas of application

Since the start of cordless systems there has been an evolution in the areas of application which are covered. The services supported by cordless systems can therefore differ. Also, the service requirements can differ depending on the market segment to be served, for example, public, residential, business, etc. Therefore the importance of the different features of a cordless system depends on its application.

To facilitate the characterization of different cordless systems, the following description of features and applications should be used.

4.1 Cordless telephony (residential)

Cordless telephony in its basic form is provided by a cordless telephone, which consists in its simplest version of two parts:

- a fixed part which is connected to a subscriber line of the ordinary telephone network, and
- a portable set.

Each part uses multi-channel access techniques and can individually perform the following operations:

- search for idle channels;
- set up speech paths using the selected channel;
- check identification codes in the signals between the fixed part and the portable set in order to ensure that only associated units will lock to each other.

More advanced installations allow the use of more portable sets.

4.2 Cordless PABX

In addition to basic cordless telephony, single cell or multi-cell systems can serve the needs of small business or large business respectively for cordless extensions and on-premises communications networks.

4.3 Seamless handover

Seamless handover, which is an optional feature, allows systems to provide uninterrupted communications throughout the coverage area while the call is in progress. Handover may occur within a single cell or between adjacent cells.

4.4 Cordless local area networks (CLAN)

Cordless LANs or more general non-voice services, including those available in the ISDN, can be offered by fully digital systems. They are the replacement of a drop-cable connection from terminals to an ISDN or LAN backbone in order to support the "wireless office" concept.

4.5 Telepoint

In this application the system offers the portable set access to public base stations via a fully standardized air interface, including the necessary protocols for call set-up and authentication which should guarantee billing security. These systems may provide roaming, including international roaming.

4.6 Local loop replacement

In this application the system provides a replacement of the local loop (extension of the PSTN, ISDN into the customers' premises) by radio. Smooth billing should be guaranteed by secure authentication and the system should be capable of serving a large number of users.

4.7 Tandeming to cellular radio

The flexibility and high quality of cordless communications offers a means of enhancing other mobile services by cordless extensions (e.g. telepoint in trains, handhelds connected to a cellular mobile).

5 Existing systems

Cordless systems employing dynamic multiple access techniques and supporting varying subsets of the possible features and areas of application have been developed in many countries. Annex 1 provides information about existing systems.

ANNEX 1

Systems features and applications

This Annex gives information about ten existing cordless systems.

Table 1 shows the features and applications which can be supported by the different systems using the categories described in this Recommendation.

The major specifications of these systems are summarized in Tables 2 and 3 for analogue and digital systems respectively.

The main features of the ten systems and the references to the detailed specifications are described in Appendices 1 to 10.

TABLE 1

Features and applications	System No.									
	1	2	3	4	5	6	7	8	9	10
Cordless telephony (residential)	×	×	×	×	×	×	×	×	×	×
Cordless PABX	×		×	×	×	×	×	×	×	×
Seamless handover				×	×	×	×	×	×	×
Cordless local area network			×	×	×	×	×	×	×	×
Telepoint			×	×	×	×	×	×	×	×
Local loop replacement			×	×	×	×	×	×	×	×
Tandeming to cellular radio					×	×			×	×

NOTE 1 – × means that a particular feature or application can be supported by the system.

TABLE 2

System characteristics of analogue systems

	System 1 ⁽¹⁾ Japan, 1988	System 2 ⁽²⁾ CEPT, 1987
Class of emission	F1D, F2 (A, B, C, D, N, X), F3E	F3E or G3E
Multiple access scheme	FDMA	FDMA
Duplex type	FDD	FDD
Transmit frequency band (MHz)		
– fixed part	380.2-381.3	959-960
– portable set	253.9-255.0	914-915
Radio frequency channel spacing (kHz)	12.5	25
Number of speech channels	87 (adding two control channels)	40
Transmitted power, e.r.p. (mW)		
– fixed part	Maximum 10 ⁽³⁾	Maximum 10
– portable set	Maximum 10 ⁽³⁾	Maximum 10
Typical service range (m)		
– indoor	50	50
– outdoor	100	100
Voice signals		
– type of modulation	Angular	Angular syllabic compandor
– processing		ITU-T Rec. G.162 (suggested)
Audio signal-to-noise ratio (dB)	Minimum SINAD 20 ⁽⁴⁾	Minimum SINAD 20 ⁽⁵⁾
Identification code	3 × 10 ⁷ combinations	3 × 10 ⁴ combinations

FDD: frequency division duplex

- (1) System 1 is in use in Japan.
- (2) System 2 is used by several European countries.
- (3) Antenna input power.
- (4) Suggested value using an IEC Publication 489-3 standard input signal level of 10 µV.
- (5) Ratio measured through psophometric weighting network (according to ITU-T Recommendation P.53 (same as O.41) using an input signal field strength of 30 dBµV/m.

TABLE 3
System characteristics of digital systems*

	System 3 ⁽¹⁾ (ETSI, 1992)	System 4 ⁽²⁾ (Sweden, 1989)	System 5 ⁽³⁾ (ETSI, 1992)	PHS ⁽⁴⁾ (Japan, 1992)	System 7 ⁽⁵⁾ (Canada, 1993)	System 8 ⁽⁶⁾ (United States of America, 1995)	System 9 ⁽⁷⁾ (United States of America, 1995)	System 10 ⁽⁸⁾ (United States of America, 1995)
Class of emission	F1EJT or G1EJT	F1W and F7W	F1W and F7W	G1W and G7W	F1EJT or G1EJT	F1EJT or G1EJT	G1WJT and G7WJT	300 KF7W
Multiple access scheme	FDMA	Multi-carrier TDMA	Multi-carrier TDMA	Multi-carrier TDMA	FDMA	FDMA	Multi-carrier TDMA	TDMA
Duplex type	TDD	TDD	TDD	TDD	TDD	TDD	TDD	TDD
Frequency band (MHz)	864.1-868.1	862-866	1 880-1 900	≈1 900	944.0-948.5	1 920-1 930	1 910-1 930	1 910-1 930
Radio frequency channel spacing (kHz)	100	1 000	1 728	300	100	100	1 250	300
Gross bit rate per carrier (kbit/s)	72	640	1 152	384	72	72	1 152	384
Number of speech channels	40	8 (per carrier)	12 (per carrier)	4 (per carrier)	40 (with 60 signalling/ control channels)	99	12 (per carrier)	128
Transmitted power, e.r.p. (mW)		Peak power over time-slot	Peak power over time-slot				Peak power over time-slot	
– fixed part	Maximum 10	Maximum 100	Maximum 250	Maximum 10 ⁽⁹⁾	Maximum 10	Maximum 30	Maximum 90	53
– portable set	Maximum 10	Maximum 100	Maximum 250	Maximum 10 ⁽⁹⁾	Maximum 10	Maximum 30	Maximum 90	53
Typical service range (m)		Average < 6 ⁽¹¹⁾						
– indoor	40	40	30	50	40	40	30	10-100
– outdoor	200	200	200	200	200	200	200	200
Voice signals		GFSK	GFSK	π/4 QPSK	2 level FSK, Gaussian shaped	2 level FSK, Gaussian shaped	π/4 DQPSK ADPCM (ITU-T Rec. G.726)	π/4 DQPSK ADPCM (ITU-T Rec. G.726)
– type of modulation	2 level FSK, Gaussian shaped							
– processing	ADPCM	ADPCM or CVSDM	ADPCM or CVSDM	ADPCM	ADPCM (ITU-T Rec. G.726)	ADPCM (ITU-T Rec. G.726)		
Identification code	1.5 × 10 ⁶ combinations	>10 ⁷ combinations	>10 ⁷ combinations	>10 ⁸ combinations	1.5 × 10 ⁶ combinations	15 × 10 ⁵ combinations	>10 ⁷ combinations	>10 ¹² combinations

Notes to Table 3:

- * Most systems indicate as audio quality that the mean opinion score (MOS), when tested subjectively, shall not fall below the MOS of 32 kbit/s ADPCM as specified in ITU-T Recommendation G.726.

TDD: time division duplex

CVSDM: continuously variable slope delta modulation

- (1) System 3 is used in the United Kingdom, Finland, France, Belgium, Germany, Italy, Portugal, Spain, The Netherlands, Singapore, Hong Kong, Malaysia and Thailand. International roaming for Telepoint operation may be provided between European countries with the possibility of extending this to the other countries listed.
- (2) System 4 is used in Sweden, New Zealand, Malaysia, Thailand, Indonesia, Philippines, Hong Kong, Brazil and Saudi Arabia.
- (3) System 5 is the digitally enhanced cordless telecommunications (DECT) system.
- (4) System 6 is the personal handphone system (PHS).
- (5) System 7 is used in Canada.
- (6) System 8 is used in the United States of America.
- (7) System 9 is used in the United States of America.
- (8) System 10 is used in the United States of America.
- (9) Antenna input power.
- (10) Except for outdoor fixed parts.
- (11) This average power assumes eight speech channels (duplex time-slots).

APPENDIX 1

TO ANNEX 1

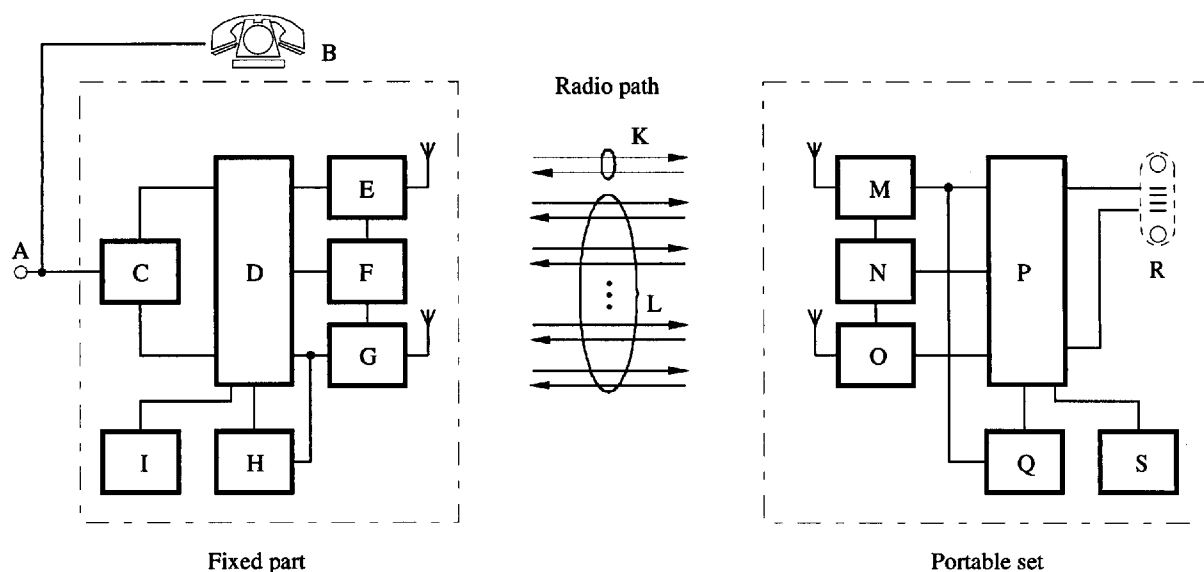
General description of System 1 (analogue)

1 System configuration [RCR Standard, 1988]

The basic configuration of a cordless telephone System 1 employing the analogue multi-channel access technique is shown in Fig. 1.

FIGURE 1

Basic block diagram of a cordless telephone system using multi-channel accessing techniques



A: subscriber line
B: ordinary telephone
C: hybrid
D: signal controller
E: transmitter
F: synthesizer
G: receiver
H: idle channel detector
I: identification code ROM

K: control channels
L: speech channels
M: receiver
N: synthesizer
O: transmitter
P: signal controller
Q: idle channel detector
R: handset
S: identification code ROM

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This system does not use a central controller. In the system, two dedicated control channels are assigned.

Each cordless telephone itself performs the functions of searching for idle channels and setting up a speech path over the selected channel.

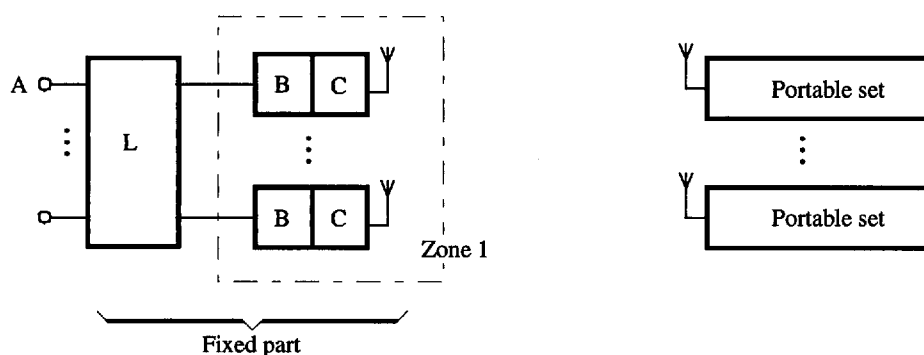
Figure 2 shows the configurations of a multi-function cordless telephone.

FIGURE 2

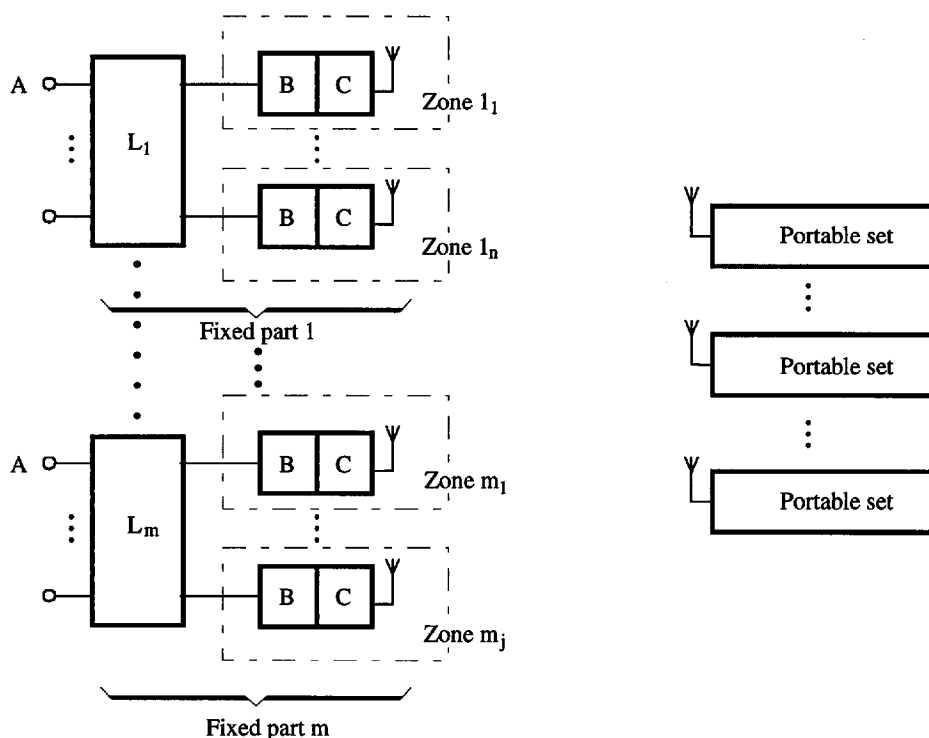
Configuration of multi-function cordless telephone



a) Block diagram of a multi-terminal cordless telephone



b) Block diagram of a cordless key telephone



c) Block diagram of a multi-zone cordless telephone

A: subscriber line
B: signal controller

C: transceiver
L: line controller

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The following types are typical examples:

- multi-terminal cordless telephone,
- cordless key telephone,
- multi-zone cordless telephone.

2 Operational characteristics

2.1 Identification code

2.1.1 Only when its own identification code coincides between the fixed part and the portable set in the control channel, the fixed part and portable set shall switch to a speech channel. The length of the identification code shall be 25 bits.

2.1.2 Modulation methods and bit rates for an identification code are as follows:

Subcarrier MSK (fast FSK): 1 200, 2 400 bit/s

Direct modulation: 600, 1 200, 2 400, 4 800 bit/s

2.2 Idle channel decision

Carrier sense shall be performed immediately before transmission and if more than 2 μ V is sensed, a radio signal shall not be emitted.

2.3 Occupied time of control channels

Considering the common use of dedicated control channels and easy introduction of sleep mode in portable sets, for originating calls from portable sets the occupied time shall be 1.3 s or less. For originating calls from fixed parts the occupied time shall be 4 s or less.

2.4 Transmitter power-off on disconnection

When disconnection is initiated, or when a radio signal is not received on any speech channel, the transmitter shall be turned off automatically.

2.5 Transmitter power-off in case of failure

When a failure in the radio equipment causing continuous transmitter power in the control channel is found, the transmitter shall be automatically turned off within 60 s.

REFERENCES

RCR Standard [December, 1988] 250 MHz/380 MHz Band Radio Equipment for Cordless Telephone. STD-13. Research and Development Centre for Radio Systems, Japan.

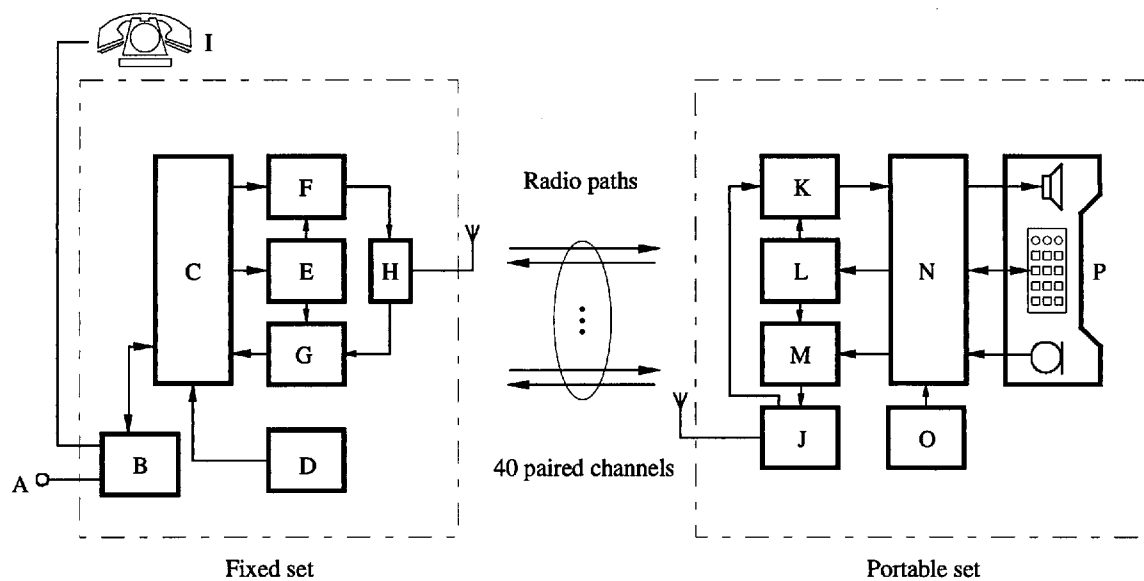
APPENDIX 2

TO ANNEX 1

General description of System 2 (analogue)**1 System configuration**

The configuration of an analogue cordless telephone of System 2 employing the multiple channel access technique is shown in Fig. 3.

FIGURE 3
System configuration



A: subscriber line
B: line interface
C: signal controller and CPU
D: identification code PROM
E: frequency synthesizer
F: transmitter
G: receiver
H: duplexer
I: associated telephone

J: duplexer
K: receiver
L: synthesizer
M: transmitter
N: signal controller and CPU
O: identification code PROM
P: handset

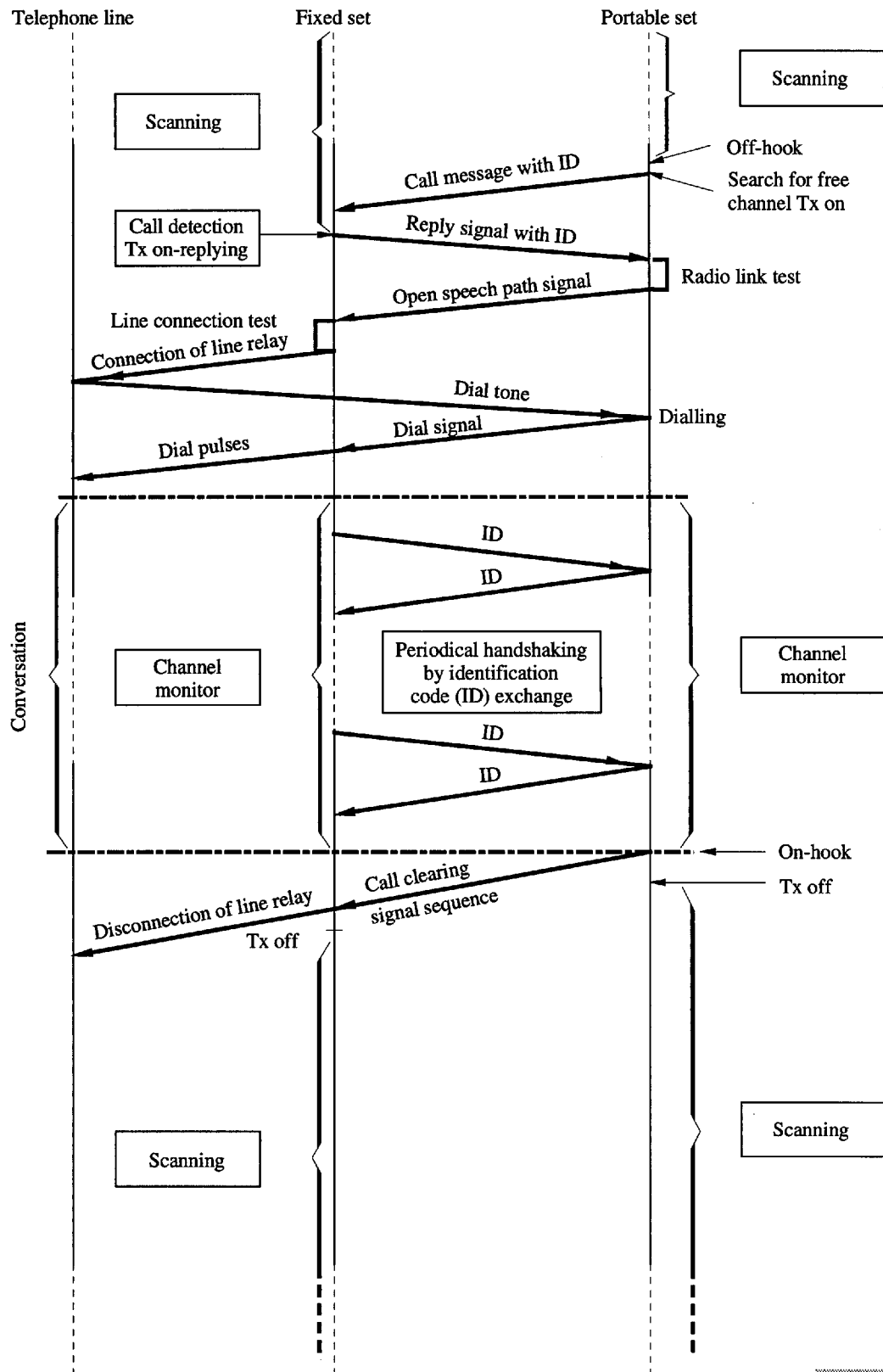
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The system configuration that has been adopted does not use a control channel to set up the RF connection between the fixed part and portable sets. Occupancy of an RF channel may be initiated by the fixed part or the portable set by following the same procedure.

2 Call setting-up procedures

The procedures for setting up a call are given in Fig. 4.

FIGURE 4a
Cordless originated call



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