

RECOMMENDATION ITU-R F.1103*

Fixed wireless systems operating in bands 8 and 9
for the provision of subscriber telephone
connections in rural areas**

(Question ITU-R 105/9)

(1994)

The ITU Radiocommunication Assembly,

considering

- a) that there is an urgent need for the provision of economic telephone subscriber connections in rural areas, especially in developing countries;
- b) that the equipment for such circuits should be simple and reliable for reduction of establishment costs, and for ease of maintenance and operation;
- c) that in the provision of such circuits, the calling rate allows the use of such methods as radio concentrators and point-to-multipoint (P-MP) systems;
- d) that fixed wireless systems in bands 8 and 9 are suitable for the provision of such circuits and it is necessary to provide technical information on these systems for the system designers;
- e) that in rural areas it is often difficult to implement metallic lines economically, however various telecommunication services provided by metallic lines should, as far as possible, be available also in rural areas,

recommends

1 that fixed wireless systems used for rural subscriber circuits should provide services also available by metallic lines. These services may include:

- 2-wire individual telephone service,
- payphone service of various kinds,
- 4-wire service with and without E&M signalling,
- the capability to carry voiceband data including facsimile and other telematic services up to a bit rate of at least 9.6 kbit/s;

2 that the digital systems should:

- carry data at rates up to and including 64 kbit/s,
- provide in the future, ISDN basic rate access, 2B + D;

* Radiocommunication Study Group 9 made editorial amendments to this Recommendation in 2002 in accordance with Resolution ITU-R 44.

** Band 8 (VHF) extends from 30 to 300 MHz and band 9 (UHF) from 300 to 3 000 MHz.

3 that giving due regard to economical considerations:

3.1 the grade of service (lost call probability) offered by such a system to a subscriber should not normally be worse than 1% and should be calculated employing ITU-T Recommendations E.506, E.541 and Supplement No. 1 to the E-series Recommendations (see Note 1);

3.2 the error performance and availability objectives of digital systems should generally be in accordance with Recommendation ITU-R F.697;

3.3 analogue systems should be designed to provide voice quality with a noise level in accordance with Recommendation ITU-R F.395 and an availability the same as for digital systems in § 3.2 above;

4 that for the effective use of frequency spectrum, radio concentrators using TDMA P-MP techniques are preferred and for detailed technical information on TDMA P-MP systems Recommendation ITU-R F.756 be referred to;

5 that many of the implementation features, and the frequency bands and possibilities of frequency sharing with other services, which are covered in § 4 of Annex 1 of Recommendation ITU-R F.756 for TDMA radio concentrators can be referred to in the general case of rural fixed wireless systems for subscriber connections;

6 that for equipment general characteristics, information contained in Annex 1 be referred to as a guide for administrations and system designers;

7 that voice encoding methods employed in digital systems be such that the integration of the system into the switched network is straightforward and introduces as few limitations as possible. Recommended encoding methods are 64 kbit/s PCM and 32 kbit/s ADPCM in accordance with ITU-T Recommendations G.711 and G.721, respectively (see Note 2).

NOTE 1 – Some administrations may adopt other values for the grade of service, e.g. as much as 5%, depending on local conditions.

NOTE 2 – 32 kbit/s ADPCM systems have limitations with respect to the upper limit of the data transmission rate.

ANNEX 1

General characteristics of fixed wireless systems operating in bands 8 and 9 for the provision of subscriber telephone connections in rural areas

1 Introduction

Special Autonomous Groups 3 and 7 (GAS 3 and 7) (ex-CCITT/ex-CCIR) have prepared three Handbooks, entitled “Economic and technical aspects of the choice of transmission systems” (1986 edition), “Rural telecommunications” (1985 edition) and “Rural telecommunications” Volume I-Volume V (1990 edition) which give detailed technical characteristics of radio equipment that may be used to provide service to rural subscribers.

This Annex complements the Handbooks and covers general characteristics of fixed wireless systems for subscriber telephone connections.

2 General description of the systems

The basic purpose of these systems is to provide a radiotelephone that will extend services to rural subscribers where wireline systems are more costly or severely restricted by terrain. As far as practicable these services should provide a transmission quality and range of facilities that are normally provided to subscribers in urban areas.

The single channel system involves the exclusive assignment of a radio circuit to each subscriber station. This system requires two transmitter-receiver units (one at each end of the link) to constitute a subscriber line.

Radio concentrator systems provide multiple access to subscribers by the use of either multiple frequencies (frequency division multiple access, FDMA) or by the use of multiple time slots (time division multiple access, TDMA). Digital radio concentrators naturally use TDMA.

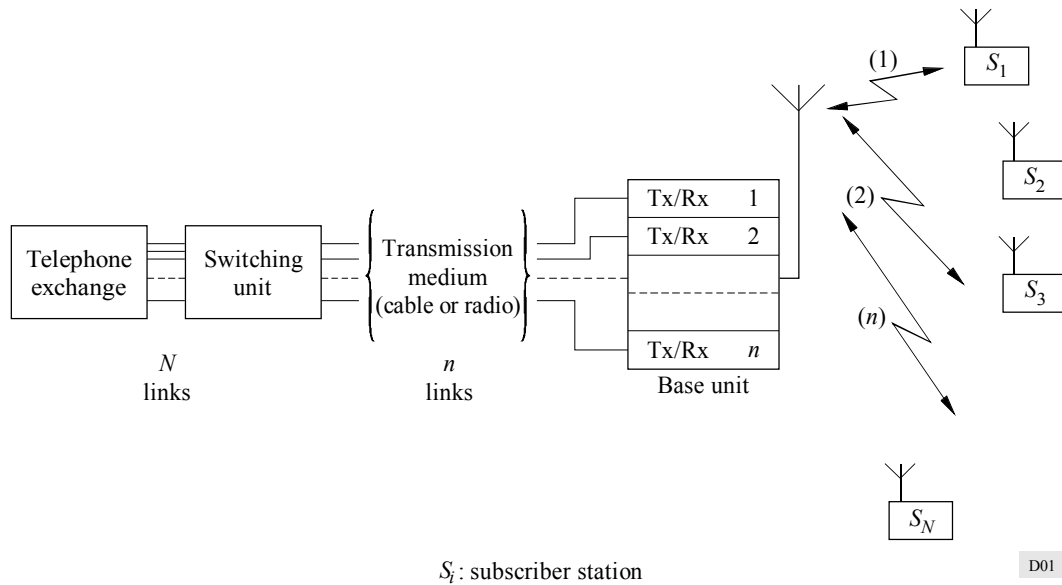
Multiple access systems give subscriber stations access to several circuits, the number n of which is smaller than the number N of subscriber stations ($n < N$). As this is a concentrator system, a certain grade of service in respect of attempts to set up calls must be accepted. The grade of service depends upon the number n of circuits, the number N of subscriber stations and the traffic that is originated/terminated.

The multiple access system requires a switching unit to provide for the concentration-expansion between the N subscriber stations and the n circuits. This unit is generally located in the telephone exchange to which the rural subscribers are connected, and where N subscriber lines are provided (see Fig. 1). The multiple access system also includes a base unit where all the subscribers are concentrated. This base unit may be located at some distance from the switching unit and can be accessed by either a radio link or a cable so that the desired coverage is easier to obtain.

From the radio standpoint the frequency division multiple access radio concentrator system (FDMA-RCS) consists of n single channel systems, with the difference that the subscriber stations have no fixed, exclusive assignment to a particular channel, but access to a specific channel is selected (generally automatically) from among the n channels. In the case of an analogue radio concentrator system as many transmitter-receiver units as there are radio circuits in the system must be installed at the base unit (see Fig. 1). A transmission medium with a capacity of n circuits will be required between the base unit and the switching unit whenever they are geographically separated.

In the case of both analogue and digital TDMA systems, it is possible to introduce repeater stations to extend the service from the exchange to far-distant subscribers. Repeater stations consist of two transmitter-receiver units connected back-to-back through appropriate equipment. Repeaters may serve local subscribers and operate as two-way RF translators that retransmit the signal into the adjacent radio zones, thereby eliminating the need for interconnecting links between cells.

FIGURE 1
Possible configuration of an FDMA radio concentrator
system for rural subscribers



3 Frequency considerations

With due regard to the mode of propagation and the present state of the art, the frequency band should be chosen from those parts of bands 8 and 9 that have been allocated to the fixed service. The lower bands are to be preferred mainly when propagation is by diffraction (mountainous regions) and the higher bands in the cases where there is a risk of interference. It should be noted that the 1.5 GHz band, the 1.7-1.9 GHz band, and the 2.3-2.5 GHz band, are being used by some administrations for this application.

Recommendation ITU-R F.701 provides details of radio-frequency channel arrangements for P-MP systems suitable for subscriber connection operating between 1.427 and 2.690 GHz. Other examples of bands used for subscriber systems are given in Table 1 of Recommendation ITU-R F.756.

4 Characteristics of the radio equipment

4.1 General

The systems referred to in § 2 of this Annex have much in common as far as analogue radio equipment is concerned. For example, the transmitters and receivers at the subscriber stations and base units of the multiple access systems are the same for both the single-channel and the multiple access options.

The most economical solution appears to be a line-of-sight or near line-of-sight (diffraction) path, making it possible to use transistorized equipment with transmitter powers of about 0.5 W to 5 W. A higher transmitter output power may be necessary in certain cases, particularly at the base unit in the multiple access system.

In rural areas radio paths are often selected at a fairly low altitude. This fact as well as the use of simple antennas like Yagi antennas may cause rural radio systems to be affected by multipath fading.

In some cases, more complex equipment can be used at the most easily supervised terminal (telephone exchange and/or multiple access base unit) and more simple equipment at the other end of the circuit (subscriber station or public call telephone).

The use of microprocessing techniques facilitates the supervision of multiple access systems, a factor which is of vital importance for the operation of such systems in rural areas. It would also be desirable for supervision at the exchange or elsewhere to include the possibility of monitoring the subscriber stations and lines.

4.2 System characteristics

Recommendation ITU-R F.756, Annex 1, § 6, gives implementation details for frequency stability, antennas, signalling and power supplies for TDMA P-MP equipment for subscriber connections. These comments should be referred to since they are equally applicable to general radio subscriber connections in bands 8 and 9.

4.3 Installation and maintenance

Equipment for subscriber connections, often in an outdoor environment, should be simple to install and require minimum maintenance. Further guidance is given in Recommendation ITU-R F.756, Annex 1, § 7 and 8.
