RECOMMENDATION ITU-R F.1105-1*

Transportable fixed radiocommunications equipment for relief operations

(Question ITU-R 121/9)

(1994-2002)

The ITU Radiocommunication Assembly,

considering

a) that rapid and reliable telecommunications are essential for relief operations in the event of natural disasters, epidemics, famines and similar emergencies;

b) that transportable fixed wireless equipment may be used for relief operation of either radio or cable links and may involve multi-hop applications with digital and analogue equipment;

c) that fixed wireless equipment for relief operations may be operated in locations with differing terrain and in differing climatic zones;

d) that fixed wireless equipment for relief operations may be used in areas with an unfavourable interference environment;

e) that interoperability and internetworking between transportable fixed wireless equipment and other networks would be beneficial in emergency situations as stated in *considering* a);

f) that the World Radiocommunication Conference (Istanbul, 2000) (WRC-2000) resolved to invite ITU-R to conduct studies on the technical and operational basis for global cross-border circulation of radiocommunication equipment in emergency and disaster relief situations (see Resolution 645 (WRC-2000)),

recommends

1 that for relief operations in devastated areas or restoration of a break in transmission links several types of transportable fixed wireless equipment as given in Table 1 are required;

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* This Recommendation should be brought to the attention of Radiocommunication Study Group 8 (Working Party 8A) and Telecommunication Development Study Group 2.

TABLE 1

Types of transportable fixed wireless equipment for relief operations

Type	Feature	Application
A	A simple communication link which can be established rapidly for telephone communication with a governmental or international headquarters	(1) (2)
B	One or more local networks which connect a communications centre and up to about 10 or 20 end-user stations with telephone links	(1)
C	A telephone link for between about 6 and 24 channels or a data link up to the primary rate over a line-of-sight or near line-of-sight path	(1) (2)
D	A link over an obstructed or trans-horizon path	(2)
E	A high-capacity telephone link (more than 24 channels) or digital fixed wireless link (above the primary rate)	(2)

Application (1): for devastated areas

Application (2): for breaks in transmission links

2 that frequency bands used for operation of transportable fixed wireless equipment should be in accordance with the Radio Regulations for the fixed service, as well as with national and regional frequency allocations (see Table 2);

3 that radio-frequency arrangements for transportable fixed wireless equipment in the chosen bands should be in accordance with ITU-R Recommendations (see Recommendation ITU-R F.746) and national standards;

4 that interconnection with working analogue and digital fixed wireless systems and cable systems at the terminal and nodal stations should be made at baseband in accordance with Recommendations ITU-R F.380, ITU-R F.270 and ITU-R F.596 (see Notes 1, 2 and 3);

5 that interconnection with working analogue radio-relay systems and digital radio-relay systems without regeneration at repeater stations should be made at the intermediate frequency in accordance with Recommendation ITU-R F.403;

6 that interconnection with analogue and digital cable systems at repeater stations should be made at baseband;

7 that interconnection with fibre-optic systems at repeater stations may be made at points with a significant level of optical power;

8 that for equipment characteristics, the information contained in § 1 of Annex 1 can be referred to as a guide for administrations and system planners;

9 that performance objectives of links which use transportable fixed wireless equipment as well as separate links formed by the transportable fixed wireless equipment during restoration should have performance values sufficient for normal service (see § 3 of Annex 1);

10 that transportable fixed wireless equipment given in Table 1 can be used for the access link to a base station in mobile communications that are operating in disaster relief and emergency situations.

NOTE 1 – For Types A and B, which usually terminate in a telephone, few interface problems will arise.

NOTE 2 – Analogue equipment can also be used for small capacity digital signal transmission provided that suitable interface equipments are available.

NOTE 3 – Digital equipment can contain multiplexing/demultiplexing functions for more effective operation.

ANNEX 1

1 Equipment characteristics

For each type of equipment in Table 1, the channel capacities, frequency bands and path distances specified in Table 2 are suitable.

TABLE 2

Basic characteristics

Equipment type	Capacity	Suitable frequency bands		Transmission path distance
A	1-2 channels	HF	(2-10 MHz)	Up to 250 km
B	Local network with 10-20 outstations (several channels)	VHF UHF	(50-88 MHz) (150-174 MHz) (335-470 MHz)	Up to a few km
C	6-24 or 30 channels up to the primary rate	UHF SHF	(335-470 MHz) (1.4-1.6 GHz) (7-8 GHz) (10.5-10.68 GHz)	Up to 100 km
D	12-120 channels	UHF SHF	(800-1 000 MHz) (1.7-2.7 GHz) (4.2-5 GHz)	Line-of-sight or obstructed paths
E	960-2 700 FDM channels STM-0 (52 Mbit/s) or STM-1 (155 Mbit/s)	SHF	(4.4-5 GHz)(1) (7.1-8.5 GHz)(1) (10.5-10.68 GHz) (11.7-13.2 GHz)(1) (23 GHz)	Up to several tens of km

FDM: frequency division multiplexing

STM: synchronous transfer mode

(1) These bands are shared with satellite services.

In the case of links to an earth station operating in a satellite service, the following additional restrictions should be considered:

– space-to-Earth frequency bands should be avoided;

– problems could arise if Earth-to-space frequency bands are used;

– trans-horizon systems (Type D) should be avoided.

It would be preferable to avoid bands likely to be in use or planned for trunk communications. However, these bands may be used for Type E with careful consideration of interference problems by the administration.

2 Engineering principles

2.1 Low-capacity links (equipment Type A)

HF transportable equipment for 1 or 2 channels should employ only solid-state components and should be designed to switch off the transmitters when not in use, in order to conserve battery power, and to reduce the potential of interference.

As an example, a solid-state 100 W single-sideband terminal in a band between, say, 2 and 8 MHz operated with a whip antenna, could have a range of up to 250 km. Simplex operation (transmitter and receiver employing the same frequency) with a frequency synthesizer to ensure a wide and rapid choice of frequency when interference occurs and to facilitate setting-up in an emergency, can give up to 24 h operation from a relatively small battery (assuming that use of the transmitter is not excessive). The battery can be charged from a vehicle generator and all units can be hand-carried over rough country.

2.2 Local radio networks (equipment Type B)

Radio networks of Type B are envisaged as local centres with single-channel radiocommunication with 10 to 20 out-stations, operating on VHF or UHF up to about 470 MHz. Single-channel and multi-channel equipments similar to types used in the land mobile service could be used.

2.3 Links up to 30 channels (equipment Type C)

d.c. operated solid-state equipment is preferred. It can be associated with light-weight, high gain Yagi (or similar) antennas, giving a range of up to 100 km line-of-sight, but capable of accepting some obstruction from trees on shorter paths. Simply erected guyed poles which can be rotated from ground level are to be preferred. If separate antennas are used for transmitting and receiving with cross-polarization, it is convenient for the transmitters to be connected to antennas which are polarized at 45° (from top right to bottom left looking along the path from behind the antenna); if transmit and receive antennas are mounted on the same sub-assembly, with male and female connectors, there can then be no confusion over the plane of polarization to be selected, since the received signal will always be cross-polarized with respect to the transmitted one.

Single frequency, or selectable pre-set frequencies are to be preferred to eliminate as many variables as possible during the initial setting-up of the equipment. Foam-filled or solid dielectric flexible cable is to be preferred as this is less liable to mechanical damage and the effects of moisture.

2.4 Trans-horizon (equipment Type D)

Equipment which is suitable for transportation by road or railway or by helicopter is available. Such equipment, together with power supply equipment, can be easily and quickly installed and put into service. The equipment capacity is from about 12 to 120 telephone channels, depending on the requirements, the topography and other factors. The use of receivers with low noise factors and with special demodulators and of diversity reception, enables the size of the antennas, the transmitter power and the size of the power supply equipment, to be smaller than those often used for conventional trans-horizon installations.

2.5 High capacity links (equipment Type E)

For capacities of 300 telephone channels and above, it is recommended that the radio-frequency equipment is integrated directly to the antennas. For transportable equipment, preference should be given to equipment in which reflectors of diameter less than about 2 m are available. Because IF interconnection at repeaters is a desirable feature, an IF interconnection should be possible between the radio-frequency heads.

However, since the equipment which is to be bypassed in an emergency or for temporary use will most likely be at ground level, the control cable should bring the IF to the control unit at ground level. The antennas of equipments used for relief operations are likely to be smaller than those of fixed microwave links and it is therefore important that the output power of the transmitters should be as high as possible and the noise factor of receivers should be as low as possible. Battery operated equipment is preferable: 12 V and/or 24 V supplies are appropriate if the batteries are to be rechargeable from the dynamos or alternators of any vehicles which are available.

An alternative arrangement would be to house the equipment in a number of containers. These would not only facilitate the transport of the equipment but each container could provide facilities for rapidly installing a number of transmitters and receivers. The maximum number of transceivers to be housed in any one container would depend on the dimensions and maximum weight adopted, allowing for transport by helicopter, aeroplane or any other means of transport. Furthermore, it is preferable to take into consideration equipment operating with ordinary commercial power supplies. Fixed wireless systems generally require line-of-sight operation. For digital fixed wireless systems, the interface should be based on the primary rate (2 Mbit/s (E1) or 1.5 Mbit/s (T1)).

3 Transmission quality

Equipment of Type A will have a noise performance which is critically dependent upon the antennas and path length in a particular case.

Equipments of Types B and C are likely to provide similar transmission quality, when in use for relief work, as in normal use.

Equipment of Type D would, as with Type A, be very dependent upon the siting of the terminals and the size of antennas.

Transportable microwave equipment of Type E, because of the need to use smaller antennas and lower transmitter powers than for fixed links, would be likely to have a transmission quality below that normally required for trunk connections. Nonetheless this performance should be such that the network can still carry out all normal functions. Guidance for the performance in such emergency conditions is given as follows:

– < 1 000 pW for up to 50 km for 960 channels (4-12 GHz);

– < 5 000 pW for up to 50 km for more than 1 800 channels (4-6 GHz);

– < 5 000 pW for up to 25 km for 2 700 channels (11 GHz);

– $< 1 \times 10^{-8}$ BER for digital systems.