RECOMMENDATION ITU-R F.1400*, **

PERFORMANCE AND AVAILABILITY REQUIREMENTS AND OBJECTIVES FOR FIXED WIRELESS ACCESS TO PUBLIC SWITCHED TELEPHONE NETWORK

(Questions ITU-R 215/8 and ITU-R 140/9)

(1999)

1 Introduction

Wireless access systems are a viable alternative to wireline for service access to the public switched telephone network (PSTN). It is, therefore, desirable that the performance and availability of the wireless access systems be equivalent to that provided by wireline.

2 Scope

This Recommendation summarizes the objectives and requirements relating to performance and availability for wireless technology used for PSTN network access. Fixed wireless access (FWA) is the connection between the user network interface (UNI) and the PSTN local exchange (LE) service node interface (SNI) (see Fig. 1).

References to and extracts of material from existing ITU Recommendations dealing with performance and availability parameters are made where appropriate.

In the framework of the generic ITU Recommendations, performance objectives and requirements are a function of the service carried over the access. Requirements and objectives for basic telephony and low speed data services are not as stringent as required for high speed data or integrated services digital network (ISDN) services. In recognition of the differing requirements the following three classifications of services for wireless access systems have been used in developing this Recommendation:

Type 1: Analogue signals such as voice and voiceband data at rates up to 64 kbit/s (minimum 3.1 kHz audio as identified in ITU-T Recommendation G.174).

Type 2: Access bearer service from 64 kbit/s to bit rates below the primary rate.

Type 3: Digital services operating at the primary rate or above.

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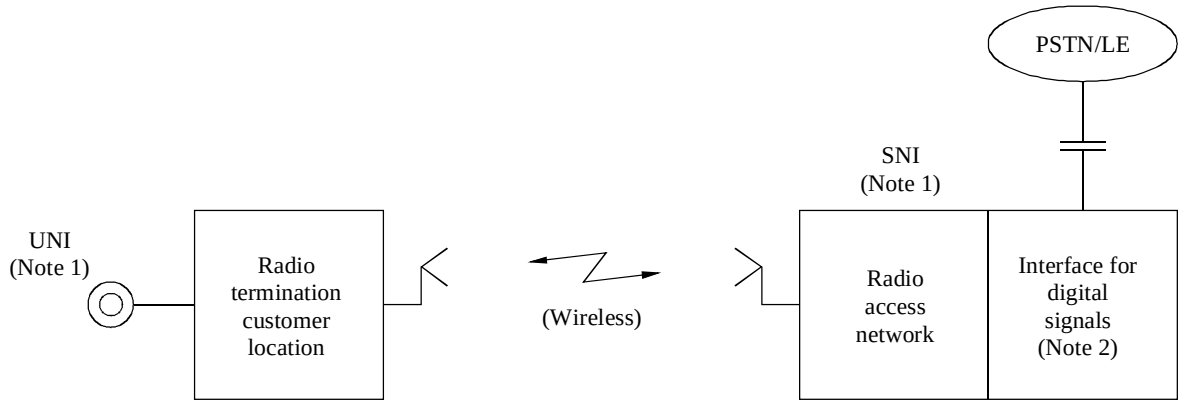
* This Recommendation was developed jointly by Radiocommunication Study Groups 8 (Working Party 8A) and 9 (Working Party 9B), and any further revision should be undertaken jointly.

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

FIGURE 1

Reference section for performance and availability objectives



Note 1 – Performance and availability criteria are defined at the SNI and UNI and should be measurable at these points.
Note 2 – Physical layer of the interface should be based on ITU-T Recommendation G.703.

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3 References

ITU-R Recommendations

– Recommendation ITU-R F.697: Error performance and availability objectives for the local-grade portion at each end of an ISDN connection at a bit rate below the primary rate utilizing digital radio-relay systems

– Recommendation ITU-R F.757: Basic system requirements and performance objectives for fixed wireless local loop applications using cellular type mobile technologies

– Recommendation ITU-R F.1104: Requirements for point-to-multipoint radio systems used in local grade portion of an ISDN connection

– Recommendation ITU-R F.1189: Error performance objectives for constant bit rate digital paths at or above the primary rate carried by digital radio-relay systems which may form part of the national portion of a 27 500 km hypothetical reference path

– Recommendation ITU-R F.1330: Performance limits for bringing into service of the parts of PDH and SDH paths and sections implemented by digital radio-relay systems

ITU-T Recommendations

– ITU-T Recommendation E.506: Forecasting international traffic

– ITU-T Recommendation E.541: Overall grade of service for international connections (subscriber-to-subscriber)

– ITU-T Recommendation G.113: Transmission impairments

– ITU-T Recommendation G.114: One-way transmission time

– ITU-T Recommendation G.173: Transmission planning aspects of the speech service in digital public land mobile networks

– ITU-T Recommendation G.174: Transmission performance objectives for terrestrial digital wireless systems using portable terminals to access the PSTN

– ITU-T Recommendation G.175: Transmission planning for private/public network interconnection of voice traffic

– ITU-T Recommendation G.703: Physical/electrical characteristics of hierarchical digital interfaces

– ITU-T Recommendation G.711: Pulse code modulation (PCM) of voice frequencies

– ITU-T Recommendation G.726: 40, 32, 24, 16 kbit/s adaptive differential pulse code modulation (ADPCM)

– ITU-T Recommendation G.728: Coding of speech at 16 kbit/s using low delay-code excited linear prediction

– ITU-T Recommendation G.821: Error performance of an international digital connection operating at a bit rate below the primary rate and forming part of an integrated services digital network

– ITU-T Recommendation G.826: Error performance parameters and objectives for international constant bit rate digital paths at or above the primary rate

– ITU-T Recommendation G.827: Availability parameters and objectives for path elements of international constant bit-rate digital paths at or above the primary rate

– ITU-T Recommendation H.221: Frame structure for a 64 to 1 920 kbit/s channel in audiovisual teleservices

4 Recommendations

The ITU Radiocommunication Assembly recommends the following performance and availability requirements and objectives for FWA systems. The performance objectives specified in § 4.1 to 4.3 should be met for each direction of transmission.

The error performance objectives apply only when the system is considered to be in an available state. The entry and exit criteria into and from unavailability state are defined in ITU-T Recommendations G.821 and G.826.

4.1 Performance requirements and objectives for Type 1 FWA

4.1.1 Services

The service provided via FWA should be basic telephony services and data transmission up to 64 kbit/s.

4.1.2 Voice MOS (mean opinion score)

For bit-error ratio (BER) better than 1×10^{-3} at the input to the decoder, the minimum performance of the wireless access should be such that the voice MOS be equivalent to or better than the voice quality corresponding to 32 kbit/s ADPCM under the same condition.

4.1.3 Voiceband data requirement

a) For PSTN networks capable of supporting 9 600 bit/s, FWA should support a minimum data bit rate of 9 600 bit/s.

b) The minimum BER for satisfactory transmission of data signals should be less than 1×10^{-5}.

c) For 1 000-bit data block transmission the block error ratio (BLER) should be less than 1×10^{-2}.

4.1.4 Coding algorithms

In the interests of efficient use of a limited spectrum resource a number of different coding algorithms may be used to reduce the bit rate required for voice transmission over FWA systems. The impact of use of such encoding schemes on

the quality of speech communications and data transmission are documented in a number of Recommendations, e.g. ITU-T Recommendations G.113 and G.174 (see Annex 1).

4.2 Error performance objectives for Type 2 FWA

The error performance should meet the performance allocation for the local grade portion of connections identified in ITU-T Recommendation G.821 and Recommendation ITU-R F.697.

4.3 Error performance objectives for Type 3 FWA

The error performance of wireless access systems operating at bit rates at the primary rate or above should comply with Recommendation ITU-R F.1189 for access network sections.

4.4 FWA availability

The design objectives for the two-way availability of the FWA should not be less than the following values including both propagation and equipment effects. The definition of unavailability for ISDN connections is given for paths below the primary rate by ITU-T Recommendation G.821, and for paths at or above the primary rate by ITU-T Recommendation G.826.

For Types 1 and 2 (see Note 1):

– 99.99% for medium quality applications;

– 99.999% for high quality applications (see Note 2).

NOTE 1 – For Types 1 and 2 connections, the outage intensity parameters are not applicable.

NOTE 2 – In order to achieve this objective including the customer location equipment, the mean time to repair (MTTR) should be sufficiently short.

For Type 3 the availability objectives are yet to be defined.

4.5 Traffic capacity - grade of service (GOS) for FWA systems

The radio access system capacity should be designed to accommodate 1% GOS (i.e. call blocking) with traffic levels equivalent to wireline. A value of between 0.05 and 0.09 E per wireless access subscriber have been suggested for Type 1. A higher allocation would be required to accommodate higher usage due to Internet access patterns.

4.6 Signal transmission delay for FWA

The total incremental delay of a voice connection should be less than 40 ms as recommended for public land mobile network (PLMN) planning in ITU-T Recommendation G.173 (the delay is inclusive of signal processing and propagation delays). It has been suggested that the maximum incremental delay for wireless access systems be below 20 ms.

Connection delay impacts voice GOS and therefore, it is desirable that the incremental delay due to wireless access systems should be kept to a minimum. Echo control measures should be considered when the one-way incremental delay is 5 ms or greater.

4.7 Performance requirements for FWA to networks other than PSTN

Further studies are required in order to establish the relationship between severely errored second ratio (SESR), errored second ratio (ESR), background block error ratio (BBLER) and the performance parameters specifically applicable to new services, such as Internet, packet data and multimedia that can be transported over FWA.

ANNEX 1

Table 1 from ITU-T Recommendation G.174 provides guidance on the suitability of coder types for the transmission of modem type data:

TABLE 1

	Signal coding method (ITU-T Recommendations)			
Modem type at maximum data rate	G.711 64 kbit/s	G.726 40 kbit/s	G.726[1] 32 kbit/s	G.728 16 kbit/s
V.21 300 bit/s	Yes	Yes	Yes	Yes
V.22 1 200 bit/s	Yes	Yes	Yes	Yes
V.27*ter*[2] 4 800 bit/s	Yes	Yes	Yes	Yes
V.32 9 600 bit/s	Yes	Yes	Yes	FS
V.29[2] 9 600 bit/s	Yes	Yes	No	No
V.32*bis* 14 400 bit/s	Yes	FS	No	No
V.17[2] 14 400 bit/s	Yes	FS	No	No
V.34 28 800 bit/s	Yes	FS	No	No
56 000 bit/s	Yes	FS	No	No

FS: Further study is needed.

Encoding algorithms are such that voice performance suffers little or no perceived degradation at radio channel error rates in excess of 1×10^{-4}.

ITU-T Recommendation G.174 suggests that for typical modem applications (e.g. facsimile) the required BER measured at the network interface should be $< 1 \times 10^{-5}$ and for less demanding applications (e.g. protected bulk data using 1000-bit blocks) BLER $< 1 \times 10^{-2}$.

(1) Entries based on ITU-T Recommendation G.721 standardization.

(2) This modulation scheme is used for Group 3 facsimile.

Improvements in voiceband transmission rate may be achieved by digitally encoding the modem tones and bypassing the voice encoder. The information would be reconverted to standard modem signal format at the wireless access terminal prior to interconnection with the PSTN.