Technical Specification Group, Radio Access Network
Meeting #3, Yokohama, 21-23 April 1999

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Title: Liaison statement from ITU-R TG 8/1

Document for: Discussion

Agenda Item: 5.6

The attached contribution is a liaison statement developed by ITU-R Task Group 8/1 at its last meeting (Fortaleza, Brazil, 8-19 March 1999).

LIAISON STATEMENT TO SDOs, PARTNERSHIP PROJECTS, RADIO INTERFACE PROPONENTS AND OPERATORS GROUP

Task Group 8/1 recognizes that input from and the cooperation of external organizations is important to the timely completion of the ITU-R work on IMT-2000. This document provides information on the work within TG 8/1 relative to radio interface specifications and requests certain information to assist TG 8/1 in its work on draft new Recommendation ITU-R M.[IMT-RSPC].

Terms of Reference for TG 8/1 Working Group 5 (RSPC)

ITU-R Task Group 8/1 is in the process of developing Recommendation [IMT.RSPC] on the radio interfaces for IMT-2000. The terms of reference for this activity are:

To develop a set of IMT-2000 Radio Interface Recommendations sufficient to meet the goals and objectives of IMT-2000 including worldwide compatibility of operation and equipment, and international and intercontinental roaming (ITU Recommendations are voluntary international standards).

To use the draft new Recommendation ITU-R M.[IMT.RKEY] on the Key Characteristics and the results of harmonisation and other work both within and outside TG 8/1.

To consider ITU-T related issues for RSPC as required.

To consider other relevant issues.

To complete this work at the 18th meeting of TG 8/1 in November 1999.

Structure of RSPC

An initial structure for RSPC has been proposed. See Attachment 1.

Request for information on Radio Interfaces

In considering the response to this question, please refer to the attached draft new Recommendation ITU-R M.[IMT.RKEY] which was approved by TG 8/1 at its 16th meeting in Fortaleza, Brazil.

Each response to this liaison providing information on radio interfaces should provide:

- radio interface information in a format similar to that in the draft RSPC structure document (see Attachment 1);
- a high level summary of the radio interface including explanation of the specification structure;
- a table of contents of their radio interface specification structure*;
- sufficient reference pointers to more detailed material (e.g. document, section, paragraph).

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* It is desirable to have the table of contents provided in electronic form as soon as possible.

Request for comment on incorporation of Externally Developed Material

ITU-R TG 8/1 is considering the use of “references to” or “direct incorporation of” external material in Recommendation ITU-R M.[IMT-RSPC]. TG 8/1 seeks guidance from the external organizations on the following issues. The response should address both approaches (“references to” and “direct incorporation of”):

- approval of an ITU-R Recommendation incorporating externally developed and maintained specifications;
- copyright and licensing aspects of non-ITU specifications, including ownership and change authority;
- publication and distribution aspects;
- maintenance of the RSPC Recommendation, including frequency of updates, version control and approval procedures;
- comments on the respective advantages/disadvantages of each approach;
- other comments relevant to the development of RSPC.

TG 8/1 will complete its Recommendation ITU-R M.[IMT.RSPC] at the 18th meeting of TG 8/1 in November 1999.

Your response is requested for the 17th meeting of TG 8/1 which will occur in Beijing, China on May 31–June 11, 1999, where work will begin on Recommendation ITU-R M.[IMT.RSPC].

<u>Attachments</u>: 2 [Structure of RSPC; Doc. 8-1/TEMP/168].

ATTACHMENT 1

Structure of RSPC

1 GENERAL INTRODUCTION

[NOTE – General introduction to RSPC (both satellite and terrestrial components), to be developed by TG 8/1].

2 TERRESTRIAL COMPONENT

2.1 Introduction

[NOTE – General introduction to the terrestrial part. To be developed by TG 8/1].

2.2 Radio Interfaces for IMT-2000

2.2.1 Introduction

[NOTE – General introduction to the "Radio Interfaces of IMT-2000", to be developed by TG 8/1].

2.2.2 Radio Interface #1

2.2.2.1 Introduction

[NOTE – General introduction to "radio interface #1" and its characteristics, to be developed by TG 8/1. Subsequent sub-sections to be developed by external SDOs and 3GPPs].

2.2.2.2 [Physical Layer

2.2.2.3 MAC

2.2.2.4 BS and MS performance

2.2.2.5 Etc]

…/…

2.2.3 Radio Interface # i

2.2.3.1 Introduction

[NOTE – General introduction to "radio interface #I" and its characteristics, to be developed by TG 8/1. Subsequent sub-sections to be developed by external SDOs and 3GPPs].

…/…

3 SATELLITE COMPONENT

[Structure to be developed by WG 3].

ATTACHMENT 2

DRAFT NEW RECOMMENDATION ITU-R [IMT.RKEY]*

KEY CHARACTERISTICS FOR THE IMT-2000 RADIO INTERFACES

(Question ITU-R 39/8)

1 INTRODUCTION

International Mobile Telecommunications-2000 (IMT-2000) are third generation mobile systems which are scheduled to start service around the year 2000 subject to market considerations. They will provide access, by means of one or more radio links, to a wide range of telecommunications services supported by the fixed telecommunication networks (e.g. PSTN/ISDN), and to other services which are specific to mobile users.

A range of mobile terminal types is encompassed, linking to terrestrial and/or satellite based networks, and the terminals may be designed for mobile or fixed use.

Key features of IMT-2000 are:

- high degree of commonality of design worldwide;
- compatibility of services within IMT-2000 and with the fixed networks;
- high quality;
- small terminals for worldwide use;

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* Note by the Director, Radiocommunication Bureau: On the basis of the written statements received todate by the ITU, compliance with the ITU-R patent policy conditions for the establishment of a Recommendatiion (see Resolution ITU-R 1-2, Annex 1, § 2.3) may not be achieved for systems based on CDMA technologies described in this Recommendation.

– worldwide roaming capability;

– capability for multimedia applications, and a wide range of services and terminals.

IMT-2000 are defined by a set of interdependent ITU Recommendations of which this one is a member.

This Recommendation forms part of the process of specifying the radio interfaces of IMT-2000 and will be used as an input into the development of the IMT-2000 Radio Specification (IMT.RSPC) recommendations. IMT.RSPC is expected to provide sufficient detail to ensure worldwide compatibility and international roaming.

This Recommendation is primarily based on the principles, requirements and framework of the IMT-2000 radio interfaces, as outlined in IMT-2000 Recommendations ITU-R M.687, ITU-R M.818, ITU-R M.819, ITU-R M.1034, ITU-R M.1035, ITU-R M.1038, ITU-R M.1167, ITU-R M.1225 and ITU-R M.1311.

This Recommendation identifies the "key characteristics" for the IMT-2000 radio interfaces and addresses the rationale by which these key characteristics are identified. Key characteristics applicable to the terrestrial and satellite components are identified. The terrestrial key characteristics are grouped into radio frequency (RF) and baseband. The satellite key characteristics are grouped into architectural, system, RF and baseband.

In order to be in a position to recommend radio transmission technologies (RTTs) for IMT-2000, the ITU invited proponents to submit their designs to meet a defined set of requirements and timings.

2 SCOPE

This Recommendation defines the key characteristics for the IMT-2000 terrestrial and satellite radio interfaces. These key characteristics are for subsequent use in the detailed specification of IMT-2000 in the IMT.RSPC Recommendation(s). The key characteristics by themselves do not constitute an implementable specification.

The key characteristics have been identified based on consideration of the evaluation results and consensus building, recognising the need to minimise the number of different radio interfaces and maximise their commonality, while incorporating the best possible performance capabilities in the various IMT-2000 radio operating environments.

These characteristics establish the major features and design parameters of IMT-2000 to enable detailed specification by the ITU and others.

3 RELATED RECOMMENDATIONS

The existing IMT-2000 Recommendations that are considered to be of importance in the development of this particular Recommendation are as follows:

ITU-R M.687-2 – International Mobile Telecommunications 2000 (IMT-2000)

ITU-R M.816-1 – Framework for services supported on IMT-2000

ITU-R M.817 – IMT-2000 Network architectures

ITU-R M.818-1 – Satellite operations within IMT-2000

ITU-R M.819-2 – IMT-2000 for developing countries

ITU-R M.1034-1 – Requirements for the radio interface(s) for IMT-2000

ITU-R M.1035 – Framework for the radio interface(s) and radio sub-system functionality for IMT-2000

ITU-R M.1036-1 – Spectrum considerations for implementation of IMT-2000 in the bands 1 885–2 025 MHz and 2 110–2 200 MHz

ITU-R M.1167 – Framework for the satellite component of IMT-2000

ITU-R M.1224 – Vocabulary of Terms for IMT-2000

ITU-R M.1225 – Guidelines for evaluation of radio transmission technologies for IMT-2000

ITU-R M.1308 – Evolution of land mobile systems towards IMT-2000

ITU-R M.1311 – Framework for modularity and radio commonality within IMT-2000

ITU-R SM.328 – Spectra and bandwidth of emissions

ITU-R SM.329 – Spurious emissions

ITU-T Q.1701 - Family of IMT-2000 Networks

ITU-T Q.1711 - Functional Network Architecture

Handbook on Principles and Approaches on Evolution to IMT-2000 - Volume 2 of Handbook on Land Mobile (including Wireless Access)

4 CONSIDERATIONS

4.1 The RTT Evaluation Process

As part of the IMT-2000 radio interface development process (see Annex 1, Figure 1) a number of RTTs were proposed in response to an invitation by the ITU. These were evaluated in accordance with a procedure given as guidelines in Recommendation ITU-R M.1225, and to a defined time scale. An intermediate step in the process concluded that all terrestrial and satellite RTT proposals met the minimum performance capability requirements.

4.2 Consensus Building

Commonalities in design and construction will simplify the implementation of small lightweight multi-mode multi-band terminals, thus facilitating intersystem roaming on a national, regional and international basis.

The main purpose of consensus building was to achieve a global system with a minimum number of IMT-2000 radio interfaces with maximum commonality among them.

The resulting set of radio interfaces should support a range of mobile terminals for mobile and/or fixed use, and permit access to terrestrial and/or satellite based networks.

Due to the constraints on satellite system design and deployment, several satellite radio interfaces will be required for IMT-2000. See Recommendation ITU-R M.1167 for further considerations. It was concluded that there was little to be gained from any merging of the satellite proposals although benefits might be obtained from seeking commonalities among elements of satellite and terrestrial RTTs.

During the consideration of evaluation results and consensus building, commonalities were sought among the terrestrial proposals, making use of the emerging key characteristics, and some proposals were merged.

The values in the terrestrial key characteristics tables represent the consensus achieved within ITU-R and reflect the significant progress made during the consensus building process. It is expected that additional improvements in commonality will be reflected in the IMT.RSPC Recommendations as they are developed.

As part of the consensus building, activities external to the ITU developed the view that further consideration should be given to a CDMA standard with three modes of operation and a TDMA standard.

4.3 Impact of Evolution on the development of the Key Characteristics for IMT-2000

The need for an evolution or migration path to terrestrial IMT-2000 from pre-IMT-2000 systems has been considered within the ITU and in particular is addressed further in Recommendation ITU-R M.1308 “Evolution of land mobile systems towards IMT-2000”. Some of the key highlights of this Recommendation are that:

a) there is a need to support terminal roaming between pre-IMT-2000 and IMT-2000 systems;

b) evolution and migration may occur in discrete steps and these steps may occur at different times in different regions and at different times for different operators;

c) the standards for IMT-2000 should be adopted as soon as possible to support the timely evolution of existing systems to IMT-2000; and

d) a key feature of IMT-2000 is the incorporation of a variety of systems.

Those operators that wish to evolve their existing systems to IMT-2000 may require radio interfaces that:

a) are backwards compatible with their current systems;

b) can co-exist with their or other operators’ current systems;

c) have the ability for incremental deployment according to the growth in the market demand for IMT-2000 services; and

d) provide graceful and resource-efficient migration path(s).

A limited number of radio interfaces is therefore needed to encourage rapid deployment of IMT-2000 services globally.

4.4 Impact of Modularity

The principles, requirements and framework for the IMT-2000 radio interfaces are outlined in Recommendations ITU-R M.687, ITU-R M.1034 and ITU-R M.1035. These Recommendations discuss the need for one or more radio interfaces depending on the deployment scenario. The need to interface to multiple core networks has also been identified.

IMT-2000 wireless networks need to support high-speed data, image and/or multimedia in addition to pure voice traffic. A common flexible infrastructure is needed that can interface with multiple radio interface technologies on the one hand and multiple network technologies on the other. This is recognised in Recommendation ITU-R M.1311 which identifies and describes the modularity and radio commonality principles which have significant impact on the key characteristics of IMT-2000 radio interfaces. These have particular relevance in adopting an RF/Baseband separation to facilitate the identification of the key characteristics.

An RF/Baseband separation would be useful in supporting the desired flexibility in deployment. RF evolution is affected by factors such as the availability of frequency bands, power classes and emissions. Baseband evolution relies mainly on advances in technology, innovation and industrial competition. However, there can be interdependence between RF and baseband values.

4.5 High Level Drivers

The key characteristics are high level descriptions of the IMT-2000 radio interfaces. They provide a basis to enable the subsequent development of detailed specifications.

An analysis of the IMT-2000 Key Features and Objectives, indicated two main categories affecting radio interface design: namely Key Design Principles and Key Characteristics. The Key Design Principles affected the development of the proposed RTTs. They carry through to the evaluation process and are inherently incorporated in the determination of the key characteristics. The key characteristics are grouped into categories reflecting the potential modular structure of the system.

The radio portion of the system is separated for convenience into two parts, one detailing the RF key characteristics, and the second detailing baseband key characteristics. For the terrestrial component, these characteristics are delineated in the Recommendation in two tables in Sections 5.1.1 and 5.1.2. The key characteristics that are more general in nature, for example, Frequency Reuse and Co-existence of Systems have been identified as System Key Characteristics but such characteristics are considered beyond the scope of this recommendation.

The satellite key characteristics are delineated in Section 5.2. They are categorised by Architectural and System key characteristics in addition to the RF and baseband key characteristics.

4.6 GENERIC IMT-2000 RADIO INTERFACE DESCRIPTION

Figure 1 shows a general block diagram of an IMT-2000 device that is implementation independent, and can be used for both terrestrial and satellite radio interfaces. The use of common components for the RF part(s) of the devices can provide the functionality needed for the various radio interfaces, and the economy of large-scale production. The RF part will cover the required band allocation for IMT-2000. Depending upon spectrum allocations, the RF part can also be designed for backward compatibility to pre-IMT-2000 systems as well. As an example of an RF front end, a filter bank or a tuneable RF filter can be implemented.

The rationale behind grouping the key characteristics into RF and baseband is to achieve as much commonality as possible in the RF part. The same rationale applies to the baseband characteristics, and the level of commonality must satisfy market needs.

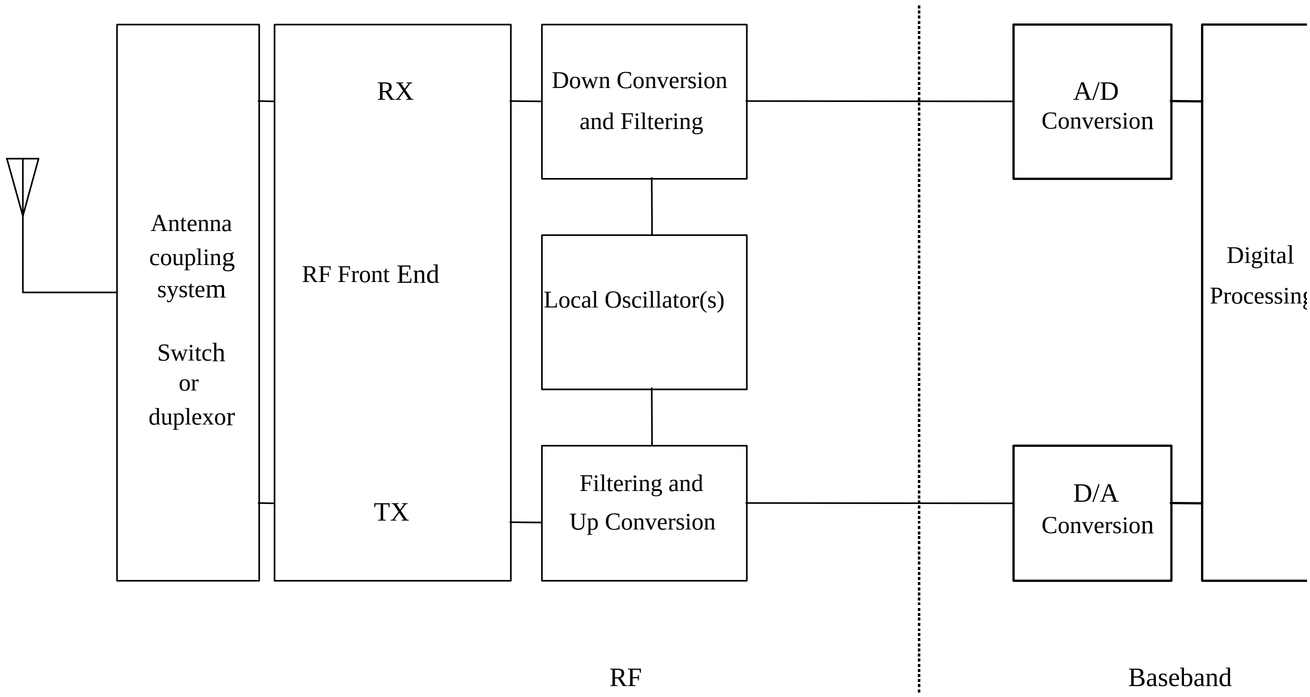

FIGURE 1

General block diagram of an IMT-2000 device

4.7 Further steps in the IMT-2000 radio interface development process

It is considered that the IMT-2000 radio interface development process should continue with a view to seeking a single terrestrial standard encompassing two high level groupings; CDMA, TDMA, or a combination thereof. The CDMA grouping accommodates FDD direct sequence, FDD multi-carrier and TDD. The TDMA grouping accommodates FDD single carrier, FDD multi-carrier and TDD. These groupings satisfy the needs expressed by the global community.

Additionally, consistent with ITU-T Recommendation Q.1701, the IMT-2000 Recommendations should include the capability of operating with both of the major third generation core networks.

5 RECOMMENDATIONS

The key characteristics of the radio interfaces given in sections 5.1 and 5.2 are recommended for subsequent use in the detailed specification of IMT-2000 in the IMT.RSPC Recommendations.

The key characteristics are grouped into RF and baseband with the dividing line being the A/D converter (see Figure 1 of section 4.6).

Note: The radio specification process will include further refining of specific values with the assistance of future harmonisation discussions outside and/or inside the ITU.

5.1 Terrestrial

Tables 1 and 2 show the key characteristics of the RF and baseband parts of the terrestrial IMT-2000 radio interfaces. The entries in the tables show either discrete values or a range of values identifying the limits in terms of upper and/or lower boundaries. The combining and mapping of the values of the key characteristics are not explicitly shown in the tables and this is the subject of RSPC development. Further, the values cannot be arbitrarily selected and combined for the purposes of creating a specific mode of operation.

5.1.1 RF Key Characteristics

TABLE 1

RF Key Characteristics

	Name of Key Characteristic	Description	List of proposed values	
			Mobile Station Value	**Base Station Value**
	Transmitter characteristics	The transmitter characteristics are specified at the antenna connector of the equipment. If there is no antenna connector, appropriate measuring mechanism should be defined. For example antenna emission power can be measured at the test site or at the Radio-Frequency Coupling Device calibrated at the test site.		
	Transmit power			
1.1	Power classes	The power classes define the maximum average output transmitter power level, measured over a unit time. The power classes together with the service type (bit rate, QoS etc.) define the coverage. An operator can use this for planning its network. For multi-standard terminals the highest power class level that needs to be supported will set the power amplifier requirements. The accuracy of the power may depend on appropriate regional regulations.	Max. output power ≤ 33 dBm	Not specified in this Recommendation.

1.2	Dynamic range	The output power dynamic range is the difference between the maximum and the minimum transmitted power for a specified reference condition.	CDMA Minimum controlled output power should be less than -50dBm /1 MHz TDMA Nominal Control Dynamic Range should be at least 32 dB. For some TDMA implementations, it is optional.	Minimum 18 dB for FDD mode Minimum 30 dB for TDD mode For some TDMA implementations, it is optional.
1.3	Power Control Steps	The power control step is the minimum step change in the transmitter output power in response to a power control command.	0.25 dB to 4 dB CDMA 1.0 dB nominal TDMA For some implementations, it is optional.	0.25 dB to 4 dB For some TDMA implementations, it is optional.
1.4	Frequency stability	The ability of mobile and base station to maintain the transmission frequency at the assigned carrier frequencies.	Subset of the following: · Less than or equal to ±0.1 ppm · Less than or equal to ±25 ppm for some TDMA implementations.	Subset of the following: · Less than or equal to ± 0.05 ppm · Less than or equal to ±25 ppm for some TDMA implementations.
	Output RF spectrum emissions			

1.5	3 dB Bandwidth	Bandwidth is the frequency range of the transmitter power per RF channel measured at the 3 dB down points.	<u>CDMA</u> 1MHz – 16.4MHz (Depend on chip rate.) <u>TDMA</u> Subset of the following: · 130 kHz · 1 MHz · 1.1 MHz	<u>CDMA</u> 1MHz – 16.4MHz (Depend on chip rate.) <u>TDMA</u> Subset of the following: · 130 kHz · 1 MHz · 1.1 MHz
1.6	Adjacent Channel Leakage power ratio	Adjacent channel leakage power is the interference power at adjacent channels that are outside the assigned channel and is defined as the power that is radiated within a specified bandwidth. Adjacent channel leakage power ratio is the ratio of the leakage power and total radiation power. Note: The modulation and power level switching spectra can produce significant interference in the adjacent channel bands. The effects on the spectrum due to continuous modulation spectrum and due to the switching transient spectrum do not occur at the same time.	Subset of the following: · ACLR ≥ 12 dBc at 3.75MHz offset ACLR ≥ 50 dBc at 5MHz offset · ACLR ≥ x dBc at 5MHz offset, where x in a value to be determined between 30 and 40. Next ACLR ≥ y dBc at 10MHz offset, where y is a value to be determined between 40 and 50. · ACLR ≥ 20 dBc for 200 kHz channel spacing ACLR ≥ 30 dBc for 1.6 MHz channel spacing ACLR ≥ 32 dBc for 1.728 MHz channel spacing	Subset of the following: · ACLR ≥ 12 dBc at 3.75MHz offset ACLR ≥ 50 dBc at 5MHz offset · ACLR ≥ z dBc at 5MHz offset, where z is a value to be determined in one of the following ranges 40-50 45-55. Next ACLR ≥ w dBc at 10MHz offset where w is a value to be determined in one of the following ranges 50-55 55-65. · ACLR ≥ 20 dBc for 200 kHz channel spacing ACLR ≥ 30 dBc for 1.6 MHz channel spacing ACLR ≥ 32 dBc for 1.728 MHz channel spacing

1.7	Out of band and Spurious emissions	Out of band and Spurious emissions are the emissions at frequencies that are outside the assigned channel, as a function of frequency offset.	Requirements based on applicable tables from Recommendation ITU-R SM.328 for out of band emissions and Rec. SM.329 for spurious emissions, are applied.	Requirements based on applicable tables from Recommendation ITU-R SM.328 for out of band emissions and Rec. SM.329 for spurious emissions, are applied.
1.8	Transmit linearity requirements	Transmit linearity characterises the linear and broadband transmitter power amplifier requirements to meet spurious and out of band emissions. This is primarily characterized by peak to average power ratio which dictates the power amplifier backoff from the saturation point.	<u>CDMA</u> Nominal values are characterized by ACLR (see 1.6 above). Using a VSF of 256, 0dB of power, Walsh channelization code 0 for In-phase channel, and using a VSF of 128, -3 dB of power, Walsh channelization code 2 for Quadrature-phase channel; 2.5 dB peak to average ratio for HPSK (also known as OCQPSK) spreading modulation with Root Raised Cosine (roll-off 0.22) filter at 1% of CCDF (Complementary Cumulative Distribution Function). 3.6 dB peak to average ratio for QPSK spreading modulation with Root Raised Cosine (roll-off 0.22) filter at 1% of CCDF. <u>TDMA</u> 3 dB backoff with QPSK 5 dB backoff with 16QAM 0 dB backoff for GFSK 2 dB backoff for DBPSK 3.5 dB backoff with D8PSK 2.5 dB peak to average power ratio for 8-PSK at 2 dB back off 4.6 dB peak to average power ratio for QOQAM at 5 dB back off	<u>CDMA</u> Characterized by ACLR (see 1.6 above) <u>TDMA</u> 3 dB backoff with QPSK 5 dB backoff with 16QAM 0 dB backoff for GFSK 2 dB backoff for DBPSK 3.5 dB backoff with D8PSK 2.5 dB peak to average power ratio for 8-PSK at 2 dB back off 4.6 dB peak to average power ratio for QOQAM at 5 dB back off

1.9	Standby RF output power	Standby RF output power is the nominal Mobile Station RF power output while registered in a valid network but being in idle state between user data transmission. Note: This definition is different from the unwanted RF emission of the Mobile Station while switched on but without authorisation from a valid network to transmit (receive-before-transmit principle) which is specified in another ITU-R IMT-2000 Recommendation.	CDMA[1] Subset of the following · -47 dBm/ 1MHz in f < 1 GHz -40 dBm/ 1MHz in f > 1 GHz · -57 dBm/ 100 kHz in f < 1 GHz -47 dBm/ 1 MHz in f > 1 GHz TDMA –128 dBm	N/A

[1] This list is not exhaustive.

	Receiver characteristics			
2.1	Receiver sensitivity	The RF sensitivity is the minimum receiver power measured at the antenna port at which the FER/BER does not exceed the specified values. The parameter will therefore depend on the bit rate and QoS requirement, but also implementation factors such as Noise Figure (NF) according to the following equation: $P_{Rx\ Sens} = kT \cdot NF \cdot \frac{E_b}{N_0} \cdot R_b$ where kT is the thermal noise density –174 dBm/Hz, NF is the receiver noise figure, Eb/N0 is the receiver information bit energy to noise density threshold (at the given QoS) and Rb is the information bit rate. Since Eb/N0 and Rb (and hence PRx Sens) will vary with the service, it is only NF that can be considered a key RF parameter. PRx Sens will set the coverage for an unloaded traffic case. If different noise figures are used in different radio interfaces, then the lowest noise figure applies for a multi-mode terminal implementation.	<u>CDMA</u> Subset of the following: · -117dBm for 12.2kbit/s measurement channel · -105 dBm for 9.6kbit/s measurement channel and NF< 7 dB · -104 dBm for 9.6kbps measurement channel <u>TDMA</u> Subset of the following: · -98.99 dBm for 8-PSK 384 kbit/sec. · -99.28dBm for QOQAM 2Mbps · -86dBm with 1.152 Mbit/s measured at 10E-3 raw BER	Not specified in this Recommendation.
2.2	Receiver dynamic range	The difference, in decibels, between the overload level and the minimum acceptable signal level in a transmission system.	≥ 72 dB Maximum usable input level: -25 dBm	≥30 dB

2.3	Intermodulation sensitivity	The intermodulation sensitivity is the receiver’s ability to receive a signal on its assigned channel frequency in the presence of two interfering RF signals. These RF signals are separated from the assigned channel frequency and from each other such that the third order mixing of the two interfering RF signals can occur in the non-linear elements of the receiver, producing an interfering signal in the band of the desired signal. The receiver performance is measured by the frame error rate or bit error rate.	CDMA Subset of the following: · The level of the interfering signal : -46 dBm · Linear receiver required, the 3rd order intercept will be specified between –10 dBm and –15 dBm. TDMA Subset of the following: · The level of the interfering signals is –47 dBm, wanted signal is –80 dBm and 10E-3 raw BER. · The level of the interfering signals is –45 dBm, wanted signal is –107 dBm and BER < 3%.	Not specified in this Recommendation.

<table>
<tr>
<td>2.4</td>
<td></td>
<td>Spurious response and Blocking</td>
<td>The spurious response and receiver blocking level are the signal level that causes the receiver to mute due to interfering RF signals. Receiver blocking level is generally not sensitive to frequency differences between the out of band signal and the receive center frequency.</td>
<td>
<u>CDMA</u>[2]

In-band: -44 dBm (over 15 MHz offset).
Out of band:-30 dBm for IMT-2000 frequency band,
-15 dBm for the other frequencies

<u>TDMA</u>

Subset of the following:
· In band within 90 kHz to 3 MHz: -45 dBm
· Out of band ≥ 3 MHz: -30 dBm with desired signal -102 dBm, 3%BER.
· With the desired signal set at 80 dBm, the BER shall be maintained below 0.001 in the presence of any one of the signals shown in the table below.
F_L and F_U are the lower and the upper edges of the allocated frequency band.
<table>
<tr><th>Frequency</th><th>interferer level for radiated measure-ments (dBµV/m)</th><th>interferer level for conducted measure-ments (dBm)</th></tr>
<tr><td>25 MHz < f < F_L –100 MHz</td><td>120</td><td>-23</td></tr>
<tr><td>F_L -100 MHz <f<F_L -5 MHz</td><td>110</td><td>-33</td></tr>
<tr><td>/f-Fc/ > 6 MHz</td><td>100</td><td>-43</td></tr>
<tr><td>F_U +5 MHz <f< F_U +100 MHz</td><td>110</td><td>-33</td></tr>
<tr><td>F_U +100 MHz <f< 12.75 GHz</td><td>120</td><td>-23</td></tr>
</table>
</td>
<td>Not specified in this R
Ú</td>
</tr>
</table>

[2] This list is not exhaustive.

2.5	Adjacent channel selectivity	Adjacent channel selectivity is the receiver ability to receive a desired signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the center frequency of the assigned channel. Receiver selectivity performance is measured at a specific frame error rate or bit error rate.	CDMA[3] Subset of the following: · Greater than or equal to 48dB for 12.2kbps measurement channel · The FER of a 9600bps call with Ic/Ior=-15.6dB, Îor= -101 dBm /1.23MHz, and a tone offset by ±1.02×NB Hz from the carrier's center frequency should not exceed 1% FER. NB = Necessary Bandwidth of the system, as defined in Rec. ITU-R SM.329. TDMA[3] For carrier spacing of 1.728 MHz, with a received signal strength of -73 dBm (i.e. 70 dBµV/m) on RF channel M, the BER shall be maintained better than 0.001 when a modulated, reference interferer of the indicated strength is introduced on the RF channels shown below Interferer on RF channel Y — Interferer signal strength dBµV/m, dBm Y=M: 60, -83 Y=M±1: 83, -60 Y=M±2: 104, -39 Y= any other channel: 110, -33	Not specified in this Recommendation

[3] This list is not exhaustive

	Other characteristics			
3.1	Diversity techniques	Diversity, as applied to the RF front-end, would imply combining or transmitting independent replicas of the same signal in space or time. Note: IMT-2000 should not preclude the use of diversity schemes.	The values are identical to those in Baseband table. Note: Some of technologies are implemented in Baseband or RF or combination of Baseband and RF.	The values are identical to those in Baseband table. Note: Some of technologies are implemented in Baseband or RF or combination of Baseband and RF.
3.2	Smart antennas	Smart antenna is an advanced antenna technology composed by an antenna array and beamformed in baseband data processing. Note: IMT-2000 should not preclude the use of smart antennas. Smart antenna is one of main features to enhance QoS and to reduce complexity.	For some implementations, it is required.	For some implementations, it is required.

3.3	Minimum operating bandwidth	Minimum operating bandwidth is characterised by RF channel spacing and the minimum bandwidth for deployment. Note: This definition refers to the minimum bandwidth required to meet the minimum performance values in the 3 relevant test environments defined in M.1225 (i.e. 144kbps for Vehicular, 384kbps for Pedestrian, 2048kbps for Indoor).	<u>CDMA</u> Subset of the following: · Minimum operating bandwidth: FDD: 2x5 MHz TDD: 1x5 MHz Minimum channel spacing: 4.4MHz. · Minimum operating bandwidth: TDD 1x1.6 MHz Minimum channel spacing: 1.6MHz. · Minimum operating bandwidth: FDD 2x1.25 MHz for Vehicular 2x3.75 MHz for Pedestrian 2x7.5 MHz for Indoor TDD 1x1.25 MHz for Vehicular 1x3.75 MHz for Pedestrian 1x7.5 MHz for Indoor Minimum channel spacing: 1.25MHz <u>TDMA</u> Minimum channel spacing: 200 kHz or 1.6 MHz or 1.728MHz Minimum operating bandwidth: · 2 x 600 kHz for 200 kHz Channel spacing for Vehicular and Pedestrian environments · 2 x 1.6 MHz for 1.6 MHz Channel spacing for Indoor environment · Typical 5 to 20 MHz for	<u>CDMA</u> Subset of the following: · Minimum operating bandwidth: FDD: 2x5 MHz TDD: 1x5 MHz Minimum channel spacing: 4.4MHz. · Minimum operating bandwidth: TDD 1x1.6 MHz Minimum channel spacing: 1.6MHz. · Minimum operating bandwidth: FDD 2x1.25 MHz for Vehicular 2x3.75 MHz for Pedestrian 2x7.5 MHz for Indoor TDD 1x1.25 MHz for Vehicular 1x3.75 MHz for Pedestrian 1x7.5 MHz for Indoor Minimum channel spacing: 1.25MHz <u>TDMA</u> Minimum channel spacing: 200 kHz or 1.6 MHz or 1.728MHz Minimum operating bandwidth: · 2 x 600 kHz for 200 kHz Channel spacing for Vehicular and Pedestrian environments · 2 x 1.6 MHz for 1.6 MHz Channel spacing for Indoor environment · Typical 5 to 20 MHz for

5.1.2 Baseband Key Characteristics

TABLE 2

Baseband Key Characteristics

#	Names of the Key Characteristics	Description	Values
1	**Multiple access technique**	The multiple access technique allows multiple users to share transmission media without creating uncontrollable interference to each other. The multiple access techniques can be used individually or in a hybrid mode, for example, time, code and space multiplexing (TD/CD/SDMA).	Subset of or combination of the following: · TDMA · CDMA · SDMA: in combination with some or all of the above.
2	**Multi-carrier**	Multi-carrier is a method to allow one transceiver to receive or transmit several carriers simultaneously.	For some implementations, it is required.
3	**Duplexing Scheme**	The duplexing scheme is the method by which the transmitter and the receiver share the limited sources, such as time and frequency. This can be achieved through the use of frequency (Frequency Division Duplexing – FDD) and time (Time Division Duplexing – TDD).	FDD or TDD
4	**Modulation (up-link and down-link)**	The process of varying certain parameters of a digital code signal (carrier), through digital signal processing, in accordance with a digital message signal, to allow transmission of the message signal through IF and RF channels, followed by its possible detection. Modulation can be categorised as data modulation and spreading modulation. Data modulation explains how data can be mapped to the in-phase branch and quadrature-phase branch. Spreading modulation explains how in-phase branch data and quadrature-phase branch data are spread by channelization code and scrambled by scrambling code.	**Data modulation** Subset of the following: · UL – BPSK UL and DL – QPSK,DQPSK,16QAM · UL and DL– QPSK, 8PSK, DBPSK, DQPSK, D8PSK, GFSK, GMSK, QOQAM, BOQAM, 16QAM **Spreading modulation** Subset of the following: · UL – HPSK (also known as OCQPSK) · UL and DL – BPSK, QPSK

5	**Channelization code (up-link and down-link)**	Channelization codes are set of orthogonal codes used for spreading and identification of certain channels. Note: It is important in CDMA systems to minimize the interference between users and between channels in the cell in down-link and between channels of a user in up-link	For CDMA only: · Orthogonal code
6	**Scrambling code** **(up-link and down-link)**	Scrambling code is used in DS-CDMA systems to identify BTS or sector in downlink, and MS in up- link.	For CDMA only FDD: Subset of the following: · DL: Complex code, from Gold codes. UL: Complex code, from Gold codes (long codes) or extended S(2) codes (short codes). · DL & UL: QPSK time shifted Pseudo Noise code. TDD: Subset of the following: · Complex codes, with phase-transition restrictions. · DL & UL: QPSK time shifted Pseudo Noise code.
7	**Pilot structure**	The system pilot is used for channel searching, estimation, acquisition, demodulation and can also be used to assist soft handover. It can also be used to implement fast power control and adaptive antenna technologies. The pilot can be continuous and code multiplexed, or periodic and time multiplexed. Note: A pilot channel or pilot symbols provide a phase reference for coherent detection. It also provides a means for signal strength comparison between the base stations. This makes soft handover possible. The downlink pilot can either be common to all users in a cell or a sector, or dedicated to each traffic channel. The pilot channel structure can impact overall system capacity and performance.	For CDMA only Subset of the following: · Time-multiplexed dedicated pilot symbols · A combination of time multiplexed and dedicated pilot · Time-multiplexed common pilot symbols on common control physical channel · Time-multiplex dedicated pilot sequence · Code divided continuous common pilot/auxiliary pilot · Code divided dedicated pilot

8	**Detection (up-link and down-link)**	The process performed by the receiver to recover the original signal in the presence of channel degradation and to transform the detected signal back to a digital signal. **Joint detection** is used to coherently detect the data in CDMA and TDMA time slots that are spread with a limited number of CDMA codes to cope with multi-path propagation effects at the MS and BS and improve overall performance. **Multi-user detection** involves the joint detection of all users in a cell. This technique significantly helps in reducing intra-cell interference and thereby increases the capacity of the reverse link. The implementation of multi-user detection will have an impact on the base station receiver complexity and architecture.	**Detection** CDMA: Coherent TDMA: Coherent or Non-coherent **Joint detection**: For some implementations, it is supported. **Multi-user detection**: For some implementations, it is supported.
9	**Channel coding and interleaving**	**Channel coding and decoding** is the process to introduce some redundancy in the information sequence in a controlled manner such that the redundancy can be used at the receiver to overcome the effects of noise and interference encountered in the transmission channel, thus increasing the reliability of the received data. **Interleaving and de-interleaving** is the process to permute the transmission sequences of coded bit stream prior to modulation and to reverse this operation following demodulation. It is used to separate and redistribute bursty errors over several codewords or constraint lengths for higher probability of correct decoding by codes designed to correct random errors.	**Channel Coding** One or several of the following: · Convolutional code · Turbo code · RS code · Not used for some implementations. **Interleaving** Subset of the following: · Channel interleaving (with the depth, subset of 5/10/20/40/80 ms) · Not used for some implementations.

10	**Variable data rate (up-link and down-link)**	A feature that adapts the instantaneous transmission rate on a specific traffic channel to the instantaneous amount of data to be transmitted in accordance with the demands of a data source or the propagation conditions. **Symmetric/asymmetric data rate** The capability of a system to operate with equal (symmetric) or different (asymmetric) data rate on the downlink and uplink in order to support symmetric or asymmetric uplink / downlink traffic.	Different data rates supported with subset of the following: · Variable spreading factor · Multi-code · Multi-slot (TDD only) · Code puncturing · Unequal repetition · Repetition · DTX (FDD DL and TDD DL & UL) · Link adaptation depending on channel condition · Slot aggregation Rate can change on frame-by-frame basis UL/DL data-rate asymmetry supported Overall UL/DL asymmetry supported with TDD
11	**Chip rate**	The rate at which information data is spread by pseudo random code modulation elements in a direct sequence CDMA system.	For CDMA only Subset of the following: 1.024 Mcps, N×4.096 Mcps: N=1, 2, 4 N×1.2288 Mcps: N=1, 3 ,6, 9, 12 1.3568 Mcps
12	**Frame structure**	Frame Structure is a specified portion of time slots. Frame structure has two important aspects, one of which is number of time slots in a frame and another one is frame length. · Number of time slots in a frame · Frame Length	**Number of time slots in a frame** Subset of : 1, 2, 4, 6, 8, 10, 12, 16, 24, 48, 64 / frame **Frame Length** Subset of : 4.6, 5, 10, 20, 40 ms
13	**Variable length spreading factor**	A modification of a direct sequence spreading code that creates a family of orthogonal codes of variable length to support variable data rates in a DS-CDMA system.	For CDMA only Subset of : 2^n: n=0 to 10

14	**Random access**	Random Access is the technique for multiple mobile stations to access radio channels without prior scheduling. Note: Because of the lack of pre-arrangement, collisions of the transmissions from different stations occur, at an average rate that depends on the traffic and re-transmission rules. An optimized random access design minimizes collisions among mobile stations, thereby maximizing throughput and reducing delay and interference.	CDMA Subset of the following: · FDD: Acquisition indication based random-access mechanism with power ramping on preamble followed by message. TDD: Slotted ALOHA, 1 slot RACH · FDD&TDD: RsMA – Flexible Random Access Scheme allowing three modes of access: – Pure Aloha – Power controlled Aloha – Reserved Access TDMA Subset of the following: · Instant dynamic channel selection for every set-up using the least interfered channel measured at the mobile · Random access with shared channel feedback · Reserved access
15	**Inter base station asynchronous/ synchronous operation**	System base stations whose relative time difference is determined and maintained to a very tight tolerance e.g., a chip period, by utilization of a common clock or timing source, are said to be synchronized. Asynchronous base stations may use a common timing source mainly for frequency stability purposes, but there is no requirement on the relative time difference between them.	For some implementations, synchronous operation is required.
16	**Absolute up-link chip code synchronization**	A method used to synchronize all DS-CDMA user transmissions in a sector or cell at the base station receiver.	For some implementations, it is required.

17		**Handover**	In general, handover is the process of transferring the mobile station’s communication from one radio channel to another when the mobile is moving between sectors or between cells. Note: Handover is an essential element of a mobile telecommunications system as it permits mobility through the coverage area of the network. There are two types of handover - hard and soft, depending upon whether there are simultaneous connections to more than one base station during the handover process. Soft handover has the benefit of allowing diversity combining of signals to enhance performance. Of particular importance when defining the handover mechanism are the measurement method that triggers the handover, whether the mobile station assists in the handover process by performing measurements, or initiates the handover, and the messaging between the mobile station and base station during the course of the handover.wSubset of the following: · Hard handover · Soft handover · Inter- and intra-system handover (including between 2G and 3G) · Softer handover · Inter-frequency handover · Baton handover[4]

[4] High efficiency handover based on user position information; can support hard-, soft- and inter-system handovers.

18	**Power control** **(up-link and down-link)**	The adjustment of the transmitted power in order to keep the received power from each station in a multiple-access communication system at the minimum power required to maintain a given QoS.	<u>CDMA</u> Closed loop and/or Open loop FDD: · Closed loop power control on dedicated channels · Open loop and optional closed loop power control for random-access channels TDD: · Open or closed loop power control on dedicated channels · Open loop power control for random-access channel <u>TDMA</u>: · Per slot and/or per carrier · None

19	**Diversity**	Diversity is the process by which several replicas of the same information-bearing signal are transmitted and received over multiple channels that exhibit independent fading. Note: There is a good likelihood that at least one or more of the received signals will not be in a fade at any given instance in time, thus providing adequate signal level to the receiver with reasonable transmitted power. Diversity techniques seek to generate and exploit multiple branches over which the signal shows low fade correlation. To obtain the best diversity performance, the multiple access scheme, modulation, coding and antenna design must all be carefully chosen so as to provide a rich and reliable level of well-balanced, low correlation diversity branches in the propagation environment. Successful exploitation of diversity leads to: Reduced power requirements Increased coverage Improved battery life Improved voice quality and handover performance.	Subset or combination of the following: · Time diversity · Frequency diversity · Space diversity · Polarization diversity · Code diversity · Multi-path diversity · Antenna diversity · Multi-carrier transmission diversity · Transmit diversity · Macro diversity · Relaying diversity (ODMA in TDD)
20	**Adaptive equalizer**	Time varying channel dispersion due to multi-path propagation can cause inter-symbol interference, resulting in increased Bit Error Ratio (BER) or dropped calls on wireless communication systems. Active equalization is the process of reducing inter-symbol interference in a communication system by real-time adjustment of a filter that compensates for a time-varying multi-path channel.	For some implementations, it is required.
21	**Dynamic Channel Allocation**	Dynamic Channel Allocation (DCA) is the assignment of channels in real-time, in accordance with observed traffic/interference conditions, as opposed to a prearranged channel assignment. DCA avoids planning of the radio channels and is required for uncoordinated systems sharing the same frequency band.	CDMA For some implementations, it is supported. FDD: Dynamic assignment to carriers TDD: Dynamic assignment to carriers/time slots TDD ODMA (Opportunity Driven Multiple Access) TDMA For some implementations, it is supported.

5.2 Satellite

Key Characteristics of the Radio Interfaces for the IMT-2000 Satellite Component

	Satellite Radio Interface	*A*	*B*	*C*	*D*	*E*	*F*
Architectural Key Characteristics							
A-1.	*Satellite constellation*						
A-1.1	*Orbit type (e.g. LEO, MEO, GSO, HEO)*	SW-CDMA can be used with all type, or combination, of listed constellations.	SW-CTDMA can be used with all type, or combination, of listed constellations.	LEO	MEO	GSO	LEO
A-1.2	*Orbit altitude (km)*	Depending on the constellation type	Depending on the constellation type	Nominally 1,600	Nominally 10,390	36,000	Apogee: 862.4 Perigee: 843.5 or 850
A-1.3	*Number of orbital planes*	Depending on the constellation type	Depending on the constellation type	8	2	1	8 or 10
A-1.4	*Inclination (type, e.g. polar, equatorial, or degrees)*	Depending on the constellation type	Depending on the constellation type	54 °	45 °	±5 °	Polar or inclined
A-1.5	*Satellites per plane*	Depending on the constellation type	Depending on the constellation type	6	5 - 6	3 - 4	12 or 10
A-2.	*Inter-satellite links (y/n)*	N	N	Y	N	N	Y
A-3.	*On-board baseband processing (y/n)*	Suggested, if adaptive antenna concept is adopted	Suggested, if adaptive antenna concept is adopted	Y	N	N	Y

A-4.	*Geographical coverage (e.g. global, near global, below xx degree lat, regional)*	Global	Regional / Multi-regional	Below 69 ° latitude.	Global	Concentration on land masses	Global or near global
A-5.	*Number of spot beams per satellite*	Depending on the constellation type	Depending on the constellation type	37	163	150 - 250	228 (variable)
A-6.	*Dynamic beam traffic distribution (y/n)*	Y	Y	Y	Y	Y	Y
System Key Characteristics							
S-1.	*Handover technique (e.g. intra and inter satellite, soft or hard or hybrid)*	Mobile Assisted Network Initiated Soft Handover (MANISH). Soft handoff and softer handover is supported	Mobile Assisted Network Initiated Soft Handover (MANISH). Soft handoff is supported	Handover supported intra-satellite, inter-satellite and inter-LES. Hard/soft handover supported.	Handover supported intra-satellite, inter-satellite and inter-LES. Hard handover supported. Soft handover supported and preferred.	Intra-satellite hard handover	Intra and inter satellite, using soft/hard handover
S-2.	*Information rate for each service types (kbit/s)*	Net user data: 1.2 – 144	Net user data: 1.2 - 144	Voice: 8 Data: up to 128	Voice: 4.8 (after coding using nominal codec). Other codecs can be supported. Data: up to 38.4 can be supported	Voice: codec dependant 4 - 64 Data: 144 and 72, variable bit-rate	Voice: 2.4 - 4 Data: up to 144
S-3.	*Service features*						
S-3.1	*Bandwidth on demand (y/n)*	Y	Y	Y	Y	Y	Y

S-3.2	*Bit rate on demand (y/n)*	Y	Y	Y	N	Y	Y
S-3.3	*Asynchronous data (y/n)*	Y	Y	Y	Y	Y	Y
S-3.4	*Asymmetric data (y/n)*	Y	Y	Y	Y	Y	Y
S-4.	*Diversity (e.g. time, frequency, space)*	Space and time diversity respectively through the use of multiple satellite and channel coding / interleaving	Space and time diversity respectively through the use of multiple satellite and channel coding / interleaving	Time, space, etc.	Time, space and frequency diversity supported. Except for speech and transparent data which do not support time diversity.	Time	Time, space, etc.
S-5.	*Terminal features*						
S-5.1	*Terminal types*	Handheld (H) Vehicular (V) Transportable (T)	Handheld (H) Vehicular (V) Transportable (T)	Handheld, portable, nomadic, fixed, etc.	Multiple terminal types supported; examples include handheld, ruggedised, private vehicle, commercial vehicle and semi-fixed.	Portable, nomadic, semi-fixed, vehicular	Handheld, portable, nomadic, fixed, aero, etc.
S-5.2	*Multiple service capability (e.g. combined phone, pager, data terminal)*	Possible	Possible	Y	Y	Y	Y

S-5.3	*Mobility restrictions for each terminal type (e.g. up to xx km/h or yy m/s)*	250 km/h for 2.048 Mcps 500 km/h for 4.096 Mcps	250 km/h for 2.048 Mcps 500 km/h for 4.096 Mcps	Not specified in this Recommendation.	Nominally up to 100 km/h, potentially up to at least 1000 km/h.	1500 km/h	Up to 500 km/h for handheld Up to 5000 km/h for aero

S-6.	*Minimum satellite channelisation (kHz)*	2.5 MHz for 2.048 Mcps 5.0 MHz for 4.096 Mcps	2.5 MHz for 2.048 Mcps 5.0 MHz for 4.096 Mcps	5.0 MHz for 4.096 Mcps	170 kHz	200 kHz	TDMA: 250 kHz CDMA: 1.25 MHz
S-7.	*Operation in satellite radio operating environments of M.1034-1*	All	All	All	All	All	All
RF Key Characteristics (at 2 GHz)							
RF-1.	*User terminal transmitter EIRP*						
RF-1.1	*Maximum EIRP for each terminal type (dBW)*	The exact value depends on space segment characteristics. Typical values: – Hand-held: 3 – Vehicular: 16 – Transportable: 16	The exact value depends on space segment characteristics. Typical values: F/TTD mode: – Hand-held: 8 – Vehicular: 11 – Transportable: 20 FDD mode: – Hand-held: 2 – Vehicular: 8 – Transportable: 20	Not specified in this Recommendation.	For example terminal types, nominal maximum EIRP: – Handheld: ≤7 – Ruggedised: ≤7 – Private Vehicle: ≤10 – Commercial Vehicle: ≤10 – Semi-fixed: ≤10	– Type 1: ≥15 – Type 2: ≥10	-2 to 4 for handheld – Not specified in this Recommendation. for other terminal types

RF-1.2	*Average EIRP for each terminal type (dBW)*	Depending on space segment characteristics	Depending on space segment characteristics	Not specified in this Recommendation.	For example terminal types, nominal average EIRP: – Handheld: ≤-4 – Ruggedised: ≤-4 – Private Vehicle: ≤-1 – Commercial Vehicle: ≤-1 – Semi-fixed: ≤-1 (Calculated assuming single slot voice use with discontinuous transmission)	– Type 1: ≥12 – Type 2: ≥7	-8 to -2 for handheld – Not specified in this Recommendation. for other terminal types
RF-2.	*Antenna gain for each terminal type (dBi)*	Typical values envisaged for the different terminal classes are: – Hand-held: 2 – Vehicular: 2.0 (LEO), 8.0 (GSO) – Transportable: 4.0 (LEO), 25.0 (GSO)	Typical values envisaged for the different terminal classes are: – Hand-held: 2 – Vehicular: 2.0 (LEO), 8.0 (GSO) – Transportable: 4.0 (LEO), 25.0 (GSO)	2	For example terminal types, nominal antenna gain: – Handheld: 2 – Ruggedised: 3.5 – Private Vehicle: 3.5 – Commercial Vehicle: 6.5 – Semi-fixed: 10	– Type 1: ≥13.5 – Type 2: ≥9.5	-2 for handheld – Not specified in this Recommendation. for other terminal types

RF-3.	*User terminal G/T for each terminal type (dB/K)*	Typical values envisaged for the different terminal classes are: – Handheld: -23.5 (LEO / MEO) , -22.0 (GSO) – Aeronautical / maritime: -24.8 (LEO / MEO), -24.8 (GSO) – Vehicular: -23.5 (LEO / MEO), -20.0 (GSO) – Transportable: -22.8 (LEO / MEO), -19.0 (GSO)	Typical values envisaged for the different terminal classes are: – Handheld: -23.5 (LEO / MEO) , -22.0 (GSO) – Aeronautical / maritime: -24.8 (LEO / MEO), -24.8 (GSO) – Vehicular: -23.5 (LEO / MEO), -20.0 (GSO) – Transportable: -22.8 (LEO / MEO), -19.0 (GSO)	-22	For example terminal types, nominal G/T: – Handheld: -23.8 – Ruggedised: -21.5 – Private Vehicle: -21.5 – Commercial Vehicle: -18 – Semi-fixed: -14	– Type 1: ≥-11 – Type 2: ≥-16	-29.8 for handheld – Not specified in this Recommendation. for other terminal types
RF-4.	*Maximum satellite EIRP (dBW) per carrier*	Depending on the constellation type	Depending on the constellation type	37.2	Typically 34.3	38	29.6
RF-5.	*Maximum satellite G/T (dB/K)*	Depending on the constellation type	Depending on the constellation type	Nominally -9.44	Nominally 4.9	15	0.1
RF-6.	*Channel bandwidth*	Independently of terminal type. 2x2500 kHz (duplex) or 2x5000 kHz (duplex)	Independently of terminal type. 2x2500 kHz (duplex) or 2x5000 kHz (duplex)	5 MHz	25 kHz	100 kHz	TDMA: 27.17 kHz CDMA: 1.25 to 5 MHz
RF-7.	*Multiple channel capability (y/n)*	Y	Y	Y	Y	Y	Y
RF-8.	*Power control*						
RF-8.1	*Range (dB)*	20	15	20	16	8	25

RF-8.2	*Step size (dB)*	0.25 - 1	0.25 - 1	0.25 – 1	1	1	TDMA: 2 CDMA: 0.5
RF-8.3	*Rate (cycles/sec)*	50 - 100	50 - 400	100	2	Variable	50
RF-9.	*Frequency stability*						
RF-9.1	*Uplink (ppm)*	3	3	1	Unlocked: 3 Locked: 0.1	±1	10 thermal
RF-9.2	*Downlink (ppm)*	0.5	0.5	0.1	0.5	±1	1
RF-10.	*Doppler compensation (y/n)*	Y	Y	Y	Y	Y	Y
RF-11.	*Terminal transmitter/receiver isolation (dB)*	60 for the MS 80 for the BS	60 for the MS 80 for the BS	75	≥57	50	63
RF-12.	*Maximum fade margins for each service type (dB)*	Depending on service and satellite constellation characteristics. In any case, ≤20	Depending on service and satellite constellation characteristics. In any case, ≤20	Nominally 25	≥8	3	Voice: 25 Messaging / Paging: 45
Baseband Key Characteristics							
BB-1.	*Multiple access*						
BB-1.1	*Technique*	Direct Sequence CDMA	Code Time Division Multiple Access	CDMA / FDMA	TDMA / FDMA	TDMA	FDMA / TDMA and FDMA / CDMA
BB-1.2	*Chip rate (where appropriate)*	2.048 Mcps or 4.096 Mcps	2.048 Mcps or 4.096 Mcps	4.096 Mcps	N/A	N/A	1.228 to 4.096 Mcps
BB-1.3	*Time slots (where appropriate)*	16 time slots / frame	8 time slots / frame	N/A	6	18	4 time slots / frame

BB-2.	*Modulation type*	– Dual-code BPSK in the up-link – QPSK or BPSK in the down-link	– Dual-code BPSK selectable in the asynchronous up-link – QPSK or BPSK selectable in the down-link and in the quasi-synchronous up-link	– Reverse link (Data / Spreading): Dual-channel QPSK / OCQPSK (also known as HPSK) – Forward link (Data / Spreading): QPSK / QPSK	Dependant on carrier type. – Reverse link: GMSK – Forward link: QPSK / BPSK	QPSK / 16QAM	16QAM / QPSK
BB-3.	*Dynamic channel allocation (y/n)*	N	N	N	Y	Y	Y
BB-4.	*Duplex method (e.g. FDD, TDD)*	FDD	FDD or F/TDD	FDD	FDD	FDD	TDD / FDD
BB-5.	*Forward Error Correction*	Standard quality: convolutional coding with code rate 1/3 and constraint length k=9. High quality: Reed Solomon code over GF(2^8) as outer code (Turbo coder as an option). Convolutional coding with code rate 1/3 and constraint length k=9 as inner code.	Standard quality: convolutional coding with code rate 1/3 and constraint length k=9. High quality: Reed Solomon code over GF(2^8) as outer code (Turbo coder as an option). Convolutional coding with code rate 1/3 and constraint length k=9 as inner code.	Y	Y	Turbo Coding	Y

BB-6.	*Interleaving*	Interleaving on a single frame basis (default). Interleaving on a multiple frame basis (optional)	Interleaving on a single burst basis (default). Interleaving on a multiple burst basis (optional)	Y	Y Voice: Intra-burst interleaving Data: Intra-burst interleaving and interleaving over 4 TDMA frames	Y	Y
BB-7.	*Synchronisation between satellites required (y/n)*	Synchronisation between BS's working on different satellites is not required. Synchronisation between BS's working on the same satellite is required.	Synchronisation between BS's working on the same channel of different satellites is required. Synchronisation between BS's working on different channels of the same satellite is not required.	N	Y	N	Y

ANNEX 1

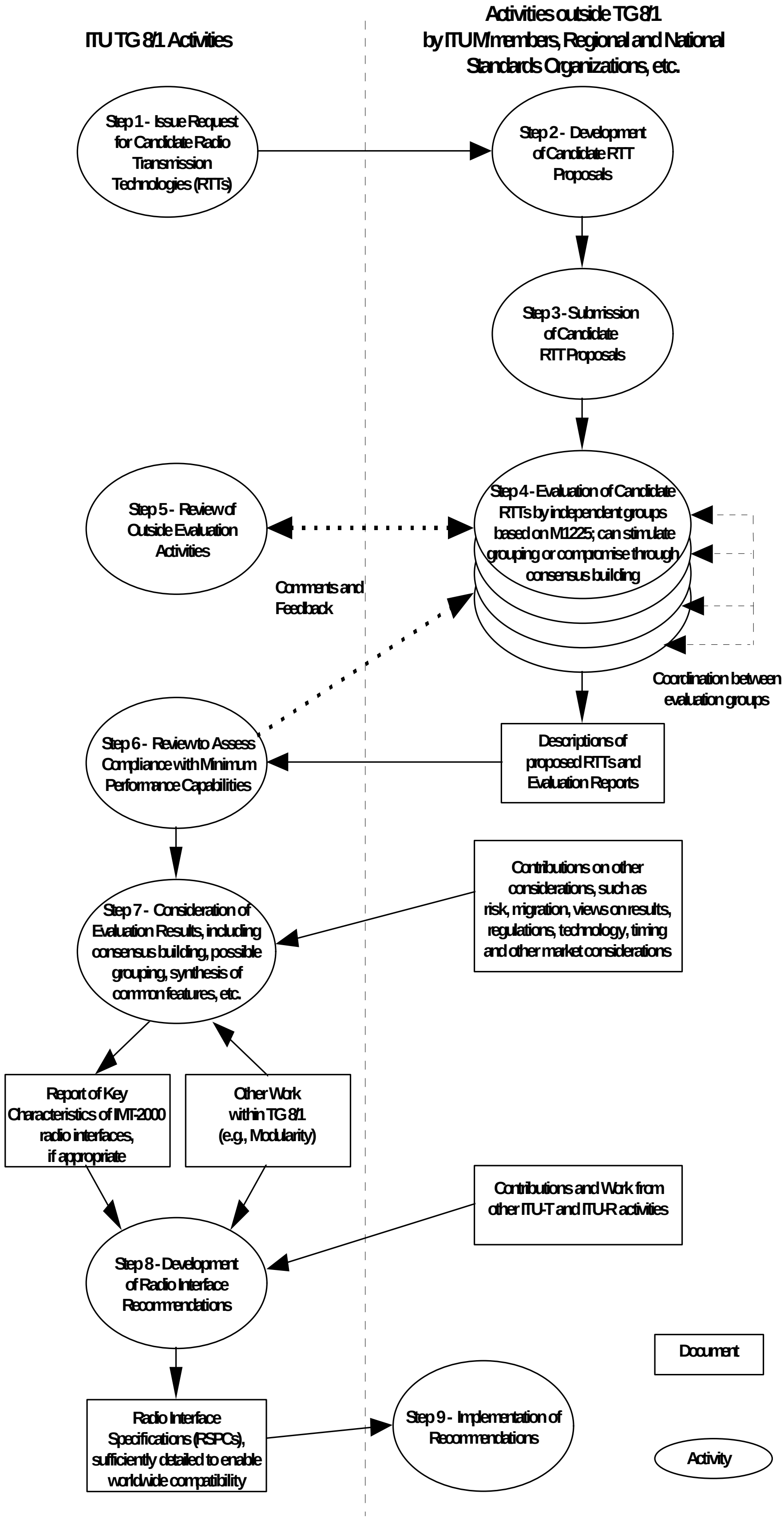

Figure 1 - The radio interface development process

[*Editor's note: The left-hand box below Step 7 in the diagram above is to be edited by the ITU Secretariat to reflect that "Key Characteristics of the Radio Interfaces" is a Recommendation, not a report.*]