RECOMMENDATION ITU-R M.1455-2*

Key characteristics for the International Mobile Telecommunications-2000 (IMT-2000) radio interfaces

(2000-2001-2003)

1 Introduction

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 telecommunication 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;

– 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 Recommendation which 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.

* Radiocommunication Study Group 8 made editorial amendments to this Recommendation in 2004 in accordance with Resolution ITU-R 44.

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 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 Recommendation ITU-R M.1457. 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, recognizing the need to minimize the number of different radio interfaces and maximize 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:

Recommendation ITU-R M.687:	International Mobile Telecommunications-2000 (IMT-2000)
Recommendation ITU-R M.816:	Framework for services supported on International Mobile Telecommunications-2000 (IMT-2000)
Recommendation ITU-R M.817:	International Mobile Telecommunications-2000 (IMT-2000). *Network architectures*
Recommendation ITU-R M.818:	Satellite operation within International Mobile Telecommunications-2000 (IMT-2000)
Recommendation ITU-R M.819:	International Mobile Telecommunications-2000 (IMT-2000) for developing countries
Recommendation ITU-R M.1034:	Requirements for the radio interface(s) for International Mobile Telecommunications-2000 (IMT-2000)
Recommendation ITU-R M.1035:	Framework for the radio interface(s) and radio sub-system functionality for International Mobile Telecommunications-2000 (IMT-2000)
Recommendation ITU-R M.1036:	Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications-2000 (IMT-2000) in the bands 806–960 MHz, 1 710-2 025 MHz, 2 110-2 200 MHz and 2 500-2 690 MHz

Recommendation ITU-R M.1167:	Framework for the satellite component of International Mobile Telecommunications-2000 (IMT-2000)
Recommendation ITU-R M.1224:	Vocabulary of terms for International Mobile Telecommunications-2000 (IMT-2000)
Recommendation ITU-R M.1225:	Guidelines for evaluation of radio transmission technologies for IMT-2000
Recommendation ITU-R M.1308:	Evolution of land mobile systems towards IMT-2000
Recommendation ITU-R M.1311:	Framework for modularity and radio commonality within IMT-2000
Recommendation ITU-R M.1457:	Detailed specifications of the radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)
Recommendation ITU-R SM.328:	Spectra and bandwidth of emissions
Recommendation ITU-R SM.329:	Unwanted emissions in the spurious domain
ITU-T Recommendation Q.1701:	Framework of IMT-2000 networks
ITU-T Recommendation Q.1711:	Network functional model for IMT-2000

Handbook on principles and approaches on evolution to IMT-2000/FPLMTS. Volume 2 – 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 Fig. 2) 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 multiband 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 Recommendation ITU-R M.1457.

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. Some of the key highlights of this Recommendation are that:

– there is a need to support terminal roaming between pre-IMT-2000 and IMT-2000 systems;
– 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;
– the standards for IMT-2000 should be adopted as soon as possible to support the timely evolution of existing systems to IMT-2000; and
– 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:

– are backwards compatible with their current systems;
– can co-exist with their or other operators’ current systems;
– have the ability for incremental deployment according to the growth in the market demand for IMT-2000 services; and
– 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 recognized 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 descriptions

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 Tables 1 and 2. The key characteristics that are more general in nature, for example, frequency re-use 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 § 5.2. They are categorized 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.

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 frequency division duplex (FDD) direct sequence, FDD multi-carrier and time division duplex (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

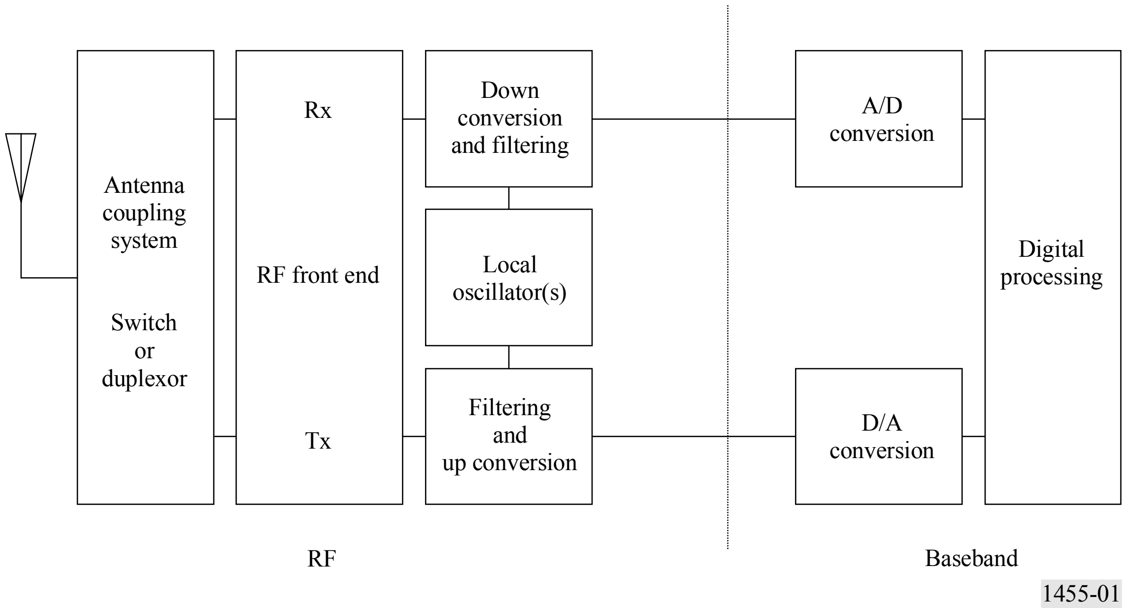
The key characteristics of the radio interfaces given in § 5.1 and 5.2 are recommended for subsequent use in the detailed specification for IMT-2000 in Recommendation ITU-R M.1457.

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

NOTE 1 – The radio specification process will include further refining of specific values with the assistance of future harmonization discussions outside and/or inside the ITU.

FIGURE 1

General block diagram of an IMT-2000 device



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 the development of the radio interface specifications. 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

Item	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 RF 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	Maximum 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 –50 dBm/1 MHz *TDMA* Nominal control dynamic range should be at least 32 dB	Minimum 18 dB for FDD mode Minimum 30 dB for TDD mode For some TDMA implementations it is optional

TABLE 1 (*continued*)

Item	Name of key characteristic	Description	List of proposed values	
			Mobile station value	Base station value
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	For some TDMA implementations it is optional 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 stations to maintain the transmission frequency at the assigned carrier frequencies	Subset of the following: – $\leq \pm 0.1 \times 10^{-6}$ – $\leq \pm 25 \times 10^{-6}$ for some TDMA implementations	Subset of the following: – $\leq \pm 0.05 \times 10^{-6}$ – $\leq \pm 25 \times 10^{-6}$ 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	*CDMA:* 1-16.4 MHz (depends on chip rate) *TDMA:* subset of the following: 130 kHz 1 MHz 1.1 MHz	
1.6	Adjacent channel leakage power ratio (ACLR)	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. ACLR is the ratio of the leakage power and total radiation power	Subset of the following: – ACLR ≥ 12 dBc at 3.75 MHz offset. ACLR ≥ 50 dBc at 5 MHz offset. – ACLR ≥ *x* dBc at 5 MHz offset, where *x* is a value to be determined between 30 and 40. Next ACLR ≥ *y* dBc at 10 MHz offset, where *y* is a value to be determined between 40 and 50	Subset of the following: – ACLR ≥ 12 dBc at 3.75 MHz offset. ACLR ≥ 50 dBc at 5 MHz offset. – ACLR ≥ *z* dBc at 5 MHz offset, where *z* is a value to be determined in one of the following ranges: 40-50 45-55. Next ACLR ≥ *w* dBc at 10 MHz offset, where *w* is a value to be determined in one of the following ranges: 50-55 55-65

TABLE 1 (*continued*)

Item	Name of key characteristic	Description	List of proposed values	
			Mobile station value	Base station value
1.6 (*cont.*)		NOTE 1 – 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	– 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	– 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 Rec. ITU-R SM.328 for out-of-band emissions and Rec. ITU-R SM.329 for spurious emissions, are applied	
1.8	Transmit linearity requirements	Transmit linearity characterizes the linear and broadband transmitter power amplifier requirements to meet spurious and out-of-band emissions. This is primarily characterized by the peak-to-average power ratio which dictates the power amplifier back-off from the saturation point	*CDMA* Nominal values are characterized by ACLR (see item 1.6 above). Using a variable spreading factor (VSF) of 256, 0 dB 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 hybrid phase shift keying (HPSK) (also known as orthogonal complex QPSK-OCQPSK) spreading modulation with root raised cosine (roll-off 0.22) filter at 1% of complementary cumulative distribution function (CCDF). 3.6 dB peak-to-average ratio for QPSK spreading modulation with root raised cosine (roll-off = 0.22) filter at 1% of CCDF	*CDMA* Characterized by ACLR (see item 1.6 above). *TDMA* 3 dB back-off with QPSK. 5 dB back-off with 16-QAM. 0 dB back-off for GFSK. 2 dB back-off for DBPSK. 3.5 dB back-off with D8-PSK. 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

TABLE 1 (*continued*)

Item	Name of key characteristic	Description	List of proposed values	
			Mobile station value	Base station value
1.8 (*cont.*)			*TDMA* 3 dB back-off with QPSK. 5 dB back-off with 16-QAM. 0 dB back-off for Gaussian filtered FSK (GFSK). 2 dB back-off for differential binary PSK (DBPSK). 3.5 dB back-off with differential 8-PSK (D8-PSK). 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 quaternary offset QAM (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 1 – This definition is different from the unwanted RF emission of the mobile station while switched on, but without authorization 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/1 MHz in f < 1 GHz –40 dBm/1 MHz in f < 1 GHz – –57 dBm/100 kHz in f < 1 GHz –47 dBm/1 MHz in f < 1 GHz *TDMA* –117 dBm	Not available

TABLE 1 (*continued*)

Item	Name of key characteristic	Description	List of proposed values	
			Mobile station value	**Base station value**
	Receiver characteristics			
2.1	Receiver sensitivity	The RF sensitivity is the minimum receiver power measured at the antenna port at which the frame error ratio/bit error ratio (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: $P_{Rx\ sens} = k\ T \cdot NF \cdot \frac{E_b}{N_0} \cdot R_b$ where: $k\ T$: thermal noise density, –174 dB(m/Hz) NF: receiver noise figure E_b/N_0: receiver information bit energy to noise density threshold (at the given QoS) R_b: information bit rate Since E_b/N_0 and R_b (and hence $P_{Rx\ sens}$) will vary with the service, it is only NF that can be considered a key RF parameter. $P_{Rx\ sens}$ will set the coverage for an unloaded traffic case. If different noise figures are used in different radio inter-faces, then the lowest noise figure applies for a multi-mode terminal implementation	*CDMA* Subset of the following: – –117 dBm for 12.2 kbit/s measurement channel – –105 dBm for 9.6 kbit/s measurement channel and NF < 7 dB – –104 dBm for 9.6 kbit/s measurement channel. *TDMA* Subset of the following: – –98.99 dBm for 8-PSK 384 kbit/s – –99.28 dBm for QOQAM 2 Mbit/s – –86 dBm with 1.152 Mbit/s measured at 1×10^{-3} raw BER	Not specified in this Recommendation
2.2	Receiver dynamic range	The difference (dB) between the overload level and the minimum acceptable signal level in a transmission system	≥ 72 dB Maximum usable input level: –25 dBm	≥ 30 dB

TABLE 1 (*continued*)

Item	Name of key characteristic	Description	List of proposed values	
			Mobile station value	Base station value
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 FER or BER	*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: – level of the interfering signals: –47 dBm, wanted signal: –80 dBm, raw BER: 1×10^{-3} – level of the interfering signals: –45 dBm, wanted signal: –107 dBm, BER: < 3%	Not specified in this Recommendation
2.4	Spurious response and blocking	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 centre frequency	*CDMA*(1) In-band: –44 dBm (over 15 MHz offset). Out-of-band: –30 dBm for IMT-2000 frequency band, –15 dBm for the other frequencies. *TDMA* 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, BER: 3% – with the desired signal set at –80 dBm, the BER shall be maintained below 1×10^{-3} in the presence of any one of the signals shown in the Table below where: F_L and F_U : lower and upper edges F_C : centre frequency of the allocated frequency band	Not specified in this Recommendation

TABLE 1 (*continued*)

Item	Name of key characteristic	Description	List of proposed values			
			Mobile station value			Base station value
24 (*cont.*)			Frequency	Interferer level for radiated measure-ments (dB(µV/m))	Interferer level for conducted measure-ments (dBm)	
			25 MHz < f < F_L – 100 MHz	120	–23	
			F_L – 100 MHz < f < F_L – 5 MHz	110	–33	
			$\lvert f - F_C \rvert$ > 6 MHz	100	–43	
			F_U + 5 MHz < f < F_U + 100 MHz	110	–33	
			F_U + 100 MHz < f < 12.75 GHz	120	–23	
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 centre frequency of the assigned channel. Receiver selectivity performance is measured at a specific FER or BER	*CDMA*(1) Subset of the following: – ≥ 33 dB for 12.2 kbit/s measurement channel – the FER of a 9 600 bit/s call with I_c/I_{or} = –15.6 dB, $\hat{I}_{or}$ = –101 dBm/1.23 MHz, and a tone offset by ±1.02 × *NB* Hz from the carrier's centre frequency should not exceed 1% where: I_c: average power per pseudo noise chip I_{or}: total transmit power spectral density of the forward link at the base station antenna connector			Not specified in this Recommendation

TABLE 1 (*continued*)

Item	Name of key characteristic	Description	List of proposed values	
			Mobile station value	**Base station value**
2.5 (*cont.*)			$\hat{I}_{or}$: received power spectral density of the forward link as measured at the user equipment antenna connector I_c/I_{or}: ratio of the average transmit power per pseudo noise chip for different fields or physical channels to the total transmit power spectral density NB: necessary bandwidth of the system, as defined in Rec. ITU-R M.329 *TDMA*(1) For carrier spacing of 1.728 MHz, with a received signal strength of –73 dBm (i.e. 70 dB(μV/m)) on RF channel M, the BER shall be maintained better than 1×10^{-3} 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 (dB(μV/m)) (dBm) $Y = M$ — 60 — –83 $Y = M \pm 1$ — 83 — –60 $Y = M \pm 2$ — 104 — –39 Y = any other channel — 110 — –33	
	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 1 – IMT-2000 should not preclude the use of diversity schemes	The values are identical to those in the baseband Table. NOTE 2 – Some of technologies are implemented in baseband or RF or a combination of baseband and RF	

TABLE 1 (*end*)

Item	Name of key characteristic	Description	List of proposed values	
			Mobile station value	Base station value
3.2	Smart antennas	A smart antenna is an advanced antenna technology composed by an antenna array and beam formed in baseband data processing. NOTE 1 – IMT-2000 should not preclude the use of smart antennas. Smart antenna is one of the main features to enhance QoS and to reduce complexity	For some implementations, it is required.	
3.3	Minimum operating bandwidth	Minimum operating bandwidth is characterized by RF channel spacing and the minimum bandwidth for deployment. NOTE 1 – This definition refers to the minimum bandwidth required to meet the minimum performance values in the three relevant test environments defined in Recommendation ITU-R M.1225 (i.e. 144 kbit/s for vehicular, 384 kbit/s for pedestrian, 2 048 kbit/s for indoor)	*CDMA* Subset of the following: – minimum operating bandwidth: FDD: 2 × 5 MHz TDD: 1 × 5 MHz minimum channel spacing: 4.4 MHz. – minimum operating bandwidth: TDD: 1 × 1.6 MHz minimum channel spacing: 1.6 MHz. – minimum operating bandwidth: FDD 2 × 1.25 MHz for vehicular 2 × 3.75 MHz for pedestrian 2 × 7.5 MHz for indoor TDD 1 × 1.25 MHz for vehicular 1 × 3.75 MHz for pedestrian 1 × 7.5 MHz for indoor Minimum channel spacing: 1.25 MHz *TDMA* Minimum channel spacing: 200 kHz or 1.6 MHz or 1.728 MHz Minimum operating bandwidth: – 2 × 600 kHz for 200 kHz channel spacing for vehicular and pedestrian environments – 2 × 1.6 MHz for 1.6 MHz channel spacing for indoor environment – Typical 5 to 20 MHz for 1.728 MHz channel spacing for indoor and pedestrian environments	

(1) This list is not exhaustive.

5.1.2 Baseband key characteristics

TABLE 2

Baseband key characteristics

Number	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 (TDMA/CDMA/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 FDD and TDD	FDD or TDD
4	Modulation (uplink (UL) and downlink (DL))	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 categorized 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,16-QAM – UL and DL: QPSK, 8-PSK, DBPSK, DQPSK, D8-PSK, GFSK (Gaussian FSK), GMSK (Gaussian filtered minimum shift keying), QOQAM, BOQAM (binary offset QAM), 16-QAM *Spreading modulation* Subset of the following: – UL: HPSK (also known as OCQPSK) – UL and DL: BPSK, QPSK
5	Channelization code (uplink and downlink)	Channelization codes are a set of orthogonal codes used for spreading and identification of certain channels. NOTE 1 – It is important in CDMA systems to minimize the interference between users and between channels in the cell in downlink and between channels of a user in uplink	*For CDMA only:* – Orthogonal code and/or quasi-orthogonal code

TABLE 2 (*continued*)

Number	Names of the key characteristics	Description	Values
6	Scrambling code (uplink and downlink)	A scrambling code is used in direct spread-CDMA (DS-CDMA) systems to identify a base station (BS) or sector in downlink, and a mobile station (MS) in uplink	*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 and UL: QPSK time shifted pseudo noise code. TDD: subset of the following: – complex codes, with phase-transition restrictions – DL and 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 1 – 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 division continuous common pilot – code division continuous auxiliary pilot – code division dedicated pilot
8	Detection (uplink and downlink)	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 multipath propagation effects at the MS and BS and improve overall performance	*Detection:* CDMA: coherent TDMA: coherent or non-coherent Joint detection: for some implementations, it is supported

TABLE 2 (*continued*)

Number	Names of the key characteristics	Description	Values
8 (*cont.*)		*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	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 code words 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 (uplink and downlink)	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 – discontinuous transmission, DTx (FDD DL and TDD DL and 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

TABLE 2 (*continued*)

Number	Names of the key characteristics	Description	Values
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: $N \times 3.84$ Mchip/s: $N = 1, 2, 4$ $N \times 1.2288$ Mchip/s: $N = 1, 3, 6, 9, 12$ 1.28 Mchip/s
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, 14, 15, 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 (direct spread-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 1 – 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 and TDD: RsMA (Reservation sense Multiple Access) – 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

TABLE 2 (*continued*)

Number	Names of the key characteristics	Description	Values
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 uplink 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 1 – Handover is an essential element of a mobile telecommunication 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 is 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	Subset of the following: – hard handover – soft handover – inter- and intra-system handover (including between second and third generation systems) – softer handover – inter-frequency handover – baton handover(1)
18	Power control (uplink and downlink)	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	*CDMA* 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

TABLE 2 (*end*)

Number	Names of the key characteristics	Description	Values
18 (*cont.*)			*TDMA* – 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 1 – 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 – multipath diversity – antenna diversity – multi-carrier transmission diversity – transmit diversity – macro diversity – relaying diversity, opportunity driven multiple access (ODMA) in TDD (TDD ODMA)
20	Adaptive equalizer	Time varying channel dispersion due to multipath propagation can cause inter-symbol interference, resulting in increased 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 multipath channel	For some implementations, it is required
21	Dynamic channel allocation (DCA)	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 *TDMA* For some implementations, it is supported

(1) High efficiency handover based on user position information; can support hard-, soft- and inter-system handovers.

5.2 Satellite

TABLE 3

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 types, or combination, of listed constellations	W-C/TDMA can be used with all types, or combination, of listed constellations	LEO	MEO	GSO	LEO
A-1.2	Orbit altitude (km)	Depends on constellation type		Nominally 1 600	Nominally 10 390	36 000	Apogee: 862.4 Perigee: 843.5
A-1.3	Number of orbital planes	Depends on constellation type		8	2	1	8
A-1.4	Inclination (type, e.g. polar, equatorial or degrees)	Depends on constellation type		54°	45°	±3°	Polar or inclined
A-1.5	Satellites per plane	Depends on constellation type		6	5-6	3-4	12
A-2	Inter-satellite links	Not required		Yes	No		Yes
A-3	On-board baseband processing	Not required. Adaptive antennas are supported		Yes	No		Yes
A-4	Geographical coverage (e.g. global, near global, below xx degrees latitude, regional)	Global/regional Multi-regional (depends on constellation type)	Regional/multi-regional	Below 69° latitude	Global	Concentration on land masses	Global or near global
A-5	Number of spot beams per satellite	Depends on constellation type		37	163	150-250	228 (variable)

TABLE 3 (*continued*)

	Satellite radio interface	**A**	**B**	**C**	**D**	**E**	**F**
A-6	Dynamic beam traffic distribution	Yes					
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 are supported	MANISH Soft handoff is supported	Handover supported intra-satellite, inter-satellite and inter-land earth stations. Hard/soft handover supported	Handover supported intra-satellite, inter-satellite and inter-land earth stations. Hard handover supported. Soft handover supported and preferred	Intra-satellite hard handover and interbeam soft 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		Voice: 4.8-64 Data: up to 144	Voice: 4.8 (after coding using nominal codec). Other codecs can be supported. Data: up to 38.4 can be supported	Voice: 4-64 codec dependant Data: up yo 512, variable bit rate	Voice: 2.4-4 Data: up to 144
S-3	Service features						
S-3.1	Bandwidth on demand	Yes					
S-3.2	Bit rate on demand	Yes			No	Yes	
S-3.3	Asynchronous data	Yes					
S-3.4	Asymmetric data	Yes					
S-4	Diversity (e.g. time, frequency, space)	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.

TABLE 3 (*continued*)

	Satellite radio interface	**A**	**B**	**C**	**D**	**E**	**F**
S-5	Terminal features						
S-5.1	Terminal types	Handheld Vehicular Transportable		Handheld Vehicular Transportable Fixed	Multiple terminal types supported; examples include handheld, ruggedised, private vehicle, commercial vehicle and semi-fixed	Multiple terminal types supported; examples include: Class 1 (A3 or briefcase like) Class 2 (A4 or notebook like) Class 3 (A5 or pocket like) terminal	Handheld Portable Nomadic Fixed Aeronautical Maritime, etc.
S-5.2	Multiple service capability (e.g. combined phone, pager, data terminal)	Possible		Yes			
S-5.3	Mobility restrictions for each terminal type (e.g. up to xx km/h)	250 km/h for 1.920 Mchip/s 500 km/h for 3.840 Mchip/s		500 km/h	Nominally up to 100 km/h, potentially up to at least 1 000 km/h	1 500 km/h	Up to 500 km/h for handheld Up to 5 000 km/h for aeronautical
S-6	Minimum satellite channelization	2 350 kHz for 1.920 Mchip/s 4 700 kHz for 3.840 Mchip/s		5.0 MHz for 3.840 Mchip/s	170 kHz	200 kHz	TDMA: 27.17 kHz CDMA: 1.25 MHz
S-7	Operation in satellite radio operating environments of Rec. ITU-R M.1034	All					
RF key characteristics (at 2 GHz)							
RF-1	User terminal transmitter e.i.r.p.						
RF-1.1	Maximum e.i.r.p. for each terminal type (dBW)	The exact value depends on space segment characteristics	The exact value depends on space segment characteristics	– Handheld: 2 – Vehicular: 15.8 – Transportable: 21 – Fixed: 36	For example, terminal types nominal maximum e.i.r.p.: – handheld: ≤ 7 – Ruggedised: ≤ 7	Nominal: Class 1: 20 Class 2: 15 Class 3: 10	–2 to 4 for handheld. Market driven for other terminal types

TABLE 3 (*continued*)

	Satellite radio interface	A	B	C	D	E	F
RF-1.1 (*cont.*)		Typical values: – handheld: 3 – vehicular: 16 – transportable: 16	Typical values: FDD/TDD mode: – handheld: 8 – vehicular: 11 – transportable: 20 FDD mode: – handheld: 12 – vehicular: 18 – transportable: 20		– private vehicle: ≤ 10 – commercial vehicle: ≤ 10 – semi-fixed: ≤ 10		
RF-1.2	Average e.i.r.p. for each terminal type (dBW)	Depends on space segment characteristics		– Handheld: –10 – Vehicular: 3 – Transportable: 5 – Fixed: 27	For example, terminal types nominal average e.i.r.p.: – handheld: ≤ –4 – ruggedised: ≤ –4 – private vehicle: ≤ –1 – commercial vehicle: ≤ –1 – semi-fixed: ≤ –1 (calculated assuming single slot voice use with discontinuous transmission)	Range: Class 1: 20 to 10 Class 2: 15 to 5 Class 3: 10 to 4	–8 to –2 for handheld Market driven for other terminal types
RF-2	Antenna gain for each terminal type (dBi)	Typical values envisaged for the different terminal classes are: – handheld: –1.0 – vehicular: 2.0 (LEO), 8.0 (GSO) – transportable: 4.0 (LEO), 25.0 (GSO)	Typical values envisaged for the different terminal classes are: – handheld: –2 – vehicular: 2.0 (LEO), 8.0 (GSO) – transportable: 4.0 (LEO), 25.0 (GSO)	– Handheld: 2 – Vehicular: 2 – Transportable: 4 – Fixed: 23	For example, terminal types nominal antenna gain: – handheld: 2 – ruggedised: 3.5 – private vehicle: 3.5 – commercial vehicle: 6.5 – semi-fixed: 10	Class 1: > 17 Class 2: > 14 Class 3: < 7	+2 for handheld. Market driven for other terminal types

TABLE 3 (*continued*)

	Satellite radio interface	A	B	C	D	E	F
RF-3	User terminal *G*/*T* for each terminal type (dB(K^{-1}))	Typical values envisaged for 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 different terminal classes are: – handheld: –23.0 (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)	– Handheld: –22.8 – Vehicular: –22.8 – Transportable: –20.8 – Fixed: –4	For example, terminal types nominal *G*/*T* – handheld: –23.8 – ruggedised: –21.5 – private vehicle: –21.5 – commercial vehicle: –18 – semi-fixed: –14	Class 1: ≥ –10.5 Class 2: ≥ –13.5 Class 3: ≥ –18.5	–24.8 for handheld. Market driven for other terminal types
RF-4	Maximum satellite e.i.r.p. per carrier (dBW)	Depends on constellation type		37.2	Typically 34.3	38	29.6
RF-5	Maximum satellite *G*/*T* (dB(K^{-1}))	Depends on constellation type		Nominally –7	Nominally 4.9	12	0.1
RF-6	Channel bandwidth	Independently of terminal type: 2 350 kHz or 4 700 kHz		5 MHz	25 kHz	200 kHz	TDMA: 27.17 kHz CDMA: 1.25-5 MHz
RF-7	Multiple channel capability	Yes					
RF-8	Power control						
RF-8.1	Range (dB)	20	15	20	16	8	25
RF-8.2	Step size (dB)	0.20-1		±0.25, ±1	1		TDMA: 2 CDMA: 0.5
RF-8.3	Rate (cycles/s)	50-100	50-400	100	2	Variable	50
RF-9	Frequency stability						
RF-9.1	Uplink (ppm)	3		1	Unlocked: 3 Locked: 0.1	±1	0.375 (Automatic frequency control) (AFC)

TABLE 3 (*continued*)

	Satellite radio interface	**A**	**B**	**C**	**D**	**E**	**F**
RF-9.2	Downlink (ppm)	0.5		0.1	0.5	±1	1.5 thermal
RF-10	Doppler compensation	Yes					
RF-11	Terminal transmitter/ receiver isolation (dB)	> 169		110	≥ 57	40	63
RF-12	Maximum fade margin for each service type (dB)	Depends on service and satellite constellation characteristics. In any case, ≤ 20		Nominally 25	≥ 8	3	Voice: 15-25 Messaging/paging: 45
Baseband key characteristics							
BB-1	Multiple access						
BB-1.1	Technique	Direct sequence CDMA	*Forward Uplink:* hybrid wideband orthogonal CDM/TDM (W-O-CDM/TDM) *Return link:* Hybrid wideband quasi-synchronous quasi-orthogonal CDMA/TDMA (W-QS-QO-CDMA/TDMA)	CDMA/FDMA	TDMA/FDMA	Forward link, TDM Return link, TDMA	FDMA/TDMA and FDMA/CDMA
BB-1.2	Chip rate (where appropriate) (Mchip/s)	1.920 or 3.840		3.840	Not available		1.228 to 4.096
BB-1.3	Time slots/frame (where appropriate)	15	8	15	6	16, 5 ms slots or 4, 20 ms slots or a combination	4

TABLE 3 (*continued*)

	Satellite radio interface	**A**	**B**	**C**	**D**	**E**	**F**
BB-2	Modulation type	– Dual-code BPSK in the uplink – QPSK or BPSK in the downlink	– Dual-code BPSK selectable in the asynchronous uplink – QPSK or BPSK selectable in the downlink and in the quasi-synchronous uplink	– Reverse link (data/spreading): dual-channel QPSK/OCQPSK (also known as HPSK) – Forward link (data/spreading): QPSK/QPSK	Dependent on carrier type: – reverse link: GMSK – forward link: QPSK/BPSK	QPSK π/4 QPSK 16-QAM	QPSK 16-QAM
BB-3	Dynamic channel allocation	No			Yes		
BB-4	Duplex method (e.g. FDD, TDD)	FDD	FDD or FDD/TDD	FDD			TDD/FDD
BB-5	FEC	*Standard quality*: convolutional coding with code rate 1/3 and constraint length $k = 9$. Variable puncturing repetition to match the required information rate. *High quality*: Reed-Solomon (RS) code over gold function GF(2^8) as outer code concatenated with inner convolutional code with rate 1/3 or 1/2, constraint length $k = 9$. Turbo coder as option		For the performance of BER = 1×10^{-3}: convolutional coding with rate 1/3, constraint length $k = 9$. For the performance of BER = 1×10^{-6}: concatenated coding with (12, $T = 8$) RS coding and convolutional coding with rate 1/2, constraint length $k = 9$	Yes	Turbo coding	Yes

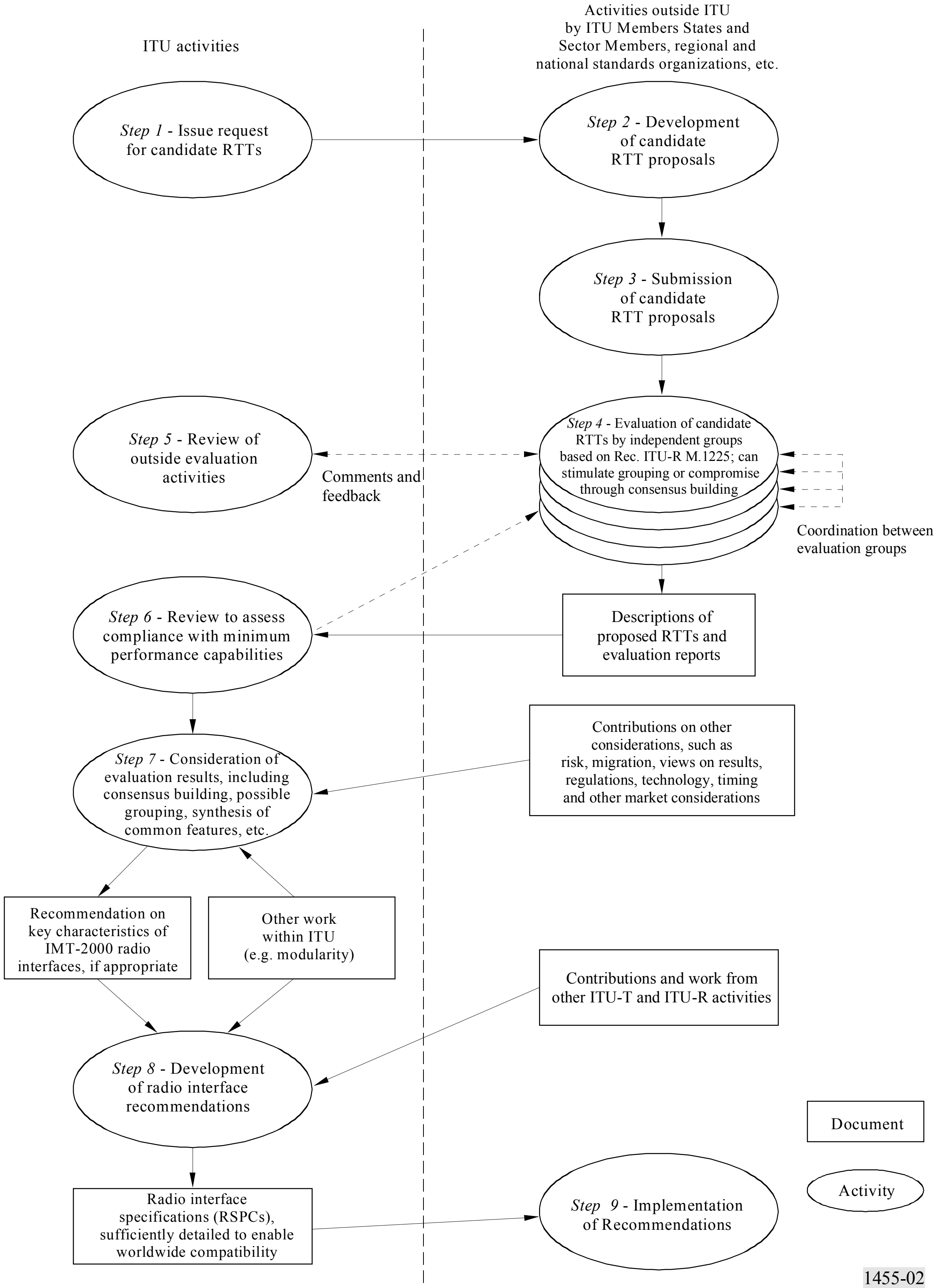
TABLE 3 (*end*)

	Satellite radio interface	A	B	C	D	E	F
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)	Inter-frame interleaving and intra-frame interleaving	Yes *Voice:* intra-burst interleaving *Data:* intra-burst interleaving and interleaving over 4 TDMA frames	Yes	
BB-7	Synchronization between satellites required	Synchronization between BSs working on different satellites is not required. Synchronization between BSs working on the same satellite is required	Synchronization between BSs working on the same channel of different satellites is required. Synchronization between BSs working on different channels of the same satellite is not required	No	Yes	No	Yes

Annex 1

FIGURE 2

The radio interface development process



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