B U I L D I N G   G L O B A L   C O M M U N I C A T I O N S

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Please find attached a file, *EvaluationReport_v0.3(clean).doc*, that contains our initial questions regarding the proposal for a sixth Radio Transmission Technology for IMT-2000. The questions are captured in the evaluators' comments column to show their relevance.

Our Ad-Hoc Group on International Mobile Telecommunications is scheduled to meet on 2007-04-17 and 2007-04-27, with a contingency plan for 2007-05-08.

Your reply prior to those dates would be appreciated since that would allow us to take account of your response prior to filing our evaluation report with ITU-R WP 8F.

If you have any further questions, please do not hesitate to contact me,

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B U I L D I N G G L O B A L C O M M U N I C A T I O N S _

TR-45 Ad-Hoc Group on International Mobile Telecommunications
TR-45·AHIMT

DRAFT EVALUATION REPORT
PROPOSED SIXTH RADIO TRANSMISSION TECHNOLOGY (RTT)
FOR IMT-2000

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1) Introduction

TIA TR-45 received notification of a proposal for a sixth Radio Transmission Technology (RTT) via a Circular Letter, 8F/LCCE/153, dated 14 February, 2007. TR-45 considered the Circular Letter at their meeting of March 7 - 8, 2007, and, in order to continue to assist ITU-R WP 8F in their work, agreed to create an Evaluation Group. The scope and charter of that group is available on the TIA ftp site, *«editor's note: URL to be inserted»*

2) Summary of Results

«editor's note: to be completed upon conclusion of evaluation, and beforefiling report with TR-45»

3) Conclusions

«editor's note: to be completed upon conclusion of evaluation, and beforefiling report with TR-45»

Annex-1Radio transmission technologies description template

«editor's note: introductory material is copied from M.1225, is provided for completeness, and it is proposed that it be removed before filing report with TR-45, leaving just the table and any supporting material from the evaluation group»

ATTACHMENT 3 to Circular-letter 8/LCCE/47 (ANNEX 1 to Recommendation ITU-R M.1225)

a) Description of the radio transmission technology

The RTT has to be described in a detailed form to get an overview and an understanding of the functionalities of the technical approach. This Annex provides a template to aid in the technical description of the characteristics of a candidate RTT.

The following technical parameters, the relevant templates given in Annex 2 and any additionally useful information, should be provided for each test environment for which the candidate RTT is proposed to operate. This can be done by preparing:

– a separate template submission for each test environment; or

– a single submission that includes multiple answers for those technical parameters impacted by a test environment.

In addition to the detailed technical description described below, proponents should assure that their submission meets the overall IMT-2000 objectives as defined in existing Recommendations (see § 4). Submittors should also state if the current ITU policy for IPR is met for their RTT proposals.

The following table describes the technical parameters needed to characterise a proposal. Proponents should feel free to add any new information if required for a better assessment of their proposal.

IMT-2000 may serve both mobile users as well as fixed wireless users sharing common geographical locations and frequency bands. As a result, certain parameters may be designed for one or the other type of user in combination. To account for fixed wireless use of a candidate RTT, thedescription given in the template should indicate when a parameter has been designed for dual use.

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.1	Test environment support		
A1.1.1	In what test environments will the RTT operate?	- indoor - outdoor to indoor and pedestrian, - vehicular - mixed	
A1.1.2	If the RTT supports more than one test environment, what test environment does this technology description template address?	One template for all	
A1.1.3	Does the RTT include any features in support of FWA application? Provide detail about the impact of those features on the technical parameters provided in this template, stating whether the technical parameters provided apply for mobile as well as for FWA applications.	Yes (cf. Rec. ITU-R F.1763). Flexible mixed fixed and mobile design. - QoS - Dynamic bandwidth allocation - Continuous and variable bit rate support - Support of nomadic operation - Support of fixed wireless voice, image, video and data services.	
A1.2	Technical parameters NOTE 1 – Parameters for both forward link and reverse link should be described separately, if necessary.		
A1.2.1	What is the minimum frequency band required to deploy the system (MHz)?	5 MHz or 10 MHz (10 MHz provides better performance).	
A1.2.2	What is the duplex method: TDD or FDD?	TDD	
A1.2.2.1	What is the minimum up/down frequency separation for FDD?	N/A	
A1.2.2.2	What is requirement of transmit/receive isolation? Does the proposal require a duplexer in either the mobile station (MS) or BS?	Does not require a duplexer.	No transmitter/receiver isolation requirement is specified

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.3	Does the RTT allow asymmetric transmission to use the available spectrum? Characterize.	Yes. The ratio of uplink to downlink transmission can be reconfigured on a system-wide basis.	
A1.2.4	What is the RF channel spacing (kHz)? In addition, does the RTT use an interleaved frequency plan? NOTE 1 – The use of the second adjacent channel instead of the adjacent channel at a neighbouring cluster cell is called "interleaved frequency planning". If a proponent is going to employ an interleaved frequency plan, the proponent should state so in § A1.2.4 and complete § A1.2.15 with the protection ratio for both the adjacent and second adjacent channel.	5 000 kHz or 10 000 kHz The RTT does not use an interleaved frequency plan	
A1.2.5	What is the bandwidth per duplex RF channel (MHz) measured at the 3 dB down points? It is given by (bandwidth per RF channel) (1 for TDD and 2 for FDD). Provide detail.	For 5 MHz (TDD): about 4.7 MHz, depending on the permutation used. For 10 MHz (TDD): about 9.4 MHz, depending on the permutation used.	Precise Bandwidth for each permutation is not specified
A1.2.5.1	Does the proposal offer multiple or variable RF channel bandwidth capability? If so, are multiple bandwidths or variable bandwidths provided for the purposes of compensating the transmission medium for impairments but intended to be feature transparent to the end user?	The RTT offers variable RF channel bandwidth capability through the use of OFDMA sub-channelization.	No information concerning multiple Bandwidths for purpose of compensating for impairments is supplied

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.6	What is the RF channel bit rate (kbit/s)? NOTE 1 – The maximum modulation rate of RF (after channel encoding, adding of in-band control signalling and any overhead signalling) possible to transmit carrier over an RF channel, i.e. independent of access technology and of modulation schemes.	DOWNLINK Distributed permutation of sub-carriers Assumptions: 10 MHz channel bandwidth, 32 data symbols per frame (35 symbols in sub-frame, 1 symbol for preamble, 2 symbols for control information), 5 ms frame duration, 64 QAM 5/6 code rate, 30 slots for 2 symbols, 48 data tones per slot. Maximum data rate: 23 040 kbit/s Note 1: The above numbers are calculated based on the maximum DL/UL ratio supported by IP-OFDMA. Note 2: The equivalent maximum data rate number for 5 MHz channel Bandwidth is 11520 kbit/s UPLINK Distributed permutation of sub-carriers Assumptions: 10 MHz channel bandwidth, 18 data symbols per frame (21 symbols in UL sub frame, 3 symbols for control channels), 5 ms frame duration, 16 QAM 3/4 code rate, 35 slots for 3 symbols, 48 data tones per slot. Maximum data rate: 6 048 kbit/s Note 1: The above numbers are calculated based on the maximum UL/DL ratio supported by IP-OFDMA. Note 2: The equivalent maximum data rate number for 5 MHz channel Bandwidth is 3024 kbit/s.	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.7	Frame structure: describe the frame structure to give sufficient information such as: – frame length, – the number of time slots per frame, – guard time or the number of guard bits, – user information bit rate for each time slot, – channel bit rate (after channel coding), – channel symbol rate (after modulation), – associated control channel (ACCH) bit rate, – power control bit rate. NOTE 1 – Channel coding may include forward error correction (FEC), cyclic redundancy checking (CRC), ACCH, power control bits and guard bits. Provide detail. NOTE 2 – Describe the frame structure for forward link and reverse link, respectively. NOTE 3 – Describe the frame structure for each user information rate.	Frame length: 5 ms The number of time slots per frame: N/A The number of time symbols per frame: 48 symbols (including TTG and RTG gaps) The number of sub-carriers per each symbol: 512 and 1024 FFT for 5 and 10 MHz respectively. Resource allocation: 2 dimensional structure for frequency and time (see section 2.4 of the RTT System Description for more details) Sub-channel structure: see Section 2.2 of the RTT System Description for details Ratio of DL and UL sub-frame: Ranging from 35 symbols: 12 symbols to 26 symbols: 21 symbols (DL:UL) (35: 12), (34: 13), (33: 14), (32:15), (31: 16), (30: 17), (29: 18), (28: 19), (27: 20), (26: 21) TTG / RTG : 105.7 µs / 60 µs Common control overhead : 1 symbol per frame for preamble (see section 2.4 of the RTT System Description for more details) DOWNLINK (See A1.2.5.1) Distributed permutation of sub-carriers The number of sub-carriers per slot : 48 (data) + 8 (pilots) Guard sub-carrier: 184 (including DC sub-carrier) The channel bit or symbol rate is variable, depending on the number of allocated slots, and the modulation and coding rate. Power control rate: no power control Adjacent permutation of sub carriers The number of sub-carriers per slot : 48 (data) + 6 (pilots) Guard sub-carrier : 160 (including DC sub-carrier)	Control channel symbol rate and bit rate not specified. ACH bit rate not specified. Power control overhead is missing

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.7		UPLINK Distributed permutation of sub-carriers The number of subcarriers per slot : 48 (data) + 24 (pilots) Guard subcarrier : 184 (including DC subcarrier) The channel bit or symbol rate is variable, depending on the number of allocated slots, and the modulation and coding rate. Power control rate : 200 Hz Adjacent permutation of subcarriers The number of subcarriers per slot : 48 (data) + 6 (pilots) Guard subcarrier : 160 (including DC subcarrier)	
A1.2.8	Does the RTT use frequency hopping? If so, characterize and explain particularly the impact (e.g. improvements) on system performance.	No	
A1.2.8.1	What is the hopping rate?	N/A	
A1.2.8.2	What is the number of the hopping frequency sets?	N/A	
A1.2.8.3	Are BSs synchronized or non-synchronized?	Synchronized in frequency and in time for TDD operation, even though frequency hopping is not used	
A1.2.9	Does the RTT use a spreading scheme?	No	
A1.2.9.1	What is the chip rate (Mchip/s)? Rate at input to modulator.	N/A	
A1.2.9.2	What is the processing gain? 10 log (chip rate/information rate).	N/A	
A1.2.9.3	Explain the uplink and downlink code structures and provide the details about the types (e.g. personal numbering (PN) code, Walsh code) and purposes (e.g. spreading, identification, etc.) of the codes.	N/A	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.10	Which access technology does the proposal use: TDMA, FDMA, CDMA, hybrid, or a new technology? In the case of CDMA, which type of CDMA is used: frequency hopping (FH) or direct sequence (DS) or hybrid? Characterize.	OFDMA	
A1.2.11	What is the baseband modulation technique? If both the data modulation and spreading modulation are required, describe in detail. What is the peak to average power ratio after baseband filtering (dB)?	DOWNLINK QPSK, 16 QAM, 64 QAM for data modulation. Spreading modulation does not apply. UPLINK QPSK, 16 QAM for data modulation. Spreading modulation does not apply. PAPR is about 12 dB without any PAPR reduction scheme.	PAPR for Downlink not specified. Spreading information not supplied (Ranging channel uses spreading).
A1.2.12	What are the channel coding (error handling) rate and form for both the forward and reverse links? E.g., does the RTT adopt: – FEC or other schemes? – Unequal error protection? Provide details. – Soft decision decoding or hard decision decoding? Provide details. – Iterative decoding (e.g. turbo codes)? Provide details. – Other schemes?	Convolutional Coding and Convolutional Turbo Coding are supported Modulation schemes: QPSK, 16 QAM and 64 QAM for downlink, QPSK and 16 QAM for uplink. Coding rates: QPSK 1/2, QPSK 3/4, 16 QAM 1/2, 16 QAM 3/4, 64 QAM 1/2, 64 QAM 2/3, 64 QAM 3/4, 64 QAM 5/6. Coding repetition rates: 1x, 2x, 4x and 6x. Unequal error protection: None Soft decision decoding and iterative decoding: It is an implementation issue not covered by the specification.	
A1.2.13	What is the bit interleaving scheme? Provide detailed description for both uplink and downlink.	The bit interleaving scheme is the same for both uplink and downlink. All encoded data bits shall be interleaved by a block interleaver with a block size corresponding to the number of coded bits per the encoded block size.	Interleaver details not specified

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.14	Describe the approach taken for the receivers (MS and BS) to cope with multipath propagation effects (e.g. via equalizer, Rake receiver, etc.).	To cope with the multipath propagation effect, the cyclic prefix and 1-tap equalizer are employed. The length of cyclic prefix is 1/8 of symbol duration thus 11.4 µs.	
A1.2.14.1	Describe the robustness to intersymbol interference and the specific delay spread profiles that are best or worst for the proposal.	The intersymbol interference can be removed by the use of sufficiently longer cyclic prefix than delay spread.	How Vehicular B delay spread is handled is not specified
A1.2.14.2	Can rapidly changing delay spread profile be accommodated? Describe.	Yes, delay spread variation within the length of cyclic prefix does not cause the intersymbol interference.	
A1.2.15	What is the adjacent channel protection ratio? NOTE 1 – In order to maintain robustness to adjacent channel interference, the RTT should have some receiver characteristics that can withstand higher power adjacent channel interference. Specify the maximum allowed relative level of adjacent RF channel power (dBc). Provide detail how this figure is assumed.	Min adjacent channel rejection at BER=10-6 for 3 dB degradation C/I 11 dB – 16 QAM, 3/4 coding rate 4 dB – 64 QAM, 2/3 coding rate Min non-adjacent channel rejection at BER=10-6 for 3 dB degradation C/I 30 dB – 16 QAM, 3/4 coding rate 23 dB - 64 QAM, 2/3 coding rate	
A1.2.16	Power classes	Mobile Station Peak Transmit power (dBm) for 16QAM 1. 18 <= Ptx,max < 21 2. 21 <= Ptx,max < 25 3. 25 <= Ptx,max < 30 4. 30 <= Ptx,max Peak Transmit power (dBm) for QPSK 1. 20 <= Ptx,max < 23 2. 23 <= Ptx,max < 27 3. 27 <= Ptx,max < 30 4. 30 <= Ptx,max	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.16.1	Mobile terminal emitted power : what is the radiated antenna power measured at the antenna? For terrestrial component, give (dBm). For satellite component, the mobile terminal emitted power should be given in e.i.r.p. (effective isotropic radiated power) (dBm).	See A.1.2.16	
A1.2.16.1.1	What is the maximum peak power transmitted while in active or busy state?	See A.1.2.16	
A1.2.16.1.2	What is the time average power transmitted while in active or busy state? Provide detailed explanation used to calculate this time average power.	See A.1.2.16	Average transmitter power is not supplied
A1.2.16.2	Base station transmit power per RF carrier for terrestrial component	See A.1.2.16	
A1.2.16.2.1	What is the maximum peak transmitted power per RF carrier radiated from antenna?	Not limited by RTT	Transmit Powers are not specified
A1.2.16.2.2	What is the average transmitted power per RF carrier radiated from antenna?	Not limited by RTT	Transmit Powers are not specified
A1.2.17	What is the maximum number of voice channels available per RF channel that can be supported at one BS with 1 RF channel (TDD systems) or 1 duplex RF channel pair (FDD systems), while still meeting ITU-T Recommendation G.726 performance requirements?	The maximum number of voice channels per 1 RF channel depends on the bit rate and sampling rate supported by the codecs defined in the G.726. For instance, in case of the bit rate of 16 kbit/s with 20 msec sampling rate, up to 256 users can be supported simultaneously by a 10 MHz RF channel, while meeting the delay requirements of VoIP. In the case of a 5 MHz channel up to 120 users can be supported. The capacity calculated assumes a blocking-limited scenario with Voice Activity Factor = 1, DL 64 QAM 5/6, and UL 16QAM 3/4.	Specific codec is not defined

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.18	Variable bit rate capabilities : describe the ways the proposal is able to handle variable baseband transmission rates. For example, does the RTT use: – adaptive source and channel coding as a function of RF signal quality? – Variable data rate as a function of user application? – Variable voice/data channel utilization as a function of traffic mix requirements? Characterize how the bit rate modification is performed. In addition, what are the advantages of your system proposal associated with variable bit rate capabilities?	Variable bit rate is supported by the flexible resource allocation. By assigning the variable number of sub-channels and using various modulations and coding rates frame by frame, the bit rate for each user can be variable frame by frame. Modulation and coding rate is usually defined by user's RF signal quality (CQI). For higher data rates, the bit rate information is provided to the receiver via scheduling mechanisms and associated control signaling every frame.	Adaptive modulation and coding details are not supplied

Index	Criteria and attribute	Proponents’ comments	Evaluator’s Comments
A1.2.18.1	What are the user information bit rates in each variable bit rate mode?	The user information bit rates are variable according to the number of sub-channels assigned and modulation and coding rate used. DOWNLINK BW: 10 MHz Modulation : QPSK, 16 QAM, 64 QAM Coding rate : 1/2, 2/3, 3/4, 5/6 3312 kbit/s (1/2, QPSK, (DL:UL)=(26:21) symbols) ~ 23040 kbit/s (5/6, 64 QAM, (DL:UL)=(35:12) symbols). See equation below. Note 1: The above numbers are calculated based on the maximum DL/UL ratio supported by IP-OFDMA. Note 2: The equivalent maximum data rate number for 5 MHz channel Bandwidth is 11520 kbit/s UPLINK BW: 10 MHz Modulation : QPSK, 16 QAM Coding rate : 1/2, 3/4 1008 kbit/s (1/2, QPSK, (DL:UL)=(35:12) symbols) ~ 6048 kbit/s (3/4, 16 QAM, (DL:UL)=(26:21) symbols). See equation below. Note 1: The above numbers are calculated based on the maximum UL/DL ratio supported by IP-OFDMA. Note 2: The equivalent maximum data rate number for 5 MHz channel Bandwidth is 3024 kbit/s. Equation used: PHY Data Rate=(Data sub-carriers/Symbol period) × (information bits per symbol)	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.19	What kind of voice coding scheme or codec is assumed to be used in proposed RTT? If the existing specific voice coding scheme or codec is to be used, give the name of it. If a special voice coding scheme or codec (e.g. those not standardized in standardization bodies such as ITU) is indispensable for the proposed RTT, provide detail, e.g. scheme, algorithm, coding rates, coding delays and the number of stochastic code books.	Due to the IP-based characteristics of the radio interface it can utilize any speech codec.	Specific codec is not defined
A1.2.19.1	Does the proposal offer multiple voice coding rate capability? Provide detail.	Yes. The RTT supports flexible data rate for each user and also provide variety scheduling services. A constant bit rate is provided by UGS service, while a variable bit rate is provided by ErtPS service. See A.1.2.18, A1.2.20.1 and A1.2.20.2	Voice coding rates are not defined
A1.2.20	Data services : are there particular aspects of the proposed technologies which are applicable for the provision of circuit-switched, packet-switched or other data services like asymmetric data services? For each service class (A, B, C and D) a description of RTT services should be provided, at least in terms of bit rate, delay and BER/frame error rate (FER). NOTE 1 – See Recommendation ITU-R M.1224 for the definition of: – "circuit transfer mode", – "packet transfer mode", – "connectionless service", and for the aid of understanding "circuit switched" and "packet switched" data services. NOTE 2 – See ITU-T Recommendation I.362 for details about the service classes A, B, C and D.	Yes, a wide range of data services and applications with varied QoS requirements are supported. These are summarized in Table 7 of Section 0 in this submission (8F/1079R1).	
A1.2.20.1	For delay constrained, connection oriented (Class A).	The RTT provides UGS (unsolicited grant service), corresponding to the Class A. UGS is characterized as constant and low data rates and low delay data service.	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.20.2	For delay constrained, connection oriented, variable bit rate (Class B).	The RTT provides rtPS (real-time polling service), corresponding to the Class B. rtPS is utilized for low to high data rate services. The RTT provides ErtPS (extended real-time polling service) as well. ErtPS is utilized for low data rate and low delay data services.	
A1.2.20.3	For delay unconstrained, connection oriented (Class C).	The RTT provides nrtPS (non-real-time polling service), corresponding to the Class C. nrtPS is utilized for high data rate services.	
A1.2.20.4	For delay unconstrained, connectionless (Class D).	The RTT provides BE (best effort service) corresponding to the Class D. BE is utilized for moderate data rate services.	
A1.2.21	Simultaneous voice/data services: is the proposal capable of providing multiple user services simultaneously with appropriate channel capacity assignment? NOTE 1 – The following describes the different techniques that are inherent or improve to a great extent the technology described above to be presented. Description for both BS and MS are required in attributes from § A1.2.22 through § A1.2.23.2.	Yes, multiple parallel services are supported with different QoS requirements. Each service is associated with a set of QoS parameters that quantify aspects of its behavior. These parameters are managed using the dynamic service provisions, represented by the DSA and DSC message dialog.	
A1.2.22	Power control characteristics : is a power control scheme included in the proposal? Characterize the impact (e.g. improvements) of supported power control schemes on system performance.	Yes. A closed loop power control scheme and an open loop power control scheme are included. By means of these power control schemes, the interference level is reduced and the uplink system level throughput is increased.	

<table>
<tr><th>Index</th><th>Criteria and attribute</th><th>Proponents’ comments</th><th>Evaluator’s Comments</th></tr>
<tr><td>A1.2.22.1</td><td>What is the power control step size (dB)?</td><td>Power control step size is variable ranging from 0.25 dB to 32 dB. An 8-bit signed integer in power control information element indicates the power control step size in 0.25 dB units. Normally implemented in 1 dB increments.</td><td></td></tr>
<tr><td>A1.2.22.2</td><td>What are the number of power control cycles per second?</td><td>The power control cycle of closed-loop power control is dependent on the rate of power control information element transmission, but less than 200 Hz.

Due to TDD nature, the open loop power control cycle is inherently identical to the number of frames per seconds, thus 200 Hz.</td><td></td></tr>
<tr><td>A1.2.22.3</td><td>What is the power control dynamic range (dB)?</td><td>The minimum power control dynamic range is 45 dB.</td><td></td></tr>
<tr><td>A1.2.22.4</td><td>What is the minimum transmit power level with power control?</td><td>The RTT supports 45 dB under the full power assumption</td><td>Minimum transmit power is not specified</td></tr>
<tr><td>A1.2.22.5</td><td>What is the residual power variation after power control when RTT is operating? Provide details about the circumstances (e.g. in terms of system characteristics, environment, deployment, MS-speed, etc.) under which this residual power variation appears and which impact it has on the system performance.</td><td>The accuracy for power level control can vary from

± 0.5 dB to ± 2 dB depending on the power control step size.

Single step size m | Required relative accuracy

|m| = 1dB | +/- 0.5 dB

|m| = 2dB | +/- 1 dB

|m| = 3dB | +/- 1.5 dB

4dB< |m|< = 10dB | +/- 2 dB

Two exception points of at least 10 dB apart are allowed over the 45 dB range, where in these two points an accuracy of up to +/- 2 dB is allowed for any size step.</td><td></td></tr>
<tr><td>A1.2.23</td><td>Diversity combining in MS and BS : are diversity combining schemes incorporated in the design of the RTT?</td><td>Yes</td><td></td></tr>
</table>

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.23.1	Describe the diversity techniques applied in the MS and at the BS, including micro diversity and macro diversity, characterizing the type of diversity used, for example: – time diversity: repetition, Rake-receiver, etc., – space diversity: multiple sectors, multiple satellite, etc., – frequency diversity: FH, wideband transmission, etc., – code diversity: multiple PN codes, multiple FH code, etc., – other scheme. Characterize the diversity combining algorithm, for example, switch diversity, maximal ratio combining, equal gain combining. Additionally, provide supporting values for the number of receivers (or demodulators) per cell per mobile user. State the dB of performance improvement introduced by the use of diversity. For the MS: what is the minimum number of RF receivers (or demodulators) per mobile unit and what is the minimum number of antennas per mobile unit required for the purpose of diversity reception? These numbers should be consistent to that assumed in the link budget template of Annex 2 and that assumed in the calculation of the "capacity" defined at § A1.3.1.5.	The standard supports beamforming, transmit/receive diversity and MIMO. The receiver also supports maximal ratio combining. There is no need for a Rake receiver because it is an OFDM system.	Degree of diversity improvement not specified. Minimum number of receivers is not specified. The minimum number of antennas is not specified
A1.2.23.2	What is the degree of improvement expected (dB)? Also indicate the assumed conditions such as BER and FER.	Please refer to Section 2.3 (of 8F/1079R1)	Degree of diversity improvement not specified. Minimum number of receivers is not specified. The minimum number of antennas is not specified

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.24	Handover/automatic radio link transfer (ALT): do the radio transmission technologies support handover? Characterize the type of handover strategy (or strategies) which may be supported, e.g. MS assisted handover. Give explanations on potential advantages, e.g. possible choice of handover algorithms. Provide evidence whenever possible.	Yes. The RTT supports handover and also provides means for expediting handover. Each base station broadcasts the information on the list of neighboring base stations and their channel information such as the operating center frequency, preamble index and synchronization periodically. The channel information in this broadcasting is used for a mobile station to synchronize with the neighboring base station. After a mobile station monitors the signal strength of a neighboring base station and seeks suitable base station(s) for handover, the mobile station or its serving base station can initiate handover by handover request message. But only the mobile station can transmit handover indication message to the its serving base station. After transmitting handover indication message, the mobile station stops monitoring the downlink frame of its serving base station and performs network re-entry to target base station. To reduce the handover latency further, the serving base station provides the target base station with network entry information on a mobile station to be handed over the target base station. Further information is available in the IEEE 802.16 standard; Section 6.3.22 MAC layer handover procedures.	
A1.2.24.1	What is the break duration (s) when a handover is executed? In this evaluation, a detailed description of the impact of the handover on the service performance should also be given. Explain how the estimate was derived.		
A1.2.24.2	For the proposed RTT, can handover cope with rapid decrease in signal strength (e.g. street corner effect)? Give a detailed description of: – the way the handover detected, initiated and executed, – how long each of this action lasts (minimum/maximum time (ms)), – the time-out periods for these actions.	Yes. A base station broadcasts the criterion which is being used for mobile station to request handover. The mobile station issues handover request message whenever the criterion is met. The handover criterion depends on the implementation but usually the received signal strength by a mobile station is used. Further information is available in the IEEE 802.16 standard; Section 11.1.7 MOB-NBR-ADV message encodings.	Very limited information provided on Handover. Details requested are not supplied

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.25	Characterize how the proposed RTT reacts to the system deployment (e.g. necessity to add new cells and/or new carriers) particularly in terms of frequency planning.	All base stations can use the same frequency or different frequency depending on the frequency reuse deployment scenario. OFDMA sub-channelization allows various permutations of sub-carriers. A distributed permutation of sub-carriers, e.g., PUSC (partial usage of sub-carrier) in this RTT, minimizes interferences from neighboring cells and/or sectors in case of the frequency reuse of 1. Different operators usually use different frequencies.	
A1.2.26	Sharing frequency band capabilities : to what degree is the proposal able to deal with spectrum sharing among IMT-2000 systems as well as with all other systems: – spectrum sharing between operators, – spectrum sharing between terrestrial and satellite IMT-2000 systems, – spectrum sharing between IMT-2000 and non-IMT-2000 systems, – other sharing schemes.	The proposed RTT utilizes OFDMA which has inherent interference protection capabilities due to allocation of a varying subset of available sub-carriers to different users. This capability, complemented by interference mitigation techniques described in Report ITU-R M.2045 such as use of appropriate filters and linear power amplifiers would ensure excellent potential for optimum spectrum sharing between the proposed RTT and other IMT-2000 systems. ITU-R WP 8F is in the process of performing sharing studies between fixed/nomadic and mobile IEEE 802.16 and IMT-2000. Preliminary results show similarities with the case of coexistence between IMT-2000 TDD and FDD technologies as captured in Reports ITU-R M.2030 and ITU-R M.2045.	
A1.2.27	Dynamic channel allocation : characterize the dynamic channel allocation (DCA) schemes which may be supported and characterize their impact on system performance (e.g. in terms of adaptability to varying interference conditions, adaptability to varying traffic conditions, capability to avoid frequency planning, impact on the reuse distance, etc.).	Various permutations of OFDMA sub-carriers enable dynamic usage of the spectrum among cells to balance the load and/or average interferences.	
A1.2.28	Mixed cell architecture : how well does the RTT accommodate mixed cell architectures (pico, micro and macrocells)? Does the proposal provide pico, micro and macro cell user service in a single licensed spectrum assignment, with handoff as required between them? (terrestrial component only). NOTE 1 – Cell definitions are as follows: – pico – cell hex radius: r 100 m – micro: 100 m r 1 000 m – macro: r 1 000 m.	The proposed RTT can support flexible frequency reuse operation thus mixed cell architecture is supported well on the same or different frequencies depending on the implementation.	

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A1.2.29	Describe any battery saver/intermittent reception capability.		
A1.2.29.1	Ability of the MS to conserve standby battery power : provide details about how the proposal conserves standby battery power.	The battery power saving of mobile station is supported by the sleep mode and the idle mode operations. Since the RTT basically provides packet-based transmission, both two modes operate in a slotted mode. In those modes, a mobile station communicates to its serving base station only in a listening interval and saves its power consumption otherwise. The information on listening, sleep and idle intervals are determined by the negotiation between the base station and the mobile station before the mobile station transits to either of two modes. A mobile station maintains the connection to its serving base station even in the sleep mode, while a mobile station in the idle mode returns system resources relevant to the existing connection to a base station. In latter case, the mobile station is managed by the multiple base stations grouped in a paging zone. Further information can be found in the IEEE 802.16 standard Sections 6.3.21, Sleep Mode, and 6.3.24, Idle Mode.	
A1.2.30	Signalling transmission scheme : if the proposed system will use RTTs for signalling transmission different from those for user data transmission, describe the details of the signalling transmission scheme over the radio interface between terminals and base (satellite) stations.	The same RTT is used for both user data and signaling transmission.	
A1.2.30.1	Describe the different signalling transfer schemes which may be supported, e.g. in connection with a call, outside a call. Does the RTT support: – new techniques? Characterize. – Signalling enhancements for the delivery of multimedia services? Characterize.	Flexible message-based signaling scheme is used.	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.2.31	Does the RTT support a bandwidth on demand (BOD) capability? BOD refers specifically to the ability of an end-user to request multi-bearer services. Typically, this is given as the capacity in the form of bits per second of throughput. Multi-bearer services can be implemented by using such technologies as multi-carrier, multi-time slot or multi-codes. If so, characterize these capabilities. NOTE 1 – BOD does not refer to the self-adaptive feature of the radio channel to cope with changes in the transmission quality (see § A1.2.5.1).	Yes. The scheduling service is provided for both downlink and uplink traffic. In order for the scheduler to make an efficient resource allocation and provide the desired QoS and data rate in the uplink, mobile stations must feedback accurate and timely information as to the traffic conditions and QoS requirements. To this end, multiple uplink bandwidth request mechanisms, such as bandwidth request through ranging channel, piggyback request and polling are provided to support uplink bandwidth requests. Frequency and time resource allocation in both downlink and uplink is on a per frame basis to duly react to the traffic and channel conditions. Additionally, the amount of resource in each allocation can range from one slot to the entire frame. Further information can be found in the IEEE 802.16 standard, Sections 6.3.6 Bandwidth Allocation and Request mechanism, 6.3.7.3 DL-MAP, 6.3.7.4 UL-MAP, and 8.4.4 Frame Structure.	
A1.2.32	Does the RTT support channel aggregation capability to achieve higher user bit rates?	No	
A1.3	Expected performances.		
A1.3.1	For terrestrial test environment only.		
A1.3.1.1	What is the achievable BER floor level (for voice)? NOTE 1 – The BER floor level is evaluated under the BER measuring conditions defined in Annex 2 using the data rates indicated in § 1 of Annex 2.	Coded BER floor is implementation-dependent but achievable floor is significantly below GoS requirements (10-3) within the specified ranges of tolerable delay spread (20 µs) and Doppler shifts (250Hz).	BER floor is not specified
A1.3.1.2	What is the achievable BER floor level (for data)? NOTE 1 – The BER floor level is evaluated under the measuring conditions defined in Annex 2 using the data rates indicated in § 1 of Annex 2.	Coded BER floor is implementation-dependent but achievable floor is significantly below GoS requirements (10-6) within the specified ranges of tolerable delay spread (20 µs) and Doppler shifts (250 Hz).	BER floor is not specified

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.3.1.3	What is the maximum tolerable delay spread (ns) to maintain the voice and data service quality requirements? NOTE 1 – The BER is an error floor level measured with the Doppler shift given in the BER measuring conditions of Annex 2.	The maximum specified range of delay spread (20 μ s in Vehicular B) can be tolerated without an equalizer.	
A1.3.1.4	What is the maximum tolerable Doppler shift (Hz) to maintain the voice and data service quality requirements? NOTE 1 – The BER is an error floor level measured with the delay spread given in the BER measuring conditions of Annex 2.	At least 500 Hz, based on the observation that Doppler frequency shows about 570 Hz for 250 km/h at 2.5 GHz	
A1.3.1.5	Capacity : the capacity of the radio transmission technology has to be evaluated assuming the deployment models described in Annex 2 and technical parameters from § A1.2.22 through § A1.2.23.2.		
A1.3.1.5 .1	What is the voice traffic capacity per cell (not per sector): provide the total traffic that can be supported by a single cell (E/MHz/cell) in a total available assigned non-contiguous bandwidth of 30 MHz (15 MHz forward/15 MHz reverse) for FDD mode or contiguous bandwidth of 30 MHz for TDD mode. Provide capacities for all penetration values defined in the deployment model for the test environment in Annex 2. The procedure to obtain this value is described in Annex 2. The capacity supported by not a standalone cell but a single cell within contiguous service area should be obtained here.	See Section 2.3 (of 8F/1079R1) for details Voice capacity (ITU Vehicular path loss model, Pedestrian B 3 channel model): - 90 Erlangs/MHz/cell for reuse 3, SIMO,10 MHz PUSC - 80 Erlangs/MHz/cell for reuse 3, SIMO, 5 MHz PUSC	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.3.1.5 .2	What is the information capacity per cell (not per sector): provide the total number of user-channel information bits which can be supported by a single cell (Mbit/s/MHz/cell) in a total available assigned non-contiguous bandwidth of 30 MHz (15 MHz forward/15 MHz reverse) for FDD mode or contiguous bandwidth of 30 MHz for TDD mode. Provide capacities for all penetration values defined in the deployment model for the test environment in Annex 2. The procedure to obtain this value is described in Annex 2. The capacity supported by not a standalone cell but a single cell within contiguous service area should be obtained here.	See reference 0 (of 8F/1079R1) for details : Data capacity (PUSC, ITU Vehicular, 60% Pedestrian B 3, 30% Vehicular A 30, 10% Vehicular A 120, DL:UL=28:9) SIMO: 10 MHz DL = 3.57 Mbps/MHz/cell UL = 1.59 Mbps/MHz/cell 5 MHz DL = 3.45 Mbps/MHz/cell UL = 1.6 Mbps/MHz/cell MIMO: 10 MHz DL = 5.52 Mbps/MHz/cell UL = 2.10 Mbps/MHz/cell - - Beamforming technology increases the spectral efficiency of the system.	
A1.3.1.6	Does the RTT support sectorization? If yes, provide for each sectorization scheme and the total number of user-channel information bits which can be supported by a single site (Mbit/s/MHz) (and the number of sectors) in a total available assigned non-contiguous bandwidth of 30 MHz (15 MHz forward/15 MHz reverse) in FDD mode or contiguous bandwidth of 30 MHz in TDD mode.	Yes, the RTT supports sectorization. The sectorization and frequency reuse schemes are implementation-dependent and consequently, so are the capacities achieved. The tri-sector scheme is the typical scenario with frequency reuse 1 or reuse 3.	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.3.1.7	Coverage efficiency : the coverage efficiency of the radio transmission technology has to be evaluated assuming the deployment models described in Annex 2.		
A1.3.1.7 .1	What is the base site coverage efficiency (km2/site) for the lowest traffic loading in the voice only deployment model? Lowest traffic loading means the lowest penetration case described in Annex 2.	See Link Budget in Section 2.3.4 (of 8F/1079R1)	
A1.3.1.7 .2	What is the base site coverage efficiency (km2/site) for the lowest traffic loading in the data only deployment model? Lowest traffic loading means the lowest penetration case described in Annex 2.	See Link Budget in Section 2.3.4 (of 8F/1079R1)	
A1.3.2	For satellite test environment only		
A1.3.2.1	What is the required C/N0 to achieve objective performance defined in Annex 2?		
A1.3.2.2	What are the Doppler compensation method and residual Doppler shift after compensation?		
A1.3.2.3	Capacity : the spectrum efficiency of the radio transmission technology has to be evaluated assuming the deployment models described in Annex 2.		
A1.3.2.3 .1	What is the voice information capacity per required RF bandwidth (bit/s/Hz)?		
A1.3.2.3 .2	What is the voice plus data information capacity per required RF bandwidth (bit/s/Hz)?		
A1.3.2.4	Normalized power efficiency : the power efficiency of the radio transmission technology has to be evaluated assuming the deployment models described in Annex 2.		
A1.3.2.4 .1	What is the supported information bit rate per required carrier power-to-noise density ratio for the given channel performance under the given interference conditions for voice?		
A1.3.2.4 .2	What is the supported information bit rate per required carrier power-to-noise density ratio for the given channel performance under the given interference conditions for voice plus data?		

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.3.3	Maximum user bit rate (for data) : specify the maximum user bit rate (kbit/s) available in the deployment models described in Annex 2.	The maximum bit rates are well above 20160 kbit/s. (DL/UL ratio = 2:1, PUSC, 64QAM, 5/6 coding rate)	Maximum user data rates for the different deployment models are not supplied
A1.3.4	What is the maximum range (m) between a user terminal and a BS (prior to hand-off, relay, etc.) under nominal traffic loading and link impairments as defined in Annex 2?	See Link Budget in Section 2.3 (of 8F/1079R1). The maximum range depends on the deployment and the QoS of a connection	Maximum range not supplied for the mandated deployment models
A1.3.5	Describe the capability for the use of repeaters.	Repeaters can be used. There is nothing in the technology that precludes the use of repeaters.	
A1.3.6	Antenna systems : fully describe the antenna systems that can be used and/or have to be used; characterize their impacts on systems performance, (terrestrial only); e.g., does the RTT have the capability for the use of: – remote antennas: describe whether and how remote antenna systems can be used to extend coverage to low traffic density areas; – distributed antennas: describe whether and how distributed antenna designs are used, and in which IMT-2000 test environments; – Smart antennas (e.g., switched beam, adaptive, etc.): describe how smart antennas can be used and what is their impact on system performance; – other antenna systems.	The air-interface does not place any restrictions on the types of antenna systems such as smart antenna technologies, including Beamforming, Transmit/Receive diversity and MIMO, as well as a combination of these like Beamforming plus MIMO. The uses of remote and distributed antennas are not precluded.	
A1.3.7	Delay (for voice)	Voice services are provided in the PS-domain with appropriate QoS setting (UGS, rtPS or ErtPS)	
A1.3.7.1	What is the radio transmission processing delay due to the overall process of channel coding, bit interleaving, framing, etc., not including source coding? This is given as transmitter delay from the input of the channel coder to the antenna plus the receiver delay from the antenna to the output of the channel decoder. Provide this information for each service being provided. In addition, a detailed description of how this parameter was calculated is required for both the uplink and the downlink.	The minimum delay is roughly 10ms assuming a 5ms TDD frame and the maximum is implementation and traffic load-dependent (scheduling metric, traffic load, buffer sizes, retransmission scheme etc)	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.3.7.2	What is the total estimated round trip delay (ms) to include both the processing delay, propagation delay (terrestrial only) and vocoder delay? Give the estimated delay associated with each of the key attributes described in Fig. 6 that make up the total delay provided.	Assuming a 20 ms vocoder, 5ms frame and ignoring queuing delay (typically <30ms), the RTD delay is approximately 60 ms	Specific vocoder delay scenarios are not supplied
A1.3.7.3	Does the proposed RTT need echo control?	Yes	
A1.3.8	What is the MOS level for the proposed codec for the relevant test environments given in Annex 2? Specify its absolute MOS value and its relative value with respect to the MOS value of ITU-T Recommendation G.711 (64 k PCM) and ITU-T Recommendation G.726 (32 k ADPCM). NOTE 1 – If a special voice coding algorithm is indispensable for the proposed RTT, the proponent should declare detail with its performance of the codec such as MOS level. (See § A1.2.19)	The RTT supports VoIP and is not limited to any particular codecs. Applications/implementations determine the choice of codec.	
A1.3.9	Description of the ability to sustain quality under certain extreme conditions.		
A1.3.9.1	System overload (terrestrial only) : characterize system behaviour and performance in such conditions for each test services in Annex 2, including potential impact on adjacent cells. Describe the effect on system performance in terms of blocking grade of service for the cases that the load on a particular cell is 125%, 150%, 175%, and 200% of full load. Also describe the effect of blocking on the immediate adjacent cells. Voice service is to be considered here. Full load means a traffic loading which results in 1% call blocking with the BER of 1 x 10–3 maintained.	The RTT provides many features that can be used to ensure optimal loading in the event of system overload. Among these are admission control, handover, rate adaptation, fractional frequency reuse and power control.	Blocking data not supplied for 125%, 150%, 175%, and 200% of full load
A1.3.9.2	Hardware failures : characterize system behaviour and performance in such conditions. Provide detailed explanation on any calculation.	This is implementation-dependent. The RTT does not preclude any means to build in redundancy or other reliability features.	
A1.3.9.3	Interference immunity : characterize system immunity or protection mechanisms against interference. What is the interference detection method? What is the interference avoidance method?	In addition to frequency reuse, and intelligent scheduling/RRM, the RTT's TDD OFDM interface is inherently robust against delay spread, suitable for multi-user detection and supports various smart antenna schemes. Also, the RTT does not preclude any means to cancel interference or to protect against interference	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.3.10	Characterize the adaptability of the proposed RTT to different and/or time-varying conditions (e.g. propagation, traffic, etc.) that are not considered in the above attributes of § A1.3.	The RTT supports modulation and coding adaptation, HARQ, power control and opportunistic scheduling	
A1.4	Technology design constraints		
A1.4.1	Frequency stability : provide transmission frequency stability (not oscillator stability) requirements of the carrier (include long term – 1 year – frequency stability requirements (ppm)).		
A1.4.1.1	For BS transmission (terrestrial component only).	BS frequency tolerance ≤ 2ppm of carrier frequency BS to BS frequency accuracy ≤ 1% of subcarrier spacing	
A1.4.1.2	For MS transmission.	MS to BS frequency synchronization tolerance ≤ 2% of the subcarrier spacing	
A1.4.2	Out-of-band and spurious emissions : specify the expected levels of base or satellite and mobile transmitter emissions outside the operating channel, as a function of frequency offset.	Base stations and terminals supporting this RTT will comply with local, regional, and international regulations for out of band and spurious emissions, wherever applicable. Similar to other IMT-2000 RTTs, terminals adhering to a single global mask will be used to provide global roaming.	Out of band and spurious emissions are not specified

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.4.3	Synchronisation requirements : describe RTT's timing requirements, e.g. – Is BS-to-BS or satellite land earth station (LES)-to-LES synchronisation required? Provide precise information, the type of synchronisation, i.e., synchronisation of carrier frequency, bit clock, spreading code or frame, and their accuracy. – Is BS-to-network synchronisation required? (terrestrial only). – State short-term frequency and timing accuracy of BS (or LES) transmit signal. – State source of external system reference and the accuracy required, if used at BS (or LES) (for example: derived from wireline network, or GPS receiver). – State free run accuracy of MS frequency and timing reference clock. – State base-to-base bit time alignment requirement over a 24 h period (µs).	BS-to-BS synchronisation : Yes. All BSs should be time and frequency synchronized to a common source signal. The common source signal is typically provided by GPS. BS-to-network synchronisation: No. BS-to-network synchronisation is not required. Frequency accuracy : BS frequency tolerance ≤ 2ppm of carrier frequency Timing accuracy ≤ 1usec compared to reference timing. Source of external system reference and the accuracy : GPS (the synchronizing reference shall be a 1 ps timing pulse and a 10 MHz frequency reference) Free run accuracy : MS frequency tolerance ≤ maximum 2% of the subcarrier spacing Timing tolerance: 25% of minimum guard interval((Tb/32)/4) The BS's timing accuracy is required to be 1 µs compared to reference timing when GPS locked.	
A1.4.4	Timing jitter : for BS (or LES) and MS give: – the maximum jitter on the transmit signal, – the maximum jitter tolerated on the received signal. Timing jitter is defined as r.m.s. value of the time variance normalized by symbol duration.	BS The BS's timing accuracy is required to be 1µsec compared to reference timing. MS MS Transmit symbol timing accuracy within ± (Tb/32)/4	
A1.4.5	Frequency synthesizer : what is the required step size, switched speed and frequency range of the frequency synthesizer of MSs?	Frequency step size : 200 and 250 KHz Switched speed : 200 µs Frequency range : 5, 10 MHz Start frequencies are various, depending on channel bandwidth and profile	
A1.4.6	Does the proposed system require capabilities of fixed networks not generally available today?	No	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.4.6.1	Describe the special requirements on the fixed networks for the handover procedure. Provide handover procedure to be employed in proposed RTT in detail.	The RTT supports handover and also provides means for expediting handover. Each base station broadcasts the information on the list of neighboring base stations and their channel information such as the operating center frequency, preamble index and synchronization periodically. The channel information in this broadcasting is used for a mobile station to synchronize with the neighboring base station. After a mobile station monitors the signal strength of a neighboring base station and seeks suitable base station(s) for handover, the mobile station or its serving base station can initiate handover by handover request message. But only the mobile station can transmit handover indication message to the its serving base station. After transmitting handover indication message, the mobile station stops monitoring the downlink frame of its serving base station and performs network re-entry to target base station. To reduce the handover latency further, the serving base station provides the target base station with network entry information on a mobile station to be handed over the target base station.	
A1.4.7	Fixed network feature transparency		
A1.4.7.1	Which service(s) of the standard set of ISDN bearer services can the proposed RTT pass to users without fixed network modification.	Convergence Sublayer in the proposed RTT supports interface to various fixed networks such as ATM, Ethernet, IP, and VLAN.	Question not answered as to ISDN services provided
A1.4.8	Characterize any radio resource control capabilities that exist for the provision of roaming between a private (e.g., closed user group) and a public IMT-2000 operating environment.	Handover between the different access networks is basically supported. Furthermore, Operator ID in the signalling during the handover enable mobile stations to recognize the operator of access network they are handed over to.	
A1.4.9	Describe the estimated fixed signalling overhead (e.g., broadcast control channel, power control messaging). Express this information as a percentage of the spectrum which is used for fixed signalling. Provide detailed explanation on your calculations.	The fixed MAP overhead is typically about 10% in a 10 MHz channel with a 5ms frame size.	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.4.10	Characterize the linear and broadband transmitter requirements for BS and MS (terrestrial only).	BS - Tx dynamic Range = 10 dB - Spectral flatness according to the following: ≤ ±2 dB for spectral lines from – Nused/4 to 1 and +1 to Nused/4 Within +2/-4 dB for spectral lines from – Nused/2 to Nused/4 and +Nused/4 to Nused/2 - Per sub-carrier flatness ≤ 0.1 dB - Power difference between adjacent subcarriers according to the following: Tx downlink radio frame shall be time-aligned with the 1pps timing pulse within 1 µsec - Tx relative constellation error according to the following: QPSK-1/2 ≤ -15.0 dB QPSK-3/4 ≤ -18.0 dB 16QAM-1/2 ≤ -20.5 dB 16QAM-3/4 ≤ -24.0 dB 64QAM-1/2 (if 64-QAM supported) ≤ -26.0 dB 64QAM-2/3 (if 64-QAM supported) ≤ -28.0 dB 64QAM-3/4 (if 64-QAM supported)≤ -30.0 dB	

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		MS - Tx dynamic Range = 45 dB - Tx power level min adjustment step = 1 dB - Tx power level min relative step accuracy = ± 0.5 dB - Spectral flatness according to the following: ≤ ±2 dB for spectral lines from –Nused/4 to –1 and +1 to Nused/4 Within +2/-4 dB for spectral lines from –Nused/2 to –Nused/4 and +Nused/4 to Nused/2 - Power difference between adjacent subcarriers ≤ 0.1 dB - Tx relative constellation error according to the following: QPSK-1/2 ≤ -15.0 dB QPSK-3/4 ≤ -18.0 dB 16QAM-1/2 ≤ -20.5 dB 16QAM-3/4 ≤ -24.0 dB	
A1.4.11	Are linear receivers required? Characterize the linearity requirements for the receivers for BS and MS (terrestrial only).	BS No. The PAPR of the proposed RTT is around 12dB, and which is not required a stringent linear receiver.	Receiver linearity requirements are not specified. What are the MS linearity requirements?

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.4.12	Specify the required dynamic range of receiver (terrestrial only).	BS Max input level on-channel reception tolerance = -45 dBm Max input level on-channel damage tolerance = -10 dBm MS Max input level on-channel reception tolerance = -30 dBm Max input level on-channel damage tolerance = 0 dBm BS and MS Max input level sensitivity (Distributed permutation of subcarriers) for 10 MHz case: -88.5 dBm - QPSK-1/2 -85.1 dBm - QPSK-3/4 -82.8 dBm - 16QAM-1/2 -78.7 dBm - 16QAM-3/4 -77.6 dBm - 64QAM-1/2 -74.5 dBm - 64QAM-2/3 -73.4 dBm - 64QAM-3/4 -71.5 dBm - 64QAM-5/6	

Index	Criteria and attribute	Proponents’ comments	Evaluator’s Comments
		Max input level sensitivity (Distributed permutation of subcarriers) for 5 MHz case: -91.5 dBm - QPSK-1/2 -88.1 dBm - QPSK-3/4 -85.8 dBm - 16QAM-1/2 -81.7 dBm - 16QAM-3/4 -80.6 dBm - 64QAM-1/2 -77.5 dBm - 64QAM-2/3 -76.4 dBm - 64QAM-3/4 -74.5 dBm - 64QAM-5/6 Sensitivity numbers are calculated based on assumption of repetition factor 1 and Distributed permutation of subcarriers.	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.4.13	What are the signal processing estimates for both the handportable and the BS? – MOPS (millions of operations per second) value of parts processed by DSP (digital signal processing), – gate counts excluding DSP, – ROM size requirements for DSP and gate counts (kbytes), – RAM size requirements for DSP and gate counts (kbytes). NOTE 1 – At a minimum the evaluation should review the signal processing estimates (MOPS, memory requirements, gate counts) required for demodulation, equalization, channel coding, error correction, diversity processing (including Rake receivers), adaptive antenna array processing, modulation, A-D and D-A converters and multiplexing as well as some IF and baseband filtering. For new technologies, there may be additional or alternative requirements (such as FFTs etc.). NOTE 2 – The signal processing estimates should be declared with the estimated condition such as assumed services, user bit rate and etc.	It is an implementation issue not covered by the description.	Signal processing estimates are not provided
A1.4.14	Dropped calls : describe how the RTT handles dropped calls. Does the proposed RTT utilize a transparent reconnect procedure – that is, the same as that employed for handoff?	No specific process to handle call dropping recovery is defined. However, mobile station can recover the connection after call dropping by means of the Idle mode re-entry procedure.	

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.4.15	Characterize the frequency planning requirements: – frequency reuse pattern: given the required C/I and the proposed technologies, specify the frequency cell reuse pattern (e.g. 3-cell, 7-cell, etc.) and, for terrestrial systems, the sectorization schemes assumed; – characterize the frequency management between different cell layers; – does the RTT use an interleaved frequency plan? – are there any frequency channels with particular planning requirements? – all other relevant requirements. NOTE 1 – The use of the second adjacent channel instead of the adjacent channel at a neighbouring cluster cell is called "interleaved frequency planning". If a proponent is going to employ an interleaved frequency plan, the proponent should state so in § A1.2.4 and complete § A1.2.15 with the protection ratio for both the adjacent and second adjacent channel.	The RTT supports frequency reuse configuration of 1 and 3. In order for MS to provide BS with a correct DL channel quality information, MS is required to properly measure CINR of preamble with considering the frequency reuse configuration: i.e. For frequency reuse of 3, consider the modulated subcarriers of the preamble only. For frequency reuse of 1, consider both the un-modulated and the modulated subcarriers of the preamble. There are 114 different preamble code sets in the proposed RTT to differentiate the cell ID and sector ID's per each sector. The RTT can use both the interleaved frequency plan and the non-interleaved frequency plan.	
A1.4.16	Describe the capability of the proposed RTT to facilitate the evolution of existing radio transmission technologies used in mobile telecommunication systems migrate toward this RTT. Provide detail any impact and constraint on evolution.		Question on evolution of existing technologies is not answered. Please provide an answer.
A1.4.17	Are there any special requirements for base site implementation? Are there any features which simplify implementation of base sites? (terrestrial only)	No	
A1.5	Information required for terrestrial link budget template Proponents should fulfil the link budget template given in Table 6 and answer the following questions.	see Section 2.3 (of 8F/1079R1)Link Budget	
A1.5.1	What is the BS noise figure (dB)?	4 dB used for Section 2.3 (of 8F/1079R1) Link Budget Max 8 dB Noise Figure is considered in RTT.	

Index	Criteria and attribute	Proponents’ comments	Evaluator’s Comments
A1.5.2	What is the MS noise figure (dB)?	7 dB see Section 2.3 (of 8F/1079R1)Link Budget Max 8 dB Noise Figure is considered in RTT for MS clients supporting multi band operation.	
A1.5.3	What is the BS antenna gain (dBi)?	15 dBi (see Section 2.3 (of 8F/1079R1)Link Budget)	
A1.5.4	What is the MS antenna gain (dBi)?	-1 dBi (see Section 2.3 (of 8F/1079R1)Link Budget)	
A1.5.5	What is the cable, connector and combiner losses (dB)?	0 dB (see Section 2.3 (of 8F/1079R1)Link Budget)	Cable and connector loss for BS is not specified
A1.5.6	What are the number of traffic channels per RF carrier?	Function of required QoS	
A1.5.7	What is the RTT operating point (BER/FER) for the required Eb/N0 in the link budget template?	1% FER	
A1.5.8	What is the ratio of intra-sector interference to sum of intra-sector interference and inter-sector interference within a cell (dB)?	Depends on environment and receiver implementation	
A1.5.9	What is the ratio of in-cell interference to total interference (dB)?	Negligible at low Doppler (<300 Hz) and depends on receiver implementation at high Doppler	
A1.5.10	What is the occupied bandwidth (99%) (Hz)?	Depends on nominal bandwidth, permutation scheme, and on the subchannelization. For the case considered in Section 2.3 (of 8F/1079R1) Link Budget, it is approximately 9.2 MHz on the downlink and 2.4 MHz on the uplink	
A1.5.11	What is the information rate (dBHz)?	Depends on service rate with the maximum subject to the channel bandwidth employed. (see Section 2.3 (of 8F/1079R1) Link Budget)	Maximum information rate is not supplied
A1.6	Satellite system configuration (applicable to satellite component only): Configuration details in this subsection are not to be considered as variables. They are for information only.		*Not Applicable*
A1.6.1	Configuration of satellite constellation		*Not Applicable*
A1.6.1.1	GSO, HEO, MEO, LEO or combination?		*Not Applicable*
A1.6.1.2	What is the range of height where satellites are in active communication?		*Not Applicable*

Index	Criteria and attribute	Proponents' comments	Evaluator's Comments
A1.6.1.3	What is the orbit inclination angle?		*Not Applicable*
A1.6.1.4	What are the number of orbit planes?		*Not Applicable*
A1.6.1.5	What are the number of satellites per orbit plane?		*Not Applicable*
A1.6.2	What is the configuration of spot beams/cell layout pattern?		*Not Applicable*
A1.6.3	What is the frequency reuse plan among spot beams?		*Not Applicable*
A1.6.4	What is the service link G/T of satellite beam (average, minimum)?		*Not Applicable*
A1.6.5	What is the service link saturation e.i.r.p. of each beam (average, minimum), when configured to support 'hot spot'?		*Not Applicable*
A1.6.6	What is the service link total saturation e.i.r.p. per satellite?		*Not Applicable*
A1.6.7	Satellite e.i.r.p. per RF carrier for satellite component.		*Not Applicable*
A1.6.7.1	What is the maximum peak e.i.r.p. transmitted per RF carrier?		*Not Applicable*
A1.6.7.2	What is the average e.i.r.p. transmitted per RF carrier?		*Not Applicable*
A1.6.8	What is the feeder link information?		*Not Applicable*
A1.6.9	What is the slot timing adjustment method (mainly applicable to TDMA system)?		*Not Applicable*
A1.6.10	What is the satellite diversity method, if applicable?		*Not Applicable*

Annex-2Summary of IMT-2000 Requirements and Objectives and Compliance Template

«editor's note: introductory material is copied from M.1225, is provided for completeness, and it is proposed that it be removed before filing report with TR-45, leaving just the tables and any supporting material from the evaluation group»

ATTACHMENT 4 to Circular-letter 8/LCCE/47

This attachment highlights the requirements and objectives for IMT-2000 that will be used in the evaluation of radio transmission technologies for IMT-2000. For the sake of brevity, the requirements and objectives are summarized in topical form and in some cases, several individual sections from the source Recommendation have been consolidated into one topic. (A complete listing of all existing Recommendations and Task Group 8/1 documents for IMT-2000 reviewed in preparing this summary is provided in Attachment 5 to this letter). **The reader is encouraged to use the source documents to assess whether a candidate set of radio transmission technologies (SRTT) meets the stated requirements and objectives.**

a) Introduction to IMT-2000

The concept of a small, light weight and convenient pocket communicator is a fundamental part of IMT-2000, and provides terminal mobility which is complementary to the personal mobility and service profile management provided by Universal Personal Telecommunication (UPT), under study in the Telecommunication Standardization Sector (ITU-T).

A number of different radio environments are involved in covering the range from very small indoor cells with high capacity all the way through large outdoor terrestrial cells and on to satellite coverage. A major focus of the ITU-R standards work on IMT-2000 is to maximize the commonality between the various radio interfaces involved in order to simplify the task of building multi-mode mobile terminals which may be needed to cover more than one operating environment.

An important part of the ITU-R studies on IMT-2000 is the potential for these new mobile radio technologies to provide cost effective and flexible access to the global telecommunications networks in developing countries and under-developed parts of developed countries.

The integrated terrestrial and satellite components of IMT-2000 are complementary in terms of service provision. Together they cover the wide range of user densities, service types, and available service sets which comprise IMT-2000. Each component has particular advantages and constraints.

The terrestrial component provides, economically, high quality telecommunication services typically to areas of high to very high user densities. The satellite component provides users with quality telecommunication services primarily on a virtually global coverage basis, and is most economic outside those areas covered by the terrestrial component. Additionally to providing this global coverage, the satellite component may, in more densely populated areas, precede and encourage later coverage by the terrestrial component.

IMT-2000 are third generation systems which aim to advance and unify the diverse systems we see in the mid 1990s into a radio infrastructure capable of offering a wide range of services around the year 2000 in many different environments. The key features and objectives of IMT-2000 as compared to pre-IMT-2000 (which refer to mobile services that are currently in service or will be introduced prior to IMT-2000), are as follows:

Global System

- a global standard promoting a high degree of commonality of design worldwide while incorporating a variety of systems;
- use of a small pocket terminal worldwide, but also the accommodation of a variety of other terminal types;

- bigger marketplace leading to lower costs;
- worldwide common frequency band;
- worldwide roaming based on terminal mobility;
- worldwide, off-the-shelf compatible equipment.

New Services and Capabilities

- provision of capability which enables new voice and data services which are significantly more advanced than pre-IMT-2000 technologies;
- availability to mobile users of a range of voice and non-voice services, including packet data and multimedia services;
- higher service quality, in particular voice;
  - high quality and integrity, comparable to the fixed network;
- significantly higher user bit rate capability;
- flexible radio bearer;
- the capability to provide bandwidth on demand supporting a wide range of data rates, from simple low rate paging messages through voice to high rates associated with video or file transfer;
- support for asymmetrical data capabilities which require high rates in one direction but much lower rates in the other;
- improved security;
- improved ease of operation;
- intelligent network (IN) based service creation and service profile management based on ITU-T Q.1200-series of Recommendations;
- coherent systems management based on ITU-T M.3000-series of Recommendations.

Evolution and Migration

- flexibility for evolution of systems, and migration of users, both from pre-IMT-2000 and evolution within IMT-2000;
- compatibility of services within IMT-2000 and with the fixed telecommunications network (e.g., PSTN/ISDN);
- provision of a framework for the continuing expansion of mobile network services and access to services and facilities of the fixed network;
- an open architecture which will permit easy introduction of advances in technology and of different applications;
- ability to coexist and interwork with pre-IMT-2000.

Flexibility: Multi-Environment Capabilities

- accommodation of a maximum level of interworking between networks of different types to provide customers with greater coverage, seamless roaming and consistency of services;
- integrated satellite/terrestrial networks;
- provision of services by more than one network in any coverage area;
- provision of these services over a wide range of user densities and coverage areas;

- provision of services to both mobile and fixed users in urban, rural and remote regions;
- wider range of operating environments, including aeronautical and maritime;
- a modular structure which will allow the system to start from as small and simple a configuration as possible and grow as needed, in size and complexity;
- caters to needs of developing countries;
- flexibility to utilize adaptive software downloadable terminals to support multiband and multi-environment capabilities;
- key parameters of bandwidth, transmission quality and delay can be selected, negotiated, mixed and matched by the requirements of the service according to the instantaneous capability of the radio channel;
- better (e.g., more efficient) use of the radio spectrum than pre-IMT-2000 consistent with providing services at acceptable costs, taking into account their differing demands for data rates, symmetry, channel quality, and delay.

IMT-2000 supports a wide range of services based on those of the fixed telecommunication network and those specific to mobile users. IMT-2000 users will in most circumstances not notice the fact that a radio link is used to connect their terminal to the world's telecommunication network.

Services range from basic wide area paging, through voice telephony (probably the prime requirement of the personal terminal), digital data services, to audio and visual communications. One of the overall service objectives of IMT-2000 is to enable the provision of simultaneous voice, data and video (i.e. multimedia). Requirements for the radio transmission technologies must therefore take into account the support of multimedia services. The actual services obtained by the user will depend on the terminal capabilities, the set of services subscribed to, and the services set provided by the relevant network operator. Services requiring high transmission rates are most likely to be found in high density areas, such as business centres.

The different service aspects and service environments for IMT-2000, and the importance of making the best use possible of the limited radio spectrum, call for a very flexible solution to the radio interface and its interworking with the transmission technology used in the fixed networks (e.g. "resource on demand" in a dynamic way, within fractions of a second). Broadband ISDN (B-ISDN) technologies will also be at an advanced stage when IMT-2000 is introduced. Therefore, B-ISDN access and interworking and the flexibility of Asynchronous Transfer Mode (ATM) transmission technology are taken into account and efficient interworking with ATM is defined. IMT-2000 also need to be interconnected to many earlier analogue and digital fixed networks.

Work on IMT-2000 has already aided the development of second generation systems and it will provide significant advances beyond them. These include high quality advanced personalized telecommunications, support of worldwide roaming, a wide range of services and radio environments, highly efficient use of radio and network resources and cost-efficient overall network operation.

b) IMT-2000 Requirements and Objectives Compliance Template

The following tables divide the summary of the requirements and objectives for IMT-2000, which will be used in the evaluation of radio transmission technologies, into three categories. Table 1 provides technical requirements and objectives for which a performance metric has been quantified. Table 2 provides generic requirements and objectives which specify functionality or a qualitative performance attribute. Requirements and objectives which require a subjective assessment or for which additional specificity is required to determine conformance are provided in Table 3.

Any of these requirements and objectives may apply to either the terrestrial or satellite component of IMT-2000, or both. The tables indicate whether each item is an objective or a requirement, as well as the source ITU Recommendations, which should be used for assessing whether the stated requirements and objectives are met.

Those who respond with a proposal should indicate whether the candidate set of radio transmission technologies (SRTT) meets the IMT-2000/FPLMTS requirement or objective by checking the appropriate box in Tables 1 and 2. **Comments may be attached as an aid in providing additional information regarding the SRTT performance. With respect to the subjective requirements or objectives in Table 3, descriptive information should be provided explaining how the candidate SRTT supports the concept specified in the Recommendation.**

TABLE 1

Technical Requirements and Objectives Relevant to the Evaluation of Candidate Radio Transmission Technologies

IMT-2000 Item Description	Obj /Req	Source	Proponents Meets?[*]	Evaluators Meets?	Proponents' Comments	Evaluators' Comments
Voice and data performance requirements						
One-way end to end delay less than 40 ms[**]	Req	G.174, § 7.5	☑ Yes ☐ No	☐ Yes ☐ No		
For mobile videotelephone services, the IMT-2000 terrestrial component should operate so that the maximum overall delay (as defined in ITU-T Rec. F.720) should not exceed 400 ms, with the one way delay of the transmission path not exceeding 150 ms	Req	Suppl. F.720, F.723, G.114	☑ Yes ☐ No	☐ Yes ☐ No		
Speech quality should be maintained during 3% frame erasures over any 10 second period. The speech quality criterion is a reduction of 0.5 mean opinion score unit (5 point scale) relative to the error-free condition (G.726 at 32 kb/s)	Req	G.174, § 7.11 & M.1079 § 7.3.1	☑ Yes ☐ No	☐ Yes ☐ No		
DTMF signal reliable transport (for PSTN is typically less than one DTMF errored signal in 10^4)	Req	G.174, § 7.11 & M.1079 § 7.3.1	☑ Yes ☐ No	☐ Yes ☐ No		
Voiceband data support including G3 facsimile	Req	M.1079 § 7.2.2	☑ Yes ☐ No	☐ Yes ☐ No		
Support packet switched data services as well as circuit switched data; requirements for data performance given in ITU-T G.174	Req	M.1034-1 § 10.1.5, 10.2.4	☑ Yes ☑ No	☐ Yes ☐ No	See note [1]	
Radio interfaces and subsystems, network related performance requirements						

* Explanation is requested when the candidate SRTT checks the No box.

* * The source Recommendation suggests numerical limits for the overall delay, but provides no guidance about the measurement techniques. Moreover there is an apparent inconsistency with ITU-T Recommendation G.114, where the value of 40 ms is indicated as the 'objective' value. These issues are addressed in a liaison statement sent to the relevant ITU groups. Until TG 8/1 receives a response and resolves this issue, proponents should submit candidates providing delay values using the methodology specified in Recommendation ITU-R M.1225.

1 The RTT is purely a Packet switch data technology. Circuit switched data is not supported. But will support seamless interworking with circuit switched systems using media gateways and support for QoS classes.

IMT-2000 Item Description	Obj /Req	Source	Proponents Meets?	Evaluators Meets?	Proponents' Comments	Evaluators' Comments
Network interworking with PSTN and ISDN in accordance with Q.1031 and Q.1032	Req	M.687-2 § 5.4	☑ Yes ☐ No	☐ Yes ☐ No		
Meet spectral efficiency and radio channel performance requirements of M.1079	Req	M.1034 – 1§ 11.3.3/4	☑ Yes ☐ No	☐ Yes ☐ No		
Provide phased approach with data rates up to 2 Mbit/s in phase 1	Obj	M.687-2, § 1.1.6	☑ Yes ☐ No	☐ Yes ☐ No		
Maintain bearer channel bit-count integrity (e.g. synchronous data services and many encryption techniques)	Obj	M.1034-1, § 10.2.5	☑ Yes ☐ No	☐ Yes ☐ No		
Support for different cell sizes, for example - Mega cell Radius ~100-500 km Macro cell Radius 35 km, Speed 500 km/h Micro cell Radius 1 km, Speed 100 km/h Pico cell Radius 50m, Speed 10 km/h	Obj	M.1035 § 10.1	☑ Yes ☐ No	☐ Yes ☐ No		
Application of IMT-2000 for fixed services and developing countries						
Circuit noise - idle noise levels in 99% of the time about 100 pWp	Obj	M.819-2, § 10.3	☑ Yes ☐ No	☐ Yes ☐ No		
Error performance - as specified in ITU-R F.697	Obj	M.819-2, § 10.4	☑ Yes ☐ No	☐ Yes ☐ No		
Grade of service better than 1%	Obj	M.819-2, § 10.5	☑ Yes ☐ No	☐ Yes ☐ No		

TABLE 2

Generic Requirements and Objectives Relevant to the Evaluation of Candidate Radio Transmission Technologies

IMT-2000 Item Description	Obj /Req	Source	Proponents Meets?*	Evaluators Meets?	Proponents' Comments	Evaluators' Comments
Radio interfaces and subsystems, network related performance requirements						
Security comparable to that of PSTN/ISDN	Obj	M.687-2 § 4.4	☑ Yes ☐ No	☐ Yes ☐ No		
Support mobility, interactive and distribution services	Req	M.816-1 § 6	☑ Yes ☐ No	☐ Yes ☐ No		
Support UPT and maintain common presentation to users	Obj	M.816 § 4	☐ Yes ☐ No	☐ Yes ☐ No	*No assessment supplied*	Please provide comments on the support of UPT.
Voice quality comparable to the fixed network (applies to both mobile and fixed service)	Req	M.819-2 Table 1, M.1079 § 7.1	☑ Yes ☐ No	☐ Yes ☐ No		
Support encryption and maintain encryption when roaming and during handover	Req	M.1034-1 § 10.3.1/2	☑ Yes ☐ No	☐ Yes ☐ No		
Network access indication similar to PSTN (e.g. dialtone)	Req	M.1034-1 § 10.1.9	☑ Yes ☐ No	☐ Yes ☐ No	See note [2]	
Meet safety requirements and legislation	Req	M.1034-1 § 10.6.1	☑ Yes ☐ No	☐ Yes ☐ No		
Meet appropriate EMC regulations	Req	M.1034-1 § 10.6.2	☑ Yes ☐ No	☐ Yes ☐ No		
Support multiple public/private/ residential IMT-2000 operators in the same locality	Req	M.1034-1 § 11.1.2	☑ Yes ☐ No	☐ Yes ☐ No		
Support multiple mobile station types	Req	M.1034-1 § 11.1.4	☑ Yes ☐ No	☐ Yes ☐ No		
Support roaming between IMT-2000 operators and between different IMT-2000 radio interfaces/ environments	Req	M.1034-1 § 11.2.2	☑ Yes ☐ No	☐ Yes ☐ No		
Support seamless handover between different IMT-2000 environments such that service quality is maintained and signalling is minimized	Req	M.1034-1 § 11.2.3	☑ Yes ☐ No	☐ Yes ☐ No		

* Explanation is requested when the candidate SRTT checks the No box.

2 These are application specific and not mandated by the RTT. But applications may support this.

IMT-2000 Item Description	Obj /Req	Source	Proponents Meets?	Evaluators Meets?	Proponents' Comments	Evaluators' Comments
Simultaneously support multiple cell sizes with flexible base location, support use of repeaters and umbrella cells as well as deployment in low capacity areas	Req	M.1034-1 § 11.2.5.1/2/3/6	☑ Yes ☐ No	☐ Yes ☐ No		
Support multiple operator coexistence in a geographic area	Req	M.1034-1 § 11.2.5.4	☑ Yes ☐ No	☐ Yes ☐ No		
Support different spectrum and flexible band sharing in different countries including flexible spectrum sharing between different IMT-2000 operators (see M.1036)	Req	M.1034-1 § 11.2.8.1/2	☑ Yes ☐ No	☐ Yes ☐ No		
Support mechanisms for minimizing power and interference between mobile and base stations	Req	M.1034-1 § 11.2.8.3	☑ Yes ☐ No	☐ Yes ☐ No		
Support various cell types dependent on environment (M.1035 § 10.1)	Req	M.1034-1 § 11.2.9	☑ Yes ☐ No	☐ Yes ☐ No		
High resistance to multipath effects	Req	M.1034-1 § 11.3.1	☑ Yes ☐ No	☐ Yes ☐ No		
Support appropriate vehicle speeds (as per § 7) NOTE: applicable to both terrestrial and satellite proposals	Req	M.1034-1 § 11.3.2	☑ Yes ☐ No	☐ Yes ☐ No		
Support possibility of equipment from different vendors	Req	M.1034-1 § 11.1.3	☑ Yes ☐ No	☐ Yes ☐ No		
Offer operational reliability as least as good as 2nd generation mobile systems	Req	M.1034-1 § 11.3.5	☑ Yes ☐ No	☐ Yes ☐ No		
Ability to use terminal to access services in more than one environment, desirable to access services from one terminal in all environments	Obj	M.1035 § 7.1	☑ Yes ☐ No	☐ Yes ☐ No		
End-to-end quality during handover comparable to fixed services	Obj	M.1034-1 § 11.2.3.4	☑ Yes ☐ No	☐ Yes ☐ No		
Support multiple operator networks in a geographic area without requiring time synchronization	Obj		☑ Yes ☐ No	☐ Yes ☐ No		

IMT-2000 Item Description	Obj /Req	Source	Proponents Meets?	Evaluators Meets?	Proponents' Comments	Evaluators' Comments
Layer 3 contains functions such as call control, mobility management and radio resource management some of which are radio dependent. It is desirable to maintain layer 3 radio transmission independent as far as possible	Obj	M.1035 § 8	☑ Yes ☐ No	☐ Yes ☐ No		
Desirable that transmission quality requirements from the upper layer to physical layers be common for all services	Obj	M.1035 § 8.1	☑ Yes ☐ No	☐ Yes ☐ No		
The link access control layer should as far as possible not contain radio transmission dependent functions	Obj	M.1035 § 8.3	☑ Yes ☐ No	☐ Yes ☐ No		
Traffic channels should offer a functionally equivalent capability to the ISDN B-channels	Obj	M.1035 § 9.3.2	☑ Yes ☐ No	☐ Yes ☐ No		
Continually measure the radio link quality on forward and reverse channels	Obj	M.1035 § 11.1	☑ Yes ☐ No	☐ Yes ☐ No		
Facilitate the implementation and use of terminal battery saving techniques	Obj	M.1035 § 12.5	☑ Yes ☐ No	☐ Yes ☐ No		
Accommodate various types of traffic and traffic mixes	Obj	M.1036 § 1.10	☑ Yes ☐ No	☐ Yes ☐ No		
Application of IMT-2000 for fixed services and developing countries						
Repeaters for covering long distances between terminals and base stations, small rural exchanges with wireless trunks etc.	Req	M.819-2 Table 1	☑ Yes ☐ No	☐ Yes ☐ No		
Withstand rugged outdoor environment with wide temperature and humidity variations	Req	M.819-2 Table 1	☑ Yes ☐ No	☐ Yes ☐ No		
Provision of service to fixed users in either rural or urban areas	Obj	M.819-2 § 4.1	☑ Yes ☐ No	☐ Yes ☐ No		
Coverage for large cells (terrestrial)	Obj	M.819-2 § 7.2	☑ Yes ☐ No	☐ Yes ☐ No		
Support for higher encoding bit rates for remote areas	Obj	M.819-2 § 10.1	☑ Yes ☐ No	☐ Yes ☐ No		
Additional satellite- component specific requirements and objectives						

IMT-2000 Item Description	Obj /Req	Source	Proponents Meets?	Evaluators Meets?	Proponents' Comments	Evaluators' Comments
Links between the terrestrial and satellite control elements for handover and exchange of other information	Req	M.818-1 § 3.0	☐ Yes ☐ No	☐ Yes ☐ No	*Not Applicable*	*Not Applicable*
Take account for constraints for sharing frequency bands with other services (WARC-92)	Obj	M.818-1 § 4.0	☐ Yes ☐ No	☐ Yes ☐ No	*Not Applicable*	*Not Applicable*
Compatible multiple access schemes for terrestrial and satellite components	Obj	M.818-1 § 6.0	☐ Yes ☐ No	☐ Yes ☐ No	*Not Applicable*	*Not Applicable*
Service should be comparable quality to terrestrial component as far as possible	Obj	M.818-1 § 10.0	☐ Yes ☐ No	☐ Yes ☐ No	*Not Applicable*	*Not Applicable*
Use of satellites to serve large cells for fixed users	Obj	M.819-2 § 7.1	☐ Yes ☐ No	☐ Yes ☐ No	*Not Applicable*	*Not Applicable*
Key features (e.g. coverage, optimization, number of systems)	Obj	M.1167 § 6.1	☐ Yes ☐ No	☐ Yes ☐ No	*Not Applicable*	*Not Applicable*
Radio interface general considerations	Req	M.1167 § 8.1.1	☐ Yes ☐ No	☐ Yes ☐ No	*Not Applicable*	*Not Applicable*
Doppler effects	Req	M.1167 § 8.1.2	☐ Yes ☐ No	☐ Yes ☐ No	*Not Applicable*	*Not Applicable*

TABLE 3

Subjective Requirements and Objectives Relevant to the Evaluation of Candidate Radio Transmission Technologies*

IMT-2000 Item Description	Obj /Req	Source	**Proponents' Comments**	**Evaluators' Comments**
Fixed Service - Power consumption as low as possible for solar and other sources	Req	M.819-2 Table 1	These are implementation dependent and are not restricted by the RTT definition	
Minimize number of radio interfaces and radio sub-system complexity, maximize commonality (M.1035 § 7.1)	Req	M.1034-1 § 11.2.1	Yes	
Minimize need for special interworking functions	Req	M.1034-1 § 11.2.4	Yes. Interworking functions are only needed when interfacing to non-IP networks.	
Minimum of frequency planning and inter-network coordination and simple resource management under time-varying traffic	Req	M.1034-1 § 11.2.6	Yes	
Support for traffic growth, phased functionality, new services or technology evolution	Req	M.1034-1 § 11.2.7	Yes	
Facilitate the use of appropriate diversity techniques avoiding significant complexity if possible	Req	M.1034-1 § 11.2.10	Yes	
Maximize operational flexibility	Req	M.1034-1 § 11.2.11	Yes	
Designed for acceptable technological risk and minimal impact from faults	Req	M.1034-1 § 11.2.12	Yes	
When several cell types are available, select the cell that is the most cost and capacity efficient	Obj	M.1034-1 §[9.2] M.1035 § 10.3.3	Yes	
Minimize terminal costs, size and power consumption, where appropriate and consistent with other requirements	Obj	M.1036 § 2.1.12	Yes	

* Descriptive information should be provided explaining how the candidate SRTT supports the concept specified in the Recommendation.

Annex-3Detailed evaluation procedures

«editor's note: introductory material is copied from M.1225, is provided for completeness, and it is proposed that it be removed before filing report with TR-45, leaving just the table and any supporting material from the evaluation group»

ANNEX 3 of M.1225

a) Introduction

This Annex lists technical attributes which should be considered for the evaluation of RTTs against each of the criteria and gives indication on what possible impact they may have upon the different criteria. Other information submitted based on the template in Annex 1, or additionally relevant information, may be considered during the evaluation. The evaluation described in this Annex shall be done on the basis of the deployment models in Annex 2. RTT performance evaluation is to be based on a common set of verifiable parameter assumptions for all evaluation criteria for each test environment; if conditions change the technology descriptions should explain it. This Annex identifies which attributes can be described qualitatively (q) and quantitatively (Q).

When more than one candidate RTT is evaluated, it is useful to provide evaluation summaries for each evaluation criteria. A criteria evaluation summary may be difficult to make when both qualitative and quantitative attributes must be considered and when each technical attribute may have different relative importance with the overall evaluation criteria.

To facilitate such criteria evaluation summaries, this Annex identifies the importance or relative ranking of the various technical attributes within each evaluation criteria by giving a grouping G1 (most important), G2, G3, G4 (least important). Ranking of some attributes may be different for different test environments, in particular for the satellite environment. These rankings are based upon current anticipated market needs within some countries. It is recognized that the market needs may differ in the various countries in which IMT-2000 may be deployed and that they may also change during the time in which RTTs are being evaluated. It is also recognized that some new technical attributes or important considerations may be identified during the evaluation procedure that could impact any evaluation criteria summary. As such, evaluation groups may, if appropriate, modify the groupings of technical attributes, or add new attributes or considerations, in determining a criteria evaluation summary. Therefore, all evaluation groups are requested to include in their evaluation reports, information of the criteria evaluation summaries including the relative importance which was placed on each technical attribute and any other considerations that affected the summaries.

The evaluation methodology is discussed in § 9.

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.1	Spectrum efficiency The following entries are considered in the evaluation of spectrum efficiency:					
A3.1.1	For terrestrial environment					
A3.1.1.1	Voice traffic capacity (E/MHz/cell) in a total available assigned non-contiguous bandwidth of 30 MHz (15 MHz forward/15 MHz reverse) for FDD mode or contiguous bandwidth of 30 MHz for TDD mode. This metric must be used for a common generic continuous voice bearer with characteristics 8 kbit/s data rate and an average BER 1 ´ 10^{-3} as well as any other voice bearer included in the proposal which meets the quality requirements (assuming 50% voice activity detection (VAD) if it is used). For comparison purposes, all measures should assume the use of the deployment models in Annex 2, including a 1% call blocking. The descriptions should be consistent with the descriptions under criterion § 6.1.7 – Coverage/power efficiency. Any other assumptions and the background for the calculation should be provided, including details of any optional speech codecs being considered.	Q and q	G1	A1.3.1.5.1	TDD mode Voice capacity using VoIP: -90 Erlangs/MHz/cell for reuse 3, SIMO, 10 MHz PUSC Subchannelization -80 Erlangs/MHz/cell for reuse 3, SIMO, 5 MHz PUSC Subchannelization Assumptions: -ITU vehicular path loss model -Pedestrian B3 channel model	8F/1079R1, §2.3.1.1, step 2 picks a SINR at random. How is the range and distribution of the random values determined to ensure that it reflects path loss, shadowing, and interference? This simulation appears to mix two environments – is it reasonable to use ITU Pedestrian-B at step 3 of §2.3.1.1, yet use vehicular path loss and antenna height in §2.2.1.2? *«editor's note: check whether channel models are being used correctly»* §2.3.1.2 lists three codecs. Are all three used in the simulation? What is the distribution among users?

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.1.1.2	Information capacity (Mbit/s/MHz/cell) in a total available assigned non-contiguous bandwidth of 30 MHz (15 MHz forward/15 MHz reverse) for FDD mode or contiguous bandwidth of 30 MHz for TDD mode. The information capacity is to be calculated for each test service or traffic mix for the appropriate test environments. This is the only measure that would be used in the case of multimedia, or for classes of services using multiple speech coding bit rates. Information capacity is the instantaneous aggregate user bit rate of all active users over all channels within the system on a per cell basis. If the user traffic (voice and/or data) is asymmetric and the system can take advantage of this characteristic to increase capacity, it should be described qualitatively for the purposes of evaluation.	Q and q	G1	A1.3.1.5.2	For the packet data bearer (UDD) service: Data capacity: -DL SIMO 5MHz= 3.45 Mbit/s/MHz/cell -DL SIMO 10MHz = 3.57 Mbit/s/MHz/cell -UL SIMO 5MHz = 1.6 Mbit/s/MHz/cell -DL MIMO 10MHz= 5.52 Mbit/s/MHz/cell -UL SIMO 10MHz= 1.59 Mbit/s/MHz/cell -UL MIMO 10MHz= 2.1 Mbit/s/MHz/cell Assumptions: - PUSC, ITU vehicular, 60% Pedestrian B 3, 30% Vehicular A 30, 10% Vehicular A 120, -DL:UL=28:9 (payload only)	8F/1079R1, Table 18 states channel estimation is assumed to be ideal. This is not practical, particularly when the delay spread exceeds the period of the cyclic prefix, 11.4µs. It is difficult to obtain meaningful channel estimates for channels whose delay spread exceeds the cyclic prefix interval, see for example: 3GPP TSG-RAN-1, "Link Level Simulation Results for OFDM", Tdoc R1-030780, Meeting #33, New York, August 25-29, 2003 What is a practical estimate of information capacity?
A3.1.2	For satellite environment These values (§ A3.1.2.1 and A3.1.2.2) assume the use of the simulation conditions in Annex 2. The first definition is valuable for comparing systems with identical user channel rates. The second definition is valuable for comparing systems with different voice and data channel rates.					
A3.1.2.1	Voice information capacity per required RF bandwidth (bit/s/Hz)	Q	G1	A1.3.2.3.1	NA	*Not Applicable*
A3.1.2.2	Voice plus data information capacity per required RF bandwidth (bit/s/Hz)	Q	G1	A1.3.2.3.2	NA	*Not Applicable*

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.2	Technology complexity – Effect on cost of installation and operation The considerations under criterion § 6.1.2 – Technology complexity apply only to the infrastructure, including BSs (the handportable performance is considered elsewhere).					
A3.2.1	Need for echo control The need for echo control is affected by the round trip delay, which is calculated as shown in Fig. 6. Referring to Fig. 6, consider the round trip delay with the vocoder (D1, ms) and also without that contributed by the vocoder (D2, ms). NOTE 1 – The delay of the codec should be that specified by ITU-T for the common generic voice bearer and if there are any proposals for optional codecs include the information about those also.	Q	G4	A1.3.7.2 A1.3.7.3	Echo control is needed for voice applications. The voice delay is also dependent on the codec used. Selection of the codec is implementation dependent and no specific codec is mandated. Echo control is used on the MS and also optionally on a need basis at the BS or Gateways. The performance characteristics meet the delay requirements outlined in ITU-R M.1079.	
A3.2.2	Transmitter power and system linearity requirements NOTE 1 – Satellite e.i.r.p. is not suitable for evaluation and comparison of RTTs because it depends very much on satellite orbit. The RTT attributes in this section impact system cost and complexity, with the resultant desirable effects of improving overall performance in other evaluation criteria. They are as follows.					
A3.2.2.1	Peak transmitter/carrier (P_b) power (not applicable to satellite)	Q	G1	A1.2.16.2.1	This is not limited by RTT but rather by regulations for the specific RF bands. Mobile Station @ 2.5GHz 23 dBm EIRP (Power class I, QPSK, Refer to Section A3.2.2.2)	Peak Transmitter powers are not supplied (is to be the same as used in link budgets)
	Peak transmitter power for the BS should be considered because lower peak power contributes to lower cost. Note that P_b may vary with test environment application. This is the same peak transmitter power assumed in Annex 2, link budget template (Table 6).				This is not limited by RTT but rather by regulations for the specific RF bands.	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.2.2.2	Broadband power amplifier (PA) (not applicable to satellite) Is a broadband power amplifier used or required? If so, what are the peak and average transmitted power requirements into the antenna as measured in watts.	Q	G1	A1.4.10 A1.2.16.2.1 A1.2.16.2.2 A1.5.5 A1.2.5	A broadband power amplifier is required. Tx Power is not limited by RTT but by regulations. <u>BS</u> Tx dynamic range = 10 dB Spectral flatness as per conditions in A.1.4.10 Peak Tx power on BS is limited only by regulations and not by the RTT. <u>MS</u> Tx dynamic range = 45 dB Spectral flatness as per conditions in A.1.4.10 4 power classes are supported as shown below: Peak Transmit power (dBm) for 16QAM 1. 18 <= Ptx,max < 21 2. 21 <= Ptx,max < 25 3. 25 <= Ptx,max < 30 4. 30 <= Ptx,max Peak Transmit power (dBm) for QPSK 1. 20 <= Ptx,max < 23 2. 23 <= Ptx,max < 27 3. 27 <= Ptx,max < 30 4. 30 <= Ptx,max	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.2.2.3	Linear base transmitter and broadband amplifier requirements (not applicable to satellite)					
A3.2.2.3.1	Adjacent channel splatter/emission and intermodulation affect system capacity and performance. Describe these requirements and the linearity and filtering of the base transmitter and broadband PA required to achieve them.	q	G3	A1.4.2 A1.4.10	Base stations and terminals supporting this RTT will comply with local, regional, and international regulations for out of band and spurious emissions, wherever applicable.	Adjacent channel emission is not supplied. Please answer the question and provide spectral emissions.
A3.2.2.3.2	Also state the base transmitter and broadband PA (if one is used) peak to average transmitter output power, as a higher ratio requires greater linearity, heat dissipation and cost.	Q and q	G2	A1.4.10 A1.2.16.2.1 A1.2.16.2.2	These are implementation dependent. The PAPR of the proposed RTT is around 12dB	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.2.2.4	Receiver linearity requirements (not applicable to satellite) Is BS receiver linearity required? If so, state the receiver dynamic range required and the impact of signal input variation exceeding this range, e.g., loss of sensitivity and blocking.	q	G4	A1.4.11 A1.4.12	BS Max input level on-channel reception tolerance = -45 dBm Max input level on-channel damage tolerance = -10 dBm MS Max input level on-channel reception tolerance = -30 dBm Max input level on-channel damage tolerance = 0 dBmBS/MS BS and MS Max input level sensitivity (Distributed permutation of subcarriers) for 10 MHz case: -88.5 dBm - QPSK-1/2 -85.1 dBm - QPSK-3/4 -82.8 dBm - 16QAM-1/2 -78.7 dBm - 16QAM-3/4 -77.6 dBm - 64QAM-1/2 -74.5 dBm - 64QAM-2/3 -73.4 dBm - 64QAM-3/4 -71.5 dBm - 64QAM-5/6 Max input level sensitivity (Distributed permutation of subcarriers) for 5 MHz case: -91.5 dBm - QPSK-1/2 -88.1 dBm - QPSK-3/4 -85.8 dBm - 16QAM-1/2	

<table>
<tr><th>Index</th><th>Criteria and attributes</th><th>Q
or
q</th><th>Gn</th><th>Related attributes in Annex 1</th><th>Proponents Comment</th><th>Evaluators Comments</th></tr>
<tr><td>A3.2.3</td><td>Power control characteristics (not applicable to satellite)

Does the proposed RTT utilize transmitter power control? If so, is it used in both forward and reverse links? State the power control range, step size (dB) and required accuracy, number of possible step sizes and number of power controls per second, which are concerned with BS technology complexity.</td><td>Q
and
q</td><td>G4</td><td>A1.2.22
A1.2.22.1
A1.2.22.2
A1.2.22.3
A1.2.22.4
A1.2.22.5</td><td>Open loop and closed loop transmitter power control methods are used.

Power control is done on the DL as well as the UL.

Power control step size is variable ranging from 0.25 dB to 32 dB. An 8-bit signed integer in power control information element indicates the power control step size in 0.25 dB units. Normally implemented in 1 dB increments.

The power control cycle of closed-loop or open-loop power control is dependent on the rate of power control information element transmission, but less than 200 Hz.

The accuracy for power level control can vary from

± 0.5 dB to ± 2 dB depending on the power control step size.

Single step size m | Required relative accuracy

|m| = 1dB| ± 0.5 dB

|m| = 2dB|± 1 dB

|m| = 3dB|± 1.5 dB

4dB <|m|< = 10 dB|± 2 dB

Two exception points of at least 10 dB apart are allowed over the 45 dB range, where in these two points an accuracy of up to ± 2 dB is allowed for any size step.

The minimum power control dynamic range is 45 dB.</td><td></td></tr>
</table>

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.2.4	Transmitter/receiver isolation requirement (not applicable to satellite) If FDD is used, specify the noted requirement and how it is achieved.	q	G3	A1.2.2 A1.2.2.2 A1.2.2.1	Not Applicable as it is TDD.	Transmitter/Receiver isolation requirement is not specified
A3.2.5	Digital signal processing requirements					
A3.2.5.1	Digital signal processing can be a significant proportion of the hardware for some radio interface proposals. It can contribute to the cost, size, weight and power consumption of the BS and influence secondary factors such as heat management and reliability. Any digital circuitry associated with the network interfaces should not be included. However any special requirements for interfacing with these functions should be included. This section of the evaluation should analyse the detailed description of the digital signal processing requirements, including performance characteristics, architecture and algorithms, in order to estimate the impact on complexity of the BSs. At a minimum the evaluation should review the signal processing estimates (MOPS, memory requirements, gate counts) required for demodulation, equalization, channel coding, error correction, diversity processing (including Rake receivers), adaptive antenna array processing, modulation, A-D and D-A converters and multiplexing as well as some IF and baseband filtering. For new technologies, there may be additional or alternative requirements (such as FFTs). Although specific implementations are likely to vary, good sample descriptions should allow the relative cost, complexity and power consumption to be compared for the candidate RTTs, as well as the size and the weight of the circuitry. The descriptions should allow the evaluators to verify the signal processing requirement metrics, such as MOPS, memory and gate count, provided by the RTT proponent.	Q and q	G2	A1.4.13	The Hardware requirements are implementation dependent. For 5 MHz a 512 FFT and for 10 MHz and 1024 FFT is required. Memory and Processing needs are very much specific to the type of hardware.	Digital signal processing requirements are not supplied

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.2.5.2	What is the channel coding/error handling for both the forward and reverse links? Provide details and ensure that implementation specifics are described and their impact considered in DSP requirements described in § A3.2.5.1.	q	G4	A1.2.12 A1.4.13	An 8bit CRC is used for MAC PDU errors. Forward Error Correction schemes Convolutional Coding and Convolutional Turbo Coding are supported Modulation schemes: QPSK, 16 QAM and 64 QAM for downlink, QPSK and 16 QAM for uplink. Coding rates: QPSK 1/2, QPSK 3/4, 16 QAM 1/2, 16 QAM 3/4, 64 QAM 1/2, 64 QAM 2/3, 64 QAM 3/4, 64 QAM 5/6. Coding repetition rates: 1x, 2x, 4x and 6x.	
A3.2.6	Antenna systems					

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
	The implementation of specialized antenna systems while potentially increasing the complexity and cost of the overall system can improve spectrum efficiency (e.g. smart antennas), quality (e.g. diversity), and reduce system deployment costs (e.g. remote antennas, leaky feeder antennas). NOTE 1 – For the satellite component, diversity indicates the number of satellites involved; the other antenna attributes do not apply.				MS: 1 Tx Antenna 2 Rx Antennas BS: 2 or more Tx Antennas 2 or more Rx Antennas Both MIMO and Beamforming support are mandatory at the Mobile Stations. Base Stations may support either MIMO or Beamforming. In general, it is expected for Beamforming to be deployed in scenarios where increased coverage is required (urban and suburban scenarios), while MIMO is expected to be employed in scenarios requiring high system capacity (urban scenarios). For MIMO operation: Adaptive switching between STC and SM is supported, see Section 1.3. 5 for a detailed description. Two transmit and two or more receive antennas are employed at the BS; one transmit and two receive antennas are supported at the MS. The typical antenna spacing at the BS and MS is 10 λ and 0.5 λ, respectively, where λ stands for the carrier wavelength. Regarding the type of equalizers for the SM MIMO mode, either minimum mean squared error (MMSE) or maximum-likelihhod (ML) based receivers will be implemented by MS vendors. Regarding the CSI, this is based either on physical or effective carrier-to-interference-	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.2.6.1	*Diversity*: describe the diversity schemes applied (including micro and macro diversity schemes). Include in this description the degree of improvement expected, and the number of additional antennas and receivers required to implement the proposed diversity design beyond and omni-directional antenna.	Q	G2	A1.2.23 A1.2.23.1 A1.2.23.2	When the MIMO option is deployed: In the downlink, both transmit diversity and receive diversity is supported through the use of STC (use of the Alamouti code which is a space-time block coding code for two transmit antennas, while two receive antennas are used at the MS for receive diversity). Note that when SM is used, although there is also inherent transmit and receive diversity due to the use of two antennas at both the BS and MS, the target is the increase of the peak rate by transmitting two data streams over one OFDMA symbol per subcarrier, see also Section 1.3.5 for a detailed description. In the uplink where CSM (collaborative spatial multiplexing) is supported, receive diversity is applied by the use of two or more receive antennas at the BS. Depending on the propagation environment (mainly characterized by the frequency and time diversity of the link-level channel model), the signal-to-noise ratio (SNR) gain of STC ranges from 4 dB to 7dB compared to a single antenna system; the SNR gain of SM ranges from 2 dB to 4 dB compared to a single antenna system, where there is double data throughput supported by SM compared to the single antenna system. Regarding the CSM mode, higher gains on the order of 1 dB to 2 dB are expected compared to the SM gains reported above. When the Beamforming option is applied: In the downlink, transmit	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.2.6.2	*Remote antennas* : describe whether and how remote antenna systems can be used to extend coverage to low traffic density areas.	q	G2	A1.3.6	These can be used for extending coverage. Performance is implementation and deployment scenario specific.	
A3.2.6.3	*Distributed antennas* : describe whether and how distributed antenna designs are used.	q	G3	A1.3.6	They can be used in microcellular environments.	
A3.2.6.4	*Unique antenna* : describe additional antenna systems which are either required or optional for the proposed system, e.g., beam shaping, leaky feeder. Include in the description the advantage or application of the antenna system.	q	G4	A1.3.6	MIMO and Beamforming types of Smart Antenna capability are supported. MIMO is used for capacity enhancements. Beamforming is used for coverage enhancement.	
A3.2.7	BS frequency synchronization/time alignment requirements Does the proposed RTT require base transmitter and/or receiver station synchronization or base-to-base bit time alignment? If so, specify the long term (1 year) frequency stability requirements, and also the required bit-to-bit time alignment. Describe the means of achieving this.	Q And q	G3	A1.4.1 A1.4.3	As it is a TDD system, BS synchronization is required. Methods used are implementation dependent. GPS based methods are typically used. BS frequency tolerance ≤ ± 2ppm of carrier frequency BS to BS frequency accuracy ≤ ± 1% of subcarrier spacing MS to BS frequency synchronization tolerance ≤ 2% of the subcarrier spacing. Time alignment between BS and MS is achieved using the Downlink Preambles and the Uplink ranging operation which corrects time offset errors. The OFDMA Cyclic Prefix marks the Symbol level time alignment.	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.2.8	The number of users per RF carrier/frequency channel that the proposed RTT can support affects overall cost – especially as bearer traffic requirements increase or geographic traffic density varies widely with time. Specify the maximum number of user channels that can be supported while still meeting ITU-T Recommendation G.726 performance requirements for voice traffic.	Q	G1	A1.2.17	The maximum number of voice channels per 1 RF channel depends on the bit rate and sampling rate supported by the codecs defined in the G.726. For instance, in case of the bit rate of 16 kbit/s with 20 msec sampling rate, up to 256 users can be supported simultaneously by a 10 MHz RF channel, while meeting the delay requirements of VoIP. In the case of a 5 MHz channel up to 120 users can be supported. The performance characteristics meet the delay and traffic requirements outlined in ITU-R M.1079.	
A3.2.9	Base site implementation/installation requirements (not applicable to satellite) BS size, mounting, antenna type and height can vary greatly as a function of cell size, RTT design and application environment. Discuss its positive or negative impact on system complexity and cost.	q	G1	A1.4.17	No RTT specific requirements exist.	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.2.10	Handover complexity Consistent with handover quality objectives defined in criterion § 6.1.3, describe how user handover is implemented for both voice and data services and its overall impact on infrastructure cost and complexity.	Q and q	G1	A1.2.24 A1.4.6.1	Simple Hard Handover and Optimized Hard Handover is supported. As the MS is only attached to one BS at a time significantly less complexity is expected. As voice is supported as an application over the IP data bearer the handover is always treated as a data connection. Base stations and Mobile stations implement the ability to buffer data during handover as well the protocols necessary for handover. See section 2.2.2.2 for handover performance analysis.	
A3.3	Quality					

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.3.1	Transparent reconnect procedure for dropped calls Dropped calls can result from shadowing and rapid signal loss. Air interfaces utilizing a transparent reconnect procedure – that is, the same as that employed for hand-off – mitigate against dropped calls whereas RTTs requiring a reconnect procedure significantly different from that used for hand-off do not.	q	G2	A1.4.14	Voice is supported as an application over the RTT. The RTT is primarily designed to support Voice using Voice Over IP Protocols. MAC connections that provide reliable Quality of Service for Voice Over IP data flows are supported. These data connections are managed using timers and well as MAC layer signaling to ensure a reliable connection is maintained. Transparent reconnects are provided by the application layer for the voice traffic. As the RTT supports Adaptive Modulation and Coding, and Link Adaptation methods, the MAC level transport connections are managed to make them reliable.	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.3.2	Round trip delay, D1 (with vocoder (ms)) and D2 (without vocoder (ms)) (See Fig. 6). NOTE 1 – The delay of the codec should be that specified by ITU-T for the common generic voice bearer and if there are any proposals for optional codecs include the information about those also. (For the satellite component, the satellite propagation delay is not included.)	Q	G2	A1.3.7.1 A1.3.7.2	Assuming G.729 with a vocoder delay of 20ms for a 20 Byte voice sample. D1 = 20ms (vocoder) + 50ms (max one-way air interface delay) x 2 = 120ms D2 = 50ms x 2 = 100ms	Table 1 of the Requirements and Objectives Template in M.1225 is correctly captured in Table 8 of 8F/1079R1. The first requirement in this table calls for one-way delay less than 40ms. Document IEEE L802.16-07/012, "Report of the IP-OFDMA Evaluation Group Coordination Meeting" corrects an error in 8F/1079R1, and states that: D1 = 2 x One way delay = 2 x (20 ms (vocoding) + 50ms { 5 ms (processing) + 10 ms (Tx+Rx) + 35 ms (radio network) }) = 140 ms; The one-way delay of 70ms exceeds the required 40ms. *«editor's note: Check that equivalent measurements are being used»*
A3.3.3	Handover/ALT quality Intra switch/controller handover directly affects voice service quality. Handover performance, minimum break duration, and average number of handovers are key issues.	Q	G2	A1.2.24 A1.2.24.1 A1.2.24.2 A1.4.6.1	Handover signaling is designed to minimize loss of data. Handover latency is <= 50ms if no network re-entry is required. This ensures minimum disruption to data transfer. If NW re-entry is required the latency is <= 85ms. Handover frequency is scenario specific.	
A3.3.4	Handover quality for data There should be a quantitative evaluation of the effect on data performance of handover.	Q	G3	A1.2.24 A1.2.24.1 A1.2.24.2 A1.4.6.1	Handover for voice and data are treated the same way in this RTT.	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.3.5	Maximum user bit rate for data (bit/s) A higher user bit rate potentially provides higher data service quality (such as high quality video service) from the user's point of view.	Q	G1	A1.3.3	The maximum bit rates are well above 20160 kbit/s. (DL/UL ratio = 2:1, PUSC, 64QAM, 5/6 coding rate)	Maximum user bit rate is not supplied. The answer provided is not consistent with A3.4.1.1 and A3.4.1.5. Please explain.
A3.3.6	Channel aggregation to achieve higher user bit There should also be a qualitative evaluation of the method used to aggregate channels to provide higher bit rate services.	q	G4	A1.2.32	No channel aggregation is necessary as IP-OFDMA can operate over the entire 10 MHz channel. However, flexible allocation of subchannels (in frequency domain) within an RF channel can be used to dynamically allocate bandwidth to individual users for various bit rate services (see also Section s 1.3.1 to 1.3.3) .	
A3.3.7	Voice quality Recommendation ITU-R M.1079 specifies that IMT-2000 speech quality without errors should be equivalent to ITU-T Recommendation G.726 (32 kbit/s ADPCM) with desired performance at ITU-T Recommendation G.711 (64 kbit/s PCM). NOTE 1 – Voice quality equivalent to ITU-T Recommendation G.726 error free with no more than a 0.5 degradation in MOS in the presence of 3% frame erasures might be a requirement.	Q and q	G1	A1.2.19 A1.3.8	The vocoder is independent of the RTT. Any suitable vocoder can be used as voice is supported over using Voice over IP protocol. Therefore the MOS values for the G.726 or any other vocoder used will apply.	The RTT does not specify a codec. Consequently, on what basis do we assess whether these requirements are met? If we assume a G.726 codec, what are the MOS scores of this codec when delivered via VoIP on this radio channel under the conditions in A3.1.1.1? What are the conditions under which the performance is equivalent to G.726? Can performance equivalent to G.711 be achieved? Under what conditions? Are these the conditions used to simulate voice channel capacity in A3.1.1.1? *Check for MOS scores in vocoder Recommendations*

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.3.8	System overload performance (not applicable to satellite) Evaluate the effect on system blocking and quality performance on both the primary and adjacent cells during an overload condition, at e.g. 125%, 150%, 175%, 200%. Also evaluate any other effects of an overload condition.	Q and q	G3	A1.3.9.1	System overload causes graceful degradation as data transmission bandwidth can be traded off for lower quality connections. As adaptive modulation and coding are supported the system adapts to the load conditions as per the policies implemented.	
A3.4	Flexibility of radio technologies					
A3.4.1	Services aspects					

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.4.1.1	Variable user bit rate capabilities Variable user bit rate applications can consist of the following: – adaptive signal coding as a function of RF signal quality; – adaptive voice coder rate as a function of traffic loading as long as ITU-T Recommendation G.726 performance is met; – variable data rate as a function of user application; – variable voice/data channel utilization as a function of traffic mix requirements. Some important aspects which should be investigated are as follows: – how is variable bit rate supported? – what are the limitations? Supporting technical information should be provided such as – the range of possible data rates, – the rate of changes (ms).	q and Q	G2	A1.2.18 A1.2.18.1	The user bit rates are variable according to the number of subchannels assigned and modulation and coding rate used. The rates can be changed every 5ms which is every frame. The DL-MAP and UL-MAP signal the changes every frame. DOWNLINK BW: 10 MHz Modulation : QPSK, 16 QAM, 64 QAM Coding rate : 1/2, 2/3, 3/4, 5/6 Data rates: 9.6 kbit/s to 23040 kbit/s UPLINK BW: 10 MHz Modulation : QPSK, 16 QAM Coding rate : 1/2, 3/4 Data rates: 9.6kbit/s to 6048 kbit/s	
A3.4.1.2	Maximum tolerable Doppler shift, F_d (Hz) for which voice and data quality requirements are met (terrestrial only) Supporting technical information: F_d	q and Q	G3	A1.3.1.4	F_d ~500 Hz Voice and Data are treated the same way from the Physical layer perspective.	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.4.1.3	Doppler compensation method (satellite component only) What is the Doppler compensation method and residual Doppler shift after compensation?	Q and q	G3	A1.3.2.2	N/A	
A3.4.1.4	How the maximum tolerable delay spread of the proposed technology impact the flexibility (e.g., ability to cope with very high mobile speed)?	q	G3	A1.3.1.3 A1.2.14 A1.2.14.1 A1.2.14.2 A1.3.10	~20µs of delay spread can be tolerated without an equalizer.	**8F/1079R1, §2.1, A1.2.14 states "The length of cyclic prefix is 1/8 of symbol duration thus 11.4 µs." The proponents comment seems to be in conflict with a fundamental characteristic of an OFDM system. Please explain.**
A3.4.1.5	Maximum user information bit rate, R_u (kbit/s) How flexibly services can be offered to customers ? What is the limitation in number of users for each particular service? (e.g. no more than two simultaneous 2 Mbit/s users)	Q and q	G2	A1.3.3 A1.3.1.5.2 A1.2.31 A1.2.32	Assuming 10 MHz PUSC: - 23040 kbit/s for the Downlink (DL:UL=35:12) - 6048 kbit/s for the Uplink for (DL:UL=26:21) Services are very flexible as the Subchannels can be grouped to increase data rates.	
A3.4.1.6	Multiple vocoder rate capability – bit rate variability, – delay variability, – error protection variability.	Q and q	G3	A1.2.19 A1.2.19.1 A1.2.7 A1.2.12	Yes. Vocoders are however independent of the RTT and are implementation specific. The data transports for voice can operate at varying levels of Packet error rate and using H-ARQ can significantly boost performance.	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.4.1.7	Multimedia capabilities The proponents should describe how multimedia services are handled. The following items should be evaluated: – possible limitations (in data rates, number of bearers), – ability to allocate extra bearers during of the communication, – constraints for handover.	Q and q	G1	A1.2.21 A1.2.20 A1.3.1.5.2 A1.2.18 A1.2.24 A1.2.30 A1.2.30.1	The Data bearers have no constraints on the type of media they can carry. However typically they are mapped to the QoS of the media type being transmitted. There are no limits on the number of bearers as long as bandwidth is available. Extra bearers can be allocated during communication. There are no handover constraints as long as coverage is available.	
A3.4.2	Planning					
A3.4.2.1	Spectrum related matters					
A3.4.2.1.1	Flexibility in the use of the frequency band The proponents should provide the necessary information related to this topic (e.g., allocation of sub-carriers with no constraints, handling of asymmetric services, usage of non-paired band).	q	G1	A1.2.1 A1.2.2 A1.2.2.1 A1.2.3 A1.2.5.1	A 5 MHz or 10 MHz TDD carrier may be deployed with 1:3:3 frequency re-use or 1:3:1 reuse.	
A3.4.2.1.2	Spectrum sharing capabilities The proponent should indicate how global spectrum allocation can be shared between operators in the same region. The following aspects may be detailed: – means for spectrum sharing between operators in the same region, – guardband between operators in case of fixed sharing.	q and Q	G4	A1.2.26	The proposed RTT utilizes OFDMA which has inherent interference protection capabilities due to allocation of a varying subset of available sub-carriers to different users. So spectrum sharing is carried out using multiple channel carriers. The guard bands are RF band specific.	Guard bands are not specified

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.4.2.1.3	Minimum frequency band necessary to operate the system in good conditions Supporting technical information: – impact of the frequency reuse pattern, – bandwidth necessary to carry high peak data rate.	Q and q	G1	A1.2.1 A1.4.15 A1.2.5	5 MHz or 10 MHz 1x3x3 PUSC or 1x3x1 PUSC may be used. 10 MHz gives the optimal data rate.	
A3.4.2.2	Radio resource planning					

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.4.2.2.1	Allocation of radio resources The proponents and evaluators should focus on the requirements and constraints imposed by the proposed technology. More particularly, the following aspects should be considered: – what are the methods used to make the allocation and planning of radio resources flexible? – what are the impacts on the network side (e.g. synchronization of BSs, signalling,)? – other aspects. Examples of functions or type of planning required which may be supported by the proposed technology: – DCA, – frequency hopping, – code planning, – time planning, – nterleaved frequency planning. NOTE 1 – The use of the second adjacent channel instead of the adjacent channel at a neighbouring cluster cell is called “interleaved frequency planning”. In some cases, no particular functions are necessary (e.g. frequency reuse = 1).	q	G2	A1.2.25 A1.2.27 A1.4.15	Subchannelization schemes and zones namely PUSC and AMC are supported to provide flexibility in utilizing the frequency and time resources. Sectorized deployments are possible with flexible frequency re-use (1x3x3 or 1x3x1) using PUSC subchannelization schemes. Slots of multiple subchannels and OFDM symbols are used to manage the resource allocation granularity BSs need to be synchronized. This is typically done using GPS on the BS. No frequency planning is required across cells.	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.4.2.2.2	Adaptability to adapt to different and/or time varying conditions (e.g., propagation, traffic) How the proposed technology cope with varying propagation and/or traffic conditions? Examples of adaptive functions which may be supported by the proposed technology: – DCA, – link adaptation, – fast power control, – adaptation to large delay spreads. Some adaptivity aspects may be inherent to the RTT.	q	G2	A1.3.10 A1.2.27 A1.2.22 A1.2.14	Subchannelization and slot structure capability provides the ability to schedule frequency/time resources to mitigate the effects of propagation losses and also for traffic load balancing. Link adaptation schemes with CQI feedback capability allow operating the link more efficiently. H-ARQ also allows operations at high packet error rates resulting higher spectral efficiency as higher order coding and modulation rates can be used. The OFDMA symbol structure is designed to reduce the effects of delay spreads up to 20µs.	
A3.4.2.3	Mixed cell architecture (not applicable to satellite component)					
A3.4.2.3.1	Frequency management between different layers What kind of planning is required to manage frequencies between the different layers? e.g. – fixed separation, – dynamic separation, – possibility to use the same frequencies between different layers. Possible supporting technical information: – guard band.	q and Q	G1	A1.2.28 A1.4.15	Hierarchical layered cells are possible. The type of frequency planning is implementation/deployment scenario specific. The same frequencies can be used across layers by proper segmentation of the PUSC Subchannels.	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.4.2.3.2	User adaptation to the environment What are the constraints to the management of users between the different cell layers? e.g. – constraints for handover between different layers, – adaptation to the cell layers depending on services, mobile speed, mobile power.	q	G2	A1.2.28 A1.3.10	The RTT does not impose constraints on the management of users between different cell layers in such a hierarchical deployment.	
A3.4.2.4	Fixed-wireless access					
A3.4.2.4.1	The proponents should indicate how well its technology is suited for operation in the fixed wireless access environment. Areas which would need evaluation include (not applicable to satellite component): – ability to deploy small BSs easily, – use of repeaters, – use of large cells, – ability to support fixed and mobile users within a cell, – network and signalling simplification.	q	G4	A1.1.3 A1.3.5 A1.4.17 A1.4.7 A1.4.7.1	The RTT is very much suited for fixed wireless access as well. Pico or Micro cells or Macro cells and repeaters are possible. Both fixed and mobile users can work in the same cell. Network signaling for fixed devices are simpler compared to mobile devices.	
A3.4.2.4.2	Possible use of adaptive antennas (how well suited is the technology) (not applicable to satellite component) Is RTT suited to introduce adaptive antennas? Explain the reason if it is.	q	G4	A1.3.6	Yes the RTT supports adaptive antenna/Beamforming solutions.	
A3.4.2.4.3	Existing system migration capability	q	G1	A1.4.16	NA	
A3.5	Implication on network interface					

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.5.1	Examine the synchronization requirements with respect to the network interfaces. *Best case*: no special accommodation necessary to provide synchronization. *Worst case*: special accommodation for synchronization is required, e.g. additional equipment at BS or special consideration for facilities.	q	G4	A1.4.3	Synchronization of the BSs across the network is required and this is typically accomplished using GPS.	
A3.5.2	Examine the RTTs ability to minimize the network infrastructure involvement in cell handover. *Best case*: neither PSTN/ISDN nor mobile switch involvement in handover. *Worst case*: landline network involvement essential for handover.	q	G3	A1.2.24 A1.4.6.1	Handover within the same ASN (Access Service Network) does not involve the CSN (Core Service Network). In most handover scenarios with neighboring cells there is minimal involvement of the CSN. Only the BS and ASN GW may need to be involved in these scenarios.	
A3.5.3	Landline feature transparency					
A3.5.3.1	Examine the network modifications required for the RTT to pass the standard set of ISDN bearer services. *Best case*: no modifications required. *Worst case*: substantial modification required, such as interworking functions.	q	G1	A1.4.7.1	ISDN is supported as an application running over the IP protocol and is not natively supported. As voice is supported using Voice over IP protocols, the use of ISDN is only involved interworking functions between the IP networks and PSTN.	
A3.5.3.2	Examine the extent of the PSTN/ISDN involvement in switching functionality. *Best case*: all switching of calls is handled by the PSTN/ISDN. *Worst case*: a separate mobile switch is required.	q	G2	A1.4.6 A1.4.8	PSTN/ISDN is not used for switching within the IP network.	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.5.3.3	Examine the depth and duration of fading that would result in a dropped call to the PSTN/ISDN network. The robustness of an RTTs ability to minimize dropped calls could be provided by techniques such as transparent reconnect.	Q and q	G3	A1.2.24 A1.4.14	Voice is supported as an application over the RTT. The robustness of the link maintained is implementation dependent. The RTT supports HARQ and hence can operate in higher Packer Error Rates up to 10%.	Depth of fading tolerated is not supplied
A3.5.3.4	Examine the quantity and type of network interfaces necessary for the RTT based on the deployment model used for spectrum and coverage efficiencies. The assessment should include those connections necessary for traffic, signalling and control as well as any special requirements, such as soft handover or simulcast.	Q	G2	A1.2.30 A1.2.30.1 A1.4.9	The RTT design is to minimize impacts on the network. All the connections necessary for traffic, signaling and control terminate on the BS for PHY/MAC layer. The Radio Resource Management functions implemented over the IP protocol reside in the ASN. So most RTT configuration parameters are controlled on the BS which is interfaced using an IP connection to the ASN-GW .	
A3.6	Handportable performance optimization capability					
A3.6.1	Isolation between transmitter and receiver Isolation between transmitter and receiver has an impact on the size and weight of the handportable.	Q	G2	A1.2.2 A1.2.2.1 A1.2.2.2	As the RTT is a TDD based technology, no specific isolation requirements exist.	Transmitter/Receiver isolation requirement is not specified
A3.6.2	Average terminal power output P_0 (mW) Lower power gives longer battery life and greater operating time.	Q	G2	A1.2.16.1.2	This is implementation dependent. The terminals have different power classes to which they belong as shown in A3.2.2.2.2.	Transmitter/Receiver isolation requirement is not specified

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.6.3	System round trip delay impacts the amount of acoustical isolation required between handportable microphone and speaker components and, as such, the physical size and mechanical design of the subscriber unit. NOTE 1 – The delay of the codec should be that specified by ITU-T for the common generic voice bearer and if there are any proposals for optional codecs include the information about those also. (For the satellite component, the satellite propagation delay is not included.)	Q and q	G2	A1.3.7 A1.3.7.1 A1.3.7.2 A1.3.7.3	The Round trip delay will be well within the ITU-T specified limits for a typical Voice application that may be implemented using the RTT.	Round trip delay is not supplied
A3.6.4	Peak transmission power	Q	G1	A1.2.16.1.1	This is not limited by RTT but by regulations. The peak terminal power output P_0 = 1000 mW (Power class 3). Also see A3.2.2.2.2 for more details.	
A3.6.5	Power control characteristics Does the proposed RTT utilize transmitter power control? If so, is it used in both forward and reverse links? State the power control range, step size (dB) and required accuracy, number of possible step sizes and number of power controls per second, which are concerned with mobile station technology complexity.				Yes the RTT does utilize transmitter power control for both Downlink and Uplink.	
A3.6.5.1	Power control dynamic range Larger power control dynamic range gives longer battery life and greater operating time.	Q	G3	A1.2.22 A1.2.22.3 A1.2.22.4	The minimum power control dynamic range is 45 dB.	

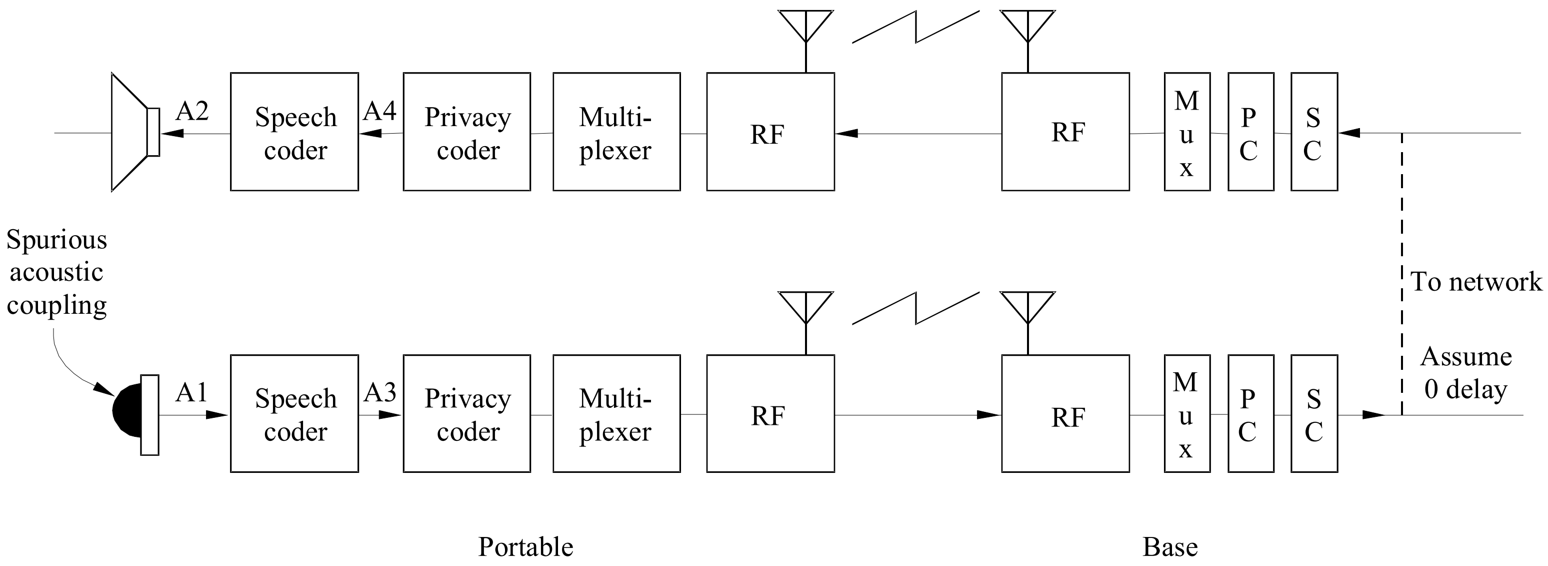
Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.6.5.2	Power control step size, accuracy and speed	Q	G3	A1.2.22 A1.2.22.1 A1.2.22.2 A1.2.22.5	The accuracy for power level control can vary from ± 0.5 dB to ± 2 dB depending on the power control step size. Single step size m | Required relative accuracy |m| = 1dB| ± 0.5 dB |m| = 2dB| ± 1 dB |m| = 3dB| ± 1.5 dB 4dB< |m|< = 10dB| ± 2 dB Two exception points of at least 10 dB apart are allowed over the 45 dB range, where in these two points an accuracy of up to +/- 2 dB is allowed for any size step.	
A3.6.6	Linear transmitter requirements	q	G3	A1.4.10	Linear transmitters are used on the BS and MS.	
A3.6.7	Linear receiver requirements (not applicable to satellite)	q	G3	A1.4.11	Linear receivers are used on the BS and MS.	
A3.6.8	Dynamic range of receiver The lower the dynamic range requirement, the lower the complexity and ease of design implementation.	Q	G3	A1.4.12	80dB for the MS receiver and 65dB for the BS receiver	
A3.6.9	Diversity schemes Diversity has an impact on handportable complexity and size. If utilized describe the type of diversity and address the following two attributes.	Q and q	G1	A1.2.23 A1.2.23.1 A1.2.23.2	MIMO and Beamforming are supported. Within the MIMO scheme both Transmit Diversity and Spatial Multiplexing are supported.	
A3.6.10	The number of antennas	Q	G1	A1.2.23.1	BS: 2 Tx, 2 Rx MS: 1 Tx, 2 Rx	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.6.11	The number of receivers	Q	G1	A1.2.23.1	BS: 2 Receivers MS : 2 Receivers	
A3.6.12	Frequency stability Tight frequency stability requirements contribute to handportable complexity.	Q	G3	A1.4.1.2	BS frequency tolerance ≤ ± 2ppm of carrier frequency BS to BS frequency accuracy ≤ ± 1% of subcarrier spacing MS to BS frequency synchronization tolerance ≤ 2% of the subcarrier spacing	
A3.6.13	The ratio of “off (sleep)” time to “on” time	Q	G1	A1.2.29 A1.2.29.1	This implementation dependent and is programmable by the BS or MS implementations.	Sleep ratio is not specified
A3.6.14	Frequency generator step size, switched speed and frequency range Tight step size, switch speed and wide frequency range contribute to handportable complexity. Conversely, they increase RTT flexibility.	Q	G2	A1.4.5	Frequency step size : 200 and 250 KHz Switched speed : 200 µsec Frequency range : 5, 10 MHz	

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.6.15	Digital signal processing requirements Digital signal processing can be a significant proportion of the hardware for some radio interface proposals. It can contribute to the cost, size, weight and power consumption of the BS and influence secondary factors such as heat management and reliability. Any digital circuitry associated with the network interfaces should not be included. However any special requirements for interfacing with these functions should be included. This section of the evaluation should analyse the detailed description of the digital signal processing requirements, including performance characteristics, architecture and algorithms, in order to estimate the impact on complexity of the BSs. At a minimum the evaluation should review the signal processing estimates (MOPS, memory requirements, gate counts) required for demodulation, equalization, channel coding, error correction, diversity processing (including Rake receivers), adaptive antenna array processing, modulation, A-D and D-A converters and multiplexing as well as some IF and baseband filtering. For new technologies, there may be additional or alternative requirements (such as FFTs). Although specific implementations are likely to vary, good sample descriptions should allow the relative cost, complexity and power consumption to be compared for the candidate RTTs, as well as the size and the weight of the circuitry. The descriptions should allow the evaluators to verify the signal processing requirement metrics, such as MOPS, memory and gate count, provided by the RTT proponent.	Q and q	G1	A1.4.13	These are again implementation dependent.	Digital signal processing requirements are not supplied
A3.7	Coverage/power efficiency					
A3.7.1	Terrestrial Coverage efficiency: – the coverage efficiency is considered for the lowest traffic loadings; – the base site coverage efficiency can be quantitatively determined by addressing coverage limitation and/or by calculating the maximum coverage range for the lowest traffic loading.					

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponents Comment	Evaluators Comments
A3.7.1.1	Base site coverage efficiency The number of base sites required to provide coverage at system start-up and ongoing traffic growth significantly impacts cost. From § 1.3.2 of Annex 2, determine the coverage efficiency, *C* (km^2/base sites), for the lowest traffic loadings. Proponent has to indicate the background of the calculation and also to indicate the maximum coverage range.	Q	G1	A1.3.1.7 A1.3.1.7.1 A1.3.1.7.2 A1.3.4	80-95% at system startup 95-100% in a mature system See section 2.2.4.2 for more details.	
A3.7.1.2	Method to increase the coverage efficiency Proponent describes the technique adopted to increase the coverage efficiency and drawbacks. Remote antenna systems can be used to economically extend vehicular coverage to low traffic density areas. RTT link budget, propagation delay system noise and diversity strategies can be impacted by their use. Distributed antenna designs – similar to remote antenna systems – interconnect multiple antennas to a single radio port via broadband lines. However, their application is not necessary limited to providing coverage, but can also be used to economically provide continuous building coverage for pedestrian applications. System synchronization, delay spread, and noise performance can be impacted by their use.	q	G1	A1.3.5 A1.3.6	MIMO and Beamforming can be used to increase coverage efficiency. Remote or Distributed antenna systems can also be used. However the use of these methods is deployment scenario specific based on the implementations.	
A3.7.2	Satellite Normalized power efficiency Supported information bit rate per required carrier power-to-noise density ratio for the given channel performance under the given interference conditions for voice Supported information bit rate per required carrier power-to-noise density ratio for the given channel performance under the given interference conditions for voice plus data mixed traffic.	Q	G1	A1.3.2.4 A1.3.2.4.1 A1.3.2.4.2	N/A	*Not Applicable*

FIGURE 6



D1: delay between A1 and A2
D2: delay between A3 and A4
Mux: multiplexer
PC: privacy coder
SC: speech coder

1225-06

b) Deployment model result matrix

Table 11 from M.1225.

<table>
<tr><td colspan="5">Input assumptions</td></tr>
<tr><td colspan="2">Test environment</td><td colspan="3"></td></tr>
<tr><td colspan="2">Test service</td><td colspan="3"></td></tr>
<tr><td colspan="2">Base station antenna height (m)</td><td colspan="3"></td></tr>
<tr><td colspan="2">Any other assumptions made by the proponent (e.g. antenna pattern, sectorization etc.)</td><td colspan="3"></td></tr>
<tr><td colspan="5">Deployment results</td></tr>
<tr><td>Total number of cell sites</td><td>Total number of RF channels</td><td>Number of voice channels per RF channel</td><td>Coverage efficiency (km^2 /site)</td><td>Spectrum efficiency (E/MHz/cell) for speech (Mbit/s/cell) for data</td></tr>
</table>