Association of Radio Industries and Businesse

Self Evaluation Report on Japan's Proposal for Candidate Radio Transmission Technology on IMT-2000 : W-CDMA

ARIB IMT-2000 Study Committee

Association of Radio Industries and Businesses (ARIB)

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Preface

The primary objective for the next-generation mobile communications system for Japan is to establish a 'Global System'. Therefore, Japan has made its studies with a flexible and global perspective to achieve a common system for the world, while cooperating with the standard bodies of other countries and regions.

Based on such viewpoints, Japan submitted its 'Proposal for Candidate Radio Transmission Technology on IMT-2000: W-CDMA' to ITU-R in June 1998, according to the schedule for submission set forth by ITU-R. While this proposal was compiled after a close examination on technologies in Japan, as Japan's primary goal is to standardize a globally common radio transmission technology, studies on the proposal will continue as part of the international efforts for harmonization.

At the same time, in line with ITU's process for IMT-2000, Association of Radio Industries and Businesses (ARIB) of Japan formed an Evaluation Group in its organization for the evaluation of proposed technologies, which was registered to ITU-R, TG8/1.

The Evaluation Group of ARIB established its 'evaluation principles and methodology', and mainly performed a self-evaluation on the Japanese proposal, instead of carrying out a relative comparison with other technologies proposed, with a purpose to facilitate the harmonization activities. Since ARIB has been studying the possibility of merging its technology with the cdma2000 proposal from TR 45.5 of the United States for the past year, it made an evaluation on this technology as well, based on the perspective to promote harmonization. Note that the UTRA proposal from ETSI, whose parameters are almost harmonized with the Japanese proposal, and the Global CDMA-II proposal from TTA of Korea, which is now under the technical harmonization process, are both treated as a supplementary explanation in the evaluation report on the Japanese proposal.

This evaluation report contains the outcome of the self-evaluation on the Japanese proposal performed by the Evaluation Group of ARIB, which will be input to ITU-R as a Japanese contribution in the end of September 1998.

Self Evaluation Report on Japan's Proposal for Candidate Radio Transmission Technology on IMT-2000 : W-CDMA

Part I　Evaluation Results

Self Evaluation Report on Japan's Proposal for Candidate Radio Transmission Technology on IMT-2000 : W-CDMA

Part I Evaluation Results

1. INTRODUCTION

International Mobile Telecommunications - 2000 (IMT-2000) defines third generation mobile systems that are scheduled to start service around the year 2000. IMT-2000 will provide access by means of one or more radio links to a wide range of telecommunication services supported by the fixed and mobile telecommunication networks, and to other services, which may be unique to IMT-2000. The goal for IMT-2000 is to provide universal coverage and to allow terminals to support seamless roaming among multiple networks. It is the design objective of IMT-2000 that the number of radio interfaces should be kept to minimal. These radio interfaces will serve for a variety of radio operating environments, such as indoor, pedestrian, and vehicular environments.

ITU-R announced to initiate the process of IMT-2000 radio interface development by its Circular Letter 8/LCCE/47, on April 4, 1997. Association of Radio Industries and Businesses of Japan (ARIB) established a drafting group responsible for compiling Japan's proposal for the candidate radio transmission technologies of IMT-2000, named the Ad Hoc-T Group. After drafting was completed at Ad Hoc-T, the proposal was posted to ITU-R as a contribution from Japan in June 1998. In addition, ARIB also formed an Evaluation Group, which was registered to ITU-R as an independent outside evaluation entity for the radio transmission technology (RTT) proposals submitted to ITU in accordance with the Circular Letter. The roles of these two groups are clearly separated, working as two groups independent from each other. The Evaluation Group announced its evaluation principles and evaluation methodology that has been established, developed, and agreed upon in the IMT-2000 Study Committee of ARIB with its document titled 'Evaluation Methodology for IMT-2000 Radio Transmission Technologies,' dated June 19, 1998. The group has evaluated RTT candidates for IMT-2000 in accordance with the descriptions in the document. One of the most important principles in ARIB for this process, as described in the methodology document, is to ensure that the evaluation activities should not be carried out for the purpose of making a selection out of the proposed RTT candidates. Rather, the evaluation activity is intended to accelerate the convergence process within and between standardization bodies so that a unified global standard can be achieved. Therefore, the primary purpose of the evaluation at ARIB is to confirm that all the requirements and objectives for IMT-2000 are fulfilled.

2. SCOPE

This document reports the self-evaluation outcome for 'W-CDMA', the candidate radio transmission technology for IMT-2000 proposed by Japan to ITU-R.

The primary requirement for the Third-Generation Mobile Communications System in Japan is to establish a 'Global System'. Therefore, ARIB has carried out its studies in a flexible manner based on a worldwide perspective to create a globally common technology, while cooperating with the standards bodies of other countries and regions. ARIB is continuing its international harmonization activities even after the submission of the RTT proposal to ITU. This self-evaluation report consists of two parts, Part I and Part II. Part I describes the results of evaluations conducted by the Evaluation Group, whereas Part II contains the revised RTT proposal, which reflects the results of harmonization activities between other evaluation groups and self-checking as an evaluator. These revisions on the original proposal were made by Ad Hoc-T. The report includes the compliance template for IMT-2000 requirements and objectives, the template for minimum performance capabilities confirmed by the Evaluation Group, and the evaluation spreadsheet for the criteria.

3. Objectives of Evaluation

The purposes of the self-evaluation on the 'W-CDMA' proposal are;

- to check if the proposal gives sufficient information defined by ITU-R,
- to point out deficiency of information required to obtain understanding from other evaluation groups,
- to reflect ongoing standardization activities in ARIB,
- to reflect ongoing harmonization activities between standardization bodies and cooperative activities between other evaluation groups,
- to accelerate harmonization activities between standardization bodies,
- to confirm that all the IMT-2000 requirements and objectives are fulfilled,
- to contribute to fair and proper evaluation at ITU-R and other evaluation groups.

4. Summary of Evaluation

4.0 Evaluation Procedures

The Evaluation Group of ARIB evaluated Japan’s candidate W-CDMA RTT proposal for IMT-2000, according to the Evaluation Procedures described in chapter 4 of ARIB’s Evaluation Methodology. Since the responsibility is clearly separated between the Evaluation Group and Ad Hoc-T Group, the evaluator vs. proponent, the evaluation process was carried out based on the interaction between these two groups.

Throughout the process, the Evaluation Group examined the contents of the RTT proposal including the System Description, Technical Description Template, Compliance Templates, and Simulation Model and Simulation Results. In some cases, the Evaluation Group asked Ad Hoc-T for clarification on some items. The contents of the RTT proposal were refined after this series of information exchange processes, and subsequently the Evaluator’s comments were successfully finalized.

4.1 Requirements and Objectives

Through the evaluation process, it was confirmed and concluded that the W-CDMA RTT proposal from Japan meets the Requirements and Objectives, defined in Attachment 4 of Circular Letter and in ANNEX 4 of ARIB’s Evaluation Methodology. This is shown in the descriptions of System Description, Technology Description Template, and Simulation Models and Evaluation Results.

For the details on Evaluator’s Comment, see Attachment 1 to this report.

4.2 Minimum Performance Capabilities

Through the evaluation process, it was also confirmed and concluded that the W-CDMA RTT proposal meets the Minimum Performance Capabilities defined in Attachment 6 of Circular Letter, which is described in the System

Description, Technology Description Template, and Simulation Models and Evaluation Results.

For the details on the Evaluator's Comments, see Attachment 2 to this report.

4.3 Performance

The performance of the W-CDMA proposal is evaluated in terms of spectrum and coverage efficiency. The simulation conditions and results of the proposal were carefully reviewed and evaluated according to the Evaluation Methodology agreed by the IMT-2000 Study Committee of ARIB. This process was employed to ensure that information required by ITU-R for the evaluation of technologies is sufficiently provided. Evaluations on the spectrum and coverage efficiency are elaborated in the following section and Attachment 3.

4.4 Evaluation Based on the Criteria

The proposed RTT is evaluated based on the criteria defined in M. 1225. This section provides the summary of this evaluation report referring to each criterion. See Attachment-4 'Evaluation Spread Sheet' to Part I of this document for more detailed information.

In order to carry out the self-evaluation on the proposed RTT, ARIB organized two groups for two specific functions: the evaluator and the proponent. While the Evaluation Group is responsible for the evaluation on the proposed RTT, Ad Hoc-T is the group taking the responsibility for drafting the proposal. Note that these two groups perform their own responsibilities independently from each other. The Proponent's comments in the templates were revised by Ad Hoc-T based on the evaluator's comments provided by the Evaluation Group. The proponent's comments are thus improved through the revision processes. If we take the example of Item A.3.6.6 (linear transmitter requirements), in the beginning the Proponent's comment stated merely: 'the linear amplifiers are required.' This explanation, however, was later revised after the Evaluation Group sent the evaluator's comment, requesting more detailed explanations, such as the following: 'base station: class A amplifiers, mobile station: class A-B amplifiers.' For details, refer to Attachment-4 'Evaluation Spread Sheet' to Part I of this document.

1) Spectrum Efficiency

The simulation results provided were evaluated by the evaluator. As a result, it was shown that these results are reliable, supported by reasonable calculations. It is indicated that the proposal has a very high capacity for voice traffic in both FDD and TDD modes, exceeding the spectrum efficiency provided by the current 2nd generation mobile systems. It was also verified that sufficient spectrum efficiency can be secured for circuit and packet switched services in all test environments. Those services are not supported in the current 2nd generation mobile systems. See Part II of this document, the revised proposal, for more detailed information.

2) Technology Complexity

The information provided by the proponents is sufficient and well detailed, i.e., providing descriptions on the detailed features of transmit power control, the procedures and effects of diversity, and so forth. Although the proposed RTT requires some additional complexity, it is shown that the requirement is feasible and reasonable to implement and that the system performance level is improved by adding the complexities.

3) Quality

The proponent elaborately described that the proposed RTT provides very high quality levels for both voice and data, and the technology through which high quality is achieved. For example, the link control procedures such as re-connection and handover procedures are explained in details. Furthermore, the delay and the quality level are discussed from both qualitative and quantitative viewpoints.

4) Flexibility of Radio Technologies

The proponent thoroughly described that the proposed RTT is based on very flexible radio technologies for high data rate services, multimedia services and flexible use of the radio spectra. The proponent also described in details by which technology the flexibility is achieved.

5) Implications on Network interface

Explanations on synchronization requirements with respect to the network interfaces are requested by this criterion. The requirements of special accommodation, e.g. additional equipment at BS or special consideration for facilities, are also requested to be described. The proponent presented the detailed requirements for synchronization for both the FDD and TDD modes from qualitative and quantitative viewpoints. It is shown that no specific accommodation is required by the proposed RTT.

6) Hand-portable performance optimization capability

The detailed requirements to compose hand-portable terminals are presented from both qualitative and quantitative viewpoints. Furthermore, the technical and physical impacts of the radio technologies to the hand-portable terminals are well discussed, and it is shown that the proposed RTT can be applied to the hand-portable terminals without any technical difficulties.

7) Coverage Efficiency

The proponent describes the coverage efficiency from a quantitative viewpoint, referring to the link budget templates. It is shown that the proposed RTT can provide sufficient coverage without any technical difficulties. The system can support all services in all test environments such as micro cells for the indoor office, outdoor to indoor and pedestrian environments, and macro cells for the vehicular environment. Moreover, there are methods to increase the coverage efficiency even further by using technologies being developed, e.g. adaptive antenna, etc.

5. Harmonaization

The primary objective for the Third-Generation Mobile Communications System in Japan is to establish a 'Global System'. Therefore, Japan has carried out its studies in a flexible manner based on a world-wide perspective to create a globally common technology, while cooperating with the standards bodies of other countries and regions.

The European Telecommunications Standard Institute, ETSI, decided to adopt W-CDMA for the FDD mode of UTRA, which is a radio transmission scheme very similar to the Japanese proposal. Also in the U.S., T1P1 is likely to harmonize their activities with this decision by ETSI. Within TIA, TR45.5 proposed an RTT proposal based on wideband CDMA called cdma2000. In Korea, wideband CDMA is studied as one of the candidates for the radio transmission technology of IMT-2000. Thus, W-CDMA is not only a more competent technology than other systems, but it is also the most promising system to be applied as a global system. Therefore, ARIB recognized the necessity to harmonize at an international level various RTT proposals based on different wideband CDMA technologies, and has made efforts on a bilateral basis with ETSI (UTRA), TIA (cdma2000), and TTA (TTA proposal II) in order to achieve a common solution for the radio transmission technologies.

5.1 UTRA

ETSI decided in January 1998 that UTRA/FDD should be based on W-CDMA technology, which has the nearly the same key parameters as those of ARIB's W-CDMA proposal. ETSI and ARIB agreed to maximize the commonality between two proposals for a global IMT-2000 system, and to allow mutual participation in each other's RTT refinement process to this end. After the ETSI decision, both ARIB and ETSI proceeded with the refinement process at their respective institutes independently. During this period, the two organizations succeeded in maintaining or rather increasing the commonality between the two proposals, while allowing for some options needed to cater for the unique requirements of their respective regions. See table 5.1-1.
Regarding the TDD mode, ARIB W-CDMA has the same key parameters including chip rate, frame length, and modulation/demodulation schemes between FDD and TDD modes. On the other hand, ETSI decided that UTRA/TDD mode should be based on TD-CDMA, which originally had differences in the above mentioned key parameters. However, since the ETSI decision also included that UTRA/TDD mode should be harmonized with UTRA/FDD mode, UTRA/TDD mode changed its original key parameters through the harmonization process, which subsequently resulted in having almost the same key parameters as shown in Table 5.1-2. The efforts for harmonization are still continued as of today to achieve further commonality between W-CDMA/TDD and UTRA/TDD.

Table 5.1-1 Comparison between ARIB W-CDMA and ETSI UTRA (FDD Mode)

		ARIB(W-CDMA)	ETSI UTRA
Multiple Access		DS-CDMA	DS-CDMA
Band Width		5MHz (1.25/10/20)	5MHz (10/20)
Chip Rate		4.096Mcps (1.024/8.192/16.384)	4.096Mcps (8.192/16.384)
Inter BS timing		Asynchronous (Sync. possible)	Asynchronous (Sync. possible)
Cell Search Scheme		3 step code acquisition based on non-scrambled symbols	3 step code acquisition based on non-scrambled symbols
Frame Length		10ms	10ms
HO		SHO (DHO)	SHO
DL	Data mod.	QPSK	QPSK
	Spreading mod.	QPSK	QPSK
	Pilot structure	TCH dedicated Pilot symbol	TCH dedicated Pilot symbol
		Time multiplexed	Time multiplexed
	Detection	Pilot symbol based coherent	Pilot symbol based coherent
	Power control	Closed-loop based on dedicated CH SIR : 1.6kbps	Closed-loop based on dedicated CH SIR : 1.6kbps
UL	Data mod.	BPSK	BPSK

	Spreading mod.	HPSK (*)	QPSK
	Pilot structure	IQ multiplexed	IQ multiplexed
	Detection	Pilot symbol- based coherent	Pilot symbol-based coherent
	Power control	Open-loop(initial, RACH), Closed-loop (1.6kbps DCH SIR based)	Open-loop(initial, RACH), Closed-loop (1.6kbps DCH SIR based)
Channel Coding		Convolutional codes Turbo codes	Convolutional codes RS codes Turbo codes
Interleaving periods		10/20/40/80ms	10/20/40/80ms

* The HPSK (QCQPSK) is the name for the joint modulation and spreading scheme. HPSK: Hybrid PSK. OCQPSK: Orthogonal Complex QPSK.

Table 5.1-2 Comparison between ARIB W-CDMA and ETSI UTRA (TDD Mode)

		ARIB(W-CDMA)	ETSI UTRA
Multiple Access		TDMA/CDMA	TDMA/CDMA
Band Width		5MHz (1.25/10/20)	5MHz
Chip Rate		4.096Mcps (1.024/8.192/16.384 Mcps)	4.096Mcps
Carrier Spacing		Flexible with 200kHz carrier raster	Flexible with 200kHz carrier raster
Inter BS Sync.		Synchronous	Synchronous
Cell Search Scheme		3 step code acquisition based on non-scrambled symbols	SCH in Beacon slot (1slot per 240ms)
Frame Length		10ms	10ms
VSF(spreading code)		1-512	2-16
HO		SHO (DHO)	HHO
DL	Data mod.	QPSK	QPSK
	Spreading mod.	QPSK	QPSK
	Spreading code	1 symbol length	1 symbol length
	Scrambling code	10ms	1 symbol length
	Pilot structure	TCH dedicated Pilot symbol.	TCH dedicated Pilot symbol
		Time multiplexed	Time multiplexed (Midamble for Joint Detection)
	Detection	Coherent based on Pilot Symbols	Coherent based on Midamble Symbols
	Power control	Closed-loop (0.8-0.1kbps DCH SIR based)	Closed-loop (0.1-0.02k cycles/sec)*1
	Variable rate concept	Orthogonal VSF + VTS(Time slot)+VMC(Multi-code)+ DTX	Orthogonal VSF +VTS+VMC+ DTX
UL	Data mod.	QPSK	QPSK
	Spreading mod.	QPSK	QPSK
	Spreading code	1 symbol length	1 symbol length
	Scrambling code	2^9x720ms	1 symbol length (Cell specific)

	Pilot structure	Time multiplexed	Time multiplexed (Midamble for Joint Detection)
	Detection	Coherent based on Pilot Symbols	Coherent based on Midamble Symbols
	Power control	Fast Open-loop (Perch CH based) + Closed -loop (0.8-0.1kbps DCH SIR based)	Open-loop(initial), Closed-loop (0.1-0.02k cycles/sec)
	Variable rate concept	VSF+ Rate Matching+ Multi-code	VSF+VTS(Time Slot)+VMC
Cannel Coding		Convolutional code Turbo code	Convolutional code RS code Turbo code
Interleaving		10/20/40/80ms	10/20/40/80ms
Rate Detection		Variable length RI (with/without Blind detection)	Not clearly defined in the UTRA proposal (Negotiation by MAC Layer)
Other Features		BS Tx-diversity	Joint Detection is required DCA is required
Random Access		Message(10ms) SF=128,32	RACH specific slot
TPC		1dB(DL) 0.25dB(UL)	2dB(1.5-3dB)
Super Frame Length		720ms	240ms (multi-frame)

*1: The descriptions of the system description and technology template are different. The TPC concept of original proposal is based on slow control.

5.2 cdma2000

The RTT proposal from TIA/TR45.5.4 based on cdma2000 is designed for the third generation evolution of the TIA/EIA-95-B family of standards to meet the ITU IMT-2000 requirements. In ARIB, the basic architecture of cdma2000 RTT was presented in July 1997 by the cdmaOne group, consisting of several manufacturers of North America and Korea. It was recognized that the proposal contained many similar technologies to ARIB's W-CDMA RTT, since both RTTs are based on a direct sequence CDMA (DS-CDMA) technique. For approximately one year, ARIB studied and discussed the proposed technologies, and how to solve the differences between the two proposals. As a result, in April 1998, ARIB managed to derive a consensus on almost all major technical points, e.g. modulation scheme, BTS sync/async operation, etc., except for the chip rate. Table 5.2 shows the current technical differences between cdma2000 and ARIB's W-CDMA proposals in the FDD mode. In order to achieve a common solution between the two wideband CDMA-based RTT proposals, TIA and ARIB started to discuss how to harmonize both RTT's based on the consensus made in April 1998, e.g. forward and reverse link structure, turbo coding, power control rate, etc. The harmonization efforts continue in the future standardization process.

Table 5.2 Technical difference (FDD Mode)

	ARIB(W-CDMA)	TIA TR45.5 cdma2000
Multiple Access	DS-CDMA	DS-CDMA or multi-carrier CDMA

Band Width		5MHz (1.25/10/20)	3.75MHz (1.25 x N times, N=3) Other bandwidths (1,25 xN , N=1, 6, 9, 12)
Chip Rate		4.096Mcps (1.024/8.192/16.384)	3.6864Mcps (1.2288xN, N=3) (Other chip rates : Nx1.2288, N=1, 6, 9, 12)
Inter BS timing		Asynchronous (Sync. possible)	Synchronous
Cell Search Scheme		3 step code acquisition based on non-scrambled symbols	Pilot channel
Frame Length		10ms	Common control CH : 5ms, 10ms, 20ms Dedicated control CH : 5ms or 20ms Supplemental CH : 20ms
HO		SHO (DHO)	SHO
DL	Data mod.	QPSK	QPSK
	Spreading mod.	QPSK	QPSK
	Pilot structure	TCH dedicated Pilot symbol	Common Pilot symbols/ Auxiliary PL
		Time multiplexed	Code multiplexed
	Detection	Pilot symbol-based coherent	Pilot symbol-based coherent
	Power control	Closed-loop based on dedicated CH SIR - 1.6kbps	Closed-loop based on Fundamental CH. or DCCH SIR - 0.8kbps
UL	Data mod.	BPSK	BPSK
	Spreading mod.	HPSK(OCQPSK)*	QPSK
	Pilot structure	IQ multiplexed	IQ/code multiplexed
	Detection	Pilot based coherent	Pilot based coherent
	Power control	Open-loop(initial, RACH), Closed-loop (1.6kbps DCH SIR based)	Open-loop + Closed-loop (0.8kbps Pilot code SIR based)
Channel Coding		Convolutional codes Turbo codes	Convolutional codes Turbo codes
Interleaving periods		10/20/40/80ms	5/20ms

* The HPSK (QCQPSK) is the name for the joint modulation and spreading scheme. HPSK: Hybrid PSK. OCQPSK: Orthogonal Complex QPSK.

5.3 TTA proposal II

The Korean standards body, TTA, proposed two RTT candidates for the terrestrial system. One of them, the so-called TTA-II proposal is based on wideband DS-CDMA technology, which has the same key features with ARIB's W-CDMA such as chip rate and inter-cell synchronization requirement.

Between TTA and ARIB, studies have been carried out to compile a common standard for IMT-2000 since August 1997. As a result of such activities, a great deal of commonality with the ARIB proposal was identified. At the same time, TTA members participated in ARIB activities to achieve harmonization. TTA and ARIB also agreed to establish a Joint Study Group (JSG) to perform detailed technical discussion between the two bodies. JSG has been held once every two or three months since June 1998. The discussions for harmonizing the two proposals are still underway on a component technology basis. Thanks to the efforts undertaken so far, ARIB has agreed to adopt several technologies advocated by TTA, including optional uplink orthogonal transmission with time alignment function and a new uplink modulation scheme.

5.4 Future Global Harmonization

As described above, Japan has been conducting its studies in a flexible manner with a global perspective so that a common solution can be adopted on a global scale, while cooperating with the standards bodies of other countries and regions. Therefore, Japan is committed to continue the international harmonization initiative even after submitting this evaluation report to achieve a common global IMT-2000 system solution at ITU-R, and on a bilateral or trilateral basis, while taking into account of the deployment schedule of IMT-2000.

6. CONCLUSION

This report describes the evaluation results on the W-CDMA RTT proposal from Japan. The results of the evaluation show that the W-CDMA RTT proposal satisfies the requirements and objectives of IMT-2000. It is also confirmed that the proponent provides detailed and sufficient information on the RTT both from a qualitative and quantitative viewpoint. The report, thus, concludes that the proposed RTT is an excellent candidate for IMT-2000 proven with reliable information and data.

Attachment 1

Confirmation on Requirements and Objectives

This Attachment contains the following two Compliance Templates.

(1) Requirements and Objectives (Attachment 4 of Circular Letter)

(2) Additional Requirements and Objectives (ANNEX 4 of ARIB Evaluation Methodology)

Requirements and Objectives (Attachment 4 to Circular Letter)

Table 1
Technical Requirements and Objectives Relevant to the Evaluation of Candidate Radio Transmission Technologies

IMT-2000 Item Description	Obj/Req	Source	Meets?*	Proponent's Comment	Evaluator's Comment
Voice and data performance requirements					
1. One-way end-to-end delay less than 40 ms**	Req	G.174, § 7.5	Yes	Radio dependent delay within PLMN excluding CODEC delay is assumed at 35ms. Thus, the proposed RTT can satisfy the required delay for data transmission. Examples of estimated delays for uplink are as follows. Channel Processing at MS 12ms (Including Interleaving) Channel Processing at BS 15ms (Including De-Interleaving) Frame Processing at MSC 8ms Propagation delay in the Air is negligible. (See also ANNEX1 A1.3.7.1, A1.3.7.2 of System Description Template.) Speech PLMN delay depends on CODEC delay, and CODEC delay is assumed from 20ms to 45ms. This value depends on CODEC type and DSP performance. Thus, the objective value for the total speech delay in PLMN is 80ms or less.	The values for radio dependent delay are confirmed as reasonable. It is understood that the CODEC delay values are typical (Reference: ANNEX1 Technologies Description Template - A1.3.7.1, A1.3.7.2)

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

2. For mobile video telephone 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	The allowable end-to-end delay for video telephone services is assumed at 150-400ms. Radio dependent delay is assumed at 35ms, and network dependent delay shall be added. The network dependent delay is expected not exceeding 100ms. Thus, one-way delay is expected not exceeding 135ms.	It is confirmed that the assumed values of the radio dependent delay and network dependent delay are valid for the maximum overall delay.
3. Speech quality should be maintained during $\leq 3\%$ 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	The speech quality is dependent on CODEC rather than RTT. CODEC is now under study, see Annex1 A1.2.19 and A1.3.8 of Technology Description Template. The proposed RTT can provide high-quality bearer channels.	It is confirmed that speech quality depends on a CODEC. The various speech CODEC schemes under consideration are expected to satisfy the speech quality criterion. (Reference: ANNEX1 Technologies Description Template – A1.2.19, A1.3.8)
4.DTMF signal reliable transport (for PSTN is typically less than one DTMF errored signal in 10^4)	Req	G.174, § 8.5 & M.1079 § 7.2.1	Yes	This requirement is fulfilled with 64kbit/s PCM channel which enables transmission of any tone or signal within around 3kHz audio band, or out-band signaling messages such as keypad facility. Re-transmission technology such as ARQ will support reliable transportation of messages.	It is confirmed that the reliable DTMF signal transport can be supported with in-band or out-band signaling transmission. (Reference: ANNEX1 Technologies Description Template – A1.2.30)
5. Voiceband data support including G3 facsimile	Req	M.1079 § 7.2.2	Yes	This requirement is fulfilled with 64kbit/s PCM channel which enables transmission of any tone or signal within around 3kHz audio band, or inter-working functions.	It is confirmed that the transmission of voiceband data including G3 facsimile is supported by 64kbps PCM channel.
6. 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	Quality of both packet switched data and circuit switched data services are satisfied with more than the minimum performance capabilities defined in Attachment 6 of Circular Letter. See Annex2 Minimum Performance Capability for IMT-2000 Candidate RTT, and Link Budget calculation, Simulation Result, for details.	It is confirmed that packet and circuit switched data services are supported. (Reference: Minimum Performance Capabilities for IMT-2000 Candidate RTT)
Radio interfaces and subsystems, network related performance requirements					

** 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.

7. Network interworking with PSTN and ISDN in accordance With Q.1031 and Q.1032	Req	M.687-2 § 5.4	Yes	This requirement is regarded to be supported by network capabilities. However, the proposed RTT can support such requirement. See ANNEX1 Technologies Description template A1.4.6, A1.4.7.1, A1.4.8.	It is confirmed that the requirement is supported by the network capabilities. (Reference: ANNEX1 Technologies Description Template - A1.4.6, A1.4.7.1, A1.4.8)
8. Meet spectral efficiency and radio channel performance requirements of M.1079	Req	M.1034–1 § 11.3.3/4	Yes	The spectrum efficiency of the proposed RTT is assumed to exceed those of current mobile systems. See ANNEX1 Technologies Description template A1.3.1.5.1, A1.3.1.5.2.	It is confirmed that the spectrum efficiency requirement is supported. (Reference: ANNEX1 Technologies Description Template - A1.3.1.5.1, A1.3.1.5.2)
9. Provide phased approach with data rates up to 2 Mbit/s in phase 1	Obj	M.687-2, § 1.1.6	Yes	The proposed RTT offers this capability. See 3.3.5.4, ANNEX1 A1.2.20.1, A1.2.20.2, A1.2.20.3, A1.3.3.	Confirmed. (Reference: 3.3.5.4, ANNEX1 A1.2.20.1, A1.2.20.2, A1.2.20.3, A1.3.3)
10. Maintain bearer channel bit-count integrity (e.g. synchronous data services and many encryption techniques)	Obj	M.1034-1, § 10.2.5	Yes	Frame/symbol/bit synchronization of the system are realized with bearer channel bit-count integrity. Digital synchronization with wide dynamic range will be applied for this purpose.	Proponent's comment is sufficient. It is considered that this objective can be achieved by digital synchronization with wide dynamic range provided by the proposed RTT.
11.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	The proposed RTT supports each of the different cell types. Some examples of cell sizes can be seen in the Link Budget tables, and A1.3.1.7.1, A1.3.1.7.2, A1.3.4. The cell size will depend on transmission power, antenna gain, etc. Note that some technical enhancements may be needed to support mega-cell.	Proponent's comment is sufficient. It is confirmed that the Link Budget tables and A1.3.1.7.1, A1.3.1.7.2, A1.3.4 show some examples of cell sizes.
Application of IMT-2000 for fixed services and developing countries					
12. Circuit noise - idle noise levels in 99% of the time about 100 pWp	Obj	M.819-2, § 10.3	Yes	This objective can be achieved easily by using appropriate CODEC. The 64k PCM or other CODEC using digital processing can support this objective.	Proponent's comment is sufficient. It is considered that this objective can be achieved by the CODEC using digital processing.

13. Error performance - as specified in ITU-R F.697	Obj	M.819-2, § 10.4	Yes	Error performance shall be satisfied so that the quality of speech, audio, video and data services should be as good as those in the fixed network services. In the Link Budget calculation, a 95% coverage area probability is assumed. This objective can be achieved by changing this coverage area probability, and by adjusting the transmission power or fade margin. See Link Budget tables.	Proponent's comment is sufficient. The Link Budget tables show that this objective is supported.
14. Grade of service better than 1%	Obj	M.819-2, § 10.5	Yes	This objective is regarded as network capability, and depends on operator's business strategy and market conditions. Note that the proposed RTT itself can support this objective thanks to its reliable transmission capability.	Proponent's comment is sufficient. It is considered that this objective is deployment dependent.

TABLE 2

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

IMT-2000 Item Description	Obj/Req	Source	Meets?	Proponent's Comment	Evaluator's Comment
Radio interfaces and subsystems, network related performance requirements					
1. Security comparable to that of PSTN/ISDN	Obj	M.687-2 § 4.4	Yes	This objective depends on network capabilities. However, the proposed RTT can support this objective through reliable transmission of signaling messages.	Proponent's comment is sufficient, because this objective is higher layer dependent.
2. Support mobility, interactive and distribution services	Req	M.816-1 § 6	Yes	This requirement depends on network capabilities. However the proposed RTT can support this requirement through reliable transmission of signaling messages.	Proponent's comment is sufficient, because this requirement is higher layer dependent.
3. Support UPT and maintain common presentation to users	Obj	M.816 § 4	Yes	This objective depends on network capabilities. However, the proposed RTT can support this objective through reliable transmission of signaling messages.	Proponent's comment is sufficient, because this objective is higher layer dependent.

4. 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	This requirement depends on CODEC. However, the proposed RTT supports sufficient quality of the bearer channel.	Proponent's comment is sufficient. It is confirmed that voice quality depends on CODEC. Simulation results show that it is capable to obtain the required radio quality.
5. Support encryption and maintain encryption when roaming and during handover	Req	M.1034-1 § 10.3.1/2	Yes	This requirement depends on network capabilities. However, the proposed RTT can support this requirement by reliable transmission of signaling messages.	Proponent's comment is sufficient, because this objective is higher layer dependent. Encryption is supported by higher layers.
6. Network access indication similar to PSTN (e.g. dialtone)	Req	M.1034-1 § 10.1.9	Yes	It is easy and effective to make such indication at the mobile terminal itself.	The description is confirmed to be appropriate. It is considered that such indication can be easily made at the mobile terminal.
7. Meet safety requirements and legislation	Req	M.1034-1 § 10.6.1	Yes	The proposed RTT has a mechanism to minimize the output power. Due to continuous transmission in CDMA, the peak power can be kept low.	The description is confirmed to be appropriate.
8. Meet appropriate EMC regulations	Req	M.1034-1 § 10.6.2	Yes	It may depend on the equipment specification. However, continuous transmission can inherently offer solutions to meet EMC-related regulations.	The description is confirmed to be appropriate.
9. Support multiple public/private/ residential IMT-2000 operators in the same locality	Req	M.1034-1 § 11.1.2	Yes	Frequency coordination may be needed.	Confirmed. The comment is valid.
10. Support multiple mobile station types	Req	M.1034-1 § 11.1.4	Yes	The proposed RTT does not restrict the types of mobile stations. Various types of mobile stations can be supported. For example, mobile stations can be made with various types of maximum output power, and service capabilities (Voice only, with high speed data), etc.	Confirmed. This requirement is also implementation dependent.
11. Support roaming between IMT-2000 operators and between different IMT-2000 radio interfaces/ environments	Req	M.1034-1 § 11.2.2	Yes	This objective depends on the network capabilities. However, the proposed RTT can support this requirement through reliable transmission of signaling messages. Multi-mode terminal or card-roaming using UIM may be helpful to support this objective.	The comment is valid. This objective mainly depends on network capabilities.

12. 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	The proposed RTT supports all environments except for satellite. (The ability for satellite has not been considered yet.) Both inter-cell and intra-cell diversity handover techniques are applied. See Annex 1 A1.2.24. Multi-mode terminals may be used to support handover between different types of IMT-2000 operators.	The proponent's comment is valid. Annex1 A1.2.24 supports this comment.
13. 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	The proposed RTT can support various cell sizes simultaneously, and repeaters can be used. See Annex1 A1.2.28.	The proponent's comment is valid. The comment is supported by Annex1 A1.2.28.
14. Support multiple operator coexistence in a geographic area	Req	M.1034-1 § 11.2.5.4	Yes	Coexistence of multiple operators is possible by coordinating the spectrum allocation. See Annex1 A1.2.26.	The proponent's comment is valid. Annex1 A1.2.26 supports this comment.
15. 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	The combination of FDD and TDD modes can support this requirement, while some coordination of spectrum allocation may be needed. See Annex1 A1.2.26.	The proponent's comment is valid. Annex1 A1.2.26 supports this comment.
16. Support mechanisms for minimizing power and interference between mobile and base stations	Req	M.1034-1 § 11.2.8.3	Yes	The proposed RTT includes a precise closed-loop power control mechanism based on SIR measurement . See Annex1 A1.2.22.	The proponent's comment is valid. A1.2.22 supports this comment.
17. Support various cell types dependent on environment (M.1035 § 10.1)	Req	M.1034-1 § 11.2.9	Yes	The proposed RTT can support various cell types simultaneously. See Annex1 A1.2.28.	The proponent's comment is valid. A1.2.28 supports this comments.
18. High resistance to multipath effects	Req	M.1034-1 § 11.3.1	Yes	A RAKE receiver technique enhancing the performance in a multi-path environment is applied. See Annex1 A1.2.14 and A1.2.23.	The proponent's comment is valid, A1.2.14 and A1.2.23 support this comment..

19. Support appropriate vehicle speeds (as per § 7) NOTE: applicable to both terrestrial and satellite proposals	Req	M.1034-1 § 11.3.2	Yes	The maximum vehicle speed r depends on receiver implementation. The proposed RTT is highly tolerable against variations in path amplitudes and phases, due to very short pilot symbol period of 0.625ms. Coherent detection, thus, can cope with the vehicle speed of 250 km/h without any serious performance degradation. Higher speeds up to 500km/h can be supported, but may require advanced detection technique such as decision-directed adaptive coherent detection.	It is confirmed that the proposed RTT offers the capability to satisfy this requirement.
20. Support possibility of equipment from different vendors	Req	M.1034-1 § 11.1.3	Yes	Since a well detailed interface specifications are provided, infrastructure and user equipment can be supplied by different vendors.	Confirmed. The description is appropriate.
21. Offer operational reliability at least as good as 2nd generation mobile systems	Req	M.1034-1 § 11.3.5	Yes	This requirement depends on the equipment specification and design. However, the proposed RTT is largely based on mature technology, so the risk for degrading reliability is minimal.	Confirmed. The description is appropriate.
22. 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	It depends on the mobile terminal specifications, but the proposed RTT supports the required types of terminals.	Confirmed. The description is appropriate.
23. End-to-end quality during handover comparable to fixed services	Obj	M.1034-1 § 11.2.3.4	Yes	A diversity handover technique enables to maintain the quality during handover. See Annex 1 A1.2.24.	Confirmed. The proposed RTT satisfies this objective.
24. Support multiple operator networks in a geographic area without requiring time synchronization	Obj		Yes	The proposed RTT doesn't require time synchronization between base stations.	Confirmed by 3.5.1.1 of the System Description.
25. 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	This objective depends on network capabilities in Layer 3. Among the Layer 3 functions, only radio resource management may be radio dependent.	Confirmed. The description is appropriate.

26. Desirable that transmission quality requirements from the upper layer to physical layers be common for all services	Obj	M.1035 § 8.1	Yes	The required quality of services is achieved. The proposed RTT can support various types of QoS. Different types of physical channels and service multiplexing on to one channel are made available in the proposed RTT. The proposal offers a variety of options; the transmission quality requirement can either be made common to all services, or independent for each service.	Confirmed. Different services have different quality of service requirements. Various types of QoS can be supported by the flexible capabilities of the proposed RTT.
27. The link access control layer should as far as possible not contain radio transmission dependent functions	Obj	M.1035 § 8.3	Yes	The radio dependent part is minimized. Only the interface between LAC and MAC may be radio dependent.	Confirmed The proposed RTT satisfies this objective. Reference: RTT Fig.2-2-1
28. Traffic channels should offer a functionally equivalent capability to the ISDN B-channels	Obj	M.1035 § 9.3.2	Yes	The proposed RTT has the capability to support up to 2Mbps. See 3.3.5.2 and 3.3.5.3 of System Description, and Annex1 A1.2.20.1.	Confirmed. The proposed RTT satisfies this objective. Description: A1.2.20.1
29. Continually measure the radio link quality on forward and reverse channels	Obj	M.1035 § 11.1	Yes	Frame error measuring based on CRC check, and bit error rate estimation using e.g., RSSI or SIR measurement, are provided on both downlink and uplink.	Confirmed. The proposed RTT satisfies this objective. Description: RTT 3.5.3
30. Facilitate the implementation and use of terminal battery saving techniques	Obj	M.1035 § 12.5	Yes	Intermittent receiving and technologies to minimize the output power are applied for the proposed RTT. See Annex1 A1.2.29.	Confirmed. The proposed RTT satisfies this objective. Description: A1.2.29
31. Accommodate various types of traffic and traffic mixes	Obj	M.1036 § 1.10	Yes	Various types of bearer services can be supported simultaneously. Different types of physical channels and service multiplexing on to one channel are made available in the proposed RTT.	The description is appropriate. It is confirmed by the description on service multiplexing.
Application of IMT-2000 for fixed services and developing countries					
32. Repeaters for covering long distances between terminals and base stations, small rural exchanges with wireless trunks etc.	Req	M.819-2 Table 1	Yes	Repeaters and wireless trunks can be applied. See A1.3.5.	Confirmed. The proposed RTT satisfies this requirement. Description: A1.3.5.
33. Withstand rugged outdoor environment with wide temperature and humidity variations	Req	M.819-2 Table 1	Yes	The proposed RTT can withstand such environments. However, note that this depends on the equipment specifications.	Confirmed. This requirement depends on equipment specifications.

34. Provision of service to fixed users in either rural or urban areas	Obj	M.819-2 § 4.1	Yes	The proposed RTT can provide service in such areas.	Confirmed. Proposed RTT satisfies this objective.
35. Coverage for large cells (terrestrial)	Obj	M.819-2 § 7.2	Yes	The proposed RTT can support macro cells. See Link Budget, and Annex1 A1.3.4. Note that some considerations may be needed for mega-cells. The proposed system may offer larger coverage when the user density is smaller, as described in § 7.2 of M.819-2, than the prescribed 0.1% subscriber penetration in M.1225 Annex 2.	The proponent's comment is confirmed by the Link Budget in Technologies Description Template. Cell radiuses of 3 to 6 km are shown in the vehicular test environment for both speech and data services. If the calculation is based on a single user and single cell environment, the proponent's descriptions that coverage becomes larger when user density is lower can be verified.
36. Support for higher encoding bit rates for remote areas	Obj	M.819-2 § 10.1	Yes	The proposed RTT supports various types of data rates, ranging from low to high rates. See Chapter 2 to 5 of the System Description.	The proponent's comment is confirmed by Chapters 2 to 5 of the System Description. Various types of data transmission up to 2Mbps are declared and the method to accommodate such data rates is described in the Chapters.
Additional satellite- component specific requirements and objectives					
37. Links between the terrestrial and satellite control elements for handover and exchange of other information	Req	M.818-1 § 3.0	N/A	The proposed RTT has not yet considered the details on the applicability for satellite environment.	No considerations are made for the satellite environment.
38. Take account for constraints for sharing frequency bands with other services (WARC-92)	Obj	M.818-1 § 4.0	N/A	The proposed RTT has not yet considered the details on the applicability for satellite environment.	No considerations are made for the satellite environment.
39. Compatible multiple access schemes for terrestrial and satellite components	Obj	M.818-1 § 6.0	N/A	The proposed RTT has not yet considered the details on the applicability for satellite environment.	No considerations are made for the satellite environment
40. Service should be comparable quality to terrestrial component as far as possible	Obj	M.818-1 § 10.0	N/A	The proposed RTT has not yet considered the details on the applicability for satellite environment.	No considerations are made for the satellite environment.
41. Use of satellites to serve large cells for fixed users	Obj	M.819-2 § 7.1	N/A	The proposed RTT has not yet considered the details on the applicability for satellite environment.	No considerations are made for the satellite environment.
42. Key features (e.g. coverage, optimization, number of systems)	Obj	M.1167 § 6.1	N/A	The proposed RTT has not yet considered the details on the applicability for satellite environment.	No considerations are made for the satellite environment.

43. Radio interface general considerations	Req	M.1167 § 8.1.1	N/A	The proposed RTT has not yet considered the details on the applicability for satellite environment.	No considerations are made for the satellite environment.
44. Doppler effects	Req	M.1167 § 8.1.2	N/A	The proposed RTT has not yet considered the details on the applicability for satellite environment.	No considerations are made for the satellite environment.

TABLE 3

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

IMT-2000 Item Description	Obj/Req	Source	Meets?	Proponent's Comment	Evaluator's Comment
1. Fixed Service - Power consumption as low as possible for solar and other sources	Req	M.819-2 Table 1	Yes	The proposed RTT has a power control mechanism which minimizes the output power. See 3.5.3 of System Description.	The proponent's comment is confirmed by 3.5.3 of System Description for Power Control.
2. Minimize number of radio interfaces and radio sub-system complexity, maximize commonality (M.1035 § 7.1)	Req	M.1034-1 § 11.2.1	Yes	The proposed RTT is applicable to all terrestrial environments. See Annex1 A1.1.1, A1.1.2, A1.1.3, and Annex3.	All terrestrial environments are discussed in the System Description, Technologies Description Template including the Evaluation Results
3. Minimize need for special interworking functions	Req	M.1034-1 § 11.2.4	Yes	Interworking functions may be needed only when connecting to other systems.	Interworking functions are not included in the RTT proposal and should be discussed in the studies on the network. This question, therefore, does not need to be discussed here.
4. Minimum of frequency planning and inter-network coordination and simple resource management under time-varying traffic	Req	M.1034-1 § 11.2.6	Yes	Resource management can be carried out easily. See 2.1 of System Description.	The proponent's comment is confirmed by the descriptions in §2.1 of System Description.
5. Support for traffic growth, phased functionality, new services or technology evolution	Req	M.1034-1 § 11.2.7	Yes	The proposed RTT can be expanded to new types of services or traffics.	Confirmed. Several chip rates are adopted in the proposed system. It can handle well traffic growth, phased introduction of functionality and new services.

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

6. Facilitate the use of appropriate diversity techniques avoiding significant complexity if possible	Req	M.1034-1 § 11.2.10	Yes	It is easy to use diversity techniques for the proposed RTT. RAKE diversity and site diversity are applied in the proposal. The nature of wideband spectrum offers high performance by using RAKE diversity. See 2.1 of the System Description.	The proponent's comment is confirmed through the description of §2.1 of the System Description.
7. Maximize operational flexibility	Req	M.1034-1 § 11.2.11	Yes	This requirement depends on the capabilities of the higher layers. However, the proposed RTT supports the modification of operational data in the mobile station via the radio interface.	Confirmed. It can be considered that, the proposed RTT can support this requirement, e.g. via bearer channels.
8. Designed for acceptable technological risk and minimal impact from faults	Req	M.1034-1 § 11.2.12	Yes	The proposed RTT is specified based on field trial results (see Introduction of the System Description). Therefore, such risks are kept low. See Annex1, A1.2.25, A1.2.26, A1.2.27, A1.3.9, A1.4.15 and A1.4.17.	(1)According to the Introduction of System Description, it is confirmed that the proposed RTT is designed based upon the results from two years of intensive studies with hardware demonstration and field trials. It can be considered the proposed RTT investigated various operational conditions. (2) Descriptions in A1.2.25, A1.2.26, A1.2.27, A1.3.9, A1.4.15 and A1.4.17 in the System Description show the proposed RTT has sufficient capability to reduce operational risks.
9. 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	This objective is handled by resource management functions. See 3.5 of System Description, and Annex1 A1.2.28.	Confirmed by the following descriptions in the System Description: 3.5: Radio Resource Functions A1.2.28: Mixed cell architecture
10. Minimize terminal costs, size and power consumption, where appropriate and consistent with other requirements	Obj	M.1036 § 2.1.12	Yes	This objective may depend on manufacturers' designs. The proposed RTT itself has a mechanism to minimize the output power and to perform intermittent receiving to reduce power consumption. See Annex1 A1.2.29, A1.2.29.1.	Confirmed by the following descriptions in the System Description: A1.2.29 and A1.2.29.1.

Additional Requirements and Objectives (ANNEX 4 of ARIB Evaluation Methodology)

ARIB Evaluation group requests additional requirements and objects that will be used by the group in its evaluation process in addition to original Requirements and Objectives shown ATTACHMENT 4 of Circular letter.

Table 1
Generic Requirements and Objectives Relevant to the Evaluation of Candidate Radio Transmission Technologies

IMT-2000 Item Description	Obj/Req	Source	Meets?[1]	Proponent's Comment	Evaluator's Comment
Radio interfaces and subsystems, network related performance requirements					
1. Support of IP(Internet Protocol)-based services which provide a number of multimedia and data application via the Internet	Obj	ARIB[2] § 5.1.1.6	Yes	This objective depends on network capabilities, but the proposed RTT can support such capability as packet type data transfer.	Confirmed. (Given description is sufficient.)
2. Support Location services using position identification information with appropriate accuracy	Obj	M.816 § 8.2.2	Yes	Various positioning methods can be applied. When TOA (Time of Arrival) or TDOA (Time Difference of Arrival) methods are applied, high accuracy can be achieved. For example, when 1/4 chips synchronization accuracy is assumed at 4Mcps, position can be estimated with a precision of 114m or better. The accuracy depends on implementation.	As mentioned in the proponent's comment, it can be considered that the proposed RTT can support the required Location Service requirements using various position detection methods. The actual accuracy may be implementation dependent.
3. Support Priority Access and The Emergency services as are contained in ITU-T Recommendation F.115.	Req	M.1034-1 § 10.16	Yes	This requirement depends on network capabilities. However, the proposed RTT can support this requirement through reliable transmission of signaling messages.	(1) The requirement should be mainly supported by the higher layer functions and the network side. (2) Reliable transmission is one of the fundamental features to support the required services. It is considered that it can be achieved by well-designed schemes mentioned in the System Description 3.3 through 3.5.

[1] Explanation is requested when the candidate SRTT checks the No box.
[2] ARIB 'Requirements and Objectives for a 3G Mobile Services and System'

Attachment 2

Confirmation on the Minimum Performance Capabilities

(Attachment 6 to the Circular Letter)

Test environments	Reference	Indoor Office	Outdoor to Indoor and Pedestrian	Vehicular
Mobility considerations		mobility type (low)	mobility type (medium)	mobility type (high)
Handover	A1.2.24, A1.2.24.1, A1.2.24.2	Yes	Yes	Yes
Evaluator's Comment	References show the descriptions on required capabilities. Simulation method is described in ANNEX3-Soft/Softer Data Combining (§1.1.2.3).	It is confirmed as follows. Description: System Description and ANNEX1-Template. Simulations were conducted assuming inter-cell handover.	-same as left-	It is confirmed as follows. Description: System Description and ANNEX1-Template. Simulations were conducted assuming inter/intra-cell handover.
Support of general service capabilities				
Packet data	A1.2.20.2, A1.2.20.3, §3.1.1.3, §3.3.5.5 and §3.5.6	Yes	Yes	Yes
Evaluator's Comment	References show descriptions on required capabilities.	Service support capabilities for packet data are described in System Description (§3.1.1.3, §3.3.5.5 and §3.5) and Technologies Description Template.	-same as left-	-same as left-

Asymmetric services	A1.2.3,A1.2.20 §2.1, §2.3, §3.3.4, §3.5.4, §4.4	Yes	Yes	Yes
Evaluator's Comment	References show the descriptions on required capabilities.	Confirmed. A1,2,3, A1.2.20 and §2.1, §2.3, §3.3.4, §3.5.4, §4.4 of the System Description describe that the proposed RTT can support asymmetric services. For FDD mode, puncture and repetition (§3.3.4) are used for rate matching, and they support asymmetric services. For TDD mode, flexible UL/DL timeslot allocation supports asymmetric services (§4.4).	-same as left-	-same as left-
Multimedia	A1.2.21, A1.2.31, A1.3.3	Yes	Yes	Yes
Evaluator's Comment	References show descriptions on required capabilities	Confirmed by the description and simulation results in Annex3. It is considered that those various bearers can support multimedia applications. The variable rate and multicode transmission capabilities of the proposed RTT support multi-bearer services.	- same as left -	- same as left -
Variable bit rate	A1.2.18, A1.2.18.1 §3.5.4., §4.7.4	Yes	Yes	Yes

Evaluator's Comment	References show descriptions on required capabilities.	Confirmed. A1.2.18 and A1.2.18.1 of the System Description describe that the proposed RTT supports variable bit rates. §3.5.4. §4.7.4 of System Description describes FDD and TDD mode in details, respectively.	- same as left -	- same as left -
Data services key capabilities		user bit rates BER	user bit rates BER	user bit rates BER
Circuit-switched low and long delay	Simulation Models and Evaluation Results, §3.3.5	2048 kbps $\leq 10^{-6}$	384 kbps $\leq 10^{-6}$	384 kbps $\leq 10^{-6}$
Evaluator's Comment	References show descriptions on required capabilities. Service Example (§3.3.5)shows channel coding and mapping up to 2Mbps.	Confirmed. Evaluation results for 64kbps and 2048kbps are shown in §1.2.2.2.1 and §1.3.2.2.1 of Simulation Models and Evaluation Results.	Confirmed. Evaluation results for 64kbps and 384kbps are shown in §1.2.2.2.1 and §1.3.2.2.1 of Simulation Models and Evaluation Results.	Confirmed. Evaluation results for 64kbps, 144kbps and 384kbps are shown in §1.2.2.21 and §1.3.2.2.1 of Simulation Models and Evaluation Results.
Packet	Simulation Models and Evaluation Results §3.5.6, §4.7.7	2048 kbps $\leq 10^{-6}$	384 kbps $\leq 10^{-6}$	384 kbps $\leq 10^{-6}$

Evaluator's Comment	References show descriptions on required capabilities. It is confirmed that packet is described by the System Description (§3.5.6, §4.7.7) and ANNEX1- Template (A1.3.1.2). Simulation results of Packet (UDD) are presented in ANNEX3-Results (§1.2, §1.3.2). Performance of Packet is evaluated by BLER, and the reason is shown in Performance measures- Packet services (§1.1.2.6).	Confirmed. Evaluation results for 64kbps and 2048kbps are shown in §1.2.2.2.2 and §1.3.2.2.2 of Simulation Models and Evaluation Results.	Confirmed. Evaluation results for 64kbps and 384kbps are shown in §1.2.2.2.2 and §1.3.2.2.2 of Simulation Models and Evaluation Results.	Confirmed. Evaluation results for 64kbps, 144kbps and 384kbps are shown in §1.2.2.2.2 and §1.3.2.2.2 of Simulation Models and Evaluation Results.

Attachment 3

Verification of simulation conditions and results

The Evaluation Group of ARIB reviewed the simulation conditions and results for the spectrum and coverage efficiency for Japan's W-CDMA proposal, which was submitted to ITU-R in June 1998. The following major comments were pointed out to Ad Hoc-T Group of ARIB, the group in charge of drafting the proposal. The W-CDMA proposal was slightly modified based on the correspondence between the Evaluation Group and Ad Hoc-T. The following table presents the major comments from the Evaluation Group, and results of modifications made by Ad Hoc-T.

Comments from the Evaluation Group	Results of modifications	Related section in the proposal
Simulation results of the Channel B defined in Annex 2 / M.1225 are not provided.	The simulation results and conditions for the Channel B are included as reference information.	Annex 3
Simulation results of the services based on Turbo code are not provided.	The simulation results and conditions for Turbo codes are included as reference information.	Annex 3
Simulation results of LDD are not provided.	Reason for no LDD results is added referring to the ARIB Evaluation Methodology.	1/ Annex 3
Deployment model result matrix is recommended to use.	The deployment models and matrixes are included.	3/ Annex 3
Results of LCD/UDD 384 in uplink for the Vehicular environment are not provided.	The results are included.	Annex 3
The PC dynamic range 80 dB seems to be wrong.	It is corrected to 'Infinite'.	Table 3 and 19/ Annex 3
The antenna diversity of downlink MS-Rx 'On and Off' is not relevant.	It is corrected to 'Off'.	Table 21/ Annex 3
The cell capacity of downlink LCD64 in Indoor (A) '5.66 Erlang/carrier/cell' seems to be wrong.	It is corrected to '22.7'.	Table 16 and 18/ Annex 3
The cell capacity of downlink LCD64 in Indoor (A) '3.32 Erlang/carrier/cell' seems to be wrong.	It is corrected to '16.1'.	Table 26 and 28/ Annex 3
The cell capacity of downlink LCD64 in Vehicular (A) '12.0 Erlang/carrier/cell' seems to be wrong.	It is corrected to '6.9'.	Table 26 and 28/ Annex 3
The spectrum efficiency of downlink UDD384 in Vehicular (A) '217.2 kbps/MHz/cell' seems to be wrong.	It is corrected to '175'	Table 27 and 28/ Annex 3

The RX antenna gain for uplink should not be 13 dB, but 10 dB.	It is corrected to 10 dB, based on which the Link Budget is re-calculated.	Link Budget template for LCD and UDD in Pedestrian
The values of Power control TX power increase are different from those in UTRA.	They are corrected to the same values as UTRA, and the Link Budget is calculated again.	Link Budget template for UDD in Indoor office and Pedestrian
The coverage efficiency '0.0 km^2/site' is not relevant.	It is corrected to '0.05'.	Link Budget template for LCD2048 in Indoor office

In addition to the above modifications, descriptions in the W-CDMA proposal were brushed up based on the comments from the Evaluation Group, in order to facilitate understanding of Annex 3 'Simulation Models and Evaluation Results' and the link budget template in the proposal.

Attachment 4

Evaluation Spread Sheet

Index	Criteria and attributes	Q or q	Gn	Related attributes in Annex 1	Proponent's Comment	Evaluator's Comment
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 x 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	The results of the vehicular-(A) environment are as follows. FDD mode : 57 Erlangs/MHz/cell (up-link) 56.5 Erlangs/MHz/cell (down-link) These values are calculated using 'call capacity' for speech (20 ms interleave) in Annex 3 'Simulation Models and Evaluation Results' of this RTT proposal document as: (Call Capacity) x 3 / 5MHz. TDD mode : 106 Erlangs/MHz/cell (up-link) 68.0 Erlangs/MHz/cell (down-link) These values are calculated using 'call capacity' for speech (20 ms interleave) in Annex 3 'Simulation Models and Evaluation Results' of this RTT proposal document as: (Call Capacity) x 3 / (5MHz/2). A tri-sectored cell model is assumed. Please note that the word 'cell' is referred to as the area covered by a sector in Annex 3 'Simulation Models and Evaluation Results', while it is referred to as the area covered by three sectors in this template. The values for spectrum efficiency presented here are derived assuming 2 x 5 MHz bandwidth for FDD and 5	In the evaluation of the system capacity, it is very important to describe the conditions and assumptions of the simulations, since there is no concrete way to evaluate the capacity, and the results are strongly dependent on these conditions and assumptions. The description and Annex 3 'Simulation Models and Evaluation Results' are sufficient to clarify the results and conditions. The reasonable calculations make these results reliable. It is indicated that the proposal has a very high capacity of voice traffic on both FDD mode and TDD mode.

					MHz for TDD. With a 30-MHz bandwidth, the spectrum efficiency is equal or higher compared to these values. In other words, if multiple carriers are used independently, spectrum efficiency would not change. On the other hand, if multiple carriers are used as a chunk, higher spectrum efficiency can be expected because of trunking efficiency. Furthermore, the simulations are based on an infinite strict area model with 'wrap around', thus, better capacity could be expected, if an edged model were employed for the calculations. See Annex 3 See the Simulation Models and Evaluation Results for more information.	
A3.1.1.2	Information capacity (Mbit/s/MHz/cell) for voice and data(see Table1 of ANNEX2) 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	The results of the circuit-switched 144 kbps services in the vehicular-(A) environment are as follows. FDD mode : 0.657 Mbps/MHz/cell (up-link) 0.753 Mbps/MHz/cell (down-link) TDD mode : 0.846 Mbps/MHz/cell (up-link) 0.452 Mbps/MHz/cell (down-link) A tri-sectored cell model is assumed. Please note that the word 'cell' is referred to as the area covered by a sector in Annex 3 'Simulation Models and Evaluation Results' of this RTT proposal document while it is referred to as the area covered by three sectors in this template. The values for spectrum efficiency presented here are derived assuming 2 x 5 MHz bandwidth for FDD and 5 MHz for TDD. With a 30-MHz bandwidth, the spectrum efficiency is equal or higher compared to these values. In other words, if multiple carriers are used independently, the spectrum efficiency would not change. On the other hand, if multiple carriers are used as a whole, 30 MHz bandwidth higher spectrum efficiency is expected because of trunking efficiency. Furthermore, edge effects that tends to increase the capacity are eliminated employing 'wrap around.' See	In the evaluation of the system capacity, it is very important to describe the conditions and assumptions of the simulations, since there is no concrete way to evaluate the capacity, and the results are strongly dependent on these conditions and assumptions. The description and Annex 3 'Simulation Models and Evaluation Results' are sufficient to clarify the results and conditions. The reasonable calculations make these results reliable. It is indicated that the proposal has a very high information capacity on both FDD mode and TDD mode.

					Annex 3 Simulation Models and Evaluation Results for more information.	
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.				NA	NA
A3.1.2.1	Voice information capacity per required RF bandwidth (bit/s/Hz)	Q	G1	A1.3.2.3.1	NA	NA
A3.1.2.2	Voice plus data information capacity per required RF bandwidth (bit/s/Hz)	Q	G1	A1.3.2.3.2	NA	NA
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 hand-portable performance is considered elsewhere).					
A3.2.2	Transmitter power and system linearity requirements NOTE 1 – Satellite e.i.r.p. is not suitable for the evaluation and comparison of RTTs because it highly depends 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) Peak transmitter power for the BS should be considered because lower peak power contributes to lower cost. Note that Pb may vary with the applied test environment. This is the same peak transmitter power assumed in Annex 2, link budget template (Table 6).	Q	G1	A1.2.16.2.1	The maximum transmit power level per carrier depends on cell design, quality design and traffic design by operators. Nominal values of transmitter power per 8kbps voice transmission are ; FDD mode 10 dBm for Indoor, 20 dBm for Pedestrian, 30 dBm for Vehcular TDD mode 13.2 dBm for Indoor 23.2 dBm for Pedestrian, 33.2 dBm for Vehcular.	Proponent's comment is valid. Described power can be confirmed with the Annex1 link budget template.

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	Broadband power amplifiers are required. Required bandwidth is 1.25/5.0/10.0/20.0 MHz. See Link Budget Template. Nominal values of average transmitted power per 8kbps transmission are ; 0.01 W for Indoor, 0.1 W for Pedestrian, 1 W for Vehicular.	Proponent's comment is valid.
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	Leakage power at adjacent carrier frequency BS : -55 dB MS : -40 dB Linear amplifiers are required.	Described values are valid. Small impact for BS cost.
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	Linear amplifiers are required. According to the link budget template, the ratio is expected to be relatively small. Thus, low-cost linear amplifiers would be able to be applied. The peak–to-average ratio depends on traffic design by operators. The following is an example of a certain design. Peak-to-average ratio is 8dB on the following condition. Multiplied channels are 16*32ksps CH, 16*64ksps CH, 4*128k CH, 4*256k CH and 2*control CH. And the peak amplitude of multiplied output is limited to the level that degradation of the BER performance is negligible.	The proponent's comment is valid.
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	q	G4	A1.4.11 A1.4.12	Yes Above 80dB The accommodated user channels per RF carrier would decrease, depending on non-linearity above 80dB.	The qualitative comment is valid.

	impact of signal input variation exceeding this range, e.g., loss of sensitivity and blocking.					
A3.2.3	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.	Q and q	G4	A1.2.22 A1.2.22.1 A1.2.22.2 A1.2.22.3 A1.2.22.4 A1.2.22.5	Yes FDD mode: The RTT uses SIR based closed-loop power control on both uplink and down link. Open loop power control is used for random access. The use of fast power control significantly improves the link-performance (BER as a function of Eb/N_0) especially in the case of a slow moving mobile station. TDD mode: Open-loop power control on uplink based on the estimation of propagation loss from downlink (Perch Channel) improves the degradation due to fading. And it's possible to decrease the control accuracy and quality difference between channels by combining with SIR based closed loop power control. For downlink, SIR-based closed-loop power control is applied for reduction of the interference from other cells and improvement of the degradation due to fading. Typical step size : 1dB FDD mode : 1600 per second TDD mode : 800 per second 80dB :Uplink control range 30dB :Downlink control range Not specified FDD mode : 2.4dB @fD=222Hz, 2paths TDD mode : 3dB @fD=222Hz, 2paths	The proponent's comments are sufficient for quantitative questions. Detailed power control feature is shown. SIR based closed loop fast power control with 1600Hz is one characteristic for FDD mode, and open loop power control on reverse link is one characteristic for TDD mode.
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	Both FDD and TDD modes are specified. FDD mode: Duplexer needed. Transmit/receive isolation: Required isolation is no more than 60dB. The percentage of Duplexer cost in the total of the W-CDMA terminal equipment is not negligible at present, however, the cost can be lower through mass production in the future.	In case of the FDD mode, a duplexer is required and the isolation of 60dB is valid. The proponent's comment is very concrete.

					TDD mode: No duplexer needed Depends on system frequency bandwidth to be deployed. 80MHz is a sufficient value for the case of 60MHz bandwidth which is expected to be the size of one total contiguous bandwidth in FDD paired band.	
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	Q and q	G2	A1.4.13	The signal processing and memory requirements are implementation dependent. The following is an example of a particular design. MOPS : 25 MOPS Gate : 385k ROM : 90kB RAM : 90kB The above values are assumed on 64kbps user channel and includes the processing estimates of both uplink and downlink. The value of MOPS with DSP includes the signal processing such as searcher, RAKE, modulation, demodulation, TPC and so on. The channel encoding/decoding such as convolutional and turbo coding is not included. The required value of MOPS for channel coding by a general DSP is too large to be processed. For instance, the Viterbi decoding needs almost more than one hundred of MOPS. Therefore, the signal processing for channel coding should be performed by using the specific DSP or specific ASIC. The voice CODEC is not included.	The description is sufficient. The each value shown as an example is feasible to realize.

	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.					
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	Convolutional coding of R=1/3 or 1/2, K=9 Turbo codes with K=3 are applied to data transmissions of 32kbps and higher rates. Puncturing/Repetition for variable rate 8-bit, 13-bit, 14-bit or 16-bit CRC is used for error detection 10ms, 20ms, 40ms or 80ms interleaving Decoding scheme for FEC is an implementation issue and is not covered by the Specification	The description is sufficient.
A3.2.6	Antenna systems 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.					
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 and omni-directional antenna.	Q	G2	A1.2.23 A1.2.23.1 A1.2.23.2	Yes Time diversity: RAKE diversity with maximal ratio combining for both base and mobile station. Space diversity : (1) Antenna diversity with maximal ratio combining in base station and optionally in mobile station. (2) Transmit diversity in base station can be applied on downlink. For FDD mode, TDTD (Time Domain Transmit Diversity) can be used. There are two different modes of antenna switching control: PreDetermined(PD) mode and FeedBack(FB) mode.	The description is sufficient. The effects due to diversity on both FDD and TDD mode are described respectively and clearly.

					PD mode can be used on all channels. FB mode can be used on dedicated channels depending on channel conditions. For TDD mode, STD (Selective Transmit Diversity) or PTD (Parallel Transmit Diversity) can be employed. STD can be applied only to dedicated physical channels. (3) Site diversity Inter-sector : maximal ratio combining Inter-cell : maximal ratio combining (down link) and selection combining (uplink) Frequency diversity is not used Code diversity is not used. At least 4 finger RAKE receiver One RF receiver and one antenna per mobile station The degree of expected improvement depends on the environment: FDD mode RAKE diversity : 1.4dB @ fD=120Hz,2paths Space diversity (antenna diversity) : 2.4dB @fD=120Hz, 2paths Site diversity : 8dB @outage=5% TDD mode RAKE diversity : 1.4dB @ fD=120Hz, 2paths Space diversity : 2dB @ fD=120Hz, 2paths Site diversity : 8dB @outage=5%	
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	Remote antennas are available in the proposed system. In general, remote antenna is assumed for use in small areas of micro-cell or pico-cell environment such as indoor rooms, underground shopping areas etc. and at dead space of radio wave propagation. All the standard types of Base Stastion antenna can be used for both FDD and TDD modes. This includes those that povide omni-directional, sectored, fixed or variable patterns.	The description is sufficient. The environment where the coverage area can be extended is described. Further more, standard types of antenna is described.

A3.2.6.3	*Distributed antennas* : describe whether and how distributed antenna designs are used.	q	G3	A1.3.6	Distributed antennas can be used in micro cellular environments where the distribution of time delay spread is not sufficient for path diversity.	The description is sufficient. The available environment is described clearly.
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 advantages or application of the antenna system.	q	G4	A1.3.6	Adaptive antennas are recognized as a way to enhance capacity and coverage of the system. Solutions employing adaptive antennas are supported in the proposed RTT through the use of connection-dedicated pilot bits in both uplink and downlink. In other words, both the user information and the pilot bits that are necessary for demodulating the user information are directed to the user, because the pilot bits are dedicated to the connection. This channel structure greatly enhances the use of adaptive antennas. In addition, adaptive antenna considerations have been included in the design of the downlink common physical channels. For both FDD and TDD modes, transmit diversity can be used on downlink. See A.3.2.6.1 of this Attachment.	The description is sufficient. It is indicated that employment of adaptive antennas enhances capacity and coverage. The proposed RTT has the capability to adopt adaptive antennas since each traffic channel has its own pilot bits. Furthermore, transmit diversity is described.
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 for achieving this.	Q and q	G3	A1.4.1 A1.4.3	For TDD operation inter-cell synchronization is required. All base stations are required to operate synchronously within plus or minus 3 microseconds offset. External system reference from wire-line network or GPS receiver is required. It is possible to use GPS only for initial adjustment of synchronization among BSs. The synchronization can be maintained by external reference not only from GPS but also from wire-line network. Inter-cell synchronization is unnecessary for FDD operation. For both TDD and FDD modes, BS-to-network synchronization is required. BS transmission frequency stability of 0.05ppm is required. MS transmission frequency stability of 3ppm (unlocked) and 0.1ppm (locked) are required. Long-term free run accuracy of MS frequency and timing reference clock must be within 3ppm. Base-to-base bit time alignment must be within 10ms over a 24h period when soft handover between base stations is employed.	The description is sufficient. Requirements on inter-cell synchronization in TDD are presented explicitly with actual values of stability requirements. The proposal allows flexible cell deployment in FDD due to asynchronous inter-cell operation, though it is pointed out that interference may increase in downlink due to lack of orthogonality among signals transmitted from different BSs.

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 proposed RTT accommodates 128 data channels with FDD and 64 data channels with TDD per carrier for 4.096Mcps. The maximum number of channels is limited by the number of the orthogonal spreading codes for the downlink channel. Note that the number of actual communication channels depends on the environments and conditions. Refer to Annex 3 'Simulation Models and Evaluation Results' of RTT proposal for the actual capacity.	It is confirmed that the proposal has the ability to provide larger capacity than the existing systems with the actual numbers of user channels per RF carrier given in Annex 3 of RTT proposal. Fundamentally, the numbers provided cannot be used for reliable evaluation on different access methods. The assumption and models used are not consistent.
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	The proposed RTT is based on a CDMA architecture and has an asynchronous operation mode between BSs. It allows operators to deploy their networks in all environments supported by the RTT without any frequency planning or any synchronization between BSs. The BSs of the proposed W-CDMA system consist of fewer transceiver units than conventional FDMA/TDMA systems, because the BSs of the W-CDMA system can adopt a common transceiver architecture. In contrast, the BSs of conventional systems require dedicated transceiver units for each channel. Moreover, the inherent property of W-CDMA, that frequency reuse factor is one and the system capacity is determined by interference power in each sector, allows to increase the capacity by sectorizing more precisely without any difficulties. These features provide flexible enhancement of the system performance according to the increase of users and demands for quality requirements.	The description is sufficient. It is described that the proposed RTT requires fewer transceiver units than conventional FDMA/TDMA systems and is also indicated that flexible enhancement of system performance is available without difficulties.
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	Q and q	G1	A1.2.24 A1.4.6.1	The proposed RTT supports two types of automatic handovers. One handover scheme is based on a mobile assisted	The description is sufficient. Procedures of diversity handover and hard handover both supported in the

	data services and its overall impact on infrastructure cost and complexity.				diversity handover mechanism. The mobile station (MS) monitors the pilot signal levels received from neighbouring base stations, and reports to the network pilots crossing or above a given set of dynamic thresholds. Based on this information, the network orders the MS to add or remove pilots from its Active Set. The Active Set is defined as the set of base station for which user signal is simultaneously demodulated and coherently combined. The same user information modulated by the appropriate base station code is sent from multiple base stations. Coherent combining of the different signals from different sectorized antennas, from different base stations, or from the same antenna but on different multiple path components is performed in the MS by the usage of RAKE receivers. The signal transmitted by a mobile station is processed by base stations with which the mobile station is in diversity handover. The received signal from different sectors of a base station (cell) can be combined in the base station, and the received signal from different base stations (cells) can be combined at the base station controller. Diversity handover results in increased coverage range on the uplink. This diversity handover mechanism results in seamless handover without any disruption of service. The spatial diversity obtained reduces the frame error rate in the handover regions and allows for improved performance in difficult radio environment. Another handover mechanism is the so called hard handover. During hard handover, only one radio link is used between a mobile station and a base station. The radio link establishment procedure at the destination base station uses the same procedure as in originating a	proposal are described in details. Although implementation of the Active Set control becomes complex, the diversity handover mechanism causes no connection break during handover, and hence, the proposed RTT is able to retain quality during diversity handover.

					call. Hard handover is used during packet transmission over the common physical channel, and is also used in changing transmission rate of physical channel during packet transmission. No special requirements are necessary for fixed networks to realize the handover of the proposed RTT.	
A3.3	Quality					
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	When the link is lost due to shadowing or interference, MS and BS try to reconnect using reconnection type control, which are already employed by existing 2G mobile communication systems. There are no special requirements for the proposed RTT to realize the reconnect procedure.	It is indicated that the reconnect procedure adopted in the proposal is similar as the 2G systems.
A3.3.2	Round trip delay, 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 them as well. (For the satellite component, the satellite propagation delay is not included.)	Q	G2	A1.3.7.1 A1.3.7.2	Service specific delay, which depends on interleaving/channel–coding setting, is assumed. Typical values are provided below. Minimum delay: 12ms for 10ms interleaving, 2ms if non-interleaved mode is applied. Processing time of 2ms included. Delay specified above is one-way delay. Round trip delay can be calculated by doubling the values provided. The proposed RTT has a flexible bearer capability supporting different bit rate allocations and both 10 and 20ms frame lengths. This means that it can support various voice codec's as well as adaptive multirate coding schemes. The following codec schemes are under consideration in ARIB for the proposed RTT. Other codec's that are in the standardization process today may become candidates in the future.	Round trip delay are given quantitatively in the explanation. It is described that the proposal supports both 10 and 20 ms frame length which enables use of various codecs.

					Codec name / Standard number / Standardization body CS-ACELP / G.729 / ITU-T GSM-EFR / GSM 06.51 GSM 06.60 / ETSI J-STD-007.Vol-3 / TIA EVRC / IS-127 / TIA TDMA-EFR / IS-641 / TIA	
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	The proposed RTT supports two types of automatic handovers. One handover scheme is based on a mobile assisted diversity handover mechanism. In this type of handover, there is no break duration, which enables to completely maintain the voice service quality without deterioration. Another handover mechanism is the so called hard handover. Handover between different frequency bands in different cells causes break duration. It has the same level of break duration as 2G systems. However, it is possible to avoid break duration by a sequential process such as diversity handover between cells in a same frequency band and no-break duration hard handover between different frequency bands in a cell. See A3.2.10 for details of handover procedure.	The descriptions clarify that the proposal is capable of providing high service quality with use of diversity handover. A solution to break duration in hard handover is given, and the proposed RTT is shown capable of retaining voice service quality during handover. Detailed handover procedure is found in A3.2.10.
A3.3.4	Handover quality for switched data and packet data(see Table1 of ANNEX2) There should be a quantitative evaluation on the effect on data performance from handover.	Q	G3	A1.2.24 A1.2.24.1 A1.2.24.2 A1.4.6.1	Quality of both circuit switched data and packet data services are satisfied with achieving more than the minimum performance capabilities defined in Attachment 6 of Circular Letter. The same handover procedure and quality are applied to switched data. Please note that there is no break duration in diversity handover. On the other hand, for packet data, the same handover procedure as that for circuit switched mode is applied to dedicated physical channel (DCH for UPCH). However, Hard handover is applied to common physical channel (FACH and RACH). Please note that the common physical channels are used for light or infrequent data transmission. There is, therefore, no break duration in hard handover of common physical channels.	The description is sufficient. The ability of the proposed RTT to retain highly reliable data transmission both for circuit switch and packet is described. It is indicated that in the proposal, break duration is avoided by appropriately assigning the two handover schemes, diversity handover and hard handover, to each kind of data channels. Detailed handover procedure is found in A3.2.10.

					See A.3.2.10 for details of handover procedure.	
A3.3.5	Maximum user bit rate for switched data and packet data(see Table1 of ANNEX2) (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 proposed RTT provides the maximum data rate of at least 2048kbps for 4.096Mcps. Higher chip rates (with 8.192Mcps or 16.384Mcps) give better efficiency. Up to 2Mbps transmission for indoor, and 384kbps for pedestrian and vehicular environments were evaluated through simulations.	The fine ability of the proposed RTT on high data rate transmission even in vehicular environment with up to 384kbps is indicated.
A3.3.6	Channel aggregation to achieve higher user bit There should also be a qualitative evaluation on the method used to aggregate channels to provide higher bit rate services.	q	G4	A1.2.32	The proposed RTT supports channel aggregation to achieve higher bit rate using multicode transmission. With use of multicode, users are able to transmit high speed data on a single RF carrier.	A scheme of channel aggregation is introduced, and it is shown that the proposal is taking higher data rates into account.
A3.3.7	Voice quality Recommendation ITU-R M.1079 specifies that FPLMTS speech quality without errors should be equivalent to ITU-T Recommendation G.726 (32 kbit/s ADPCM) with desired performance in 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	G2	A1.2.19 A1.3.8	The proposed RTT has a flexible bearer capability supporting different bit rate allocations and both 10 and 20ms frame lengths. This means that it can support various voice codecs as well as adaptive multirate coding schemes. The following codec schemes are under consideration in ARIB for the proposed RTT. Other codec's that are in the standardization process today may become candidates in the future. Codec name / Standard number / Standardization body CS-ACELP / G.729 / ITU-T GSM-EFR / GSM 06.51 GSM 06.60 / ETSI J-STD-007.Vol-3 / TIA EVRC / IS-127 / TIA TDMA-EFR / IS-641 / TIA MOS levels for the above codecs are listed below. (Candidate Codec > G.726 32k-ADPCM) CS-ACELP 3.92>3.85 GSM-EFR 4.2>4.0 EVRC 4.14>3.76 TDMA-EFR 4.00>3.76	It is indicated that the proposed RTT supports various codecs which produce superior voice quality than G.726. It is pointed out that the voice codec testing is based on subjective evaluations.
A3.3.8	System overload performance (not applicable to satellite)	Q and q	G3	A1.3.9.1	Overload causes graceful degradation of system performance. The techniques commonly referred to as cell breathing can also be applied, i.e., when the loading	The proposed RTT can cope with system overload in a very flexible manner with

	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.				of a cell in a system is overloaded, the uplink interference is high and the effective range of MS/BS is reduced due to power constraints. If the downlink power is reduced accordingly then the MS on the border will be naturally handed over to the neighbouring cells, effectively reducing the coverage of the overloaded cell and decreasing its load without impacting the link performance. Variable bit rate capability of the proposed RTT also helps by adjusting available bit rate in high loading conditions.	cell breathing.
A3.4	Flexibility of radio technologies					
A3.4.1	Services aspects					
A3.4.1.1	Variable user bit rate capabilities for voice and data(see Table1 of ANNEX2) 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	q and Q	G2	A1.2.18 A1.2.18.1	Adaptive signal coding as a function of RF signal quality is not needed, because transmitter power control maintains received power and/or BER/FER at constant levels, and also because multi-rate scheme and spreading provide appropriate channel resources. Adaptive voice coding as a function of RF quality is possible. The user rate can vary on a 10ms basis with a granularity of 100bps (1bit/10ms) from 0-2048kbps. For a given connection, a sub-set of these rates is chosen upon call set-up. During the call, the rate can vary between the rates within the sub-set on a frame-by-frame basis. The sub-set of rates can also be changed during a call, e.g. due to the addition/removal of services. Different channel bit rates are possible by changing the spreading factor in factors of 2 from 512 down to 1. For the highest rates, multi-code transmission, i.e. transmission on several parallel code channels, is used. An arbitrary user bit rate after channel coding is matched to the closest possible channel bit rate by code puncturing/repetition. The proposed RTT has two modes to specify or detect transmitted data rate. One method is that explicit rate information, to simplify decoding, may be transmitted on	The proposed RTT has a very high capability to support variable rate services due to the use of variable spreading factor, rate matching, and multi-code scheme.

	– the range of possible data rates, – the rate of changes (ms).				a parallel control channel. Another method is a blind rate detection using CRC check. The proposed RTT allows for variable voice/data channel utilization as a function of traffic mix requirements. Multiple variable services can be time multiplexed on one variable-rate physical channel or code multiplexed on different variable-rate physical channels. The advantage with this approach is that the bit rate can vary on a frame-by-frame basis without any explicit resource allocation and negotiation. It is also useful for the independent quality control of each service on a multi-service connection.	
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	At least, more than 500Hz. The upper limit is also receiver implementation dependent. Variations in path amplitudes/phases can be tracked with pilot-symbol-assisted coherent detection. The period of pilot symbols is 0.625 ms, and the coherent detection can cope with variation of at least 500Hz with almost no performance degradation. Decision-directed adaptive coherent detection can further increase the value of maximum tolerable Doppler shift.	The short period of pilot symbols, 0.625ms, indicates its high potential in Doppler tolerability.
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	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	Receiver implementation dependent. The proposed RTT maintains the service quality up to the delay spread equivalent to the searcher window size. The processing gain of DS-CDMA suppresses interference due to multipath propagation. A RAKE receiver (or more advanced multi-user detectors) combines multi-path and gives diversity gain. The theoretical upper-limit of tolerable time dispersion is dependent on the scrambling code length. It is $720*2^9$	The proposal is very robust to delay spread. Descriptions in A.1.2.14.1 and A.1.2.14.2 give a comprehensive explanation.

					ms for uplink and 10ms for downlink. In practice, the limit of time dispersion is dependent on the implementation of the searcher window size, which should be more than the maximum excess delay to be experienced in various typical operation environments. Within the limit, the size of the delay spread does not, in itself, have any impact on the performance. On the other hand, the shape of the delay spread profile may have an impact on the performance. RAKE receiver efficiently captures signal energy dispersed over the searcher window size and provides multipath diversity gain. There may be a performance degradation due to non-captured signal energy in the case of larger number of non-negligible rays than that of RAKE fingers or in the case of non-negligible rays at the excess delay beyond the searcher window size. Variations in path amplitudes/phases can be tracked with pilot-symbol-assisted coherent detection. The period of pilot symbols is 0.625 ms, and the coherent detection can cope with variation of at least 500Hz with almost no performance degradation. Long term variations in the path profile, e.g. the occurrence of new paths, can be detected by the searcher. Update time of path profile is dependent on searcher implementation, typically ranging from 10ms (on a frame-basis) to several 10s ms. Typically, de-correlation length of the long-term fading is 20m in vehicular environment, which requires 288ms to travel at the speed of 250km/h. Due to this fact, the above update period is sufficient to track path profile changes to be encountered in practice.	
A3.4.1.5	Maximum user information bit rate, R_u (kbit/s) for switched data and packet data (see Table1 of ANNEX 2) How flexibly services can be offered to customers? What is the limitation in number of users for	Q and q	G2	A1.3.3 A1.3.1.5.2 A1.2.31 A1.2.32	At least 2048kbps for 4.096Mcps. Higher chip rates (with 8.192Mcps or 16.384Mcps) give better efficiency. Up to 2Mbps transmission for indoor, and 384kbps for pedestrian and vehicular environments were evaluated through simulations. Bandwidth on demand for information bit rate is	Maximum user rate satisfies the minimum performance capabilities. The proposal has a fine BOD capability. The quantitative limitation is

	each particular service? (e.g. no more than two simultaneous 2 Mbit/s users)				supported with a granularity of 100bps ranging from 100bps to 2.048Mbps. The bandwidth on demand possibility is implemented by multiplexing the multi-bearer traffic on a single L1 traffic stream to be carried by the variable rate DPDCH resource. For low and medium rates, a variable spreading factor single code channel is used, while a combination of variable spreading factor and multi-code transmission is adopted for higher rates. Regarding the limitation in number of users for each particular service, please refer to Annex 3: Simulation Models and Evaluation Results. The following is a particular example. Circuit-switched 144 kbps services in the vehicular-(A) environment : FDD mode : 0.657 Mbps/MHz/cell (uplink) 0.753 Mbps/MHz/cell (downlink) TDD mode : 0.846 Mbps/MHz/cell (uplink) 0.452 Mbps/MHz/cell (downlink) A tri-sectored cell model is assumed. Furthermore, edge effects that tend to increase the capacity are eliminated by employing 'wrap around.' See Annex 3 Simulation Models and Evaluation Results for more information.	given by simulation, and the results are reliable.
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	The proposed RTT has a flexible bearer capability supporting different bit rate allocations and both 10 and 20ms frame lengths. This means that it can support various voice codecs as well as adaptive multirate coding schemes. The following codec schemes are under consideration in ARIB for the proposed RTT. Other codecs that are in the standardization process today may become candidates in the future. Codec name Standard number Standardization body CS-ACELP G.729 ITU-T	The proposed RTT has a flexible bearer capability supporting different bit rate allocations.

					GSM-EFR GSM 06.51 GSM 06.60 ETSI J-STD-007.Vol-3 TIA EVRC IS-127 TIA TDMA-EFR IS-641 TIA The proposed RTT supports multi-rate transmission. Moreover, the proposed RTT utilizes rate information to make variable rate transmission easily implemented. By means of those techniques, the proposed RTT potentially supports multiple voice coding rates. See also A.3.4.1.1 : variable user bit rate capabilities for voice and data.	
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	Circuit-switched, packet switched and asymmetric services are all supported by the proposed RTT. Multiple variable services can be time multiplexed on one variable-rate physical channel or code multiplexed on different variable-rate physical channels. The advantage with this approach is that the bit rate can be varied on a frame-by-frame basis without any explicit resource allocation and negotiation. Parallel services can be provided. The different services can have independent bit rates, bit error rates, etc., and can have different transfer modes (packet/circuit-switched). The proposed RTT supports two types of automatic handovers. The main handover scheme is a mobile assisted diversity handover. Another handover mechanism is hard handover. Hard handover is used during packet transmission over the common physical channel, and is also used in changing transmission rate of physical channel during packet transmission.	The proposed RTT offers high multimedia capabilities.
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,	q	G1	A1.2.1 A1.2.2 A1.2.2.1 A1.2.3	Both an FDD mode and a TDD mode are utilized for the duplex schemes of the proposal.. The FDD mode is used for a paired band, while TDD mode can be used for a non-paired band. The combination of FDD and TDD	The proposed RTT provides both FDD mode and TDD mode. This enables flexible use of allocated spectrum.

	handling of asymmetric services, usage of non-paired band).			A1.2.5.1	makes it possible to use the allocated frequency efficiently according to the frequency conditions of each region, and thus increases flexibility. Most of the key parameters such as the chip rate, frame length, and modulation/demodulation schemes are made common to both modes. The possibility for a large range of uplink/downlink asymmetry on the connection level is achieved by the possibility of independent setting of uplink and downlink bearer-service characteristics (rate, delay, bit-error-rate etc.). The possibility for uplink/downlink asymmetry on the cell-level is supported through the use of one-cell reuse, where downlink and uplink resources can be moved independently from each other between neighbouring cells. Asymmetry on a total-system level can be achieved with the proposed TDD mode, where the total available time can be asymmetrically allocated to the uplink/downlink. For the FDD mode, total-system asymmetry is possible as long as more bandwidth is allocated to downlink than uplink or vice versa. The proposed RTT offers various types of bandwidths corresponding to chip rates ranging from 1.024 to 16.384 Mcps. The combination of these bandwidths allows various ways of using the spectrum in the overall available bandwidth, which may differ from one region to another.	Asymmetric services on a user basis can be provided in both modes. The system-level asymmetry can be provided efficiently with the TDD mode.
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	q and Q	G4	A1.2.26	Frequency division makes spectrum sharing possible in following cases. Between IMT-2000 systems Between terrestrial and satellite IMT-2000 systems Between IMT-2000 and non-IMT-2000 systems Between private and public IMT-2000 operators For uncoordinated systems, frequency sharing is possible through code division within one frequency band with some limitations.	Frequency division is the only practical means for spectrum sharing except in the case of uncoordinated private systems.

	fixed sharing.				Necessary guard bands are different per radio regulatory in each region.	
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	FDD: 2 x 5 MHz TDD: 1 x 5 MHz The above is the minimum frequency band required to deploy the system, but wider frequency bandwidth is recommended for more efficient operation. The proposed RTT can offer its full capability efficiently if 2x20MHz (FDD) / 1x20MHz (TDD) bandwidth is allocated. Frequency reuse of 1 in the proposed RTT does not impose an additional constraint to minimum frequency band requirement.	Minimum frequency band is 2x5MHz (FDD) / 1x5MHz (TDD). Wider bandwidth is recommended for efficient accommodation of high rate services.
A3.4.2.1.4 (New attribute)	Band plans and frequency duplexing The proponent should describe how their system will provide global service delivery in the different regional/national band plans and frequency duplexing arrangements for IMT2000 systems.	Q and q	G1	A1.2.1 A1.2.2 A1.2.2.1 A1.2.4	Band plans depend on system deployment scenarios. In the case of 4.096Mcps system, carrier spacing is from 4.2-4.6MHz. However, 200 kHz carrier raster enables carrier spacing to be flexible and minute, and improves spectrum utilization efficiency. Both FDD and TDD modes are applied as the duplex schemes of the proposal. The combination of FDD and TDD enables highly efficient use of spectrum depending on the conditions in each region, and at the same time offers high degree of flexibility. Most of the key parameters including the chip rate, the frame length, and modulation/demodulation schemes are made common to both modes. Most countries adopt almost identical frequency bands for IMT-2000, which will be easy to support global service. There seems to be two promising bands that can be used commonly in many countries: paired bands 1920MHz-1980MHz and 2110MHz-2170MHz. Unpaired band such as 2010MHz-2025MHz may be also possible. In the proposed system, FDD and TDD are assumed to be applicable to paired band and unpaired band, respectively. If the frequency bands of some countries are different, dual-band mobile terminals	The 200KHz carrier raster of the RTT offers flexiblity in frequency allocation. And since the proposal provides both FDD mode and TDD mode, it also enables flexible use of allocated spectrum.

					should be used. ARIB consider globalization as one of the most important element of IMT-2000, therefore, it is actively promoting harmonization with different proposed modes from other countries or regions.	
A3.4.2.2	Radio resource planning					
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	Since DS-CDMA allows reuse of all the carrier frequency in every cell (1-cell reuse), no frequency planning is required. Spreading codes have a two-layered structure of spreading codes and scrambling codes, which makes code planning easy as well as flexible. In downlink, the scrambling codes are assigned specifically to each cell, while they are assigned specifically to each user in uplink. Multiple scrambling codes can be assigned to one cell upon request. Since there are plenty of scrambling codes, the codes can be assigned to each cell without any constraints. Spreading codes are orthogonal, and all codes are used commonly for all cells, minimizing the interference between users within the cell. The uplink and downlink rates can be set up independently in CDMA systems by the use of independent different spreading factors for uplink and downlink for each user. Consequently, radio resources can be used efficiently also in asymmetric traffic communications. Inter-cell asynchronous FDD operation that does not require precise synchronization between base stations was adopted for the proposal, so that freedom for deployment of base stations to indoors and outdoors can be secured. However, the proposal can also adopt inter-cell synchronous operation in order to provide flexibility of operation. TDD operates in inter-cell synchronous condition with a guard time level accuracy.	The proposed RTT is good in having no major constraints in radio resource planning due to frequency reuse of 1 and asynchronous inter-BS operation in the FDD mode.
A3.4.2.2.2	Adaptability to adapt to different and/or time	q	G2	A1.3.10	Following functions and approaches are possible;	The description is sufficient.

	varying conditions (e.g., propagation, traffic) How does 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.			A1.2.27 A1.2.22 A1.2.14	- Adaptive transmitter power control FDD mode: The RTT uses SIR based closed-loop power control on both uplink and down link. Open loop power control is used for random access. The use of fast power control significantly improves the link-performance (BER as a function of Eb/N_0) especially in the case of a slow moving mobile station. TDD mode: Open-loop power control on uplink based on the estimation of propagation loss from downlink (Perch Channel) improves the degradation due to fading. And it's possible to decrease the control accuracy and quality difference between channels by combining with SIR based closed loop power control. For downlink, SIR-based closed-loop power control is applied for reduction of the interference from other cells and improvement of the degradation due to fading. - The processing gain of DS-CDMA suppresses interference due to multipath propagation - A RAKE receiver (or more advanced multi-user detectors) to combine multi-path and gives diversity gains. - Path/Antenna/site diversity	The technologies to adapt to the conditions are clarified.
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	The proposed RTT can provide pico-, micro-, and macro-cells in one common frequency band without frequency planning, or in separate frequency bands with fixed separation.	The description is sufficient.

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	Handover between different cell layers is possible with minimal disruption of traffic. Adaptive transmitter power control is used.	The description is sufficient.
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 concept can be applied to FWA applications. The proposed RTT provides the same or higher quality and capacity for FWA services as/than those of the mobile services without any system or hardware impact. Complexity of terminals is reducible because some functions, which are indispensable for mobile terminals such as handover capability, fast power control, etc., can be cut down for FWA applications. System capacity can be increased since there is no terminal connected to multiple base stations by handover. Moreover, service area can be extended by use of a directional antenna in the terminal side. Repeaters can be used. It is easy to deploy small BSs that support only one frequency band. The proposed RTT is based on CDMA architecture and has an asynchronous operation mode between BSs. It allows operators to deploy their networks in all environments supported by the RTT without any frequency planning or any synchronization between BSs. The BSs of the proposed W-CDMA system consist of fewer transceiver units than conventional FDMA/TDMA systems, because the BSs of the W-CDMA system can adopt a common transceiver architecture. The proposed RTT provides equivalent services to the fixed ISDN up to 2Mbit/s without any modification on	The description is sufficient. The characteristics for FWA are well covered.

					the fixed network. In this case, 'equivalent services' indicate connection and protocol compatibility. The services provided by the proposed RTT may not be fully compatible with the fixed ISDN in terms of network communication quality, such as delay and BER/FER, determined by the recommendations ITU-T G-series. There is no constrains for use of large cells because of the CDMA characteristics in which the cell can be larger when the traffic is lower.	
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	Adaptive antennas are supported through the use of connection dedicated pilot bits in both uplink and downlink.	The description is sufficient.
A3.4.2.4.3	Existing system migration capability	q	G1	A1.4.16	The proposed RTT is based on a completely new radio interface suitable for 3G systems, taking into account of the feasibility of dual mode terminals with typical 2nd generation systems, e.g. PDC, GSM and IS-95. Therefore it does not have any technical constraints and impacts imposed on the proposed RTT to achieve the evolution from 2nd generation systems. The migration in terms of service aspects can be achieved by using dual mode terminals in a transition period, because the proposed RTT assumes to provide IMT-2000 services in addition to those provided by 2nd generation systems.	The description is sufficient.
A3.5	Implication on network interface					
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	FDD mode: No BS-to-BS synchronization is required. BS-to-network synchronization is required with no special accommodation, e.g. external system reference derived from wire-line network. TDD mode; BS-to-BS synchronization is required, where all base stations are required within plus or minus 3	The description is sufficient. No special accommodation is required for BS-to-network synchronization.

					microseconds of synchronization in system timing. External system reference from wire-line network or GPS receiver is required. It is possible to use GPS only for initial adjustment of synchronisation among BSs. The synchronisation can be maintained by external reference not only from GPS but also from wire-line network. BS-to-network synchronization is required with no special accommodation, e.g. external system reference derived from wire-line network.	
A3.6	Hand-portable 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 hand-portable.	Q	G2	A1.2.2 A1.2.2.1 A1.2.2.2	FDD mode: Duplexer needed. Transmit/receive isolation: Required isolation is no more than 60dB. TDD mode: No duplexer needed	The description is sufficient.
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	FDD mode: 24dBm (100% transmission for DPCCH) TDD mode: 24dBm, duty ratio is 47.5% (-3.2dB)	The description is sufficent.
A3.6.3	System round trip delay impacts the amount of acoustical isolation required between hand-portable microphone and speaker components and, thus, 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 them as well. (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	At least 25ms for 10ms interleaving, not including vocoder delay. 64 ms including vocoder (G.729 with 50 MIPS DSP for processing delay is assumed).	The description is sufficient.
A3.6.4	Peak transmission power	Q	G1	A1.2.16.1.1	Not limited by RTT FDD mode : Nominal value 24dBm (8kbps voice transmission) TDD mode : Nominal value 27.2dBm (8kbps voice transmission)	The description is sufficient.

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.					
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	80dB :Uplink 30dB :Downlink	The description is sufficient.
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	FDD mode: The RTT uses SIR based closed-loop power control on both uplink and down link. Open loop power control is used for random access. The use of fast power control significantly improves the link-performance (BER as a function of Eb/N_0) especially in the case of a slow moving mobile station. TDD mode: Open-loop power control on uplink based on the estimation of propagation loss from downlink (perch channel) improves the degradation due to fading. And it's possible to decrease the control accuracy and quality difference between channels by combining with SIR based closed loop power control. For downlink, SIR-based closed-loop power control is applied for reduction of the interference from other cells and improvement of the degradation due to fading. Step size: 1dB Power control cycle per second: FDD mode : 1600 TDD mode : 800 TPC Error (dB) at average FDD mode : 2.4dB @fD=222Hz, 2paths TDD mode : 3dB @fD=222Hz, 2paths	The description is sufficient. Power control schemes are described for some environments. Also, step size, accuracy and speed are described. A1.2.22, A1.2.22.1, A1.2.22.2 and A1.2.22.5 support the description.
A3.6.6	Linear transmitter requirements	q	G3	A1.4.10	Base Station : Class A Amplifiers Mobile Station : Class A-B Amplifiers	The description is fair.
A3.6.7	Linear receiver requirements (not applicable	q	G3	A1.4.11	Linear receivers are employed by both MS and BS.	The description is fair.

	to satellite)					
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	Above 80dB	This value is provided in A1.4.12.
A3.6.9	Diversity schemes Diversity has an impact on hand-portable 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	Time diversity: RAKE diversity with maximal ratio combining for both base and mobile station. Space diversity : (1) Antenna diversity with maximal ratio combining in base station and optionally in mobile station. (2) Transmit diversity in base station can be applied on downlink. For FDD mode, TDTD (Time Domain Transmit Diversity) can be used. There are two different modes of antenna switching control: PreDetermined(PD) mode and FeedBack(FB) mode. PD mode can be used on all channels. FB mode can be used on dedicated channels depending on channel conditions. For TDD mode, STD (Selective Transmit Diversity) or PTD (Parallel Transmit Diversity) can be employed. STD can be applied only to dedicated physical channels. (3) Site diversity Inter-sector : maximal ratio combining Inter-cell : maximal ratio combining (down link) and selection combining (uplink) Frequency diversity is not used Code diversity is not used. At least 4 finger RAKE receiver One RF receiver and one antenna per mobile station The degree of expected improvement depends on the environment: FDD mode	The description is sufficient. A1.2.23, A1.2.23.1 and A1.2.23.2 support these schemes and values.

					RAKE diversity : 1.4dB @ fD=120Hz, 2paths Space diversity (antenna diversity) : 2.4dB @fD=120Hz, 2paths Site diversity : 8dB @outage=5% TDD mode RAKE diversity : 1.4dB @ fD=120Hz, 2paths Space diversity : 2dB @ fD=120Hz, 2paths Site diversity : 8dB @outage=5%	
A3.6.10	The number of antennas	Q	G1	A1.2.23.1	At least 2 antennas for BS and 1 for MS. Antenna diversity with maximal ratio combining in base station and optionally in mobile station. For TDD mode, transmit diversity in base station can be applied on downlink.	The description is provided in A1.2.23.1, which isconsistent with simulation assumptions.
A3.6.11	The number of receivers	Q	G1	A1.2.23.1	At least 2 RF receivers for BS and 1 for MS. Antenna diversity with maximal ratio combining in base station and optionally in mobile station. For TDD mode, transmit diversity in base station can be applied on downlink.	The description is provided in A1.2.23.1, which is consistent with simulation assumptions.
A3.6.12	Frequency stability Tight frequency stability requirements contribute to hand-portable complexity.	Q	G3	A1.4.1.2	0.05ppm Refer to A.1.4.1.1: BS frequency stability of Annex1 of the RTT proposal document.	This value is provided in A1.4.1.1.
A3.6.13	The ratio of 'off (sleep)' time to 'on' time	Q	G1	A1.2.29 A1.2.29.1	Sleep mode: An MS is awake for a short period to listen to PI (Paging Indicator) of paging channel. Furthermore, the proposed RTT provides 288 paging groups by the mapping method of PCH as shown in the system description. The ratio of "ON" time to the whole (ON+OFF) time is 5.2e-4 assuming that 5.6 % of the bits in a group are assigned to PI and that the probability of arriving incoming calls is 10%. Variable rate transmission: The ratio of "ON" time to the whole (ON+OFF) time can be decreased by applying the DTX because an MS is only awake to listen to pilot and TPC bits. In this case, a typical value of the ratio is 0.25.	These values are fair.
A3.6.14	Frequency generator step size, switched speed and frequency range	Q	G2	A1.4.5	STEP size : 200kHz Switched speed : 0.25 msec	These values are fair. A.1.4.5 provides these

	Tight step size, switch speed and wide frequency range contribute to hand-portable complexity. Conversely, they increase RTT flexibility.				This value is decided by requirement of the round-trip change between two frequencies in idle slot on condition that number of idle slot is 1. Frequency range : 140MHz (Maximum value for IMT-2000 band)	values.
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 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	Q and q	G1	A1.4.13	The signal processing and memory requirements are implementation dependent. The following is an example of a particular design. MOPS : 25MOPS Gate : 385k ROM : 90kB RAM : 90kB The above values are assumed on a 64kbps-user channel and includes the processing estimetes of both uplink and downlink. The value of MOPS with DSP includes the signal processing such as searcher, RAKE, modulation, demodulation, TPC and so on. The channel encoding/decoding such as convolutional and turbo coding is not included. The required value of MOPS for channel coding by a general DSP is too large to be processed. For instance, the Viterbi decoding needs alomost more than one hundred of MOPS. Therefore, the signal processing for channel coding should be performed by using a specific DSP or a specific ASIC. The voice CODEC is not included.	The description is fair.

	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.					
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.					
A3.7.1.1	Base site coverage efficiency The number of base sites required to provide coverage upon 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	For the vehicular-(A) environment using 5 MHz Bandwidth, the coverage efficiencies with 20ms interleaver are as follows. FDD mode : 13.0 km^2/site (up-link) 21.8 km^2/site (down-link) TDD mode : 18.1 km^2/site (up-link) 23.7 km^2/site (down-link) For LCD 144 kbps services in vehicular-(A) environment using 5MHz bandwidth, the coverage efficiencies are as follows. FDD mode : 4.1 km^2/site (up-link) and 9.6 km^2/site (down-link) TDD mode : 4.7 km^2/site (up-link) and 8.9 km^2/site (down-link) The maximum range between a user terminal and a BS isas follows, assuming speech services (20 ms interleave) in the vehicular-(A) environment. FDD mode : 4475 m (up-link) and 5787 m (down-link) TDD mode :	The description and the link budget template are sufficient to clarify the results and conditions. It should be noted that the coverage characteristics strongly depend on the results of link level simulations. In Annex 3 'Simulation Models and Evaluation Results', there are sufficient description to assume that the coverage results are reliable. It is indicated that the proposal has a large coverage on both voice service and high-speed data.. It is confirmed that the results of other services and other environments are given in Link Budget Template in Annex 1.

					5279 m (up-link) and 6041 m (down-link) See Link Budget Template in Annex 1 for more information.	
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 necessarily 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	Repeaters can be used. Remote antennas can be used. Distributed antennas can be used. Adaptive antennas are supported through the use of connection-dedicated pilot bits in both uplink and downlink. For both FDD and TDD modes, transmit diversity can be used on the downlink. See A.3.2.6.1 of this Attachment. The introduction of the above-mentioned technologies can slightly complicate the system. However, this shall not be interpreted as the complexity of the proposed RTT. It is rather due to the complexity of the mentioned technologies. Therefore, there is no RTT specific drawback.	The description is sufficient to show the possible methods. It is indicated that the proposal can adopt various techniques to increase the coverage efficiency. A concrete idea to support adaptive antenna is shown.
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	NA	NA