ARIB

Association of Radio Industries and Businesse

Evaluation Report for 'cdma2000' Proposed by TIA TR-45.5

ARIB IMT-2000 Study Committee

Association of Radio Industries and Businesses (ARIB)

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ARIB Evaluation Group (contact point)

Name : Fumio WATANABE (Chairman, ARIB Evaluation Group)

Organization: Kokusai Denshin Denwa Co., Ltd. (KDD)

Address: 2-1-15 Ohara Kamifukuoka-shi, Saitama 356-8502 Japan

Tel : +81-492-78-7860 Fax: +81-492-78-7521

Email: watanabe@ kddlabs.co.jp

ARIB Evaluation Group Web Site

http://www.arib.or.jp/IMT-2000/evaluation

ARIB Secretariat (Secretariat, IMT-2000 Study Committee of ARIB)

Address: Nittochi Bldg. 14F, 1-4-1 Kasumigaseki, Chiyoda-ku, Tokyo,100-0013 Japan

Tel: +81-5510-8594 Fax: +81-3592-1103

m-shirai@arib.or.jp, h-saito@arib.or.jp, sasaki@arib.or.jp

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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 evaluation on the cdma2000 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.

Evaluation Report for 'cdma2000' Proposed by TIA TR-45.5

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 that may be unique to IMT-2000. A goal for IMT-2000 is to provide universal coverage and to enable terminals to be capable of handling 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) has established an Evaluation Group and registered it to ITU-R as an independent outside evaluation entity to evaluate the proposals for radio transmission technologies (RTT) submitted to ITU in accordance with the Circular Letter. 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 under the document titled 'Evaluation Methodology for IMT-2000 Radio Transmission Technologies,' dated June 19, 1998. The Group evaluated a couple of RTT candidates for IMT-2000 in accordance with the stipulations in the document. One of the most important principles in ARIB, 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 process at ARIB is to confirm that all the requirements and objectives for IMT-2000 are fulfilled.

2. SCOPE

This document reports the evaluation outcome for 'cdma2000', which is under development within the TIA TR-45.5 subcommittee as a candidate radio transmission technology for IMT-2000.

ARIB is producing the specifications for the air interface of IMT-2000 based on the wideband CDMA (W-CDMA) technology. The primary objective for the Third-Generation Mobile Communications System in Japan is to achieve a 'Global System'. In order to harmonize different wideband-CDMA technologies advocated by different countries and regions of the world, ARIB has been carrying out its studies in a flexible manner with a world-wide perspective to create a globally common technology, while cooperating with the standards bodies of other countries and regions. TIA and ARIB have been discussing on a continuous basis how to harmonize the RTT proposal of TIA TR45.5 and that of ARIB's. For this purpose, the two standard institutes have convened bilateral meetings. Besides these bilateral activities, ARIB received technical proposals based on 'cdma2000', intended to promote harmonization, from members of ARIB as part of its internal standardization activities. ARIB has already incorporated many elements from such technical proposals into the W-CDMA specifications of ARIB's. Thanks to such efforts, the two candidate proposals based on wideband CDMA technology, ‘cdma2000’ and ‘W-CDMA’, have now become quite similar to each other, although some important parameters and technologies still remain to be aligned.

ARIB has prepared this evaluation report with an intention to accelerate the convergence process toward a common technology resolving the remaining differences. The report presents ARIB’s views as to how ‘cdma2000’ complies with the requirements and objectives for IMT-2000. It also contains the results of technical harmonization activities with ‘cdma2000’ performed by ARIB.

3. OBJECTIVES OF EVALUATION

The purposes of ARIB’s evaluation activities on ‘cdma2000’ proposed by TIA TR-45.5 are listed below;

- to accelerate ongoing harmonization activities between ARIB and TIA TR45.5,
- to confirm that all IMT-2000 requirements and objectives are fulfilled,
- to provide information on the harmonization activities undertaken by ARIB,
- to contribute to fair and proper evaluation at ITU-R and other evaluation groups.

4. SUMMARY OF EVALUATION

4.1 REQUIREMENTS AND OBJECTIVES

For the Requirements and Objectives of the cdma2000 RTT proposal, the same processes mentioned in ARIB W-CDMA Evaluation Report were applied. After reviewing the proposal from TIA TR45.5, ARIB made some comments to the proposal, which were sent back to TIA TR45.5.

TIA replied us with updated Proponent’s Comments. Since the updated comments included sufficient descriptions, ARIB revised its original comments.

As a result of the evaluation process, it was confirmed, through a close examination on the TIA TR45.5’s documents System Description, Technology Description Template, and Test Environments and Deployment Models, that the Requirements and Objectives, defined in Attachment 4 of Circular Letter and in ANNEX 4 of ARIB’s Evaluation Methodology, are fulfilled. .

For details on the Evaluator’s Comments, see attachment 1 to this report.

4.2 MINIMUM PERFORMANCE CAPABILITIES

For the Minimum Performance Capabilities of the cdma2000 RTT proposal, the same process mentioned in ARIB’s W-CDMA Evaluation Report could not be applied, because the original proposal of cdma2000 did not include a Compliance Template format. However, ARIB made a review on the cdma2000 proposal, and made comments to the said proposal using a similar template as the one for ARIB’s, which was sent to TIA TR45.5.

TIA replied to ARIB creating a Compliance Template, which included sufficient references and Proponent’s Comments. Based on this, the original comments from ARIB were revised.

Through the close examinations on the documents of System Description, Technology Description Template, and

Test Environments and Deployment Models during the evaluation process, it was concluded that the Minimum performance capabilities defined in Attachment 6 of Circular Letter are satisfied by the proposal. For details on the Evaluator's Comment, see attachment 2 to this report.

4.3 PERFORMANCE

The performance of the cdma2000 proposal is evaluated in terms of spectrum and coverage efficiency. The simulation conditions and results in the proposal were carefully reviewed and evaluated. Through this process, it was confirmed that information required by ITU-R for the evaluation of technologies was sufficiently given in the proposal. Evaluations on the spectrum and coverage efficiency are found in Attachments 3 and 4.

4.4 EVALUATION BASED ON THE CRITERIA

See Attachment 4.

5. HARMONIZATION

5.1 TECHNICAL DIFFERENCE

The TIA TR45.5 cdma2000 proposal was evaluated and compared with the ARIB's W-CDMA proposal. Tables A and B show technical differences on the FDD mode and TDD mode, respectively. Since both of the two proposals are based on direct sequence CDMA (DS-CDMA) technique, most of the items in the tables are similar. The major differences that exist between these two proposals are the chip rate and the structure of the pilot channel. Harmonization activities focus on these major differences, which are elaborated in the next section.

Table A Technical difference (FDD Mode)

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 x N , 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)
Carrier Spacing	Flexible with 200kHz carrier raster	Not described in the RTT proposal, however in IS-95 raster equals 30 kHz carrier raster in Cellular band (800MHz) and 50 kHz in the PCS band.
Inter BS timing	Asynchronous (Sync. possible)	Synchronous

Cell Search Scheme		3-step code acquisition based on non-scrambled symbols	Pilot channel
Frame Length		10ms	Dedicated control channel and fundamental channel: 5, 20 ms Common control channel: 5, 10, 20 ms Supplemental channel: 20 ms
VSF(spreading code)		1-512	For N=3 DL : 4-256 depending on channel type (Fundamental, Supplemental), Rate set (RS-1, RS-2) and bit rate UL : 2, 4 or 8 + repetition (SF depends on channel type and number of supplemental channels but independent of chip rate and repetition depends on chip rate and bit rate) For other N DL : 4-512 (N=6), 4-1024 (N=9), 4-1024 (N=12)) UL : same as for N=3
HO		SHO (DHO)	SHO
DL	Data mod.	QPSK	QPSK
	Spreading mod.	QPSK	QPSK
	Spreading code	1 symbol length	1 symbol length
	Scrambling code	10ms	2^ 15 x N chips (26.6 msec)
	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
	Variable rate accommodation	Orthogonal VSF + Multi-Code (MC)+DTX	Orthogonal VSF + Repetition
UL	Data mod.	BPSK	BPSK
	Spreading mod.	HPSK (OCQPSK) *	QPSK
	Spreading code	1 symbol length	1 symbol length
	Scrambling code	2^9 x 720ms	2^{42}-1 chips
	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 CH SIR based)
	Variable rate concept	VSF+ Rate Matching + Muti-code	VSF + Rate Matching (Repetition/Puncturing)
Channel Coding		Convolutional codes Turbo codes	Convolutional codes Turbo codes
Interleaving periods		10/20/40/80ms	5/20ms

Rate Detection	Variable length Rate Info. (with/without Blind detection)	Fundamental CH : Blind. Supplemental CH : No Blind detection for rates > 14.4kbps
Other Features	MIL (Multi-stage Interleaving)	Multi-Carrier (DL) Auxiliary Pilots (DL) Orthogonal Tx diversity (OTD)
Random Access mechanism	Message(I-ch)+ Signature(Q-ch) SF of Q-ch = 128,32	Preamble(Nx1.25ms)+ Message (Nx5(10,20)ms)
Power control steps	1dB	1dB (0.5,0.25 option)
Super Frame Length	720ms	N/A

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

Table B Technical difference (TDD mode)

TDD mode		
	ARIB(W-CDMA)	TIA TR45.5 cdma2000
Multiple Access	DS-CDMA with TDMA component	DS-CDMA or multi-carrier CDMA
Band Width	5MHz (1.25/10/20)	3.75MHz (1.25 x N times, N=3) Other bandwidths: N=1,6,9,12
Chip Rate	4.096Mcps (1.024/8.192/16.384)	3.6864Mcps (1.2288/7.3728/ 11.0592/ 14.7456)
Carrier Spacing	Flexible with 200kHz carrier raster	Not described in the RTT proposal, however in IS-95 raster equals 30 kHz carrier raster in Cellular band (800MHz) and 50 kHz in the PCS band.
Inter BS Sync.	Synchronous	Synchronous
Cell Search Scheme	3-step code acquisition based on non-scrambled symbols	Pilot channel
Frame Length	10ms	Dedicated control channel and fundamental channel: 5, 20 ms Common control channel: 5, 10, 20 ms Supplemental channel: 20 ms
VSF(spreading code)	1-512	For N=3 DL : 4-128 depending on channel type (Fund, Suppl), Rate set (RS-1, RS-2) and bit rate UL : 2, 4 or 8 + repetition (SF depends on channel type and number of supplemental channels but independent of chip rate and repetition depends on chip rate and bit rate) For other N DL : 4-256 (N=6), 4-512 (N=9), 4-512 (N=12)) UL : same as for N=3

HO		SHO(DHO)	SHO
DL	Data mod.	QPSK	QPSK
	Spreading mod.	QPSK	QPSK
	Spreading code	1 symbol length	1 symbol length
	Scrambling code	10ms	2^ 15 x N chips (26.6 msec)
	Pilot structure	TCH dedicated Pilot symbol	Common Pilot symbol/ Auxiliary Pilot symbol
		Time multiplexed	Code multiplexed
	Detection	Coherent based on Pilot Symbols	Coherent based on Pilot Channel
	Power control	Closed-loop (0.8-0.1kbps DCH SIR based)	Closed-loop (0.8kbps Fund. CH SIR based)
	Variable rate concept	Orthogonal VSF + VTS(Time slot)+VMC (Multi-code)+ DTX	Orthogonal VSF + Repetition
UL	Data mod.	QPSK	BPSK
	Spreading mod.	QPSK	OQPSK
	Spreading code	1 symbol length	1 symbol length
	Scrambling code	2^9x720ms	2^{42}-1 chips
	Pilot structure	Time mux.	IQ/code mux.
	Detection	Pilot based coherent	Pilot based coherent
	Power control	Fast Open-loop (Perch CH based) + Closed -loop (0.8-0.1kbps DCH SIR based)	Open-loop + Closed-loop (0.8kbps Pilot code SIR based)
	Variable rate concept	VSF+ Rate Matching + Multi-code	Rate Matching (Repetition/Puncturing)
Cannel Coding		Convolutional code Turbo code	Convolutional code Turbo code
Interleaving		10/20/40/80ms	5/20ms
Rate Detection		Variable length RI (Rate-Info.) (with/without Blind detection)	Fundamental CH : Blind Supplemental CH : No blind detection for rate > 14.4kbps
Other Features		BS Tx-div.	Multi-Carrier(DL) Auxiliary Pilots (DL) Orthogonal Tx diversity(OTD)
Random Access		Message (10ms) SF=128, 32	Preamble (Nx1.25ms) + Message (Nx5 (10, 20) ms)
TPC		1dB(DL) 0.25dB(UL)	1dB (0.5, 0.25 option)
Super Frame Length		720ms	N/A

5.2 HARMONIZED RESULTS

Two major streams of activities have been carried out by ARIB in an attempt to harmonize its proposal with the cdma2000 proposal. The first is the activity based on mutual collaboration between ARIB and TIA, and the other is an internal standardization activity of ARIB that was started after receiving from ARIB members a technical improvement proposal based on cdma2000.

The latter activity was initiated in June 1997, when some member companies of ARIB proposed cdma2000-

based technologies in an attempt to incorporate them into ARIB's W-CDMA draft specification. In response to the request from some companies, ARIB organized two special groups, Ad Hoc-CR and Ad Hoc-S. Ad Hoc-CR was the group formed to conduct technical comparison between the chip rates of 4.096 Mcps and 3.6864 Mcps, and Ad Hoc-S on the other hand was organized to make some technical considerations on the proposed technologies. As a result of these studies within ARIB, a consensus was obtained on the main points listed below.

a) A judicious choice of the chip rate can facilitate achieving a globally common IMT-2000 standard, and ARIB maintains a flexible position on this issue to establish a common standard for the world. The document 'Consensus Decision on IMT-2000 Chip Rate in ARIB,' Attachment-5 to this report, describes more in detail.

b) Based on the agreement made at Ad Hoc-S, ARIB succeeded in gaining a consensus on all of the aforesaid major technical elements that were proposed. For example, the ARIB system was agreed to offer the capability to support both synchronous and asynchronous base stations, and support both common and dedicated pilots. Detailed study results are shown in Attachment-5.

Currently, the collaboration activities with TIA to discuss how to harmonize the two RTT proposals from TIA TR45.5 and ARIB are ongoing and accelerated. At the bilateral meeting held in April 1998, the two bodies agreed to cooperate in performing studies, after confirming the study items based on the above-mentioned consensus derived at Ad Hoc-S of ARIB.

The following are the main study items agreed by the two organizations.

- Reverse Link
- Forward Link Structure
- Base Station Synchronous / Asynchronous operation
- Convergence on Chip Rate
- Turbo Code
- Flexible Frame Length, 10ms and 20ms

At the bilateral meeting in August 1998, detailed action items were identified for these subjects to show the future direction for harmonization.

6. CONCLUSION

This report describes the evaluation results on the cdma2000 RTT proposal from TR45.5.4, performed by the Evaluation Group of ARIB for the revised proposal (ver. 0.18). As a result, it was concluded that the RTT proposal meets the requirements and objectives of IMT-2000, and thoroughly designed as an adequate candidate RTT supported with reliable data. As seen in the above chapters, the two RTT proposals, cdma2000 of TIA TR45.5 and W-CDMA of ARIB, share many common CDMA technologies. This indicates there is a good possibility to harmonize the two RTT proposals in the course of future development and standardization processes at ITU-R. It is expected that harmonization activities will further continue on both a bilateral and global scale in order to achieve a common solution between the two proposed RTTs based on wideband CDMA technologies.

ATTACHMENT 1

Confirmation on Requirements and Objectives Compliance

This Attachment contains the following two Compliance Templates.

Requirements and Objectives (Attachment 4 of Circular Letter)

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

Requirements and Objectives (Attachment 4 of Circular Letter)

Table 1

TECHNICAL REQUIREMENTS AND OBJECTIVES RELEVANT TO THE EVALUATION OF CANDIDATE RADIO TRANSMISSION TECHNOLOGIES

Item Description	Obj/ Req	Source	Meets*	Comments / Assumptions	Evaluator's Comments
Voice and data performance requirements					
1. One-way end-to-end delay less than 40 ms**	Req	G.174, §7.5	Yes	For data only. Not met for voice if vocoder delays are considered. See A.1.3.7.1 and A.1.3.7.2 in Annex 1 for more details.	Confirmed.

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

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

2. For mobile video telephone services, the FPLMTS terrestrial component should operate so that the maximum overall delay (as defined in ITU-T Rec F.720) should not exceed 400 ms, with one-way delay of transmission path not exceeding 150 ms.	Req	Suppl. F.720, F.723, G.114	Yes	It can be supported since the estimated transmission delay (one-way) without vocoder is 25.6ms. This value is described in A3.2.1. Total delay depends on implementation and video/voice coding scheme. Video coding scheme is not specified in RTT.	Confirmed.
3. Speech quality should be maintained at <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 kbit/s).	Req	G.174, §7.11 and M.1079, §7.3.1	Yes	As per IS-127	Confirmed
4. DTMF signal reliable transport (for PSTN is typically less than one DTMF errored signal in 10^4	Req	G.174, §7.11 and M.1079, §7.3.1	Yes	DTMF implemented via signaling with ARQ	Confirmed
5. Voiceband data support including G3 facsimile.	Req	M.1079, §7.2.2	Yes		Confirmed.
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, §10.8, 10.9	Yes		Confirmed.
Radio interfaces and subsystems, network related performance requirements					
7. Network interworking with PSTN and ISDN in accordance with Q.1031 and Q.1032.	Req	M.687-1, §5.4	Yes		Confirmed.
8. Meet spectral efficiency and radio channel performance requirements of M.1079	Req	M.1034, §12.3.3/4	Yes		Confirmed.
9. Provide phased approach with data rates up to 2 Mbit/s in phase 1	Obj	M.687, §1.1.14	Yes	Supported in 15 MHz bandwidth	Confirmed.
10. Maintain bearer channel bit-count integrity (e.g., synchronous data services and many encryption techniques)	Obj	M.1034, §10.12	Yes		Confirmed.

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	Special design considerations may be required to support mega-cells and speeds higher than 120 Kmph	Confirmed.
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.819-1, § 10.3	Yes		Confirmed.
13. Error performance - as specified in ITU-R F.697	Obj	M.819-1, § 10.4	Yes	The required error performance can be satisfied to meet the quality of speech, video and data services should be as good as those in the wireline network. The shown simulation date is based on 5% outage probability, which translates into 95% coverage as required by ITU. It is possible to achieve this objective by changing system operation parameter, e.g. TX power, etc.	Proponent’s comment is sufficient. Link Budget tables shows that this objective is satisfied.
14. Grade of service better than 1%	Obj	M.819-1, § 10.5	Yes	Actual GoS is deployment dependent	

Table 2

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

FPLMTS Item Description	Source	Req/ Obj	Meets? Yes/No	Comments/Assumptions	Evaluator’s Comments

1. Security comparable to that of PSTN/ISDN	M.687-1 § 4.4	Obj	Yes	cdma2000 offers authentication and encryption.	The proposed RTT can support this objective.
2. Support mobility, interactive and distribution services	M.816 § 6	Req	Yes	cdma2000 supports mobility, conversational, messaging, retrieve and storage services.	The proposed RTT can support this requirement.
3. Support UPT and maintain common presentation to users	M.816 § 4	Obj	Yes	Implementation of this service is at the upper layers and is inherently supported by RTT	The proposed RTT can support this objective.
4. Voice quality comparable to the fixed network (applies to both mobile and fixed service)	M.819-1 Table 1 M.1079 §7.1	Req	Yes	The EVRC MOS scores indicate that the voice quality of cdma2000 is comparable to that of fixed networks. The delay will be between 50 and 100 ms.	The proposed RTT can support this requirement.
5. Support encryption and maintain encryption when roaming and during handover	M.1034 §11.3	Req	Yes	cdma2000 will provide authentication, signaling message encryption, and voice privacy. For example, see section 6.3.12 of IS-95-A.	The proposed RTT can support this requirement.
6. Network access indication similar to PSTN (e.g., dial tone)	M.1034 §11.5	Req	Yes		It is dependent on the terminal specifications. The proposed RTT can support this requirement.
7. Meet safety requirements and legislation	M.1034 §11.6	Req	Yes	cdma2000 satisfies current safety requirements (especially hearing aid compatibility)	The proposed RTT can support this requirement.
8. Meet appropriate EMC regulations	M.1034 §11.7	Req	Yes		It is dependent on the equipment specifications. The proposed RTT can meet the EMC legislation.
9. Support multiple public/private/residential FPLMTS operators in the same locality	M.1034 §12.1.2	Req	Yes	Coexistence between different FPLMTS operators in the same locality will require some frequency coordination.	It may depend on the regulations by the government authorities. The proposed RTT can support this requirement.
10. Support multiple mobile station types	M.1034 §12.1.4	Req	Yes	cdma2000 supports mobile stations of various power class and service capabilities.	It is dependenton the equipment specifications. The proposed RTT can support this requirement.
11. Support roaming between FPLMTS operators and between different FPLMTS radio interfaces/environments	M.1034 §12.2.2	Req	Yes	Roaming between different FPLMTS radio interfaces require multi-mode terminals and network function to support such terminals.	Confirmed. IS-95B supports this.

12. Support seamless handover between different FPLMTS environments so that service quality is maintained and signaling is minimized	M.1034 §12.2.3	Req	Yes	cdma2000 supports intra-cell handover with softer handoff and inter-cell handover with soft and hard handoff. Handoff between multiple operators are supported in the standards. Handoff between different FPLMTS operators is to be defined.	Confirmed
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	M.1034 §12.2.5	Req	Yes	Capacity is shared between umbrella and internal cells. In the RTT repeater can be used. It is described in A3.4.2.4.1.	Confirmed
14. Support multiple operators coexisting in the same geographic area	M.1034 §12.2.5	Req	Yes	Multiple operators have to operate n different frequency bands.	Confirmed
15. Support different spectrum and flexible band sharing in different countries including spectrum sharing between different FPLMTS operators (see M.1036).	M.1034 §12.2.8	Req	Yes	With appropriate frequency coordination and channel assignment, it is possible to share spectrum with other services. cdma2000 supports many frequency band in TDD/FDD manners	Confirmed
16. Support mechanisms for minimizing power and interference between mobile and base stations.	M.1034 §12.2.8.3	Req	Yes	Both forward and reverse link are controlled by closed-loop power control.	Confirmed
17. Support various cell types dependent on environment (M.1035 §10.1)	M.1034 §12.2.9	Req	Yes	Standards support many cell types - small to large cells, indoor, mobile, and pedestrian. The size of the cell depends on the user population and terminal power class.	Confirmed
18. High resistance to multipath effects	M.1034 §12.3.1	Req	Yes	cdma2000 uses RAKE receivers to minimizes multipath effects	Confirmed
19. Support appropriate vehicle speeds	M.1034 §12.3.2	Req	Yes	Special design considerations may be required to support speeds higher than 120 Kmph	Confirmed
20. Support possibility of equipment from different vendors.	M.1034 §12.1.3	Req	Yes	Multiple vendors can supply both subscriber and infrastructure equipment.	Confirmed
21. Offer operational reliability as least as good as 2nd generation mobile.	M.1034 §12.3.5	Req	Yes	Reliability will meet or exceed that of 2nd generation mobile.	Confirmed

22. Ability to use terminal to access services in more than one environment, desirable to access services from one terminal in all environments	M.1035 § 7.1	Obj	Yes	System supports various environments and services with the same radio interface, which can be optimized accordingly.	Confirmed
23. End-to-end quality during handover comparable to fixed services.		Obj	Yes	For soft handoff, end-to-end quality is comparable to fixed services. For hard handoff, the quality will be affected.	Confirmed. Proponent's comment gives the exact description.
24. Support multiple operator networks in a geographic area without requiring time synchronization.		Obj	Yes		Confirmed. According to the system description 2.3.8.2, it can support multiple operator networks, since the system operates with BS synchronization.
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.	M.1035 §8	Obj	Yes		Confirmed. According to the system description 3.1.1, the proposed system is designed to allow various Layer 3 protocols to utilize data transport services.
26. Desirable that transmission quality requirements from the upper layer to physical layers be common for all services.	M.1035 §8.1	Obj	*ITU Clarification is pending*	Various service requires different quality requirements for MAC and physical layer. It is desirable to adjust the quality of service for each layer for efficient spectrum utilization. The scheme how the RTT support various type of QoS is described in the system 3.1.1.2 'Link Layer'.	Confirmed. As mentioned in ITU-R recommendation e.g. M.816, each service should have unique QoS requirements. Therefore, the system should be able to adjust QoS for each layer for efficient spectrum utilization. It is confirmed by the System Description 3.1.1.2.
27. The link access control layer should as far as possible not contain radio transmission dependent functions.	M.1035 §8.3	Obj	Yes	For each service, access to logical channel mapping is independent to logical to physical channel mapping.	It is confirmed by the system description 3.1.1.2.
28. Traffic channels should offer a functionally equivalent capability to the ISDN B Channels	M.1035 §9.3.2	Obj	Yes	cdma2000 supports data rates up to 2MB/sec.	It is confirmed by the system description 3.1.1.1.2, A1.2.20.1, A1.2.20.2, A1.2.20.3, A1.2.20.4 and A3.1.1.2.

29. Continually measure the radio link quality on forward and reverse channels.	M.1035 §11.1	Obj	Yes	The qualities of both the forward and reverse links are controlled by power control loop.	It is confirmed by the system description 3.2.1.1.7 and 3.2.2.1.7.
30. Facilitate the implementation and use of terminal battery saving techniques.	M.1035 §12.5	Obj	Yes	cdma2000 supports variable data rate and associated output power control.	Confirmed. Proponent's comment gives the exact description.
31. Accommodate various types of traffics and traffic mixes.	M.1036 §1.10	Obj	Yes	cdma2000 supports voice, circuit data, packet switch data and mixed traffic.	It is confirmed by the system description 2.3.5, 3.1.1.4 and A3.4.1.7.
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.	M.819-1 Table 1	Req	Yes		It is confirmed by A1.3.5.
33. Withstand rugged outdoor environment with wide temperature and humidity variations	M.819-1 Table 1	Req	Yes		It is considered that it is implementation dependent.
34. Provision of service to fixed users in either rural or urban areas	M.819-1 § 4.1	Obj	Yes		It is confirmed by the system description 2.3.5.3 and A3.4.2.4.1.
35. Coverage for large cells (terrestrial)	M.819-1 § 7.2	Obj	Yes		Confirmed by A3.4.2.4.1.
36. Support for higher encoding bit rates for remote areas	M.819-1 § 10.1	Obj	Yes		Confirmed. Cdma2000 has enough flexibility to provide various encoding bit rates.

Table 3

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

FPLMTS Item Description	Source	Req/ Obj	Comments/Assumptions	Evaluator's Comments
1. Fixed Service - Power consumption as low as possible for solar and other sources	M.819-1 Table 1	Req	This rec. is mainly concerned with FPLMTS for developing countries and, as such, this requirement is probably best interpreted in connection with WLL applications. Although lowest power consumption is certainly a target (especially for handset implementations), this should probably not be a very stringent requirement for the BS. Most of the requirements included in Table 1 of this rec. (voice encoding, radio coverage, design life, reliability, environmental, power consumption and antenna directivity) will be met in the wideband systems.	It is confirmed that the proposed RTT is designed to meet lower –power consumption requirements.
2. Minimize number of radio interfaces and radio sub-system complexity, maximize commonality (M. 1035 §7.1)	M.1034 §12.2.1	Req	A common radio interface is used for all operating environments	Confirmed by A3.4.2.4.1.
3. Minimize need for special interworking functions	M.1034 §12.2.4	Req	This refers to interworking between mobile and fixed networks for data service applications. This issue should ideally be addressed in the standardization process for high speed/packet data in the wideband system.	Confirmed. The MAC architecture of cdma2000 already addresses this.
4. Minimum of frequency planning and inter-network coordination and simple resource management under time-varying traffic	M.1034 §12.2.6	Req	Due to 'universal' frequency reuse, frequency planning and inter-network coordination for operation of a single FPLMTS operator's network is simplified. Resource management under varying traffic loads is similarly simplified, but new issues will have to be addressed as mixtures of voice, low and high speed data begin to proliferate	Confirmed.
5. Support for traffic growth, phased functionality, new services or technology evolution	M.1034 §12.2.7	Req	This is already being addressed and high data rate and other services are introduced.	Confirmed.

6. Facilitate the use of appropriate diversity techniques avoiding significant complexity if possible	M.1034 §12.2.10	Req	The use of diversity is intrinsic in the wideband system design, since RAKE receivers are employed at both MS and BS. In addition, space diversity (with two antennas and/or receivers) may be employed at the BS and MS. This is deemed a reasonable compromise between performance and complexity.	Confirmed.
7. Maximize operational flexibility	M.1034 §12.2.11	Req	This refers to the ability to provide modification of operational data to mobile stations via the radio interface and is addressed by the radio link protocol (e.g., rate set 1 or 2 multiplex sublayers)	Confirmed. This feature can be recognized as one solution to achieve operational flexibility.
8. Designed for acceptable technological risk and minimal impact from faults	M.1034 §12.2.12	Req	RTT is based on a proven CDMA standard (TIA/EIA-95-B) which greatly reduces risk	Confirmed. Actual commercial records with TIA-95 systems may contribute to reduce possible risks.
9. When several cell types are available, select the cell that is the most cost and capacity efficient	M. 1034 §10.3.3	Obj	To serve a mobile in the wideband system, generally the cell that requires the least amount of power from a mobile is selected. This minimizes interference and enhances capacity, thus the objective is directly addressed.	Confirmed.
10. Minimize terminal costs, size and power consumption, where appropriate and consistent with other requirements	M.1036 §1.12	Obj	This is a general objective of all viable wireless systems which is being addressed by the wideband system	Confirmed.

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

ARIB Evaluation Group requests additional requirements and objects that will be used by that Group in its evaluation process in addition to original the Requirements and Objectives shown in 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					
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	As seen in the system description, the RTT has appropriate layering structure, which can support those IP-based services.	The proposed RTT has sufficient capabilities to support packet switched bearer and IP- based services. It can be confirmed by the following chapters: 3.1.1.4.3 and 3.3.1.2.1.
Support Location services using position identification information with appropriate accuracy	Obj	M.816 § 8.2.2	Yes	Proposed RTT can support the location services by using any position detection methods (Various methods are being evaluated. The accuracy is implementation dependent and varies with operation conditions.)	According to the description 2.3.5.4, the proposed RTT can support location services. The accuracy is considered as implementation dependent.
Support Priority Access and The Emergency services as are contained in ITU-T Recommendation F.115.	Req	M.1034-1 § 10.16	Yes	As seen in the system description, the RTT is designed to support and full backward compatibility with existing TIA/EIA-95-B system. The required PACA services can be already supported by TIA/EIA-95-B.	The proposed RTT can support PACA (Priority Access and Channel Assignment) defined in IS-53.

[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 descriptions on the required capability.	Yes, confirmed	Yes, confirmed	Yes, confirmed
Support of general service capabilities				
Packet data	System Description – 3.1.1.5.3 A1.2.20, A1.2.20.4 Annex-2	Yes	Yes	Yes
Evaluator's Comment	References show descriptions on the required capability.	Yes It is confirmed that the proposed RTT can support Packet Data services in this environment.	Yes It is confirmed that the proposed RTT can support Packet Data services in this environment.	Yes It is confirmed that the proposed RTT can support Packet Data services in this environment.
Asymmetric services	A1.2.3, A1.2.20	Yes	Yes	Yes
Evaluator's Comment	References show descriptions on the required capability.	Yes, confirmed	Yes, confirmed	Yes, confirmed
Multimedia	A1.2.20, A1.4.7.1, Annex-2, A3.4.1.7	Yes	Yes	Yes

Evaluator's Comment	References show descriptions on the required capability.	Yes It is confirmed that the proposed RTT can support Multimedia services in this environment.	Yes It is confirmed that the proposed RTT can support Multimedia services in this environment.	Yes It is confirmed that the proposed RTT can support Multimedia services in this environment.
Variable bit rate	A1.2.18, A1.2.18.1	Yes	Yes	Yes
Evaluator's Comment	References show descriptions on the required capability.	Yes, confirmed	Yes, confirmed	Yes, confirmed
Data services key capabilities		user bit rates BER	user bit rates BER	user bit rates BER
Circuit-switched low and long delay	A1.4.7.1, A1.2.31, (Annex-2) 8.2.3, 8.2.5 A3.3.5 Simulation Models and Evaluation Results Preliminary RL data provided for 2048 Kbps. Final RL and FL evaluation results will be available 9/30/98.	2048 kbps $\leq 10^{-6}$ Note : - Net user information through put ; - 15 MHz channel BW; with mobile antenna receive diversity.	384 kbps $\leq 10^{-6}$ Note : - Net user information through put ; - 5 MHz channel BW; without mobile antenna receive diversity.	144 kbps $\leq 10^{-6}$ Note : - Net user information through put ; - 5 MHz channel BW; without mobile antenna receive diversity.
Evaluator's Comment	Descriptions on required capability are given in A.1.4.7.1	It is confirmed that the proposed RTT can support the required bearer channel.	It is confirmed that the proposed RTT can support the required bearer channel.	It is confirmed that the proposed RTT can support the required bearer channel.
Packet	Simulation Models and Evaluation Results	= ditto =	= ditto =	= ditto =
Evaluator's Comment	Simulation Models and Evaluation Results	It is expected to have the same capability as circuit-switched mode.	= ditto =	= ditto =

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 provided by the cdma2000 RTT proposal submitted to ITU-R. ARIB's evaluation was made based on its revised version 0.18. In the evaluation process, the following major items were pointed out to TIA TR45.5, to which responses were made from TR45.5. The correspondence between the two bodies in this process is summarized in the table below.

Comments from the Evaluation Group	Reponses from TIA TR45.5	Related section in the proposal
Results for 2048 kbps in Indoor office environment are not provided.	Preliminary results were provided to ARIB Evaluation Group on September 10 and 18, 1998.	8 and 8.2.5 TIA response on Sept. 10, 18
The results of First and Second Simulator: The first simulator determines the number of users according to Poisson distributions, and defines 'outage' as the situation when interference gets larger than the 7-dB margin. On the other hand, the second simulator takes a fixed value for the number of users, and defines 'outage' as the situation where the FER worsens from the predetermined value. ARIB considers that the second simulator is given looser conditions, which will result in larger capacity calculated for the second simulator, due to the following reasons. a) Poisson distributions assume very large number of users at a certain moment, while it is always constant in the second simulator and b) FER will not be degraded even if the interference exceeds the limit (7dB) when the mobile station is close to the base station. Despite these factors, it is not clear why the results for these two simulators are almost the same.	a) For the first simulator, the numbers of mobiles per *geographic cell areas* are randomly varied from one trial to the next, in accordance with a Poisson distribution. On the other hand, for the second simulator, the number of mobiles per *coverage area* is fixed. Note that although this value is fixed, the actual number of mobiles per geographic cell areas randomly vary for each trial. It can be shown that for a large number of cells and mobiles per coverage area, the distribution of mobiles per geographic cell areas are approximately Poisson. Thus, the difference between the results of these two simulators is expected to be small. b) The reverse link outage criteria used for both simulators are *identical*. For each trial, a random number of mobiles are placed uniformly within the coverage area. Next, the minimum mobile transmit powers are computed such that target Eb/(Io+No) values are met. An outage occurs every time noise rise, (Io+No)/No, exceeds 7 dB. Average number of mobiles per cell is reported for which noise rise is below 7 dB over 95% of the trials.	8.2.3.
It is not clear why the results of spectrum efficiency (Mbps/MHz/cell) for packet data services are lower than circuit data services at the same data rate.	The QoS requirements such as FER and outage probability are assumed to be the same for both circuit and packet data simulations. For both the circuit and packet data simulations, the data rates specified in the RTT are the actual over-the-air data rates. For circuit data simulations, the data activity over the traffic channel is assumed to be at 100%, whereas for the packet data case, less than 100% data activity results due to the bursty nature of the traffic.	8.2.5

ATTACHMENT 4

EVALUATION SPREAD SHEET FOR cdma2000

Index	Criteria and attributes	Q or q	Gn	Reference Section (Annex 1)	Proponent's Comments	Evaluator's Comments
A3.1	Spectrum efficiency The following entries are considered in the evaluation of spectrum efficiency:					
A3.1.1	For terrestrial environment					
A3.1.1.1	Voice traffic capacity (E/MHz/cell) in a total available assigned non-contiguous bandwidth of 30 MHz (15 MHz forward/15 MHz reverse) for FDD mode or contiguous bandwidth of 30 MHz for TDD mode. This metric must be used for a common generic continuous voice bearer with characteristics 8 kbit/s data rate and an average BER 1 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	Voice traffic capacity (at 9.6 Kbps) (Erlangs/MHz/cell) Vehicular Environment Omni Cells 3-Sector Cells RL/FL RL/FL 29/36.7 69.6/88.1 Pedestrian Environment Omni Cells 3-Sector Cells RL/FL RL/FL 33.5/34.7 80.4/83.3 Indoor Environment Omni Cells 3-Sector Cells RL/FL RL/FL 34.2/32.3 82.1/79.7 Key assumptions: GoS: 1% blocking Capacity was computed and verified using two independent simulators. See Annex 2 for additional details on evaluation procedures. Note: RL = reverse link, FL = forward link	The answers to this question are subject to change if the assumptions and methodologies are modified. The results shown here should not directly comparable in every instance. Fundamentally, the numbers provided cannot be used for reliable evaluations on different RTTs, because the assumptions and models used are not consistent. There seems to be no description for the concept of blocking. So, the proponent should describe how the blocking is taken into account. The proponent should explain how the capacity for 3-sector cells is calculated using the capacity of omni-cells.
A3.1.1.2	Information capacity (Mbit/s/MHz/cell) in a	Q	G1	A1.3.1.5.2	Information capacity (Mbps/MHz/cell)	The answers to this

	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. Notes: For CDMA2000 information capacity evaluation, the following FER targets were used for the various simulated data rates: <u>Rate (Kbps)</u> <u>Target FER (%)</u> 10 5 15 Capacity estimates for long delay data assume soft-handoff. Capacity was computed and verified using two independent simulators. See Annex 2 for additional details on evaluation procedures.	and q			Vehicular Environment 76.8 Kbps Long Delay Data Omni Cells 3-Sector Cells RL/FL RL/FL 0.212/0.134 0.509/0.322 153.6 Kbps Long Delay Data Omni Cells 3-Sector Cells RL/FL RL/FL 0.197/0.078 0.473/0.187 Pedestrian Environment 76.8 Kbps Long Delay Data Omni Cells 3-Sector Cells RL/FL RL/FL 0.264/0.140 0.634/0.336 460.8 Kbps Long Delay Data Omni Cells 3-Sector Cells RL/FL RL/FL 0.215/0.055 0.516/0.132 Indoor Environment 76.8 Kbps Low Delay Data Omni Cells 3-Sector Cells RL/FL RL/FL 0.226/0.73 0.542/0.175 Note: RL = reverse link, FL = forward link		question are subject to change if the assumptions and methodologies are modified. The results shown here should not be directly comparable in every instance. Fundamentally, the numbers provided cannot be used for reliable evaluations on different RTTs, because the assumptions and models used are not consistent. There seems to be no description for the concept of blocking. So, the proponent should describe how the blocking is taken into account. The proponent should explain how the capacity for 3-sector cells is calculated using the capacity of omni-cells.	
A3.1.2	For satellite environment These values (§ A3.1.2.1 and A3.1.2.2) assume the use of the simulation conditions in Annex 2. The first definition is valuable for comparing systems with identical user channel rates. The second definition is valuable for comparing systems with different voice and data channel rates.							
A3.1.2.1	Voice information capacity per required RF bandwidth (bit/s/Hz)	Q	G1					

A3.1.2.2	Voice plus data information capacity per required RF bandwidth (bit/s/Hz)	Q	G1					

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).					
A3.2.1	Need for echo control The need for echo control is affected by the round trip delay, which is calculated as shown in Fig. 6. Referring to Fig. 6, consider the round trip delay with the vocoder (D1, ms) and also without that contributed by the vocoder (D2, ms). NOTE 1 – The delay of the codec should be that specified by ITU-T for the common generic voice bearer and if there are any proposals for optional codecs, include the information about those also.	Q	G4	A1.3.7.2 A1.3.7.3	This delay varies depending on the vocoder used. The following delay budget assumes the use of EVRC. Typical reverse link delays are shown (forward link results are comparable) Delay (ms.) **Mobile Station** Vocoder delay 33.0 Vocoder processing 10.0 Channel processing 2.0 **Air transmission** Frame trans. Time 20.0 **Base station** Channel processing 2.0 Viterbi decoding 1.6 Vocoder speech Generation 1.0 Total delay 69.6 ms Delay without vocoder is 25.6 ms. Delay specified above is one-way delay. Approximate round trip delays can be estimated by doubling the numbers provided. Echo control is needed for voice services.	Self-evaluation comments are satisfactory.
A3.2.2	Transmitter power and system linearity requirements NOTE 1 – Satellite e.i.r.p. is not suitable for evaluation and comparison of RTTs, because it depends very much on satellite orbit. The RTT attributes in this section impact system cost and complexity, with the resultant desirable effects of improving overall performance in other evaluation criteria. They are as follows.					
A3.2.2.1	Peak transmitter/carrier (P_b) power (not applicable to satellite) Peak transmitter power for the BS should be	Q	G1	A1.2.16.1 A1.2.16.2.1	The RTT itself does not impose any constraints on the peak transmitter/carrier power. BS power levels are subject to radio regulatory agencies	Self-evaluation comments are satisfactory. (A3.2 is BS related.)

	considered, because lower peak power contributes to lower cost. Note that P_b may vary with test environment application. This is the same peak transmitter power assumed in Annex 2, link budget template (Table 6).				(e.g., the FCC in the United States) There are expected to be less than a total EIRP of 1640 W in transmit bandwidth and a maximum total power of 100 W. The maximum total transmitter power at the BS used in the link budget calculation is 47 dBm. MS are expected to be of five power classes: Class I: 28 dBm < EIRP < 33 dBm Class II: 23 dBm < EIRP < 30 dBm Class III: 18 dBm < EIRP < 27 dBm Class IV: 13 dBm < EIRP < 24 dBm Class V: 8 dBm < EIRP < 21 dBm	
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 A1.2.16.1 A1.2.16.1.2	Broadband amplifiers are required. Peak to average (99.9% c.d.f.): MS: 3.2 dB BS 8.3 dB Maximum power levels are constrained to values given in A3.2.2.1 above	Self-evaluation comments are satisfactory.
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	A1.4.10	Emission limits established by local radio regulatory agencies generally apply (e.g. FCC in the U.S.) The limits given below are representative for a chip rate of 3.6864 Mcps for both MS and BS. Freq. Offset (MHz) — Power 2.5 < |Δf| < 3.5 — -13 dBm/37 kHz |Δf| > 3.5 — -13dBm/1MHz where Δf = center frequency of the CDMA signal – closer measurement edge frequency	Self-evaluation comments are satisfactory.
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	A1.2.16.2.1 A1.2.16.2.2	Peak to average transmitter power is 8.3 dB with multiple traffic channels. Regarding to the detailed description how to calculate it, see the attached paper**.**	Self-evaluation comments are satisfactory.
A3.2.2.4	Receiver linearity requirements (not applicable to satellite)	q	G4	A1.4.11 A1.4.12	Receiver linearity is required in BS and MS. The nominal 3rd order intercept point is required to be <	Self-evaluation comments are satisfactory.

	Is BS receiver linearity required? If so, state the receiver dynamic range required and the impact of signal input variation exceeding this range, e.g., loss of sensitivity and blocking.				16 dBm. The conditions are : Tone spacing of 900 and 1700 kHz. Tones are 72 dB above the carrier. 3 dB increase in required transmit power for target FER. 3X and 76.8 kbps data rate. The dynamic range specifications below are for static channel conditions (AWGN) MS: 79 dB BS: 52 dB	
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	Power control is used on both forward and reverse links (FL and RL). Open loop and closed loop power control schemes are employed. Power Control Step Size: FL: 0.5 dB nominal RL: 1.0 dB nominal (0.5 dB and 0.25 dB are available as options) Power Control Cycles per second: FL and RL: 800 Hz nominal Power control dynamic range: FL closed loop: function of BS capacity. RL Open loop: ± 40 dB RL Closed loop: ± 24 dB (around open loop estimate) Minimum transmit power level with power control: FL -50 dB relative to total BS power. RL -50 dBm Power control accuracy (RL): Power control error can vary from about 1.3 dB (low mobility case) to 2.7 dB (high-speed vehicular case).	Self-evaluation comments are satisfactory.
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 A1.2.2.1 A1.2.2.2	Duplexer required in MS for FDD operation. Different requirements may apply for different MS classes. Tx to Rx isolation: - Typical Class II MS: 55 dB (provided by the duplexer);	Self-evaluation comments are satisfactory.

					- Typical BS: 90 dB; This increased requirement is due to high effective BS power and about 5dB better noise figure in the receiver. This isolation could be provided from a combination of antenna spacing and Rx filtering.	
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 analyze the detailed description of the digital signal processing requirements, including performance characteristics, architecture and algorithms, in order to estimate the impact on complexity of the BSs. At a minimum, the evaluation should review the signal processing estimates (MOPS, memory requirements, gate counts) required for demodulation, equalization, channel coding, error correction, diversity processing (including Rake receivers), adaptive antenna array processing, modulation, A-D and D-A converters and multiplexing as well as some IF and baseband filtering. For new technologies, there may be additional or alternative requirements (such as FFTs). Although specific implementations are likely to vary, good sample descriptions should allow the relative cost, complexity and power consumption to be compared for the candidate RTTs, as well as the size and the weight of the	Q and q	G2	A1.4.13	MS and BS signal processing and memory requirements are implementation dependent. It is estimated that third generation processing requirements will range from 1.0 times (for voice applications) to 1.5 times (for high-speed data applications) those of second generation requirements. It is feasible and desirable that the both the BS and the MS signal processing functions be highly integrated in a baseband integrated circuit (IC), which performs the following major functions: Wideband Receiver Analog to Digital Converter (ADC) and Wideband Transmitter Digital to Analog Converter (DAC) Speech processing ADC and DAC (applicable for MS baseband IC) Digital Signal Processor (DSP), and DSP memory (ROM and RAM) Control Processor (CPU), and CPU ROM/RAM Any CDMA Logic that is not allocated to a software function. This may include Rake searcher and other Rake receiver elements, power control sub-channel MUX/De-MUX, Spreaders and modulators. The exact breakdown is an implementation choice, with a general trend in favor of software function at the expense of dedicated logic. Interface and control circuits to RF devices, PLL, etc; The following is an estimate of complexity for an implementation of a baseband BS IC designed to operate at data rates from speech to the maximum of about 1 Mb/s. The estimate includes speech codec, but does not include turbo encoder/decoder, since turbo coding is still	Self-evaluation comments are satisfactory.

	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.				work in progress for cdma2000. Estimated RAM size: 65 kbytes Estimated ROM size: 240 kbytes Estimated gate count excluding ROM and RAM: 155 thousand; Estimated peak processing power of DSP: 60 MIPS	
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	FORWARD LINK 6-bit, 8-bit, 10-bit,12-bit, or 16-bit CRC frame error checking; 9/16, 1/2, 1/3,1/4 rate, K=9 convolutional coding (other derived rates obtained via puncturing) Equivalent rate Turbo Codes with K=4 for Supplemental Channels;. 20 ms and 5 ms interleaving REVERSE LINK 6-bit, 8-bit, 10-bit,12-bit, or 16-bit CRC frame error checking; 9/16, 1/2, 1/3, 1/4 rate, K=9 convolutional coding Equivalent rate Turbo Codes with K=4 for Supplemental Channels;. 20 ms and 5 ms interleaving; Each Supplemental Channel may use different coding schemes.	Self-evaluation comments are satisfactory.
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 beyond and omni-directional antenna.	Q	G2	A1.2.23 A1.2.23.1 A1.2.23.2	**Time diversity**: symbol interleaving and error coding and correction. **Path Diversity**: RAKE receiver **Space diversity**: BS uses 2 antennas; MS antenna diversity is optional **Orthogonal Transmit Diversity** can be used on the	Self-evaluation comments are satisfactory.

					forward link **Frequency Diversity**: 1.2288, 3.686, 7.3728, 11.0592, or 14.7456 MHz spreading **Delay transmit diversity**: may be employed for both Multi-carrier and Direct Spread deployments. **Diversity combining**: either maximal-ratio or equal gain combining may be used with multiple RAKE fingers. **Minimum number of demodulators/receivers**: 1 per MS 2 per BS **Minimum # of antennas**: 1 per MS (antenna diversity is optional) 2 per BS **Overall Performance Improvement due to Diversity:** Function of situation, Typically up to 10 dB for 1% FER. Time diversity : 5dB Space diversity : 3dB Path diversity : 1.5dB Path & Freq diversity are the same thing. Transmit Diversity = 0 to 4dB Site Diversity = 5dB to 8.3dB. RAKE = 1 to 2 dB Additive diversity gains can average as high as 10dB in some cases. *(added on*	
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 can be used to extend coverage. Auxiliary pilots can be used to orthogonolize these remote antennas if needed.	Self-evaluation comments are satisfactory.
A3.2.6.3	Distributed antennas : describe whether and how distributed antenna designs are used.	q	G3	A1.3.6	Field proven distributed antenna configurations can be used in micro-cellular and indoor coverages with very high efficiency.	Self-evaluation comments are satisfactory.
A3.2.6.4	Unique antenna : describe additional antenna systems which are either required or optional for the proposed system, e.g., beam shaping, leaky feeder. Include in the description the advantage or application of the antenna	q	G4	A1.3.6	The use of antenna beam-forming and adaptive antennas increases the performance of the system by reducing the interference for a single or cluster of Mobile Stations. Antenna beam-forming can extend the range toward voice terminals in difficult propagation conditions or	Self-evaluation comments are satisfactory.

	system.				increase the supported data rate for high speed data terminals. One or more Auxiliary Pilot channels can be used to provide phase reference, timing information and a strength measure to the Mobile Stations within the different beams.	
A3.2.7	BS frequency synchronization/time alignment requirements Does the proposed RTT require base transmitter and/or receiver station synchronization or base-to-base bit time alignment? If so, specify the long-term (1 year) frequency stability requirements, and also the required bit-to-bit time alignment. Describe the means of achieving this.	Q and q	G3	(A1.2.8.3) A1.4.1 A1.4.3	BS-to-BS synchronization is required. **The synchronization requirements are:** Short-term timing accuracy = ±10 µs Short-term frequency accuracy = 0.05 ppm Base-to-base bit time alignment over a 24 hour period = ±10 µs The mobile station corrects its reference frequency and adjusts it to that of the BS during acquisition and operation by using the continuous common pilot. **The BS to BS synchronization allows:** fast acquisition; simplified, faster and more reliable hand off procedures; improved emergency position localization; increased capacity and reliability by allowing common channels to be in soft handoff; usage of a poorly synchronized network (developping coutries, etc.); Any synchronization technique can be used. The use of GPS has been in the past the most popular method.	Self-evaluation comments are satisfactory.
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	For a 5 MHz deployment, 253 Walsh codes (and thus an equal number of channels) are available for voice per BS sector. This result can be scaled accordingly for the number of sectors used for a particular BS. The maximum number of user channels for voice traffic in different environments are: Vehicular: 109 Pedestrian: 118 Indoor: 112 Note: worst case numbers between channel A and channel B are chosen as required per ITU-R M.1225.	The answers to this question are subject to change if the assumptions and methodologies are modified. The results shown here should not directly comparable in every instance. Fundamentally, the numbers provided cannot be used for reliable evaluations on different RTTs, because the

						assumptions 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	**None.**	
A3.2.10	Handover complexity Consistent with handover quality objectives defined in criterion § 6.1.3, describe how user handover is implemented for both voice and data services and its overall impact on infrastructure cost and complexity.	Q	G1	A1.2.24 A1.4.6.1	Various types of handover are supported (see below). Soft Handover between neighboring CDMA base stations on the same frequency (see section 3.2.3.3 of the RTT System Description). Soft handover results in increased coverage range on the reverse link. This soft 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 a difficult radio environment. Hard Handover between CDMA base stations on different frequencies. Hard Handover CDMA to other bandwidths or technologies. Mobile Assisted Handover (MAHO) is supported. The Supplemental Channel Handover does not necessarily use the complete Active Set of the Fundamental Channel. The optimal policy varies with channel conditions. For detailed description of handover procedures, see section 3.2.3.3 of the RTT System Description.	Self-evaluation comments are satisfactory.

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	q	G2	A1.4.14	The common continuos pilot channel described in the RTT system allows to rapidly reacquire synchronization in the case of shadowing and rapid signal loss. In addition, the RTT system provides hard-handoff	Technology independent solutions may be implemented to re-establish a "dropped call" (e.g. re-

	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.				failure recovery procedures which allow the Mobile to return to its Serving BS and reconnect the call in case of hard-handoff failure. cdma2000 uses a technique called Enhanced MAHO which further reduces the potential for dropped calls.	page, etc.) Self-evaluation comments are satisfactory.
A3.3.2	Round trip delay, D1 (with vocoder (ms)) and D2 (without vocoder (ms)) (See Fig. 6). NOTE 1 – The delay of the codec should be that specified by ITU-T for the common generic voice bearer and if there are any proposals for optional codecs include the information about those also. (For the satellite component, the satellite propagation delay is not included.)	Q	G2	A1.3.7 A1.3.7.1 A1.3.7.2	Some of these delays may be implementation dependent. Typical values are shown for both forward and reverse links and voice transmission only (excluding vocoder delay) **Delay (ms.)** Channel processing (MS + BS) 4.0 Frame trans. 20.0 Viterbi decoding 1.6 -------- **Total 25.6 ms** Delay specified above is one way delay. Approximate round trip delays can be estimated by doubling the numbers provided. For a delay budget that includes vocoder delay, see A3.2.1 above.	Self-evaluation comments are satisfactory.
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	Soft-handover does not cause any disruption of service ("make before break" principle). Handover procedures are designed to minimize loss of service. Break duration: Soft handover: none (seamless) Inter-frequency: in the order of 20 ms on forward link, 40 ms on reverse link (exact value is implementation dependent).	Self-evaluation comments are satisfactory.
A3.3.4	Handover quality for data There should be a quantitative evaluation of the effect on data performance of handover.	Q	G3	A1.2.24 A1.2.24.1 A1.2.24.2 A1.4.6.1	Soft-handover does not cause any disruption of service and has no impact on the data quality. In the case of hard-handover with non-real time packet data services, ARQ is applied and there should be no impact on the data quality. For a hard-handover and real time data services, the connection is terminated for a short period of time. The	Self-evaluation comments are satisfactory.

					time out periods are system implementation dependent.	
A3.3.5	Maximum user bit rate for data (bit/s) A higher user bit rate potentially provides higher data service quality (such as high quality video service) from the user's point of view.	Q	G1	A1.3.3	The maximum allowable data rate depends on spectrum allocation. FDD: 1X: 307.2 kbps 3X: 1036.8 kbps 6X: 2073.6 kbps 9X: 2073.6 kbps 12X: 2457.6 kbps **TDD:** 1X: 229.2 kbps 3X: 613.2 kbps 6X: 1.2276 Mbps 9X: 2.4564 Mbps **12X: 2.4564 Mbps**	Self-evaluation comments are satisfactory.
A3.3.6	Channel aggregation to achieve higher user bit There should also be a qualitative evaluation of the method used to aggregate channels to provide higher bit rate services.	q	G4	A1.2.32	Channel aggregation is supported through the use of parallel Supplemental Channels. Any combination of one Fundamental and several Supplemental Channels is allowed, each with different QoS. Assuming we do not use quasi-orthogonal codes, appropriate aggregation of one Fundamental and several Supplemental Channels using different codes allows one to obtain user bit rates up to: **FDD:** 1.25 MHz: 1.1918 Mbps 3X: 3.8628 Mbps 6X: 8.124 Mbps 9X: 8.8922 Mbps 12X: 16.4148 Mbps **TDD**: 1X: 809 kbps 3X: 2.2526 Mbps 6X: 4.5554 Mbps 9X: 8.5298 Mbps 12X: 9.2774 Mbps	Self-evaluation comments are satisfactory.

					Note: These data rates can only be reached in optimal channel conditions.	
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 at ITU-T Recommendation G.711 (64 kbit/s PCM). NOTE 1 – Voice quality equivalent to ITU-T Recommendation G.726 error free with no more than a 0.5 degradation in MOS in the presence of 3% frame erasures might be a requirement.	Q and q	G1	A1.2.19 A1.3.8	Existing CODECs: TIA/EIA/IS-127 (8.5 kbps) TIA/EIA/IS-733 (13.3 kbps) A frame size adaptation interface can allow the RTT to use any CODEC with any frame size. The following MOS scores came from a joint test performed in clear channel conditions: *IRS Filtering of Clean Input Speech* Codec MOS 64K μ-law PCM 4.27 32K ADPCM (G.726) 3.76 IS-127 EVRC 4.14 **IS-733 13K 4.13**	It is indicated that the proposed RTT supports various codecs which produce superior voice quality than G.726. However, the Evaluation Group of ARIB points out that the low-bit-rate voice coder testing is subjective and may result in large variances from test to test.
A3.3.8	System overload performance (not applicable to satellite) Evaluate the effect on system blocking and quality performance on both the primary and adjacent cells during an overload condition, at e.g. 125%, 150%, 175%, 200%. Also evaluate any other effects of an overload condition.	Q and q	G3	A1.3.9.1	System overload causes graceful degradation of the system. The technique called "cell-breathing" can be applied to reduce blocking on the overloaded cell and to minimize its impact on the system. When a particular cell is overloaded its reverse link interference level increases. The effective reverse link range of the cell is reduced due to power constraints in the mobile station. By adjusting the forward link power accordingly, a mobile station at the border of the overloaded cell will naturally and gracefully handoff to adjacent cells. This will reduce the effective coverage of the overloaded cell and reduce its interference. An additional feature for managing and improving the QoS for high load conditions is the variable rate voice codec. The codec bit rate will drop to improve the coverage or range as necessary during high loading conditions.	The proposed RTT can cope with system overload in a flexible manner due to cell breathing..

A3.4	Flexibility of radio technologies

A3.4.1	Services aspects					
A3.4.1.1	Variable user bit rate capabilities Variable user bit rate applications can consist of the following: – adaptive signal coding as a function of RF signal quality; – adaptive voice coder rate as a function of traffic loading as long as ITU-T Recommendation G.726 performance is met; – variable data rate as a function of user application; – variable voice/data channel utilization as a function of traffic mix requirements. Some important aspects which should be investigated are as follows: – how is variable bit rate supported? – what are the limitations? Supporting technical information should be provided such as – the range of possible data rates, – the rate of changes (ms).	q and Q	G2	A1.2.18 A1.2.18.1	The RTT provides adaptive signal coding as a function of RF signal quality and RF environment through automatic reduction of data rate and increase of symbol repetition (e.g. reduced rate modes in codec –TIA/EIA/IS-733). On the forward link the user information bit rate can vary from 0 to 2.457 Mbps(12X). Variable rates are achieved by adjusting the code rate, using symbol repetition, puncturing, and changing the spreading factor in factors of 2 from 1024 down to 4. On the reverse link the user information bit rate can vary from 0 to 2.073 Mbps. Variable rates are achieved by adjusting the code rate, symbol repetition and puncturing. For bit rates up to 14.4 kbps the mobile station can select prior to connection setup between two sets of data rates: Rate Set 1: 1.5, 2.4, 4.8, 9.6 kbps Rate Set 2: 1.8, 3.6, 7.2, 14.4 kbps The rate can be changed on a frame by frame basis (i.e. every 20 ms). The rate can be blindly detected by the receiver (based on a given Rate Set) The rate can vary between each sub rate of the Rate Set based on: signal quality voice activity signaling needs user data requirements For bit rates exceeding 14.4 kbps rate information is explicitly provided to the receiver. If the rate is scheduled, then it can be varied on a frame by frame basis from 0 to 2.457 Mbps according to the user needs.	Self-evaluation comments are satisfactory.
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	The RTT uses a continuous pilot on both the forward and reverse links for phase estimation. The pilot filter output sampling rate is therefore implementation dependent and is not imposed by the	Self-evaluation comments are satisfactory.

					pilot design of the RTT. This approach does not introduce any particular limitation on the maximum Doppler frequency. There is a tradeoff between the tolerance of the pilot filter to high Doppler shift and requirements of user data Eb/Nt. The set point between the two is implementation dependent. For a typical pilot power setting and pilot filter Doppler shift up to 900 Hz can be tolerated (this corresponds to a maximum phase change of π/8 during one symbol).	
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			
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	CDMA provides inherent robustness against both multipath and intersymbol interference. There is no inherent limitation on the maximum tolerable delay spread on the reverse link. On the forward link, the maximum tolerable delay spread is limited by the constraint of the minimum time offset in PN scrambling codes between two adjacent base stations. Careful PN code planning takes care of this issue. The RTT currently supports up to 184 µs delay spreads (limited by the size of the search window) based on code planning consideration. There is a trade-off between the maximum delay spread any RAKE receiver needs to search for and the speed of the mobile. The maximum delay spread is directly linked to the implementation of the RAKE receiver and the searchers.	Self-evaluation comments are satisfactory.
A3.4.1.5	Maximum user information bit rate, R_u (kbit/s) How flexibly services can be offered to customers?	Q and q	G2	A1.3.3 A1.3.1.5.2 A1.2.31 A1.2.32	Assuming we do not use quasi-orthogonal codes, appropriate aggregation of one Fundamental and several Supplemental Channels allows to obtain user bit rates up to: **FDD:**	The answers to this question are subject to change if the assumptions and methodologies are modified. The results shown here

	What is the limitation in number of users for each particular service? (e.g. no more than two simultaneous 2 Mbit/s users)				1X: 1.1918 Mbps 3X: 3.8628 Mbps 6X: 8.124 Mbps 9X: 8.8922 Mbps 12X: 16.4148 Mbps **TDD:** 1X: 809 kbps 3X: 2.2526 Mbps 6X: 4.5554 Mbps 9X: 8.5298 Mbps 12X: 9.2774 Mbps Note: These data rates can only be reached in optimal channel conditions. A single user can have multiple concurrent services (multiple Bearer Channels) with different bit rates and QoS. The deployment matrices of Annex 2 of the cdma2000 RTT provides the maximum number of users for each service and environment.	should not be directly comparable in every instance.
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 following 20 ms frame length variable rate codecs are supported : TIA/EIA/IS-127 (8.5 kbps) TIA/EIA/IS-733 (13.3 kbps) The RTT does not preclude the usage of other CODECs.	Self-evaluation comments are satisfactory.
A3.4.1.7	Multimedia capabilities The proponents should describe how multimedia services are handled. The following items should be evaluated: – possible limitations (in data rates, number of bearers), – ability to allocate extra bearers during of the communication, – constraints for handover.	Q and q	G1	A1.2.21 A1.2.20 A1.3.1.5.2 A1.2.18 A1.2.24 A1.2.30 A1.2.30.1	The cdma2000 system supports multiple parallel services with different delay constraint, FER and BER requirements through the use of multiple Supplemental Channels. Both circuit switched data and packet switched data services with frame by frame variable bit rates are supported individually and simultaneously. The number of simultaneous Supplemental Channels to a given user is limited by the Walsh code space on the forward link and by the maximum allowable power in the mobile station. Service Negotiation permits the addition of bearers	

					during a call. There are no particular constraints imposed by handover in the delivery of multimedia services. Different parallel services can indeed have different Active Sets (number of Forward Link active legs in soft handover) to achieve various QoS.	
A3.4.2	Planning					
A3.4.2.1	Spectrum related matters					
A3.4.2.1.1	Flexibility in the use of the frequency band The proponents should provide the necessary information related to this topic (e.g., allocation of sub-carriers with no constraints, handling of asymmetric services, usage of non-paired band).	q	G1	A1.2.1 A1.2.2 A1.2.2.1 A1.2.3 A1.2.2.5	The system has both an FDD and TDD mode. The FDD mode requires a paired band while the TDD mode does not. The system supports bandwidths of: 1x 1.25 MHz 1x 5 MHz 1x 10 MHz 1x 15 MHz 1x 20 MHz 2x 1.25 MHz 2x 5 MHz 2x 10 MHz 2x 15 MHz 2x 20 MHz The frequency band assignment to deploy the system is as follow: **FDD:** 2x 1.25 MHz, if coordinated with adjacent frequency bands 2x [1.25MHz + 2 x 625kHz guard band] = 2x 2.5MHz, otherwise **TDD:** 1.25 MHz, if coordinated with adjacent frequency bands 1.25 MHz + 2 x 625 kHz = 2.5 MHz, otherwise For FDD, the Duplex separation for the existing band plans is as follow: 45 MHz for cellular 80 MHz for PCS	Self-evaluation comments are satisfactory.

					The RTT does not preclude the usage of other frequency separation. Asymmetric transmission is possible for both the FDD and TDD modes.	
A3.4.2.1.2	Spectrum sharing capabilities The proponent should indicate how global spectrum allocation can be shared between operators in the same region. The following aspects may be detailed: – means for spectrum sharing between operators in the same region, – guardband between operators in case of fixed sharing.	q and Q	G4	A1.2.26	Different operators generally (but not necessarily) operate on different frequencies. System allows flexible deployment to ensure meeting all spectrum-sharing requirements as per radio regulatory agencies. In case of fixed sharing, 625 kHz guard-band on each side are recommended.	Self-evaluation comments are satisfactory.
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	Minimum bandwidth required per duplex RF channel: **FDD:** 1X: 2 x 1.23 = 2.46 MHz 3X: 2 x 3.69 = 7.38 MHz 6X: 2 x 7.37 = 14.74 MHz 9X: 2 x 11.1 = 22.2 MHz 12X: 2x 14.74 = 29.48 MHz **TDD:** 1X: 1 x 1.23 = 1.23 MHz 3X: 1 x 3.69 = 3.69 MHz 6X: 1 x 7.37 = 7.37 MHz 9X: 1 x 11.1 = 11.1 MHz 12X: 1 x 14.74 = 14.74 MHz The maximum user bit rate per code channel for a given bandwidth configuration is as follows: **FDD:** 1X: 306.0 kbps 3X: 1.0356 Mbps 6X: 2.0724 kbps 9X: 2.4564 kbps 12X: 2.4564 kbps **TDD:** 1X: 229.2 kbps	Self-evaluation comments are satisfactory.

					3X: 613.2 kbps 6X: 1.2276 Mbps 9X: 2.4564 Mbps 12X: 2.4564 Mbps The frequency reuse is 1 regardless of the operating configuration.	
A3.4.2.1.4	The proponent should describe how their system will provide global service delivery in the different regional/national band plans and frequency duplexing arrangements for IMT-2000 systems	Q and q	G1	A1.2.2.5 A1.2.2.6	The system has not been designed for a particular band plan and can operate wherever the minimum spectrum requirements specified in A3.4.2.1.3 can be met. In addition the different chip rates (multiples of 1.2288 Mcps) have been chosen to fit in all existing band plans.	Self-evaluation comments are satisfactory.
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, signaling,)? – 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, – interleaved frequency planning. NOTE 1 – The use of the second adjacent channel instead of the adjacent channel at a neighboring cluster cell is called "interleaved frequency planning". In some cases, no particular functions are necessary	q	G2	A1.2.25 A1.2.26 A1.2.27 A1.4.15	No frequency planning is required. All base station can be on the same frequency (frequency reuse = 1). Different operators are generally on different frequencies. No tight constraint on code planning. All base stations share the same unique pair of short PN codes. Neighboring base stations are identified by using a different offset of the same PN code from a set of 512 offsets. Different offset steps can be selected for code planning, depending on the density of base station and average cell radius. - No frequency hopping, interleaved frequency planning or time planning is required. Code resources for channelization: The number of orthogonal functions for channelization on the forward link is: 128 for 1X 256 for 3X 512 for 6X 1024 for 12X In the rare event of shortage of orthogonal code channels on the forward link Quasi-Orthogonal function may be used to increase the channelization code space.	Self-evaluation comments are satisfactory.

	(e.g. frequency reuse = 1).					
A3.4.2.2.2	Adaptability to adapt to different and/or time 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.	q	G2	A1.3.10 A1.2.27 A1.2.22 A1.2.14 A1.2.24.2	DCA (in the sense used in TDMA) on a channel basis is not required Open loop and closed loop power control mechanisms are used to adapt to the varying propagation and traffic conditions. On a system wide basis, the capacity of neighboring base stations can be dynamically shared and cell breathing technique can be used to compensate for system overload. When multiple CDMA carriers are deployed, the load can be shared and dynamically balanced between different carriers using inter-frequency handover mechanism. A mobile on a heavily loaded CDMA carrier can be handed over to another CDMA carrier on the same cell or different cell for load balancing.	Self-evaluation comments are satisfactory.
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	Multiple frequencies and hierarchical cell structure can be implemented by deploying multiple CDMA carriers. Adjacent CDMA carriers can be deployed at fixed bandwidth separation. The number of CDMA carriers that can be deployed depends on the available spectrum and the system bandwidth (1X, 3X, 6X, 9X, or 12X). No guard bands between carriers are necessary if multiple frequencies are used at the same cell. Guard bands may or may not be necessary for hierarchical cell structures depending on the relative cell sizes. Auxiliary Pilots can be used to create different layers within the same frequency and the same sector.	Self-evaluation comments are satisfactory.
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,	q	G2	A1.2.28 A1.3.10	Inter-frequency search and inter-frequency hard handover procedures enables the deployment of adjacent CDMA carriers within a same system and the management of hierarchical cell structures. No soft handover is possible between different CDMA carriers.	Self-evaluation comments are satisfactory.

	– adaptation to the cell layers depending on services, mobile speed, mobile power.				When layers are deployed using auxiliary pilot and beam forming techniques or micro-cell on the same frequency users can go into soft-handover between the different layers.	
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 signaling simplification.	q	G4	A1.1.3 A1.3.5 A1.4.17 A1.4.7 A1.4.7.1	There is no distinction in the air interface's technical parameters between fixed and mobile applications. The system is optimized to handle both mobile and FWA. Fixed users and mobile users can co-exist within the same system. Each user's specific FER and BER requirement are adjusted independently to the radio environment (mobile or fixed) by fast closed loop and outer loop power control. Procedures and messages already included in TIA/EIA-95-B to support FWA and WLL (Wireless Local Loop) applications are part of the RTT. The standard set of ISDN circuit switched and packet switched bearers can be provided over the Supplemental Channel. Repeaters can be used and adjusting the search window of the mobile station receiver can accommodate large cells with large delay spread.	Self-evaluation comments are satisfactory.
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	The RTT is well suited for all form of advanced adaptive antenna technology. A separate Auxiliary Pilot within a sector can be associated with each sub-beam of a sector. Auxiliary Pilots can be shared among a group of mobiles to improve coverage towards coverage holes or to increase capacity towards a high traffic load area. Alternatively, Auxiliary Pilots can be dedicated to a mobile user to enable connection specific antenna beam steering techniques.	Self-evaluation comments are satisfactory.
A3.4.2.4.3	Existing system migration capability	q	G1	A1.4.16	cdma2000 system will be fully backward compatible with TIA/EIA-95-B.	Self-evaluation comments are satisfactory.

					Handovers from a cdma2000 system to a TIA/EIA-95-B system will be supported. In addition the deployment of cdma2000 system in the same frequency as TIA/EIA-95-B (overlay situation) is supported. A flexible layering structure accommodates various kind of signaling for a smooth integration with existing and newly defined signaling protocols. Inter-frequency hard handover enables handover to existing or newly defined technologies (cdma2000 provides hard handover to AMPS).	

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	A1.2.8.3 A1.4.3	cdma2000 chip level air interface synchronization is independent of network synchronization.	Self-evaluation comments are satisfactory.
A3.5.2	Examine the RTTs ability to minimize the network infrastructure involvement in cell handover. Best case : neither PSTN/ISDN nor mobile switch involvement in handover. Worst case : landline network involvement essential for handover.	q	G3	A1.4.6.1 A.1.2.24	In certain handover scenarios neither PSTN/ISDN nor mobile switch involvement is necessary. Base Stations could control the soft handover so no special involvment of the mobile switch would be necessary. In practice it is much simpler to implement the handover combiner in the mobile switch.	This question depends on network capabilities.
A3.5.3	Landline feature transparency					
A3.5.3.1	Examine the network modifications required for the RTT to pass the standard set of ISDN bearer services. Best case : no modifications required. Worst case: substantial modification	q	G1	A1.4.7.1	No modifications are required to offer both basic and enhanced ISDN bearer services. Impacts to network: *Best case* : no modifications required.	This question depends on network capabilities.

	required, such as interworking functions.				*Worst case*: Interworking functions may be necessary to provide air-interface to network synchronization in specific bit synchronous services.	
A3.5.3.2	Examine the extent of the PSTN/ISDN involvement in switching functionality. Best case : all switching of calls is handled by the PSTN/ISDN. Worst case : a separate mobile switch is required.	q	G2	A1.4.6 A1.4.8	The following functionality may be required: Additional mobility management Fast packet access Protocol conversion These may be provided in a mobile switch thereby not requiring any changes to the PSTN/ISDN network. However, modifying the PSTN/ISDN to provide these capabilities is not precluded. Where these functions are implemented is a implementation issue.	This question depends on network capabilities.
A3.5.3.3	Examine the depth and duration of fading that would result in a dropped call to the PSTN/ISDN network. The robustness of an RTTs ability to minimize dropped calls could be provided by techniques such as transparent reconnect.	Q and q	G3	A1.2.24 A1.4.14	The common continuos pilot channel described in the RTT system allows to rapidly reacquire synchronization in the case of shadowing and rapid signal loss. In addition the RTT system provides hard-handoff failure recovery procedures which allows the mobile to return to its serving BS and reconnect the call in case of hard-handoff failure. Depth and duration of fading that would result in a dropped call are implementation dependent. Typically a called can be dropped if a fade of over 60 dB lasts at least 5 seconds.	This question depends on network capabilities.
A3.5.3.4	Examine the quantity and type of network interfaces necessary for the RTT based on the deployment model used for spectrum and coverage efficiencies. The assessment should include those connections necessary for traffic, signaling and control as well as any special requirements, such as soft handover or simulcast.	Q	G2	A1.2.30 A1.2.30.1 A1.4.9	Both voice and data interfaces are required to support cdma2000. Current interface reference models supported are defined within TIA/EIA/TSB-100 "TR45 Wireless Network Reference Model"	This question depends on network capabilities.

A3.6	Handportable performance optimization capability					
A3.6.1	Isolation between transmitter and receiver Isolation between transmitter and receiver has	Q	G2	A1.2.2	FDD: duplexer required in MS.	Self-evaluation comments are satisfactory.

	an impact on the size and weight of the handportable.			A1.2.2.1 A1.2.2.2	TDD: no duplexer required. Different requirements may apply for different MS classes. A typical Class II MS will require about 55 dB of Tx to Rx isolation to be provided by the Rx Duplexer filter. A BS will require about 90 dB of Tx to Rx isolation. This increased requirement is due to high effective BS power and about 5dB better noise figure in the receiver. This isolation could be provided from a combination of antenna spacing and Rx filtering.	
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	In the active state, the time-averaged maximum output power levels are the same as the maximum EIRPs. However the exact transmitted average is less and is service dependent (example: for voice services the voice activity factor significantly reduces the transmitted power) Values used in the link budget calculation: 24 dBm for vehicular 14 dBm for pedestrian 4 dBm for indoor	Self-evaluation comments are satisfactory.
A3.6.3	System round trip delay impacts the amount of acoustical isolation required between handportable microphone and speaker components and, as such, the physical size and mechanical design of the subscriber unit. NOTE 1 – The delay of the codec should be that specified by ITU-T for the common generic voice bearer and if there are any proposals for optional codecs include the information about those also. (For the satellite component, the satellite propagation delay is not included.)	Q and q	G2	A1.3.7 A1.3.7.1 A1.3.7.2 A1.3.7.3	This delay varies depending on vocoder used. The following delay budget assumes EVRC is used. Typical reverse link delays are shown (forward link results are comparable) Delay (ms.) **Mobile Station** Vocoder delay 33.0 Vocoder processing 10.0 Channel processing 2.0 **Air transmission** Frame trans. Time 20.0 **Base station** Channel processing 2.0 Viterbi decoding 1.6 Vocoder speech Generation 1.0 --------	Self-evaluation comments are satisfactory.

					Total delay 69.6 ms Delay without vocoder is 25.6 ms. Delay specified above is one way. Approximate round trip delays can be estimated by doubling the numbers provided. Echo control is needed for voice services.	
A3.6.4	Peak transmission power	Q	G1	A1.2.16.1.1	The RTT itself does not impose any constraints on the peak transmitter/carrier power. Class I: 28 dBm < EIRP < 33 dBm Class II: 23 dBm < EIRP < 30 dBm Class III: 18 dBm < EIRP < 27 dBm Class IV: 13 dBm < EIRP < 24 dBm Class V: 8 dBm < EIRP < 21 dBm	Self-evaluation comments are satisfactory.
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	The power control dynamic ranges for the open and closed loops are: Open loop: ± 40 dB Closed loop: ± 24 dB (around open loop estimate)	Self-evaluation comments are satisfactory.
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	**Power control step size:** 1.0 dB nominal on RL 0.5 dB nominal on FL 0.25 dB, 0.5 dB and 1.0 dB are available as options. **Residual power variation after power control:** Power control error is typically below 1.3 dB (low mobility case) to 2.7 dB (high-speed vehicular case). **Power control speed:** 800 Hz nominal	Self-evaluation comments are satisfactory.
A3.6.6	Linear transmitter requirements	q	G3	A1.4.10	Base Station: Class A amplifiers Mobile Station: Class A-B amplifiers	Self-evaluation comments are satisfactory.
A3.6.7	Linear receiver requirements (not applicable to satellite)	q	G3	A1.4.11	Linear receivers are employed by both MS and BS.	Self-evaluation comments are satisfactory.
A3.6.8	Dynamic range of receiver	Q	G3	A1.4.12	The specifications below are for static channel conditions	Self-evaluation comments

	The lower the dynamic range requirement, the lower the complexity and ease of design implementation.				(AWGN) MS: 79 dB BS: 52 dB	are satisfactory.
A3.6.9	Diversity schemes Diversity has an impact on handportable complexity and size. If utilized describe the type of diversity and address the following two attributes.	Q and q	G1	A1.2.23 A1.2.23.1 A1.2.23.2	**Time Diversity:** symbol interleaving and error coding and correction. **Path Diversity:** RAKE receiver **Space Diversity:** BS uses 2 antennas; MS antenna diversity is optional **Orthogonal Transmit Diversity** can be used on the forward link **Frequency Diversity:** 1.2288, 3.686, 7.3728, 11.0592, or 14.7456 MHz spreading **Diversity Combining:** either maximal-ratio or equal gain combining may be used with multiple RAKE fingers. **Minimum number of demodulators/receivers**: 1 per MS 2 per BS **Minimum # of antennas**: 1 per MS (antenna diversity is optional) 2 per BS **Overall Performance Improvement due to Diversity: Function of situation.** Typically up to 10 dB for 1% FER. **Impact on handportable complexity and size:** MS antenna diversity (optional): need to accommodate second antenna. Other diversity shemes: No impact.	Self-evaluation comments are satisfactory. (A3.6 is MS related.)
A3.6.10	The number of antennas	Q	G1	A1.2.23.1	**Minimum number of antennas:** 1 per MS (antenna diversity is optional) 2 per BS	Self-evaluation comments are satisfactory.
A3.6.11	The number of receivers	Q	G1	A1.2.23.1	**Minimum number of demodulators/receivers:** 1 per MS 2 per BS	Self-evaluation comments are satisfactory.

A3.6.12	Frequency stability Tight frequency stability requirements contribute to handportable complexity.	Q	G3	A1.4.1.2	BS: 0.05 ppm MS: 0.08 ppm (assuming approx. ± 150 Hz MS transmit accuracy) The mobile station obtains its frequency from the BS using the continuous common pilot. The mobile station's transmit frequency is required to be within 150 Hz of the ideal transmit frequency	Self-evaluation comments are satisfactory.
A3.6.13	The ratio of "off (sleep)" time to "on" time	Q	G1	A1.2.29 A1.2.29.1	This ratio depends on the slot cycle index used in slotted mode while monitoring a paging channel (a mobile station monitors all slots while operating in non-slotted mode). The maximum length slot cycle is 2048 slots and the maximum sleep/on ratio is obtained when a mobile station is required to monitor just one slot. Therefore, the maximum sleep/on ratio is 2047:1, with smaller ratios obtained when different slot cycles are used.	Self-evaluation comments are satisfactory.
A3.6.14	Frequency generator step size, switched speed and frequency range Tight step size, switch speed and wide frequency range contribute to handportable complexity. Conversely, they increase RTT flexibility.	Q	G2	A1.4.5	Switch speed: implementation dependent. Step size = 50 kHz Frequency range = 60 MHz The actual frequency range depends on the frequency band in use.	Self-evaluation comments are satisfactory.
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 analyze the detailed description of the digital signal processing requirements, including	Q and q	G1	A1.4.13	MS and BS signal processing and memory requirements are implementation dependent. It is estimated that third generation processing requirements will range from 1.0 times (for voice applications) to 1.5 times (for high-speed data applications) from those of second generation requirements. It is feasible and desirable that the both the BS and the MS signal processing functions be highly integrated in a baseband integrated circuit (IC), which performs the following major functions: Wideband Receiver Analog to Digital Converter (ADC) and Wideband Transmitter Digital to Analog Converter (DAC); Speech processing ADC and DAC (applicable for MS baseband IC);	Self-evaluation comments are satisfactory.

	performance characteristics, architecture and algorithms, in order to estimate the impact on complexity of the BSs. At a minimum the evaluation should review the signal processing estimates (MOPS, memory requirements, gate counts) required for demodulation, equalization, channel coding, error correction, diversity processing (including Rake receivers), adaptive antenna array processing, modulation, A-D and D-A converters and multiplexing as well as some IF and baseband filtering. For new technologies, there may be additional or alternative requirements (such as FFTs). Although specific implementations are likely to vary, good sample descriptions should allow the relative cost, complexity and power consumption to be compared for the candidate RTTs, as well as the size and the weight of the circuitry. The descriptions should allow the evaluators to verify the signal processing requirement metrics, such as MOPS, memory and gate count, provided by the RTT proponent.				Digital Signal Processor (DSP), and DSP memory (ROM and RAM); Control Processor (CPU), and CPU ROM/RAM; Any CDMA Logic that is not allocated to a software function. This may include rake searcher and other rake receiver elements, power control sub-channel MUX/De-MUX, Spreaders and modulators. The exact breakdown is an implementation choice, with a general trend in favor of software function at the expense of dedicated logic; Interface and control circuits to RF devices, PLL, etc; The following is an estimate of complexity for an implementation of a baseband BS IC designed to operate at data rates from speech to the maximum of about 1 Mb/s. The estimate includes speech codec, but does not include turbo encoder/decoder, since turbo coding is still work in progress for cdma2000. Estimated RAM size: 65 kbytes	

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 at system start-up and ongoing traffic growth significantly impacts cost. From § 1.3.2 of Annex 2, determine the coverage efficiency, C (km^2/base sites), for the lowest	Q	G1	A1.3.1.7 A1.3.1.7.1 A1.3.1.7.2 A1.3.4	Voice Traffic (9.6 Kbps) Coverage Efficiency (km^2/site) **Vehicular Environment** RL/FL **72.1/113.6** **Pedestrian Environment** RL/FL	Self-evaluation comments are satisfactory.

	traffic loadings. Proponent has to indicate the background of the calculation and also to indicate the maximum coverage range.				**0.391/0.375** **Indoor Environment** RL/FL **0.01/0.01** Key assumptions: Derived from link budget calculations Note: RL = reverse link, FL = forward link	
A3.7.1.2	Method to increase the coverage efficiency Proponent describes the technique adopted to increase the coverage efficiency and drawbacks. Remote antenna systems can be used to economically extend vehicular coverage to low traffic density areas. RTT link budget, propagation delay system noise and diversity strategies can be impacted by their use. Distributed antenna designs – similar to remote antenna systems – interconnect multiple antennas to a single radio port via broadband lines. However, their application is not necessary limited to providing coverage, but can also be used to economically provide continuous building coverage for pedestrian applications. System synchronization, delay spread, and noise performance can be impacted by their use.	q	G1	A1.3.5 A1.3.6	Distributed antennas can be used in micro-cellular environments to extend coverage. Similarly, spot antennas can be used to direct a beam to a group of mobiles to extend coverage. A spot beam can be static or can follow a group of mobiles. The degree to which the above techniques can be used to extend coverage is dependent on implementation and deployment scenarios. See A3.2.6.2, A3.2.6.3, and A3.2.6.4 for further detail.	Self-evaluation comments are satisfactory.
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			

Peak to Average Performance Results (additional descriptions on A3.2.2.3.2.)

A straightforward simulation was performed for both the above schemes to evaluate the crest factor of the RF envelope. The results are tabulated in table 1.

Table 1 Peak-to-Average Values (dB) for IS-95 and cdma2000

NUSERS	CCDF	IS-95	cdma2000
1	1%	4.0	4.0
	.1%	5.0	5.0
	0.01%	5.7	5.7
16	1%	7.9	6.5
	.1%	9.8	8.1
	.01%	11.1	9.1
32	1%	7.9	6.6
	.1%	10.0	8.3
	.01%	11.3	9.4
64	1%	7.9	6.6
	.1%	10.0	8.3
	.01%	11.5	9.5

The first column represents the number of Walsh codes used (number of traffic channels), the second column the overload probability. Results have been tabulated for both IS-95 and the cdma2000 proposed schemes.

It is important to observe that the crest factor does not increase much after 16 users for either case. This is due to the convergence to a Gaussian distribution for large N. The more important fact is that the crest factor is in fact reduced by 1.7 – 2 dB for the cdma2000 system, compared to IS-95.

Attachment 5

Consensus Decision on IMT-2000 Chip Rate in ARIB

CG 9-2 (Rev.2)

Coordination Group, IMT-2000 Study Committee, ARIB

The 9th Coordination Group (CG) meeting held on April, 21, 1998 agreed to take the following fundamental stance for the standardization of the wide CDMA-based IMT-2000 Radio Transmission Technologies (RTT) and the chip rate of the specification.

1 Basic Principles for Standardization

The CG agreed on the items below as “Basic principles” for the standardization process at ARIB:

a) to establish an globally common IMT-2000 standard as ARIB's primary objective,

b) to establish a Japanese standard, which is common to standards for other countries and/or regions,

c) to continuously coordinate with on-going cooperative standardization activities conducted in ITU, other countries and regions.

2 Report on ARIB's Activities

In response to the request from cdmaOne group, i.e. LMNQS, to incorporate the technical elements from the cdmaOne proposal into ARIB's W-CDMA draft specifications, the 6th CG meeting decided to organize two Ad Hoc groups, i.e. Ad Hoc-CR and Ad Hoc-S. Ad Hoc-CR was formed to conduct technical comparison between the two chip rates of 4.096 Mcps and 3.6864 Mcps, while Ad Hoc-S was given a mandate tomake technical considerations on proposed cdmaOne-based technical elements..

As a result of these studies within ARIB, CG came to a consensus described below.

The 7th CG meeting reviewed the document “Report from Ad Hoc-CR” (CG 7-3), which is presented in Attachment 1, and recognized the following points:

i) The technical comparison between the chip rates of 4.096 Mcps and 3.6864 Mcps as to the performance, spectrum related issues and feasibility of dual mode terminal, indicates that changing the chip rate from 4.096 Mcps to 3.6864 Mcps causes no fatal impact from a technical viewpoint, and

ii) The third item,“Required Conditions” defined in “Proposed method of chip rate consideration” (Reference Doc.-2 at the 6th CG) was satisfied.

In addition, at the 7th CG meeting the document “Report from Ad Hoc-S'”(CG 7-2) given in Attachment 2 was reviewed, and the following points were recognized:

iii) The Group reached a consensus on many issues related to the reverse link structure Furthermore, the 8th CG meeting reviewed the document “Report from Ad Hoc-S” (CG 8-2) described in Attachment 3, and recognized the following points:

iv) A consensus was built on all major technical points proposed by cdmaOne group to Ad Hoc-S, including;
The ARIB proposal offers the capability to support both synchronous and asynchronous base stations, and
The ARIB proposal adopts both common and dedicated pilots. Detailed study results are shown in Attachment 3.

3 Agreement

The members of CG agreed unanimously at its 9th meeting,

a) that a judicious choice of a chip rate can facilitate achieving the primary objective of establishing a globally common IMT-2000 standard;

b) that ARIB takes a flexible stance on the chip rate in order to establish a worldwide common standard;

c) that the members of CG will exert their best efforts to establish a worldwide common standard including choice of the chip rate;

d) that the members of CG shall support the final standard agreed upon, if a common standard can be introduced on a worldwide basis, and

e) that the members of CG will offer their best efforts in other standardization bodies towards the common standard based on a certain single chip rate.

The CG recognizes

a) that the above agreements are essential and important to facilitate the convergence procedures with other standardization bodies,

and, therefore, CG decides,

a) that ARIB should accelerate its cooperative activities with other standards bodies to have a unified chip rate for wideband CDMA technologies;

b) that ARIB communicates the above agreements to other standardization bodies, and

c) that ARIB requests ETSI SMG, TIA and TTA to facilitate coordination amongst one another,

and, the CG recommends

a) that all other members in ARIB IMT-2000 Study Committee support the above agreements, and also consider other chip rate values in addition to 3.6864 Mcps and 4.096 Mcps, if necessary, as a working assumption for global convergence.

Attachments

1 Report from Ad Hoc-CR on impact of changing chip rate for the ARIB 3G mobile system (CG7-3)

2 Report of Ad Hoc-S (CG7-2)

3 Report of Ad Hoc-S (CG8-2)

ATTACHMENT 1

CG 7-3

Report from Ad Hoc-CR on Impact of Changing the Chip Rate for ARIB 3G Mobile System

Ad Hoc-CR Leader

1 Introduction

In response to the request from CG, this paper summarizes the considerations made on the chip rate issue for ARIB's 3G mobile system, which was studied at Ad Hoc-CR, chaired by Mr. S. Nagareda (Panasonic). The scope of Ad Hoc-CR's studies include:

a) To conduct technical comparison between 4.096 Mcps and 3.6864 Mcps:

- (a-1) performance (capacity, transmission quality, coverage);
- (a-2) spectrum (filter, guard band, PA back off);
- (a-3) dual mode terminal feasibility;

b) To identify possible modification areas in volume3 (version 0-4.0) of ARIB's draft specification t if the chip rate was changed.

2 Assumption for the study

1) Chip rates for study shall be restricted to 4.096 Mcps and to 3.6864 Mcps.

2) Bandwidth of 5 MHz, 15 MHz and 20 MHz shall be considered as a system bandwidth.

3) GSM, PDC and IS-95 shall be assumed for the 2nd generation systems.

4) Carrier spacing for 3.6864 Mcps is set to 4.5 MHz in proportion to 5 MHz for 4.096 Mcps[1]

5) Roll-off factor is set to 0.22 both for 4.096 Mcps and 3.6864 Mcps.

3 Study results

3.1 Conclusion for technical comparison

Although there are some differences, particularly in the capacity and spectrum as described below, there shall be no fatal impacts due to changing chip rate from 4.096 Mcps to 3.6864 Mcps.

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[1] Ad Hoc-CR members agreed with this carrier spacing for relative comparison between two chip rates.. Within the band of coordinated system, however, narrower carrier spacing is also available. In this sense, we should note that a carrier spacing of 3.75 MHz for a chip rate of 3.6864 Mcps was considered in TIA, and that carrier spacing (4.4-5.0 MHz in steps of 200 kHz) was considered in ETSI/SMG2 WCDMA for coordinated spectrum allocation. Therefore, it is possible to achieve more guard band for both of the two chip rates by using the flexible carrier spacing for coordinated spectrum allocation.

(a-1) performance

	4.096 Mcps	3.6864 Mcps
Capacity	1 (Reference)	•0.9 (per carrier) •0.9 + α (per system bandwidth)[2]
Transmission quality	same quality	
Coverage	1 (Reference)	almost same

(a-2) spectrum

		4.096 Mcps	3.6864 Mcps
Filter		same complexity assumed	
Guard band	5 MHz BW[3]	none (with 1 carrier)	0.5 MHz (with 1 carrier)
	15 MHz BW	none (with 3 carriers)	•1.5 MHz (with 3 carriers) •[none/0.375 MHz] (with additional 1 N-CDMA carrier)
	20 MHz BW	none (with 4 carriers)	•2.0 MHz (with 4 carriers) •[0.5/0.875 MHz] (with additional 1 N-CDMA carrier)
PA Back off		equal back off required	

(a-3) dual mode terminal feasibility

The study on dual mode terminal feasibility take many factors into consideration.

The following table mainly addresses the issue of synthesizer's reference frequency.

Source	Ericsson	LMNQS	Matsushita
Document #	CGAH-2-6	CGAH-3-5 (comment to CHAH-2-6)	CGAH-2-3, 3-3
Studied 2G system	GSM	GSM, PDC, IS-95	GSM, PDC, IS-95
Viewpoints for comparison	(1) number of possible reference frequencies	(1) number of suitable reference frequencies	(1) complexity of clock generation (2) commonality of RF circuit

2 With an additional N-CDMA carrier, capacity can be improved toward 1.0 in cases of 15 and 20 MHz bandwidth.

3 This difference means that the 3.6864 Mcps chip rate has better characteristics regarding out-–of-block interference than e 4.096 Mcps.

			(3) commonality of analog baseband filter
Considerations	None of these two chip-rates are ideally suitable for WCDMA-GSM dual-mode terminal implementation, in terms of easy generation of clocks. However, the 3.6864 Mcps chip-rate is slightly worse than the 4.096 Mcps chip-rate in this respect.	A chip rate of 3.6864 Mcps is no worse than a chip rate of 4.096 Mcps.	There are no major differences if the chip rate is changed from 4.096 Mcps to 3.6864 Mcps
Conclusion	There are no major differences between the two chip rates in terms of the feasibility study on dual mode terminals.		

3.2 Possible Modification Areas in Volume 3 (Version 0-4.0) of ARIB Draft Specification

See Attachment F, 'Possible Modification Areas in Volume 3 (Version 0-4.0) of ARIB Draft Specification'.

ATTACHMENT F

Possible Modification Areas in Volume 3 (Version 0-4.0) of ARIB Draft Specification

1 Assumptions

Prior to identifying the possible modification areas to ARIB's draft specifications, the following assumptions were introduced.

- Spreading factors are unchanged. Therefore, transmission rate of physical channels becomes 0.9 (=3.6864/4.096) times lower. (e.g., 16 ksps becomes 14.4 ksps.)
- Frame structure is maintained. i.e., 1 super frame = 64 radio frames, 1 radio frame = 16 slots, 1 slot = 0.625 msec.
- Pending items in ARIB's draft specification are not taken into account.

2 Typical methods to change chip rate

For changing chip rate from 4.096 to 3.6864 Mcps, several methods are conceivable. In this report, the following three methods are considered:

1) reducing layer-1 overhead such as pilot symbol, TPC or RI symbol;
2) reducing transmission rate of layer-1 payload , i.e., information rate of upper layer (user rate);
3) adjusting rate matching.

3 Class of modification

The type of modification can be roughly classified into the following three classes:

i) Modification is necessary. There is only one way to conduct modification. Typically, this type of modification is performed by replacing some letters or descriptions (e.g., replacing "4.096" with "3.6864").

ii) Modification is necessary. However, there is more than one method to modify the document.

iii) Modification may be necessary, depending on the way of modification in (ii).

NOTE – Further modification which may be caused by (iii) is not fully considered.

4 Possible modification areas

Class (i) modifications

section #	part	items to be changed
3.1	Table 3.1-1	chip rate
3.2.1.2	Table 3.2-1	symbol rate
3.2.1.3.2.3	body	symbol rate
3.2.1.3.3	body, Fig.3.2-8	symbol rate
3.2.2.1	Fig.3.2.2-1	symbol rate
3.2.2.2.1	Fig.3.2.2-2	symbol rate
3.2.2.2.2	body, Table 3.2.2-3	symbol rate
3.2.2.3.1	Table3.2.2-4	symbol rate
	Table3.2.2-4	Bits/Frame(TOT) , Bits/Slot
3.2.2.3.2	Table 3.2.2-7	channel bit rate, symbol rate , Ndata
	Table 3.2.2-8	channel bit rate, symbol rate, bits/frame, bits/slot
3.2.3	Fig.3.2.3-1~9,14,16,24, Table 3.2.3-1	symbol rate
	Fig.3.2.3-20,21	number of bits (160 → 144); see 3.2.2.3.2 Table 3.2.2-7
3.2.3.2.2.1	Table3.2.3-3	symbol rate
3.2.4.2.2.1	Table3.2.4-1	chip rate
3.2.4.2.2.2	body	long code phase shift (250 usec → 277.8 usec)[4]
3.2.6.1	body	chip rate, offset value (e.g., 320 x C)[5]
	Fig.3.2-46~49	chip number (e.g.,40959 → 36863)
3.3.1.2	Table3.3-1	symbol rate

[4] In this case, long code phase shift between I-ch and Q-ch is fixed to 1 024 chips.

[5] In this section, timing offset for four chip rates (1.024, 4.096, 8.192 and 16.384 Mcps) is described inclusively. Therefore, when changing chip rate from 4.096 to 3.6864 Mcps, its impact on other 3 chip rates should also be considered.

3.3.2.1	Fig.3.3-2	symbol rate
3.3.2.2	Fig.3.3-3	symbol rate
3.3.2.3.1	Fig.3.3-4	symbol rate
3.3.3.2.1	Table3.3-3	symbol rate
3.3.6.1	body, Table3.2-19	chip rate

Class (ii) modifications

section #	part	items to be modified
3.2.2.1	Fig.3.2.2-1	number of symbols
3.2.2.2.1	Fig.3.2.2-2	number of symbols
3.2.2.2.2	Table 3.2.2-3	number of bits
3.2.2.2.3	Fig.3.2.2-4	number of symbols
3.2.2.3.1	Table3.2.2-4	Bits/Frame(DPDCH,DPCCH), DPDCH/DPCCH Bits/Slot
3.2.2.3.2	Table 3.2.2-8	Npilot2, NTPC2, NRI
3.2.3	Fig.3.2.3-1~9,24	number of bits and/or symbols
3.2.6.1	body	offset value (e.g.,320 x C) (see class (i) modification)

Class (iii) modifications

section #	part	items to be checked	related modification area
3.2.1.3.2.1	body	description	PCH format (Fig.3.2.3-2)
3.2.1.3.2.2	body	description	FACH format (Fig.3.2.3-3 ~ 5)
3.2.1.3.2.3	body	description	RACH format (Fig.3.3.2-6 ~ 7)
3.2.1.3.2.4	body	description	PCCH format (Fig.3.2.3-24)
3.2.2.1.1	body	description	3.2.2.1
3.2.2.2.1.1	body	description	3.2.2.2.1
3.2.2.2.2	body	number of octets	RACH format in Fig.3.3.2-6 ~ 7
3.2.2.3.1.1	body	description	3.2.2.3.1
3.2.2.3.1.2	body	description	3.2.2.3.1
3.2.2.3.2.2	body	description	3.2.2.3.2
3.2.3	Fig.3.2.3-10~14,16~19	number of bits	Physical Channel Mapping Unit (Fig.3.2.3-20 ~ 23)
	Fig.3.2.3-22	number of bits (640)	Fig.3.2.3-22
3.2.3.1.1	body	description	size of CRC in Fig.3.2.3-xx
3.2.3.2.1	body	description	how to change chip rate
3.2.3.2.3	body	description	Fig.3.2.3-17,18
3.2.3.3.1	Table3.2.3-5	number of bits	Fig.3.2.3-20~23
3.2.3.3.2	body	description	Fig.3.2.3-17,18

3.2.6.1	Table3.2-19	offset values	3.2.6.1
	Fig.3.2- 46~49	offset values	3.2.6.1

ATTACHMENT 2

CG 7-2

Report from Ad Hoc-S

1998.2.2
Ad Hoc-S Leader

1 On Reverse Link Structure

a) OQPSK vs. QPSK

LMNQS withdrew the OQPSK proposal.

– According to the simulation results by Motorola and Nokia, it was confirmed that QPSK shows better performance than OQPSK.

b) Pilot and TPC, code multiplexed vs. time multiplexed

LMNQS will perform some studies on time-multiplexed pilot and TPC. ARIB will keep its current philosophy unchanged.

– Time multiplexed method (ARIB) requires less output back-off.

The difference is 0.3-0.5 dB for voice channel. If the pilot energy becomes larger, the difference also becomes larger, and vice versa.

– Time multiplexed method gives shorter TPC delay, meaning better performance. The difference may be around 0.3 dB.

c) Fundamental channel, supplemental channel

LMNQS agreed that it is not necessary to define fundamental and supplemental channels as physical channels. Instead, LMNQS will make separate technology inputs to ARIB. They are:

1) Mapping from services to physical channels

LMNQS recommend that the system should have a possibility to map single service to plural physical channels.

2) Soft handover control

LMNQS recommends two cases for soft handover.

Case 1: same information will be transmitted from plural base stations.
Case 2: same information will be transmitted from only one base station, although logical links are established with plural base stations.

3) Packet access control

LMNQS recommends to use a different type of packet access from the current ARIB system. The point is to allocate two physical channels for high-speed packet service, one for user data and another for signalling, including Ack/Nack.

1) and 2) can be directly proposed to SWG2, since these items are not discussed yet. 3) requires authorization from the CG, since it is a counter proposal to the current ARIB system.

d) Spreading for reverse link

This item is regarded pending.

– A question was raised from ARIB and LMNQS needs some time to answer the question.

2 On Forward Link Structure

A clear conclusion could not be derived for theforward link structure.

It was agreed that:

– It is necessary to conduct comparison based on agreeable numerical data.

– Both common and individual pilot concepts will be necessary.

– Comparison should be made between code multiplexed-pilot and time-multiplexed pilot.

a) Performance difference between common and individual pilot

LMNQS insisted that common pilot reduces required Eb/No for voice channel by 1 dB, but it was not agreed in ARIB. This item remains as pending and will be discussed in the next meeting with more numerical data.

The concerns raised by ARIB were:

– Power control method assumed in LMNQS evaluation is different from the method adopted by ARIB.

– ARIB considers that the power control scheme adopted by ARIB is better.

The power control scheme advocated by LMNQS may be affected largely by TPC bit transmission error.

b) On introduction of adaptive antenna technology

LMNQS pointed out that adaptive antenna technology can be introduced through the use of an auxiliary pilot.

c) Common pilot symbol concept

Ericsson pointed out that common pilot is possible for the pilot symbol method as well.

3 Base station Sync/Async

It was agreed that both sync and async mode will be necessary to achieve an efficient system. Both sides will bring a compromised proposal and discuss on this at the next meeting.

LMNQS proposed base station synchronization method using timings of MSs in soft handover mode. ARIB commented that it is difficult to guarantee synchronization with this method. It is said that this is good for improving asynchronous base station systems.

Motorola proposed a method to include asynchronous base stations in synchronous base station systems. Since this is not a proposal agreed by the entire members of LMNQS, this proposal was treated as a reference material.

4 Others

a) Turbo code

Both parties are studying the turbo code. Neither party has made any decision yet.

b) Power control interval

LMNQS presented comparative simulation results on 800 Hz power control and 1 600 Hz power control. ARIB pointed out that the results are different from the results obtained by ARIB. LMNQS will further study the results.

5 Next meeting

Next meeting will be held on Feb.13th, 1998, 9:30 AM.

ATTACHMENT 3

CG 8-2

Report from Ad Hoc-S

March 25, 1998
Ad Hoc-S Leader

1 Summary

Ad Ho-S came to an agreement on all major technical points.. Below shoes the brief summary of the agreed points.

– Base Station Sync/Async issue.

ARIB system will be able to adopt both base station synchronous mode and base station asynchronous mode.

Ad Hoc-S agreed on the handset cell search procedure to identify the base station mode.

– Forward link pilot.

ARIB system will have both common and dedicated pilots.

The common pilot format is parameterized, so either code multiplexed format or time multiplexed format can be used. Working assumption on the common pilot format is time multiplexed on the common physical channels.

Dedicated pilot is also parameterized, but only has a time multiplexed format.

2 Agreed contents

– On base station synchronous and asynchronous operation.

ARIB system can adopt both synchronous mode and asynchronous mode.

In order to inform handset about the sync./async. mode, ARIB system will have following three-stage cell search method:

1) A handset searches a Common Sync Code, which is a short code common to all base stations. From this process, the handset obtains some timing information.

2) After the Common Sync Code, the handset searches the Group Identification Code, which identifies a cluster of long code. When the GICs are supposed as { G0, G1, G2, …, Gk }, G0 corresponds to a single long code L0, which is used for BS sync. mode. Each of Gi (I=1,..,k) corresponds to a cluster of long code { Li1, Li2, …, Lim}.

3) If a handset receive G0, it knows that the system is in the base station synchronous mode, and it will search L0, which is the long code used for base station synchronous mode. Otherwise, the handset will search a cluster of long code.

Agreement

ARIB system shall have both common and dedicated pilots.

Common pilot will have length L1, transmit power P1, insertion interval T1, spreading code C1.

Dedicated pilot will have length L2, transmit power P2, insertion interval T2, spreading code C2, which is common to the traffic channel, multiplexed in time.

Mobile station negotiates with the Base station about down link pilot parameters, if necessary.

Working assumptions

L1, P1, C1 are the same as pilot parts of current ARIB's perch channel. (For detailed explanation and pilot part of common physical channel, see Ad Hoc-S 6-7).

L2,T2 are the same as pilot part of current ARIB' DPCH.

T1 is the slot length of perch channel.

Note - The above agreement is based on the discussion at the 6th- Ad Hoc S. (See meeting minutes).

If some data, which will have large impact on the basis of the discussion, is submitted to the secretary of Ad Hoc-S by March 22, working assumption will be reconsidered.

3 Discussion procedures

After the last CG meeting, three Ad Hoc-S meetings were held.

3.1 Meeting on Feb. 13

— Base station synchronous/asynchronous operation

Both ARIB side and LMNQS side proposed a compromised solution on base station synchronous mode and asynchronous mode.

TTA (Korea) proposed two pilot schemes to accelerate base station search in asynchronous mode.

Ad Hoc-S agreed to adopt a three-stage BS search method, which includes two pilot concepts.

— Forward Link Pilot

LMNQS submitted simulation data showing that a common continuous pilot is better.

Many questions were asked from the ARIB side. No agreements were reached as to the acceptance of the submitted data. It was concluded that the simulation model should be clarified. Basic simulation conditions were discussed and agreed.

3.2 Meeting on Feb. 26

— Forward Link Pilot

LMNQS updated simulation data and explained power control mechanism in detail.

The discussion proceeded in two steps:

1) Common vs. Dedicated pilot

After a lengthy discussion, the following comparison table was compiled.

Common	Dedicated
Eb/N0 loss(8k) 1.5 dB* (Further 0.6 dB improvement by more FL TPC)	2.5 dB 1.3 dB
Eb/N0 loss(64 k) 1.5 dB • Better in reduced rate. • Better phase recovery for weak multipath. • Rapid initial acquisition and fast soft handoff candidate selection. (Further 0.6 dB improvement by more FL TPC)	

*LMNQS reported more advantages offered by common pilot for variable rate transmission.

Ericsson stated that there are some questionable parts in the simulation data.

It was agreed that ARIB system will have both common and dedicated pilots, (AHS 5-7) as a harmonization results.

AHS 5-7

Downlink Pilot Signal Structure

For downlink pilot signal structure, two schemes, i.e. a common pilot scheme and a dedicated pilot scheme, have been proposed. The 5th meeting of Ad Hoc-S unanimously agreed on the following harmonized scheme.

> The harmonized scheme for downlink pilot signal allowing the use of both schemes:
> - accommodating both common pilot signals and dedicated pilot signals,
> - assigning spreading code for traffic data and pilot signals independently

Notes:

(1) A separate document prepared by the chairman of Ad Hoc-S describes the reason why Ad Hoc-S agreed on the harmonized scheme.

(2) Further studies are needed for the appropriate mechanism to select or assign two pilot schemes.

(3) Further studies are needed in order to come to a conclusion on how to incorporate the harmonized scheme into ARIB specification.

2) Code Multiplexed vs. Time Multiplexed Pilot

The format of the pilot was discussed in details for the Common Pilot.

The result is summarized in the following table.

	Time-multiplexed		Code-multiplexed
Lucent	2	Correlater	1.5 → 3 or 4
Motorola	1TPC or 2 TPC(worst case)	PC delay during soft handoff	≅ OTPC
Motorola NEC DoCoMo*	0.8 0.95 larger than 1	Orthogonal code space(number)	1
Lucent NEC	1.2 1.07	Peak power	1
QUALCOMM			Flexibility trade off between common pilot & capacity.

* This was not well discussed, since the statement was made at the last minute.

Ad Hoc-S failed to come to a consensus based on these results.

The opinions raised include:

Code Multiplexing is better.
LMNQS

Code Multiplexing looks better, but further study is needed to make a decision.
KDD, DDI, Air Touch, NEC

At this moment, decision cannot be made due to lack of sufficient discussion.
Ericsson, Nokia, Panasonic

Time Multiplexing is better.
DoCoMo

3.3 Discussion on March 9

1) Discussion on Common vs Dedicated Pilot

ARIB submitted a better performance data with improved algorithm on individual pilot. The performance is about 0.8 dB better than LMNQS simulation results agreed in the previous discussion. This was accepted.

2) Comparison on dedicated pilot

After a long discussion, the features of each method were summarized in the following table.

	CDM	TDM	notes
Correlators	Fair	Good	
TPC Delay	Fair (1.3 + a)	Good (1)	Required Eb/No 0.5-1.0 dB difference
Orthogonal Codes	≅ Flexible		
AFC	-- ? --		
Cross- correlator / Ch-estimation	Fair	Good	

Hardware			
Peak Power	≅		

3) Comparison on the Common Pilot

Lots of counter arguments were made from ARIB side about the table from the previous meeting. After discussion, the following comparison table was made.

	CDM	TDM	notes
Correlators	Fair	Good	
TPC Delay	Good	Fair	Required Eb/No 0.1 dB better normally (0.1+a) dB better SHO
Orthogonal Codes	Theoretically ≅ better reality		
Peak Power	≅		

The comparison shows that Time multiplex is better for dedicated pilot while it is hard to judge for common pilot. After e discussion, the meeting came to the consensus t shown above.