Radiocommunication Study Groups

International Telecommunication Union

Received: 16 April 2008

Source: Document 5D/97, Attachment 6.11, Chapter 6

Document 5D/112-E
21 April 2008
English only

Institute of Electrical and Electronics Engineers (IEEE)

PROPOSED AMENDMENTS TO SECTION 4 OF THE ITU-R/IMT-ADVANCED/ IMT.TECH DOCUMENT AS PRESENTED IN DOCUMENT 5D/TEMP/28

1 Source information

This contribution was developed by IEEE Project 802®, the Local and Metropolitan Area Network Standards Committee ("IEEE 802"), an international standards development committee organized under the IEEE and the IEEE Standards Association ("IEEE-SA").

The content herein was prepared by a group of technical experts in IEEE 802 and industry and was approved for submission by the IEEE 802.11™ Working Group on Wireless Local Area Networks, the IEEE 802.16™ Working Group on Wireless Metropolitan Area Networks, the IEEE 802.18 Radio Regulatory Technical Advisory Group, and the IEEE 802 Executive Committee, in accordance with the IEEE 802 policies and procedures, and represents the view of IEEE 802.

2 Comments

This contribution proposes changes to Section 4 of the ITU-R/IMT-Advanced/IMT.TECH document, as presented in Attachment 6.11, Chapter 6 to Document 5D/97 (Source: Document 5D/TEMP/28).

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Attachment

Source: Doc. 5D/97, Attachment 6.11, Chapter 6

Draft [Report on] requirements related to technical system performance for IMT-Advanced radio interface(s) [IMT.TECH]

TABLE OF CONTENTS

1 Introduction

[Editor's note: Text will be imported from the common text which is discussed in WG-SERV.]

2 Scope and purpose

IMT.TECH describes requirements related to technical system performance for IMT-Advanced candidate radio interfaces. These requirements are used in the development IMT.EVAL, and will be attached as Annex 4 to the Circular Letter to be sent announcing the process for IMT-Advanced candidacy.

IMT.TECH also provides the necessary background information about the individual requirements (technology enablers) and the justification for the items and values chosen. Provision of such background information is needed for wider reference and understanding.

IMT.TECH is based on the ongoing development activities from external research and technology organizations. The information in IMT.TECH will also feed in to the IMT.SERV document. IMT.TECH provides the radio interface requirements which will be used in the development of IMT.RADIO.

3 Related documents

Recommendation ITU-R M.[IMT.SERV]

Recommendation ITU-R M.1645

Recommendation ITU-R M.1768

Report ITU-R M.2038

Report ITU-R M.2072

Report ITU-R M.2074

Report ITU-R M.2078

Report ITU-R M.2079

Recommendation ITU-R M.1224

Recommendation ITU-R M.1225

[ITU-T Recommendation Q.1751

ITU-T Recommendation Q.1761

ITU-T Recommendation Q.1711

ITU-T Recommendation Q.1721

ITU-T Recommendation Q.1731

ITU-T Recommendation Q.1703

[Editor's note: Document to be added]

4 Minimum requirements

[Editorial note: This should be a very limited set of parameters, to determine that proposals provide performance beyond IMT-2000 systems]

Each requirement is considered to be assessed independently and need to be evaluated according to the criteria defined in IMT.EVAL. The IMT-Advanced systems should meet the minimum requirements in all test environments. However With reference to Step 2 of the IMT-Advanced process, candidate radio interference technologies may be submitted that only address certain test environments and hence only require demonstrating compliance to the minimum requirements in those environments

Note 1: It still needs to be agreed what statement or requirement, if any, shall be made in IMT.TECH regarding in how many of the test environments a RIT has to fulfil the requirements.

4.1 Cell spectral efficiency

Cell[1] spectral efficiency (η) is defined as the aggregate throughput of all users (the number of correctly received bits, i.e. the number of bits contained in the SDUs delivered to Layer 3, over a certain period of time) divided by the channel bandwidth divided by the number of cells. The cell spectral efficiency is measured in b/s/Hz/cell.

Denote by χ_i the number of correctly received bits by user i (downlink) or from user i (uplink) in a system comprising a user population of N users and M cells. Furthermore, let ω denote the channel bandwidth size and T the time over which the data bits are received. The cell spectral efficiency is then defined according the Eq. 1.

$$\eta = \frac{\sum_{i=1}^{N} \chi_i}{T\omega M}$$

Eq 1.

[1] A cell is equivalent to a sector, e.g. a 3-sector site has 3 cells.

TABLE 1

Minimum Cell Spectral Efficiency (b/s/Hz/cell)

Test environment **	Downlink (b/s/Hz/cell)	Uplink (b/s/Hz/cell)
Indoor	3.0	1.5
Microcellular	2.6	1.3
Base coverage urban	2.4	1.2
High speed	1.2	0.6

[IEEE Note: Case 1 is omitted in order to have only one antenna reference configuration. The downlink spectral efficiency for the base coverage urban and high speed test environments have been increased because they should be readily achievable]

[Note 2: It shall be discussed and agreed how to define a single set of values for the uplink starting from cases 1 and 2 above]

[Note 3: For the purpose of defining the values in table 1, the following assumptions on antenna configuration were takenmade: downlink – 44x2, uplink case 1 – 2x4, uplink case 2 – 1x2x44.]

These values were defined assuming […].However this does not form part of the requirement and the conditions for evaluation are described in IMT.EVAL.

(*) A cell is equivalent to a sector, e.g. a 3-sector site has 3 cells.

(**) The test environments are described in IMT.EVAL

.2 Peak Spectral Efficiency

The peak spectral efficiency is the highest theoretical data rate (normalised by bandwidth), which is the received data bits assuming error-free conditions assignable to a single mobile station, when all available radio resources for the corresponding link direction are utilised (that is excluding radio resources that are used for physical layer synchronisation, reference signals or pilots, guard bands and guard times).

The minimum requirements for peak spectral efficiencies are as follows:

– Downlink peak spectral efficiency is [147/10] b/s/Hz

– Uplink peak spectral efficiency is [5.62.5/5] b/s/Hz

[IEEE Note: The new values reflect the antenna configuration in Note 4].

[Note 4: For the purpose of defining these values, the following assumptions on antenna configuration were takenmade: downlink – 4x4, uplink – 2x4.]

These values were defined assuming an antenna configuration of 4x4 in the downlink and 2x4 in the uplink[….]. However this does not form part of the requirement and the conditions for evaluation are described in IMT.EVAL.

For information peak data rates can then be determined as in the following examples, which are calculated by multiplying the peak spectral efficiency and the bandwidth:

- Example Downlink peak data rate in [20] MHz is [200] 280 Mb/s
- Example Downlink peak data rate in [100] MHz is [1000] Mb/s
- Example Uplink peak data rate in [20] MHz is [100] 112 Mb/s
- Example Uplink peak data rate in [100] MHz is [500] Mb/s

4.3 Operating Bandwidth

The RIT shall support a scalable bandwidth from 5 <= *x* <= 205 MHz up to and including [20/40] MHz.

[Proponents are encouraged to consider extensions to sSupport of operation in wider bandwidths (e.g. up to 100 MHz) and tin order to meet the performance targets expressed in Recommendation ITU-R M.1645.] may be further consideredused.

4.4 Normalized Cell edge user throughput

The (normalized) *user throughput* is defined as the average user throughput (i.e., the number of correctly received bits by users, i.e. the number of bits contained in the SDU delivered to Layer 3, over a certain period of time, divided by the channel bandwidth and is measured in b/s/Hz. The normalized cell edge user throughput is defined as 5% point of CDF of the normalized user throughput. Table 3 lists the normalized cell edge user throughput requirements for various test environments.

With χi denoting the number of correctly received bits of user *i*, T_i the active session time for user *i* and ω the channel bandwidth, the (normalized) user throughput of user *i* γi is defined according to Eq. 2.

$$\gamma_i = \frac{\chi_i}{T_i \omega} \qquad \text{Eq. 2}$$

TABLE 2

Normalized Cell Edge User Throughput (b/s/Hz) ~~Table 2~~

Test environment* *	Downlink (b/s/Hz)	Uplink (b/s/Hz)
Indoor	0.1	0.05
Microcellular	0.08	0.04
Base coverage urban	0.06	0.03
High speed	0.04	0.02
* The test environments are described in IMT.EVAL.		

These values were defined assuming an antenna configuration of 4x4 in the downlink and 2x4 in the uplink. However this specific antenna configuration is used only for testing and does not form part of the IMT-Advanced requirements and the conditions for evaluation are described in IMT.EVAL.

4.5 Latency

4.5.1 Control plane latency

Control plane (C-Plane) latency is typically measured as transition time from different connection modes, e.g. from idle to active state. A transition time (excluding downlink paging delay and wireline network signalling delay) of less than **100 ms** shall be achievable from idle state to an active state in such a way that the user plane is established.

4.5.2 User Plane Latency

The User Plane latency (also known as Transport delay) is defined as the one-way transit time between an SDU packet being available at the IP layer in the user terminal/base station and the availability of this packet (PDU) at IP layer in the base station/user terminal. User plane packet delay includes delay introduced by associated protocols and control signalling assuming the user terminal is in the active state. IMT-Advanced systems shall be able to achieve a User Plane Latency of less than **10 ms** in unloaded conditions (i.e. single user with single data stream) for small IP packets (e.g. 0 byte payload + IP header) for both downlink and uplink.

[Note 5: section 4.4.3 on QoS has been deleted assuming that is captured in the service requirements (Annex 3 of CL) and in chapter 5 of IMT.TECH.]

4.6 Mobility

The following classes of mobility are defined:

– Stationary: 0 km/h

– Pedestrian: 0 km/h to10 km/h

– Vehicular: 10 to 120 km/h

– High speed vehicular: 120 to 350 km/h

The table defines the mobility classes that shall be supported in the respective test environment.

TABLE 3_

Mobility Classes

	Test environments*			
	Indoor	**Microcellular**	**Base coverage urban**	**High speed**
Mobility classes supported	Stationary, pedestrian	Stationary, pedestrian	Stationary, pedestrian, vehicular	High speed vehicular, vehicular

* The test environments are described in IMT.EVAL

4.7 Handover

IMT-Advanced systems shall provide intra-system handover methods to maintain seamless connectivity, as measured by handover interruption time, when moving between cells. ~~The maximum intra-system handover interruption times specified in the following apply to handover of IMT-Advanced compliant user terminals between IMT-Advanced compliant base stations.~~ _

Intra-system ~~H~~handover performance requirements for the interruption times are defined for:

- Intra-frequency handovers within IMT-Advanced
- Inter-frequency handovers within IMT-Advanced
  - Within a spectrum band
  - Between spectrum bands

~~[In addition inter-system handovers between the candidate IMT-Advanced system and at least one IMT[2000] system shall be supported].~~

The handover interruption time is defined as the time duration during which a user terminal cannot exchange packets with any base station.

The maximum MAC-service interruption times during handover are specified in the table below.

Handover Type	Max. Interruption Time (ms)
Intra-Frequency	30
Inter-Frequency - within a spectrum band - between spectrum bands	 100 100

TABLE 4_

Maximum Intra-system Handover Interruption Times for IMT-Advanced Systems

[Note 6: no working assumption could be reached for the inter-frequency handover interruption time value.]

4.8 VoIP Capacity

VoIP capacity assumes a 12.2 kbps codec with a 50% activity factor such that the percentage of users in outage is less than 2% where a user is defined to have experienced a voice outage if less than 98% of the VoIP packets have been delivered successfully to the user within a one way radio access delay bound of 50 ms.

The packet delay is defined based on the 98 percentile of the CDF of all individual users 98 packet delay percentiles (i.e., first for each user the 98 percentile of the packet delay CDF is determined then the 98 percentile of the CDF that describes the distribution of the individual user delay percentiles is obtained).

It should be noted that the VoIP capacity is the minimum of the capacities calculated for the downlink and uplink.

The minimum VoIP capacity in terms of number Active users/sector/MHz is shown in Table 5.

Test environment*	Min VoIP Capacity
Indoor	50**
Microcellular	40**
Base coverage urban	30
High speed	10

* The test environments are described in IMT.EVAL.

** These values do not apply to devices operating at less than 20 dBm

A minimum of [40] active users/MHz/cell shall be supported by IMT-Advanced systems.

[Note 7: It was noted that the working assumption value should be reviewed in light of the assumptions taken to derive the cell spectral efficiency values]

TABLE 5

Minimum VoIP Capacity

Note that bidirectional VoIP capacity is measured in Active Users/MHz/Sector. The total number of active users on the DL and UL is divided by total bandwidth occupied by the system accounting for frequency reuse. For an FDD configuration, the bandwidth is calculated as the sum of the uplink and downlink channel bandwidths. For a TDD configuration, the bandwidth is simply the channel bandwidth.

These values were defined assuming an antenna configuration of 4x4 in the downlink and 2x4 in the uplink. However this does not form part of the requirement and the conditions for evaluation are described in IMT.EVAL.