Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**Proposed input to IEEE 802.18 on ITU-R SWG Radio Aspects**
Date Submitted	**September 12, 2007**
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Re:	Call for Contributions: Proposed Contribution to IEEE 802.18 on IMT-Advanced Requirements
Abstract	This contribution proposes changes to IMT-TECH in response to liaison from ITU-R WP8F regarding minimum performance requirements and evaluation guidelines for IMT-Advanced.
Purpose	Recommendations to be discussed and forwarded to IEEE 802.18
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Comment IMT-TECH

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Purpose

This contribution proposes changes to IMT-TECH in response to liaison from ITU-R WP8F regarding minimum performance requirements and evaluation guidelines for IMT-Advanced.

Justification for changes:

Section 4.1 – Cell Spectral Efficiency	Cell spectral efficiency is dependent on the simulation environment defined by the evaluation methodology. In particular, the spectral efficiency will be dependent on the channel model, path loss model, cell spacing, base/mobile transmit power, base/mobile receiver noise figure, etc. Moreover, a variety of subscriber speeds will encountered within the cell. A typical deployment will simultaneously serve subscribers traveling at stationary, pedestrian, vehicular and high speed distributions. It is recommended that the cell spectral efficiency be specified on evaluation scenario rather than a unique speed. The IEEE 802.16m task group in contribution IEEE C802.16m-07/158r3 has adopted 5 test scenarios that would be suitable for ITU adoption.
Section 4.2 – Peak Spectral Efficiency	The peak spectral efficiency is a functional requirement independent of vehicular speed. The peak rate may be calculated based on the maximum modulation level, highest coding rate and number of spatial streams supported by the specification. It is recommended that the spectral efficiency be specified as a function of the base station and subscriber antenna configuration. The IEEE 802.16m task group has specified a baseline and target configuration in IEEE 802.16m-07/002r3.
Section 4.3 – Cell edge user throughput	5% point is consistent with IEEE 802.16m requirements and is recommended to remove the brackets.
Section 4.4.1 – Control plane latency	100 ms is consistent with IEEE 802.16m requirements and is recommended to remove the brackets.
Section 4.4.2 – Transport delay	10 ms is consistent with IEEE 802.16m requirements and is recommended to remove the brackets.
Section 4.6.2 – Handover Interruption Time	A 30 ms intra-frequency hand and 100 ms inter-frequency handoff interruption time is recommended.

ATTACHMENT 6.8

Source: Document 8F/TEMP/574

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

[Recommendation ITU-T Q.1751

Recommendation ITU-T Q.1761

Recommendation ITU-T Q.1711

Recommendation ITU-T Q.1721

Recommendation ITU-T Q.1731

Recommendation ITU-T 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]

[Candidate radio interface technologies do not have to meet the requirements in all test environments, only those for which the technology is proposed to operate].

The requirements are considered to be assessed separately and need to be evaluated according to the criteria defined in annex 7 of the Circular Letter.

4.1 Cell spectral efficiency

[Cell[1] spectral efficiency is defined as the aggregate throughput of all users divided by the spectrum block assignment size (inclusive of only PHY/MAC layer overhead).]

Test environment*	Downlink	Uplink
~~Stationary~~Baseline	[~~5~~TBD] b/s/Hz/cell	[~~5~~TBD] b/s/Hz/cell
NGMN~~Pedestrian~~	[~~3~~TBD] b/s/Hz/cell	[~~3~~TBD] b/s/Hz/cell
Urban Macrocell~~Vehicular~~	[~~2~~TBD] b/s/Hz/cell	[~~2~~TBD] b/s/Hz/cell
Suburban Macrocell~~High Speed~~	[~~2~~TBD] b/s/Hz/cell	[~~2~~TBD] b/s/Hz/cell
Urban Microcell	[TBD] b/s/Hz/cell	[TBD] b/s/Hz/cell

* Assuming the Test Environments are described in the IMT.EVAL working document, Doc. 8F/1170, Attachment 6.3.

4.2 Peak data rate

[Editors note: There is still discussion in SWG Radio Aspects as to how to include actual peak data rates within this document. This discussion will continue through the upcoming correspondence activity between WP 8F Meetings #22 and #23]

[The peak spectral efficiency is the highest theoretical normalised (by bandwidth) data rate available to applications running over the radio interface and assignable to a single mobile station. The peak spectral efficiency can be determined from the combination of modulation constellation, coding rate, symbol rate, receiver structure amongst others that yields the maximum data rate (including layer 1 overhead).

~~Mobility classes~~	~~Stationary (0 km/h)~~	~~Pedestrian (10 km/h)~~	~~Vehicular (120 km/h)~~	~~High speed vehicular (350 km/h)~~
~~Downlink Peak spectral efficiency~~	~~[10] b/s/Hz~~	~~[10] b/s/Hz~~	~~[5] b/s/Hz~~	~~[5] b/s/Hz~~
~~Uplink Peak spectral efficiency~~	~~[10] b/s/Hz~~	~~[10] b/s/Hz~~	~~[5] b/s/Hz~~	~~[5] b/s/Hz~~

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

Requirement Type	Link direction	MIMO Configuration	Normalized peak rate (bps/Hz)
Baseline	Downlink	2x2	8.0
	Uplink	1x2	2.8
Target	Downlink	4x4	15.0
	Uplink	2x4	5.6

Notes applicable to table:

a) The baseline requirement denotes the minimum peak data rate achievable between a BS and an MS equipped with the minimum supported antenna configuration.
b) The target requirement denotes the minimum peak data rate achievable between a BS and a MS equipped with a higher order antenna configuration that exceeds the minimum MS antenna configuration.
c) Other MIMO antenna configurations beyond those specified can be used. For example, the extended uplink requirement for the 2x4 configuration would apply to an uplink 2x2 configuration etc.
d) The specified requirements of normalized peak rates are not distinguished by duplex mode. Rather, 100% of available radio resources are assumed – for the purposes of calculation– allocable to downlink and uplink respectively regardless of duplexing mode. For example, for TDD, when assessing downlink performance, all available radio resources are assigned for downlink transmission.
e) The peak rates account for layer 1 overhead due to provisioning of radio resources for essential functions such as pilots, cyclic-prefix, guard bands and guard intervals.
a) The specified minimum supported normalized peak rates are applicable to all supported bandwidths.

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Peak data rates can then be determined as in the following examples:

- Downlink peak data rate for vehicular mobility in 20MHz is [100]Mb/s
- Downlink peak data rate for pedestrian mobility in 100MHz is [1]Gb/s]

4.3 Cell edge user throughput

Cell edge user throughput to be greater than [y] b/s

Cell edge user throughput is defined as ~~[~~5~~]~~% point of cdf of user throughput

4.4 Latency

4.4.1 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** should be achievable from idle state to an active state in such a way that the user plane is established.

4.4.2 Transport delay

The Transport delay or User Plane (U-Plane) delay is defined in terms of the one-way transit time between a packet being available at the IP layer in either the user terminal/base station or the availability of this packet 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. [Assuming all radio resources have been previously assigned]

IMT-Advanced should be able to achieve a U-plane delay of less than ~~[~~**10**~~]~~ **ms** in unloaded condition (i.e. single user with single data stream) for small IP packet, e.g. 0 byte payload + IP headers.

4.4.3 QoS

[Editor's note: include placeholder on QoS]

4.5 Mobility

IMT-Advanced should support at least the following mobility classes:

- Stationary
- Pedestrian: up to10 Km/h
- Vehicular up to 120 Km/h
- High speed vehicular: up to 350 Km/h

There is a need to define which mobility classes are supported by each test environment.

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

* Assuming the Test Environments are as described in the IMT.EVAL working document, Doc. 8F/1170, Attachment 6.3.

IMT-Advanced shall be optimized for low speeds such as mobility classes from stationary to pedestrian and provide high performance for higher mobility classes. The performance shall be degraded gracefully at the highest mobility. In addition, IMT-Advanced shall be able to maintain the connection up to highest supported speed and to support the required spectrum efficiency.

The table below summarizes the mobility performance.

Mobility	Performance
Stationary, pedestrian (0 –10 km/h)	Optimized
Vehicular (10– 120 km/h)	Marginal degradation
High speed vehicular (120 km/h to 350 km/h)	System should be able to maintain connection

4.6 Handover

4.6.1 Handover Support

IMT-Advanced systems shall provide handover methods to facilitate continuous service for a population of mobile terminals. Thelayer 2 or higher layers handover methods should enable mobile terminals to maintain seamless connectivity when moving between cells between radio interface technologies, between frequencies.

[Editor's note: Including support of at least one IMT-2000 family member to be included in chapters 5 and 6.]

4.6.2 Handover Interruption Time

Handover performance requirements, and specifically the interruption times applicable to handovers for compatible IMT-2000 and IMT-Advanced systems, and intra- and inter-frequency handover should be defined.

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

Handover Type	**Max. Interruption Time (ms)**
Intra-Frequency	~~[50]~~30
Inter-Frequency	~~[150]~~100
~~[Inter-system]~~	~~[z]~~