Note: This document was approved by the IEEE 802.16 ITU-R Liaison Group and Task Group m, as authorized by the 802.16 WG, for transmission to 802.18.

The following track changes are with respect to Attachment 6.8 of Document 8F/1322.

DRAFT [REPORT ON] REQUIREMENTS RELATED TO TECHNICAL SYSTEM PERFORMANCE FOR IMT-ADVANCED RADIO INTERFACE(S) [IMT.TECH]

TABLE OF CONTENTS

2 Application of ~~multi-input multi-output~~MIMO technology in IMT-Advanced System

~~3 Input text to 22nd meeting of WP8F on general requirements~~

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~~are not required to meet the requirements in all test environments, only those for which the technology is proposed to operate are required to be met or exceeded~~]~~.

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~~and MAC layer overheads).~~]~~

Test environment*	Downlink	Uplink
Stationary	~~[5]~~[2.6] bit/s/Hz/cell	~~[5]~~[1.3] bit/s/Hz/cell
Pedestrian	~~[3]~~[2.6] bit/s/Hz/cell	~~[3]~~[1.3] bit/s/Hz/cell
Vehicular	~~[2]~~[2] bit/s/Hz/cell	~~[2]~~[1] bit/s/Hz/cell
High Speed	~~[2]~~[1] bit/s/Hz/cell	~~[2]~~[0.5] bit/s/Hz/cell

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

[Editorial Note: The proposed values in the table are in square brackets because they are still under study in IEEE 802.16.]

4.2 Peak ~~data rate~~spectral efficiency

[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~~ normalized (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~~PHY overhead~~)~~. The minimum peak spectral efficiency requirements are given in the following table.

~~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~~

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

~~Uplink Peak spectral efficiency~~	~~[10] b/s/Hz~~	~~[10] b/s/Hz~~	~~[5] b/s/Hz~~	~~[5] b/s/Hz~~

Requirement Type	Link direction	Normalized peak rate (bit/s/Hz)
Minimum	Downlink	8.0
	Uplink	2.8

Notes applicable to table:

a) 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.

b) The peak rates account for layer 1 overhead due to provisioning of radio resources for essential functions such as OFDMA pilots, cyclic-prefix, guard bands and guard intervals.

c) The specified minimum supported normalized peak rates are applicable to all supported bandwidths.

~~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 Average user throughput and ~~C~~cell edge user throughput

The average user throughput is defined as the sum of the average data throughput of each user in the system divided by the total number of users in the system. The value is [TBD].

Cell edge user throughput is defined as 5% point of cdf (cumulative distribution function) of user throughput.

Cell edge user throughput is to be greater than ~~[y]~~ [TBD] bit/s/Hz and [TBD] bit/s/Hz for downlink and uplink, respectively. ~~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~~signaling delay) of less than ~~[~~**100**~~]~~ **ms** ~~should~~shall be achievable from idle state to an active state in such a way that the user plane is established.

4.4.2 Transport delay (User/Data plane latency)

The t~~T~~ransport delay or User/Data 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/Data plane packet delay includes delay introduced by associated protocols and control ~~signalling~~signaling assuming the user terminal is in the active state. ~~[~~ ~~A~~assuming all radio resources have been previously assigned.~~]~~

IMT-Advanced systems ~~should~~shall be able to achieve a ~~U-plane~~ transport 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]*~~

IMT-Advanced systems shall support QoS classes, enabling matching of service, application and protocol requirements (including higher layer signaling) to radio access network resources and radio characteristics. This includes enabling new applications such as interactive gaming. IMT-Advanced systems should provide support for preserving QoS during handover with other RITs.

4.5 Mobility

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

- Stationary: 0 km/h
- Pedestrian: ~~up to~~0-10 ~~K~~km/h
- Vehicular: ~~up to~~ 10-120 ~~K~~km/h
- High speed vehicular: ~~up to~~ 120-350 ~~K~~km/h

Vehicular speeds in excess of 350 km/h may also be supported depending on frequency band and deployment.
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~~ degradation~~ed~~ as a function of speed should be graceful~~ly 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. The layer 2 or higher layers handover methods should enable mobile terminals to maintain seamless connectivity when moving between cells, between radio interface technologies, or 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 intra-system 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]~~

[Editorial Note: The contents of the remainder of Attachment 6.8 to Document 8F/1322 has not been reviewed in detail by 802.16. It includes some material that is not in line with the scope of IMT.TECH and therefore should be considered for deletion from the requirements; some of the deleted text may be transferred to the technology description template and the evaluation guidelines.]