Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	**Proposed Inputs to IEEE 802.18 on IMT-Advanced Requirements (Edited 8F/TEMP/560-E)**	
Date Submitted	**2007-09-17**	
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Re:	Call for Contributions: Proposed Contribution to IEEE 802.18 on IMT-Advanced Requirements, 8/25/2007	
Abstract	For discussion and approval by IEEE 802.16 Working Group and forward to IEEE 802.18 TAG for consideration	
Purpose	To help IEEE 802.16 Working Group to develop a contribution to IEEE 802.18 TAG on IMT-Advanced requirements.	
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INTERNATIONAL TELECOMMUNICATION UNION

RADIOCOMMUNICATION STUDY GROUPS
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Subject: Question ITU-R 229-1/8

SWG Radio Aspects

DRAFT TEXT FOR ANNEX 4 OF THE CIRCULAR LETTER ON AN INVITATION TO PROPOSE CANDIDATE RADIO INTERFACE TECHNOLOGIES FOR IMT-ADVANCED

Requirements related to technical system performance

[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 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. ~~[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.

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 and~~/~~ MAC layer overheads).] The following requirements shall be met with a minimum of 2 transmit and 2 receive antennas in the base station and 1 transmit and 2 receive antennas in the mobile station. Higher order antenna configurations may also be considered which results in higher cell spectral efficiencies. These targets assume that there are 10 active users per cell.

Test environment*	Downlink	Uplink
Stationary	3 b/s/Hz/cell~~[5] b/s/Hz/cell~~	1.5 b/s/Hz/cell~~[5] b/s/Hz/cell~~
Pedestrian	3 b/s/Hz/cell~~[3] b/s/Hz/cell~~	1.5 b/s/Hz/cell~~[3] b/s/Hz/cell~~
Vehicular	2 b/s/Hz/cell~~[2] b/s/Hz/cell~~	1 b/s/Hz/cell~~[2] b/s/Hz/cell~~
High Speed	1 b/s/Hz/cell~~[2] b/s/Hz/cell~~	0.5 b/s/Hz/cell~~[2] b/s/Hz/cell~~

* The current test environments are described in the current IMT.EVAL working document, Doc. 8F/1170, Attachment 6.3.

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

~~[~~Peak ~~data rate~~spectral efficiency

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 following requirements shall be met with a minimum of 2 transmit and 2 receive antennas in the base station and 1 transmit and 2 receive antennas in the mobile station. Higher order antenna configurations may also be considered which results in higher peak spectral efficiencies.

[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]

Mobility classes	Stationary (0 km/h)	Pedestrian (0-10 km/h)	vehicular (10-120 km/h)	High speed vehicular (120-350 km/h)
Downlink Peak spectral efficiency	8 b/s/Hz~~[10] b/s/Hz~~	8 b/s/Hz~~[10] b/s/Hz~~	4 b/s/Hz ~~[5] b/s/Hz~~	2 b/s/Hz~~[5] b/s/Hz~~
Uplink Peak spectral efficiency	2.8 b/s/Hz~~[10] b/s/Hz~~	2.8 b/s/Hz~~[10] b/s/Hz~~	1.4 b/s/Hz ~~[5] b/s/Hz~~	0.7 b/s/Hz~~[5] b/s/Hz~~

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

Downlink peak data rate for vehicular mobility in 20 MHz is ~~[100]~~80 Mb/s

Downlink peak data rate for pedestrian mobility in 100 MHz is ~~[1]~~800 ~~G~~Mb/s~~]~~

Note that downlink peak data rates in the excess of 1 Gb/s can be achieved through the use of higher order antenna configurations.

Cell edge user throughput

Cell edge user throughput to be greater ~~than~~ than 0.1 b/s/Hz and 0.06 b/s/Hz for downlink and uplink, respectively. ~~[y] b/s.~~

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

Latency

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.

Transport delay (User/Data plane latency)

The ~~T~~transport 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 plane

packet delay includes delay introduced by associated protocols and control ~~signalling~~signaling assuming the user terminal is in the active state,~~.~~ ~~[Assuming~~ 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. The user/data plane latency shall be calculated when H-ARQ is operated at an initial transmission error probability of 0.3.

QoS
~~*[Editor's note: Include placeholder on QoS.]*~~
IMT-Advanced systems shall support QoS classes, enabling an optimal 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 shall provide support for preserving QoS during handover with other RITs when it is feasible.

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 and up to 500 km/h may be considered 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

* The current Test Environments are described in the current 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)	Graceful degradation as a

	function of vehicular speed~~Marginal degradation~~
High speed vehicular (120 ~~km/h to~~- 350 km/h)	System should be able to maintain connection

Handover

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.

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]~~