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| Project | **IEEE 802.16 Broadband Wireless Access Working Group <**<http://ieee802.org/16>**>** |
| Title | ***Proposed Applications and Requirements for Mobile Broadband Network Performance Measurements*** |
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| Re: | Call for Contributions, IEEE 802.16’s Metrology Study Group (IEEE 802.16-12-0379-03-Gdoc) toward IEEE 802.16’s Session #80 of 16-19 July 2012. |
| Abstract | This document discusses considerations regarding applications and requirements for Mobile Broadband Network Performance Measurements. |
| Purpose | This proposal requests that the Metrology Study Group review the documentation in the context of the proposed P802.16.3 project, issue a Study Group document based on the contribution, and solicit comment on the result in preparation for Session #81. |
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Proposed Applications and Requirements for

Mobile Broadband Network Performance Measurements

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# Abstract

This document discusses considerations regarding applications and requirements for Mobile Broadband Network Performance Measurements (MBNPM).

This document responds to the a Call for Contributions ([IEEE 802.16-12-0379-03-Gdoc](https://mentor.ieee.org/802.16/dcn/12/16-12-0379)) issued by the IEEE 802.16 Working Group’s [Metrology Study Group](http://ieee802.org/16/sg/met) (SG) toward IEEE 802.16’s Session #80 of 16-19 July 2012. One of the topics in the solicitation is the draft PAR P802.16.3 and Five Criteria Statement on *Mobile Broadband Network Performance Measurements* ([IEEE 802.16-12-0395](https://mentor.ieee.org/802.16/dcn/12/16-12-0395)). The Call for Contributions requested input on “applications of a standard on Mobile Broadband Network Performance Measurements, highlighting the specific requirements that would follow.”

# Purpose

This proposal requests that the Metrology Study Group review the documentation in the context of the proposed P802.16.3 project, issue a Study Group document based on the contribution, and solicit comment on the result in preparation for Session #81.

# Proposal

This proposal requests that the Metrology Study Group incorporate the documentation below into a Study Group document entitled “[Draft] Applications and Requirements for Mobile Broadband Network Performance Measurements” and solicit comment on the result in preparation for Session #81.

# Application perspectives in Draft P802.16.3 PAR

Draft PAR P80216.3, on *Mobile Broadband Network Performance Measurements,* includes several elements relevant to an understanding of potential applications of the standard, particularly in PAR Item 5.5 (“Need for the Project”). Here, PAR Item 5.5 is reproduced, with text underlining added to call out content relevant to understanding the application space:

Users of broadband mobile networks, including enterprises such as corporations and governments, lack reliable, comparable data on which to base their assessment of network performance. Such data can be valuable to determine overall network quality and to pinpoint specific weaknesses, including limitations in deployment. Improved knowledge of system performance will lead the market toward more effective networks and therefore encourage the redeployment of scarce spectrum using the most efficient technologies and implementations. Also, policy makers seeking information on performance of available networks will directly benefit by the opportunity to apply the standardized metrics and methods. Researchers will also gain by the ability to compare measured performance data to simulated results and thereby assess the theoretical models. One application of such information is the assessment of technology elements proposed during standards development.

# Table of Applications

Based on the perspective of the previous section, we can itemize some key applications. In Table 1, we have listed these applications in tabular form, along with a list of various stakeholder roles, drawn significantly from PAR Item 5.6 (“Stakeholders for the Standard”). Table 1 also indicates an assessment of the applications of greatest interest to each stakeholder role.

**Table 1 – Assessment of key measurement applications per stakeholder role**

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| --- | --- |
|  | **Stakeholder role** |
| **Measurement application** | **policy maker** | **enterprise user (corporation, government)** | **cell tower operator** | **wireless carrier** | **researcher** | **standards developer** |
| Overall data on Quality of Experience of set of networks available to consumers | x | x | x | x | x |  |
| Quality of Experience of a specific network |  | x | x | x | x |  |
| Identify limitations in deployment of a specific network |  | x | x | x |  |  |
| Monitor for changes in operation of a specific network |  | x |  | x |  |  |
| Diagnose problems in a specific network |  |  | x | x |  |  |
| improve knowledge of system performance |  |  |  | x | x |  |
| lead the market toward more effective networks | x |  |  |  |  |  |
| encourage the redeployment of scarce spectrum using efficient technologies and implementations | x |  | x | x |  |  |
| compare measured performance data to simulated results |  |  |  |  | x | x |
| assess theoretical models |  |  |  |  | x | x |
| assess technology elements proposed during standards development |  |  |  |  |  | x |

# Requirements perspectives in Draft P802.16.3 PAR

In this section, we propose a list of requirements that the MBNPM standard should satisfy in order to meet the needs to the applications identified. Some key information in the draft PAR related to the requirements is in the follow sections, with text underlining added to call out content relevant to understanding the requirements:

PAR Item 5.2 (“Scope”): This standard specifies procedures for characterizing the performance of deployed mobile broadband networks from a user perspective. It specifies metrics and test procedures as well as communication protocols and data formats allowing a network-based server to coordinate and manage test operation and data collection.

PAR Item 5.4 (“Purpose”): By standardizing the metrics and methods, the standard provides a framework for characterizing and assessing the performance of various mobile broadband networks. By standardizing the protocols and data formats, it allows for a measurement server to collect information from a disparate set of devices on the network.

Five Criteria Item 1 (“Broad Market Potential”):

(a) The standard will specify metrics broadly applicable to all IP-based mobile broadband networks.

(b) By providing standard data format and data exchange protocols, the standard will allow the measurement process to be implemented by any IP-based server in conjunction with any IP-based mobile device.

(c) The standard will be implemented in software, so the cost will be low. The terminals may incur a cost burden from the measurement process to the extent that data transfer may be subject to a fee from the carrier, may interfere with other active terminal processes, and may drain the terminal power. The project will address these issues and try to minimize this burden on the terminal, consistent with an overall optimized solution.

Five Criteria Item 4a (“Technical Feasibility/ Demonstrated system feasibility”):

The technical feasibility of wide-scale *in situ* network performance measurements is well established. Existing tools measure a number of parameters, typically including upload rate, download rate, latency, and jitter. Sometimes additional data, such as information on packet loss and timeouts, is reported as well, with various types of metadata.

Five Criteria Item 5b (“Economic Feasibility/ Reasonable cost for performance”):

The costs identified in (a) are generally low enough to be compatible with the measurement process, depending on the value of the specific measurement to the terminal user. Nevertheless, the project will attempt to minimize the burden on the terminal, consistent with an overall optimized solution. The standard will provide for control of the tradeoff between cost and performance, so that cost-driven users can reduce the number of measurements and the thoroughness of measurements to obtain lower-cost operation, albeit with less complete information. In order to assess whether the cost of measurement is “reasonable,” it needs to be compared to the benefit of measurement. Those who use the broadband mobile network professionally, including enterprise users, will have additional incentive to undertake network performance assessment as a tool in meeting communications requirements.

Five Criteria Item 5c (“Consideration of installation costs”):

Since the solution is expected to operate in software, installation costs are expected to be minimal. The solution will be compatible with over-the-air installation of terminal software.

# Proposed Requirements

A set of requirements drawn significantly from these highlights is proposed here:

* The standard shall specify procedures for characterizing and assessing the performance of deployed mobile broadband networks from a user perspective.
* The standard shall specify metrics broadly applicable to all IP-based mobile broadband networks.
* The standard should reference metrics specified by IETF (particularly from the IP Performance Metrics (ippm) Working Group) whenever feasible.
* The standard shall specify test procedures.
* The standard shall specify procedures for a measurement server to collect information from a disparate set of devices on the network.
* The standard shall specify communication and data exchange protocols and data formats allowing a network-based server to coordinate and manage test operation and data collection.
* The standard shall be compatible with implementation in software.
* The standard shall be compatible with over-the-air installation of terminal software.
* The standard should be compatible with implementation by any IP-based server in conjunction with any IP-based mobile device.
* The standard should consider how to minimize (consistent with an overall optimized solution) the cost burden on the terminal due to the extent that data transfer may be subject to a fee from the carrier, may interfere with other active terminal processes, and may drain the terminal power.
* The standard shall specify procedures for measuring including uplink throughput rate, downlink throughput rate, latency, and jitter.
* The standard shall specify procedures for quantifying packet loss and timeouts.
* The standard shall specify procedures for collecting and transmitting various types of metadata, to include carrier network, network type, cell ID, device make/model, network policy information, and radio resource control parameters, if available.
* The standard shall specify procedures for collecting and transmitting terminal location and location accuracy associated with measurement events.
* The standard shall specify procedures for reducing terminal location accuracy for privacy protection.
* The standard shall specify procedures to ensure that Personally Identifiable Information (PII) is treated sensitively and protected from unauthorized disclosure.
* The standard shall specify procedures to manage and respond to user consent authorization with regard to PII.
* The standard shall specify anonymization procedures.
* The standard shall provide for control of the tradeoff between cost and performance, so that cost-driven users can reduce the number of measurements and the thoroughness of measurements to obtain lower-cost operation, albeit with less complete information. The standard should recommend means of estimating and reporting the statistical validity of a set of measurement data.
* The standard shall specify procedures based on active probing.
* The standard should specify procedures based on passive measurements.

# References

Feng Qian, Zhaoguang Wang, Alexandre Gerber, Zhuoqing Mao, Subhabrata Sen, and Oliver Spatscheck. 2011. [Profiling resource usage for mobile applications: a cross-layer approach](http://web.eecs.umich.edu/~zmao/Papers/aro_mobisys11.pdf). In *Proceedings of the 9th international conference on Mobile systems, applications, and services (MobiSys '11)*. ACM, New York, NY, USA.