

## P802.16.3

**Submitter Email:** [r.b.marks@ieee.org](mailto:r.b.marks@ieee.org)  
**Type of Project:** New IEEE Standard  
**PAR Request Date:** 20-Jul-2012  
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**PAR Expiration Date:** 31-Dec-2016  
**Status:** PAR for a New IEEE Standard

**1.1 Project Number:** P802.16.3  
**1.2 Type of Document:** Standard  
**1.3 Life Cycle:** Full Use

**2.1 Title:** Standard for Mobile Broadband Network Performance Measurements

**3.1 Working Group:** Broadband Wireless Access Working Group (C/LM/WG802.16)

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None

**3.2 Sponsoring Society and Committee:** IEEE Computer Society/LAN/MAN Standards Committee (C/LM)

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**4.1 Type of Ballot:** Individual

**4.2 Expected Date of submission of draft to the IEEE-SA for Initial Sponsor Ballot:** 07/2013

**4.3 Projected Completion Date for Submittal to RevCom:** 02/2014

**5.1 Approximate number of people expected to be actively involved in the development of this project:** 30

**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.

**5.3 Is the completion of this standard dependent upon the completion of another standard:** No

**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.

**5.5 Need for the Project:** 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.

**5.6 Stakeholders for the Standard:** Individual and enterprise users of mobile broadband networks; government policy agencies studying broadband deployments; companies and universities engaged in network performance assessment; operators of mobile broadband networks.

**Intellectual Property**

**6.1.a. Is the Sponsor aware of any copyright permissions needed for this project?:** No

**6.1.b. Is the Sponsor aware of possible registration activity related to this project?:** No

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**7.1 Are there other standards or projects with a similar scope?:** No

**7.2 Joint Development**

**Is it the intent to develop this document jointly with another organization?:** No

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**8.1 Additional Explanatory Notes (Item Number and Explanation):** (7.1) Standardization activities relevant to this work, though not with a similar scope and primarily oriented to fixed networks, include:

\*IETF (Internet Engineering Task Force) Working Group on IP Performance Metrics (ippm)

\*IETF pre-standardization activity "Imap" on Large Scale Measurement of Access Network Performance

\* ITU-T (International Telecommunication Union Standardization Sector) Study Group 12

## Five Criteria Statement for P802.16.3

### 1 Broad Market Potential

A standards project authorized by IEEE 802 LMSC shall have a broad market potential. Specifically, it shall have the potential for:

- (a) Broad sets of applicability.
- (b) Multiple vendors and numerous users.
- (c) Balanced costs (LAN versus attached stations).

- (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.

### 2 Compatibility

IEEE 802 LMSC defines a family of standards. All standards should be in conformance with IEEE Std 802, IEEE Std 802.1D, and IEEE Std 802.1Q. If any variances in conformance emerge, they shall be thoroughly disclosed and reviewed with the IEEE 802.1 Working Group. In order to demonstrate compatibility with this criterion, the Five Criteria statement must answer the following questions:

- (a) Does the PAR mandate that the standard will comply with IEEE Std 802, IEEE Std 802.1D, and IEEE Std 802.1Q?
- (b) If not, how will the Working Group ensure that the resulting draft standard is compliant or, if not, receives appropriate review from the IEEE 802.1 Working Group?

- (a) The PAR does not mandate that the standard will comply with IEEE Std 802, IEEE Std 802.1D, and IEEE Std 802.1Q. However, it will not conflict with those standards in any way. Data communication over IEEE 802 networks, including those incorporating 802.1D and 802.1Q, shall be fully supported.
- (b) In order to ensure that the resulting draft standard is compliant or, if not, receives appropriate review from the IEEE 802.1 Working Group, the draft will be provided to the 802.1 WG Chair when it enters WG Letter Ballot, and comments from or collected by the 802.1 WG Chair will be addressed during comment resolution.

### 3 Distinct Identity

Each IEEE 802 LMSC standard shall have a distinct identity. To achieve this, each authorized project shall be: Substantially different from other IEEE 802 LMSC standards.

- (a) One unique solution per problem (not two solutions to a problem).
- (b) Easy for the document reader to select the relevant specification.

This standard will be distinct from every other IEEE 802 standard. No other IEEE 802 standard addresses measurements of mobile broadband network performance. The standard will specify a unique solution, although it may provide more tools than are required for any particular measurement requirement, so some application may require implementation of only a partial tool set. The title and scope of the standard will enable the reader to identify the specification.

### 4 Technical Feasibility

For a project to be authorized, it shall be able to show its technical feasibility. At a minimum, the proposed project shall show:

(a) 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 uplink throughput rate, downlink throughput rate, latency, and jitter. Sometimes additional data, such as information on packet loss and timeouts, is reported as well, with various types of metadata. Some of the deployed tools and activities are summarized in the following non-exclusive list:

Fixed-Centric Activities

- Measurement Lab (M-Lab) <<http://www.measurementlab.net>> describes itself as “an open, distributed server platform for researchers to deploy Internet measurement tools... to advance network research and empower the public with useful information about their broadband connections.” The platform supports at least nine tools, created by various researchers, that can be engaged by end users to initiate testing in conjunction with M-Lab servers. Collected data, without Personally Identifiable Information (PII), is publicly available.
- Network Diagnostic Tool (NDT) <<http://www.internet2.edu/performance/ndt/api.html>> is provided by the Internet2 consortium. NDT collects not only bandwidth information but also additional data characterizing latency, packet loss, congestion, and bottlenecks on the end-to-end path. NDT is an M-Lab tool.
- Project BISmark <<http://projectbismark.net>> is the Broadband Internet Service Benchmark activity, led by Georgia Tech and the University of Napoli Federico II. Data collection is driven by a customized hardware gateway that automatically initiates active measurements of the access link performance. BISmark is an M-Lab tool.
- SamKnows <<http://www.samknows.com>> is a UK-based company that has developed measurement methodology for fixed broadband using a customized client-based hardware device that autonomously performs a suite of broadband measurements during quiet periods on consumer’s LAN. The company has conducted studies for the US’s FCC and the UK’s Ofcom and is currently conducting a similar study for the European Commission <<https://www.samknows.eu>>.
- In consideration of its National Broadband Plan (NBP), the US Federal Communications Commission (FCC) has conducted research to assessment broadband performance, targeting fixed terminals. In 2009, OBI Technical Paper No. 4 (“Broadband Performance”) published research on this topic. The methodology of the study was criticized in a report <[http://www.netforecast.com/Reports/NFR5103\\_comScore\\_ISP\\_Speed\\_Test\\_Accuracy.pdf](http://www.netforecast.com/Reports/NFR5103_comScore_ISP_Speed_Test_Accuracy.pdf)> developed by NetForecast for the National Cable & Telecommunications Association (NCTA).
- The FCC’s subsequent “Measuring Broadband America” program <<http://www.fcc.gov/measuring-broadband-america>> published in 2011 the results of a “performance study of residential wireline broadband service.” The data was collected using the technology of SamKnows, a UK-based analytics company. The methodology made use of a customized client-based hardware device that autonomously performed a suite of broadband measurements during quiet periods on consumer’s LAN. Measurement servers were provided by M-Lab. Additional data, not included in the published report, was collected by several participating ISPs at reference points within their own networks.

- The FCC hosts an ongoing “Consumer Broadband Test (Beta)” <<http://www.broadband.gov/qualitytest>>, run in a web browser, to “give consumers additional information about the quality of their broadband connections,” while provided the FCC with data, by submitted street address, to analyze broadband quality and availability on a geographic basis. Users are “randomly” assigned to run one of two tools: one by Ookla and one by M-Lab.
- Ookla <<http://www.ookla.com>> provides software and methodologies for broadband testing and web-based network diagnostic applications. The tools are in wide use, and the company claims use by over three million people a day. The company offers testing directly to consumers via Speedtest.net and Pingtest.net.

### Fixed-Centric Standardization Activities

- The IETF Working Group on IP Performance Metrics (ippm) <<http://datatracker.ietf.org/wg/ippm>> has developed many RFCs and Internet Drafts.
- In April 2012, the IETF announced a new non-working group “lmap” email list on Large Scale Measurement of Access Network Performance <<http://www.ietf.org/mail-archive/web/lmap/current/msg00000.html>>. The topic is “requirements, architectures, metrics, and protocols for measuring the performance and reliability of (mostly) residential and small-enterprise access links on a large scale.” The activity was initiated by the FCC and motivated by its “Measuring Broadband America” effort “to provide consumers and service providers with better information about broadband (access) performance. Such measurements can inform public policy, facilitate informed consumer choice of broadband providers, and allow debugging of performance issues.”
- ITU-T Study Group 12 <<http://www.itu.int/ITU-T/studygroups/com12>> is ITU’s lead study group on quality of service and quality of experience. It has conducted relevant standardization work, particularly under Question 17 on “Performance of packet-based networks and other networking technologies” <<http://www.itu.int/ITU-T/studygroups/com12/sg12-q17.html>>.
- The (expired) Internet Measurement Research Group (IMRG) <<http://irtf.org/concluded/imrg>> of the Internet Research Task Force (IRTF) was initiated in 2002 and retired in 2008 after several years of inactivity. The IMRG issued a report <<http://icir.org/imrg/ipmp-report.txt>> in 2004 critically evaluating the IP Measurement Protocol (IPMP), which was embodied in an IETF Internet draft <<https://datatracker.ietf.org/doc/draft-mcgregor-ipmp>> that expired as of 2004.

### Mobile-Centric Activities

- Within 3GPP, activity to specify measurement methods, identified as “Minimization of Drive Test” (MDT) is conducted in RAN2, with related work on “Management of UE based network performance measurements” in SA5.
- The Next Generation Mobile Network Alliance (NGMN) has recently established the Service Quality Definition and Measurement (SERQU) group to improve understanding of the end user experience. Specifically, the group is studying the correlation between QoS/KPI metrics and user QoE for video streaming.
- Epitiro <<http://www.epitiro.com>> is a UK-based company providing service assurance solutions for fixed and wireless network operators and regulatory authorities. The company’s “ipQ” tool is deployed on subscriber, actively and autonomously testing IP service, with a focus on user-centric “quality of experience” testing.
- UK regulator Ofcom published a research study in 2011 <<http://consumers.ofcom.org.uk/2011/05/mobile-broadband-speeds-revealed>> using tools provided by Epitiro.

- The FCC is also addressing the issue of “Measuring Mobile Broadband” <<http://www.fcc.gov/encyclopedia/measuring-mobile-broadband>>. In 2010, it released a Request For Information on “Measurement and Reporting of Mobile Broadband Performance and Coverage” <<https://www.fbo.gov/index?s=opportunity&mode=form&id=2821c1539006659a6907ba75c0a3c34a>>, but it appears that no public followup information has been released. The FCC supports iOS and Android applications, in conjunction with Ookla, by the name of “FCC Broadband Test,” as “the FCC’s first attempt at providing consumers real0time information about the quality of their mobile broadband connection.”
- MobiPerf <<http://mobiperf.com>>, from the University of Michigan, provides a Mobile Network Measurement System application for iOS and Android mobile devices. Diagnostic information is provided to the user, and non-PII statistical information is available to the public.
- Mobile Pulse, Inc. <<http://www.mobilepulse.com>> is a US-based company providing wireless carrier performance measurements to enterprises and government agencies based on real-time testing initiated by terminal software in conjunction with managing servers.
- RootMetrics <<http://www.rootmetrics.com>> provides consumers with iOS and Android applications to test network performance. The consolidated results are displayable by map.
- Tools such as OpenSignalMaps <<http://opensignalmaps.com>> provide crowd-sourced maps indicating statistical representation of cellular signal levels, not of network performance.

(b) Proven technology, reasonable testing.

The technology to conduct measurements is an element of the deployments discussed in (a), demonstrating that the technology is proven and that testing can be “reasonable.” The standardization challenge will be to agree on a measurement approach that will be considered “reasonable” and “proven” on a consensus basis.

(c) Confidence in reliability.

The technology to conduct measurements is an element of the systems discussed in (a). A number of questions remain open regarding the reliability of measurement methods as an accurate assessment of ongoing system performance. Different approaches have been utilized, dependent to large degree on the intended uses. The project will attempt to reach consensus on preferred methods with high reliability.

#### ***4.1 Coexistence of IEEE 802 LMSC wireless standards specifying devices for unlicensed operation***

A WG proposing a wireless project is required to demonstrate coexistence through the preparation of a Coexistence Assurance (CA) document unless it is not applicable.

- (a) The WG will create a CA document as part of the WG balloting process.
- (b) If the WG elects not to create a CA document, it will explain to the Sponsor the reason the CA document is not applicable.

The Working Group will not create Coexistence Assurance (CA) document because no physical layer or MAC layer will be specified.

### **5 Economic Feasibility**

For a project to be authorized, it shall be able to show economic feasibility (so far as can reasonably be estimated) for its intended applications. At a minimum, the proposed project shall show:

(a) Known cost factors, reliable data.

Since the solution is expected to operate in software, the cost of implementation is expected to be low. However, terminal users 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.

(b) 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.

(c) 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.