
IEEE P802.20
Mobile Broadband Wireless Access

Project IEEE P802.20 Working Group for Mobile Broadband Wireless Access (MBWA)

Title **802.20 Technical Requirements – Strawman Version 00**

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Abstract This contribution is an attempt to establish a framework for and some initial technical requirements for 802.20 project. It continues the process initiated by C802.20-03-025r1 as presented at the March Meeting of 802.20

Purpose [The intent of this contribution is to establish a working document that will become the repository for the terms, definitions and high level requirements to be used in the selection process for a Draft Standard for 802.20.]

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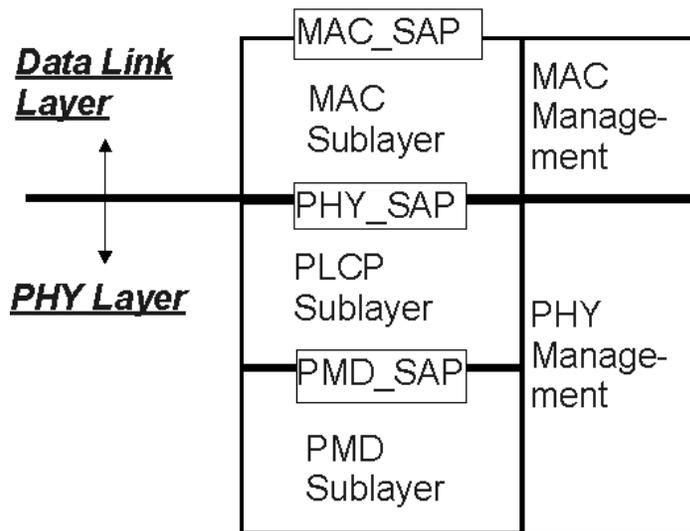
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Introduction

This document begins to provide the technical content for the 802.20 project to develop standards for Mobile Broadband Wireless Access (MBWA). The project is expected to encompass both Physical Layer (PHY) and Media Access Control (MAC) features for licensed operation in bands below 3.5 Ghz.

This document serves two purposes. It is first a repository for high level requirements and definitions derived from the 802.20 PAR. Second, it is planned over time to also contain summaries of other requirements derived from any application presentations received by 802.20. This document does not address selection criteria for the case where multiple technologies are proposed to fulfill the 802.20 project; a separate selection criteria document, yet to be developed will guide proposers on how to respond to a call for proposals. The working group may update this document as discoveries are made while working on the 802.20 project documents.

To aid the discussion in this document, a strawman Reference Partitioning of the 802.20 functionality is described in Figure 1. This reference partitioning model is similar to those used in 802.11 and 802.15 working groups.



- MAC_SAP: MAC Service Access Point
- PHY_SAP: PHY Service Access Point
- PLCP: PHY Layer Convergence Protocol, contains FEC
- PMD: Physical Medium Dependent (radio)

Figure 1 – Reference partitioning

1.0 Applications and Traffic Types for MBWA

This section provides definitions of anticipated traffic types, and should be derived from a "Call for Applications" phase of the project. The following items are examples.

1.1 Data Communications Applications

This section will describe the anticipated Data Communications applications for MBWA and associated requirements.

- 1.1.1 World Wide Web Browsing
 - 1.1.1.1 Definition and Characteristics
 - 1.1.1.2 Requirements
- 1.1.2 Electronic Mail Transmission and Retrieval
 - 1.1.2.1 Definition and Characteristics
 - 1.1.2.2 Requirements
- 1.1.3 Instant Messaging
 - 1.1.3.1 Definition and Characteristics
 - 1.1.3.2 Requirements

1.2 Telecommunications Applications

1.2.1 Voice Services

Voice Services are currently among the most profitable services available to the cellular and PCS service providers. These services are highly optimized to provide high quality at very minimal cost to provide. It is expected that MBWA will need to make some accommodation to provide voice services as an integral part of any service offering.

- 1.2.1.1 Definition and Characteristics
- 1.2.1.2 Requirements

1.2.2 Supplementary Services

1.2.1.1 Definition and Characteristics

To complement a basic point to point voice service offering, service providers normally provide several "supplementary" services, such as call forwarding, Calling Number Identification and Presentation. Some approach should be adopted so that MBWA access can accommodate these basic services.

1.2.1.2 Minimum Requirements

1.3 Multimedia Applications

Multimedia Applications are perceived as those of great interest for the future.

1.4 Telematics Applications

Telematics is an emerging area that is expected to become a popular application for macro-cellular systems in the next few years. Delivering services to a car such as positioning, location based services, electronic toll tags and others are currently proving to be one of the more challenging areas. This section is meant to capture anticipated services and to act as a repository for requirements that may affect the 802.20 specification.

1.5 E911 Services

Current systems implementing mobile access are required to implement FCC-mandated emergence services, called E911 services, these typically consist of a positioning service as well as mechanisms to activate priority access in times of emergency.

1.5.1 Location Services

1.5.1.1 Definition and Characteristics

1.5.1.2 Requirements on MBWA

1.5.2 Priority Access

1.5.2.1 Definition and Characteristics

1.5.2.2 Requirements on MBWA

1.5 Messaging Services

These services are Data-Like services, but currently are not implemented as true “data services.” Examples of these services are the current SMS offerings of GSM and CDMA2000 networks, as well as the “instant messaging” type services provided by independent service providers.

1.5.1 SMS Messaging

1.5.1.1 Definition and Characteristics

“Classic” SMS messaging was first described for 2G systems such as GSM and IS-95 and currently are implemented directly over the cellular infrastructure, without need of data communication networking infrastructure. Several different variations of these services exist, to be described as part of this section.

1.5 3G Service Application Extensions for MBWA

1.6 Messaging Services

1.6.1 Definition and Characteristics

1.6.2 Requirements

1.6 Some Example Applications

The following information is informative material, taken from the 802.15SG3a work in developing a clear set of technical requirements. It is included here primarily as an example of the sort of detail that should be captured in the applications sections. The reader should note that these paragraphs are specific to Pico-nets; appropriate material for the macro-cellular application of 802.20 should be developed.

Peripherals – H.323 / T.120 Video Conferencing

This application involves a set of wireless peripherals (at range $\leq 4\text{m}$) being used for a H.323 videoconferencing session (e.g., NetMeeting) using video, audio, and application sharing over a broadband connection or a corporate Intranet Ethernet connection.

| Application Ingredients | Data Format | Min Data Rate | Max Data Rate |
|-------------------------|----------------------------------|---------------|---------------|
| Video Camera | MPEG2 resolution w/o compression | 75Mb/s | 150Mb/s |
| Monitor | Varying compression | 63Mb/s | 1Gb/s |
| H.323 comm (broadband) | H.261/H.263, G.711/G.723, T.120 | 128kb/s | 10Mb/s |
| Audio (mono) | PCM | 64kb/s | 64kb/s |
| Mass storage | | 50Mb/s | 240 Mb/s |
| Mouse | | < 9600 b/s | < 9600 b/s |
| Keyboard | | < 9600 b/s | < 9600 b/s |
| Total | | 188+ Mb/s | 1.4+ Gb/s |

Home Theater

This application involves a set of wireless consumer electronics devices (at range $\leq 10\text{ m}$) that might be used in a home theater room. The key focus of this collection of devices is the video and audio signals. A wireless web pad would allow the user to explore details about the programs being viewed using an Internet connection.

| Application Ingredients | Data Format | Min Data Rate | Max Data Rate |
|-------------------------|--------------------------------|---------------|---------------|
| Monitor/Projector | HD Video | 19.2 Mb/s | 19.2 Mb/s |
| Audio (speakers) | 5.1 to 10.2 channels (24 bits) | 13.8 Mb/s | 27.6 Mb/s |
| Web Pad | Internet (streaming media) | 10 Mb/s | 10 Mb/s |
| Remote Controller | | ?? | ?? |
| Total | | 43 Mb/s | 56.8 Mb/s |

Interactive Applications

These applications have significant market appeal in that wireless links will not only improve the ease of setup/positioning and storage, but they will also

promote safer operation (fewer wires to trip over). The requirements are listed here in order of priority, with the display and audio transmission having a higher priority than the interactive controllers.

| Application Ingredients | Data Format | Min Data Rate | Max Data Rate |
|-------------------------|--------------------------------|---------------|---------------|
| Monitor/Projector | XGA w/ Varying compression | 63 Mb/s | 1 Gb/s |
| Audio (speakers) | 5.1 to 10.2 channels (24 bits) | 13.8 Mb/s | 27.6 Mb/s |
| Interactive controller | (Reaction Sensitive) | ?? | ?? |
| Total | | | |

Content Downloading

These applications concentrate on reducing the user's waiting time when downloading large loads of information, such as video, audio and digital images. The transfer time indicates the amount of time the user spends waiting for a typical data transfer to complete.

| Content Downloaded | Data Format | Data Rate | Transfer Time |
|--------------------|--------------------|-------------|---------------|
| Audio | MP3 | 60 Mb/s | 10 sec |
| | CD | 90 Mb/s | 60 sec |
| Photos | Varied Compression | 90 Mb/s | 10 sec |
| Movies | DV | ?? (higher) | ?? |
| Total | | | |

These are minimum download rates for an initial implementation. Consumer desire is always that faster downloads are better and thus significant importance is attached to the ability of the proposed technology to significantly increase download rates in the future.

2.0 System Requirements for MBWA

This section describes requirements and characteristics of a "systems" nature that are related to MBWA.

2.1 User "Visible" System Requirements

The MBWA PAR indicates that the new system will accommodate "significantly more" users than current systems with "significantly higher" per-user data rates than found in existing systems. This section defines basic concepts and provides requirements in this area.

2.1.1 Numbers of Users

2.1.1.1 Definitions and Characteristics

2.1.1.2 Requirements

2.1.2 User Data Rates

2.1.2.1 Peak User Data Rates

2.1.2.1.1 Definitions and Characteristics

2.1.2.1.2 Requirements

2.1.2.2 Average User Data Rates

2.1.2.2.1 Definitions and Characteristics

2.1.2.2.2 Requirements

2.2 Signaling Requirements

A signaling system for MBWA is key to providing services over the system and tying these services into currently existing 2.5G and 3G infrastructure. This section presents requirements for signaling channels, latencies and other items of interest.

2.2.1 Signaling Subchannels

2.2.1.1 Definition and Characteristics

2.2.1.2 Requirements

2.2.2 Signaling Subchannel Reliability

2.2.2.1 Definition and Characteristics

2.2.2.2 Requirements

2.2.3 Signaling Subchannel Latency and Data Rates

2.2.3.1 Definitions and Characteristics

2.2.3.2 Requirements

2.3 Network Security

Network security in MBWA systems is assumed to have goals similar to those in cellular or PCS systems. These goals are to protect the service provider from theft of service, and to protect the user's privacy and mitigate against denial of service attacks. Security for these systems is generally broken into Access control, privacy methods, billing and authorization.

2.3.1 Access Control

2.3.1.1 Definitions and Characteristics

2.3.1.2 Requirements

2.3.2 Privacy Methods

2.3.2.1 Definitions and Characteristics

2.3.2.2 Requirements

2.3.3 Billing Considerations

2.3.3.1 Definitions and Characteristics

2.3.3.2 Requirements

2.3.4 Authorization

2.3.4.1 Definitions and Characteristics

2.3.4.2 Requirements

2.4 Handoff Methods

Handoff methods are required in MBWA systems to facilitate providing continuous service for a population of moving Mobile Stations. Mobile stations may move between cells, between systems, between frequencies, and at the higher layer between IP Subnets. At the lowest layers, handoffs can be classified as either soft or hard handoffs, depending on whether there is a momentary service disruption or not. Handoffs to and from 3G technology are assumed to be important in this context as well, since MBWA is being designed to co-exist with current 3G systems.

2.4.1 Soft Handoff

2.4.1.1 Definitions and Characteristics

2.4.1.2 Requirements

2.4.2 Hard Handoff

2.4.2.1 Hard Handoff Between Similar MBWA Systems

2.4.2.1.1 Definition and Characteristics

2.4.2.1.2 Requirements

2.4.2.2 Hard Handoff Between Frequencies

2.4.2.2.1 Definition and Characteristics

2.4.2.2.2 Requirements

2.4.2.3 Hard Handoff Between MBWA and 3G Systems

2.4.2.3.1 Definitions and Characteristics

2.4.2.3.2 Requirements

2.4.3 IP-Level Handoff

Regardless of the lower layer handoff types required, it is expected that a higher level handoff utilizing a mechanism such as Mobile IP will be required for MBWA systems.

2.4.3.1 Definitions and Characteristics

2.4.3.2 Requirements

3. Media Access Control

Media access control methods are those methods by which a mobile station gains access to the over-the-air resource to communicate with MBWA infrastructure.

3.1 Active and “Dormant” Stations

It is expected that MBWA will accommodate both stations actively engaged in transmitting or receiving information, and those not actively engaged in such activities, but awaiting the opportunity to do so. These are termed “active” and “dormant”

3.1.1 Definitions and Characteristics

3.1.2 Requirements

3.2 MAC Latency

3.2.1 MAC Latency Definition and Characteristics

3.2.2 Requirements

3.3 MAC Latency Variation

3.3.1 Definition and Characteristics

3.3.2 Requirements

3.4 MAC Frame RTT

3.4.1 Definition and Characteristics

3.4.2 Requirements

3.5 Random Access MAC Features

3.5.1 Definitions and Characteristics

3.5.2 Requirements

3.6 Polled Access MAC Features

3.6.1 Definitions and Characteristics

3.6.2 Requirements

3.7 Quality of Service and the MAC

Many of the latest service concepts such as multimedia applications, video on demand, and others require that data transmission and delivery performance be bounded to provide a good user experience. To achieve this, there are many efforts in progress to define a Quality of Service “framework” and from that framework to define requirements to assure that such services can be offered. This section is meant to capture relevant QoS work, and to derive appropriate requirements for the 802.20 technology.

3.7.1 Definitions and Characteristics

3.7.2 Requirements

3.8 MAC Complexity

To make the MBWA technology commercially feasible, it is necessary the complexity is minimized at the MAC, consistent with the goals defined for the technologies. This section defines complexity measures to be used in estimating MAC complexity.

3.8.1 Definition and Characteristics

3.8.2 Requirements

3.9 Mobility and the 802.20 MAC

As listed in the PAR, the 802.20 specification should provide robust communications under vehicular mobility conditions up to 250 Km/hr. This section seeks to parameterize this requirement and to derive MAC layer requirements to meet the goal of a robust air interface in these mobility conditions.

3.9.1 Definitions and Characteristics

3.9.2 Requirements

4.0 Physical Layer

4.1 Channelization and Spectral Masks

In this section it is necessary to define exact bands below 3.5 Ghz, and the operation intended in these bands (FDD, TDD) for MBWA. A brief description of the service anticipated in each band, and any regulatory requirements such as EIRP, etc should be fully described.

4.1.1 Definitions and Characteristics

4.1.2 Requirements

4.2 Spectral Efficiency

The 802.20 PAR indicates that the MBWA technology shall have a much greater spectral efficiency than “existing systems”. This section defines the fundamentals of Spectral Efficiency in terms of “achievable” and “maximum” spectral efficiency and the necessary requirements for the concept of “much greater.”

4.2.1 Definition and Characteristics

4.2.2 Requirements

4.3 Data Rate Requirements

This Section is devoted to defining data rate requirements and the conditions under which candidate technologies should meet these. PAR statements on bit rate indicate that data rates should be “significantly greater” than existing

technologies. This section defines bit rate requirements in greater details, including range, SAP definitions of bit rates, and the range and conditions under which these are measured.

4.3.1 Cell-Wide (Aggregate) Data Rates and Capacity

4.3.1.1 Definitions and Characteristics

4.3.1.2 Requirements

4.3.2 Per Mobile Station Data Rates

4.3.2.1 Peak Mobile Station Data Rate

4.3.2.1.1 Definitions and Characteristics

4.3.2.1.2 Requirements

4.3.2.2 Achievable Mobile Station Data Rate

4.3.2.2.1 Definitions and Characteristics

4.3.2.2.2 Requirements

4.3.2.3 Average Mobile Station Data Rate

4.3.2.3.1 Definition and Characteristics

4.3.2.3.2 Requirements

4.4 Channel Models for MBWA

This section defines channel models to be considered for MBWA. Several different channel conditions have been mentioned in meetings, including ITU-R M.1031. M.1031 codifies channel models for SISO technologies; however as MBWA is anticipated to encompass MIMO technologies as well, channel definitions for MIMO systems should also be specified here.

4.4.1 SISO Channel Models for MBWA

4.4.1.1 Definition and Characteristics

4.4.1.2 Requirements

4.4.2 MIMO Channel Models for MBWA

4.4.2.1 Definition and Characteristics

4.4.2.2 Requirements

4.5 Power Consumption

The MBWA technology should be economical of power, since portable devices are envisioned. This section should describe power consumption requirements, and required power management features for the proposed technologies.

Proposals should indicate the possible power management actions that can be initiated. Furthermore, the proposers should provide text including a table that indicates the number of power save levels offered and how much power each level saves.

4.5.1 Definition and Characteristics

4.5.2 Requirements

4.6 Complexity Estimates

To make the MBWA technology commercially feasible, it is necessary the complexity is minimized, consistent with the bit rate and spectral efficiency goals. This section defines complexity measures to be used in estimating PHY complexity.

4.6.1 Definition and Characteristics

4.6.2 Requirements

4.7 Mobility and 802.20

802.20 is targeted at full vehicular mobility, which means mobility in excess of 250 Km/hour. To achieve this it is necessary to set some performance requirements on they Physical Layer so as to be robust up to this speed. This section attempts to define basic parameters and requirements in this area.

4.7.1 Definition and Characteristics

4.7.2 Requirements

5.0 Coexistence and Interference Resistance

Since MBWA technology will be operative in licensed bands some of which are currently being utilized by other technologies, it is important that coexistence and interference issues be considered from the outset, unlike the situation in unlicensed spectrum where there is much more freedom of design.

Interference can be grouped as co-channel and adjacent channel interference; evaluation of all combinations of technologies likely to be encountered should be part of the 802.20 process. Furthermore, 802.20 technology is described in the PAR to encompass both TDD and FDD techniques. These should be evaluated separately, and requirements provided below.

5.1 Coexistence Scenarios

5.1.1 FDD Deployments

In this section, scenarios should be developed with 802.20 deployed as FDD, following the FDD "rules" for each of the 2G and 3G technologies likely to be encountered in practice.

5.1.1.1 802.20 and AMPS

5.1.1.2 802.20 and IS-95

- 5.1.1.3 802.20 and GSM
- 5.1.1.4 802.20 and LMR
- 5.1.1.5 802.20 and CDMA2000
- 5.1.1.6 802.20 and WCDMA
- 5.1.1.7 802.20 and 1xEVDO
- 5.1.1.8 802.20 and HSDPA
- 5.1.1.9 802.20 and 1xEV/DV

5.1.2 TDD Deployments

In this section, scenarios should be developed with 802.20 deployed as TDD, following any TDD “rules” for each of the 2G and 3G technologies likely to be encountered in practice. Since the majority of existing technologies are deployed as FDD solutions, some new ground is being explored here, and it will be necessary to make sure that the 802.20 technology will not seriously impact the existing services.

- 5.1.2.1 802.20 and AMPS
- 5.1.2.2 802.20 and IS-95
- 5.1.2.3 802.20 and GSM
- 5.1.2.4 802.20 and LMR
- 5.1.2.5 802.20 and CDMA2000
- 5.1.2.6 802.20 and WCDMA
- 5.1.2.7 802.20 and 1xEVDO
- 5.1.2.8 802.20 and HSDPA
- 5.1.2.9 802.20 and 1xEV/DV

5.2 Adjacent Channel Interference

- 5.2.1 Definitions and Characteristics
- 5.2.2 Requirements

5.3 Co-channel Interference

- 5.3.1 Definitions and Characteristics
- 5.3.2 Requirements

5.4 TDD Interference in Traditionally FDD Bands

Since 802.20 is listed as being both TDD and FDD, it should be evaluated in a scenario where TDD 802.20 technology is deployed in a traditionally FDD frequency band. 802.20 should develop appropriate scenarios and requirements so that the new technology meets all necessary coexistence requirements that may be placed upon it.

- 5.1.1 Definition and Characteristics
- 5.1.2 Requirements