IEEE P 802.20™ V9

Date: November 5, 2003

Draft 802.20 Permanent Document

<802.20 Requirements Document – Ver. 9>

This document is a Draft Permanent Document of IEEE Working Group 802.20. Permanent Documents (PD) are used in facilitating the work of the WG and contain information that provides guidance for the development of 802.20 standards. This document is work in progress and is subject to change.

Contents

1 Overview (Closed)

1.1 Scope (Closed)

This document defines system requirement for the IEEE 802.20 standard development project. These requirements are consistent with the PAR (IEEE SA Project Authorization Request) document (see section 1.3 below) and shall constitute the top-level specification for the 802.20 standard. For the purpose of this document, an "802.20 system" constitutes an 802.20 MAC and PHY implementation in which at least one Mobile station communicates with a base station via a radio air interface, and the interfaces to external networks, for the purpose of transporting IP packets through the MAC and PHY protocol layers.

1.2 Purpose (Closed)

This document establishes the detailed requirements for the Mobile Broadband Wireless Access (MBWA) systems. How the system works is left to the forthcoming 802.20 standard, which will describe in detail the interfaces and procedures of the MAC and PHY protocols.

1.3 PAR Summary (Closed)

The scope of the PAR (listed in Item 12) is as follows:

"Specification of physical and medium access control layers of an air interface for interoperable mobile broadband wireless access systems, operating in licensed bands below 3.5 GHz, optimized for IP-data transport, with peak data rates per user in excess of 1 Mbps. It supports various vehicular mobility classes up to 250 Km/h in a MAN environment and targets spectral efficiencies, sustained user data rates and numbers of active users that are all significantly higher than achieved by existing mobile systems."

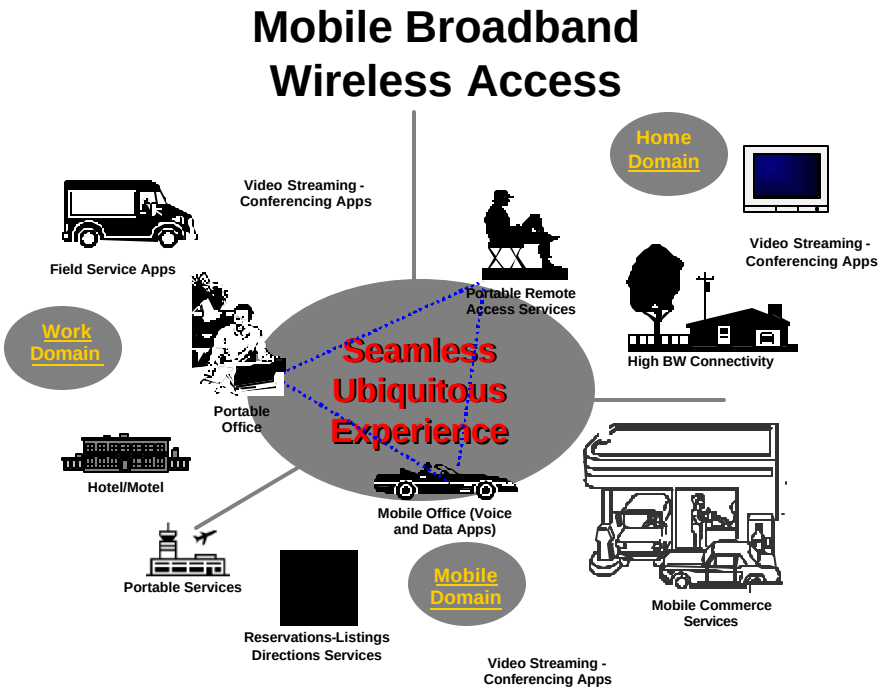
In addition, a table (provided in Item 18) lists "additional information on air interface characteristics and performance targets that are expected to be achieved."

Characteristic	***Target Value***
Mobility	*Vehicular mobility classes up to 250 km/hr (as defined in ITU-R M.1034-1)*
Sustained spectral efficiency	*> 1 b/s/Hz/cell*
Peak user data rate (Downlink (DL))	*> 1 Mbps**
Peak user data rate (Uplink (UL))	*> 300 kbps**

Peak aggregate data rate per cell (DL)	*> 4 Mbps**
Peak aggregate data rate per cell (UL)	*> 800 kbps**
Airlink MAC frame RTT	*< 10 ms*
Bandwidth	*e.g., 1.25 MHz, 5 MHz*
Cell Sizes	*Appropriate for ubiquitous metropolitan area networks and capable of reusing existing infrastructure.*
Spectrum (Maximum operating frequency)	*< 3.5 GHz*
Spectrum (Frequency Arrangements)	*Supports FDD (Frequency Division Duplexing) and TDD (Time Division Duplexing) frequency arrangements*
Spectrum Allocations	*Licensed spectrum allocated to the Mobile Service*
Security Support	*AES (Advanced Encryption Standard)*

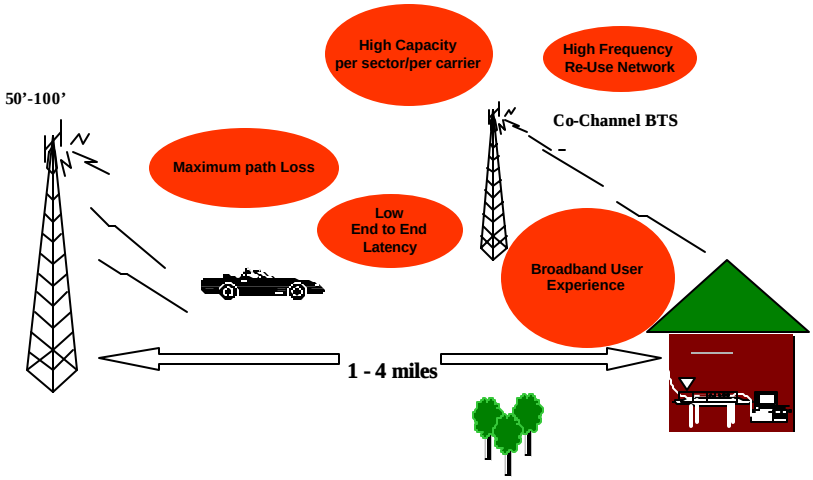
** Targets for 1.25 MHz channel bandwidth. This represents 2 x 1.25 MHz (paired) channels for FDD and a 2.5 MHz (unpaired) channel for TDD. For other bandwidths, the data rates may change.*

2 Overview of Services and Applications (Closed)



The 802.20 Air-Interface (AI) shall be optimized for high-speed IP-based data services operating on a distinct data-optimized RF channel. The AI shall support compliant Mobile Terminal (MT) devices for mobile users, and shall enable improved performance relative to other systems targeted for wide-area mobile operation. The AI shall be designed to provide best-in-class performance attributes such as peak and sustained data rates and corresponding spectral efficiencies, system user capacity, air- interface and end-to-end latency, overall network complexity and quality-of-service management. Applications that require the user device to assume the role of a server, in a server-client model, shall be supported as well.

Applications: The AI all shall support interoperability between an IP Core Network and IP enabled mobile terminals and applications shall conform to open standards and protocols. This allows applications including, but not limited to, full screen video, full graphic web browsing, e-mail, file upload and download without size limitations (e.g., FTP), video and audio streaming, IP Multicast, Telematics, Location based services, VPN connections, VoIP, instant messaging and on- line multiplayer gaming.



Always on: The AI shall provide the user with "always-on" connectivity. The connectivity from the wireless MT device to the Base Station (BS) shall be automatic and transparent to the user.

2.1 Voice Services (Closed)

The MBWA will support VoIP services. QoS will provide latency, jitter, and packet loss required to enable the use of industry standard Codec's.

2.2 Broadcast/Multicast Support (Closed)

The AI shall support broadcast and multicast services

3 System Reference Architecture (open)

3.1 System Architecture (open)

The 802.20 systems must be designed to provide ubiquitous mobile broadband wireless access in a cellular architecture. The system architecture must be a point to multipoint system that works from a base station to multiple devices in a non-line of sight outdoor to indoor scenario. The system must be designed to enable a macro-cellular architecture with allowance for indoor penetration in a dense urban, urban, suburban and rural environment.

Editors Note Diagram in Appendix B
Action: Change the notations in the bubbles to point to the relevant section of the text (or remove the bubbles).

The AI shall support a layered architecture and separation of functionality between user, data and control. The AI must efficiently convey bi-directional packetized, bursty IP traffic with packet lengths and packet train temporal behavior consistent with that of wired IP networks. The 802.20 AI shall support high-speed mobility.

Comment: *Editors note:* Suggestion from 9/16/03 Conference call. See meeting minutes for details

3.1.1 MBWA System Reference Architecture (open)

Adopting current communications systems specification principles, 802.20 MBWA systems will be specified using a layered architecture. The 802.20 standards, in conjunction with other 802 standards, will specify the services to be delivered by layers 1 and 2 to an IP based layer 3 or a switching layer, e.g. PPP, MPLS. To facilitate a layered approach, the 802.20 specification shall incorporate a reference partitioning model consisting of Layers 1 and 2. This layered approach shall be generally consistent with other IEEE 802 standards and shall remain generally within the scope of other IEEE 802 standards as shown in figures 1 & 2. The 802.20 standard shall also address the needs of logical link control and how and when the 802.2 LLC functionality is used. The 802.20 standards include PHY and MAC layer specifications with a well-defined service interface between the PHY and MAC layer. To provide the best possible performance, the MAC layer design may be optimized for the specific characteristics of the air interface PHY. Figure 2 shows the relationship of various 802 PHY and MAC layer standards to other 802 architectural components. The 802.20 standards shall clarify how 802.20 fits into this architecture.

Comment: *Editors note:* Suggestion from 9/16/03 Conference call. See meeting minutes for details

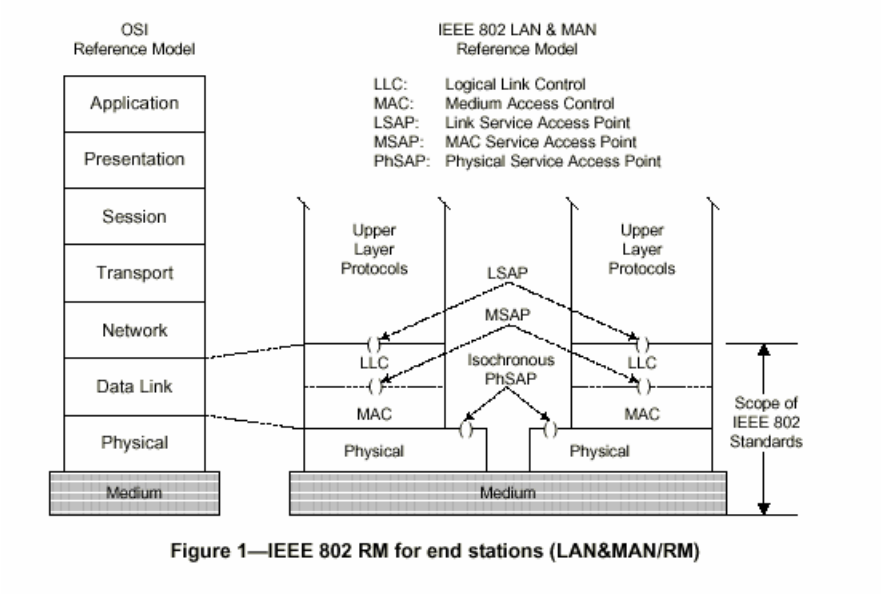


Figure 1—IEEE 802 RM for end stations (LAN&MAN/RM)

Figure 3.1

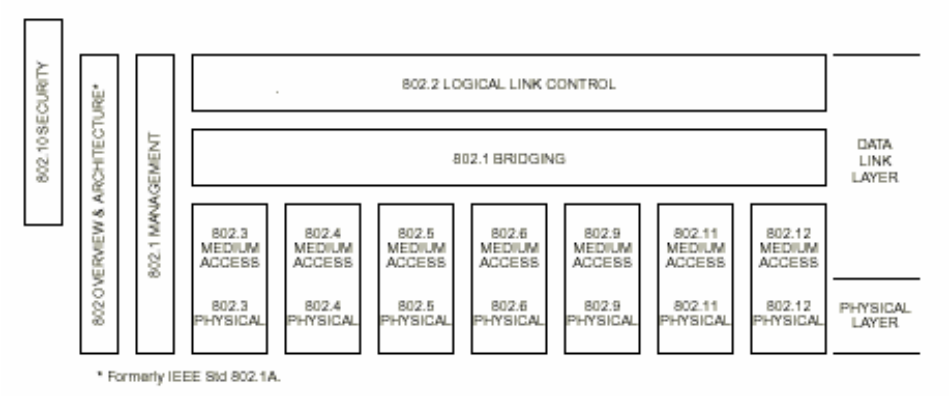


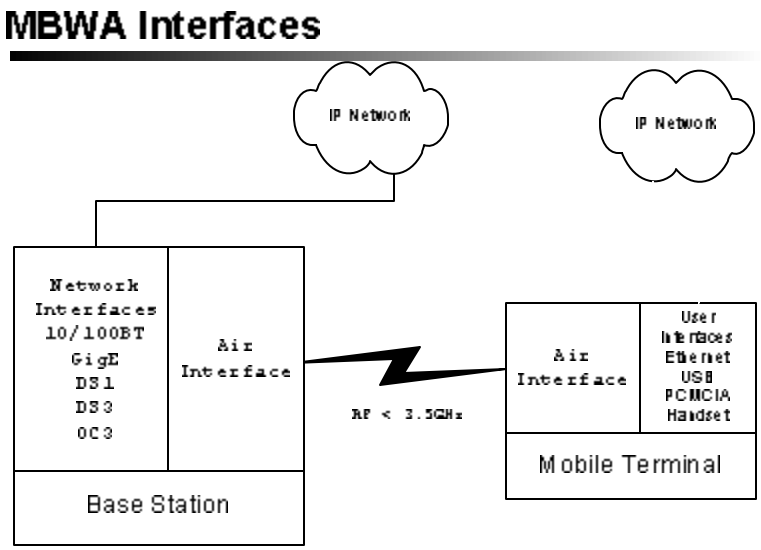
Figure 2

3.1.2 Layer 1 to Layer 2 Inter-working (Closed)

The interface between layers 1 and 2 is not an exposed interface; it may be handled at the implementer's discretion.

3.2 Definition of Interfaces (Closed)

Open interfaces: The AI shall support open interfaces between the base station and any upstream network entities. Any interfaces that may be implemented shall use IETF protocols as appropriate. Some of the possible interfaces are illustrated below.



4 Functional and Performance Requirements (open)

4.1 System (open)

4.1.1 System Gain (Closed)

Comment: *Editors note: this section closed on 10/16/03 conference call. The definition of system gain is repeated in Appendix A.*

4.1.2 Spectral Efficiency (bps/Hz/sector) (open)

Sustained spectral efficiency is computed in a loaded multi-cellular network setting. It is defined as the ratio of the expected aggregate throughput (taking out all PHY/MAC overhead) to all users in an interior cell divided by the system bandwidth. The sustained spectral efficiency

calculation shall assume that users are distributed uniformly throughout the network and shall include a specification of the minimum expected data rate/user.

[Downlink > 2 bps/Hz/sector**]**

[Uplink >1 bps/Hz/sector**]**

4.1.3 Support for Different Block Assignments (open)

The AI shall support deployment of 802.20 systems in the following sized block assignments:

FDD Assignments	2 x 1.25 MHz 2 x 5 MHz 2 x 10 MHz 2 x 20 MHz
TDD Assignments	2.5 MHz 5 MHz 10 MHz 20 MHz 40 MHz

The individual 802.20 AI proposals may optimize their MAC and PHY designs for specific bandwidth and Duplexing schemes.

4.1.4 Duplexing (open)

The AI shall support both Frequency Division Duplexing (FDD) and Time Division Duplexing (TDD).

4.1.5 Mobility (Closed)

The AI shall support different modes of mobility from pedestrian (3 km/hr) to very high speed (250 km/hr). As an example, data rates gracefully degrade from pedestrian speeds to high speed mobility.

4.1.6 Aggregate Data Rates – Downlink & Uplink (open)

[The aggregate data rate for downlink and uplink shall be consistent with the spectral efficiency. An example of a 5MHz FDD channel is shown in Table 1 below.

Description	Downlink	Uplink

Comment: Michael Youssefmir from Arraycomm asked the previous two tables be stricken. Khurram Sheikh contributed the fo llowing table for 5 MHz channels in line with the spectral efficiency above. Kei Suzuki believes the numbers were not reflective of the Par. Shall the PAR be minimums?

Outdoor to Indoor Expected Aggregate Data Rate	> 10 Mbps/Sector	> 5Mbps/Sector

TDD Aggregate Data Rate Example 16QAM Weighted

Description	Downlink	Uplink
Outdoor to Indoor Expected Aggregate Data Rate	> 10 Mbps/Sector	> 5Mbps/Sector

Editors Note: The following text should be rewritten, needs to be written as a requirement that can be considered in lieu of the above.

[Regarding Average Aggregate Data Rage specification definition, I would like to raise simple question.

Currently, Description of Rev.5 (DL: 10Mbps / UL 5Mbps) and new proposal from Mr. Bill Young (DL:7 Mbps / UL 4 Mbps) is not same ratio of Downlink and Uplink as PA peak user data rate and Peak aggregate data rate per cell

PAR peak data rate DL:UL > 1Mbps : >300Kbps = 10 :3

PAR aggregate data rate DL:UL > 4Mbps : >800Kbps = 10 : 2

Requirements Rev.5 Average Aggregate data rate >10Mbps : > 5 Mbps = 10 : 5

New proposal from Mr. Bill young DL:UL > 7Mbps : > 4 Mbps = 10 : 6

To respect peak data rate in PAR and in Rev. 5 description, I think we may need to keep same ratio of DL and UL because it is difficult to explain this unbalance description between peak data rate and Average Aggregate data rate

Average Aggregate Data Rage DL: UL = 10 Mbps: 3 Mbps or 7Mbps : 2.1 Mbps]

Comment: <Submitted Bill Young 7/22/03>

Comment: Action: Remove this table.

Rationale: The sustained spectral efficiency is defined as >1 b/s/Hz/sector in the PAR, so that the expected aggregate data rates should be >5 Mbps/sector. Hence, the numbers in this table are not consistent with the numbers in the PAR. This issue of expected aggregate data rates should be addressed in the evaluation criteria.

Comment: Action: Remove the sentence "Average user data rates in a loaded system shall be in excess of 512Kbps downlink and 128Kbps uplink. This shall be true for 90% of the cell coverage or greater."

Rationale: These expected per-user data rates are ill-defined because as discussed on 7/23/03 they depend on the overall combination of coverage and aggregate capacity and system deployment. Expected per-user rates are not an intrinsic characteristic of the system. This issue of expected per-user data rates should be addressed in the evaluation criteria. <John Fan 7/23/03> ... [1]

Comment: Can you expand on why you specify the per user data rates in terms of a specific modulation bandwidth? Why not specify the throughput without the bandwidth constraint?

<Walter Rausch 7/31/03>

4.1.6.1 User Data Rates - Downlink & Uplink (Closed)

The AI shall support peak per-user data rates in excess of 1 Mbps on the downlink and in excess of 300 kbps on the uplink. These peak data rate targets are independent of channel conditions, traffic loading, and system architecture. The peak per user data rate targets are less than the peak aggregate per cell data rate to allow for design and operational choices.

Average user data rates in a loaded system shall be in excess of 512Kbps downlink and 128Kbps uplink. This shall be true for 90% of the cell coverage or greater.

4.1.7 Number of Simultaneous Active Users (open)

The system should support > 100 simultaneous active users per carrier. An active user is a terminal that is registered with a cell and is using or seeking to use air link resources to receive and/or transmit data within a short time interval (e.g., within 50 or 100 ms).

Comment: 4.1.8 "Number of Simultaneous Sessions" the author quotes a number ">100". We need further qualification on that number. I see MAC having two types of traffic. One that is time critical (Voice/streaming) and one that can accept delays (data). So are we saying > 100 voice or > 100 of some combination. If it is some combination, we need to specify what the ratio is.
< Comment by Alan Chickinsky 8/7/2003>

4.1.8 Latency (open)

The AI shall minimize the round-trip times (RTT) and the variation in RTT for acknowledgements, within a given QoS traffic class. The RTT over the airlink for a MAC data frame is defined here to be the duration from when a data frame is received by the physical layer of the transmitter to the time when an acknowledgment for that frame is received by the transmitting station. The airlink MAC frame RTT, which can also be called the "ARQ loop delay," shall be less than 10 ms. Fast acknowledgment of data frames allows for retransmissions to occur quickly, reducing the adverse impact of retransmissions on IP packet throughput. This particularly improves the performance of gaming, financial, and other real-time low latency transactions.

Comment: Rationale: This is attempting to reflect the latency for applications, which may be better to evaluate in the evaluation criteria, since it will depend on traffic models, QoS of individual users and load conditions. It is appropriate to specify latency from the time that a packet is delivered from the transmitting-side MAC until the time that it is received at the receiving side MAC. This is reflected in the second paragraph describing the ARQ loop delay.
<John Fan 7/23/03>

4.1.9 Frame Error Rate (OPEN)

The air interface shall support two modes of operation, one for delay sensitive applications and one for error sensitive applications.

Note to Evaluation Criteria Group: The evaluation criteria shall require demonstration of the frame error rate for error sensitive modes. The evaluation criteria shall require demonstration of the latency for delay sensitive modes.

4.1.10 Support for Multi Antenna Capabilities (Closed)

Interconnectivity at the PHY/MAC will be provided at the Base Station and/or the Mobile Terminal for advanced multi antenna technologies to achieve higher effective data rates, user capacity, cell sizes and reliability. As an example, MIMO.

4.1.11 [Antenna Diversity (open)

Editors Note: there are two versions of this section and there are numerous proponents for deleting this section.

At a minimum, both the Base Station and the Mobile Terminal shall provide two element diversity. Diversity may be an integral part of an advanced antenna solution.]

[Delete section]

[The Base Station shall provide antenna diversity. Diversity may be an integral part of an advanced antenna solution. Antenna diversity shall not be a requirement of the mobile station.]

[The base station shall provide support for multiple antenna processing]

4.1.12 Support for the use of Coverage Enhancing Technologies (Closed)

The system shall support the use of coverage enhancing technologies.

4.1.13 [Best Server Selection (open)

In the presence of multiple available Base Stations, the system PHY/MAC will select the best server based upon system loading, signal strength, capacity and tier of service. Additional weighting factors may also include back haul loading and least cost routing.]

[*Editors note: proposal to delete section*]

4.1.14 QoS (open)

The AI shall support the means to enable end-to-end QoS within the scope of the AI and shall support a Policy-based QoS architecture. The resolution of QoS in the AI shall be consistent with the end-to-end QoS at the Core Network level. The AI shall support IPv4 and IPv6 enabled QoS resolutions. The AI shall support efficient radio resource management (allocation, maintenance, and release) to satisfy user QoS and policy requirements

4.1.15 Network Security (Closed)

Network security in MBWA systems shall protect the service provider from theft of service, the user's privacy and mitigate against denial of service attacks. Provision shall be made for authentication of both base station and mobile terminal, for privacy, and for data integrity consistent with the best current commercial practice. 802.20 security is expected to be a partial

Comment: Support for multiple antenna capability is described section 4.1.11.
Section 4.1.12 defines a minimum antenna number for
Base Station and Mobile Terminal.
There is a contradiction between 4.1.11 and 4.1.12.
Only section 4.1.11 description is enough for multiple antenna capability I
think.
And the antenna number of Mobile Terminal should not be defined in the ... [2]

Comment: I have to disagree with your notion of not putting a minimum requirement on antenna diversity. Current generation systems have these capabilities in the pipeline, so it seems very illogical not to ... [3]

Comment: Rationale: This requirement is a vendor specific implementation requirement, and not related to the MAC/PHY Also this material was not introduced with a rationale. In fact, Rev3 of the document contained the text ... [4]

Comment: Rationale: This requirement is a vendor specific implementation requirement, and not related to the MAC/PHY Also this material was not introduced with a rationale. In fact, Rev3 of the document conta ... [5]

Comment: Consensus text from the 10/23/03 conference call.

Comment: Rationale: This material was not introduced with a rationale.
<John Fan 7/23/03>

I agree with Fan John's comment on July 24 as follows.
... [6]

solution complemented by end-to-end solutions at higher protocol layers such as EAP, TLS, SSL, IPSec, etc.

4.1.15.1 Access Control (Closed)

Access control shall be provided using a cryptographic method.

4.1.15.2 Privacy Methods (Closed)

A method that will provide message integrity across the air interface to protect user data traffic, as well as signaling messages from unauthorized modification will be specified.

Encryption across the air interface to protect user data traffic, as well as signaling messages, from unauthorized disclosure will be incorporated.

4.1.15.3 User Privacy (Closed)

The system will prevent the unauthorized disclosure of the user identity.

4.1.15.4 Denial of Service Attacks (Closed)

It shall be possible to prevent replay attacks by minimizing the likelihood that authentication signatures are reused.

It shall be possible to provide protection against Denial of Service (DOS) attacks.

4.1.15.5 Security Algorithm (Closed)

The authentication and encryption algorithms shall be publicly available on a fair and non-discriminatory basis.

National or international standards bodies shall have approved the algorithms.

The algorithms shall have been extensively analysed by the cryptographic community to resist all currently known attacks.

4.2 PHY/RF (open)

4.2.1 Receiver sensitivity (Closed)

Blocking and selectivity specifications shall be consistent with best commercial practice for mobile wide-area terminals.

4.2.2 Link Adaptation and Power Control (closed)

Comment: Closed on 10/9/03 Conference call

The AI shall support automatic selection of optimized user data rates that are consistent with the RF environment constraints and application requirements. The AI shall provide for graceful

reduction or increasing user data rates, on the downlink and uplink, as a mechanism to maintain an appropriate frame error rate performance.

Link adaptation shall be used by the AI for increasing spectral efficiency, data rate, and cell coverage reliability. The AI shall support adaptive bandwidth allocation, and adaptive power allocation. The system will have adaptive modulation and coding in both the uplink and the downlink

4.2.3 Performance under Mobility & Delay Spread (open)

The system is expected to work in dense urban, suburban and rural outdoor-indoor environments and the relevant channel models shall be applicable. The system shall NOT be designed for indoor only and outdoor only scenarios. The system should support a delay spread of at least 5 micro-seconds.

4.2.4 Duplexing – FDD & TDD (Closed)

The 802.20 standard shall support both Frequency Division Duplex (FDD) and Time Division Duplex (TDD) frequency arrangements.

4.2.5 Synchronization (Closed)

The air interface shall support downlink synchronization and uplink synchronization. Synchronization between Base Stations is optional.

Editors Note: See contribution C802.20-03/84 presented at the Singapore WG session.

4.2.6 Measurements (Open)

The system shall support the functionality of measurements in the physical layer of both the network and the mobile terminal sides. The physical layer provides a set of measurement capabilities that include different types, for instance, such as intra-frequency, inter-frequencey, inter-system, quality measurements, etc.

4.3 Spectral Requirements (Closed)

The system shall be targeted for use in TDD and FDD licensed spectrum allocated to mobile services below 3.5GHz. The AI shall be designed for deployment within existing and future licensed spectrum below 3.5 GHz. The MBWA system frequency plan shall include both paired and unpaired channel plans with multiple bandwidths, e.g., 1.25 or 5 MHz, etc., to allow co-deployment with existing cellular systems. Channel bandwidths are consistent with frequency plans and frequency allocations for other wide-area systems

The design shall be readily extensible to wider channels as they become available in the future.

Comment: **Rationale**

From my experience, the max. delay spread value is an essential requirement.

The specific proposed value is resonable, and I would like to see it reflected by the Channel models.

<Marianna Goldhammer 7/30/03>
Marianna, I do not wish to imply that there should not be numbers in the Requirements document. I believe that we have a fine line to walk in Evaluating each of the proposed requirements to make sure that
(a) It is a requirement on the PHY or MAC layer, and not an upper layer Requirement, and
(b) It is a primary requirement for a system which will lead to a successful Standard and successful products, as opposed to a secondary requirement derived from some primary requirement but directed toward a specific Implementation.
or (c) the requirement is necessary for interoperability.

Note that requirements that really belong to the upper layers may be translated into requirements for capabilities at the MAC or PHY layers to support those upper layer capabilities. An example might be a special address in the frame format that is required by the upper layers t... [7]

Comment: *Editors Note: Source Refelctor - Jin-Weon Chang [jwchang1@samsung.com] on 10/23/03*

4.4 Layer 2 MAC (Media Access Control) (open)

4.4.1 Quality of Service and the MAC (Open)

802.20 protocols shall provide mechanisms for quality of service (QOS). The 802.20 protocol standards shall define the interfaces and procedures that facilitate the configuration and enforcement of QoS policies, which operators may choose to implement.

The 802.20 air interface shall support the IETF Differentiated Services (DS) Architecture to be compatible with other IP network standards including IP mobile standards. To this end, 802.20 shall support the standard DiffServ QoS model. Some of the forwarding behaviors that should be supported by 802.20 include: Expedited Forwarding (EF), Assured Forwarding (AF), and Best Effort (BE) DS per Hop Behaviors (PHBs) as defined by the RFC 2597 and RFC 2598. 802.20 shall also support configuration of the PHBs by a DS API that shall be based on a subset of the information model defined in RFC 3289.

Service and QoS Mapping

The classes of service and QoS parameters of all services may be translated into a common set of parameters defined by 802.20. A QoS based IP network may employ the Resource Reservation Protocol (RSVP) to signal the allocation of resources along a routed IP path.

4.5 Layer 3+ Support (open)

The system must support both IPv4 and IPv6.

4.5.1 Handoff Support (Closed)

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.

Editors Note: Sections 4.5.1.1 to 4.5.1.4 were closed and deleted because there were no submissions.

4.5.1.1 IP-Level Handoff (open)

[Delete requirement]

Comment: Kei Suzuki Asked this be removed. Sprint would like it to be considered even though it is above level 2.

[In supporting high speed mobility in an all IP network, the MBWA air interface shall be designed in a manner that does not preclude the use of MobileIP or of SimpleIP for the preservation of IP session state as a subscriber's session is handed over from one base station or sector to another. Multiple IP addresses behind one terminal may also be supported.]

Comment: Version by Michael Youssefmir

4.5.2 802.1Q tagging (open)

Editors Note: This section is proposed for deletion because this is tied a specific network architecture.

[802.1Q tagging must be supported by the system (such that network egress traffic can be switched by a L2 device to the appropriate L2 termination device for managing backbone traffic or distinguishing traffic for wholesale partners in a wholesale environment).]

Comment: Given the unspecified nature of the network architecture in which a .20 air-interface would plug in and the number of ways by which different users' traffic can be partitioned at Base Stations/other elements in the network infrastructure, its not clear if specifically using 802.1Q VLAN tags ought to be a requirement, particularly a binding one. So I would second Mike'e suggestion to not have it so. Regarding software push, software loads etc, since these pertain more generally to the management/admin of the user terminal and not to the desired behavior of the MAC/PHY itself, we should not be specifying them in this requirements document. Regards,
<Samir 8/3/03>

4.5.3 CPE software upgrade "push" (Closed)

CPE software upgrade "push" – an operator should have the ability to "push" a software upgrade to CPE that are currently connected to the network. The packets that make up the software image should be given a very high priority and should be coded heavily such that they have a very high chance of arriving error free at the CPE. The CPE should be capable of holding 2 software loads (the existing one and a new one) such that an operator can ensure that the "new" software load has arrived safely at the CPE before deciding to switch from the "old" software load to the "new" software load.

Comment: Rationale
It is very important for operators to be able to manage traffic on the backbone for different customer types (business vs. residential) or to enter into wholesale arrangements whereby the wholesale partner provides the CPE to the end user, but the network is owned and maintained by the operator. In this scenario, the operator needs to have the ability to separate traffic from CPE belonging to each wholesale partner and direct that traffic to each wholesale partner independently.
It is very important (particularly during the early deployment stage) that operators have the ability to "push" out new software loads to CPE quickly and efficiently to ensure network element software upgrades can efficiently coincide with user CPE software upgrades.
<Neka Hicks 7/29/03

4.5.4 OA&M Support (Open)

The air interface will provide necessary infrastructure in order for a network operator to monitor the performance of the 802.20 air interface.

Editors Note: The following parameters should be considered for inclusion. Comments are solicited as to which parameters should be included in the basic requirements. Parameters not receiving support will be deleted.

[The following values must be made available in real-time with redisplay intervals of no less than 1000 msecs, with the option to be displayed in both cumulative and delta modes:

- Aggregate base station bytes served at each coding/modulation configuration
- Correctable and uncorrectable block errors
- Identity of specific Mobile Stations which exhibit a higher than average packet error rate
- PHY/MAC/NET based usage consumption statistics per Mobile Station
- Successful and failed service requests for both up and downlink directions
- Unique number of active Mobile Stations, as well as which specific stations are active, for both up and downlink directions
- Number of ungraceful session disconnections
- Signal strength per user (UL and DL)

- Interference level or C/I per user (UL and DL)
- Bit Error Rate per user (UL and DL) for both traffic and signaling information
- Aggregate percent resource space utilization (UL and DL) per sector. Resource space should include time slots, codes, tones, etc.
- ID of sector serving each user
- Effective Noise Floor seen at the BTS (should rise with increased levels of interference)
- Effective Throughput per user (DL/UL)
- Interface statistics (RFC1213); SNMP OID group 1.3.6.1.2.1.2.2

These statistics should be made available via the SNMP (Simple Network Management Protocol) standard. It is recommended that these statistics also be available using an EMS developed by each specific vendor.**]**

Comment: Rationale
These statistics will need to be available for an operator to have the appropriate amount of visibility into network and customer related problems. The statistics need to be made available using the SNMP standard so that any SNMP based network management solution may be used to gather such statistics.
<Neka Hicks 7/29/03>

4.5.5 MAC Complexity Measures (open)

[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.**]**

[Delete this section**]**

Comment: Reason: MAC complexity measures should not be addressed by this requirements document. Our driving goal must be to achieve the performance of the PAR. Complexity measures even, if they could be articulated in this document, are not relevant when compared to the overriding goal of achieving performance for data.
<John Fan 7/23/03>

4.5.6 Call Blocking (Open)

Editor's note: This section is proposed for deletion because it is viewed as already being included in section 4.4.1.

[When the bandwidth required for a call cannot be reserved, the system will provide signaling to support call blocking.**]**

[No sentence**]**

Comment: Rationale: The sentence related to call blocking should be removed because call blocking is an application layer specific issue. The Requirements document should specify the classes of supported QoS, but application-specific exception handling should not be included in the document.

Call blocking or other exception handling techniques should be handled at a higher layer for any application t... [8]

[When MAC/PHY resources cannot be allocated to support the QOS characteristics defined as "high priority bandwidth reserved" are not available the MAC/PHY API will provide messaging to the higher layer to support blocking. Example VOIP allowing the higher layer application to provide a busy signal blocking the call and providing feedback. The QOS must allow the assignment of specific resources to the QOS class so that the MAC/PHY may make this determination.**]**

Comment: Reasoning
Certain types of traffic like VOIP, Streaming Video, etc. require committed resources to function correctly. It is important that the MAC/PHY have the ability to support them at a higher layer. The QOS section needs to be able to provide bandwidth
<David McGinniss 8/6/03>

4.6 Scheduler (Closed)

The AI specification shall not preclude proprietary scheduling algorithms, so long as the standard control messages, data formats, and system constraints are observed.

4.7 User State Transitions (Closed)

The AI shall support multiple protocol states with fast and dynamic transitions among them. It will provide efficient signaling schemes for allocating and de-allocating resources, which may include logical in-band and/or out-of-band signaling, with respect to resources allocated for end-user data. The AI shall support paging polling schemes for idle terminals to promote power conservation for MTs.

4.8 Resource Allocation (Closed)

The AI shall support fast resource assignment and release procedures on the uplink and Duplexing – FDD & TDD

5 References (open)

- 802.20 - PD-02: Mobile Broadband Wireless Access Systems: Approved PAR (02/12/11)
- 802.20 - PD-03: Mobile Broadband Wireless Access Systems: Five Criteria (FINAL) (02/11/13)
- C802.20-03/45r1: Desired Characteristics of Mobile Broadband Wireless Access Air Interface (Arif Ansari, Steve Dennett, Scott Migaldi, Samir Kapoor, John L. Fan, Joanne Wilson, Reza Arefi, Jim Mollenauer, David S. James, B. K. Lim, K. Murakami, S. Kimura (2003-05-12))
- C802.20-03/47r1: Terminology in the 802.20 PAR (Rev 1) (Joanne Wilson, Arif Ansari, Samir Kapoor, Reza Arefi, John L. Fan, Alan Chickinsky, George Iritz, David S. James, B. K. Lim, K. Murakami, S. Kimura (2003-05-12))

Appendix A Definition of Terms and Concepts

- *Active users* - An active user is a terminal that is registered with a cell and is using or seeking to use air link resources to receive and/or transmit data within a short time interval (e.g., within 100 ms).

- *Airlink MAC Frame RTT* - The round-trip time (RTT) over the airlink for a MAC data frame is defined here to be the duration from when a data frame is received by the physical layer of the transmitter to the time when an acknowledgment for that frame is received by the transmitting station.

- Air Interface ("AI") –

    1. *The air interface is the radio-frequency portion of the transmission path between the wireless terminal (usually portable or mobile) and the active base station or access point.*

    2. *The air interface is the shared boundary between a wireless terminal and the base station or access point.*

-

- *Bandwidth or Channel bandwidth* - Two suggested bandwidths are 1.25 MHz and 5 MHz, which correspond to the bandwidth of one channel (downlink or uplink) for paired FDD spectrum.

- *Block Assignment* – A block assignment, which may include paired or unpaired spectrum, is the amount of licensed spectrum assigned to an individual operator.

- *Cell* - The term "cell" refers to one single-sector base station or to one sector of a base station deployed with multiple sectors.

- *Cell sizes* – The maximum distance from the base station to the mobile terminal over which an acceptable communication can maintained or before which a handoff would be triggered determines the size of a cell.

- *Frequency Arrangements* – The frequency arrangement of the spectrum refers to its allocation for paired or unpaired spectrum bands to provide for the use of Frequency-Division Duplexing (FDD) or Time-Division Duplexing (TDD), respectively. The PAR states that the 802.20 standard should support both these frequency arrangements.

- ***Frequency reuse*** - (N) is defined as the total number of sectors in a given configuration divided by the number of times that the same frequency is reused

- *Interoperable* – Systems that conform to the 802.20 specifications should interoperate with each other, e.g., regardless of manufacturer. (Note that this statement is limited to systems

Comment: *Editors note: This was the latest concrete proposal on the reflector that seemed to have some support.*

that operate in accordance with the same frequency plan. It does not suggest that an 802.20 TDD system would be interoperable with an 802.20 FDD system.)

- *Licensed bands below 3.5 GHz* – This refers to bands that are allocated to the Mobile Service and licensed for use by mobile cellular wireless systems operating below 3.5 GHz.

- *MAN* – Metropolitan Area Network.

- *Mobile Broadband Wireless Access systems* – This may be abbreviated as MBWA and is used specifically to mean "802.20 systems" or systems compliant with an 802.20 standard.

- *Optimized for IP Data Transport* – Such an air interface is designed specifically for carrying Internet Protocol (IP) data traffic efficiently. This optimization could involve (but is not limited to) increasing the throughput, reducing the system resources needed, decreasing the transmission latencies, etc.

- *Peak aggregate data rate per cell* – The peak aggregate data rate per cell is the total data rate transmitted from (in the case of DL) or received by (in the case of UL) a base station in a cell (or in a sector, in the case of a sectorized configuration), summed over all mobile terminals that are simultaneously communicating with that base station.

- *Peak data rates per user (or peak user data rate)* – The peak data rate per user is the highest theoretical data rate available to applications running over an 802.20 air interface and assignable to a single mobile terminal. The peak data rate per user can be determined from the combination of modulation constellation, coding rate and symbol rate that yields the maximum data rate.

- *Spectral efficiency* – Spectral efficiency is measured in terms of bits/s/Hz/cell. (In the case of a sectorized configuration, spectral efficiency is given as bits/s/Hz/ sector.)

- *Sustained spectral efficiency* – Sustained spectral efficiency is computed in a network setting. It is defined as the ratio of the expected aggregate throughput (bits/sec) to all users in an interior cell divided by the system bandwidth (Hz). The sustained spectral efficiency calculation should assume that users are distributed uniformly throughout the network and should include a specification of the minimum expected data rate/user.

- *Sustained user data rates* – Sustained user data rates refer to the typical data rates that could be maintained by a user, over a period of time in a loaded system. The evaluation of the sustained user data rate is generally a complicated calculation to be determined that will involve consideration of typical channel models, environmental and geographic scenarios, data traffic models and user distributions.

- *System gain* - ***is*** defined as the difference, in dB, between transmitter power output at the base station and the receiver threshold (sensitivity) at the mobile terminal.

- *Targets for 1.25 MHz channel bandwidth* – This is a reference bandwidth of 2 x 1.25 MHz for paired channels for FDD systems or a single 2.5 MHz channel for TDD systems. This is established to provide a common basis for measuring the bandwidth-dependent characteristics. The targets in the table indicated by the asterisk (*) are those dependent on the channel bandwidth. Note that for larger bandwidths the targets may scale proportionally with the bandwidth.

- *Various vehicular mobility classes* – Recommendation ITU-R M.1034-1 establishes the following mobility classes or broad categories for the relative speed between a mobile and base station:

    - Stationary (0 km/h),
    - Pedestrian (up to 10 km/h)
    - Typical vehicular (up to 100 km/h)
    - High speed vehicular (up to 500 km /h)
    - Aeronautical (up to 1 500 km/h)
    - Satellite (up to 27 000 km/h).

Page 13: [1] Comment **John Humbert** **9/19/2003 11:36 AM**

Action: Remove the sentence "Average user data rates in a loaded system shall be in excess of 512Kbps downlink and 128Kbps uplink. This shall be true for 90% of the cell coverage or greater."

Rationale: These expected per-user data rates are ill-defined because as discussed on 7/23/03 they depend on the overall combination of coverage and aggregate capacity and system deployment. Expected per-user rates are not an intrinsic characteristic of the system. This issue of expected per-user data rates should be addressed in the evaluation criteria.
<John Fan 7/23/03>

Page 15: [2] Comment **John Humbert** **9/19/2003 11:36 AM**

Support for multiple antenna capability is described section 4.1.11.
Section 4.1.12 defines a minimum antenna number for Base Station and Mobile Terminal.
There is a contradiction between 4.1.11 and 4.1.12.
Only section 4.1.11 description is enough for multiple antenna capability I think.
And the antenna number of Mobile Terminal should not be defined in the Requirements Document.
The important thing is the system performance with cost.

Thank you.
<Kimura Shigeru 8/7/2003

Dear Khurram-san

I consider many kinds of Mobile Terminals.

Some kinds of mobile terminal will not require to achieve high performance up to 250km/h.

High end terminal will have two or more antenna diversity to achieve high performance up to 250Km/h.

Single antenna may be enough for low end terminal in case of TDD System.

So single antenna option may be important for TDD system.
<Kimura Shigeru 8/8/2003>

Page 15: [3] Comment **John Humbert** **9/19/2003 11:36 AM**

I have to disagree with your notion of not putting a minimum requirement on antenna diversity. Current generation systems have these capabilities in the pipeline, so it seems very illogical not to shoot for higher performance by putting at least a minimum requirement for antenna diversity.
<Khurram Sheikh 8/7/2003>

Page 15: [4] Comment **John Humbert** **9/19/2003 11:36 AM**

Rationale: This requirement is a vendor specific implementation requirement, and not related to the MAC/PHY Also this material was not introduced with a rationale. In fact, Rev3 of the document contained the text !§Antenna diversity shall not be a requirement of the mobile station.!¨ We should leave it up to vendors/operators who understand the cost/form factor tradeoffs whether they support user terminal diversity. For example, there is a wide variety of 802.11 cards some have diversity/some do not."

Page 15: [5] Comment **John Humbert** **9/19/2003 11:36 AM**

Rationale: This requirement is a vendor specific implementation requirement, and not related to the MAC/PHY Also this material was not introduced with a rationale. In fact, Rev3 of the document contained the text ¡§Antenna diversity shall not be a requirement of the mobile station.¡¨ We should leave it up to vendors/operators who understand the cost/form factor tradeoffs whether they support user terminal diversity. For example, there is a wide variety of 802.11 cards some have diversity/some do not.
<John Fan 7/23/03>

Page 15: [6] Comment **John Humbert** **11/4/2003 6:57 PM**

Rationale: This material was not introduced with a rationale.
<John Fan 7/23/03>

I agree with Fan John's comment on July 24 as follows.

Section 4.1.13 is never proposed, discussed by E-mail contributions.

>4.1.13 Best Server Selection

>Action: Delete entire section

>Rationale: This material was not introduced with a rationale.

<Masaaki Yuza 8/7/2003>

Page 17: [7] Comment **John Humbert** **10/10/2003 3:34 PM**

Rationale

From my experience, the max. delay spread value is an essential requirement.

The specific proposed value is resonable, and I would like to see it reflected by the Channel models.

<Marianna Goldhammer 7/30/03>
Marianna, I do not wish to imply that there should not be numbers in the
Requirements document. I believe that we have a fine line to walk in
Evaluating each of the proposed requirements to make sure that
(a) It is a requirement on the PHY or MAC layer, and not an upper layer
Requirement, and
(b) It is a primary requirement for a system which will lead to a successful
Standard and successful products, as opposed to a secondary requirement
derived from some primary requirement but directed toward a specific
Implementation.
or (c) the requirement is necessary for interoperability.

Note that requirements that really belong to the upper layers may be
translated into requirements for capabilities at the MAC or PHY layers to
support those upper layer capabilities. An example might be a special
address in the frame format that is required by the upper layers to execute
a required feature.

I believe that a list of requirements document that adheres to these
guidelines will have significant quantitative specifications to be used for
evaluating the various choices.

Best regards.

<Robert D. Love 7/31/03>

Page 20: [8] Comment **John Humbert** **9/19/2003 11:36 AM**

Rationale: The sentence related to call blocking should be removed because call blocking is an application layer specific issue. The Requirements document should specify the classes of supported QoS, but application-specific exception handling should not be included in the document.

Call blocking or other exception handling techniques should be handled at a higher layer for any application that requires special QOS treatment. If there is an application (such as VoIP) that requires special QoS treatment, the application shall request it of the air interface via an API. If the air interface cannot provide the desired QoS, it shall inform the application of that fact via the API. It is up to the application to take the appropriate action, e.g., "blocking" the call.
<John Fan 7/23/03>