Project	**IEEE 802.16 Broadband Wireless Access Working Group**
Title	**Summary of IEEE 802.16 System Requirements**
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Re:	Summary of Document IEEE 802.16s0-99/5
Abstract	This document contains a summary of Draft 5 System Requirements Document
Purpose	This document was prepared as an appendix to the System Requirements Document as summary of the system requirements to aid the MAC and PHY groups in the development of their documents.
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Summary of IEEE 802.16 System Requirements

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The following table summarizes the specific requirements that have been obtained from the "Preliminary Draft Working Document for 802.16 Broadband Wireless Access System Requirements", document number IEEE 802.16s0-99/5.

First, the following descriptions regarding the compliance of the requirements are provided, with the text taken directly from the System Requirements document.

"MUST" or "SHALL": These words or the adjective "REQUIRED" means that the item is an absolute requirement.

"MUST NOT": This phrase means that the item is an absolute prohibition.

"SHOULD": This word or the adjective "RECOMMENDED" means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.

"SHOULD NOT": This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.

"MAY": This word or the adjective "OPTIONAL" means that this item is truly optional. One implementation may include the item because the target marketplace requires it or because it enhances the product, for example; another implementation may omit the same item.

Item #	Page #	Line #	Requirement	Compliance	Possible effected area
1	1	18	The forthcoming air interface standard MUST comply with the system requirements.	MUST	MAC and PHY
2	2	22	The 802.16 air interface interoperability standard SHALL be part of a family of standards for local and metropolitan area networks.	SHALL	MAC & PHY
3	4	12	Support more than one paying customer	SHOULD	MAC and PHY
4	5	21	802.16 systems SHALL be multiple-cell frequency reuse systems.	SHALL	MAC & PHY
5	6	10	The base station radio SHOULD be P-MP	SHOULD	MAC and PHY

6	7	24	The air interface MUST NOT preclude repeaters or reflectors to bypass obstructions and extend cell coverage.	MUST NOT	PHY
7	7	44	The standard (e.g., MAC/PHY protocols) SHALL describe common access protocol(s) and common modulation technique(s).	SHALL	MAC & PHY
8	8	6	Since all data traffic in a single cell of an 802.16 network MUST go through the base station, that station SHALL serve as a radio Resource supervisor.	MUST SHALL	MAC & PHY
9	8	17	802.16 protocols MUST provide the means to multiplex traffic from multiple subscriber stations nodes in the downstream direction, and provide for a means to resolve contention and allocate bandwidth in the upstream direction.	MUST	MAC and PHY
10	8	29	Services that an 802.16 system at least SHOULD support	SHOULD	MAC and PHY
11	8	30	(some services MUST be supported).	MUST	MAC and PHY
12	9	13	The MAC and PHY protocols may not have explicit support for each and every bearer service, since they SHOULD be handled as data streams in a generic fashion.	SHOULD	MAC and PHY
13	9	19	Efficiently transport digital audio/video streams to subscribers	SHOULD	PHY…broadcast in DS to bypass MAC
14	9	25	Support telephony "pipes" to subscribers for legacy equipment and PSTN…including SDH and PDH	SHOULD	MAC & Phy…CBR and synch. reqs.
15	9	27	802.16 protocols MAY transport any layer in the nationally- and internationally-defined digital telephony service hierarchies	MAY	MAC and PHY
16	9	42	802.16 systems and protocols MUST support the QoS requirements of these services: ▪ Narrowband/Voice Frequency Telephony - POTS (supporting FAX services), Centrex, ISDN BRI 35 ▪ NxDSO Trunking - Fractional DS1/E1 to PBXs and/or data equipment, ISDN PRI 36 ▪ Full DS1/E1 - transparent mapping including all framing information	MUST	MAC and PHY

			▪ Voice Over IP, Voice Over Frame Relay, Voice and Telephony over ATM (VtoAVTOA), and similar services as defined in Section.		
17	10	26	The amount of delay between a user speaking and another user hearing the speech MUST be kept below a certain level to support two-way conversation.	MUST	MAC and PHY
18	11	5	BWA protocols MUST support efficient transport of encoded voice data in terms of bandwidth, reliability and delay.	MUST	MAC and PHY
19	11	19	MUST meet the transport requirements of such telephony signaling, whether TDM- or message-oriented.	MUST	MAC and PHY
20	11	30	Efficient transport of ATM cell relay service and preserve its QoS features	SHOULD	MAC…CBR, VBR, UBR, ABR
21	11	32	802.16 systems SHALL broadly address the target markets mentioned in section 1.2	SHALL	MAC & PHY
22	11	40	Provide a means to utilize ATM addresses such as ITU-T E.164	SHOULD	MAC…more an IWF req.
23	12	2	Directly transport variable length IP datagrams efficiently	MUST	MAC & Phy…var. length packets
24	12	2	Both IP version 4 and 6 MUST be supported.	MUST	MAC& PHY
25	12	4	Use TCP/IP header compression over the air	SHOULD	MAC & Phy…var. length packets and support algorithm
26	12	4	The 802.16 IP service MUST provide support for real-time and non-real-time services.	MUST	MAC and PHY
27	12	6	It SHOULD be possible to support the emerging IP Quality of Service (QoS) efforts	SHOULD	MAC and PHY
28	12	24	The 802.16 protocols MAY support bridged LAN services,	MAY	MAC & PHY
29	13	8	The 802.16 protocols SHOULD NOT preclude the transport of the following services: ▪ **Back-haul service** ▪ **Virtual point-to-point connections** ▪ **Frame Relay Service**	SHOULD NOT	MAC and PHY
30	14	29	The MAC protocol MUST define interfaces and procedures to	MUST	MAC

			provide guaranteed service to the upper layers.		
31	14	32	The MAC protocol MUST efficiently resolve contention and bandwidth allocation.	MUST	MAC
32	15	11	Further details, and finalization of the protocol reference model, SHALL be worked out by the 802.16 MAC and PHY task groups while developing the air interface interoperability standard.	SHALL	MAC and PHY
33	15	29	The 802.16 protocols SHOULD allow for different “scales” of capacity and performance for 802.16 system instances.	SHOULD	MAC and PHY
34	15	41	802.16 protocols SHALL be optimized to provide the peak capacity from 2 to 155 Mbps to a subscriber station sufficiently close to the base station.	SHALL	MAC and PHY
35	16	1	802.16 MAC protocol SHOULD allow the upper range of delivered bandwidth to scale beyond 155 Mbps. 2	SHOULD	MAC and PHY
36	16	2	802.16 protocols SHALL NOT preclude the ability of an 802.16 system to deliver less than 2 Mbps peak per-user capacity.	SHALL NOT	MAC and PHY
37	16	7	802.16 protocols SHOULD allow for flexibility between delivered upstream and downstream bandwidth and CoS/QoS.	SHOULD	MAC and PHY
38	16	19	An 802.16 system SHOULD be available to transport all services at better than their required maximum error rates (see section 5.5) 99.99from about 99.9 to 99.999% of the time.	SHOULD	MAC and PHY
39	16	24	The 802.16 specifications SHALL not preclude the ability of the radio link to be engineered for different link availabilities, based on the preference of the system operator.	SHALL	MAC & PHY
40	17	2	802.16 MAC and PHY protocols MUST accommodate rain fall, perhaps consuming more radio bandwidth and/or requiring smaller radio propagation distance (radius) to meet the availability requirements.	MUST	MAC & PHY
41	17	5	Since statistical rain rates vary widely in geography, the 802.16 protocols MUST be flexible in	MUST	MAC & PHY

			consumed radio bandwidth (spectral efficiency), cell radius, and transmit power to 6 accommodate a rain allowance that varies with geography 7		
42	17	10	Support adjustable power, modulation, and other parameters for rapid channel changes due to rain	SHOULD	MAC & PHY
43	17	20	The error rate, after application of the appropriate error correction mechanism (e.g., FEC), delivered by the PHY layer to the MAC layer SHALL meet IEEE 802 functional requirements: The bit error rate (BER) is 10E-9.	SHALL	MAC & PHY
44	17	23	Each block of data delivered by the PHY to the MAC layer MUST allow for detection of errors by the MAC (e.g., by CRC) with 1, 2 or 3 errored bits (a Hamming Distance of 4)	MUST	MAC & PHY
45	18	18	In a telephony network, for example, the maximum acceptable end-to-end delay for the longest path is RECOMMENDED to be less than 300ms.	RECOMMENDED	MAC & PHY
46	18	22	The budget for the 802.16 system transit delay and access delay MUST be derived. The MAC layer may have different requirements for each direction, upstream and downstream.	MUST	MAC & PHY
47	18	25	In the upstream direction, time MUST be budgeted for requesting bandwidth and contending among nodes.	MUST	MAC & PHY
48	18	40	In a given 802.16 system instance, capacity MUST be carefully planned to ensure that subscribers'quality of service guarantees and maximum error rates are met.	MUST	MAC & PHY
49	18	43	The following parameters of an 802.16 system SHOULD be addressed by the MAC and PHY protocols: ▪ Radio range (shaped sector radius) ▪ Width of the sector ▪ Upstream/downstream channels' data rates	SHOULD	MAC & PHY

			▪ Allocation of prospective subscriber data rate to channels. Note: the MAC and PHY standards may allow subscribers to hop between channels ▪ Types of modulation		
50	19	8	The MAC and PHY protocols MUST accommodate channel capacity issues and changes in channel capacity to meet contracted service levels with customers.	MUST	MAC & PHY
51	19	11	As subscribers are added to 802.16 systems, the protocols MUST accommodate them in an automated fashion.	MUST	MAC & PHY
52	19	28	802.16 protocols MUST support classes of service (CoS) with various quality of service (QoS) guarantees to support the bearer services (see section 9) that an 802.16 system MUST transport.	MUST	MAC & PHY
53	19	31	802.16 protocol standards MUST define interfaces and procedures that accommodate the needs of the bearer services with respect to allocation of prioritization of bandwidth.	MUST	MAC & PHY
54	19	33	802.16 protocols MUST provide the means to enforce QoS contracts and Service Level Agreements [2] (see section 7.1).	MUST	MAC & PHY
55	19	37	The 802.16 protocols MUST be capable of dedicating constant-rate, provisioned, bandwidth for bearer services such as SDH/PDH.	MUST	MAC & PHY
56	19	43	For QoS-based, connectionless, but not circuit-based, bearer services, the 802.16 protocols MUST support bandwidth negotiation “on-demand” [9].	MUST	MAC & PHY
57	22	8	802.16 protocols SHALL define a set of parameters that preserve the intent of QoS parameters for both ATM- and IP-based services. (TBD)	SHALL	MAC & PHY
58	22	12	The classes of service and QoS parameters of bearer services SHALL be translated into a common set of parameters defined by 802.16.	SHALL	MAC & PHY
59	22	14	A network node that serves as an inter-working function (IWF) between a QoS-capable LAN or	MUST	MAC & PHY

			WAN and an 802.16 system MUST participate in signaling protocols to set up QoS parameters for connection-oriented services.		
60	22	18	The IWF MUST participate in the ATM signaling protocol that sets up the circuit.	MUST	MAC & PHY
61	22	23	If 802.16 is to be a “link” in the IP network, an IWF MUST interface with 802.16 to negotiate resource allocation.	MUST	MAC & PHY
64	22	27	the QoS parameters for 802.16 MUST be chosen and interface primitives defined that allow for bearer services’ IWFs to negotiate QoS “through” an 802.16 system.	MUST	MAC &PHY
63	22	32	BWA systems SHOULD include a mechanism that can support dynamically-variable-bandwidth channels and paths (such as those defined for ATM and IP environments).	SHOULD	MAC & PHY
64	23	7	The 802.16 protocol MUST permit operators (def) to enforce service level agreements (SLAs) with subscribers by restricting access to the air link, discarding data, dynamically controlling bandwidth available to a user or other appropriate means. [3]	MUST	MAC & PHY
65	23	11	The operator MUST have means to shut down a subscriber station if necessary, remote from the subscriber station, in the face of a malfunction.	MUST	MAC & PHY
66	23	12	The operator also MUST have the means to shut down a BTS remotely.	MUST	MAC & PHY
67	23	13	The 802.16 protocols SHOULD support a function that automatically shuts down transmission from a subscriber station or base station in case of malfunction (e.g., power exceed limits).	SHOULD	MAC & PHY
68	23	17	The 802.16 system management framework, architecture, protocols and managed object MUST allow for operators to effectively administer accounting and auditing.	MUST	MAC & PHY
69	23	18	An operator MUST be able to account for time- and bandwidth-utilization and the various QoS	MUST	MAC & PHY

			parameters for each subscriber.		
70	23	23	The 802.16 system SHALL enforce security procedures described in this section.	SHALL	MAC & PHY
71	23	33	This initial authentication MUST be very strong in order to prevent an 'enemy' subscriber station from entering the network or an 'enemy' base station from emulating a real base station.	MUST	MAC & PHY
72	23	38	This level of authentication MUST be supported by the 802.16 MAC layer.	MUST	MAC
73	24	7	The authentication mechanisms MUST be secure so that an “enemy” subscriber station is not able to gain access to an 802.16 system, or to the core network beyond.	MUST	MAC & PHY
74	24	8	Passwords and secrets MUST NOT be passed “in the clear” through the air interface.	MUST NOT	MAC & PHY
75	24	14	The 802.16 standard SHALL identify a standard set of credentials and allow for vendors to extend the defined credentials with non-standard credentials.	SHALL	MAC & PHY
76	24	25	Subscriber authorization requests and responses MUST be transacted securely.	MUST	MAC & PHY
77	24	34	Allow for a strong cryptographic algorithm to be employed that is internationally applicable for privacy.	SHOULD	MAC
78	24	35	Facilities SHOULD also be defined in the protocol for the use of alternate cryptographic algorithms that can be used in certain localities and that can replace algorithms as they are obsoleted or “legalized” for international use.	SHOULD	MAC
79	24	40	802.16 SHOULD strive to fit into the 802 system model.	SHOULD	MAC & PHY