Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**802.16a PHY Nomenclature**
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Re:	This document responds to the proposed TG3 "Call for Contributions" originating from Comment 351 in the Commentary database 80216-01/53r5
Abstract	Comment 351 (and others) sought simplification and clarification over the naming and structuring of the various PHY modes / options etc within the current 802.16a Draft standard. This document addresses these concerns from the perspective of users of the proposed Standard.
Purpose	This document includes text which can be used as the basis for a Proposed Resolution of Comment 351.
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Introduction

Comments 351, 369 and 452 had raised various concerns about the confusion and complexity of the Draft Standard in relation to the naming and documentation of the various 2 — 11GHz PHY modes / types / techniques and options. This concern was exacerbated at Meeting #16 (Austin) by the agreement to consolidate licensed and license-exempt into a single standard plus the need to ensure consistency with the already adopted 802.16 (10-66GHz) standard from an editing point of view, and possible (re-)naming of the 10-66 GHz PHY.

Much of the confusion / complexity expressed in these comments has arisen from the combination of historical, technology and procedural factors incumbent in the current Draft of the 802.16a standard.

In addressing these comments / concerns, my primary thrust has been to consider the issues from the perspective of the (eventual) merged 802.16 and 802.16a standard and the needs / interests / priorities of the Service Provider, Regulatory and Vendor communities who will be the intended users of the published standard. This in turn sets the proposed structure and nomenclature for the eventual standard, and hence the most useful (and logical) structure for clearly and simply editing the various sub-sections and detailed text.

The interests of Intended Users

The prime purpose of the Standard is to provide a clear, unambiguous set of references which can be called up by Service Providers, Regulators and Equipment Vendors to specify their requirements / capabilities in relation to the relevant air interface(s). This will inevitably be a multi-element reference.

Element 1 : This distinguishes the Standard from all others, and is clearly **IEEE 802.16, with its (successive) amendments 802.16 a, b, c,   etc,** followed by the year of publication   **(e.g. 2001, 2002,   etc).** The Marketing label for this specification is **WirelessMAN**   ™   — or its suggested abbreviation   **WMAN**

The Medium Access Layer (MAC) is common for all 802.16 air interfaces (although the capability and applicable options will vary to match the specific amendment, services and PHY types) and is thus implied by the WirelessMAN™/WMAN designation. The MAC is specified in its own MAC Section, regardless of PHY mode or type.

Element 2 : This must be the Frequency range / type (e.g 2 — 11 GHZ, 10 — 66GHz, licensed, license exempt etc) with provision for future additions (e.g. below 2GHZ or above 66GHz). This is independent of the MAC specification. One solution is to tag these as specific PHY types **WMAN1, WMAN2, WMAN3,   etc.** Users of the specification would have to qualify these with particular frequency band and Regulatory designations for actual equipment or compatibility purposes, but this is outside the scope of the PHY (and the 802.16 standard) itself.

Element 3 : A major interest of Service Providers and Vendors is to clearly understand which Base Station (air interface) characteristics a particular (multi-vendor) Subscriber Station product is or can be interoperable with. At the highest level, this would be a single modulation type and deployment topology (e.g. Single Carrier, MC-OFDM, MC-DVB/RCT, MC-AMB, PMP, Mesh etc, recognizing that vendors might offer CPE which can be configured for more than one modulation type / sub-type within the same frequency band / range. The suggested solution is to tag the main PHY Types (above) with a suffix **A,B,C,   etc.** It would help if this suffix could be consistent for similar modulation techniques / deployment topologies across different PHY types. The suggested solution is therefore to use :

- **WMAN1A/PMP** for 10 — 66 GHz licensed, single carrier, PMP topology
- **WMAN1A/MESH** for (potential) 10 — 66 GHZ licensed, Single Carrier, Mesh topology.

- **WMAN2A/PMP** for 2 — 11 GHz licensed, single carrier, PMP topology
- **WMAN2B/PMP** for 2 — 11 GHz licensed, MC-OFDM, PMP topology
- **WMAN2C/PMP** for 2 — 11 GHz licensed, MC-DVB, PMP topology
- **WMAN2D/PMP** for 2 — 11 GHz licensed, MC-AMB, PMP topology

- **WMAN3B/PMP** for 2 — 11 GHz license exempt, MC-OFDM, PMP topology
- **WMAN3B/MESH** for 2-11 GHZ, license exempt, MC-OFDM, Mesh topology
- **WMAN3C/PMP** for 2 — 11 GHz, license exempt, MC-DVB/RCT, PMP topology.
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- **WMAN4x/xxx** for (potential) below 2GHz or above 66 GHz air interfaces.

There should be a clearly identified definition in the PHY Section of the document for each generic PHY type (WMAN1, WMAN2 and WMAN3), for each sub-type (A,B,C,D,) and each topology (PMP, MESH), summarizing the scope of its application and associated characteristics (as they would interest a Service Provider or Regulator). Detailed modulation schemes, options and parameters would be specified in supporting sub-sections within the PHY Section of the Standard, using references to common sub-sub-sections wherever possible.

Element 4 : This defines the Options (within the PHY Type / sub-type) which are needed for licensing and interoperability purposes. This is primarily the **Duplexing Option** (e.g .FDD, TDD, HFDD) and the **Advanced Antenna Option** (e.g.SISO, MIMO, MISO, SIMO, AA) where appropriate.

A full specification would therefore read :

<div align="center">

IEEE802.16a:2002 WMAN2B/PMP (FDD,MIMO)
Or, more simply
IEEE WMAN2B/PMP (FDD,MIMO)

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Users of the specification would then need to associate the relevant details concerning specific frequency band, regulatory regime, power levels, frequency reuse plan, modulation rates and other engineering / deployment parameters supported by the particular air interface standard and licensing / interoperability options.

The suggested nomenclature scheme is summarized in Table www below, which could be incorporated into the Draft standard, with appropriate description and editing changes.

Table www : 802.16 PHY Types and Supported Options

PHY TYPE		Included Techniques		Options	
		Modulation[1,2]	MA[3,4]	Duplex	AAS
WMAN1 (10-66GHz L)	A/PMP	SC	TDMA	TDD,FDD,HFDD	n/a
	A/MESH	*SC*	*TBD*	*TBD*	*Mesh*
WMAN2 (2-11GHz L)	B/PMP	SC	TDMA	TDD,FDD,HFDD	Optional
	B/PMP	OFDM	TDMA	TDD,FDD	Optional
	C/PMP	OFDMA-DVB	TDMA+FDMA	TDD,FDD	Optional
	D/PMP	OFDMA-AMB	TDMA+FDMA+SDMA	TDD	Included
WMAN3 (2-11GHz LE)	B/MESH	OFDM	TDMA	TDD	Included
	B/PMP	OFDM	TDMA	TDD	Optional
	C/PMP	OFDMA-DVB	TDMA+FDMA	TDD,FDD	Optional
WMAN4	*X/XXX*	*TBD*	*TBD*	*TBD*	*TBD*

ALTERNATIVE SCHEMES

The Same information could be organized in a different order — there are two suggested variations to consider :

a) The WMAN1,2,3,4 designation could refer to the modulation technology (SC, OFDM, OFDMA-DVB, OFDMA-AMB), followed by the Frequency Bands (A=10-66GHz, licensed), B=2-11GHZ, licensed), C=2-11GHz, unlicensed etc. These would be followed by the applicable topology scheme (PMP, Mesh). Table xxx below summarizes what this would look like.

Table xxx : 802.16 PHY Types and Supported Options

PHY TYPE		Included Techniques		Options	
		Frequency	MA[5,6]	Duplex	AAS
WMAN1 (SC)	A/PMP	10-66GHz L	TDMA	TDD,FDD,HFDD	n/a
	B/PMP	2-11GHz L			
	A/MESH	10-66GHz L	*TBD*	*TBD*	*Included*
WMAN2 (OFDM)	B/PMP	2-11GHz L	TDMA	TDD,FDD,HFDD	Optional
	C/MESH	2-11GHz LE	TDMA	TDD	Included
WMAN3 (OFDMA-DVB)	B/PMP C/PMP	2-11GHz L 2-11GHz LE	TDMA+FDMA TDMA+FDMA	TDD,FDD TDD	Optional Optional
WMAN4 (OFDMA-AMB)	B/PMP	2-11GHz L	TDMA+FDMA+SDMA	TDD	Included

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[1]   DVB is Digital Video Broadcast — Reverse Channel Telephony technology from ETSI 301 958
[2]   AMB is Adaptive Multi-Beam technology
[3]   FDMA is supported in the downlink (BS to SS) as well as the uplink (SS to BS)
[4]   SDMA is supported in the downlink (BS to SS) as well as the uplink (SS to BS)
[5]   FDMA is supported in the downlink (BS to SS) as well as the uplink (SS to BS)
[6]   SDMA is supported in the downlink (BS to SS) as well as the uplink (SS to BS)

b) The WMAN1,2,   designation could refer to the topology (PMP, Mesh), followed by the Frequency Bands (A=10-66GHz, licensed), B=2-11GHZ, licensed), C=2-11GHz, unlicensed etc. These would be followed by the modulation technology (SC, OFDM, OFDMA-DVB, OFDMA-AMB). Table yyy below summarizes what this would look like.

Table yyy : 802.16 PHY Types and Supported Options

PHY TYPE		Included Techniques		Options	
		Frequency	MA[7,8]	Duplex	AAS
WMAN1	A/SC	10-66GHz L	TDMA	TDD,FDD,HFDD	n/a
(PMP)	B/SC	2-11GHz L	TDMA	TDD,FDD,HFDD	Optional
	B/OFDM	2-11GHz L	TDMA	TDD,FDD,HFDD	Optional
	B/DVB	2-11GHz L	TDMA + FDMA	TDD,FDD	Optional
	B/AMB	2-11GHz L	TDMA+FDMA+SDMA	TDD	Included
WMAN2	A/SC	10-66GHz L	TBD	TBD	Included
(Mesh)	C/OFDM	2-11GHz LE	TDMA	TDD	Included

CONCLUSION

The nomenclature for the Draft Standard should be based around some combination of the three basic **Elements** (modulation technology, frequency band and topology), complemented by the available licensing / interoperability **Options** (Duplex and AAS). The solution chosen should be the one that is most convenient / least confusing for the Service Provider and Regulatory users of the Standard and which would enable Equipment / system vendors to clearly identify the characteristics of any particular Base station or SS for licensing, compatibility and interoperability purposes.

After discussion / modification of the suggested alternatives at Meeting #17 (Levi) the WG should be asked to adopt a solution which would apply for the proposed 802.16a Amendment, including the appropriate re-designation of the existing 802.16 (10-66GHz) PHY for consistency.

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[7]   FDMA is supported in the downlink (BS to SS) as well as the uplink (SS to BS)
[8]   SDMA is supported in the downlink (BS to SS) as well as the uplink (SS to BS)