



Technical Working Group

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Gordon Antonello

WiMAX Board Member and Chair <11GHz TWG

Technical Advisor, Wi-LAN Inc. gantonello@wi-lan.com

Hassan Yaghoobi

Secretary <11GHz TWG

Technical Marketing Manager, Intel BWA Division hassan.yaghoobi@intel.com

Aditya Agrawal (aagrawal@fma.fujitsu.com)

Board Member, WiMAX Vice-President

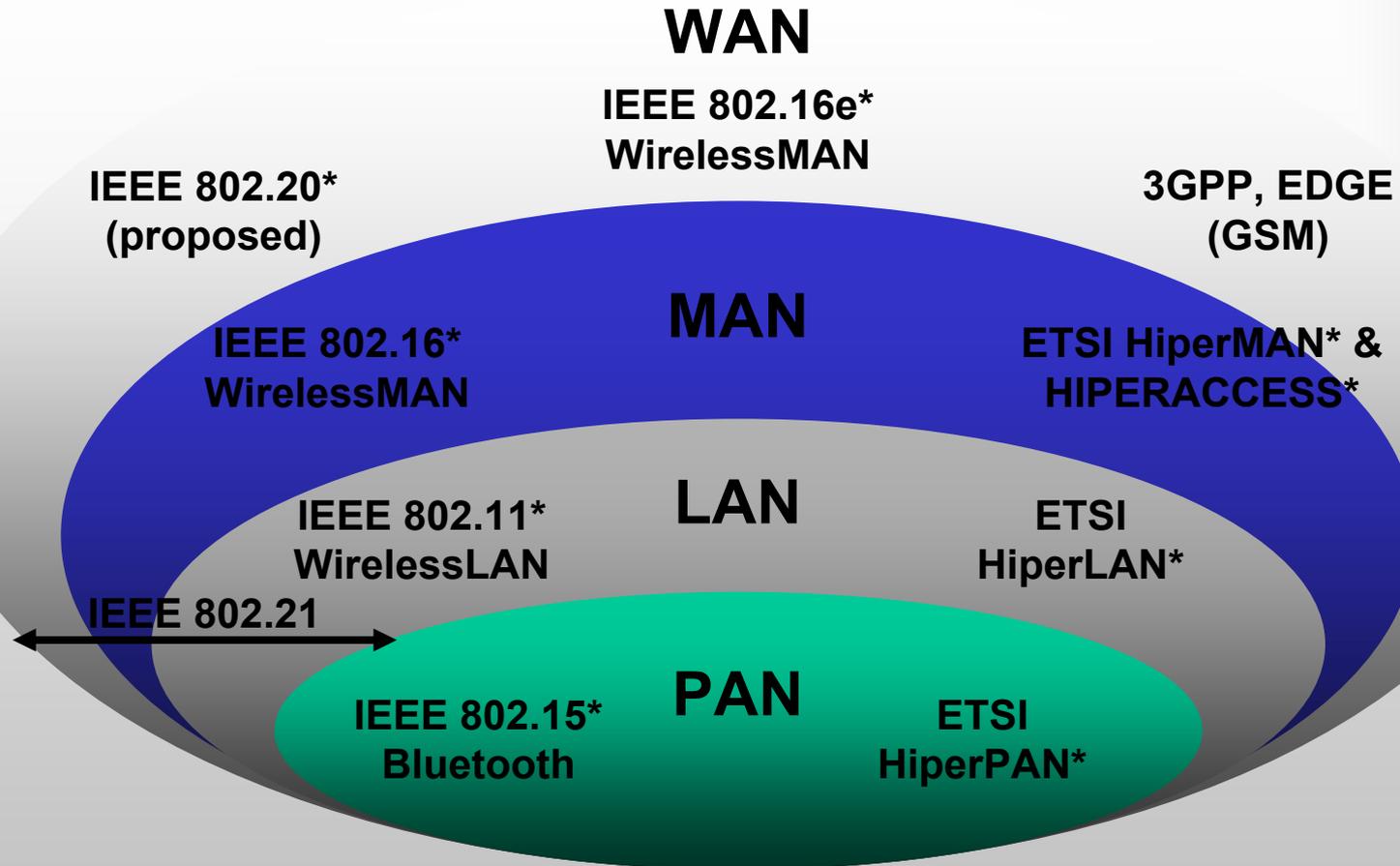
Sr. Marketing Manager, Fujitsu Microelectronics America

802.16: Designed from Ground Up for the Outdoor MAN



- Higher throughput at longer ranges (up to 50 km)
 - Better bits/second/Hz at longer ranges
- Scalable system capacity
 - Easy addition of channels maximizes cell capacity
 - Flexible channel bandwidths accommodate allocations for both licensed and license exempt spectrum
- Coverage
 - Standards-based mesh and smart antenna support
 - Adaptive modulation enables tradeoff of bandwidth for range
- Quality of Service
 - Grant/Request MAC supports voice and video
 - Differentiated service levels: E1/T1 for business; best effort for residential
- Cost & Investment Risk
 - Interoperable equipment lets operators purchase equipment from more than one vendor – WiMAX-Certified*
 - Standards-based platform improves OpEx by sparking innovation across the ecosystem: radio, NW mgmt, antennas, services

Global Wireless Standards



Wireless Platforms



Fixed

Licensed and Unlicensed
E1/ T1 & DSL level service

Enterprise
/ Backhaul

Residential
access

802.16
HiperMAN

802.16
HiperMAN



Portable

Licensed and Unlicensed
Consumer DSL level service

Destination
based

Nomadic

802.11 Hot
Spots

802.16e



Mobile

Licensed
Wideband Data Rates

Cellular
Wideband

2.5G, 3G

IEEE 802.16* Standard



	802.16	802.16a/REVd	802.16e
Completed	Dec 2001	802.16a: Jan 2003 802.16REVd: Q3'04	Estimate Q3'04
Spectrum	10 - 66 GHz	< 11 GHz	< 6 GHz
Channel Conditions	Line of Sight Only	Non Line of Sight	Non Line of Sight
Bit Rate	32 – 134 Mbps at 28MHz channelization	Up to 75 Mbps at 20MHz channelization	Up to 15 Mbps at 5MHz channelization
Modulation	QPSK, 16QAM and 64QAM	OFDM 256 sub-carriers QPSK, 16QAM, 64QAM	Same as 802.16a
Mobility	Fixed	Fixed	Pedestrian Mobility – Regional Roaming
Channel Bandwidths	20, 25 and 28 MHz	Selectable channel bandwidths between 1.25 and 20 MHz	Same as 802.16a with uplink sub-channels to conserve Power
Typical Cell Radius	1-3 miles	3 to 5 miles; Max range 30 miles based on tower height, antenna gain and power transmit	1-3 miles

How do 802.16 and 802.11 Differ?



	802.11	802.16	Technical Explanation
Range	<ul style="list-style-type: none"> Optimized for users within a 100 meter radius Add access points or high gain antenna for greater coverage 	<ul style="list-style-type: none"> Optimized for typical cell size of 7-10 km Up to 50 km range No "hidden node" problem 	<ul style="list-style-type: none"> 802.16 PHY tolerates 10 more multi-path delay spread than 802.11
Coverage	<ul style="list-style-type: none"> Optimized for indoor environments 	<ul style="list-style-type: none"> Optimized for outdoor environments (trees, buildings, users spread out over distance) Standard support for advanced antenna techniques & mesh 	<ul style="list-style-type: none"> 802.16: 256 OFDM (vs. 64 OFDM) Adaptive modulation
Scalability	<ul style="list-style-type: none"> Channel bandwidth for 20 MHz is fixed 	<ul style="list-style-type: none"> Channel b/w is flexible from 1.5 MHz to 20 MHz for both licensed and license exempt bands Frequency re-use Enables cell planning for commercial service providers 	<ul style="list-style-type: none"> Only 3 non-overlapping 802.11b channels; 5 for 802.11a 802.16: limited only by available spectrum
Bit rate	<ul style="list-style-type: none"> 2.7 bps/Hz peak data rate; Up to 54 Mbps in 20 MHz channel 	<ul style="list-style-type: none"> 3.8 bps/Hz peak data rate; Up to 75 Mbps in a 20 MHz 5 bps/Hz bit rate; 100 Mbps in 20 MHz channel 	<ul style="list-style-type: none"> 802.16: 256 OFDM (vs. 64 OFDM)
QoS	<ul style="list-style-type: none"> No QoS support today -> 802.11e working to standardize 	<ul style="list-style-type: none"> QoS designed in for voice/ video, differentiated services 	<ul style="list-style-type: none"> 802.11: contention-based MAC (CSMA) 802.16: grant request MAC

802.16 Standards Genealogy



802.16
(Dec 2001)

- Original fixed wireless broadband air Interface for 10 – 66 GHz
- Line-of-sight only, Point-to-Point applications

802.16c
(2002)

**802.16 Amendment
WiMAX System Profiles
10 - 66 GHz**

802.16a
(Jan 2003)

- Extension for 2-11 GHz
- Targeted for non line of sight, Point-to-Multi-Point applications like “last mile” broadband access

802.16REVd
(Q3 2004)

- 802.16 Revision PAR for 802.16 & 802.16a to add WiMAX System Profiles and Errata for 2-11 GHz in support of 802.16e requirements

802.16e
(2005 exp.)

- Amendment for Mobile wireless broadband up to vehicular speeds in licensed bands from 2-6 GHz
- Enables roaming for portable clients (laptops) within & between service areas

802.16 Standard and Usage Model Mapping



	1H 2005	2005	2006
Deployment Type / Usage Model	<ul style="list-style-type: none"> • Outdoor install • Fixed wireless broadband 	<ul style="list-style-type: none"> • Indoor install • Fixed wireless broadband • Portability for nomadic wireless broadband • NO roaming across Service Providers 	<ul style="list-style-type: none"> • Higher speed support • Roaming • Higher level network support
Standards Mapping	802.16REVd	802.16REVd / 802.16e	802.16e
OEMs, TEMs & Carriers	<ul style="list-style-type: none"> • BWA Equipment Mfrs • Carriers & WISPs in emerging and developing markets; low population density markets 	<ul style="list-style-type: none"> • BWA Equipment Mfrs • Larger Telecom Equipment Mfrs (infrastructure) • Major carriers in all geos 	

802.16 WG Current Status & Timeline



Task Group / Milestones	Current Status	WG Letter Ballot Dates	Sponsor Ballot Dates	Standards Approval
802.16d (REVd)	WG Ballot Draft D3* Conditional Sponsor Ballot requested	<div style="border: 1px solid black; background-color: yellow; padding: 2px; display: inline-block;">Span ~6 months</div> #13: 9/29-10/31/03 #13a: 12/6-12/29/03	<div style="border: 1px solid black; background-color: yellow; padding: 2px; display: inline-block;">Span ~4 months</div> SEC Approval for Sponsor Ballot : 2/9/04 #0: 2/13/04-3/12/04 #1: 4/1/04-4/16/04	<div style="border: 1px solid black; background-color: yellow; padding: 2px; display: inline-block;">Span ~3 months</div> To RevCom: 3/19/04 RevCom Submission: 2/13/04 SA Approval: 6/10/04
802.16e	Pre-Ballot Draft D0	#14: 11/24-12/31/03 #14a: 1/23-2/29/04 #14b: 3/26-4/10/04	SEC Approval for Sponsor Ballot : 3/19/04 #0: 4/16-5/16/04 #1: 6/01-6/25/04 #2: 7/25-8/13/04	To RevCom: 7/16/04 RevCom Submission: 8/13/04 SA Approval: 9/23/04

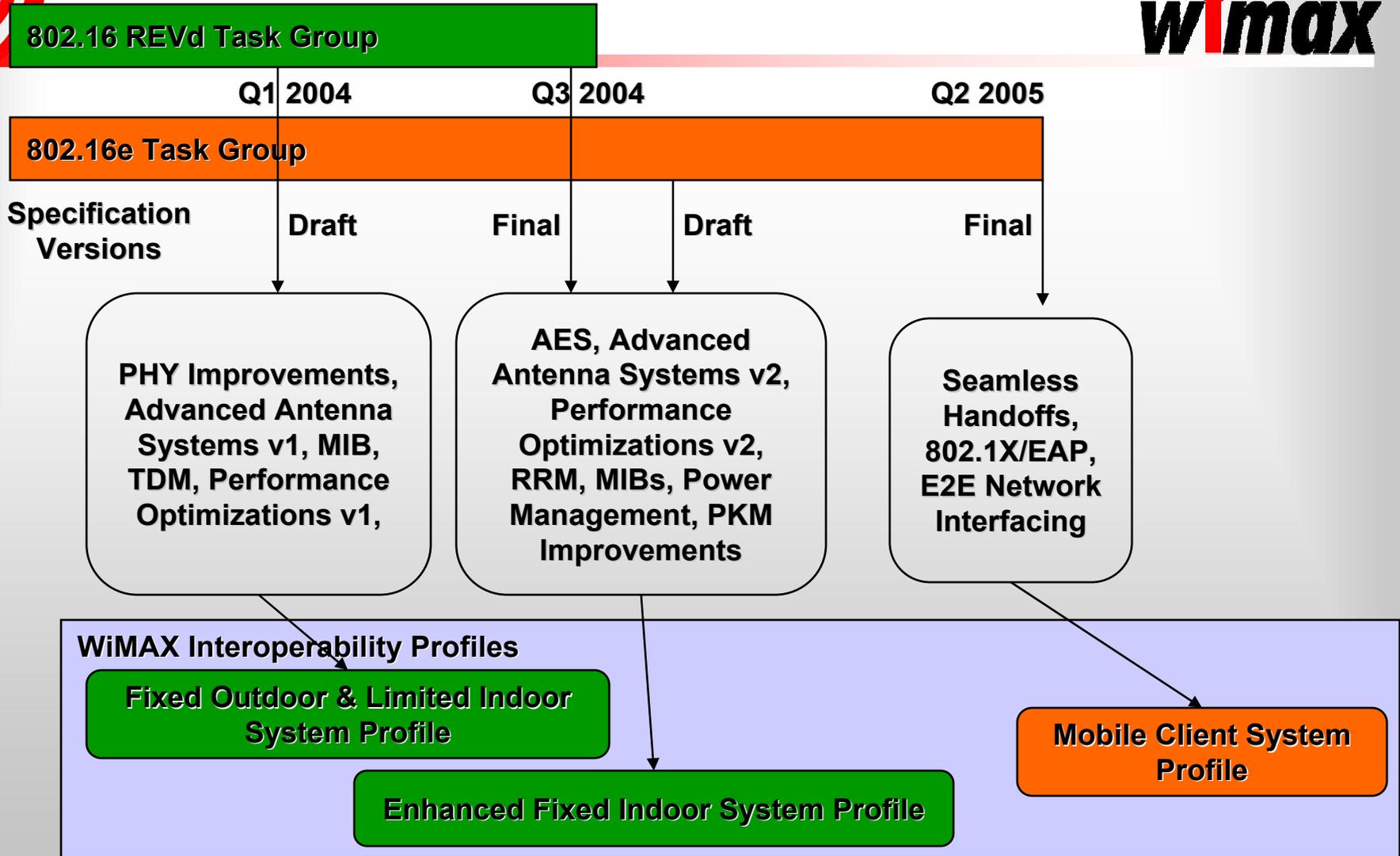
- IEEE only publishes standards for layer 1 & 2
 - Air Interface = MAC, PHY and radio
- Need an e2e system-level definition for system interoperability
 - For applications like VoIP, roaming, IP session mobility
- Propose new SIG for upper layer network infrastructure
 - NW architecture for RAN (Radio Access Network)
 - BS to BS; BS to core network / data center

IEEE 802.21: Media Independent Handoff Scheme



- In Nov '03, IEEE 802 Handoff Study Group approved to become a new Working Group: IEEE 802.21
 - Handoff between the different 802 standards (802.3, 802.15, 802.11, 802.16, etc.)
- There already exists a 3GPP-WLAN Internetworking group
 - Step 1: Common authentication and roaming (SIM-based)
 - Step 2: IP session mobility
- In general
 - Many opportunities to leverage commonalities in OFDM-based wireless systems
 - Many opportunities to build upon existing network infrastructure

Standards & WiMAX Role



WiMAX enables packaging features as appropriate from drafts/specs for timely market enablement



Global Standard



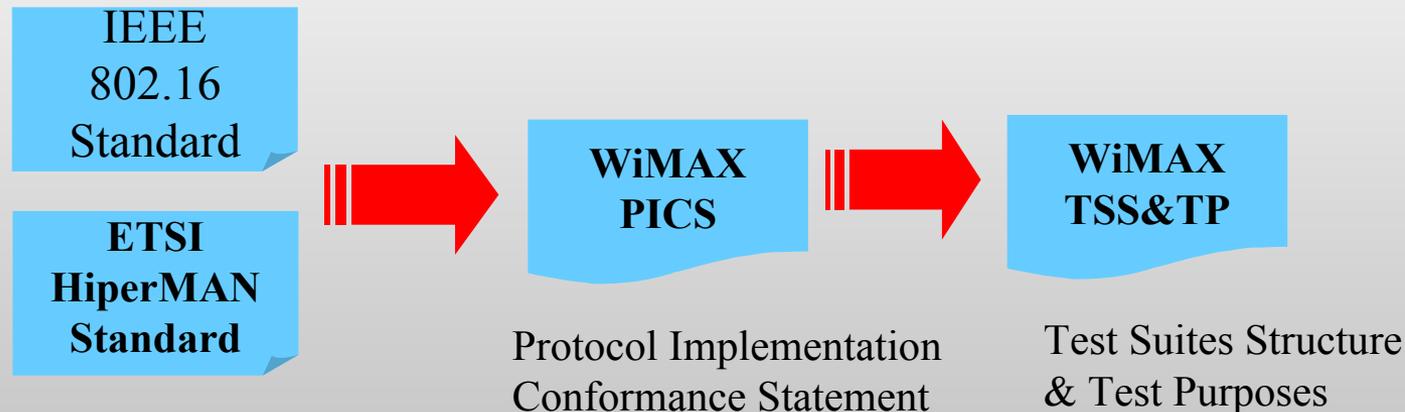
- WiMAX targets Harmonization of standards
 - Participating organizations; WiMAX members
 - Participating standards bodies; ETSI, IEEE
- Conformance and interoperability specifications
- Interoperability events and marketing
- Target is Global interoperability
 - Test Labs with a Global presence
 - For fixed and nomadic wireless access
 - Reduced risk and cost for system operators with deployments in more than one region
 - Reduced risk of product supply

Conformance ≠ Interoperability



- **Conformance – tested in 3rd party test lab**
 - Conformance can be achieved by individual organizations, independent test labs, certification agencies, etc.
 - Can be against their own personal interpretation of the IEEE or ETSI standard
- **Interoperability – tested via PlugFests**
 - Interoperability is achieved by organizations getting together to test their implementations against each other
 - The goal is to achieve interoperability by removing ambiguities in the standards and the implementations at an early stage
- **Certification = Verified Conformance + Interoperability**

- **What is WiMAX Certification? (what does it guarantee)**
 - **Certifies**
 - 1. Interoperability of equipment to other vendors' BS/SS**
 - 2. Conformance to WiMAX defined PICS, TSS&TP**
 - **WiMAX PICS, TSS&TP are based on IEEE* 802.16 and ETSI* HiperMAN standards**



FAQ



- Certification provided to equipment (BS,SS), not to components (silicon, RF, software...)
- Certified equipment can use “WiMAX CERTIFIED” text and logo
- “WiMAX CERTIFIED” is an approved certification mark in the US and trademark application is pending for other countries



(logo design is being revised)

- **Why Certification?**
 - **3rd party guarantee of quality**
 - **Service Provider can choose from multiple vendors with interoperable equipment**
 - **Multiple sources of Broadband Wireless hardware minimize the risk of product availability for deployments**
 - **Interoperable solutions amongst WiMAX-Certified* Base Stations and Subscriber Stations**
 - **Backwards compatibility with 802.16 IEEE stacks**
 - **Innovative Time-to-Market solutions with a stable, standards-based PHY design**

- **How does WiMAX compare to other types of certification?**
 - **More involved than WiFi certification since**
 - **WiMAX equipment used in carrier environment**
 - **WiMAX is testing for conformance as well as interop**
 - **Similar to DOCSIS in complexity**

Timeline



Establishment of
Service Provider
Working Group

WiMAX
Plugfest
Dec'04

WiMAX
Plugfest
Feb'04

WiMAX
Plugfest
Apr'05

WiMAX at
over 67
members

Certification Tests Ready
Oct'04

WiMAX
Certification
Begins

WiMAX certified
Products Deployed

Q1'04

Q2'04

Q3'04

Q4'04

Q1'05

Q2'05

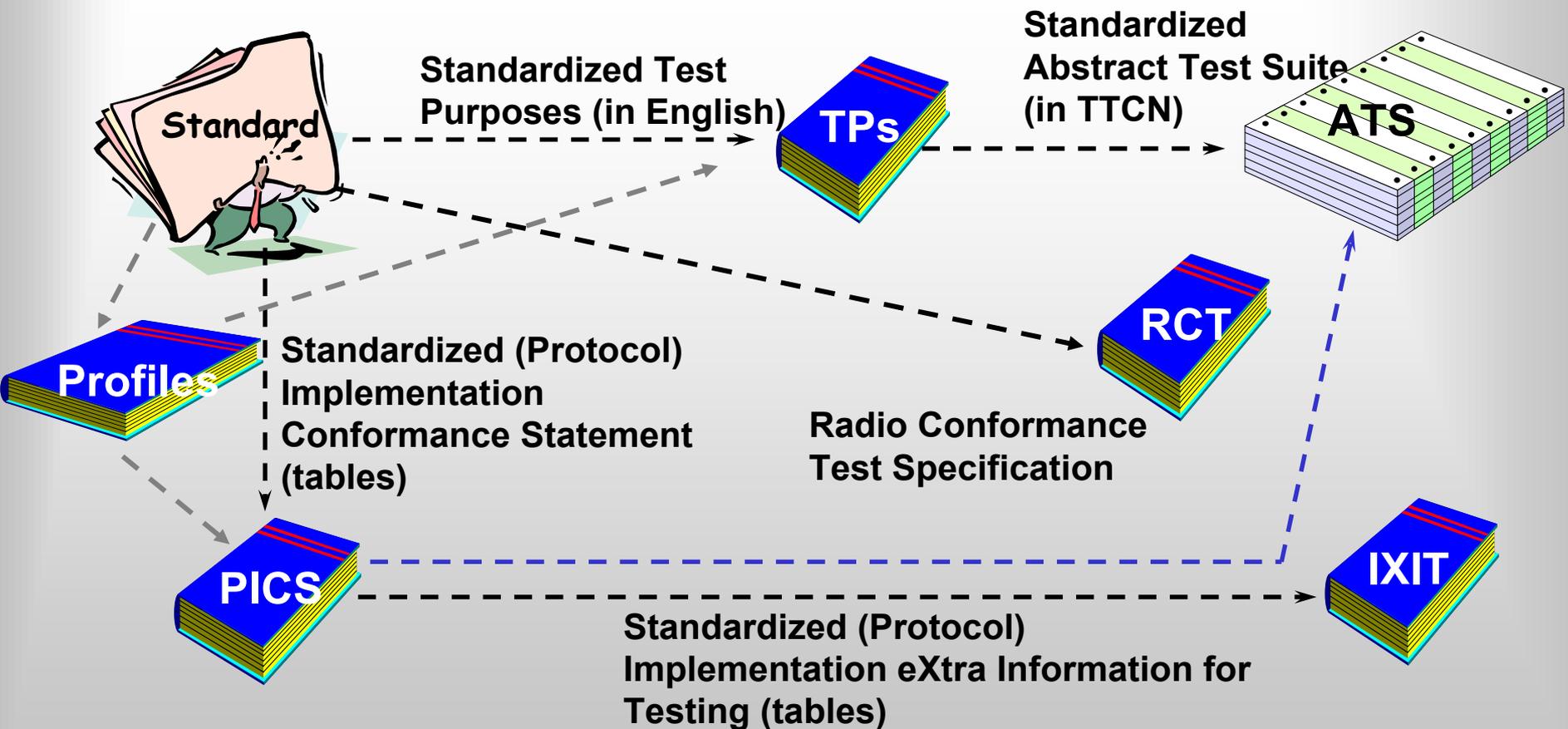


WiMAX conformance & Certification Plan



WiMAX Milestones	Completion Date
System Profiles	5/05/03
PICS (Protocol Implementation Conformance Statement)	1/30/04
Test Suite Structure Set	6/03/04
Test Cases w/Executable Test Scripts	10/13/04
Abstract Test Suites (ATS)	11/10/04
Plugfest Lab Ready	Oct/04
1st WiMAX Plugfest	Nov-Dec/04
WiMAX Certification Begins	Dec/04
2nd WiMAX Plugfest	Feb/05

Test Specifications



Certification



- **Before submitting equipment for certification**
 - **Vendor is encouraged to test for conformance in their own lab**
 - **Conformance Specifications available**
 - **Test bed setup that lab is using will be available to WiMAX Members**

 - **Vendors expected to participate in PlugFests**
 - **PlugFests will be held once every quarter**

 - **Once equipment “succeeds” in PlugFest, equipment may be submitted for formal certification to test lab**

 - **Scheduling done on a first come first serve basis**

Certification



- **During certification process**
 - **Vendor will be given full attention by test lab engineers**
 - **Firmware updates may be made by vendor engineers to fix problems on the fly and continue testing process**
 - **Process could take about 4 weeks**

Certification



- **After certification tests conclude**
 - **If Certification tests are successful**
 - **Vendor and WiMAX will receive a “Pass” PICS report-card**
 - **Vendor allowed to use “WiMAX CERTIFIED” on that model of equipment**
 - **WiMAX will publish vendor equipment name/model# on WiMAX website**
 - **If tests are not successful**
 - **Vendor may fix problems and re-submit**
 - **Vendor may work with test lab separately for debug**

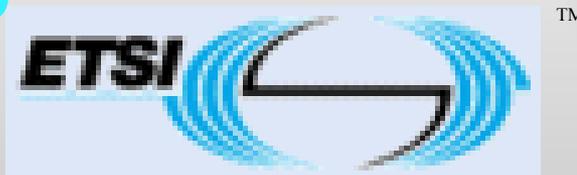
Contact



Feel free to contact any one of us for questions or input

- **Aditya Agrawal**
 - **WiMAX VP, Certification Lab Team**
 - aagrawal@fma.fujitsu.com
 - **408-737-5603**
- **Gordon Antonello**
 - **TWG Chair, Certification Lab Team**
 - gantonello@wi-lan.com
 - **403-207-6477**
- **Ed Agis**
 - **WiMAX Certification Lab Team**
 - ed.agis@intel.com
 - **805-402-8666**

Working Towards a Global interoperable standard



www.wimaxforum.org