IEEE 802

Introduction

- **IEEE 802** refers to a family of IEEE standards
  - Dealing with local area network and metropolitan area network.
  - Restricted to networks carrying variable-size packets.
  - Specified in IEEE 802 map to the lower two layers
    - Data link layer
      - LLC sublayer
      - MAC sublayer
    - Physical layer

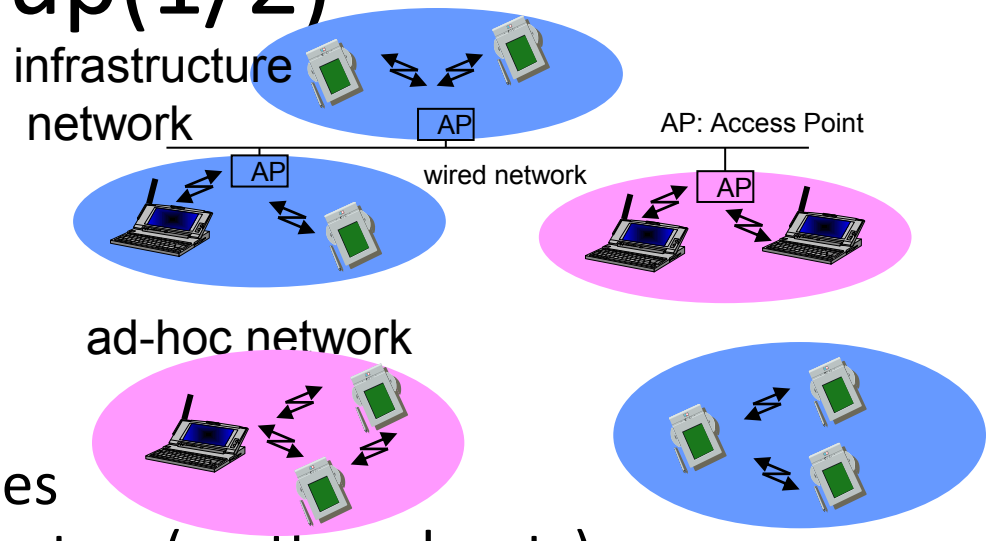
- The most widely used standards
  - The Ethernet family, Token Ring, Wireless LAN.
  - Bridging and Virtual Bridged LANs.
  - An individual Working Group provides the focus for each area.

IEEE 802 Working Groups

Active working groups		Inactive or disbanded working groups	
802.1	Higher Layer LAN Protocols Working Group	802.2	Logical Link Control Working Group
802.3	Ethernet Working Group	802.4	Token Bus Working Group
802.11	Wireless LAN Working Group	802.5	Token Ring Working Group
802.15	Wireless Personal Area Network (WPAN) Working Group	802.7	Broadband Area Network Working Group
802.16	Broadband Wireless Access Working Group	802.8	Fiber Optic TAG
802.17	Resilient Packet Ring Working Group	802.9	Integrated Service LAN Working Group
802.18	Radio Regulatory TAG	802.10	Security Working Group
802.19	Coexistence TAG	802.12	Demand Priority Working Group
802.20	Mobile Broadband Wireless Access (MBWA) Working Group	802.14	Cable Modem Working Group
802.21	Media Independent Handoff Working Group		
802.22	Wireless Regional Area Networks		

802.11 Wireless LAN Working Group(1/2)

- Types
  - Infrastructure based
  - Ad-hoc

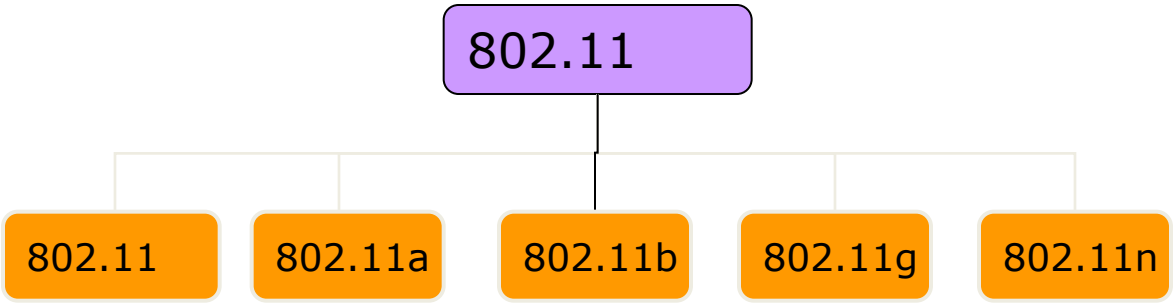


- Advantages
  - Flexible deployment
  - Minimal wiring difficulties
  - More robust against disasters (earthquake etc)

- Disadvantages
  - Low bandwidth compared to wired networks (1-10 Mbit/s)
  - Need to follow wireless spectrum regulations
  - Not support mobility

802.11 Wireless LAN Working Group(2/2)

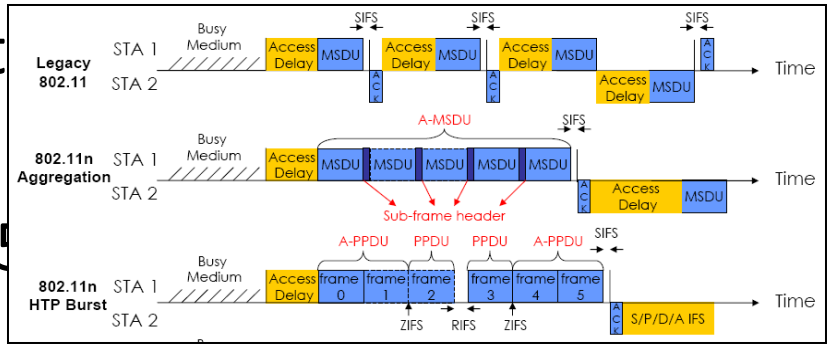
- Working Groups summary



Protocol	Release date	Op. Frequency	Data rate (Max)	Range (indoor)	Range (outdoor)
Legacy	1997	2.5~2.5 GHz	2 Mbit/s		
802.11a	1999	5.15~5.35/5.47~5.725/5.725~5.875 GHz	54 Mbit/s	~25 m	~75 m
802.11b	1999	2.4~2.5GHz	11 Mbit/s	~35 m	~100 m
802.11g	2003	2.4~2.5GHz	54 Mbit/s	~25 m	~75 m
802.11n	2007	2.4GHz or 5GHz	540 Mbit/s	~50 m	~125 m

802.11n Working Group

- What is the 802.11n?
  - Uses MIMO radio technology and OFDM as a basis
  - Anywhere from 100Mbps t
    implementation
  - Support both 2.4 GHz and 5
  - Use muiltiple stream

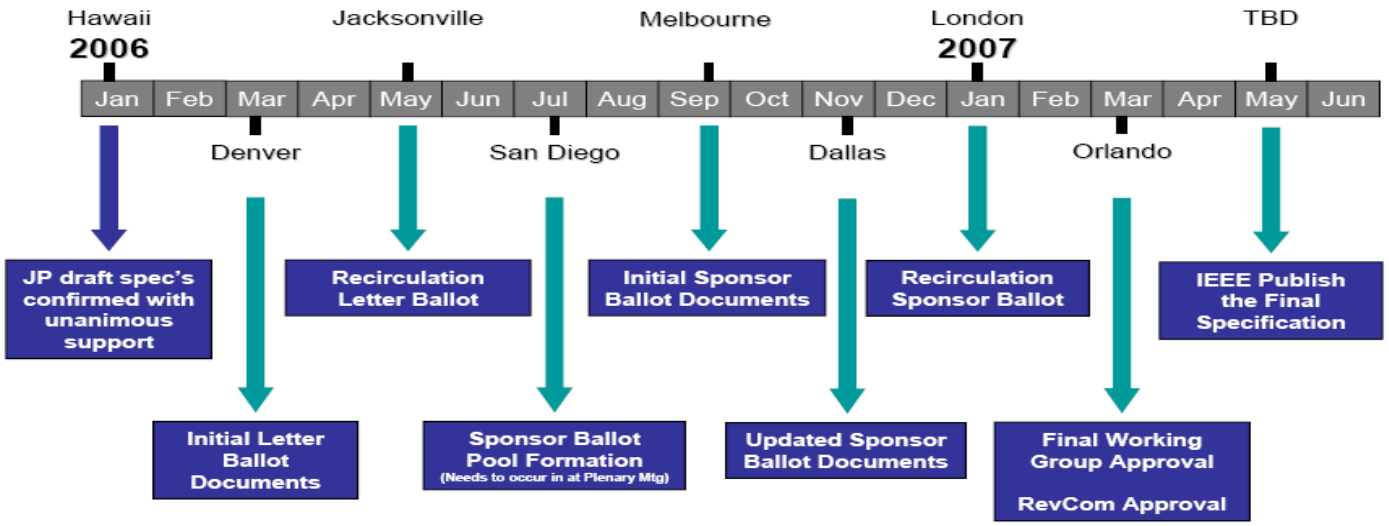


30~50% => 70%

- 802.11n increase transmission efficiency of MAC
  - Cutting guard band time in half
  - Reducing the number of pilot carrier for data

802.11n Working Group

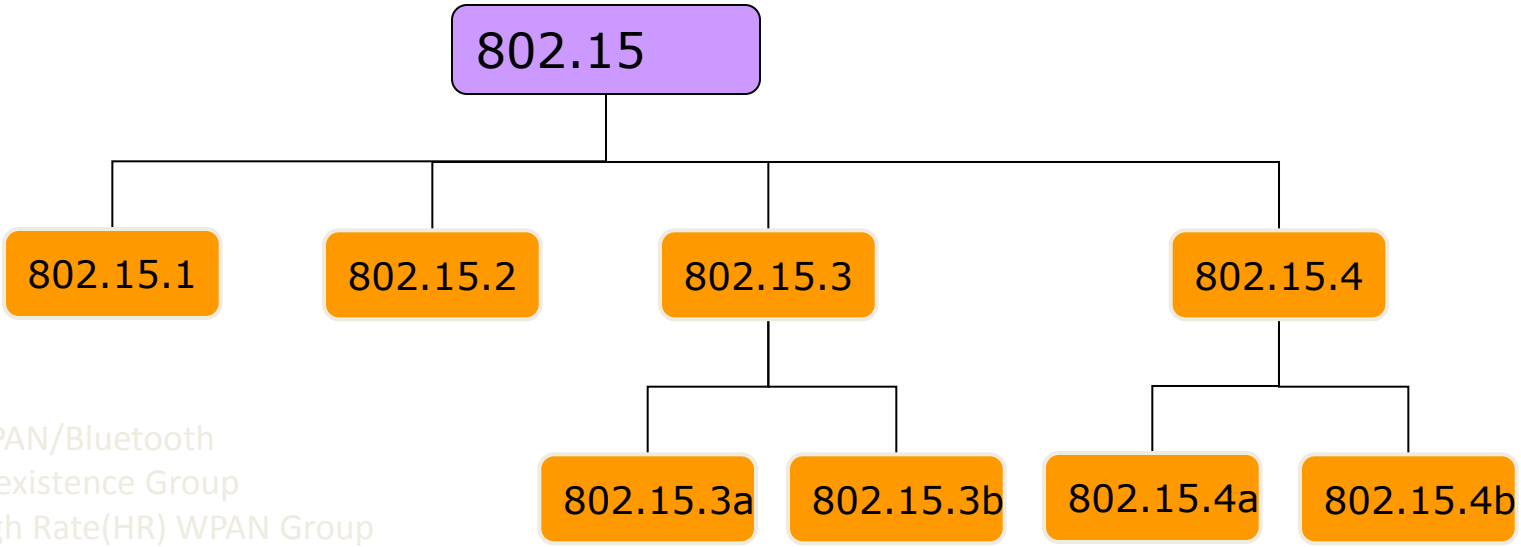
- Timeline



Draft 1.0 failed IEEE meeting ballot
IEEE record – 12,000 comments received
Draft 2.0 is now required – Orlando March 2007 IEEE Meeting
Pre-N certification program start March 2007
Result – expect ratification in early 2008

802.15 Wireless Personal Area Network(WPAN) Working Group

- Working Groups summary



- 802.15.1 : WPAN/Bluetooth
- 802.15.2 : Coexistence Group
- 802.15.3 : High Rate(HR) WPAN Group
  - 802.15.3a : WPAN HR Alternative PHY Task Group
  - 802.15.3b : MAC Amendment Task Group
- 802.15.4 : Low Rate(LW) WPAN Group(Zigbee)
  - 802.15.4a : WPAN Low Rate Alternative PHY
  - 802.15.4b : Revisions and Enhancements
- UWB Forum

Bluetooth

- What is the Bluetooth?
  - Radio modules operate in 2.45GHz. RF channels:2420+k MHz
  - Devices within 10m of each other can share up to 1Mbps
  - Projected cost for a Bluetooth chip is ~$5.
  - Its low power consumption
  - Can operate on both circuit and packet switching modes
  - Providing both synchronous and asynchronous data services

	Bluetooth	IEEE 802.11A	UWB
frequency	2.4Ghz	5GHz	3.1~10.6GHz
MAX data rate	1Mbps	54Mbps	100Mbps~1Gbps
Range	5~10m	35~50m	10~30m
The number of channel	79	12	…..

Bluetooth versions

- **Bluetooth 1.0 and 1.0B**
  - Versions 1.0 and 1.0B had many problems
    - Manufacturers had difficulty making their products interoperable.
- **Bluetooth 1.1**
  - Many errors found in the 1.0B specifications were fixed.
  - Added support for non-encrypted channels.
  - Received Signal Strength Indicator (RSSI).
- **Bluetooth 1.2**
  - Faster Connection and Discovery
  - Use the *Adaptive frequency-hopping spread spectrum (AFH)*
    - improves resistance to radio frequency interference
  - Higher transmission speeds in practice, up to 721 kbps
- **Bluetooth 2.0**
  - This version, specified November 2004
  - The main enhancement is the introduction of an enhanced data rate (EDR) of 3.0 Mbps.
  - Lower power consumption through a reduced duty cycle.
  - Simplification of multi-link scenarios due to more available bandwidth.
- **Bluetooth 2.1**
  - A draft version of the Bluetooth Core Specification Version 2.1 + EDR is now available

Ultra Wide Band(UWB)(1/2)

- What is the UWB?
  - Transmitting information spread over a large bandwidth (>500 MHz)
  - Provide an efficient use of scarce radio bandwidth
    - High data rate in WPAN connectivity and longer-range
  - A February 14, 2002
    - Report and Order by the FCC authorizes the unlicensed use of UWB
  - November of 2005.
    - ITU-R have resulted in a Report and Recommendation on UWB
  - Expected to act on national regulations for UWB very soon.

- The advantage of the UWB
  - Take advantage of inverse relationship between distance and throughput
  - Huge bandwidth : very high throughput
  - Low power consumption
  - Convenience and flexibility
  - No interference

Ultra Wide Band(UWB)(2/2)

- Current wireless Comparison

Wireless technology	Power mW	Rage meter	BW/channel	Rate bps
CDMA 1xEVDO	600	~2000	1.25 MHz	2.4M
802.16(WiMAX)	250	~4000	25MHz	120M
802.11g(WiFi)	50	~100	25MHz	54M
Bluetooth	1	~10	1MHz	<1M
UWB	<30	10~30	500MHz	100M~1G

- Key application
  - Wireless USB
  - Toys and game
  - Consumer electronics
  - Location tracking
  - Handset

802.16 Broadband Wireless Access(BWA) Working Group(1/2)

- IEEE 802.16
  - Be was established by IEEE Standards Board in 1999, aims to prepare formal specifications for the global deployment of broadband Wireless Metropolitan Area Network.
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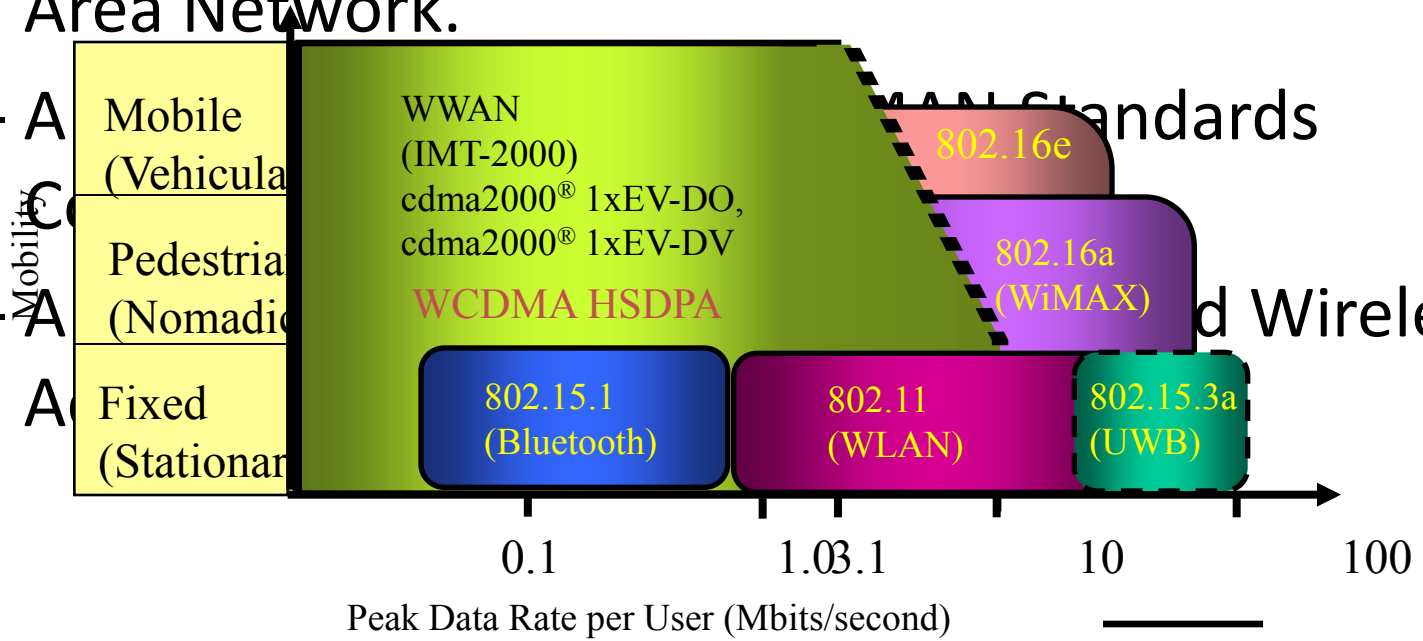
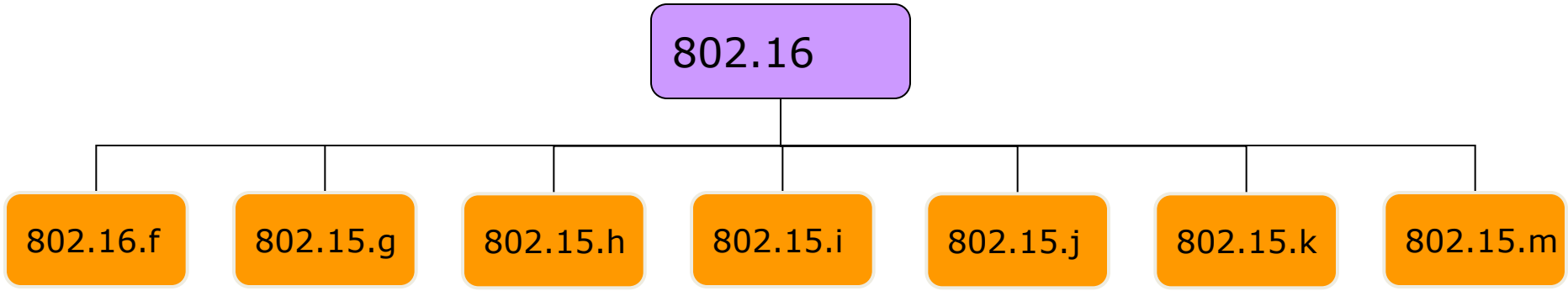


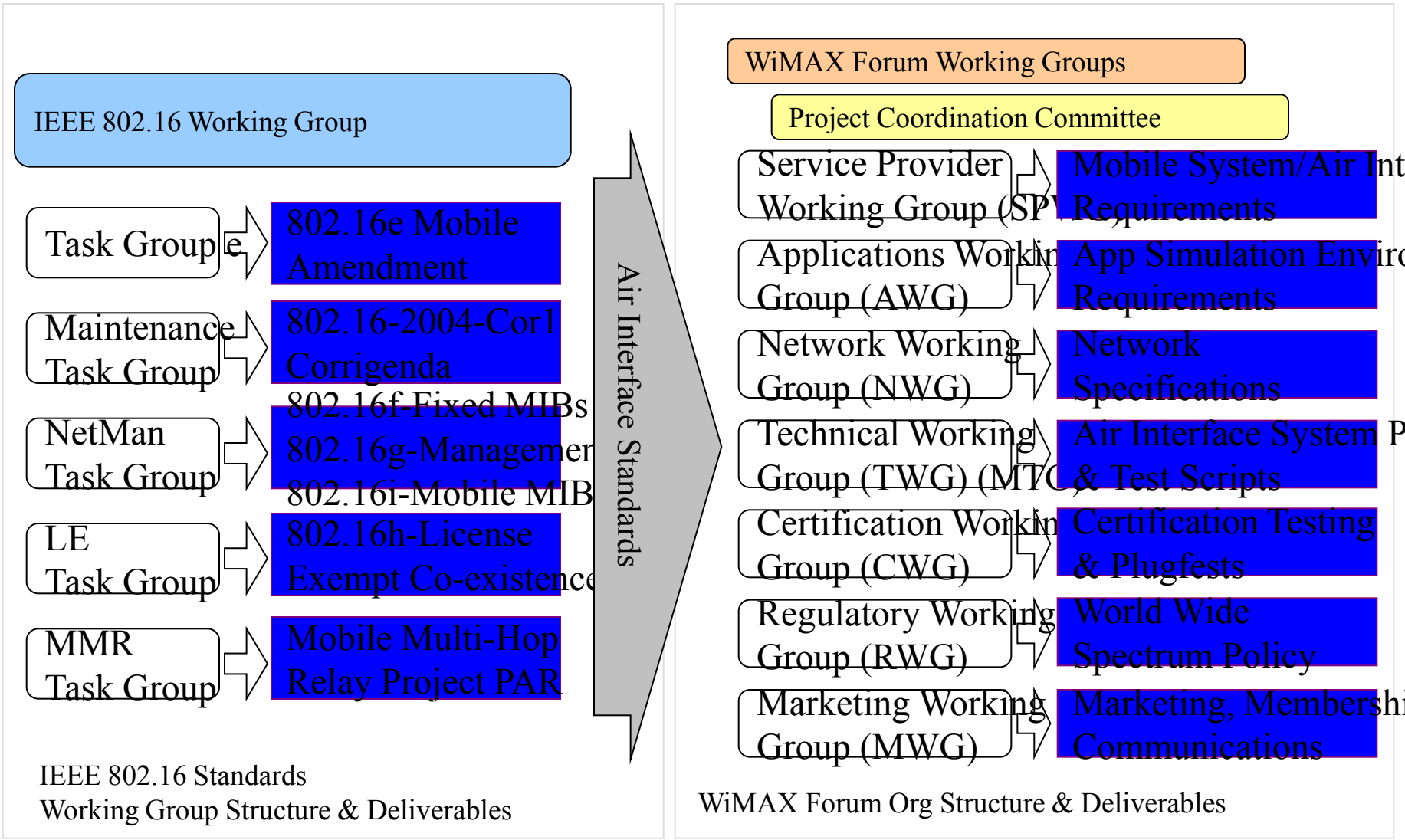
802.16 Broadband Wireless Access(BWA) Working Group(2/2)

- Working Groups summary



- 802.16f : Management Information Base
- 802.16g : Management Plane Procedures and Services
- 802.16h : Improved Coexistence Mechanisms for License-Exempt Operation
- 802.16i : Mobile Management Information Base
- 802.16j : Multihop Relay Specification
- 802.16k : Bridging of 802.16
- 802.16m : Advanced Air Interface. Data rates of 100 Mbps for mobile applications and 1 Gbps for fixed applications.

802.16 and WiMAX Forum



WiMAX Forum

- What is the WiMAX Forum ?
  - Founded in April 2001
  - Industry organization to promote IEEE 802.16 standard for broadband wireless access (BWA) and provide certification of conformance and interoperability
  - Lke WiFi Alliance for WLAN

- Principles
  - Support IEEE 802.16 standard
  - Propose and promote access profiles for their IEEE