Current IEEE 802 Standardization Efforts

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Outline

- Introduction
- History
- Organization
- Standards process
- Meetings/sessions
- Standards overview
- Outlook

Introduction

- IEEE 802 LAN/MAN Standards Committee (LMSC)
  - Generating standards for Local and Metropolitan Area Networks (LAN/MAN)
- To many of us, IEEE (in the US) is more known as an academic society!
  - More IEEE standards, e.g., IEEE 1394 for high-speed bus
  - Some IEEE 802 standards are published by ISO as international standards
- Mainly for lowest 2 years
  - Physical (PHY) and link layers including Medium Access Control (MAC)

History

- First meeting in February 1980 as IEEE Computer Society “Local Network Standards Committee”, Project 802
  - The number 802 (Feb, ’80) was coincidence?
  - Originally to standardize a LAN technology based on Ethernet with bus topology
  - Ended up standardizing Ethernet (802.3), Token Bus (802.4), and Token Ring (802.5)
- Scope has been grown up to include MANs, security, wireless, etc.

Organization and Standards Process

Organization

- LMSC is organized in a number of subgroups:
  - 802.0 Sponsor Executive Committee (SEC)
  - 802.x Working Groups (WGs)
  - 802.x Technical Advisory Groups (TAGs)
  - 802.x WG generates 802.x standards
  - Up to 802.22 today
  - Many of today's active WGs and TAGs are wireless groups

Active WGs and TAGs

- 802.1 High Level Interface (HILI) WG
- 802.3 CSMA/CD WG
- **802.11 Wireless LAN (WLAN) WG (since ’91)**
- **802.15 Wireless Personal Area Network (WPAN) WG**
- **802.16 Broadband Wireless Access (BBWA) WG**
- 802.17 Resilient Packet Ring (RPR) WG
- **802.18 Radio Regulatory TAG**
- **802.19 Coexistence TAG**
- **802.20 Mobile Wireless Access WG**
- **802.21 Media Independent Handover WG**
- **802.22 Wireless Regional Area Network (WRAN) WG**

Other WGs and TAGs

- Hibernating WGs (standards published, but inactive)
  - 802.2 Logical Link Control (LLC) WG
  - 802.5 Token Ring WG
  - 802.12 Demand Priority WG
- Disbanded WGs and TAGs (all standards withdrawn or did not publish a standard)
  - 802.4 Token Bus WG
  - 802.6 Metropolitan Area Network (MAN) WG
  - 802.7 Broadband TAG (BBTAG)
  - 802.8 Fiber Optics TAG (FOTAG)
  - 802.9 Integrated Services LAN (ISLAN) WG
  - 802.10 Standard for Interoperable LAN Security (SILS) WG
  - 802.14 Cable-TV Based Broadband Communication Network WG

New Group Establishment

- For standard, recommended practice, and guide
- First, a Study Group (SG) is formed
  - Investigating a new area for new standard
  - Generates Project Authorization Request (PAR) and 5 Criteria for 6 months
  - Within a WG or independently
- An approved new project out of a SG is established as
  - A new WG, e.g., 802.nn, or
  - A new Task Group (TG) within a WG/TAG, e.g., Task Group x (or TGx) for 802.11x or Task Group n for 802.15.n

Standards Process

1. A SG generates and submits PAR
   - A draft PAR is voted on by SEC and IEEE Standards Board New Standards Committee (NesCom)
2. A WG or TG solicits and discusses proposals
   - Lots of technical discussion/presentations are involved during the selection process
3. A draft standards is generated, and voted on
   - Via (many) WG letter ballots by WG voting members
   - Once ballot passes (i.e., >75% yes), recirculation ballot stage continues with fixed voting pool
4. The draft goes for (many) Sponsor Ballots
   - By IEEE Standard Association (SA) members
5. New standard or amendment published
   - After IEEE Standards Board Standards Review Committee (RevCom) approvals

Patent Issue

- IEEE standards are not royalty free!
  - Could be if patentee promises it during the standards process
- IEEE standards may include known essential patents (or application) if the patentee assures that
  - Patentee shall not enforce patent usage against person complying standard, or
  - Patentee will grant license under reasonable rates, with reasonable terms and conditions without any unfair discrimination.

Meetings / Sessions

- 3~6 face-to-face meetings per year
- 3 plenary sessions (~1,500 people)
  - All 802 WGs meet together
  - Opening plenary session in Monday morning
  - March, July, November
- Possibly 3 interim sessions
  - Up to individual WGs
    - .11, .15, .21, .22 meet together
    - .16 interim meetings are usually held separately
  - January, May, September
- Possibly many teleconferences and ad-hoc meetings in between
  - Up to individual TGs mostly

Typical Plenary Session Schedule

Sun	all day: some Working Group meetings* 5pm-8pm: registration
Mon	8am-10:30am: Opening Executive Committee meeting 8am-10:30am: some Working Group meetings 11am-noon: Opening Plenary meeting 1pm-6:00pm*: Working Group meetings 6:30pm-9:30pm: tutorials
Tue	8am-6pm*: Working Group meetings 6:30pm-9:30pm: tutorials
Wed	8am-6pm*: Working Group meetings 6:30 pm-9:30pm: Social Reception
Thu	8am-6pm*: Working Group meetings
Fri	8am-noon: Working Group meetings 1pm–6pm: Closing Executive Committee meeting

More about Meetings

- Executive Committee meetings are open to everyone
- Monday and Tuesday evening tutorials are often used to publicize a potential new standard
- The real work of the plenary session happens in the individual Working Group meetings, with some Working Groups split into several subgroups during part of the week
- Working Group meetings often last until 10pm!

Membership and Procedure

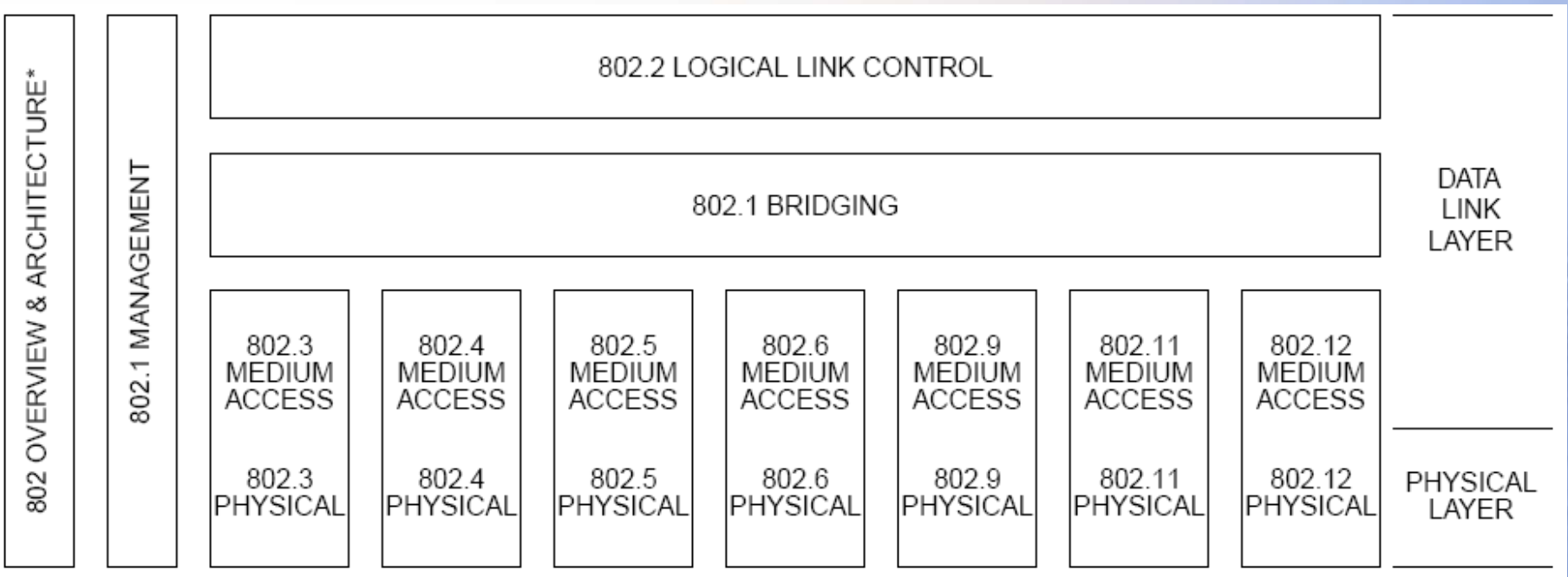
- Individual voting membership is by WG/TAG
  - After attending two of last four plenary sessions
  - Interim sessions of a WG/TAG may be counted
  - Attendance means presence in at least 75% of the meetings in a WG/TAG session
  - Note1: IEEE started having entity-based (i.e., company) membership as well, e.g., IEEE 1901 PLC
  - Note2: Anyone can become an IEEE Standard Association (SA) member to participate in sponsor ballots
- Working style of a WG/TAG depends
  - On number of members and subject at hand
  - With some topics decided informally while others through letter ballots
  - Robert's Rule of Order (used in US Congress)

Documents

- During meetings:
  - No paper documents used
  - Electronic documents distributed via WLAN
- Standard proposals:
  - Can be downloaded from WG homepage, ftp, etc.
- Draft standards:
  - Available for voting members
  - Some drafts can be purchased from IEEE
- Standard specifications:
  - Can be purchased from IEEE, e.g., digital library
  - Freely available at after six months from publication


IEEE 802 Standards Overview

IEEE 802 Architecture



- 802.1x and 802.2 are common across all 802.x technology
- 802.x defines its own MAC and PHY

IEEE 802.1

- Working areas:
  - 802 LAN/MAN architecture
  - Internetworking among 802 LANs, MANs, etc.
  - 802 security
  - 802 overall network management
  - Protocol layers above MAC & LLC layers
- Widely used standards:
  - 802.1D MAC bridge
    - Used for Ethernet switch, WLAN AP
  - 802.1Q Virtual LANs
  - 802.1X Port Based Network Access Control
    - Used for WLAN access control, e.g., user authentication in KT NESPOT

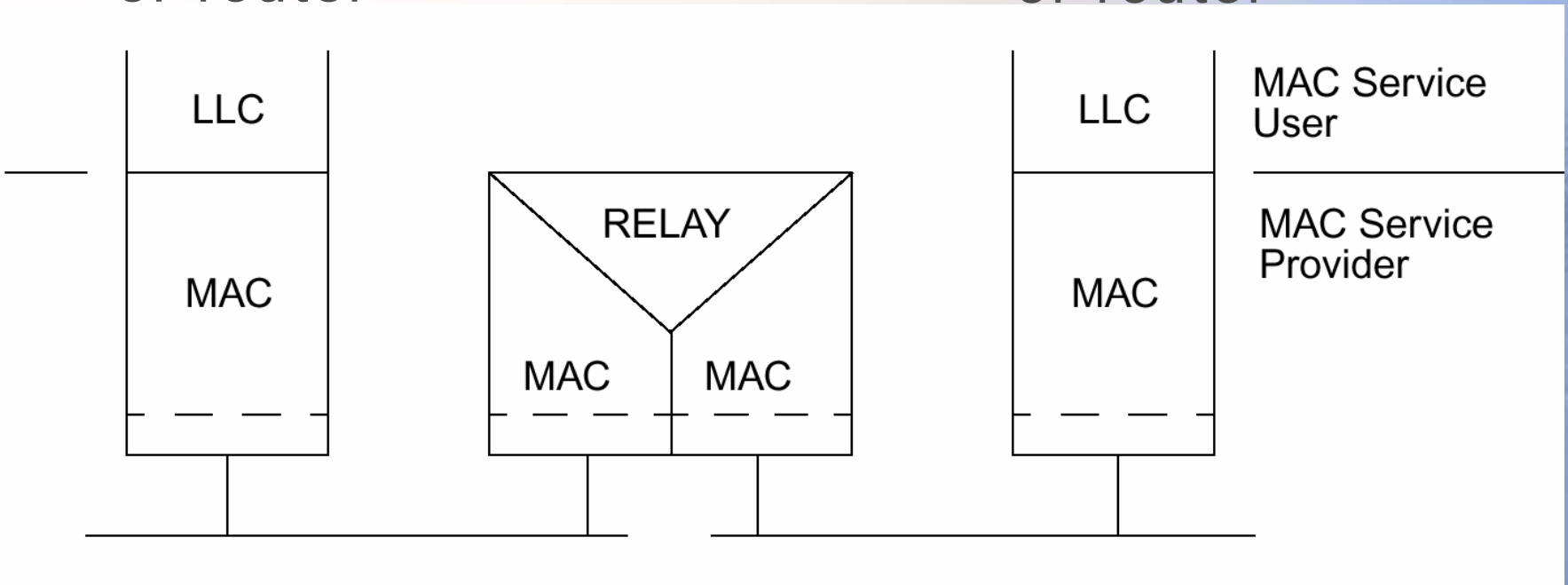
802.2 Logical Link Control (LLC)

- Completed and published standard
- Interface between 802.x MAC and layer 3
  - Provides multiplexing to different layer 3 protocols
- 3 types of services
  - Unacknowledged connectionless-mode
    - Used for 802.11 and Ethernet
  - Connection-mode
  - Acknowledged connectionless-mode

MAC vs. .2 LLC and .1d Bridge

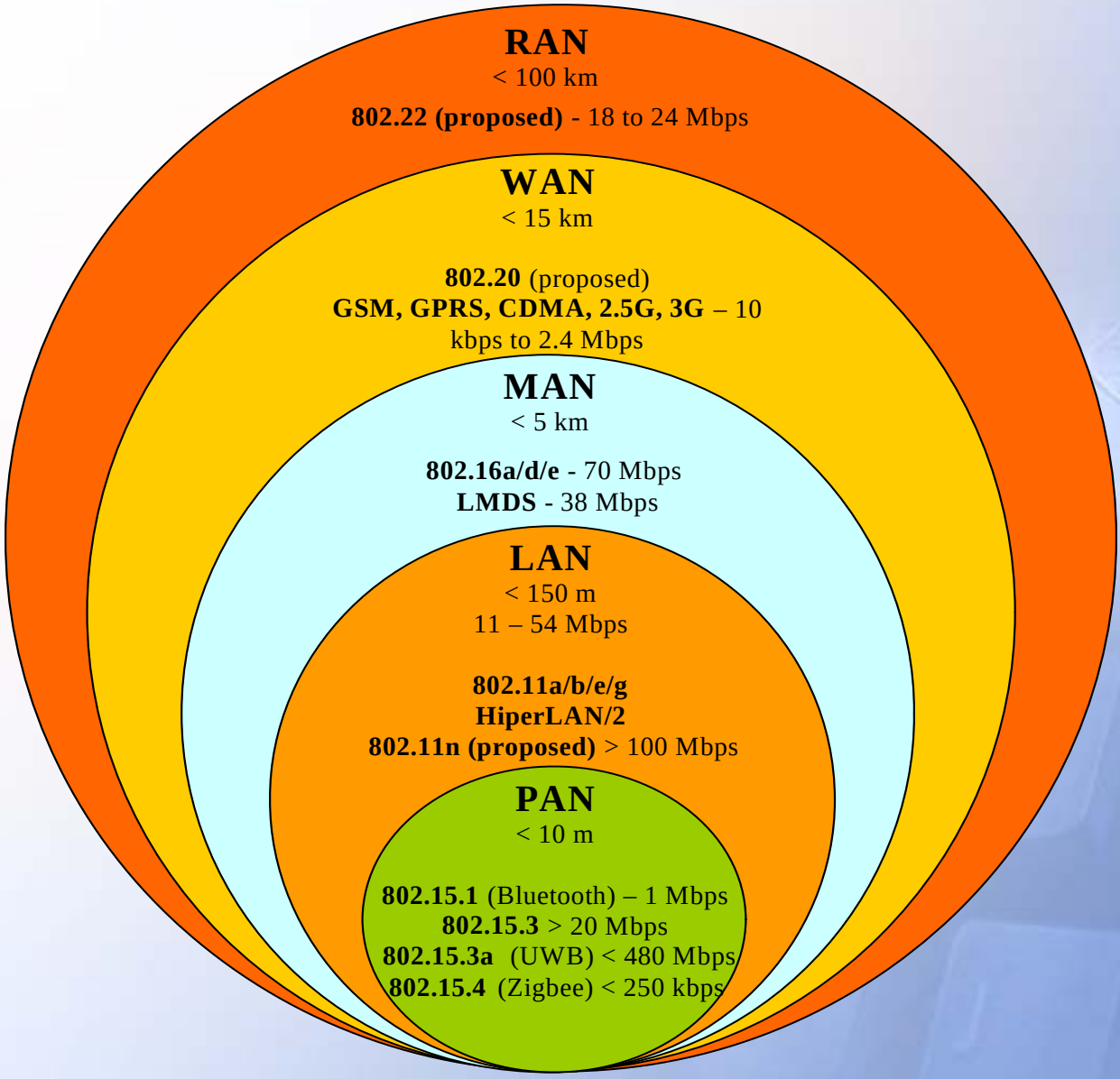
End host
or router

End host
or router



MAC bridge
e.g.) Ethernet switch, AP

Various 802 Wireless Solutions



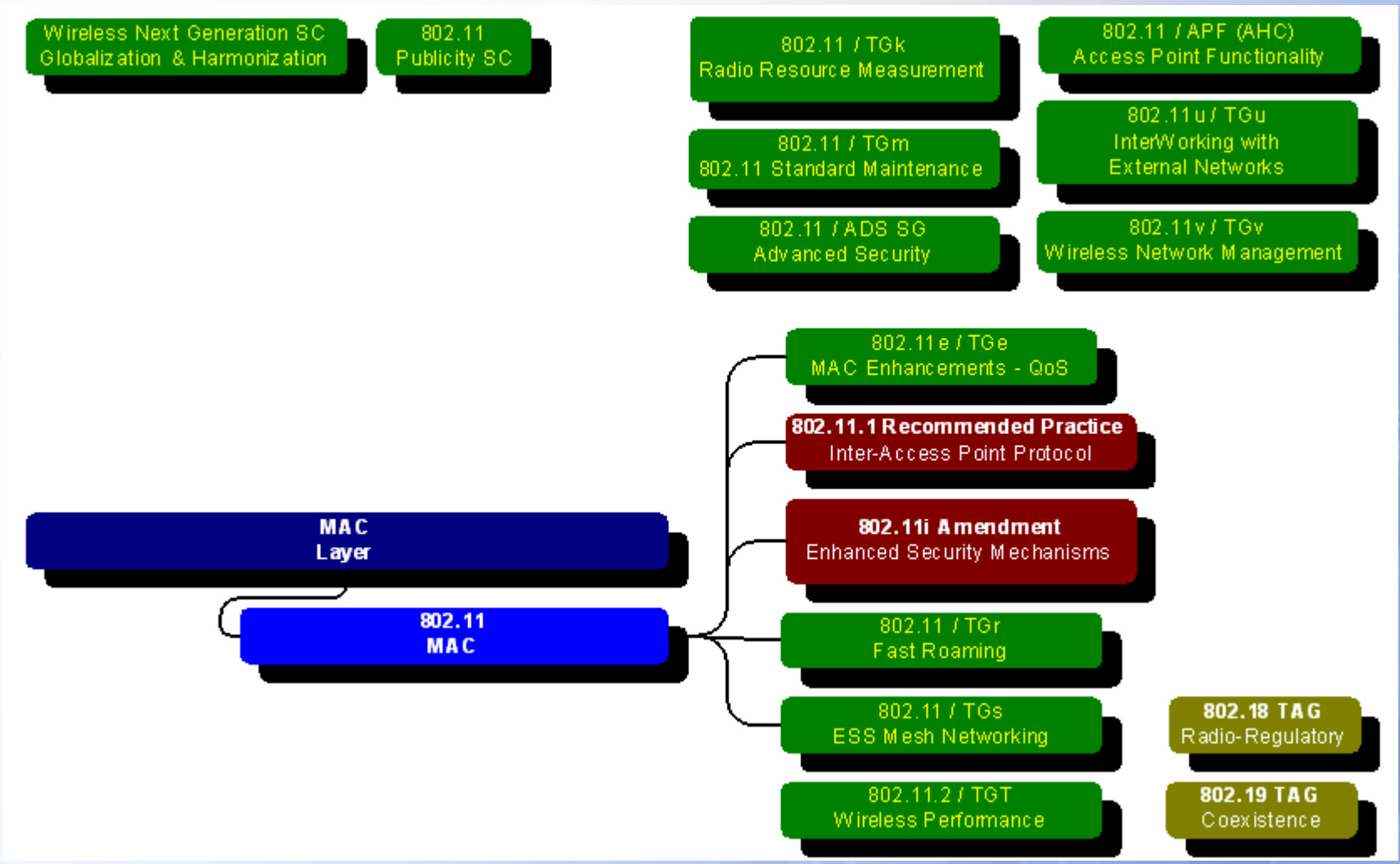
802.11 Wireless Local Area Network (WLAN) (1)

- Most well-known and successful wireless standard within IEEE 802
  - Started in 1991; known as the Wireless Ethernet, and now experiencing its evolution
- Selected recent developments
  - .11e Quality of Service (2005)
  - .11i Security Enhancement (2004)
  - .11g High Data Rate @2.4 GHz (2003)
- .11x is an amendment of the baseline protocols (1997)
  - Other than new PHYs at different band, new spec is backward compatible with old ones

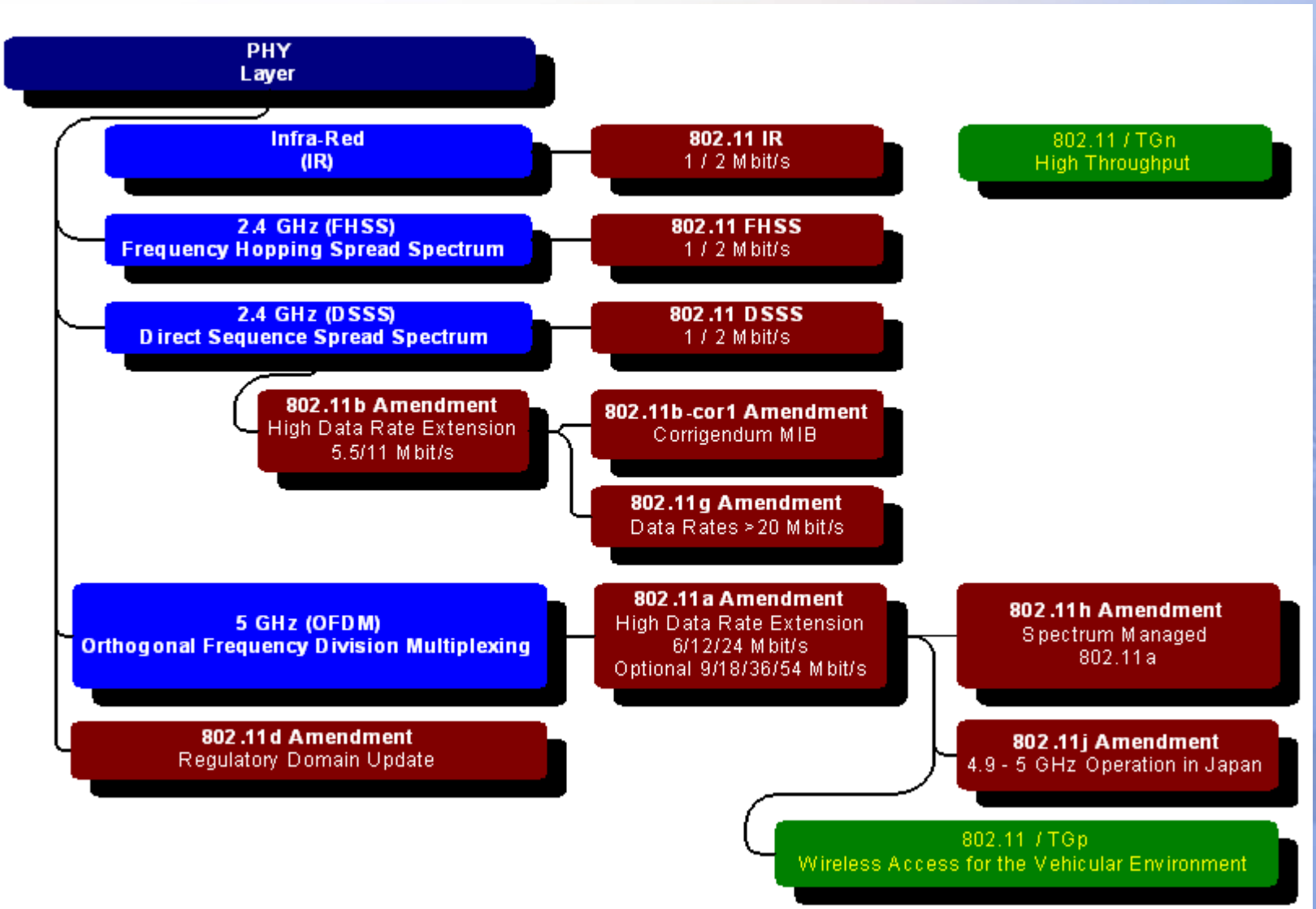
802.11 Wireless Local Area Network (WLAN) (2)

- List of all on-going efforts
  - .11k Radio Resource Measurement Enhancements
  - .11n Enhancements for Higher Throughput
  - .11p Wireless Access for the Vehicular Environment (WAVE)
  - .11s Mesh Network
  - .11t (Recommended Practice for) Evaluation of 802.11 Wireless Performance
  - .11u Interworking with External Networks
  - .11v Wireless Network Management
  - .11w Protected Management Frames
  - To-be-.11y Contention-Based Protocol (CBP)

802.11 MAC


Wireless Next Generation SC
Globalization & Harmonization
802.11
Publicity SC
802.11 / TGk
Radio Resource Measurement
802.11 / APF (AHC)
Access Point Functionality
802.11 / TGm
802.11 Standard Maintenance
802.11u / TGu
InterWorking with
External Networks
802.11 / ADS SG
Advanced Security
802.11v / TGv
Wireless Network Management
802.11e / TGe
MAC Enhancements - QoS
802.11.1 Recommended Practice
Inter-Access Point Protocol
MAC
Layer
802.11i Amendment
Enhanced Security Mechanisms
802.11
MAC
802.11 / TGr
Fast Roaming
802.11 / TGs
ESS Mesh Networking
802.18 TAG
Radio-Regulatory
802.11.2 / TGT
Wireless Performance
802.19 TAG
Coexistence

802.11 PHY


PHY
Layer
Infra-Red
(IR)
802.11 IR
1 / 2 Mbit/s
802.11 / TGn
High Throughput
2.4 GHz (FHSS)
Frequency Hopping Spread Spectrum
802.11 FHSS
1 / 2 Mbit/s
2.4 GHz (DSSS)
Direct Sequence Spread Spectrum
802.11 DSSS
1 / 2 Mbit/s
802.11b Amendment
High Data Rate Extension
5.5/11 Mbit/s
802.11b-cor1 Amendment
Corrigendum MIB
802.11g Amendment
Data Rates >20 Mbit/s
5 GHz (OFDM)
Orthogonal Frequency Division Multiplexing
802.11a Amendment
High Data Rate Extension
6/12/24 Mbit/s
Optional 9/18/36/54 Mbit/s
802.11h Amendment
Spectrum Managed
802.11a
802.11d Amendment
Regulatory Domain Update
802.11j Amendment
4.9 - 5 GHz Operation in Japan
802.11 / TGp
Wireless Access for the Vehicular Environment

802.15 Wireless Personal Area Network (WPAN)

- Different protocol families
  - .15.1 (2002) @2.4 GHz = Bluetooth v1.1
    - Tx rates of < 1 Mbps
  - .15.3 High Rate WPAN (2003) @2.4 GHz
    - Tx rates of < 55 Mbps
  - .15.4 Low Rate WPAN (2003) @800/900MHz & 2.4 GHz
    - Tx rates of 250, 40, and 20 kbps
- Other groups/protocols
  - .15.2 (2003) (Recommended practice for) co-existence with WLAN
  - .15.5 (on-going) Mesh Networking

802.15 On-Going Standards (1)

- .15.3 High Rate WPAN
  - .15.3a – Ultra Wide Band (UWB)
    - In Jan. 2006, decided to end the group without standards due to lack of agreement
    - Had two competing proposals; Multi-Band (MB) OFDM and DS-CDMA
    - Two competing groups will fight with non-standard products in the market!
    - The winner might return to IEEE 802.15 for standardization
  - .15.3c – mmWave @57-64 GHz unlicensed band
    - Tx rate of > 2 Gbps (optionally, 3 Gbps)
    - Targeted first letter ballot in Jan. 2007

802.15 On-Going Standards (2)

- .15.4 Low Rate WPAN
  - .15.4a – Alternative PHYs
    - The first letter ballot “passed” in Jan. 2006
    - UWB (for precision ranging/location capability)
    - Chirp Spread Spectrum @2.4 GHz
  - .15.4b – Revision and Enhancement
    - Revision of the original .15.4 protocols
- .15.5 Mesh Networking
  - Mesh networking for both .15.3x and .15.4x
  - Might need different approaches for different PHY/MAC
  - Currently in proposal discussion phase

802.16 Wireless Metropolitan Area Network (WMAN)

- Started in July 1999
  - For “Last Mile” connectivity support
- Originally for building-to-building networking, and now for mobile (.16e) as well
  - .16e is a superset of WiBro in Korea!
  - .16(e) defines centralized MAC, TDD/FDD, & OFDMA/TDMA (using Single Carrier & OFDM)
  - WiBro is for TDD/OFDMA @2.3 GHz licensed band
- Status:
  - 802.16e/D12 is approved in Dec. 2005!

802.16 Standards

- Active approved standards
  - .16 (2004) Air Interface for Fixed Broadband
  - .16f (2005, amendment of .16-2004) Management Information Base
  - .16.2 (2004) Coexistence
  - .16/Conformance01-03 (2003, 2003, 2004)
- Recently developed/approved drafts
  - .16e Mobile Operation in Licensed Bands
  - .16-2004/Cor1
- Note: should be careful since many old standards are superseded by new one!

802.15 Active Groups

- Network Management (NetMan) Task Group
  - Working on .16g/i
- Conformance Task Group
  - Working on .16/Conformance04
- License-Exempt (LE) Task Group
  - Working on .16h
- Mobile Multi-hop Relay (MMR) Study Group
  - To-be-.16j in early 2006

802.16 On-Going Standardization

- .16g Management Plane Procedures and Services
  - Enhancements to .16-2004 & 802.16e to create standardized procedures and interfaces for the management of conformant 802.16 devices
- .16h Improved Coexistence Mechanisms
  - Improved mechanisms to enable coexistence among license-exempt .16 systems and to facilitate the coexistence of such systems with primary users
- .16i Mobile Management Information Base
  - Mobility enhancements to 802.16 MIB for the MAC, PHY and associated management procedures
- To-be-.16j Mobile Multi-hop Relay
  - OFDMA PHY and MAC enhancements to .16 for licensed bands to enable the operation of relay stations

802.20 Mobile Broadband Wireless Access (MBWA) (1)

- **Mission**
  - The mission of IEEE 802.20 is to develop the specification for an efficient packet based air interface that is optimized for the transport of IP based services.
- **Scope**
  - 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.

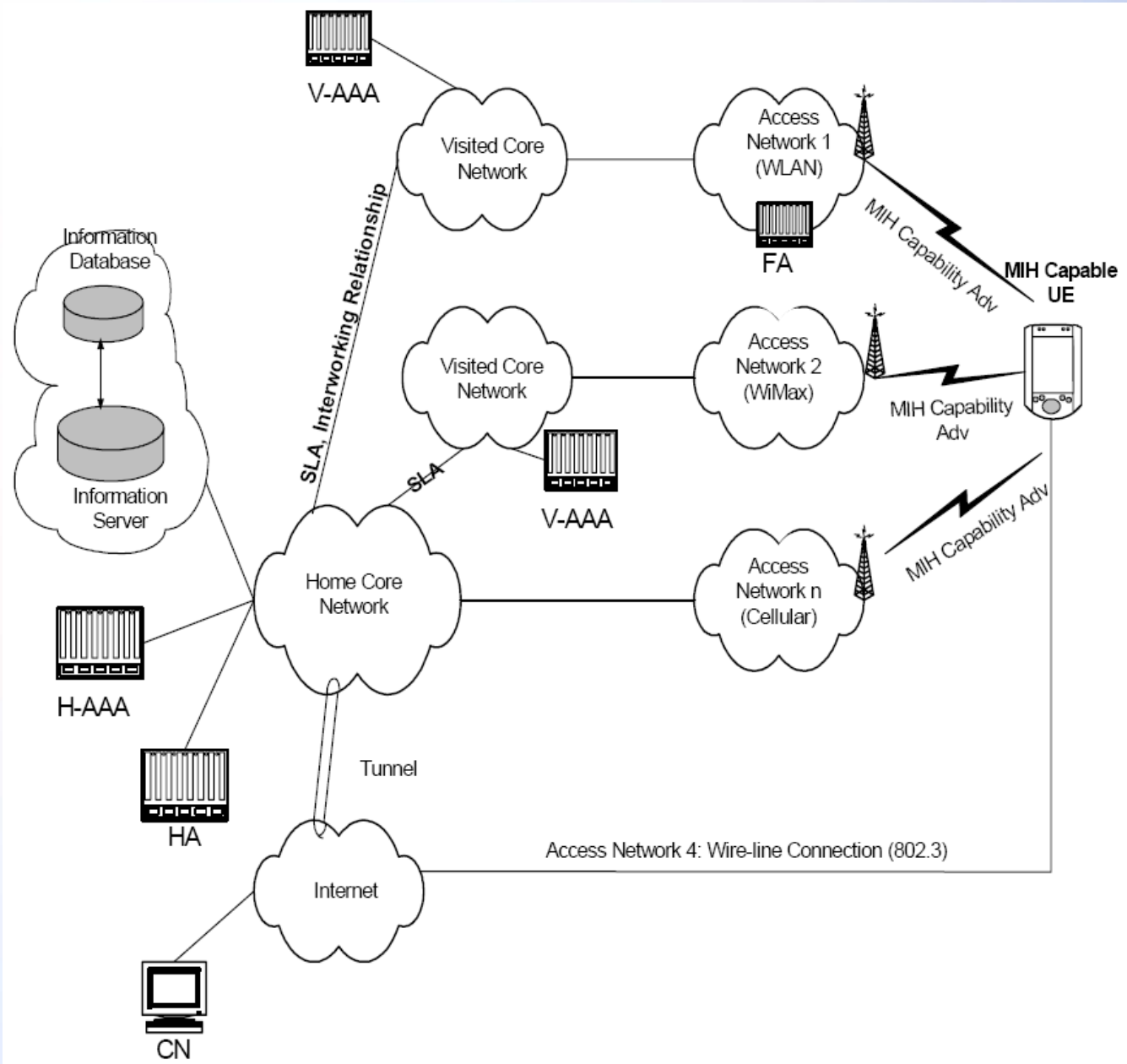
802.20 Mobile Broadband Wireless Access (MBWA) (2)

- Dominated by Qualcomm (acquired Flarion)
  - With over 75% pro-Qualcomm members
- History
  - Initiation: Dec. 2002 (mainly by Flarion and ArrayComm)
  - Call for proposal: Sept. 2005
  - Proposal presentation: Nov. 2005
  - Adopting proposal & issuing letter ballot: Jan. 2006
- Anticipation
  - .20 will be another standard of Qualcomm
  - .20 will be a big threat to .16e/Wibro
  - The question is when it will be finalized

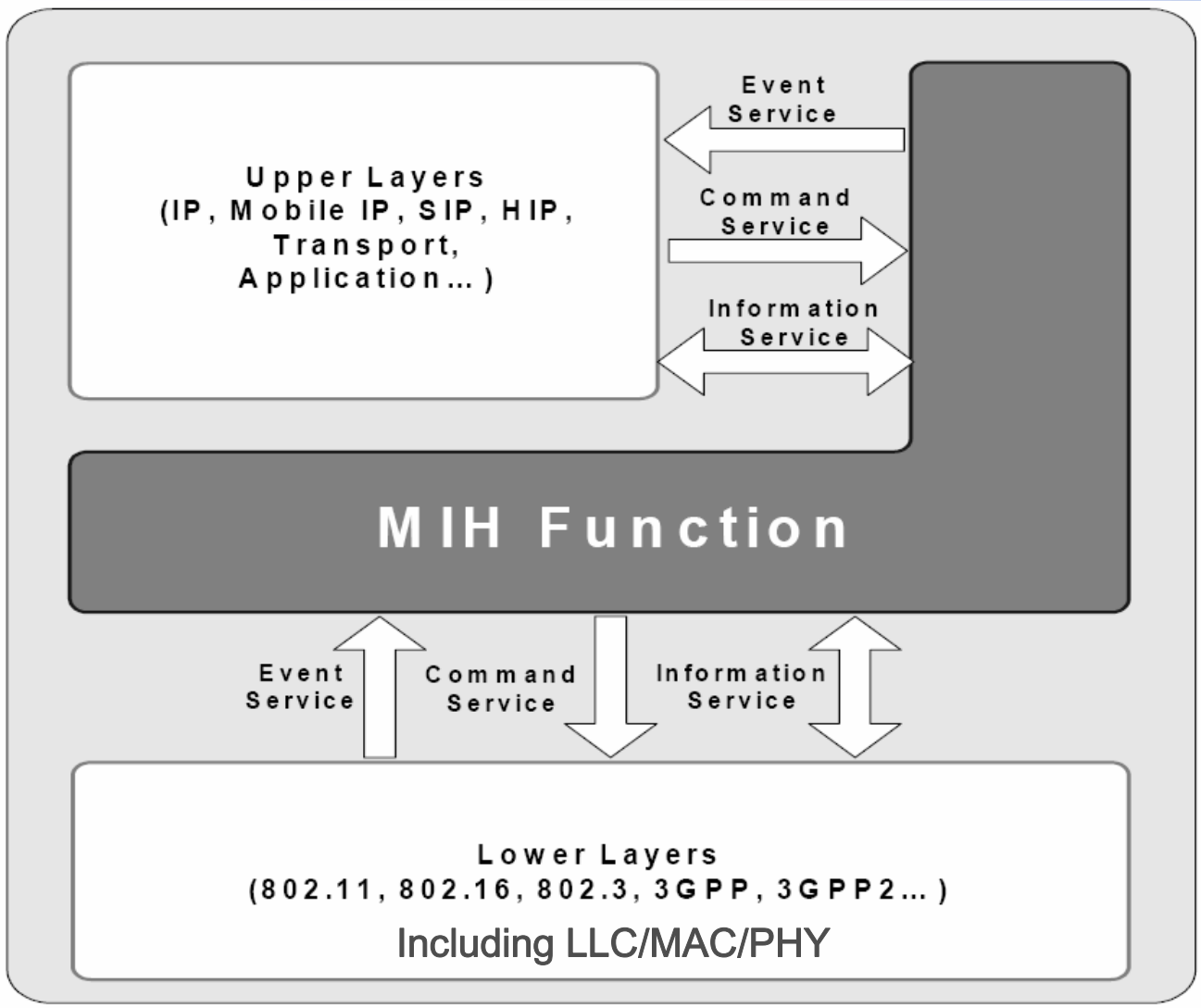
802.21 Media Independent Handover (MIH)

- Scope:
  - To develop a specification that provides link layer intelligence and other related network information to upper layers to optimize handovers between heterogeneous media. This includes links specified by 3GPP, 3GPP2 and both wired and wireless media in the IEEE 802 family of specifications.
  - For handover initiation and preparation, NOT the handover execution!
- Status:
  - Draft 802.21/D0.04 (Nov. 2005) is available

MIH Logical Network Reference



MIH Function Location and Key Services



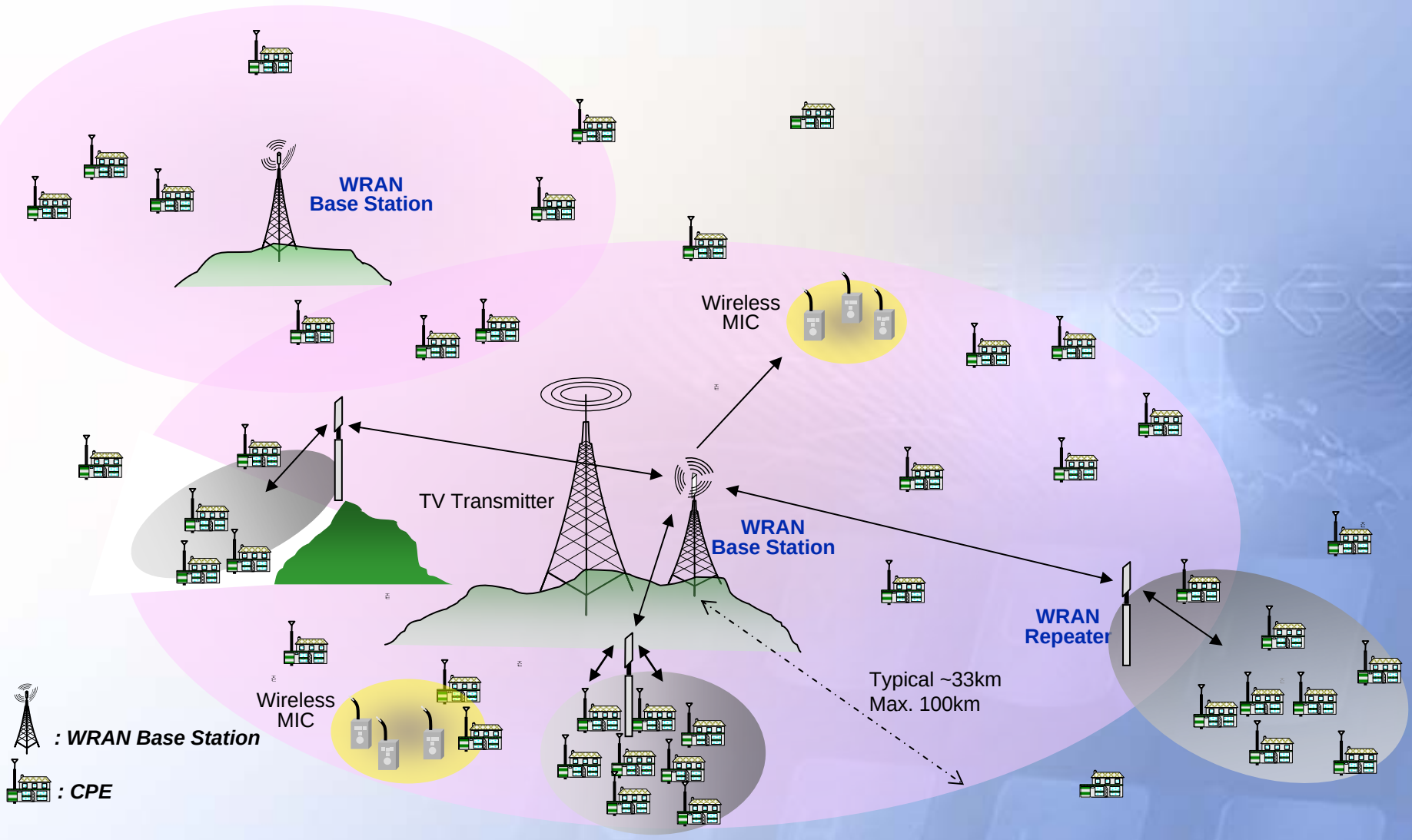
802.22 Wireless Regional Area Network (WRAN) (1)

- **Charter**
  - The charter of IEEE 802.22 is to develop a standard for a cognitive radio-based PHY/MAC/air_interface for use by license-exempt devices on a non-interfering basis in spectrum that is allocated to the TV Broadcast Service.
- **Scope**
  - This standard specifies the air interface, including the medium access control layer (MAC) and physical layer (PHY), of fixed point-to-multipoint wireless regional area networks operating in the VHF/UHF TV broadcast bands between 54 MHz and 862 MHz.

802.22 Wireless Regional Area Network (WRAN) (2)

- PAR approved in Sept. 2004
- Issues:
  - Tx range of <100 km (~33 km typical)
  - Avoiding collisions with TV signals and wireless microphones
- Some technical numbers
  - From 18 Mbps to 24 Mbps
  - Propagation delays in excess of 300 μs
  - Operates in TV bands
    - 54 to 862 MHz
    - 6 MHz, 7 MHz and 8 MHz channel bandwidth

WRAN Deployment Scenario



IEEE 802 Groups vs. Industry

- Industry association/alliance
  - Promotion of 802.x technology
  - Certifying 802.x-based products after interoperability test
  - Also possibly defining higher layer protocols along with application profiles
- Examples
  - 802.11 vs. Wi-Fi
  - 802.15.1 vs. Bluetooth (?)
  - 802.15.3 vs. WiMedia
  - 802.15.4 vs. ZigBee
  - 802.16 vs. WiMAX

Summary

- IEEE 802 LMSC has been there over 25 years
  - It has recently become one of the hottest standard groups!
- Especially, it generates many hot wireless standards today
  - By attracting lots of interest and participants
- Expect to observe/experience some 4G revolution in this group

Further Information

- More information in group homepages
  - http://www.ieee802.org
  - http://www.ieee802.org/xx
  - E.g., http://www.ieee802.org/11

- Thank you !!!