IEEE Project 802.16m as an IMT-Advanced Technology

IEEE 802.16 Working Group on Broadband Wireless Access

IEEE 802.16

- A Working Group:
  - The IEEE 802.16 Working Group on Broadband Wireless Access
  - Develops and maintain a set of standards
- The Working Group's core standard
  - IEEE Std 802.16: Air Interface for Broadband Wireless Access Systems
    - The WirelessMAN® standard for Wireless Metropolitan Area Networks

IEEE 802.16 Working Group

- Developing IEEE Std 802.16 in stages since 1999
  - IP-based interface
  - MIMO OFDMA standardized since 2003
- Meets six times a year, around the globe
  - Session #57: September 2008 (Kobe, Japan)
  - ~420 participants
- Membership attained by sustained participation
  - Currently 456 Members
- Worldwide participation
  - Member addresses include Canada, China, Egypt, Finland, France, Germany, India, Israel, Italy, Japan, Korea, Netherlands, Russia, Singapore, Sweden, Taiwan, UK, USA

IEEE 802.16 and ITU

- IEEE: Sector Member of ITU-R
  - "Regional and other International Organizations"
- fixed wireless access
  - Rec. F.1763: IEEE 802.16 in the fixed service
- land mobile radio:
  - Rec. M.1801: IEEE 802.16 in mobile service
- IMT-2000:
  - Rec. M.1457 includes OFDMA TDD WMAN
    - Based on IEEE Std 802.16
    - Implementation profile developed by WiMAX Forum

IEEE Project 802.16m

- Authorized standards development project since December 2006

- Title: “Air Interface for Fixed and Mobile Broadband Wireless Access Systems – Advanced Air Interface”

- Scope: “This standard amends the IEEE 802.16 WirelessMAN-OFDMA specification to provide an advanced air interface for operation in licensed bands. It meets the cellular layer requirements of IMT-Advanced next generation mobile networks. This amendment provides continuing support for legacy WirelessMAN-OFDMA equipment.”

IEEE Project 802.16m: Key Documents

- P802.16m PAR and Five Criteria Statement
  - Project Authorization: Scope, Purpose, deadline, etc.
- Project 802.16m Work Plan
  - timeline
- Project 802.16m System Requirements Document (SRD)
  - high-level system requirements for 802.16m project ("Stage 1")
- Project 802.16m System Description Document (SDD)
  - system level description based on the SRD ("Stage 2")
- Project 802.16m Evaluation Methodology Document (EMD)
  - link-level and system-level simulation models and parameters
- Draft P802.16m standard
  - "Stage 3"
  - Development beginning in November 2008

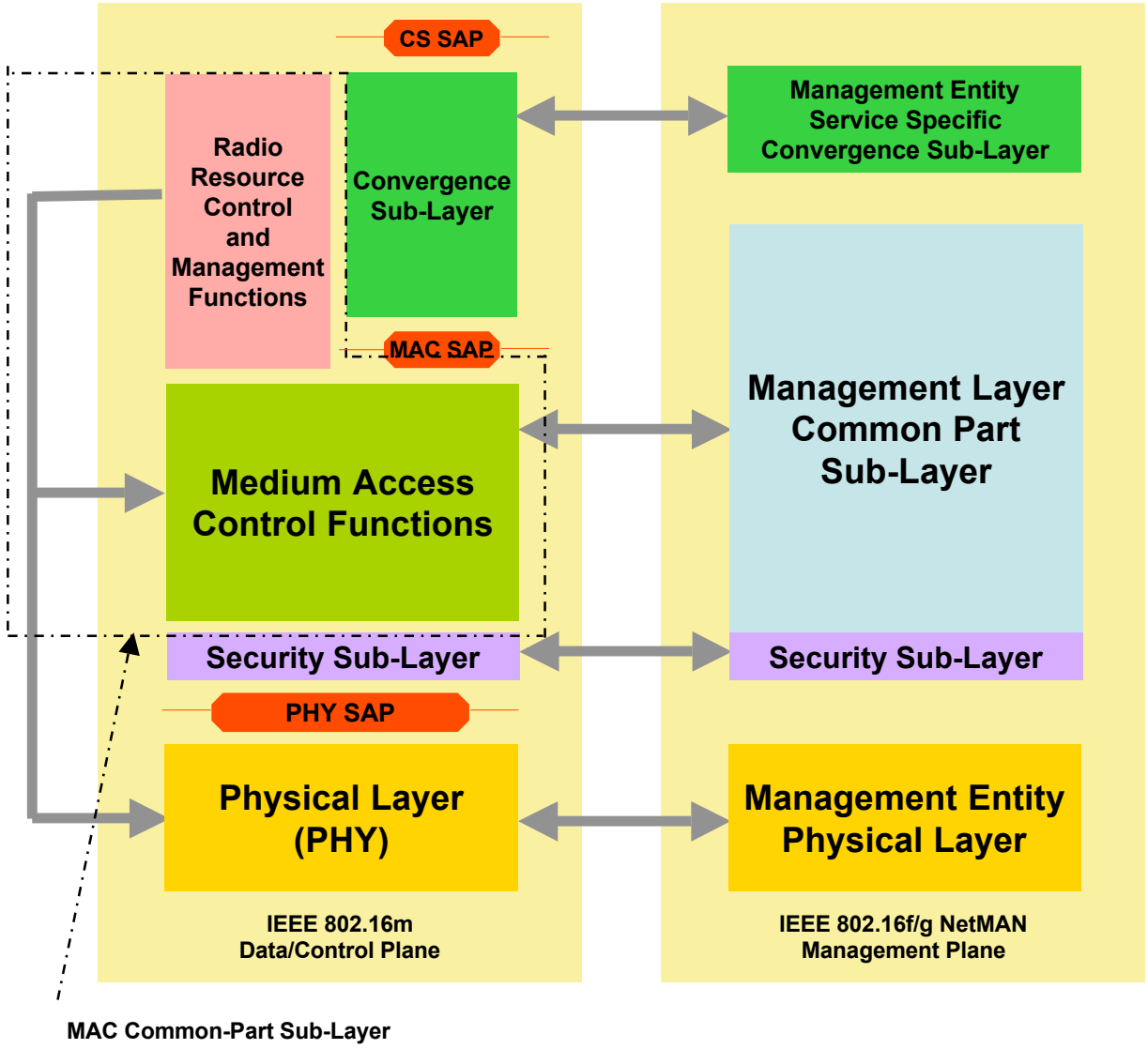
Technical Highlights

- Backward compatible with IMT-2000's Newest Radio Interface (OFDMA TDD WMAN)
- TDD and FDD (including half-duplex FDD terminals)
- OFDMA (both downlink and uplink)
- Advanced multi-element antenna technologies
  - DL: 2x2, 2x4, 4x2, 4x4, 8x8
  - UL: 1x2, 1x4, 2x4, 4x4
- Connection-oriented MAC with full QoS management
- Open interface to IP networks, including QoS for real-time services, etc.
- Will meet IMT-Advanced requirements
- Support for multiple bands and scalable bandwidths
- Multicast and Broadcast Service (MBS) support
- Location based services (LBS) support

New Features Beyond OFDMA TDD WMAN

- Unified Single-User/Multi-User MIMO Architecture
- Multi-Carrier Support
  - Support of wider bandwidths through aggregation of contiguous or non-contiguous channels
- Multi-Hop Relay-Enabled Architecture
- Support of Femto-Cells and Self-Organization
- Enhanced Multicast and Broadcast Service
- Coexistence with other radio technologies
- Multi-technology radio support
  - For example, Wi-Fi and Bluetooth in handset
- Advanced interference mitigation
- Advanced LBS support

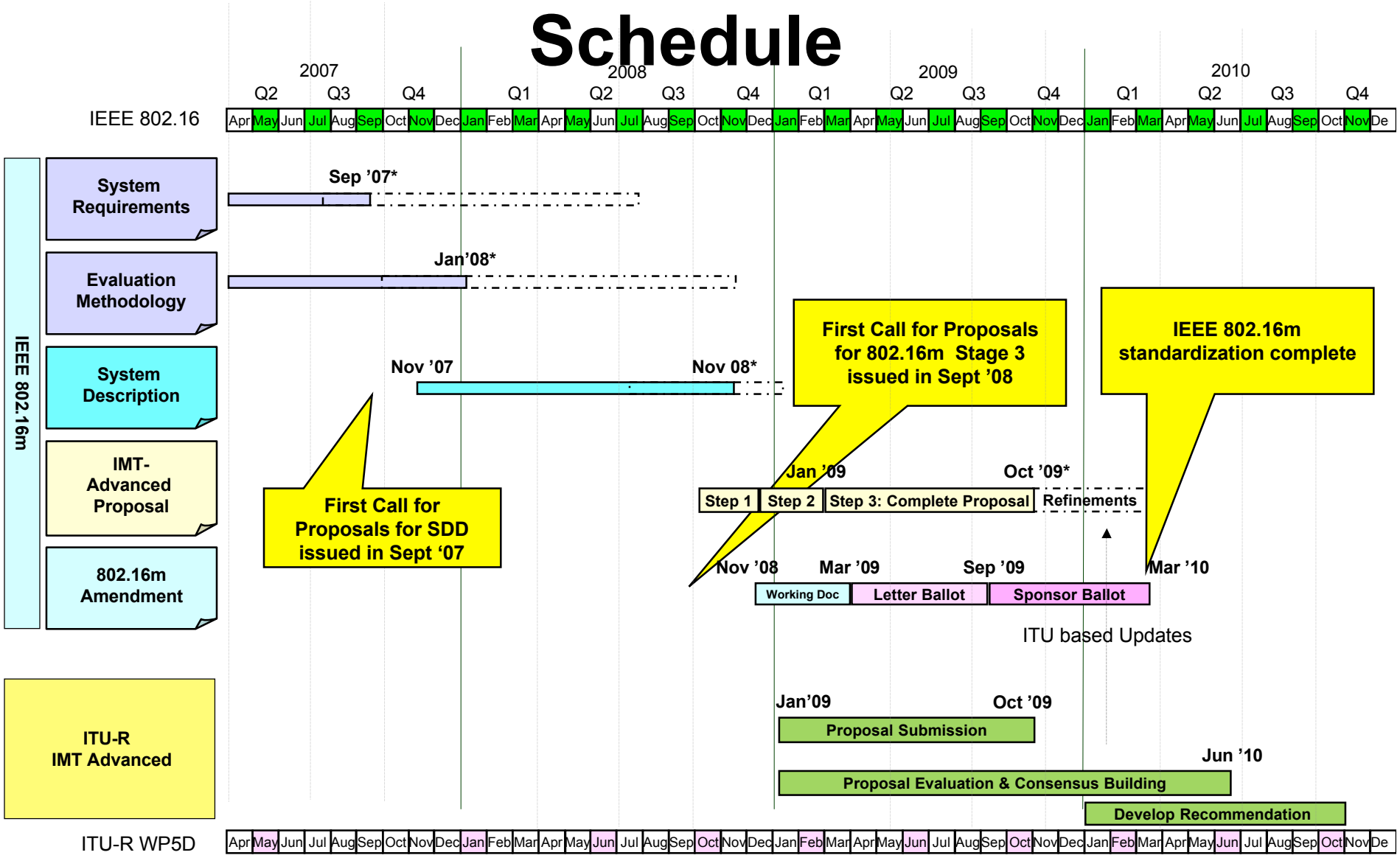
System Reference Model (Layers 1 and 2)



IEEE 802.16 Participation in IMT-Advanced

- Document 8F/1083 (3 January 2007):
  - "New IEEE Project to Develop a Standard to Meet the Cellular Layer Requirements of IMT-Advanced"
  - Notified ITU-R that 802.16m project is intended for future contributions on IMT-Advanced.
- Discussed IEEE 802.16m Project during IMT-Advanced Working in Kyoto (May 2007)
- IEEE 802.16 Working Group has participated in the development of many IEEE contributions to ITU-R on IMT-Advanced topics.

802.16m Project Development Schedule

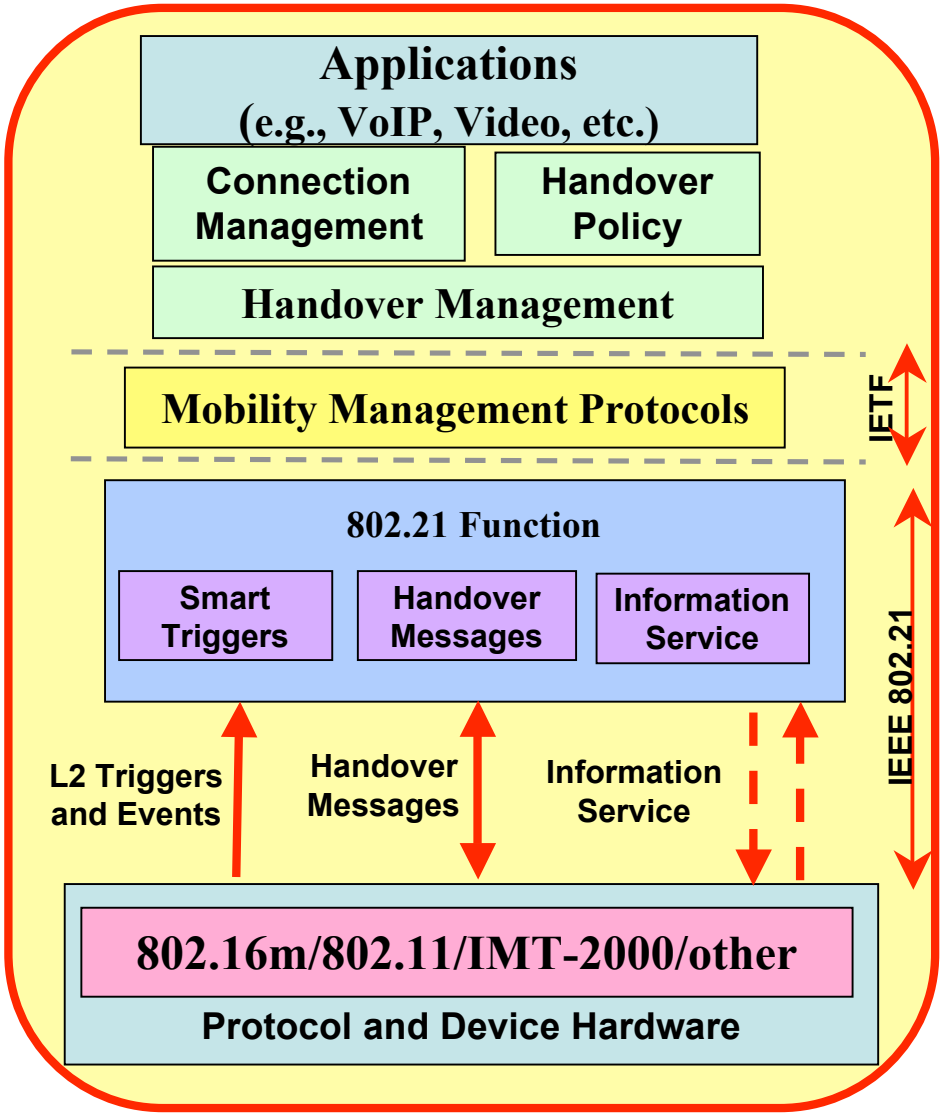


IMT-Advanced Requirements

- 802.16m is intended as a single RIT to meet or exceed the IMT-Advanced requirements in multiple test environments.

Test Environment	**Intended IMT-Advanced Proposal**
Indoor	✓
Microcellular	✓
Base Coverage Urban	✓
High Speed	Under consideration

Inter-system Handover using IEEE 802.21



- Supporting 802.16/802.11 handover
- Open interface for handover to/from other technologies including IMT-Advanced RITs
- Could facilitate formation of SRIT

Enabling IMT-Advanced Service Requirements

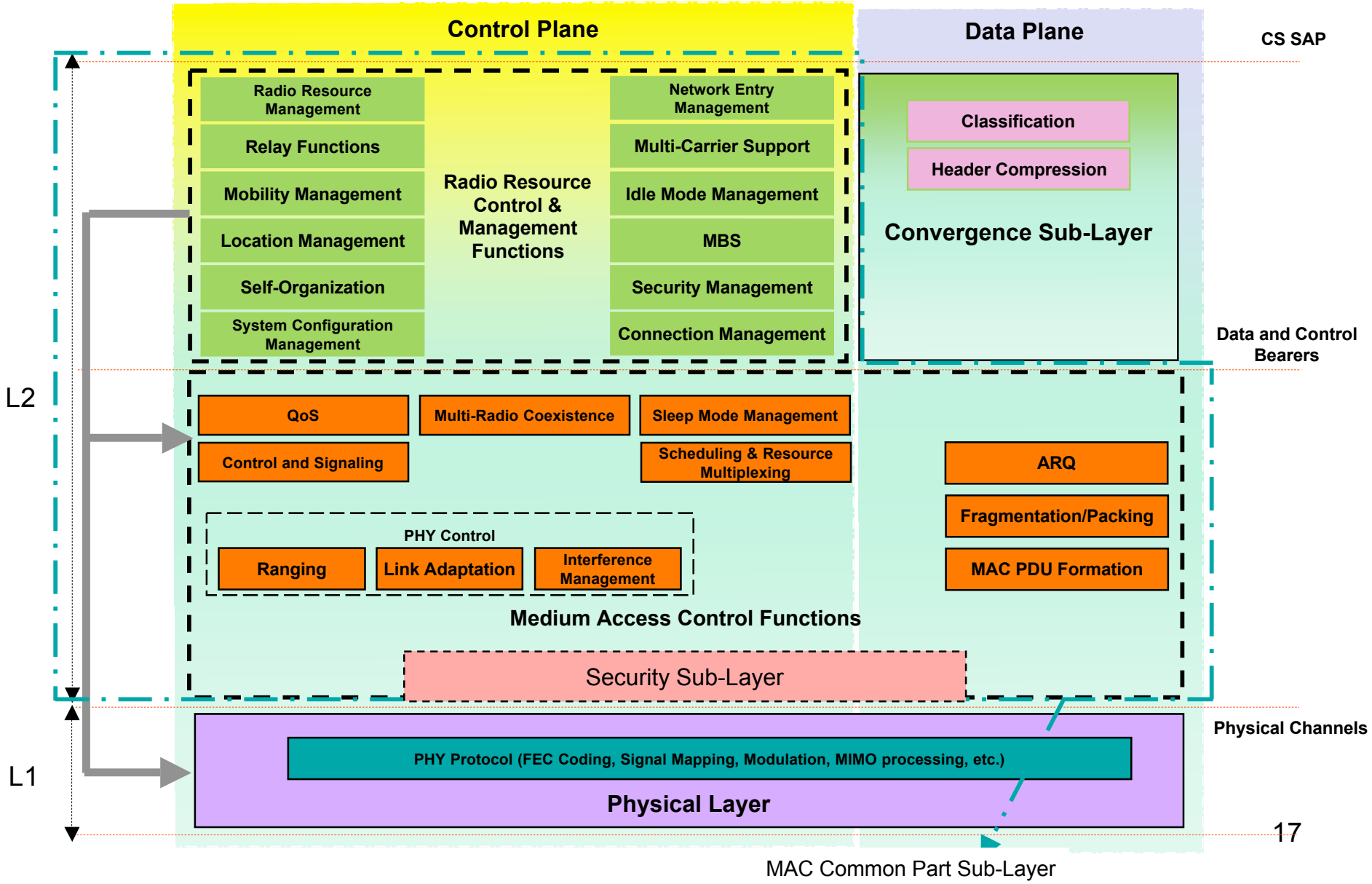
User Experience Class	Service Class	802.16m Support
Conversational	Basic conversational service	**Enabled**
	Rich conversational service	**Enabled**
	Conversational low delay	**Enabled**
Streaming	Streaming Live	**Enabled**
	Streaming Non-Live	**Enabled**
Interactive	Interactive high delay	**Enabled**
	Interactive low delay	**Enabled**
Background	Background	**Enabled**

References

1. IEEE 802.16 Web Site
   <http://WirelessMAN.org>
2. IEEE 802.16m Web Page
   <http://WirelessMAN.org/tgm>
3. IEEE 802.16 Published Standards and Drafts
   <http://ieee802.org/16/published.html>
4. IMT-Advanced Submission and Evaluation Process
   <http://www.itu.int/ITU-R/go/rsg5-imt-advanced>

Backup

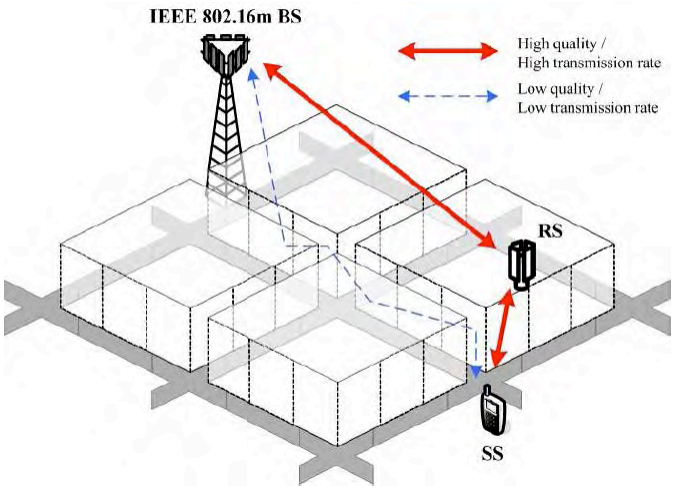
IEEE Project 802.16m Protocol Stack



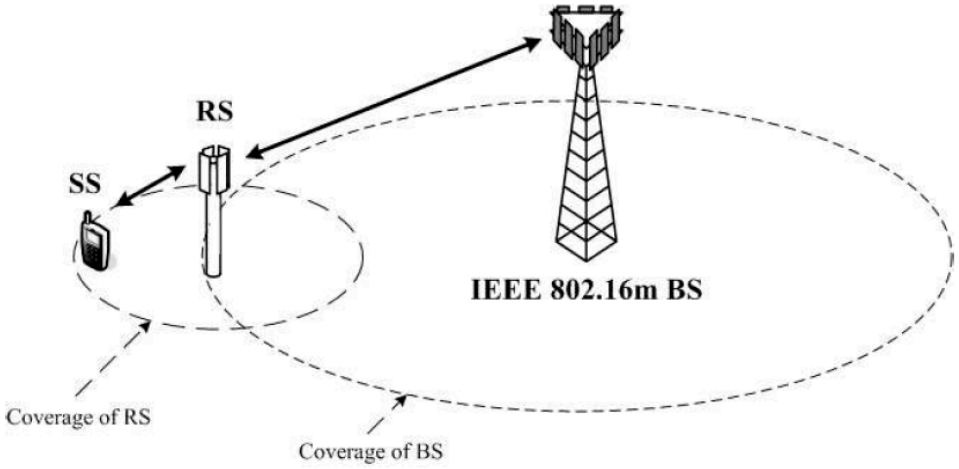
Unified Single-User/Multi-User MIMO Architecture

- Advanced multi-antenna processing techniques
  - open-loop and closed-loop
  - single-user/multi-user MIMO schemes
  - single and multiple spatial streams
- Multiple transmit diversity techniques
- Transmit beam-forming with rank/mode adaptation capability
- Multi-cell MIMO techniques supported

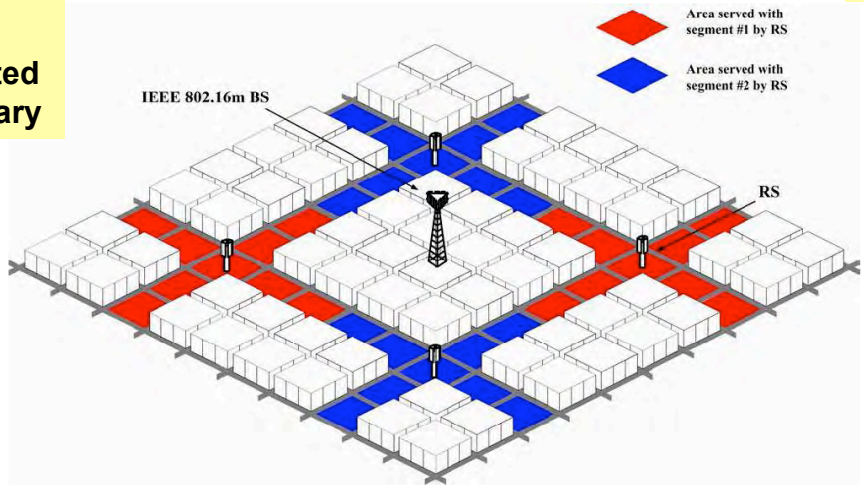
Multi-Hop Relay-Enabled Architecture



Relays can enhance transmission rate for Subscriber Station (SS) located in shaded area or cell boundary



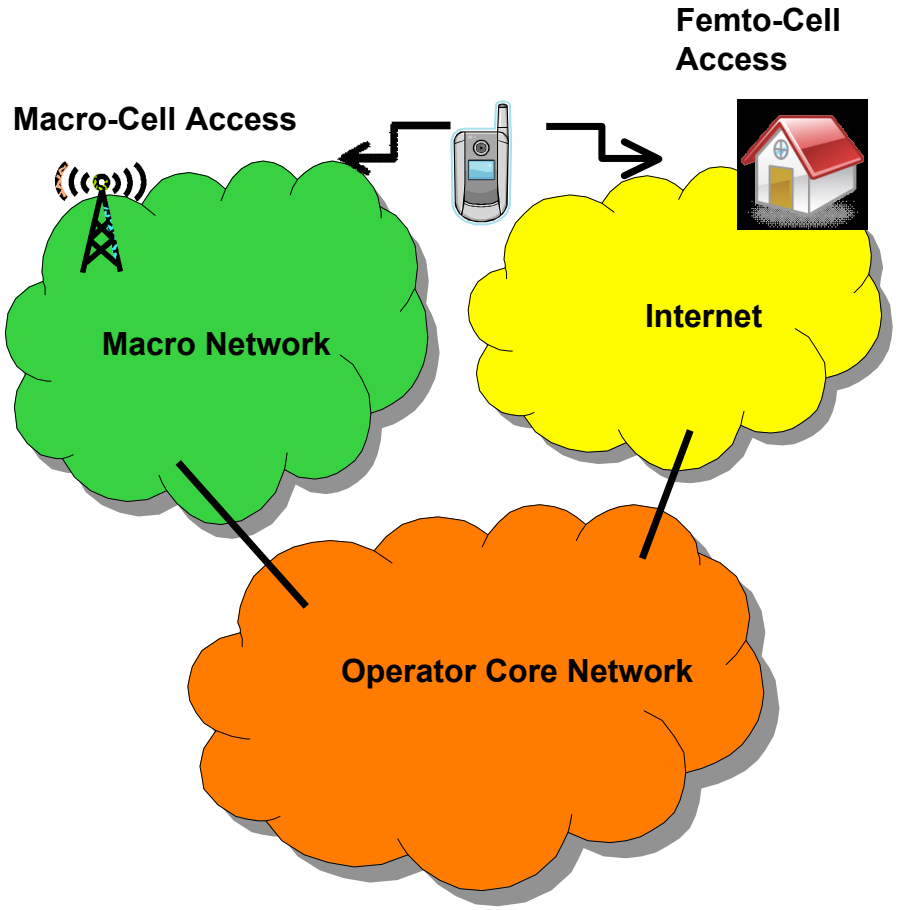
Coverage extension by deploying Relay Station (RS)



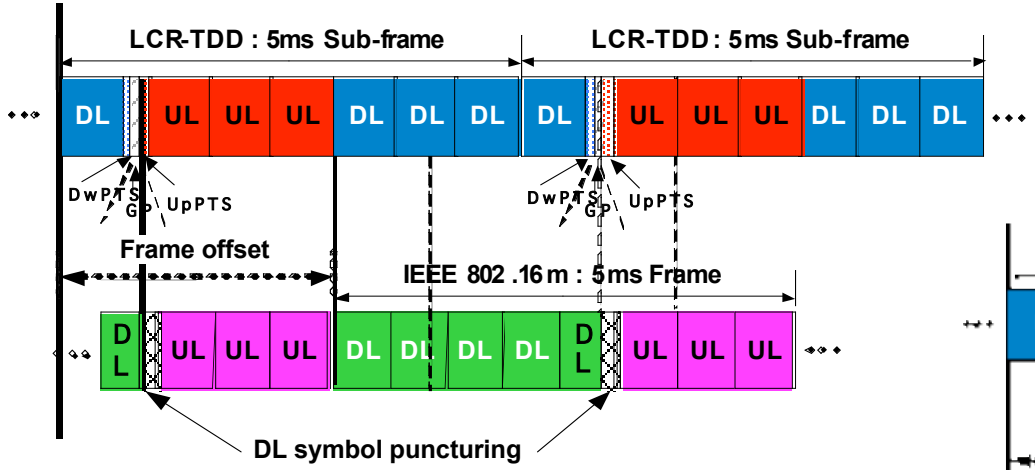
More aggressive radio resource reuse by deploying Relay Station (RS)

Support of Femto-Cells and Self-Organization

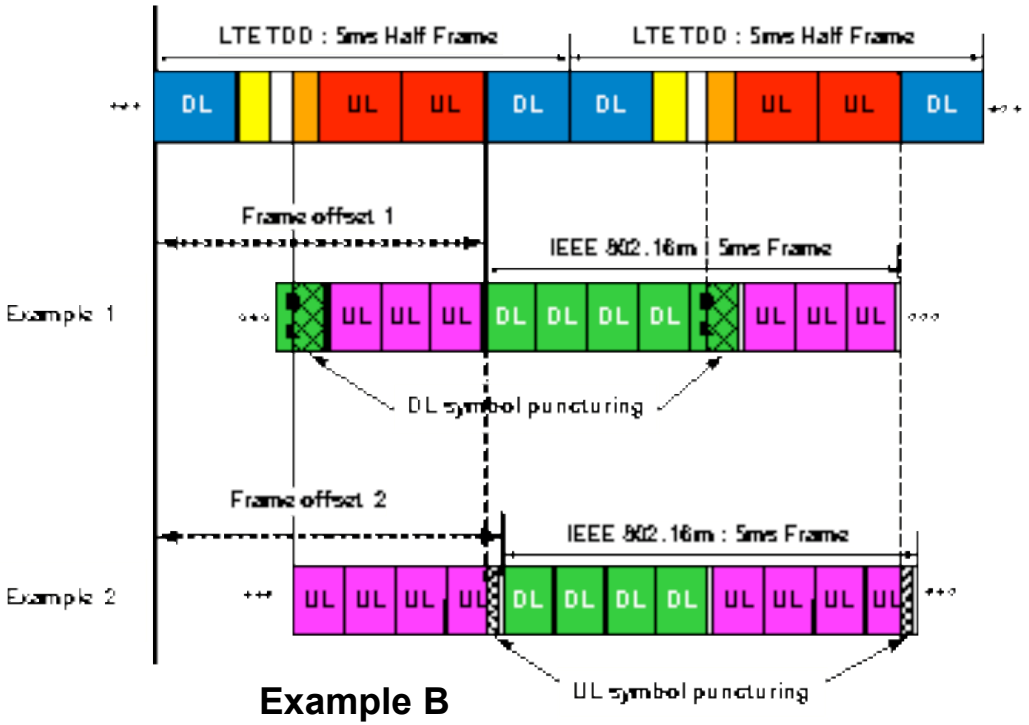
- Femto-cell support to offer service providers greater deployment flexibility
- Self-configuration support to enable plug and play installation; i.e. self-adaptation of initial configuration, including neighbor update as well as means for fast reconfiguration and compensation in failure cases.
- Self-optimization support to enable automated or autonomous optimization of network performance with respect to service availability, QoS, network efficiency, and throughput.



Coexistence with other radio technologies by synchronization

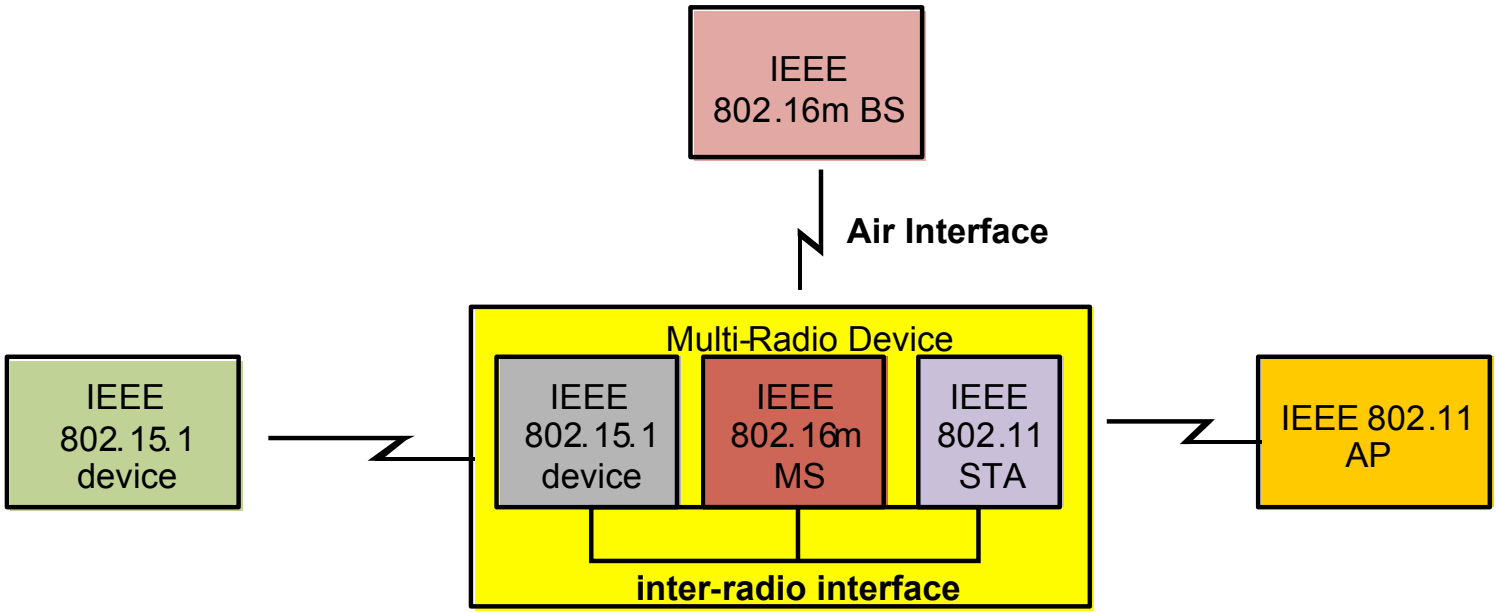


Example A
Adjacent Channel Coexistence with UTRA LCR-TDD (TD-SCDMA)



Example B
Adjacent Channel Coexistence with E-UTRA (LTE-TDD)

Multi-Technology Radio Support



Multi-Radio Device with Co-Located
IEEE 802.16m MS, IEEE 802.11, and IEEE 802.15.1 device