

Relays in IEEE 802.16 - Applications and Performance Evaluation

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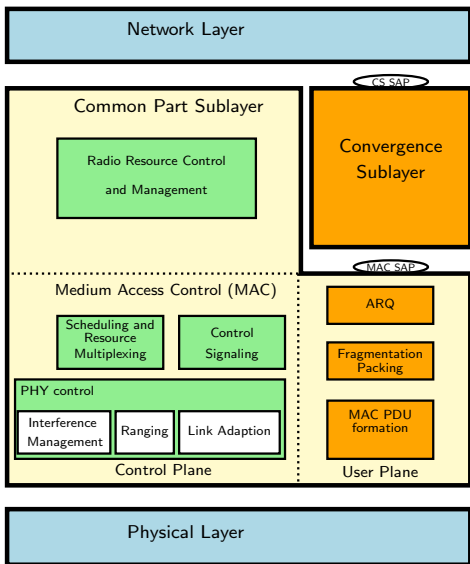
- 1 Introduction
- 2 IEEE 802.16m protocol functions
- 3 802.16m Frame Structure
 - 802.16m Point to Multi Point Frame
 - 802.16e Legacy Zones
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- 4 802.16m in the openWNS: WiMAC

Evolution of IEEE 802.16

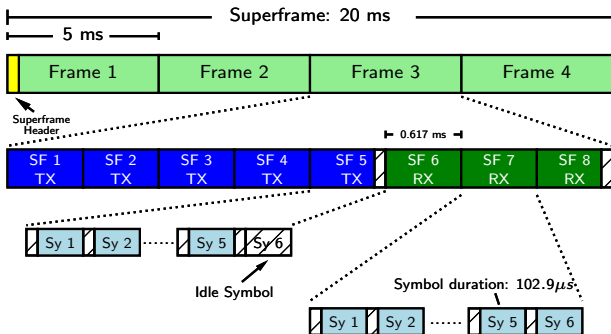
- IEEE 802.16 working group has been established in 1999
- First standard has been released in 2002 (802.16-2001)
 - Specified for frequencies above 11 GHz
 - Only single carrier physical layer supported
- Next major release in 2005 (802.16-2004)
 - Additional physical layer specification for 2 - 11 GHz
 - Multi carrier physical layer (OFDM, and OFDMA)
 - Supersedes 802.16a-2003 (2-11 GHz), 802.16c-2002 (10-66 GHz) and 802.16-2001
- Task group e introduces mobility in 802.16e-2005, known as **Mobile WiMAX**
- Introduction of relay stations with task group 802.16j
 - Multihop relay frame specified with OFDMA physical layer.
- Task group 802.16m is working towards an **IMT-Advanced** system that also supports multihop relay

Five criteria

- Broad market potential
 - Broad sets of applicability
 - Multiple vendors and users
 - Balanced costs
- Compatibility
 - 802.16m must conform to the 802 architecture
 - Compatibility is not an IMT-Advanced but an IEEE internal requirement
- Distinct identity
 - Substantially different from other IEEE 802 standards
 - One unique solution per problem
 - Easy for document reader to select the relevant specification
- Technical Feasibility
 - Demonstrated system feasibility, proven technology, reasonable testing, confidence in reliability
- Economic Feasibility
 - Known cost factors
 - Reasonable cost for performance
 - Consideration of installation cost

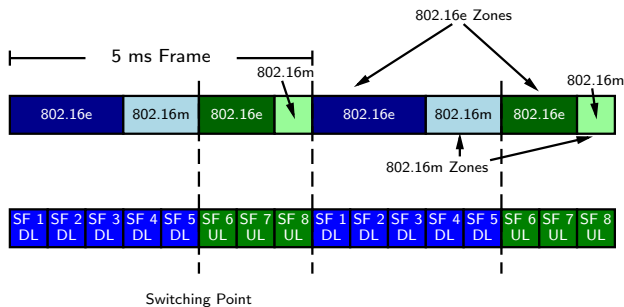


- Consist of convergence sublayer and common part sublayer
- Control plane contains protocol functions for
 - Radio resource management
 - Connection management (connection admission control, mobility management ...)
 - Quality of service through service flows
- Data plane controls ARQ mechanism, fragmentation and packing ...



- Superframe duration of 20 ms
- Superframe is subdivided into four frames of 5 ms duration
- Each frame consists of 8 subframes
- Each subframe is assigned to downlink or uplink direction
- Each subframe consists of 6 or 7 OFDM Symbols

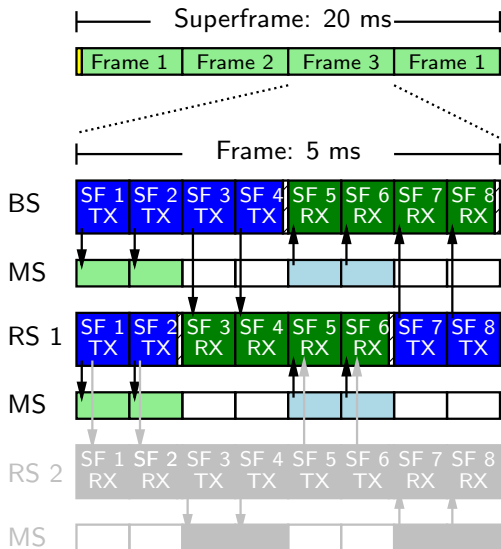
802.16e Zones in the 802.16m Frame



- Frame can be subdivided into **zones** to support new and legacy terminals
- Each subframe belongs to 802.16m or 802.16e zone

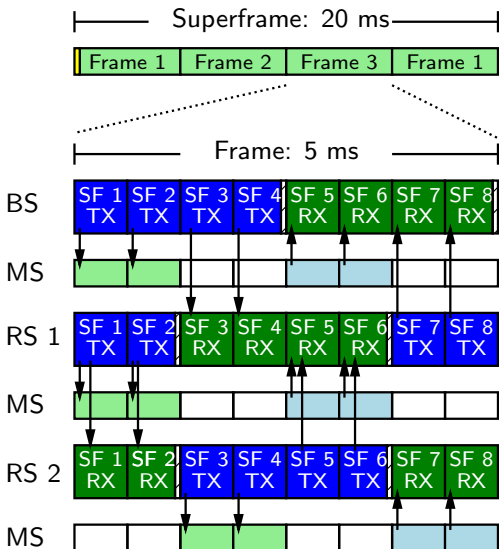
Frame of the relay enhanced system

- Dedicated subframes for BS \leftrightarrow RS communication
- Concurrent communication of BS \leftrightarrow MS and RS \leftrightarrow MS
- High downlink packet delay, low uplink packet delay



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Simulation of the 802.16m system



WiMAC module provides:

- Frame layout of the 802.16e protocol
- IP convergence sublayer
- Connection management
- Network entry, handover process
- Various packet scheduling strategies (round robin, proportional fair)
- Support for SDMA operation (adaptive beamforming)
- Several traffic models through **openWNS** support

Ongoing and planned work at ComNets

- Adaption of the IEEE 802.16m frame structure
- Support for several ARQ strategies
- Centralized coordination across BS by radio resource control functions
- Coordination across BS by mutual observation
- Evaluation of relay system performance in several scenarios (manhattan, urban, suburban)

Thank you

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