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
   - Relay Enhanced Frame

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
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 ↔ RS communication
- Concurrent communication of BS ↔ MS and RS ↔ 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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