This presentation is intended to provide an overview of the submission IEEE 802.16mc-99/16, “Media Access Control Protocol Based on DOCSIS 1.1”

Notice:
This document has been prepared to assist the IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.

Release:
The contributor acknowledges and accepts that this contribution may be made public by 802.16.

IEEE Patent Policy:
The contributor is familiar with the IEEE Patent Policy, which is set forth in the IEEE-SA Standards Board Bylaws <http://standards.ieee.org/guides/bylaws> and includes the statement: “IEEE standards may include the known use of patent(s), including patent applications, if there is technical justification in the opinion of the standards-developing committee and provided the IEEE receives assurance from the patent holder that it will license applicants under reasonable terms and conditions for the purpose of implementing the standard.”
Media Access Control Protocol
Based on DOCSIS 1.1

IEEE 802.16mc-99/16
Glen Sater
Karl Stambaugh
Motorola Inc.
Overview

• Point to multi-point MAC protocol
  – Broadcast downstream
  – TDMA upstream (multiple upstreams possible)
• Scheduler separate from MAC
• Variable-length native MAC PDU
  – Mapped into mini-slots for upstream bursts
• Service Flows
  – Integral to bandwidth allocation process
  – Multiple service flows per SS
  – Provides upstream and downstream QoS management
Protocol Reference Stack

- Support for ethernet/802.3
- Support for ATM/STM convergence
- Optional Security Layer
MAC Frame Format

- Variable-length native MAC PDU
- Same format in both upstream & downstream
- Downstream MAC frame starts anywhere
- Payload Mac header = 6 bytes
Upstream Access

- Timing based on mini-slots
  - Length independent of modulation symbol rate
    - Typical length: 8, 16, or 32 bytes
  - Timing relative to downstream SYNC MAC message
- MAP messages allocate mini-slots to SS
- Available access/transmission modes:
  - Contention (collision or polled)
  - Unsolicited (reservation-based or polled)
  - Transmission with contention
  - Maintenance (initial and ranging)
- Reservation request in upstream MAC burst
Scheduling Services

- Best Effort (BE)
  - traditional IP traffic
- Unsolicited Grant (UGS)
  - CBR traffic
- Unsolicited Grant with Activity Detection
  - switch between UGS and rtPS based on activity
  - VoIP with activity detection
- Real-Time Polling (rtPS)
  - periodic
- Non-Real-Time Polling (nrtPS)
  - non-periodic
Allocation MAP Example

Received from the BS on the downstream channel
The MAP MAC msg. describes the permitted use of the upstream channel

MAP PDU

Upstream Opportunities

mini-slots

SS Tx opportunity request contention area SS Tx opportunity maintenance

previous map slots described by the current map as-yet unmapped slots

11/9/99 IEEE 802.16mp-99/16
Additional Efficiency and QoS Features

• Fragmentation
  – Defined in upstream; expanded to downstream

• Payload Header Suppression
  – Simple method for reducing bandwidth
  – Both directions

• Service Flows
  – Created, modified, and deleted dynamically
  – Assigned QoS characteristics
Ranging

• Ranging Parameters for Upstream Transmission
  – RF Power
  – Timing
  – Frequency
  – Equalizer coefficients (optional)

• Ranging Types
  – Initial
    • When SS enters the network
  – Maintenance
    • Scheduled at regular intervals
Security

- **DOCSIS Baseline Privacy Plus Interface (BPI+)**
  - Optional (implementation and use)
  - Optional by Service Flow
- **Authentication**
  - RSA Private/Public Key
  - Digital X.509 Certificates
- **Privacy**
  - DES Encryption using Cipher Block Chaining mode
    - User payload only
Proposed Extensions

• Mini-slot length (bytes) independent of symbol rate
• Support for ATM/STM transport
  – multiple cells within MAC frame
• Downstream Fragmentation
  – upstream fragmentation already defined
• Payload Header Suppression for ATM Cells
  – Ethernet header suppression now defined
Benefits

• Supports all BWA system requirements
• Minimal modification to existing standards
• Scales to support high transmission rates
• Available OPNET modeling and field data
• Good independence from PHY layer
• Optional security protocol
• Support for multiple bearer services to each SS
• Efficient usage of bandwidth
• Ability to bound delay and jitter
• Statistical multiplexing gain