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Re:	IEEE 802.16c-02/01
Abstract	Modifications to Clause 12 of IEEE Std 802.16.
Purpose	For adoption into the IEEE 802.16a draft.
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System Profiles

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Background

The 802.16 *Draft Air Interface Specification for Fixed Broadband Wireless Access Systems* is evolving to cover a wide range of possibilities, from systems carrying predominantly ATM traffic to systems carrying predominantly IP traffic, and from systems with wide channels at high frequencies to systems with narrower channels at lower frequencies. This causes the specification to contain a plethora of features. This overabundance of features causes 2 main problems for implementers of standards compliant systems.

First, is the issue of what is mandatory versus optional. This question does not have a clear cut answer. For instance, it may be obvious that it is mandatory to support the convergence sublayer for the user data a system is carrying. But, due to system differences, it is not obvious that there is any one particular convergence sublayer that is mandatory (with the exception of enough of the packet sublayer to implement the secondary management connections). It would be reasonable for devices for a system that is IP based to not implement the ATM convergence sublayer if they are being sold to a market that will never see ATM cells. Similarly, it would be reasonable for an ATM system to not be required to implement the VLAN portion of the packet convergence sublayer. Similar issues arise in the physical layer. If devices are designed for the 10-66 GHz PHY with 25 MHz channels they need not be required to also work with 28 MHz channels. Similar issues arise with TDD versus FDD.

The second issue arises from the first. If it is accepted that the set of mandatory versus optional features is situationally dependent, then there must be a concise method of specifying which situation a device was designed to accommodate, i.e., which feature set is implemented.

The concept of system profiles, actually pairs of profiles for the convergence sublayer and the physical layer, solves both of these problems. First it defines the set of mandatory and optional features for a given situation. Second, it guarantees interoperability by ensuring that multiple devices, from any combination of vendors, will interoperate if they have implemented the same profiles.

The following section gives text for a basis amendment to the profile section of the 802.16 air interface specification.

Text for New Document Section

The following text should replace chapter 12.

12 System Profiles

This subclause defines system profiles which list sets of features to be used in typical implementation cases. Each profile is assigned an identifier for use in such documents as PICS proforma documents. Mandatory and forbidden features are listed for each profile. Any feature not mandatory or forbidden for a profile is optional for the profile. Optional features shall be implemented as specified in the standard.

12.1 10-66 GHz System Profiles

This subclause defines system profiles for systems operating with the 10-66 GHz PHY.

12.1.1 10-66 GHz MAC System Profiles

This subclause defines MAC profiles for systems operating with the 10-66 GHz PHY.

12.1.1.1 Basic ATM MAC System Profile

Profile identifier: profM1.

Mandatory features:

- PVCs.
- VC-switched connections.
- VP-switched connections.
- ATM payload header suppression is mandatory as a capability, but may be turned on or off on a per connection basis.
- IPv4 on the Secondary Management connection.
- Packing of multiple ATM cells into a single MAC PDU is mandatory as a capability, but may be turned on or off on a per connection basis.
- SDU fragmentation on the Primary Management and Secondary management connections.
- Support of GPSS mode.
- Operation with a frame duration of 1 ms.

Conditionally Mandatory features:

- If nrtPS or BE services are supported, then the SS responding to broadcast polling is mandatory.
- If multicast polling groups are supported, multicast polling must be supported.

Features not supported under this profile:

- Support on SVCs.

- Support of Soft PVCs.
- Fragmentation of SDUs on ATM traffic connections.
- ARQ.
- GPC mode.

12.1.1.2 Basic Packet MAC System Profile

Profile identifier: profM2.

Mandatory features:

- IPv4 support on transport connection.
- Classification of packets in the SS based on the incoming physical port.
- Reception of multiple SDUs packed into a single MAC PDU is mandatory as a capability, but may be turned on or off on a per connection basis.
- Fragmentation of SDUs is mandatory as a capability, but may be turned on or off on a per connection basis.
- Support of GPSS mode.
- Operation with a frame duration of 1 ms.

Conditionally Mandatory features:

- If nrtPS or BE services are supported, then the SS responding to broadcast polling is mandatory.
- If multicast polling groups are supported, multicast polling must be supported.

Features not supported under this profile. Systems adhering to profile profM2 shall not attempt to use the features listed below :

- SS initiated DSx actions.
- ARQ.
- GPC mode.

12.1.1.3 Conventions for MAC Management Messages for profiles profM1 and profM2

The following rules shall be followed when reporting parameters in MAC Management messages:

- Symbol Rate, Frequency, and Roll-off Factor shall not be reported in UCD messages.
- Block Turbo Code parameters shall not be reported in UCD Messages.

- BCC Code Type shall not be reported in UCD messages.
- Frame Duration shall not be reported in DCD messages.
- Block Turbo Code parameters shall not be reported in DCD Messages.
- BCC Code Type shall not be reported in DCD messages.
- UL Channel Override shall not be reported in RNG-RSP messages.
- Service Class Names shall not be used.
- No TLVs besides Error Encodings and HMAC Tuples shall be reported back in DSA-RSP and DSC-RSP messages.
- No TLVs besides HMAC Tuples shall be reported back in DSA-ACK messages.
- DSC-REQ messages shall not contain Request/Transmission Policy, Fixed vs. Variable Length SDU Indicator, SDU Size, ATM Switching, or Convergence Sublayer Specification TLVs.

12.1.1.4 MAC Management messages, parameter transmission order

The following sections define the order in which systems meeting profiles profM1 and profM2 shall transmit the TLV encoded parameters in the respective messages. Systems implementing either profile shall only include the parameters listed under the respective message in its transmission of said messages.
Parameters with defined default values should be omitted if the desired value coincides with the default one.

DCD

- BS Transmit Power
- PHY Type
- Power Adj Rule
- Downlink Burst Profile(s)
  - Modulation Type
  - FEC Code Type (default to RS only if omitted)
  - RS Information Bytes
  - RS parity bytes
  - Last Codeword Length (default to shortened if omitted)
  - Exit Threshold
  - Entry Threshold
  - Preamble Present (default to ‘not present’ if omitted)

DL-MAP:
Message contains no TLV encoded information

UCD

- SS Transition Gap (default to 24 symbols if omitted)

- Power Adjustment Rule
- Contention-based Reservation Timeout
- Uplink Burst Profiles(s)
  - Modulation Type
  - Preamble Length
  - FEC Code Type (default to RS only)
  - RS Information Bytes
  - RS Parity Bytes
  - Scrambler Seed
  - Last Codeword Length (default to shortened)

UL-MAP: n/a

RNG-REQ

- Requested DL Burst Profile
- SS MAC Address
- Ranging Anomalies

RNG-RSP

- Ranging Status
- Timing Adjust (default to 0)
- Power Adjust (default to 0)
- DL frequency Override (if needed)
- DL operational Burst profile (only if changed)
- SS MAC Address (only on CID 0x0000)
- Basic CID (only on CID 0x0000)
- Primary Management CID (only on CID 0x0000)

REG-REQ

- UL CID Support
- Vendor ID Encoding (optional)
- PKM Flow Control (default = no limit)
- DSx Flow Control (default = no limit)
- MCA Flow Control (default = no limit)
- IP version (default = IPv4)
- MAC CRC support (default = support)
- Multicast Polling Group CID support (default = 4)
- HMAC Tuple

REG-RSP

- MAC Version
- Secondary Management CID
- UL CID Support
- Vendor ID Encoding (if present in REG-REQ or changed from default)
- PKM Flow Control (if present in REG-REQ or changed from default)
- DSx Flow Control (if present in REG-REQ or changed from default)
- MCA Flow Control (if present in REG-REQ or changed from default)
- IP version (if present in REG-REQ or changed from default)
- MAC CRC support (if present in REG-REQ or changed from default)
- Multicast Polling Group CID support (if present in REG-REQ or changed from default)
- Vendor Specific Extensions (If Vendor ID present in REG-REQ, and extensions provided)
- HMAC Tuple

PKM-RSP: SA Add

- Key-Sequence-Number
- SA Descriptor(s)
- SAID
- SA-Type
- Cryptographic Suite
- HMAC-Digest

PKM-REQ: Auth Request

- SS-Certificate
- Security Capabilities
- Version (default = 1)
- Cryptographic-Suite-List (default is that both no encryption and 56-bit DES are supported, no data authentication, and 3-DES EDE with 128-bit key)
- SAID

PKM-RSP: Auth Reply

- AUTH-Key
- Key-Lifetime
- Key-Sequence-Number
- SA-Descriptor(s)
- SAID
- SA-Type
- Cryptographic Suite

PKM-RSP: Auth Reject

- Error Code
- Display String (optional)

PKM-REQ: Key Request

- Key Sequence Number
- SAID
- HMAC Digest

PKM-RSP: Key Reply

- Key Sequence Number
- SAID
- TEK-Parameters (Older)
  - TEK
  - Key Lifetime
  - Key Sequence Number
  - CBC-IV
- TEK-Parameters (Newer)
  - TEK
  - Key Lifetime
  - Key Sequence Number
  - CBC-IV
- HMAC Digest

PKM-RSP: Key Reject

- Key Sequence Number
- SAID
- Error Code
- Display String (optional)
- HMAC Digest

PKM-RSP: Auth Invalid

- Error Code
- Display String (optional)

PKM-RSP: TEK Invalid

- Key Sequence Number
- SAID

- Error Code
- Display String (optional)
- HMAC Digest

PKM-REQ: Authent Info

- CA-Certificate

DSA-REQ – BS Initiated

- Uplink Service Parameters
  - Service Flow ID
  - Transport CID
  - Target SAID
  - QoS Parameter Set Type
  - Service Flow Scheduling Type
  - Request/Grant Transmission Policy
  - Convergence Sublayer Specification
  - Fixed vs. Variable Length SDU Indicator (default = variable)
  - SDU Size (required if fixed, forbidden if variable SDU)
  - Maximum Sustained Traffic Rate
  - Minimum Reserved Traffic Rate (default = 0 for BE, Max Sust Rate for UGS, required for rtPS and nrtPS)
  - Maximum Traffic Burst (required for rtPS and nrtPS, excluded otherwise)
  - Traffic Priority (optional, BE only)
  - Tolerated Jitter (optional)
  - Maximum Latency (optional)
  - Convergence Sublayer Specific Parameters (see below)
  - Vendor Specific QoS Parameters
- Downlink Service Parameters
  - Service Flow ID
  - Transport CID
  - Target SAID
  - QoS Parameter Set Type
  - Service Flow Scheduling Type
  - Request/Grant Transmission Policy
  - Convergence Sublayer Specification
  - Fixed vs. Variable Length SDU Indicator (default = variable)
  - SDU Size (required if fixed, forbidden if variable SDU)
  - Convergence Sublayer Specific Parameters (see below)
  - Vendor Specific QoS Parameters

- HMAC-Tuple

DSA-RSP – BS Initiated

- Uplink Service Parameters
  - Service Flow Error Parameter Set(s) (one per errored parameter)
    - Errored Parameter
    - Error Code
    - Error Message (optional)
- Downlink Service Parameters(s)
  - Service Flow Error Parameter Set(s) (one per errored parameter)
    - Errored Parameter
    - Error Code
    - Error Message (optional)
- HMAC-Tuple

DSA-ACK

- HMAC-Tuple

DSC-REQ – BS Initiated

- Uplink Service Parameters
  - Service Flow ID
  - Transport CID
  - QoS Parameter Set Type
  - Maximum Sustained Traffic Rate
  - Minimum Reserved Traffic Rate (default = 0 for BE, Max Sust Rate for UGS, required for rtPS and nrtPS)
  - Maximum Traffic Burst (required for rtPS and nrtPS, excluded otherwise)
  - Traffic Priority (optional, BE only)
  - Tolerated Jitter (optional)
  - Maximum Latency (optional)
  - Convergence Sublayer Specific Parameters (see below)
  - Vendor Specific QoS Parameters
- Downlink Service Parameters
  - Service Flow ID
  - Transport CID
  - QoS Parameter Set Type
  - Convergence Sublayer Specific Parameters (see below)

    - Vendor Specific QoS Parameters
- HMAC-Tuple

DSC-RSP – BS Initiated

- Uplink Service Parameters
    - Service Flow Error Parameter Set(s) (one per errored parameter)
        - Errored Parameter
        - Error Code
        - Error Message (optional)
- Downlink Service Parameters(s)
    - Service Flow Error Parameter Set(s) (one per errored parameter)
        - Errored Parameter
        - Error Code
        - Error Message (optional)
- HMAC-Tuple

DSC-ACK

- HMAC-Tuple

DSD-REQ

- HMAC-Tuple

DSD-RSP

- HMAC-Tuple

MCA-REQ

- Multicast CID
- Assignment

MCA-RSP – no TLVs

DBTC-REQ – no TLVs

DBTC-RSP – no TLVs

RES-CMD

- HMAC-Tuple

SBC-REQ

- 10-66 GHz PHY SS Demod Support
- 10-66 GHz PHY SS Modulator Support
- 10-66 GHz PHY SS DL FEC Types
- 10-66 GHz PHY SS UL FEC Types
- BW Allocation Support

SBC-RSP

- 10-66 GHz PHY SS Demod Support
- 10-66 GHz PHY SS Modulator Support
- 10-66 GHz PHY SS DL FEC Types
- 10-66 GHz PHY SS UL FEC Types
- BW Allocation Support

CLK-CMP – no TLVs

DSX-RVD – no TLVs

TFTP-CPLT

- HMAC-Tuple

TFTP-RSP – no TLVs

12.1.1.5 Message parameters specific to profM1

The following sections define the order in which systems meeting profile profM1 shall transmit the TLV encoded parameters specific to the ATM Convergence Sublayer. Parameters with defined default values should be omitted if the desired value coincides with the default one.

Convergence Sublayer Specific Parameters for DSA-REQ – BS Initiated

- ATM
  - ATM Switching
  - ATM Classifier Rule(s) (default = don't classify)
    - VPI Classifier
    - VCI Classifier(s) (must follow associated VPI, default = don't classify on VCI)

Convergence Sublayer Specific Parameters for DSA-RSP – BS Initiated

- ATM – no parameters for DSA-RSP

Convergence Sublayer Specific Parameters for DSC-REQ – BS Initiated

- ATM
  - ATM Classifier Rule(s) (default = don't classify)

- VPI Classifier
- VCI Classifier(s) (must follow associated VPI, default = don't classify on VCI)

Convergence Sublayer Specific Parameters for DSC-RSP – BS Initiated

- ATM – no parameters for DSC-RSP

12.1.1.6 Message parameters specific to profM1

Convergence Sublayer Specific Parameters for DSA-REQ – BS Initiated

- Packet
  - Packet Classification Rule(s) (uplink service flows only, default is no classification)
    - Classifier Rule ID
    - Classifier Rule Priority (default to 0)
    - IP Type of Service/DSCP (only for IP CSs, default = don't classify on this)
    - Protocol (only for IP CSs, default = don't classify on this)
    - IP Masked Source Address (only for IP CSs, default = don't classify on this)
    - IP Destination Address (only for IP CSs, default = don't classify on this)
    - Protocol Source Port Range (only for IP CSs, default = don't classify on this)
    - Protocol Destination Port Range (only for IP CSs, default = don't classify on this)
    - Ethernet Destination MAC Address (only for Ethernet CSs, default = don't classify on this)
    - Ethernet Source MAC Address (only for Ethernet CSs, default = don't classify on this)
    - Ethertype/IEEE 802.2 SAP (only for Ethernet CSs, default = don't classify on this)
    - IEEE 802.1D User Priority (only for VLAN CSs, default = don't classify on this)
    - IEEE 802.1Q VLAN_ID (only for VLAN CSs, default = don't classify on this)
    - Associated Payload Header Suppression Index (default is no PHS for this classifier match)
    - Vendor Specific Classifier Parameters
  - Payload Header Suppression Rule(s)
    - Payload Header Suppression Index
    - Payload Header Suppression Size
    - Payload Header Suppression Field
    - Payload Header Suppression Mask (default is suppress all bytes of the suppression field)
    - Payload Header Suppression Verification (default is verify)
    - Vendor Specific PHS Parameters

Convergence Sublayer Specific Parameters for DSA-RSP – BS Initiated

- Packet
  - Packet Classification Rule(s) (uplink service flows only, default is no classification)
    - Classifier Error Parameter Set(s) (one per errored parameter)
      - Classifier Rule ID

        - Errored Parameter
        - Error Code
        - Error Message (optional)
    - Payload Header Suppression Rule(s)
        - PHS Error Parameter Set(s) (one per errored parameter)
        - Payload Header Suppression Index
            - Errored Parameter
            - Error Code
            - Error Message (optional)

DSC-REQ – BS Initiated

- Uplink Service Parameters
    - Service Flow ID
    - Transport CID
    - QoS Parameter Set Type
    - Maximum Sustained Traffic Rate
    - Minimum Reserved Traffic Rate (default = 0 for BE, Max Sust Rate for UGS, required for rtPS and nrtPS)
    - Maximum Traffic Burst (required for rtPS and nrtPS, excluded otherwise)
    - Traffic Priority (optional, BE only)
    - Tolerated Jitter (optional)
    - Maximum Latency (optional)
    - Convergence Sublayer Specific Parameters (see below)
    - Vendor Specific QoS Parameters
- Downlink Service Parameters
    - Service Flow ID
    - Transport CID
    - QoS Parameter Set Type
    - Convergence Sublayer Specific Parameters (see below)
    - Vendor Specific QoS Parameters
- HMAC-Tuple

Convergence Sublayer Specific Parameters for DSC-REQ – BS Initiated

- Packet
    - Classifier Dynamic Service Change Action(s)
    - Packet Classification Rule(s) (uplink service flows only, 1 per Action)
        - Classifier Rule ID
        - Classifier Rule Priority (default to 0)
        - IP Type of Service/DSCP (only for IP CSs, default = don’t classify on this)

    - Protocol (only for IP CSs, default = don't classify on this)
    - IP Masked Source Address (only for IP CSs, default = don't classify on this)
    - IP Destination Address (only for IP CSs, default = don't classify on this)
    - Protocol Source Port Range (only for IP CSs, default = don't classify on this)
    - Protocol Destination Port Range (only for IP CSs, default = don't classify on this)
    - Ethernet Destination MAC Address (only for Ethernet CSs, default = don't classify on this)
    - Ethernet Source MAC Address (only for Ethernet CSs, default = don't classify on this)
    - Ethertype/IEEE 802.2 SAP (only for Ethernet CSs, default = don't classify on this)
    - IEEE 802.1D User Priority (only for VLAN CSs, default = don't classify on this)
    - IEEE 802.1Q VLAN_ID (only for VLAN CSs, default = don't classify on this)
    - Associated Payload Header Suppression Index (default is no PHS for this classifier match)
    - Vendor Specific Classifier Parameters
- PHS Dynamic Service Change Action
- Payload Header Suppression Rule(s) (1 per Action)
    - Payload Header Suppression Index
    - Payload Header Suppression Size
    - Payload Header Suppression Field
    - Payload Header Suppression Mask (default is suppress all bytes of the suppression field)
    - Payload Header Suppression Verification (default is verify)
    - Vendor Specific PHS Parameters

DSC-RSP – BS Initiated

- Uplink Service Parameters
    - Service Flow Error Parameter Set(s) (one per errored parameter)
        - Errored Parameter
        - Error Code
        - Error Message (optional)
- Downlink Service Parameters(s)
    - Service Flow Error Parameter Set(s) (one per errored parameter)
        - Errored Parameter
        - Error Code
        - Error Message (optional)

12.1.2 10-66 GHz Physical Layer Profiles

This subclause defines PHY profiles for systems operating with the 10-66 GHz PHY.

12.1.2.1 US 25 MHz Channel 10-66 GHz PHY Profile

Profile identifier: profP1.

Mandatory features:

- Frame Duration of 1 ms
- QPSK and QAM-16 in the DL
- QPSK in the UL
- Roll-off Factor = 0.25
- RS outer codes with $t \in \{0, 4, 8, 10, 12\}$.
- Fixed and shortened last code word operation.
- RS block lengths of 6-255.
- 20 Mbaud symbol rate
- 5000 PS per frame
- Minimum Performance Numbers?

Forbidden features:

- Block Turbo Codes

12.1.2.1.1 FDD Specific US 25 MHz Channel 10-66 GHz PHY Profile Features

Profile identifier: profP1f.

Mandatory features:

- FDD operation
- BS must respect half-duplex nature of half-duplex SSs

12.1.2.1.2 TDD Specific US 25 MHz Channel 10-66 GHz PHY Profile Features

Profile identifier: profP1t.

Mandatory features:

- TDD operation

12.1.2.2 European 28 MHz Channel 10-66 GHz PHY Profile

Profile identifier: profP2.

Mandatory features:

- Frame Duration of 1 ms
- QPSK and QAM-16 in the DL
- QPSK in the UL
- Roll-off Factor = 0.25
- RS outer codes with t ∈ {0, 4, 8, 10, 12}.
- Fixed and shortened last code word operation.
- RS block lengths of 6-255.
- 22.4 Mbaud symbol rate
- 5600 PS per frame
- Minimum Performance Numbers?

Forbidden features:

- Block Turbo Codes

12.1.2.2.1 FDD Specific European 28 MHz Channel 10-66 GHz PHY Profile Features

Profile identifier: profP2f.

Mandatory features:

- FDD operation
- BS must respect half-duplex nature of half-duplex SSs

12.1.2.2.2 TDD Specific European 28 MHz Channel 10-66 GHz PHY Profile Features

Profile identifier: profP2t.

Mandatory features:

- TDD operation