

# **TR-024**

## **DMT Line Code Specific MIB**

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**Abstract:**

This technical report defines a standard SNMP MIB for the DMT line code. Configuration, statistics, performance and history count elements are defined elements for DMT coded lines. These elements cover use during normal operation of ADSL lines as well as detailed measurements for fault prediction and location.

## **1. Introduction**

This technical report details the elements of a Line Code Specific (LCS) MIB for ITU G.992.1 and G.992.2 (and referenced regional standards) based Discrete Multi-Tone (DMT) ADSL lines including formal object definitions in ASN-1. Configuration profiles and current performance statistics are defined. This LCS MIB text fills the space in the ADSL line MIB defined by the ADSL Forum in TR-006 where line code specific details for ATU-C and ATU-R are left for future definition. The DMT LCS MIB detail is presented in ASN-1 format at the end of the document.

## **2. DMT LCS MIB Structure**

The following additions are made to the generic ADSL Line MIB:

- To facilitate a general purpose LCS architecture, the `adslLCSMib` element is added to the `adslMibObjects` structure. All LCS MIB tables are based off this element, including `adslDMTMibObjects`.
- LCS tables are added under this new structure for each LCS type. These tables are organised identically to the elements under `adslMibObjects`. These tables perform the same functions as the tables under `adslMibObjects`; only their scope is limited to LCS parameters.
- The LCS tables use the INDEX clause, allowing them to be indexed as logical extensions of the generic line MIB tables.

Figure 1 shows the DMT LCS MIB structure and how it extends the ADSL Line MIB. Although the MIB structure is in place to add LCS tables that correspond to all tables in `adslMibObjects`, not all are required for DMT. As shown in Figure 1, the DMT LCS MIB only requires the following LCS tables:

- DMT line table (i.e. actual configuration) for the line.
- Physical tables (i.e. actuals) for both ATU-C and ATU-R.
- Line configuration profile table.

Following the precedent of The Broadband Forum reports TR-005 and TR-006, this MIB definition assumes that the SNMP agent is located at the ATU-C and acts as a proxy for the ATU-R. The mechanisms by which the ATU-C controls and monitors the ATU-R is mainly through standard DMT ADSL exchanges and the mechanism specific to each object in the DMT LCS MIB is identified in the attached ASN-1 code. Because the DMT LCS MIB resides at the central office and the SNMP agent proxies the ATU-R, some ATU-R elements may not be correctly reported when the link is not in steady state.

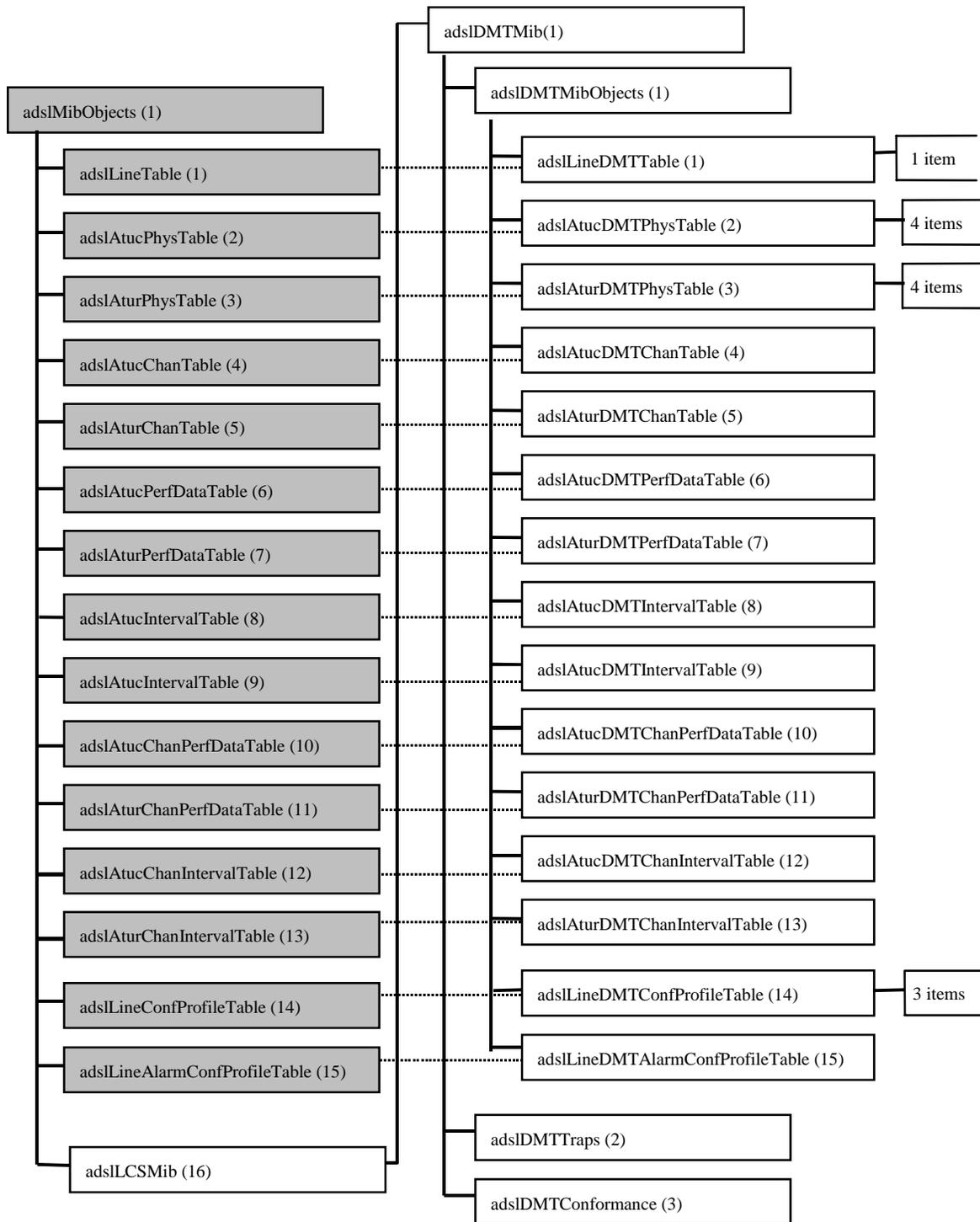


Figure 1. DMT Line Code Specific MIB

### **3. DMT LCS MIB Tables**

To facilitate a general purpose LCS architecture, the `adslLCSMib` object is added to the `adslMibObjects` structure in TR006. All LCS MIB tables are based off this element, including `adslDMTMibObjects`.

#### **3.1 DMT Line Table**

The DMT physical line table, **`adslLineDMTTable`**, reports the following elements common to the line that result from a successful line initialisation and training process:

- Report whether autonomous data streaming<sup>1</sup> is allowed on the eoc or only transaction based data exchanges using the `adslLineDMTTEOC` object. See ITU recommendation G.997.1 and 994.1 for further details.

#### **3.2 DMT Physical Tables**

The **`adslAtucDMTPhysTable`** and **`adslAturDMTPhysTable`** tables contain DMT specific operating status information. This includes ATU state as well as per bin information for bit loading, SNR and attenuation.

Both ATU-C state and ATU-R state are reported by the relevant physical tables (objects `adslAtucDMTState` and `adslAturDMTState`) and will change dynamically. The ATU-R status may not be current and depends on having an operating link to be reported because the SNMP agent proxies the ATU-R.

During start-up each ATU determines the SNR in each bin. In addition an approximation of the signal attenuation at that frequency is calculated. This information is used to calculate the bit loading (bits and gain) to achieve the configured rate. Once in SHOWTIME each ATU continues to monitor the SNR and uses this information to suggest bit swaps (or dynamic rate changes if this optional procedure is implemented) which causes the bit loading (bits or gain per bin) to change. Up to 32 bins may be used in the upstream direction and up to 256 bins in the downstream direction. Only instantaneous (or raw) versions of these objects are available in this MIB. The ATU-R SNR and Attenuation status may not be current and depends on having an operating link to be reported because the SNMP agent proxies the ATU-R. Note that all per bin objects are optional.

#### **3.3 DMT Channel Tables**

The DMT LCS MIB includes placeholders for the **`adslAtucDMTChanTable`** and **`adslAturDMTChanTable`** tables, which are not currently used.

#### **3.4 DMT Physical Performance Tables**

The DMT LCS MIB includes placeholders for the **`adslAtucDMTPerfDataTable`** and **`adslAturDMTPerfDataTable`** tables, which are not currently used.

#### **3.5 DMT Physical Interval Tables**

---

<sup>1</sup> The autonomous data streaming mode is sometimes known as eoc clear channel mode. Autonomous data streaming is a mandatory function defined in ITU G.992.1 and G.992.2. The transport of SNMP messages over the clear eoc channel has been identified by G.997.1 as optional and is indicated during initialization by messages defined in Recommendation G.994.1.

The DMT LCS MIB includes placeholders for the **adslAtucDMTIntervalTable** and **adslAturDMTIntervalTable** tables, which are not currently used.

### **3.6 DMT Channel Performance Tables**

The DMT LCS MIB includes placeholders for the **adslAtucDMTChanPerfDataTable** and **adslAturDMTChanPerfDataTable** tables, which are not currently used.

### **3.7 DMT Channel Interval Tables**

The DMT LCS MIB includes placeholders for the **adslAtucDMTChanIntervalTable** and **adslAturDMTChanIntervalTable** tables, which are not currently used.

### **3.8 Profile Group**

When dynamic profiles are used, the mechanism prescribed in TR-006 should be used to manage profile elements for both the generic **adslLineConfProfileTable** and the LCS specific table.

When a DMT ADSL line is initialising and training, the configuration is controlled by the ATU-C thus allowing operators to define various line profiles. The DMT configuration profile table (**adslLineDMTConfProfileTable**) allows the following aspects of the line to be configured before initialisation is attempted. The ATU-R or line condition may restrict the final configuration to be different from that requested in the target configuration. The target configuration elements are:

- Enable/disable each upstream DMT frequency bin using the **adslAtucDMTConfFreqBins** element and each downstream frequency bin using **adslAturDMTConfFreqBins**. The default and initial value is to enable all frequency bins. The **adslAturDMTConfFreqBins** element is passed to the ATU-R, using a vendor specific mechanism, for use during subsequent initialisations. Note that user control of certain bins may be ignored when transceiver operation may be compromised (eg. pilot tone may not be disabled, certain bins may not be used for operation as per G.992.2 (lite) and G.992.1 Annex B (ISDN under), etc).
- Configure the eoc processor to support transaction based eoc only or support additional autonomous data streaming operation. Although ITU Recommendations G.992.1 and G.992.2 require support for autonomous data transfers, the use of SNMP protocol over this clear channel eoc is optional as per G.997.1. It is this optional support of SNMP that is enabled when autonomous data streaming operation is enabled using the **adslLineDMTConfEOC** element. The default value is to disable autonomous data streaming operation (and thereby SNMP transfers) in the profile.

### **3.9 Alarm Configuration Profile Tables**

The DMT LCS MIB includes placeholders for the **adslLineDMTAlarmConfProfileTable** which are not currently used.

## **4. DMT Definitions for ADSL Line MIB**

The following definitions are made for use in The Broadband Forum document TR-006, which defines the ADSL Line MIB:

- SNR values quoted in the ADSL Line MIB are single numbers, not separate values for each frequency bin. SNR values in the ADSL Line MIB should be calculated in the same manner as ITU G.992.1. Initialisation SNR values are exchanged in the C-MSG1, C-MSG1-RA, R-MSG2 and R-MSG2-RA and may be reported

directly in the ADSL Line MIB. The current SNR measurement at the ATU-R may be obtained using an eoc read register exchange.

- Line attenuation values quoted in the ADSL Line MIB are single numbers, not separate values for each frequency bin. Attenuation values in the ADSL Line MIB should be calculated in the same manner as ITU G.992.1. Line attenuation values are reported by the ATU-R during initialisation in R-MSG2 and R-MSG-RA and may be reported directly in the ADSL Line MIB. The current line attenuation measurement at the ATU-R may be obtained using an eoc read register exchange.

These definitions customise certain generic elements in the ADSL Line MIB for application to a DMT line.

## **5. References**

1. ANSI T1.413-1995; Telecommunications - Network and Customer Installation Interfaces - Asymmetric Digital Subscriber Line (ADSL) Metallic Interface.
2. ANSI T1E1.4/98-007R1, Draft version of ADSL T1.413 Issue 2, May 1998.
3. The Broadband Forum TR-006; Network Management Technical Report, SNMP-Based ADSL Line MIB.
4. The Broadband Forum contributions 97-144 and 97-145 describing eoc autonomous data streaming proposals.
5. IETF, draft-ietf-adslmib-adslinemib-04.txt, Definitions of Managed Objects for the ADSL Lines
6. ITU, Draft G.997.1, Physical Layer Management for Digital Subscriber Line (DSL) Transceivers
7. ITU, Draft G.992.1, Asymmetrical Digital Subscriber Line (ADSL) Transceivers
8. ITU, Draft G.992.2, Splitterless Asymmetrical Digital Subscriber Line (ADSL) Transceivers
9. ITU, Draft G.994.1, Handshake Procedures for Digital Subscriber Line (DSL) Transceivers
10. The Broadband Forum contribution 99-079, Suggested Changes to DMT Line Code Specific MIB.
11. The Broadband Forum contribution 99-135, Proposal for In-Service Line Analysis and Test MIB

**ASN-1 Format DMT Line Code Specific MIB.**

```

ADSL-DMT-LINE-MIB DEFINITIONS ::= BEGIN
  IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE FROM SNMPv2-SMI
    MODULE-COMPLIANCE, OBJECT-GROUP FROM SNMPv2-CONF
    ifIndex FROM IF-MIB
    adslLCSMib, adslLineConfProfileName FROM ADSL-LINE-MIB ;

  -- DMT LCS MIB OBJECTS
  adslDMTMib MODULE-IDENTITY
    LAST-UPDATED "9906221200Z"
    ORGANIZATION "The Broadband Forum"
    CONTACT-INFO
      "
        Kevin Godfrey
        Motorola Inc.
        Colvilles Road, East Kilbride,
        Glasgow, United Kingdom.
        Tel: +44 1355 565597
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        Fax: +1 602-582-7697
        E-mail: bathricg@agcs.com

        Chuck Storry
        Newbridge Networks
        600 March Rd.
        Kanata, On, Canada K2K 2E6
        Tel: +1 613-591-3600
        Fax: +1 613-599-3634
        E-mail: cstorry@newbridge.com
      "
    DESCRIPTION
      "Naming Conventions:
      Atuc -- (ATUC) modem at near (Central) end of line
      Atur -- (ATUR) modem at Remote end of line
      LCS -- Line Code Specific"
  ::= {adslLCSMib 1}

  adslDMTMibObjects OBJECT IDENTIFIER ::= { adslDMTMib 1 }

  --DMT LINE TABLE
  adslLineDMTTable OBJECT-TYPE
    SYNTAX SEQUENCE OF AdslLineDMTEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
      "DMT interface physical layer actuals information
      table."

```

```

  ::= {adslDMTMibObjects 1}

  adslLineDMTEntry OBJECT-TYPE
    SYNTAX AdslLineDMTEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
      "DMT physical layer line actuals information entry"
    INDEX { ifIndex }
    ::= {adslLineDMTTable 1}

  AdslLineDMTEntry ::=
    SEQUENCE {
      adslLineDMTTEOC INTEGER
    }

  adslLineDMTTEOC OBJECT-TYPE
    SYNTAX INTEGER {
      unknown (1),
      -- eoc mode is unknown yet
      transaction (2),
      -- eoc only operates in original transaction mode
      streaming (3)
      -- eoc supports autonomous data streaming mode and
      -- original transaction mode
    }
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Reports whether the eoc can support autonomous data
      streaming mode or only transaction mode. After
      initialization, unknown is reported until
      the capability of both ATUs has been
      determined. Streaming support is only reported if both
      ATU's support this capability."
    ::= { adslLineDMTEntry 1 }

  -- ATU-C PHYSICAL TABLE
  adslAtucDMTPhysTable OBJECT-TYPE
    SYNTAX SEQUENCE OF AdslAtucDMTPhysEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
      "DMT interface physical layer actuals information
      table for the central office."
    ::= {adslDMTMibObjects 2}

  adslAtucDMTPhysEntry OBJECT-TYPE
    SYNTAX AdslAtucDMTPhysEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
      "DMT physical layer actuals information entry"
    INDEX { ifIndex }
    ::= {adslAtucDMTPhysTable 1}

```

```

AdslAtucDMTPHysEntry ::=
    SEQUENCE {
        adslAtucDMTState          INTEGER,
        adslAtucDMTBinBits       OCTET STRING,
        adslAtucDMTBinSNR        OCTET STRING,
        adslAtucDMTBinAtn        OCTET STRING
    }

adslAtucDMTState OBJECT-TYPE
    SYNTAX          INTEGER {
        other (1),          -- Unknown or other state
        powerup (2),       -- DMT transceiver not yet configured
        configure (3),     -- DMT transceiver being configured
        idle (4),          -- transceiver is initialized but idle
        quiet (5),        -- awaiting activation request from ATU-R
        tone (6),         -- requesting ATU-R to be silent
        activating (7),    -- activation in progress
        training (8),     -- transceiver training in progress
        analyzing (9),    -- channel analysis in progress
        exchange (10),   -- exchanging final operating parameters
        steadystate (11), -- normal operating mode
        notresponding (12) -- DMT transceiver not responding
    }
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Reports current state of the ATU-C DMT transceiver.
        The current state can change dynamically. The SNMP
        agent reports the state after querying the ATU-C
        state machine."
    ::= { adslAtucDMTPHysEntry 1 }

adslAtucDMTBinBits OBJECT-TYPE
    SYNTAX          OCTET STRING (SIZE (32))
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Each octet contains the number of bits per bin
        for the bin indexed by this element of the
        string. The 0th element contains the number of
        bits for bin 0 through to the 31st element
        which contains the number of bits for bin 31.
        The range of expected values is from 0 to 15
        bits per bin."
    ::= { adslAtucDMTPHysEntry 2 }

adslAtucDMTBinSNR OBJECT-TYPE
    SYNTAX          OCTET STRING (SIZE (32))
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Each octet contains the SNR per bin
        for the bin indexed by this element of the
        string. Each octet is coded as an unsigned
        integer, ranging from 0 to 127, corresponding
        to a 0 to 63.5 dB SNR (0.5 dB steps)."
    ::= { adslAtucDMTPHysEntry 3 }

adslAtucDMTBinAtn OBJECT-TYPE
    SYNTAX          OCTET STRING (SIZE (32))
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Each octet contains the attenuation per bin
        for the bin indexed by this element of the
        string. Each octet is coded as an unsigned
        integer, ranging from 0 to 255, corresponding
        to a 0 to 127.5 dB Attenuation (0.5 dB
        steps)."
    ::= { adslAtucDMTPHysEntry 4 }

-- ATU-R PHYSICAL TABLE
adslAturDMTPHysTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF AdslAturDMTPHysEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "DMT interface physical layer actuals information
        table for the remote unit."
    ::= { adslDMTMibObjects 3 }

adslAturDMTPHysEntry OBJECT-TYPE
    SYNTAX          AdslAturDMTPHysEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "DMT physical layer actuals information entry"
    INDEX           { ifIndex }
    ::= { adslAturDMTPHysTable 1 }

AdslAturDMTPHysEntry ::=
    SEQUENCE {
        adslAturDMTState          INTEGER,
        adslAturDMTBinBits       OCTET STRING,
        adslAturDMTBinSNR        OCTET STRING,
        adslAturDMTBinAtn        OCTET STRING
    }

adslAturDMTState OBJECT-TYPE
    SYNTAX          INTEGER {
        other (1),          -- Unknown or other state
        activating (2),    -- activation in progress
        training (3),     -- transceiver training in progress
        analyzing (4),    -- channel analysis in progress
        exchange (5),    -- exchanging final operating parameters
        steadystate (6)   -- normal operating mode
    }
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Reports current state of the ATU-R DMT transceiver.
        The current state can change dynamically. ATU-R state is
        reported by the SNMP agent at the ATU-C which infers the
        state depending on the ATU-C state. When the inference
        cannot be made, unknown state is returned."
    ::= { adslAturDMTPHysEntry 1 }

```

```

adslAturDMTBinBits OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (256))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Each octet contains the number of bits per bin
        for the bin indexed by this element of the
        string. The 0th element contains the number of
        bits for bin 0 through to the 255th element
        which contains the number of bits for bin
        255. The range of expected values is from 0 to
        15 bits per bin "
    ::= { adslAturDMTPhysEntry 2 }

adslAturDMTBinSNR OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (256))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Each octet contains the SNR per bin
        for the bin indexed by this element of the
        string. Each octet is coded as an unsigned
        integer, ranging from 0 to 127, corresponding
        to a 0 to 63.5 dB SNR (0.5 dB steps)."
    ::= { adslAturDMTPhysEntry 3 }

adslAturDMTBinAtn OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (256))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Each octet contains the attenuation per bin
        for the bin indexed by this element of the
        string. Each octet is coded as an unsigned
        integer, ranging from 0 to 255, corresponding
        to a 0 to 127.5 dB Attenuation (0.5 dB
        steps)."
    ::= { adslAturDMTPhysEntry 4 }

-- CHANNEL TABLES
adslAtucDMTChanTable OBJECT IDENTIFIER ::= {adslDMTMibObjects 4}
adslAturDMTChanTable OBJECT IDENTIFIER ::= {adslDMTMibObjects 5}

-- PERFORMANCE DATA TABLES
adslAtucDMTPerfDataTable OBJECT IDENTIFIER ::= {adslDMTMibObjects 6}
adslAturDMTPerfDataTable OBJECT IDENTIFIER ::= {adslDMTMibObjects 7}

-- INTERVAL TABLES
adslAtucDMTIntervalTable OBJECT IDENTIFIER ::= {adslDMTMibObjects 8}
adslAturDMTIntervalTable OBJECT IDENTIFIER ::= {adslDMTMibObjects 9}

-- CHANNEL PERFORMANCE DATA TABLES
adslAtucDMTChanPerfDataTable OBJECT IDENTIFIER ::= {adslDMTMibObjects 10}
adslAturDMTChanPerfDataTable OBJECT IDENTIFIER ::= {adslDMTMibObjects 11}

-- CHANNEL INTERVAL TABLES
adslAtucDMTChanIntervalTable OBJECT IDENTIFIER ::= {adslDMTMibObjects 12}

adslAturDMTChanIntervalTable OBJECT IDENTIFIER ::= {adslDMTMibObjects 13}

-- CONFIGURATION FOR ATU-C/ATU-R DMT INTERFACES
adslLineDMTConfProfileTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF AdslDMTConfProfileEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This table contains the target DMT specific configuration
        parameters for the physical layer before initialization."
    ::= {adslDMTMibObjects 14}

adslDMTConfProfileEntry OBJECT-TYPE
    SYNTAX      AdslDMTConfProfileEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "DMT interface config information entry"
    INDEX      { adslLineConfProfileName }
    ::= {adslLineDMTConfProfileTable 1}

AdslDMTConfProfileEntry ::=
    SEQUENCE {
        adslAtucDMTConfFreqBins      OCTET STRING,
        adslAturDMTConfFreqBins      OCTET STRING,
        adslLineDMTConfEOC            INTEGER
    }

-- Configuration profiles define the starting point for line
-- initialization. After initialization is complete, the
-- parameters may have changed due to the negotiation and rate
-- options process. Check the adslAtucDMTPhysTable and
-- adslLineDMTTable for the final settings.

adslAtucDMTConfFreqBins OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(4))
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "A string of 32 bits to enable/disable the incoming DMT
        frequency bins that the ATU-C receiver monitors. Each
        bit controls one bin with the first bit of the first
        octet controlling sub-carrier zero (lowest frequency
        bin). A bit set to 1 disables reception of the specified
        sub-carrier frequency bin and a 0 enables reception."
    DEFVAL     { '00000000'H }
    ::= { adslDMTConfProfileEntry 1 }

adslAturDMTConfFreqBins OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(32))
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "A string of 256 bits to enable/disable the incoming DMT
        frequency bins that the ATU-R receiver should monitor
        after the next activation. The mechanism to pass
        adslAturDMTConfFreqBins to the ATU-R is vendor specific."

```

