

Internet Engineering Task Force (IETF)
Request for Comments: 6765
Category: Standards Track
ISSN: 2070-1721

E. Beili
Actelis Networks
M. Morgenstern
ECI Telecom
February 2013

xDSL Multi-Pair Bonding (G.Bond) MIB

Abstract

This document defines a Management Information Base (MIB) module for use with network management protocols in TCP/IP-based internets. This document defines an extension to the Interfaces Group MIB with a set of common objects for managing multi-pair bonded Digital Subscriber Line (xDSL) interfaces, as defined in ITU-T Recommendations G.998.1, G.998.2, and G.998.3. The textual conventions defining the bonding schemes are contained in a separate MIB module maintained by Internet Assigned Numbers Authority (IANA). The MIB modules specific to each bonding technology are defined in G9981-MIB, G9982-MIB, and G9983-MIB, respectively.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at <http://www.rfc-editor.org/info/rfc6765>.

Copyright Notice

Copyright (c) 2013 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Table of Contents

1. Introduction	3
2. The Internet-Standard Management Framework	4
3. The Broadband Forum Management Framework for xDSL Bonding	4
4. Relationship to Other MIB Modules	5
4.1. Relationship to Interfaces Group MIB Module	5
4.1.1. Layering Model	5
4.1.2. xDSL Bonding	7
4.1.3. Discovery Operation	8
4.1.4. Initialization of G.Bond Ports	10
4.1.5. Usage of the ifTable	11
4.2. Relationship to G.Bond ATM, ETH, and TDIM MIB Modules	13
4.3. Relationship to xDSL MIB Modules	13
4.4. Addition of New Bonding Schemes	13
5. MIB Structure	13
5.1. Overview	13
5.2. Performance Monitoring	14
5.3. Mapping of Broadband Forum TR-159 Managed Objects	14
6. xDSL Multi-Pair Bonding MIB Definitions	19
7. IANA-Maintained G.Bond TC Definitions	65
8. Security Considerations	67
9. IANA Considerations	69
10. Acknowledgments	69
11. References	70
11.1. Normative References	70
11.2. Informative References	71

1. Introduction

xDSL Multi-pair bonding allows a service provider to provide high-bandwidth services to business and residential customers over multiple xDSL lines, with greater speed and resiliency than service over a single xDSL line, bridging the gap between xDSL and fiber-based transport.

Currently, there are three xDSL Multi-pair bonding schemes, also known under the collective name "G.Bond":

- o ATM-Based Multi-pair bonding, as specified in ITU-T Recommendation G.998.1 [G.998.1], which defines a method for the bonding (or aggregating) of multiple xDSL lines (or individual bearer channels in multiple xDSL lines) into a single bidirectional logical link carrying an ATM stream. This specification can be viewed as an evolution of the legacy Inverse Multiplexing for ATM (IMA) technology [AF-PHY-0086], applied to xDSL with variable rates on each line/bearer channel.
- o Ethernet-Based Multi-pair bonding, as specified in ITU-T Recommendation G.998.2 [G.998.2], which defines a method for the bonding (or aggregating) of multiple xDSL lines (or individual bearer channels in multiple xDSL lines) into a single bidirectional logical link carrying an Ethernet stream. This specification can be viewed as IEEE 802.3-2005 [802.3] Clause 61, Physical Medium Entity (PME) Aggregation, generalized to work over any xDSL technology (2Base-TL and 10Pass-TS interfaces defined by IEEE use G.SHDSL (Single-pair High-speed DSL) and VDSL (Very high speed DSL) technology, respectively).
- o Multi-pair bonding using Time-Division Inverse Multiplexing (TDIM), specified in ITU-T Recommendation G.998.3 [G.998.3], which defines a method for the bonding (or aggregating) of multiple xDSL lines into a single bidirectional logical link carrying a mix of various traffic streams (e.g., Ethernet, ATM, TDM).

Architecturally, all three bonding schemes define a new "bonded" Transport Protocol Specific - Transmission Convergence (TPS-TC) sub-layer, stacked above multiple ATM-TC, Ethernet/Packet Transfer Mode-TC (PTM-TC), or Synchronous Transfer Mode-TC (STM-TC) (clear channel) sub-layers for the ATM, Ethernet, or TDIM bonding, respectively. Each underlying TPS-TC sub-layer represents a protocol-specific interface to an xDSL line or an individual bearer channel of an xDSL line. Bonding of multiple bearer channels in the same xDSL line is not allowed.

All schemes allow bonding of up to 32 individual line/channel sub-layers with variable rates, providing common functionality for the configuration, initialization, operation, and monitoring of the bonded link.

This document defines a MIB module common to all 3 schemes. Additional managed objects specific to each bonding technology are defined in the G9981-MIB [RFC6768], G9982-MIB [RFC6767], and G9983-MIB [RFC6766] modules.

The textual conventions listing the bonding schemes are defined in a separate, IANA-maintained MIB module, the first version of which is provided in this document. This arrangement would allow for future bonding schemes to be easily supported, without the need to update the common GBOND-MIB module.

2. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This document specifies a MIB module that is compliant to the SMIV2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14, RFC 2119 [RFC2119].

3. The Broadband Forum Management Framework for xDSL Bonding

This document makes use of the Broadband Forum technical report "Management Framework for xDSL Bonding" [TR-159], defining a management model and a hierarchy of management objects for the bonded xDSL interfaces.

4. Relationship to Other MIB Modules

This section outlines the relationship of the MIB modules defined in this document with other MIB modules described in the relevant RFCs. Specifically, the following MIB modules are discussed: the Interfaces Group MIB (IF-MIB), Inverse Stack Table MIB (IF-INVERTED-STACK-MIB), and Interface Stack Capability MIB (IF-CAP-STACK-MIB); G.Bond scheme-specific modules G.Bond/ATM (G9981-MIB), G.Bond/Ethernet (G9982-MIB), and G.Bond/TDIM (G9983-MIB); and DSL-specific MIB modules ADSL (ADSL-LINE-EXT-MIB), ADSL2 (ADSL2-LINE-MIB), SHDSL (HDSL2-SHDSL-LINE-MIB), VDSL (VDSL-LINE-MIB), and VDSL2 (VDSL2-LINE-MIB).

4.1. Relationship to Interfaces Group MIB Module

A bonded xDSL port is a stacked (a.k.a. aggregated or bonded) interface and as such is managed using generic interface management objects defined in the IF-MIB [RFC2863].

The stack management, i.e., actual connection of the sub-layers to the top layer interface, is done via the ifStackTable, as defined in the IF-MIB [RFC2863] and its inverse -- the ifInvStackTable, as defined in the IF-INVERTED-STACK-MIB [RFC2864].

The ifCapStackTable and its inverse -- the ifInvCapStackTable, as defined in the IF-CAP-STACK-MIB [RFC5066] -- extend the stack management with an ability to describe possible connections or cross-connect capability, when a flexible cross-connect matrix is present between the interface layers.

4.1.1. Layering Model

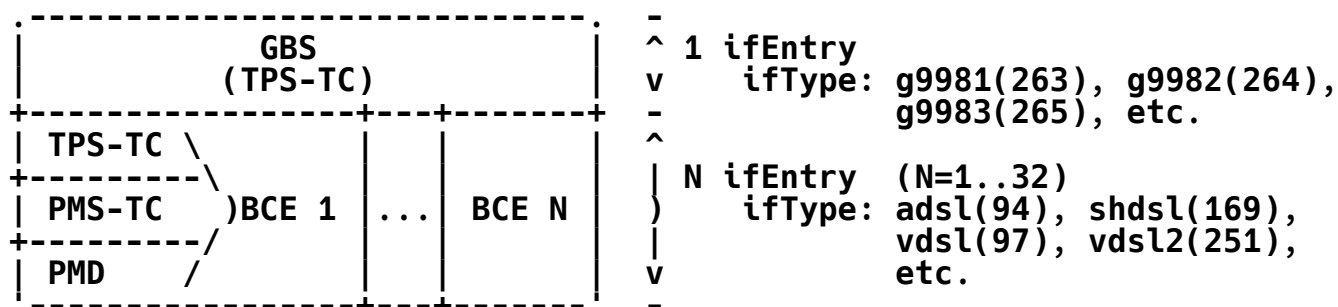
A G.Bond interface can aggregate up to 32 channel sub-layers, with each channel representing an xDSL line or an xDSL bearer channel. For the purpose of brevity we will refer to the bonded interface as the Generic Bonding Sub-layer (GBS) and to the channel sub-layer as the Bonding Channel Entity (BCE).

A generic G.Bond device can have a number of GBS ports, each connected to a particular upper layer (e.g., a Media Access Control (MAC) interface for the G.998.2 scheme), while simultaneously cross-connected to a number of underlying BCEs, with a single-GBS-per-BCE relationship.

A GBS port is represented in the Interfaces table (ifTable) as a separate interface with an ifType reflecting a particular bonding scheme, e.g., g9981(263), g9982(264), or g9983(265).

Each BCE in the aggregated GBS port is represented in the ifTable as a separate interface with an ifType relevant to a particular xDSL technology, e.g., shdsl(169) or vdsl(97). The ifType values are defined in [IANAifType-MIB].

The following figure shows the layering diagram and corresponding use of the ifTable for the bonded xDSL interfaces:



BCE - Bonding Channel Entity
 GBS - Generic Bonding Sub-layer
 PMD - Physical Medium Dependent
 TPS-TC - Transport Protocol Specific - Transmission Convergence
 PMS-TC - Physical Media Specific - Transmission Convergence

Figure 1: Use of ifTable for Bonded xDSL Interfaces

The ifStackTable is indexed by the ifIndex values of the aggregated G.Bond port (GBS) and the BCEs connected to it. The ifStackTable allows a network management application to determine which BCEs are connected to a particular GBS and change connections (if supported by the application). The ifInvStackTable, being an inverted version of the ifStackTable, provides an efficient means for a network management application to read a subset of the ifStackTable and thereby determine which GBS runs on top of a particular BCE.

The ifCapStackTable, defined in the IF-CAP-STACK-MIB module, specifies for each higher-layer interface (e.g., GBS port) a list of lower-layer interfaces (e.g., BCEs), which can possibly be cross-connected to that higher-layer interface, determined by the cross-connect capability of the device. This table, modeled after the ifStackTable, is read only, reflecting current cross-connect capability of a stacked interface, which can be dynamic in some implementations (e.g., if xDSL lines are located on a pluggable module and the module is pulled out). Note that BCE availability per GBS, described by the ifCapStackTable, can be constrained by other parameters -- for example, by the aggregation capacity of a GBS or by the BCE in question being already connected to another GBS. So, in

order to ensure that a particular BCE can be connected to the GBS, all respective parameters (e.g., ifCapStackTable, ifStackTable, and gBondPortCapCapacity) SHALL be inspected.

The ifInvCapStackTable, also defined in the IF-CAP-STACK-MIB module, describes which higher-layer interfaces (e.g., GBS ports) can possibly be connected to a particular lower-layer interface (e.g., BCE), providing inverted mapping of the ifCapStackTable. While it contains no additional information beyond that already contained in the ifCapStackTable, the ifInvCapStackTable has the ifIndex values in its INDEX clause in the reverse order, i.e., the lower-layer interface first, and the higher-layer interface second, providing efficient means for a network management application to read a subset of the ifCapStackTable and thereby determine which interfaces can be connected to run on top of a particular interface.

4.1.2. xDSL Bonding

The G.998.x Bonding allows a number of BCEs to be aggregated onto a single logical GBS port by splitting the incoming traffic into multiple streams, transmitting each stream over a specific BCE, and combining the streams at the remote GBS port, preserving the original traffic order.

The Ethernet frames MAY be fragmented before the transmission and reassembled at the remote end to minimize transportation delay. The G.998.2 (G.Bond/Ethernet) ports with multiple BCEs MUST perform the fragmentation and reassembly of the Ethernet frames. However, for single-BCE G.998.2 ports this function MAY be omitted (a.k.a. bonding bypass), to minimize fragmentation overhead and additional processing delay as well as to be able to interoperate with non-G.998 DSL equipment.

The agent is REQUIRED to indicate all supported bonding schemes (for example, ATM, Ethernet, and TDIM), including OPTIONAL support for the bonding bypass in G.998.2 single-BCE ports.

The GBOND-MIB module allows a network management application to query Bonding capability and enable/disable it if supported. Note that enabling Bonding (by setting the value of the gBondPortConfAdminScheme and gBondPortConfPeerAdminScheme objects to any supported bonding scheme other than 'none') effectively turns on the fragmentation and reassembly function, even on a single-BCE port.

4.1.3. Discovery Operation

The G.Bond ports may optionally support a discovery operation whereby BCEs, during initialization, exchange information about their respective aggregation groups (GBS), via the [G.994.1] handshake (G.hs) protocol. This information can then be used to detect copper misconnections or for an automatic assignment of the local BCEs into aggregation groups instead of a fixed preconfiguration.

The MIB module defined in this document allows a network management application to control the G.Bond discovery mechanism and query its results.

Two tables are used by the G.Bond discovery mechanism: the ifStackTable and the ifCapStackTable. The following pseudocode gives an example of the discovery and automatic BCE assignment for a generic multi-GBS G.Bond device, located at the Central Office (CO), using objects defined in this MIB module as well as the IF-CAP-STACK-MIB and IF-MIB modules [Note that automatic BCE assignment is only shown here for the purposes of the example. Fixed BCE pre-assignment, manual assignment, or auto-assignment using an alternative internal algorithm may be chosen by a particular implementation]:

```
// Go over all GBS ports in the CO device
FOREACH gbs[i] IN CO_device
{ // Perform discovery and auto-assignment on GBS ports
  // with room for more channels.
  IF ( gbs[i].NumBCEs < gbs[i].BondCapacity )
  { // Assign a unique 6-octet local discovery code to the GBS,
    // e.g., MAC address of the associated port or some other
    // unique number specifically allocated for this purpose.
    dc = gbs[i].DiscoveryCode = MAC[i];
    // Go over all disconnected channels, which can
    // potentially be connected to the GBS.
    FOREACH bce[j] IN ifCapStackTable[gbs[i]] AND
                        NOT IN ifStackTable[gbs[i]] // not connected
    { // Try to grab the Remote Terminal device (RT) by writing the
      // value of the local 6-byte discovery code to the remote
      // discovery code register (via a handshake mechanism).
      // This operation is an atomic Set-if-Clear action; i.e., it
      // would succeed only if the remote discovery register was
      // zero. Read the remote discovery code register via a Get
      // operation to see if the RT, attached via the BCE,
      // is indeed marked as being the CO_device peer.
      bce[j].RemoteDiscoveryCode = dc;           // Set-if-Clear
      r = bce[j].RemoteDiscoveryCode;           // Get
    }
  }
}
```



```

IF ( r == dc AND gbs[i].NumBCEs < gbs[i].BondCapacity )
{ // RT connected via BCE[j] is/was a peer
  // for GBS[i], and there is room for another BCE in the
  // GBS[i] aggregation group (max. Bonding capacity is
  // not reached yet).
  // Connect this BCE to the GBS (via the ifStackTable; the
  // ifInvStackTable, which is the inverse of the ifStackTable,
  // is updated automatically; i.e., gbs[i] is auto-added
  // to ifInvStackTable[bce[j]]).
  ADD bce[j] TO ifStackTable[gsb[i]];
  gbs[i].NumBCEs = gbs[i].NumBCEs + 1;
  // Discover all other disconnected BCEs
  // attached to the same RT and connect them to
  // the GBS, provided there is enough room for more BCEs.
  FOREACH bce[k] IN ifCapStackTable[gsb[i]] and
    NOT IN ifStackTable[gsb[i]]
  { // Get the remote discovery code from the BCE to see if
    // it belongs to a connected RT "grabbed" by
    // the CO device.
    r = bce[k].RemoteDiscoveryCode;
    IF ( r == dc AND gbs[i].NumBCEs < gbs[i].BondCapacity )
    { // Physically connect the BCE to the GBS.
      // (gsb[i] is auto-added TO ifInvStackTable[bce[k]]).
      ADD bce[k] TO ifStackTable[gsb[i]];
      gbs[i].NumBCEs = gbs[i].NumBCEs + 1;
    }
  }
}
}
// At this point we have discovered all local BCEs that
// are physically connected to the same RT and
// connected them to GBS[i]. Go to the next GBS.
BREAK;
}
}
}

```

An SNMP agent for a G.Bond device builds the ifCapStackTable and its inverse -- the ifInvCapStackTable -- on device initialization, according to the cross-connect capabilities of the device.

Adding a BCE to the ifStackTable row for a specific GBS involves actual connection of the BCE to the GBS.

Note that a GBS port does not have to be operationally 'down' for the connection to succeed. In fact, a dynamic BCE addition (and removal) MAY be implemented with an available BCE being initialized first (by setting its ifAdminStatus to 'up') and then added to an operationally 'up' GBS port, by modifying a respective ifStackTable (and respective ifInvStackTable) entry.

It is RECOMMENDED that removal of the last operationally 'up' BCE from an operationally 'up' GBS, i.e., modification of a respective entry in the ifStackTable, and a corresponding entry in the ifInvStackTable, would be rejected by the implementation (in the case of SNMP, with the error inconsistentValue), as this action would completely drop the link.

In addition to the standard handshake-based discovery described above, [G.998.2] defines an optional frame-based discovery and pair management. These frame-based methods are discussed in [RFC6767].

4.1.4. Initialization of G.Bond Ports

G.Bond ports built on top of xDSL technology require a lengthy initialization or 'training' process before any data can pass. During this initialization, both ends of a link (peers) work cooperatively to achieve a required data rate on a particular copper pair. Sometimes, when the copper line is too long or the noise on the line is too high, that 'training' process may fail to achieve a specific target rate with required characteristics.

The ifAdminStatus object from the IF-MIB controls the desired state of a GBS with all the BCEs connected to it or of an individual BCE port. Setting this object to 'up' instructs a particular GBS or a BCE to start the initialization process, which may take tens of seconds for G.Bond ports. The ifOperStatus object from the IF-MIB shows the operational state of an interface for the GBS, extended by the gBondPortStatFltStatus object defined in this document, and a corresponding *Status object from a relevant xDSL line MIB for BCE interfaces.

A disconnected BCE may be initialized by changing the ifAdminStatus from 'down' to 'up'. Changing the ifAdminStatus to 'up' on the GBS initializes all BCEs connected to that particular GBS. Note that in the case of bonding, some interfaces may fail to initialize while others succeed. The GBS is considered operationally 'up' if at least one bonded BCE is operationally 'up'. When all BCEs connected to the GBS are 'down', the GBS SHALL be considered operationally 'lowerLayerDown'. The GBS SHALL be considered operationally

'notPresent' if it is not connected to any BCE. The GBS/BCE interface SHALL remain operationally 'down' during initialization, indicated by the 'init' value of the gBondPortStatFltStatus object.

4.1.5. Usage of the ifTable

Both BCE and GBS interfaces are managed using interface-specific management objects defined in the GBOND-MIB module and generic interface objects from the ifTable of the IF-MIB, with all management table entries referenced by the interface index ifIndex.

The following table summarizes G.Bond-specific interpretations for some of the ifTable objects specified by the mandatory ifGeneralInformationGroup:

IF-MIB Object	G.Bond Interpretation
ifIndex	Interface index. Note that each BCE and each GBS in the G.Bond PHY MUST have a unique index, as there are some GBS- and BCE-specific attributes accessible only on the GBS or BCE level.
ifType	g9981(263), g9982(264), or g9983(265) for the ATM, Ethernet, or TDIM GBS, respectively; shdsl(169) for the G.SHDSL BCE, vdsl(97) for the VDSL BCE, etc.
ifSpeed	Operating data rate for the BCE. For the GBS, it is the sum of the current operating data rates of all BCEs in the aggregation group, without the encapsulation overhead and G.Bond overhead, but accounting for Inter-Frame Gaps (IFG). When a GBS or a BCE is operating in an asymmetrical fashion (the upstream data rate differs from the downstream one), the lowest of the values is shown.
ifAdminStatus	Setting this object to 'up' instructs a particular GBS (with all BCEs connected to it) or a BCE to start the initialization process.
ifOperStatus	A relevant *Status object from a particular line MIB supplements the value of ifOperStatus for BCEs. gBondPortStatFltStatus supplements the value of ifOperStatus for a GBS. Note that both relevant objects shall be inspected to determine the real operational status of a BCE/GBS port, e.g., a GBS port may be operationally 'up' with gBondPortStatFltStatus indicating lowRate(4) fault condition, or 'down' with no gBond faults.

Table 1: G.Bond Interpretation of IF-MIB Objects

4.2. Relationship to G.Bond ATM, ETH, and TDIM MIB Modules

The MIB module defined in this document is common to all G.998 bonding schemes. It **MUST** be used in conjunction with a bonding scheme-specific MIB module:

- o G9981-MIB [RFC6768] for a G.998.1 bonded interface.
- o G9982-MIB [RFC6767] for a G.998.2 bonded interface.
- o G9983-MIB [RFC6766] for a G.998.3 bonded interface.

4.3. Relationship to xDSL MIB Modules

Each xDSL technology is described in a relevant xDSL line MIB module: e.g., the HDSL2-SHDSL-LINE-MIB [RFC4319] for G.SHDSL, ADSL-LINE-EXT-MIB [RFC3440] for ADSL, ADSL2-LINE-MIB [RFC4706] for ADSL2, VDSL-LINE-MIB [RFC3728] for VDSL, or VDSL2-LINE-MIB [RFC5650] for VDSL2.

These MIB modules are used to manage individual xDSL lines/channels (BCEs).

4.4. Addition of New Bonding Schemes

In case a new bonding scheme is introduced in a revision of G.998, IANA can update the IANA-maintained MIB module, adding the corresponding new value to the IANAgBondScheme and IANAgBondSchemeList textual conventions, as well as listing the new scheme-specific MIB module's name (e.g., G998x-MIB).

Any scheme-specific aspect of an existing GBOND-MIB object **SHALL** be described in the corresponding G998x-MIB module, to prevent an unnecessary reissue of the GBOND-MIB module. For example, an exact definition of an Errored Second (ES) or a Severely Errored Second (SES) can be bonding-scheme specific; see the definitions for the gBondPortPmCurES and gBondPortPmCurSES objects.

5. MIB Structure

5.1. Overview

The main management objects defined in the GBOND-MIB module are split into 2 groups, structured as recommended by RFC 4181 [RFC4181]:

- o gBondPort - containing objects for configuration, capabilities, status, historical Performance Monitoring, and notifications, common to all G.Bond ports (GBS).

- o gBondBce - containing a single common object for configuration of the remote discovery code per BCE. Note that the rest of the objects for BCE configuration, capabilities, status, and notifications are located in relevant xDSL line MIB modules as well as in the bonding scheme-specific MIB modules.

5.2. Performance Monitoring

The OPTIONAL Performance Monitoring counters, thresholds, and history buckets (interval-counters) defined in [TR-159] are implemented using the textual conventions defined in the HC-PerfHist-TC-MIB [RFC3705]. The HC-PerfHist-TC-MIB defines 64-bit versions of the textual conventions found in the PerfHist-TC-MIB [RFC3593].

The agent SHOULD align the beginning of each interval to a fifteen-minute boundary of a wall clock. Likewise, the beginning of each one-day interval SHOULD be aligned with the start of a day.

The rationale behind this is to simplify collection and analysis of Performance Monitoring (PM) from multiple agents by a network management system (NMS) -- each PM interval can be "time-stamped" using the gBond*IntervalIndex object, from the fact that the 1-day interval starts at 00:00 and the 15-minute intervals are aligned with each 1/4 hour and the network-wide "wall clock", typically distributed via NTP or the Simple Network Time Protocol (SNTP) [RFC5905]. If the agent does not have access to the wall clock, a local clock can be used. In this case, as well as when coping with multiple time zones, the NMS would have to correlate the difference between the agent's local clock (available, for example, via the hrSystemDate object from the HOST-RESOURCES-MIB [RFC2790]) and the wall clock.

Counters are not reset when a GBS is re-initialized, but rather only when the agent is reset or re-initialized.

Note that the accumulation of certain performance events for a monitored entity is inhibited (counting stops) during periods of service unavailability on that monitored entity. The DESCRIPTION clause of Performance Monitoring counters in this MIB module specifies which of the counters are inhibited during periods of service unavailability.

5.3. Mapping of Broadband Forum TR-159 Managed Objects

This section contains the mapping between relevant managed objects (attributes) defined in [TR-159] and managed objects defined in this document and in associated MIB modules, i.e., the IF-MIB [RFC2863].

G.Bond Managed Object	Corresponding SNMP Object
oBondingGroup - Basic Package (Mandatory)	
aGroupID	ifIndex (IF-MIB)
aGroupBondSchemesSupported	gBondPortCapSchemesSupported
aGroupPeerBondSchemesSupported	gBondPortCapPeerSchemesSupported
aGroupAdminBondScheme	gBondPortConfAdminScheme
aGroupPeerAdminBondScheme	gBondPortConfPeerAdminScheme
aGroupOperBondScheme	gBondPortStatOperScheme
aGroupPeerOperBondScheme	gBondPortStatPeerOperScheme
aGroupEnd	gBondPortStatSide
aGroupOperState	ifOperStatus (IF-MIB)
aGroupAdminState	ifAdminStatus (IF-MIB)
aGroupStatus	gBondPortStatFltStatus
aGroupCapacity	gBondPortCapCapacity
aGroupPeerCapacity	gBondPortCapPeerCapacity
aGroupNumChannels	gBondPortStatNumBCEs
aGroupName	ifName (IF-MIB)
aGroupDiscoveryCode	gBondPortConfDiscoveryCode
aGroupUpRate	gBondPortStatUpDataRate
aGroupDownRate	gBondPortStatDnDataRate
aGroupTargetUpRate	gBondPortConfTargetUpDataRate
aGroupTargetDownRate	gBondPortConfTargetDnDataRate
aGroupThreshLowUpRate	gBondPortConfThreshLowUpRate

aGroupThreshLowDownRate	gBondPortConfThreshLowDnRate
aGroupLowRateCrossingEnable	gBondPortConfLowRateCrossingEnable
nGroupLowUpRateCrossing	gBondLowUpRateCrossing
nGroupLowDownRateCrossing	gBondLowDnRateCrossing
aGroupLinkUpDownEnable	ifLinkUpDownTrapEnable (IF-MIB)
nGroupLinkUp	linkUp (IF-MIB)
nGroupLinkDown	linkDown (IF-MIB)
oBondingGroup - PM Package (Optional)	
aGroupPerfES	gBondPortPmCurES
aGroupPerfSES	gBondPortPmCurSES
aGroupPerfUAS	gBondPortPmCurUAS
aGroupPerf15MinValidIntervals	gBondPortPmCur15MinValidIntervals
aGroupPerf15MinInvalidIntervals	gBondPortPmCur15MinInvalidIntervals
aGroupPerfCurr15MinTimeElapsed	gBondPortPmCur15MinTimeElapsed
aGroupPerfCurr15MinES	gBondPortPmCur15MinES
aGroupPerfCurr15MinSES	gBondPortPmCur15MinSES
aGroupPerfCurr15MinUAS	gBondPortPmCur15MinUAS
aGroupPerfTcaEnable	gBondPortConfPmTcaEnable
aGroupPerfThreshold15MinES	gBondPortPmTcaProfileThresh15MinES
aGroupPerfThreshold15MinSES	gBondPortPmTcaProfileThresh15MinSES
aGroupPerfThreshold15MinUAS	gBondPortPmTcaProfileThresh15MinUAS
nGroupPerfTca15MinES	gBondPmTca15MinESCrossing
nGroupPerfTca15MinSES	gBondPmTca15MinSESCrossing

nGroupPerfTca15MinUAS	gBondPmTca15MinUASCrossing
aGroupPerf1DayValidIntervals	gBondPortPmCur1DayValidIntervals
aGroupPerf1DayInvalidIntervals	gBondPortPmCur1DayInvalidIntervals
aGroupPerfCurr1DayTimeElapsed	gBondPortPmCur1DayTimeElapsed
aGroupPerfCurr1DayES	gBondPortPmCur1DayIntervalES
aGroupPerfCurr1DaySES	gBondPortPmCur1DayIntervalSES
aGroupPerfCurr1DayUAS	gBondPortPmCur1DayIntervalUAS
aGroupPerfThreshold1DayES	gBondPortPmTcaProfileThresh1DayES
aGroupPerfThreshold1DaySES	gBondPortPmTcaProfileThresh1DaySES
aGroupPerfThreshold1DayUAS	gBondPortPmTcaProfileThresh1DayUAS
nGroupPerfTca1DayES	gBondPmTca1DayESCrossing
nGroupPerfTca1DaySES	gBondPmTca1DaySESCrossing
nGroupPerfTca1DayUAS	gBondPmTca1DayUASCrossing
aGroupPerf15MinIntervalNumber	gBondPortPm15MinIntervalIndex
aGroupPerf15MinIntervalValid	gBondPortPm15MinIntervalValid
aGroupPerf15MinIntervalES	gBondPortPm15MinIntervalES
aGroupPerf15MinIntervalSES	gBondPortPm15MinIntervalSES
aGroupPerf15MinIntervalUAS	gBondPortPm15MinIntervalUAS
aGroupPerf1DayIntervalNumber	gBondPortPm1DayIntervalIndex
aGroupPerf1DayIntervalValid	gBondPortPm1DayIntervalValid
aGroupPerf1DayIntervalMoniSecs	gBondPortPm1DayIntervalMoniTime
aGroupPerf1DayIntervalES	gBondPortPm1DayIntervalES
aGroupPerf1DayIntervalSES	gBondPortPm1DayIntervalSES

aGroupPerf1DayIntervalUAS	gBondPortPm1DayIntervalUAS
oLine - Basic Package (Mandatory)	
aLineID	ifIndex (IF-MIB)
aLineType	ifType (IF-MIB)
aLineOperState	ifOperStatus (IF-MIB)
aLineStatus	*dsl*CurrStatus (*DSL-LINE-MIB)
aLineEnd	*dsl*Side (*DSL-LINE-MIB)
aLineAdminState	ifAdminStatus (IF-MIB)
aLineRemoteDiscoveryCode	gBondBceConfRemoteDiscoveryCode
aLineUpDownEnable	ifLinkUpDownTrapEnable (IF-MIB)
nLineUp	LinkUp (IF-MIB)
nLineDown	LinkDown (IF-MIB)
oChannel - Basic Package (Mandatory)	
aChannelID	ifIndex (IF-MIB)
aChannelGroupID	
aChannelType	ifType (IF-MIB)
aChannelOperState	ifOperStatus (IF-MIB)
aChannelStatus	*dsl*CurrStatus (*DSL-LINE-MIB), xdsl2ChStatus*Status (VDSL2-LINE-MIB)

Table 2: Mapping of TR-159 Managed Objects

6. xDSL Multi-Pair Bonding MIB Definitions

The GBOND-MIB module IMPORTS objects from SNMPv2-SMI [RFC2578], SNMPv2-TC [RFC2579], SNMPv2-CONF [RFC2580], SNMP-FRAMEWORK-MIB [RFC3411], IF-MIB [RFC2863], and HC-PerfHist-TC-MIB [RFC3705]. The module has been structured as recommended by [RFC4181].

GBOND-MIB DEFINITIONS ::= BEGIN

```

IMPORTS
    MODULE-IDENTITY,
    OBJECT-TYPE,
    NOTIFICATION-TYPE,
    mib-2,
    Unsigned32,
    Gauge32
        FROM SNMPv2-SMI                -- RFC 2578
    TEXTUAL-CONVENTION,
    TruthValue,
    RowStatus,
    PhysAddress
        FROM SNMPv2-TC                -- RFC 2579
    MODULE-COMPLIANCE,
    OBJECT-GROUP,
    NOTIFICATION-GROUP
        FROM SNMPv2-CONF              -- RFC 2580
    SnmpAdminString
        FROM SNMP-FRAMEWORK-MIB       -- RFC 3411
    ifIndex
        FROM IF-MIB                   -- RFC 2863
    HCPerfCurrentCount,
    HCPerfIntervalCount,
    HCPerfIntervalThreshold,
    HCPerfValidIntervals,
    HCPerfInvalidIntervals,
    HCPerfTimeElapsed,
    HCPerfTotalCount
        FROM HC-PerfHist-TC-MIB       -- RFC 3705
    IANAgBondScheme,
    IANAgBondSchemeList
        FROM IANA-GBOND-TC-MIB
    ;

```

gBondMIB MODULE-IDENTITY**LAST-UPDATED "201302200000Z" -- 20 February 2013****ORGANIZATION "IETF ADSL MIB Working Group"****CONTACT-INFO****"WG charter:****<http://datatracker.ietf.org/wg/adslmib/charter/>****Mailing Lists:****General Discussion: adslmib@ietf.org****To Subscribe: adslmib-request@ietf.org****In Body: [subscribe your_email_address](#)****Chair: Menachem Dodge****Postal: ECI Telecom, Ltd.****30 Hasivim St.****Petach-Tikva 4951169****Israel****Phone: +972-3-926-8421****Email: menachemdodge1@gmail.com****Editor: Edward Beili****Postal: Actelis Networks, Inc.****25 Bazel St., P.O.B. 10173****Petach-Tikva 49103****Israel****Phone: +972-3-924-3491****Email: edward.beili@actelis.com****Editor: Moti Morgenstern****Postal: ECI Telecom****30 Hasivim St.****Petach-Tikva 4951169****Israel****Phone: +972-3-926-6258****Email: moti.morgenstern@ecitele.com****DESCRIPTION**

"The objects in this MIB module are used to manage the multi-pair bonded xDSL interfaces, as defined in ITU-T Recommendations G.998.1, G.998.2, and G.998.3.

This MIB module MUST be used in conjunction with a bonding scheme-specific MIB module, that is, G9981-MIB, G9982-MIB, or G9983-MIB.

The following references are used throughout this MIB module:

[G.998.1] refers to:

ITU-T Recommendation G.998.1: 'ATM-based multi-pair bonding', January 2005.

[G.998.2] refers to:

ITU-T Recommendation G.998.2: 'Ethernet-based multi-pair bonding', January 2005.

[G.998.3] refers to:

ITU-T Recommendation G.998.3: 'Multi-pair bonding using time-division inverse multiplexing', January 2005.

[TR-159] refers to:

Broadband Forum Technical Report: 'Management Framework for xDSL Bonding', December 2008.

Naming Conventions:

- BCE - Bonding Channel Entity
- BTU - Bonding Terminating Unit
- BTU-C - Bonding Terminating Unit, CO side
- BTU-R - Bonding Terminating Unit, Remote Terminal (CPE) side
- CO - Central Office
- CPE - Customer Premises Equipment
- GBS - Generic Bonding Sub-layer
- PM - Performance Monitoring
- SNR - Signal to Noise Ratio
- TCA - Threshold Crossing Alert

Copyright (c) 2013 IETF Trust and the persons identified as authors of the code. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, is permitted pursuant to, and subject to the license terms contained in, the Simplified BSD License set forth in Section 4.c of the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>)."

REVISION "201302200000Z" -- 20 February 2013
DESCRIPTION "Initial version, published as RFC 6765."

::= { mib-2 211 }

-- Sections of the module
-- Structured as recommended by RFC 4181, Appendix D

```
gBondObjects      OBJECT IDENTIFIER ::= { gBondMIB 1 }
gBondConformance OBJECT IDENTIFIER ::= { gBondMIB 2 }

-- Groups in the module

gBondPort         OBJECT IDENTIFIER ::= { gBondObjects 1 }
gBondBce          OBJECT IDENTIFIER ::= { gBondObjects 2 }

-- Textual Conventions

GBondPm1DayIntervalThreshold ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS      current
    DESCRIPTION
        "This textual convention defines a range of values that may be
        set in a fault threshold alarm control for a 1-day Performance
        Monitoring interval.
        As the number of seconds in a 1-day interval numbers at most
        86400, objects of this type may have a range of 0...86400,
        where the value of 0 disables the alarm."
    SYNTAX      Unsigned32 (0..86400)

-- Port Notifications group

gBondPortNotifications OBJECT IDENTIFIER ::= { gBondPort 0 }

gBondLowUpRateCrossing NOTIFICATION-TYPE
    OBJECTS {
        -- ifIndex is not needed here, since we are under specific GBS
        gBondPortStatUpDataRate,
        gBondPortConfThreshLowUpRate
    }
    STATUS      current
    DESCRIPTION
        "This notification indicates that the G.Bond port's upstream
        data rate has reached/dropped below or exceeded the low
        upstream rate threshold, specified by
        gBondPortConfThreshLowUpRate.

        This notification MAY be sent for the -0 subtype ports
        while the port is 'up', on the crossing event in both
        directions: from normal (rate is above the threshold) to low
        (rate equals the threshold or is below it) and from low to
        normal. This notification is not applicable to the -R
        subtypes."
```

It is RECOMMENDED that a small debouncing period of 2.5 sec, between the detection of the condition and notification, be implemented to prevent simultaneous LinkUp/LinkDown and gBondLowUpRateCrossing notifications from being sent.

The adaptive nature of the G.Bond technology allows the port to adapt itself to the changes in the copper environment; e.g., an impulse noise, alien crosstalk, or a micro-interruption may temporarily drop one or more BCEs in the aggregation group, causing a rate degradation of the aggregated G.Bond link. The dropped BCEs would then try to re-initialize, possibly at a lower rate than before, adjusting the rate to provide the required target SNR margin.

Generation of this notification is controlled by the gBondPortConfLowRateCrossingEnable object.

This object maps to the TR-159 notification nGroupLowUpRateCrossing."

REFERENCE

"[TR-159], Section 5.5.1.24"

::= { gBondPortNotifications 1 }

gBondLowDnRateCrossing NOTIFICATION-TYPE

OBJECTS {

-- ifIndex is not needed here, since we are under specific GBS
gBondPortStatDnDataRate,
gBondPortConfThreshLowDnRate

}

STATUS current

DESCRIPTION

"This notification indicates that the G.Bond port's downstream data rate has reached/dropped below or exceeded the low downstream rate threshold, specified by gBondPortConfThreshLowDnRate.

This notification MAY be sent for the -0 subtype ports while the port is 'up', on the crossing event in both directions: from normal (rate is above the threshold) to low (rate equals the threshold or is below it) and from low to normal. This notification is not applicable to the -R subtypes.

It is RECOMMENDED that a small debouncing period of 2.5 sec, between the detection of the condition and notification, be implemented to prevent simultaneous LinkUp/LinkDown and gBondLowDnRateCrossing notifications from being sent.

The adaptive nature of the G.Bond technology allows the port to adapt itself to the changes in the copper environment; e.g., an impulse noise, alien crosstalk, or a micro-interruption may temporarily drop one or more BCEs in the aggregation group, causing a rate degradation of the aggregated G.Bond link. The dropped BCEs would then try to re-initialize, possibly at a lower rate than before, adjusting the rate to provide the required target SNR margin.

Generation of this notification is controlled by the gBondPortConfLowRateCrossingEnable object.

This object maps to the TR-159 notification nGroupLowDownRateCrossing."

REFERENCE

"[TR-159], Section 5.5.1.25"

::= { gBondPortNotifications 2}

gBondPmTca15MinESCrossing NOTIFICATION-TYPE

OBJECTS {

-- ifIndex is not needed here, since we are under specific GBS
gBondPortPmCur15MinES,
gBondPortPmTcaProfileThresh15MinES

}

STATUS current

DESCRIPTION

"This notification indicates that the Errored Seconds threshold, specified by gBondPortPmTcaProfileThresh15MinES, has been reached or exceeded for the GBS port.

Generation of this notification is controlled by the gBondPortConfPmTcaEnable and gBondPortPmTcaProfileThresh15MinES objects.

This object maps to the TR-159 notification nGroupPerfTca15MinES."

REFERENCE

"[TR-159], Section 5.5.1.42"

::= { gBondPortNotifications 3}

gBondPmTca15MinSESCrossing NOTIFICATION-TYPE

OBJECTS {

-- ifIndex is not needed here, since we are under specific GBS
gBondPortPmCur15MinSES,
gBondPortPmTcaProfileThresh15MinSES

}

STATUS current

DESCRIPTION

"This notification indicates that the Severely Errored Seconds threshold, specified by gBondPortPmTcaProfileThresh15MinSES, has been reached or exceeded for the GBS port.

Generation of this notification is controlled by the gBondPortConfPmTcaEnable and gBondPortPmTcaProfileThresh15MinSES objects.

This object maps to the TR-159 notification nGroupPerfTca15MinSES."

REFERENCE

"[TR-159], Section 5.5.1.43"
 ::= { gBondPortNotifications 4}

gBondPmTca15MinUASCrossing NOTIFICATION-TYPE**OBJECTS {**

-- ifIndex is not needed here, since we are under specific GBS
 gBondPortPmCur15MinUAS,
 gBondPortPmTcaProfileThresh15MinUAS

}

STATUS current

DESCRIPTION

"This notification indicates that the Unavailable Seconds threshold, specified by gBondPortPmTcaProfileThresh15MinUAS, has been reached or exceeded for the GBS port.

Generation of this notification is controlled by the gBondPortConfPmTcaEnable and gBondPortPmTcaProfileThresh15MinUAS objects.

This object maps to the TR-159 notification nGroupPerfTca15MinUAS."

REFERENCE

"[TR-159], Section 5.5.1.44"
 ::= { gBondPortNotifications 5}

gBondPmTca1DayESCrossing NOTIFICATION-TYPE**OBJECTS {**

-- ifIndex is not needed here, since we are under specific GBS
 gBondPortPmCur1DayES,
 gBondPortPmTcaProfileThresh1DayES

}

STATUS current

DESCRIPTION

"This notification indicates that the Errored Seconds threshold, specified by gBondPortPmTcaProfileThresh1DayES, has been reached or exceeded for the GBS port.

Generation of this notification is controlled by the gBondPortConfPmTcaEnable and gBondPortPmTcaProfileThresh1DayES objects.

This object maps to the TR-159 notification nGroupPerfTca1DayES."

REFERENCE

"[TR-159], Section 5.5.1.54"

::= { gBondPortNotifications 6}

gBondPmTca1DaySESCrossing NOTIFICATION-TYPE

OBJECTS {

-- ifIndex is not needed here, since we are under specific GBS
gBondPortPmCur1DaySES,
gBondPortPmTcaProfileThresh1DaySES

}

STATUS current

DESCRIPTION

"This notification indicates that the Severely Errored Seconds threshold, specified by gBondPortPmTcaProfileThresh1DaySES, has been reached or exceeded for the GBS port.

Generation of this notification is controlled by the gBondPortConfPmTcaEnable and gBondPortPmTcaProfileThresh1DaySES objects.

This object maps to the TR-159 notification nGroupPerfTca1DaySES."

REFERENCE

"[TR-159], Section 5.5.1.55"

::= { gBondPortNotifications 7}

gBondPmTca1DayUASCrossing NOTIFICATION-TYPE

OBJECTS {

-- ifIndex is not needed here, since we are under specific GBS
gBondPortPmCur1DayUAS,
gBondPortPmTcaProfileThresh1DayUAS

}

STATUS current

DESCRIPTION

"This notification indicates that the Unavailable Seconds threshold, specified by gBondPortPmTcaProfileThresh1DayUAS, has been reached or exceeded for the GBS port.

Generation of this notification is controlled by the gBondPortConfPmTcaEnable and gBondPortPmTcaProfileThresh1DayUAS objects.

This object maps to the TR-159 notification
nGroupPerfTca1DayUAS."

REFERENCE

"[TR-159], Section 5.5.1.56"

::= { gBondPortNotifications 8 }

-- G.Bond Port (GBS) group

gBondPortConfTable OBJECT-TYPE

SYNTAX SEQUENCE OF GBondPortConfEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Table for configuration of G.Bond GBS ports. Entries in this table MUST be maintained in a persistent manner."

::= { gBondPort 1 }

gBondPortConfEntry OBJECT-TYPE

SYNTAX GBondPortConfEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry in the G.Bond Port Configuration table.

Each entry represents a G.Bond port indexed by the ifIndex.

Note that a G.Bond GBS port runs on top of a single or multiple BCE port(s), which are also indexed by the ifIndex."

INDEX { ifIndex }

::= { gBondPortConfTable 1 }

GBondPortConfEntry ::=

SEQUENCE {

gBondPortConfAdminScheme

gBondPortConfPeerAdminScheme

gBondPortConfDiscoveryCode

gBondPortConfTargetUpDataRate

gBondPortConfTargetDnDataRate

gBondPortConfThreshLowUpRate

gBondPortConfThreshLowDnRate

gBondPortConfLowRateCrossingEnable

gBondPortConfPmTcaConfProfile

gBondPortConfPmTcaEnable

}

IANA gBondScheme,

IANA gBondScheme,

PhysAddress,

Unsigned32,

Unsigned32,

Unsigned32,

Unsigned32,

TruthValue,

SnmpAdminString,

TruthValue

gBondPortConfAdminScheme OBJECT-TYPE

SYNTAX IANA gBondScheme

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"A desired bonding scheme for a G.Bond GBS port.
The following values instruct the port to use the corresponding bonding scheme if supported:

- none(0) - instructs the port not to use bonding
(only on a single-BCE G.998.2 GBS)
- g9981(1) - instructs the port to use G.998.1 bonding
- g9982(2) - instructs the port to use G.998.2 bonding
- g9983(3) - instructs the port to use G.998.3 bonding

Changing of the gBondPortConfAdminScheme object MUST be performed when the link is administratively 'down', as indicated by the ifAdminStatus object in the IF-MIB.

Attempts to change this object MUST be rejected (in the case of SNMP, with the error inconsistentValue), if the link is 'up' or initializing. Attempts to change this object to an unsupported bonding scheme (see gBondPortCapSchemesSupported) SHALL be rejected (in the case of SNMP, with the error wrongValue).

Setting this object to the value of 'none' must be rejected for GBS ports with multiple BCEs (with the error inconsistentValue).

This object maps to the TR-159 attribute aGroupAdminBondScheme."

REFERENCE

"[TR-159], Section 5.5.1.6; RFC 2863, IF-MIB, ifAdminStatus"
::= { gBondPortConfEntry 1 }

gBondPortConfPeerAdminScheme OBJECT-TYPE

SYNTAX IANA gBondScheme

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"A desired bonding scheme for a peer (link partner) G.Bond port (GBS).

The following values instruct the peer port to use the corresponding bonding scheme if supported:

- none(0) - instructs the port not to use bonding
(only on a single-BCE G.998.2 GBS)
- g9981(1) - instructs the port to use G.998.1 bonding
- g9982(2) - instructs the port to use G.998.2 bonding
- g9983(3) - instructs the port to use G.998.3 bonding

Changing of this object MUST be performed when the link is administratively 'down', as indicated by the ifAdminStatus object in the IF-MIB.

Attempts to change this object MUST be rejected (in the case of SNMP, with the error inconsistentValue), if the link is 'up' or initializing. Attempts to change this object to an unsupported bonding scheme (see gBondPortCapPeerSchemesSupported) SHALL be

rejected (in the case of SNMP, with the error wrongValue).
 Setting this object to the value of 'none' must be rejected for
 GBS ports with multiple BCEs (with the error inconsistentValue).

This object maps to the TR-159 attribute
 aGroupPeerAdminBondScheme."

REFERENCE

"[TR-159], Section 5.5.1.7; RFC 2863, IF-MIB, ifAdminStatus"
 ::= { gBondPortConfEntry 2 }

gBondPortConfDiscoveryCode OBJECT-TYPE

SYNTAX PhysAddress (SIZE (6))

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"A discovery code of the G.Bond port (GBS).

A unique 6-octet-long code used by the Discovery function.

This object MUST be instantiated for the -0 subtype GBS before
 write operations on the gBondBceConfRemoteDiscoveryCode
 (Set_if_Clear and Clear_if_Same) are performed by BCEs
 associated with the GBS.

The initial value of this object for -R subtype ports after
 reset is all zeroes. For -R subtype ports, the value of this
 object cannot be changed directly. This value may be changed
 as a result of a write operation on the
 gBondBceConfRemoteDiscoveryCode object of a remote BCE of -0
 subtype, connected to one of the local BCEs associated with
 the GBS.

Discovery MUST be performed when the link is administratively
 'down', as indicated by the ifAdminStatus object in the IF-MIB.
 Attempts to change this object MUST be rejected (in the case of
 SNMP, with the error inconsistentValue), if the link is 'up' or
 initializing.

This object maps to the TR-159 attribute
 aGroupDiscoveryCode."

REFERENCE

"[TR-159], Section 5.5.1.20; [802.3], Sections 61.2.2.8.3,
 61.2.2.8.4, 45.2.6.6.1, 45.2.6.8, 61A.2;
 RFC 2863, IF-MIB, ifAdminStatus"
 ::= { gBondPortConfEntry 3 }

gBondPortConfTargetUpDataRate OBJECT-TYPE

SYNTAX Unsigned32 (0|1..10000000)

UNITS "Kbps"

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"A desired G.Bond port data rate in the upstream direction, in Kbps, to be achieved during initialization, under restrictions placed upon the member BCEs by their respective configuration settings.

This object represents a sum of individual BCE upstream data rates, modified to compensate for fragmentation and encapsulation overhead (e.g., for an Ethernet service, the target data rate of 10 Mbps SHALL allow lossless transmission of full-duplex 10-Mbps Ethernet frame stream with minimal inter-frame gap).

Note that the target upstream data rate may not be achieved during initialization (e.g., due to unavailability of required BCEs) or the initial bandwidth could deteriorate, so that the actual upstream data rate (gBondPortStatUpDataRate) could be less than gBondPortConfTargetUpDataRate.

The value is limited above by 10 Gbps, to accommodate very high speed bonded xDSL interfaces (e.g., 32 x 100 Mbps).

The value between 1 and 100000000 indicates that the total upstream data rate of the G.Bond port after initialization SHALL be equal to the target data rate or less, if the target upstream data rate cannot be achieved under the restrictions configured for BCEs. In cases where the copper environment allows a higher upstream data rate to be achieved than that specified by this object, the excess capability SHALL be either converted to an additional SNR margin or reclaimed by minimizing transmit power.

The value of 0 means that the target data rate is not fixed and SHALL be set to the maximum attainable rate during initialization (best effort), under specified spectral restrictions and with a desired SNR margin per BCE.

This object is read-write for the -0 subtype G.Bond ports. It is irrelevant for the -R subtypes -- attempts to read or change this object for such ports MUST be rejected (in the case of SNMP, with the error inconsistentValue).

Changing of the target upstream data rate MUST be performed when the link is administratively 'down', as indicated by the ifAdminStatus object in the IF-MIB.

Attempts to change this object MUST be rejected (in the case of SNMP, with the error inconsistentValue), if the link is 'up' or initializing.

This object maps to the TR-159 attribute aGroupTargetUpRate."

REFERENCE

"[TR-159], Section 5.5.1.17; RFC 2863, IF-MIB, ifAdminStatus"
::= { gBondPortConfEntry 4 }

gBondPortConfTargetDnDataRate OBJECT-TYPE

SYNTAX Unsigned32 (0|1..10000000)

UNITS "Kbps"

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"A desired G.Bond port data rate in the downstream direction, in Kbps, to be achieved during initialization, under restrictions placed upon the member BCEs by their respective configuration settings.

This object represents a sum of individual BCE downstream data rates, modified to compensate for fragmentation and encapsulation overhead (e.g., for an Ethernet service, the target data rate of 10 Mbps SHALL allow lossless transmission of full-duplex 10-Mbps Ethernet frame stream with minimal inter-frame gap).

Note that the target downstream data rate may not be achieved during initialization (e.g., due to unavailability of required BCEs) or the initial bandwidth could deteriorate, so that the actual downstream data rate (gBondPortStatDnDataRate) could be less than gBondPortConfTargetDnDataRate.

The value is limited above by 10 Gbps, to accommodate very high speed bonded xDSL interfaces (e.g., 32 x 100 Mbps).

The value between 1 and 10000000 indicates that the total downstream data rate of the G.Bond port after initialization SHALL be equal to the target data rate or less, if the target downstream data rate cannot be achieved under the restrictions configured for BCEs. In cases where the copper environment allows a higher downstream data rate to be achieved than that specified by this object, the excess capability SHALL be either converted to an additional SNR margin or reclaimed by minimizing transmit power.

The value of 0 means that the target data rate is not fixed and SHALL be set to the maximum attainable rate during initialization (best effort), under specified spectral restrictions and with a desired SNR margin per BCE.

This object is read-write for the -0 subtype G.Bond ports. It is irrelevant for the -R subtypes -- attempts to read or change this object for such ports MUST be rejected (in the case of SNMP, with the error inconsistentValue).

Changing of the target downstream data rate **MUST** be performed when the link is administratively 'down', as indicated by the ifAdminStatus object in the IF-MIB. Attempts to change this object **MUST** be rejected (in the case of SNMP, with the error inconsistentValue), if the link is 'up' or initializing.

This object maps to the TR-159 attribute aGroupTargetDownRate."
REFERENCE
 "[TR-159], Section 5.5.1.18; RFC 2863, IF-MIB, ifAdminStatus"
 ::= { gBondPortConfEntry 5 }

gBondPortConfThreshLowUpRate OBJECT-TYPE
 SYNTAX Unsigned32 (1..10000000)
 UNITS "Kbps"
 MAX-ACCESS read-write
 STATUS current
DESCRIPTION

"This object configures the G.Bond port low upstream rate crossing alarm threshold. When the current value of gBondPortStatUpDataRate for this port reaches/drops below or exceeds this threshold, a gBondLowUpRateCrossing notification **MAY** be generated if enabled by gBondPortConfLowRateCrossingEnable.

This object is read-write for the -0 subtype G.Bond ports. It is irrelevant for the -R subtypes -- attempts to read or change this object for such ports **MUST** be rejected (in the case of SNMP, with the error inconsistentValue).

This object maps to the TR-159 attribute aGroupthreshLowUpRate."
REFERENCE
 "[TR-159], Section 5.5.1.21"
 ::= { gBondPortConfEntry 6 }

gBondPortConfThreshLowDnRate OBJECT-TYPE
 SYNTAX Unsigned32 (1..10000000)
 UNITS "Kbps"
 MAX-ACCESS read-write
 STATUS current
DESCRIPTION

"This object configures the G.Bond port low downstream rate crossing alarm threshold. When the current value of gBondPortStatDnDataRate for this port reaches/drops below or exceeds this threshold, a gBondLowDnRateCrossing notification **MAY** be generated if enabled by gBondPortConfLowRateCrossingEnable.

This object is read-write for the -0 subtype G.Bond ports. It is irrelevant for the -R subtypes -- attempts to read or change this object for such ports MUST be rejected (in the case of SNMP, with the error inconsistentValue).

This object maps to the TR-159 attribute
aGroupThreshLowDownRate."

REFERENCE

"[TR-159], Section 5.5.1.22"

::= { gBondPortConfEntry 7 }

gBondPortConfLowRateCrossingEnable OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"Indicates whether gBondLowUpRateCrossing and gBondLowDnRateCrossing notifications should be generated for this interface.

A value of true(1) indicates that the notifications are enabled. A value of false(2) indicates that the notifications are disabled.

This object is read-write for the -0 subtype G.Bond ports. It is irrelevant for the -R subtypes -- attempts to read or change this object for such ports MUST be rejected (in the case of SNMP, with the error inconsistentValue).

This object maps to the TR-159 attribute
aGroupLowRateCrossingEnable."

REFERENCE

"[TR-159], Section 5.5.1.23"

::= { gBondPortConfEntry 8 }

gBondPortConfPmTcaConfProfile OBJECT-TYPE

SYNTAX SnmpAdminString (SIZE (1..32))

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"The value of this object is the index of the row in the GBS Port Alarm Configuration Profile table for Performance Monitoring Threshold Crossing Alerts -- the gBondPortAlarmConfProfileTable, which applies to this GBS port."

DEFVAL { "DEFVAL" }

::= { gBondPortConfEntry 9 }

gBondPortConfPmTcaEnable OBJECT-TYPE**SYNTAX** TruthValue**MAX-ACCESS** read-write**STATUS** current**DESCRIPTION**

"Indicates whether the gBondPerfTca*Crossing set of notifications should be generated for this interface.

A value of true(1) indicates that the notifications are enabled. A value of false(2) indicates that the notifications are disabled.

This object maps to the TR-159 attribute aGroupPerfTcaEnable."

REFERENCE

"[TR-159], Section 5.5.1.38"

::= { gBondPortConfEntry 10 }

gBondPortCapTable OBJECT-TYPE**SYNTAX** SEQUENCE OF GBondPortCapEntry**MAX-ACCESS** not-accessible**STATUS** current**DESCRIPTION**

"Table for capabilities of G.Bond ports. Entries in this table MUST be maintained in a persistent manner."

::= { gBondPort 2 }

gBondPortCapEntry OBJECT-TYPE**SYNTAX** GBondPortCapEntry**MAX-ACCESS** not-accessible**STATUS** current**DESCRIPTION**

"An entry in the G.Bond Port Capability table.

Each entry represents a G.Bond port indexed by the ifIndex.

Note that a G.Bond GBS port runs on top of a single or multiple BCE port(s), which are also indexed by the ifIndex."

INDEX { ifIndex }

::= { gBondPortCapTable 1 }

GBondPortCapEntry ::=**SEQUENCE** {

gBondPortCapSchemesSupported

gBondPortCapPeerSchemesSupported

gBondPortCapCapacity

gBondPortCapPeerCapacity

}

IANA gBondSchemeList,

IANA gBondSchemeList,

Unsigned32,

Unsigned32

gBondPortCapSchemesSupported **OBJECT-TYPE**

SYNTAX IANAgBondSchemeList

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Bonding capability of the G.Bond port (GBS). This is a read-only bitmap of the possible bonding schemes supported by the GBS. The various bit positions are:

 none(0) - GBS is capable of bonding bypass on a single-BCE G.998.2 GBS

 g9981(1) - GBS is capable of G.998.1 bonding

 g9982(2) - GBS is capable of G.998.2 bonding

 g9983(3) - GBS is capable of G.998.3 bonding

Note that for ports supporting multiple bonding schemes, the actual administrative scheme is set via gBondPortConfAdminScheme object. The current operating bonding scheme is reflected in the gBondPortStatOperScheme object.

This object maps to the TR-159 attribute aGroupBondSchemesSupported."

REFERENCE

"[TR-159], Section 5.5.1.2"

::= { gBondPortCapEntry 1 }

gBondPortCapPeerSchemesSupported **OBJECT-TYPE**

SYNTAX IANAgBondSchemeList

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Bonding capability of the peer G.Bond port (GBS). This is a read-only bitmap of the possible bonding schemes supported by the link partner GBS. The various bit positions are:

 none(0) - peer GBS does not support bonding, or the peer unit could not be reached, or peer GBS is capable of bonding bypass on a single-BCE G.998.2 GBS

 g9981(1) - peer GBS is capable of G.998.1 bonding

 g9982(2) - peer GBS is capable of G.998.2 bonding

 g9983(3) - peer GBS is capable of G.998.3 bonding

Note that for ports supporting multiple bonding schemes, the actual administrative scheme is set via the gBondPortConfPeerAdminScheme object. The current operating bonding scheme is reflected in the gBondPortStatPeerOperScheme object.

This object maps to the TR-159 attribute
aGroupPeerBondSchemesSupported."

REFERENCE

"[TR-159], Section 5.5.1.3"

::= { gBondPortCapEntry 2 }

gBondPortCapCapacity OBJECT-TYPE

SYNTAX Unsigned32 (1..32)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Number of BCEs that can be aggregated by the local GBS.
The number of BCEs currently assigned to a particular G.Bond
port (gBondPortStatNumBCEs) is never greater than
gBondPortCapCapacity."

This object maps to the TR-159 attribute aGroupCapacity."

REFERENCE

"[TR-159], Section 5.5.1.12"

::= { gBondPortCapEntry 3 }

gBondPortCapPeerCapacity OBJECT-TYPE

SYNTAX Unsigned32 (0|1..32)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Number of BCEs that can be aggregated by the peer GBS port.
A value of 0 is returned when peer Bonding capacity is unknown
(peer cannot be reached)."

This object maps to the TR-159 attribute aGroupPeerCapacity."

REFERENCE

"[TR-159], Section 5.5.1.13"

::= { gBondPortCapEntry 4 }

gBondPortStatTable OBJECT-TYPE

SYNTAX SEQUENCE OF GBondPortStatEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table provides overall status information of G.Bond
ports, complementing the generic status information from the
ifTable of the IF-MIB. Additional status information about
connected BCEs is available from the relevant line MIBs."

This table contains live data from the equipment. As such,
it is NOT persistent."

```
::= { gBondPort 3 }
```

gBondPortStatEntry OBJECT-TYPE

SYNTAX GBondPortStatEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry in the G.Bond Port Status table.

Each entry represents a G.Bond port indexed by the ifIndex.

Note that a G.Bond GBS port runs on top of a single or multiple BCE port(s), which are also indexed by the ifIndex."

INDEX { ifIndex }

```
::= { gBondPortStatTable 1 }
```

GBondPortStatEntry ::=

SEQUENCE {

gBondPortStatOperScheme

IANA gBondScheme,

gBondPortStatPeerOperScheme

IANA gBondScheme,

gBondPortStatUpDataRate

Gauge32,

gBondPortStatDnDataRate

Gauge32,

gBondPortStatFltStatus

BITS,

gBondPortStatSide

INTEGER,

gBondPortStatNumBCEs

Unsigned32

}

gBondPortStatOperScheme OBJECT-TYPE

SYNTAX IANA gBondScheme

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Current operating bonding scheme of a G.Bond port.

The possible values are:

- none(0) - bonding bypass on a single-BCE G.998.2 GBS
- g9981(1) - G.998.1 bonding
- g9982(2) - G.998.2 bonding
- g9983(3) - G.998.3 bonding

This object maps to the TR-159 attribute

aGroupOperBondScheme."

REFERENCE

"[TR-159], Section 5.5.1.4"

```
::= { gBondPortStatEntry 1 }
```

gBondPortStatPeerOperScheme OBJECT-TYPE

SYNTAX IANA gBondScheme

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Current operating bonding scheme of a G.Bond port link partner.
The possible values are:

- unknown(0) - peer cannot be reached due to the link state or bonding bypass on a single-BCE G.998.2 GBS
- g9981(1) - G.998.1 bonding
- g9982(2) - G.998.2 bonding
- g9983(3) - G.998.3 bonding

This object maps to the TR-159 attribute
aGroupPeerOperBondScheme."

REFERENCE

"[TR-159], Section 5.5.1.5"
::= { gBondPortStatEntry 2 }

gBondPortStatUpDataRate OBJECT-TYPE

SYNTAX Gauge32
UNITS "bps"
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"A current G.Bond port operational data rate in the upstream direction, in bps.
This object represents an estimation of the sum of individual BCE upstream data rates, modified to compensate for fragmentation and encapsulation overhead (e.g., for an Ethernet service, the target data rate of 10 Mbps SHALL allow lossless transmission of full-duplex 10-Mbps Ethernet frame stream with minimal inter-frame gap).

Note that for symmetrical interfaces, gBondPortStatUpDataRate == gBondPortStatDnDataRate == ifSpeed.

This object maps to the TR-159 attribute aGroupUpRate."

REFERENCE

"[TR-159], Section 5.5.1.15"
::= { gBondPortStatEntry 3 }

gBondPortStatDnDataRate OBJECT-TYPE

SYNTAX Gauge32
UNITS "bps"
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"A current G.Bond port operational data rate in the downstream direction, in bps.
This object represents an estimation of the sum of individual BCE downstream data rates, modified to compensate for

fragmentation and encapsulation overhead (e.g., for an Ethernet service, the target data rate of 10 Mbps SHALL allow lossless transmission of full-duplex 10-Mbps Ethernet frame stream with minimal inter-frame gap).

Note that for symmetrical interfaces, gBondPortStatUpDataRate == gBondPortStatDnDataRate == ifSpeed.

This object maps to the TR-159 attribute aGroupDownRate."

REFERENCE

"[TR-159], Section 5.5.1.16"

::= { gBondPortStatEntry 4 }

gBondPortStatFltStatus OBJECT-TYPE

SYNTAX BITS {

noPeer(0),
peerPowerLoss(1),
peerBondSchemeMismatch(2),
bceSubTypeMismatch(3),
lowRate(4),
init(5),
ready(6)

}

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"G.Bond (GBS) port fault status. This is a bitmap of possible conditions. The various bit positions are:

- | | |
|------------------------|---|
| noPeer | - Peer GBS cannot be reached (e.g., no BCEs attached, all BCEs are 'down', etc.). |
| peerPowerLoss | - Peer GBS has indicated impending unit failure due to loss of local power ('Dying Gasp'). |
| peerBondSchemeMismatch | - Operating bonding scheme of a peer GBS is different from the local one. |
| bceSubTypeMismatch | - Local BCEs in the aggregation group are not of the same sub-type, e.g., some BCEs in the local device are -0 while others are -R subtype. |
| lowRate | - gBondUpRate/gBondDnRate of the port has reached or dropped below gBondPortConfThreshLowUpRate/gBondPortConfThreshLowDnRate. |

- | | |
|-------|---|
| init | - The link is initializing, as a result of ifAdminStatus being set to 'up' for a particular BCE or a GBS to which the BCE is connected. |
| ready | - At least one BCE in the aggregation group is detecting handshake tones. |

This object is intended to supplement the ifOperStatus object in the IF-MIB.

This object maps to the TR-159 attribute aGroupStatus."

REFERENCE

"[TR-159], Section 5.5.1.9; RFC 2863, IF-MIB, ifOperStatus"
::= { gBondPortStatEntry 5 }

gBondPortStatSide OBJECT-TYPE

SYNTAX INTEGER {
subscriber(1),
office(2),
unknown(3)
}

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"G.Bond port mode of operation (subtype).

The value of 'subscriber' indicates that the port is designated as '-R' subtype (all BCEs assigned to this port are of subtype '-R').

The value of 'office' indicates that the port is designated as '-0' subtype (all BCEs assigned to this port are of subtype '-0').

The value of 'unknown' indicates that the port has no assigned BCEs yet or that the assigned BCEs are not of the same side (subTypeBCEMismatch).

This object maps to the TR-159 attribute aGroupEnd."

REFERENCE

"[TR-159], Section 5.5.1.11"
::= { gBondPortStatEntry 6 }

gBondPortStatNumBCEs OBJECT-TYPE

SYNTAX Unsigned32 (0..32)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Number of BCEs that are currently aggregated by the local GBS (assigned to the G.Bond port using the ifStackTable).

This number is never greater than gBondPortCapCapacity.

This object SHALL be automatically incremented or decremented when a BCE is added or deleted to/from the G.Bond port using the ifStackTable.

This object maps to the TR-159 attribute aGroupNumChannels."
REFERENCE

"[TR-159], Section 5.5.1.14"
::= { gBondPortStatEntry 7 }

-- Performance Monitoring group

gBondPortPM OBJECT IDENTIFIER ::= { gBondPort 4 }

gBondPortPmCurTable OBJECT-TYPE

SYNTAX SEQUENCE OF GBondPortPmCurEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table contains current Performance Monitoring (PM) information for a GBS port. This table contains live data from the equipment and as such is NOT persistent."

::= { gBondPortPM 1 }

gBondPortPmCurEntry OBJECT-TYPE

SYNTAX GBondPortPmCurEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry in the G.Bond Port PM table.

Each entry represents a G.Bond port indexed by the ifIndex.

Note that a G.Bond GBS port runs on top of a single or multiple BCE port(s), which are also indexed by the ifIndex."

INDEX { ifIndex }

::= { gBondPortPmCurTable 1 }

GBondPortPmCurEntry ::=

SEQUENCE {

gBondPortPmCurES

gBondPortPmCurSES

gBondPortPmCurUAS

gBondPortPmCur15MinValidIntervals

gBondPortPmCur15MinInvalidIntervals

gBondPortPmCur15MinTimeElapsed

gBondPortPmCur15MinES

gBondPortPmCur15MinSES

gBondPortPmCur15MinUAS

gBondPortPmCur1DayValidIntervals

HCPperfTotalCount,

HCPperfTotalCount,

HCPperfTotalCount,

HCPperfValidIntervals,

HCPperfInvalidIntervals,

HCPperfTimeElapsed,

HCPperfCurrentCount,

HCPperfCurrentCount,

HCPperfCurrentCount,

Unsigned32,

gBondPortPmCur1DayInvalidIntervals	Unsigned32,
gBondPortPmCur1DayTimeElapsed	HCPperfTimeElapsed,
gBondPortPmCur1DayES	HCPperfCurrentCount,
gBondPortPmCur1DaySES	HCPperfCurrentCount,
gBondPortPmCur1DayUAS	HCPperfCurrentCount

}

gBondPortPmCurES OBJECT-TYPE
 SYNTAX HCPperfTotalCount
 UNITS "seconds"
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION

"A count of Errored Seconds (ES) on the GBS since the BTU was last restarted.

An Errored Second for a G.998.x interface is defined as a count of 1-second intervals during which one or more GBS errors are declared. The errors are specific for each bonding scheme, e.g.,

- lost cells for the ATM bonding
- lost or discarded (due to an error or a buffer overflow) fragments for the Ethernet bonding
- CRC-4, CRC-6, or CRC-8 errors for the TDM bonding

This object is inhibited during Unavailable Seconds (UAS).

This object maps to the TR-159 attribute aGroupPerfES."

REFERENCE

"[TR-159], Section 5.5.1.29"
 ::= { gBondPortPmCurEntry 1 }

gBondPortPmCurSES OBJECT-TYPE
 SYNTAX HCPperfTotalCount
 UNITS "seconds"
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION

"A count of Severely Errored Seconds (SES) on the GBS since the BTU was last restarted.

A Severely Errored Second for a G.998.x interface is defined as a count of 1-second intervals during which GBS errors cause at least 1% traffic loss of the nominal bonded link rate or at least 12 ms for the TDM traffic. The exact definition is specific for each bonding scheme, e.g.,

- 234 lost cells for the ATM bonding with 10-Mbps nominal link rate

- 60 lost/discarded fragments for the Ethernet bonding with 10-Mbps nominal link rate and fixed 192-byte-long fragment size
- 6 or more CRC-4 errors, one or more CRC-6 errors, or one or more CRC-8 errors for the TDM bonding

This object is inhibited during Unavailable Seconds (UAS).

This object maps to the TR-159 attribute aGroupPerfSES."

REFERENCE

"[TR-159], Section 5.5.1.30"

::= { gBondPortPmCurEntry 2 }

gBondPortPmCurUAS OBJECT-TYPE

SYNTAX HCPerfTotalCount

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of Unavailable Seconds (UAS) on the GBS since the BTU was last restarted.

An Unavailable Second for a G.998.x interface is defined as a count of 1-second intervals during which the bonded link is unavailable. The G.998.x link becomes unavailable at the onset of 10 contiguous SESs. The 10 SESs are included in the unavailable time. Once unavailable, the G.998.x line becomes available at the onset of 10 contiguous seconds with no SESs. The 10 seconds with no SESs are excluded from the unavailable time.

This object maps to the TR-159 attribute aGroupPerfUAS."

REFERENCE

"[TR-159], Section 5.5.1.31"

::= { gBondPortPmCurEntry 3 }

gBondPortPmCur15MinValidIntervals OBJECT-TYPE

SYNTAX HCPerfValidIntervals

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A number of 15-minute intervals for which data was collected. The value of this object will be 96 or the maximum number of 15-minute history intervals collected by the implementation, unless the measurement was (re)started recently, in which case the value will be the number of complete 15-minute intervals for which there are at least some data.

In certain cases, it is possible that some intervals are unavailable. In this case, this object reports the maximum interval number for which data is available.

This object maps to the TR-159 attribute
aGroupPerf15MinValidIntervals."

REFERENCE

"[TR-159], Section 5.5.1.32"

::= { gBondPortPmCurEntry 4 }

gBondPortPmCur15MinInvalidIntervals OBJECT-TYPE

SYNTAX HCPerfInvalidIntervals

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A number of 15-minute intervals for which data was not always available. The value will typically be zero, except in cases where the data for some intervals are not available.

This object maps to the TR-159 attribute
aGroupPerf15MinInvalidIntervals."

REFERENCE

"[TR-159], Section 5.5.1.33"

::= { gBondPortPmCurEntry 5 }

gBondPortPmCur15MinTimeElapsed OBJECT-TYPE

SYNTAX HCPerfTimeElapsed

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of seconds that have elapsed since the beginning of the current 15-minute performance interval.

This object maps to the TR-159 attribute
aGroupPerfCurr15MinTimeElapsed."

REFERENCE

"[TR-159], Section 5.5.1.34"

::= { gBondPortPmCurEntry 6 }

gBondPortPmCur15MinES OBJECT-TYPE

SYNTAX HCPerfCurrentCount

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of Errored Seconds (ES) on the GBS in the current 15-minute performance interval.

This object maps to the TR-159 attribute aGroupPerfCurr15MinES."

REFERENCE

"[TR-159], Section 5.5.1.35"

::= { gBondPortPmCurEntry 7 }

gBondPortPmCur15MinSES OBJECT-TYPE

SYNTAX HCPerfCurrentCount

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of Severely Errored Seconds (SES) on the GBS in the current 15-minute performance interval."

This object maps to the TR-159 attribute aGroupPerfCurr15MinSES."

REFERENCE

"[TR-159], Section 5.5.1.36"

::= { gBondPortPmCurEntry 8 }

gBondPortPmCur15MinUAS OBJECT-TYPE

SYNTAX HCPerfCurrentCount

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of Unavailable Seconds (UAS) on the GBS in the current 15-minute performance interval."

This object maps to the TR-159 attribute aGroupPerfCurr15MinUAS."

REFERENCE

"[TR-159], Section 5.5.1.37"

::= { gBondPortPmCurEntry 9 }

gBondPortPmCur1DayValidIntervals OBJECT-TYPE

SYNTAX Unsigned32 (0..7)

UNITS "days"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A number of 1-day intervals for which data was collected. The value of this object will be 7 or the maximum number of 1-day history intervals collected by the implementation, unless the measurement was (re)started recently, in which case the value will be the number of complete 1-day intervals for which there are at least some data."

In certain cases, it is possible that some intervals are unavailable. In this case, this object reports the maximum interval number for which data is available."

This object maps to the TR-159 attribute
aGroupPerf1DayValidIntervals."

REFERENCE

"[TR-159], Section 5.5.1.45"
::= { gBondPortPmCurEntry 10 }

gBondPortPmCur1DayInvalidIntervals OBJECT-TYPE

SYNTAX Unsigned32 (0..7)

UNITS "days"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A number of 1-day intervals for which data was not always available. The value will typically be zero, except in cases where the data for some intervals are not available.

This object maps to the TR-159 attribute
aGroupPerf1DayInvalidIntervals."

REFERENCE

"[TR-159], Section 5.5.1.46"
::= { gBondPortPmCurEntry 11 }

gBondPortPmCur1DayTimeElapsed OBJECT-TYPE

SYNTAX HCPerfTimeElapsed

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of seconds that have elapsed since the beginning of the current 1-day performance interval.

This object maps to the TR-159 attribute
aGroupPerfCurr1DayTimeElapsed."

REFERENCE

"[TR-159], Section 5.5.1.47"
::= { gBondPortPmCurEntry 12 }

gBondPortPmCur1DayES OBJECT-TYPE

SYNTAX HCPerfCurrentCount

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of Errored Seconds (ES) on the GBS in the current 1-day performance interval.

This object maps to the TR-159 attribute aGroupPerfCurr1DayES."

REFERENCE

"[TR-159], Section 5.5.1.48"
 ::= { gBondPortPmCurEntry 13 }

gBondPortPmCur1DaySES OBJECT-TYPE

SYNTAX HCPperfCurrentCount
 UNITS "seconds"
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION

"A count of Severely Errored Seconds (SES) on the GBS in the current 1-day performance interval."

This object maps to the TR-159 attribute aGroupPerfCurr1DaySES."

REFERENCE

"[TR-159], Section 5.5.1.49"
 ::= { gBondPortPmCurEntry 14 }

gBondPortPmCur1DayUAS OBJECT-TYPE

SYNTAX HCPperfCurrentCount
 UNITS "seconds"
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION

"A count of Unavailable Seconds (UAS) on the GBS in the current 1-day performance interval."

This object maps to the TR-159 attribute aGroupPerfCurr1DayUAS."

REFERENCE

"[TR-159], Section 5.5.1.50"
 ::= { gBondPortPmCurEntry 15 }

-- PM history: 15-min buckets

gBondPortPm15MinTable OBJECT-TYPE

SYNTAX SEQUENCE OF GBondPortPm15MinEntry
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION

"This table contains historical 15-minute buckets of Performance Monitoring information for a GBS port (a row for each 15-minute interval, up to 96 intervals)."

Entries in this table MUST be maintained in a persistent manner."

::= { gBondPortPM 2 }

gBondPortPm15MinEntry OBJECT-TYPE

SYNTAX GBondPortPm15MinEntry
 MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry in the G.Bond Port historical 15-minute PM table. Each entry represents Performance Monitoring data for a GBS port, indexed by the ifIndex, collected during a particular 15-minute interval, indexed by the gBondPortPm15MinIntervalIndex."

INDEX { ifIndex, gBondPortPm15MinIntervalIndex }
 ::= { gBondPortPm15MinTable 1 }

gBondPortPm15MinEntry ::=

```
SEQUENCE {
    gBondPortPm15MinIntervalIndex      Unsigned32,
    gBondPortPm15MinIntervalMoniTime   HCPerfTimeElapsed,
    gBondPortPm15MinIntervalES         HCPerfIntervalCount,
    gBondPortPm15MinIntervalSES        HCPerfIntervalCount,
    gBondPortPm15MinIntervalUAS        HCPerfIntervalCount,
    gBondPortPm15MinIntervalValid      TruthValue
}
```

gBondPortPm15MinIntervalIndex OBJECT-TYPE

SYNTAX Unsigned32 (1..96)

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Performance data interval number. 1 is the most recent previous interval; interval 96 is 24 hours ago. Intervals 2..96 are OPTIONAL."

This object maps to the TR-159 attribute
 aGroupPerf15MinIntervalNumber."

REFERENCE

"[TR-159], Section 5.5.1.57"

::= { gBondPortPm15MinEntry 1 }

gBondPortPm15MinIntervalMoniTime OBJECT-TYPE

SYNTAX HCPerfTimeElapsed

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of seconds over which the performance data was actually monitored. This value will be the same as the interval duration (900 seconds), except in a situation where performance data could not be collected for any reason."

::= { gBondPortPm15MinEntry 2 }

gBondPortPm15MinIntervalES OBJECT-TYPE**SYNTAX** HCPerfIntervalCount**UNITS** "seconds"**MAX-ACCESS** read-only**STATUS** current**DESCRIPTION**

"A count of Errored Seconds (ES) on the GBS in the 15-minute performance history interval.

This object maps to the TR-159 attribute
aGroupPerf15MinIntervalES."

REFERENCE

"[TR-159], Section 5.5.1.59"

::= { gBondPortPm15MinEntry 3 }

gBondPortPm15MinIntervalSES OBJECT-TYPE**SYNTAX** HCPerfIntervalCount**UNITS** "seconds"**MAX-ACCESS** read-only**STATUS** current**DESCRIPTION**

"A count of Severely Errored Seconds (SES) on the GBS in the 15-minute performance history interval.

This object maps to the TR-159 attribute
aGroupPerf15MinIntervalSES."

REFERENCE

"[TR-159], Section 5.5.1.60"

::= { gBondPortPm15MinEntry 4 }

gBondPortPm15MinIntervalUAS OBJECT-TYPE**SYNTAX** HCPerfIntervalCount**UNITS** "seconds"**MAX-ACCESS** read-only**STATUS** current**DESCRIPTION**

"A count of Unavailable Seconds (UAS) on the GBS in the current 15-minute performance interval.

This object maps to the TR-159 attribute
aGroupPerf15MinIntervalUAS."

REFERENCE

"[TR-159], Section 5.5.1.61"

::= { gBondPortPm15MinEntry 5 }

gBondPortPm15MinIntervalValid OBJECT-TYPE**SYNTAX** TruthValue**MAX-ACCESS** read-only

STATUS current

DESCRIPTION

"A read-only object indicating whether or not this history bucket contains valid data. A valid bucket is reported as true(1) and an invalid bucket as false(2).

If this history bucket is invalid, the BTU-C MUST NOT produce notifications based upon the value of the counters in this bucket.

Note that an implementation may decide not to store invalid history buckets in its database. In such a case, this object is not required, as only valid history buckets are available while invalid history buckets are simply not in the database.

This object maps to the TR-159 attribute
aGroupPerf15MinIntervalValid."

REFERENCE

"[TR-159], Section 5.5.1.58"

::= { gBondPortPm15MinEntry 6 }

-- PM history: 1-day buckets

gBondPortPm1DayTable OBJECT-TYPE

SYNTAX SEQUENCE OF GBondPortPm1DayEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table contains historical 1-day buckets of Performance Monitoring information for a GBS port (a row for each 1-day interval, up to 7 intervals).

Entries in this table MUST be maintained in a persistent manner."

::= { gBondPortPM 3 }

gBondPortPm1DayEntry OBJECT-TYPE

SYNTAX GBondPortPm1DayEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry in the G.Bond Port historical 1-day PM table.

Each entry represents Performance Monitoring data for a GBS port, indexed by the ifIndex, collected during a particular 1-day interval, indexed by the gBondPortPm1DayIntervalIndex."

INDEX { ifIndex, gBondPortPm1DayIntervalIndex }

::= { gBondPortPm1DayTable 1 }

GBondPortPm1DayEntry ::=

SEQUENCE {

gBondPortPm1DayIntervalIndex

gBondPortPm1DayIntervalMoniTime

Unsigned32,

HCPperfTimeElapsed,

gBondPortPm1DayIntervalES	HCPperfIntervalCount,
gBondPortPm1DayIntervalSES	HCPperfIntervalCount,
gBondPortPm1DayIntervalUAS	HCPperfIntervalCount,
gBondPortPm1DayIntervalValid	TruthValue

}

gBondPortPm1DayIntervalIndex OBJECT-TYPE

SYNTAX Unsigned32 (1..7)

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Performance data interval number. 1 is the most recent previous interval; interval 7 is 7 days ago. Intervals 2..7 are OPTIONAL.

This object maps to the TR-159 attribute aGroupPerf1DayIntervalNumber."

REFERENCE

"[TR-159], Section 5.5.1.62"

::= { gBondPortPm1DayEntry 1 }

gBondPortPm1DayIntervalMoniTime OBJECT-TYPE

SYNTAX HCPerfTimeElapsed

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of seconds over which the performance data was actually monitored. This value will be the same as the interval duration (86400 seconds), except in a situation where performance data could not be collected for any reason.

This object maps to the TR-159 attribute aGroupPerf1DayIntervalMoniSecs."

REFERENCE

"[TR-159], Section 5.5.1.64"

::= { gBondPortPm1DayEntry 2 }

gBondPortPm1DayIntervalES OBJECT-TYPE

SYNTAX HCPerfIntervalCount

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of Errored Seconds (ES) on the GBS in the 1-day performance history interval.

This object maps to the TR-159 attribute
aGroupPerf1DayIntervalSES."

REFERENCE

"[TR-159], Section 5.5.1.65"

::= { gBondPortPm1DayEntry 3 }

gBondPortPm1DayIntervalSES OBJECT-TYPE

SYNTAX HCPerfIntervalCount

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of Severely Errored Seconds (SES) on the GBS in the
1-day performance history interval."

This object maps to the TR-159 attribute
aGroupPerf1DayIntervalSES."

REFERENCE

"[TR-159], Section 5.5.1.66"

::= { gBondPortPm1DayEntry 4 }

gBondPortPm1DayIntervalUAS OBJECT-TYPE

SYNTAX HCPerfIntervalCount

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of Unavailable Seconds (UAS) on the GBS in the current
1-day performance interval."

This object maps to the TR-159 attribute
aGroupPerf1DayIntervalUAS."

REFERENCE

"[TR-159], Section 5.5.1.67"

::= { gBondPortPm1DayEntry 5 }

gBondPortPm1DayIntervalValid OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A read-only object indicating whether or not this history
bucket contains valid data. A valid bucket is reported as
true(1) and an invalid bucket as false(2).
If this history bucket is invalid, the BTU-C MUST NOT produce
notifications based upon the value of the counters in this
bucket."

Note that an implementation may decide not to store invalid history buckets in its database. In such a case, this object is not required, as only valid history buckets are available while invalid history buckets are simply not in the database.

This object maps to the TR-159 attribute
aGroupPerf1DayIntervalValid."

REFERENCE

"[TR-159], Section 5.5.1.63"
::= { gBondPortPm1DayEntry 6 }

-- Performance Monitoring TCA Configuration profile

gBondPortPmTcaProfileTable OBJECT-TYPE

SYNTAX SEQUENCE OF GBondPortPmTcaProfileEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table supports definitions of Performance Monitoring (PM) Threshold Crossing Alert (TCA) configuration profiles for GBS ports.

Entries in this table MUST be maintained in a persistent manner."

::= { gBondPortPM 4 }

gBondPortPmTcaProfileEntry OBJECT-TYPE

SYNTAX GBondPortPmTcaProfileEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry in the GBS PM TCA Configuration table.

Each entry corresponds to a single TCA configuration profile.

Each profile contains a set of parameters for setting alarm thresholds for various performance attributes monitored at GBS ports. Profiles may be created/deleted using the row creation/deletion mechanism via

gBondPortPmTcaProfileRowStatus. If an active entry is referenced via gBondPortConfPmTcaConfProfile, the entry MUST remain active until all references are removed.

A default profile with an index of 'DEFVAL' will always exist, and its parameters will be set to vendor-specific values unless otherwise specified in this document."

INDEX { gBondPortPmTcaProfileName }

::= { gBondPortPmTcaProfileTable 1 }

```

GBondPortPmTcaProfileEntry ::=
SEQUENCE {
    gBondPortPmTcaProfileName          SnmpAdminString,
    gBondPortPmTcaProfileThresh15MinES HCPerfIntervalThreshold,
    gBondPortPmTcaProfileThresh15MinSES HCPerfIntervalThreshold,
    gBondPortPmTcaProfileThresh15MinUAS HCPerfIntervalThreshold,
    gBondPortPmTcaProfileThresh1DayES   GBondPm1DayIntervalThreshold,
    gBondPortPmTcaProfileThresh1DaySES   GBondPm1DayIntervalThreshold,
    gBondPortPmTcaProfileThresh1DayUAS   GBondPm1DayIntervalThreshold,
    gBondPortPmTcaProfileRowStatus       RowStatus
}

```

```

gBondPortPmTcaProfileName OBJECT-TYPE
SYNTAX      SnmpAdminString (SIZE (1..32))
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object is a unique index (name) associated with this
    GBS PM TCA profile."
 ::= { gBondPortPmTcaProfileEntry 1 }

```

```

gBondPortPmTcaProfileThresh15MinES OBJECT-TYPE
SYNTAX      HCPerfIntervalThreshold
UNITS       "seconds"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "A desired threshold for the number of Errored Seconds (ES)
    within any given 15-minute performance data collection interval.
    If the number of ESs in a particular 15-minute collection
    interval reaches or exceeds this value, a
    gBondPmTca15MinESCrossing notification MAY be generated if
    enabled by gBondPortConfPmTcaEnable.
    At most one notification can be sent per interval.
    Setting this attribute to zero (default) effectively disables
    the gBondPmTca15MinESCrossing notification.

```

This object maps to the TR-159 attribute
aGroupPerfThreshold15MinES."

```

REFERENCE
    "[TR-159], Section 5.5.1.39"
 ::= { gBondPortPmTcaProfileEntry 2 }

```

```

gBondPortPmTcaProfileThresh15MinSES OBJECT-TYPE
SYNTAX      HCPerfIntervalThreshold
UNITS       "seconds"
MAX-ACCESS  read-create
STATUS      current

```

DESCRIPTION

"A desired threshold for the number of Severely Errored Seconds (SES) within any given 15-minute performance data collection interval.

If the number of SESs in a particular 15-minute collection interval reaches or exceeds this value, a gBondPmTca15MinSESCrossing notification MAY be generated if enabled by gBondPortConfPmTcaEnable.

At most one notification can be sent per interval.

Setting this attribute to zero (default) effectively disables the gBondPmTca15MinSESCrossing notification.

This object maps to the TR-159 attribute
aGroupPerfThreshold15MinSES."

REFERENCE

"[TR-159], Section 5.5.1.40"

::= { gBondPortPmTcaProfileEntry 3 }

gBondPortPmTcaProfileThresh15MinUAS OBJECT-TYPE

SYNTAX HCPperfIntervalThreshold

UNITS "seconds"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"A desired threshold for the number of Unavailable Seconds (UAS) within any given 15-minute performance data collection interval.

If the number of UASs in a particular 15-minute collection interval reaches or exceeds this value, a gBondPmTca15MinUASCrossing notification MAY be generated if enabled by gBondPortConfPmTcaEnable.

At most one notification can be sent per interval.

Setting this attribute to zero (default) effectively disables the gBondPmTca15MinUASCrossing notification.

This object maps to the TR-159 attribute
aGroupPerfThreshold15MinUAS."

REFERENCE

"[TR-159], Section 5.5.1.41"

::= { gBondPortPmTcaProfileEntry 4 }

gBondPortPmTcaProfileThresh1DayES OBJECT-TYPE

SYNTAX GBondPm1DayIntervalThreshold

UNITS "seconds"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"A desired threshold for the number of Errored Seconds (ES) within any given 1-day performance data collection interval.

If the number of ESs in a particular 1-day collection interval reaches or exceeds this value, a gBondPmTca1DayESCrossing notification MAY be generated if enabled by gBondPortConfPmTcaEnable.

At most one notification can be sent per interval.

Setting this attribute to zero (default) effectively disables the gBondPmTca1DayESCrossing notification.

This object maps to the TR-159 attribute aGroupPerfThreshold1DayES."

REFERENCE

"[TR-159], Section 5.5.1.51"

::= { gBondPortPmTcaProfileEntry 5 }

gBondPortPmTcaProfileThresh1DaySES OBJECT-TYPE

SYNTAX GBondPm1DayIntervalThreshold

UNITS "seconds"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"A desired threshold for the number of Severely Errored Seconds (SES) within any given 1-day performance data collection interval.

If the number of SESs in a particular 1-day collection interval reaches or exceeds this value, a gBondPmTca1DaySESCrossing notification MAY be generated if enabled by gBondPortConfPmTcaEnable.

At most one notification can be sent per interval.

Setting this attribute to zero (default) effectively disables the gBondPmTca1DaySESCrossing notification.

This object maps to the TR-159 attribute aGroupPerfThreshold1DaySES."

REFERENCE

"[TR-159], Section 5.5.1.52"

::= { gBondPortPmTcaProfileEntry 6 }

gBondPortPmTcaProfileThresh1DayUAS OBJECT-TYPE

SYNTAX GBondPm1DayIntervalThreshold

UNITS "seconds"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"A desired threshold for the number of Unavailable Seconds (UAS) within any given 1-day performance data collection interval.

If the number of UASs in a particular 1-day collection interval reaches or exceeds this value, a gBondPmTca1DayUASCrossing notification MAY be generated if enabled by

gBondPortConfPmTcaEnable.

At most one notification can be sent per interval.

Setting this attribute to zero (default) effectively disables the gBondPmTca1DayUASCrossing notification.

This object maps to the TR-159 attribute
aGroupPerfThreshold1DayUAS."

REFERENCE

"[TR-159], Section 5.5.1.53"

::= { gBondPortPmTcaProfileEntry 7 }

gBondPortPmTcaProfileRowStatus OBJECT-TYPE

SYNTAX RowStatus

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This object controls the creation, modification, or deletion of the associated entry in the gBondPortPmTcaProfileTable per the semantics of RowStatus.

If an 'active' entry is referenced via gBondPortConfPmTcaConfProfile instance(s), the entry MUST remain 'active'.

An 'active' entry SHALL NOT be modified. In order to modify an existing entry, it MUST be taken out of service (by setting this object to 'notInService'), modified, and set to 'active' again."

::= { gBondPortPmTcaProfileEntry 8 }

-- The BCE group

gBondBceConfTable OBJECT-TYPE

SYNTAX SEQUENCE OF GBondBceConfEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Table for configuration of G.Bond common aspects for the Bonding Channel Entity (BCE) ports (modems/channels).

Entries in this table MUST be maintained in a persistent manner."

::= { gBondBce 1 }

gBondBceConfEntry OBJECT-TYPE

SYNTAX GBondBceConfEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry in the G.Bond BCE Configuration table.

Each entry represents common aspects of a G.Bond BCE port indexed by the ifIndex. Note that a G.Bond BCE port can be stacked below a single GBS port, also indexed by the ifIndex, possibly together with other BCE ports if bonding is enabled."

INDEX { ifIndex }

::= { gBondBceConfTable 1 }

GBondBceConfEntry ::=

SEQUENCE {

gBondBceConfRemoteDiscoveryCode PhysAddress

}

gBondBceConfRemoteDiscoveryCode OBJECT-TYPE

SYNTAX PhysAddress (SIZE (0|6))

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"A remote discovery code of the BCE port at the C0.

A 6-octet-long discovery code of the peer GBS connected via the BCE.

Reading this object results in a Discovery Get operation.

Setting this object to all zeroes results in a Discovery Clear_if_Same operation (the value of gBondPortConfDiscoveryCode at the peer GBS SHALL be the same as gBondPortConfDiscoveryCode of the local GBS associated with the BCE for the operation to succeed).

Writing a non-zero value to this object results in a Discovery Set_if_Clear operation.

A zero-length octet string SHALL be returned on an attempt to read this object when bonding is not enabled.

This object is irrelevant in BCE-R port subtypes (CPE side): in this case, a zero-length octet string SHALL be returned on an attempt to read this object. An attempt to change this object MUST be rejected (in the case of SNMP, with the error inconsistentValue).

Discovery MUST be performed when the link is 'down'.

Attempts to change this object MUST be rejected (in the case of SNMP, with the error inconsistentValue), If the link is 'up' or initializing.

This object maps to the TR-159 attribute aLineRemoteDiscoveryCode."

REFERENCE

"[TR-159], Section 5.5.6.7"
::= { gBondBceConfEntry 1 }

--

-- Conformance Statements

--

gBondGroups OBJECT IDENTIFIER ::= { gBondConformance 1 }

gBondCompliances OBJECT IDENTIFIER ::= { gBondConformance 2 }

-- Object Groups

gBondBasicGroup OBJECT-GROUP

OBJECTS {

gBondPortStatOperScheme,
gBondPortStatUpDataRate,
gBondPortStatDnDataRate,
gBondPortConfTargetUpDataRate,
gBondPortConfTargetDnDataRate,
gBondPortCapSchemesSupported,
gBondPortCapCapacity,
gBondPortStatNumBCEs,
gBondPortStatSide,
gBondPortStatFltStatus

}

STATUS current

DESCRIPTION

"A collection of objects representing management information
common to all types of G.Bond ports."

::= { gBondGroups 1 }

gBondDiscoveryGroup OBJECT-GROUP

OBJECTS {

gBondPortStatPeerOperScheme,
gBondPortCapPeerSchemesSupported,
gBondPortCapPeerCapacity,
gBondPortConfDiscoveryCode,
gBondBceConfRemoteDiscoveryCode

}

STATUS current

DESCRIPTION

"A collection of objects supporting OPTIONAL G.Bond discovery
in G.Bond ports."

::= { gBondGroups 2 }

```
gBondMultiSchemeGroup OBJECT-GROUP
  OBJECTS {
    gBondPortConfAdminScheme,
    gBondPortConfPeerAdminScheme
  }
  STATUS      current
  DESCRIPTION
    "A collection of objects providing OPTIONAL management
    information for G.Bond ports supporting multiple bonding
    schemes."
  ::= { gBondGroups 3 }

gBondTcaConfGroup OBJECT-GROUP
  OBJECTS {
    gBondPortConfThreshLowUpRate,
    gBondPortConfThreshLowDnRate,
    gBondPortConfLowRateCrossingEnable
  }
  STATUS      current
  DESCRIPTION
    "A collection of objects required for configuration of alarm
    thresholds and notifications in G.Bond ports."
  ::= { gBondGroups 4 }

gBondTcaNotificationGroup NOTIFICATION-GROUP
  NOTIFICATIONS {
    gBondLowUpRateCrossing,
    gBondLowDnRateCrossing
  }
  STATUS      current
  DESCRIPTION
    "This group supports notifications of significant conditions
    (non-PM threshold crossing alerts) associated with G.Bond ports."
  ::= { gBondGroups 5 }

gBondPmCurGroup OBJECT-GROUP
  OBJECTS {
    gBondPortPmCurES,
    gBondPortPmCurSES,
    gBondPortPmCurUAS,
    gBondPortPmCur15MinValidIntervals,
    gBondPortPmCur15MinInvalidIntervals,
    gBondPortPmCur15MinTimeElapsed,
    gBondPortPmCur15MinES,
    gBondPortPmCur15MinSES,
    gBondPortPmCur15MinUAS,
    gBondPortPmCur1DayValidIntervals,
    gBondPortPmCur1DayInvalidIntervals,
```

```
    gBondPortPmCur1DayTimeElapsed,  
    gBondPortPmCur1DayES,  
    gBondPortPmCur1DaySES,  
    gBondPortPmCur1DayUAS  
  }  
  STATUS      current  
  DESCRIPTION  
    "A collection of objects supporting OPTIONAL current Performance  
    Monitoring information for G.Bond ports."  
  ::= { gBondGroups 6 }
```

gBondPm15MinGroup OBJECT-GROUP

```
  OBJECTS {  
    gBondPortPm15MinIntervalMoniTime,  
    gBondPortPm15MinIntervalES,  
    gBondPortPm15MinIntervalSES,  
    gBondPortPm15MinIntervalUAS,  
    gBondPortPm15MinIntervalValid  
  }  
  STATUS      current  
  DESCRIPTION  
    "A collection of objects supporting OPTIONAL historical  
    Performance Monitoring information for G.Bond ports, during  
    previous 15-minute intervals."  
  ::= { gBondGroups 7 }
```

gBondPm1DayGroup OBJECT-GROUP

```
  OBJECTS {  
    gBondPortPm1DayIntervalMoniTime,  
    gBondPortPm1DayIntervalES,  
    gBondPortPm1DayIntervalSES,  
    gBondPortPm1DayIntervalUAS,  
    gBondPortPm1DayIntervalValid  
  }  
  STATUS      current  
  DESCRIPTION  
    "A collection of objects supporting OPTIONAL historical  
    Performance Monitoring information for G.Bond ports, during  
    previous 1-day intervals."  
  ::= { gBondGroups 8 }
```

gBondPmTcaConfGroup OBJECT-GROUP

```
  OBJECTS {  
    gBondPortConfPmTcaConfProfile,  
    gBondPortConfPmTcaEnable,  
    gBondPortPmTcaProfileThresh15MinES,  
    gBondPortPmTcaProfileThresh15MinSES,  
    gBondPortPmTcaProfileThresh15MinUAS,  
  }
```

```

    gBondPortPmTcaProfileThresh1DayES,
    gBondPortPmTcaProfileThresh1DaySES,
    gBondPortPmTcaProfileThresh1DayUAS,
    gBondPortPmTcaProfileRowStatus
}
STATUS      current
DESCRIPTION
    "A collection of objects required for configuration of
    Performance Monitoring Threshold Crossing Alert notifications
    in G.Bond ports."
 ::= { gBondGroups 9 }

```

```

gBondPmTcaNotificationGroup NOTIFICATION-GROUP
NOTIFICATIONS {
    gBondPmTca15MinESCrossing,
    gBondPmTca15MinSESCrossing,
    gBondPmTca15MinUASCrossing,
    gBondPmTca1DayESCrossing,
    gBondPmTca1DaySESCrossing,
    gBondPmTca1DayUASCrossing
}
STATUS      current
DESCRIPTION
    "This group supports notifications of Performance Monitoring
    Threshold Crossing Alerts associated with G.Bond ports."
 ::= { gBondGroups 10 }

```

-- Compliance Statements

```

gBondCompliance MODULE-COMPLIANCE
STATUS      current
DESCRIPTION
    "The compliance statement for G.Bond interfaces.
    Compliance with the following external compliance statements
    is REQUIRED:

```

MIB Module	Compliance Statement
-----	-----
IF-MIB	ifCompliance3

Compliance with the following external compliance statements is OPTIONAL for implementations supporting bonding with flexible cross-connect between the GBS and BCE ports:

MIB Module	Compliance Statement
-----	-----
IF-INVERTED-STACK-MIB	ifInvCompliance
IF-CAP-STACK-MIB	ifCapStackCompliance"

```
MODULE -- this module
MANDATORY-GROUPS {
    gBondBasicGroup,
    gBondTcaConfGroup,
    gBondTcaNotificationGroup
}

GROUP          gBondDiscoveryGroup
DESCRIPTION
    "Support for this group is only required for implementations
    supporting the G.Bond Discovery function."

GROUP          gBondMultiSchemeGroup
DESCRIPTION
    "Support for this group is only required for implementations
    supporting multiple bonding schemes."

GROUP          gBondPmCurGroup
DESCRIPTION
    "Support for this group is only required for implementations
    supporting Performance Monitoring."

GROUP          gBondPm15MinGroup
DESCRIPTION
    "Support for this group is only required for implementations
    supporting 15-minute historical Performance Monitoring."

GROUP          gBondPm1DayGroup
DESCRIPTION
    "Support for this group is only required for implementations
    supporting 1-day historical Performance Monitoring."

GROUP          gBondPmTcaConfGroup
DESCRIPTION
    "Support for this group is only required for implementations
    supporting Performance Monitoring Threshold Crossing Alert
    notifications."

GROUP          gBondPmTcaNotificationGroup
DESCRIPTION
    "Support for this group is only required for implementations
    supporting Performance Monitoring Threshold Crossing Alert
    notifications."

OBJECT          gBondPortCapSchemesSupported
SYNTAX          IANA gBondSchemeList
DESCRIPTION
    "Support for all bonding scheme types is not required."
```

However, at least one value SHALL be supported."

OBJECT gBondPortCapPeerSchemesSupported

SYNTAX IANAxBondSchemeList

DESCRIPTION

"Support for all bonding scheme types is not required.
However, at least one value SHALL be supported."

::= { gBondCompliances 1 }

END

7. IANA-Maintained G.Bond TC Definitions

The IANA-GBOND-TC-MIB module IMPORTS objects from SNMPv2-SMI [RFC2578] and SNMPv2-TC [RFC2579].

IANA-GBOND-TC-MIB DEFINITIONS ::= BEGIN

```
IMPORTS
    MODULE-IDENTITY,
    mib-2
    FROM SNMPv2-SMI
    TEXTUAL-CONVENTION
    FROM SNMPv2-TC
;
```

```
ianaGBondTcMIB MODULE-IDENTITY
    LAST-UPDATED "201302200000Z" -- 20 February 2013
    ORGANIZATION "IANA"
    CONTACT-INFO "          Internet Assigned Numbers Authority

                        Postal: ICANN
                        12025 Waterfront Drive, Suite 300
                        Los Angeles, CA 90094-2536

                        Tel: +1-310-301-5800
                        EMail: iana@iana.org"
```

DESCRIPTION

"This MIB module defines IANAgBondScheme and IANAgBondSchemeList TEXTUAL-CONVENTIONS, specifying enumerated values of the gBondPortConfAdminScheme, gBondPortConfPeerAdminScheme, gBondPortStatOperScheme, gBondPortStatPeerOperScheme, gBondPortCapSchemesSupported, and gBondPortCapPeerSchemesSupported objects, respectively, as defined in the GBOND-MIB.

It is intended that each new bonding scheme defined by the ITU-T Q4/SG15 working group and approved for publication in a revision of the ITU-T G.998 specification will be added to this MIB module, provided that it is suitable for being managed by the base objects in the GBOND-MIB. An Expert Review, as defined in RFC 5226, is REQUIRED for such additions.

The following references are used throughout this MIB module:

[G.998.1] refers to:
ITU-T Recommendation G.998.1: 'ATM-based multi-pair bonding',
January 2005.

[G.998.2] refers to:
ITU-T Recommendation G.998.2: 'Ethernet-based multi-pair bonding', January 2005.

[G.998.3] refers to:
ITU-T Recommendation G.998.3: 'Multi-pair bonding using time-division inverse multiplexing', January 2005.

Naming Conventions:

BCE - Bonding Channel Entity
GBS - Generic Bonding Sub-layer

These references should be updated as appropriate when a new bonding scheme is added to this MIB module.

Copyright (c) 2013 IETF Trust and the persons identified as authors of the code. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, is permitted pursuant to, and subject to the license terms contained in, the Simplified BSD License set forth in Section 4.c of the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>)."

REVISION "201302200000Z" -- 20 February 2013
DESCRIPTION "Initial version, published as RFC 6765."

::= { mib-2 215 }

-- Textual Conventions

IANAxBondSchemeList ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"This textual convention defines a bitmap of possible ITU-T G.998 (G.Bond) bonding schemes. Currently, the following values are defined for the corresponding bonding schemes:

g9981(1) - G.998.1 (G.Bond/ATM; see the G9981-MIB)

g9982(2) - G.998.2 (G.Bond/Ethernet; see the G9982-MIB)

g9983(3) - G.998.3 (G.Bond/TDIM; see the G9983-MIB)

An additional value of none(0) can be returned as a result of a GET operation when a value of the object cannot be determined (for example, a peer GBS cannot be reached), the port does not support any kind of bonding, or when a single-BCE G.998.2 GBS supports bonding (frame fragmentation/reassembly) bypass."

```
SYNTAX      BITS {  
    none(0),  
    g9981(1),  
    g9982(2),  
    g9983(3)  
}
```

IANAxBondScheme ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"This textual convention defines ITU-T G.998 bonding scheme values. Possible values are:

none(0) - no bonding (e.g., on a single-BCE G.998.2 GBS)
 or unknown

g9981(1) - G.998.1 (G.Bond/ATM)

g9982(2) - G.998.2 (G.Bond/Ethernet)

g9983(3) - G.998.3 (G.Bond/TDIM)"

```
SYNTAX      INTEGER {  
    none(0),  
    g9981(1),  
    g9982(2),  
    g9983(3)  
}
```

END

8. Security Considerations

There are a number of management objects defined in this MIB module with a MAX-ACCESS clause of read-write and/or read-create. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations. These are the tables and objects and their sensitivity/vulnerability:

- o Changing of the gBondPortConfAdminScheme object may lead to a potential locking of the link, if the peer device does not support the desired bonding scheme.
- o Changing of the gBondPortConfDiscoveryCode object, before the discovery operation, may lead to a wrongful discovery -- for example, when two C0 ports are connected to the same multi-channel RT port, while both C0 ports have the same discovery register value.

- o Changing of the target upstream/downstream data rate via gBondPortConfTargetUpDataRate/gBondPortConfTargetDnDataRate may lead to anything from degradation of link quality and data rate to a complete link initialization failure, as the ability of a G.Bond port to support a particular configuration depends on the copper environment.
- o Activation of a specific line/channel may cause a severe degradation of service for another G.Bond port, whose channel(s) may be affected by the cross-talk from the newly activated channel.
- o Removal of a channel from an operationally 'up' G.Bond port, aggregating several channels, may cause degradation of the port's data rate.

Some of the readable objects in this MIB module (i.e., those with MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments since, collectively, they provide information about the performance of network interfaces and can reveal some aspects of their configuration.

In particular, since a bonded xDSL port can be comprised of multiple Unshielded Twisted Pair (UTP) voice-grade copper, located in the same bundle with other pairs belonging to another operator/customer, it is theoretically possible to eavesdrop on a G.Bond transmission, simply by "listening" to cross-talk from the bonded pairs, especially if the operating parameters of the G.Bond link in question are known.

It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP. These are the tables and objects and their sensitivity/vulnerability:

- o gBondPortStatTable - objects in this table provide status information for the G.Bond port, which may aid in identification of the pairs belonging to the bonded port and eavesdropping on the traffic over that port.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPsec), there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

Implementations SHOULD provide the security features described by the SNMPv3 framework (see [RFC3410]), and implementations claiming compliance to the SNMPv3 standard MUST include full support for

authentication and privacy via the User-based Security Model (USM) [RFC3414] with the AES cipher algorithm [RFC3826]. Implementations MAY also provide support for the Transport Security Model (TSM) [RFC5591] in combination with a secure transport such as SSH [RFC5592] or TLS/DTLS [RFC6353].

Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

9. IANA Considerations

Three new values of IANAifType -- g9981(263), g9982(264), and g9983(265) -- have been allocated by IANA <<http://www.iana.org/>> in the IANAifType-MIB module [IANAifType-MIB].

An object identifier for gBondMIB MODULE-IDENTITY has been allocated by IANA in the MIB-2 transmission sub-tree (211).

This document defines the first version of the IANA-maintained IANA-GBOND-TC-MIB module. It is intended that each new G.998 bonding scheme defined by the ITU-T Q4/SG15 working group and approved for publication in a revision of ITU-T G.998.x will be added to the IANA-maintained MIB module, provided that it is suitable for being managed by the base objects in the GBOND-MIB module. An object identifier for ianaGBondTcMIB MODULE-IDENTITY has been allocated by IANA in the MIB-2 transmission sub-tree (215).

For each new bonding scheme added, a short description of the bonding protocol and, wherever possible, a reference to a publicly available specification SHOULD be specified. An Expert Review, as defined in [RFC5226], is REQUIRED for each modification.

10. Acknowledgments

This document was produced by the [ADSLMIB] working group.

Special thanks to Dan Romascanu for his meticulous review of this text.

11. References

11.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.
- [RFC2578] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.
- [RFC2579] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.
- [RFC2580] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIv2", STD 58, RFC 2580, April 1999.
- [RFC2863] McCloghrie, K. and F. Kastenholz, "The Interfaces Group MIB", RFC 2863, June 2000.
- [RFC3411] Harrington, D., Presuhn, R., and B. Wijnen, "An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks", STD 62, RFC 3411, December 2002.
- [RFC3414] Blumenthal, U. and B. Wijnen, "User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)", STD 62, RFC 3414, December 2002.
- [RFC3705] Ray, B. and R. Abbi, "High Capacity Textual Conventions for MIB Modules Using Performance History Based on 15 Minute Intervals", RFC 3705, February 2004.
- [RFC3826] Blumenthal, U., Maino, F., and K. McCloghrie, "The Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model", RFC 3826, June 2004.
- [RFC5226] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 5226, May 2008.
- [RFC5591] Harrington, D. and W. Hardaker, "Transport Security Model for the Simple Network Management Protocol (SNMP)", RFC 5591, June 2009.

- [RFC5592] Harrington, D., Salowey, J., and W. Hardaker, "Secure Shell Transport Model for the Simple Network Management Protocol (SNMP)", RFC 5592, June 2009.
- [RFC6353] Hardaker, W., "Transport Layer Security (TLS) Transport Model for the Simple Network Management Protocol (SNMP)", RFC 6353, July 2011.
- [TR-159] Beili, E. and M. Morgenstern, "Management Framework for xDSL Bonding", Broadband Forum Technical Report TR-159, December 2008, <<http://www.broadband-forum.org/technical/download/TR-159.pdf>>.

11.2. Informative References

- [802.3] IEEE, "IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications", IEEE Std 802.3-2005, December 2005.
- [ADSLMIB] IETF, "ADSL MIB (adslmib) Charter", <<http://datatracker.ietf.org/wg/adslmib/charter/>>.
- [AF-PHY-0086] ATM Forum, "Inverse Multiplexing for ATM (IMA) Specification Version 1.1", ATM Forum specification af-phy-0086.001, March 1999, <<http://www.broadband-forum.org/ftp/pub/approved-specs/af-phy-0086.001.pdf>>.
- [G.994.1] ITU-T, "Handshake procedures for digital subscriber line (DSL) transceivers", ITU-T Recommendation G.994.1, June 2012, <<http://www.itu.int/rec/T-REC-G.994.1/en>>.
- [G.998.1] ITU-T, "ATM-based multi-pair bonding", ITU-T Recommendation G.998.1, January 2005, <<http://www.itu.int/rec/T-REC-G.998.1/en>>.
- [G.998.2] ITU-T, "Ethernet-based multi-pair bonding", ITU-T Recommendation G.998.2, January 2005, <<http://www.itu.int/rec/T-REC-G.998.2/en>>.
- [G.998.3] ITU-T, "Multi-pair bonding using time-division inverse multiplexing", ITU-T Recommendation G.998.3, January 2005, <<http://www.itu.int/rec/T-REC-G.998.3/en>>.

[IANAifType-MIB]

Internet Assigned Numbers Authority (IANA), "IANAifType Textual Convention definition",
<<http://www.iana.org/assignments/ianaiftype-mib>>.

- [RFC2790] Waldbusser, S. and P. Grillo, "Host Resources MIB", RFC 2790, March 2000.
- [RFC2864] McCloghrie, K. and G. Hanson, "The Inverted Stack Table Extension to the Interfaces Group MIB", RFC 2864, June 2000.
- [RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework", RFC 3410, December 2002.
- [RFC3440] Ly, F. and G. Bathrick, "Definitions of Extension Managed Objects for Asymmetric Digital Subscriber Lines", RFC 3440, December 2002.
- [RFC3593] Tesink, K., "Textual Conventions for MIB Modules Using Performance History Based on 15 Minute Intervals", RFC 3593, September 2003.
- [RFC3728] Ray, B. and R. Abbi, "Definitions of Managed Objects for Very High Speed Digital Subscriber Lines (VDSL)", RFC 3728, February 2004.
- [RFC4181] Heard, C., "Guidelines for Authors and Reviewers of MIB Documents", BCP 111, RFC 4181, September 2005.
- [RFC4319] Sikes, C., Ray, B., and R. Abbi, "Definitions of Managed Objects for High Bit-Rate DSL - 2nd generation (HDSL2) and Single-Pair High-Speed Digital Subscriber Line (SHDSL) Lines", RFC 4319, December 2005.
- [RFC4706] Morgenstern, M., Dodge, M., Baillie, S., and U. Bonollo, "Definitions of Managed Objects for Asymmetric Digital Subscriber Line 2 (ADSL2)", RFC 4706, November 2006.
- [RFC5066] Beili, E., "Ethernet in the First Mile Copper (EFMCu) Interfaces MIB", RFC 5066, November 2007.
- [RFC5650] Morgenstern, M., Baillie, S., and U. Bonollo, "Definitions of Managed Objects for Very High Speed Digital Subscriber Line 2 (VDSL2)", RFC 5650, September 2009.

- [RFC5905] Mills, D., Martin, J., Burbank, J., and W. Kasch, "Network Time Protocol Version 4: Protocol and Algorithms Specification", RFC 5905, June 2010.
- [RFC6766] Beili, E., "xDSL Multi-Pair Bonding Using Time-Division Inverse Multiplexing (G.Bond/TDIM) MIB", RFC 6766, February 2013.
- [RFC6767] Beili, E. and M. Morgenstern, "Ethernet-Based xDSL Multi-Pair Bonding (G.Bond/Ethernet) MIB", RFC 6767, February 2013.
- [RFC6768] Beili, E., "ATM-Based xDSL Bonded Interfaces MIB", RFC 6768, February 2013.

Authors' Addresses

Edward Beili
Actelis Networks
25 Bazel St.
Petach-Tikva 49103
Israel

Phone: +972-3-924-3491
EMail: edward.beili@actelis.com

Moti Morgenstern
ECI Telecom
30 Hasivim St.
Petach-Tikva 4951169
Israel

Phone: +972-3-926-6258
EMail: moti.morgenstern@ecitele.com