                 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.

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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:
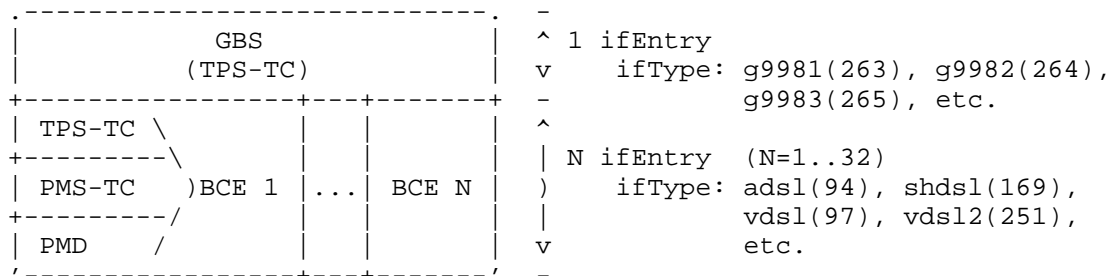
```
.-----------------------------.  -
|             GBS             |  ^ 1 ifEntry
|          (TPS-TC)           |  v    ifType: g9981(263), g9982(264),
+-----------------+---+-------+  -             g9983(265), etc.
| TPS-TC \        |   |       |  ^
+---------\       |   |       |  | N ifEntry  (N=1..32)
| PMS-TC   )BCE 1 |...| BCE N |  )    ifType: adsl(94), shdsl(169),
+---------/       |   |       |  |            vdsl(97), vdsl2(251),
| PMD    /        |   |       |  v            etc.
'-----------------+---+-------'  -


 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[gbs[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[gbs[i]] and
                           NOT IN ifStackTable[gbs[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.
              // (gbs[i] is auto-added TO ifInvStackTable[bce[k]]).
              ADD bce[k] TO ifStackTable[gbs[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

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  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

   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 -O 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 -O 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             IANAgBondScheme,
    gBondPortConfPeerAdminScheme         IANAgBondScheme,
    gBondPortConfDiscoveryCode           PhysAddress,
    gBondPortConfTargetUpDataRate        Unsigned32,
    gBondPortConfTargetDnDataRate        Unsigned32,
    gBondPortConfThreshLowUpRate         Unsigned32,
    gBondPortConfThreshLowDnRate         Unsigned32,
    gBondPortConfLowRateCrossingEnable   TruthValue,
    gBondPortConfPmTcaConfProfile        SnmpAdminString,
    gBondPortConfPmTcaEnable             TruthValue
  }

gBondPortConfAdminScheme  OBJECT-TYPE
  SYNTAX       IANAgBondScheme
  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   IANAgBondScheme
     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 -O 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 -O
          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 10000000 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 -O 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 -O 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 -O 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 -O 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 -O 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          IANAgBondSchemeList,
    gBondPortCapPeerSchemesSupported      IANAgBondSchemeList,
    gBondPortCapCapacity                  Unsigned32,
    gBondPortCapPeerCapacity              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             IANAgBondScheme,
    gBondPortStatPeerOperScheme         IANAgBondScheme,
    gBondPortStatUpDataRate             Gauge32,
    gBondPortStatDnDataRate             Gauge32,
    gBondPortStatFltStatus              BITS,
    gBondPortStatSide                   INTEGER,
    gBondPortStatNumBCEs                Unsigned32
  }

gBondPortStatOperScheme  OBJECT-TYPE
  SYNTAX        IANAgBondScheme
  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        IANAgBondScheme
  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 -O
                                     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 '-O' subtype (all BCEs assigned to this port are of
      subtype '-O').
      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                     HCPerfTotalCount,
       gBondPortPmCurSES                    HCPerfTotalCount,
       gBondPortPmCurUAS                    HCPerfTotalCount,
       gBondPortPmCur15MinValidIntervals    HCPerfValidIntervals,
       gBondPortPmCur15MinInvalidIntervals  HCPerfInvalidIntervals,
       gBondPortPmCur15MinTimeElapsed       HCPerfTimeElapsed,
       gBondPortPmCur15MinES                HCPerfCurrentCount,
       gBondPortPmCur15MinSES               HCPerfCurrentCount,
       gBondPortPmCur15MinUAS               HCPerfCurrentCount,
       gBondPortPmCur1DayValidIntervals     Unsigned32,

```
      gBondPortPmCur1DayInvalidIntervals     Unsigned32,
      gBondPortPmCur1DayTimeElapsed          HCPerfTimeElapsed,
      gBondPortPmCur1DayES                   HCPerfCurrentCount,
      gBondPortPmCur1DaySES                  HCPerfCurrentCount,
      gBondPortPmCur1DayUAS                  HCPerfCurrentCount
   }

gBondPortPmCurES  OBJECT-TYPE
   SYNTAX       HCPerfTotalCount
   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 TDIM 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       HCPerfTotalCount
   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        HCPerfCurrentCount
     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        HCPerfCurrentCount
     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          Unsigned32,
        gBondPortPm1DayIntervalMoniTime       HCPerfTimeElapsed,
```

```
      gBondPortPm1DayIntervalES              HCPerfIntervalCount,
      gBondPortPm1DayIntervalSES             HCPerfIntervalCount,
      gBondPortPm1DayIntervalUAS             HCPerfIntervalCount,
      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
          aGroupPerf1DayIntervalES."
        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   HCPerfIntervalThreshold
      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 CO.
       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       IANAgBondSchemeList
        DESCRIPTION
          "Support for all bonding scheme types is not required.
```

```
      However, at least one value SHALL be supported."

   OBJECT      gBondPortCapPeerSchemesSupported
   SYNTAX      IANAgBondSchemeList
   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.

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

      ::= { mib-2 215 }

   -- Textual Conventions

   IANAgBondSchemeList ::= 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)
      }

    IANAgBondScheme ::= 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 CO ports are connected to the same multi-channel
      RT port, while both CO 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

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