Vanguard Managed Solutions

Vanguard Applications Ware
IP and LAN Feature Protocols

G.SHDSL

Notice

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To comment on this manual, please send e-mail to LGEN031@vanguardms.com

Overview

Introduction

This manual describes the Vanguard Single-Pair High Speed Digital Subscriber Line (G.SHDSL) hardware, software and configurable parameters available with Release 6.4 and greater.

Note

The G.SHDSL daughtercard is supported on five Vanguard platforms: Vanguard 340, 340 Enhanced, 342, 6435 and 6455. Installation information on the card can be found in the *Daughtercard Installation Guide* (Part Number T0020).

G.SHDSL (or G.991.2) is an international standard for Symmetric Digital Subscriber Line (DSL) developed by the International Telecommunication Union (ITU). G.SHDSL can send and receive high-speed symmetrical data streams over a single pair of copper wires at rates between 192 kbps and 2.31 Mbps. G.SHDSL was developed to incorporate the features of other DSL technologies, such as Asymmetric Digital Subscriber Line (ADSL) and Symmetric Digital Subscriber Line (SDSL) and transports ISDN, ATM, T1, E1, and IP signals. G.SHDSL is the first DSL technology that is an international standard. G.SHDSL is the preferred choice for business applications, which require higher-speed bandwidth in both directions (upstream and downstream bit-rate). Asymmetric DSL (ADSL) was designed for more residential use (downstream bit-rate).

In This Manual

Features and Benefits

The major features of Vanguard G.SHDSL Daughtercard are:

- DSL Solution
- Increased Data Rates
- Asynchronous Transfer Mode (ATM) Support and Enhancements
  - Plain Old Telephony Service (POTS) Network Transmission (use of existing copper telephone lines)
  - Wide Area Network (WAN) interface
- Support of the International Standards G.991.2 Single Pair high speed Digital Subscriber Line (DSL), ITU-T, February 2001.
- Support of the G.994.1 handshake procedure for Digital Subscriber Line (DSL) transceivers, ITU-T, May 2003.

Benefits

The major benefits of Vanguard G.SHDSL Daughtercard are:

1) Symmetrical higher speed and more cost effective bandwidth compared to existing WAN services such as Frame Relay, ISDN and leased line services. Users can integrate higher bandwidth applications such as video conferencing, high speed LAN traffic, etc..

2) Using DSL technologies at the remote branch offices, you now gain more bandwidth and integrate voice and data services with Quality of Service, reducing the overall cost of networks. Parallel separate voice and data networks can be merged.

3) VPN applications can run over DSL services and can obtain a secure means of communication while having an “Always On” infrastructure.

4) G.SHDSL is a standards based solution, customers can own this technology without being constrained with interoperability concerns or vendor specific products. Service providers can deploy this technology to a large customer base with no concerns with respect to cost and product limitations.

Limitation

There is a limitation in terms on available memory available in the 340 that does not allow you to run G.SHDSL and Voice at the same time. This is caused by the 4M flash limit in 340. This limit would not be present in the Enhanced 340 or 342.

Classes of Service

The following Classes of Service (CoS) are supported:

- Constant Bit Rate (CBR)
- Variable Bit Rate-real time (VBR-rt)
- Variable Bit Rate-non real time (VBR-nrt)
- Unspecified Bit Rate (UBR)

G.SHDSL Hardware

Introduction

Figure 1 shows the Vanguard G.SHDSL Daughtercard.

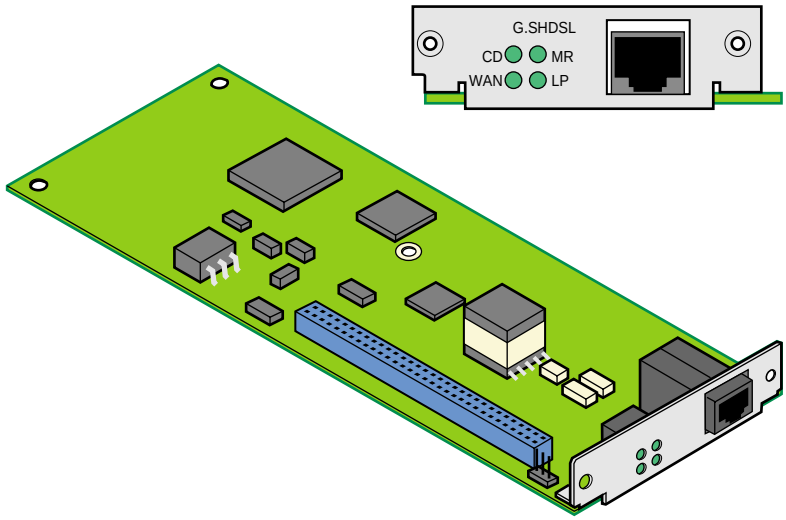

Figure 1. Vanguard G.SHDSL Daughtercard

Vanguard Model	*G.SHDSL Daughtercard Support*
340, 340 Enhanced, 342	One G.SHDSL Daughtercard is supported in either of the two daughtercard slots.
6435 and 6455	Two G.SHDSL Daughtercards are supported simultaneously in any of the three daughtercard slots.

Note

Information on LEDs, pin descriptions and installing the card is available in the *Daughtercard Installation Guide* (Part Number T0020).

The G.SHDSL Daughtercard is implemented with support for two wire DSL operation.

Installing a Ferrite Bead on a 6435 and 6455

This notice explains how to install a ferrite bead, which filters out line disturbances, on audio and power cables. Installation of a bead is required to ensure compliance with the European Union (EU) EMC Directive 89/336/EEC and compliance with FCC Part 15, Class A. Failure to install the ferrite component will result in non-compliance with the EU EMC Directive and may cause interference with other electrical equipment.

Note

The bead is required on the Vanguard 6435 and 6455.

Before installing a ferrite bead on an audio cable, be sure you have the audio cable that shipped with your G.SHDSL Daughtercard.

Step	Action
1	Snugly wrap the cable twice completely around the bead (see Figure 2).
2	Set the cable into the bead cutouts.
3	Ensure 1 to 1-1/2 inches (25 to 38mm) of the cable protrudes from the bead (on the end you insert into the G.SHDSL Daughtercard's rear panel connector).
4	Snap the bead closed. You can re-open and close it to re-set the cable.
5	Insert the cable into the appropriate connector on the rear of the G.SHDSL Daughtercard (with the ferrite bead closest to the Daughtercard's rear panel connector).

Example Installation

Figure 2 shows how to install the ferrite bead on the cable.

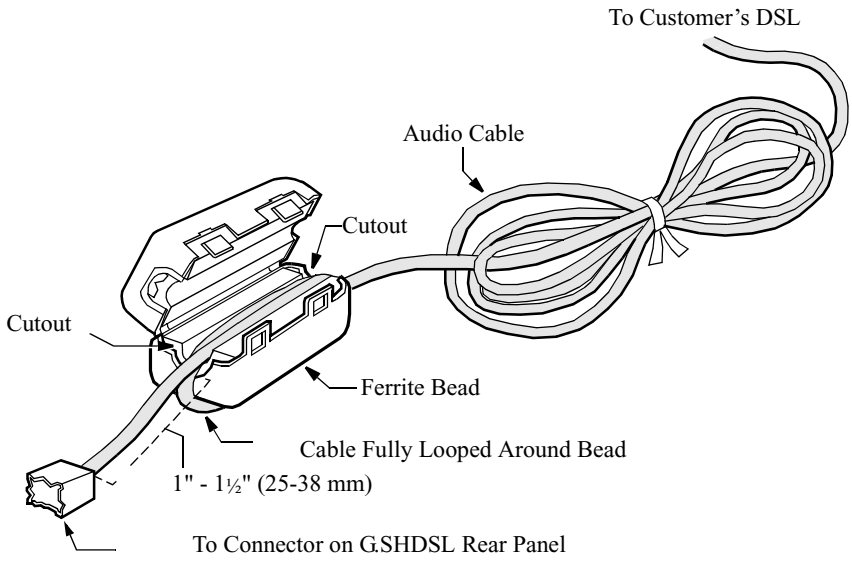

Figure 2. Installing a Ferrite Bead on an Audio Cable

Switches and LED Indicators

There are no DIP switches on the G.SHDSL daughtercard that can be set by the user. Figure 3 below shows the four G.SHDSL Daughtercard LEDs:

- CD
- MR
- WAN
- LP

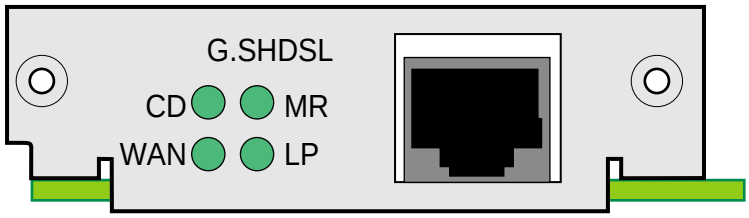

Figure 3. LED Indicators

There are four LEDs available on the G.SHDSL Module. These LEDs are labeled as described in the Figure 3 and their functions are described below:

- **CD**: When this LED is in the solid GREEN state, it indicates that the G.SHDSL carrier has been detected by the DSP/Framer and that it is stable enough for ATM cell delineation to occur.
- **MR**: When this LED is in the solid GREEN state, it indicates that the G.SHDSL Module is loaded with software and the software is functioning correctly. If the LED is OFF, the G.SHDSL card is in reset state and cannot be used. Under normal conditions, the reset state is a transient state since the main system card will make an effort to get the G.SHDSL card up and running. The first step is to get software loaded. If the LED is in a FLASHING GREEN state, it means the G.SHDSL card is being loaded with software. This state should last less than 10s and be followed by the running state (solid GREEN LED).
- **WAN**: When this LED is in the GREEN state, it indicates data activity on the G.SHDSL interface. This LED is turned on for 0.5 seconds at 1 second intervals when data is sensed to be passing over the DSL connection.
- **LP**: When this LED is in the solid GREEN state, it indicates that the associated port is in a loopback condition. This applies to any loopback condition that is induced by local or far end maintenance procedures.

Environmental

The following environmental conditions are required:

- Operating temperature: (0° to 40°C)
- Operating humidity: 0% to 95% (non-condensing)
- Non-Operating Temperature: (-40 and 70°C)
- Non-Operating Humidity: 0% to 95% (non-condensing)

Alarms and Reports

The Alarms and Reports manual shows the alarms that are generated by the SHDSL port. Alarms are generated due to conditions that might arise on any one of a number of individual software modules on different hardware including those on the SHDSL Daughtercard. These alarms are identified by the prefix of SHDSL port numbers: **Example:** *SHDSL-1 -, SHDSL-2* - (for port number 1, 2 etc.). For more information, reference the *Alarms and Reports Manual* (Part Number T0005).
The alarms and traps database is also available on the web:

1) Access the web site: **http://www.vanguardms.com/support/**

2) Select Alarm Search

G.SHDSL Software

CPE and CO

When using release 6.4 and greater software, select the G.SHDSL daughtercard to operate as either:

- Customer Premise Equipment (CPE)
  (STU-R Device - the customer located modem)
- Central Office (CO) Device for back to back operation
  (STU-C Device- the DSLAM)

Term	*Definition*
STU-R	The Asymmetric Digital Subscriber Line (ADSL) Transceiver Unit located on the Remote terminal end.
STU-C	The Symmetric Digital Subscriber Line (SDSL) Transceiver Unit located on the Central Office (CO) end.

The maximum distance and data rates are:

- 2.312Mbps at 5,200 feet
- 1.544 Mbps at 6,400 feet
- 768 Kbps at 10,200 feet
- 384 Kbps at 13,800 feet
- 192 Kbps at 19,100 feet

Customer Premise Equipment (CPE)

You normally configure the G.SHDSL daughtercard to operate as a Customer Premise Equipment (CPE) device and connect it to a Central Office (CO) device (Digital Subscriber Line Access Multiplexer (DSLAM)). The connection to the DSLAM is usually made over copper twisted pair supplied by the DSL service provider. The G.SHDSL daughtercard is connected to the copper pair through an RJ45 connector that is shipped with the daughtercard.

Central Office (CO)

You may select the G.SHDSL daughtercard to operate as a Central Office (CO) device when operating in back to back mode with another CPE device. When the G.SHDSL daughtercard is in Central Office Mode, the G.SHDSL occupies the position of the Digital Subscriber Line Access Mulitplexer (DSLAM) device and connects to the Customer Premise Equipment (CPE).

Central Office (CO) DSLAM Limitations

Listed below are limitations to the support of the Central Office (CO) DSLAM role:

1) A configuration parameter sets the CO or CPE role.

2) The CO/CPE setting only varies the Q.994.2 protocol role, it does not imply anything else, for example: wetting current, span power, full EOC, remote loopback control over EOC, etc. are not supported.

3) Other configuration parameters will control other aspects of the CO/CPE role, most notable is selecting clock source.

4) Only allows back to back operation with other Vanguards with DSL interface or other vendors CPE, rather than providing full DSLAM control and functionality.

ATM Support

Asynchronous Transfer Mode (ATM) traffic is supported on the G.SHDSL interface. Dual Bearer Mode, which is TDM and ATM traffic together is not supported. The major ATM features of Vanguard G.SHDSL are:

- ATM Adaptation Layer 5 (AAL5)
- Virtual Connections (VCs)
- Queuing
- Shaping

AAL5

ATM Adaptation Layer 5 (AAL5) support is available for Voice over IP (VoIP) applications. The protocols supported over ATM are IPoA, PPPoA and PPPoEoA according to the following specifications:

- RFC 2684 (formally RFC 1483) Multiprotocol Encapsulation over ATM Adaptation Layer 5.
- RFC 2364 PPP over AAL5

Note

X.25 is supported over ATM via Frame Relay Service Termination (FRST) stations.

Virtual Connections

Virtual Connections (VCs) are Permanent Virtual Circuits (PVCs). The number of supported VCs over a single G.SHDSL link for the Vanguard 340, 340 Enhanced, 342, 6435 and 6455 is a maximum of 32.

Note

Switched Virtual Circuits (SVCs) are not supported.

Queuing

Queuing is supported on a per Virtual Connection (VC) basis.

Shaping

Shaping is supported on a per Virtual Connection (VC) basis. Shaping is available for the following traffic categories:

- Constant Bit Rate (CBR) - Traffic is shaped according to the configured value for Peak Cell Rate (PCR).
- Variable Bit Rate (VBR) - Traffic is shaped according to the configured values for PCR, Sustained Cell Rate (SCR) and Maximum Burst Size (MBS).
- Unspecified Bit Rate (UBR) - Traffic is not shaped. Traffic is sent whenever bandwidth is available.

Note

VBR real time (VBRrt) and VBR non-real time (VBRnrt) characteristics can be obtained by configuring a VBR virtual circuit (VCC) at a higher priority compared to other VCCs. The same effect is available for UBR traffic. When a single VCC is used to carry a mix of data and voice traffic, other methods of prioritization are available.

Note

MLPPP Multiclass can be used with Link Fragmentation Interleaving (LFI). For more information regarding LFI, refer to the Multilink PPP over Frame Relay (MLPoFR) Application section in the *Point-to-Point Protocol Manual* (Part Number T0106-08).

The ATM function is designed to shape VCC traffic at a configured rate set by the Peak Cell Rate (PCR) and Sustained Cell Rate (SCR), whichever apply for a given VCC. In some cases, there may be a mismatch between the configured rates and the available bandwidth on the physical line. This can happen for a number of reasons:

- **Error in configuration:** the sum of configured PCR/SCR rates actually exceeds the line rate. When most VCC are VBR and there is a high probability that not all VCC have the data they need to transmit at the same time. Overall this situation works without any noticeable degradation on a statistical basis, but occasionally bursts occur where the cell bandwidth demands exceed the line bandwidth and VCC will not get their expected rates. The frequency of this occurring depends on how oversubscribed the line bandwidth is and traffic burst statistics.
- **Line speed degradation:** in the case of DSL, unexpected conditions (usually in the outside plant wiring, such as exposure noise or exposure moisture) degrades the DSL communications to the point where a retraining is triggered. This may cause the CO and CPE to agree on a lower data rate than normal in order to obtain a good Signal to Noise Ration (SNR). If the configuration is designed to use close to all the bandwidth available for the unimpaired condition then in the degraded condition the sum of PCR and SCR will likely exceed the available bandwidth.

For each of the above conditions, the environment under which the ATM pacing occurs is virtually the same. The required data cell rate may occasionally exceed the line bandwidth. In this case it is not desirable to shut down any individual VCC (for example, not allow it to pass data). Instead, the behavior of the pacing mechanism in ATM is to slow down cell transmission on all VCC's. Under these conditions, the VCC are statistically given a chance to transmit cells. The transmission is roughly proportional to their PCR, SCR and their priority but there are no guarantees of minimum throughput or any precise throughput number for any individual VCC.

The policy of moderating the cell rate for VCCs and keeping them active in the above conditions is a uniform way to treat the condition for whatever reason arises. If required, the node buffers data whenever this condition occurs due to traffic burst. Only when all available buffer resources are exhausted, or when defined discard thresholds are reached, should the node discard data. The operating software reports alarms and statistics update should occur when this condition happens.

Quality of Service (QoS)

For more information on Quality of Service (QoS), reference the *Quality of Service (QoS) Manual* (Part Number T0100-10).

Applications

DSL Solution

The Vanguard G.SHDSL Daughtercard is part of the Vanguard solution. Figure 4 shows an application involving a Vanguard 340 Enhanced at the remote site (SHDSL/ATM) and a Vanguard 7300 at the central site (T3/ATM). This arrangement could represent a migration of an existing network that uses Frame Rely attached remote devices (the devices migrate to DSL attached). This does not require IP or PPP, but rather carries the Annex-G or X.25 protocol layers which data and voice applications use in the Frame Relay context.

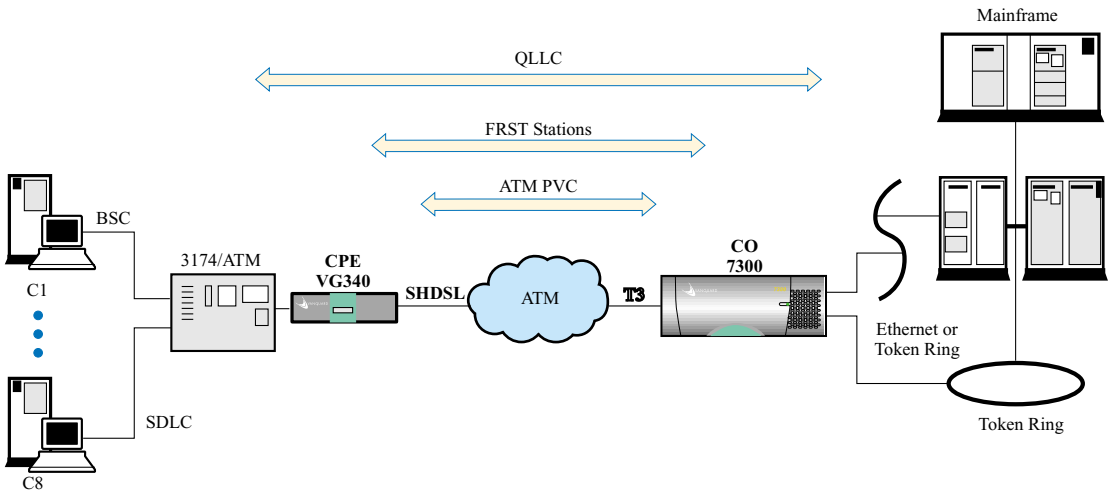

Figure 4. Vanguard Migration to DSL

In the Frame Relay context, the remote data was passing into the Frame Relay network via Annex-G Frame Relay. The network provides Frame Relay ATM Interworking, transparent FRF.8, so that the central Vanguard 7300 receives the data as Annex-G over ATM. This can be done by configuring Frame Relay Service Termination (FRST) in the central Vanguard 7300 to operate over an ATM station. When migrating to DSL, the remote encapsulation must be changed to allow the same traffic over ATM, namely FRST must be used at the remote Vanguard 340.

Note

For more information on connection to the FRST Module, reference the *T3 ATM Manual* (Part Number T0100-12).

When connecting the WAN Adapter (LCON) to an ATM Station (AAM Station-> ATM VCC) you can configure the WAN Adapter LCON to use one of the following encapsulations:

- 1483 - This is standard encapsulation for ATM, used especially if interconnecting to Third Party equipment.
- 1490 - This is standard frame relay encapsulation, used especially if the far end is a Frame Relay (FR) link and the network is providing FR-ATM IWF (FRF.8) transparent mode (= mode where network does not translate between 1483 and 1490).

- VC Muxing - There is no encapsulation, IP, IXP, bridge traffic, for example are separated on different VCCs as a means of identifying traffic type. This is not common, but it can be used if you are trying to use the line as efficiently as possible (no encapsulation overhead).

AAM Station Connections

Other connections below include:

- **A direct connection to another station within the node**: if the station is AAM, you have ATM VCC to ATM VCC switching; if the other station is FRI you have ATM-FR interworking (transparent mode only).
- **Frame Relay Service Termination (FRST) channel**: In this case the far end is a FRI station. The FRI station could be Annex G. It could also be doing FR segmentation (proprietary MSP or FRF.12 end to end) that is not terminated in the network provided IWF. You can think of the FRST as sitting on top of the AAM station and providing enhancements that allow the circuit to work with a far end FRI station where the far end station is doing something the network cannot convert or handle. For example, no IWF I know of will handle (terminate) Annex G so set up the IWF in transparent mode so that Annex G passes end to end and have the FRST terminate the Annex G at the ATM end.
- **PPP MLPPP and PPPoE**: Defines a PPP (MLPPP Bundle, PPPoE) to use an AAM station and you connect the two together much like an LCON to an AAM station.

PPP Support over DSL

The connection to the SHDSL network can be carried out using the method described in Figure 5:

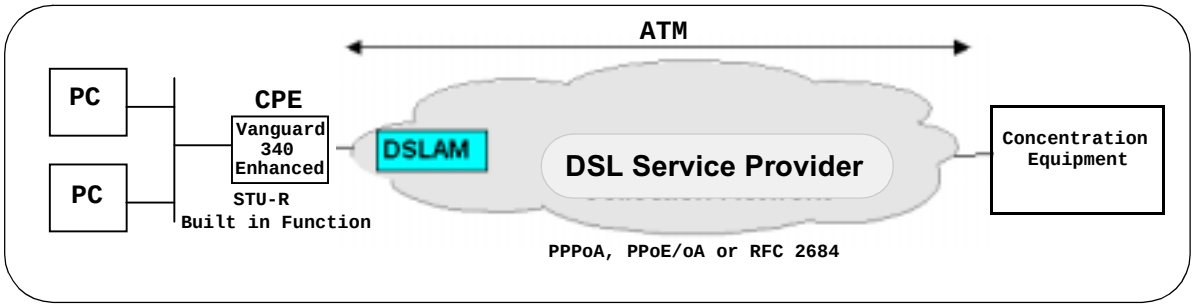

Figure 5. PPP Support over DSL

The Customer Premise Equipment (CPE) directly integrates the SHDSL modem function.

Note

Availability of the RFC 2364 (protocol PPP over AAL5) and RFC 2684 (formally RFC 1483) are required for this configuration. PPPoA, PPPoE/oA, and RFC 2684 are required for the IP flow encapsulation.

PPPoE Bridging with Internal DSL

A Vanguard router with an installed G.SHDSL daughtercard is used as a replacement for a stand-alone DSL modem. The PCs connected to the local network establish independent PPPoE sessions to the SMS.

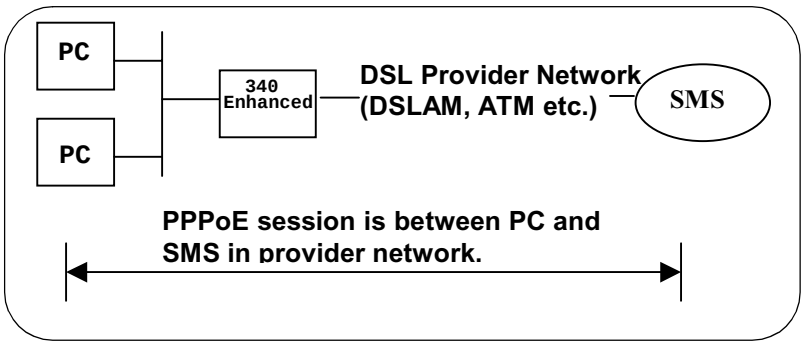

Figure 6. PPPoE Network Support General Layout

In the configuration example above, the Vanguard 340 Enhanced is functioning as a simple transparent bridge.

Note

It is assumed that all devices on the local network side must support PPPoE.

PPPoE Network

Figure 7 below illustrates the networking example for this application:

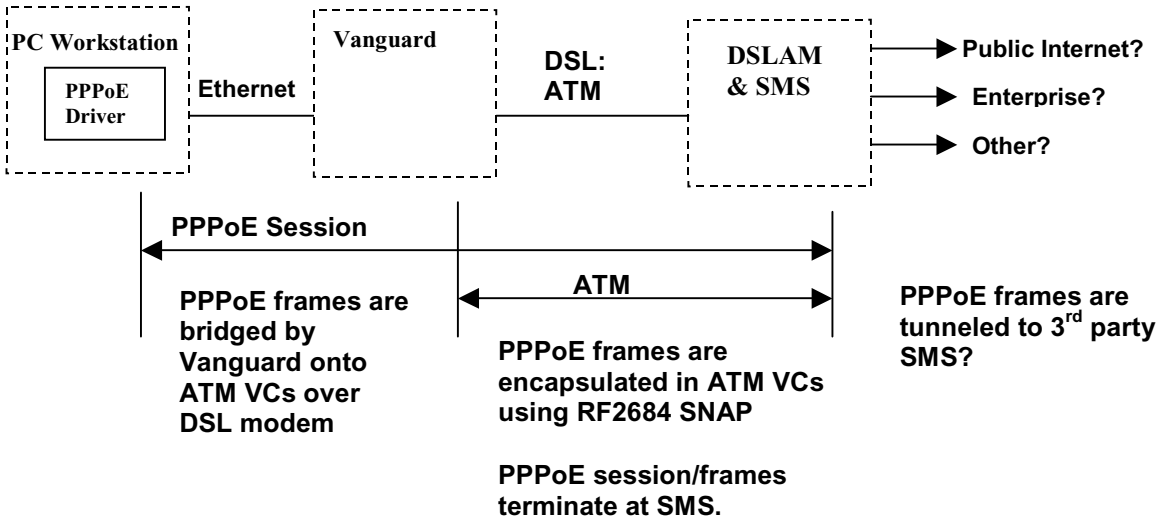

Figure 7. PPPoE Network Example

PPPoE Traffic Flow

The PPPoE traffic flow example is shown below:

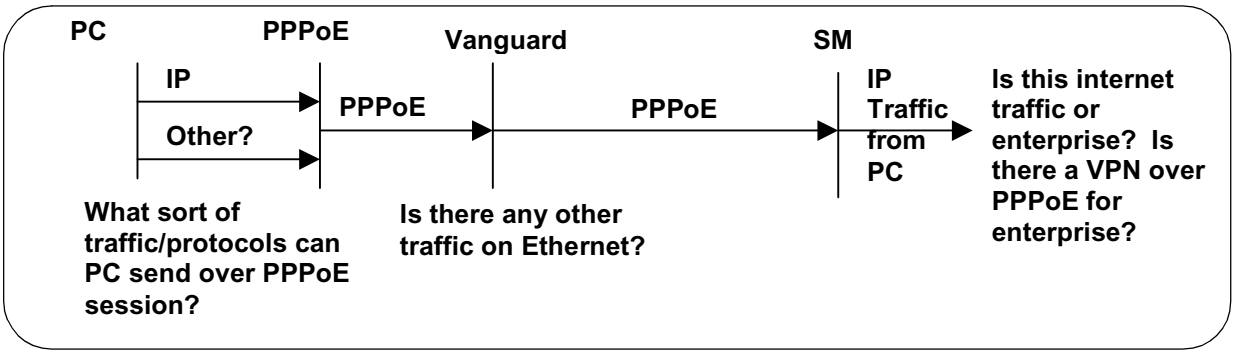

Figure 8. PPPoE Traffic Flow Example

IP Address assignment is typically done dynamically per PPPoE session. The transparent bridging floods the initial PPPoE service requests to all bridge links (sent with broadcast MAC address) and learns the MAC address of the SMS when the response comes back from the SMS. The PPPoE selects the SMS it wants to use for the session and binds to it based on MAC address and session ID. All subsequent packets sent for that session are sent to the MAC address of the selected SMS. The transparent bridging will have learned which link is associated with the SMS MAC address.

PPPoE Bridging Configuration

Figure 9 below illustrates a PPPoE Bridging configuration. In this example two (2) ATM Virtual Connections over the DSL modem are defined.

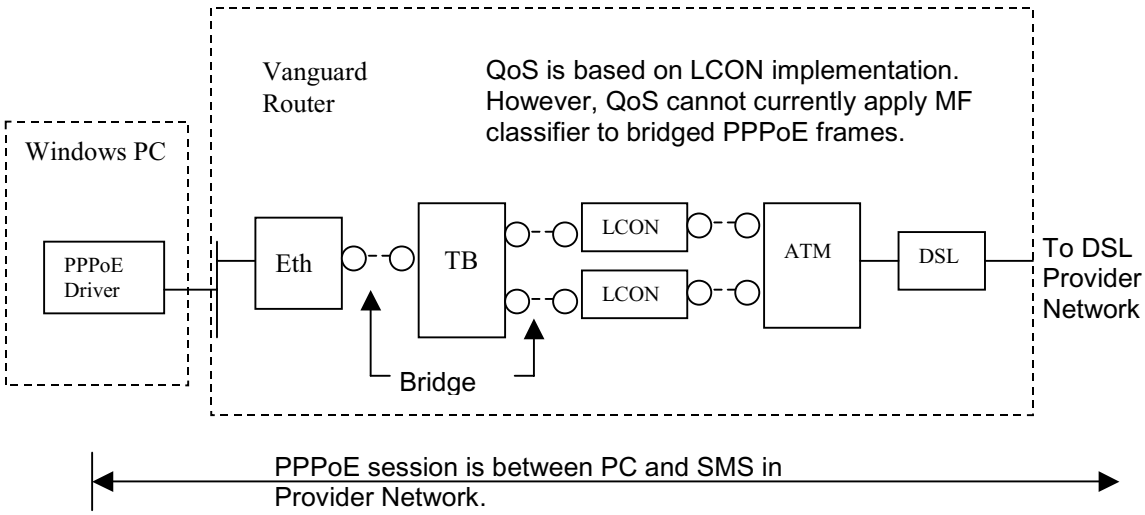

Figure 9. PPPoE Bridging Configuration

Port Boot

Port Initialization and Port Boot

Port boot for the G.SHDSL port is provided. A port boot restarts the DSL port with the current CMEM configuration for the DSL port.

Node Boot Elimination

A node boot will not be required to change any SHDSL port parameter. The SHDSL hardware is tied directly to the port type. The node management cannot re-configure the port type to anything other than SHDSL.

- If a valid CMEM record is not found which corresponds to the presence of SHDSL daughtercard, one will be created based on the default values given in the port configuration table.
- If another CMEM record of a different port type is found for a SHDSL port, the record is ignored (not deleted from CMEM).

A CMEM record for a SHDSL port can be configured for an empty daughtercard slot. The running port type is NULL. Booting the SHDSL port does not affect the running configuration of the AAM port and stations that are using the SHDSL port. Booting the AAM port does not have an effect on the running configuration of the SHDSL port.

Port Disable/ Enable

The SHDSL port supports port enable and disable commands, as required by all software ports. The state of the port can survive a node boot. A disabled port cannot accept a port boot. The enable/disable state of the SHDSL port does not effect the enable/disable state of the AAM port. The enable/disable state of the AAM port does not effect the enable/disable state of the SHDSL port. When the SHDSL port is disabled, the AAM port reports its state as disconnected from the line and gives the cause.

Port Control

When loopback is selected, outbound data is looped back toward the node before it reaches the DSL line. (Loopback is in the form of analog Loopback.) The DSL line is not loopbacked. To control loopbacks, access the Diagnostics Menu.

Software Migration

When using nodes prior to Release 6.4, proper operation of the node with SHDSL daughtercard (DC) hardware does not require the installation of a new bootprom image for the motherboard (MB). The software image needed is stored on the daughtercard's on-board flash. This software may require updating from time to time. A copy of the up-to-date daughtercard software is kept in the motherboard on-board flash. When the node starts up from power up or cold boot, the motherboard will determine whether the software in the daughtercard is absent or whether it needs to be updated. The motherboard downloads a copy of the software to the daughtercard. The daughtercard stores the image in on-board flash when the download is finished. The node continues to boot up and the daughtercard uses the newly downloaded software. If the software in the daughtercard on-board flash is present and up to date, the download procedure is skipped. The daughtercard uses the software that is in its on-board flash.

Power Up and Recovery

The power-up sequence for the G.SHDSL Module is listed below:

1) The G.SHDSL Module receives power and the local processor loads a boot image from the on-board flash device located on the G.SHDSL Module.

2) This boot image configures the registers of the local processor and runs the local diagnostics software.

3) Upon completion of the diagnostics software, a message is sent to the system host identifying the results of the diagnostics.

4) If the diagnostics are successful, the system host checks whether the software on the GSHDSL daughtercard needs to be updated. If an update is required it is downloaded to the G.SHDSL daughtercard and stored in that module's on-board flash.

5) The G.SHDSL Module will then run this run-time software.

The hardware is designed to have enough local on-board flash memory to accept a full run-time image, including diagnostics. The G.SHDSL Module has enough local SDRAM to store the uncompressed run-time software, along with any necessary buffers, etc.

Note

A minimum of 32 MBytes of SDRAM and 4 MBytes of on-board flash memory is provided on the G.SHDSL Module.

Configuration

Introduction

You can configure the SHDSL port for either CO or CPE operation. This configuration allows nodes to be connected back-to-back and to operate properly. Some restrictions are listed below:

- The Operational Mode should be set to CO on one side and CPE on the other. (The default is CPE).
- The Maximum Line Rate should be set the same on both sides in a Bitrate Mode. (Not necessary in an Adaptive Mode).
- The parameter Network Timing Recovery must be set to INT on CO and REC on CPE.

When placed in back-to-back operation there is also a Release 6.4 restriction on the configuration of the protocol stack operating above the DSL level (due to the PPPoE stack not supporting server side operations).

To pass data between back-to-back nodes:

1) Another node that supports PPPoE server side operation must be used.

2) The protocol stack should not contain “over Ethernet” (oE).

Usable stacks include PPPoATMoDSL and IPoATMoDSL. For back-to-back operation, any protocol which can be configured to run over ATM should be able to run over ATM over DSL. Additional stacks include FRSToATMoDSL and ATMoDSL stations connected to other ATMoDSL stations (but not ATM T1/E1), and ATMoDSL stations connected to FR stations on other ports.

Error messages and indicators

Error messages and indicators are available in three forms: LEDs, CTP messages on the G.SHDSL Module, and messages sent from the G.SHDSL Module to the motherboard processor.

G.SHDSL Module CTP Messages

Messages from the G.SHDSL Module to its CTP port are those generated by the local processor. The CTP will not be available to the customer and therefore no connector is available on the rear panel. The G.SHDSL Module includes a location that a connector can be soldered. This connector provides access to the local processor CTP and can be used for both development and lab-based debugging.

G.SHDSL Module to Motherboard Messages

Messages between the G.SHDSL Module and motherboard are passed along the Serial HDLC link between the Module and the Motherboard.

Configuration Parameters

The SHDSL port configuration is a port type which includes the following parameters:

Port Type

Range:	SHDSL
Default:	SHDSL
Description:	DSL port type is SHDSL.

Operational Mode

Range:	CPE, CO
Default:	CPE
Description:	This parameter specifies whether the SHDSL port operates in Central Office (CO) mode or Customer Premise Equipment (CPE) mode.

Bitrate Mode

Range:	ADAPTIVE, FIXED
Default:	ADAPTIVE
Description:	This parameter determines whether the transceiver uses a fixed bit rate or rate adapts during startup.

Annex Type

Range:	A, B, B_ANFP, AB, AB_ANFP
Default:	A
Description:	This parameter specifies current G.991.2 standard used (G.SHDSL). • A - Enable Annex A support • B - Enable Annex B support • B_ANFP - Enable Annex B support with Access Network Frequency Plan Power Spectral Density mask • AB - Enable Annex A & Annex B • AB_ANFP - Enable Annex A & Annex B with Access Network Frequency Plan Power Spectral Density mask"

Maximum Line Rate (kbps)

Range:	200, 264, 328, 392, 456, 520, 584, 648, 712, 776, 840, 904, 968, 1032, 1096, 1160, 1224, 1288, 1352, 1416, 1480, 1544, 1608, 1672, 1736, 1800, 1864, 1928, 1992, 2056, 2120, 2184, 2248, 2312, 2320 **Note** Use one of the decimal numbers above.
Default:	2320
Description:	This parameter is used to specify the maximum DSL line bit rate used for Adaptive and Fixed Bit Rate Modes.

Minimum Line Rate (kbps)

Range:	200, 264, 328, 392, 456, 520, 584, 648, 712, 776, 840, 904, 968, 1032, 1096, 1160, 1224, 1288, 1352, 1416, 1480, 1544, 1608, 1672, 1736, 1800, 1864, 1928, 1992, 2056, 2120, 2184, 2248, 2312, 2320 **Note** Use one of the decimal numbers above.
Default:	200
Description:	This parameter is used to specify the minimum DSL line bit rate used for Adaptive Bit Rate Mode.

Startup Initiator

Range:	CPE, CO
Default:	CPE
Description:	This parameter determines whether the CPE or CO device initiates a startup. • Customer Premise Equipment (CPE) - The CPE is responsible for initiating the link activation. If this port is configured in CPE role, it initiates activation (otherwise it waits for the other end to do so). • Central Office (CO) - the CO is responsible for initiating the link activation. If this port is configured in CO role, it initiates activation (otherwise it waits for the other end to do so).

Network Timing Recovery

Range:	INT, REC
Default:	REC
Description:	This parameter specifies how the transceiver performs network timing recovery. INT - No Network Timing Recovery. Timing is generated internally. REC - The transceiver receives its timing from the Network. It accepts the 8000Hz (+-100ppm) clock from the Network

Decoder Coefficient - A

Range:	0 to 20978151
Default:	366
Description:	This parameter specifies “Decoder Coefficient A” as defined in the G.991.2 standard (G.SHDSL standard).

Decoder Coefficient - B

Range:	0 to 2097151
Default:	817
Description:	This parameter specifies “Decoder Coefficient B” as defined in the G.991.2 standard (G.SHDSL standard).

RX Upstream Frame Sync

Range:	0 to 16383
Default:	13727
Description:	This parameter selects a 14-bit frame sync word (FSW). The default FSW is taken from the G.991.2 standard.

Power Backoff

Range:	Disable, Enable
Default:	Enable
Description:	This parameter specifies whether transmit power backoff is used at the device at the other end of the DSL line. • Disable - Disable the remote transmit power backoff • Enable - Enables the remote transmit power backoff **Note** This value adjusts the level of the PSD Mask at the output of the G.SHDSL device.

Power Scale

Range:	0 to 65534
Default:	26112
Description:	This parameter is used to adjust power in small increments (fractions of a dB) to compensate fro minor differences in power between testing units. Power Scale Formula: Change in TX Power = 20 x LOG (Power Scale Value / 26112) Examples: • If Power Scale Value = 26112, then the change in TX power = 0dB • If Power Scale Value = 25226, then the change in TX power = -0.3dB

Current Margin (dB)

Range:	-10, -9, -8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 (Use one of these decimal numbers)
Default:	0
Description:	This parameter indicates the minimum desired target margin (in dB) for the local line conditions during the startup sequence.

Self-Next Margin (dB)

Range:	-10, -9, -8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 (Use one of these decimal numbers)
Default:	0
Description:	This parameter indicates the minimum desired target margin (in dB) with a worst case self-NEXT noise model (49 disturbers), given the current loop insertion loss.

RX Upstream Stuff Bits

Range:	0 to 100
Default:	16
Description:	This is the number of stuff bits inserted into the SLDSL frame in the upstream direction.

RX Downstream Stuff Bits

Range:	0 to 100
Default:	16
Description:	This is the number of stuff bits inserted into the SLDSL frame in the downstream direction.

Test Mode

Range:	NONE, COMPLIANCE
Default:	NONE
Description:	This parameter specifies testing. It is for internal use only. • NONE - select this for normal operation • COMPLIANCE - selected for internal testing where LOC is not indicated if the DSL cable is unplugged

Maximum Data Subrate Multiplier

Range:	0, 1, 2, 3, 4, 5, 6, 7 (Use one of these decimal numbers)
Default:	0
Description:	This parameter is prompted for only if the Test Mode parameter is in COMPLIANCE. This parameter is used to specify the maximum data subrate. It is the value of "I" for the formula below. **Rate Formula:** Data Rate = Nx64 + 8xI + 8 (See also BASERATE MIN/MAX Parameters for "N" values)

Minimum Data Subrate Multiplier

Range:	0, 1, 2, 3, 4, 5, 6, 7 (Use one of these decimal numbers)
Default:	0
Description:	This parameter is prompted for only if the Test Mode parameter is in COMPLIANCE. This parameter is used to specify the minimum data subrate. It is the value of "I" for the formula below. Rate Formula: Data Rate = Nx64 + 8xI + 8 (See also BASERATE MIN/MAX Parameters for "N" values)

Statistics

Introduction

Statistics provided by the G.SHDSL daughtercard. A typical SHDSL port statistic page is shown below:

```
Node: CO        Address: 100                Date:  9-DEC-2003  Time: 11:30:00
 Detailed SHDSL Port Statistics: Port 1                      Page:  1 of  2

Port Type: SHDSL              Loopback:    None         Port Status: Enable

mSW Revision:      V6.4P01A (8-Dec-2003 19:25:29)        HW Revision: A
Transceiver Mode:   CO         Line Rate: 2320Kbps      Carrier:     Present
Startup Initiator:  CPE        Annex: A                 Frame Sync:  IN SYNC
Operational State:  Data

Physical Summary:
  Carrier Losses:         0            Cell Delineation Losses:   0
  CRC Errors:             0            Transmit Power:             7.5 dB
  OOS Errors:             0            Signal to Noise Ratio:     38.76dB
  SEGA Indications:       0            Loop Attenuation:           0.0 dB
  LOSW Conditions:        0            Receiver Gain:              5.6 dB

Last Handshake Status:  FRAME_OK+MSG_STATUS=3+SESSION_TXED_MS
Last Retrain Reason:    No Retrain
Last Failed Status:     No_Failed_Status
```

Figure 10. SHDSL Port Statistics

The display of port statistics shows the standard set of 6.4 and greater software statistics (port number, time of last reset, etc.). For the DSL specific statistics, the following definitions and values apply to the port statistics:

Note

The determination of db statistics requires the calculation of a floating point log value from binary integers supplied by the Globespan DSL chipset. These calculations are performed so that the error introduced by numerical methods does not exceed +- 0.1 db. The displayed value includes one decimal digit (e.g. 25.7 db).

DSL Port Statistics

Term	*Value*	*Description*
Transceiver Mode	CPE, CO	CPE - the port is configured and running in the CPE mode CO- the port is configured and running in the CO mode
Line Rate	0 or the integer in the range of: 200 to 2,320,000	This is the current data rate for the DSL line. The rate can be either fixed configuration or adapted during the process of line activation.A value of 0 means the adaptive value is not determined due to line not in service or other impairment.

DSL Port Statistics

Term	Value	Description
Carrier	Present, Lost	The current state of the DSL line signal.
Startup Initiator	CPE, CO	This is the configured value for the Startup initiator. If the Transceiver Mode parameter matches this parameter, then this port is the initiator
Annex	A, B, B_ANFP, AB, AB_ANFP	Access Network Freq Plan PSD mask 4.1.19.
Frame Sync	IN SYNC, OOS	
Operational State	Idle, Data, Standby, Bootup Load, Bootup Done, Handshaking, Silence Mode, Training, Frame Sync, Action Gear, Hybrid Test, CL Test, DL Test, Tx Spectrum, DownLoad Test, PSD Test, Data LL Test, I/F LB Test	Idle - Data - the DSL port is in data passing mode Standby - Bootup Load - the DSL adapter is being loaded with software. This is a temporary condition that transitions to Bootup Done state Bootup Done - the DSL adapter has been loaded with software. This is a temporary condition that transition to the next operational state. The next state is configuration dependent. Handshaking - The line is being activated according to Q.994 procedures. Silence Mode, Training, Frame Sync, Action Gear, Hybrid Test, CL Test, DL Test, Tx Spectrum, DownLoad Test, PSD Test, Data LL Test, I/F LB Test.
Carrier Losses	32 bit integer	Total number of times the DSL line carrier has been lost.
CRC Errors	32 bit integer	Total number of times data frames on the DSL line have failed CRC.
OOS Errors	32 bit integer	Total number of times the DSL line has failed its CRC.
Sega Errors	32 bit integer	
Cell Deliniation Losses	32 bit integer	Count of number of Cell Deliniation failures have been indicated by the indications received by the local DSL transceiver
Transmit Power	Integer in the range -127 to +127	
Mean Square Error		
LOSW Errors	32 bit integer	Count of number of LOSW indications received by the local ATM PHY layer operating above the DSL transceiver.
Detailed Handshake Status	Frame_OK+MSG_OK+Session_OK	This indicates the handshake status.
Last Retrain Reason	Signal to Noise Ratio (SNR), Excessive CRC, Excessive OOS, No Retrain	If DSL line has required one of more retrain sequences since its last normal activation, then the reason for the last retraining is given by this statistic: Signal to Noise Ratio (SNR) Excessive CRC Excessive OOS No Retrain - the DSL line has required a retraining since last normal activation.

DSL Port Statistics

Term	Value	Description
Carrier	Present, Lost	The current state of the DSL line signal.
Startup Initiator	CPE, CO	This is the configured value for the Startup initiator. If the Transceiver Mode parameter matches this parameter, then this port is the initiator
Annex	A, B, B_ANFP, AB, AB_ANFP	Access Network Freq Plan PSD mask 4.1.19.
Frame Sync	IN SYNC, OOS	
Operational State	Idle, Data, Standby, Bootup Load, Bootup Done, Handshaking, Silence Mode, Training, Frame Sync, Action Gear, Hybrid Test, CL Test, DL Test, Tx Spectrum, DownLoad Test, PSD Test, Data LL Test, I/F LB Test	Idle - Data - the DSL port is in data passing mode Standby - Bootup Load - the DSL adapter is being loaded with software. This is a temporary condition that transitions to Bootup Done state Bootup Done - the DSL adapter has been loaded with software. This is a temporary condition that transition to the next operational state. The next state is configuration dependent. Handshaking - The line is being activated according to Q.994 procedures. Silence Mode, Training, Frame Sync, Action Gear, Hybrid Test, CL Test, DL Test, Tx Spectrum, DownLoad Test, PSD Test, Data LL Test, I/F LB Test.
Carrier Losses	32 bit integer	Total number of times the DSL line carrier has been lost.
CRC Errors	32 bit integer	Total number of times data frames on the DSL line have failed CRC.
OOS Errors	32 bit integer	Total number of times the DSL line has failed its CRC.
Sega Errors	32 bit integer	
Cell Deliniation Losses	32 bit integer	Count of number of Cell Deliniation failures have been indicated by the indications received by the local DSL transceiver
Transmit Power	Integer in the range -127 to +127	
Mean Square Error		
LOSW Errors	32 bit integer	Count of number of LOSW indications received by the local ATM PHY layer operating above the DSL transceiver.
Detailed Handshake Status	Frame_OK+MSG_OK+Session_OK	This indicates the handshake status.
Last Retrain Reason	Signal to Noise Ratio (SNR), Excessive CRC, Excessive OOS, No Retrain	If DSL line has required one of more retrain sequences since its last normal activation, then the reason for the last retraining is given by this statistic: Signal to Noise Ratio (SNR) Excessive CRC Excessive OOS No Retrain - the DSL line has required a retraining since last normal activation.

DSL Port Statistics

Term	Value	Description
Last Failed Status	No_Failed_Status HS_PREACTIVATION HS_ACTIVATION CHECK_BITRATE_CAPABILITY PMMS_CHECK_COMMON_RATE CO_RX_AR CO_TX_BC CO_WAIT_4_ARP CO_TX_BCP CO_SC_STARTED CP_TX_AR CP_RX_BC CP_TX_ARP CP_CR_STARTED CP_SR_STARTED CO_LINE_AGC CP_LINE_AGC FD_EC_TRAINING EQU_TRAINING TNR_DETECTED CO_TX_TC CO_RX_TR CO_TX_FC1 CO_TX_FC2 CP_RX_TC CP_TX_TR CP_RX_FC	Last Failed Status indicates the status of failed startup.

Debug

Introduction

The implementation of the G.SHDSL Module includes a special port which is designed to pass data between system card and daughtercard. This special port will be re-used for other intelligent daughtercards. The name of this special board interchange facility is the Daughtercard Communications Module (DCCM). A Debug Menu is included that can be used to examine and control the daughtercard.

Debug Menu

The item in the Debug menu for the special facility is DCCM Debug. When this item is chosen, the following items are displayed:
Main Menu->Debug->DCCM Debug

```
Node: Nodename Address:  (blank) Date: 10-22-2003  Time 6:09:04
Menu: DCCM Debug                                 Path: (Main.18.26)

1. DCCM Status
2. Detailed Port Stats
3. Reset DCCM Stats
4. Reset Daughtercard



#Enter Selection
```

Figure 11. DCCM Debug Menu

DCCM Status

DCCM Status is used to display all the DCCM instances that are currently running on the node, together with their status. There should be one instance per Daughtercard (DC) installed. Figure 12 displays the status:

```
      Daughtercard Communication Module Status

Port#        Card Type    Card Status         Last Event
-------------------------------------------------------------
2            SHDSL_A      Functioning         No Events Occurred


 Press any key to continue ( ESC to exit )...
```

Figure 12. Daughtercard Communication Module Status

Screen Terms

The debug screen terms are as follows:

Daughtercard Status and Statistics Variables

Screen Term	Value	Description
Port #	Same as port number for the DC G.SHDSL port.	The instance of the DCCM is referred to as a port with a port number. The port number is the same as the physical port on the DC. Typical values: • 1, 2 for 300 series routers • 7, 10, 13 for 6400 series routers.
Card Type	SHDSL_A	In general, this will be the board type followed by underscore followed by hardware revision. Currently SHDSL is the only card type to use DCCM and it is at revision A. Thus SHDSL_A is the only value that should be seen at release 6.4. If another revision for the G.SHDSL Module is produced, it will be shown as SHDSL_B, and so forth.
Card Status	Functioning R1:Notify R2:In Reset R3:Running R4:HW Config R5:Ready Wait R6:SW Config, Unknown	The system card constantly monitors the DC to see that it is responding to keep alives and routine message exchanges. Functioning - the DC is running normally. R1 - R6 : - the DC is being recovered from a non-functioning state
Last Event	No Events Occurred (Date and Time)	This is the most recent failure event that has to do with the DC status. A normal event such as loading code is not reported.No Events Occurred - from last node restart<date and time> date and time of the last event.

Figure 13 shows the detailed DCCM port statistics.

```
Detailed DCCM Port Statistics                                    Page: 1 of 2

Port Number: 2    Card Type: SHDSL_A        Card Status:Functioning
mONS Revision:    Vdc_shdsl (28-Oct-2003 09:53:27)

Local DCCM Summary:
RX Bytes:         6205     RX Packets:      5066     RX Sanity Packets: 5019
TX Bytes:         1701     TX Packets:      49       TX Queue Overflow:  0

Undefined Calls:
Remote:  0        EIA:     1        L1:      2

Remote DCCM Summary: (Last Update at 28-Oct-2003 11:43:27)
RX Bytes:         1701     RX Packets:      49       RX Sanity Packets: 5019
TX Bytes:         6128     TX Packets:      5065     TX Queue Overflow:  0

Undefined Calls:
Remote:  1        EIA:     1        L1:      2

Physical Summary:
TX Underrun:      0        RX Overrun:      0        RX CRC:           0
RX Parity:        0        RX Framing:      0        RX Drops:         0

Press any key to continue ( ESC to exit )...
```

Figure 13. Detailed DCCM Port Statistics

Daughtercard Status and Statistics Variables

Screen Term	Value	Description
Port #	Same as port number for the DC G.SHDSL port.	The instance of the DCCM is referred to as a port with a port number. The port number is the same as the physical port on the DC. Typical values: • 1, 2 for 300 series routers • 7, 10, 13 for 6400 series routers.
Card Type	SHDSL_A	In general, this will be the board type followed by underscore followed by hardware revision. Currently SHDSL is the only card type to use DCCM and it is at revision A. Thus SHDSL_A is the only value that should be seen at release 6.4. If another revision for the G.SHDSL Module is produced, it will be shown as SHDSL_B, and so forth.
Card Status	Functioning R1:Notify R2:In Reset R3:Running R4:HW Config R5:Ready Wait R6:SW Config, Unknown	The system card constantly monitors the DC to see that it is responding to keep alives and routine message exchanges. Functioning - the DC is running normally. R1 - R6 : - the DC is being recovered from a non-functioning state
Software Revision	String	Set to current version of software running on the daughtercard.
Local DCCM Summary		These statistics are calculated by the system card.
RX, TX Bytes	32 bit integer	Count of the number of bytes sent and received by the system card.
RX, TX Packets	32 bit integer	Count of the number of bytes sent and received by the system card.
Undefined calls		
EIA		
L1		
Remote DCCM Summary		These statistics are calculated by the daughtercard and reported to the system card.
Physical Summary TX Underrun RX Overrun RX CRC RX Parity RX Framing RX Drops		These are statistical counters of errors that occur on the DCCM Communications Link

Reset Statistics

The Reset Statistics Menu item resets the status and statistics reported in the DCCM Status and Detailed Port Statistics menus. When this item is selected the CTP will prompt for a port number. The port number entered must be a running DCCM port, (one presented in the DCCM status display).

Reset Daughtercard

The Reset Daughtercard item resets the daughtercard corresponding to a DCCM port. When this item is selected the CTP warns the user as follows, to allow a successful exit from the action:
WARNING. . . Data Loss May Occur. Proceed? (y/n): y
If the action proceeds, the CTP will prompt for a port number. The port number entered must be a running DCCM port (one presented in the DCCM status display).

DCCM Alarms

The alarms and reports generated by the Daughtercard Communications Module (DCCM, DCCM-%d) can be found in the *Alarms and Reports Manual*. For additional information, reference the *Alarms and Reports Manual* (Part Number T0005), or access the following web site: **http://www.vanguardms.com/support/**. Select Alarm Search.

Performance Requirements

The G.SHDSL module is designed to minimize impact on the motherboard processor. The majority of the packet processing is used on the G.SHDSL module. A high speed serial link is used between the system card (motherboard) and the G.SHDSL daughtercard module. The link passes control and data messages between the system card and the daughtercard. Due to existing limitation of the hardware design, the serial link is limited in its speed depending on the hardware platform it is used on:

Hardware Serial Link Speed

Vanguard Platform	*Link Speed (Mbps)*
34x Series	8.192
6435 and 6455	2.048

The link speed of the serial line can be less than or greater than the DSL Link speed. Furthermore, the outbound speed can also be in excess of the allowed rate of transmission of the ATM VCCs involved in the data flow on account of respecting Peak Cell Rate (PCR) or Sustained Cell Rate (SCR) traffic parameters. This speed mismatch is mitigated by the large memory available on the daughtercard. It is unlikely, but ultimately this memory can be used up and the ATM module on the daughtercard could be forced to discard data, either upstream or downstream. Proper statistical updates in the ATM Port and stations statistics indicate this occurrence. The customer can correct this situation by sizing the ATM VCC traffic parameters to match the expected data flows correctly.

Node Boot Time

G.SHDSL card Startup diagnostics FBIST has a duration of about thirty seconds if the daughtercard's image is all right and there is no need to load software to the daughtercard. If the daughtercard needs to be downloaded with software, this will take approximately an additional fifty seconds. the daughtercard can only be downloaded one at a time so that if two daughtercards are in the node, they each take the additional fifty seconds.

Embedded Operations Channel (EOC) Support

Introduction

The Embedded Operations Channel (EOC) is a part of the G.991.2 (G.SHDSL) standard.
The EOC is used for both interoperability and for manageability. SHDSL DSLAM, CPE and repeaters communicate through this channel. Since the SHDSL implementation operate as both a CPE and as a CO, providing EOC functionality requires both generating and responding to EOC request messages.

- The 6.4 Release of SHDSL will not support the generation of message that are option for the CPE role. For both the CO and CPE role, those messages that are beyond the needs listed here are for future releases.
- The CPE will hold the EOC state = off-line until probed by any request message, including Discovery request.
- The CO implementation implements a six second timer and five tries count to wait for responses to request that are sent. For the discovery probes, the six second timer is for receiving the response from the CPE.

Transceiver Modes

When the SHDSL port is configured to operate in:

- **Transceiver Mode = CPE**, Responds to EOC messages to the extent they are implemented.
- **Transceiver Mode = CO**, Responds to EOC messages to the extent they are implemented, only if parameter Remote EOC = ENABLED.

Diagnostics

The figure below shows how to access the SHDSL Diagnostics Menu:
Main->Diagnostics->SHDSL Diagnostics

```
Node: CO        Address: 100                Date:  9-DEC-2003  Time: 11:36
Menu: Diagnostics                           Path: (Main.12)

  1.  Local Loopback                    19.  ATM Ping
  2.  V.54 Loopback 2                   20.  Multiple Ping
  3.  V.54 Loopback 3                   21.  DHCP Client
  4.  Fatal Error Reports               22.  SHDSL Diagnostics
  5.  Logged Alarms
  6.  Startup Diagnostics
  7.  Display DRAM Code Errors
  8.  Display User Configuration Logs
  9.  VLAN Diagnostics
 10.  Start Delay Measurement
 11.  Stop Delay Measurement
 12.  Display Delay Summary
 13.  IP Ping
 14.  Traceroute
 15.  Telnet
 16.  ISDN Packet Viewer
 17.  Start T1/E1 Remote Loopback
 18.  Stop T1/E1 Remote Loopback

#Enter Selection: 22
```

Figure 14. Diagnostics

SHDSL Diagnostics

Figure 15 shows the SHDSL Diagnostic Menu.

```
Node: CO        Address: 100                Date:  9-DEC-2003  Time: 11:36:
Menu: SHDSL Diagnostics                     Path: (Main.12.22)

  1.  EOC Discovery Invocation
  2.  EOC Inventory Invocation
  3.  EOC Status Invocation
  4.  EOC Configuration Invocation
  5.  EOC Discovery Last Result
  6.  EOC Inventory Last Result
```

Figure 15. SHDSL Diagnostics Menu

Note

The complete Vanguard supported EOC Message Set information is available with Release 6.4 and greater software.

EOC Message Set ITU-T

The following table has been take from the International Telecommunication Union (ITU) G.SHDSL standard, G.991.2. The table summarizes message ID's and the level of support in the SHDSL implementation. Message IDs are listed as decimal numbers. Messages 0 to 64 represent request messages. Messages 128 to 192 represent messages that are sent in response to request messages. Each request message is acknowledged with the corresponding response. Request/Response Message IDs usually differ by an offset of 128.

EOC Message Set - ITU-T (G.991.2)

ID Value	*Message Type*	*Initiator*	*Release Availability*
0	Reserved		N/A
1	Discovery Probe	STU-C, STU-R*, SRU	6.4
2	Inventory Request	STU-C, STU-R*	6.4
3	Configuration Request - SHDSL	STU-C	Future
4	Reserved for Application Interface Configuration		N/A
5	Configuration Request - Loopback Timeout	STU-C, STU-R*	Future
6	Virtual Term. Connect Req.	STU-R*, SRU*	Future
7	Virtual Terminal Disc. Req.	STU-R*, SRU*	Future
8	Keyboard Data Message	STU-R*, SRU*	Future
9	Maintenance Request - System Loopback	STU-C, STU-R*	Future
10	Maintenance Request - Element Loopback	STU-C, STU-R*	Future
11 c	Status Request	STU-C, STU-R*	6.4
12 c	Full Status Request	STU-C, STU-R*	6.4

EOC Message Set - ITU-T (G.991.2)

ID Value	Message Type	Initiator	Release Availability
13-14	Reserved		N/A
15	Soft Restart Power Backoff Disable Request	STU-C	Future
16	Reserved (Future)		N/A
17	ATM Cell Status Request	STU-C, STU-R*	Future
18	STU-R Configuration Request - Management	STU-C	Future
19	Reserved for Voice Transport Request - (Future)	Undefined	N/A
20	ISDN Request	STU-C, STU-R	Future
21-63	Reserved (Future)		N/A
64-88	Reserved for Line Management Request	Undefined	N/A
89-111	Reserved		N/A
112-119	Proprietary Message	Undefined	N/A
120	External Message	Undefined	N/A
121	G.997.1 Message	STU-C*, STU-R*	Future
122-124	Reserved		N/A
125-127	Excluded ($7D_{16}$, $7E_{16}$, $7F_{16}$)		N/A
128	Reserved		N/A
129 c	Discovery Response	All	6.4
130 c	Inventory Response	All	6.4
131 c	Configuration Response - SHDSL	STU-R, SRU	6.4
132	Reserved for Application Interface Configuration		N/A
133	Configuration Response - Loopback Timeout	All	Future
134	Virtual Terminal Connect Response	STU-C, SRU*, STU-R*	Future
135	Reserved		N/A
136	Screen Data Message	STU-C, SRU*, STU-R*	Future
137	Maintenance Status	All	Future
138	Reserved		N/A
139	Status/SNR	All	Future
140 c	Performance Status SHDSL Network Side	SRU, STU-R	6.4
141	Performance Status SHDSL Customer Side	STU-C, SRU	Future
142	Reserved for Application Interface Performance		N/A
143	Reserved (Future)		N/A
144 c	Generic Unable to Comply (UTC)		6.4
145	ATM Cell Status Information	All	Future
146	Configuration Response - Management	STU-R, SRU	Future
147	Reserved for Voice Transport Response (Future)	Undefined	N/A
148	ISDN Response	STU-C, STU-R	Future
149-191	Reserved (Future)		N/A

EOC Message Set - ITU-T (G.991.2)

ID Value	*Message Type*	*Initiator*	*Release Availability*
192-216	Segment Management Response (Reserved)	Undefined	N/A
217-239	Reserved (Future)		N/A
240-247	Proprietary Message Response	Undefined	N/A
248-252	Reserved		N/A
253-255	Excluded (FD_{16}, FE_{16}, FF_{16})		N/A

Initiator: STU-C = CO, STU-R = CPE, SRU = not applicable for G.SHDSL Module
Asterisk (*): indicates the feature is optionally available for the equipment specified according to G.991.2, but will be implemented in the G.SHDSL Module.
Any item listed as "Future" should not be taken as a commitment to deliver in the future. It has to be evaluated according to market circumstances and must also be possible to achieve from a hardware/software point of view.
ID values with a "c" are the France Telecom compatibility messages.

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