



# WATSON

## Watson Ethernet Operating Manual

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# Declaration of Conformity



## Tabletop

Watson Ethernet tabletop 1p Ethernet

SZ.847.V350

Watson Ethernet tabletop 2p 1xEth

SZ.847.V450

## Plug-in

Watson Ethernet plug-in, 4 x Ethernet, 4 x DSL

SZ.866.V654

### Manufacturer:

Schmid Telecom AG, Binzstrasse 35, CH-8045 Zurich

The products mentioned above comply with the regulations of the following European Directives:

#### 2004/108/EC

Directive containing requirements regarding electromagnetic compatibility.

The compliance of the above mentioned product with the requirements of the directive 2004/108/EC is ensured by complete application of the following harmonized European Standards:

EN 300386:2000

#### 2006/95/EC

Directive containing requirements regarding safety.

The compliance of the above mentioned product with the requirements of the directive 2006/95/EC is ensured by complete application of the following harmonized European Standards:

EN 60950:2006 (IEC 60950:2005)

#### 99/5/EEC

Directive containing requirements regarding Radio & Telecommunication Terminal Equipment.

The compliance of the above mentioned product with the requirements of the directive 99/5/EEC is ensured by complete application of the following harmonized European Standards:

EN 55022:1998, EN 55024:1998

EN 60950:2006 (IEC 60950:2005)

#### 2002/96/CE

Directive containing requirements regarding the prevention of waste electrical and electronic equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste.

The product mentioned above is labeled in accordance with European Directive 2002/96/EC concerning waste electrical and electronic equipment (WEEE). The Directive determines the framework for the return and recycling of used appliances as applicable throughout the European Union. This label is applied to the product to indicate that the product is not to be thrown away, but rather reclaimed upon end of life per this Directive.



**2002/95/CE**

Directive containing requirements to approximate the laws of the Member States on the restrictions of the use of hazardous substances (**RoHS**) in electrical and electronic equipment and to contribute to the protection of human health and the environmentally sound recovery and disposal of waste electrical and electronic equipment.

The product mentioned above has been designed and produced following the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment and is compliant to the allowed concentration values defined by the European Committee.

The compliance of the above mentioned products with the specified requirements of the applicable directives and harmonized and non-harmonized standards is shown in the following internal and external test reports:

- W5A Safety Report.pdf
- W5B LTU 4xEth 4xDSL Protection Report 0.1.doc
- Watson\_ETH\_EMC\_Report\_1.0.pdf
- Watson\_Ethernet\_MS\_EMC\_External\_Report\_1\_EMCKP1240A.pdf
- SZ.847.Vxxx Safety Report EN60950.pdf (tabletop, external)

**CE Label attached to the product(s):** on tabletop, for plug-in on minirack and on 19" subrack

**Issued by:** Schmid Telecom AG  
Binzstrasse 35  
CH-8045 Zurich

**Place and date:** Zurich, 2009-02-26

**Signatures:**

Signature 1



Ronny Colotto

Signature 2





Marcel Beerli

# Important Safety Precautions

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To reduce the risk of fire, bodily injury, and damage to the equipment the following precautions must be observed:

- Read and follow all warning notices and instructions marked on the product or included in the manual.
- Installation of this equipment has to be done by qualified personnel only.
- To achieve safety and satisfactory EMC performance, the plug-in boards have to be inserted into appropriate subracks. Subrack slots that are not used must be covered with a blanking plate.
- The subracks must be connected to earth. This is achieved by installing the subracks into properly grounded rack or by connecting the protective ground terminal provided on some subracks to the earthing network.
- If the subracks are installed in racks then these racks must be connected to the earthing network according to ETS 300 253.
- Where protective ground terminals are available on the subracks these terminals are marked with the symbol . The following rules must be observed:
  - The earthing network must be connected to the protective ground terminal continuously and securely.
  - Where the subracks are fitted with an AC power connector the earthing network must be connected securely to the protective ground terminal even if the AC power cord is disconnected from the subracks.
  - The protective grounding may only be disconnected from the subracks after the DSL line has been disconnected from the plug-in.
- Ground terminals on the tabletop modems are marked with the symbol . The following rules must be observed:
  - Use of the ground terminal is optional. If used then the earthing network must be connected to the ground terminal continuously and securely. Otherwise the ground terminal can be left open.
  - The grounding may only be disconnected from the modem after the DSL line has been disconnected.
- This product is to be used with telecommunications circuits. Take the following precautions:
  - Never install telephone wiring during a lightning storm.
  - Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.
  - Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.
  - Use caution when installing or modifying telephone lines.

- Avoid using a telephone (other than a cordless type) during an electrical storm. There may be a remote risk of electric shock from lightning.
- Do not use the telephone to report a gas leak in the vicinity of the leak.
- Condensation may occur externally or internally if this product is moved from a colder room to a warmer room. When moving this product under such conditions, allow ample time for this product to reach room temperature and to dry before operating.
- This product is intended for use in environments as stated in the technical specifications. Do not use this product in areas classified as hazardous locations. Such areas include patient care areas of medical and dental facilities, oxygen-laden environments, or industrial facilities. Contact your local electrical authority governing building construction, maintenance, or safety for more information regarding the installation of this product.
- Slots and openings in this product are provided for ventilation and should never be blocked or covered, since these ensure reliable operation of this product and protect it from overheating. This product should not be placed in a built-in apparatus such as a rack unless the apparatus has been specifically designed to accommodate the product, proper ventilation is provided for the product, and the product instructions have been followed.
- This product should be placed away from radiators, heat registers, stoves, or other pieces of equipment that produce heat. Allow sufficient air circulation around the product and the AC adapter during use to ensure adequate cooling of the device.
- Do not use this product in a wet location.
- Normal operation of this product is only possible when the external housing is left in place.
- This product should be operated only from the type of power source indicated on the product's electrical ratings label. If you have questions about the type of power source to use, contact your local Schmid Distributor or local power company.
- Be sure that the power outlet you plug the power cord into is easily accessible and located as close to the equipment operator as possible. When you need to disconnect power to this product, be sure to unplug the power cord from the electrical outlet.
- Ensure that the voltage select switch, if provided on this product, is in the correct position for the type of voltage in your country (115 VAC or 230 VAC).
- Do not allow anything to rest on any of the attached cables and do not position this product where persons will walk or trip on the cables.
- Unplug this product from the wall outlet before cleaning. Do not use liquid cleaners or aerosol cleaners. Use a damp cloth for cleaning.
- Never push a foreign object through an opening in this product.

- Unplug the product from the electrical outlet and contact your local Schmid Distributor under the following conditions:
  - The power cord, extension cord, or plug is damaged.
  - Liquid has been spilled or an object has fallen into this product.
  - This product has been exposed to water.
  - This product has been dropped or damaged in any way.
  - There are noticeable signs of overheating.
  - This product does not operate normally when you follow the operating instructions.
- Do not attempt to service this product yourself, as opening or removing covers may expose you to dangerous high voltage points or other risks. Refer all servicing to your local Schmid Distributor.
- Upon completion of any service or repairs to this product, have your local Schmid Distributor perform any safety checks required by the repair procedure or by local codes to determine that the product is in proper operating condition.





# Limited Product Warranty

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Schmid Telecom warrants that for two (2) years from the date of shipment to the Customer, all products manufactured by Schmid Telecom will be free from defects in materials and workmanship. Schmid Telecom also warrants that products will conform to the applicable specification and drawings for such products, as contained in the Product Manual or in Schmid Telecom internal specifications and drawings for such products (which may or may not be reflected in the Product Manual). This warranty only applies if Customer gives Schmid Telecom written notice of defects during the warranty period. Upon such notice, Schmid Telecom will, at its option, either repair or replace the defective item.

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# 1

## Related Documents

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- [1] Schmid Telecom, *Watson SHDSL Router Manual*
- [2] Schmid Telecom, *Watson SHDSL Router GUI Manual*
- [3] Schmid Telecom, *Watson SHDSL Router Application Manual*
- [4] Schmid Telecom, *Watson Rack Operating Manual*
- [5] Schmid Telecom, *Watson Minirack Mechanics Operating Manual*
- [6] Schmid Telecom, *Watson Tabletop Housing for Plug-in Manual*
- [7] Schmid Telecom, *Watson Ethernet Application Manual*
- [8] Schmid Telecom, *Watson TDM Manual*
- [9] Schmid Telecom, *WEM-2 Users Manual*
- [10] Schmid Telecom, *Flashloader Operating Manual*
- [11] ETSI TS 101 524 (2006)



## 2.1 Introduction

The Watson Ethernet modems are SHDSL transmission systems compliant to ITU-T G.991.2 Annex B (G.SHDSL.bis) and to ETSI TS 101 524 (2006).

SHDSL uses Trellis-coded PAM-16 and PAM-32 linecodes supporting multiple line rates as well as 1-pair, 2-pair and 4-pair DSL transmission.

The Watson Ethernet modems are available as plug-in cards and as tabletop units. Both plug-in cards and tabletops can work as DSL master modems (STU-C) and as DSL slave modems (STU-R).

The modems can be configured with an RS-232 terminal through a command line interface (Monitor).

For remote management a Telnet access to the Monitor is available. The plug-in modems also have an SNMP agent integrated. One agent can control all plug-in modems in a subrack and all tabletop modems connected to the subrack modems.

## 2.2 Applications

Figure 2-1 shows typical deployment scenarios of Watson Ethernet to deliver Metro Ethernet Services:

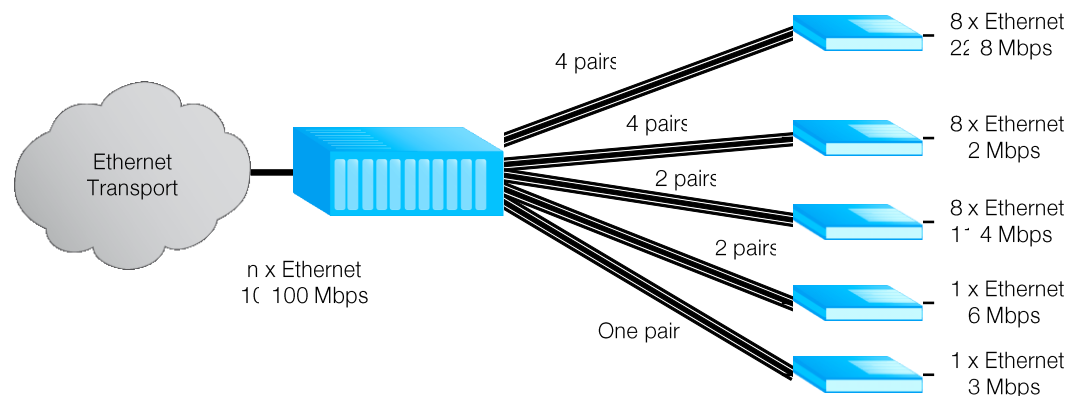


Figure 2-1: Ethernet Services

Several Ethernet plug-in cards are installed in a subrack at the central office or the point of presence. Depending on the service offered each plug-in can serve between one and four customers. At the customer premises either a tabletop

modem or a plug-in card in a tabletop housing is installed. Traffic from each customer is available at a dedicated Ethernet interface in the central office. Alternatively traffic from several customers can be aggregated to a single Ethernet port. Advanced VLAN functions allow for customer isolation and traffic management.

Watson Ethernet modems can also be used back-to-back as shown in Figure 2-2:

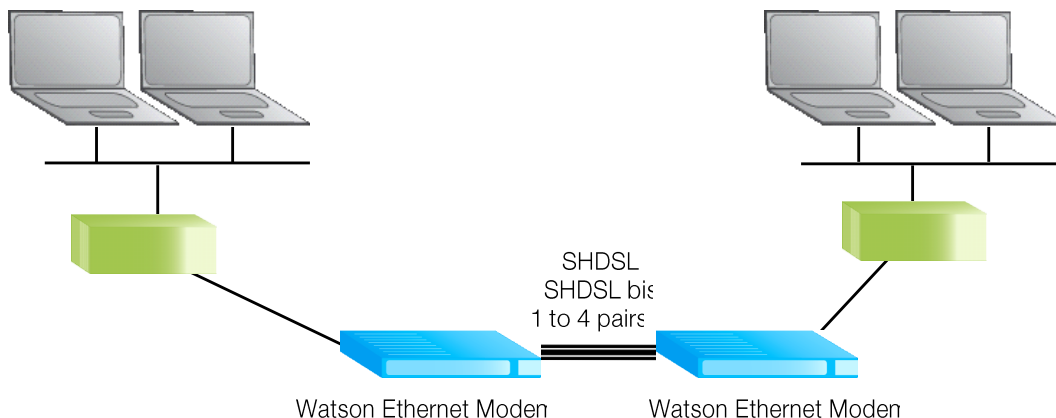


Figure 2-2: Campus Networks

For these applications either two tabletop modems or two plug-in modems (in an appropriate housing) are connected back to back with one of the modems being configured as DSL master and the other one as DSL slave. Depending on the distance and the number of wire pairs available line rates up to 22.8 MBit/s are available. VLAN and MAC Address filtering functions allow for traffic management and optimal use of the available DSL bandwidth.

Deployment in linear networks is supported with the Watson Ethernet plug-in card:

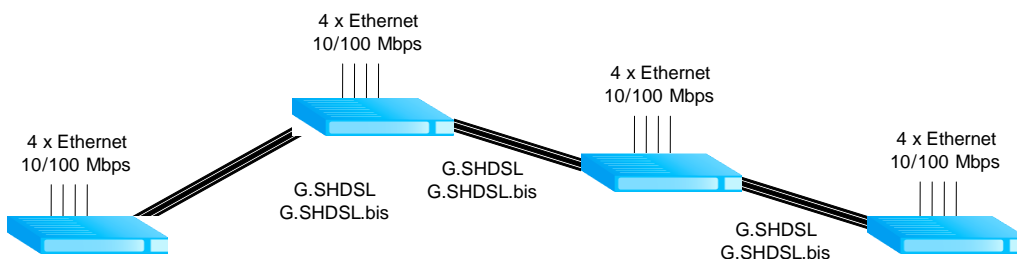


Figure 2-3: Linear Ethernet Network

In Figure 2-3 several sites (e.g. stations along a pipeline or a power line) are connected with single or two pair DSL systems. In each site a single Watson Ethernet plug-in card terminates the DSL spans coming from "East" and "West" sides and gives four local Ethernet interfaces e.g. to connect local station control equipment. Traffic from the local interfaces can be aggregated with traffic on the DSL and can be sent to either direction along the line. Traffic streams are kept separate through VLANs, and Class of Service/Priority functions allow for traffic management.

The entire chain can be managed from a centralized site through inband management.

The Watson Ethernet tabletop modems can also be used together with Watson TDM modems with E1 or nx64 user interfaces to transport Ethernet packets over Wide Area Networks:

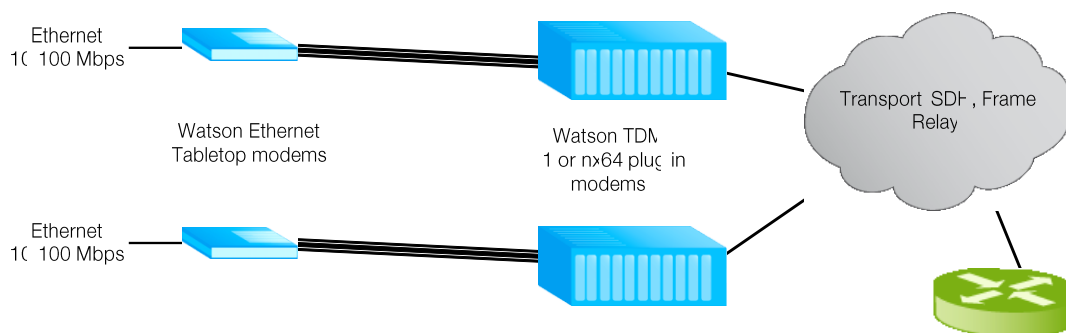


Figure 2-4: Ethernet over WAN

Here Watson Ethernet tabletop modems are installed at the customer premises and Watson TDM modems in the central office. Ethernet packets are transported transparently from one Watson Ethernet modem to the other. No intermediate protocol conversion (e.g. ATM) is required to map Ethernet to the E1/SDH or Frame Relay WAN. Instead of establishing a connection between two Watson Ethernet tabletop modems the connection can also be terminated in the WAN port of a router supporting the Cisco HDLC protocol.



# 3

# Modem Features

## 3.1 DSL

### 3.1.1 Linerates and DSL sync rates

Watson Ethernet supports SDSL as specified in ETSI TS 101 524 and ITU-T G.991.2. The linecode used is TC-PAM 16, the maximum linerate rate per pair is 2'306 kbit/s (36 timeslots with 64 kbit/s each).

The Watson Ethernet plug-in can be configured for the 2004 revision of ETSI TS 101 524, also known as eSDSL (ETSI) or G.SHDSL.bis (ITU-T). G.SHDSL.bis allows for higher symbol rates and a 32-level linecode (TC-PAM 32). The maximum number of timeslots per pair in G.SHDSL.bis is 89, the maximum linerate rate per pair is 5'696 kbit/s.

There is some overlap between the linerates attainable in G.SHDSL and G.SHDSL.bis:

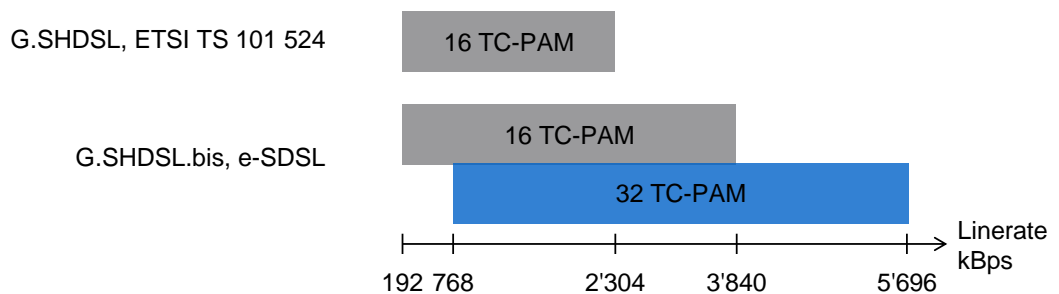


Figure 3-1: G.SHDSL and G.SHDSL.bis linerates

This means that for certain linerates either TC-PAM 16 or TC-PAM 32 can be configured in the modem. TC-PAM 16 has the better DSL performance than TC-PAM 32. However with linerates rates higher than 2.3 MBit/s (36 timeslots) and TC-PAM 16 the symbol rate over the DSL becomes higher than what was specified in the original version of TS 101 524. Higher symbol rates mean wider PSDs which in turn can lead to higher interference to other DSL systems in the same cable binder, e.g. ADSL, ADSL2, ADSL2+.

The linerate rate, i.e. the data rate available to the application is calculated as follows:

$$\text{Linerate} = m \times n \times 64 \quad \text{[bit/s]}$$

*m* = number of wire pairs (1...4)

*n* = number of timeslots per pair (3...89)

*Note: n = 3 ... 36 for the Watson Ethernet tabletop modem*

The physical DSL synchronization rate per pair is

$$\text{Syncrate} = n \times 64 + \text{OH} \quad \text{[bit/s]}$$

*n* = number of timeslots (3...89)

*OH* = SHDSL Overhead (8 kbit/s including 3.2 kbit/s EOC)

*Note: n = 3 ... 36 for the Watson Ethernet tabletop modem*

The sync rate determines the DSL reach. Decreasing the sync rate increases DSL reach and vice versa. The linerate rate has no influence on the DSL reach.

### 3.1.2 Multipair operation

Watson Ethernet modems support multipair operation (m-wire mode). This allows for bandwidth aggregation of individual DSL wire pairs for higher speeds or increased reach at a given speed.

Each wire pair of a multipair DSL span must be configured with the same linerate. If one pair of an m-wire span fails then the entire span must be restarted.

The following naming conventions are used in multipair operation on the Watson Ethernet plug-in:

- DSL spans are named DSL1, DSL2, DSL3 and DSL4. A span can consist of one or several wire pairs. The number of DSL spans available on a plug-in depends on the plug-in configuration (Monitor command `CARDMODE`).
- Wire pairs within a span are named A, B, C and D. Depending on the number of wire pairs within a span the wire pairs B, C or D might not exist.
- Physical wire pairs available at the plug-in DSL connector are named a, b, c and d.



Depending of the operation mode of the Watson Ethernet plug-in (which is set by the Monitor command `CARDMODE`, cf. 7.2.1) the following combinations are possible:

<b>CARDMODE</b>	<b>Spans</b>	<b>Wire pairs</b>	<b>Connection Points</b>
1	DSL1	A	a1, a2
	DSL2	A	b1, b2
	DSL3	A	c1, c2
	DSL4	A	d1, d2
2	DSL1	A, B	a1, a2, b1, b2
	DSL3	A, B	c1, c2, d1, d2
3	DSL1	A, B	a1, a2, b1, b2
	DSL3	A	c1, c2
	DSL4	A	d1, d2
4	DSL1	A, B, C, D	a1, a2, b1, b2 c1, c2, d1, d2

Table 3-1: Naming of DSL spans, pairs and connection points

### 3.1.3 Single-pair fallback

The Watson Ethernet plug-in supports single-pair fallback on multipair DSL spans.

Should a failure occur on a multipair span then the modem will attempt to reconnect using one of the existing wire pairs; which one will be used is random. The remaining spans are blocked and do not carry any traffic.

If a failure occurs on a fallback wire pair the modem will attempt to switch to another of the wire pairs.

The single-pair fallback mode is cleared by issuing a `RESET DSLx` Monitor command.

Single-pair fallback can be enabled/disabled with the `FALLBACK` Monitor command and by SNMP.

Notes:

- *Single-pair fallback is only supported between two plug-in modems*
- *The fallback process is controlled by the STU-C modem. The STU-R adapts automatically to fallback and does not need any configuration..*

### 3.1.4 Power Backoff

The transmit power of the modems can be decreased by activating the power back-off mode. This reduces interference to other transmission systems operating on adjacent pairs bundled in the same cable.

With enabled power back-off the transmit power will be reduced adaptively in function of the estimated cable attenuation:

Estimated Power Loss(*)	Power Backoff
< 1 dB	6 dB
< 2 dB	5 dB
< 3 dB	4 dB
< 4 dB	3 dB
< 5 dB	2 dB
< 6 dB	1 dB
≥ 6 dB	no backoff

(\*) Calculated as Tx Power – Estimated Rx Power

Table 3-2: Power Backoff

*Note: Power backoff can be configured individually for plug-in and tabletop.*

### 3.1.5 Symmetric and Asymmetric PSDs

The Watson Ethernet tabletop modems support asymmetric PSDs for linerates of 2'056 kbit/s and 2'312 kbit/s.

Activating asymmetrical PSD masks will increase upstream transmit power (STU-R → STU-C). This improves near-end crosstalk (NEXT) at the STU-C side and will increase the possible loop length in cases where many DSL spans have to share the same cable e.g. coming out of a central office.

*Note: The Watson Ethernet plug-in and the Watson SHDSL Router do not support asymmetric PSDs.*

### 3.1.6 DSL Performance Parameters

The Watson Ethernet modems provide information about the current Signal Quality and Attenuation of a DSL span.

#### *Signal Quality*

The Signal Quality is the noise margin calculated by the modem:

$$SQ = SNRI - SNR0$$

Where

*SQ* is the calculated noise margin

*SNRI* is the signal to noise ratio calculated by the transceiver by analyzing the error correction bits (Trellis bits) in the line code.

*SNRO* is the signal to noise ratio that gives a bit error rate of  $10^{-7}$  in presence of average white Gaussian noise. For TC-PAM16 the theoretical value for *SNRO* is 27.7 dB.

#### *Attenuation*

The link attenuation is calculated by the modem assuming 0.4mm PE cable without bridged taps and measured at 150 kHz (for line rates of 200 kbit/s up to 1'992 kbit/s) or 200 kHz (for line rates of 2'056 kbit/s and above). This calculated attenuation may differ from the attenuation measured by other equipment for other cable configurations (other cable diameter, splices, bridged taps).

Both Signal Quality and Attenuation are effective maintenance tools for determining inadequate or bad cable pairs. They are available with the `DIAGNOSTIC Monitor` command.

### 3.1.7 Wetting Current

The Watson Ethernet plug-in can source or sink wetting current over the DSL line. Wetting current is configured per wire pair by jumpers located on the lower left corner of the plug-in:

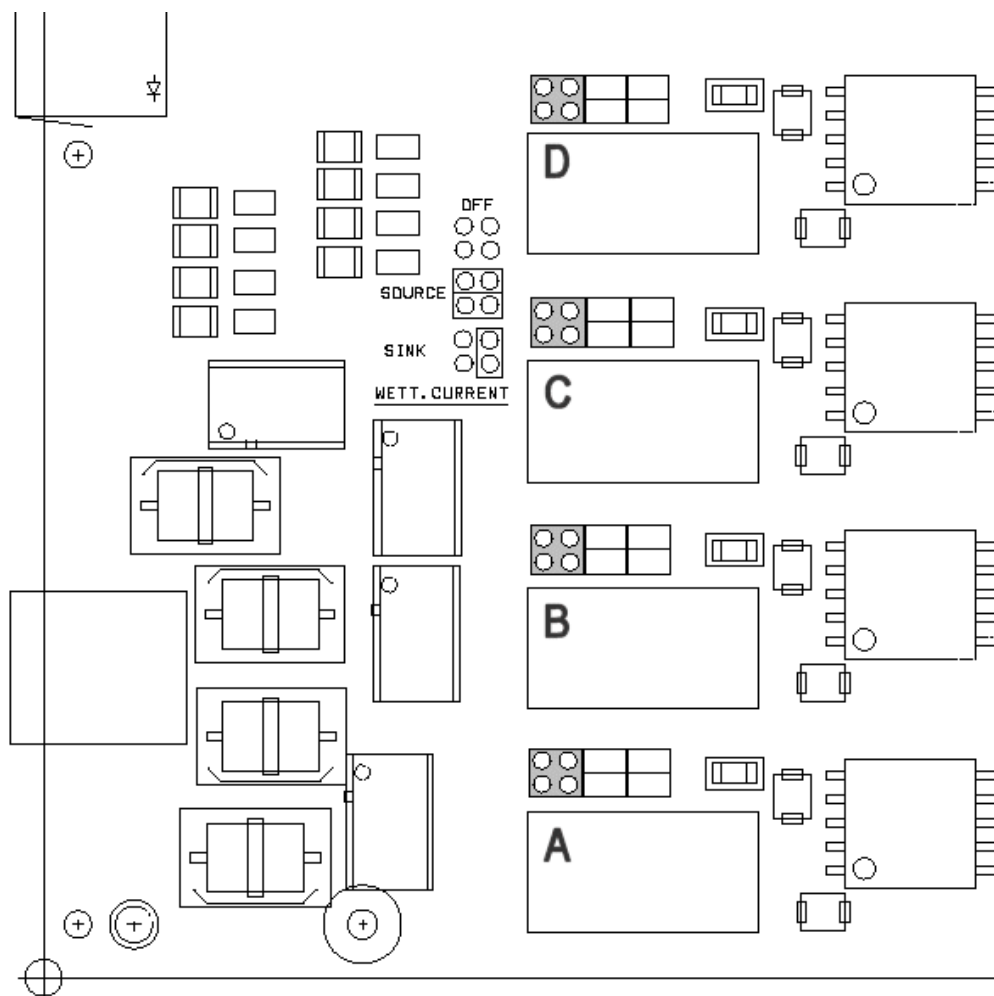


Figure 3-2: Wetting current jumper location

Jumper Configuration	Wetting Current Function
(no jumpers)	Wetting current off
(two jumpers)	Wetting current source
(one jumper)	Wetting current sink

Table 3-3: Wetting current jumper settings

The Watson Ethernet tabletop modems cannot source wetting current. It will always sink wetting current when local powering is used.

### 3.1.8 Master / Slave

To start up a DSL span, one system unit must be configured as master modem (STU-C) and the other one as slave (STU-R). The master controls the span start-up procedure. If both system units are configured as master or as slave, no start-up will occur.

Usually, the plug-in is configured as master and the tabletop modem as slave (default setting). However, it is possible to set up a DSL span between two plug-ins or two tabletops, as long as one is configured as master and the other one as slave.

### 3.1.9 DSL Clocking

Watson Ethernet modems have a crystal controlled DSL clock that does not depend on the clocking of the Ethernet user interfaces (clockmode 1 of TS 101 524).

## 3.2 Ethernet (plug-in modem)

### 3.2.1 Ethernet over DSL

Ethernet packets are mapped on the DSL frame using the packet mode TPS-TC layer of ETSI TS 101 524. The modems use bit stuffing to improve efficiency.

The Ethernet MAC-frames are reformatted before being transmitted over the DSL span:

- Preamble (PRE), Start-of-Frame delimiter (SFD) and PAD fields are stripped off
- The Ethernet CRC-32 is replaced by a CRC-16 calculated over all fields of the MAC frame

PRE, SFD, an eventual PAD and the CRC-32 are reconstructed by the receiving modem before transmitting the MAC frame over its Ethernet interface.

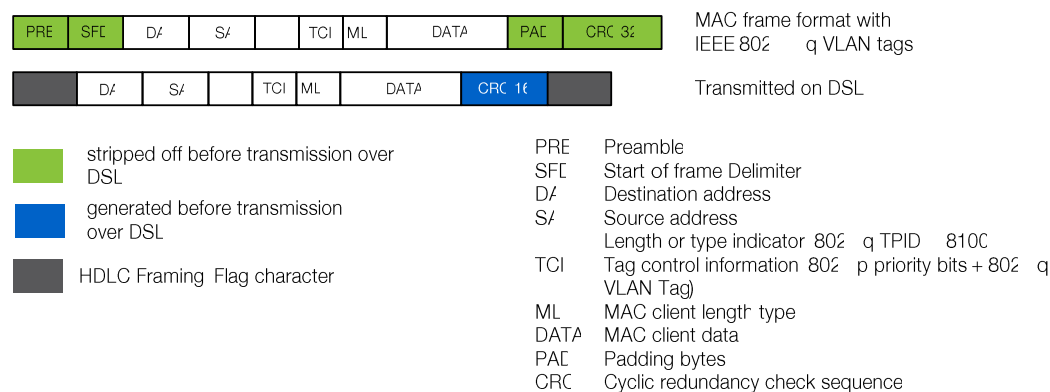


Figure 3-3: Ethernet over DSL

### 3.2.2 Ethernet Bridging

The Watson Ethernet plug-in card has a built-in Ethernet bridge that connects Ethernet ports, DSL spans and the plug-in controller:

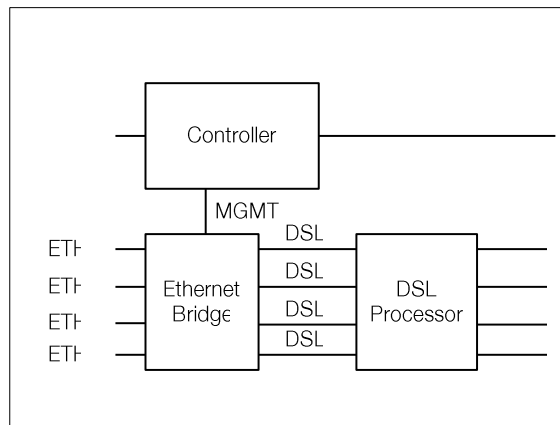


Figure 3-4: Watson Ethernet plug-in Block diagram

The Ethernet bridge supports the following modes

- 1) VLAN bridging. Layer 2 VLANs are used to control the traffic. For an Ethernet packet to be sent from one port to another both ports must be configured to be in the same VLAN. This bridging mode allows that Ethernet user interfaces can be switched to DSL interfaces and vice versa. It is also possible to switch packets from several DSL interfaces to one Ethernet interface (concentration), to switch packets from an Ethernet or DSL interface to the Management Processor interface MGMT3 (used for inband management) or to switch packets from DSL to DSL interface.
- 2) Transparent bridging. In this mode there is a fixed association between DSL and Ethernet bridge ports:

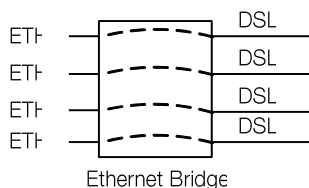


Figure 3-5: Transparent bridging

Transparent bridging is similar to the VLAN transparency provided by the Watson Ethernet tabletop modem, cf. 3.3.2. Transparent bridging lacks the flexibility of VLAN bridging, and inband management or linear networks are not supported in this mode. The advantage of transparent bridging is that it is not required to configure any VLAN tags on the bridge, any VID received on an Ethernet port will be relayed to the corresponding DSL span and vice versa.

Note that the association between Ethernet and DSL spans is independent of the currently configured multipair mode of the DSL spans. If for example all four DSL wire pairs are combined to a single DSL span (DSL1) then Ethernet port ETH1 will be associated with DSL span DSL1 while ports ETH2 .. ETH4 and DSL2 .. DSL4 do not carry any traffic at all.

- 3) Transparent bridging with inband management. This mode is equivalent to the Transparent bridging mode but allows inband management through the DSL spans, cf. 3.5.5.

The bridging modes are controlled by the `BRIDGEMODE Monitor` command.

### 3.2.3 MAC Defect Signaling

The operating status of DSL Spans and remote Ethernet interfaces can be linked to the status of the local Ethernet interfaces through MAC Defect Signaling (MDS).

If MDS is active then the Ethernet User Interfaces will be disabled if

- the DSL span is not synchronized OR
- the Ethernet User interface at the remote end is not active (LKINT alarm from the remote side)

There is a fixed association between DSL spans and Ethernet interfaces for MDS (DSL1 is associated with ETH1, DSL2 with ETH2 etc.). This association is independent of the currently configured `BRIDGEMODE`.

MDS can be enabled and disabled individually per Ethernet interface with the `MDS Monitor` command.

### 3.2.4 VLANs

The Watson Ethernet plug-in supports VLAN functions according to IEEE 802.1q. Each of the Ethernet bridge ports (ETH1 .. ETH4, DSL1 .. DSL4, MGMT3) can be member of one or several VLANs. The maximum number of VLANs is 64. Each VLAN has a VLAN Identifier (VID) between 1 and 4094.

Upon reception of an Ethernet packet at a port its VID is checked against the VIDs of all VLANs this port is a member of. Packets that do not carry one of these VIDs will be discarded.

For untagged packets the default VID for the port is used to determine VLAN membership.

Packets are only forwarded to ports that are a member of the VLAN of this packet.

Upon transmission the packet will be tagged with the VLAN tag originally received. If the packet was untagged then the default tag of the receiving port is added to the packet. The port can also be configured to send the packets untagged.

### 3.2.5 VLAN Examples

VLANs are always used within the Watson Ethernet plug-in to segregate traffic from different ports. This is true even when no VLAN tags are present on packets ingressing or egressing the plug-in.

Figure 3-6 below shows a simple VLAN configuration example. Both on the DSL and on the Ethernet side untagged packets are used. On the Watson Ethernet plug-in four VLANs (VLAN 1, VLAN 2, VLAN 3 and VLAN 4) are configured. Depending on its ingress port each packet gets a default tag between 1 and 4. This tag is then used to switch the packet to the correct egress port, effectively con-

necting ETH1 to DSL1, ETH2 to DSL2 etc. while blocking all traffic between Ethernet ports and between DSL spans. The VLAN configuration of Figure 3-6 is automatically activated when issuing the `DEFAULT 2 Monitor` command.

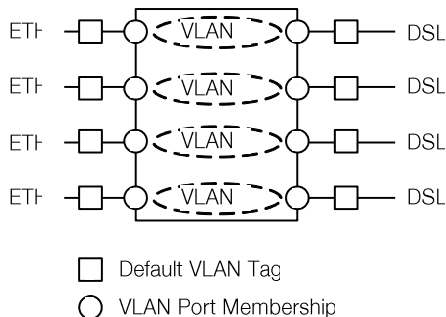


Figure 3-6: Simple VLAN Example

Figure 3-7 shows how the VLAN switching function can be used for traffic concentration:

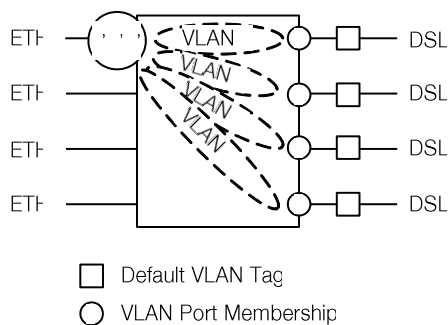


Figure 3-7: VLAN configuration for traffic concentration

In this example four independent DSL customers are concentrated to a single Ethernet trunk interface. On the DSL lines untagged packets are used. Upon ingress into the Watson Ethernet plug-in the packets get a default VLAN tag between 1 and 4 based on their ingress port. All traffic is switched to port ETH1 which is member of all four VLANs. The packets egress the Watson Ethernet plug-in with VLAN tags, allowing to separate traffic streams from the four DSL spans different customers. Ports ETH2 .. ETH4 are unused in this scenario.



Figure 3-8 shows how Ethernet user interfaces are used for inband management:

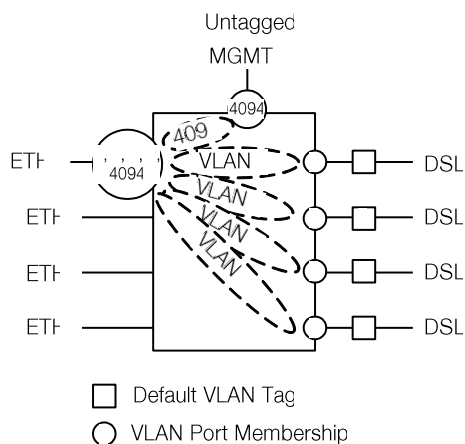


Figure 3-8: VLAN configuration for Inband Management

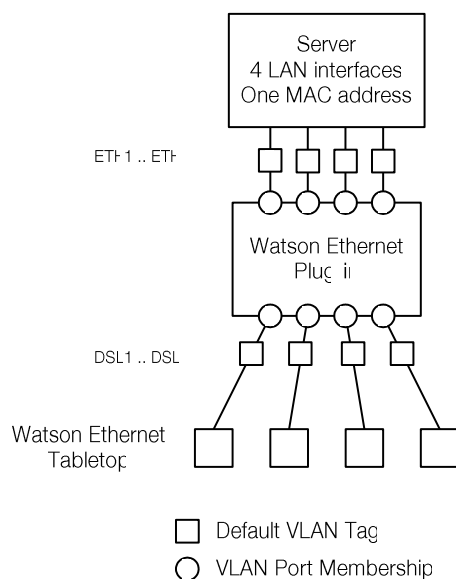
For user traffic we have the same configuration as in Figure 3-7. However we have added one additional VLAN 4094 which is used for inband management. Ports ETH1 and MGMT3 are members of this VLAN. Because the DSL spans are not member of VLAN 4094 management traffic is isolated from user traffic and there is no access to management function through the DSL spans.

Note that port MGMT3 must use untagged packets to properly interface with the card controller. Management packets coming from the card controller are tagged with VLAN 4094 upon ingress into the bridging function.

### 3.2.6 Individual and shared forwarding databases

VLANs can have individual or shared forwarding databases (IVL or SVL operation). The Watson Ethernet plug-in supports 16 separate forwarding databases which can be freely assigned to VLANs. Address learning is always done based on MAC addresses without taking VIDs into account.

IVL is required e.g. if a single server is connected to several Ethernet user ports on different VLANs and all of the server interfaces use the same MAC address. In this case the server MAC address will appear to move between Ethernet ports and VLANs depending upon which interface has most recently transmitted a frame. Communication to the server will be disrupted



If SVL is used

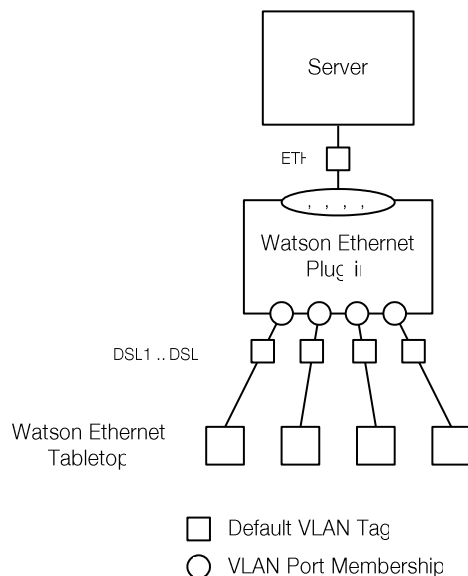
- 1 Server transmits an Ethernet packet to client A. MAC address of Server is learned at port ETH 1
- 2 Client B tries to send a packet to Server. Packets from client B are tagged with VID 2. If SVL is used then this packet will be forwarded to port ETH 2 (where the Server MAC address has been learned) but it cannot egress there because ETH 2 is member of VLAN 2. Communication between client B and Server is interrupted until Server sends a packet to client E).

**Conclusion:**  
Each VLAN must use an individual forwarding database (IVL)

Figure 3-9: Individual VLAN learning (IVL) example

For IVL operation each VLAN must be configured to use an own forwarding database. This is done by specifying individual forwarding database identifiers (FIDs) per VLAN in the `VLANCREATE` Monitor command.

SVL is used e.g. in asymmetric VLAN configurations. Asymmetric VLANs together with Port-based tagging allow several clients to access a common server while prohibiting the clients from talking to each other:



Upstream VLANs: 1, 2, 3, 4  
Downstream VLAN: 5

**Upstream :** Any packet being sent to the Server from any client will always will always egress at ETH 1 regardless of its VID but cannot reach any other client because their ports are in different VLANs. The MAC address of the Clients are learned at ports DSL1 .. DSL4 for all VLANs

**Downstream :** All packets are tagged with VID 5 and will be sent to the correct client port (the client MAC address has been learnt when the first packet was sent upstream to the server). The shared FDB ensures that the Server MAC addresses is learnt at port ETH 1 for all VLANs

Figure 3-10: Shared VLAN learning (SVL) example

For SVL operation several VLANs are configured to use the same forwarding database.

- Notes:
- The Watson Ethernet tabletop modems are transparent to VLANs, i.e. VLAN tags are preserved during transmission over the DSL.
  - The Watson Ethernet tabletop modem has a single address learning database which does not take VIDs into account.

### 3.2.7 Stacked VLANs

The Watson Ethernet plug-in also supports double-tagged VLANs (a.k.a stacked VLANs). Stacked VLANs is a method to increase the number of available VIDs in a structured and hierarchical fashion that is backward-compatible with single-tagged VLANs as long as the network supports packet sizes of 1526 bytes or more.

This method places an extra tag (often referred to as the S-TAG or Service Provider Tag) in front of the first tag (known as the C-TAG or Customer Tag). The double tag format is shown in Figure 3-11.

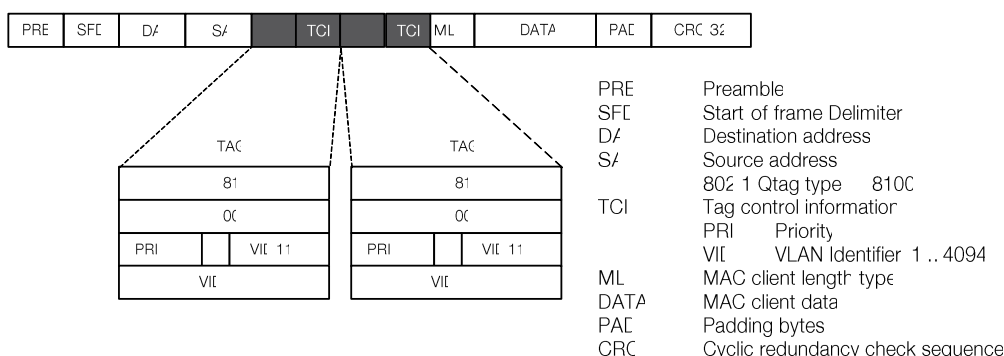


Figure 3-11: Stacked VLAN frame format

Each port can be configured for double tagging in incoming (ingress) and outgoing (egress) direction. Normally ingress and egress double tagging are enabled simultaneously.

A port with ingress double tagging enabled expects double tagged frames. The port will remove the outer tag. If a frame contains only a single tag then this tag will be removed. Untagged frames are not modified.

After removal of the outer tag the Ethernet bridge will process the packet as a single-tagged VLAN packet, cf. 3.2.3. For packets with a single tag or no tag the default tag for this port will be used to determine VLAN membership and possible egress ports.

A port with egress double tagging enabled will transmit all packets with an extra outer tag. When the packet had no tag, it will be sent with a single tag. When the packet had a single tag, it will egress double-tagged. The tag added is the default tag of the source port of the packet.

- Note: The tabletop modems support frame sizes of 2048 bytes and are transparent to double-tagged Ethernet packets.

## 3.2.8 Class of Service (CoS)

The Watson Ethernet plug-in supports differentiated treatment of Ethernet packets according to their class of service. The plug-in supports four different classes named Q1 .. Q4 (Q4 is the highest priority queue, Q1 has lowest priority), classification based on layer 2 or layer 3 information and ingress as well as egress rate limiting.

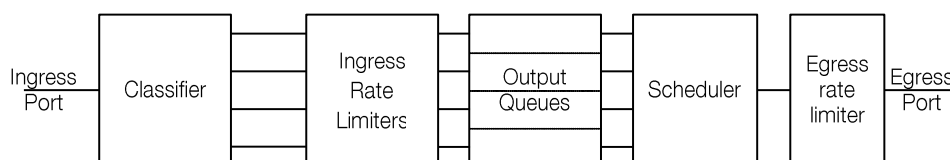


Figure 3-12: Class of Service functions

When a packet enters the Watson Ethernet plug-in its priority is be classified either by layer 2 information (IEEE 802.1p bits in the VLAN tag) or by layer 3 information (DSCP in the IP header). The packet is then associated with one of the priority levels.

On ingress each priority level can be individually rate limited according to the following rules:

- Q1 can be limited to 128 kbps, 256 kbps, 512 kbps, 1'024 kbps, 2'048 kbps, 4'096 kbps or 8'192 kbps
- Each higher priority level can be rate limited either to the same rate as the next lower priority level or to twice as much.

Table 3-4 shows of all possible rate combinations (k → kbit/s, M → MBit/s):

Pro- file	Q1	Q2	Q3	Q4	Pro- file	Q1	Q2	Q3	Q4
1	128k	128k	128k	128k	2	128k	128k	128k	256k
3	256k	256k	256k	256k	4	256k	256k	256k	512k
5	512k	512k	512k	512k	6	512k	512k	512k	1M
7	1M	1M	1M	1M	8	1M	1M	1M	2M
9	2M	2M	2M	2M	10	2M	2M	2M	4M
11	4M	4M	4M	4M	12	4M	4M	4M	8M
13	8M	8M	8M	8M	14	8M	8M	8M	16M
15	128k	256k	256k	256k	16	128k	256k	256k	512k
17	256k	512k	512k	512k	18	256k	512k	512k	1M
19	512k	1M	1M	1M	20	512k	1M	1M	2M
21	1M	2M	2M	2M	22	1M	2M	2M	4M
23	2M	4M	4M	4M	24	2M	4M	4M	8M
25	4M	8M	8M	8M	26	4M	8M	8M	16M
27	8M	16M	16M	16M	28	8M	16M	16M	32M
29	128k	128k	256k	256k	30	128k	128k	256k	512k
31	256k	256k	512k	512k	32	256k	256k	512k	1M
33	512k	512k	1M	1M	34	512k	512k	1M	2M
35	1M	1M	2M	2M	36	1M	1M	2M	4M
37	2M	2M	4M	4M	38	2M	2M	4M	8M
39	4M	4M	8M	8M	40	4M	4M	8M	16M
41	8M	8M	16M	16M	42	8M	8M	16M	32M
43	128k	256k	512k	512k	44	128k	256k	512k	1M
45	256k	512k	1M	1M	46	256k	512k	1M	2M
47	512k	1M	2M	2M	48	512k	1M	2M	4M
49	1M	2M	4M	4M	50	1M	2M	4M	8M
51	2M	4M	8M	8M	52	2M	4M	8M	16M
53	4M	8M	16M	16M	54	4M	8M	16M	32M
55	8M	16M	32M	32M	56	8M	16M	32M	64M

Table 3-4: Ingress rate limiter profiles

Each combination of rates is associated with a profile number. This profile number is used in the `RATELIMIT IN` Monitor command to configure a particular combination of rates.

Note that the ingress rate limits are overlap and non-cumulative. The aggregate bandwidth of Q1 .. Q4 is limited by the maximum bandwidth of Q4. Figure 3-13 shows the bandwidth allocation for ingress profile 50:

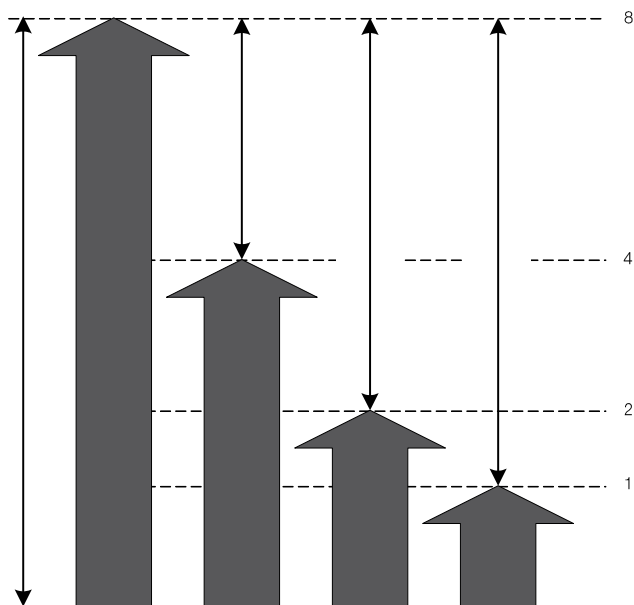


Figure 3-13: Ingress rate limiter example

After classification and rate limiting, the packets are sent to their output queues. A scheduler will schedule packets according to their priorities and send them to the egress port. The scheduler can be configured to work either in strict priority mode or in weighted fair queuing mode with fixed weights 8:4:2:1 for Q4:Q3:Q2:Q1 respectively. Scheduling policy is a global setting and affects all ports simultaneously.

Finally the egress port can be rate limited according to the following profiles:

Profile	Rate
8	23.5M
7	11.8M
6	5.9M
5	2.9M
4	1.5M
3	734.4k
2	367.2k

Table 3-5: Egress rate limiter profiles

The profile number is used in the `RATELIMIT OUT` command to configure a particular egress rate. Only the entire port after scheduling can be rate limited, there are no individual queues at this stage.

*Note:* CoS functions are not available on the Watson Ethernet tabletop modems.

### 3.2.9 Spanning Tree Protocol

The Watson Ethernet plug-in modems support the Rapid Spanning Tree (RSTP) protocol according to IEEE 802.1D-2004.

The spanning tree network protocol provides a loop free topology for any bridged LAN. It detects/disables network loops and provides backup links between bridges. If a loop is detected then the protocol blocks one or more redundant ports.

The bridges continually exchange information. When they recognize a change in network topology then RSTP automatically reconfigures bridge ports to avoid network failure.

#### *Bridge Protocol Data Units (BPDUs)*

The bridges in a network continuously exchange RSTP information carried in special frames called bridge protocol data units (BPDUs). BPDUs are exchanged regularly at configurable intervals (the Hello time, 2 seconds by default) and enable bridges to keep track of network changes and activate or disable ports as required.

Topology Change Notification (TCN) BPDUs are used to inform other bridges of port changes. TCNs are injected into the network by a non-root bridge and propagated to the root. Upon reception of the TCN the root bridge will set a Topology Change flag in its normal BPDUs. This flag is propagated to all other bridges to instruct them to rapidly age out their forwarding table entries.

#### *Port states*

Each port on a bridge can be in one of three states:

- Learning - the port processes BPDUs and awaits possible new information that would cause it to return to the blocking state. While the port does not yet forward frames it does learn source addresses from frames received and adds them to the filtering database.
- Blocking – the port processes BPDUs but discards all other frames.
- Forwarding – the port forwards frames and processes BPDUs.

When a bridge port is initialized it will not immediately start to forward frames. It will instead go into the Learning state while it processes BPDUs and determines the topology of the network.

The port will go into Forwarding state after expiry of a timer (the forwarding delay timer) unless RSTP determines that this port would cause a loop in the network. In this case the port will transition to Blocking state.

#### *RSTP Protocol operation*

- Root bridge election: one bridge in the network is selected as the root bridge. The root bridge is the root of the tree spanning the entire network once the RSTP has converged.

Selection is based on the Bridge Identifier (BID) which uniquely identifies each bridge. A BID is composed of a configurable bridge priority and the MAC address of the bridge. BPDUs exchange results in the bridge with the numerically lowest BID to be selected as root bridge.

The bridge priority is normally left at its default value (32768) but can be re-configured to a lower number if the network administrator wishes a particular bridge to be elected as root bridge.

- **Root port determination:** each non-root bridge designates one root port. The root port is the port through which this non-root bridge communicates with the root bridge.

The root port is the port on the non-root bridge with the lowest path cost (measured as sum the costs of all paths traversed to the root) to the root bridge. The root port is in Forwarding state.

- **Designated port determination:** for each LAN segment (collision domain) the RSTP configures one Designated port. The Designated port is the port on this segment that has the lowest path cost to the root bridge. If more than one port in the segment have the same path cost, the port of the bridge with the lowest bridge ID is selected as a Designated port.

Designated ports are set to Forwarding state, all other ports are in Blocking state.

### *Edge Ports*

Ports which are known to be at the edge of the network i. e. not connected to any other bridge can be configured as edge ports. Edge ports will immediately transition into forwarding state since there is no possibility of it participating in a loop.

Note that configuring a non-edge port as edge port might create loops in the network. Any port configured as edge port will automatically revert to non-edge configuration if a BPDU is received on this port.

### *Point-to-point ports*

Ports which connect to exactly one other bridge (no shared media) can be configured as point-to-point ports. Point-to-point ports can signal to the neighboring bridge their desire to be Designated and Forwarding. Upon explicit acknowledgement from the neighboring bridge these ports can transition directly into forwarding state without waiting for a timer expiry.

### *Path cost*

Path cost is the total cost of transmitting a frame on to a LAN through that port to the root bridge. This is the sum of the costs of each LAN segment or link along the path.

Cost values are configured according to the bandwidth of the link. The slower the media, the higher the cost.

Recommended cost values are:

<b>Link Speed</b>	<b>Recommended Cost</b>	<b>Recommended Cost Range</b>
1 Mbps	20'000'000	2'000'000 – 200'000'000
2 Mbps	10'000'000	1'000'000 – 100'000'000
4 Mbps	5'000'000	500'000 – 50'000'000
8 Mbps	2'500'000	250'000 – 25'000'000
10 Mbps	2'000'000	200'000 – 20'000'000
100 Mbps	200'000	20'000 – 2'000'000

Table 3-6: Recommended port cost values



### *Performance parameters*

The operation of the RSTP is controlled by a set of configurable performance parameters:

- Hello Time: the interval between periodic transmissions of configuration messages by Designated ports. Configurable with the `STP HELLO Monitor` command.
- Maximum Age: maximum age of a BPDU before it is discarded. The age of a BPDU is incremented by one on each traversal through a bridge. A bridge port that was disabled (e.g. through a reset or a link integrity failure) will wait Maximum Age seconds before transiting into Learning state. The Maximum Age parameter is controlled with the `STP MAXAGE Monitor` command.
- Forwarding Delay timer: the delay used by the bridge in STP mode to transition Root and Designated Ports to Forwarding (this transition will take maximum Hello Time seconds in RSTP mode). Set with the `STP FORWARD Monitor` command.

The following relationships are enforced by the Watson Ethernet plug-in:

$$2 \cdot (\text{Forward-Delay-Timer} - 1.0 \text{ seconds}) \geq \text{Maximum-Age-Timer}$$
$$\text{Maximum-Age-Timer} \geq 2 \cdot (\text{Hello-Time} + 1.0 \text{ seconds})$$

- Transmit Hold Count: the maximum number of bridging protocol data units (BPDUs) transmitted per second. Controlled with the `STP TXHOLD Monitor` command.

## 3.3 Ethernet (tabletop modem)

### 3.3.1 Ethernet over DSL

The Watson Ethernet tabletop modem uses the same HDLC procedure to transport Ethernet frames over DSL as the Watson Ethernet plug-in modem. Cf. 3.2.1

### 3.3.2 VLAN features

The Watson Ethernet tabletop modem is transparent for VLAN tags according to IEEE 802.1p/q.

A default VLAN tag can be added to packets without VLAN tags.

In double tagging mode a second VLAN tag is supported.

### 3.3.3 Mixed mode operation

The Watson Ethernet tabletop modems are interoperable with other Watson TDM modems:

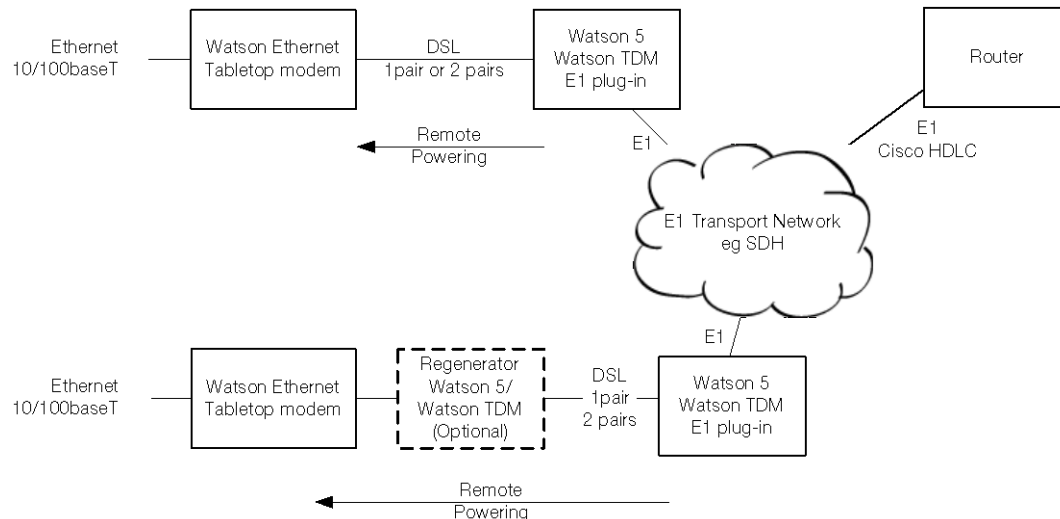


Figure 3-14: Mixed mode operation

One pair and two pair links are supported in mixed mode operation. The maximum throughput is 2.048 Mbps (32 timeslots) in E1 mixed mode operation and 9.9 Mbps (156 timeslots) in nx64 mixed mode operation. In mixed mode operation the Watson Ethernet tabletop modems can be remotely powered from the E1 or nx64 plug-ins. The Watson Regenerator is supported.

### 3.3.4 Cisco HDLC

The Watson Ethernet tabletop modems support "Cisco HDLC" formatting described in RFC 1547 with 16-bit FCS and bit-stuffed framing. Use Cisco HDLC in mixed mode operation (Figure 3-14) to directly connect the remote end of the link to the WAN port of a router.

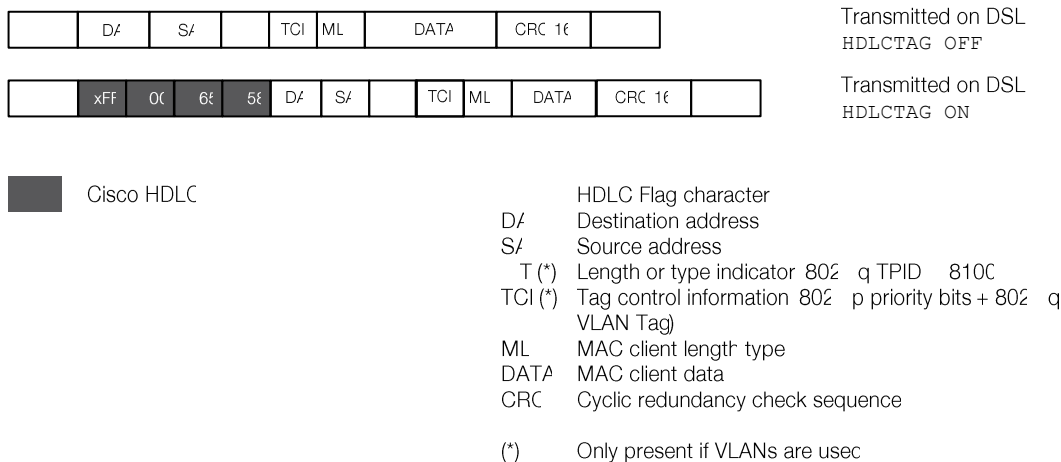


Figure 3-15: Cisco HDLC

The Cisco HDLC formatting is controlled with the HDLC TAG Monitor command.

## 3.4 Firmware update

### 3.4.1 Plug-in

Firmware of the Watson Ethernet plug-in can be updated remotely using the TFTP protocol. To load a new firmware package into a plug-in, copy the package on the TFTP server and use the `UPDATE GET Monitor` command to load the new package into the plug-in.

Once the new package is loaded in it must be activated. This is done with the `UPDATE COMMIT` command. The plug-in will automatically reboot to activate the new firmware package.

If there are any problems with the newly loaded firmware package then it is possible to revert to the last installed package using the `UPDATE REVERT` command.

### 3.4.2 Tabletop

The Watson Ethernet tabletop firmware can be upgraded either through the local RS-232 monitor port or remotely from a Watson Ethernet plug-in modem through the DSL span.

In the first case a PC with the Watson Flashloader application [10] must be used to load a new firmware package into the tabletop. This PC must be connected the RS-232 interface of the tabletop modem.

In the second case a new firmware package can be transferred into the tabletop through the DSL span and the Watson Ethernet plug-in using the TFTP protocol. This is controlled by the `DOWNLOAD Monitor` command, cf. 7.5.4.

## 3.5 Management

### 3.5.1 Management interfaces

Watson Ethernet modems have several management possibilities:

- Management through a local RS-232 port using a command line interface (Monitor)
- DSL slave modems (STU-R) can be managed inband through the DSL EOC from the DSL master modem.
- The Watson Ethernet plug-in modem has a dedicated Ethernet interface (Q – Interface) for remote management through Telnet or SNMP.
- SNMP and Telnet management are also available through the Ethernet user interfaces of the Watson Ethernet plug-in modem (Ethernet inband management). Normally a dedicated management VLAN is used in this case.
- Ethernet inband management is also possible through a DSL span that is terminated by a Watson Ethernet plug-in modem.

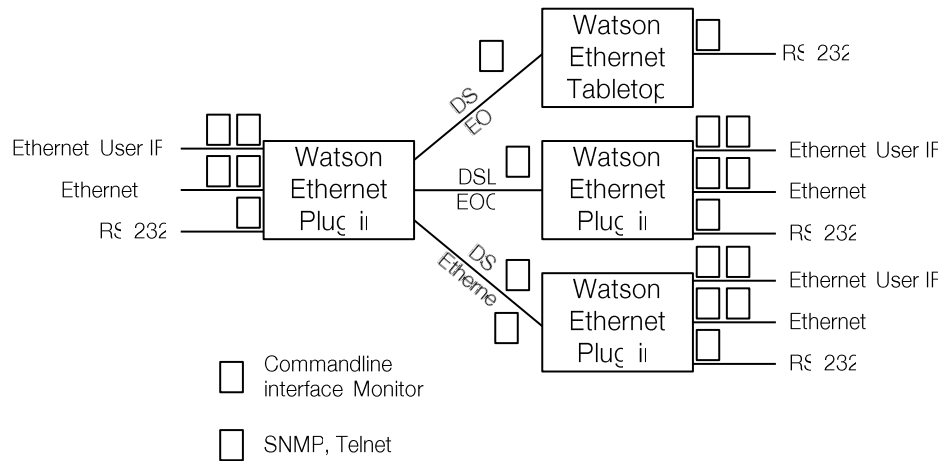


Figure 3-16: Management interfaces

Monitor access through the DSL EOC is only possible from a DSL master to a DSL slave. DSL Master/Slave configuration and the Autorestart option cannot be changed through the DSL EOC as doing so might result in loss of the communication between master and slave.

Telnet access gives the same commands as Monitor access through the local RS-232 port. However it is not possible to modify IP parameters through Telnet because doing so might result in loss of communication to the modem.

### 3.5.2 Chain Management through the DSL EOC

If several Watson Ethernet plug-ins are connected in a linear network then the entire can be managed through the DSL EOC using the Monitor commands `CONNECT` and `DISCONNECT`. `CONNECT` connects to the modem on a particular DSL span. A next `CONNECT` will connect to the next modem in the chain. `DISCONNECT` disconnects one segment in the chain. To connect an entire chain at once you can use the combination `<ESC><ESC>` (the ESCAPE key pressed twice).

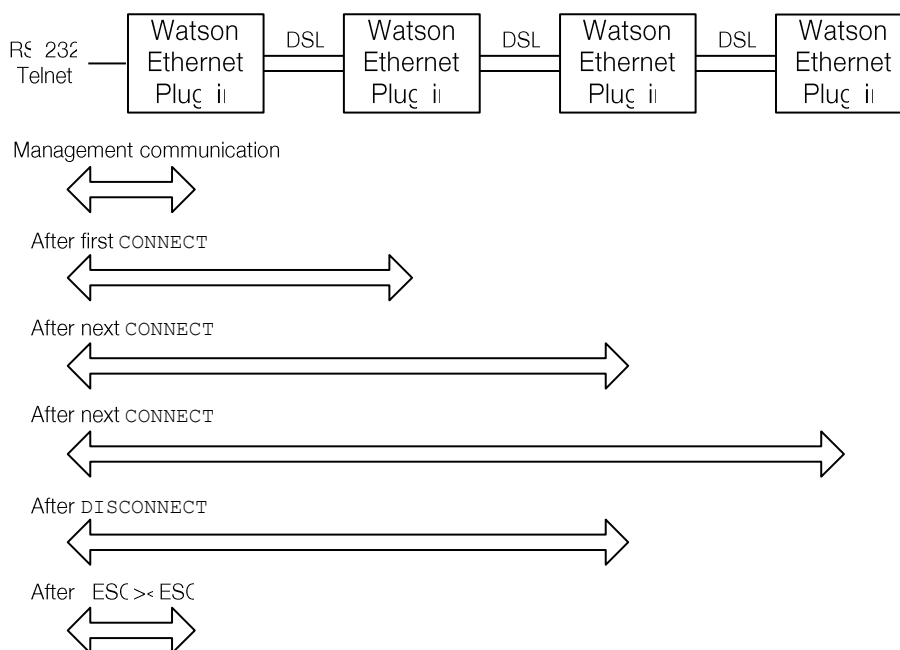


Figure 3-17: Chain Management through the DSL EOC

It is also possible (and recommended) to use Ethernet inband management over the DSL to manage a modem chain:

- SNMP is only possible with Ethernet inband management
- the EOC has a limited bandwidth and CLI reaction times will be slow, especially on long chains

However chain management through the EOC must be used sometimes, e.g. to set up IP configurations in the remote modems.

### 3.5.3 Management IP Address Configuration

Each Watson Ethernet plug-in contains a management router that connects three networks:

- one network at the Q – Interface (MGMT1) on the front panel of the modem
- one network at the backplane interface (MGMT2) on the subrack SZ.379.V3W
- one network at the internal interface (MGMT3) connecting to the Ethernet bridge

Cf. the block diagram of the Watson Ethernet plug-in Figure 3-4.

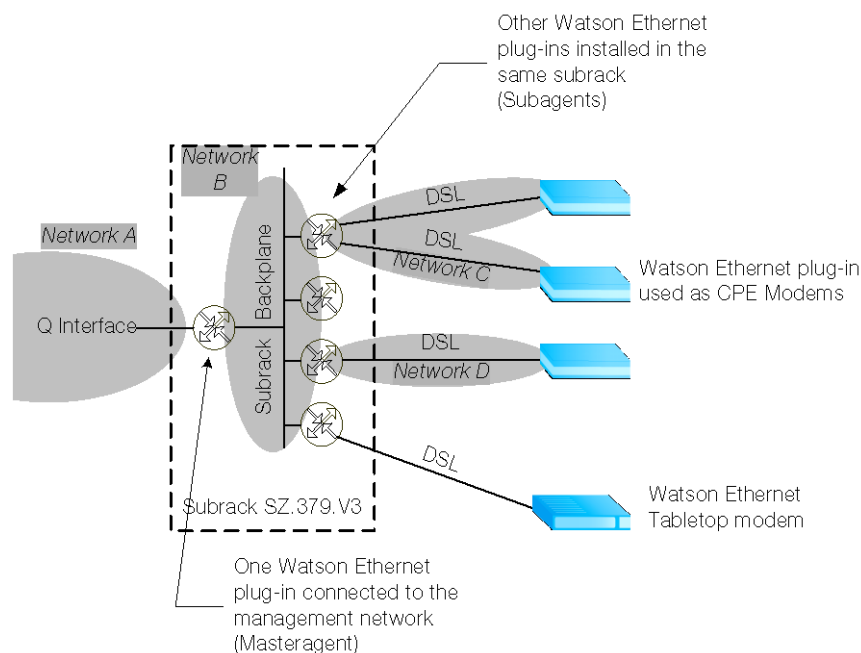


Figure 3-18: IP networks for Management

In a Watson Ethernet system where several plug-in cards are installed in a subrack and where the DSL spans are also terminated with Watson Ethernet plug-in cards the following subnetworks must be configured:

- one subnetwork (Network A) for the Q – Interface on the front panel of the modem which is connected to the management system
- one subnetwork (Network B) for the subrack connecting all backplane interfaces
- one subnetwork for all DSL spans of a plug-in. Within a subrack the DSL spans of each plug-in must be in separate subnetworks (Networks C, D in Figure 3-18)

The Watson Ethernet tabletop modem does not have management routing functions. No subnetwork has to be defined for DSL spans that are terminated with the tabletop modem.

### 3.5.4 Management VLAN configuration

The Watson Ethernet plug-in modems support Ethernet inband management, i.e. it is possible to manage the modems through the Ethernet user interfaces or through the Ethernet payload carried over the DSL.

Ethernet inband management traffic is always routed through the internal management port MGMT3 that connects the plug-in controller to the Ethernet bridge.

To configure Ethernet inband management and to isolate management traffic from user traffic a dedicated management VLAN has to be set up. By default the MGMT3 port is member of VLAN 4094, but it is possible to use a VID different from 4094 for management traffic.

To access MGMT3 from a user interface this user interface (ETH1 .. ETH4) has to be member of the management VLAN. To access MGMT3 through the DSL Ethernet payload the corresponding DSL span (DSL1 .. DSL4) has to be member of the management VLAN.

### 3.5.5 Transparent bridging with inband management

The Watson Ethernet plug-in supports a special bridging mode that allows for in-band management in combination with transparent bridging. This bridging mode uses stacked VLAN tags for packets from the Ethernet user interfaces and single-tagged packets for management information on the DSL interfaces:

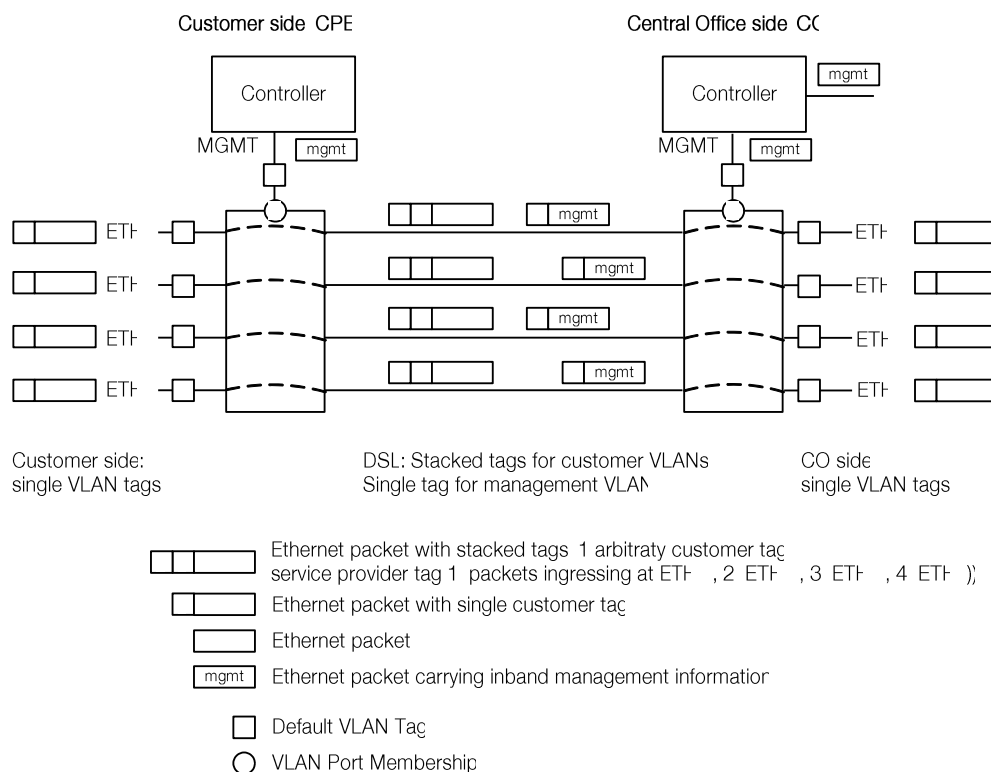


Figure 3-19: Transparent bridging with inband management

Management packets ingressing at the Q – interface of the Central Office are routed to port MGMT3 of the management controller. There they are tagged with the default VLAN tag m and are sent as single-tagged packets over the DSL to the Watson Ethernet plug-in at the Customer side.

At the Customer side the outer tag is stripped off, leaving management packets untagged. VLAN switching will send these packets to port MGMT3 which is member of VLAN m.

Single-tagged packets ingressing at ports ETH1 .. ETH4 of the CPE modem will be tagged with an outer tag s1 .. s4 depending on their ingress port and then sent over the DSL. At the CO side the outer tag is stripped off, leaving single-tagged packets egressing the CO modem at ETH1 .. ETH4.

Transparent bridging with inband management is configured with the Monitor command `BRIDGEMODE 3`. This bridging mode must be enabled on both central office (CO) and customer (CPE) modems.

### 3.6 G.826 Performance Monitoring

Watson Ethernet modems support performance monitoring as specified in ITU-T G.826. The G.826 error performance parameters provide quantitative performance information of a specific loop. They are intended to be used for long-term evaluation of operating DSL spans.

The evaluation of the G.826 error performance parameters is based on CRC (Cyclic Redundancy Check) error detection. The estimation of a bit-error rate is not within the scope of the G.826 calculations.

On the DSL side, six CRC6 check bits are generated per DSL frame for each channel and direction. The software counts block errors and evaluates the error performance according to ITU-T G.826 using these CRC6 bits.

G.826 statistics are available with the `G826 Monitor` command.

### 3.7 Test loops

Test loops can be activated via the Monitor or SNMP. Loop 1 will initiate a loopback on a local Ethernet interface, Loop 2 will initiate a loopback on a remote DSL interface. Only one test loop can be active at a given time.

Activation of a test loop will deactivate any previous loop. A system reset will deactivate any test loop. A non-urgent alarm is raised while any loop is active.

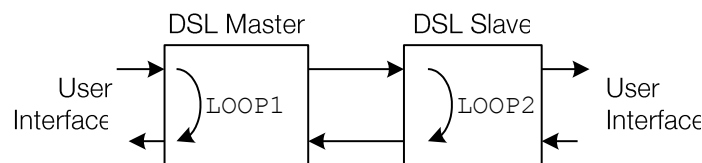


Figure 3-20: Test Loops controlled by the DSL Master

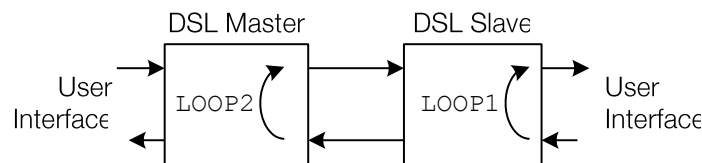


Figure 3-21: Test Loops controlled by the DSL Slave



- Notes:
- *The looped-back Ethernet packets egress the modems from the same port they were sent to and have the same source and destination addresses they were sent with. While Ethernet testing equipment can handle this situation it might be very confusing for normal Ethernet ports or Ethernet bridges.*
  - *The Watson Ethernet tabletop modems operated as DSL slave can only control LOOP1.*

## 3.8 Password protection

The Watson Ethernet modems feature password protection to management functions to prevent unauthorized access e.g. on a modem that is installed at a customer site but is owned and managed by the service provider.

Password protection is global i.e. once the correct password is entered access to all commands is granted.

By default password protection is disabled. To enable it use the `SET PASSWORD` command to define a password and then use the `LOGOFF` command to lock access to the Monitor. Now Monitor access must be enabled by entering the password before any Monitor commands can be entered.

Once the password is entered all Monitor commands are available. The password has to be re-entered

- after each `LOGOFF`
- after 5 minutes of inactivity
- after a restart of the modem

Passwords can be changed with the `CHANGE PASSWORD` command. To disable password protection use the `CLEAR PASSWORD` command.

Password protection is only applied to access from the local RS-232 interface. Monitor access through the DSL EOC is never protected by the password. If a password has been lost then it can be reset through the DSL EOC with the `CLEAR PASSWORD` and `SET PASSWORD` commands.

Of course this is only possible if the modem who's password has been lost is configured as DSL slave. If it is configured as DSL master then no remote access through the DSL EOC is possible. In this situation the modem can be configured as DSL slave with the `DSL_SLAVE` command which can be entered at the prompt for the password. After `DSL_SLAVE` the modem will be reconfigured as DSL slave and the password can be reset from the DSL master as described above.



## 4.1 Plug-in

Each plug-in is fed via the subrack backplane with dual -48VDC (referenced to 0VDC of the exchange battery). The plug-in generates the used voltages on-board.

Additionally, the plug-in is fed over the backplane with an auxiliary +5VDC supply (referenced to ground) generated on the ACU. The only purpose of this voltage is to drive the alarm circuitry on each plug-in, even in the case of a failure of the plug-in onboard powering circuitry

## 4.2 Tabletop

The tabletop modem is normally powered locally from an AC/DC adapter with 48VDC output. Power adapter SZ.410.080.V1E is available from Schmid Telecom to power the tabletop modem.

**Caution:** *Only power sources below maximum hazardous energy levels according IEC 60950-1 chapter 1.2.8.10 may be used as local power source. The insulation voltage of the power source must support elevated insulation voltage according to EN 60950-1 (at least 4 KV insulation). The power adapters available from Schmid Telecom fulfill these requirements.*

**Caution:** *Do not connect a 48VDC supply directly to the "AC/DC adapter" connector. High voltage transients from the DSL line may damage the modem or other equipment connected to the battery. A DC/DC converter with 4kV transient isolation voltage must be used in this case.*

**Caution:** *The local supply voltage input is protected against reversal of polarity but not fused. Appropriate fusing has to be done externally.*

The tabletop modem can also be powered through the DSL span from to a Watson TDM plug-in modem with remote powering functions. Switching between local and remote powering is done automatically with local power taking precedence over remote power feeding.

**Note:** *The Watson Ethernet plug-in does not support remote powering of a tabletop.*

The ground of the tabletop modem is normally floating when referenced to earth. A ground connector (Faston type) is available on the rear panel of the modem.



# 5

# LEDs and Alarms

## 5.1 Plug-in LEDs

The plug-in is equipped with four LEDs. Depending on the currently selected CARDMODE the LEDs are mapped to local and remote status as follows:

Cardmode								
1 (4 x 1p)			2 (2 x 2p)		3 (1 x 2 + 2x1p)		4 (1 x 4p)	
LED	Span	Function	Span	Function	Span	Function	Span	Function
A	DSL1	Local Status	DSL1	Local Status	DSL1	Local Status	DSL1	Local Status
B	DSL 2	Local Status	DSL1	Remote Status	DSL1	Remote Status	DSL1	Remote Status
C	DSL 3	Local Status	DSL3	Local Status	DSL3	Local Status	-	Off
D	DSL 4	Local Status	DSL3	Remote Status	DSL4	Local Status	-	Off

Table 5-1: LED mapping for plug-in

The "Local Status" LED indicates the status of the local end of the DSL span (STU-C side). The "Remote Status" LED indicates the status of the remote end of the DSL span (STU-R side). If the modem is configured as DSL slave then only the local status is indicated, the "Remote Status" LED is switched off.

### 5.1.1 Plug-in LED Indications

Status	LED
Power failure	Off
Hardware / Software failure	blinking red
Normal operation (Master)	Green
Normal operation (Slave)	Green
Non-urgent alarms (local/remote) or loop active	Amber
Urgent alarms (local/remote)	Red

Table 5-2: Plug-in LED indications

## 5.2 Tabletop LEDs

### 5.2.1 Front LEDs

The tabletops are fitted with two LEDs labeled "1" and "2" ("Local" and "Remote" on some older modems, "1" is equivalent to "Local" and "2" to "Remote"). The LEDs display the local status and (if the tabletop is configured as a DSL master) the remote status:

<b>Status</b>	<b>LED "1"</b>	<b>LED "2"</b>
Power failure	Off	Off
Hardware / Software failure	Blinking red	Off
Memory Selftest Failure (Watson Ethernet tabletop only)	Off	Red
Normal operation (Master)	Green	Green
Normal operation (Slave)	Green	Off
User Interface Activity on Tx (Slave)	Green	Blinking Green
User Interface Activity on Rx (Slave)	Green	Blinking Amber
Non-urgent alarms (local/remote) or loop active	Amber	Amber (off for Slave)
Urgent alarms (local/remote)	Red	Red (off for Slave)

Table 5-3: Tabletop front LED indications

During Firmware download the LEDs are used as follows:

<b>Download Status</b>	<b>LED "Local"</b>	<b>LED "Remote"</b>
Flash erase	blinking red	Off
Download in progress	blinking green	Off
Download completed	blinking amber	Off
Activating remotely downloaded firm-ware	Off	blinking amber

Table 5-4: Tabletop front LED indications during firmware download

## 5.2.2 Back LEDs

The Watson Ethernet tabletop modem is fitted with 2 LEDs on the backpanel indicating the status of the Ethernet interface: (Activity ACT and High-Speed HS indicator):

Status LED	ACT (Green)	HS (Amber)
Link down	Off	Off
Link up, 10 Mbps, no activity	On	Off
Link up, 100 Mbps, no activity	On	On
Link up, 10 Mbps, activity	Blinking	Off
Link up, 100 Mbps, activity	Blinking	On

Table 5-5: Tabletop backpanel Ethernet LED indications

## 5.3 Alarm Conditions

An alarm condition is displayed on the LEDs if one of the following conditions occurs:

### **Urgent alarm (red):**

- Hardware or software failure (blinking)
- Loss of signal / frame alignment on the DSL side (LOSW)
- DSL block-error-rate according G.826  $\geq$  30% (BER-H)
- Plug-in only: overcurrent detected in remote power feeding circuit (CLD)

### **Non-urgent alarm (amber):**

- DSL block-error-rate according G.826  $>$  15% (BER-L)
- Either Loop 1, Loop 2, Analog Loopback, or the Regenerator Loopback is active (LOOP1, LOOP2, BERT)
- Link integrity alarm on Ethernet user interface
- Alarm cut off is activated (ACO)

## 5.4 Alarm Relays

### 5.4.1 Plug-in

Plug-in alarms can be signaled through relay contacts present on the ACU2R which is normally installed in the subrack. Two relays are present on the ACU2R for urgent and non-urgent alarms.

*Note: The ACU-48R is not compatible with the Watson Ethernet plug-in.*

Under normal plug-in power conditions the two output stages of each plug-in are controlled by its microcontroller. In case of a power failure on an plug-in, both the "Urgent" and "Non-urgent" alarms will be activated on the ACU. (The ACU gene-

rates an auxiliary +5 V<sub>DC</sub> which is used to pull-up the open collector alarm output stages of the plug-ins.)

Both minirack mechanics and the plug-in tabletop housing have urgent and non-urgent alarm relay contacts.

**Urgent Alarm:**

- At least one of the plug-in – LEDs displays an urgent alarm
- Power failure of any one of the plug-ins
- Power failure of the auxiliary +5V<sub>DC</sub> auxiliary supply on the ACU
- Power failure of both –48V<sub>DC</sub> supplies

**Non-urgent Alarm:**

- At least one of the plug-in – LEDs displays a non-urgent alarm and none of the plug-in – LEDs displays an urgent alarm
- Power failure of any one of the plug-ins
- Power failure of the auxiliary +5V<sub>DC</sub> auxiliary supply on the ACU
- Power failure of one of the –48 V<sub>DC</sub> supplies

## 5.5 Initialization Errors

At system startup, various hardware selftests are performed. If any initialization errors occur, the startup procedure will be aborted and appropriate error messages are sent to the serial interface (RS-232).

On the Watson Ethernet tabletop an initialization error code in hexadecimal representation is sent to the serial interface:

Error Code	Initialization Error
0x0001	Microcontroller RAM test failure
0x0002	EEPROM test failure
0x0004	Framer initialization failure
0x0008	DSL transceiver failure (Loop A)
0x0010	DSL transceiver failure (Loop B)
0x0080	Ethernet interface initialization failure
0x8000	Software Copyright Protection Error

Table 5-6: Software Initialization Errors (tabletop modem).

If several errors are detected simultaneously then the error code displayed is a combination (OR) of the individual error codes, e.g. 0x83 will be displayed if during selftest the RAM test fails, the EEPROM test fails and the Ethernet interface cannot be initialized.



## 6.1 Introduction

For configuration and diagnostics the modems have a serial interface to connect a terminal or a PC with terminal emulation. The serial interface is available on the backplane of the tabletops, on the ACU, the minirack mechanics and the plug-in tabletop housing.

A modem configured as DSL slave is also accessible from the master side through the DSL EOC.

The Monitor terminal or terminal emulation must be VT100 compatible and must be configured as follows:

- 9600 baud, asynchronous
- 8 bits, no parity, one stop bit
- No new line on carriage return (i.e. no line feed on carriage return)
- XON/XOFF enabled

*Notes:*

- *Between plug-in and the terminal the XON/XOFF protocol is used for flow control. In order to re-enable communication with an plug-in occasionally left in XOFF state, it is recommended to start each session with Ctrl-Q (=XON) followed by an ECHO command.*
- *If you use the HyperTerm terminal emulator delivered with Windows® then you must configure HyperTerm for VT100 emulation in the "Settings" tab of the connection properties (File – Properties).*

## 6.2 Addressing of Plug-ins

### 6.2.1 Plug-in in Subrack

The Monitor terminal connects through the ACU to a serial bus on the subrack backplane which is accessible by all plug-ins.

At any time, only one of the plug-ins in the subrack can be logically connected to the Monitor interface. The appropriate plug-in interface is addressed (i.e. selected) according to its physical position in the subrack, starting with the leftmost slot number 01 and ascending rightwards to number 12. To select a plug-in in slot number *nn* just type *%nn* in the terminal, e.g. to select the plug-in in slot 7 type *%07*.

Device	Slot	Slot	Slot	Slot	Slot	Slot	Slot	Slot	Slot	Slot	Slot	Slot	ACL	PSE
Address	%01	%02	%03	%04	%05	%06	%07	%08	%09	%10	%11	%12		

Figure 6-1: Plug-in Addressing Scheme

To see which units in a rack are available, you can use the `ECHO` command. Each unit will respond with its associated slot number (`%SN`).

The response could be: `%01 %03 %08 %10 %11`

**Notes:**

- *The `ECHO` command is not echoed on the terminal*
- *The selection command (`%nn`) is not echoed on the terminal*
- *Each command must be terminated by a carriage return.*

### 6.2.2 Plug-in in Minirack mechanics or tabletop housing

No addressing procedure is required in these cases. After power-up the Monitor menu appears directly.

### 6.2.3 Tabletop

There is no addressing procedure required for Tabletop modems. After power-up of a Tabletop modem the Monitor menu appears.

## 6.3 Naming of ports

Many commands of the Monitor relate to a particular port. These ports are identified as follows:

Port	Name
Bridge port of 1 <sup>st</sup> DSL span	DSL1
Bridge port of 2 <sup>nd</sup> DSL span	DSL2
Bridge port of 3 <sup>rd</sup> DSL span	DSL3
Bridge port of 4 <sup>th</sup> DSL span	DSL4
1 <sup>st</sup> Ethernet user interface	ETH1
2 <sup>nd</sup> Ethernet user interface	ETH2
3 <sup>rd</sup> Ethernet user interface	ETH3
4 <sup>th</sup> Ethernet user interface	ETH4
1 <sup>st</sup> Management Ethernet interface (Q)	MGMT1
2 <sup>nd</sup> Management Interface (Backplane)	MGMT2
3 <sup>rd</sup> Management Interface (Bridge)	MGMT3

Table 6-1: Port naming

Cf. also Figure 3-4.

The number of DSL spans varies depending on the card configuration set by the `CARDMODE` command, cf. Table 3-1.

## 6.4 Telnet Access

To use a remote Monitor through Telnet on the Watson Ethernet plug-in you first have to configure the IP address of the plug-in through a monitor on the RS-232 interface with the `MGMTIP` command.

Then use any Telnet client to open a telnet session into the modem. You will see a Telnet welcome screen:

```

+-----+
|           Welcome to Watson Ethernet Quad LTU           |
| (C) by Schmid Telecom AG Zuerich, Switzerland |
+-----+

      OS/HW:  Linux ppc 2.4.20
      Nodename:  SzW5EthLtu

SzW5EthLtu login:

```

Enter username and password to display the Monitor Welcome Screen.

*Note:* The default username is `root`, the default password is `sz`. It is not possible to change these.

## 6.5 Monitor Command Structure

### 6.5.1 Welcome Screen

After connecting the Terminal/PC the welcome screen is shown with information about the modem type and Firmware Version, e.g.:

```

                Watson 5 SHDSL Ethernet
                ZRH01
                Monitor V3.0
Copyright (C) 2001-2006 by Schmid Telecom AG Zuerich, Switzerland

                +-----+
                |           Main Menu           |
                +-----+

                1. Performance management (PM)
                2. Fault and maintenance management (FMM)
                3. Configuration management (CM)
                4. Security and remote management (SM)
                5. Exit

LTU_01>

```

To select the desired sub-menu, type the appropriate number.

The available Monitor commands are described in chapter 7.

*Notes:*

- *The `Exit` command is only available on the plug-in if it is installed in a sub-rack or accessed via Telnet.*
- *To address another plug-in in the subrack after `Exit` type `%nn` (*nn* = slot number)*

### 6.5.2 Menus

The Monitor menu is structured in the following sub-sets:

Subset	Short-form
Performance management	PM
Fault and maintenance management	FMM
Configuration management	CM
Security and remote management	SM

Table 6-2: Monitor Command Subsets

### 6.5.3 Prefixes and Shortcuts

The available commands depend on the submenu currently active.

To access a command from a different submenu the command can be prefixed with the name of the submenu and a . (Dot), e.g. you can use `PM.G826 DSL1` to display the G.826 statistics for SHDSL span 1 while in the Configuration submenu. If the Performance Management submenu is active then `G826 DSL1` will display the G.826 statistics and `CM.CONFIG DSL1` will display the configuration of DSL span 1.

*Note:* *Prefixing is only available on the Watson Ethernet plug-in.*

The most popular commands are available in all submenus as shortcuts:

Command	Shortcut
CONNECT	CON
DIAGNOSTIC	DIA
DISCONNECT	DIS or <ESC> key

Table 6-3: Command Shortcuts

### 6.5.4 Tab completion

You can use tab completion to simplify typing of long commands. By typing the <TAB> character in after entering the first character(s) of a command word the Monitor will try to complete the command as much as possible. Example:

```
LTU_01_CM> SN <TAB> will do a partial completion of the command to
LTU_01_CM> SNMP
```

Typing now `C <TAB>` will complete the command to

```
LTU_01_CM> SNMPCOMMUNITY
```

- Notes:*
- *Tab completion is only possible for commands, not for parameters.*
  - *Tab completion is only available on the Watson Ethernet plug-in.*

### 6.5.5 Help

Typing `H` or `HELP` at any submenu will list all commands available in that submenu in alphabetical order. Typing `H Command` (or `HELP Command`) will display help for a particular command.

### 6.5.6 Command History

The Watson Ethernet plug-in keeps a command history. To recall a command recently entered use the up-arrow and down-arrow keys to scroll through the history of commands. Commands may be edited by using the DEL key and the cursor keys.

## 6.5.7 Continuous Displays

Some commands (`DIAGNOSTIC`, `G.826`, `BERT`) continuously update the screen with the latest information. These commands will stop updating the screen if a new command is entered that generates displays with more than one line. (e.g. `CONFIG`, `STATUS`, `ALARM`, `READBER`).

# 7

# Monitor Command Reference

---

## 7.1 Introduction

This chapter defines the Monitor command language. The language is made up of the following elements:

COMMAND	Commands are written in CAPITALS
KEYWORD	Keywords are written in CAPITALS
<i>Parameter</i>	Parameters are written in Italics. Replace the parameter with the actual value. Example: LINERATE n
<i>Parameter</i>   <i>Parameter</i> KEYWORD   KEYWORD	Choices are denoted with vertical bars  . In a choice group one of the parameters must be specified.
[ <i>Parameter</i> ] [ KEYWORD ]	Optional parameters are enclosed in [ brackets ]. Optional parameters can be specified but are not required.
{ Parameter-List }	A parameter list is enclosed in { braces }. A list of parameters is a sequence of parameters separated by one or more spaces.

Table 7-1: Command language elements

## 7.2 Configuration Management CM

### 7.2.1 General Commands

**ADMIN-NAME** [ **SYSTEM** *String* | **DSLx** *String* ]

Defines an administrative name for the system or for one of the DSL spans.

The administrative name of the system is displayed in the Monitor welcome screen, the administrative names of the DSL spans in the **STATUS** display. Use quotes (" ") to enter upper/lowercase administrative names.

The command **ADMIN-NAME** without parameters will display all currently configured administrative names.

*Note* This command is not available on the Watson Ethernet tabletop modem.

**ADMINSTATUS** *Port* **UP** | **DOWN**

Set the administrative state of a port.

**Parameters:**

<i>Port</i>	Port (DSL1 .. DSL4, ETH1 .. ETH4)
UP, DOWN	Administratively enable (UP) or disable (DOWN) the port.

Ports that are set to **DOWN** are blocked for traffic and do not create any alarms. The currently active administrative status is displayed in the **STATUS** and **STATUS ETHERNET** commands.

- Notes*
- *Setting the ADMINSTATUS of a DSL span to DOWN deactivates the DSL physical layer. Three alarms (SNMP Traps) are generated in this situation: Link Down alarm, SNR margin alarm and Loop attenuation alarm*
  - *Setting the ADMINSTATUS of an Ethernet port to DOWN deactivates the Ethernet physical layer. Other devices connected to this port will generate a link integrity alarm.*
  - *This command is not available on the Watson Ethernet tabletop modem.*



**CARDMODE [ mode ]**

The Watson Ethernet plug-in can be configured flexibly to support 1/2/4 pair operation. This is done with the `CARDMODE` command. Entering `CARDMODE` without any parameter will display the current plug-in mode:

```

LTU_01_CM> CARDMODE
Current cardmode: 4x1 pair (mode 1)
Bridge Port           Wire Pair
~~~~~
      DSL1 <-----> a1a2
      DSL2 <-----> b1b2
      DSL3 <-----> c1c2
      DSL4 <-----> d1d2
    
```

Available `CARDMODES`:

1	4x1p, four independent 1-pair systems
2	2x2p, two independent 1-pair systems
3	1x2p + 2x1p, one 2-pair and two 1-pair systems
4	1x4p, one 4-pair system

When changing the cardmode, the newly configured DSL spans will be reset and their configuration set to the default configuration of the new mode as defined in Table 7-2. Note that only the DSL defaults are set, the Ethernet interface configuration is not changed by `CARDMODE`. For security reasons, the command must be confirmed.

The Watson Ethernet tabletops have no card mode.

### DEFAULT Configuration

The `DEFAULT` command sets a default configuration. The following default settings are available on the plug-in:

Parameter	DEFAULT 0	DEFAULT 1	DEFAULT 2
<b>SHDSL</b>			
Master/Slave	Master	Master	Master
Autorestart	Enabled	Enabled	Enabled
Power Backoff	Enabled	Enabled	Enabled
Linerate per span	8'192 kbit/s	4'096 kbit/s	2'048 kbit/s
Operating Mode	1 x 4 Pair	2 x 2 Pair	4 x 1 Pair
DSL Sync rate per pair	2'056 kbit/s	2'056 kbit/s	2'056 kbit/s
<b>Ethernet</b>			
Interface mode	Auto	Auto	Auto
Flow control	Auto	Auto	Auto
<b>VLAN Settings</b>			
Bridgemode	1 (VLAN Bridging)		
VLANs	VLAN 1: ETH1, DSL1	VLAN 1: ETH1, DSL1 VLAN 3: ETH3, DSL3	VLAN 1: ETH1, DSL1 VLAN 2: ETH2, DSL2 VLAN 3: ETH3, DSL3 VLAN 4: ETH4, DSL4
	VLAN 4094: MGMT3 All ports are configured as untagged		
<b>CoS Settings</b>			
Default Priority	Q1 on all ports		
Priority source	IEEE THEN IP on all ports		
Priority mapping	L2 Priority: 0 1 2 3 4 5 6 7 Queue : Q2 Q1 Q1 Q2 Q3 Q3 Q4 Q4		

Table 7-2: DEFAULT values (plug-in)

For the Watson Ethernet tabletop modems the `DEFAULT` values are as follows:

Parameter	DEFAULT 0	DEFAULT 1	DEFAULT 2
<b>SHDSL</b>			
Autorestart	Enabled	Enabled	Enabled
Power Backoff	Disabled	Disabled	Disabled
Payload Rate	2048 kbit/s	2304 kbit/s	4608 kbit/s
Operating Mode	1 Pair	1 Pair	2 Pairs
Line Rate	2056 kbit/s	2312 kbit/s	2312 kbit/s
<b>Ethernet</b>			
Bit Rate	2048 kbit/s	2304 kbit/s	4608 kbit/s
FDX	Auto	Auto	Auto
Flow	Auto	Auto	Auto
Filtering	On	On	On
Aging Time	300s	Remote	Remote
Scheduling	Strict	Strict	Strict
Ratelimit	Off	Off	Off

Table 7-3: `DEFAULT` values (tabletop)

*Notes*

- *The default configurations are given for DSL master mode. If the modem is in DSL slave mode then the DSL linerate is determined by the DSL master and not by the `DEFAULT` command.*
- *The factory setting can be loaded using the `DEFAULT 2` command. All DSL plug-ins and tabletops are delivered with this configuration (plug-ins as DSL master, tabletops as DSL slave).*
- *The Master/Slave and Remote Powering settings are not affected by the `DEFAULT` command*

## 7.2.2 DSL Configuration (Plug-in)

### **BACKOFF *Span* ON | OFF**

Set SHDSL Power Back-Off function ON / OFF for a particular DSL span. The default setting is BACKOFF ON.

### **CONFIG DSL *Span***

The CONFIG command displays the current configuration of a DSL spans of the unit. You can also use CONFIG *Span* as a shortcut.

```
LTU_01_CM> CONFIG DSL1
~~~~~
Local Configuration of SHDSL Span No 1
~~~~~
Master/Slave      : Master
Autorestart       : Enabled
Power Backoff     : Enabled
Payload Rate (max): 2048 kbit/s
Wire Pairs        : 1
Line Rate         : 2056 kbit/s
Line Code         : PAM-16
```

### **FALLBACK *Span* [ *timeout* | OFF ]**

Activates or deactivates single-pair fallback for a DSL span. The *timeout* value specifies the number of minutes the STU-C tries to restart a multipair span before reverting to single-pair fallback. It is recommended to use 3 minutes as *timeout* value.

FALLBACK *Span* will display the current configuration of single-pair fallback of a span.

*Note* It is not required to configure FALLBACK mode on the STU-R side. The entire fallback process is controlled by the STU-C

### **LINERATE *Span n p***

Set line rate for a DSL span

#### **Parameters:**

*Span* the DSL span

*n* number of DSL timeslots to be transmitted ( $3 \leq n \leq 89$ )

*p* number of constellations used:  $p = 16$  for TC-PAM 16,  $p = 32$  for TC-PAM 32. If possible (i.e. consistent with *n*) the DSL span will be configured accordingly. If *p* is omitted then PAM-16 will be configured when possible and PAM-32 otherwise.

### **MASTER *Span* ON | OFF**

Set DSL master mode ON/OFF for a DSL span. On the Watson Ethernet plug-in each DSL span can be configured individually as master or slave.

**RESTART Span ON | OFF**

Set Autorestart ON / OFF for a DSL span

### 7.2.3 DSL Configuration (Tabletop)

There is only one DSL interface available on the tabletop modem. The DSL configuration commands are somewhat simplified.

**BACKOFF ON | OFF**

Set SHDSL Power Back-Off function ON / OFF.

**CONFIG**

Shows the current configuration (DSL and Ethernet ports)

```
NTU_CM_REMOTE> CONFIG
~~~~~
Local Configuration                               Id : Ethernet
~~~~~
ETH
  Bit Rate      : 32 x 64 = 02048 kbit/s
  FDX           : Auto
  Flow         : Auto
  Filtering     : On
  Aging Time   : 300s
  Scheduling    : WFQ
  Provider Tag : ETH:      Off    DSL:      Off
  TPID         : ETH: 0x88A8  DSL: 0x88A8
  Prio Source  : ETH: IPTHENIEEE DSL: IPTHENIEEE
  Default VLAN : ETH: 0x001   DSL: 0x001
  Default Prio : ETH: 7       DSL: 7
  Ratelimit    : Off
SHDSL
  Master/Slave : Slave
  Autorestart  : Enabled
  Power Backoff : Disabled
  Payload Rate : 02048 kbit/s
  Operating Mode : 2 Pair, plesiochronous
  Line Rate    : 01032 kbit/s
  Wetting Current : Off
Management
  Admin Name   : (void)
```

**LINERATE n i**

Set line rate:

**Parameters:**

- n denotes the number of DSL timeslots to be transmitted ( $3 \leq n \leq 89$ )
- i 1 denotes the Z-bits automatically used to increase the EOC bandwidth of about 3.2 kbit/s by 8 kbit/s ( $i = 0$  or  $1$ , default  $i = 1$ )

**Notes**

- *The LINERATE command is only available if the modem is acting as a DSL master (MASTER ON). If the modem is configured as DSL slave then the line-rate is set by the master.*
- *Use of Z-bits for the EOC and asymmetric PSD operation is provided for compatibility of the Watson Ethernet tabletop with Watson TDM modems, cf. [8]. The Watson Ethernet plug-in does not support these features.*

**MASTER ON | OFF**

Set DSL master mode ON/OFF.

**MODE 1 | 2**

Select DSL operating mode:

1: 1 pair operation

2: 2 pair operation

**RESTART ON | OFF**

Set Autorestart ON / OFF.

**WETTING ON | OFF**

Set wetting current sink ON / OFF.

## 7.2.4 Ethernet Configuration (Plug-in)

**FDX Ethernet-Port mode**

Sets duplex mode and speed of an Ethernet port (ETH1 .. ETH4).

Possible values for *mode*:

AUTO Autonegotiation of parameters

10H 10 MBit/s, half duplex

10F 10 MBit/s, full duplex

100H 100 MBit/s, half duplex

100F 100 MBit/s, full duplex

**FLOW Ethernet-Port AUTO | ON | OFF**

Ethernet flow control:

AUTO Auto negotiation

ON flow control enabled

OFF flow control disabled

Flow control is implemented with PAUSE frames in full duplex mode and with backpressure (forced collisions) in half duplex mode.

**Note** *It is not possible to auto-negotiate flow control without auto-negotiating speed and duplex modes. Setting FDX to a value different from AUTO and then setting FLOW to AUTO results in disabling flow control, i. e. has the same effect as FLOW OFF.*

**MDS Ethernet-Port {Ethernet-Port} [ ON | OFF ]**

Enables/disables MAC Defect Signaling for an Ethernet user interface.

MDS *Ethernet-Port* will display the current state of MDS for a particular interface.

MDS can be controlled for several interfaces with a single command, e.g.

MDS ETH1 ETH2 ETH3 ETH4 ON  
will enable MDS on all four Ethernet user interfaces.

## 7.2.5 Ethernet Configuration (Tabletop)

### **BITRATE** *n*

Defines the bandwidth used on the DSL span for Ethernet data.

*n* number of 64 kbit/s timeslots (0 .. 178, FULL)

If the Watson Ethernet tabletop modem is connected to the Watson Ethernet plug-in modem then the **BITRATE** must be exactly equal to the DSL **LINERATE** in single pair operation or the **BITRATE** must equal 2 \* **LINERATE** in two-pair operation.

If the Watson Ethernet tabletop modem is used in a back-to-back configuration (or connected to a Watson TDM modem with E1 or V35 interfaces) then the **BITRATE** must be less or equal than the **LINERATE** (or 2 \* **LINERATE** in 2-pair operation).

When the bitrate configured with the **BITRATE** command exceeds the available DSL linerate or the **BITRATES** on both ends of the link to not match then an appropriate warning is displayed in the Monitor of the tabletop modem.

Cf. chapter 3.2

When **BITRATE** = **FULL** the Ethernet interface is automatically configured to fill up the DSL payload with the maximum possible Ethernet packets. This mode is very usefull when the Watson Ethernet tabletop modem is connected to the Watson Ethernet plug-in modem.

### **CONFIG**

Displays the current configuration of DSL and Ethernet ports. Cf. 7.2.3.

### **FDX** *mode*

Ethernet interface operating mode. Possible values for *mode*:

**AUTO** Auto negotiation (factory default)  
**10H** 10 Mbps half duplex mode  
**10F** 10 Mbps full duplex mode  
**100H** 100 Mbps half duplex mode  
**100F** 100 Mbps full duplex mode

### **FLOW** **AUTO** | **ON** | **OFF**

Ethernet flow control:

**AUTO** Auto negotiation  
**ON** flow control enabled  
**OFF** flow control disabled

Flow control is implemented with **PAUSE** frames in full duplex mode and by backpressure (forcing collisions) in half duplex mode.

**HDLCTAG ON | OFF**

- ON Ethernet frames are transmitted over the DSL span with Cisco HDLC framing
- OFF Ethernet frames are transmitted with compressed HDLC framing. This setting must be used if the Watson Ethernet tabletop is connected to the Watson Ethernet plug-in.

Cf. chapter 3.2

## 7.2.6 Ethernet Bridging Configuration (Plug-in)

**AGING [ Time ]**

Defines the aging time for all entries in the address learning database of the Ethernet bridge.

**Parameter:**

Time Aging time in seconds: 16 .. 4'000

AGING without parameters will display the current aging time.

**BRIDGEMODE [ Mode ]**

Sets the Ethernet bridge mode. Cf. 3.2.2

**Parameter:**

- 1 VLAN bridging: bridging is based on 802.1Q based VLAN tags
- 2 Transparent bridging (port-based)
- 3 Transparent bridging with inband management cf. 3.5.5

BRIDGEMODE without parameter will display the currently active Bridgemode.

**CONFIG ETHERNET *Ethernet-Port***

Shows the current configuration of an Ethernet port:

```
LTU_01_CM> CONFIG ETHERNET ETH1
~~~~~
Local Configuration of Bridges Ethernet Port ETH1
~~~~~
AutoNegFDX      : auto
FlowControl     : off
Doubletagging   : off
DefaultVlanId   : 1
DefaultPrio     : Q1
VlanList        : egress tagged   : -
                  egress untagged : 1
Loop            : Off
PrioSrc         : IEEEETHERNIP
```

**FLT [ ON | OFF ]**

Bridge filtering mode (global for the entire bridge):

- ON MAC address filtering enabled. Only broadcast packets and packets with destination addresses known to be on the Ethernet segment of a port will be forwarded to this port. Address filtering is VLAN aware.



OFF MAC address filtering disabled. All Ethernet packets are transferred transparently to all Ethernet interfaces.

Typing `FLT` without argument displays the current configuration

## 7.2.7 Ethernet Bridging Configuration (Tabletop)

### AGING [ *Time* ]

Defines the aging time for all entries in the address learning database of the Ethernet bridge.

#### Parameter:

`Time` Aging time in seconds: 0 .. 3825

AGING without parameters will display the current aging time.

### FLT [ ON | OFF ]

Bridge filtering mode (global for the entire bridge):

ON MAC address filtering enabled. Only broadcast packets and packets with destination addresses known to be on the Ethernet segment of a port will be forwarded to this port. Address filtering is VLAN aware.

OFF MAC address filtering disabled. All Ethernet packets are transferred transparently to all Ethernet interfaces.

Typing `FLT` without argument displays the current configuration

## 7.2.8 VLAN Configuration (Plug-in)

### CONFIG VLAN

VLAN without parameters displays the current VLAN configuration:

```

LTU_01_CM> CONFIG VLAN
~~~~~
VLAN-Id  FID    ETH          DSL          MGMT Name
          1* 2* 3* 4*    1* 2* 3* 4*    3*
~~~~~
      1    1    U    -    -    -    T    -    -    -    -    VLAN-1
      2    2    -    U    -    -    -    T    -    -    -    VLAN-2
      3    3    -    -    U    -    -    -    T    -    -    VLAN-3
      4    4    -    -    -    U    -    -    -    T    -    VLAN-4
    4094   16    -    -    -    -    -    -    -    -    U    VLAN-4094
~~~~~
Ports:          ETH1  ETH2  ETH3  ETH4  DSL1  DSL2  DSL3  DSL4  MGMT3
Default Vlan:      1    2    3    4    1    2    3    4    4094
Default Prio:     Q1    Q1    Q1    Q1    Q1    Q1    Q1    Q1    Q4
Doubletagging:   off  off  off  off  off  off  off  off
Bridgemode:      2 (Transparent VLAN)

```

VLAN-ID

VLAN Id

FID

Forwarding database used for this VLAN

ETH 1-4	-	this port is not member of this VLAN
DSL 1-4	U	this port is member of this VLAN, egress frames will be sent without VLAN tag
MGMT3	T	this port is member of this VLAN, egress frames will be sent with VLAN tag
		Ports marked with * do not use VLANs for switching, but are configured for transparent bridging.
Name		Administrative name of this VLAN
Default VLAN		Default VLAN for this port
Default Prio		Default priority for this port
Doubletagging		Second VLAN tag will be added on egress
Bridgemode		Currently active Bridgemode

#### **DEFAULTVLAN *Bridge-Port VLAN-ID Priority***

Sets the default VLAN ID and the default priority for untagged packets entering the plug-in.

Bridge-Port	One of the bridge ports (ETH1 .. ETH4, DSL1 .. DSL4, MGMT3)								
VLAN-ID	VLAN ID to add to all untagged packets entering at this port (1 .. 4094). Note that the Bridge-Port must also be member of this VLAN – otherwise all untagged packets will be discarded.								
Priority	Default priority to assign to all untagged packets entering at this port. Four priority levels (Q4, Q3, Q2, Q1) are supported. Q4 is the highest priority level. If a VLAN tag is added to an Ethernet packet on egress then the priority levels are mapped to IEEE 802.1p bits as follows: <table> <tr> <td>Q4</td> <td>110</td> </tr> <tr> <td>Q3</td> <td>100</td> </tr> <tr> <td>Q2</td> <td>010</td> </tr> <tr> <td>Q1</td> <td>000</td> </tr> </table>	Q4	110	Q3	100	Q2	010	Q1	000
Q4	110								
Q3	100								
Q2	010								
Q1	000								

#### **DOUBLETAGGING *Bridge-Port Direction***

Enables/disables double tagging (stacked VLAN operation) on a bridge port, cf. 3.2.5.

Bridge-Port	One of the bridge ports (ETH1 .. ETH4, DSL1 .. DSL4)				
Direction	<table> <tr> <td>OFF</td> <td>Double tagging is disabled</td> </tr> <tr> <td>IN</td> <td>Double VLAN tags are expected on this port. The first (outer) VLAN tag will be removed before the packet is</td> </tr> </table>	OFF	Double tagging is disabled	IN	Double VLAN tags are expected on this port. The first (outer) VLAN tag will be removed before the packet is
OFF	Double tagging is disabled				
IN	Double VLAN tags are expected on this port. The first (outer) VLAN tag will be removed before the packet is				

	processed any further. If an incoming packet has a single tag then this tag will be removed. Untagged frames will not be modified.
OUT	An outer VLAN tag will be added to the packet sent over this port. Untagged packets will be sent tagged. Tagged packets will be sent double-tagged. The VLAN ID of the outer tag is defined by the default VLAN ID of the source port. The priority-bits of the extra tag are determined by the default priority of the ingress port. ( <code>DEFAULTVLAN</code> command).
InAndOut	Combination of IN and OUT

**VLANADD *VLAN-ID* { *Bridge-Port* T | U }**

Adds a bridge port to a VLAN. A list of bridge-ports can be specified in a single command:

<i>VLAN-ID</i>	VLAN Id (1 .. 4094)
<i>Bridge-Port</i>	ETH1 .. ETH4, DSL1 .. DSL4, MGMT3
T	T Ethernet frames will be sent from this port with VLAN tags
U	U Ethernet frames will be sent from this port without VLAN tags

*Note* Never configure port MGMT3 with VLAN tags. The Watson Ethernet plug-in controller does not support tagged Ethernet packets..

**VLANCREATE *VLAN-ID* *FID* *Administrative-Name***

Creates a new VLAN.

<i>VLAN-ID</i>	VLAN Id (1 .. 4094)
<i>FID</i>	Forwarding database to be used for this VLAN (1 .. 16).
<i>Administrative-Name</i>	An administrative name for this VLAN. Arbitrary text string.

**VLANDEL *VLAN-ID* { *Bridge-Port* }**

Removes a bridge port from a VLAN. A list of bridge-ports can be specified in a single command:

<i>VLAN-ID</i>	VLAN Id (1 .. 4094)
----------------	---------------------

*Bridge-Port*            ETH1 .. ETH4, DSL1 .. DSL4, MGMT3

**VLANFID** *VLAN-ID Forwarding-Database-ID*

Changes the forwarding database of a VLAN

*VLAN-ID*                    VLAN Id (1 .. 4094)  
*Forwarding-Database-ID*    Forwarding database to be used for this VLAN (0 .. 15)

**VLANNAME** *VLAN-ID Administrative-Name*

Changes the administrative name of a VLAN.

*VLAN-ID*                    VLAN Id (1 .. 4094)  
*Administrative-Name*        An administrative name for this VLAN. Arbitrary text string.

**VLANREMOVE** *VLAN-ID*

Removes all data configured for a particular VLAN. This command must be confirmed.

*VLAN-ID*                    VLAN Id (1 .. 4094)

## 7.2.9 VLAN Configuration (Tabletop)

**DEFAULTVLAN** *Bridge-Port VLAN-ID*

Sets the default VLAN ID and the default priority for untagged packets entering the tabletop.

*Bridge-Port*                One of the bridge ports (ETH, DSL)  
*VLAN-ID*                    VLAN ID to add to all untagged packets entering at this port (0 .. 4094).

**DEFAULTPRIO** *Bridge-Port Priority*

Sets the default priority for untagged packets entering the plug-in.

*Bridge-Port*                One of the bridge ports (ETH, DSL)  
*Priority*                    Default priority assign to Ethernet packets entering at this port. Eight priority levels (0 . . 7) are supported. 7 is the highest priority level. The mapping from DEFAULTPRIO which is set with this command to the queue priority is the same as for the IEEE tagged

frames (configurable using QMAP IEEE).

#### **PROVIDERTAG *Bridge-Port Mode***

Set provider tag on/off (stacked VLAN operation) on a bridge port.

Bridge-Port	One of the bridge ports (ETH, DSL)
Mode	Provider tag mode (ON, OFF)

If set to ON then an additional tag (S-Tag) will be added to Ethernet packets. The value of the tag is determined by the DEFAULTVLAN setting of this port. The TPID used in the outer tag is defined by the TPID setting.

#### **TPID *Bridge-Port tpid***

Set provider tag TPID on a bridge port.

Bridge-Port	One of the bridge ports (ETH, DSL)
tpid	TPID (0 .. FFFFH)

### 7.2.10 Class of Service Configuration (Plug-in)

#### **PRIOSRC *Bridge-Port Priority-Source***

Determines how packets are prioritized by the bridge:

<i>Bridge-Port</i>	One of the bridge ports (ETH1 .. ETH4, DSL1 .. DSL4)
<i>Priority-Source</i>	Priority source. Possible values:
IP	Use the IP TOS/DSCP bits to determine priority
IEEE	Use the IEEE 802.1p priority bits to determine priority
IPTHENIEEE	Use IP TOS/DSCP bits if present, IEEE 802.1p bits otherwise
IEEEETHENIP	Use IEEE 802.1p bits if present, IP TOS/DSCP bits otherwise
STATIC	Set priority bits to the default priority of the ingress port. The default priority is set with the DEFAULTVLAN command, cf. 7.2.8.

**QMAP Protocol-Layer Queue Codepoints**

Assigns Codepoints to priority queues. This command is global for all queues for all ports.

*Protocol-Layer* IEEE To classify according to IEEE 802.1p priority bits  
 IP To classify according to the IP TOS/DSCP field  
*Queue* Q1, Q2, Q3, Q4 . Q4 is the highest priority queue, Q1 has lowest priority  
*Codepoints* Space-separated List of priority codes (0 .. 7 for IEEE classification, 0 .. 63 for IP classification).

Several Codepoints can be associated to a queue with a single command, e.g.

```
LTU_01_CM> QMAP IEEE Q2 3 4 5
```

results in all packets with IEEE 802.1p priority bit combinations 011, 100 and 101 to be sent to queue 2.

QMAP without parameters displays the current CoS configuration:

```
LTU_01_CM> QMAP
~~~~~
Bridge IEEE Priority Mapping
~~~~~
VLAN-Tag Prio:    0    1    2    3    4    5    6    7
Priority Queue:   Q2   Q1   Q1   Q2   Q3   Q3   Q4   Q4
~~~~~
Bridge DSCP Priority Mapping
~~~~~
DSCP Q | DSCP Q | DSCP Q | DSCP Q | DSCP Q | DSCP Q | DSCP Q | DSCP Q
~~~~~
 0: Q1 | 1: Q1 | 2: Q1 | 3: Q1 | 4: Q1 | 5: Q1 | 6: Q1 | 7: Q1
 8: Q1 | 9: Q1 |10: Q1 |11: Q1 |12: Q1 |13: Q1 |14: Q1 |15: Q1
16: Q2 |17: Q2 |18: Q2 |19: Q2 |20: Q2 |21: Q2 |22: Q2 |23: Q2
24: Q2 |25: Q2 |26: Q2 |27: Q2 |28: Q2 |29: Q2 |30: Q2 |31: Q2
32: Q3 |33: Q3 |34: Q3 |35: Q3 |36: Q3 |37: Q3 |38: Q3 |39: Q3
40: Q3 |41: Q3 |42: Q3 |43: Q3 |44: Q3 |45: Q3 |46: Q3 |47: Q3
48: Q4 |49: Q4 |50: Q4 |51: Q4 |52: Q4 |53: Q4 |54: Q4 |55: Q4
56: Q4 |57: Q4 |58: Q4 |59: Q4 |60: Q4 |61: Q4 |62: Q4 |63: Q4
```

**RATELIMIT [ Bridge-Port Direction Rate-Profile ]**

Configures the rate limiter of a bridge port.

*Bridge-Port* One of the bridge ports (ETH1 .. ETH4, DSL1 .. DSL4, MGMT3)  
*Direction* IN (ingress rate limiters) or OUT (Egress rate limiter)  
*Rate-Profile* Rate limiter profile. A number between 1 and 56 for ingress rate limiting. A number between 2 and 8 for egress rate limiting. Cf. Table 3-4 and Table 3-5.  
 Use the *Rate-Profile* OFF to turn off rate limiting for this port.

RATELIMIT without parameters will display the current rate limiting configuration:

```

LTU_01_CM> RATELIMIT
~~~~~
Bridge Ethernet Port Ratelimits [kbit/s]
~~~~~
 Ethernet Port      Q1      Q2      Q3      Q4      OUT
~~~~~
 ETH1      not limited      -      -      -      not limited
 ETH2      not limited      -      -      -      not limited
 ETH3      not limited      -      -      -      not limited
 ETH4      not limited      -      -      -      not limited
 DSL1      not limited      -      -      -      2941
 DSL2      not limited      -      -      -      5882
 DSL3      not limited      -      -      -      5882
 DSL4      not limited      -      -      -      5882
 MGMT3     not limited      -      -      -      not limited

```

**SCHEDULING Policy**

Determines the scheduling policy of all ports in the bridge.

<i>Policy</i>	STRICT	Strict priority scheduling. Higher priority queues are emptied before any lower priority queue is processed. Note that strict priority scheduling can lead to starving of lower priority queues. Starving can be avoided either by rate limiting or by using WFQ scheduling.
	WFQ	Weighted fair queuing. Queues are emptied with weights 8:4:2:1 applied to the priorities.

SCHEDULING without parameters will display the currently active scheduling mode.

**7.2.11 Class of Service Configuration (Tabletop)**

**PRIOSRC Bridge-Port Priority-Source**

Determines how packets are prioritized by the bridge:

<i>Bridge-Port</i>	One of the bridge ports (ETH, DSL)
<i>Priority-Source</i>	Priority source. Possible values:
	IP            Use the IP TOS/DSCP bits to determine priority
	IEEE        Use the IEEE 802.1p priority bits to determine priority
	IPTHENIEEE Use IP TOS/DSCP bits if present, IEEE

	802.1p bits otherwise
IEEE THEN IP	Use IEEE 802.1p bits if present, IP TOS/DSCP bits otherwise
STATIC	Set priority bits to the default priority of the ingress port. The default priority is set with the <code>DEFAULTPRIORITY</code> command, cf. 7.2.9.

**QMAP Protocol-Layer Queue Codepoints**

Assigns Codepoints to priority queues. This command is global for all queues for all ports.

<i>Protocol-Layer</i>	IEEE To classify according to IEEE 802.1p priority bits
	IP To classify according to the IP TOS/DSCP field
<i>Queue</i>	Q1, Q2, Q3, Q4. Q4 is the highest priority queue, Q1 has lowest priority
<i>Codepoints</i>	Space-separated List of priority codes (0 .. 7 for IEEE classification, 0 .. 63 for IP classification).

Several Codepoints can be associated to a queue with a single command, e.g.

```
NTU_CM> QMAP IEEE Q2 3 4 5
```

results in all packets with IEEE 802.1p priority bit combinations 011, 100 and 101 to be sent to queue 2.

QMAP without parameters displays the current CoS configuration:

```
NTU_CM> QMAP
~~~~~
Bridge IEEE Priority Mapping:
~~~~~
 0 : Q2 | 1 : Q1 | 2 : Q1 | 3 : Q2 | 4 : Q3 | 5 : Q3 | 6 : Q4 | 7 : Q4 |
~~~~~
Bridge DSCP Priority Mapping:
~~~~~
 0 : Q1 | 1 : Q1 | 2 : Q1 | 3 : Q1 | 4 : Q1 | 5 : Q1 | 6 : Q1 | 7 : Q1 |
 8 : Q1 | 9 : Q1 | 10 : Q1 | 11 : Q1 | 12 : Q1 | 13 : Q1 | 14 : Q1 | 15 : Q1 |
16 : Q2 | 17 : Q2 | 18 : Q2 | 19 : Q2 | 20 : Q2 | 21 : Q2 | 22 : Q2 | 23 : Q2 |
24 : Q2 | 25 : Q2 | 26 : Q2 | 27 : Q2 | 28 : Q2 | 29 : Q2 | 30 : Q2 | 31 : Q2 |
32 : Q3 | 33 : Q3 | 34 : Q3 | 35 : Q3 | 36 : Q3 | 37 : Q3 | 38 : Q3 | 39 : Q3 |
40 : Q3 | 41 : Q3 | 42 : Q3 | 43 : Q3 | 44 : Q3 | 45 : Q3 | 46 : Q3 | 47 : Q3 |
48 : Q4 | 49 : Q4 | 50 : Q4 | 51 : Q4 | 52 : Q4 | 53 : Q4 | 54 : Q4 | 55 : Q4 |
56 : Q4 | 57 : Q4 | 58 : Q4 | 59 : Q4 | 60 : Q4 | 61 : Q4 | 62 : Q4 | 63 : Q4 |
~~~~~
NTU_CM>
```

**RATELIMIT CIR CBR**

Configures the ingress rate limiter of the Ethernet port.



<i>CIR</i>	Committed information rate -> ingress rate limit [in bps], [1..100M, OFF]. Use the <i>RATELIMIT OFF</i> to turn off rate limiting for this port.
<i>CBR</i>	Committed burst size -> buffer depth reserved for bursts [in bytes],

If the port has flow control enabled (i.e. PAUSE in full duplex mode or jamming in half duplex mode), flow control shall be triggered if the buffer is over the limit. In other modes the frames simply get discarded.

Due to the embedded memory size of 64 KB, the CBS is limited to ~32 KB. Larger values may be configured, but have no effect on Ethernet performance.

### **SCHEDULING *Policy***

Determines the scheduling policy.

<i>Policy</i>	STRICT	Strict priority scheduling. Higher priority queues are emptied before any lower priority queue is processed. Note that strict priority scheduling can lead to starving of lower priority queues. Starving can be avoided either by rate limiting or by using WFQ scheduling.
	WFQ	Weighted fair queuing. Queues are emptied with weights 8:4:2:1 applied to the priorities.

## 7.2.12 Spanning Tree Configuration

The Rapid Spanning Tree Protocol (RSTP) is available on the Watson Ethernet plug-in only. The Watson Ethernet tabletop modem is transparent for spanning tree bridge protocol data units (BPDUs) but will not interpret them.

### STP

Displays the current STP configuration. Data for both the bridge and for the root bridge are shown. The bridge is identified by its ADMIN-NAME.

```

LTU_01_CM> STP
~~~~~
Configuration of Rapid Spanning Tree Protocol
~~~~~
Spanning Tree protocol:                RSTP
Topology Change Count:                 0
Time Since Last Topology Change:      0 days, 0:01:11
~~~~~
Bridge:                                Root                BRIDGE-1
Bridge Priority:                        32768                32768
Bridge ID:          8000-00:80:6B:6B:04:86      8000-00:80:6B:6B:04:86
Hello Time (sec):                       2                    2
MaxAge (sec):                            20                   20
Forwarding Delay (sec):                  15                   15
Transmit Hold Count:                     6                    6
Cost to Bridge:                           0
Root Port:

```

Spanning Tree protocol	Currently active STP version (STP IEEE 802.1d or RSTP IEEE 802.1w)
Topology Change Count	Number of topology changes
Time Since Last Topology Change	Time since last topology change (days, h:m:s)
Bridge Priority	Bridge priority
Bridge ID	Bridge identifier (Bridge priority and MAC Address of interface MGMT3)
Hello Time	Hello timer. Determines how often the bridge broadcasts its hello message to other bridge.
MaxAge	Maximum age timer. Determines the maximum age of a BPDU
Forwarding Delay	Forwarding delay timer. Determines (in STP mode) the time before a port will change from learning to listening and from listening to forwarding states
Transmit Hold Count	Transmit hold counter. The maximum number of BPDUs transmitted per second.
Cost to Bridge	Path cost to the root bridge
Root Port	Selected root port. This is the port providing the lowest path cost to the root bridge. Left empty on the root bridge.

### **STP PROTOCOL OFF | STP | RSTP**

Enables/disables the STP protocol:

OFF	STP is disabled.
STP	Spanning Tree Protocol (IEEE 802.1D-1998)
RSTP	Rapid Spanning Tree Protocol (IEEE 802.1w and IEEE 802.1D-2004)

### **STP PRIORITY *prio***

Sets the priority of the bridge. Possible values for *prio* are 0 .. 61440 in increments of 4096. The bridge priority determines how the root bridge is selected in a spanning tree.: the root bridge will be the bridge with lowest numerical priority.

### **STP HELLO *time***

Sets the Hello time of the bridge. Possible values for *time* are 1 .. 10 (seconds). The Hello time determines how often the bridge broadcasts its Hello message to other bridges. This is also the delay for a port to transition from Blocking into Learning state in RSTP mode (unless a Rapid Transition takes place)

### **STP MAXAGE *time***

Sets the Maximum Age of BPDUs. Possible values for *time* are 6 .. 40. The age of a BPDU is incremented by one on each traversal through a bridge. BPDUs that reach MAXAGE are discarded.

A bridge port that was disabled (e.g. through a reset or a link integrity failure) will wait MAXAGE seconds before transiting into Learning state.

### **STP FORWARD *time***

Sets the Forwarding Delay timer. Possible values for *time* are 4 .. 30 (seconds). In STP mode the forwarding delay determines the time before a port will change from learning to listening and from listening to forwarding states.

### **STP TXHOLD *count***

Sets the transmit hold count. Possible values for *count* are 1.. 10. This is the maximum number of bridging protocol data units (BPDUs) transmitted per second.

**STP PORT**

Displays per-port configuration data for STP:

```

LTU_01_CM> STP PORT
~~~~~
Iface Port      Cost      Status      Designated      Designated
Name  ID          Port Edge PtP  Path Cost      Bridge ID  Port
~~~~~
ETH1  8001    200000    BLK  No  No      0 0000-00:00:00:00:00:00  0000
ETH2  8002    200000    BLK  No  No      0 0000-00:00:00:00:00:00  0000
ETH3  8003    200000    BLK  No  No      0 0000-00:00:00:00:00:00  0000
ETH4  8004    200000    BLK  No  No      0 0000-00:00:00:00:00:00  0000

DSL1  8005  10000000    BLK  No  No      0 0000-00:00:00:00:00:00  0000
DSL2  8006  10000000    BLK  No  No      0 0000-00:00:00:00:00:00  0000
DSL3  8007  10000000    BLK  No  No      0 0000-00:00:00:00:00:00  0000
DSL4  8008  10000000    BLK  No  No      0 0000-00:00:00:00:00:00  0000
    
```

Iface Name	Name of the bridge port
Port ID	Identifier of d bridge port. First digit is the port priority (hexadecimal). The remaining three digits are 001 for ETH1, 002 for ETH2 etc.
Cost	Path cost for this port
Status	Port status: BLK       Blocking FWD       Forwarding LRN       Learning
Designated Path Cost	Path cost to the root bridge of the designated port on the LAN segment connected to this port
Designated Bridge ID	Bridge identifier of the designated bridge of the LAN segment connected to this port
Designated Port	Port identifier on the designated bridge of the LAN segment connected to this port

**STP PORT *port* Prio *prio***

Configures the priority of the port. Possible values for *port* are \*, ETH1 .. ETH4 and DSL1 .. DSL4. Use STP PORT \* Prio *prio* to configure the same priority for all ports. Possible values for *prio* are 0 .. 240 in increments of 16. The port priority determines the selection of a designated port.

**STP PORT *port* Cost *cost***

Defines the cost of the LAN segment or link connected to a port. Possible values for *port* are \* (all ports), ETH1 .. ETH4 and DSL1 .. DSL4. Possible values for *cost* are 1 .. 200'000'000. The port cost is inversely proportional to the speed of the LAN segment this port is connected to. Cf. Table 3-6 for recommended cost values.

**STP PORT *port* FORCE MIGRATION**

Forces a port to do a STP → RSTP migration check. Possible values for *port* are \* (all ports), ETH1 .. ETH4 and DSL1 .. DSL4.

The migration check forces the port to transmit only RSTP BPDUs for some time, to test whether all legacy STP Bridges on the attached LAN segment have been removed and the Port can continue to transmit RSTP BPDUs.

**STP PORT *port* EDGE ON | OFF**

Configures a port as edge port i. e. a port that has no other bridged attached to it. Possible values for *port* are \* (all ports), ETH1 .. ETH4 and DSL1 .. DSL4.

Edge Ports transition directly to the Forwarding state, since there is no possibility of it participating in a loop.

Note that configuring a non-edge port as edge port might create loops in the network. Any port configured as edge port will automatically revert to non-edge configuration if a BPDU is received on this port.

**STP PORT *port* PTP ON | OFF | AUTO**

Configures a port-as-point to point port i. e. a port not connected to a shared LAN segment. Possible values for *port* are \* (all ports), ETH1 .. ETH4 and DSL1 .. DSL4.

- OFF The port is configured as non point-to-point. It will transition into Forwarding state after expiry 2 x the Forwarding Delay
- ON The port is configured as point-to-point and will transition rapidly into Forwarding state.
- AUTO The port will be configured as point-to-point on full-duplex links and as non point-to-point on half duplex links. This setting should only be used if all bridges participating in a network support the spanning tree protocol.

Note that configuring a non point-to-point port as point-to-point might create loops in the network.

## 7.2.13 Management Configuration

The management configuration commands allow you to set up the IP parameters required for management communications via Telnet or SNMP. They are available on the Watson Ethernet plug-in only.

### CONFIG MGMT

Displays the current configuration of management IP addresses:

```

LTU_01_CM> CONFIG MGMT
~~~~~
Management Configuration
~~~~~
      IP-Address/Netmask      state  VID
Front      (MGMT1):      192.168.0.16/24      up
Backplane  (MGMT2):      127.0.0.1/8          down
Bridge     (MGMT3):      192.168.0.1/24       up      4094

Masteragent      : ON
MasterIP         : 127.0.0.1

RIPv2           : OFF

Trap Destinations :      IP-Address  Port  Version  Community
                  192.168.0.107    162   v1       "traps"
    
```

### GW *IP-Address* | DEL

Sets the default gateway.

#### Parameters:

- IP-Address*            IP address of the default gateway. Must be on the subnet of one of the management ports
- DEL                    Deletes the currently configured default gateway

### MASTERAGENT ON | OFF

Enables (ON) or disables (OFF) the SNMP Agent-X master agent function. Within one group of modems using Agent-X only ONE modem may be designated Master Agent (MASTERAGENT ON), all others must be designated as slave agents (MASTERAGENT OFF). All slave agents must have the IP address of the master agent properly configured (with the MASTERIP command). Cf. 8.1.1

### MASTERIP *IP-Address*

Configures the IP address of the Master Agent for those plug-ins that are configured as Subagents.

#### Parameter:

- IP-Address*            IP address of the SNMP Agent-X master agent.

*Note*            *The plug-in which is configured as Master Agent also contains Sub-agents. It is required to configure a MASTERIP address on this plug-in. Cf. 8.1.1*

**MGMTIP Management-Port IP-Address/Netmask [ State ]**

Sets the IP address and netmask of a management port.

**Parameters:**

Management-Port	One of the management ports (MGMT1, MGMT2 or MGMT3)
IP-Address/ Netmask	IP address and network mask for this port. Use the /nn notation for the network mask, e.g. 10.100.249.67/16.  The last part of the address can be replaced by the keyword #S to represent the subrack slot number where the card is inserted in.  Factory default: 192.168.0.#S/24 for MGMT1 192.168.1.#S/24 for MGMT2  Use address 0.0.0.0 to delete an address.
State	Status of the port (UP or DOWN)

*Note*            *The MGMTIP command is only available through the RS-232 Monitor interface, not through Telnet.*

**RIP ON | OFF**

Enables/disables the Routing Information Protocol. The Watson Ethernet plug-in supports RIPv2 (RFC 1388). If RIP is enabled then there is no need to manually set up routes using the ROUTE command. The current setting of RIP is displayed with the CONFIG MGMT command.

- Notes*
- *There are no configurable parameters for RIP*
  - *RIP is either active on all management ports (MGMT1, MGMT2 and MGMT3) or completely disabled.*

**ROUTE [ ADD IP-Address/Netmask Gateway | DEL IP-Address/Netmask ]**

Adds or deletes a static route to the management routing table.

**Parameters:**

ADD IP-Address/ Netmask Gateway	Adds a route to the destination IP-Address/Netmask through the gateway Gateway.
DEL IP-Address/ Netmask	Deletes a route to destination IP-Address/Netmask

ROUTE without parameters displays the routing table:

```

LTU_01_CM> ROUTE
~~~~~
Management Route Configuration
~~~~~
Destination      Mask           Gateway
10.101.0.0       255.255.0.0   10.100.249.1
    
```

**SNMPCOMMUNITY [ READ | WRITE *Community-Name* ]**

Configures the SNMP read and write community strings. If the *Community-Name* is to include lowercase letters then it must be enclosed in quotes " ".

SNMPCOMMUNITY without parameters will display the currently configured community strings.

- Notes:*
- This command is only available on the Master agent (MASTERAGENT ON)
  - SNMP community strings are limited to 32 characters in length

**SNMPTRAP ADD|DEL *Destination Port Version Community-Name***

Configures SNMP trap destinations.

**Parameters:**

ADD	Add destination
DEL	Delete destination. To identify the destination to be deleted it is required to enter all trap parameters ( <i>Destination, Port, Version</i> and <i>Community-Name</i> )
<i>Destination</i>	IP - Address of the trap destination
<i>Port</i>	protocol port (default 162)
<i>Version</i>	SNMP version (V1 or V2, default is V1)
<i>Community-Name</i>	Trap community name (default is the currently configured SNMP read community).

It is possible to configure several trap destinations. Traps will be sent to all configured destinations. Use CONFIG MGMT to display the current list of trap destinations.

- Notes:*
- This command is only available on the Master agent (MASTERAGENT ON)
  - Trap community strings are limited to 32 characters in length



## 7.3 Fault and Maintenance Management FMM

### 7.3.1 Diagnostic

#### DIAGNOSTIC

The `DIAGNOSTIC` (or `DIA`) command shows the current DSL status. It is available from all menus by typing `DIA`.

```

LTU_01_FMM> DIA
-----+-----
Diagnostic:  SQ  Attn    PWR  Status  | Alarms
-----+-----
DSL span 1
STU-C  A:    18    0  +13.5  Sync    | LKINT
STU-R  A:    14    0  +13.5  Sync    | LKINT
-----+-----
DSL span 2
STU-C  A:     0    0  +13.5  Handshake | LOSW,LKINT
STU-R  A:    --   --   --   Idle    | ---
-----+-----
DSL span 3
STU-C  A:     0    0  +13.5  Handshake | LOSW,LKINT
STU-R  A:    --   --   --   Idle    | ---
-----+-----
DSL span 4
STU-C  A:     0    0  +13.5  Handshake | LOSW,LKINT
STU-R  A:    --   --   --   Idle    | ---
-----+-----

```

On the tabletop the `DIA` display looks different:

```

NTU_CM> DIA
-----+-----
Diagnostic:  SQ  G.826(ES)  Attn  Status  | Alarms
-----+-----
NTU-A:    +25.0  00000001  +00.00  Sync    | LOS-S
NTU-B:    +25.0  00000001  +00.00  Sync    |
-----+-----
NTU_CM>

```

After `DIA` the screen is continuously updated until the next Monitor command is entered.

SQ	Signal Quality
G.826(ES)	G.826 errored seconds (only available on the Watson Ethernet tabletop)
Attn	Link attenuation
PWR	Transmit power (only available on the Watson Ethernet plug-in)
Status	Synchronization status
Alarms	List of all active alarms

*Note* A DSL master displays information both for the local and remote ends (STU-C and STU-R on the Watson Ethernet plug-in, LTU and NTU sides on the Watson Ethernet tabletop). DSL slaves display only local information.

### 7.3.2 Status (Plug-in)

#### STATUS

STATUS displays information about the status of the DSL spans.

```

LTU_01_CM> STATUS
~~~~~
SHDSL STATUS
Span          :          1          |          3          |
Name          :          UBS01      |          ETHZ        |
Pair          :          A          |          B          |
Wire Pair     :          ala2       |          b1b2       |          c1c2       |          d1d2       |
~~~~~
Admin. Status :          up        |          up          |
Master/Slave  :          Master     |          Master      |
Line Rate     :          2056 kb/s  |          0 kb/s     |
Payload Rate  :          4096 kb/s  |          0 kb/s     |
Transmission Mode:  ANNEX_B       |          --         |
PID           :          1          |          2          |          1          |          2          |
    
```

#### Attributes:

- Master/Slave           DSL Master or slave status
- ActualPaylRate       Currently configured linerate
- MaxAttnPaylRate      The maximum possible linerate
- TransmissionMode     Current transmission mode (always ANNEX\_B)
- PID                   Pair identification

## STATUS ETH

STATUS ETH displays status information of the Ethernet bridge interfaces:

```

LTU_01_FMM> STATUS ETH
~~~~~
Status of the bridge's Ethernet interfaces
~~~~~
Port      AdminStatus  Mtu  OperStatus  Speed  Dup  Flow
~~~~~
ETH1      up           1536  down        0 b/s  auto auto
ETH2      up           1536  down        0 b/s  auto auto
ETH3      up           1536  down        0 b/s  auto auto
ETH4      up           1536  down        0 b/s  auto auto
DSL1      up           1536  up          100 Mb/s auto on
DSL2      up           1536  up          100 Mb/s auto on
DSL3      up           1536  up          100 Mb/s auto on
DSL4      up           1536  up          100 Mb/s auto on
MGMT3     up           1536  down        0 b/s  auto off
    
```

Port	The bridge port
AdminStatus	Administrative state
Mtu	Maximum frame size
OperStatus	Operating state
Speed	Interface speed. Note that for ports DSL1 .. DSL4 this is the internal speed between the Ethernet bridge and the DSL processor, not the DSL sync rate. Cf. Figure 3-4
Dup	Duplex mode
Flow	Flow control

### 7.3.3 Status (Tabletop)

The status of the tabletop is available with the following command

#### STATUS

```

NTU_FMM> STATUS
~~~~~
Local System Status                                     V5.0
~~~~~
SYNC-A: 02 OPS-A: 01 PID-A: 01 PWR-A: +13.50 UPS: 01
SYNC-B: 02 OPS-B: 01 PID-B: 02 PWR-B: +13.50
~~~~~
NTU_FMM>

```

SYNC		Status of SHDSL synchronization state machine according to TS 101 524.
	00	Out of Sync State
	01	State 0
	02	In Sync State
	03	State 1
	04	State 2
	05	State 3
	06	State 4
	07	State 5
OPS		Operational mode of the transceiver
	00	Idle Mode
	01	Data Mode
	10	Startup handshake in progress
	18	Startup training in progress
	80	Local analog loopback
PWR	n	Transmit power of each channel [dBm]

## STATUS ETH

This command displays the current status of the local Ethernet user interface. The status is determined by the results of the autonegotiation process and can differ from settings in the configuration menu.

```

NTU_FMM> STATUS ETH
~~~~~
Status of the bridge's Ethernet interfaces
~~~~~
Port  AdminStatus  Mtu  OperStatus  Speed  Duplex  Flow
~~~~~
ETH          up 2048          up 100Mb/s   full   ON
DSL          up 2048          up 100Mb/s   full   ON
~~~~~
NTU_FMM>

```

### Attributes:

Port	The bridge port
AdminStatus	Administrative state
Mtu	Maximum frame size
OperStatus	Operating state
Speed	Interface speed. Note that for ports <code>DSL</code> this is the internal speed between the Ethernet bridge and the DSL processor, not the DSL sync rate.
Dup	Duplex mode
Flow	Flow control

## 7.3.4 Alarms

### ACO *DSL-Link ON | OFF*

The `ACO` (Alarm Cut Off) command enables or disables the alarm relays on the plug-in for a particular DSL span. When `ACO` is 'on', alarms for this link will not be shown on the alarm relays. The local alarm LED signals a non-urgent alarm while `ACO` is active.

### ALARM [ T ]

The `ALARM` command displays the current alarm status:

```

LTU_01_FMM> ALARM
~~~~~
Alarm Status:          local          remote
BER  LOSW  LKINT  LOOP  BER  LOSW  LKINT  LOOP
DSL1  off  off      off  off  off      off  off
DSL2  off  on       off  -    -        -    -
DSL3  off  on       off  -    -        -    -
DSL4  off  on       off  -    -        -    -
ETH1          on  off      off          on  off
ETH2          on  off      off          -    -
ETH3          on  off      off          -    -
ETH4          on  off      off          -    -
ACO:

```

On the Watson Ethernet tabletop:

```

NTU_FMM_REMOTE> ALARM
~~~~~
Local Alarm Status
~~~~~
LOOP1:off   ACO:off   LKINT:on
LOOP2:off   ALB:off
LOSW-A:off  BER-A:off  SEG-A:off  BERT:off

```

With `ALARM T` each change in the alarm status will be shown on the screen with a time stamp counted in min:sec:millisec from the last system reset.

To deactivate alarm trace, enter `ALARM T` a second time or leave the FMM menu.

**Alarms (plug-in):**

- BER High bit error rate on DSL (CRC6 – faults)
- LOSW DSL loss of synchronization word
- LKINT Ethernet link integrity
- LOOP Test loop active
- DFA DSL Fallback Alarm

**Alarms (tabletop)**

- ACO Alarm cutoff
- ALB Analog loopback (Watson Ethernet tabletop only)
- BER-A SDSL block-error-rate according G.826  $\geq 30\%$  on loops A/B
- BER-B
- LKINT Ethernet link integrity
- LOOP1 Test loop active
- LOOP2
- LOSW-A DSL loss of synchronization word on loops A/B
- LOSW-B

## 7.3.5 Test loops

### **LOOP1 Ethernet-Port ON timeout | OFF**

The **LOOP1** command controls the local loopback, cf. chapter 3.6:

The loop is automatically cleared after the timeout specified in the command (5 minutes in the example above). If no timeout value is specified then the loop will stay active until it is deactivated by a **LOOP1 OFF** command.

### **LOOP2 Span ON timeout | OFF**

The **LOOP2** controls the remote loopback on a DSL span.

The loop is automatically cleared after the timeout specified in the command (5 minutes in the example above). If no timeout value is specified then the loop will stay active until it is deactivated by a **LOOP2 OFF** command.

In case of remote Loop 2 requests, the master has higher priority than the slave.

#### *Notes:*

- *On the Watson Ethernet tabletop modems it is not possible to specify an Ethernet port or a DSL span. LOOP1 loops the Ethernet port, LOOP2 the DSL span at the remote side..*
- *On the Watson Ethernet tabletop modems a loop timeout is not supported*
- *The LOOP2 command is not available on the Watson Ethernet tabletop modem if it is configured as DSL slave*
- *Looped-back Ethernet packets egress the modems from the same port they were sent to and have the same source and destination addresses they were sent with. While Ethernet testing equipment can handle this situation it might be very confusing for "normal" Ethernet ports or Ethernet switches.*

## 7.3.6 Reset Commands

### **RESET**

Typing **RESET** on the Watson Ethernet tabletop resets the modem.

### **RESET Span**

Typing **RESET Span** on the Watson Ethernet plug-in restarts a DSL span:

### **RESETCARD**

The **RESETCARD** command initiates a complete hardware and software reset of the Watson Ethernet plug-in. The **RESETCARD** command must be confirmed before it is processed.

*Note:* This command is not available on the Watson Ethernet tabletop modem.

## 7.4 Performance Management PM

### 7.4.1 G.826 Statistics

#### G826 *Span* [ *C* ]

The G826 command displays the ITU-T G.826 error performance parameters on the specified DSL span. *G826 Span C* will continuously update the display.

```

LTU_01_PM> G826 DSL1
~~~~~
SHDSL Performance Span 1 :      Pair-A
~~~~~
Errored Blocks           :          0
Errored Seconds         :          0
Severely Errored Seconds :          0
Available time          :          19
Unavailable time        :          0
    
```

On the Watson Ethernet tabletop it is not required to specify a DSL span:

```

NTU_PM_REMOTE> G826
~~~~~
G.826 Error Performance :      CRC6 A
~~~~~
Errored blocks           : 00000002
Errored seconds         : 00000001
Severely errored seconds : 00000000
ESR [%]                 :          0.00
SESR [%]                :          0.00
BBER [%]                :          0.00
Available time          : 00339976
Unavailable time        : 00009044
    
```

Errored blocks	A block in which one or more bits are in error (CRC6 error)
Errored seconds	A one second period with one or more errored blocks
Severely errored seconds	A one second period which contains >=30% errored blocks
ESR [%]	Errored seconds to total sum of seconds ratio
SESR [%]	Severely errored seconds to total sum of seconds ratio
BBER [%]	Errored blocks to total sum of blocks ratio
Available time	Available time since last reset (modem reset or RESETG826)
Unavailable time	Unavailable time (errored seconds + severely errored seconds) since last reset



### RESETG826 *Span*

The RESETG826 command resets the G.826 values for a DSL span. On the Watson Ethernet tabletop it is not required to specify a port.

```
LTU_01_PM> RESETG826 DSL1
G.826 error performance parameter reset for DSL1
```

## 7.4.2 Ethernet Statistics

### ETHERNET *Port* [ *C* ]

The ETHERNET command displays Ethernet statistics. It may be abbreviated to ETH. ETHERNET *Port C* updates the display continuously. For *Port* any of the external or internal Ethernet ports may be specified: ETH1 .. ETH4, DSL1 .. DSL4, MGMT1 .. MGMT3, cf. Table 6-1.

```
LTU_01_PM> ETHERNET ETH1
~~~~~
Statistics of the Ethernet Bridge Port ETH1
~~~~~
InDiscards      :                0
InErrors        :                0
InNUcastPkts   :                0
InOctets        :                0
InUcastPkts    :                0
OutDiscards     :                0
OutErrors       :                0
OutNUcastPkts  :                0
OutOctets       :                0
OutUcastPkts   :                0
```

InDiscards	Number of discarded packets during reception
InErrors	Number of errored packets received
InNUcastPkts	Number on non-unicast packet received
InOctets	Number of octets received
InUcastPkts	Number on unicast packets received
OutDiscards	Number of packets discarded during transmission
OutErrors	Number of packets sent with errors
OutNUcastPkts	Number on non-unicast packet sent
OutOctets	Number of octets sent
OutUcastPkts	Number on unicast packets sent

The Ethernet statistics for the Watson Ethernet tabletop modem are similar:

```

NTU_PM> ETHERNET
~~~~~
Ethernet Statistics:          ETH          DSL
~~~~~
InDiscards      :          0          0
InErrors        :          0          0
InNUcastPkts   :          0          0
InOctets        :          0          0
InUcastPkts     :          0          0
InPause         :          0          0
OutErrors       :          0          0
OutNUcastPkts  :          0          0
OutOctets       :          0          0
OutUcastPkts   :          0          0
OutPause        :          0          0
~~~~~

```

InDiscards	Number of discarded packets during reception
InErrors	Number of errored packets received
InNUcastPkts	Number on non-unicast packet received
InOctets	Number of octets received
InUcastPkts	Number on unicast packets received
InPause	Number of pause frames received
OutErrors	Number of packets sent with errors
OutNUcastPkts	Number on non-unicast packet sent
OutOctets	Number of octets sent
OutUcastPkts	Number on unicast packets sent
OutPause	Number of pause frames sent

**RESETETH *Port***

This command resets the Ethernet statistics for a particular port. On the Watson Ethernet tabletop modem it is not required to specify a *Port* number.

**7.4.3 Bit error rate tests**

Bit error rate testing functions are available on the tabletop modems only.

**STARTBER *m dir p***

The `STARTBER m dir p` command starts the pseudo random binary sequence (PRBS) generator and bit error rate (BER) meter for a duration of *m* minutes.

The test signal generator sends a PRBS of length  $2^{15}-1$  according to ITU-T O.151 ( $p = 0$ ) or a PRBS of length  $2^{11}-1$  according to ITU-T O.152 ( $p = 1$ ).

If *dir* is 0 then the PRBS is sent towards the remote modem and an external hardware loop must be established at the user interface of the remote modem (loopback connector).

Selecting *dir* = 3 will start an internal DSL bit error rate test which is independent of the user interface. A loopback with `LOOP2` on the remote modem must be

established in this case. Make sure that the DSL span is running before starting the internal BER test. If the DSL span fails during the internal BER test, the test must be restarted after the link is re-established.

The test will stop automatically after *m* minutes; a manual stop is possible with the `STOPBER` command.

```
NTU_PM>STARTBER 3
~~~~~
BER Test Results                                     Test running
~~~~~
Test direction      :      SHDSL
Test interval       :        180
Test pattern        :      2^15-1
Test bit rate       :     2048000
Bit errors          :          0
Bit error rate      :     0.00E+00
Sync loss seconds  :          0
Elapsed seconds     :         51
```

The display of the BER test status is continuously updated. If you navigate away from this screen the BER test continues running. The rest results can be displayed anytime with the `READBER` command. Use `READBER C` to have continuous updates.

**STOPBER**

Use `STOPBER` to immediately terminate a running BER test.

**READBER [ C ]**

To display the results of a BER test. When a test is running, the current results are displayed, when no test is running, the results of the last BER test are displayed. If the test is running then you can use `READBER C` to continuously updates the display with the latest BER test results.

```
NTU_PM> READBER
~~~~~
BER Test Results                                     Test stopped
~~~~~
Test direction      :      SHDSL
Test interval       :        180
Test pattern        :      2^15-1
Test bit rate       :     2048000
Bit errors          :          0
Bit error rate      :     0.00E+00
Sync loss seconds  :          0
Elapsed seconds     :         180
```

## **RESETBER**

The **RESETBER** command resets the error and time counters of a BER test.

# 7.5 Security and Remote Management SM

## 7.5.1 Connection control

### **CONNECT** *Span*

The **CONNECT** (or **CON**) command establishes a connection over a DSL span to a remote unit for configuration purposes. This connection uses the DSL EOC for communication.

### **DISCONNECT**

The **DISCONNECT** (or **DIS**) command breaks the connection to the remote unit. In a modem chain the **DISCONNECT** command will disconnect one modem and connect to the previous modem in the chain, cf. 3.5.2.

To disconnect an entire chain at once you can type <ESC><ESC>

#### *Notes:*

- *Connection control commands are only available on modems that are configured as DSL master*
- *The **CONNECT** and **DISCONNECT** commands are available from all sub-menus, but are not displayed in the respective help screens.*

## 7.5.2 Inventory

### **RCHM**

The **RCHM** command displays the CHM code of the connected device. The CHM code includes the hardware type identifier, information about hardware and software revisions as well as the default delivery settings.

### **RFW**

The **RFW** command displays the firmware version of the connected device.

### **RHM**

The **RHM** command displays the HM code of the connected device and displays it on the terminal.

The HM code includes the serial number of the device as well as information about manufacturer and warranty.

## 7.5.3 Password

### CHANGE PASSWORD

The `CHANGE PASSWORD` command is used to change a password. The old password has to be known to change it. The new password must be entered twice to confirm it.

```
NTU_SM> CHANGE PASSWORD
Old password: *****
New password: *****
Confirm new password: *****
52:11:40 new password set
```

### CLEAR PASSWORD

The `CLEAR PASSWORD` command clears the currently set password and disables password protection. This is the factory default setting.

```
NTU_SM> CLEAR PASSWORD
Old password: *****
Password cleared and Monitor protection disabled
```

### DSLSLAVE

The `DSLSLAVE` command is the only command allowed while password protection is active. The `DSLSLAVE` command is used to configure a master tabletop as a DSL slave to allow a remote terminal access in case the password of a master tabletop has to be changed or cleared.

```
Monitor Password Protection
Enter password: ***** (typed DSLSLAVE)
Device is now DSL slave
```

*Note:* Through the remote terminal, i.e. through the DSL EOC the password commands are available without password protection. If a modem has been password protected and the password has been lost then it can be cleared again from modem configured as DSL master. If the modem who's password has been lost is configured as DSL master it can be set to DSL slave with the `DSLSLAVE` command that is available even while password protection is active.

### LOGOFF

`LOGOFF` activates the password protected mode. The previously set password has to be entered before any new Monitor commands can be issued via the local terminal.

### SET PASSWORD

The `SET PASSWORD` command allows definition of a password on the tabletop. Once a password is set the modem will go into a protected mode either after the command `LOGOFF` is issued, after a timeout of 5 minutes or after a restart.

While in protected mode no Monitor command can be executed from a terminal connected to the local RS-232 port of the modem before the correct password has been given. All commands are still available on the remote terminal, i.e. through the DSL EOC. This allows somebody with access to an unprotected modem to reset the password of a protected modem.

Passwords are always displayed as a series of asterisks (\*) on the Monitor screen.

```
NTU_SM> SET PASSWORD
New password: *****
Confirm new password: *****
47:52:50 new password set and Monitor protection enabled
```

*Notes:*

- *Password protection is disabled by default*
- *Firmware upgrades have no influence on the status of password protection, i.e. if a modem is password protected it will stay password protected after a firmware download*
- *The password is not saved in cleartext in the modem configuration database.*

## 7.5.4 Firmware Update

### DOWNLOAD *Span IP-Address Package*

This command downloads a new firmware package through a DSL span into a Watson Ethernet tabletop modem.

#### Parameters

<i>IP-Address</i>	IP address of the TFTP server where the new firmware package is stored
<i>Package</i>	Filename of the new firmware package

### UPDATE *Command*

This command loads new firmware into the Watson Ethernet plug-in using the TFTP protocol, cf. 3.2.9.

#### Parameters

INFO	Displays information about the currently installed firmware packages on the plug-in.
GET <i>IP-Address Package</i>	Downloads a firmware package from a TFTP server . The TFTP server is specified by the <i>IP-Address</i> . On this server a firmware package with the name <i>Package</i> must be available. The <i>Package</i> must have a file extension of <i>.SZU</i>
COMMIT	Will activate the firmware package downloaded with GET and reboot the plug-in
REVERT	Will revert to the old firmware package (i.e. that was active <i>before</i> the last GET) and reboot the plug-in.
FORCE <i>IP-Address Package</i>	Downloads and commits a firmware package from a TFTP server. The TFTP server is specified by the <i>IP-Address</i> . On this server a firmware package with the name <i>Package</i> must be available. The <i>Package</i> must have a file extension of <i>.SZU</i>  UPDATE FORCE does not keep a backup of the old firmware package. The UPDATE COMMIT and UPDATE REVERT commands will fail after UPDATE FORCE.

#### Notes:

- *UPDATE GET should be used to update the modem firmware. Use UPDATE FORCE only when instructed so by the firmware release notes or by Schmid Telecom Customer Support*
- *Do NOT disconnect the power supply from the Watson Ethernet plug-in modem while UPDATE FORCE is being executed.*





## 8.1 Introduction

The Watson Ethernet plug-in contains a built-in SNMP agent. The agent is accessible through the front-panel Q interface connector or through Ethernet in-band management, either from an Ethernet user interface or over the DSL Ethernet payload, cf. 3.5.

The agent uses standardized Management Information Bases (MIBs) to represent the managed objects of the plug-in, its interfaces, the DSL spans and the Ethernet bridging functions. All supported variables are listed in chapter 8.2.

The Watson Ethernet tabletop modem when connected as DSL slave to a Watson Ethernet plug-in is manageable through the SNMP agent of the plug-in. The tabletop modem is modeled with a vendor-specific MIB (Schmid Telecom HDSL MIB, cf. 8.2.12).

If two Watson Ethernet plug-in modems are connected back to back then each is managed by its own SNMP agent. In this situation the slave modem will normally use Ethernet inband management.

### 8.1.1 AgentX

Several Watson Ethernet plug-in cards, installed in the same subrack, act as a single SNMP agent towards the management system. The agents on the individual plug-ins cooperate to form one common data structure of the management information available on each plug-in.

Within a subrack SNMP functions are divided between

- a single processing entity called the master agent, which sends and receives SNMP protocol messages in an agent role
- several processing entities called subagents, which are "shielded" from the SNMP protocol messages processed by the master agent, but which have access to management information.

From the management systems point of view this combination of one master agent and several subagents behaves exactly as would a single agent that has access to the all management information within the subrack.

The communication between master agent and subagents uses the AgentX protocol which has been standardized as RFC 2741.

Subrack-wide information (e.g. inventory of subrack slots and the plug-ins contained in the slots) is handled by a rack agent. This rack agent is a subagent residing on the same plug-in as the master agent.

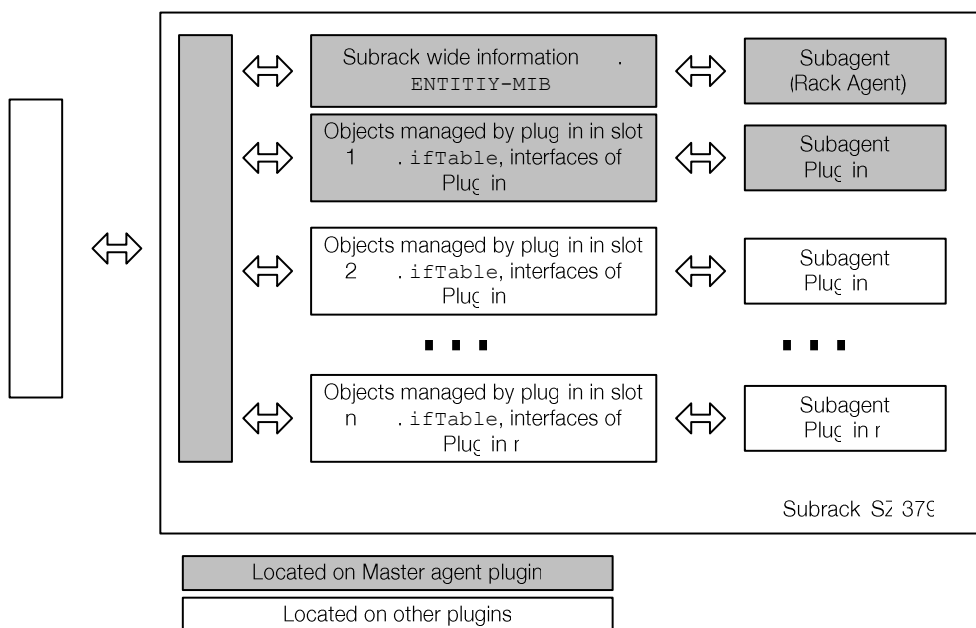


Figure 8-1: SNMP Master agent and subagents

## 8.1.2 Default Context and Card Contexts

AgentX is optimized to access tabular information distributed over several subagents. Each subagent handles certain rows of one or more tables containing management information. For instance the subagent on a plug-in is responsible for the rows in the `ifTable` representing the interfaces physically contained on this plug-in.

Some data structures cannot reasonably be distributed over several subagents with the AgentX protocol. An example is the scalars and tables used to manage the Rapid Spanning Tree protocol: on each plug-in we need an own set of scalars/tables representing timers, priorities, port states etc.

To access these per-card data structures we use "Card Contexts" which are SNMP community strings specific for each plug-in in a subrack.

Card Contexts are formed by appending the characters `@slotnn` to the "Default Context":

- The Default Context is the SNMP community string. It consists of the two strings defined with the Monitor commands `SNMPCOMMUNITY READ` and `SNMPCOMMUNITY WRITE`.
- `nn` is the number of the subrack slot (1 .. 12)
- If the plug-in is inserted in the minirack mechanics or in the tabletop housing for plug-ins then the Card Context is `community@slot1`

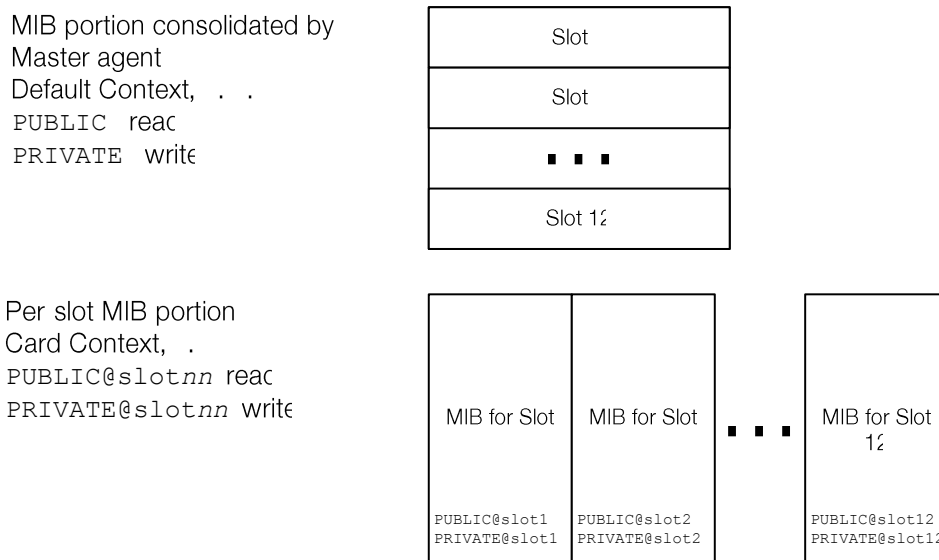


Figure 8-2: Default Context and Card Contexts

Note that for convenience some SNMP variables are accessible both under the Default Context and under the Card Context.

All Card Contexts are listed in the `vacmContextTable` of the `SNMP-VIEW-BASED-ACM-MIB`.

### 8.1.3 SNMP Configuration

IP addresses and master agent behavior must be configured as follows:

- 1) One plug-in in the subrack must be designated as master agent functions (Monitor command `MASTERAGENT ON`). This plug-in communicates with the management system. Note that configuring more than one master agent in one subrack will disrupt all communication between master agents and sub-agents.
- 2) The `MASTERIP` address of the master agent plug-in must be configured to the `MGMT2` address of this (i. e. the master agent) plug-in.
- 3) The master agent function must be disabled on all other plug-ins in the subrack (Monitor command `MASTERAGENT OFF`).
- 4) The `MASTERIP` address of all other plug-ins must be configured to the `MGMT2` address of the master agent plug-in.

### 8.1.4 The Entity MIB

A subrack is modeled in the Default Context with the Entity MIB (cf. 8.2.4) that describes the relation between subrack, plug-ins and interfaces. The `entPhysicalTable`, `entLogicalTable` and the `entAliasMappingTable` are used.

A subrack is represented by a single row in the `entPhysicalTable` with an `entPhysicalClass` of `chassis`.

Every slot in the subrack is represented by a row of the `entPhysicalTable` with an `entPhysicalClass` value `container`.

Every plug-in is represented by a row of the `entPhysicalTable` with `entPhysicalClass` set to `module`. The column `entPhysicalParentRelPos` represents the slot number, column `entPhysicalContainedIn` gives the relation to the subrack.

Each interface (DSL or Ethernet) is represented by a row of the `entPhysicalTable` with `entPhysicalClass` set to `port`. Column `entPhysicalParentRelPos` is the port number. Column `entPhysicalContainedIn` gives the relation to the plug-in.

The `entAliasMappingTable` defines the relation between the ports and the `ifIndex` from the `ifTable` used in all other tables to index a port.

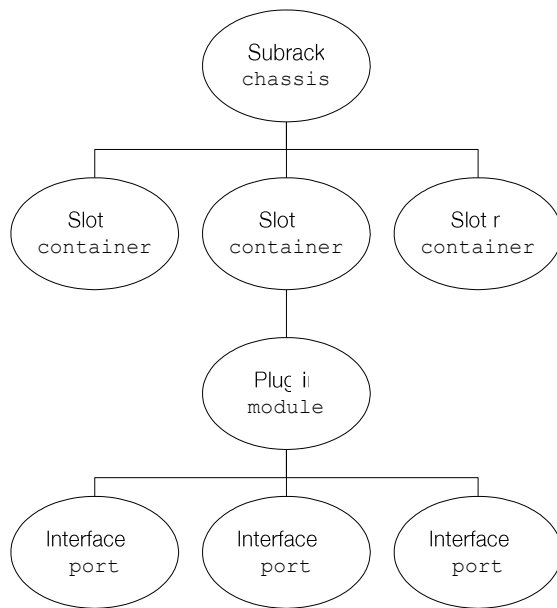


Figure 8-3 Entity MIB `entPhysicalTable`

There is one row in the `entLogicalTable` which describes the master agent. The relation between the master agent and its plug-in card defined in the `entLPMappingTable`.

## 8.1.5 VLAN indexing in the Default Context

VLANs are controlled through various tables which are typically indexed by the VID of the VLAN, e.g. the `dot1qVlanIndex` which indexes the `dot1qVlan-StaticTable`.

For each plug-in the VLAN tables are available in the Card Context and can be indexed by the VID.

In the Default context however a VID cannot be guaranteed to be unique since each VLAN on each plug-in can have any VID out of the possible range of 1 .. 4094. An extended VLAN indexing scheme is used in the Default Context to uniquely identify a VLAN:

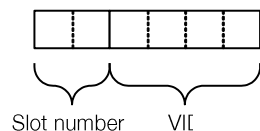


Figure 8-4: VLAN indexing in the Default Context

The first two digits of a VLAN index define the slot number, the following 4 digits define the VID.

Example: index = 102201 → plug-in in slot 10, VLAN number 2201.

If the plug-in is inserted in the minirack mechanics or in the tabletop housing for plug-ins then slot number 16 must be used to index VLANs in the Default Context.

## 8.1.6 The `ifTable`

Each Watson Ethernet plug-in creates 15 rows in the `ifTable`:

- 4 rows for the four Ethernet user interfaces (ETH1 – ETH4)
- 4 rows for the four internal interfaces between Ethernet Bridge and DSL processor (Figure 3-4)
- 4 rows for the four DSL Spans DSL1 – DSL4
- 3 rows for the three management interfaces MGMT1 (front panel Q interface), MGMT2 (backplane interface) and MGMT3 (internal interface to Ethernet Bridge)

Interfaces can be administratively enabled and disabled with the `ifAdminStatus`.

If MAC Defect Signaling is turned off then the `ifOperStatus` for the internal interfaces is always `up(1)`. If MDS is turned on then the `ifOperStatus` for the internal interfaces follows the state of the Ethernet User Interfaces and the DSL spans.

## 8.2 MIB Reference

The management information of the Watson Ethernet plug-in is modeled according to standardized MIBs. Additionally two vendor-specific MIBs are supported: the Schmid HDSL MIB to control the Watson Ethernet tabletop modems and the Schmid MIB which contains a unique hardware identifier for the modems.

The following paragraphs document the supported MIB variables in a tree structure. For each variable its name, type, OID and `MAX-ACCESS` are given.

Unless otherwise noted the variables are available in the Default Context. Some variables are accessible both in the Default Context and in the Card Contexts. Use the Default Context to access the variables of the Master agent. Using Card Contexts will access data of an individual slot in the subrack.

### 8.2.1 MIB II (RFC 1213)

MIB-II contains basic information about the system and its interfaces.

Implemented data structures:

- `system` group (Default Context and Card Context)

Note that the Ethernet interfaces of the Watson Ethernet tabletop modems are not visible in the `ifTable`.

### 8.2.2 P-BRIDGE-MIB (RFC 2674)

The P-Bridge-MIB controls behavior of the bridge layer 2 priority features (802.1p bits)

Implemented data structures:

- `dot1dExtBase` group (Default Context and Card Context)
- `dot1dPortCapabilitiesTable` table (Default Context and Card Context)
- `dot1dPortPriorityTable` table (Default Context and Card Context)
- `dot1dTrafficClassTable` table (Default Context and Card Context)

### 8.2.3 Q-Bridge-MIB (RFC 2674)

The Q-Bridge-MIB controls the VLAN functions of the Ethernet bridge of the Watson Ethernet plug-in modem. Note that the Q-Bridge-MIB only supports single VLAN tags.

Implemented data structures:

- `dot1qBase` group (Default Context and Card Context)
- `dot1qVlanCurrentTable` (Default Context and Card Context). VLAN change history with `dot1qVlanTimeMark` is not supported. The object `dot1qVlanFdbId` is writeable and allows to define the FDB of this VLAN.
- `dot1qVlanStaticTable` (Default Context and Card Context)
- `dot1qPortVlanTable` (Default Context and Card Context)

## 8.2.4 Entity MIB (RFC 2737)

The Entity MIB contains data structures modeling the subrack and the plug-ins in the subrack.

Implemented data structures:

- `entPhysicalTable`
- `entLogicalTable`
- `entLPMappingTable`
- `entAliasMappingTable`
- `entityGeneral` group

Implemented notifications:

- `entConfigChange`

## 8.2.5 RMON (RFC 2819)

The RMON MIB contains Ethernet statistics counters.

Implemented data structures:

- `etherStatsTable`. The `etherStatsPkts1024to1518Octets` counter also counts packets from 1519 up to the maximum packet size supported by the Watson Ethernet plug-in card.

## 8.2.6 IF MIB (RFC 2863)

The Interfaces MIB contains a table of all interfaces of the Watson Ethernet plug-in card and the hierarchical relations between them. Note that the Ethernet interfaces of the Watson Ethernet tabletop modems are not visible in the `ifTable`.

Implemented data structures:

- `ifTable` (Default Context and Card Context)
- `ifStackTable` (Default Context and Card Context)

Implemented notifications:

- `linkDown`
- `linkUp`

## 8.2.7 SNMP Notification MIB (RFC 3413)

The SNMP Notification MIB allows to select groups of targets that are to receive notifications or traps. Each target is defined in the SNMP Target MIB.

Implemented data structures:

- `snmpNotifyTable`

## 8.2.8 SNMP Target MIB (RFC 3413)

The SNMP Target MIB allows for configuration of trap destinations.

Implemented data structures:

- `snmpTargetSpinLock`
- `snmpTargetAddrTable`
- `snmpTargetParamsTable`
- `snmpUnavailableContexts`
- `snmpUnknownContexts`

## 8.2.9 SNMP-VIEW-BASED-ACM-MIB (RFC 3415)

The SNMP-VIEW-BASED-ACM-MIB gives information about the available SNMP contexts.

Implemented data structures:

- `vacmContextTable`

The following tables are also implemented, but are reserved for internal use and may not be modified:

- `vacmSecurityToGroupTable`
- `vacmAccessTable`
- `vacmViewTreeFamilyTable`

## 8.2.10 Etherlike MIB (RFC 3635)

The Etherlike – MIB manages flow control of the Ethernet interfaces (PAUSE frames).

Implemented data structures:

- `dot3ControlTable`
- `dot3PauseTable`

## 8.2.11 MAU MIB (RFC 3636)

The MAU MIB controls speed/duplex mode of the Ethernet interfaces and Auto-negotiation.

Implemented data structures:

- `ifMauTable`
- `ifMauAutoNegTable`



## 8.2.12 Bridge-MIB (RFC 4188)

The Bridge MIB contains basic information about the Ethernet bridge of the Watson Ethernet plug-in card.

Implemented data structures:

- `dot1dBase` group (Default Context and Card Context)
- `dot1dBasePortTable` (Default Context and Card Context)
- `dot1dStp` group (Card Context only)
- `dot1dStpPortTable` (Card Context only)
- `dot1dTp` group (Default Context and Card Context)

## 8.2.13 RSTP-MIB (RFC 4318)

The RSTP MIB controls the Rapid Spanning Tree protocol.

Implemented data structures:

- Additions to the `dot1dStp` group (Card Context only)
- `dot1dStpExtPortTable` table (Card Context only)

## 8.2.14 HDLSL2-SHDSL-LINE-MIB (RFC 4319)

The HDLSL2-SHDSL Line MIB controls the DSL spans of the Watson Ethernet plug-in card.

The entire DSL span including both STU-C and STU-R ends is managed by the MIB which is accessible through the SNMP agent of the master (STU-C) modem.

DSL spans on the STU-C side are accessible in read-only mode through the SNMP agent of the STU-C..

Each DSL span has a single configuration profile and a single alarm profile. The profiles have fixed names of the format `Span xx Slot yy` where `yy` is the slot number in the subrack and `xx` is number of the DSL span (01 up to 04).

The `hds12ShdslSpanConfWireInterface` object can be used to disable a DSL span by setting it to 0, i. e. defining that the interface contains no wires.

Implemented data structures:

- `hds12ShdslSpanConfTable`
- `hds12ShdslSpanStatusTable`
- `hds12ShdslInventoryTable`
- `hds12ShdslEndpointCurrTable`
- `hds12ShdslEndpointMaintTable`
- `hds12ShdslUnitMaintTable`
- `hds12ShdslSpanConfProfileTable`
- `hds12ShdslEndpointAlarmConfProfileTable`

**Implemented notifications:**

- hdsl2ShdslLoopAttenCrossing
- hdsl2ShdslSNRMarginCrossing
- hdsl2ShdslPerfESThresh
- hdsl2ShdslPerfSESThresh
- hdsl2ShdslPerfCRCAnomaliesThresh
- hdsl2ShdslPerfLOSWSThresh
- hdsl2ShdslPerfUASThresh
- hdsl2ShdslLoopbackFailure
- hdsl2ShdslpowerBackoff

## 8.2.15 HDSL MIB

The HDSL MIB is a private MIB used to model the Watson Ethernet tabletop modems. The variables of the HDSL MIB are available through the SNMP agent of the Watson Ethernet plug-in card connected to the tabletop.

**Implemented data structures:**

- hdslNtuGenTable
- hdslNtuConfTable
- hdslNtuTestTable
- hdslNtuTestStPamTable
- hdslNtuTestBerPrbsTable
- hdslNtuTestEthStatTable
- hdslNtuTrapStatusTable
- hdslNtuLinParPamTable
- hdslNtuG826ResetTable
- hdslNtuG826LinATable
- hdslNtuG826LinBTable

**Implemented notifications:**

- `loop1Alarm`
- `initAlarm`
- `acoAlarm`
- `locAlarm`
- `remotePowerFailureAlarm`
- `resetAlarm`
- `linkIntAlarm`
- `confEr03Alarm`
- `confEr04Alarm`
- `confEr05Alarm`
- `bertAlarm`
- `loswAAlarm`
- `loswBAlarm`
- `berAAlarm`
- `berABlarm`

## 8.2.16 Schmid MIB

The Schmid MIB contains vendor-specific hardware identifiers (called the model codes) for Schmid DSL modems. The model code can be read as `sysObjectID` in the `system` group of `mib-2`.

**Implemented data structures:**

- `schmidGeneralWatsonModelCodes` group

## 8.2.17 Watson MIB

The Watson MIB contains vendor-specific data structures for Watson modems.

**Implemented data structures:**

- `watsonSpecificCardTable` to configure
  - Card Reset
  - CoS Scheduling Policy
  - Cardmode
  - Bridgemode
- `watsonSpecificIfConfTable` to configure
  - interface-specific CoS features (Rate limiting, priority source)
  - doubletagging
  - MAC Defect Signaling

- `watsonSpecificSpanConfTable` to configure DSL parameters:
  - Linecode (TC-PAM16/TC-PAM32)
  - DSL Master or Slave
  - Single-pair fallback
- `watsonSpecificSpanStatusTable` gives the current state of single-pair fallback operation
- `watsonCard` group
  - enable/disable Spanning Tree Protocol operation
  - status of the front panel LEDs

Note that the `watsonCard` group is available in the default context.

Implemented notification:

- `watsonSpecificDslFallbackTrap`. This notification is sent on a status change of the single-pair fallback operation.

# 9

# Front and Rear Panels

## 9.1 Front Panel (Plug-in)

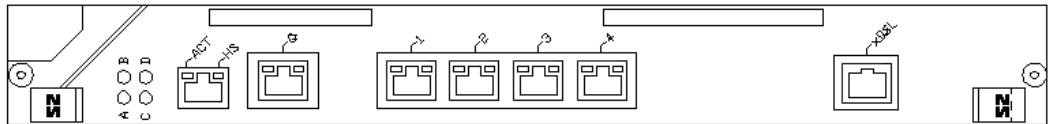


Figure 9-1: Plug-in front panel

## 9.2 Rear Panel (Tabletop)

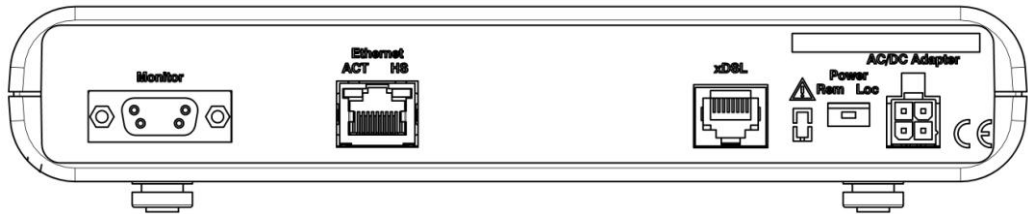


Figure 9-2: Tabletop rear panel



# 10 Connectors and Cables

## 10.1 Overview

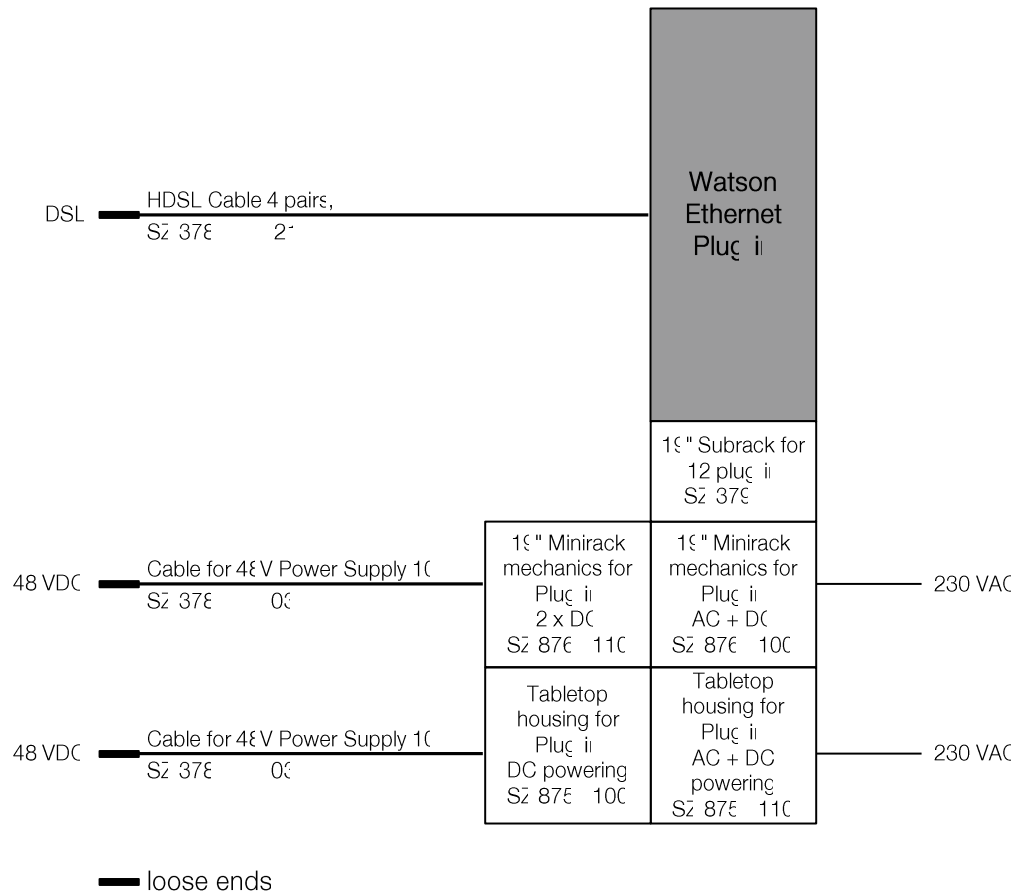


Figure 10-1: Cabling and mechanics (plug-in)

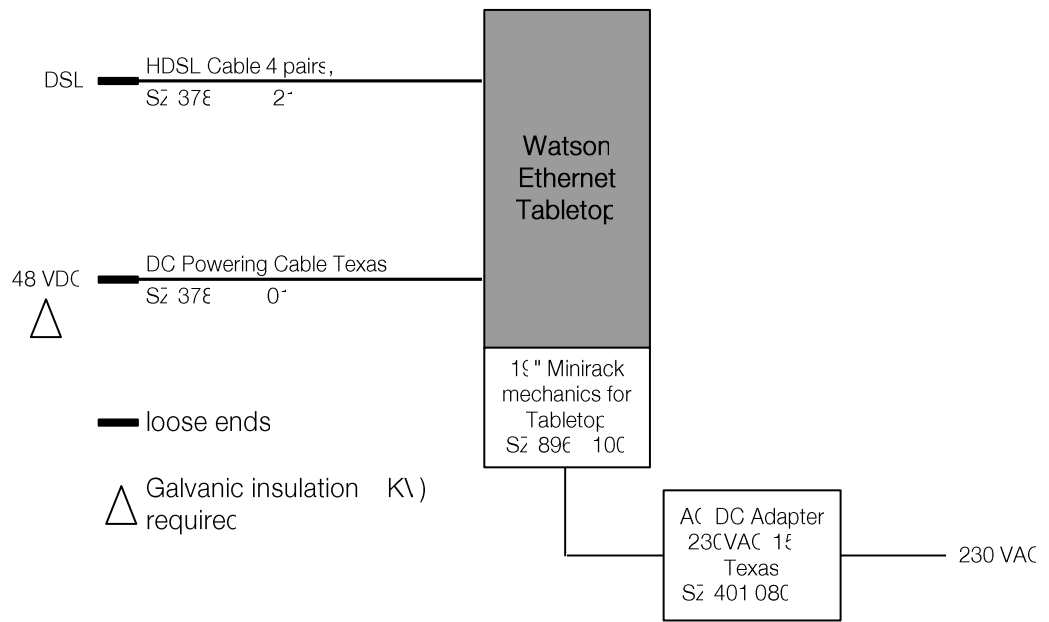


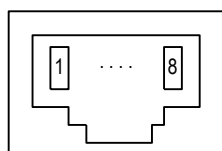
Figure 10-2: Cabling and mechanics (tabletop)



## 10.2 DSL Interface

### 10.2.1 Connector

Connector Type RJ45-8



Front View

Figure 10-3: DSL Connector

The connector pin assignment for plug-ins is as shown below:

Pin	Signal	Description
1	d1	Wire pair d, tip
2	d2	Wire pair d, ring
3	b1	Wire pair b, tip
4	a1	Wire pair a, tip
5	a2	Wire pair a, ring
6	b2	Wire pair b, ring
7	c1	Wire pair c, tip
8	c2	Wire pair c, ring

Table 10-1: DSL connector pin assignment (Plug-in)

On the Watson Ethernet tabletop modem the pin assignment is as follows:

Pin	Signal	Description
1	NC	-
2	Shield	DSL cable shield (optional)
3	b1	Wire pair b, tip
4	a1	Wire pair a, tip
5	a2	Wire pair a, ring
6	b2	Wire pair b, ring
7	Shield	DSL cable shield (optional)
8	NC	-

Table 10-2: DSL connector pin assignment (Tabletop)

Pins 2 and 7 of the tabletop are connected to Functional Protective Earth (FPE). They can be used to connect the shield of the DSL cable or can be left open.

### 10.2.2 DSL Cable

SZ.378.0M0V21W: HDSL Cable, 4 pairs, 5m, open end

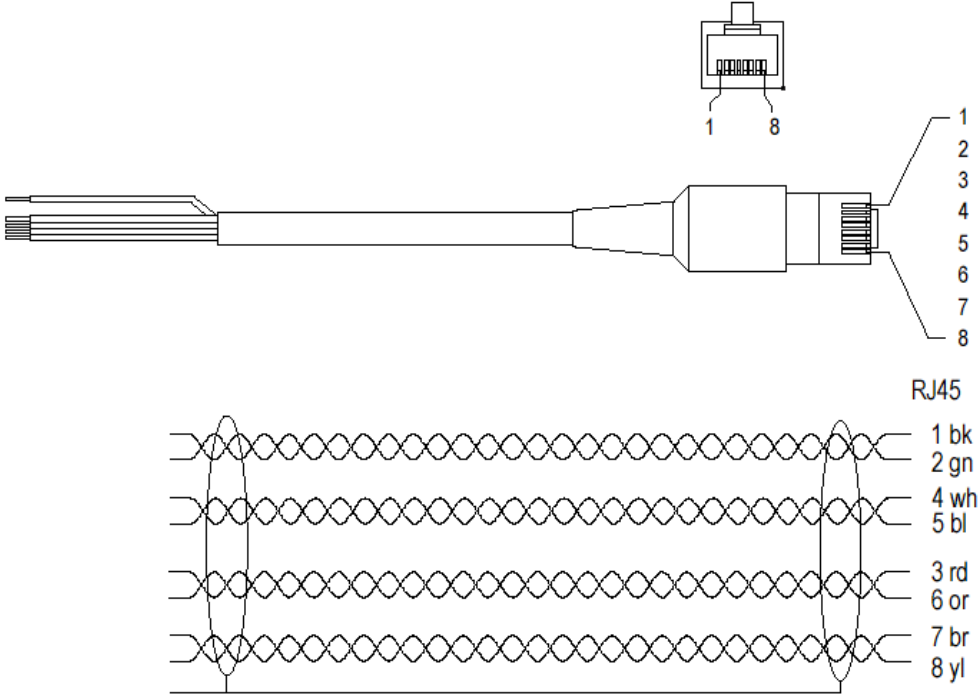
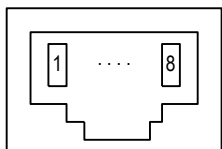


Figure 10-4: HDSL Cable, 4 pairs, 5m, open end

## 10.3 Ethernet Interface



Type: RJ45-8 (Front View)

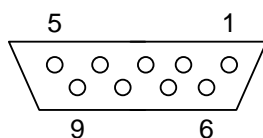
Figure 10-5: Ethernet Connector

Pin No	Signal Name
1	Transmit Data +
2	Transmit Data -
3	Receive Data +
4	Not used
5	Not used
6	Receive Data -
7	Not used
8	Not used

Table 10-3: Ethernet Connector

## 10.4 Monitor Interface

The Monitor connector is available on the tabletop modem.



SubD9 female (Front View)

Figure 10-6: Monitor Connector

Pin	Signal	Description
1	SGND	RS-232 Signal Ground
2	TXD	RS-232 Transmit Data
3	RXD	RS-232 Receive Data
4		not used
5	SGND	RS-232 Signal Ground
6 .. 9		not used

Table 10-4: Monitor Connector

## 10.5 Power and Grounding

### 10.5.1 Tabletop Power Connector

Type: Molex Minifit Junior, safety approved connector to the mains adapter with snap-in characteristic. It is suitable for connection to the power supplies SZ.378.0A0.V1 and SZ.378.0A0.V2EA.

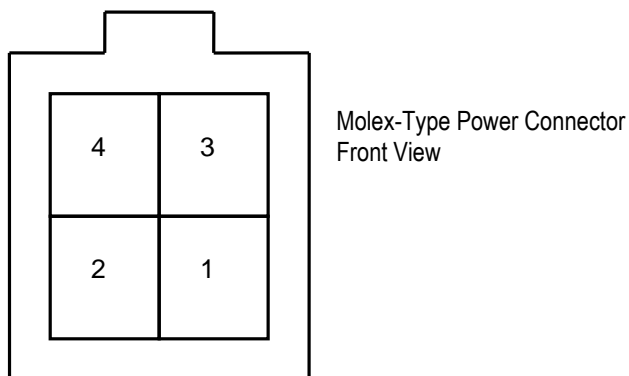


Figure 10-7: Power Connector

Pin	Signal	Description
1	-PWR	Negative power supply terminal for mains adapter
2	PROT	Connected to the center taps of the gas absorbers at the DSL line input
3	NC	Not connected
4	+PWR	Positive power supply terminal for mains adapter

Table 10-5: Power connector

### 10.5.2 Tabletop ground connector

The Watson Ethernet Tabletops is fitted with a ground connector. The connector is normally covered by the rear panel of the housing. To get access to the connector a hole has to be cut in the rear panel around the indicated marks e.g. using a paper cutter.:

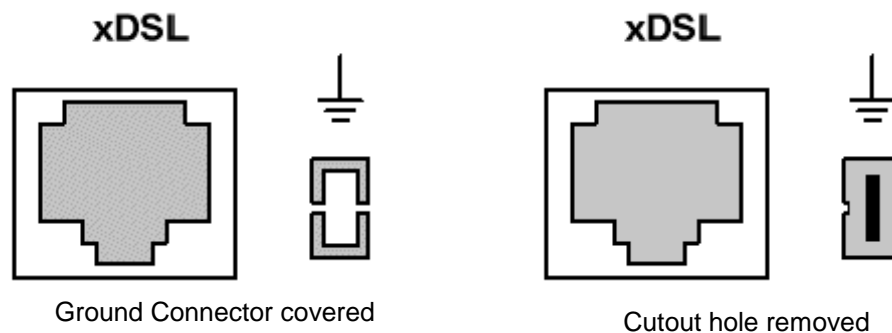


Figure 10-8: Ground Connector

The connector type is Faston 4.8 x 0.5 mm connector (DIN 46244) The hole in the rear panel is dimensioned for non-insulated Faston ferrules (DIN 46245).



# 11

# Technical Specifications

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## 11.1 Interfaces

### 11.1.1 DSL Line Interface

Standard referred:	ETSI TS 101 524, ITU-T G.991.2 Annex B (Revision 2005)
Number of Pairs:	1, 2 or 4
Line Rate per Pair:	200 – 5'704 kbit/s
Line Code:	Trellis-coded PAM-16, PAM-32
Nominal Line Impedance:	135 $\Omega$
Transmit Power @ 135 $\Omega$ :	According to TS 101 524
Overvoltage Protection:	plug-in: ITU-T K.20 (basic level) tabletop: ITU-T K.21 (basic level, enhanced level with additional ground connection)
Connector Type:	RJ-45, 8 pin
Wetting current source (plug-in modem only)	2.7 mA @ 48VDC per pair (with 48VDC power supply and 0 Ohm loop resistance)
Wetting current sink	Plug-in: 1.5 mA per pair (0 Ohm loop resistance) Tabletop: 0.25 mA per pair in 1-pair operation 0.125 mA per pair in 2-pair operation

### 11.1.2 Ethernet Interfaces

Standard referred:	IEEE 802.3
Crossover	Auto-Crossover
Bitrates	10/100 Mbps (Auto-negotiation)
Duplex Mode	Half/Full Duplex (Auto-negotiation)
Flow control	PAUSE Frames (full duplex) Backpressure (half duplex)

### 11.1.3 Monitor Interface

Signal Level:	RS-232
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Data Rate:	9600 Baud, Asynchronous
Protocol:	8 Bit, No Parity, 1 Stop Bit No Linefeed with Carriage Return XON/XOFF enabled
Connector Type:	SubD9 female

## 11.2 Power Consumption

### 11.2.1 Plug-in

Supply Voltage:	-40.5V <sub>DC</sub> .. -72V <sub>DC</sub>
Power Consumption:	9 W max

### 11.2.2 Tabletop

	Local Power Supply	Remote Power Supply
Supply Voltage	-40.5V <sub>DC</sub> .. -72V <sub>DC</sub>	-112V <sub>DC</sub> .. -65V <sub>DC</sub> at tabletop DSL-Connector
Power Consumption	SZ.847.V350	2.1 W max
	SZ.847.V450	3.1 W max

## 11.3 Ethernet

	Plug-in	Tabletop
Maximum Frame Size	1'536 bytes	2'048 bytes
Number of MAC addresses	1'024	1'024
Number of address databases	15	1
Number of VLANs	64	VLAN transparent
Frame buffer size	120 Kbytes shared between all queues	56 Kbytes shared between all queues
Rate limiters	Configurable (128/256/512 Kbps and 1/2/4/8 Mbps)	Configurable (CIR=1 bit/s to 100 Mbps, CBS=0 to 64 Kbytes)
Number of Queues	4 per port	4 per port
CoS Classifiers	Layer 2 Priority	Layer 2 Priority
	Layer 3 DSCP	Layer 3 DSCP



## 11.4 Latency and Throughput

These measurements are valid for the Watson Ethernet plug-in modem. They are measured between two Ethernet user interfaces of a modem pair connected through a DSL span.

		Line rate	2'048 kbps	4'608 kbps	9'216 kbps	22'784 kbps
Packet Size	64 Byte	Latency	1.00 ms	0.80 ms	0.70 ms	0.70 ms
	Throughput	1.95 Mbps	4.40 Mbps	8.80 Mbps	21.7 Mbps	
512 Byte	Latency	3.00 ms	1.80 ms	1.30 ms	1.00 ms	
	Throughput	2.00 Mbps	4.55 Mbps	9.10 Mbps	22.60 Mbps	
1'518 Byte	Latency	7.10 ms	3.80 ms	2.40 ms	1.60 ms	
	Throughput	2.00 Mbps	4.60 Mbps	9.20 Mbps	22.70 Mbps	

## 11.5 Management Functions

Management Protocols	SNMPv1 (RFC 1157), Agent-X (RFC 2741) Telnet (RFC 854)
Supported MIBs	MIB II (RFC 1213) P-BRIDGE-MIB, Q-Bridge-MIB (RFC 2674) Entity MIB (RFC 2737) RMON (RFC 2819) Interfaces MIB (RFC 2863) SNMP Target MIB, SNMP Notification MIB (RFC 3413) SNMP View based ACM MIB (RFC 3415) Etherlike MIB (RFC 3635) MAU MIB (RFC 3636) Bridge MIB (RFC 4188) RSTP MIB (RFC 4318) HDSL2-SHDSL Line MIB (RFC 4319) HDSL Private MIB Schmid Private MIB Watson Private MIB
Firmware Upgrade	TFTP (RFC 783)

## 11.6 MTBF

Modem Type	MTBF
SZ.847.V350	58 years
SZ.847.V450	50 years
SZ.866.V654	39 years

## 11.7 Environment

### 11.7.1 Climatic Conditions (Plug-in and Tabletop)

Storage:	ETS 300 019-1-1 Class 1.2	-25°C ... +55°C, 10% .. 100% RH
Transportation:	ETS 300 019-1-2 Class 2.3	-40°C ... +70°C, max. 95% RH
Operation:	ETS 300 019-1-3 Class 3.2e	-5°C ... +60°C, 5% .. 95% RH

### 11.7.2 Safety

According to EN 60950:2006 (IEC60950:2005)

### 11.7.3 EMC

According to EN 300386:2000

## 11.8 Physical dimensions and weight

### 11.8.1 Plug-in

19" Plug-in unit: height: 259mm (6 HE), width: 30mm

PCB dimensions: height: 233.35mm, length: 220mm

Weight 500g

### 11.8.2 Tabletop

Tabletop unit: width 220mm, depth 195mm, height 43mm

Weight 750g

# 12 Terminology

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Throughout this document the following terminology is used:

<b>Term</b>	<b>Meaning</b>
CoS	Class of Service
DSCP	Differentiated Services Code Point. Code contained in the IP header used to determine the priority of IP packets.
DSL Linerate	Data rate of a DSL span available to the application
DSL Master	Synonymous for STU-C
DSL Payload rate	Synonymous to DSL Linerate
DSL Slave	Synonymous for STU-R
DSL Span	Connection between STU-C and STU-R, composed of one or more wire pairs.
DSL Sync rate	Physical synchronization rate of a DSL wire pair
EOC	Embedded Operations Channel, an overhead channel available in SHDSL for management purposes
Linerate	cf. DSL Linerate
LTU	Line Termination Unit, functionally equivalent to STU-C
NTU	Network Termination Unit, functionally equivalent to STU-R
Payload rate	Synonymous to linerate
STU-C	Synchronous Terminal Unit – Central Office Side. The end of a DSL span that starts up and controls the link. Typically installed at the central office
STU-R	Synchronous Terminal Unit – Remote Side. The end of a DSL span that is controlled by the STU-C. Typically installed at the customer premises
Sync rate	Cf. DSL Sync rate
VID	Virtual LAN Identifier, a.k.a "VLAN Number". The unique identifier of a VLAN. Carried in the VLAN Tag of an Ethernet frame.
VLAN	Virtual LAN (IEEE 802.1q)



# 13

# Product Order Codes

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## 13.1 Modems

The following Watson Ethernet modems are available:

Description	Order Code
Watson Ethernet plug-in 4xDSL 4xEthernet	SZ.866.V654
Watson SHDSL Router 2p 8xEthernet	SZ.441.V400
Watson SHDSL Router 4p 8xEthernet	SZ.441.V800
Watson Ethernet tabletop 1p Ethernet	SZ.847.V350
Watson Ethernet tabletop 2p 1xEth	SZ.847.V450

Table 13-1: Watson Ethernet modem types

## 13.2 Accessories

The following accessories for the Watson Ethernet modems are available:

### 13.2.1 Accessories for plug-in

Description	Order Code
19" Subrack for WATSON HDSL (for 12 plug-in + 1 ACU/CMU)	SZ.379.V3
Alarm Control Unit (2 Relays) with ext. Clock, for 19" Subrack	SZ.369.V5
19" Minirack Mechanics for Plug In 2xDC Power	SZ.876.V110
19" Minirack Mechanics for Plug In AC & 2xDC Power	SZ.876.V100
Tabletop Housing for Watson Plug-in DC Powering	SZ.875.V100
Tabletop housing for Watson Plug In AC + DC Power	SZ.875.V110

Table 13-2: Accessories for plug-in

## 13.2.2 Accessories for tabletop

<b>Description</b>	<b>Order Code</b>
AC/DC Adapter 100-240 VAC, 48 VDC, 15W AC Euro Plug.	SZ.410.080.V1E
19" Minirack Mechanics for Table Top	SZ.896.V100W

Table 13-3: Accessories for tabletop