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Broadband and triple-play multimedia services –
Broadband multimedia services over VDSL

Full-Service VDSL – Operations, Administration Maintenance & Provision aspects

ITU-T Recommendation H.611

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ITU-T Recommendation H.611

Full-Service VDSL – Operations, Administration Maintenance & Provision aspects

Summary

This Recommendation defines service provisioning, service assurance, network build and data management requirements for video, data and voice services on an end-to-end Full-Service VDSL platform. It also specifies the functionality of the Element Management System and the management interfaces of the platform.

Source

ITU-T Recommendation H.611 was approved by ITU-T Study Group 16 (2001-2004) under the ITU-T Recommendation A.8 procedure on 14 July 2003.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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ITU-T Recommendation H.611

Full-Service VDSL – Operations, Administration Maintenance & Provision aspects

1 Scope

This Recommendation addresses service provisioning, service assurance, network build and data management requirements for services on an end-to-end Full-Service VDSL platform. It defines operational requirements from an operator perspective that enable the provisioning of bundled services in a reliable way with minimal user intervention and at a cost compatible with mass market deployment. It also gives functional requirements for the Element Management System and the management interfaces of the platform.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

2.1 Normative references

– ITU-T Recommendation G.993.1 (2001), *Very high speed digital subscriber line foundation*.

– ITU-T Recommendation G.997.1 (1999), *Physical layer management for digital subscriber line (DSL) transceivers*.

– ITU-T Recommendation H.610 (2003), *Full-Service VDSL – System architecture and customer premises equipment*.

– ITU-T Recommendation I.610 (1999), *B-ISDN operation and maintenance principles and functions*.

– ANSI T1.424 – Part-1-2000, *Very high-bit-rate Digital Subscriber Line (VDSL) Metallic Interface, Part 1*: *Functional Requirements and Common Specification*.

– ETSI TS101 270-1 (2003), *Transmission and multiplexing (TM); Access Transmission systems on metallic access cables; Very high speed Digital Subscriber line (VDSL); Part 1: Functional requirements*.

– ETSI TS101 270-2 (2003), *Transmission and multiplexing (TM); Access Transmission systems on metallic access cables; Very high speed Digital Subscriber line (VDSL); Part 2: Transceiver specification*.

– IETF RFC 1157 (1999), *A Simple Network Management Protocol (SNMP)*.

– IETF RFC 1213 (1991), *Management Information Base for Network Management of TCP/IP-based internets: MIB-II*.

2.2 Non-normative references

– IETF draft-ietf-adslmib-vdsl-03.txt, *Definition of Managed Objects for VDSL Lines*, June 2002.

– DSL Forum TR-057, *VDSL Element Management,* February 2003.

3 Definitions

This Recommendation defines the following terms:

3.1 access network domain: The Access Network Domain encompasses the domain between the U-R and V interface of the system reference model (Figure 1).

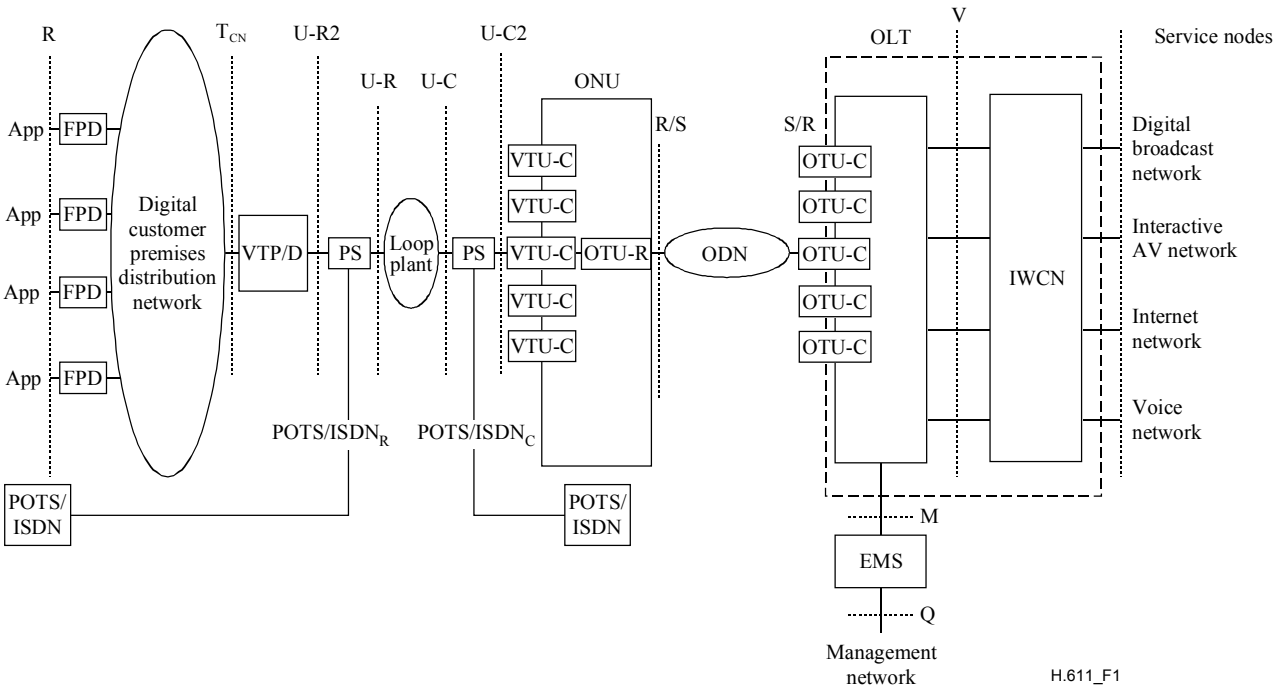


Figure 1/H.611 – FS-VDSL reference model

3.2 core network domain: The Core Network Domain is beyond the V interface and the OLT physical interface.

3.3 the platform: The platform is the hardware and software that comprises the Access Network and its Element Manager.

3.4 network operation domain: The Network Operation Domain comprises the entities that manage the end-to-end network, including the Operations Systems Functions of the Network Management Layer, the technicians who install and repair network elements and the back office people who deal with network issues.

3.5 service operation domain: The Service Operation Domain includes the physical equipment of multiple or single service nodes that interface the Core/AN and provide users access to various services including data connection, broadcast video, VoD, and voice, and the Operations Systems Functions of the Service Management Layer used to manage the services and service nodes.

3.6 Functional Processing (FP): A point of signal transformation or processing.

3.7 Functional Processing and Decoding (FPD): Typically terminals performing the application layer processing of video, audio and data, e.g., Set top box (STB).

3.8 VDSL Termination Processing (VTP): Refers to the unit that operates the VDSL modem termination and protocol processing functions. A device that implements the VTP functions includes Ethernet based layer-2 interface to the in-home Network.

3.9 VTP and Decoding (VTPD): Refers to a unit that operates the video decoding function as well as the VTP functions and interfaces.

3.10 VTP/D: When mentioned in this Recommendation, refers to both the VTP and the VTPD.

3.11 auto-discovery: the process of the platform detecting when new hardware or software entity has been added to it, identifying the entity and extracting any relevant parameters from it.

3.12 EMS-NMS interface: The interface between the FS-VDSL platform element manager and the full service broadband network management system as shown in Figure 2.

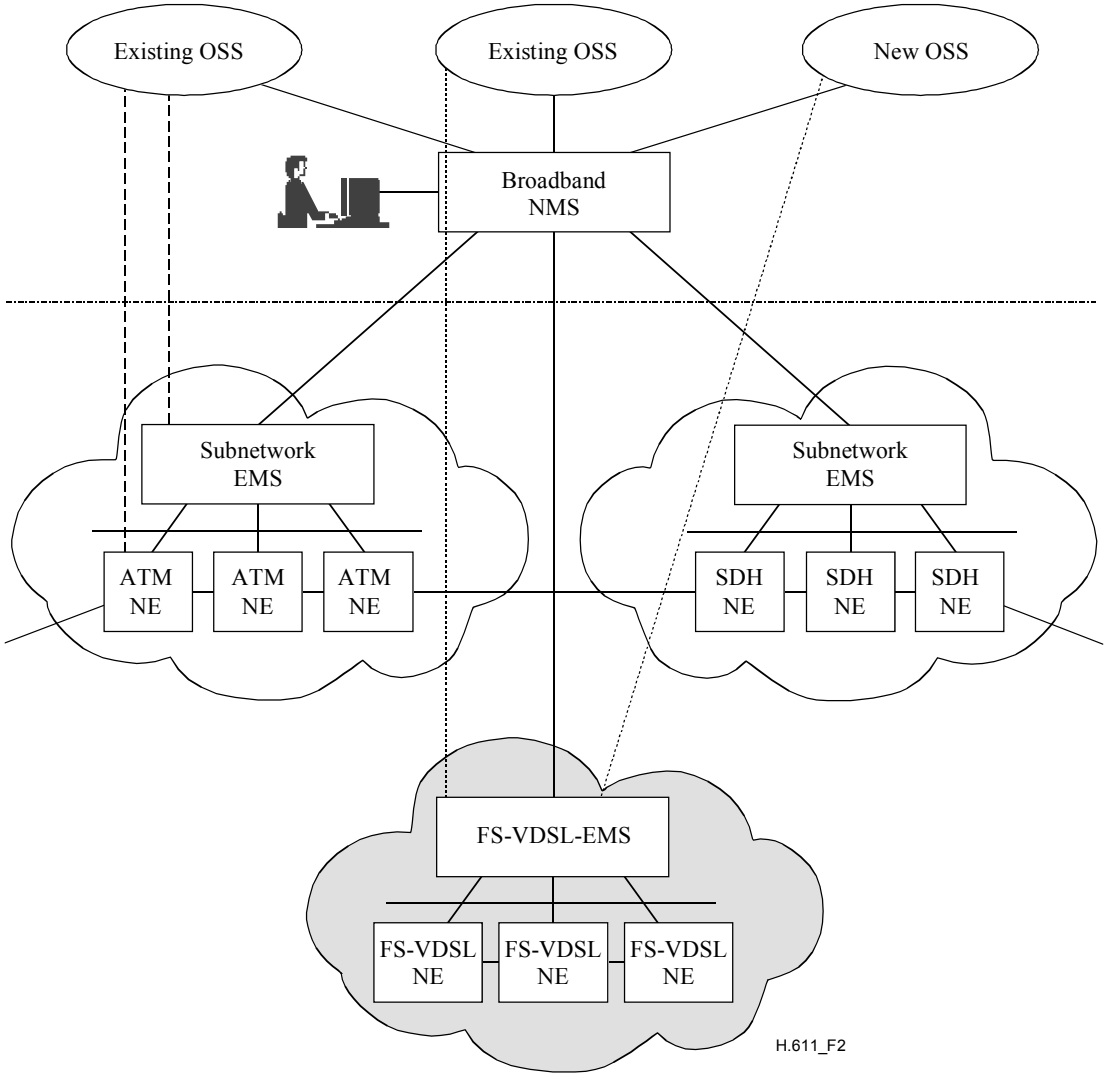


Figure 2/H.611 – Management architecture

4 Abbreviations

This Recommendation uses the following abbreviations:

AAL2 ATM Adaptation Layer 2

ADSL Asymmetric Digital Subscriber Line

ANSI American National Standards Institute

ATM Asynchronous Transfer Mode

AWG American Wire Gauge

B-ISDN	Broadband Integrated Services Digital Network [ITU-T]
BLES	Broadband Loop Emulated Service
BOOTP	Bootstrap Protocol [IETF]
CBR	Constant Bit Rate
CMISE	Common Management Information Service Element [ISO]
CO	Central Office
CORBA	Common Object Request Brokerage Architecture
CPE	Customers' Premises Equipment
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
dBm	Decibels in milliwatts
DCT	Digital Communications Tester
DRP	Disaster Recovery Plan
DS0	Digital Signal level 0
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
DSM-CC	Digital Storage Media – Command and Control
EMS	Element Management System
ETSI	European Telecommunications Standards Institute
F4	Flow 4 [ATM]
F5	Flow 5 [ATM]
FP	Functional Processing
FPD	Functional Processing and Decoding
FRU	Field Replaceable Unit
FS-VDSL	Full Service Access Network – Very high speed Digital Subscriber Line
FTTC	Fibre To The Cabinet
FTTEx	Fibre To The Exchange
FTTK	Fibre To The Kerb
GUI	Graphical User Interface
HAM	Amateur Radio Operator
HTML	HyperText Mark-up Language
HTTP	HyperText Transfer Protocol
IETF	Internet Engineering Task Force
IGMP	Internet Group Management Protocol [IETF]
ILMI	Integrated Local Management Interface
IP	Internet Protocol [IETF]
ISDN	Integrated Services Digital Network

LAN	Local Area Network
LED	Light-Emitting Diode
MAC	Media Access Control
MDU	Multi-Dwelling Unit
MIB	Management Information Base
MPEG	Moving Picture Experts Group
NE	Network Element
NML	Network Management Layer
NMS	Network Management System
NO	Network Operator
OAM&P	Operations, Administration, Maintenance and Provisionning
ODN	Optical Distribution Network
OF	Optical Fibre
OLT	Optical Line Termination
ONU	Optical Network Unit
OSS	Operational Support System
PCI	Protocol Control Information
PON	Passive Optical Network
POTS	Plain Old Telephone Service
PPPoA	Point-to-Point Protocol over Asynchronous Transfer Mode
PPPoE	Point-to-Point Protocol over EtherNet
PPV	Pay Per View
PSD	Power Spectral Density
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RFC	Request for Comment
SNMP	Simple Network Management Protocol
SNR	Signal to Noise Ratio
SP	Service Provider
STB	Set Top Box
TOM	Telecom Operations Model
UBR	Unspecified Bit Rate
UDP	User Datagram Protocol [IETF]
USB	Universal Serial Bus
VC	Virtual Channel
VCC	Virtual Circuit Connection
VCI	Virtual Channel Identifier

VDSL Very high speed Digital Subscriber Line

VoD Video on Demand

VoDSL Voice over Digital Subscriber Line

VP Virtual Path

VPC Virtual Path Connection

VPI Virtual Path Identifier

VPL Virtual Path Link

VTP VDSL Termination Processing

VTP/D VDSL modem with Protocol processing and Decoding

VTU VDSL Terminal Unit

WAN Wide Area Network

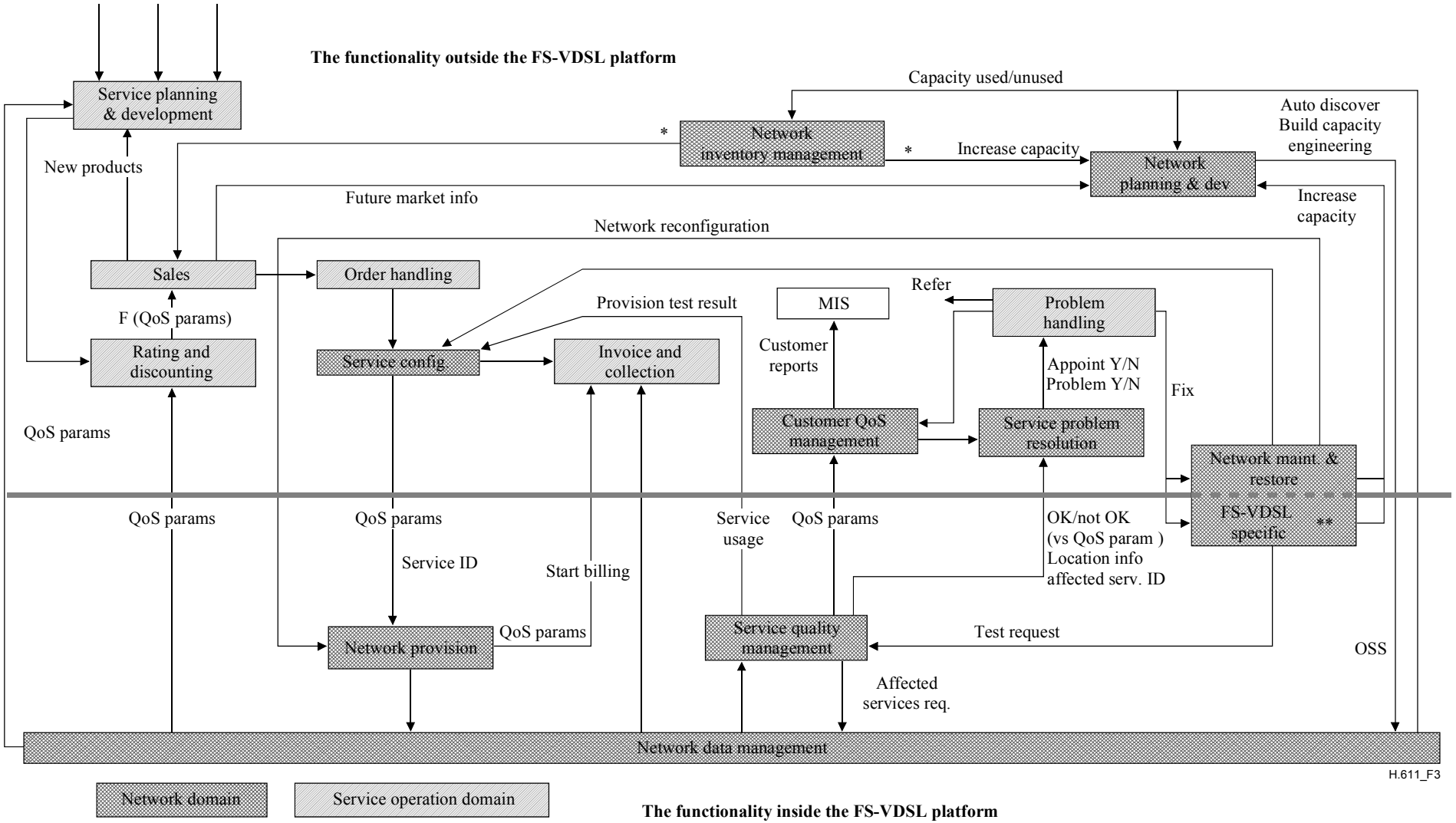
5 Conventions

In this Recommendation, the following conventions are used:

- "shall" indicates a mandatory requirement;
- "should" indicates a suggested but optional course of action;
- "may" indicates an optional course of action rather than a recommendation that something take place.

6 Functional diagram

The linkage between the processes and the functions that relate to the FS-VDSL platform are shown in Figure 3. The diagram is divided by a continuous line, below the line are four functional areas, Network Provision, Network Data Management, Service Quality Management and FS-VDSL Maintain and Restore that are specific to the platform. Above the line are the functions that are required, but are not FS-VDSL specific, and would be implemented in the Network Operation domain or Service Operation Domain. It also identifies the interfaces between these specific and non-specific functions.



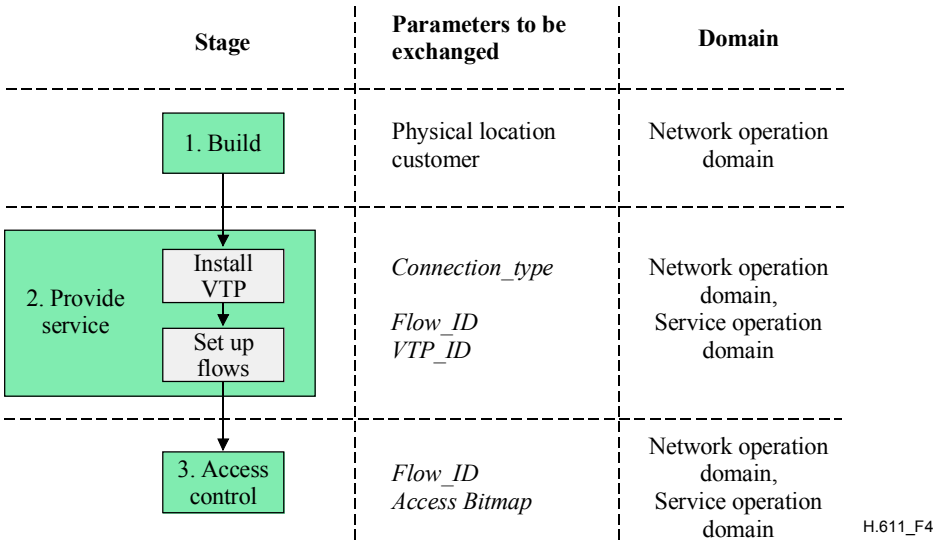
* = Auto detect
** = Access domain (VDSL transport)
in building network Set Top Box

Figure 3/H.611 – Functional diagram

7 Network provision

This Recommendation does not define the precise set-up of a given service once the network has been configured sufficiently to support it. It is expected that this will be undertaken by the Service Operation Domain. However, the control of access to broadcast video channels is managed within the FS-VDSL platform and is defined in 7.3 below.

Figure 4 shows the Network Provision functionality broken down into three distinct stages. The requirements for each stage are dealt with in 7.1 to 7.3.



NOTE 1 – The text in the right hand column suggests the domain(s) most likely to be responsible for the stage.

NOTE 2 – The text in italics in the centre column identifies those parameters that will be passed into, or out of, the FS-VDSL platform (see interface specifications in clause 12 for more details).

Figure 4/H.611 – Network provision functionality

7.1 Stage 1 – Build the network

This stage includes both providing network equipment in new geographical areas, and adding capacity to existing Core and Access Network Domains. It is up to the Network Operation Domain to maintain records of which specific areas could potentially be served by the equipment that is installed. It is expected that these records will be kept in the Network Operation Domain's OSS, not within the FS-VDSL platform. Note that at this stage the VTP/D will not be installed.

7.1.1 Auto discovery and auto configure

Any equipment added to the platform during a build activity shall be auto-discovered and configured by the FS-VDSL platform.

7.1.2 VDSL configuration parameters

The parameters that are required to configure VDSL lines are given in DSL Forum TR-57 and IETF draft-ietf-adslmib-vdsl-02.txt. Annex A provides a list of the parameters required; these parameters are definable on a per line basis and the MIB present at the ONU for each line shall be configured when the VDSL linecard is installed. Configuration of the VDSL line will then take place when the VTP/D is installed and the VDSL modems train up.

7.1.3 ONU & OLT configuration parameters

There will be ONU and OLT parameters which need configuring. However these are vendor specific and so do not form part of this Recommendation.

7.2 Stage 2 – Provide service

Once network capacity is available the Service Operation Domain may sell services to individual customers. This may in turn result in the Service Operation Domain asking the Network Operation Domain to provide network capability to a specific customer, upon which the service will be carried.

7.2.1 Installation of the VTP/D

At installation the end user's copper pair will be connected to a spare port on the ONU. There is no requirement to stipulate which port will be used (although this can optionally be specified). Upon connection of the VTP/D at the customer's premise end of the copper pair, the FS-VDSL platform shall auto-detect the VTP/D and following train up of the VDSL transceiver, read its unique VTP_ID (e.g., its MAC address or serial number), and add it to the inventory information held within the platform (usually within the EMS). Note that, during this part of the service provision activity, there is no requirement for any information to cross the Q interface into the FS-VDSL platform.

7.2.2 Management of the VTP/D

Any management of the VTP/D that is undertaken from the Core and/or Access Network Domain shall be initiated via the EMS. The ability for a customer to configure the VTP/D locally, e.g., via an HTML interface, is optional.

A method of raising a notification from the FS-VDSL platform to indicate that a VTP/D has been connected, which ONU port it has been connected to, and what its VTP_ID is, shall however be provided. This is required to deal with the case where the Network Operation Domain does not provide the VTP/D and therefore has no prior knowledge of its VTP_ID.

The Service Operation Domain is expected to maintain the relationship between each VTP/D and the customer it serves, using the unique VTP_ID. It is expected that the Service Operation Domain will use an existing customer database to store this relationship. Note that this relationship is not held within the FS-VDSL platform.

VTP/D remote reset functionality shall be provided. Example: Performing a warm or cold restart of the VTP/D. Groups of VTP/Ds can be reset by the EMS.

7.2.3 VTP/D configuration management

A VTP/D shall be capable of retrieving configuration information from the EMS for the VDSL line and for ATM configuration. Higher layer configuration information shall be retrieved from the appropriate system in the Service Operation Domain. Details of the configuration parameters for ATM and higher layers are given in ITU-T Rec. H.610.

7.2.4 Setting up flows

A request to provide service to a particular customer shall, as far as the FS-VDSL platform is concerned, be a request to set up one or more ATM flows, which shall be of one of the ATM flow types defined in ITU-T Rec. H.610.

For the request the Network Operation Domain shall determine the precise flows that need to be set up and instruct the FS-VDSL platform to set them up to a given VTP_ID.

NOTE 1 – At this stage the VTP_ID for a given customer will be known by the Service Operation Domain and/or the Network Operation Domain. This will be achieved either because the VTP is provided by the Network Operation Domain or because the VTP_ID has been discovered by the platform and reported back to the Service Operation Domain.

Before any attempt is made to set up a given flow, a check shall be made to ensure that the VTP/D can support the flow requested.

Once a given flow has been set up successfully on the FS-VDSL platform, the platform shall assign to it a unique identifier known as the flow_id. This flow_id shall include the VTP_ID. This event shall be reported back to the NMS via the EMS, and shall only be reported once the path between the VTP/D and the V interface has been verified. The FS-VDSL platform shall initiate this verification activity automatically.

NOTE 2 – Following reception of this event report, the Network Operation Domain or Service Operation Domain can initiate a service verification activity that ensures the VTP/D can access the service – for example, a 'welcome' web page or video signal. This service verification activity is not part of this Recommendation. The platform can only verify flows at the ATM layer.

NOTE 3 – The flow_id is used within the platform to identify a specific flow to a specific VTP_ID. The Network Operation Domain and Service Operation Domain can use the flow_id to identify specific services to specific customers, by relating the flow_id to services and customers within their own systems.

The primary identifiers for performing OAM&P functions on the FS-VDSL platform are the VTP_ID and flow_id. These are used extensively by the platform during most OAM functions. The format of these identifiers is given in ITU-T Rec. H.610.

The Platform may be able to handle predefined sets of flow configurations that correspond to specific types of service (e.g., three channels of broadcast video with IGMP channel control).

NOTE 4 – All flows set-up within the FS-VDSL platform will be performed remotely via the EMS. No site visit should be necessary to undertake any of the provisioning functions.

NOTE 5 – Connection of the VTP/D can be performed by the end user, thus eliminating completely the need for any customer site visit by Network Operation Domain or Service Operation Domain personnel.

7.3 Stage 3 – Access control

Once a service has been provided, there may be a need to change some parameters of that service at a later date. The only service-specific parameters that form part of this Recommendation are those associated with access control to support broadcast video channel switching. It shall therefore be possible to download an access control bitmap as defined in ITU-T Rec. H.610, that defines what multicast ATM flows the customer is able to connect to. This access control bitmap can be associated either with a given flow_id or VTP_ID. This functionality means that different levels of access can be provided for different flows to the same VTP/D, which enables (for example):

- multiple users to be supported via the same VTP/D;
- control authorization of PPV programming;
- restore VTP/D to known default configuration, e.g., to clear parental lock.

If only the VTP_ID is specified the bitmap will apply to all flow_ids containing that VTP_ID.

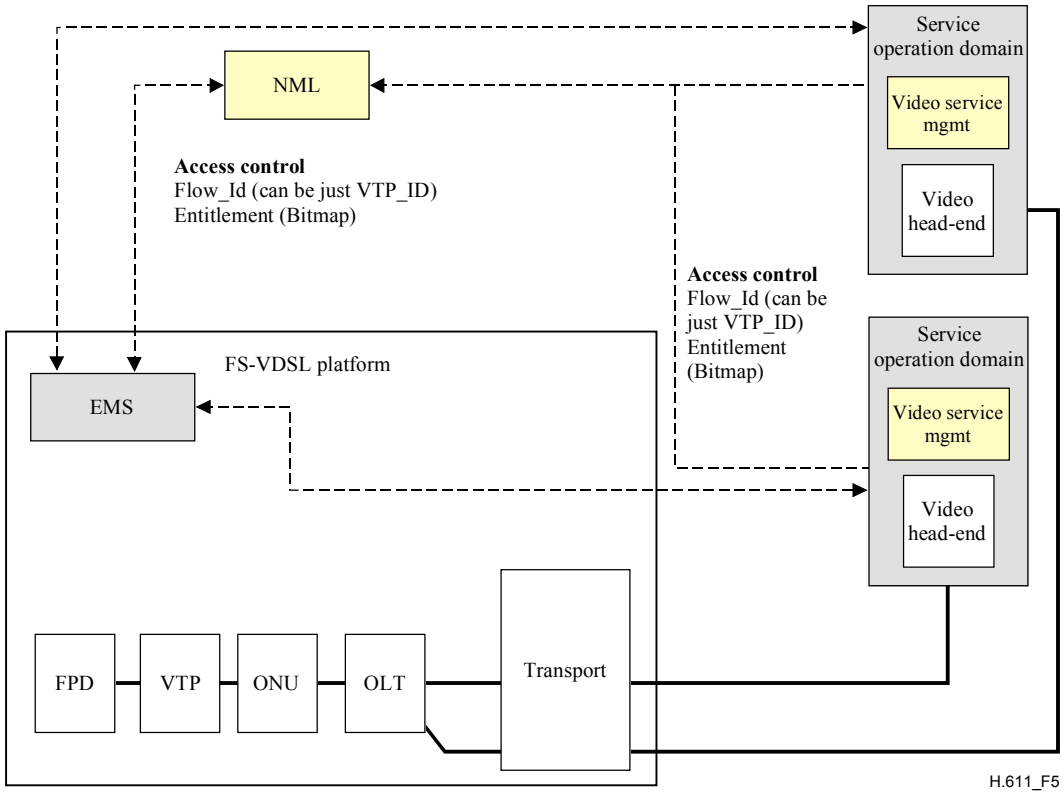


Figure 5/H.611 – Access control channels

8 Network data management

8.1 Usage data

It is expected that most usage information will come from outside the VDSL platform, e.g., the Service Operation Domain. For this reason, only limited usage information is specified as being logged and stored within the VDSL platform.

ATM switching event logging and ATM cell count logging shall be activated on a per flow_id basis if required by the Service Operation Domain.

Service usage events shall be stored within the platform so that they can be extracted by Domain specific OSS. The platform will be capable of storing service usage data for a period as specified by the domain.

This functionality allows charging:

- by bits transferred;
- by elapsed time;
- by time of day (implies date stamping);
- by access to content – Metasignalling data;
- by access to content for a limited time – Metasignalling data;
- according to QoS.

8.2 Ensuring accuracy of usage information

VTP/D MAC ID's, Serial Numbers and IP addresses shall match individual customer service subscriptions and service requests. Most of these relationships are held outside the FS-VDSL platform, however it is essential that 100% accuracy is maintained within the platform between VTP_ID, flow_id and ATM level usage information. This may be more challenging when the VTP/D is not provided or managed by the Network Operation Domain. The platform should provide a facility to allow only the known VTP/D to be recognized unless the Network Operation Domain intervenes.

8.3 Topology (relationship between equipment and services)

It shall be possible to generate a list of physical hardware and software components, using terminology defined in ITU-T Rec. H.610, that are used to deliver a particular instance of a particular service. This would, for example, enable the Network Operation Domain to look for relevant alarms in response to a trouble report.

There should be minimum manual inventory and configuration recording.

The Network Operation Domain shall be able to request, on demand, the EMS to provide the view of the sub-network of the EMS for all physical hardware and software components. This should include associated facility link information and link terminations for the network elements. It should be possible for the Network Operation Domain to be able to construct an updated physical network map/topology view from such information.

If the EMS automatically and autonomously performs network discovery and has updated information in its database, then it should provide such information to the Network Operation Domain, upon request.

8.4 Utilization/capacity management

It shall be possible to generate a list of all components in the platform, using standard FS-VDSL terminology, showing the total capacity and the current utilization of each component. This will enable capacity planning rules to be set in the Network Operation Domain. It should be possible to mark unused capacity as reserved.

There shall be a facility to hold configuration information including that of pre-provisioning and capacity reservation during maintenance activities.

8.5 Equipment information

It shall be possible to obtain the following information for all FS-VDSL inventory where applicable: software version, hardware version, serial number, MAC address, IP address, ATM address, vendor and model number.

In addition for any inventory item, it shall be possible for a User Defined Label to be provided by the Network Operation Domain and associated with that item. This label shall have a minimum available character length of 256 bytes.

9 Service quality management

For a specific customer flow_id there shall be:

- Auto-reporting of QoS exceptions based on downloaded thresholds. The requirement from the Network Operation Domain is real time, the vendor should be able to advise the maximum delay between the exception occurring and the report being generated;
- the ability to report QoS parameters on demand;

- the ability to report QoS parameters against predefined schedule (i.e., timescales);
- the ability to feed in QoS thresholds.

Any QoS exception report shall have an associated location statement and suggested course of action to clear the problem that indicates the root cause and, if desired, only the root cause. Figure 1/H.610 defines the minimum set of locations. The suggested course of action statements shall be human readable text no greater than 1024 characters:

- location statements should define a FRU (Field Replaceable Unit) or bearer if appropriate;
- distance to fault along bearer may be provided.

NOTE – A valid corrective action could be to increase capacity at a given network node or link between nodes.

10 Network maintenance and restoration

10.1 General requirements

a) There should be no prevention of the testing of telephone apparatus, baseband telephony service or ISDN service.

b) There is no requirement to gain information about the FPDs.

c) The OLT, ONU and VTP/D shall include a local access port for craft terminal access to system information including alarms and MIBs.

d) Test functions if required by the Network Operation Domain shall manage subscriber drop testing and channel testing.

e) The OAM functionality of the interface between the FS-VDSL platform and legacy PSTN platform needs to be defined if VoDSL services are to be supported. This is currently not part of this Recommendation.

f) The facility to extend alarms to physical contact monitoring systems within the CO is optional. Alarm unit and alarm test unit options can include:
   - contact closure alarm inputs;
   - loop closure output alarms;
   - alarm severity and location indicators;
   - bay lamp control;
   - alarm cut-off switch with alarm cut-off LED;
   - channel test;
   - serial interface driver;
   - digital by-pass support.

g) Each compliant FRU (e.g., linecard, VTP/D) shall have a visible indication of status: as a minimum active /non-active/ error. These indications shall be consistent with alarms as indicated on the EMS, in addition the VTP/D should indicate the VDSL link status.

h) It is assumed that correlation between the FS-VDSL platform alarms and alarms from other network elements will take place in Network Operation Domain OSS and is therefore not part of this Recommendation.

i) While VTP/D operational problems may be detected by a technician upon installation, they are unfortunately more commonly reported by customers after initial installation. Therefore information available from the VTP/D shall reveal pertinent VTP/D internal information, network conditions, channel selection problems, pay-per-view problems, interactive-program guide problems, etc. VTP/D operational problems consist of video problems, audio problems, channel selection problems, remote control problems, telephony.

j) IP-based services shall be managed using SNMP messages as per IETF RFC 1157 and maintain a MIB in the format defined in IETF RFC 1213. MIB entries should include Diagnostics, Fault Detection and Hacker detection.

k) Power shedding shall be required to turn off non-essential services during a disruption of commercial AC power to a remote power supply. Turning off broadband services conserves RPS battery power to ensure up to eight hours of battery power for emergency telephony services. It is recommended that power shedding shall be automatically initiated by an OLT upon receipt of a loss of AC power or shall be manually requested by users.

10.2 VDSL modem performance monitoring

Various performance parameters are given in DSL Forum TR-57 and IETF draft-ietf-adslmib-vdsl-0.2.txt. Those required by this Recommendation are given in Annex B. The parameters shall be monitored in the VDSL modems and shall be available for the EMS to extract from the VTU-C MIB.

10.3 Line status

A Line Status parameter shall indicate if any of the performance parameters in Annex B are failing predefined thresholds. This status is indicated per VTU-x.

In addition, the line status shall indicate any of the following states:

- No Defect.
- Data Initialization Failure:

  VTU-C failure during initialisation due to bit errors corrupting start-up exchange data.
- Configuration Initialization Failure:

  VTU-C failure during initialization due to peer VTU not able to support requested configuration.
- Protocol Initialization Failure:

  VTU-C failure during initialization due to incompatible protocol used by the peer VTU.
- No peer modem detected:

  VTU-C failure during initialization due to no activation sequence detected from peer VTU.
- Retrain.

10.4 VTP/D information required

The VTP/D may be able to check connectivity between VTP/D and other devices in the customer premises (FPDs) including round trip delay. If this feature is provided then the information shall also be available via the EMS to the NMS.

The management information specified in ITU-T Rec. H.610 for the VTP/D shall be made available to the EMS to enable diagnostics and performance monitoring.

10.5 Metallic line

Consideration should be given to testing the integrity of the copper pair if there is no possibility to examine far-end equipment. Copper line test on PSTN should not affect VDSL transmission capabilities.

10.6 ONU CPU

Where appropriate, the following information shall be provided for each ONU:

- failure of power unit local or remote;
- external door open;
- battery high temperature;
- high/low temperature;
- fan failures;
- ingress of moisture;
- battery status;
- load and status (OK/not OK) of each ONU CPU.

This implies that in the ONU there shall be a management system capable of collecting information and reporting it using an OAM channel back to the EMS.

If in redundant mode an alarm should be generated, which notifies that a switch has taken place.

Repair and maintenance of the ONU shall be supported with minimum service interruption. Thus the ONU shall support, as far as possible, hardware replacement (hot swap) and in-service software upgrades, without losing existing configurations

10.7 Optical interface

The following parameters shall be provided for each optical interface:

- indication of Laser Diode Degradation or failure;
- indication of Optical Fibre transmission capabilities (SNR).

10.8 ATM

- The platform shall support full F4 and F5 OAM flow functionality as defined in ITU-T Rec. I.610.
- It shall be possible to set up at least the following segments, VTP/D – ONU, ONU – OLT, VTP/D – OLT.
- It shall be possible to loop cells originating from the VTP/D at the ONU and vice versa.
- It shall be possible to carry out an inter-domain loop back to occur at the V interface.

11 Element management system

11.1 General requirements

a) The following information about the Element Management System shall be provided: disk space, memory and CPU usage against resources allocated to the EMS, status of the links between the EMS and NE.

b) EMS restoration time to recover from an unscheduled shutdown shall be minimal. Example: Maximum of 10 minutes – non-customer service affecting.

c) EMS time to migrate from an existing management platform to a new hardware platform shall be minimal. Example: Maximum of 30 minutes – non-customer service affecting.

d) Upon recovery from a network outage, platform software shall be capable of recovering and in turn auto discovering multiple network elements within a maximum of 10 minutes.

e) Geographically dispersed deployment with centralised EMS management capabilities shall be supported.

f) The EMS shall support at least the following Administration Tasks:

- Starting EMS with default configuration files.
- Starting EMS with Network Operation Domain defined configuration file.
- Starting EMS without a configuration file.
- Selecting a configuration file from a list.
- Managing user accounts including the ability to limit the access to functionality on a per user and group basis. This is to facilitate for example SP access to specific functions within the EMS.
- Setting alarm message destination.
- Changing alarm message destination.
- Backing up of files, directories and databases.
- Restoring back-up files.
- Manual or Automatic file and database integrity checking.
- Managing active and stand-by modes of operation.
- DRP (Disaster Recovery Plan).
- Automatic or manual Upgrading/Downgrading EMS software. Manual mode upgrades allow for upgrading of system components one at a time while automatic mode upgrades the complete system.
- Purge superfluous information and files.
- Manage and maintain log files, e.g., alarms/history/provision.
- Restoring the EMS following loss of network.
- Restoring EMS following server crash/loss of power.
- Protect critical system file structure.
- Starting/stopping an alarm client.
- Sorting and filtering system messages.
- Viewing performance of EMS.

g) Establishing and monitoring the communication between the EMS and NE(s).

h) The NMS shall be able to request the EMS software version on request.

i) The platform shall continue to function in the event of an EMS failure.

j) The NMS shall be able to set the time and date reference in the EMS.

11.2 Event handling

a) The first instance of an event shall be recorded. All identical events within ***n*** seconds shall be suppressed but counted and made available for inspection. ***n*** shall be a configurable parameter.

b) The event shall be considered to be cleared after the last recorded event has not reoccurred for ***m*** seconds. ***m*** shall be a configurable parameter.

c) There shall be a requirement to be able to acknowledge alarms/events to prevent further notifications, these acknowledged alarms shall be recorded.

d) The EMS shall provide appended information associated with NE messages before they are forwarded to the NMS. The EMS shall forward all alarms/events (i.e., the ones passing through the filter residing in the EMS, see subsequent clauses) originating from the NEs. The EMS shall append the following information to the NE messages received at the EMS, before they are forwarded to the NMS:

- A unique EMS sequence number for the autonomous messages.
- The User Definable Label if it exists.

e) EMS shall provide a "filter" for alarms/events which are sent from EMS to NMS. The NMS shall be able to manipulate the EMS filter for autonomous messages so that the NMS can receive only an appropriate subset of EMS-originated or NE-originated messages. The parameters specified in this message shall specify the criteria for filtering messages at the EMS level. The messages shall be able to allow/inhibit EMS events from being transmitted to NMS based on parameters such as:

- Type of NE, e.g., VTP/D.
- Specific NE ID.
- Specific flow_ids.
- Severity of alarms such as Critical, Major, Minor, etc.
- Message type.
- User Definable Label (for both physical and logical entities).

f) If specific type of EMS autonomous messages are inhibited, this should not impact other commands issued by NMS and responses provided by that EMS.

g) The NMS shall be able to retrieve current NE-specific events (i.e., current problem list, operational data) from the EMS for diagnostic purposes. This data is used to evaluate the current network situation either before or after maintenance operations. The NMS shall be able to restrict the status information to specific parts of the NE (i.e., ports, boards or miscellaneous equipment (e.g., fans, power supply)). The EMS shall not apply any filtering to this data. If an EMS cannot provide this data from its database, it shall query the NE to acquire the information.

h) All types of alarm shall have associated with them a corresponding clearance event.

i) It shall be possible to change the priority of alarms within the EMS, with a minimum of three different priorities (e.g., Critical, Major, Minor).

j) It shall be possible to configure the length of time alarm information will be kept within the platform.

k) It shall be possible to define thresholds on reportable alarms on a per flow_id basis, where appropriate.

l) The EMS should provide a logging function for all autonomous messages generated by the EMS or the NE. The duration required for this function is for further study.

m) If the NMS/EMS link goes down, the EMS shall log the autonomous messages (i.e., NE and EMS-generated alarms/events) that would have been sent to the NMS if the link was operational. Upon link re-activation, the NMS will automatically request the EMS to upload all stored autonomous messages for the duration of the time that NMS/EMS link was down.

12 Interfaces to the platform

There are three interfaces to the platform for management purposes. These are labelled "Q", "F" and "Craft" in Figure 6.

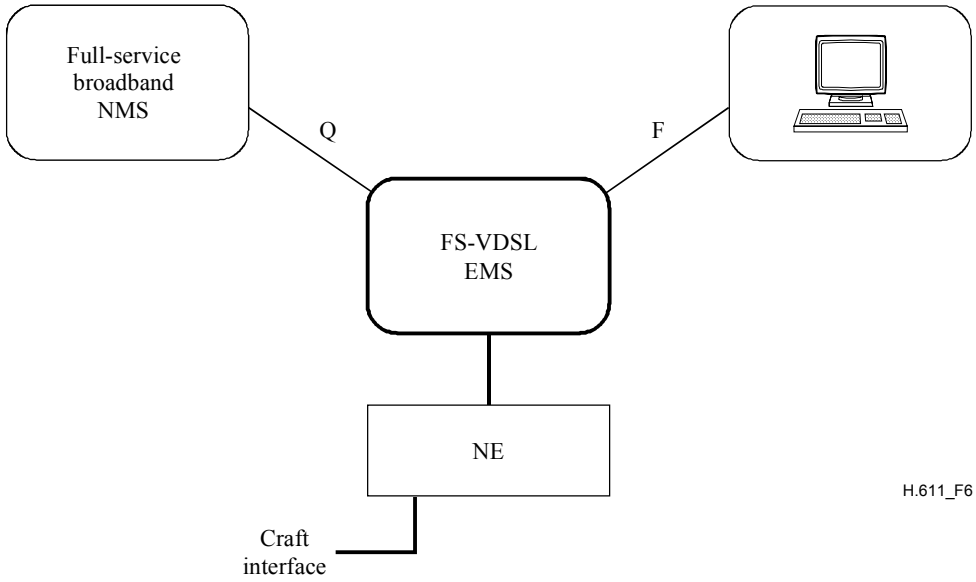


Figure 6/H.611 – Platform management interfaces

The Q interface is an electronic interface between the FS-VDSL platform's Element Manager and the Network Management Systems of the Network Operation Domain. This Recommendation gives functional requirements of this interface but does not specify an information model or a protocol, or the communications channel between the EMS and the NMS.

The F interface is an interface between the EMS and a terminal that gives access to the same functionality as the Q interface, but in a form understandable to a human operator. The F interface shall provide such functionality that supports network configuration and network maintenance and restoration. The terminal be shall capable of being remotely situated, easy to use and use readily available technologies, e.g., Web based, Client Server, X-Windows, GUI.

The Craft interface is a generic term applied to electronic interfaces on component parts of the platform and the VTP/D that allow connection of a craft terminal. The functionality of each interface is confined to the management/monitoring of the component to which the craft terminal is connected.

12.1 General interface requirements

The following clauses define the requirements for the Q interface. The requirements are specified here in 'human readable' terms.

a) Any request into the platform shall give a success/fail indication.

b) The EMS response to NMS messages will contain a correlation indicator to the NMS input command. In the response to an NMS message, the EMS may echo back the same correlation indicator contained in the NMS message. The NMS is responsible for the uniqueness of the correlation indicator across all its subtending EMS(s).

c) For each EMS autonomous message to the NMS, the EMS shall assign a sequence number for that message. Such a sequence number should be included in all EMS autonomous messages. Note that these autonomous messages may be EMS-generated or NE-generated alarms, events or report database changes. These sequence numbers are used by the NMS to identify the missing autonomous EMS messages.

d) A Logical NE is a collection of NE(s), which can be viewed from an NMS perspective as a single provisionable and/or maintainable entity. To implement an NMS logical NE command, an EMS may need to issue multiple commands to perform the requested logical NE operations in its domain. For provisioning, the NMS needs only to define the entrance and exit points to the FS-VDSL platform. The EMS will then take care of all appropriate cross-connects and routing in its domain.

e) The circuit ID is an important concept in a Service Provider's environments. Traditionally, this circuit ID is applied to network physical entities. It is proposed that this concept be extended to the logical ATM entities such as VCCs and VPCs by using flow_id.

The general philosophy is as follows: the NMS requests a particular flow, across the FS-VDSL Platform to a specific VTP/D; the EMS checks that such a flow is possible and assigns a unique flow_id. The EMS then stores the flow_ids and appends them to the associated NE autonomous messages, whenever they are forwarded from the EMS to the NMS. This would require an EMS to be able to relate flow_ids to:

- ATM VCC(s) (an end-to-end connection consisting of multiple VPL(s)).
- Cross EMS Virtual Paths (VP(s)).
- Cross EMS physical transmission facilities (e.g., VDSL, PON).
- VDSL lines.

Hence, the flow_id relates to both, physical facilities as well as ATM logical entities.

If an autonomous message is associated with the high level failure (e.g., an OLT), then the flow_ids affected by that failure shall be appended to the message which is sent from the EMS to NMS.

f) The EMS should send periodic heartbeat notifications to the NMS to indicate that it is alive at user-definable intervals. The option to disable this notification should also be provided.

g) If the actual response to specific NMS messages cannot be received within a pre-specified time period, the EMS shall send an appropriate acknowledgement to the NMS. An acknowledgement is a response to an NMS request. This acknowledgement may be implemented for specific commands for which a response could take a long time. If the response to an NMS input command takes longer than a pre-specified time interval, the EMS shall periodically issue an acknowledgement message indicating the pending state of the NMS-requested operations. These acknowledgements imply the command is being executed. The EMS shall continue to send acknowledgement messages at every interval of the designated delay period until the "completed" or "denied" response is sent back to the NMS. The periodicity of acknowledgements shall be a settable parameter. This feature prevents the NMS operator from issuing a command multiple times due to not receiving a response in a reasonable timeframe.

Example: If the NMS requests an EMS to perform NE software restoration, and if completing such a task could take approximately 20 minutes, then that EMS should send an appropriate acknowledgement to the NMS indicating that the requested operation is being performed.

12.2 Service planning and development

To support service planning and development the platform may supply:

- Usage information including fixed cost services, e.g., viewing statistics, user demand at specific times, utilization of IP path capacity.
- Information on the availability of platform capacity at various levels of granularity, e.g., specific ONUs.

12.3 Rating and discounting

To support rating and discounting the platform shall:

- Supply a list of usage statistics that are supported by the platform.
- Have access control mechanisms that are supported.

The platform may also report on non-invoiced usage.

This functionality will support promotional programming discounts and service credits.

12.4 Network provisioning

To support the initiation an instance of service (creates flow_id on platform), the platform shall be capable of acting upon the following received requests and associated parameters:

- Reserve a service type on an identified ONU and ONU port (null port parameter means use next available). The service types are defined in ITU-T Rec. H.610.
- Activate service to specified QoS parameters (null in this field means use default QoS parameters for service type) and assign a flow_id.
- Activate the service against an expected VTP/D identifier, i.e., serial number, MAC ID. Can be null in which case any VTP/D is accepted.
- Set default QoS parameter values and Service type.

The platform may also be capable of acting upon the following received requests and associated parameters:

- Additional ATM service types, where the parameters are VPI, VCI, traffic type and PCI.
- Predefined bundles of service types.

The platform shall be capable of supplying the following notifications and associated parameters:

- Acknowledgement of successful service request against a flow_id.
- A list of service types and default QoS parameter values for each type of service.
- Acknowledgement to indicate that a VTP/D and ONU port have been connected, identified by specific VTP/D ID and ONU port ID.
- Acknowledgement to indicate flow established successfully, identified by flow_id.

In order to support the cessation of an instance of service, the platform shall be capable of responding to a request to stop a flow, identified by flow_id. In addition, the platform may be capable of responding to a request to stop multiple flows identified by a list of flow_ids.

In order to restore service following a problem report, the platform shall be capable of the following:

- Reservation of an existing flow_id (the platform will reject flow_id that is not current).
- Cessation of the flow associated with the reserved flow_id.
- Activation as in initiation of an instance of service except the flow_id is specified to the platform. (The platform shall reject a flow_id that is not reserved.)

In order to initiate billing the platform shall be capable of:

- Supplying flow_ids with date and time stamps showing when verification of service is completed.
- Supplying flow_ids with date and time stamps showing when cessation of service is completed.

12.5 Invoicing and collection

To support billing using per-use information, the platform shall respond to the following requests:

- Activate and De-activate switching event logging by flow_id.
- Activate and De-activate ATM cell count logging by flow_id.
- Information on switching events and ATM cell counts by flow_id giving start time and stop time.
- Set usage information storage time, in number of seconds.

This functionality will support video service subscription and real time service transactions, i.e., PPV/VoD.

12.6 Network inventory management and network planning and development

To support Network Inventory management and Network Planning and Development, it shall be possible to retrieve a description of capacity in-use and available (real time snapshot). Specifically the platform shall respond to a request for:

- Total capacity and capacity in use, by Network Element ID (format to be that specified in ITU-T Rec. H.610), including subsidiary Network Elements. For each request a level of granularity shall be specified where zero indicates no subsidiary breakdown of information and positive integers indicate successive layers of granularity.
- Capacity available, by identifier of ONU port and OLT port, that can support a specified service type as defined in ITU-T Rec. H.610.
- The element type by Network Element ID. The type can be defined by software version, hardware version, serial number, MAC address, IP address, ATM address of element, vendor ID, model number.

In addition the platform may respond to the following requests:

- Reserve a specific amount capacity by Network element ID.
- Release a specific amount capacity by Network element ID.

12.7 Quality of Service

To support QoS Management the platform shall, for any flow_id provide on request information on QoS exceptions including QoS specified, start and stop times.

12.8 Network maintenance and restoration

To support Network Maintenance and Restoration, the NMS shall be able to monitor the platform condition as follows. The NMS shall be able to retrieve:

- Element performance information against Network Element ID (and optionally Flow_id), and any required optional parameters, including subsidiary Network Elements to a defined level of granularity (see 12.6).
- Link performance information against Network Element ID for the start of a link, Network Element ID for the end of link and any optional parameters required.

- Network Performance exceptions with a list of affected flow_ids, the Network Performance expected, the actual Network Performance, the location of a problem in terms of Network Element ID, date and time stamp, and indication of corrective action required.

The NMS may be able to retrieve the distance to a fault along a bearer.

The NMS shall be able to set the:

- Default Network performance parameter values for a given Network element type.
- Default Link performance parameter values for a given Start Network element type and End Network element type.
- Alarm storage time in seconds.

12.9 Service problem resolution

To support Service Problem Resolution, the NMS shall be able to request results from on-demand or self-generated tests against flow_id. It may also be able to initiate routine QoS reporting against a list of flow_ids with a given periodicity in seconds.

The NMS shall be able to invoke a test for a specific flow_id and obtain from the platform the test result including the QoS expected the actual QoS, location of the problem in terms of network element ID date and time stamp and indication of corrective action required.

The NMS shall be able to request a QoS exception list of affected flow_ids including the QoS expected, the actual QoS, location of the problem in terms of network element ID date and time stamp and indication of corrective action required.

The functionality in 12.8 may also be used for service problem resolution.

12.10 Access control functions

To support Access Control Functions, the platform shall respond to the following commands:

- Set Access Bitmap from an access bitmap provided by the NMS for a given VTP/D ID and its associated flow_id(s). If no flow_id is specified the bitmap applies to all flow_ids containing that VTP/D ID.
- Read Access Bitmap for particular flow_ids and associated VTP/D IDs.

13 Security management

13.1 Set privileges, authentication data and passwords for access to NE(s)

The EMS shall allow the NMS to retrieve NE security data including current passwords to access that NE. The NMS shall then have the ability to remotely set up user accounts with privileges and modify/change password information in the NE(s). The EMS shall also allow the NMS to change all the passwords associated with the NE(s) with one command. The EMS shall allow the NMS to add/delete a specific password on all NE(s) with one command.

13.2 Set privileges, authentication data and passwords for access to EMS

The EMS shall allow the NMS to retrieve EMS security data including current passwords to access that EMS. The NMS shall then have the ability to remotely set up user accounts with privileges and modify/change password information in the EMS(s). The EMS shall also allow the NMS to change all its passwords with one command. The EMS shall allow the NMS to add/delete a specific password on all EMS(s) with one command. The system administrator shall have the ability to freely configure user classes and users according to the following principle. User profiles for the individual user shall be configurable for any variation of:

- allocation by functionality;
- allocation by geographical area;
- topological view.

13.3 Autonomous reporting of NE security messages

The NMS shall receive (via EMS) any NE autonomous messages that are related to occurrence of NE security violation events. Filtering of these messages should be provided as on a operator-controlled basis.

13.4 NMS/EMS interface link security

The NMS/EMS interface shall support link layer security mechanisms that may be protocol independent.

13.5 NMS/EMS interface access control

Access Control allows association of appropriate access permissions with resources. Resources can be either physical (modems, Links, Line Cards) or logical (VCC) entities. Only specific operations indicated by the Access Control information are permitted on a resource. NMS & EMS applications shall support an Access control mechanism to associate specific permissions with resources and to protect resources from unauthorized operations. Implementation of this requirement shall require joint agreements and development between the FS-VDSL EMS and Full-Service Broadband NMS suppliers.

14 Platform software

14.1 Managing software inter-dependencies

The platform shall include an automated software upgrade capability whereby once a software component has been upgraded, all other related software components will automatically also be upgraded if necessary. For example, an OLT software upgrade might automatically trigger a linecard software upgrade. This feature is required to avoid problems that occur due to incompatible software versions being run simultaneously.

14.2 Switching over to new software versions

The platform shall allow operators to:

- load a new version of the software on the standby-processor;
- automatically or manually switch the system from the primary to the standby software, ideally without any disruption to service.

14.3 VTP/D software upgrades

The VTP/D shall have a back-up bootstrap that can retrieve an operational load as described in ITU-T Rec. H.610. BOOTP shall be available and independent of the downloaded software image. A VTP/D may have two separate sets of operating software, active and passive.

The management system shall download a new version of the operating software from a core network server, using the following steps:

- Identify the model and manufacturer of the VTP/D.
- Make sure that the needed software for that VTP/D is available.
- Delete the passive software.
- Download a new version to the area cleared by the delete action.

- Switch between active and passive.

Immediately after every start-up or synchronization process of each port, the management system will check that the active software of the VTP/D is the one planned for that port. If the software is not as planned, then the following steps shall be taken:

- Check if the passive software is the one planned for that VTP/D.
- If yes, then a switchover process shall be initiated, causing the VTP/D to lose its synchronization, activate the passive software and go back to sync and service, using the planned software.
- If the passive software is not the one planned for that VTP/D, then the process described above for downloading a new version shall be activated.

Usually, but not necessarily, in a new VTP/D shipped to an end customer, those two sets of software are identical.

In order to avoid denial of service because of a failure to complete the software upgrade procedure, the VTP/D shall perform some tests before switching over to the version stored on its passive area. All conditions shall be fulfilled:

- The length of the file is correct.
- CRC is ok.
- File name matches the planned one.
- File name matches the type of VTP/D connected to that port.

If one or more of the conditions listed in the previous paragraph fail, then:

- The switchover process shall be cancelled.
- The passive area shall be deleted.

It is recommended that each version of software should have a unique length.

Deleting the passive area, and downloading new software, shall take place even during active sessions performed by the customer.

It is preferred that the management system should not switch over during an active session: There should be the facility for the management system to force the switchover at any time or switch over at the next start-up cycle.

It should be possible to initiate an upgrade on Multiple VTP/Ds, e.g., grouped by the following:

- A single line card.
- Specific ONU.
- All ONUs parented on one OLT.
- Minimum requirement is the ability to initiate an upgrade of all VTP/Ds on an OLT with a single command.

The system shall be capable of distinguishing between types of VTP/Ds in order to download the matched software to the right VTP/D.

A requirement may be the ability to activate or de-activate a specific flow, e.g., video only or data only on a multi-service VTP/D without impacting other flows.

Annex A

VDSL configuration parameters

The following parameters are required to configure VDSL lines.

A.1 Applicable standard

This parameter specifies the applicable VDSL standard (if any) that is associated with a VDSL line.

The following options are available:

- ITU-T (ITU-T G.993.1).
- ANSI (ANSI T1.424 – Part-1).
- ETSI (ETSI TS101 270-2).
- Other proprietary.

A.2 Deployment scenario

This parameter specifies the deployment scenario applicable to a VDSL line. The options are

- FTTC.
- FTTEx.

A.3 Spectrum management

VDSL spectral usage is defined by the band plan. The various standard bodies have defined a number of band plans that have regional significance. The following parameters shall be provided per VDSL line.

- VDSL band plan:

  Selected from one of the following:

  – ITU-T G.993.1 Bandplan-A.
  – ITU-T G.993.1 Bandplan-B.
  – ITU-T G.993.1 Bandplan-C.
  – Other (for non-standard bandplans).

- Band plan C variable frequency (Fx):

  ITU-T G.993.1 Bandplan-C supports a variable frequency (Fx) which can be in the range of 3.75 .. 12 MHz.

- ADSL spectrum usage:

  ITU-T and ETSI allow optional use of the ADSL spectrum for VDSL. This parameter indicates if the ADSL Spectrum is used (enabled) or not used (disabled).

- Optional band usage:

  ITU-T envisions optional use of the spectrum in the range of 25 kHz to 138 kHz in the future. This parameter would specify if the band is used, and if so, whether it is used for downstream or upstream transmission. The values may be:

  – Up.
  – Down.
  – Not Used.

- ADSL service:

  This parameter provisions the presence of ADSL service in the associated cable bundle/binder. Selected from one of the following:

  – None (no ADSL service present).
  – ADSL over POTS.
  – ADSL over ISDN.

A.4 Power Spectral Density (PSD) management

The power spectral density shall be controlled in the downstream and upstream directions. The standard bodies have defined a number of PSD Templates. PSD configuration can be done by the following parameters per VDSL line.

- Downstream PSD template mask:

  Selected from one of the standard PSD template Masks:

  – Mask-1.
  – Mask-2.

- Upstream PSD template mask:

  Selected from one of the standard PSD template Masks:

  – Mask-1.
  – Mask-2.

A.5 Aggregate power control

The aggregate transmission power shall be controlled in both upstream and downstream directions per VDSL line.

- Maximum Aggregate Power Level – Downstream:

  The power level may be provisioned in the range of 0..14.5 dBm.

- Maximum Aggregate Power Level – Upstream:

  The power level may be provisioned in the range of 0..14.5 dBm.

A.6 Power backoff control

Optional power backoff is supported in the upstream direction. Downstream power backoff is presently not standardized, but may be supported by vendor-specific implementations. The backoff can be controlled by the following parameters per VDSL line.

- Upstream backoff PSD template:

  This parameter selects a power backoff PSD template from one of the standard PSD templates, or a custom PSD template may be used.

- Power backoff mode – Upstream:

  This parameter selects the backoff mode from one of the following:

  – No Backoff (backoff disabled).
  – Manual Backoff (per Manual Backoff Level – Upstream).
  – Automatic Backoff (based on line measurements per Power Back-off Mask calculation).

- Manual power backoff level – Upstream:

  This parameter specifies the upstream power backoff level to be used when Power Backoff Mode – Upstream is set to Manual Backoff. The level may be specified in the range of 0 to 40 dB in 0.25 dB steps, with a default value of 0 dB.

- Power Backoff Mode – Downstream (Optional):

  This parameter selects the backoff mode from one of the following:

  – No Backoff (backoff disabled).
  – Manual Backoff (per Manual Backoff Level – Downstream).
  – Automatic Backoff (based on line measurements per vendor-specific method).

- Manual Power Backoff Level – Downstream (Optional):

  This parameter specifies the downstream power backoff level to be used when Power Backoff Mode – Downstream is set to Manual Backoff. The level may be specified in the range of 0 to 12 dB in 0.25 dB steps, with a default value of 0 dB.

A.7 HAM band notching

The VDSL spectrum covers a number of HAM radio bands. To avoid interference, it is necessary to introduce power control (notching) in one or more of these bands. The following parameters are configured to support HAM band notching per VDSL line.

- HAM band template:

  The HAM Band Template configures the HAM bands that should be notched. The following standard HAM bands are defined in the VDSL spectrum:

Start frequency	Stop frequency
1810 kHz	2000 kHz
3500 kHz	3800 kHz (ETSI); 4000 kHz (ANSI)
7000 kHz	7100 kHz (ETSI); 7300 kHz (ANSI)
10 100 kHz	10 150 kHz

  Notching for each standard band above can be enabled or disabled.

  In addition, at least two more custom notches may be specified:

  – Custom Notch 1.
  – Start Frequency.
  – Stop Frequency.
  – Enabled/Disabled.
  – Custom Notch 2.
  – Start Frequency.
  – Stop Frequency.
  – Enabled/Disabled.

A.8 Noise margin management

The Noise Margin configuration for VDSL is similar to that for ADSL. The following parameters need to be configured per VDSL line.

- Maximum Noise Margin – Downstream:

  The noise margin may be configured 0..31.75 dB in steps of 0.25 dB.

- Minimum Noise Margin – Downstream:

  The noise margin may be configured 0..31.75 dB in steps of 0.25 dB.

- Target Noise Margin – Downstream:

  The noise margin may be configured 0..31.75 dB in steps of 0.25 dB.

- Maximum Noise Margin – Upstream:

  The noise margin may be configured 0..31.75 dB in steps of 0.25 dB.

- Minimum Noise Margin – Upstream:

  The noise margin may be configured 0..31.75 dB in steps of 0.25 dB.

- Target Noise Margin – Upstream:

  The noise margin may be configured 0..31.75 dB in steps of 0.25 dB.

A.9 Data rate management

The line data rate management for VDSL is similar to that for ADSL, except that no dynamic rate adaptation is supported for VDSL. As such, the following parameters are configurable per VDSL line.

- Fast Channel Maximum Data Rate – Downstream:

  The data rate may be specified in 1 kbit/s steps.

- Fast Channel Minimum Data Rate – Downstream:

  The data rate may be specified in 1 kbit/s steps.

- Slow Channel Maximum Data Rate – Downstream:

  The data rate may be specified in 1 kbit/s steps.

- Slow Channel Minimum Data Rate – Downstream:

  The data rate may be specified in 1 kbit/s steps.

- Rate Selection Mode – Downstream:

  This parameter specifies the rate selection behaviour for the line in the downstream direction. It can be set to one of following modes:

  – Manual (based on configured Fast and Slow Channel Maximum Data Rates).
  – Adapt at Start-up (adapted between Minimum and Maximum Channel Data Rates).

- Rate Adaptation Ratio – Downstream:

  When Rate Selection Mode – Downstream is set to Adapt at Start-up, the allocation of data rate in excess of the minimum rate for each channel is controlled by this parameter. This parameter specifies the ratio of the allocation of the excess data rate between the Fast and the Slow channels (i.e., Fast Channel Allocation/Slow Channel Allocation). The value can be 0 to 100% in 10% steps.

- Fast Channel Maximum Data Rate – Upstream:

  The data rate may be specified in 1 kbit/s steps.
- Fast Channel Minimum Data Rate – Upstream:

  The data rate may be specified in 1 kbit/s steps.
- Slow Channel Maximum Data Rate – Upstream:

  The data rate may be specified in 1 kbit/s steps.
- Slow Channel Minimum Data Rate – Upstream:

  The data rate may be specified in 1 kbit/s steps.
- Rate Selection Mode – Upstream:

  This parameter specifies the rate selection behaviour for the line in the upstream direction.

  It can be set to one of following modes:
  – Manual.
  – Adapt at Start-up.
- Rate Adaptation Ratio – Upstream:

  When Rate Selection Mode – Upstream is set to Adapt at Start-up, the allocation of data rate in excess of the minimum rate for each channel is controlled by this parameter. This parameter specifies the ratio of the allocation of the excess data rate between the Fast and the Slow channels (i.e., Fast Channel Allocation/Slow Channel Allocation). The value can be 0 to 100% in 10% steps.

A.10 Interleaving depth/delay management

The interleaving depth/delay management for VDSL is similar to that for ADSL. The following parameters are configurable per VDSL line.

- Maximum Interleave Delay – Downstream:

  The Maximum interleave delay for the Slow Channel: 0..255 ms in 1 ms steps.
- Maximum Interleave Delay – Upstream:

  The Maximum interleave delay for the Slow Channel: 0..255 ms in 1 ms steps.

Annex B

VDSL modem performance parameters

The following VDSL modem performance parameters are required.

B.1 Line measurements

- Current Line Data Rate – Downstream:

  The line data rate in kbit/s in steps of 1 kbit/s.
- Current Line Data Rate – Upstream:

  The line data rate in kbit/s in steps of 1 kbit/s.

- Current Line Attainable Data Rate – Downstream:

  The line data rate in kbit/s in steps of 1 kbit/s.
- Current Line Attainable Data Rate – Upstream:

  The line data rate in kbit/s in steps of 1 kbit/s.
- Current Line SNR Margin – Downstream:

  The line SNR margin: –31.75 to +31.75 dB in steps of 0.25 dB.
- Current Line SNR Margin – Upstream:

  The line SNR margin: –31.75 to +31.75 dB in steps of 0.25 dB.
- Current Aggregate Output Power – Downstream:

  The line aggregate output power: –5 to 15 dBm in 0.5 dBm steps.
- Current Aggregate Output Power – Upstream:

  The line aggregate output power: –25 to 15 dBm in 0.5 dBm steps.
- Current Line Attenuation – Downstream:

  The line attenuation: 0..63.75 dB in 0.25 dB steps.
- Current Line Attenuation – Upstream:

  The line attenuation: 0..63.75 dB in 0.25 dB steps.

B.2 VDSL modem performance monitoring counters

The following types of counter shall be provided:

- Current 15-minute Interval Counters.
- Previous N 15-minute Interval Counters.

Additionally, the following types of counter may be provided:

- Raw Counters.
- Current 1-Day interval Counters.
- Previous M 1-Day interval Counters.

B.3 VDSL line counters

The following counters shall be provided for the VDSL line at each VTU-X:

- Errored Seconds – ES.
- Severely Errored Seconds – SES.
- Loss of Power Seconds – LPRS.
- Unavailable Seconds – UAS.

Additionally, the following counters may be provided at each VTU-X:

- Loss of Frame Seconds – LOFS.
- Loss of Signal Seconds – LOSS.
- Loss of Link Seconds – LOLS.
- Line Initialisation Attempts – INITS.
- Time since last retrain.

B.4 VDSL channel counters

The following shall be provided VDSL Channels (Fast and Slow) at each VTU-X.

- Transmitted Blocks – TXB.
- Received Blocks – RXB.
- Corrected Blocks – CB.
- Uncorrectable Blocks – UB.

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