

# EDA 1200 System Overview

## DESCRIPTION



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# 1 Introduction

This system overview is intended to provide the reader with an overview of the EDA 1200 system, the concepts and available nodes.

The guide may be read without any prior knowledge of EDA 1200 and the technologies used, but to fully understand how the system functions works, the reader should be familiar with the basics of Ethernet networks, and Internet Protocol (IP) technology.

## **Additional Reading**

- EDA 1200 Descriptions and Node User guides

## 1.1 Revision Information

This guide is valid from EDA 1200 4.1 R8A. Other product versions, which include functions not described in this guide, may be available.

### 1.1.1 **This Revision (C)**

Released for 4.1 R8A. Only editorial changes.

### 1.1.2 **Revision B**

Released for 4.1 R6A. Other than editorial changes, this document has been revised as follows:

- Protocols restrictions for EDN612 removed in Section 3.1.3 on page 29 ()
- EDN612nef added
- RSC96m, RSC288m added in Table 15 on page 58
- A new variant of 10G expansion module added in Section 4.4.1 on page 52

### 1.1.3 **Revision A**

This is the first version of the guide valid from EDA 4.1 R3A. The information in this guide was previously available in *EDA 1200 System Description*.



## 2 Introduction to the EDA 1200 System

This section gives an overview of the EDA 1200 system. The concept and architecture are described.

### 2.1 EDA 1200 Concept

EDA is Ericsson's wire line access product, which offers flexible solutions for mass-deployment of high-speed triple-play services like data, voice and video. EDA 1200 focuses on the service provisioning and the access network as the means to provide these services to End-users. The access network is based on Ethernet technology, and deploys IP all the way. Different drop technologies and a variety of network solutions make EDA 1200 a flexible and cost-effective product, as illustrated in Figure 1 on page 3.

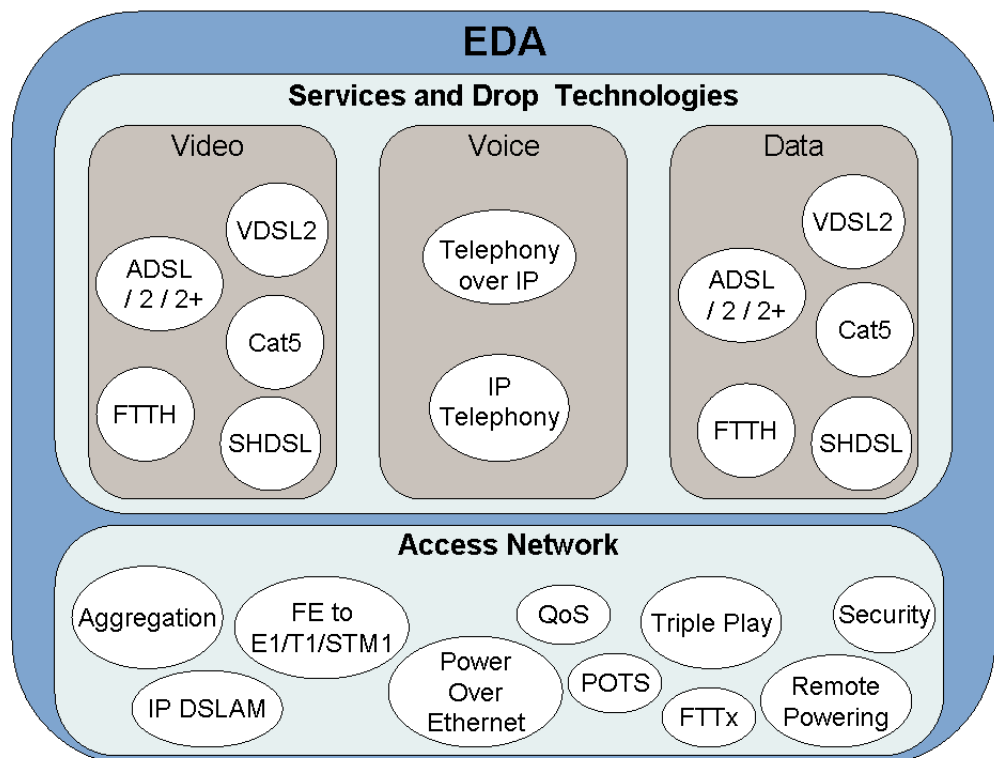


Figure 1 The EDA 1200 Concept

#### 2.1.1 Services and Drop Technologies

EDA 1200 supports services in different drop technologies in order to be able to offer the most cost efficient solution in different cases. The different drop

technologies and services can be mixed within the same network, and managed by the same management system – the Public Ethernet Manager (PEM).

### Services

EDA 1200 supports true Triple Play services:

- **Video** – all video services are IP based, and offer the same services regardless of the drop technology used. The Internet Group Multicast Protocol (IGMP) is used for efficient use of the network.
- **Voice** – the voice services are telephony services. Different drop technologies offer different types of telephony, with regard to both the perceived quality and the supplementary services.
- **Data** – various forms for data services are available, from mere Internet access to advanced services such as LAN to LAN services. The same services can be supplied regardless of the drop technology used.

### Drop Technologies

The various drop technologies allow for optimization of the network, according to the requirements of the End-users and the existing network. Both Data and Video services are based on the same broadband connection. The different drop technologies that can carry these services each have their advantages and shortcomings with regard to reach, bandwidth and cost. The principle relations of bandwidth and reach for different drop technologies are illustrated in Figure 2 on page 5. Where Fiber to the Home (FTTH) gives the highest bandwidth for the longest distance, it is also by far the most expensive drop technology (if a new connection to the customer has to be made). On the other hand, DSL lines can be bonded, thus achieving high data rates on existing copper lines.



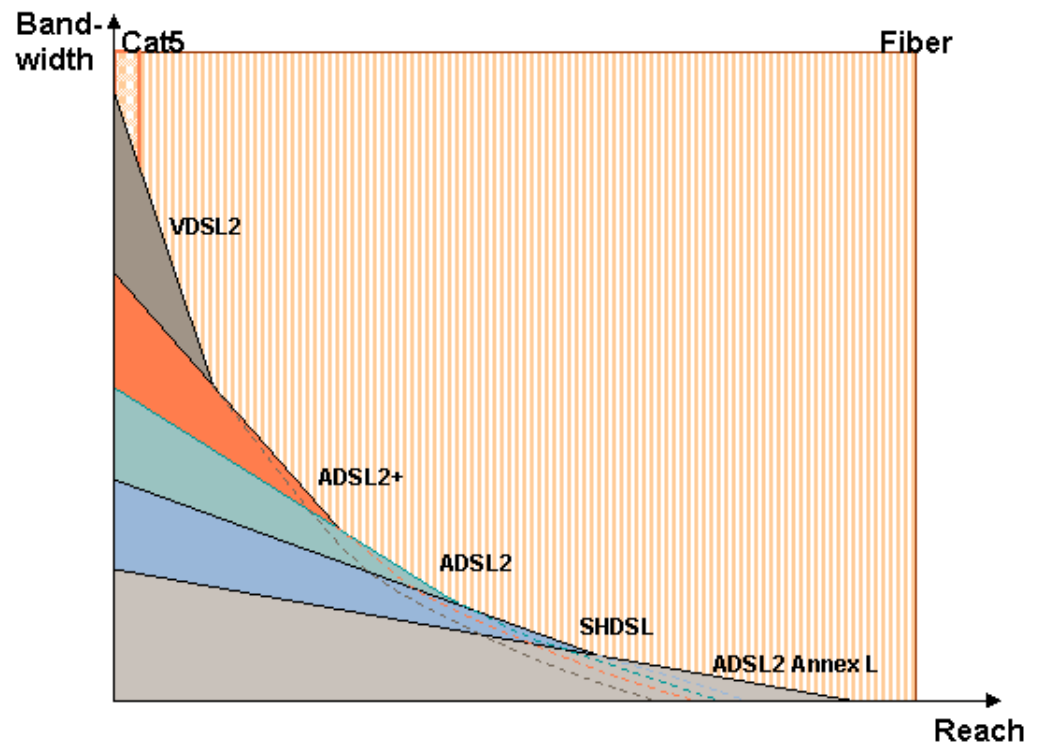


Figure 2 Broadband Drop Technologies: Bandwidth and Reach

As illustrated in Figure 2 on page 5, End-users with different line length and different needs can benefit from different drop technologies.

#### 2.1.1.1

#### DSL

EDA 1200 supports all current major DSL variants

- VDSL2
- ADSL2+
- ADSL2
- ADSL

The principles of all the different ADSL modes are the same, while VDSL2 is basically different. The difference reflects the wide deployment of Ethernet: while ADSL relies on Asynchronous Transfer Mode (ATM) mechanisms to ensure Quality of Service (QoS), VDSL2 relies on Packet Transfer Mode (PTM) scheduling mechanisms. PTM replaces both ATM and RFC 2684 (which, among others, contains AAL5) in the protocol stack.

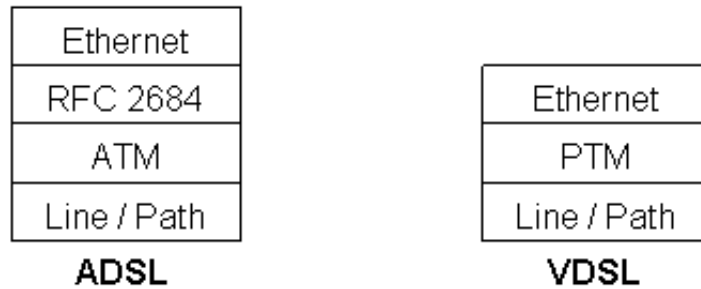


Figure 3 ADSL and VDSL Protocol Stack

Further, the segmentation unit in VDSL (codeword) is larger than in ADSL (cell), which gives a higher payload/header utilization ratio:

Table 1 ADSL and VDSL Segmentation

	<b>ADSL</b>	<b>VDSL</b>
Segmentation	53 Bytes (cell)	65 bytes (codeword)
Segmentation header	5 Bytes	1 Byte
Payload utilization (maximum) per unit	90,6%	98,5%

Apart from the theoretical maximum utilization ratio, per segmentation unit, the payload size of 64 Bytes in PTM is equal to a minimum Ethernet frame size. This will result in less padding, on average, in PTM than in ATM.

**2.1.1.2 Fiber**

Fiber to the home uses Ethernet directly over the physical media. There is no further segmentation, which reduces both the overhead and the needed processing capacity. The EDA solution allows for both single- and multi-mode fibers.

**2.1.1.3 Cat5**

Cat5 is an Ethernet connection. There is no further segmentation, which reduces overhead and needed processing capacity. Cat5 can only be used indoors, and has a reach of approximately 100 m. On the other hand, there is no need for special termination in the Customer Premises Equipment (CPE). Any off the shelf Ethernet product can be used as CPE.

**2.1.1.4 Telephony**

The different telephony drop technologies are based on different concepts, and therefore offer different properties. The principle difference between the three voice services offered by EDA 1200 is illustrated in Figure 4 on page 7.

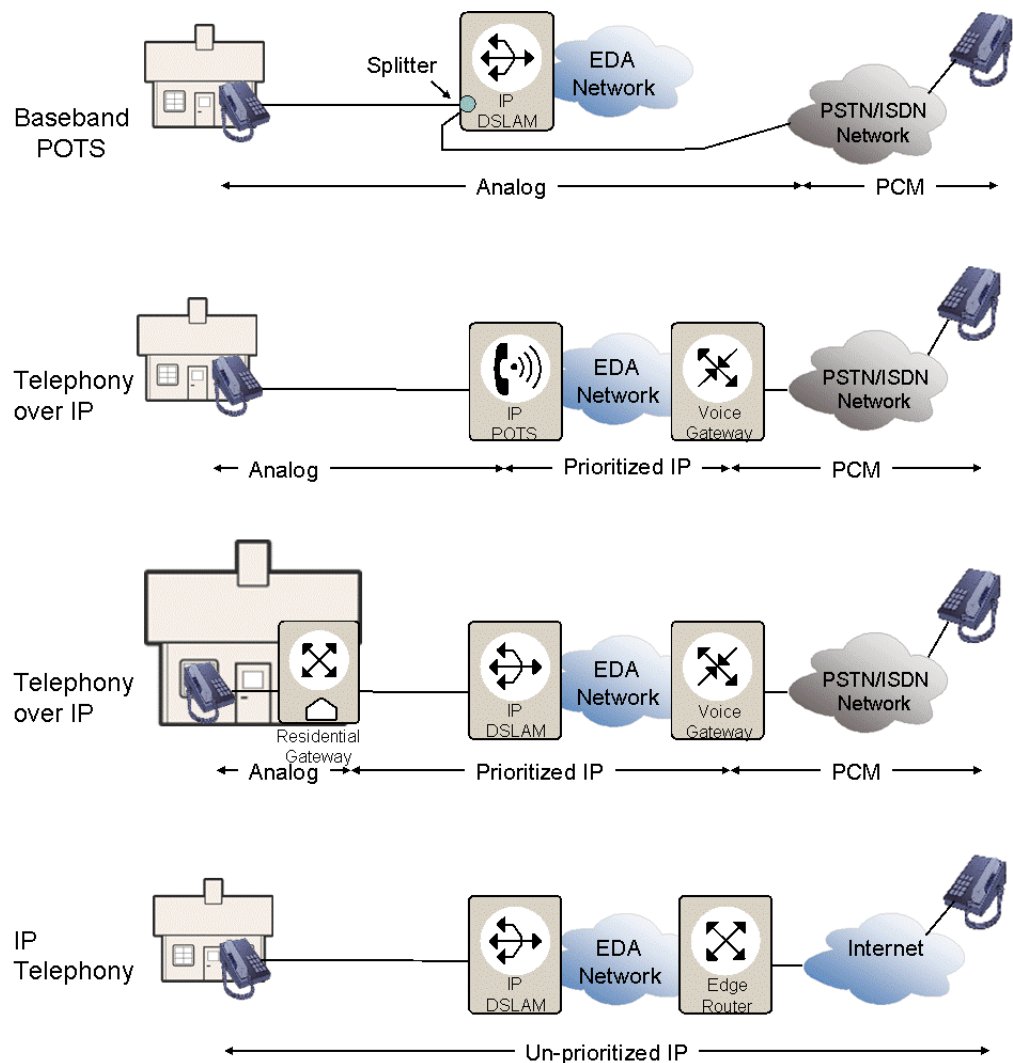


Figure 4 Voice Services

Both POTS and Telephony over IP will give the same perceived quality, and the same supplementary services. However, Telephony over IP based on residential gateway cannot be considered as a Life Line since there will be no connection if the power at the customer premises fails. IP Telephony will not give the same perceived quality. In some cases providers will offer a Voice Gateway in order to be able to call a PSTN connected telephone. The main difference is that along the IP path, the voice packets are not prioritized, which will cause longer delay, jitter, and lost packets.

**Note:** Telephony over IP is also available using optical Ethernet instead of DSL.

## 2.1.2 Access Network

The EDA 1200 access network provides the means to provide the services to the End-users. The EDA 1200 access network is composed of specialized nodes (telecom grade), with built in mechanisms to ensure network and End-user security, and Quality of Service (QoS). The main principle of the EDA 1200 access network is illustrated in Figure 5 on page 8.

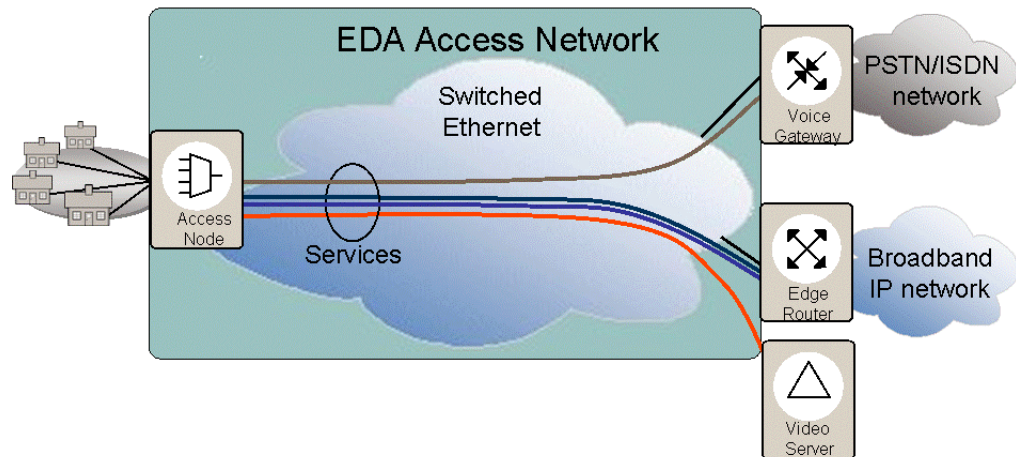


Figure 5 EDA 1200 Access Example

The access network is based on Ethernet and IP. The End-users are connected to an Access Node providing different drop technologies. The Access Node controls the services given to the End-users, and traffic to and from the End-users. An example with four services: one Voice and two data services provided from outside the network, and one video service provided from within (not through a router) is depicted in Figure 5 on page 8.

The Access Node has security mechanisms that protect the network from malicious attacks, and other mechanisms that protect the End-users.

In order to provide QoS, the Access Node has mechanisms to ensure prioritizing and minimize delay of traffic. In both cases (security and QoS), the Access Node controls the downlink traffic to the End-user, and the uplink traffic to the network. Downlink traffic from the gateways and service servers to the Access Nodes is controlled by the gateways and servers.

EDA 1200 access network using different drop technologies and different network elements is depicted in Figure 6 on page 9 .

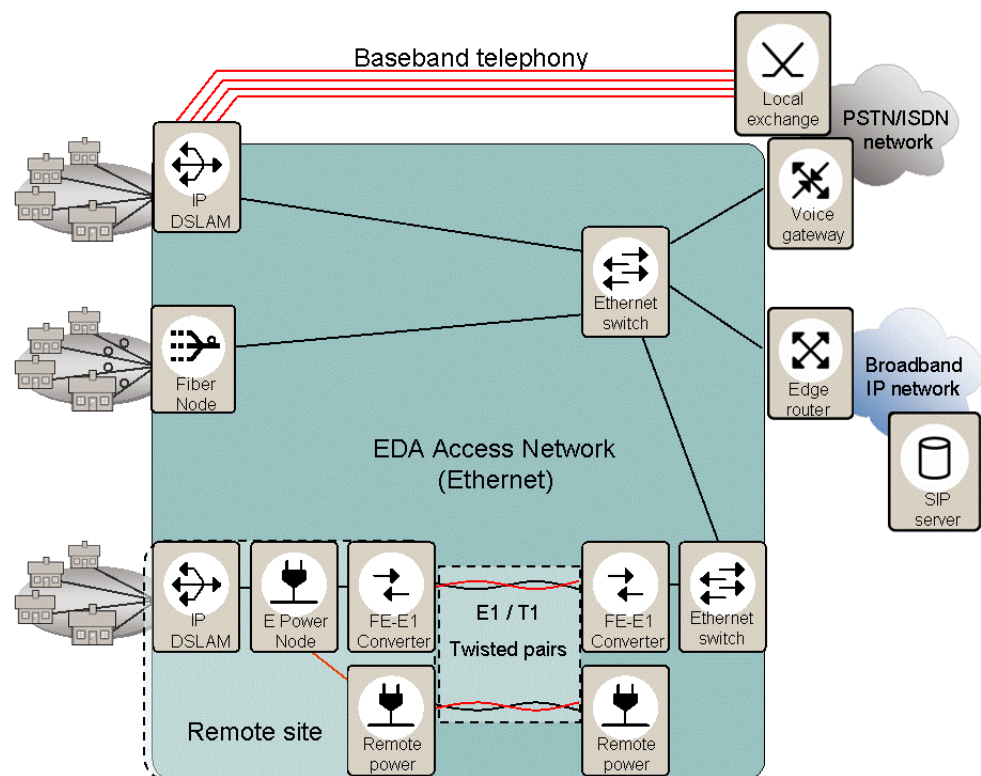


Figure 6 EDA 1200 Access Network

Some examples of utilizing different drop technologies and network elements are shown in Figure 6 on page 9. A second level aggregation switch (Ethernet Switch) aggregates the traffic from the Access Nodes, and connects them to the Voice Gateway and Edge Router.

The IP DSLAM supplies the End-users with Broadband services (BB services). The BB services can include data, video, Telephony over IP and IP telephony. These services can be supplied on top of existing Narrowband services (NB services).

The Fiber Node supplies the End-users with BB services (the same BB services as the IP DSLAM). The Fiber to the Home (FTTH) ensures a very high and symmetrical bandwidth both upstream and downstream. Despite the name, the fiber node (EFN) is also available as a CAT5 node.

An example of utilizing specific network elements is illustrated for the remote site. In this example, vacant twisted pair copper wires are used as E1 or T1 using EDA 1200's Fast Ethernet to E1 converter to transport the traffic. Other vacant twisted pairs are used to supply the remote site with power (-48 V DC). The power is then distributed to the nodes by an Ethernet Power Node (E Power Node) over the Ethernet connections.

Most of the EDA 1200 nodes uplink connections facilitate both electrical and point to point optical connections. The optical connection enables the use of FTTx:

- Fiber to the Node (FTTN)
- Fiber to the Curb (FTTC)
- Fiber to the Building (FTTB)
- Fiber to the Home (FTTH)

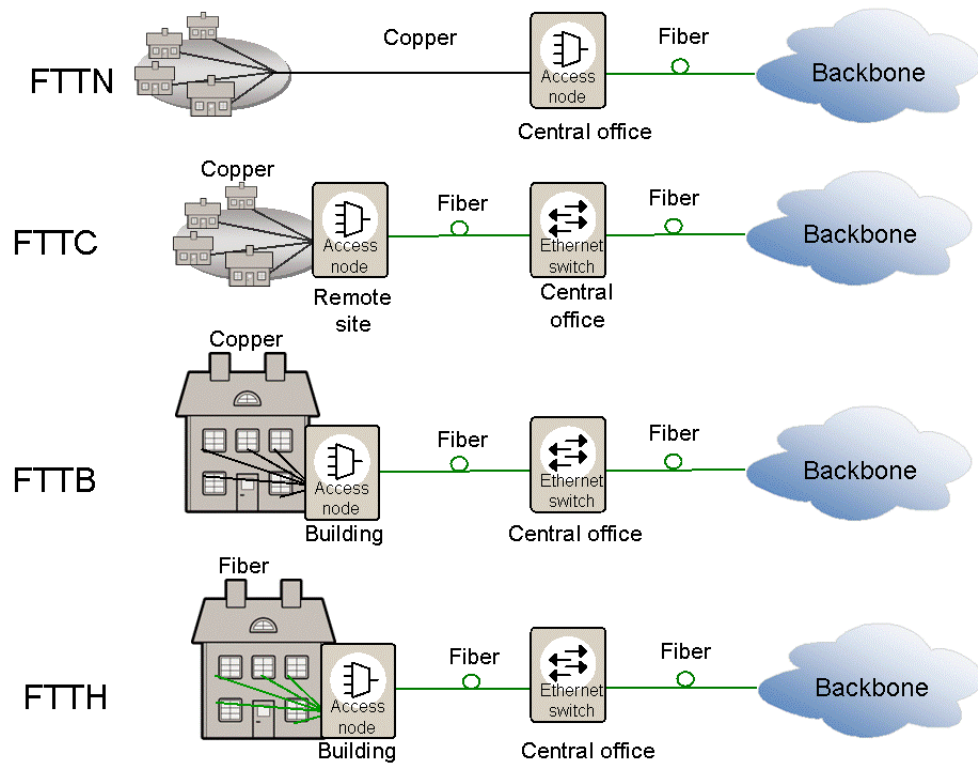


Figure 7 FTTx in EDA 1200

FTTC and FTTB can also be realized using EDA 1500 Gigabit Passive Optical Network (GPON) as a transparent part of the access network. The following figure illustrates a combination of EDA 1200 and EDA 1500.

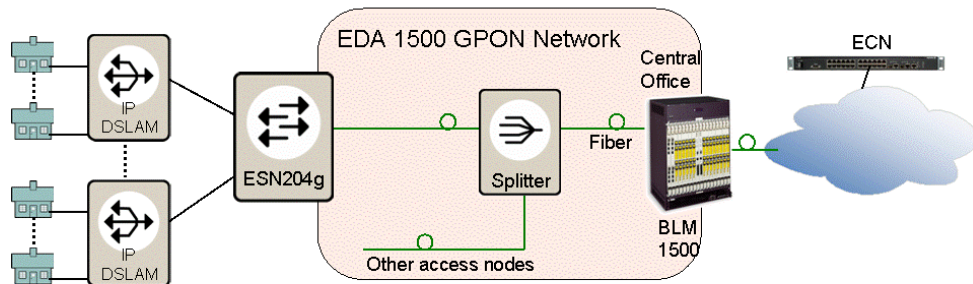


Figure 8 GPON in the EDA 1200 Network



## 2.2 EDA 1200 Realization

The EDA 1200 nodes are realized as telecom grade nodes. The basic principle architecture of an Ethernet Access Nodes (EAN) is depicted in Figure 9 on page 11.

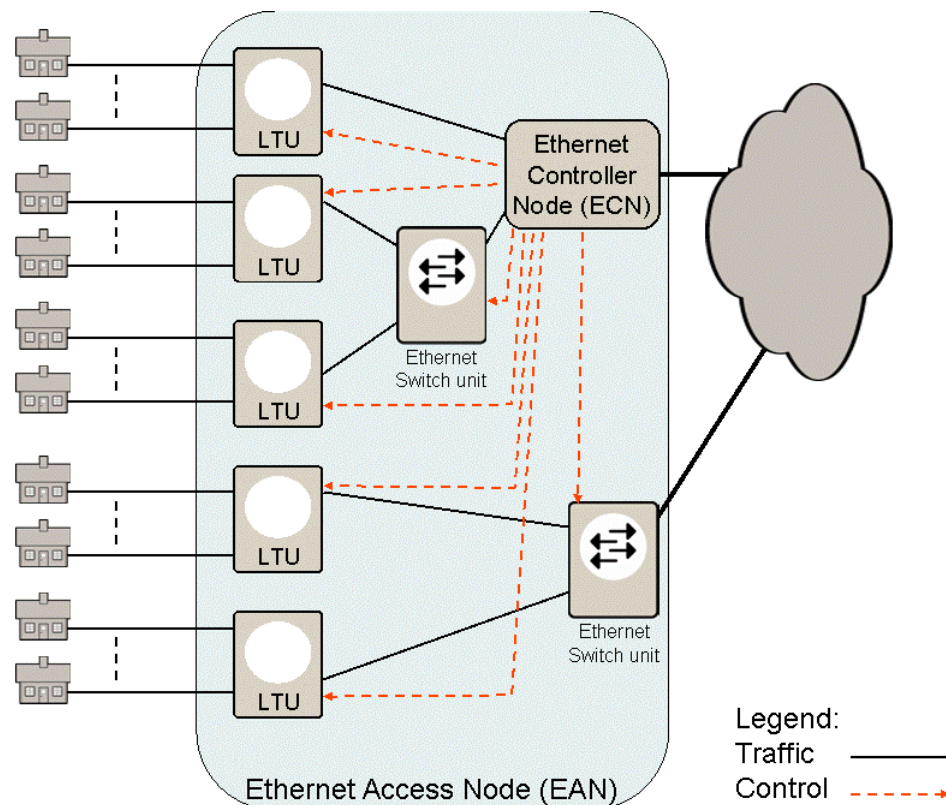


Figure 9 EDA 1200 Access Node Basic Architecture Principle

The EAN is based on IP and Ethernet architecture. All units within the EAN have private IP addresses and are managed by an ECN. A management system can manage the whole EAN through the ECN. The whole EAN will appear in a management system as one large node with many End-user lines. All End-user lines are terminated by a Line Termination Unit (LTU). The LTU can be based on different drop technologies such as DSL, Fiber or POTS. The traffic can be aggregated through the ECN or by another Ethernet Switch unit.

### 2.2.1 Network Architecture

The following figures illustrate an EDA 1200 access network with a variety of Ethernet Access Nodes.

The internal switching unit in the ECN is used to aggregate all End-user traffic as well as management traffic to the embedded EDA 1200 nodes in Figure 10 on page 12. Narrowband is supplied as baseband POTS.

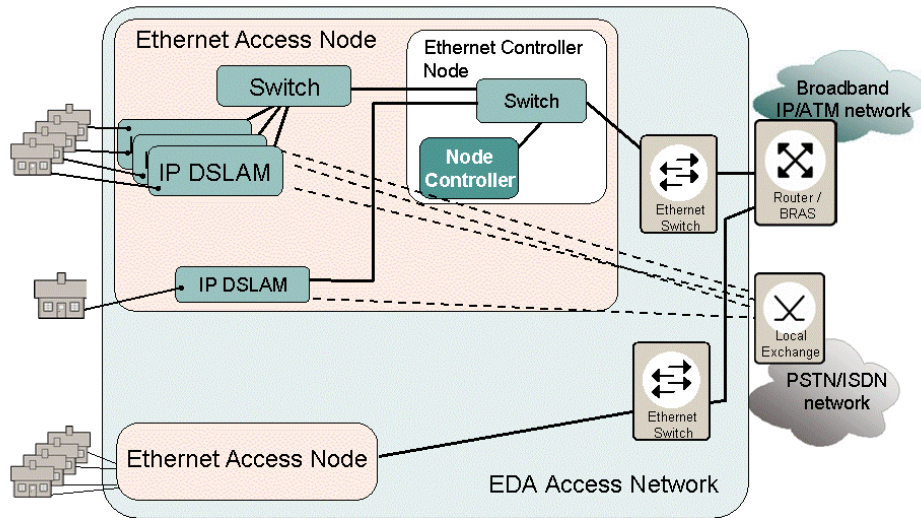


Figure 10 EDA 1200 Access Network Architecture

The ECN can also be used as control unit without aggregating traffic. In the following figure the internal switching unit in the ECN is only used to connect the Node Controller to the network, and the uplink from the ECN only carries management traffic. Naturally it is possible to extend the Ethernet Access Node with more embedded switches and IP DSLAMs. Please refer to the *ECN User Guide* for a detailed description of an Ethernet Access Node topologies.

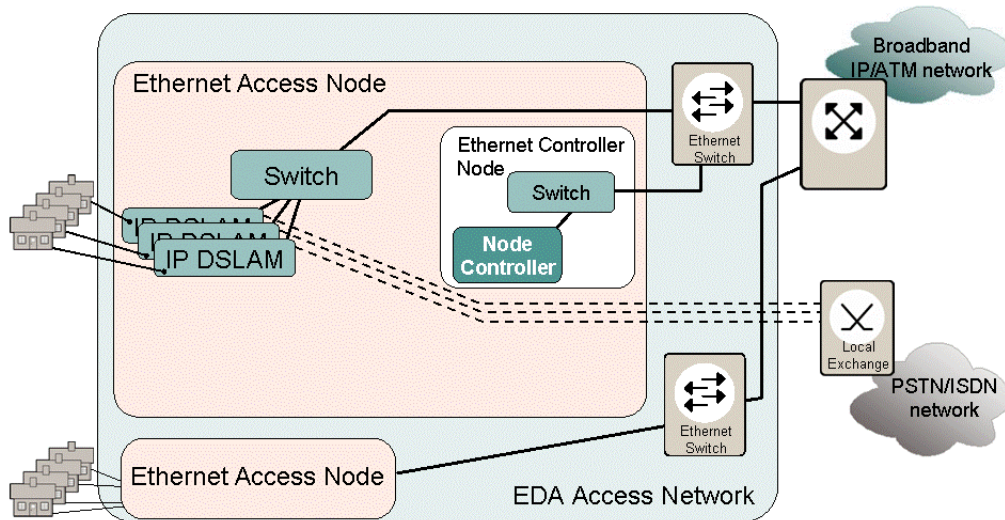


Figure 11 EDA 1200 Access Network Architecture

The Ethernet Access Node is a flexible node that allow any combination of the two previous figures.



## 2.2.2 Network Devices

EDA 1200 is a device based system. That is, all the devices are mechanically and electrically independent. Any connections between nodes are done with cables. All the nodes use -48 V DC power.

The node environment ratings are:

- Central Office Equipment, -5°C to +45°C or +55°C. This equipment can be placed outside the central office if the environment is controlled.
- Outside Equipment, -20°C to +70°C.
- Hardened Outside Equipment, -40°C to +75°C.

*Table 2 Node Environment Ratings*



Classification	Nodes
Central Office Equipment	ECN330, ECN430, EFN324, EMN120, EPN102, ESN108, ESN410, EXN104
Outside Equipment	EDN312x
Hardened Outside Equipment	EDN612 <sup>(1)</sup> , EPN210, ESN204g <sup>(2)</sup> , ESN212

*(1) The maximum temperature rating for EDN612 is 45°C.*

*(2) The maximum temperature for ESN204g is 70°C.*

The node mounting methods are shown in Table 3 on page 13.

*Table 3 Node Mounting Methods*

Nodes mounted in 19" or ETSI racks	
Nodes mounted on the rods of rod-based subracks	

The EDA 1200 rod mounted devices are mounted in subracks. EDA 1200 has a variety of dedicated subracks, as well as a general purpose subrack.

## 2.3 GPON Features

The EDA 1200 restrictions when using GPON technology are briefly described in this section. For a complete description of the features and properties of the GPON network and technology, please see the EDA 1500 Customer Product Information.

The GPON network can be configured to be logically transparent (with the exception of multicast) to the traffic of the EDA 1200 network.

The BLM sends group specific queries as unicast. The ESN204g can, however, be configured to respond as if the group specific queries were sent as multicast, in accordance with IGMP version 2.

## 2.4 Security in the Network

Various security measures can be deployed in order to protect the EDA 1200 system and the End-users connected to it. Some of the security settings may overlap, but they can still be activated simultaneously to improve security:

<b>Management Plan Protection</b>	The EDA 1200 nodes contain Access Control Lists (ACL). The ACL is a filter which can be used to allow or deny traffic from specific nodes or networks, and specific types of traffic.
<b>Filtering</b>	The Line Termination Units can be configured to filter out unwanted traffic based on a variety of parameters.
<b>Forced Forwarding</b>	Using Forced Forwarding towards the Service Provider's default gateway.
<b>Number of CPE Devices</b>	It is possible to limit the maximum allowed number of End-user devices for a specific service. This can be used to ensure that the number of End-user MAC (or VMAC) addresses connected to the network will not cause switches overflow.
<b>DHCP Relay Agent Information Option (Option 82)</b>	Using DHCP Relay agent configuration (Option 82) to authenticate End-users and to allow access to specific services
<b>Virtual MAC Addresses</b>	Using Virtual MAC addresses to prevent MAC spoofing. The MAC Address Translation (MAT) can be used as 1:1 or N:1.
<b>Separating Traffic Using VLANs</b>	VLANs can be used to create logically separated networks within the Access Domain. Users in one VLAN are totally separated (in layer 2) from users of another, even though they share the same physical Ethernet. A

specific VLAN (default 246) is reserved for management traffic.

**PPP**

PPP can be used as access method for verifying the identity of an End-user before granting access to the services. PPP sessions can be forwarded towards remote Service Providers using secure tunnels.

**SNMPv3 - User Based Access Control**

SNMPv3 provides secure access to the ECN by authenticating and encrypting packet over the network.

**Storm Control**

Limit the possible rate of broadcast and multicast traffic from the End-user.

**Note:** Some of the security features like filtering, Forced Forwarding and others, will only achieve the desired effect if only EDA 1200 nodes are deployed in the Access Domain.

**2.4.1**

**Management Plan Protection**

All management traffic is separated from any other traffic by a dedicated management VLAN. Furthermore, the EDA embedded nodes use private IP addresses. It is also recommended that other EDA nodes in the external management VLAN should use private IP addresses on a different subnet.

All management interfaces and protocols such as CLI (Telnet/SSH/Console) SNMP and Web are protected by user name and password.

Most of the nodes have Access Control List (ACL). The ACL is a filter that can be used to allow or deny traffic from specific nodes or networks, and sometimes also type of traffic.

The protection concept of an EDA 1200 system is illustrated in Figure 12 on page 16. The dedicated management VLANs (external and internal) are also part of the protection concept, but they are left out of the illustration for simplicity reasons.

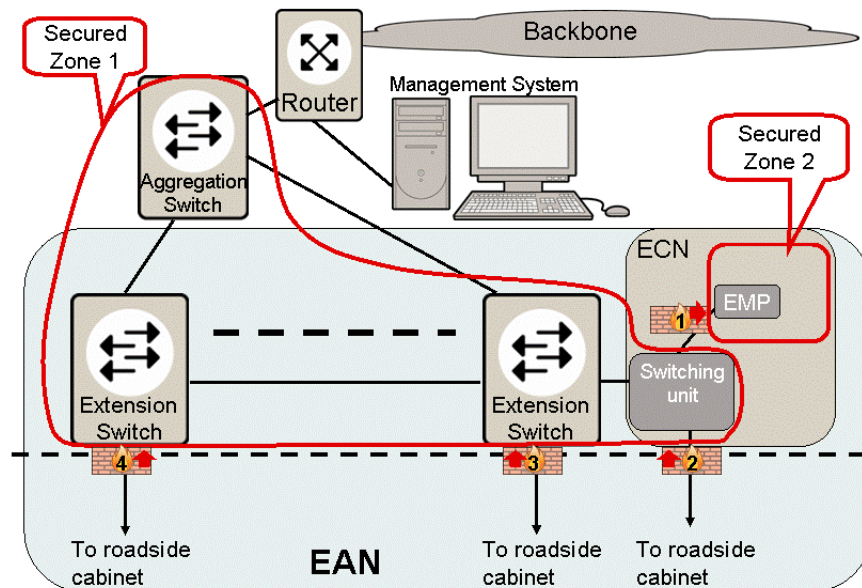


Figure 12 Protection Concept

## 2.4.2 SNMPv3 - User Based Access Control

SNMPv2 provides only weak authentication (community strings) and no privacy (encryption). Introducing SNMPv3 in the EDA 1200 system ensures security in the network management system by providing encryption and authentication including verification of user rights. Without authentication, it is possible for non authorized users to carry out SNMP network management functions. Without encryption it is also possible for non-authorized users to eavesdrop on management information as it passes from managed systems to the management system.

The following features are provided by SNMPv3:

- **Authentication** - The authentication mechanism in SNMPv3 ensures that a received message is, in fact, transmitted by the sender whose identifier appears as the source in the message header. In addition, this mechanism assures that the message was not altered in transit and that it was not artificially delayed or replayed.
- **Privacy** - Ensure that data is transmitted from source to destination without undetected modification (integrity) and protect from unauthorized disclosure (encryption).
- **Access Control** – Determines whether access to a managed object is allowed.
- **All the functionality of SNMPv3** is placed in the SNMP Entity. As a component of the SNMP Entity the Secure Subsystem authenticates and encrypts the SNMP messages. An engine ID that uniquely identifies the

ECN, a user name and a password are the parameters that must be defined for authentication.

- **If encryption is required** the enclosed PDU and some of the fields in the message header is encrypted. For encryption a password must be defined.
- 3 different groups (Context names) are defined with access to different MIBs, and a user must belong to one of these groups, see Table 4 on page 17. Access rights are defined by read-only and read-write permission and three security levels are defined:
  - No security activated – Authenticates a packet by a string match of the username and context name.
  - User authentication is activated - Authenticates a packet by using the HMAC-MD5 or HMAC-SHA algorithms.
  - User authentication and encryption is activated - Authenticates a packet by using the HMAC-MD5 or HMAC-SHA algorithms. Encryption is done using the algorithm CBC-DES (DES-56).

*Table 4 User Groups*

<b>Groups (Context name)</b>	<b>Access</b>	<b>Security Level</b>	<b>Users (Predefined)</b>
Administrator	Read-Write	User authentication and encryption is activated	PEM
Guest	Read-only	User authentication is activated	Guest
Public	Read-only	No security activated	Public

It is possible to define new users belonging to the Administrator, Guest and Public groups.



## 3 EDA 1200 Services

EDA 1200 is a versatile and flexible access system that can be designed to fit various requirements for service access functionality, network architecture, and network performance. Furthermore, the EDA 1200 system solution can be adapted to various requirements regarding network scalability and redundancy.

This section gives an overview of the services that can be provided by the EDA 1200 system.

### 3.1 Service Access

End-users are connected to Service Providers through an access network. The access network consists of two parts: the local loop and the aggregation network.

In other contexts, the local loop is often called “first mile” or “subscriber line”. It is the part of the access network that interconnects the End-user premises with the aggregation network, where it is terminated in an Access Node. The aggregation network represents the part of the access network between the Access Nodes and one or more Edge Nodes. An Edge Node can be a service gateway or a server.

An EDA 1200 Service is defined as a set of rules for how a specific part of the End-user traffic is handled through the access network. In effect, these rules are primarily enforced in the EDA 1200 Access Nodes. The rules are applied to each Ethernet frame, enabling End-users to access specific service gateways or servers, with the desired quality.

A key requirement for an aggregation network is to ensure that the End-user can access the services for which the End-user is authorized. In traditional broadband access networks, authorization is often handled by a Broadband Remote Access Server (BRAS). The BRAS is an Edge Node through which all End-user traffic flows. The BRAS is located at the border of the aggregation network, interfacing towards application servers, or external networks like the Internet, see Figure 13 on page 20.

An access network scenario, where a BRAS controls the service access for all End-users is depicted in Figure 13 on page 20. The aggregation network does not impose any service access constraints, but merely transports End-user traffic to and from the BRAS.

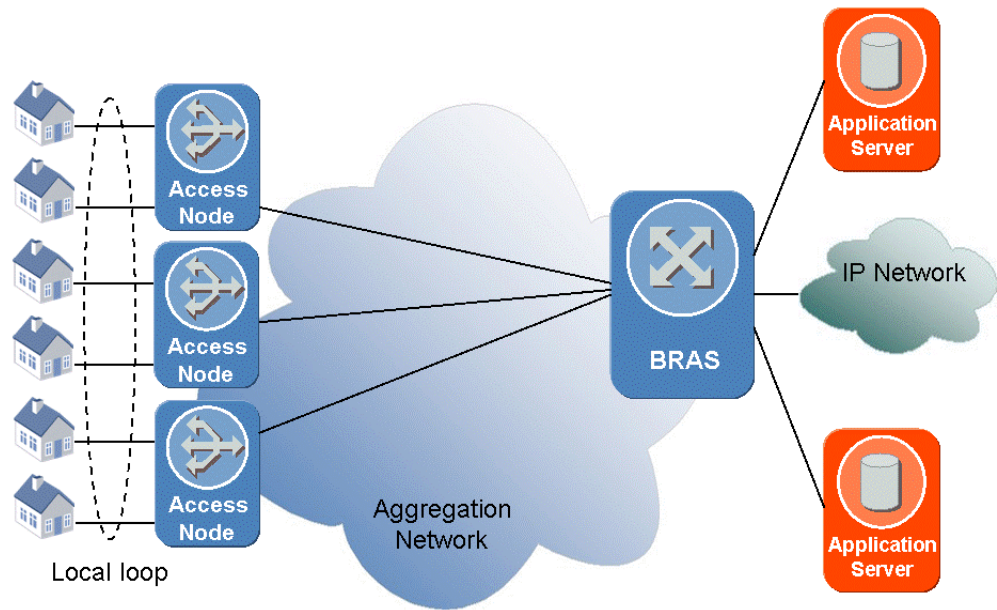


Figure 13 Traditional BRAS Controlled Access

A multi-edge access network scenario is illustrated in Figure 14 on page 20. In this scenario, constraints on the End-user traffic have to be imposed by the Access Nodes and the aggregation network.

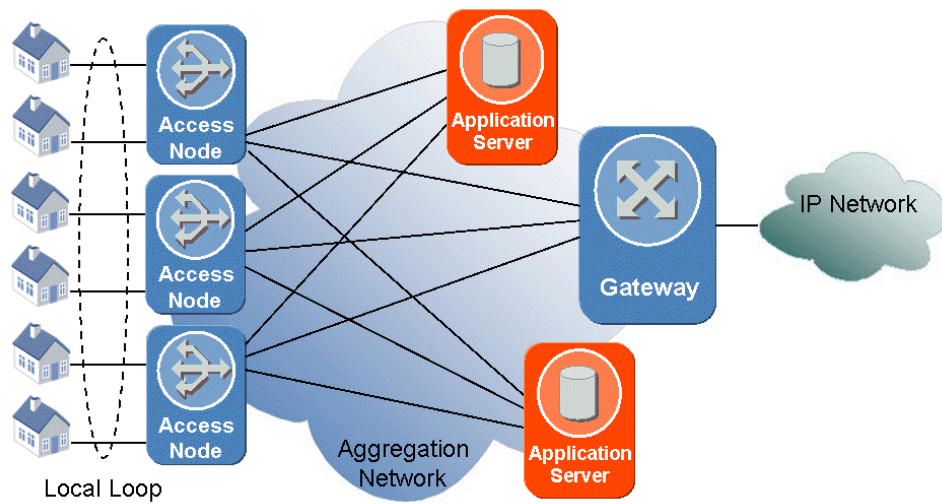


Figure 14 Multi-Edge Access

EDA 1200 supports both scenarios.



### 3.1.1 Traffic Mapping Rules

An EDA 1200 Service is in the EDA 1200 Access Node embodied as a virtual switch, and the rules defining a specific EDA 1200 Service are the functional properties of the corresponding virtual switch.

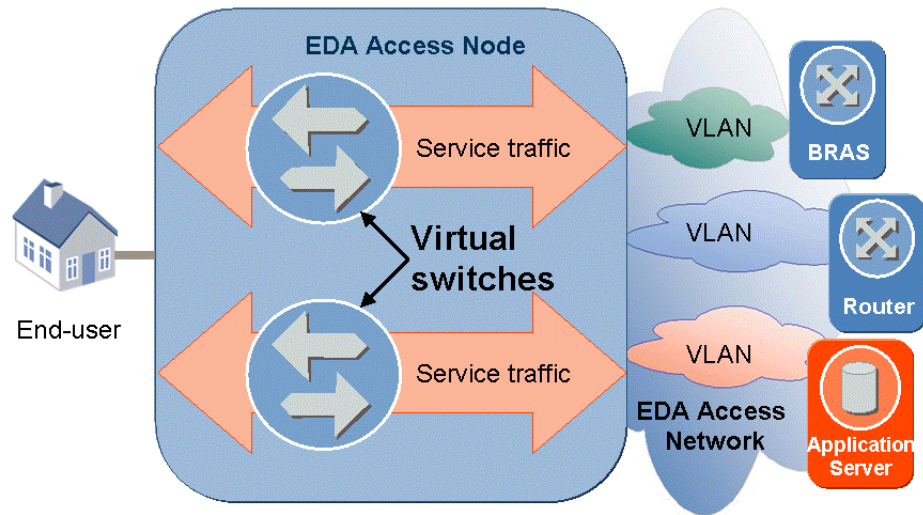


Figure 15 EDA 1200 Service Access

The functional properties of a virtual switch define its behavior towards each upstream and downstream Ethernet frame received by the virtual switch. This behavior covers the actions depicted in Figure 14 on page 23 and elaborated afterwards:

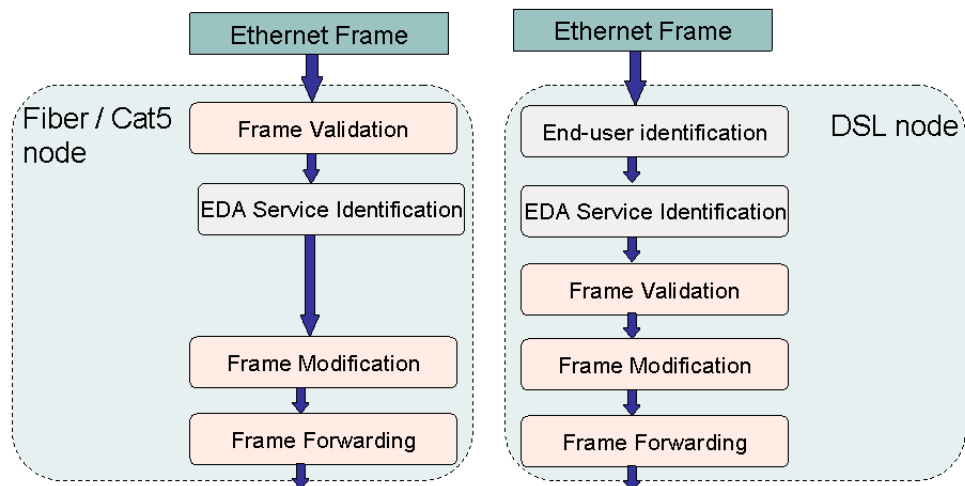


Figure 16 Actions Performed on Each Frame in the Access Node

- **End-user Identification:** Determine which End-user the frame is associated with.

- **EDA Service Identification:** Determine the EDA Service associated with the frame. This uniquely identifies the Traffic Mapping Rules for the frame.
- **Frame Validation:** Is this a legal frame, or must it be discarded?
- **Frame Modification:** DHCP options, PPP, relay agent, VMAC, VLAN ID, priority, and so on.
- **Frame Forwarding:** Send towards the right port, PVC, queue, and so on.

As Figure 16 on page 21 illustrates, each frame is first inspected in order to identify the corresponding End-user (DSL) and EDA 1200 Service. Then, the Access Node processes the frame according to the Traffic Mapping Rules. The rules for each service are set when a service is defined.

The Traffic Mapping Rules can for example include **filtering** rules, allowing only particular frame types or certain source/destination addresses. The rules may also define how the frame is to be **modified**, for example appending of DHCP options, adding or removing VLAN tags, changing source/destination addresses, and marking or remarking of priority indication. Finally, the Traffic Mapping Rules also define how frames associated with the EDA 1200 service are to be forwarded, that is, towards a specific port, PVC, VLAN or queue.

Using these mechanisms, a virtual switch controls the traffic for each service.

### 3.1.2 Traffic Mapping Schemes

A Service VLAN is a VLAN in the Ethernet aggregation network that is used for End-user traffic. The Service VLAN can be defined as either single or double tagged VLAN. The End-user traffic may be separated by Service VLANs in order to enhance network security, separate services, and reduce the size of broadcast domains. The traffic in a Service VLAN can contain traffic from several applications. For example, internet access, telephony and so on.

In order to map the traffic, each frame must be identified with respect to the service to which it belongs. The way that the traffic is identified may be different in the upstream and downstream. Downstream service identification is always based on VLAN (single or double tagged). The following are the basic ways to identify a service in the upstream direction:

- PVC or PVC bundle
- Ethertype (only supported by EDN312)
- VLAN ID
- Line
- IP destination (EFN324 only)

The following table shows the relations between Service identification and drop technologies.

Table 5 Service Identification and Drop technologies

	Line	PVC	VLAN ID	Ethertype	Dest. IP
<b>ADSL (EDN312)</b>	√	√	√	√	
<b>ADSL (EDN612)</b>	√	√	√		
<b>VDSL</b>	√		√		
<b>Fiber/ Cat5</b>	√		√		√

Supported traffic-mapping scenarios are illustrated in Figure 17 on page 23 and Figure 18 on page 24.

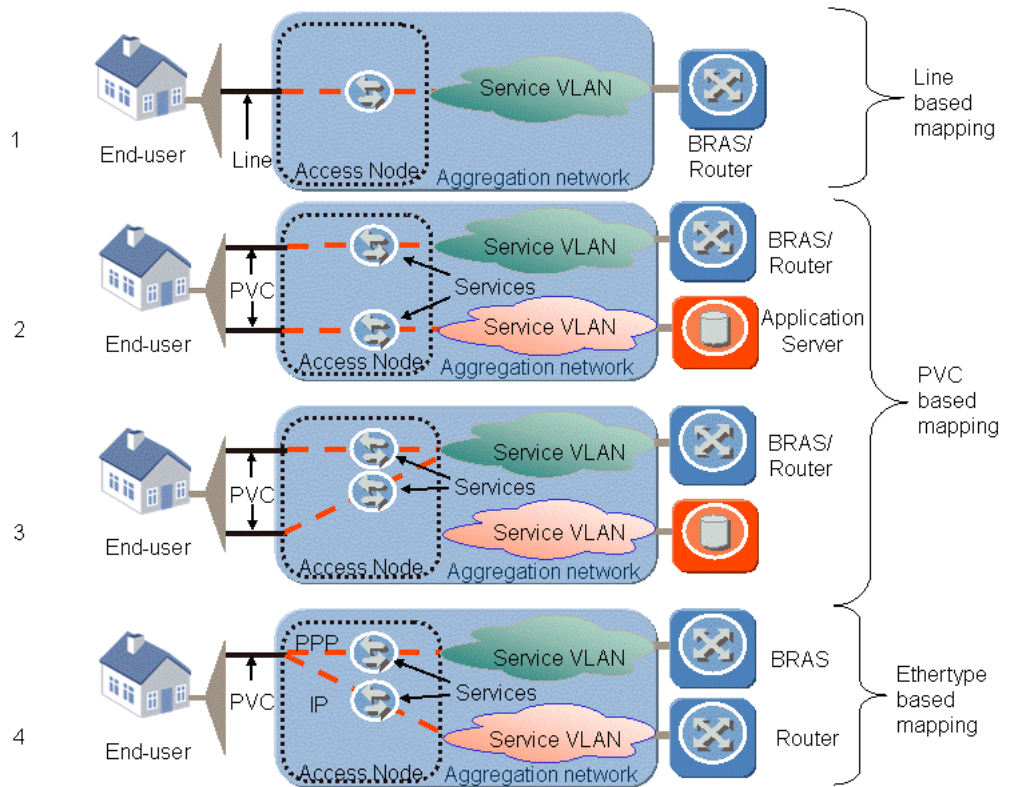


Figure 17 Traffic Mapping Schemes

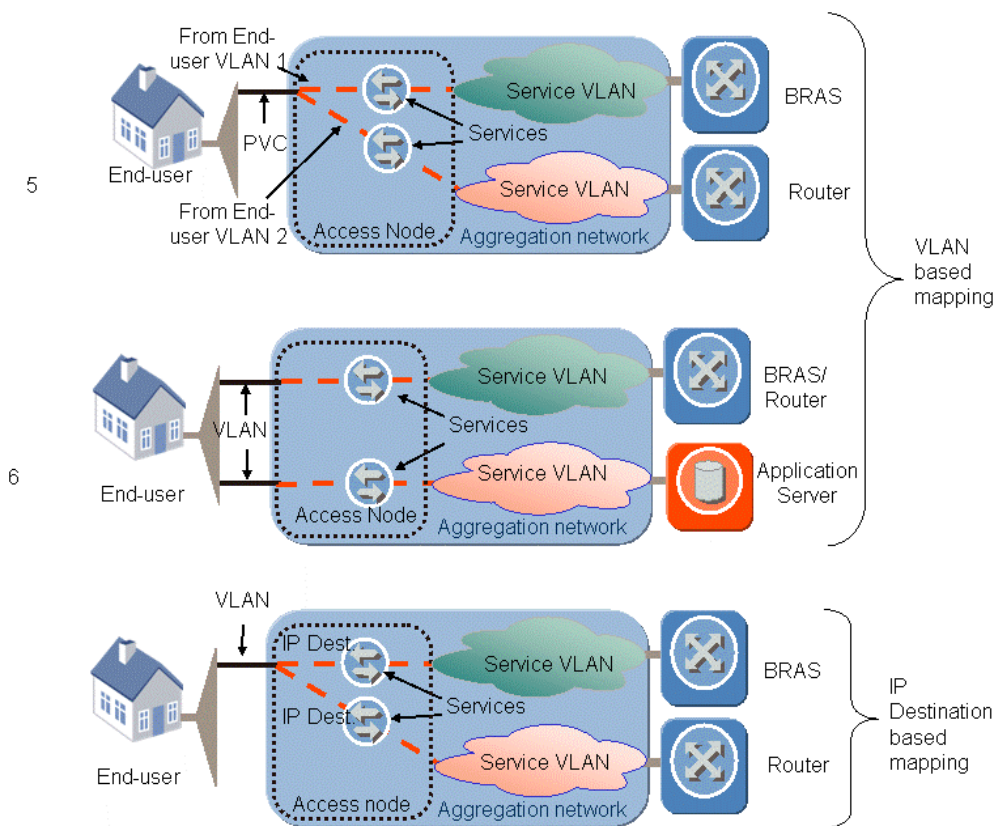


Figure 18 Traffic Mapping Schemes (continued)

The following scenarios are illustrated:

1. Traffic mapping between one line and one Service VLAN. This traffic mapping applies to ADSL, VDSL2 and Fiber/Cat5.
2. Traffic mapping between one PVC and one Service VLAN. This traffic mapping only applies to ADSL.
3. Traffic mapping where multiple PVCs share the same Service VLAN (PVC bundling). In practice this mapping is created using multiple EDA 1200 services. Downstream traffic distribution is based on p-bit distribution between the PVCs. This traffic mapping only applies to ADSL. For more information please refer to Section 3.1.2.2 on page 26.
4. Traffic mapping between two Ethertypes and two Service VLANs according to the Ethertype (PPP or IP) of each frame. This traffic mapping only applies to ADSL (EDN312 only).
5. Traffic mapping from one PVC, based on End User VLAN ID to two Service VLANs.

6. Traffic mapping between one End-user VLAN and one Service VLAN. This traffic mapping applies to VDSL2 and Fiber/Cat5.
7. Traffic mapping between an IP destination address in the upstream and a Service VLAN. This traffic mapping only applies in Fiber/Cat5.

A Service VLAN can also be used to create layer-2 connections to other End-users, either locally through the aggregation network or across a transport network, creating a Transparent LAN Service (TLS), see EDA 1200 DSL Line Features description.

The services may have different QoS demands. The Ethernet in the aggregation network is capable of treating frames with different QoS classification differently. The EDA 1200 Service allows for different traffic **Flows** with different QoS through the same PVC, or over the same VLAN, thus ensuring differential treatment of traffic through the DSL connection.

### 3.1.2.1 Multicast in Separate VLANs

Regardless of other traffic mapping schemes and mode (PTM or ATM), it is possible to create separate VLANs through which all the multicast traffic to and from the End-users is sent. If a VLAN ID and priority are defined in the Multicast Whitelist, all multicast traffic from a specific multicast range will flow through a dedicated VLAN in the network and with the specified priority. The priority is the priority of multicast traffic (including IGMP messages) sent upstream. The downstream traffic priority is set by the multicast router.

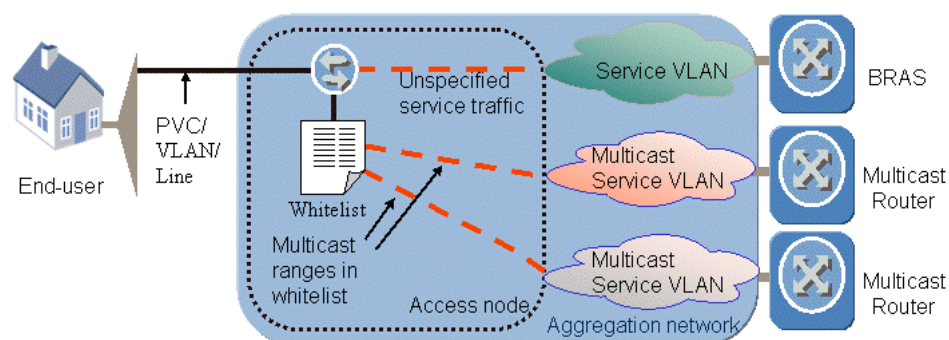


Figure 19 VLAN Separated Traffic Based on Multicast Whitelist

If a VLAN is not specified for a multicast range (unspecified) the multicast traffic will be sent in the VLAN specified for the service, together with all other unicast traffic.

For more information about Whitelists please refer to EDA 1200 DSL Line Features description.



### 3.1.2.2 PVC Based Traffic Mapping

The PVC based traffic mapping is the original ATM based mapping. However, there are two special variants: PVC bundling and Ethertype mapping. In the PVC bundling, the same Service VLAN is used for multiple traffic Flows that require different class of service. Therefore, different PVCs are used, to enable different QoS through the ADSL line. However, the two traffic Flows must have the same Access Method, and the C tag (see Section 3.1.2.3 on page 26) must either be used in both, or not used in either. In order to be able to map the traffic in the downstream direction, the same p-bit must not be used in two different downstream flows (see EDA 1200 QoS Features description.)

### 3.1.2.3 DSL VLAN Based Traffic Mapping

VLAN based traffic mapping maps traffic from a VLAN at the local loop to a Service VLAN in the Access Domain. The traffic mapping is based on a single VLAN tag in the local loop (Q tag) and one or two VLAN tags in the Access Domain. The VLAN tags in the Access Domain are referred to as S and C tags to distinguish the outer (S) and inner (C) tags.

**Note:** In the switched Ethernet, aggregation switches do not care about the inner tag. Therefore, all traffic with the same outer VLAN tag will be in the same broadcast domain.

The Ethertype used for S and C tags are configurable. Typically, the S-tag Ethertype corresponds to the S-tag of IEEE802.1ad Provider Bridges (using the Ethertype value 0x88A8), but it may also for example use the standard IEEE802.1Q tag (Ethertype 0x8100) or the VMAN tag (Ethertype 0x9100). The C-tag, in other words, the inner tag, typically uses the standard IEEE802.1Q tag (Ethertype 0x8100).

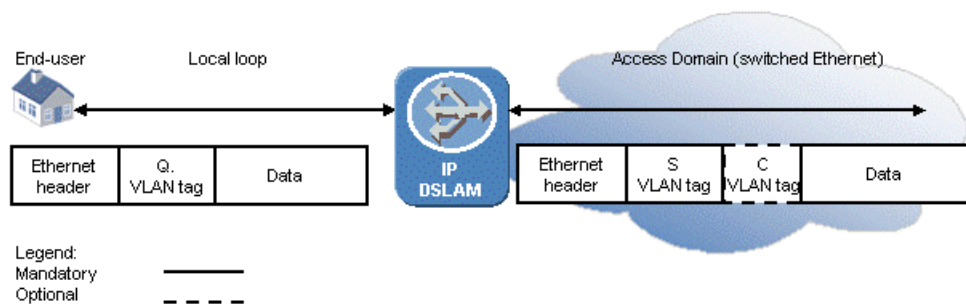


Figure 20 VLAN Tags used in VLAN Based Traffic Mapping

The VLAN ID of the Q tag, set by the End-user device, is mapped to an S tag and an optional C tag in the Access Domain, and the other way around. The identification of the service and thereby also the desired properties of the transport are based on either the Q tag (Uplink) or the S and C tags (downlink). The CoS indication in the VLAN tags (P-bit) is not used for traffic mapping, only for QoS purposes.

Q, S and C VLAN tags are shown in Figure 20 on page 26. Frame from the End-user reaches the Access Node, the Q tag is removed and one (S) or two (S and C) VLAN tags are added to the frame. The frame is sent into the Access Domain where the S VLAN tag is used as the VLAN ID, priority and Ethertype. When the frame leaves the Access Domain both VLAN tags are removed (either by an IP DSLAM or by a router). However, the node can read the C VLAN tag and use the information further if required.

An example of the VLAN based traffic mapping is illustrated in Figure 21 on page 27. There are two End-users each with two services, one for video and one for data. For both End-users, the video traffic is tagged with VLAN ID 8 and the data traffic is tagged with VLAN ID 7.

The Video Server is connected to S VLAN 12. Therefore the video traffic for both End-users is mapped from S VLAN 12 to Q VLAN 8 (and the other way around for the upstream).

The data traffic for both End-users is transferred through a BRAS connected (configured) to S VLAN 11. In this case a C VLAN is used with a separate value for each end user. In End-user 1's case the traffic is mapped from Q ID 7 to S ID 11 and C ID 5 in the upstream direction and the other way around in the downstream direction. In End-user 2's case the traffic is mapped from Q ID 7 to S ID 11 and C ID 6 in the upstream direction and the other way around in the downstream direction.

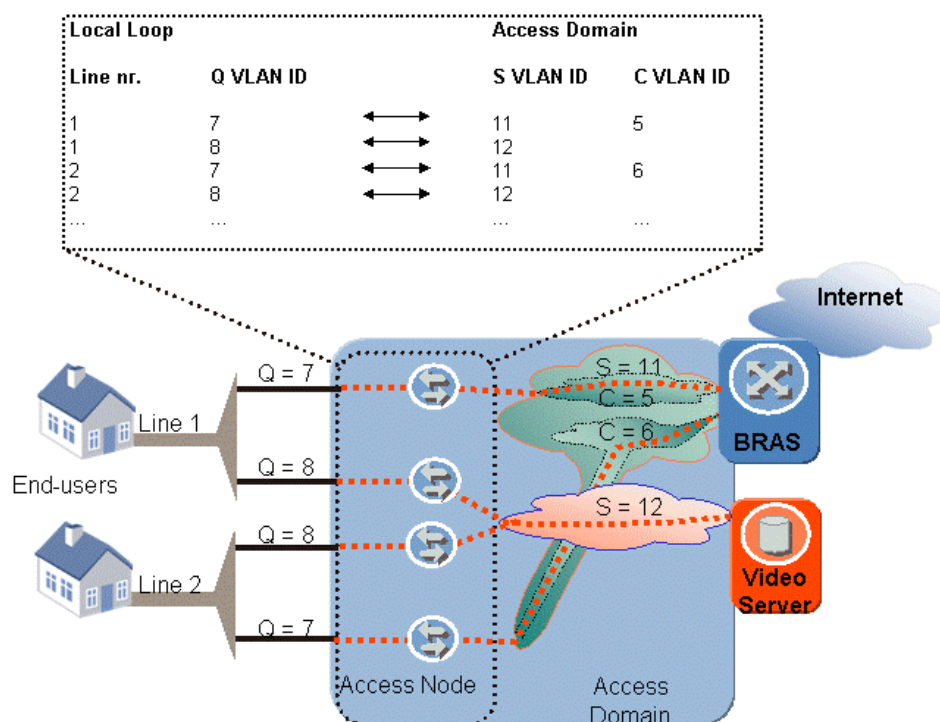


Figure 21 VLAN Based Traffic Mapping

As illustrated, the S tag determines the broadcast domain in the Access Domain. The layer 2 separation for the data traffic is achieved by filtering the traffic to the End-user. The IP DSLAM will discard any traffic that does not come with the correct C tag value.

**3.1.2.4 EFN324: VLAN Based Traffic Mapping**

The traffic mapping in Fiber/Cat5 is based on single VLAN tag, double VLAN tag or no VLAN tag as well as IP destination address. The following definitions are possible:

- **Port + End-user VLAN ID.** VLAN ID can be either a specific value, a range, wildcard (any VLAN ID) or untagged.
- **Port + End-user VLAN ID + IP destination** (in upstream packets). VLAN ID can be either a specific value, a range, wildcard (any VLAN ID) or untagged. IP destination is specified as either a specific IP address, or as an IP network.
- **Port + End-user outer VLAN ID** (specific value or wildcard) + **End-user inner VLAN ID** (specific value)
- The following traffic mapping (VLAN tagging of outgoing traffic) is possible (after a packet has been identified):

*Table 6 Outgoing Frames VLAN Tagging Possibilities*

	<b>Outer VLAN ID</b>	<b>Outer VLAN Ethertype</b>	<b>Inner VLAN ID</b>	<b>Inner VLAN Ethertype</b>
1	None (untagged)	None (untagged)	None (untagged)	None (untagged)
2	Specific value or End-user outer VLAN ID	Specific or End-user outer VLAN Ethertype	None	None
3	Specific value	Specific Ethertype	Specific value or End-user outer VLAN ID	Specific or End-user outer VLAN Ethertype
4	Specific value or End-user outer VLAN ID	Specific or End-user outer VLAN Ethertype	Specific value or End-user inner VLAN ID	Specific or End-user inner VLAN Ethertype

Explanation of terms:

- A **specific value** is an operator specified VLAN ID configured in the EFN. If a service is configured to use a specific value, this value will be used regardless of which type of traffic (tagged or untagged) was used by the End-user.
- A **specific Ethertype** is an operator specified Ethertype configured in the EFN. The following types can be configured:



- 0x8100
- 0x88A8
- 0x9100
- 0x9200
- **End-user outer VLAN ID** is the VLAN ID used as the outermost VLAN ID in the packet received from the End-user.
- **End-user Inner VLAN ID** is the VLAN ID used as the innermost VLAN ID in the packet received from the End-user. Used only when the packet from the End-user is double tagged.
- **End-user outer Ethertype** is the Ethertype used as the outermost Ethertype in the packet received from the End-user.
- **End-user Inner Ethertype** is the Ethertype used as the innermost Ethertype in the packet received from the End-user. Used only when the packet from the End-user is double tagged.

### 3.1.3 Access Methods

When the End-user subscribes to an IP based service, the CPE must be configured with IP settings: an IP address, a subnet mask and a default gateway. The way the equipment receives these settings is called the Access Method.

The access method is an attribute of an EDA 1200 Service, and when the service is assigned to an End-user, the CPE can only use that specific access method. The following access methods can be used:

- *DHCP* -Dynamic Host Configuration Protocol, which means that the IP address of the CPE is set dynamically by the Service Broker's DHCP server.
- *Static IP address* - The CPE equipment is assigned a static IP address or IP address range (that is, DHCP or PPP cannot be used).
- *Transparent LAN* – When LAN-to-LAN transparency is used, all filtering in the IP DSLAM for the subscriber is disabled, but can be configured in PEM, and broadcast is allowed.
- *PPP over Ethernet* –The CPE can only use PPPoE (RFC 2516 and RFC2684B) to access the network.
- *PPP over ATM* – Only PPPoA (RFC 2346) can be used by the CPE. The IP DSLAM will convert the PPPoA from the CPE to PPPoE. This access method is not supported by the EFN324. This method is not available if VMAC domain 60 is used. (See EDA 1200 Security Features description). Using a payload of 1500 bytes towards the BRAS, according to RFC 4638, can be enabled.

- *PPP Automatic* – The IP DSLAM will automatically sense the access method (PPPoE or PPPoA) used by the CPE. This access method is not supported by the EFN324. This method is not available if VMAC domain 60 is used. (See EDA 1200 Security Features description) Using a payload of 1500 bytes towards the BRAS, according to RFC 4638, can be enabled.
- *Static IP over ATM* – This method is used for IPoA access (RFC2684R) with End-user equipment by using a static IP address. This access method is not supported by the EFN324. This method is not available if VMAC domain 60 is used. (See EDA 1200 Security Features description)
- *Transparent IP over ATM* - This method is used for transparent IPoA access (RFC2684R). When the transparent IPoA is used, all filtering in the IP DSLAM for the subscriber is disabled, and broadcast is allowed. If any filtering or protection is desired, it must be done in the Edge Node or CPE. This access method is not supported by the EFN324. This method is not available if VMAC domain 60 is used. (See EDA 1200 Security Features description)
- *Dynamic IP over ATM* – This method is used for IPoA access (RFC2684R) with End-user equipment requesting dynamic IP address assignment via DHCP. This access method is not supported by the EFN324. This method is not available if VMAC domain 60 is used. (See EDA 1200 Security Features description)

## 3.2 Quality of Service in the Network

Quality of Service (QoS) of a network deals with the ability of the network to provide transport services suitable for the applications using the network. The Quality of Service in EDA 1200 is ensured by classifying packets and handling their transmission through the network according to the classification of each packet.

There are three main parameters that affect the quality of the transmission:

- Packet loss – packets of information that get lost in the network and do not reach the receiver
- Delay – the time it takes for a packet to traverse through the network from the sender to the receiver
- Jitter – variation in the delay within the same traffic flow

Table 6 illustrates the different requirements that different services have:

*Table 7 QoS Requirements of different Service Types*

	<b>Packet loss</b>	<b>Delay</b>	<b>Jitter</b>
<b>Video</b>	Very sensitive	(Not) sensitive	Not sensitive

	<b>Packet loss</b>	<b>Delay</b>	<b>Jitter</b>
<b>Voice</b>	Not sensitive	Sensitive	Very sensitive
<b>Data</b>	Not sensitive	Not sensitive	Not sensitive

The **Very sensitive** adjectives in Table 6 indicate which parameter will cause the perceived quality of the application using the transport to deteriorate. **Not sensitive** means that as long as the deterioration is reasonable (there is no definite definition for limits), the perceived quality will not be changed.

*Video applications* – As long as the video is only streaming video, only the packet loss is important for the perceived quality. Delay will only affect the time elapse when changing a channel. However, if the video service is interactive video, the delay becomes more important, and should be kept to a time that is acceptable as response time.

*Voice applications* – Applications like telephony are very sensitive, especially to delay and jitter. The jitter is especially important since voice packets may arrive in the wrong order if they have different delay lengths. Buffering the packets can help this, but the buffer will then increase the delay. Loss of packets can be handled by a telephony application without substantial service deterioration, provided that the loss is limited to a small fraction of the packets, and that the packets are not lost in bursts.

*Data applications* – For example, Internet surfing, using the TCP/IP protocol stack, are generally not very sensitive, neither to packet loss nor delay. Interactive gaming however, is more sensitive to large packets losses and unacceptably long delays.

Loss of packets is rare within the EDA 1200 access network, unless the loss is caused by capacity limitations. In that case it tends to occur in bursts.

Consequently, in order to provide the transport service required for Telephony over IP there are two main requirements for the QoS function. One is to minimize the delay of voice packets, the other to minimize the influence of capacity limitations on voice packets.

In a network carrying a mixture of real-time applications and data packets, delays are mainly imposed on voice packets when they have to wait for transmission of often-longer data packets.

### 3.2.1 Traffic Classification

The classification of the traffic is done by the edge nodes in the network.

The Access Node (IP DSLAM or Ethernet access switch) tags upstream frames with classification tags (also called p-bit), determined by the origin of the frame. A frame generated internally by the Access Node is tagged with the management priority tag. A frame originating from an ATM PVC is tagged with the priority tag defined for that PVC, or the flow within the PVC, by the operator.

The classification tags included in downstream frames may originate from a Voice Gateway or a Service Provider's PoP or they may be the result of a conversion performed at the edge of the EDA 1200 network. The classifying nodes in the network are illustrated in Figure 22 on page 32.

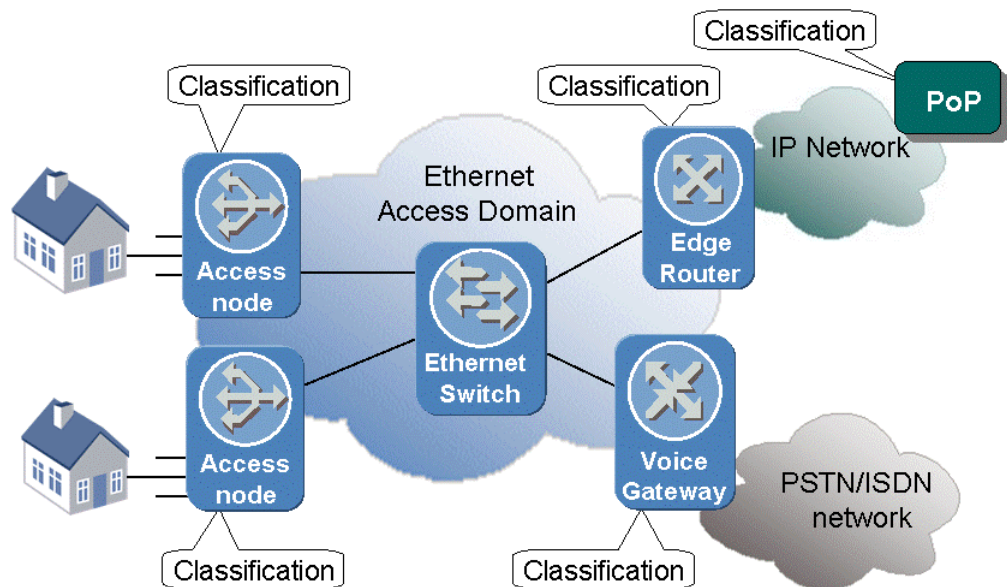


Figure 22 Traffic Classification in an EDA 1200 Network

### 3.2.2 Differentiated Services

The principle of differentiated services is that every single switch or router, as an autonomous unit, decides the order, in which packets or frames are forwarded on the transmission link. The decision is based on the classification (p-bit) of the packet or frame, and the QoS policy.

The differentiated services implementation used in the Ethernet is according to the IEEE 802.1Q specification, specifying 8 values using three bits, the so-called p-bit. The p-bit value indicates the classification of the frame.

The operation of a differentiated services based forwarding process of a network element using two priority levels (Classes of Service), one for voice and one for data is illustrated in Figure 23 on page 33.

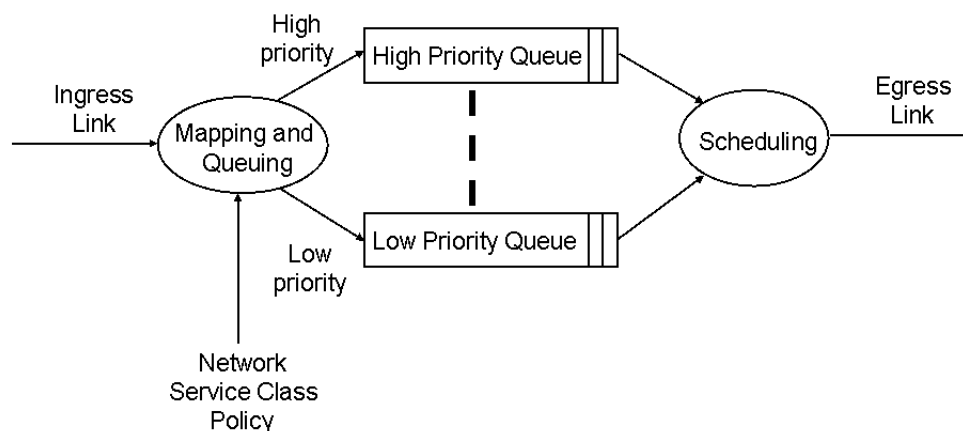


Figure 23 Differentiated Services in an Ethernet Switch

When a frame is received, the mapping and queuing process determines by examining the header, the destination port and the queue in which the frame will wait to be sent. The decision of which queue to use is based on the classification of the frame.

The scheduling process submits the queued frames for transmission. Different algorithms can be used for emptying the different queues.

Within routed parts of the network, that is, when EDA 1200 traverses an IP network in order to reach a remote Service Provider's PoP, differentiated services are used on the IP level. The principle of the forwarding process of a router is similar to the process in an Ethernet switch.

Within IP networks various standards for priority tag indication exist, using DiffServ Code Point (DSCP) fields within the IP header. The tags used to indicate specific services within these fields also differ from network to network. Therefore mapping must be performed within the edge nodes in order to adapt to the priority tags used in the specific network.

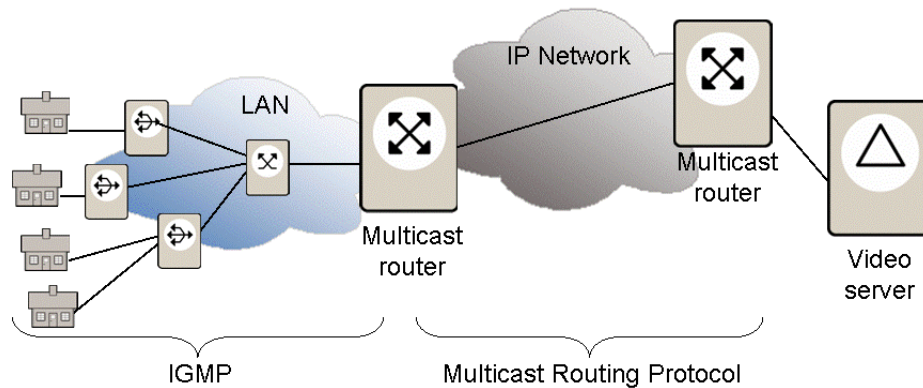
### 3.3 Multicasting

IP Multicasting is the ability to transmit a single data stream to multiple End-users at the same time. IP multicasting reduces the total traffic load in the network by eliminating unnecessary traffic:

- Only requested multicast data streams are transmitted downstream
- Only one downstream transmission to several listeners

**Note:** Multicast is only supported for single tagged traffic. However, EDN312 and EDN612 are able to forward double tagged frames (based on IGMP snooping) with a multicast group destination. Such forwarding is limited to downstream traffic towards a single End-user line per Service VLAN.

In Multicasting, a data stream is sent to a multicast group address in the reserved range between 224.0.0.0 to 239.255.255.255. Routers distribute the multicast streams using multicast routing protocols. Hosts (usually a Set Top Box or a PC) can subscribe to the specific multicast group using the Internet Group Multicast Protocol (IGMP). Routers and switches in the network will then ensure that the subscribing hosts will receive the data stream.



*Figure 24 IP Multicasting in the Network*

A multicast router (or another designated multicast querier) sends queries in order to find out whether there are interested nodes for multicast groups, and whether the already subscribing nodes are still interested in receiving. Interested nodes will then reply to the query. The query mechanism ensures that the data stream will not be sent indefinitely, if a subscriber has just turned off the set top box, thus not issuing a leave message.

IGMP is a protocol used by IP hosts and multicast routers to manage multicast group membership. The IGMP messages depend on the IGMP version.

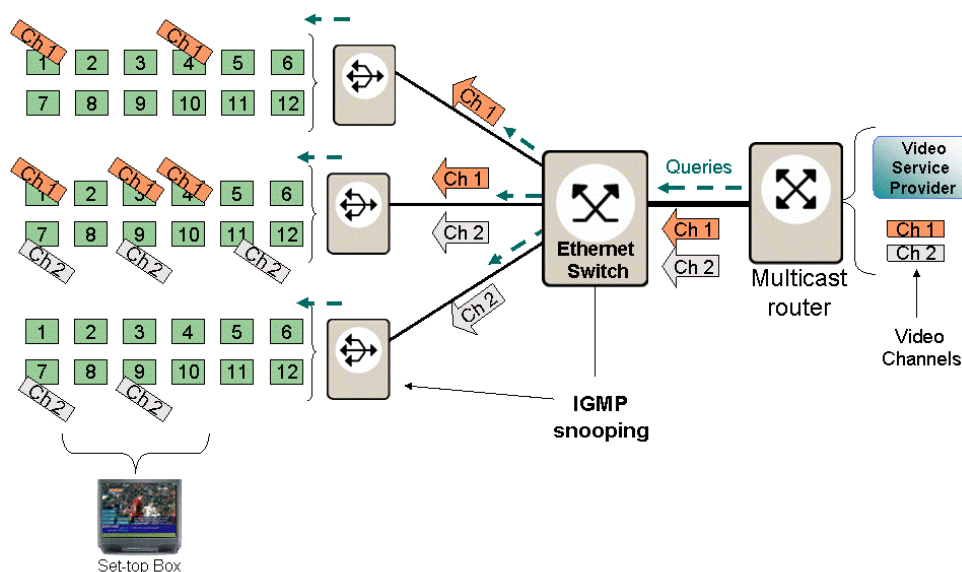


Figure 25 IP Multicasting using IGMP Snooping for Video Services

The way that a node subscribes and leaves a multicast group depends on the IGMP version used. For version 2 and 3 the following messages apply:

- Join: The node sends a report (join) message to the multicast group address.
- Leave: The node sends a leave message to the multicast group address.

IGMP snooping is the layer 2 function that optimizes IP Multicasting in a layer 2 network. A switch uses IGMP snooping to learn where to send multicast data streams, and possibly also when to stop, even if the router has not stopped yet. IGMP snooping may be combined with suppression (for example, forwarding only one response to a query even though three responses were received from the same port), in order to reduce signalling traffic.

The implementation of the multicast and IGMP functions depends on the node they are implemented in. Please refer to:

- EDA 1200 Node User Guides for general EDA implementation
- EDA 1200 DSL Line Features description for IP DSLAM implementation
- EDA 1200 Fiber and Cat5 Line Features description for EFN324 implementation

### 3.3.1 Source Specific Multicast

With IGMPv3 (RFC 3376) a new mode has been introduced Source Specific Multicast (SSM). The previous mode has been named Any Source Multicast (ASM). The difference between SSM and ASM is that in SSM the client (for example Set Top Box) specifies both the group address and the source (IP

address) of the multicast stream originator. This enables the use of multiple sources of the same multicast address within the same network. It can for example be used for different contents providers for the same multicast group. The Internet Assigned Numbers Authority (IANA) has allocated the 232/8 address range for SSM. The following figure illustrates IANA allocation of IP multicast addresses for the ASM and SSM address ranges.

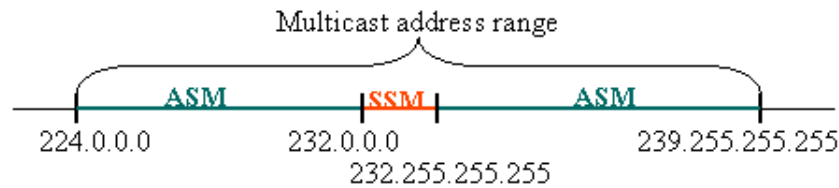


Figure 26 IANA ASM and SSM Address Ranges

The messages used for ASM and SSM are slightly different.

### 3.3.2 Multicast Applications

Multicast technology can be used for different applications. The intended application determines the requirements and desired characteristics of network. There are three main categories of applications:

- Operator multicast services such as IPTV, radio and so on. Traffic should be optimized using IGMP snooping in each node to reduce network load.
- TLS with Multicast. This is most likely a service for corporations and other companies. Multicast traffic optimization by the operator is not necessary. The TLS customer may implement optimizations mechanisms in order to lower the load on the TLS network. From the access network point of view, the streams are flooded across the whole TLS VLAN.
- Multicast in single edge network. This is used in network where VLAN per End-user is used. No traffic optimization is needed in the access network with this type of applications. The Broadband Network Gateway (BNG, defined in TR-101) is the multicast replicator that sends the stream to each End-user. In practice the stream can be flooded in each VLAN. This type of application can also be used to connect to the core network when a multicast source resides in an EDA End-user premises.

The following figure illustrates the three categories.



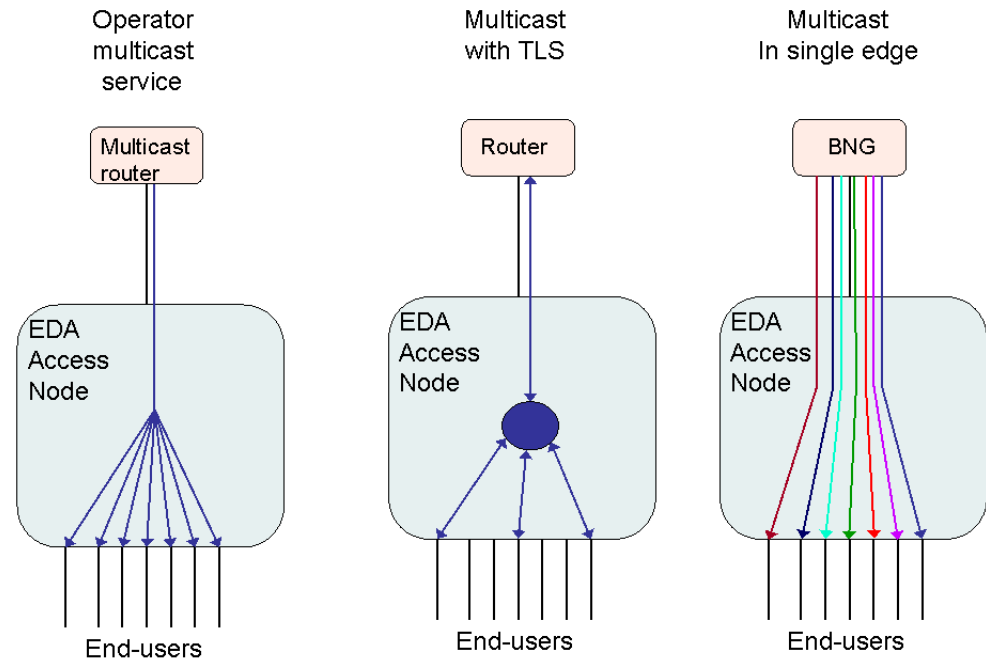


Figure 27 Multicast Applications Categories

The following table illustrates the characteristics needed for each category.

Table 8 Network Characteristics for Application Categories

Characteristic	Operator service	Multicast with TLS	Multicast in Single edge
Stream source	Single, downstream	Multiple, upstream and downstream	Single, downstream
Traffic optimization	Yes, IGMP Snooping	No	No
Multicast replication	Yes, optimized	Yes, not optimized	No
Transparent forwarding	No	Yes	Yes
Users per VLAN	Many	Few	One
LAN Signalling method	IGMP	Unknown, customer specific	IGMP
Signalling load (IGMP)	Heavy	Light	Heavy

**Note:** When IGMP snooping is not used, the default behavior of layer 2 switches is to flood the multicast traffic in the VLAN.

## 4 EDA 1200 Nodes

This section describes briefly the various nodes in the EDA 1200 portfolio. The following tables list the different nodes.

*Table 9 EDA 1200 Nodes – Access Nodes*

<b>IP DSLAMS</b>	
EDN312xp (12 lines)	Supports ADSL2+ with built-in POTS filter, 2 uplink ports enabling power supply redundancy, link aggregation (IEEE 802.1ad) or link redundancy.
EDN312x-p (12 lines)	Supports ADSL2+ without built-in POTS filter, 2 uplink ports enabling power supply redundancy, link aggregation (IEEE 802.1ad) or link redundancy.
EDN312xsp (12 lines)	Supports ADSL2+ with built-in POTS filter, 1 uplink port, No Line LEDs.
EDN312xs-p (12 lines)	Supports ADSL2+ without built-in POTS filter, 1 uplink port, No Line LEDs.
EDN312xi (12 lines)	Supports ADSL2+ with built-in ISDN filter, 2 uplink ports enabling power supply redundancy, link aggregation (IEEE 802.1ad) or link redundancy.
EDN312x-i (12 lines)	Supports ADSL2+ with built-in ISDN high-pass filter, 2 uplink ports enabling power supply redundancy, link aggregation (IEEE 802.1ad) or link redundancy. If a Low-pass filter is needed it must be mounted externally.
EDN312xs-i (12 lines)	Supports ADSL2+ without built-in ISDN filter, 1 uplink port, No Line LEDs.
EDN312xe (12 lines)	Supports ADSL2+ with built-in POTS filter, 2 uplink ports enabling power supply redundancy, link aggregation (IEEE 802.1ad) or link redundancy. Complies with the ETSI standard.

Table 9 EDA 1200 Nodes – Access Nodes

<b>IP DSLAMS</b>	
EDN312xse (12 lines)	Supports ADSL2+ with built-in POTS filter, 1 uplink port, No Line LEDs. Complies with the ETSI standard.
EDN312xa (12 lines)	Supports ADSL2+ with built-in POTS filter. 2 uplink ports enabling power supply redundancy, link aggregation (IEEE 802.1ad) or link redundancy. ANSI standard compliant.
EDN612p (12 lines)	Supports VDSL2 and ADSL2+. 2 uplink ports enabling link aggregation (IEEE 802.1ad) or link redundancy. Used with external Splitter/Filter for POTS.
EDN612i (12 lines)	Supports VDSL2 and ADSL2+. 2 uplink ports enabling link aggregation (IEEE 802.1ad) or link redundancy. Used with external Splitter/Filter for ISDN.
EDN612ef (12 lines)	Supports VDSL2 and ADSL2+. 2 uplink ports enabling link aggregation (IEEE 802.1ad) or link redundancy. Includes an ETSI internal Splitter/Filter.
EDN612nef (12 lines)	Supports VDSL2 and ADSL2+. 2 uplink ports enabling link aggregation (IEEE 802.1ad) or link redundancy. Includes an ETSI internal Splitter/Filter – a low power consumption IP DSLAM with maximum transmission of 14.5 dBm. Does not support dual latency.
EDN624p	24 lines 3 band IP DSLAM. Supports VDSL2 and ADSL2+. 2 uplink ports enabling link aggregation (IEEE 802.1ad) or link redundancy. Does not support dual latency.  Available from EDA 1200 Release 4.3.
<b>Ethernet Nodes</b>	
EFN324f	24 ports fiber node (Single-mode, Single Fiber). Dual Combo GbE uplinks, electrical RJ45 and optical SFP.
EFN324df	24 ports fiber node (Multimode, Dual Fiber). Dual Combo GbE uplinks, electrical RJ45 and optical SFP.
EFN324c	24 Cat 5 Ethernet ports. Dual Combo GbE uplinks, electrical RJ45 and optical SFP.
EFN432s	Telecom grade Ethernet access node with 32 GE downlink ports (SFP) and two 10 GE uplink ports (SFP+).  Available from EDA 1200 Release 4.3.
EFN432c	Telecom grade Ethernet access node with 32 GE downlink ports (electrical) and two 10 GE uplink ports (SFP+).  Available from EDA 1200 Release 4.3.
<b>IP POTS</b>	

Table 9 EDA 1200 Nodes – Access Nodes

EDN524s	24 line IP POTS node for Telephony over IP. EDN524 transforms the incoming analogue voice stream into a high-quality Telephony over IP (ToIP) digital stream. Has both G.711 and G.729A voice codecs. Single uplink.  Available from EDA 1200 Release 4.2.
EDN524r	24 line IP POTS node for Telephony over IP. EDN524 transforms the incoming analogue voice stream into a high-quality Telephony over IP (ToIP) digital stream. Has both G.711 and G.729A voice codecs. Dual uplink.  Available from EDA 1200 Release 4.2.

IP DSLAMs based on EDN312 can also be ordered as units containing 96, 144 and 288 lines.

Table 10 EDA 1200 Nodes – Controller Nodes &amp; Switches

<b>EDA 1200 Switches and Controller Nodes</b>	
ESN108	8-port 1st level aggregation switch with integrated power over Ethernet functionality for powering IP DSLAMs.
ESN204g	4-port aggregation switch with a GPON uplink.
ESN212	12-port (GE) 1st or 2nd aggregation switch.
ESN410	Ethernet Layer 3 Gb aggregation switch supporting IP routing and comprehensive network management such as spanning tree protocol for standard bridging, GVRP for VLAN configuration, SNMP, RMON, and Web Management.
EMN120	Metro aggregation node with layer2 and 3 switching functions. The node has 23x1Gb ports and an optional module with 4x10Gb ports.
ECN330	Ethernet Controller Node with EMP functionality (EDA Management proxy). The node has 24 fast Ethernet downlinks and two 1Gb uplink ports. ETSI version.
ECN330a	Ethernet Controller Node with EMP functionality (EDA Management Proxy). ANSI version. Complies to NEBS.
ECN430	Ethernet Controller Node with EMP functionality (EDA Management proxy). The node has 23x1Gb ports and an optional module with 4x10Gb ports.

Table 10 EDA 1200 Nodes – Controller Nodes &amp; Switches

<b>EDA 1200 Switches and Controller Nodes</b>	
ECN212	Ethernet Controller Node with EMP functionality (EDA Management proxy). Contain 12 ports (4 SFP, 8 electrical) which can be configured as uplink or downlink.  Available from EDA 1200 Release 4.3.
ECN212f	Ethernet Controller Node with EMP functionality (EDA Management proxy). Contain 12 ports (SFP) which can be configured as uplink or downlink.  Available from EDA 1200 Release 4.3.

Table 11 EDA 1200 Nodes – Ethernet Power Nodes

<b>EDA 1200 Ethernet Power Nodes</b>	
EPN102	Power over Ethernet node. Supports supply of –48 V DC power to two network nodes, but only one IP DSLAM. For example one IP DSLAM and one FE-E1 converter in a small site scenario.
EPN210	10 ports -48 V DC Power distribution unit to use with EDN612 and ESN212. Two power inputs enable redundancy.
Remote Powering	A solution to power small remote sites over twisted pair lines.

Table 12 EDA 1200 Nodes – Converters

<b>EDA 1200 Converters</b>	
EXN104	FE-E1/T1 Converter. Up to four E1 / T1 lines can be used.

## 4.1 IP DSLAMs

This section briefly describes the IP DSLAMs in the EDA 1200 portfolio.

#### 4.1.1 24-line IP DSLAM EDN624

EDN624 is a high density true multimode IP DSLAM with 24 ports of 3-band VDSL2 and support of ADSL, ADSL2 and ADSL2+. A number of new features have been added to the long list of existing EDA features already known from EDN612. For example PTM bonding, 802.1x port-based Network Access Control and PTM-over-ADSL.



EDN624 aggregates 24 DSL lines to two 1 Gbps Ethernet and offers aggregation both as bridge mode or routed encapsulation mode. The two Uplinks can be used either as Link redundancy (Rapid Spanning Tree - RSTP) or Link aggregation.

EDN624 is available with POTS analog front-end. External filter must be used.

The EDN612 has 24 fully flexible lines capable of running VDSL2, ADSL, ADSL2 or ADSL2+.

The IP DSLAM is fully managed through SNMP. A higher level configuration and provisioning can be done using the Ethernet Control Node (ECNxxx).

The EDN612 is powered through an EPN210 power distribution unit or directly from an external power supply.

#### 4.1.2 12-line IP DSLAM EDN612



The EDN612 is a small, cost-efficient, 12-port IP DSLAM designed for the EDA 1200 solution. It aggregates 12 DSL lines to one or two 1 Gbps Ethernet and offers aggregation both as bridge mode or routed encapsulation mode. The two Uplinks can be used either as Link redundancy (Rapid Spanning Tree - RSTP) or Link aggregation.

The variants of the EDN612 are described in Table 13 on page 44.

The EDN612 has 12 fully flexible lines capable of running VDSL2, ADSL, ADSL2 or ADSL2+.

The IP DSLAM is fully managed through SNMP. A higher level configuration and provisioning can be done using the Ethernet Control Node (ECNxxx).

Table 13 EDN612 Variants

Name	Analog front-end	Built-in filter	
EDN612ef	POTS(ETSI standard)	√	
EDN612nef (low power version)	POTS(ETSI standard)	√	
EDN612p	POTS	÷	
EDN612i	ISDN	÷	

The EDN612 is powered through an EPN210.power distribution unit or directly from an external power supply.



### 4.1.3 12-line IP DSLAM EDN312x

The 12-line IP DSLAM EDN312x is powered over the Ethernet cable, making installation easier as both data and power run in the same cable. EDN312x is an essential part of the large EDN288x IP DSLAM, but EDN312x can also be placed in small subracks or in environmental hardened cabinets.

The two 100 Mbps uplinks are made for redundancy purposes and the RSTP function automatically switches to the working link.

The two uplinks also make power feeding from two different sources possible. When power is down on one of the cables, the IP DSLAM automatically switches to the other inlet for power feeding. Power can only be fed from one inlet at a time. Any intermediate power feeding from both connections is not possible.

If redundancy is not required, the cost effective EDN312xs can be used. It has a single Ethernet uplink and no line LEDs. Other variants with or without built in filter and line LEDs are also available.

The following table lists the EDN312 variants:

Table 14 EDN312 Variants

Name	Uplink ports	Analog front-end	Line LEDs	Built-in filter
EDN312xp	2 x 100 Mbps	POTS	√	√
EDN312x-p	2 x 100 Mbps	POTS	√	÷
EDN312xsp	1 x 100 Mbps	POTS	÷	√
EDN312xs-p	1 x 100 Mbps	POTS	÷	÷
EDN312xe	1 x 100 Mbps	POTS (ETSI standard)	√	√
EDN312xse	1 x 100 Mbps	POTS (ETSI standard)	÷	√
EDN312xa	2 x 100 Mbps	ANSI	√	√
EDN312xi	2 x 100 Mbps	ISDN	√	√
EDN312x-i	2 x 100 Mbps	ISDN	√	÷
EDN312xs-i	1 x 100 Mbps	ISDN	÷	÷



#### 4.1.4 96-line EDN312 based IP DSLAM EDN96

The 96-line IP DSLAM EDN96 is ordered, delivered, installed, and commissioned as one pre-assembled, pre-cabled, and tested unit. EDN96 consists of 8 x 12-line IP DSLAMs (EDN312x), one Ethernet Switch (ESN108), eight numbered Ethernet cables, and a power cable.

EDN96 is available in an EU variant, assembled in a 5 HU chassis and a US variant assembled in a 5.5 HU chassis including NEBS protection and Telco connectors. The EDN96 variant for the EU can be mounted directly in existing 19" or ETSI racks, whereas the US variant fits into 19", ETSI and 23" racks.

EDN96 is power-fed from a standard telecom graded –48 V DC power supply. Traffic from the EDN96 is delivered on one or two Gigabit Ethernet fiber interfaces.

#### 4.1.5 144-line EDN312 based IP DSLAM EDN144x

The 144-line IP DSLAM EDN144x is ordered, delivered, installed, and commissioned as one pre-assembled, pre-cabled, and tested unit. EDN144x consists of 12 x 12-line IP DSLAMs (EDN312x), one Ethernet Controller Node (ECN330), 12 numbered Ethernet cables, and a power cable, all assembled in a 6.5 HU chassis.

The EDN144x is available in EU and US variants and can be plugged directly into existing 19", ETSI or 23" racks and connected to upstream Ethernet over copper or fiber. The US variant includes NEBS protection and Telco connectors.

EDN144x is power-fed from a standard telecom graded –48 V DC power supply. Traffic from the EDN144x is delivered on one or two Gigabit Ethernet fiber interfaces.

#### 4.1.6 288-line EDN312 based IP DSLAM EDN288x



The 288-line IP DSLAM EDN288x is ordered, delivered, installed, and commissioned as one pre-assembled, pre-cabled, and tested unit. EDN288x consists of 24 x 12-line IP DSLAMs (EDN312x), one Ethernet Controller Node (ECN330), 24 numbered Ethernet cables, and a power cable, all assembled in an 11 HU chassis. The EDN288x chassis can be plugged directly into existing 19" or ETSI racks and connected to upstream Ethernet over copper or fiber. EDN288x is power fed from a standard telecom graded -48 V DC power supply. Traffic from the EDN288x is delivered on one or two Gigabit Ethernet fiber interfaces.

### Expanded version of EDN288x

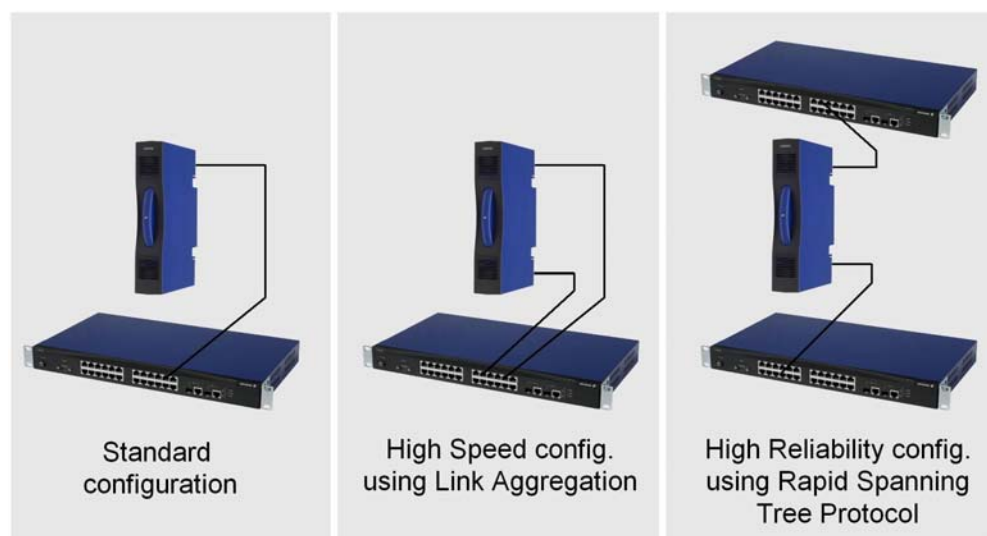


Figure 28 Different configurations of EDN288x

For redundancy or double uplink, the EDN288x can be extended with one additional Ethernet Controller Node (ECN330) configured as switch as shown in Figure 26 on page 50. Mechanical expansion is available by adding one ECN330, Ethernet cables, and mounting brackets.

## 4.2 Ethernet Access Nodes

This section briefly describes the available access nodes based on fiber and Cat5/6 drop technologies.

### 4.2.1 Ethernet Node EFN324

The EFN324 is an Ethernet Access node. It has 24 10/100 Mbps Ethernet downlink ports and two 1000 Mbps Ethernet uplink ports. The EFN324 is prepared for 19" rack mounting. The EFN324 has hardware versions for either optical or electrical downlinks.



End-users are connected directly to the EFN324, which has extensive security capabilities (both for the End-user and for the network). The EFN324 can also act as multicast proxy.

The EFN324 is available in the following variants:

- EFN324f: Single mode Single fiber optical termination
- EFN324df: Multimode Dual fiber optical termination
- EFN324c: Electrical Ethernet termination (Cat5, indoor only)

### 4.3 Ethernet switches

The Ethernet switch is in principle a standard Layer 2 switch that aggregates all connected IP DSLAMs. The connection from Ethernet switch to IP DSLAM is a 100 Mbps full duplex Ethernet (100Base-TX). Uplink connections can either be 100 Mbps full duplex or 1000 Mbps full duplex. All EDA 1200 switches include PoE.

### 4.3.1

#### ESN212

The ESN212 is a small Gigabit Ethernet Layer-2 aggregation switch developed for the EDA 1200 solution. It is used for concentrating the data traffic upwards in the network. The ESN212 is available in two version:

- The ESN212 switch is equipped with 8 electrical 1Gbps Ethernet ports, and four Small Form-factor Pluggable (SFP) cages. Each of the 12 ports can be assigned to either uplink or downlink.
- ESN212f - Equipped with 12 Gigabit Ethernet SFP ports for up or down link. Each of the 12 ports can be assigned to either uplink or downlink.

The ESN212 is fully managed through SNMP. A higher-level configuration can be done using the Ethernet Control Node (ECNxxx) or the built-in CLI interface (RS 232, SSH or telnet).

The ESN212 is powered from an EPN210.



ESN212



ESN212f

### 4.3.2

#### ESN204g

The ESN204g is a small Gigabit Ethernet Layer-2 aggregation switch developed for the EDA 1200 solution for use with the EDA1500 GPON system. It is used for concentrating data traffic upwards in the GPON network.

The ESN204g switch is equipped with 4 electrical 1Gbps Ethernet ports, and one GPON SC/APC port.

The ESN204g is fully managed through SNMP. A higher-level configuration can be done using the Ethernet Control Node (ECNxxx) or the built-in CLI interface (RS 232, SSH or telnet).



### 4.3.3 ESN108

Ethernet switch ESN108 is a small-size 8-port switch. It is installed the same way as the EDN312x IP DSLAMs, that is, directly on a KRONE LSA PLUS and PROFIL rail.

Concentrating the Ethernet traffic from the IP DSLAM, ESN108 provides eight 100 Mbps Fast Ethernet ports and for uplink one Single Mode Fiber (SMF) 100/1000 Mbps auto-configurable Small Form Factor pluggable SFP fiber port. ESN108 has built-in power over Ethernet (PoE) for distributing power to the connected IP DSLAMs via the Fast Ethernet ports.



Using the fiber uplink ESN108 may be aggregated into EFN324 (100 Mbps) or ESN410 (1 Gbps).

Priority queues are used to guarantee the QoS needed for delay-sensitive applications like voice (IP telephony), video conferencing, or video broadcast. Each packet going through the switch can be assigned a queue priority (according to IEEE 802.1Q).

ESN108 offers multicast loading of IP DSLAM software and multicast video streaming by use of IGMP snooping. Listening to IGMP messages (Internet Group Management Protocol messages), the ESN108 switch builds mapping tables and associates forwarding filters. It dynamically configures the switch ports to forward IP multicast traffic only to those ports associated with multicast hosts.

By use of VLAN technology it is possible to create separate logical networks within the Ethernet LAN. In the EDA 1200 solution, VLAN can be used to separate traffic types or different services and to improve security. ESN108 is transparent for VLAN IDs and offers port mapping filtering.

Rapid spanning tree protocol (RSTP) is implemented although the unit has only one upstream interface. The use of RSTP is to take advantage of the protocol for topology purposes. With the aid of the information in the protocol, a topology map of nodes can be made up. Also, RSTP is needed in all nodes to prevent prolonged convergence time for a new configuration.

#### 4.3.4

#### EMN120

The Ethernet Metro Node EMN120 is a Gb traffic aggregation node that can be used in the EDA access network and in any metro Ethernet. It has 23 x 10/100/1000 Mbps ports (where 20 are optical/ electrical combo, and 3 are electrical). It can be extended with a 10 Gb module that contains two 10Gb electrical interface ports with Infini-band connector and two 10 Gb optical XFP ports.



QoS is ensured with 8 queues and various scheduling mechanisms.

EMN120 provides Layer 3 IP routing and maintains a high rate of throughput. EMN120 forwards all traffic passing within the same segment and only routes traffic that passes between different sub-networks. The wire-speed routing provided by the EMN120 enables network segments or VLANs to be easily linked together. The EMN120 can be subdivided into Virtual Routers (VRs) serving different VPN or customer sites. The router is capable of storing multiple routing tables: one for each service provider connection. EMN120 supports overlapping IP address spaces between the Virtual Routers.

EMN120 supports multicast streaming on Layer 2 and Layer 3 by use of IGMP. The switch supports IGMP snooping and configurable suppression of IGMP messages towards the upstream source for multicast groups. EMN120 supports IGMP proxy and IP Multicast Routing protocols such as PIM-SM/SSM/DM and DVMRP.

EMN120 is prepared for both ETSI and 19" rack mounting and has built-in fan units that can be replaced without service interruption.



### 4.3.5 ESN410

Ethernet switch ESN410 has 12 SFP 1 Gbps ports. Four of these ports are combo ports giving the possibility to connect 4 x 10/100/1000 Mbps Base-TX.



ESN410 supports IP routing and as a routing switch combines the speed and low cost of a Layer 2 switch with the ability to route on Layer 3.

Comprehensive network management functions are provided as standard features, including Spanning Tree Protocol for standard bridging, GVRP for VLAN configuration, SNMP, RMON, and Web management.

ESN410 is prepared for 19" rack mounting and has built-in fan units that can be replaced without service interruption.

## 4.4 Ethernet Node Controller Node

Ethernet Node Controllers are Ethernet switches with an EDA Management Proxy (EMP) function.

### 4.4.1 Ethernet Controller Node ECN430

Ethernet Controller Node ECN430 is a management and traffic aggregation node for Ericsson's EDA solution. It has 20 combo and 3 fixed 100/1000 Base-T Mbps ports, and an optional 10 Gbit module with 4 x 10 Gbit ports. The Ethernet Controller Node ECN430 facilitates both Layer 2 and Layer 3 Gigabit Ethernet (GE) functionality. The ECN430 can be extended to support MPLS features.



A special feature is the built-in EDA Management Proxy (EMP) application that removes dependency on the EDA Management System during start-up and restart and reduces the number of IP addresses needed in the network.

ECN430 facilitates Layer 2 and Layer 3 GE switch functionality including advanced Layer 2 services like stacked VLAN (QinQ) and enhanced multicast features. The Layer 3 routing features include virtual router for service provider separation.



The following functions are integrated in ECN430:

- The following functions are integrated in ECN430:
- Ethernet Controller Node functionality
- Traditional Layer 2/3 Ethernet switch functions
- Routing function
- Slot for 10G expansion module (4x10 GE). The 10G module is an accessory, which is available in two variants:
  - Two XFP (10G Small Form Factor Pluggable) transceiver slots (optical), and two built-in Infiniband X4 transceivers (electrical)
  - Four XFP (10G Small Form Factor Pluggable) transceiver slots (optical).
- Telecom grade HW (QoS, availability 99.999%)

## 4.4.2 Ethernet Controller Node ECN330

Ethernet Controller Node ECN330 has 24 tributary (downlink) ports of the 10/100 Mbps Fast Ethernet type, two combo aggregate (uplink) ports (either two electrical 10/100/1000 Mbps Ethernet ports or two 100/1000 Mbps optical SFP fiber ports), and an additional electrical 10/100/1000 Mbps aggregate Ethernet port.



ECN330 supports a number of advanced features like 4k VLAN, 16k MAC table, full link aggregation, and Layer 3 routing.

ECN330 also supports Layer 2 MPLS for tunneling and a number of redundancy protocols, for example Rapid Spanning Tree Protocol (RSTP), Multiple Spanning Tree Protocol (MSTP) and Ethernet Automatic Protection Switching (EAPS).

ECN330 has built-in Power over Ethernet (PoE) functionality for power distribution to the connected IP DSLAMs. It is prepared for 19" rack mounting and has built-in fans that can be replaced without service interruption.

ECN330 also includes the EDA Management Proxy (EMP) that reduces the management of IP addresses to one single IP address per ECN330, independent of the number of IP DSLAMs aggregating to each ECN330.

The ECN330 may be configured to disable the EMP functionality for pure switch operation. Configured as a switch, the ECN330 is denoted ECN330-switch.

ECN330 is equipped with dual power inlets enabling power redundancy.

The ECN330 is available in two variants, the ECN330a, which is NEBS-compliant, and the ECN330 which is not.

## 4.5 Power Nodes

This section briefly describes the available power nodes in the EDA 1200 portfolio.

### 4.5.1 EPN210

The EPN210 is a -48 V DC rod mounted power distribution unit, capable of distributing power to 10 devices. EPN 210 supports power distribution for EDN612, ESN212 and EDN312x (power fed through Power over Ethernet). EPN210 can deliver up to 2A on a single port, though maximum 500 W in total. ESN212 supports power redundancy.

EPN210 is compact and environmental hardened, and therefore very suitable for installation and use in both Central Office and a remote roadside cabinet.

EPN210 is used to distribute power to EDN612 and ESN212. It can also be used to power an EDN312x, through one of the uplink ports. However, when this is done the port cannot be used for traffic.



### 4.5.2 EPN102

The compact 2-port Ethernet Power Node EPN102 implements an elegant way of providing power at small sites. The main functionality is to supply -48 V DC onto two of the spare wires in the standard Ethernet cable. EPN102 provides one Ethernet input port and one Ethernet output port for connection to an Ethernet aggregation switch and an IP DSLAM (EDN312x), respectively. Both ports provide Power over Ethernet (PoE) output. This allows for power feeding of both an IP DSLAM and Ericsson's Fast Ethernet to E1/T1 converter (EXN104) in case an N\*E1 uplink is preferred.

The Ethernet Power Node (EPN) operates from the supply voltage in an input range from -40.5 to -60 V DC and will provide output voltage accordingly, with a voltage drop of less than 2 Volts.

EPN102 is capable of delivering up to 21 Watts per port. A remote sensing circuit connects power when required on each individual output – similarly power will automatically be disconnected when load is removed from the output.



### 4.5.3 Remote Powering

Remote powering is a concept for distributing DC power over existing twisted pairs up to 10 km. The concept is typically for use in broadband applications,

where telecom equipment is located close to the End-user and requires power. The remote powering is independent from local power utilities and centralized back-up systems (batteries). The system consists of a Central Office Remote Power System and a remote-end converter, and is an OAM product. The system consists of a CO System and a Remote-end converter.

### CO Flat pack Remote Power Systems

The power system consists of a 2HU Flat pack Mini PRS chassis, 19" or 21" (ETSI) wide. This chassis houses up to two DC/DC converters and VA limiters.



The DC/DC converter is a 1500-watt step up converter which provides  $\pm 190$  V DC from a traditional  $-48$  V DC source.

The VA limiter distributes the  $\pm 190$  V DC and provides a safe power distribution over existing twisted pairs, protecting the Remote Feeding Circuits (RFT) from over-voltage, over-current, and leakage current to ground. The VA limiter has 12 individual outputs of up to 100 W each (RFT-V).

### Remote-end converter

The remote-end converter consists of parallel DC/DC converters that terminate the twisted pairs being fed from the CO. The converter incorporates high-energy surge protection and is specifically designed to work from a limited power source (VA limiter) fed over a high-impedance line. The modules can be paralleled to meet the power requirement at the remote end.



## 4.6 Converters

This section briefly describes the converters in the EDA 1200 portfolio.

#### 4.6.1 Fast Ethernet to E1/T1 Converter EXN104

EXN104 is a small managed Fast Ethernet to 4x E1 converter. It is developed as a cost-effective solution for EDA 1200 rollout where no Ethernet uplink is available. EXN104 makes it possible to transport the Ethernet traffic via vacant E1 lines. EXN104 is intended for installation of EDA 1200 at small sites with a few IP DSLAMs and existing physical E1 uplink connections towards the central office and EXN104 is often used in a back-to-back solution as shown in Figure 29 on page 57.

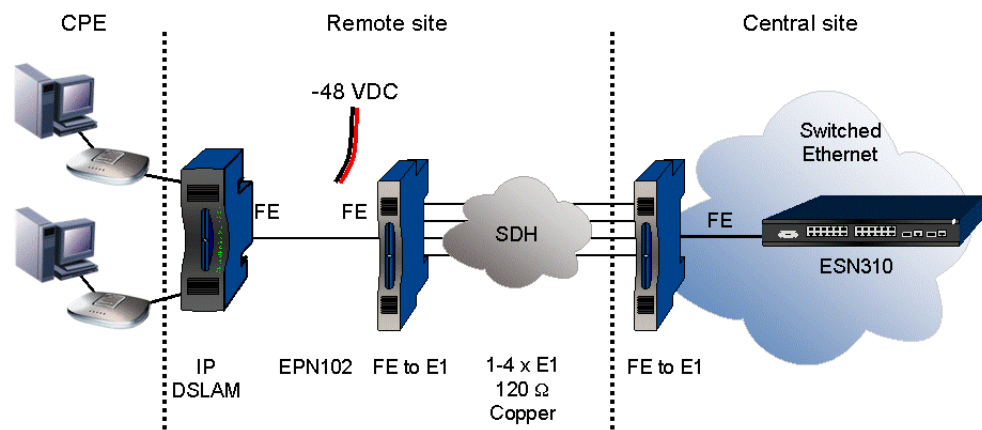


Figure 29 EXN104 in a Back to Back solution

EXN104 has a single RJ-45 port, which supports 100BASE-TX on CAT 5 cables and conforms to IEEE 802.3u. Like the IP DSLAM, EXN104 is powered via the Ethernet port. On the MDF interface EXN104 supports four 120 W E1 ports (2048 kbps) that conform to ITU-T G.703.

EXN104 is fully manageable via SNMP from, for example, the Public Ethernet Manager (PEM) and EXN104 is transparent to all kinds of traffic. Examples are IEEE 802.1Q VLAN, MAC address based VLAN, VLAN tag ID based, and untagged frames. Prioritization is handled according to IEEE 802.1Q with eight priority levels and four queues.






All software/firmware is upgradeable via the Fast Ethernet and E1 port. The EXN104 can operate autonomously because firmware and configuration is stored in flash.

The installation is Plug and Play with optional pre-configuration. EXN104 is installed directly into a 10-pair LSA-PLUS or LSA PROFILE.


## 4.7 Housing Solutions

Besides these nodes, the following subracks and cabinets are available pre-assembled.



*Table 15 Subracks and cabinets*



	<p>The 36-line subrack houses 12, 24 or 36 subscribers and can be equipped with up to three EDN312x IP DSLAMs and one 8-port switch ESN108, or it can be equipped with up to two EDN312x IP DSLAMs, one 8-port switch ESN108 and one Fast Ethernet to E1/T1 Converter EXN104, as shown here.</p>
	<p>The 96-line subrack houses from 12 to 96 subscribers and can be equipped with up to eight EDN312x IP DSLAMs and one 8-port switch ESN108. The subrack is also available in a US version including NEBS protection and Telco connectors.</p>
	<p>The 19" subrack and the ETSI (21") subrack can both be equipped with up to 96 End-user lines. The subracks have a built-in cable tray and air guide and it is possible to mount EDN612 IP DSLAMs, ESN212 switches, ESN204g switches, external splitters (if required), and an optional EPN210 Power Distribution Node in different combinations. The pictures depict 96 lines configuration with switch and power node, without splitters, and 60 lines configuration with switch power node, and splitters.</p>
	<p>The 144-line subrack ranges from 12 to 144 subscribers and includes the Ethernet Controller Node ECN330. The 144-line subrack is also available in a US variant including NEBS protection and Telco connectors.</p>
	<p>The 288-line subrack ranges from 12 to 288 subscribers and includes the Ethernet Controller Node ECN330.</p>

	<p>The environmental hardened cabinet solution is intended for EDA 1200 installation in rough environments, outdoors as well as indoor.</p> <p>The cabinet is designed for mounting EDA 1200 IP DSLAMs (EDN312x) and the 8-port Ethernet switch (ESN108). Depending on the configuration chosen, the cabinet scales from 12 to 96 ADSL/ADSL2/ADSL2+ subscribers.</p> <p>The cabinet can also be equipped with up to 48 ADSL/ADSL2/ADSL2+/VDSL2 subscribers.</p> <p>The cabinet is designed for wall or pole mounting and the dimensions are: HxWxD = 800 x 655 x 425 mm.</p>
	<p>The cabinet is designed for wall or pole mounting and the dimensions are: HxWxD = 800 x 655 x 425 mm.</p> <p>The cabinet solution scales from 12 to 24 subscribers and uses standard EDA Nodes. It is equipped with an ESN212 or ESN204g switch and one or two EDN612 IP DSLAMs, enabling VDSL2, ADSL2+, ADSL2 and ADSL transmission modes.</p> <p>To increase the capacity of fiber lines, a Coarse Wave Division Multiplexer (CWDM) can be used (ESN212 switch only).</p> <p>The cabinet uses direct air cooling instead of a traditional heat exchange Unit.</p> <p>Flexible powering solutions are available. An AC/DC power solution with optional battery backup can be chosen. Alternatively, a Remote Powering DC utility service can be used, enabling fast roll-out.</p> <p>The cabinet is designed for wall or pole mounting and the dimensions are: HxWxD = 600x350x260 mm.</p>

	<p>The EDA RSC96c is environmentally hardened outdoor cabinet used for roll-out solutions close to the End-user. It is ordered and delivered fully equipped.</p> <p>The cabinet solution scales from 12 to 96 subscribers and uses standard EDA Nodes. It is equipped with an ESN212 switch and one to eight EDN612 IP DSLAMs, enabling VDSL2, ADSL2+, ADSL2 and ADSL transmission modes. Alternatively, an ESN204g switch can be used with one to four EDN612 IP DSLAMs.</p> <p>To increase the capacity of fiber lines, a Coarse Wave Division Multiplexer (CWDM) can be used (ESN212 switch only).</p> <p>The cabinet uses direct air cooling instead of a traditional heat exchange Unit.</p> <p>Each RSC96c provides MDF capacity for 1:2 overlay, that is, up to 600 pairs of High Band MDF blocks for VDSL2, located in a separate compartment accessible from the top of the cabinet.</p> <p>Flexible AC/DC powering solutions are available for optional redundancy and up to 6 hours battery backup.</p> <p>The cabinet is designed for ground mounting on a plinth and the dimensions (excluding the plinth) are:</p> <p>HxWxD: 1180x610x490 mm</p>
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	<p>Point to Point Fiber Access System is a complete housing for point to point fiber access, which includes an Optical Distribution Frame, fiber management and optical nodes (EFN324, and ECN430 or EMN120).</p> <p>A fully equipped P2P Access System supports 1440 subscribers.</p> <p>The P2P access system is delivered with all external network cables already connected to the termination units, which speeds up installation and eliminates the need for splicing within the node.</p> <p>The modular architecture makes it easy to configure the system to meet specific requirements. The size of the system is between two to four cabinets each with a size of 800x1950x400 mm (WxHxD).</p>
	<p>The EDA RSC96m is environmental hardened outdoor cabinet used for roll-out solution close to the End-user. It is ordered and delivered fully equipped.</p> <p>The cabinet solution scales from 12 to 96 line VDSL2/ADSL2+/POTS based on EDN612, EDN524, ESN212 and optional EPN210.</p> <p>The cabinet uses direct air cooling instead of a traditional heat exchange Unit.</p> <p>The cabinet is designed for curb side mount and the dimensions are: HxWxD: 1380 x 930 x 630 mm</p>

	<p>The EDA RSC288m is environmental hardened outdoor cabinet used for roll-out solution close to the End-user. It is ordered and delivered fully equipped.</p> <p>The cabinet solution scales from 12 to 288 line VDSL2/ADSL2+/POTS based on EDN612, EDN524, ESN212 and optional EPN210. The cabinet uses direct air cooling instead of a traditional heat exchange Unit.</p> <p>The cabinet is designed for curb side mount and the dimensions are: HxWxD: 1380 x 1560 x 630 mm</p>
	<p>The EDA RSC384m is environmental hardened outdoor cabinet used for roll-out solution close to the End-user. It is ordered and delivered fully equipped.</p> <p>The cabinet solution scales from 2 to 384 line VDSL2/ADSL2+/POTS based on EDN612, EDN524, ESN212 and optional EPN210. The cabinet uses direct air cooling instead of a traditional heat exchange Unit.</p> <p>The cabinet is designed for curb side mount and the dimensions are: HxWxD: 1380 x 1560 x 630 mm</p> <p>Available from EDA 1200 4.2 release.</p>

## 4.8 North American Solution

The EDA 1200 solution introduces a solution for the North American market comprising fully equipped subracks, Telco connectors and NEBS protection as well as an environmentally hardened IP DSLAM for outdoor use and a GR 487 compliant outdoor cabinet.

The North American solution comprises the following products:

- EDN96
 

A solution housing one ESN108, NEBS protection, Telco connectors and up to eight EDN312xa. The solution houses up to 96 lines in one subrack.
- EDN144
 

A solution housing one ECN330, NEBS protection, Telco converters and up to 12 EDN312xa. The solution houses up to 144 lines in one subrack. ECN330 includes the Ericsson Management Proxy (EMP) that allows the management system to see the EDN144 as one IP DSLAM with 144 lines (one IP address).
- EDN324

An environmentally hardened IP DSLAM with 24 lines for both indoor and outdoor use. Its moisture sealing even allows submersion in water. EDN324 is in controlled sales mode – please refer to sales directive for further information.