EFN324 User Guide

EDA 1200

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Contents

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1 Introduction

This guide describes how to use the EFN324. It describes its functions, Command Line Interface (CLI) and use in EDA. This guide is intended for operation and maintenance personnel.

Some of the EFN324 functions are described in the *EDA 1200 System Description*. Reading the *System Description* before reading this guide is recommended.

Important!

When used with PEM or ServiceOn PEM, most of the EFN324 functions (including VLANs) are configured automatically by the management system. Any duplicate configurations created using the Command Line Interface (CLI) commands described in this manual will be overwritten by the management system.

Throughout this guide, the EFN324 is also referred to as the EFN and an Ethernet access switch. These terms are interchangeable.

The guide can be printed on a monochrome printer, but the pictures and illustrations may be more difficult to understand.

1.1 Revision History

This guide is valid for the EFN324 software released in EDA 4.3. This guide is also valid for ELN220 running the same software. Other product version with functions not described in this guide may be available.

1.1.1 This Version (S)

Other than editorial changes, this document has been revised as follows:

- Flows section (section 4.11 on page 22) updated with better explanations.
- A note added in Table 16 for the statistics command.

1.1.2 Version N

Other than editorial changes, this document has been revised as follows:

- Section 13.8.20 (SNMP) has been updated with SNMPv3 support.
- Section 13.8.17, Section 13.9.10 and section 13.9.2 have been updated with SFTP and FTPS support.
- Section 13.8.12 has been updated with dynamic VLAN management support.

1.1.3 Version M

Other than editorial changes, this document has been revised as follows:

- Reference in section 4.10.1 on page 21 corrected

1.1.4 Version L

Other than editorial changes, this document has been revised as follows:

- Section 4.8 on page 13 (Virtual LAN and VLAN tag) has been updated
- The illustrations and descriptions in section 5.5 on page 39 updated to make them easier to understand
- Connection Bandwidth limitation description added in section 4.10.1 on page 21
- Connect VLAN command corrected (second_ethertype, second_tags) in section 13.8.6 on page 114

1.1.5 Version K

Other than editorial changes, this document has been revised as follows:

- The maximum number of daisy chained stand-alone EFN324 has been corrected to two (2) in section 9.1 on page 72 and Figure 29 on page 73.

1.1.6 Revision J

The guide is based on the EFN324 User Guide 1553-CXP 901 0022 Uen H. Other than editorial changes, this document has been revised as follows:

- Changes made to the document structure.

- EFN324 as an embedded flexible block added. A number of changes flowed from this, including the following:

– Additional CLI commands, and extensions to existing CLI commands.

– A virtual MAC description for an embedded node.

– Additional topology description.

- Replacement of an EFN324 added in section 11.2 on page 82.
- Quality of Service for EFN324 added.
- Further DHCP Option 82 options added.
- PPPoE added.
- Configurable first Ethertype added.
- The default **`snmp write_community`** has been changed, from **`private`** to **`public`**. See section 13.8.20 on page 137.
- Descriptions of the debugging commands, including **`packet_logger`** and **`trace_logger`** commands included, see section 13.10 on page 158.

1.2 Conventions

The following conventions apply to textual instructions (not screen shots):

Tools→Options means: Choose the Tools menu item, then choose the Options menu item.

`Bold Courier letters` mark field titles in a Graphical User Interface (GUI), or text typed by the user (input) in files or the Command Line Interface (CLI, such as Command prompt).

`Regular Courier letters` mark text output in a CLI.

OK : A button in a GUI.

<***`Server`***> is a parameter that should be replaced with the actual value. <> symbols are not typed.

[**`argument`**] the brackets indicate that this argument is optional and can be omitted. If the argument is used, the brackets must not be typed.

Inde~~xIndex~~

{**`argument1|argument2`**} the brackets and pipe indicate that either argument1 or argument 2 can be used as a value for this parameter.

Press CTRL+X means hold down the Ctrl key and press the x key.

2 Introduction to the EFN324

The EFN324 is designed for use in a Public Ethernet environment. Public Ethernet systems require enhanced functions and characteristics, such as increased security and reliability, when compared to with traditional Ethernet based LAN systems.

The EFN324 is used as an Ethernet access switch in an Ethernet based fiber access system. The EFN324 aggregates physical fiber or electrical links directly from the End-users. It then relays End-user traffic to and from aggregation nodes on higher levels.

The EFN works primarily as an Access Node but it may also, when required, interact with higher levels as a Layer 2 Ethernet switch. Such interventions are broad ranging and include, for example, the following:

- Snooping information from higher level as input for packet switching decisions.
- Changing header contents.
- Discarding packets.

VLAN technology (IEEE 802.1Q) plays a central role in the EFN324. VLANs are used for enhanced security and for distinguishing different services with different requirements for transport characteristics, like delay and jitter, availability and so on. EFN324 also supports double VLAN Tags.

EFN324 can be used as a stand-alone node, that is, a node not managed by an ECN, but managed directly by PEM.

Alternatively, EFN324 can be used as an embedded node, that is, a node managed by an ECN.

3 Front Panel Description

The EFN324 front panel houses all connections and interfaces.

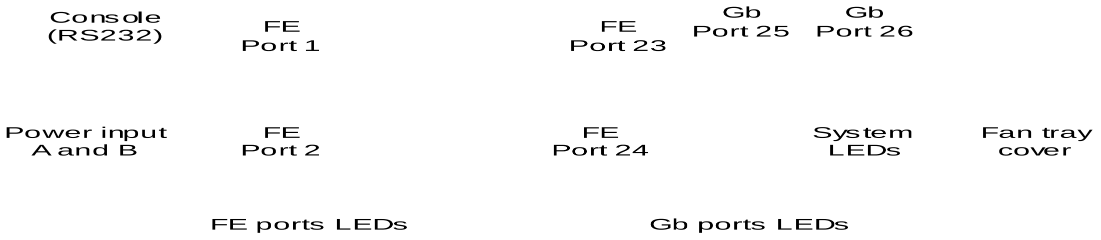


Figure 1 EFN324f Front Panel

The EFN324df and EFN324f have 24 FE optical interfaces and two combo optical-electrical Gb ports. The EFN324c has 24 FE electrical interfaces and two combo optical-electrical Gb ports.

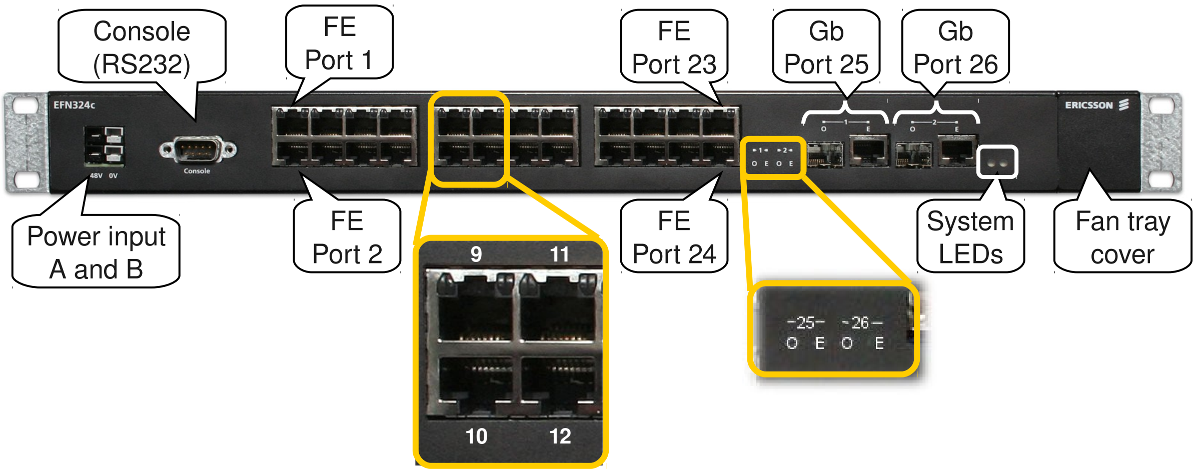


Figure 2 EFN324c Front Panel

All EFN324 are power fed through one or two power inputs. A 9 pin D-SUB connector (Serial console) is used for CLI management and initial configuration.

Table 1 LED Indication

System LEDs		**Node Status**
Green Red	___ 🟥	Power-on: Initial LED state During operation: major HW error
Green Red	🟩 ___	Normal operation
Port LEDs		**Port Status** (The Gb ports indicators are O or E, indicating whether the optical or electrical port is used)
Green	___	The port is unconnected
Green	🟩	The port is connected
Green	🟩_🟩_🟩_	Traffic ongoing
Legend: 🟥 or 🟩 : LED is On _ : LED is Off		

4 Basic Concepts

The concepts described in this chapter are the starting-point for what an operator sees, and needs to understand.

4.1 Physical View

The most important concepts are the following:

- **Ethernet port** is the physical interface between an external physical Ethernet link and the network processor.

- **Host port** is the physical interface between the network processor and the host processor.

- **Network processor** handles receiving of incoming packets from and sending of out-going packets to the Ethernet links. It handles most switching decisions independently of the host processor.

- **Host processor** (also called control processor) controls the Network Processor. This includes assistance in program loading and restart, executing of control commands and reception of counters. In exceptional cases the host processor may be involved in switching decisions for individual packets.

Figure 3 on page 9 illustrates the basic physical view of the EFN234, showing the listed items.

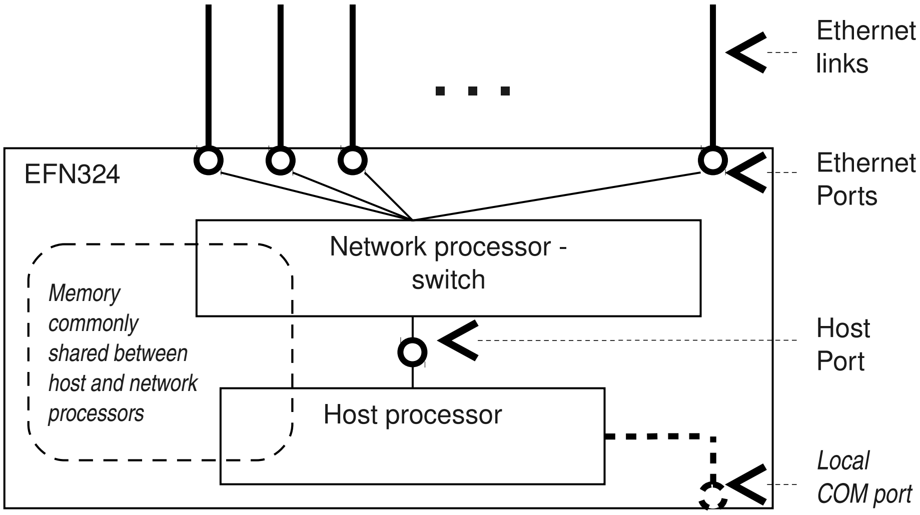

Ethernet links
Ethernet Ports
EFN324
Network processor - switch
Memory commonly shared between host and network processors
Host Port
Host processor
Local COM port

Figure 3 Basic Physical View of the EFN324

The network and host processors communicate physically through shared memory. The communication may logically be divided into the following two groups:

- Management traffic to an external management site. This is traffic over IP. In order for this traffic to flow, a connection through the switch between an Ethernet port and the host port must be configured. The operator must also configure an IP address for the host processor.

- All other communication. From an operator's point of view this traffic takes place 'under the surface', since no special configuration or other involvement from the operator is required for it to happen. Examples of this type of traffic are control messages from host processor to network processor, and packets forwarded from the network processor to the host processor during the switching procedure, for example, IGMP messages.

It is also possible for an operator to directly communicate with the Ethernet access switch from a terminal through a local COM port.

4.2 Management Interface

An operator communicates with the system through a management interface.

EFN324 offers both a CLI and a MIB interface. The latter may be used by management systems like PEM. The MIB interface may also be used for machine-machine communication with overlying management systems.

4.3 Stand-alone and Embedded Nodes

A stand-alone node in EDA 1200 is managed directly by PEM. It is transparent to any ECN that may be present in the network.

An embedded node is managed by an ECN using SNMP. The EFN324 is configured as a flexible block, with a Switch ID.

4.4 Ethernet Access Switch IP Address

The EFN324 IP address can be determined in either of the following ways:

- configured as a static IP address, for stand-alone Ethernet access switches, see section 4.4.1 on page 10.
- fetched from the ECN using DHCP, for embedded Ethernet access switches, see section 4.4.2 on page 10.

4.4.1 Static IP Address

If the EFN324 is a stand-alone node, its IP address is defined during initial configuration. The initial configuration (using CLI commands) also defines the network mask and default gateway IP address. See the *EFN324 Installation Guide* for the commands used during initial configuration.

4.4.2 DHCP IP Address

If the EFN324 is an embedded node, it fetches its IP address from the ECN using DHCP when it starts up after its initial configuration.

When the IP address is requested, the Ethernet access switch uses the Management VLAN configured during installation. If a reply is not received, four retries, using exponential timeout values, are sent. The process is illustrated in Figure 4 on page 11. There is no support for using an unmanaged VLAN.

DHCP options 43, 60 and 161 are used. Option 43 contains “*<IP address of TFTP server storing the configuration file>;<Configuration filename>;<IP address of trap receiver>*”. See Table 2 on page 11 for details of the strings used for options 60 and 161.

Table 2 DHCP Values for Options 60 and 161

	Option 60	**Option 161**
Value	Ethernet access switch's hardware ID and Switch ID	Ethernet access switch's software version number
Examples	"KDU137389/1,R1A;SID=42"	"CXP 901 0022 R8B01"

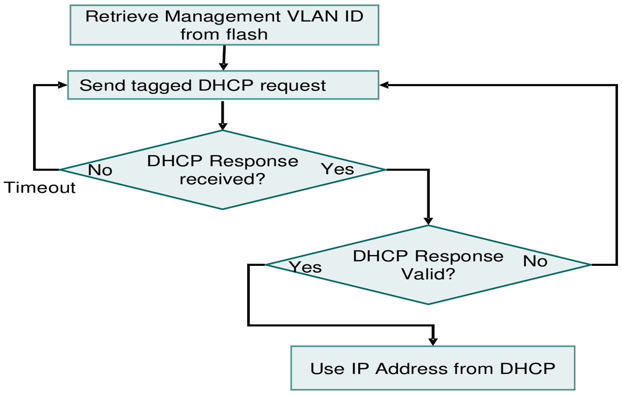


Figure 4 DHCP Procedure

4.5 Resource

All the functions of the system are expressed, or modeled, in the CLI as Resources. The MIB interface uses a similar model.

The Resource concept resembles objects in object-oriented programming. Instead of 'resource', words like 'resource object', 'resource instance' or 'object' could be used. A Resource can also be referred to by only its name. For example, instead of using 'the autologout parameter in the CLI resource', refer to 'autologout in CLI'.

Examples of resource objects in the EFN324 CLI include `main_board`, `ethernet_port` and `host_port`. `ethernet_port` is an example of an indexed resource type, in that there are multiple instances, separated using an index:

```
ethernet_port 1
ethernet_port 2
ethernet_port 3
…
ethernet_port 25
ethernet_port 26
```

4.6 Attribute

Each resource object contains data in the form of attributes. There are three types of attributes:

- **Configuration** attributes. These are also called parameters or configuration parameters. Their values are determined and set by an operator.
- **Status** attributes. Their values are determined and set by the system itself.
- **Info** attributes. Info parameters are set at the factory, during production, and are not supposed to be changed during the system lifetime.

The values of all types of parameters may be read using ‘get’ commands.

Figure 5 on page 12 shows examples of different attribute types of the main_board resource object.

main_board

Information:
# serial no = 1234

Status:
# temperature = 56

Configuration:
# temperature_limit = 80

Figure 5 Example of Different Attribute Types of a Resource Object

4.7 Command

Interact with the system by directing commands to its resource objects.

Parameter values (configuration attributes) may be read from the system using *get* commands.

The configuration attributes values are set, modified or deleted using *set, add, remove, connect, disconnect* and other commands.

There are also some system commands that do not relate to objects. For example, *exit*.

4.8 Virtual LAN and VLAN tag

Virtual LAN (VLAN) is a technique used to logically separate several independent networks that share a common physical infrastructure.

The IEEE 802.1Q standard describes how a 4-byte tag is inserted into Ethernet packets, between the source address and the length or type field, to specify the VLAN for the packet.

The 4 byte tag consists of the following:

- A 2-byte Tag Protocol Identifier
- A 2-byte Tag Control Information

The Tag Control Information consists of a 12-bit VLAN ID, a 3-bit priority field and a 1-bit Canonical Format Indicator. The latter is only used for Token Ring transmissions.

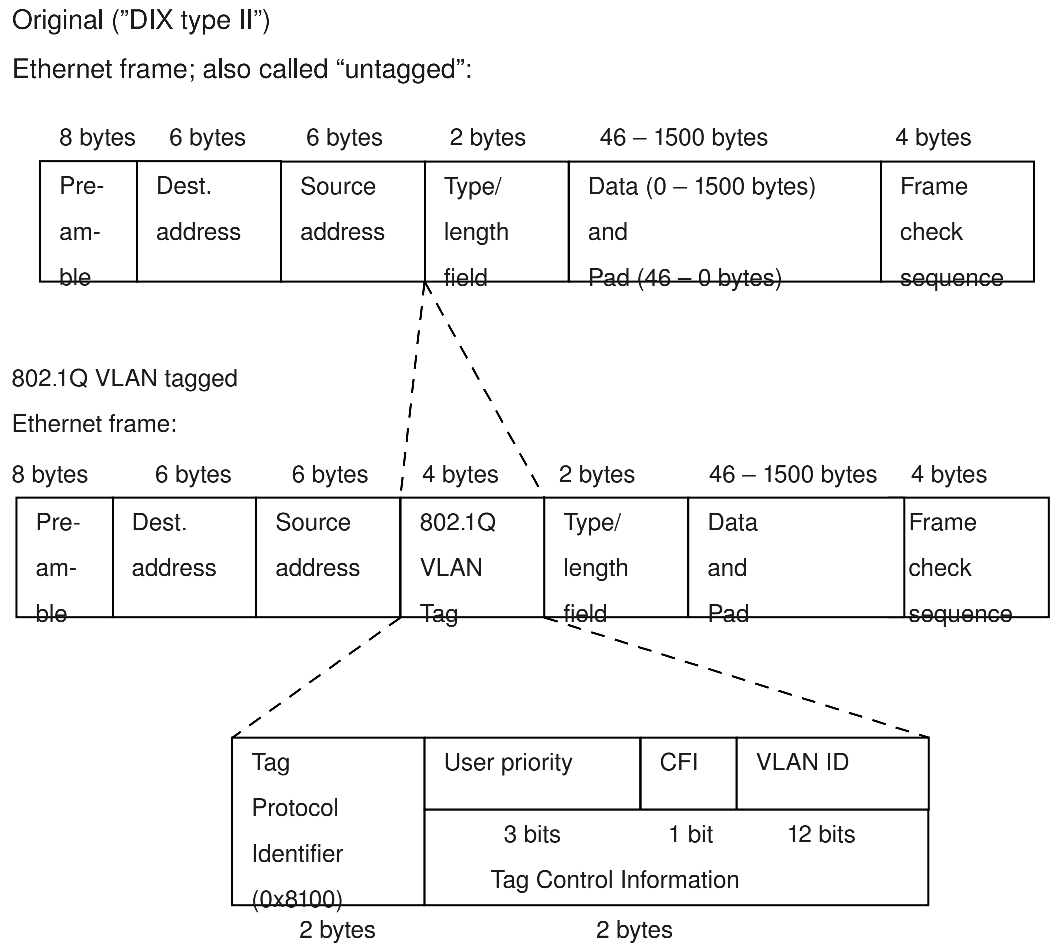


Figure 6 IEEE 802.1Q tag

EFN324 supports zero, one and two VLAN tags as described above. Within the CLI and in the MIB, the terms 'tag' and 'second_tag' are used for historical reasons, but there is no direct mapping to the more common terms "Outer and Inner VLAN tag".

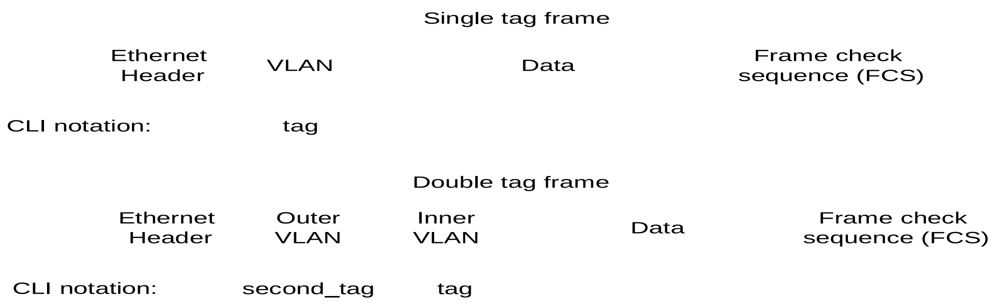


Figure 7 Definition of `tag` and `second_tag` for EFN324

In the CLI, the VLAN ID is called `tag`, the ethertype is called `first_ethertype` and the 3 bit priority field is called `p_tag`. Similarly, for second tag the prefix <`second_`> is added.

As shown in Figure 7 on page 15, the EFN is inconsistent in relating the terms Outer and Inner VLAN and the terms used in the CLI (`tag`, `second_tag`). When one tag is present, `tag` denotes the Outer VLAN, but with two VLAN tags, `tag` denotes the Inner VLAN.

The following figure illustrates the Ingress and Egress connections. Note that to enable traffic in both directions, both the ingress and egress connections must be configured for a switching domain.

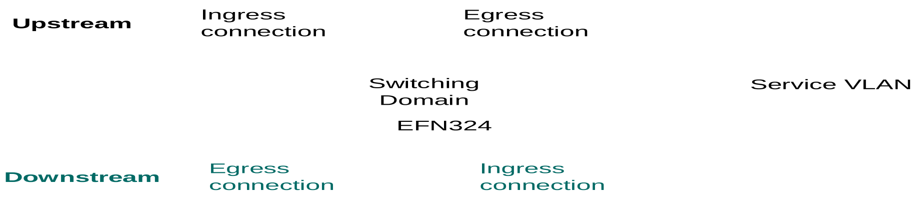


Figure 8 Ingress and Egress Connections

On the ingress connection, the EFN324 will allow packets with the following Tag Protocol Identifiers (Ethertype):

- Q-VLAN (0x8100)
- S-VLAN (0x88a8)
- Extreme Networks vMAN (0x9100)
- S-VLAN (0x9200)

The values for these Tag Protocol Identifiers cannot be configured at the ingress connection.

Only one of the Tag Protocol types may be used within the same service. The VLAN ID (and optionally, the upstream destination IP address) of the incoming frames defines the switching domain that the frame is forwarded to. If the incoming frame has either an Ethertype that is not allowed or VLAN ID that is not defined, the frame is discarded. If the frame is not discarded, VLAN mapping and tagging takes place.

Table 3 on page 16 lists the possible ways to define the ingress configuration. The outer VLAN ID is the only mandatory parameter.

Table 3 Ingress Connection Definitions

	Outer VLAN ID (`tags` for single-tagged frames `second_tags` for double-tagged frames)	**Inner VLAN ID** (`tags` for double-tagged frames)	**Destination IP address**
Single VLAN tag frame	• Specific value • Range • All (using *) • Untagged	None	• Specific address • IP network
Double VLAN tag frame	• Specific value	• Specific value • Wild card (using *)	• Specific address • IP network

Table 4 on page 18 lists the VLAN mapping possibilities in the EFN324. The table lists the configurable parameters for the egress connection and what are the results of each specific configuration. It is also possible to configure the p-bit in exactly the same way as the Ethertype, just using a p-bit value instead of Ethertype. The way that the *ingress* connection is configured must be taken into consideration when settings the egress connection.

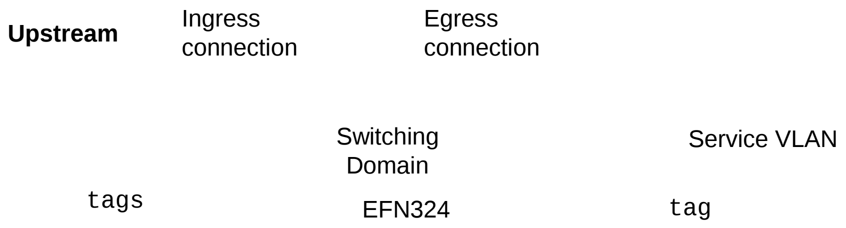


Figure 9 Ingress and Egress tag Configuration

For example if `tags` in the ingress connection is configured as untagged, setting the `tag` in the egress connection to transparent will have no meaning since there is no VLAN ID to copy.

The table shows four main scenarios that are depended on the incoming format of the frame and the desired output:

1. Untagged traffic: use this to send untagged traffic from the EFN, with no regards to the format of the incoming packets.
2. Single tagged frame in - Single tagged frame out: use this to send a single tagged frame out where the sent VLAN can either be translated or copied from the incoming frame.
3. Single tagged frame in – Double tagged frame out: Use this to send double tagged frames out with a fixed outer VLAN and an Inner VLAN that is either translated or copied from the VLAN tag of the incoming traffic.
4. Double tagged frame in – Double tagged frame out: Use this to send double tagged frames out with an outer VLAN that is copied from the outer VLAN of the incoming frame and an Inner VLAN that is either translated or copied from the inner VLAN tag of the incoming traffic.

See also the explanation of terms after the table.

Table 4 Configuration Possibilities for VLAN Mapping

Egress Connection Configuration				**Outgoing packet Sent**			
Type and Value configuration for `second_tag` (Outer VLAN for doubletagged)		Type and Value configuration for `tag` (Inner VLAN for double-tagged, Outer VLAN for single-tagged)		Outer VLAN Tag		Inner VLAN Tag	
VLAN ID	Ethertype	VLAN ID	Ethertype	VLAN ID	Ethertype	VLAN ID	Ethertype
Not applicable	Not applicable	untagged	Not applicable	None – untagged packet			
Untagged	Not applicable	tagged **<Idx>**	<Ethertype>	**<Idx>**	<Ethertype>	None	
			transparent	**<Idx>**	Ethertype of incoming outer tag		
		transparent	<Ethertype>	VLAN ID of incoming outer tag	<Ethertype>		
			transparent	VLAN ID of incoming outer tag	Ethertype of incoming outer tag		
tagged **<Idy>**	**<Ethertype>** or transparent	tagged **<Idx>**	**<Ethertype>**	**<Idy>**	**<Ethertype>** **or** Ethertype of incoming outer tag	**<Idx>**	**<Ethertype>**
			transparent	**<Idy>**	**<Ethertype>** **or** Ethertype of incoming outer tag	**<Idx>**	Ethertype of incoming outer tag
		transparent	**<Ethertype>**	**<Idy>**	**<Ethertype>** **or** Ethertype of incoming outer tag	VLAN ID of incoming outer tag	**<Ethertype>**
			transparent	**<Idy>**	**<Ethertype>** **or** Ethertype of incoming outer tag	VLAN ID of incoming outer tag	Ethertype of incoming outer tag
transparent	**<Ethertype>** or transparent	tagged **<Idx>**	**<Ethertype>**	VLAN ID of incoming outer tag	**<Ethertype>** **or** Ethertype of incoming outer tag	**<Idx>**	**<Ethertype>**
			transparent	VLAN ID of incoming outer tag	**<Ethertype>** **or** Ethertype of incoming outer tag	**<Idx>**	Ethertype of incoming inner tag
		transparent	**<Ethertype>**	VLAN ID of incoming outer tag	**<Ethertype>** **or** Ethertype of incoming outer	VLAN ID of incoming inner tag	**<Ethertype>**

					tag		
			transparent	VLAN ID of incoming outer tag	<***Ethertype***> or Ethertype of incoming outer tag	VLAN ID of incoming inner tag	Ethertype of incoming inner tag

Note: If the incoming packet from the End-user is untagged and the egress tag VLAN ID is set to transparent, then the outgoing packet is sent as untagged, regardless of how the `second_tag` and the `tag` Ethertype are configured.

Explanation of terms:

- tagged <***Idy***>: VLAN ID for outer VLAN.
- tagged <***Idx***>: VLAN ID for inner VLAN. Note that <***Idx***> is also used when there is only one VLAN tag in the outgoing packet.
- <***Ethertype***>: Ethertype. The following types can be specified:

– q_vlan	(0x8100)
– s-vlan	(0x88A8)
– vman_vlan	(0x9100)
– s_vlan	(0x9200)

- Not applicable: This value must be specified in the CLI, but is ignored later in the VLAN mapping.
- Note that VLAN ID is called `tag` or `second_tag` and Ethertype is called `first_ethertype` or `second_ethertype` in the CLI.

4.9 Switching Domain

In the EFN324 design the **switching domain** is a central resource. For historical reasons, the switching domain is called ‘`vlan`’, with small letters, in the CLI.

The switching domain is used by the operator as a connection point in the switch for ports belonging to a particular VLAN. The switching domain is capable of performing much more sophisticated switching than an ordinary learning-bridge switch.

In the descriptions in this guide, 'switching domain' is used, for the sake of clarity, instead of the '`vlan`' notation used in the CLI.

4.10 Connections

Ports, switching domains and connections are central concepts for switching in the EFN324. A port is either an Ethernet port (called `ethernet_port` in the CLI) or the Host port (called `host_port` in the CLI).

For a packet to travel through the switch, the following two connections must be defined:

- The **ingress connection**: the connection between the ingress port on which the packet arrived and a switching domain.
- The **egress connection**: the connection between the switching domain and an egress port.

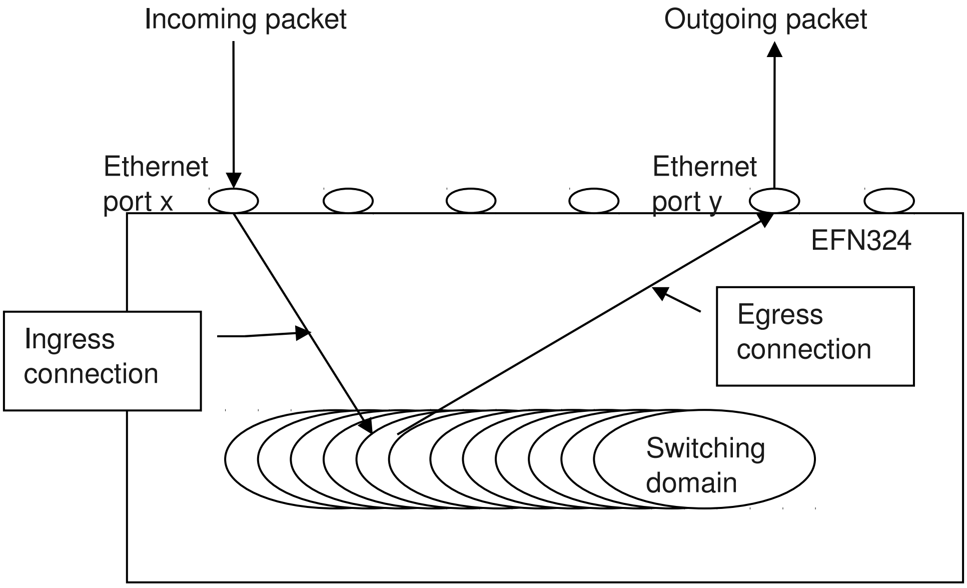


Figure 10 Ingress and Egress Connections

Even though the 26 Ethernet ports and 200 switching domain resources are, by default, present from the start, connections must be defined (configured) by the operator. A connection is created or deleted using the *connect* or *disconnect* commands. Note that apart from the management VLAN, which is configured during initial configuration, the connections are made automatically by the Public Ethernet Manager (PEM).

4.10.1 Bandwidth Limitation

A bandwidth limitation may be imposed on each connection (ingress and egress). It is implemented as a bandwidth profile (se `set bandwidth_limitation` in section 13.8.8 on page 118), which is then selected for a specific connection with the `connect vlan` command (see section 13.8.6 on page 114. Up to 32 profiles can be used. Eight profiles are created per default and can be modified.

When a bandwidth limitation profile is applied to a connection it will limit the following traffic types:

- Applied on an Ingress connection: unicast and broadcast packets
- Applied on an Egress connection: unicast Multicast and broadcast packets

Unless VLAN per End-user is used, only the connections from the switching domain to the downlink port should be configured with bandwidth limitation. That is egress connection for the downstream and ingress for the upstream. The reason is that these are the only connections that are connected to a single End-user. The connection from the switching domain will transport traffic from several End-users and there is therefore no meaning in applying bandwidth limitation to that connection.

Ingress
BW
Egress
BW
BW
Ingress
Egress
BW
Egress
Ingress
Uplink
Ingress
BW
BW
Egress
EFN324

Figure 11 Bandwidth Limitation for Multi-user Service VLAN

4.11 Flows

Flows are used to distinguish the different levels of Quality of Service (QoS) within a connection (see section 4.10 on page 20). A group of packets within a connection can be given preferential treatment by classifying them into a flow. Each flow is identified by either the p-bits or the DSCP values in the packet.

The flow determines the priority and reliability for the packets, along with the bandwidth limitation or the policing to be applied on the flow. The priority designates an output queue. The reliability indicates whether the packet should be discarded if the EFN324 has insufficient empty buffers. The higher the priority, the faster the packets are sent out. The higher the reliability, the lower the probability of the packets getting discarded in overflow situations.

Flows within a connection to an uplink port handles traffic from all End-users using the VLAN flow (see Figure 12 on page 23). This must be taken in consideration when the connections and flows from the switching domain to the uplink port are configured.

4.11.1 Flows in Connections

The EFN does not differentiate between uplink and downlink packet processing. The flows must be configured correctly, accordingly to their direction.

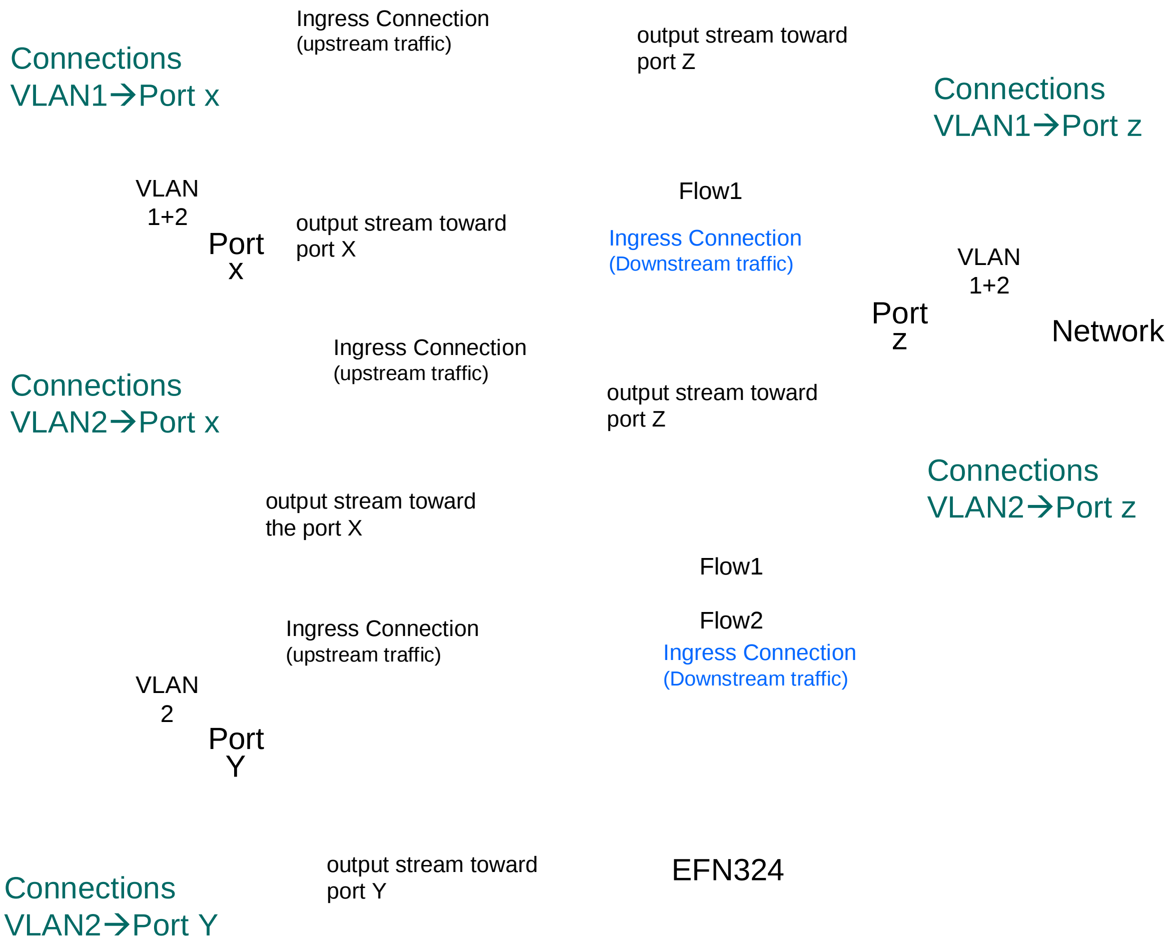


Figure 12 Flow Directions

As illustrated, flows within the connections between the switching domain and the uplink port (Port z), handles all traffic transferred from all End-users using this specific VLAN. Any flow configured within a connection to an End-user port for this VLAN, must also be configured in the uplink connection.

For downstream traffic (from the network to the End-users), the uplink ingress flow configuration (reliability and priority) will apply to all End-users using this flow.

4.11.2 Number of Flows

Four flows are globally available on the entire EFN324; to each flow can be assigned a numerical value, 1 to 4.

The *flow selector* parameter used in the configuration of the *connect* command discriminate which flow description is applied.

Four cases are available:

Flow 1 – flow id values p-bits 0, 1 or dscp 0-15
Flow 2 – flow id values p-bits 2, 3 or dscp 16-31
Flow 3 – flow id values p-bits 4, 5 or dscp 32-47
Flow 4 – flow id values p-bits 6, 7 or dscp 48-63

Flow 1 is applied in case the *flow selector* in the *connect vlan* command is defined as p-bits; in this case all frames belonging to the configured vlan and tagged with p-bit 0 or 1 will experience the configuration defined for Flow 1. Flow 1 is as well applied in case the *flow selector* in the *connect vlan* command is defined as dscp; in this case all frames belonging to the configured vlan and tagged with a dscp between 0 to 15 will experience the configuration defined for Flow 1.

When the *flow selector* in the *connect vlan* command is defined as p-bits; in this case all frames belonging to the configured vlan and tagged with any p-bit 0-7 will go through the corresponding flows 1-4. There is no configuration possible that can be specified to discard frames with certain p_bits. The parameter flows in the connect vlan command does not have any significance in choosing the flows but it is only used as a validation criteria for defining default flow. This is because default flow in connect vlan command should be one of the flows configured.

Same is the case with flow selector as dscp.

Example:

```
connect vlan 10 ethernet_port 10 ingress flow 1-2 flow_selector p-bits
default_flow 2
```

```
connect vlan 10 ethernet_port 10 ingress flow 1-3 flow_selector p-bits
default_flow 2
```

```
connect vlan 10 ethernet_port 10 ingress flow 1-4 flow_selector p-bits
default_flow 2
```

All the above commands do not have any significance for flows parameter. All the above commands will result in the same behavior of the traffic handling.

```
connect vlan 10 ethernet_port 10 ingress flow 1-2 flow_selector p-bits
default_flow 4
```

The above command will throw an error message. So the default_flow should be one of the flows defined in connect command.

connect vlan 10 ethernet_port 10 ingress flow 1-5 flow_selector p-bits default_flow 5

If default_flow is configured as >4 then behavior of the default_flow traffic is unknown.

In case the *flow selector* is defined as none, all traffic belonging to that vlan will experience the configuration of the *connection flows*.

4.11.3 Default Flow

One of the flows configured for the connection is the default flow. The default flow accepts the packets that do not match the flow selection criteria.

When DSCP is the flow selection criteria on the connection, it is important to configure a default flow. All the non-IP traffic is forwarded to the default flow, since non-IP packets do not contain the DSCP field, for example, ARPs and PPPoE packets.

When p-bit is the flow selection criteria on the connection, the default flow will be used for untagged traffic.

All the other packets, which contain the configured flow selection criteria, are forwarded to their corresponding flows.

4.12 IPsec

The EFN324 in R. 4.3, in-line with the EDA products, support the IPSec.

The IPSec can be enabled or disabled depending on the option 43 message of the DHCP ACK message. The IPSec implementation is based on Wind River Linux.

The IPsec feature on the EFN324 can be enabled or disabled without restarting the node; the feature is active or inactive depending on the option 43 information of DHCP ACK.

In case IPSec is enabled, the RS232 connection is blocked.

In case the IPSec option is enabled, the software download might be significantly slower, e.g. 40% slower then usual.

4.12.1 Enabling of IPSec

IPSec is enabled after the reception of a DHCP ACK message from the DHCP server with the option-43 contains the string ":01:EMPMAC".

If the option-43 value contains the vendor-encapsulated-options from the DHCP server and the IPSec flag set (first bit of the 4th parameter set), it indicates IPSec is enabled in the network. E.g., "172.31.25.21:Configuration.cfg:172.31.64.50:01:EMPMAC".

4.12.2 Monitor IPSec connection

Once the EFN is in IPSec Enabled state, periodic ping requests are sent towards the EMP every 60 seconds (using ipseccontrol verify). If there is no response from the EMP for three consecutive ping requests (180 seconds), the IPSec connection is considered as failed and IPSecMonitorFailed event is generated.

4.12.3 Fallback to restarting DHCP

IPSec negotiation can be restarted by doing a new DHCP discover this implies that state will fallback to idle.

The fallback to idle is implemented by reusing the code that is executed when a DHCP renew fails (basically stop and start DHCP).

As next DHCP offer may not set IPSec, then the key is deleted to protect it.

At no time a fallback to idle will cause interruption of the user traffic on the nodes. Only management traffic may be interrupted.

The EFN324 is able to restart the DHCP sequence from DHCP Discover by restarting the DHCP client. When the DHCP is restarted then the normal procedure is followed depending on if "IPSec" string is present in the DHCP option 43.

The CLI command "set cpu restart_dhcp start" can be used to restart the DHCP client in EFN.

The CLI command "get cpu ipsec_status" will give the ipsec status in EFN. Weather the IPSec is enabled or disabled in EFN.

5 Switching Functions

Switching refers to all the rules and mechanisms in the EFN324, which collectively decide what will happen to a packet which arrives at a certain port:

- Will the packet be discarded, or will it be forwarded?
- To which port, or ports, will it be forwarded?
- Will the content be modified, and if so, how?

All available switching mechanisms are described in the following sections, starting with basic switching mechanisms and ending with options like IP validation, Quality of Service and so on.

5.1 Main Switching Steps

When a packet arrives at an Ethernet port, the main question is whether there is a matching ingress connection. If not, the packet is discarded. If there is a matching connection, the packet is forwarded to the switching domain identified by that connection.

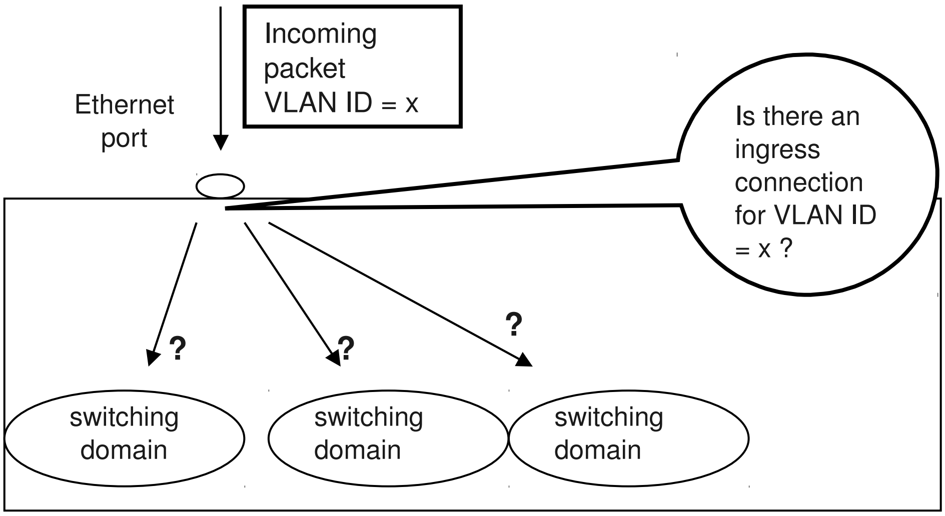

Incoming packet VLAN ID = x
Ethernet port
Is there an ingress connection for VLAN ID = x ?
?
?
?
switching domain
switching domain
switching domain

Figure 13 Ingress port switching

Similarly, when the packet arrives at a switching domain, the main question is whether there is a matching egress connection.

The ingress port switching described above is based on VLAN ID (or on VLAN ID and IP destination address), including when the packet is un-tagged or has double VLAN IDs (if QinQ is used). However, the **egress port** switching domain switching is based on destination address. See Figure 14 on page 28.

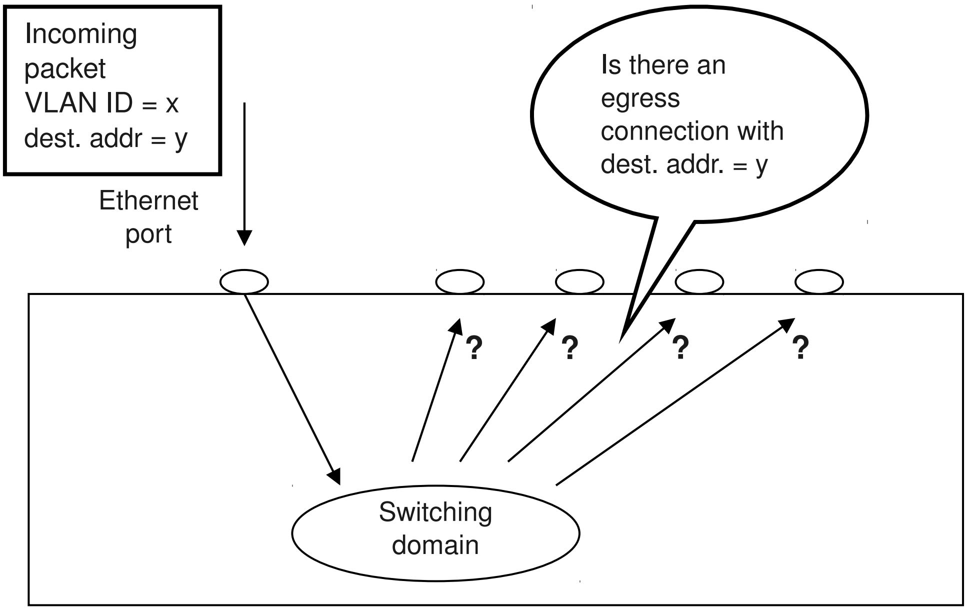


Figure 14 Switching domain switching

The EFN324 has optional functions in addition to the basic Layer 2 switching, in order to increase the security. These additional features are described under the concept Forced Forwarding, in section 8.1 on page 60.

The final processing is done at the egress port. The packet is placed in one of four priority queues and sent in the order decided by the scheduling algorithm.

Capacity limits are checked at the egress ports and, to a certain extent, at the ingress port switching. Capacity limits are either configured bandwidth limits or physical link and buffer capacities. Violation of capacity restrictions is one reason why the switch can discard a packet.

In summary, switching consists of these three main steps:

1. At the ingress port, find an ingress connection and a switching domain.

2. At the switching domain, find an egress connection. For multicast and broadcast, find the egress connections.

3. At the egress port, find the right opportunity and send the packet.

Each of these steps is described in more detail in the following sections. Quality of Service is described separately in section 5.5 on page 39.

5.2 Ingress Port Switching

The steps in ingress port switching are illustrated in Figure 15 on page 29.

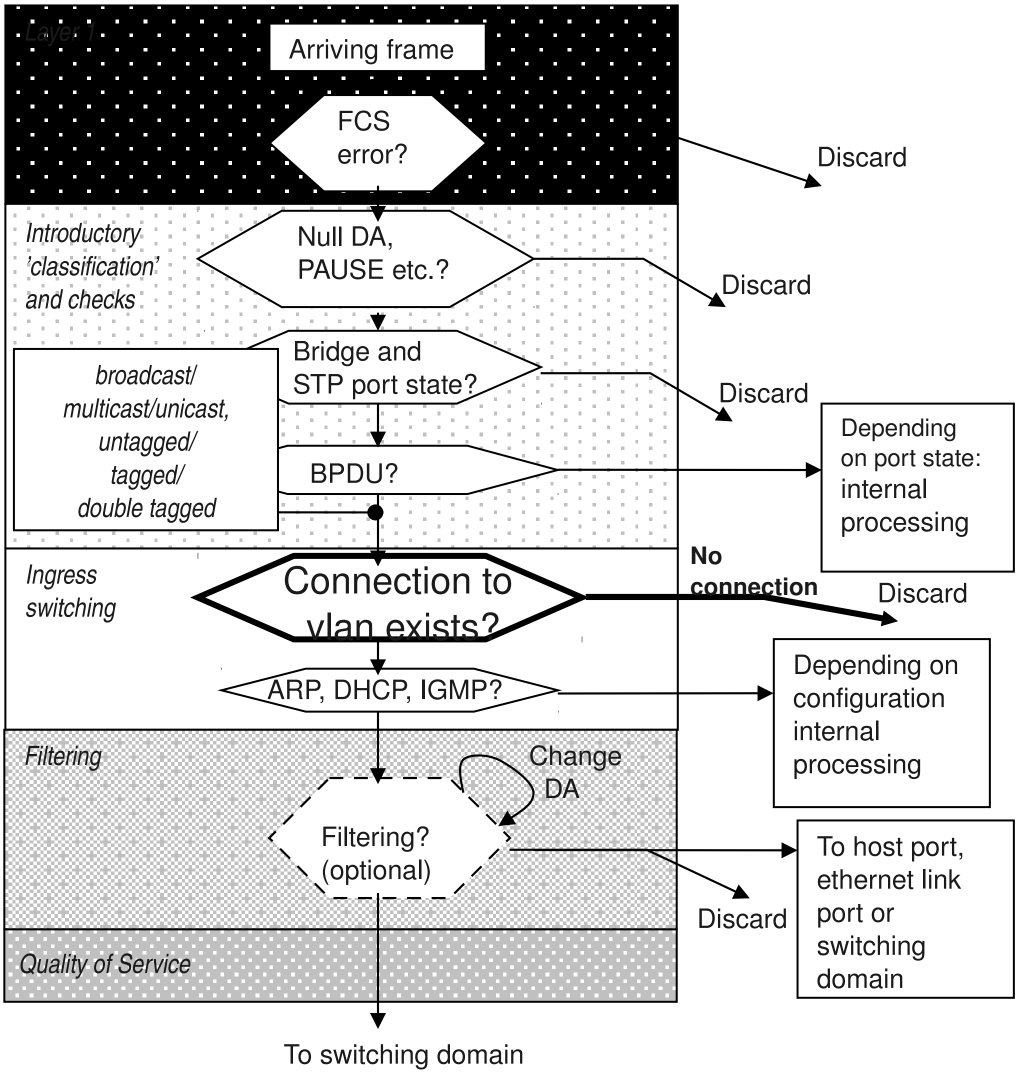

Layer 1
Arriving frame
FCS error?
Discard
Introductory 'classification' and checks
Null DA, PAUSE etc.?
Discard
Bridge and STP port state?
Discard
broadcast/ multicast/unicast, untagged/ tagged/ double tagged
BPDU?
Depending on port state: internal processing
Ingress switching
Connection to vlan exists?
No connection
Discard
ARP, DHCP, IGMP?
Depending on configuration internal processing
Filtering
Change DA
Filtering? (optional)
To host port, ethernet link port or switching domain
Discard
Quality of Service
To switching domain

Figure 15 Detailed Path from Ingress Port to Switching Domain

When a frame arrives at the ingress port, the following actions are taken:

1. **Frame Check Sequence (FCS)**

   When a frame has successfully been extracted in Layer 1, the Frame Check Sequence (FCS) is recalculated in order to detect bit-errors. Frames with detected bit-errors are discarded. The introductory 8-byte preamble and the ending 4-byte FCS are peeled off, and then the packet is delivered to Layer 2.

2. **Null Addresses**

   All packets, unless discarded in earlier phases, are checked against the basic requirements before further processing. Invalid packets are discarded. These are the basic requirements for valid packets:

- Layer 2 destination address may not be null.
- Layer 2 source address may not be null.
- Layer 2 source address may not be a multicast type address.

3. **PAUSE Message**

   If the frame is a Layer 2 PAUSE messages, intended for Layer 2 flow control, it is discarded.

4. **Port and Bridge States**

   The processing at Layer 2 depends on the bridge state and the port state. The states are determined based on either the operator configuration, or EFN324 internal algorithms processing BPDUs (see the next step).

   When the bridge or port is disabled, there is no further processing and the packet is discarded immediately.

   Packets are also discarded when the Spanning Tree Protocol (STP) or Rapid Spanning Tree Protocol (RSTP) is in a blocking, listening or learning state. However, in the learning state, the bridge table is updated, according to the contents of the validated packet.

5. **Bridge Protocol Data Units (BPDU)**

   Configuration BPDUs, that is, configuration messages sent by STP or RSTP, are extracted from the stream of packets arriving at a port. They are processed by the EFN324 itself. This processing of BPDUs is unconditional and performed in all states.

Implementation-wise, the processing of BPDUs is done in the host processor. BPDUs are forwarded to the host regardless of whether any connection is defined from this port through a switching domain to the host port.

6. **Packet Type**

   The packets are classified as multicast or unicast. Packets are also classified by the number of VLAN Tags in the packet. Untagged, single and double VLAN Tags may be handled.

7. **ARP, DHCP, IGMP**

   ARP, DHCP and IGMP control messages will, depending on the configuration, be extracted for internal processing.

   For instance, ARP messages are extracted for internal processing as soon as a gateway is defined or a switching rule is set different from normal. The EFN324 acts as ARP proxy for a specific switching domain.

   In cases where these control messages are not extracted for internal processing, they are switched in the same way as other packets.

8. **Connection to Switching Domain**

   After the introductory checks and classifications, the actual switching work begins. The ingress port switching work consists of the search for an existing connection from the ingress port to a switching domain. This search is based on VLAN IDs. If the packet is untagged, there must be an ‘untagged connection’ on which the packet can be forwarded. If there is no matching connection, the packet is discarded.

   The configuration software ensures that there can be only one matching connection. An error message appears whenever an operator tries to define an ambiguous connection.

9. **Filtering**

   Filtering is an optional feature. It can only be configured from the CLI, and not using SNMP. Filtering makes it possible to specify filter conditions for the Ethernet destination and source addresses, as well as for the Ethernet type field.

   Filtering can be performed for unicast and broadcast packets only, not for multicast packets.

When a connection is found, the EFN checks whether a filter is associated with the connection. If so, the packet header content is checked against the related global_filter resources and the actions according to the chosen filter_profile are taken. Up to 8 filter_profiles can be defined.

Each filter_profile has 8 attributes, named global_filter_1 to global_filter_8. global_filter_1 refers the action to be taken based on the result of the global_filter object, global_filter 1. Global filter objects do not have an underscore between global_filter and their index number. Similarly, global_filter_2 refers to the action to be taken based on the result of global_filter 2, and so on.

Matching starts with global_filter_1. If the matching is positive, that is, the packet header content is consistent with global_filter 1, then the measures specified at global_filter_1 are taken. When matching gives a positive result, the other global filters are skipped. If the match is negative, matching will continue with global_filter 2.

If matching with global_filter_N is negative, then matching with global_filter_N+1 is done, and so on, until either a positive match is made or all 8 global_filter have been tested. In the latter case, the actions defined for global_filter_none are performed.

The possible filtering outcomes are the following:

- The destination address is changed.
- The packet is discarded.
- The packet is forwarded directly to an egress port or a switching domain.
- The packet is allowed through for further processing, according to the normal procedure.

10. **Quality of Service**

Quality of Service functions are performed as described in section 5.5.1 on page 42.

5.3 Switching Domain

When a packet arrives at the switching domain, the main issue is to decide where to send the packet. Specifically, to which egress connection, or connections, is the packet forwarded?

A normal outcome is that the packet is forwarded to one and only one of the egress connections of the switching domain. The outcome might also be that the packet is not forwarded to any egress connection, that is, the packet is discarded. The packet may also be forwarded to more than one egress connection. This is normal for multicast, but may also occur also for unicast and broadcast.

The method used for the VLAN switching is determined by the switching rule configured for the switching domain. Switching rules are described in section 5.3.2 on page 35. First, however, topology concepts, including 'uplink', are introduced in section 5.3.1. These concepts are required to understand the switching rules, which include forced forwarding.

This description of switching domain switching refers primarily to unicast packets. Multicast and broadcast are described in sections 5.3.3 on page 36 and 5.3.4 on page 37.

5.3.1 Internal Topology

When a packet is switched through a switching domain, connections to at least two separate ports must be defined: a connection from an ingress port and a connection to an egress port. A packet cannot be forwarded to the same port from which it arrived.

Every switching domain which carries traffic must be connected to a subset of the 26 available Ethernet link ports. Management traffic must be connected to the host port. A single port may be connected to more than one switching domain, as illustrated in the following figure.

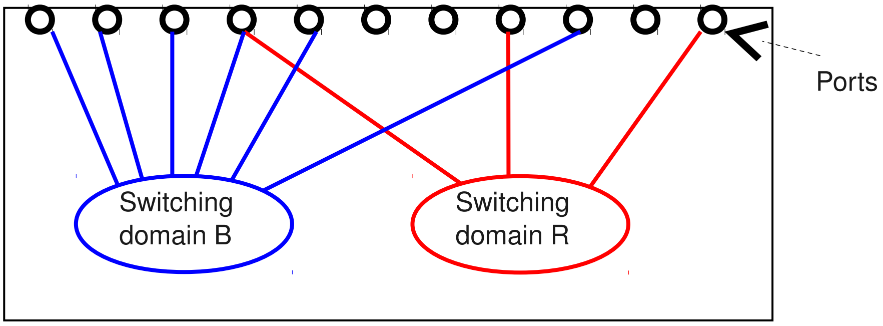


Figure 16 *Port – Switching Domain Connections*

Each switching domain works as a separate switch for its connected ports. That is, when a packet arrives from a port at a switching domain, the switching domain will select one of its other connected ports and forward the packet to that port.

In each switching domain, one of the ports can be designated as the ‘uplink’. Once an uplink is defined, all packets originating from other ports are automatically forwarded to the uplink. Packets originating from the uplink are forwarded in the same way as before. In this way, ‘uplink’ functions as one of many mechanisms supporting forced forwarding in single EFN324 nodes.

An uplink may also be used when two or more EFN324 Ethernet access switches form a daisy chain. The ports connecting to the overlying EFN324 are designated as ‘uplink’. A port that connects to an underlying EFN324 is designated as ‘transit link’.

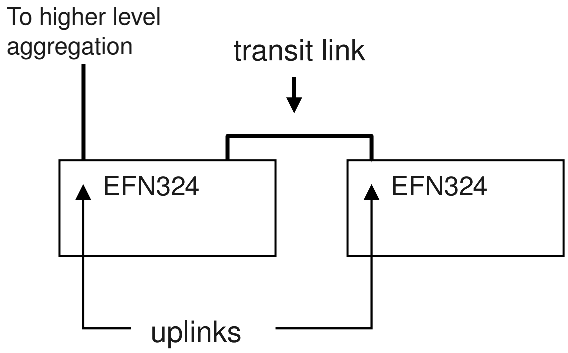


Figure 17 Daisy Chained EFN324

When transit links are defined, the switching domain switching rules are slightly modified. When no ordinary port is found to which to forward a packet that originates from an uplink, by default the packet is forwarded to the transit link. The EFN assumes if the packet destination is not found, that the receiver is located at a switch further down in the chain.

Packets originating from a transit link are forwarded to the uplink. An uplink should be defined whenever a transit link is defined. The switching might however still work, even if no uplink is defined.

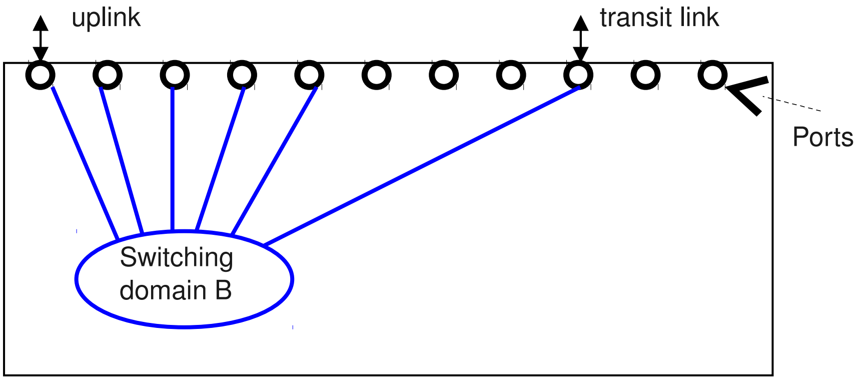


Figure 18 Switching Domain with Uplink and Transit Link

5.3.2 Switching Domain Switching Rule Modes

Each switching domain works according to one of the following switching rule modes:

- Normal
- Uplink
- Uplink + GW
- Uplink + IP validation
- Uplink + GW + IP validation
- Uplink + IP validation + virtual MAC
- Uplink + GW + IP validation + virtual MAC
- Uplink + PPPoE

The **normal** mode means that packets are switched according to the content in the bridge table. The bridge table content is maintained according to the self-learning bridge principle. When a destination address is not found in the table, the packet is forwarded (flooded) to all other ports in the switching domain.

The effects of defining an **uplink** were described previously. When an uplink is defined, a gateway can also be defined. This is discussed further in section 8.1 on page 60.

When a **gateway** is defined, all packets not originating from the uplink will have their destination MAC addresses rewritten as the MAC address of the gateway, before they are sent on the uplink. This mechanism is known as MAC forced forwarding. Packets arriving from the uplink must have the gateway as their source address in the Layer 2 network.

Please note that:

- if the gateway is left undefined then DHCP and ARPs will be resolved for multiple end user in same port

- if the gateway is configured then DHCP and ARPs will be resolved for multiple end user tags in same port only if multiple switching domains are used, i.e. unique switching domain should configure for that user tag; in other words, it is possible to have DHCP only for one user tag specific per port and per switching domain

    - in case each user needs several services it is necessary to configure a Switching Domain per service

If **IP validation** is selected, the valid IP addresses for End-users are defined. The establishment of valid IP addresses is described in section 8.2 on page 63. Switching towards End-users is then based on IP addresses. Packets with unknown IP addresses are discarded, unless a transit link is defined, as described in section 5.3.1 on page 33.

During IP validation, the source addresses of packets originating from the End-users are validated. Packets with invalid IP addresses are discarded.

If **Virtual MAC** is selected, the End-users' MAC addresses are replaced with MAC addresses defined by the system, for all packets forwarded through the uplink towards the access network. These addresses are changed back to the original MAC addresses when packets are sent back on End-user links.

If **PPPoE** is selected, the Ethertype of the packets is checked. Packets without Ethertype 0x8863 or 0x8864 are discarded.

5.3.3 Switching Domain – Multicast

There are four options for handling multicast packets in a switching domain:

- **Yes** – multicast packets are forwarded in the same manner as broadcast packets.
- **No** – multicast packets are discarded.
- **IGMP Snooping** – multicast streams are forwarded to subscribing End-user nodes. There is no suppression of IGMP messages. All messages and queries are forwarded.
- **IGMP Proxy** – When EFN324 acts as IGMP proxy, it provides a total separation between the multicast network nodes and the End-user nodes. When acting as IGMP proxy, the EFN324 fully suppresses IGMP messages. That is, none of the messages coming from the End-users are forwarded.

Multicast as Broadcast

When **Yes** is selected, IGMP snooping is not used. Multicast packets from non-uplink ports are forwarded to the uplink. Multicast packets from the uplink are broadcast to all other ports.

However, it is possible to prohibit broadcast on a specific egress connection. Multicast packets, which are distributed as broadcast, will not be let through on egress connections where broadcast_allowed is set to false.

If no uplink is defined, multicast packets will always be broadcast when **Yes** is selected.

CLI Commands

Most multicast-related settings are set using the **`set vlan`** command, since all multicast handling is done per switching domain. The following arguments are relevant to multicasting:

```
multicast {igmp_proxy|igmp_snooping|no|yes}
proxy_ip_address <IP-address>
igmp_immediate_leave {no|yes}
igmp_query_interval <interval>
igmp_query_response_interval <interval>
```

For detailed information on these commands, please refer to section 13.8.23 on page 141.

A related command is **`add connection vlan`** ***`<vlan>`*** **`ethernet_port`** ***`<port>`*** **`valid_multicast_groups`** ***`<IP_address>`***, which is used to set the multicast addresses that the user is allowed to subscribe to. For detailed information on these commands, please refer to section 13.8.1 on page 107.

Displaying Subscribed Multicast Groups

Using the **`get`** command with the resource **`vlan`** will display all multicast groups subscribed to for the switching domain. To view a single port, use **`get`** with the **`connection`**.

5.3.4 Switching Domain – Broadcast

By definition, broadcast packets are intended to reach all other stations on the network. Here, ‘the network’ is restricted to the virtual network defined by the switching domain.

Accordingly, by default, every broadcast packet arriving at a switching domain is sent out on every egress connection, except the one to the port on which the packet arrived. Depending on the configured switching rule and forced forwarding mechanisms, forwarding of broadcast packets may be restricted even further.

It is also possible to stop an egress connection from sending broadcast packets, by setting ‘broadcast_allowed’ in the egress connection to **`false`**. Broadcast packets are thereby totally eliminated on that connection.

5.4 Egress Connection Functions

The egress connection functions are illustrated in Figure 19 on page 38.

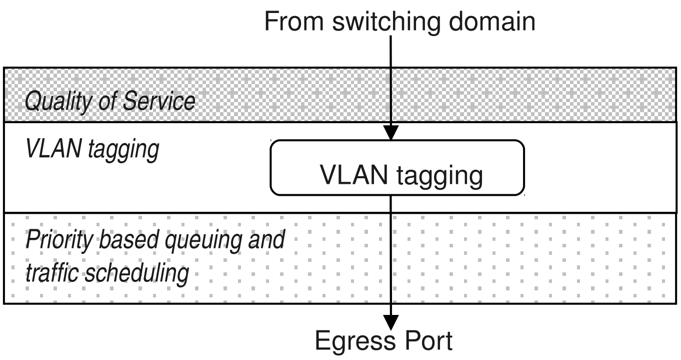


Figure 19 Detailed Path from Switching Domain to Egress Port

When the switching domain has decided to forward a packet on an egress connection, the following steps are performed before the packet is sent out on the egress port:

1. **Quality of Service**

   Quality of Service functions are performed, as described in section 5.5.2 on page 43.

2. **VLAN Tagging**

   The packet is provided with the VLAN Tag, or tags, defined for the egress connection. Note that the outgoing packets may be ‘untagged’ so that the tags, if any, in incoming packets are removed. The outgoing packet is either untagged, single tagged or double tagged (QinQ).

   Configuring VLAN IDs to be handled as transparent is possible, and as a result, the VLAN IDs will not be changed.

3. **Priority Based Queuing and Traffic Scheduling**

   Priority based queuing and traffic scheduling functions are performed, as described in section 5.5.2 on page 43.

5.5 Quality of Service

When the same VLAN is used for traffic of different QoS requirement it is possible to use flows to differentiate how the traffic will be handled within the EFN. There will always be at least one flow created. If no flows are configured manually, a default flow will be created that will handle all the traffic in the specific VLAN.

The QoS model implemented on the EFN324 in R4.3 is based on four QoS-Flows, configured at node level and one Flow per vlan. Frames are headed to the proper flow on the basis of the *flow_selector* parameter of the *connect* command, which can assume the values p-bit, dscp, or none.

In the following is described the mapping in case of p-bit or dscp.

Flow 1 – flow id values pbits 0, 1 or dscp 0-15
Flow 2 – flow id values pbits 2, 3 or dscp 16-31
Flow 3 – flow id values pbits 4, 5 or dscp 32-47
Flow 4 – flow id values pbits 6, 7 or dscp 48-63

None is the default value; in this case, frames are headed to a unique connection flow per vlan.

In case none is the flow selector, all frames headed to this flow will receive the same handling, in other words there is no differentiation for the different CoS.

The following figure illustrates VLANs and Flow in the EFN between one downlink port and the uplink port.

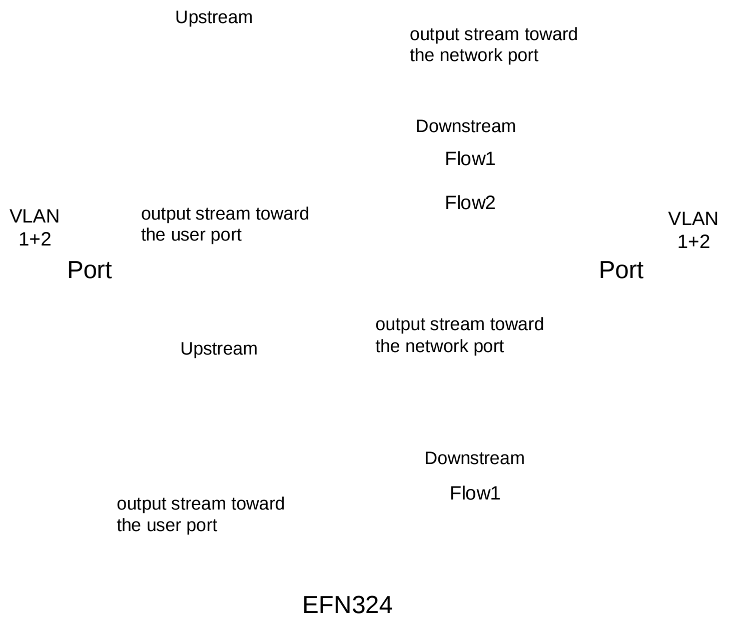

Upstream
output stream toward the network port
Downstream
Flow1
Flow2
VLAN 1+2
output stream toward the user port
VLAN 1+2
Port
Port
output stream toward the network port
Upstream
Downstream
Flow1
output stream toward the user port
EFN324

Figure 20 VLANs and Flows

The Quality of Service steps are illustrated in the following figure. Each step is described in details in section 5.5.1 on page 42 and section 5.5.2 on page 43.

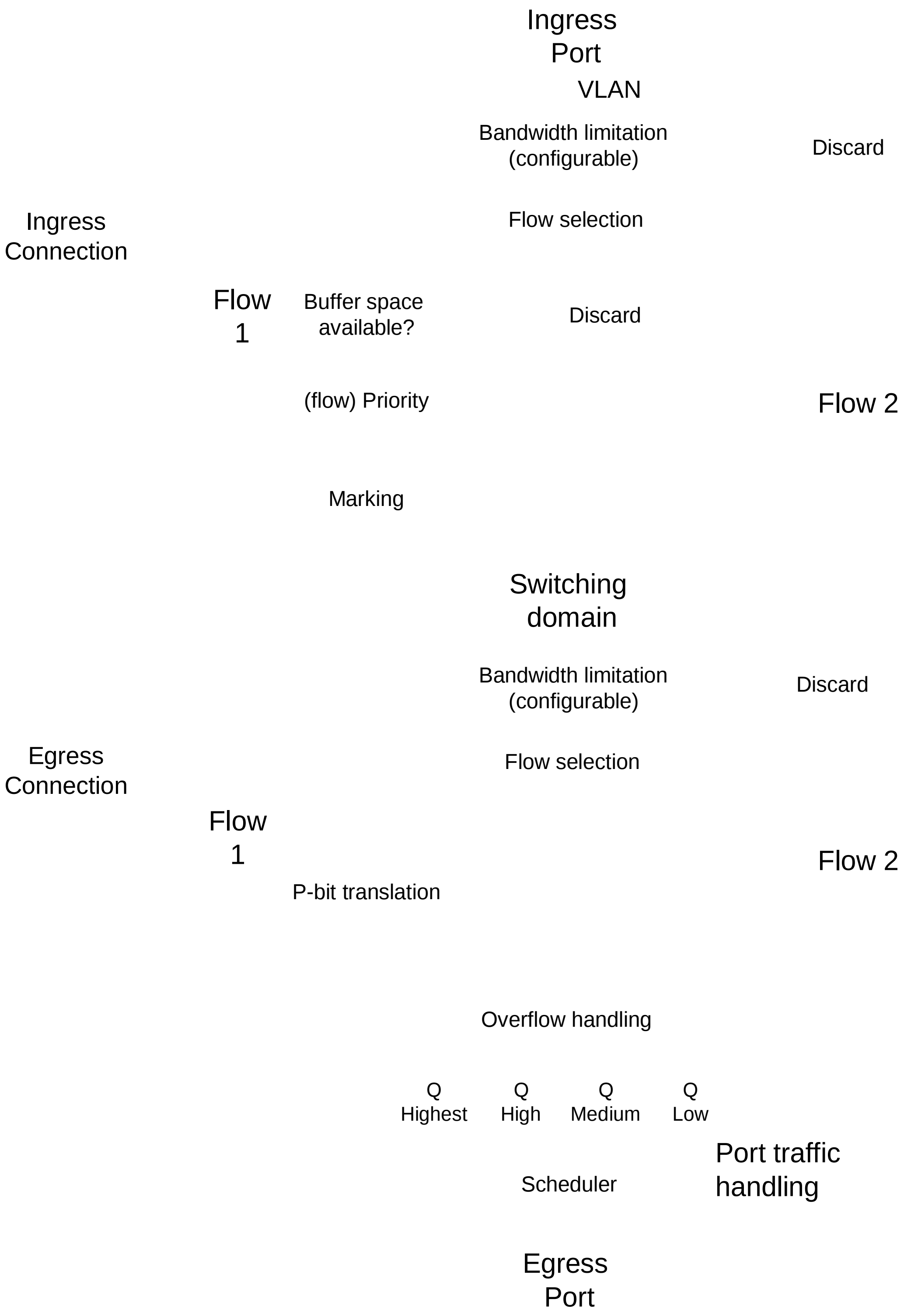


Figure 21 Quality of Service la figura sopra è aggiornata!!!

5.5.1 Ingress Quality of Service

The following Quality of Service actions are performed at the ingress:

1. **Connection Bandwidth Limitation**

   The packets are processed by the bandwidth limitation function for the *connection*. If the bandwidth limit is exceeded, the packet is discarded. The bandwidth limitation applies to all the incoming traffic of the VLAN with no regards to flow, or priority.

1. **Flow Selection**

   The flow to which the packet will be directed to is determined by the *Flow selection criteria* and *the value of either p-bit or dscp bit*. The p-bit/dscp bits are hard coded to the four global flows as given above. The following can be use as determination criteria (based on the packet header):

- P-bit
- DSCP
- None (all traffic will be directed to the connection flow)

2. **Quality of Service per Flow**

   For QoS processing, each packet is processed in the flow to which it belongs. For each flow, the following actions are performed:

- The out-queue buffer memory is checked. If, for the flow **reliability**, the current remaining memory space is too low, the packet is discarded. Overflow situations might occur if, for example, a flow exceeding 100 Mbps from an uplink is directed to a single FE downlink. The buffer availability check is related to out-queue handling. Please refer to step 3 on page 43 for more information.

- The ingress flow **priority** is used to assign the egress priority queue. The egress queue selection (queue Highest, High, Medium and low) is thus not dependent on the p-bit of packet, but only depends on the priority configured for the ingress flow. See the dashed arrow line in Figure 21 on page 41, and step 3 on page 43.

- The flow **marking** is determined, and is used in the egress p-bit translation. For each flow, a p-bit, to overwrite the existing p-bit in the outer VLAN, can be configured. If

none is selected, the EFN handles the outer VLAN p-bit transparently. See the dashed arrow line in Figure 21 on page 41, and step 2 on page 43.

5.5.2 Egress Quality of Service

The following Quality of Service actions are performed at the egress:

1. **Connection Bandwidth Limitation**

   If a bandwidth limit is configured for the egress connection, the current bandwidth utilization is checked. If forwarding the packet would exceed the configured limit, the packet is discarded. The bandwidth limitation applies to all the traffic of the VLAN with no regards to flow, or priority.

2. **p-bit Translation**

   If configured, the packet is given a new p-bit, based on the marking determined at ingress processing (see *marking* in step 2 on page 42).

3. **Port Traffic Handling**

   The port traffic handling applies for all the traffic that is to be sent out of the port (traffic from all VLANs and all flows).

- **Overflow handling**

  As has already been described under ingress quality of service, if the memory buffers are filled over certain limits, the packet may be discarded, depending on the reliability setting for the ingress connection.

  Once placed in the queue, packets will not be removed. Instead, packets that are to be placed in the queue can be discarded under certain conditions.

  When there are many packets in the out queue already and the out queue approaches its upper limit, packets that are to be placed in the queue start to be discarded. To begin with, only packets with the lowest priority are discarded. After this, packets with gradually higher priorities are discarded, if the free space in the out queue continues to decrease.

  There is a common memory area for all out-going packets in the EFN, for all ports and priorities. If there is more than one packet to be sent in a certain queue, a queue of packets to be sent through that port is established. There are four ‘out’ queues, reflecting different priority levels, for each port. Because there is only one common physical memory area, all ‘queues’ in this context are logical queues.

- **Queuing and scheduling**

  Depending on the priority setting determined during the ingress flow processing, the packet is placed in one of the four out-queues associated with each port.

  If there is more than one packet waiting to be sent, the order of the outgoing packets is determined by the scheduling method configured for the switching domain. The next packet to be sent is selected according to the scheduling mechanism. In general, the higher the priority, the shorter the waiting time.

  The following scheduling mechanisms may be configured for each port:

  – **None** – that is, first in, first out.

  – **Strict priority** – the waiting packet with the highest priority is sent first, using first in, first out, within each priority group.

  – **Weighted fair queuing (Deficit Round Robin)** – packets with lower priorities are not completely held back by packets with higher priorities. Each priority class gets a certain share of the total sending time. The lower the priority, the lower the share of sending time.

  – **Combined strict priority and weighted fair queuing (Modified Deficit Round Robin)** – the highest prioritized packets are strictly sent first. When no highest prioritized packets are in the queue, the others are sent according to weighted fair queuing.

5.6 Marking Priority

The p-bit marking or remarking takes effect in several ways, depending on how it is defined.

In case a marking is defined at node level flow, with the value transparent, frames will maintain the incoming p-bit value. In case a tag is added, the p-bit added will assume the same value as the incoming p-bit.

In case a marking is defined at node level flow, with a value between 0 and 7, frames will be remarked with the selected value. In case a tag is added, the p-bit added will assume the selected value.

In case a marking is defined at node level flow, with the value none, frames will be remarked as defined on the connect_vlan command.

5.6.1 Examples 1: trusted and untrusted users configuration

The following example describes a configuration with two different typologies of users configured on the node at the same time: the business users, which are trusted, and the residential users, which are untrusted. Traffic from the untrusted users shall be p-bit remarked, while traffic from trusted users will maintain the original p-bit tag.

For this scope the QoS Flows are explicitly defined as:

```
set connection_flow node_level flow 1 priority low reliability lowest marking transparent
set connection_flow node_level flow 2 priority medium reliability medium marking transparent
set connection_flow node_level flow 3 priority high reliability high marking 4
set connection_flow node_level flow 4 priority highest reliability highest marking 6.
```

Business customers will be tagged with vlan 500 through the Switching Domain 100, while residential customers will be tagged with vlan 600 and 700 through the Switching Domain 120 and 130.

Configuration of the business service on port 1 is defined as:

```
connect vlan 100 ethernet_port 1 ingress tags 500 flow_selector p-bit flows 1-3 default_flow 1
egress tag 500 p_tag none
connect vlan 100 ethernet_port 25 ingress tags 500 flow_selector p-bit flows 1-3 default_flow 1
egress tag 500 p_tag none
```

Residential users have two services, the Web-surfing on vlan 600 and VoIP service on vlan 700; the configuration on port 1 is:

For the Web-surfing service on vlan 600:

```
connect vlan 120 ethernet_port 1 ingress tags 600 flow_selector none egress tag 600 p_tag 0
connect vlan 120 ethernet_port 25 ingress tags 600 flow_selector none egress tag 600 p_tag 0
set connection_flow vlan 120 ethernet_port 1, 25 ingress flow 1 priority low reliability lowest
```

For the VoIP service on vlan 700:

```
connect vlan 130 ethernet_port 1 ingress tags 700 flow_selector none egress tag 700 p_tag 5
connect vlan 130 ethernet_port 25 ingress tags 700 flow_selector none egress tag 700 p_tag 5
set connection_flow vlan 130 ethernet_port 1, 25 ingress flow 1 priority high reliability high
```

With this configuration, the traffic from the business users, from VLAN 500 is handled as:

- frames tagged with p-bit 0 or 1 will be headed to flow 1; the marking in QoS-Flow_1 is defined Transparent, frames will exit with the original p-tag, i.e. p-bit = 0 or p-bit = 1
- frames tagged with p-bit 2 or 3 will be headed to flow 2; the marking in QoS-Flow_2 is defined Transparent, frames will exit with the original p-tag, i.e. p-bit = 2 or p-bit = 3
- frames tagged with p-bit 4, 5 will be headed to flow 3; the marking in QoS-Flow_3 is defined marking 4, so frames will exit with the modified p-bit = 4
- frames tagged with p-bit 6, 7 will be headed to flow 4; the marking in QoS-Flow_4 is defined marking 6, so frames will exit with the modified p-bit = 6

For residential users, all traffic on VLAN 600 shall be remarked with p-bit = 0, while all traffic on VLAN 700 shall be remarked with p-bit = 5.

5.6.2 Examples 2: trusted and untrusted users configuration

This example describes a 3-play configuration where traffic on the user side is single tagged and on the network side is double tagged; in the upstream direction the added tag will inherit the p-bit tag from the user’s tag.

Global Setting:

```
set connection_flow node_level flow 1 priority low reliability low marking transparent

set connection_flow node_level flow 2 priority low reliability low marking transparent
set connection_flow node_level flow 3 priority medium reliability medium marking transparent

set connection_flow node_level flow 4 priority high reliability high marking transparent
```

Configuration for the User 1 on port 1

```
set vlan 101 description Service1

connect vlan 101 ethernet_port 1 egress tag transparent p_tag transparent bandwidth_limitation 8 ingress tags 10-2399 flow_selector p_bits default_flow 1 flows 1-4

connect vlan 101 ethernet_port 25 egress tag transparent p_tag transparent second_tag 1001 second_p_tag transparent ingress tags * second_tags 1001 flow_selector p_bits default_flow 1 flows 1-4

set vlan 101 uplink ethernet_port 25

set ethernet_port 1 enabled yes

set connection vlan 101 ethernet_port 1 option_82_circuit_id undefined option_82_remote_id undefined

set vlan 101 option_82 configurable

set bandwidth_limitation 8 bandwidth 100000
```

Traffic from the user side, C-tagged with values from 10 to 2399, will exit toward the network with the added S-tag = 1001 and the same p-bit in the C-tag. In the downstream direction the S-tag will be stripped.

6 Topologies

Topologies are the permissible physical configurations of EFN324 Ethernet access switches. Stand-alone and embedded EFN324 support different sets of topologies.

The topologies for Stand-alone EFN324 Ethernet access switches are described in section 6.1 on page 48.

The topologies for Embedded EFN324 Ethernet access switches are described in section 6.2 on page 50.

Note that link aggregation is not supported in any of the topologies.

For consistency, port 25 is used as the transit port, and port 26 as the uplink port in this section.

6.1 Stand-alone Topologies

EFN324 may be used as a stand-alone node. In other words, the EFN324 is not controlled by an ECN, but is instead controlled directly by PEM. Figure 22 on page 48 illustrates possible use scenarios for stand-alone EFN324 Ethernet access switches.

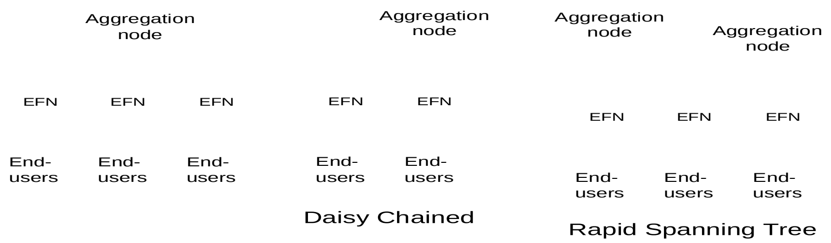


Figure 22 Stand-alone EFN324 Use Scenarios

The Switch ID for stand-alone EFN324 Ethernet access switches is always zero (the default value). In other words, stand-alone EFN324 Ethernet access switches are never configured as flexible blocks.

6.1.1 Stand-alone EFN324 Ethernet access switches

No additional CLI commands are required in the EFN324 in order to use it as a stand-alone node which is not daisy chained.

6.1.2 Stand-alone Daisy Chained

The initial configuration of the EFN and the command to configure a daisy chain are included in the *EFN324 Installation Guide*.

See section 5.3.1 on page 33 for information on configuring ports to accommodate Daisy Chained topology.

To enable traffic, the operator must configure the chain, using the following CLI command in **each** EFN324:

```
set vlan 1 transit_link ethernet_port 25 uplink
ethernet_port 26
```

Note that this example assumes that the management vlan is vlan 1.

Figure 23 on page 49 illustrates the effect of the CLI command on the port configuration in the daisy chain. Ports marked **T** are configured as transit link ports, while ports marked **U** are configured as uplinks.

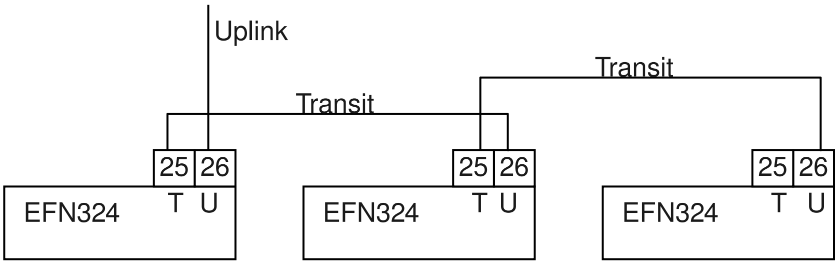


Figure 23 Port Configuration in EFN324 Daisy Chain

PEM enables the chain for other switching domains by configuring the VLANs in the chain, as needed.

Quality of Service flows will only be configured in the EFN which the End-user is connected to. In the other EFN Ethernet access switches in the chain, the

QoS is best effort, in other words, with the lowest of each QoS parameter. However, where an End-user with the same service is configured in the other EFN Ethernet access switches, the QoS parameters for that service are used.

6.1.3 Stand-alone Rapid Spanning Tree

The stand-alone daisy chained requirements also apply to stand-alone rapid spanning tree. After entering the stand-alone daisy chained CLI commands, enter the following commands in each EFN to configure Rapid Spanning Tree:

```
add rapid_spanning_tree 1 ports ethernet_port 25

add rapid_spanning_tree 1 ports ethernet_port 26
```

In the CLI commands above, `1` is used for the instance ID for the RSTP. The same value is used for all the uplink ports on all the EFN Ethernet access switches in the Rapid Spanning Tree.

In addition, see section 9.1 on page 72 for information on using Rapid Spanning Tree.

6.2 Embedded Topologies

EFN324 may also be used as an embedded node. In other words, the EFN324 is part of an Ethernet Access Node (EAN) and is managed via an ECN, instead of directly by PEM.

The following basic requirements apply to every embedded EFN324:

- To be recognized as an embedded node, the EFN324 must be configured as a flexible block, with a Switch ID number. In addition, the EFN324 must obtain its IP address using DHCP, and the management VLAN must be configured in switching domain 1.

- The EFN324 Ethernet access switch(s) uplink must be connected to a Gigabit port. If the EFN is connected directly to an ECN330, this means that only ECN330 uplink ports may be used. However, if the EFN is connected directly to an ECN430, any port may be used.

Figure 24 on page 51 illustrates the use of the EFN324 as an embedded node. Note that the EFN324 Ethernet access switches can be connected directly to the ECN330 or ECN430 and do not have to be connected via an unmanaged network.

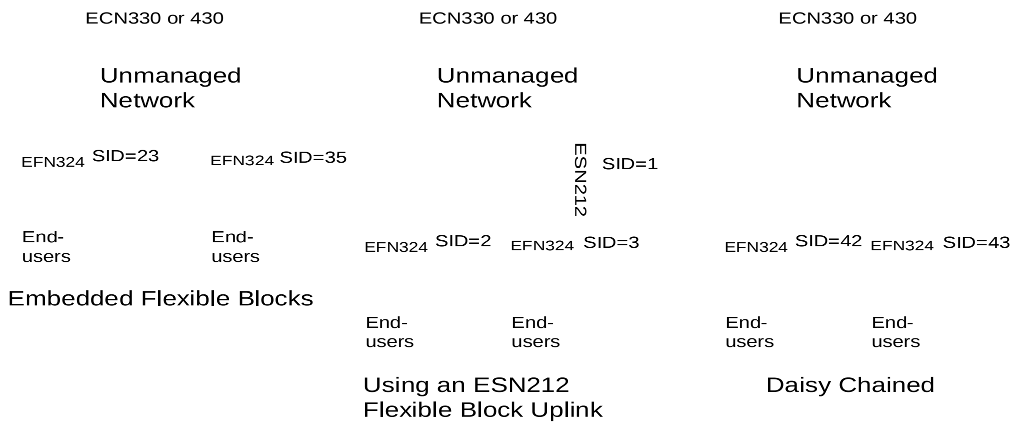


Figure 24 Embedded EFN324 Use Scenarios

6.2.1 EFN324 as Embedded Flexible Blocks

Only the basic requirements listed previously, in section 6.2 on page 50, apply to these nodes.

6.2.2 Using an ESN212 Flexible Block Uplink

EFN324 embedded flexible blocks can be connected directly to an ESN212 flexible block, as shown in Figure 24 on page 51. In addition to the basic requirements, the EFN324 must be connected to an uplink port on the ESN212 (ports 9, 10, 11 or 12).

This means that a maximum of three EFN324 Ethernet access switches can be connected directly to an ESN212 flexible block, since the ESN212 requires at least one uplink port to use as its own uplink.

6.2.3 Daisy Chaining Embedded Flexible Blocks

EFN324 embedded flexible blocks can be daisy chained to each other, as shown in Figure 24 on page 51.

The following restrictions apply to daisy chained embedded EFN324:

- No other types of flexible blocks or nodes can be included in the chain, or send traffic through the EFN324.
- Only one uplink is permitted from the daisy chain. Rapid spanning tree is not supported for embedded daisy chained EFN324 Ethernet access switches.
- The EMP and PEM do not know the order in which the EFN Ethernet access switches are connected. The EMP and PEM simply see each EFN Ethernet access switch as an independent flexible block.
- PEM only configures the service VLANs on the EFN that the End-user is connected to. In EFN Ethernet access switches where the service VLAN is not configured, the traffic is handled by the transit switching domain.
- PEM only configures Quality of Service on the EFN that the End-user is connected to. In the remaining EFN324 Ethernet access switches, traffic is forwarded as “best effort”, in other words, with the lowest of each QoS parameter.
- A transit switching domain must be configured manually in the Ethernet access switches. VLAN 2 is reserved for this. A transit link for the management VLAN switching domain must also be configured. More information on this is given in the CLI commands below.

The initial configuration of the embedded EFN and the configuration of a daisy chain are included in the *EFN324 Installation Guide*.

To configure the uplink and transit link for the management VLAN for the chain, enter the following commands in **each** EFN:

```
set vlan 1 transit_link ethernet_port 25 uplink
ethernet_port 26
```

To configure a transit switching domain manually in the Ethernet access switches, enter the following commands in **each** EFN, except the last EFN in the chain:

```
set vlan 2 description transit

set node_control default_vlan vlan 2

connect vlan 2 ethernet_port 25,26

set vlan 2 transit_link ethernet_port 25 uplink
ethernet_port 26
```

Note that if the above commands are also entered in the last EFN in the chain, this will not cause any problems.

Figure 25 on page 53 illustrates the effect of the CLI commands on the switching domain configuration in the daisy chain. Ports marked **T** are configured as transit link ports, while ports marked **U** are configured as uplinks.

The figure also shows the service switching domains, labeled **x** and **y**, configured automatically by PEM.

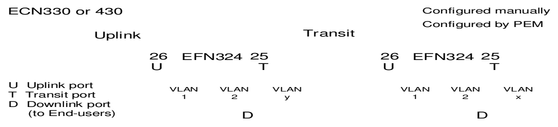


Figure 25 Switching Domains in Embedded Daisy Chained EFN324

7 Configuring Connections

This section gives a more detailed picture of how connections are used in the CLI in the form of resources, attributes and commands. Note that the term `tag` may have different meanings, as shown in Figure 7 on page 15.

Note: Switching domain is called **`vlan`** in the CLI.

When the command

```
# connect vlan 2 ethernet_port 2
```

is entered, the following attributes are set in the ‘ethernet_port 2’ and the ‘vlan 2’ objects respectively:

```
ethernet_port 2
…
# ingress_connections   Key Value
                        ...... ......
                        vlan    2
                        tags    all
…
# egress_connections      Key Value
                        ...... ......
                        vlan    2
                        tag     transparent
…
```

```
vlan 2

…
# incoming_ports   2
# outgoing_ports   2
…
```

Figure 26 Contents of Port and Switching Domain Objects Defining Connections

By default the CLI `connect` command creates the following two-way connection:

- An ingress connection from the port to the switching domain.
- An egress connection from the switching domain to the port.

(In the MIB interface, the egress and ingress connections are created separately from each other.)

When a packet arrives at a port, there must be at least one path, called the `connection` here, leading from the port to a switching domain. Otherwise, the packet is discarded at the ingress port.

Furthermore, the contents of the packet must be consistent with any additional rule set up for the connection. For example, the VLAN ID in the packet's VLAN tag, if any, must be consistent with the tag definition for the potential ingress connection. If the packet content is not consistent with any of the ingress connections leading from the port, the packet is discarded.

Likewise, when a packet arrives at a switching domain object, there must be a proper egress connection before the packet is switched out on an egress port. Otherwise, the packet is discarded at the switching domain.

7.1 Connection Configuration Example

The following example has five connections:

- ① - Ingress connection from port 2 to switching domain 2. Only untagged packets. ("tag = untagged")
- ② - Ingress connection from port 2 to switching domain 3. Only tagged with VLAN ID 2, 3 or 4. ("tag = 2, 3 or 4")
- ③ - Egress connection from switching domain 2 to port 5. Tagged with VLAN ID 22. ("tag = 22")
- ④ - Egress connection from switching domain 3 to port 7. Transparent VLAN ID. ("tag = transparent") Destination address A.
- ⑤ - Egress connection from switching domain 3 to port 9. Transparent VLAN ID. ("tag = transparent") Destination address B.

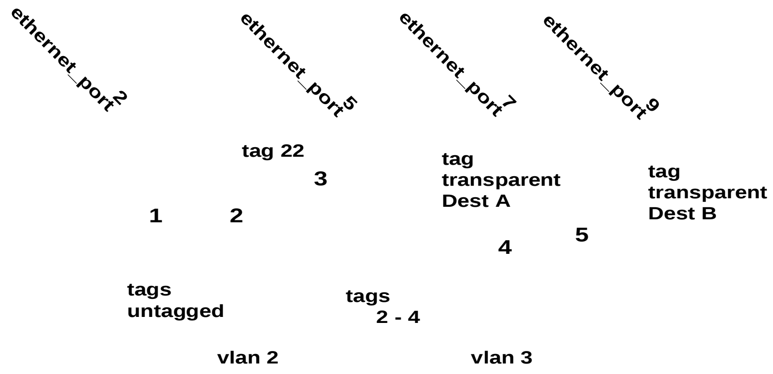


Figure 27 Example of Ingress and Egress Connections

Table 5 on page 56 shows the switching behavior which results from the connections illustrated in Figure 27.

Table 5 Examples of Switching Behavior

Incoming packet	**Switch decisions**
Untagged.	Forwarded to switching domain 2, from switching domain 2 forwarded to port 5. A VLAN Tag with VLAN ID 22 is inserted in the packet.
VLAN ID equal to anything but 2, 3 or 4.	Packet discarded at ingress port.
VLAN ID equal to 2, destination address A.	Forwarded to switching domain 3. Switching domain 3 forwards the packet to port 7. The VLAN Tag is untouched ('transparent').
VLAN ID equal to 2, destination address B.	Forwarded to switching domain 3. Switching domain 3 forwards the packet to port 9. The VLAN Tag is untouched ('transparent').

Incoming packet	Switch decisions
VLAN ID equal to 2, destination address C.	Forwarded to switching domain 3. Switching domain 3 floods the packet to both port 7 and to port 9. The VLAN Tag is untouched ('transparent').

The last row in Table 5 is an example of flooding. Flooding may occur when a switching rule is set to 'normal'. If forced forwarding is configured, flooding is restricted.

Note that switching domain number is the number of the switch domain object. Do not confuse this with the VLAN ID located inside the VLAN Tag.

At configuration, when specifying connections in the CLI, the EFN324 checks the consistency of the latest command against the commands issued earlier. The command is rejected if inconsistencies are found. Therefore, an actual configuration is always correct from the switching logic point of view. It is up to the operator to ensure that it is also correct from a traffic point of view.

7.2 The Connect Command

The previous section gave the basis for defining connections through the EFN324 switch. A connection is defined using a `connect` command, which targets the resource object types *ethernet_port* and *vlan*. In addition, the flows within each connection are assigned.

Note that the resource object type *connection* is not directly involved. The connection object may be seen as a container of additional attributes, which specify how IP validation, multicast and Option 82 are handled on the connection in question.

The syntax of the connect command is:

# **`connect vlan M`** (1 – 200) **`ethernet_port N`** (1 – 26) OPTIONAL PARTS

The optional parts are:

`ingress` followed by a sub-set of the following:

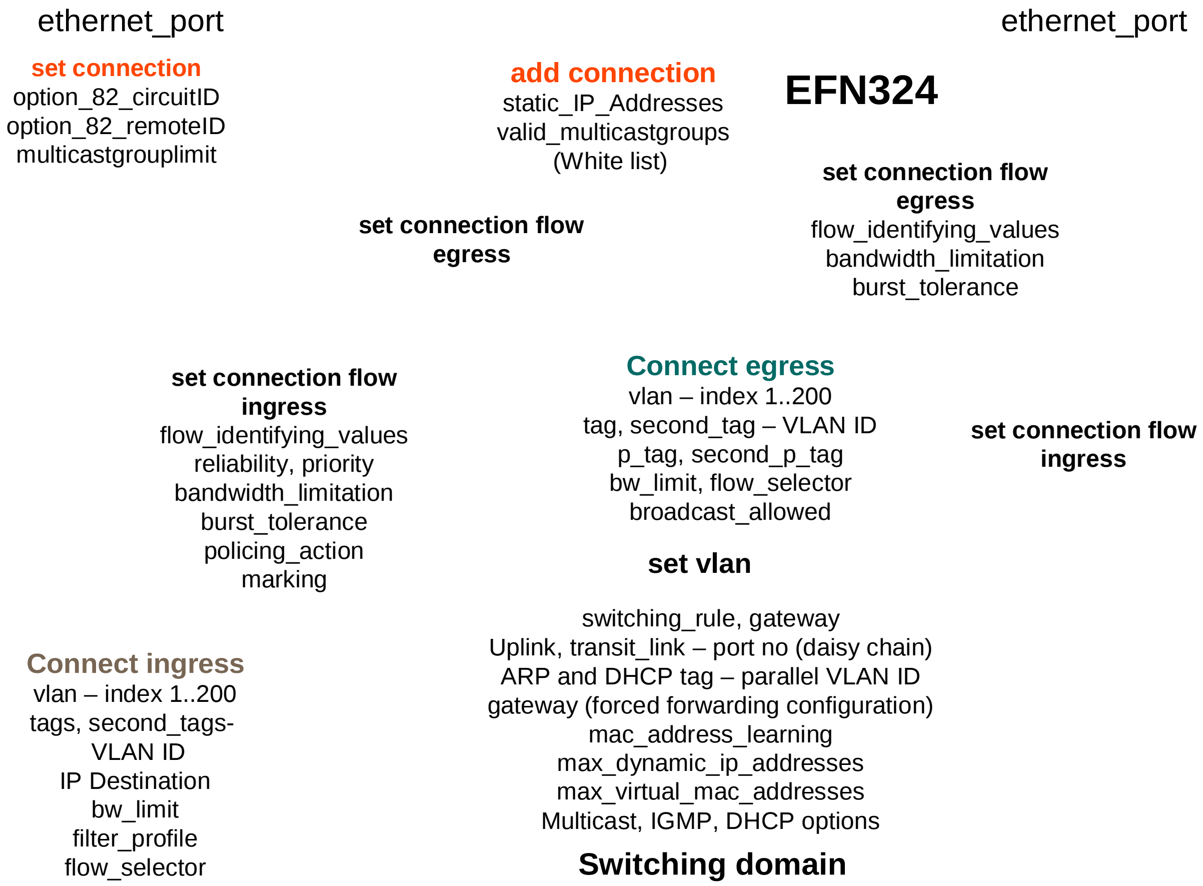
Attribute	Description
bandwidth_limitation	Specifies bandwidth limitation at ingress.

description	Optional text.
filter_profile	Specifies filter conditions.
flow_selector	Assigns specific p-bit or DSCP values to specific flows.
ip_destination	Specifies which IP addresses the End-users can use as IP destination address.
tags, second_tags	Specification of allowed VLAN IDs for incoming packets. The option ‘untagged’ is also available.

`egress` followed by a sub-set of the following:

Attribute	**Description**
bandwidth_limitation	Specifies bandwidth limitation at egress.
broadcast_allowed	Specifies whether broadcast packets are forwarded.
description	Optional text.
first_ethertype, second_ethertype	The ethertype used on the outgoing frame. It can be transparent, thus using the value from the received VLAN tag, or it can be set to a predefined value.
flow_selector	Assigns specific p-bit or DSCP values to specific flows.
p_tag, second_p_tag	Specifies the priority bits in the VLAN Tags to be set for outgoing packets. The options ‘transparent’ and ‘untagged’ are also available.
tag, second_tag	Specifies the VLAN IDs to be set for outgoing packets. The options ‘transparent’ and ‘untagged’ are also available.

The resource objects and commands involved in configuring connections are summarized in Figure 28 on page 59.



ethernet_port

set connection
option_82_circuitID
option_82_remoteID
multicastgrouplimit

add connection
static_IP_Addresses
valid_multicastgroups
(White list)

EFN324

ethernet_port

set connection flow egress

set connection flow egress
flow_identifying_values
bandwidth_limitation
burst_tolerance

set connection flow ingress
flow_identifying_values
reliability, priority
bandwidth_limitation
burst_tolerance
policing_action
marking

Connect egress
vlan – index 1..200
tag, second_tag – VLAN ID
p_tag, second_p_tag
bw_limit, flow_selector
broadcast_allowed

set connection flow ingress

set vlan

switching_rule, gateway
Uplink, transit_link – port no (daisy chain)
ARP and DHCP tag – parallel VLAN ID
gateway (forced forwarding configuration)
mac_address_learning
max_dynamic_ip_addresses
max_virtual_mac_addresses
Multicast, IGMP, DHCP options

Switching domain

Connect ingress
vlan – index 1..200
tags, second_tags-
VLAN ID
IP Destination
bw_limit
filter_profile
flow_selector

Figure 28 Connections Related Commands and Resources

8 Security Functions

Basic switching is focused on the task of distributing packets to whoever wants them. In a Public Ethernet Environment there are strong requirements that packets are not delivered to unauthorized receivers. Packets could be delivered to unauthorized receivers due to verbose switching mechanisms like broadcast, by faulty configurations, by manipulations by hostile users, and so on.

This section describes the security mechanisms offered by the EFN324.

Note: Some of the security measures are dependent on others. That is, they cannot be activated unless other security measures are activated.

8.1 Forced Forwarding

Forced Forwarding is a security measure that may be added on top of basic switching mechanisms in order to enhance security. In an access network, one such measure is to force uplink packets up to an edge node, instead of switching the packets directly to another End-user, using the shortest path. This way, there is a Layer 2 separation from End-user to End-user and End-user to Access nodes.

Forced forwarding offers additional restrictions on switching compared to the ‘normal’ switching in the EFN324. Forced forwarding may be defined with a gateway to which all packets are forwarded.

The `connect` command is used to configure forced forwarding in the EFN324. Attributes in the ‘vlan’ (switching domain) and ‘connection’ resources will show how forced forwarding has been configured.

Forced forwarding is enabled by specifying an uplink for a switching domain. Additional security mechanisms may be configured as needed.

8.1.1 Define Uplink

The first step is to define an ‘uplink’ in the switching domain. Packets arriving on links other than uplinks are forced to the uplink.

Uplink is defined as an ethernet_port number. A connection must also be defined from the switching domain to that port before packets may be forwarded to the uplink.

Note that this measure alone will not always force packets up to the border node. Intermediate aggregation switches in the Access network might forward the packet according to the destination address of the packet, before it reaches the border node. In order to ensure that packets reach the border node, a gateway for forced forwarding is needed as well.

8.1.2 Define Gateway

The second step is to define a gateway.

Note: a gateway is not needed to enable either IP validation or virtual MAC, which are described later.

Uplink packets, which are not addressed to the gateway, are discarded. Downlink packets with other source addresses are also discarded. Note that the Layer 2 MAC addresses are checked here. The Layer 3 IP addresses are not checked here.

If these checks are not made, a packet sent from one End-user, directed to a neighbor connected to the same or a neighboring EFN324, will first be forwarded through the uplink to an aggregation switch. This switch can potentially forward the packet directly to the EFN where the intended receiver is located, rather than towards the border node. That EFN will then unsuspectingly forward the packet to its destination.

So, in order to ensure that all packets pass the border node, in addition to an uplink, a gateway should be defined.

Note: Multicast packets are not subjected to the source address check.

8.1.3 ARP Proxy

The configuration of a gateway automatically activates an ARP proxy function in the EFN324.

The ARP proxy answers all ARP requests from End-users, with the MAC address of the gateway. As a result, all packets from End-users have the gateway as their Layer 2 destination. All other uplink packets are discarded.

ARP requests from the gateway (all other uplink sources are discarded) are only forwarded to the End-user with the IP address in the ARP request. The response from the End-user will also be forwarded.

8.1.4 ARP Handler

The ARP Handler allows the EFN324 to increase the ARP Processing Performance. The EFN324 will discard the ARP requests received on the uplink with a source MAC that is not equal to that of the gateway. This feature is enabled when the switching domain is configured with switching rule = ip_validation or virtual_mac. This is done to avoid processing ARPs that are not relevant to the EFN.

Improved handling of the ARPs is achieved by forwarding the ARPs to the Host if, and only if, the Client IP address is already known. Previously, some of the ARPs sent by the Host to the Clients may not have been answered because they were not destined for those Clients. The EFN now first verifies the Target Protocol Address of the ARPs from the Gateway and then forwards them to the Host for more processing. The Host load of unnecessary ARPs is thus reduced. This feature is enabled by default when the switching rule of the switching domain is configured as ip_validation or virtual_mac.

The feature can be disabled by setting the switching domain parameter, **check_gateway_source_address** to **no**. The use of the command is described in section 13.8.23 on page 141.

8.1.5 Configuration

Set an ‘uplink’ in ‘vlan’. The ‘switching_rule’ is still set to ‘normal’ here.

As has been described above, a gateway may be defined for a switching domain. Different switching domains may have different gateways.

The MAC address of the gateway is primarily used by the forced forwarding function. Besides directly specifying a MAC address (option 1 below), the gateway MAC address may also be retrieved with help of ARP (options 2 and 3).

The gateway is configured by setting the ‘gateway’ attribute in ‘vlan’ to one of the following three alternatives:

1. In the form of a **MAC address** which completes the definition of the gateway.
   It is not necessary to retrieve the GW IP address for this option. Forced

forwarding mechanisms utilize the MAC address. The IP address is only needed as a means to, through ARP, retrieve the MAC address.

2. In the form of an **IP address**. For this option, the EFN324 must send an ARP to retrieve the gateway MAC address. This is described in more detail below.

3. As **auto**. For this option, the gateway IP address is snooped from the DHCP ACK message directed to the End-user who first issued a DHCP request. After this, the gateway MAC address is retrieved in the same way as in option 2.

If, in option 3, all downlink messages in the access network originated from the gateway, the gateway MAC address could be retrieved from any downlink message. However, this may not always be the case. The DHCP traffic may enter the access network elsewhere. Therefore the gateway MAC address must be retrieved using ARP.

The switching domain resource attributes ‘ip_address’ and ‘mac_address’ are introduced as an option, so that the operator can provide the EFN324 with the switching domain specific address to be used as sender in the ARP request. By default, these attributes are ‘auto’. At ‘auto’ the IP or MAC address is snooped from the first available ARP, IGMP or DHCP message from a client, and ‘borrowed’ for use in the own ARP request.

The attributes borrowed_ip_address and borrowed_mac_address (in the switching domain resource) are status information about the sender source addresses that the EFN324 uses in ARP requests.

8.2 IP Validation

Another security measure is IP validation. That means that IP addresses are also checked during forwarding decisions for unicast packets. Multicast and broadcast are treated according to special rules.

Note: This feature can only be used if forced forwarding is activated.

End-user IP addresses are validated per port. That is, only upstream packets with the End-user IP source addresses and downstream packets with End-user address as destination addresses are let through. All other packets are discarded.

IP source address validation, also called IP source address filtering, aims to stop malicious End-users from sabotaging the network. The so-called SYN attack, where high numbers of TCP SYN messages are sent towards a host in order to drain its execution capacity, is an example of attack that may be stopped. IP source address filtering immediately stops packets with false IP source addresses.

The EFN324 gets information about valid IP addresses in two ways. Static IP addresses can be configured for each End-user by the operator. Alternatively, the EFN324 learns IP addresses dynamically by DHCP snooping. The two methods do not exclude each other, since it is possible to simultaneously have both static and dynamic addresses for an End-user.

8.2.1 Configuration of IP Validation

Set ‘switching_rule’ to ‘ip_validation’ in ‘vlan’. Also set an ‘uplink’ and optionally a ‘gateway’*.*

Valid IP addresses may be ‘static’ or ‘dynamic’. Static addresses are added to, or removed from, the connection object using *add* and *remove* commands. For example:

```
# add connection vlan 1 ethernet_port 1 static_ip_addresses
<IPv4-ADDRESS>
```

Dynamic addresses are learned by the EFN324 by snooping DHCP ACK messages on their way from the DHCP server to the End-user. It is possible to set a maximum number of dynamically learned IP addresses that can be set and saved per switching domain and End-user port.

Both static and learnt IP addresses may be read out from each connection object.

Setting max_dynamic_ip_addresses to zero means that dynamic IP addresses are not allowed. In that case static IP addresses must be defined. Note that static IP addresses may be defined even though dynamic IP addresses are allowed.

8.2.2 IP Validation to Host Port

IP validation, and other forced forwarding mechanisms, are primarily intended for use on End-user connections. IP validation may also be applied on connections to the host port. This is, however, unnecessary. The host is an internal system function and must be considered ‘safe’. In addition, the use of a Management VLAN, see section 10.3 on page 79, eliminates the need for extra forced forwarding security mechanisms.

Note also that the host port does not send DHCP requests to get its IP address. The host port IP address must be configured manually. Therefore IP validation with dynamic IP addresses would not work. The same situation may occur for End-users who receive their IP addresses by means other than through DHCP. In those cases, IP validation must be configured with static IP addresses.

8.3 Virtual MAC

Virtual MAC (VMAC) address is a security feature that replaces the End-user's original MAC addresses with a MAC address controlled by the system, before forwarding the packet to the access network. A packet to the End-user has the VMAC address as its destination within the access network, but this is replaced, by the EFN, with the original MAC address before the packet is sent to the End-user.

Using VMAC protects against Ethernet address spoofing. That is, when an End-user deliberately uses another End-user's MAC address, to trick the self-learning Layer 2 address mechanism in the switch, in order to access information sent to the other End-user or to hinder that End-user's access to the network. The VMAC also makes the Layer 2 address configuration more fault tolerant. End-users behind different ports may be given identical MAC addresses, without endangering correct routing within the access network.

Note: This feature can only be used if the switching rule is IP validation and if Forced Forwarding is activated by specifying an uplink. A gateway can optionally also be specified.

A MAC address consists of 48 bits or 6 octets. The separator sign is usually a colon (":"). A virtual MAC address is an extended use of the IEEE specification for the local MAC address format.

The VMAC format is depends on whether the EFN324 is a stand-alone (managed only by PEM) or an embedded (managed by an ECN) Ethernet access switch. These are described separately in the following subsections.

8.3.1 VMAC for a Stand-alone EFN324

The VMAC address that the system allocates to each End-user is based on the End-user port number, switching domain ID and EFN324 identity.

Table 6 Virtual MAC Address Format for a Stand-alone EFN324

6 bits	2 bits	8 bits	8 bits	8 bits	16 bits
Domain Value	10	Index	Port Number	Switching Domain Number	EFN324 ID

Parameters:

- **Domain value** is 0x00 for a stand-alone EFN324.
- **10** indicates that the MAC address is a locally administered unicast address.
- **Index** is the incrementing number per allocated VMAC address. A maximum of 256 virtual MAC addresses are allowed per port and VLAN (range 0 to 255).
- **Port number** is the physical port on the EFN324 to which the End-user is connected (range 1 to 26).
- **Switching Domain number** is the logical number assigned to the switching domain used for the connection (range 1 to 200).
- **EFN324 ID** is the last 2 bytes from the EFN MAC-address.

Configuration of Virtual MAC for a Stand-alone Node

Set eda_vmac_format to no.

Set ‘switching_rule’ to ‘virtual_mac’ in ‘vlan’. Also, set an ‘uplink’ and optionally a ‘gateway’.

When setting the switching rule in the CLI to ‘virtual_mac’, IP validation is automatically activated.

The assigned virtual MAC addresses are status attributes in the connection resource.

Suggestion: set max_virtual_mac_addresses to max_dynamic_ip_addresses plus the number of defined static IP addresses.

8.3.2 VMAC for an Embedded EFN324

The VMAC address that the system allocates to each End-user is based on the End-user port number, VMAC address node ID and EFN324 identity.

Table 7 Virtual MAC Address Format for an Embedded EFN324

6 bits	2 bits	8 bits	13 bits	13 bits	6 bits
Domain value	10	Index	Network ID	VMAC address node ID	End-user port

Parameters:

- **Domain value** is 61 (111101 in binary) for an embedded EFN324.
- **10** indicates that the MAC address is a locally administered unicast address.
- **Index** is the incrementing number per allocated VMAC address. A maximum of 256 virtual MAC addresses are allowed per port (range 0 to 255).
- **Network ID** is a number uniquely identifying the network element forming the virtual MAC address in the access network. It is generated automatically by PEM, taking the next free number (range 0 to 8191). The Network ID is configured in the EFN324 by the EMP when the EFN324 is discovered.
- **VMAC address node ID** is a single integer value (range 16 to 8160, in steps of 16). The VMAC address node ID is configured in the EFN324 by the EMP when the EFN is discovered. To configure this value, the EMP uses the 8-bit embedded EFN Switch ID, followed by five zeros.
- **End-user port** is the physical port on the EFN324 to which the End-user is connected (range 1 to 26).

Configuration of Virtual MAC for an Embedded Node

Set eda_vmac_format to yes.

Set ‘switching_rule’ to ‘virtual_mac’ in ‘vlan’. Also, set an ‘uplink’ and optionally a ‘gateway’.

When setting the switching rule in the CLI to ‘virtual_mac’, IP validation is automatically activated.

Assigned virtual MAC addresses are status attributes in the connection resource.

Suggestion: set max_virtual_mac_addresses to max_dynamic_ip_addresses plus the number of defined static IP addresses.

8.4 Valid Configuration Combinations for Security Functions

The following table identifies the valid combinations of the switching_rule and definitions of uplink and gateway. Switching_rule IP means ip_validation, switching_rule VMAC means virtual_mac.

switching_rule	normal			IP		VMAC	
Forced forwarding (1)		X	X	X	X	X	X
MAC Forced Forwarding (2)			X		X		X
Explanation (3) (see below)	1	2	3	4	5	6	7

(1) Forced forwarding is enabled when an uplink is defined for a switching domain.

(2) MAC forced forwarding is enabled when, in addition to an uplink, a gateway is specified for a switching domain.

(3) The numbers refer to the explanations in the paragraphs below.

1 The switching domain acts as a normal switch, performing MAC address learning on the fly. The switching domain may be regarded as a separate switch, except that the bridging table holding the MAC addresses is global for the EFN.

2 When a switching domain has an uplink defined, all packets received on the downlinks are sent to the uplink, without any destination address modifications. All ports connected to the switching domain are regarded as downlinks, except the port marked as uplink. The downlink port is selected

based on the MAC address learned for that port. Packets received on the uplink for unknown MAC addresses are broadcast (except for ports where this feature is explicitly disabled).

3 When a switching domain has an uplink and a MAC FF address defined, all packets received on the downlinks are sent to the uplink with the destination address replaced by the MAC address of the gateway. All ports connected to the switching domain are regarded as downlinks, except the port marked as uplink. The downlink port is selected based on the MAC address learned for that port. Packets received on the uplink for unknown MAC addresses are broadcast (except for ports where this feature is explicitly disabled).

4 With ip_validation enabled for a switching domain, all switching is based on IP addresses. Defining an uplink is mandatory in this configuration because the alternative would be for the EFN to learn all IP addresses in use, not only at the downlink but in the network connected to the EFN. The EFN keeps track of the IP addresses assigned to a given downlink port using DHCP snooping and on a provision basis for static IP addresses (static IP addresses are added per connection). The IP addresses learned by the EFN are unique within the EFN, and not within a switching domain, so this configuration does not allow duplicated IP addresses. All packets received on the downlink ports are sent out on the uplink with no destination address modifications.

5 With ip_validation enabled for a switching domain, all switching is based on IP addresses. Defining an uplink is mandatory in this configuration because the alternative would be for the EFN to learn all the IP addresses in use, not only at the downlink, but also in the network connected to the EFN. Furthermore, the definition of a gateway causes all packets received on a downlink port to have the destination address replaced by the MAC address of the gateway. The EFN keeps track of the IP addresses assigned to a given downlink port using DHCP snooping and on a provision basis for static IP addresses (static IP addresses are added per connection). The IP addresses learned by the EFN are unique within the EFN, and not within a switching domain, so this configuration does not allow duplicated IP addresses.

6 With virtual_mac enabled, the MAC address of the user is encoded in all packets sent on the uplink. Enabling virtual_mac implicitly enables ip_validation and requires an uplink to be explicitly defined. All switching is based on IP addresses.

7 With virtual_mac enabled, the MAC address of the user is encoded in all packets sent on the uplink and similarly, with gateway defined, the

destination addresses of the packets sent on the uplink are replaced with the MAC address of the gateway.

8.5 DHCP Option 82

DHCP option 82 makes it possible for the system, provided that the CPE uses DHCP, to add specific End-user information in DHCP messages from End-users.

DHCP Option 82, including header formats, is described in detail in the *System Description*.

Options

The EFN324 supports the following formats for DHCP Option 82:

- vlan option_82 = **no**, option 82 will not be appended in the DHCP packets sent out.

- vlan option_82 = **circuit_id_eda**, the Option 82 Circuit ID is formed by using the EDA format. No Remote ID is inserted.

- vlan option_82 = **circuit_id_TR101**, the Option 82 Circuit ID is formed by using the TR101 format. The Remote ID is not automatically inserted, but can be specified.

- vlan option_82 = **configurable**, the Circuit ID and Remote ID defined in the connection data table are used. Each ID can be configured to any value and is inserted in Option 82 if defined.

- vlan option_82 = **remote_id_eda**, the Option 82 Remote ID is formed by using the EDA format. No Circuit ID is inserted.

- vlan option_82 = **remote_id_TR101**, the Option 82 Remote ID is formed by using the TR101 format. No Circuit ID is inserted.

- vlan option_82 = **vlan_port_mac**, the Option 82 Circuit ID is formed by combining the VLAN ID with the port number of the EFN where the End-user is connected. The Remote ID is formed from the EFN MAC address.

- vlan option_82 = **vlan_port_sysname**, the Option 82 Circuit ID is formed by combining the VLAN ID with the port number of the EFN where the End-user is connected. The Remote ID is formed from the SNMP SYS_NAME.

8.6 End-user MAC Contained in DHCP Option

The feature **Passing `real MAC` in DHCP** is only available if the **switching rule** is set to **virtual MAC**.

The support is added in one of the options 128..254 in DHCP negotiation, for sending the real MAC to the DHCP server in the EFN.

One of the DHCP option 128..254 will be set on a switching domain, in other words, at switching domain level. If it is set at switching domain level all connections in this domain would have this feature. If the option is set to yes, then all connections in this domain would send the real MAC in DHCP negotiation to DHCP server. If it is set to no, then in all DHCP negotiations the real MAC would not be sent. Using this approach, it is not possible for an End-user in a switching domain to send the real MAC address to a DHCP server.

The advantage of this approach is that all connections in a switching domain send the real MAC to the DHCP server with a single command. If more than one user wants to send this information to the DHCP server, then this approach is ideal.

9 Network Functions

This section describes network features in the EFN324.

Rapid Spanning Tree, which applies only to stand-alone nodes, is described in section 9.1 on page 72.

The ARP and DHCP tag is described in section 9.2 on page 75.

9.1 Rapid Spanning Tree

Spanning Tree Protocols may be used to build redundant network structures. Rapid Spanning Tree (RSTP) offers a much faster convergence time than the original Spanning Tree (STP) standard. The RSTP implementation is backward compatible with STP. If there still are switches supporting only STP, STP is used in network paths where there is no RSTP support.

RSTP or STP is primarily used in the following two cases:

- To select one of two redundant uplinks.
- To select the uplink ports in a daisy chain where each end node has an uplink.

Note: Spanning tree protocols are only supported for stand-alone nodes. Embedded nodes must not have redundant uplinks or uplinks at both ends of a daisy chain.

In the EFN324, the rapid_spanning_tree and spanning_tree objects are used to control the spanning tree algorithms.

The EFN324 must not be configured as the root of the tree. A maximum of two (2) EFN324 Ethernet access switches can be located in the same tree.

For stand-alone nodes, both daisy chained and single node redundancy scenarios are supported, as illustrated in Figure 29 on page 73 and Figure 30 on page 73, respectively.

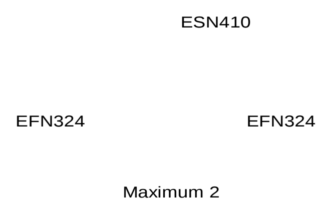


Figure 29 Daisy Chained Link Redundancy

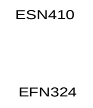


Figure 30 Single Node Link Redundancy

When RSTP is used, an uplink and a transit link must be configured for each switching domain. It does not matter which of the uplink ports is configured as uplink and which is configured as transit link. For easier understanding, configure the same uplink ports and transit ports in all switching domains. The EFN324 will automatically change the designation if a link fails and the data path changes direction, as illustrated in Figure 31 on page 74.

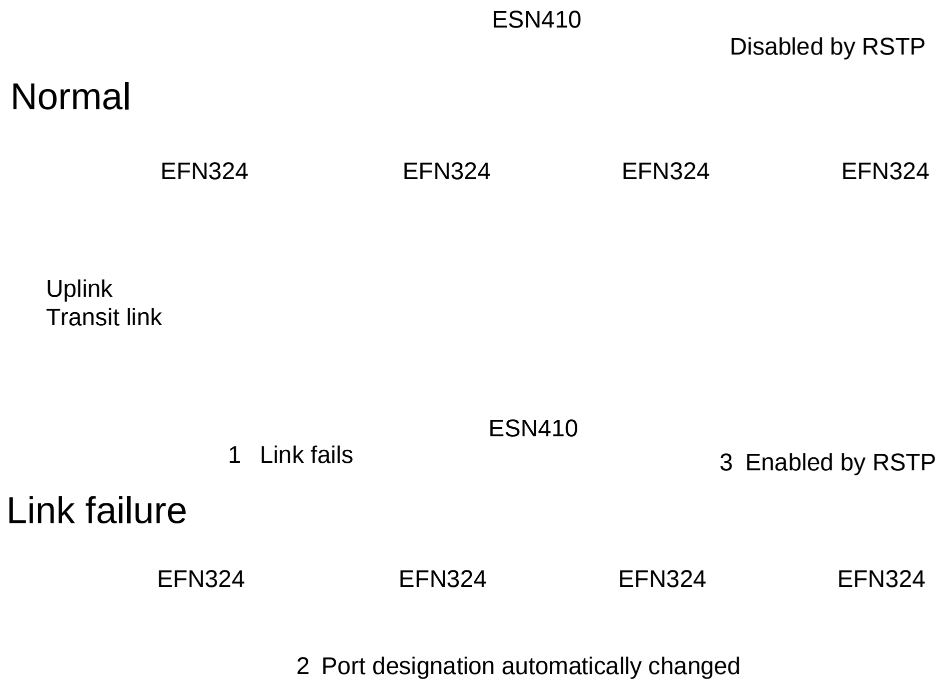


Figure 31 Uplink Ports Designation

9.1.1 Configuration of VLANs in RSTP Scenarios

When RSTP is used, all service VLANs used within the daisy chained nodes must be configured in all Ethernet access switches. If PEM is used, and the services are defined as configured automatically, all services will be configured correctly, provided that the connected Ethernet access switches are defined. If the Ethernet access switches are configured by CLI or SNMP, a switching domain for each VLAN must be configured in all Ethernet access switches, with uplink port and transit link port as illustrated in Figure 32 on page 75. Note that the EFN324 automatically reverses the uplink and change the port designation after the spanning tree has disabled the link.

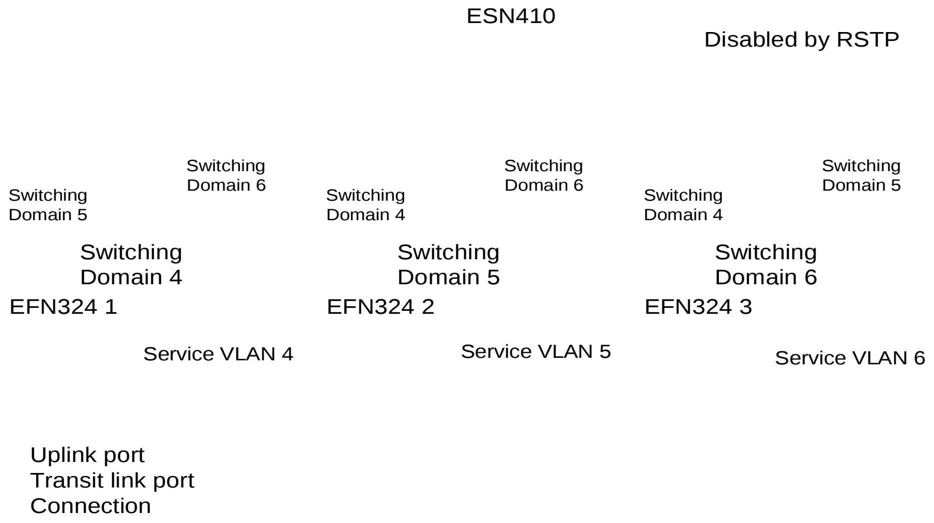


Figure 32 Service VLAN Configuration

Enable or disable RSTP per port, using the **`add rapid_spanning_tree`** command, see section 13.8.4 on page 110. Most of the RSTP properties are configured using this command. However, some properties are configured using the **`set rapid_spanning_tree`** command, see section 13.8.17 on page 132.

Note: The same rapid spanning tree instance must be used on both ports of the same node.

9.2 ARP and DHCP tag

The ‘arp_and_dhcp_tag’ attribute is used to define a parallel VLAN ID for the uplink traffic to or from a switching domain. This facility is introduced because certain aggregation switches or routers above the EFN do not switch incoming packets back to the same port and switching domain from which they were received. This might occur during forced forwarding if two End-users communicate. Note that the Layer 2 switching within the router is the problem. By creating an alternative VLAN to the same port, aggregation switches can use a different VLAN, and thus the port will not be perceived as the same port.

Upstream traffic on the uplink is tagged according to the ordinary configured VLAN ID for the switching domain. Downstream traffic from an uplink, which is marked with the arp_and_dhcp_tag VLAN tag, is also accepted by this switching domain. In other words, one VLAN is used for upstream traffic and the other VLAN is used for downstream traffic.

The second parallel VLAN ID (paths marked red in the figure below) is also used for some upstream traffic, like ARP, DHCP and IGMP.

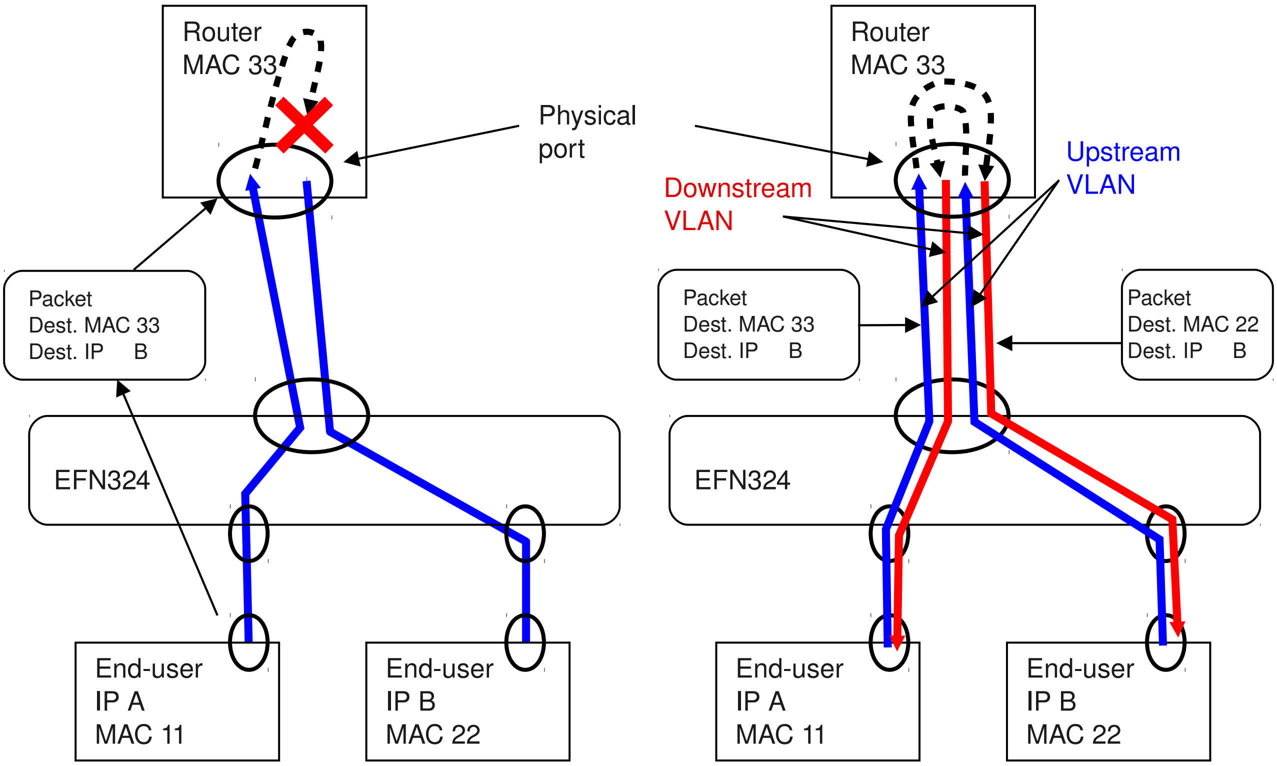


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Figure 33 ARP and DHCP VLAN ID

Note: When configured from PEM, this feature is only available when **Peer to Peer allowed** is selected as the Access Method. In this case, two VLANs are configured for the Service: Downstream VLAN and Upstream VLAN.

10 System Functions

The EFN324 software consists of the following two parts:

- Program code, which can be downloaded in one combined module, containing code for both the host and the network processor. The program code determines how the EFN324 functions are executed. Developing new enhanced and expanded versions of the program code is always possible.
- Configuration data, containing the configuration parameters. Through parameters some functionality may be further altered and specified without needing to download a new program version.

10.1 Software Management

When handling versions of the program code in a CLI context, these are referred to as ‘releases’.

EFN324 is delivered from the factory with one version of the program code loaded. EFN324 may simultaneously host two different SW releases. One of the releases is appointed as the ‘permanent’, in other words, the version which is selected at restart by default. The running program is called Current program. A new program release may be downloaded in the background while full traffic execution is done by the current program.

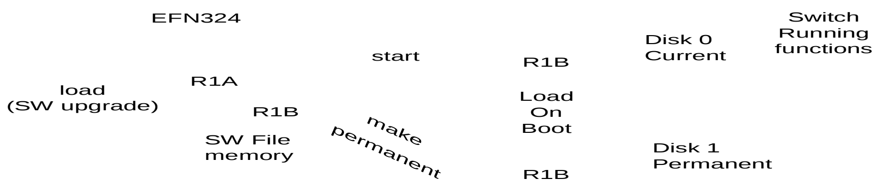


Figure 34 Basic Software Management

Software management in the EFN324 is administered using the **`release`** comman, together with the following options:

- **load** copies a file into the file memory.
- **make permanent** copies SW to disk 1. When the EFN starts, it always loads the SW from disk 1 into disk 0, which is the disk where the SW is run (current).
- **start** loads SW from the file memory into disk 0 and runs the SW (current). However, if the SW is not made permanent, the EFN will load the file saved on disk1 the next time it restarts.

The ‘software’ resource contains the names and statuses of loaded program files. Status indicates which file is current, and which is defined as permanent. The available disk partitions, the location of the current version and the release time are also indicated.

10.2 Configuration Parameters

Configuration primarily refers to a complete set of all configuration attribute values, also known as configuration parameter values, in all resources in the system. Such a set of parameters may be saved under an arbitrary name.

The system may host one or several configuration data sets, containing different versions of configuration parameters. Actual attribute and parameter values may be saved at any time. One of the configuration data sets is defined as ‘permanent’, in other words, the version that is selected at restart by default.

Parameter values may be read using the **get** command. For example:

```
Prompt# get main_board temperature_limit

temperature_limit [M-0C]

                     ------------------------

                                              80
```

Parameter values can be set using the ‘set’ command. However, parameter values can also be set or changed by other commands as well. For example:

```
Prompt# config restore NAME
```

will replace current configuration data with the set that had previously been saved under the name **NAME**.

Configuration data sets in the EFN324 are managed using the **config** command.

The ‘configuration’ resource contains the names and statuses of configuration data sets. Status indicates which set is the latest restored and which is appointed permanent.

10.3 Remote Management for Stand-alone Nodes

The EFN324 is intended mainly for remote management using either ssh, telnet or SNMP.

10.3.1 Management VLAN

In order to distinguish between End-user and management traffic, the remote management of the EFN324 is done through a dedicated management VLAN.

10.3.2 Management Access List

EFN324 allows the operator to specify which IP hosts are allowed to run Telnet, SSH sessions, or to communicate through SNMP.

10.3.3 IP Addresses for an EFN324 Node

Management of the EFN324 is normally carried out remotely from operation and maintenance sites located elsewhere. Communication is done through the IP network. Therefore, the EFN324 must function as an IP host.

An IP host must be configured with adequate address information in order for the IP based functions in the node to work properly. The IP address, net mask and IP default gateway must be allocated and set.

Address information is stored in the ‘cpu’ resource.

10.3.4 SNMP

The snmp object contains information related to SNMP. Write, read and trap ‘communities’ may be defined. Communities are a simple access control mechanism offered by SNMP.

Up to three trap receivers can be defined.

10.3.5 Auto Logout

The CLI shell has an automatic logout function. If no command is issued within a certain time, a log-out is done by the shell itself. The time for logout is configurable. See the **cli** resource.

10.3.6 Remote Restart

A restart may be ordered by using the CLI command:

```
Prompt# release start CXP_901_0022_P4C02
```

Watchdogs are implemented, to ensure that if one internal component hangs, the EFN will be restarted.

Restart times and restart causes may be read out from error or system logs.

10.4 Supervision

10.4.1 Link Quality

The number of packets discarded due to checksum errors offers an indication of link quality. The statistics object keeps counters for the total number of received and sent octets and packets per port, together with the number of discarded packets. The statistics counters can be reset using the `reset` command and viewed using the `get` command.

10.4.2 Temperature Supervision

The current temperature of the main board may be read using the main_board resource. The main_board resource can also be used to set a limit for a temperature alarm.

10.5 Real-time Clock

The EFN324 may set its real-time clock through Network Time Protocol. See the real_time_clock object.

11 Maintenance

The only maintenance required by the EFN324 is the replacement of the fans when needed. This is described in section 11.1 on page 81.

If it is necessary to replace an EFN324, follow the procedure in section 11.2 on page 82.

11.1 Replacing the Fans

The fans are located in a tray on the right side of the EFN324, and can be replaced while the EFN324 is running (provided that the replacement is done quickly). To replace the fans:

1. Use a flat screwdriver to flip the fan tray cover out.

2. Pull the cover out.

3. Pull the fan tray out.

4. Insert the new fan tray, and push it firmly all the way to ensure contact at the back. Push in the tray cover and close it.

11.2 Replacing an EFN324

The procedure to be followed for replacing an EFN324 depends on whether the Ethernet access switch is a stand-alone node or an embedded node. A stand-alone node is controlled directly by PEM. An embedded node is a node controlled by an ECN. Replacing a stand-alone EFN324 is described in section 11.2.1 on page 82. Replacing an embedded EFN324 is described in section 11.2.2 on page 83.

11.2.1 Replacing a Stand-alone EFN324

PEM only accepts the replacement of EFN324 if the EFN324 is replaced with exactly the same type of EFN324. For example, a stand-alone EFN324f cannot be replaced by an EFN324df.

Stand-alone EFN324 Ethernet access switches are managed by PEM. The EFN324 configuration data is stored in the PEM database, and so making a back up of the configuration file before the replacement is not necessary.

To replace a stand-alone EFN324 with an EFN324 of the same type, do the following:

1. Remove the power supply from the old EFN324.

2. Remove the EFN324 from the network.

3. Configure the new EFN324 using the same IP address, netmask, default gateway, management VLAN and (optionally) multicast VLANs as the old EFN324. The initial configuration for a stand-alone EFN324 is described in detail in the *EFN324 Installation Guide*.

4. Connect the new EFN324 to the network, and connect the power supply.

5. Use the PEM Synchronize function to download the configuration data to the EFN324.

The replacement of the stand-alone EFN324 is now completed.

11.2.2 Replacing an Embedded EFN324

If PEM is used, an embedded EFN324 cannot be replaced with another EFN324 of a different type. For example, an embedded EFN324f cannot be replaced with an EFN324df.

To replace an embedded EFN324, do the following:

1. Remove the power supply from the old EFN324.

2. Remove the EFN324 from the network.

3. Do the initial configuration for an embedded EFN324, using the same flexible block ID (also known as Switch ID), management VLAN and (optionally) multicast VLANs as the EFN324 that is being replaced. The initial configuration for an embedded EFN324 is described in detail in the *EFN324 Installation Guide*.

4. Connect the new EFN324 to the network, and connect the power supply.

5. The EMP gives the new EFN324 the same IP address as the old EFN324. The EMP then sends the saved copy of the EFN324 configuration file to the EFN324.

The replacement of the embedded EFN324 is now completed.

12 EFN324 Alarms

The EFN324 sends alarms as SNMP traps or notifications. Depending on the SNMP version, alarm events are named traps, notifications or informs. Trap is an SNMPv1 term. Notification and inform are both related to SNMPv2, where inform is a message type requiring an acknowledgement from the SNMP manager that the message was received. A notification does not require an acknowledgement. The EFN324 is able to handle all three alarm-types and these can be configured individually per destination (named target). By default, the EFN324 sends the alarms as notifications using SNMPv2.

12.1 Standard Alarm Format

The format of the alarms from the EFN324 adheres to the ITU-T X.733 standard, which specifies alarm handling in telecommunication networks. The following parameters are mandatory in all alarms:

Table 8 Additional Alarm Parameters according to X.733 Standard

Parameter Name	**Description**	**Coding**
Managed object class	Device or device Port	Display string
Managed object Instance	Port number if relevant	Display string
Sequence number	Sequence number; counter incremented for each alarm message sent	Unsigned integer
Perceived severity	Critical, Major, Minor, Warning or Cleared	Integer
Event time	Time stamp from real time clock retrieved through a SNTP server	Octet string
Event type	Indicates a high-level grouping of the alarms, according to the X.733 standard	Integer
Probable cause	Follows the X.733 standard	Integer

After these parameters, alarm specific variable parameters are added.

12.2 Major Severity Alarms

12.2.1 ElnOverheat

MIB: ERICSSON-ELN-TRAP-MIB

Description: A temperature has exceeded the temperature limit in the switch. The reason can be fan failure, too high ambient temperature or both.

Corrective Actions:
- Ensure that the ambient temperature is within the specified operating range.
- Check that the fan is working and the air inlets and outlets for the fans are not blocked.

Valid from EDA 2.2 R3A

Parameters:

No.	Parameter	Parameter Value
1	Managed object class	`EFN324f` or `ELN220`
2	Managed object Instance	`EFN324=<`*IP address*`>` or `ELN220=<`*IP address*`>`
3	Sequence number	Alarm sequence number
4	Perceived severity	Major
5	Event time	Time stamp from real time clock, retrieved through a SNTP server
6	Event type	`equipmentAlarm`
7	Probable cause	`temperatureUnacceptable`
8	Temperature Value	The temperature of the node
9	Temperature Limit	The temperature threshold value

Clearing Alarms

ElnOverheatOK, ElnRestart

12.3 Warning Severity Alarms

12.3.1 ElnLinkDown

MIB: ERICSSON-ELN-TRAP-MIB

Description: A link to one of the ports is not operational.

Corrective Actions:
- Ensure that the node connected to the other end of the link is operational.
- Check the physical link (optical or electrical) for damage and replace if necessary.

Valid from EDA 2.2 R3A

Parameters:

No.	**Parameter**	**Parameter Value**
1	Managed object class	EFN324fport or ELN220port
2	Managed object Instance	EFN324=<*IP address*>,port=<*no.*> or ELN220=<*IP address*>,port=<*no.*>
3	Sequence number	Alarm sequence number
4	Perceived severity	Warning
5	Event time	Time stamp from real time clock retrieved through a SNTP server
6	Event type	CommunicationsAlarm
7	Probable cause	terminalProblem

Clearing Alarms

Linkup, ElnRestart

12.3.2 ElnFanfail

MIB: ERICSSON-ELN-TRAP-MIB

Description: A fan in the EFN324 has failed.

Corrective Actions:
- Replace the fan.

Valid from EDA 2.2 R3A

Parameters:

No.	Parameter	Parameter Value
1	Managed object class	`EFN324f` or `ELN220`
2	Managed object Instance	`EFN324=<IP address>` or `ELN220=<IP address>`
3	Sequence number	Alarm sequence number
4	Perceived severity	Warning
5	Event time	Time stamp from real time clock retrieved through a SNTP server
6	Event type	`equipmentAlarm`
7	Probable cause	`heatingVentCoolingSystemProblem`

Clearing Alarms

ElnFanOK, ElnRestart

12.3.3 ElnHighTrafficLoad

MIB: ERICSSON-ELN-TRAP-MIB

Description: Packets have been discarded due to traffic overload in the EFN324.

Corrective Actions:
- Reduce the traffic load on the EFN324.

Valid from EDA 2.2 R3A

Parameters:

No.	Parameter	Parameter Value
1	Managed object class	EFN324f or ELN220
2	Managed object Instance	EFN324=<*IP address*> or ELN220=<*IP address*>
3	Sequence number	Alarm sequence number
4	Perceived severity	Warning
5	Event time	Time stamp from real time clock retrieved through a SNTP server
6	Event type	qualityOfServiceAlarm
7	Probable cause	resourceAtOrNearingCapacity

12.3.4 ElnRestart

MIB: ERICSSON-ELN-TRAP-MIB

Description: The node has restarted. This is a cold restart, indicating that configuration and SW might have changed.

Valid from EDA 2.2 R3A

Parameters:

No.	Parameter	Parameter Value
1	Managed object class	`EFN324f` or `ELN220`
2	Managed object Instance	`EFN324=<`*`IP address`*`>` or `ELN220=<`*`IP address`*`>`
3	Sequence number	Alarm sequence number
4	Perceived severity	`Warning`
5	Event time	Time stamp from real time clock retrieved through a SNTP server
6	Event type	`Other`
7	Probable cause	`unexpectedInformation`

12.4 Cleared Severity Alarms

12.4.1 ElnLinkUp

MIB: ERICSSON-ELN-TRAP-MIB

Description: A link that was down is up. This is a clearing alarm for ElnLinkDown alarm.

Valid from EDA 2.2 R3A

Parameters:

No.	Parameter	Parameter Value
1	Managed object class	EFN324fport or ELN220port
2	Managed object Instance	EFN324=<*IP address*>,port=<*no.*> or ELN220=<*IP address*>,port=<*no.*>
3	Sequence number	Alarm sequence number
4	Perceived severity	Cleared
5	Event time	Time stamp from real time clock retrieved through a SNTP server
6	Event type	CommunicationsAlarm
7	Probable cause	terminalProblem

12.4.2 ElnOverheatOK

MIB: ERICSSON-ELN-TRAP-MIB

Description: The temperature is below the temperature limit. This is a clearing alarm for ElnOverheat.

Valid from EDA 2.2 R3A

Parameters:

No.	Parameter	Parameter Value
1	Managed object class	`EFN324f` or `ELN220`
2	Managed object Instance	`EFN324=<`*`IP address`*`>` or `ELN220=<`*`IP address`*`>`
3	Sequence number	Alarm sequence number
4	Perceived severity	`Cleared`
5	Event time	Time stamp from real time clock retrieved through a SNTP server
6	Event type	`equipmentAlarm`
7	Probable cause	`temperatureUnacceptable`
8	Temperature Value	The temperature of the node
9	Temperature Limit	The temperature threshold value

12.4.3 ElnFanOK

MIB: ERICSSON-ELN-TRAP-MIB

Description: The fan is operating correctly. This is a clearing alarm for ElnFanfail.

Valid from EDA 2.2 R3A

Parameters:

No.	Parameter	Parameter Value
1	Managed object class	`EFN324f` or `ELN220`
2	Managed object Instance	`EFN324=<`*`IP address`*`>` or `ELN220=<`*`IP address`*`>`
3	Sequence number	Alarm sequence number
4	Perceived severity	`Cleared`
5	Event time	Time stamp from real time clock retrieved through a SNTP server
6	Event type	`equipmentAlarm`
7	Probable cause	`heatingVentCoolingSystemProblem`

13 Command Line Interface

13.1 How to Connect to the CLI of the EFN324

The EFN324 has a built-in CLI (Command Line Interface) for manual configuration of the switch.

The CLI can be accessed by using either of the following:

- Remotely, using a Telnet, or a SSH (Secure Shell), session.
- Locally, via the RS232 console port.

SSH offers a more secure connection than Telnet. SSH is not described further in this guide.

13.2 Using the Console Connector

Prerequisites

To be able to connect to the switch locally the following is needed.

- VT100 type terminal or a PC with HyperTerminal or similar terminal application.
- A D-sub 9 female to D-sub 9 female straight console cable.

Connecting to the switch

1. Connect the console cable to a serial port on the PC and the console connector on the front of the EFN324.

1. On the PC, start HyperTerminal and make a new connection or session, saving it with the following attributes (in this example, the COM1 port on the PC is used):

Name: **terminal_9600**
Connect using: **Direct to Com1**
Bits per second: **9600**
Data bits: **8**
Parity: **None**
Stop bits: **1**
Flow control: **none**

1. Press **ENTER** to start a CLI session.

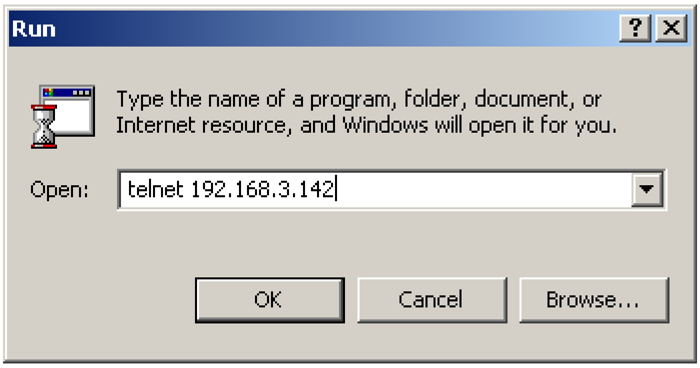
13.3 Using Telnet

Prerequisites

To be able to connect to the switch remotely, the switch has to have the following basic configuration:

- IP address, subnet mask and default gateway.
- One Ethernet port connected to the Management VLAN, for example, the uplink port 25.

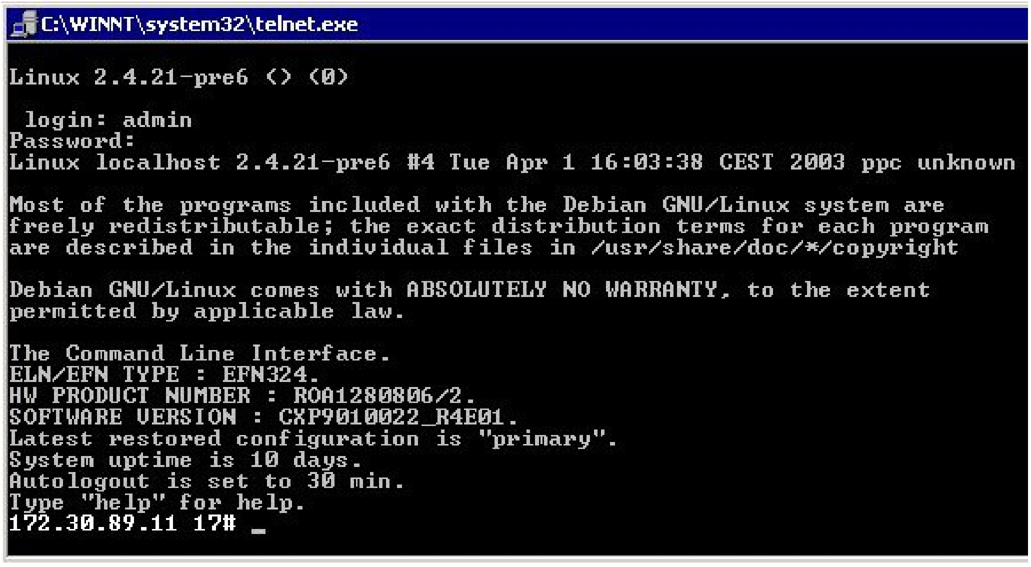
Start a Telnet session in Windows by clicking **Start→Run...**, type **`telnet <IP address>`** and click OK.


Run
Type the name of a program, folder, document, or Internet resource, and Windows will open it for you.
OK
Cancel
Browse...

Open: telnet 192.168.3.142

Figure 35 Login Session

The CLI is the same whether a serial connection or telnet is used. The login session starts, see Figure 36 on page 95:



```
Linux 2.4.21-pre6 <> (0)

 login: admin
Password:
Linux localhost 2.4.21-pre6 #4 Tue Apr 1 16:03:38 CEST 2003 ppc unknown

Most of the programs included with the Debian GNU/Linux system are
freely redistributable; the exact distribution terms for each program
are described in the individual files in /usr/share/doc/*/copyright

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

The Command Line Interface.
ELN/EFN TYPE : EFN324.
HW PRODUCT NUMBER : ROA1280806/2.
SOFTWARE VERSION : CXP9010022_R4E01.
Latest restored configuration is "primary".
System uptime is 10 days.
Autologout is set to 30 min.
Type "help" for help.
172.30.89.11 17# _
```

Figure 36 Login to the EFN324

13.4 Starting and Exiting the CLI

13.4.1 Logging In

A normal operator logs in as user *admin*.

There is also the *root* operator type. The root operator may see and use all type of commands, for example some commands for debugging and error log handling that are not available to *admin*. These extra root commands will not be further described in this guide.

1. To start the CLI for the first time, log in to the switch with the user name **admin** and password **qwerty**.

1. The switch is now ready to receive commands at the prompt.

Note: The password can be changed using the command **`set passwd`**, see section 13.7.4 on page 103.

When connecting remotely, the prompt is the EFN IP address followed by a command sequence number as showed above. When connecting locally, the prompt is `switch`.

It is also possible for the operator to define the prompt appearance, see section 13.9.1 on page 148. `efn#` is used as prompt in most of the examples in this guide.

13.4.2 Exiting the CLI

To exit the CLI, use the command **`exit`**.

13.5 Entering Commands

This section describes how to enter CLI commands.

13.5.1 Keywords and Arguments

A CLI command is a series of keywords, arguments and parameters separated by spaces. Keywords identify a command, and arguments specify configuration parameters.

For example, in the command **`set cli autologout 30`**, **`set`** and **`cli`** are keywords, **`autologout`** is an argument that specifies a function, and **`30`** is a parameter that specifies the value of the argument.

Commands can be entered by using one of the following methods:

- Enter the entire required sequence of keywords, arguments and parameters. For example, to configure CLI autologout:

```
efn# set cli autologout 30
```

- Enter the required sequence of keywords, arguments and parameters one by one. Using the **TAB** key after a keyword or argument will display a list of possible keywords and arguments. If only a part of a keyword or argument is typed, the **TAB** key can be used to complete the keyword or argument and at the same time display a list of possible keywords and arguments.

13.5.2 Command Completion

From every position, you can press the **TAB** key to get auto-completion. That is, the word you are typing is compared to all valid alternatives and a list of valid words is displayed.

Example 1

At the CLI prompt press **TAB** to get *all* valid commands:

```
efn#
Type:
add         config   connect   disconnect   execute_file
exit        get      help      history      passwd
ping        release  remove    reset        set
statistics telnet    unset
```

Example 2

At the CLI prompt, type **p** and press **TAB** to get all commands beginning with **p**:

```
efn# p
Type:
password   ping
```

Example 3

To enter the command:
`set ethernet_port 1-10,14-20 enabled no`, the following is typed on the keyboard:

`se` (**TAB**) **`et`** (**TAB**) **`1-10,14-20 e`** (**TAB**) **`no`**

13.5.3 Using Command History

The CLI maintains a history of the used commands. The up and down arrow keys can be used to scroll back and forward through the history of commands (maximum 30 commands). Any command displayed in the history list can be executed again, or modified and executed.

13.5.4 Command Execution

After a command is executed, the prompt reappears, indicating that the command has been executed. If there is no error message, the execution was successful. A new command can be entered.

13.5.5 Scripts

CLI commands can be collected in a script in the form of a text file. This script file may be executed using the `execute_file` command, see section 13.9.3 on page 150.

Note: The output after a history command may be copied from the CLI window and pasted into a text command file.
In Windows, mark the field in the CLI window while holding down the left mouse button, then right click to copy the text to the clipboard, and go to the text file and use CTRL+V to paste the selection.

13.5.6 Editing

Go backward and forward on the line:
Left-arrow and Right-arrow keys

Delete character: Backspace key.

Use **^B** and **^F** to navigate and **^D** to delete the current character. The whole line is deleted with **^K**. **^A** takes the cursor to the start of the line.

13.5.7 CLI Editing Keystrokes

The CLI Editing Keystrokes can be viewed by using the command `help usage editing`.

Table 9 CLI Editing Keystrokes

Keystroke	Function
CTRL+a	Shift cursor to start of command line
CTRL+b	Shift cursor one character to the left

CTRL+d	Delete the character at the cursor
CTRL+e	Shift cursor to end of command line
CTRL+f	Shift cursor one character to the right
CTRL+h	Delete the character before the cursor
CTRL+k	Delete the word after the cursor
CTRL+l	Clear the screen but keep the whole line
CTRL+n	Show the next command in the history list
CTRL+p	Show the previous command
CTRL+u	Delete the line before the cursor
CTRL+w	Delete the word before the cursor
Advanced features	
CTRL+t	Replace the character under with one before that one.
Esc-t	Replace the word under with one before that one.
CTRL+x CTRL+u CTRL+_	Undo editing

13.5.8 Adaptation to Different Display Sizes

Printouts from the CLI are automatically adapted to the size of the terminal display used.

- If a screen printout is too *long* for the display, it is interrupted by the text:

```
“MORE: Press Enter to continue, Esc or Q to abort”.
```

- If the screen printout is too *wide* for the display, it is rearranged to suit the size of the display.

13.6 Overview of CLI Commands

The main groups of the CLI commands used during normal operation are listed in Table 10 on page 100.

Table 10 CLI Commands Overview

Command Groups	Description	Page
General	General commands used for troubleshooting, inspection and help: **exit, help, history, passwd, ping**.	101
Display	These commands are used to obtain information about parameters and values in the configuration and the system.	161
Configuration	These commands are used to configure the system.	106
System Configuration	These commands are used for configuration file handling, software handling and system commands	147

Note: For a complete list of CLI commands, see the Table of Contents.

13.7 General Commands

Table 11 Configuration commands

Command	Description	Page
exit	Exit the CLI session.	101
help	Get help within the CLI.	102
history	Show a list of executed commands.	102
passwd	Change the password.	103
ping	Test the IP connection.	103
telnet	Start a telnet session.	104
reset	Reset an object configuration to its default value or zero.	105

13.7.1 exit

Use the command **`exit`** to exit the CLI session. CTRL+d can be used instead of exit.

Syntax

```
exit
```

Default Setting

None

Example

```
efn# exit
```

13.7.2 help

Use this command to get help within the CLI.

Syntax

```
help {usage|commands|range|usage editing|usage history}
```

Arguments:

usage – Short notes about how to use help.

commands – Gives an overview of the commands of the CLI, in list form.

range – Explains the notation of range in the CLI.

usage editing – Explains navigation and editing in the CLI during operation.

usage history - Describes how to reuse CLI commands that have already been executed.

Default Setting

None

Command Usage

This command is used to obtain information about the CLI and how to use the CLI.

Example

```
efn# help commands
```

13.7.3 history

Use this command to show a list of executed commands.

Syntax

```
history
```

Default Setting

None.

Command Usage

The CLI saves the last 100 commands. This command can be used to list all these commands. The number in front of the command is the same as the number that was in the prompt. The command **`help usage history`** will display information about how to use the history list.

Example

```
efn# history
```

13.7.4 passwd

Use this command to change the password for the current user of the EFN324.

Syntax

`passwd` ***`<password>`***

Arguments:

`<password>` – The password.

Default Setting

adminExample

```
efn# passwd topsecret2
```

13.7.5 ping

Use this command to test the IP connection to another device.

Syntax

`ping` ***`<host>`***

Arguments:

<host> – The IP address of the node to ping.

Default Setting

None

Example

```
efn# ping 172.30.38.1
```

13.7.6 telnet

Use this command to start a telnet session.

Syntax

```
telnet <node>
```

Arguments:

> ***<node>*** – Insert the IP address or the DNS name of the remote node.

Default Setting

None

Command Usage

This command is used to communicate remotely. A telnet session from an EFN may be used when an operator is locally connected via the serial port and wants to connect to another EFN (possibly daisy chained), without having to switch the physical connection between the Ethernet access switches.

Note that this starts a telnet session originating from the EFN. This must not be confused with the telnet session originating in some external terminal which starts an EFN CLI.

Example

```
efn# telnet 172.30.38.1
```

13.7.7 reset

Use this command to restore an object configuration to its original state or value.

Syntax

```
reset <object> [parameters]
```

Arguments:

<object> – The object or resource that is reset.

parameters – Any parameters that are needed for the object.

Default Setting

none

Command Usage

This command will restore all or one of the default values of an object or resource. The following objects and resources can be reset:

- all
- bandwidth_limitation
- cli
- connection
- connection_flow
- cpu
- ethernet_port
- filter_profile
- global_filter
- host_accesslist
- main_board
- node_control
- port_redundancy
- rapid_spanning_tree
- real_time_clock
- snmp
- software

- spanning_tree
- statistics
- vlan

Example

The following example will reset the statistics counters on all ports:

```
efn# reset statistics ethernet_port *
```

13.8 Configuration Commands

The commands listed in Table 12 on page 106 are used when configuring the system. The **set** command is used together with some of the commands.

Table 12 Configuration commands

Command	Description	Page
add/remove connection	Configure or remove specific connection data.	107
add/remove host_accesslist	Define the IP hosts that are allowed to access the management interfaces.	108
Remove network_processor	Remove entries in the MAC or bridging table, based on MAC address, port and IP-address.	109
add/remove rapid spanning_tree	Add or remove the Rapid Spanning Tree (RSTP) function.	110
add/remove spanning_tree	Add or remove the Spanning Tree (STP) function.	112
connect vlan	Connect a port to a switching domain, and specify QoS parameters for the connection.	114
disconnect vlan	Disconnect a port from a switching domain.	117
bandwidth_limitation	Specify the bandwidth limitation in connections.	118
Connection	Configure specific attributes associated with a connection between a VLAN and an Ethernet port.	120
connection_flow	Configure the QoS parameters for a flow.	121
Cpu	Set basic IP parameters.	124

Command	Description	Page
ethernet_port	Configure parameters for the Ethernet port.	126
filter_profile	Define filter profiles.	129
global_filter	Define the global filters.	130
log packet_logger	Configure, start, stop and reset the packet_logger.	158
log trace_logger	Start, stop and reset the trace_logger.	160
node_control	Define the global parameters for the Ethernet access switch.	132
rapid_spanning_tree	Define the Rapid Spanning Tree (RSTP) function.	135
real_time_clock	Set parameters for using the Network Time Protocol.	136
snmp	Configure SNMP.	137
software	Set the maximum time for trying to upload a software release.	139
spanning_tree	Define the Spanning Tree (STP) function.	140
vlan	Configure parameters for the switching domains.	141

13.8.1 add/remove connection

Use this command to configure or remove a specific connection between VLANs and Ethernet ports. See also **`set connection`** in section 13.8.9 on page 120. This command can be used multiple times for the same connection. For example, if a multicast white list is desired, this is configured by using this command multiple times, with a different allowed multicast address each time.

Syntax

```
{add|remove} connection vlan <vlan> ethernet_port <port>
{static_ip_addresses <IP_address>| valid_multicast_groups
<IP_address>| static_multicast_groups <IPv4-address>}
```

Arguments:

`vlan` ***`<vlan>`*** **–** Insert the number of the Switching Domain. Range 1 to 200.

ethernet_port ***<port>*** **–** Insert the number of the Ethernet port. Range 1 to 26.

static_ip_addresses ***<IP_address>*** **–** The IP addresses that are set manually, to be used for IP validation during forced forwarding. These addresses are defined by the operator, using the **add/remove connection** commands.

valid_multicast_groups ***<IP_address>*** - Multicast addresses for multicast groups which users behind this connection are allowed to join, in other words, a White List. If no address is defined, all addresses are allowed.

static_multicast_groups ***<IPv4-address>*** **–** add or remove a multicast address permanently for a connection.

Default Setting

None.

Example:

```
efn# add connection vlan 100 ethernet_port 4
static_ip_addresses 134.138.159.71
```

13.8.2 add/remove host_accesslist

Use this command to define the IP hosts that are allowed to access the management interfaces. Use the command **reset host_accesslist** to reset to default values.

Syntax

```
add host_accesslist permit ip_address <IP-address>
net_mask <netmask>

remove host_accesslist permit ip_address <IP-address>
net_mask <netmask>
```

Arguments:

ip_address ***<IP-address>*** **–** The IP address of a host that is allowed to access the management interfaces.

net_mask ***<netmask>*** **–** The corresponding net mask.

Default Settings

ip_address: undefined

net_mask: undefined

Command Usage

A host-accesslist contains a list of IP addresses and corresponding subnet masks which define the IP hosts that are allowed to access the management interfaces, that is, remotely run CLI or SSH sessions, or access the EFN using SNMP.

By default, the list is undefined, and so the control of IP source addresses for management traffic is disabled.

Example:

```
efn# add host_accesslist permit ip_address 192.75.11.6
net_mask 255.255.0.0
```

13.8.3 remove network_processor

Use this command to remove entries in the MAC or bridging table, based on MAC address, port and IP-address.

Syntax

```
remove network_processor bridging_table
{ethernet_port <*|1-26>|
ip_address < ip_address>|
 mac_address < mac_address>}
```

Arguments:

ethernet_port ***<*|1-26>*** - All Ethernet ports (*) or one of the Ethernet ports.

ip_address ***<IP-address>*** - IP address of the End-user.

mac_address **<** ***mac_address>*** - MAC address of the End-user.

Default Setting

None.

Command Usage

To delete MAC addresses on all ports, all Ethernet ports must be checked, and the MAC addresses deleted accordingly. To clear the MAC address on a port, all the data for that port must be deleted.

Examples

Remove the bridging table for Ethernet port 1:

```
10.10.10.102# remove network_processor bridging_table
ethernet_port 1
```

Remove the bridging table for a MAC address:

```
10.10.10.102# remove network_processor bridging_table
mac_address 00:d0:b7:19:b4:7c
```

Remove the bridging table when the switching rule is virtual_mac:

```
10.10.10.102# remove network_processor bridging_table
mac_address 00:d0:b7:19:b4:7c ethernet_port 1
```

Remove the bridging table:

```
10.10.10.102# remove network_processor bridging_table
```

Remove the bridging table when IP-validation is enabled:

```
10.10.10.102# remove network_processor bridging_table
ip_address 172.16.58.1
```

13.8.4 add/remove rapid_spanning_tree

Use this command to add or remove the Rapid Spanning Tree (RSTP) function. The function is defined using the command **set rapid_spanning_tree**, see section 13.8.18 on page 135.

Syntax

```
add rapid_spanning_tree <instance id> ports ethernet_port
<port>
```

```
[admin_edge {no|yes}]
[admin_path_cost {<type>|auto}]
[admin_point_to_point {auto|no|yes}]
[priority <type>]
[protocol_migration {no|yes}]
[enabled {no|yes}]
```

```
remove rapid_spanning_tree <instance id> ports
ethernet_port <port>
```

Arguments:

rapid_spanning_tree ***<instance id>*** **–** The ID (number) of the defined RSTP instance. Up to ten configurations can be defined using the command **set rapid_spanning_tree**. Range 1 to 10.

ethernet_port ***<port>*** **–** The number of the Ethernet port. Range 1 to 26.

admin_edge no/yes – Tells RSTP whether the port is an edge port. When the port is one of two redundant uplink ports, it is an edge port. When the port is situated within a daisy chain, it is not an edge port.

admin_path_cost ***<type>*****/auto** – Auto, or 1 to 200000000, can be selected for this parameter, which indicates the path cost to the root. For 'auto' the path cost is based on link speed and priority (see below). Alternatively the path cost may be given directly in the form of an integer.

admin_point_to_point auto/no/yes – yes indicates that the port is on a point-to-point LAN segment, no indicates that the port is on a non-point-to-point LAN segment. For further details and the meaning of auto, see IEEE Std 802.1w-2001 sections 6.4.3 and 6.5.

priority ***<type>*** **–** Possible values: 0, 16, 32, 64, 80, 96, 112, 128, 144, 160, 176, 192, 208, 224 or 240. Input for calculation of the path cost and the selection of the root port. This is only used when there are two links from the EFN324 to the same switch. If there are two links and this parameter is omitted, the EFN will select the lowest number port as root port.

protocol_migration no/yes – When set to yes, RSTP is forced to re-check the appropriate BPDU format to send if some segments are found to have been working in STP mode. For further details, see IEEE Std 802.1w-2001 section 17.26.

enabled no/yes – If set to 'no' the function is disabled.

Default Settings

admin_edge: yes

admin_path_cost: auto

admin_point_to_point: yes

priority: 0

protocol_migration: yes

enabled: yes

Command Usage

Use the **add** command to add the Rapid Spanning Tree (RSTP) function. This function is relevant only when the EFN is located in a network with alternative or redundant links. For example, when there are two redundant uplinks, or when the EFN is one of several daisy chained Ethernet access switches with an uplink at each end of the chain.

Use the same RSTP instance (selected using ***<instance id>***) for both uplink and transit ports in the same node.

The function is then activated on the relevant ports by using add commands. Use the **remove** command to deactivate the function.

The priority is used when two uplinks are connected to the same EFN324. In this case, the lowest priority is chosen as root port.

Example:

```
efn# add rapid_spanning_tree 1 ports ethernet_port 15
```

13.8.5 add/remove spanning_tree

Use this command to add or remove the Spanning Tree (STP) function.

Syntax

```
add spanning_tree <type> ports ethernet_port <port>
[path_cost <cost>]
[priority <priority>]
[enabled {no|yes}]
```

```
remove spanning_tree <type> ports ethernet_port <port>
```

Arguments:

spanning_tree ***<type>*** **–** The number of defined STP configurations. Range 1 to 10.

ethernet_port ***<port>*** **–** The number of the Ethernet port. Range 1 to 26.

path_cost ***<cost>*** – Set the path cost to the root. Range 1 to 65535.

priority ***<priority>*** **–** Range 0 to 255. Input for calculation of the path cost and the selection of root port. Priority affects which node becomes root (the one with lowest value on priority). In an aggregation network the most central node is the root.

enabled no/yes – If set to no, the function is disabled.

Default Setting

path_cost: 4

priority: 128

enabled: yes

Command Usage

STP is the older of STP and RSTP and should only be used if the EFN is used where collaborating nodes lack RSTP support.

The Spanning Tree (STP) function is relevant only when the EFN is located in a network with alternative or redundant links. For example, when there are two redundant uplinks, or when the EFN is one of several daisy chained switches with an uplink at each end of the chain.

Up to ten different STP configurations may be defined. The function is then activated or deactivated on relevant ports by using the add or remove commands.

In an aggregation network, the most central node is the root. If the EFN is used in a daisy chained topology, it is important that the EFN does not become the root. Prevent the EFN from becoming root by ensuring that there is a central node with a higher priority.

Example:

```
efn# add spanning_tree 1 ports ethernet_port 1-2,5
path_cost 2 priority 1 enabled no
```

13.8.6 connect vlan

Use this command to connect a port to a switching domain, and to specify QoS parameters.

Syntax

```
connect vlan <vlan> ethernet_port <port> egress
[bandwidth_limitation {<type>/none}]
[broadcast_allowed {no|yes}]
[description <string>]
[p_tag {<tag>|transparent}]
[first_ethertype {q_vlan|s_vlan|s_vlan_9200|
 transparent|vman_vlan}]
[flow_selector <flow_selection_criteria> flows <flows>
 [default_flow <default_flow>]]
[second_p_tag {<tag>|transparent}]
[second_ethertype {q_vlan|s_vlan|s_vlan_9200|
 vman_vlan| transparent}]
[second_tag {<VLAN-ID>|transparent|untagged}]
[tag {<VLAN-ID>|transparent|untagged}]

connect vlan <vlan> ethernet_port <port> ingress
[bandwidth_limitation {<type>|none}]
[description <string>]
[filter_profile <profile>]
[flow_selector <flow_selection_criteria> flows <flows>
 [default_flow <default_flow>]]
[ip_destinations {single <ip-address>|range <ip-
 address>-<ip-address>}]
[second_tags{<VLAN-ID> |untagged}]
[tags {<list-of-VLAN-IDs>|untagged|*}]

connect vlan <vlan> host_port
```

Arguments:

vlan ***<vlan>*** **–** Set the number of the Switching Domain. Range 1 to 200.

ethernet_port ***<port>*** **–** Set the number of the Ethernet port. Range 1 to 26.

egress – Parameters are set for outgoing packets.

ingress – Parameters are set for incoming packets.

bandwidth_limitation type/none – Specify the bandwidth_limitation profile to be used. The range is 1 to 32.
The bandwidth_limitation profile is defined using the command **set bandwidth_limitation**. To inspect the bandwidth, use the command **get bandwidth_limitation**, see section 13.11.1 on page 161.

broadcast_allowed no/yes – Specifies whether broadcast messages are forwarded or discarded on this connection.

description *<string>* – A text describing the connection.

host_port – The port between the network processor (essentially working at level 2) and the host processor (working at layer 3 and higher layers).

p_tag *<tag>*/tranparent – The 3-bit *user priority* in the 4-byte IEEE 802.1Q priority tag of outgoing packets may be set to this value. In the alternative transparent mode, the p-tag in incoming packets is used unchanged. The range is 0 to 7 and **transparent**.

flow_selector *<flow_selection_criteria>* flows *<flows>* [default_flow *<default_flow>*] – To connect the flow and the flow selector at the ingress or egress. ***<flow_selection_criteria>*** can be **none**, **p_bits** or **dscp**. ***<flows>*** can be a number, range or list of numbers, with valid values 1 to 8. ***<default_flow>*** is any number in <***flows***>.

second_p_tag *<tag>*/transparent – The 3-bit *user priority* in the 4-byte IEEE 802.1Q priority tag of outgoing packets may be set to this value. In the alternative *transparent mode*, the p-tag in incoming packets is used unchanged. Range 0 to 7, transparent.

first_ethertype {q_valn|s_vlan|s_vlan_9200| transparent|vman_vlan} - Tag Protocol Identifier for the first tag.

second_ethertype {q_vlan|s_vlan|s_vlan_9200| transparent|vman_vlan} – Tag Protocol Identifier for the second tag.

tag *<VLAN-id>*/transparent/untagged – VLAN ID for packets forwarded on this egress connection. Range for VLAN ID is 1 to 4095.

second_tag *<VLAN-ID>*/transparent/untagged – Second VLAN ID for packets forwarded on this egress connection. Range for VLAN ID is 1 to 4095.e

tags *<list-of-VLAN-IDs>*/untagged/* – LAN ID's that are forwarded on this ingress connection. The list of VLAN IDs is a Range from 1 to 4095. * will forward all VLAN IDs. Different options may be combined by comma (,). Range may be given as ID,ID,ID (three vlan IDs) or ID-ID (all VLAN IDs between the first and last VLAN IDs). If double tagged frames are used (`second_tags` is configured), only single VLAN IDs, * or untagged may be used (not range).

second_tags *<VLAN-ID>*/untagged – Second VLAN ID's that are forwarded on this ingress connection. Range for each VLAN ID is 1 to 4095.

filter_profile *<profile>* – The filter profile to be used.

ip_destinations – IP destination can be used as a traffic mapping mechanism, in order to identify a service by its IP destination, for example, a multicast group address, or a BRAS address. This way it is possible to send End-user traffic of different types to different switching domains even though they have the same VLAN tag or are not tagged at all.

The following limitations are in effect with respect to the range of IP addresses:

- The first IP-Address must be less than the second IP-Address

- The IP-Addresses must form a valid network that can be expressed with the /nn notation

233.0.0.0-233.0.0.7	OK because this is a valid network (233.0.0.0/29).
233.0.0.0-233.0.0.8	Not OK since this is not a valid network (end address is illegal).
233.0.0.1-233.0.0.7	Not OK since this is not a valid network. Start address is invalid in combination with this end address.

Default Settings
bandwidth_limitation: none
broadcast_allowed: yes
description: undefined
p-tag: 0

second_p_tag: 0
tag: transparent
second_tag: untagged
tags: all
flow_selection_criteria: none
second_tags: untagged
filter_profile: none

Command Usage

The command is used to connect a port with a switching domain. Instead of specifying an Ethernet port, a host port can be specified using the command **`connect host_port`**. Note that if no bandwidth_limitation is allocated, the bandwidth limitation function will not be activated for the connection and the connection has unlimited bandwidth.

It is possible to configure the switching domains in the EFN324 to have one or two VLAN tags (QinQ) attached.

The QoS type for the individual flows of a switching domain may be specified using this command.

Example:

```
efn# connect vlan 2 ethernet_port 2 egress p_tag
transparent broadcast_allowed

efn# connect vlan 2 ethernet_port 2 egress tags
3,4,untagged

efn# connect vlan 2 ethernet_port 2 egress tags *,untagged

efn# connect vlan 2 ethernet_port 2 egress tags 20-35
```

13.8.7 disconnect vlan

Use this command to disconnect a port from a specified switching domain (the first command in **Syntax**) or to disconnect a port from all switching domains (second and third command in **Syntax**).

Syntax

```
disconnect vlan <vlan> {ethernet_port <port>|host-port}

disconnect ethernet_port <port>

disconnect host-port
```

Arguments:

vlan ***<vlan>*** **–** Set the number of the Switching Domain. Range 1 to 200.

ethernet_port ***<port>*** **–** Set the number of the Ethernet port. Range 1 to 26.

host_port – The port between the network processor essentially working at level 2 and the host processor working at layer 3 and higher layers.

Default Setting

None.

Example:

```
efn# disconnect vlan 2 ethernet_port 2

efn# disconnect ethernet_port 2
```

13.8.8 set bandwidth_limitation

Use this command to define bandwidth limitation profiles. The command **reset bandwidth_limitation** will reset to default values.

Syntax

```
set bandwidth_limitation <type>
[bandwidth <bandwidth>]
[burst_tolerance {<burst_tolerance>/auto}]
```

Arguments:

<type> **–** ***none***, predefined profiles index, range 1 to 8 (which can be modified by the user), or user-defined profiles, range 9 to 32.

<bandwidth> – The bandwidth limit in kbits/s.

<burst_tolerance> – The burst tolerance in ms or auto (for automatic calculation, see below). Range 1 to 40 000 and **`auto`**.

Default Settings

Resource	Bandwidth limit [kbps]	Minimum Burst tolerance [millisecond]
bandwidth_limitation 1	500	40 000
bandwidth_limitation 2	1 000	20 000
bandwidth_limitation 3	2 000	10 000
bandwidth_limitation 4	5 000	4 000
bandwidth_limitation 5	10 000	2 000
bandwidth_limitation 6	25 000	800
bandwidth_limitation 7	50 000	400
bandwidth_limitation 8	100 000	200
Bandwidth_limitation 9 - 32	0	auto

Command Usage

The command is used to define a bandwidth limitation profile that is used when connecting a port to a switching domain, see section 13.8.23 on page 141.

Note that for profiles 9 to 32, no default bandwidth is configured. If these profiles are used without configuring bandwidth, all traffic on the connection is discarded.

When setting other bandwidth limits the ‘auto’ alternative for burst tolerance it is recommended. At ‘auto’ the burst tolerance is calculated as 20 000 kilobits divided by configured bandwidth limit.

Example: bandwidth 10 000 kbits/s, burst tolerance = 20 000 kilobits/10 000 kbps = 2 s = 2000 ms.

Caution!

Burst tolerance values that are set lower than the default values may cause too strong a limitation of the flow.

Example:

```
efn# set bandwidth_limitation 12 bandwidth 12000
burst_tolerance auto
```

13.8.9 set connection

Use this command to configure specific attributes that may be associated with a connection between a switching domain and an Ethernet port. See also **add connection** in section 13.8.1 on page 107. Use the command **reset connection** to reset to default values and **unset connection** to reset to undefined values.

Syntax

```
set connection vlan <vlan> ethernet_port <port>
[multicast_group_limit <groups>]
[option_82_remote_id <remote-id>]
[option_82_circuit_id <circuit-id>]
```

```
unset connection vlan <vlan> ethernet_port <port>
static_multicast_groups
```

Arguments:

vlan *<vlan>* – The number of the Switching Domain. Range 1 to 200.

ethernet_port *<port>* – The number of the Ethernet port. Range 1 to 26.

multicast_group_limit *<groups>* – Maximum number of simultaneously active multicast streams, that is, how many streams can be ‘joined’ at a certain point of time. This parameter is defined using **set** or **unset** commands. Range 1 to 100 or undefined.

option_82_remote_id *<remote-id>* - Content of remote ID Suboption to be used for Option 82. This parameter is used when option_82 is set to configurable, see section 13.8.23 on page 141. This parameter is defined using **set** or **unset** commands.

option_82_circuit_id <*circuit-id*> - Content of Circuit ID Sub option to be used for Option 82. This parameter is used when option_82 is set to configurable, see section 13.8.23 on page 141.
This parameter is defined using **set** or **unset** commands.

static_multicast_groups – This parameter is only defined for the **unset** command. It sets the static_multicast_groups IP address to an undefined value. The **add connection** command in section 13.8.1 on page 107 is used to assign an IP address to the static_multicast_groups.

Default Settings

option_82_circuit_id: undefined
option_82_remote_id: undefined
multicast group limit : undefined

Example:

```
efn# set connection vlan 100 ethernet_port 4 option_82_
remote_id London option_82_circuit_id Site72
```

13.8.10 set connection_flow

Use this command to define the quality of service parameters on the ingress flow which do not belongs to a QoS global flow.

reset connection_flow vlan <vlan> ethernet_port <port> ingress flow <flows> resets the ingress flow values specified to the defaults.

reset connection_flow vlan <vlan> ethernet_port <port> egress flows <flows> resets the egress flow values specified to the defaults.

Syntax

```
set connection_flow vlan <vlan> ethernet_port <port>
[ingress flow <flows>]
[flow_identifying_values <flow_identifying_values>]
[reliability <reliability>]
[priority <priority>]
```

Arguments:

vlan ***<vlan>*** **–** Insert the number of the Switching Domain. Range 1 to 200.

ethernet_port ***<port>*** **–** Insert the number of the Ethernet port. Range 1 to 26.

<flows> **–** A single value, range or list of flow numbers. Range 1 to 8.

flow_identifying_values ***<flow_identifying_values>*** **– DEPRECATED.**
Identifies the QoS the flow is associated with. **There is a unique value valid, 1; values 2 to 8 are admitted but have no action. This parameter can be omitted.**

reliability ***<reliability>*** **–** Decides the cell-limit and the threshold group limit for the port. Values: **highest, high, medium, low** and **lowest.**

priority ***<priority>*** **–** Decides the flow priority. Values: **highest, high, medium** and **low.** The priority selects the queue that the packet is placed in at the egress port.

marking <marking> – Specify the p-bits to overwrite the p-bits in the outer VLAN. Values are **none** or a range **0** to **7.** To use the original p-bit from the received packet, **none** must be selected AND the connection **p_tag** and **second_p_tag** must be configured as transparent.

Default Settings

flow_identifying_values: 1
reliability: medium
priority: medium

marking: none

Command Usage

Quality of service parameters are defined for each ingress flow. The **connect vlan** command (see section 13.8.6 on page 114) is used to select this command, which is used when flow selector is none..

Example:

```
efn# set connection_flow vlan 20 ethernet_port 1, 25 ingress flow 1 priority low reliability lowest marking 7
```

13.8.11 set connection_flow node_level

Use this command to define the quality of service.

`reset connection_flow node_level flow <*/[1-4]>` resets the ingress flow values specified to the defaults.

`get connection_flow node_level flow <*/[1-4]>` gets the ingress flow values.

Syntax

```
set connection_flow node_level flow <1/2/3/4> priority
<low/medium/high/highest> reliability
<lowest/low/medium/high/highest> marking
<none/0/1/2/3/4/5/6/7/Transparent>.
```

Arguments:

`flow <1/2/3/4>` – Insert the Flow_ID. Range 1 to 4.

`priority <low/medium/high/highest>` – Insert priority on the exit queue. Default is medium.

`reliability <lowest/low/medium/high/highest>` – Insert the reliability. Default is medium.

`marking <none/0/1/2/3/4/5/6/7/transparent>` – Insert the outgoing p-bit marking. Default is none.

Default Settings

reliability: medium
priority: medium
marking: none

Command Usage

Quality of service parameters are defined for ingress flows. The **`connect vlan`** command (see section 13.8.6 on page 114) is used to select whether the QoS is based on p-bits or DSCP values. In the **`set connection_flow`** command, the QoS is defined for each p-bit or DSCP value of the flow. Same configuration (defined for the flows 1-4 using “set connection_flow node_level” command) is used for both DSCP and p-bit QoS criteria.

Example:

```
efn# set connection_flow node_level flow 1 priority low
reliability lowest marking transparent
efn# set connection_flow node_level flow 2 priority medium
reliability medium marking transparent
efn# set connection_flow node_level flow 3 priority high
reliability high marking 4
efn# set connection_flow node_level flow 4 priority
highest reliability highest marking 6
```

13.8.12 set cpu

Use this command to set basic IP parameters. The command **reset cpu** is used to reset to default values and **unset cpu** o reset to undefined values.

Syntax

```
set cpu [broadcast_address <IP-address>]
[default_gateway <IP-address>]
[dns_primary_nameserver <IP-address>]
[dns_search_domain <string>]
[dns_secondary_nameserver <IP-address>]
[ip_address <IP-address>]
[method {static|dhcp}]
[net_mask <IP-netmask>]
[automatic_configuration <yes/no>]
```

Arguments:

broadcast_address ***<IP-address>*** – IP broadcast address. Equal to the masked IP address, though filled with ‘1’s instead of ‘0’s after the mask. It may be used by certain protocols, for example, NTP.

default_gateway ***<IP-address>*** – Default gateway.

dns_primary_nameserver ***<IP-address>*** – Primary name server.

dns_search_domain ***<string>*** – DNS search domain is a string, for example ericsson.nl.

dns_secondary_nameserver ***<IP-address>*** – Secondary name server.

ip_address *<IP-address>* – The IP address of the host processor (EFN324 external IP address). Can be specified as dotted number or domain name. It may also be undefined. If this parameter is used (specified or changed), the net_mask parameter must also be specified.

method {static|dhcp} – The IP address method. “static” allows the definition of a static IP address for the node, and is used for stand-alone nodes. “dhcp” causes the node to send a DHCP request to obtain an IP address, and is used for embedded nodes.

net_mask *<IP-netmask>* – The IP address mask.

automatic_configuration <yes|no> - sets the management connections on the management switching domain 1 for ethernet ports 25 and 26 with ingress and egress tag as 247. (For example vlan 1 in EFN324 is connected with 25,26,host and ingress and egress tag as 247 for ethernet_ports 25 and 26).

Note: When the method is **dhcp** and **automatic_configuration is <yes>**, the EFN 324 will get the IP address dynamically as it sends the DHCP request to the DHCP server. At the same time the Management connections with vlan 1 connected to ports 25,26, host_port ith ingress and egress tag as 247.(This occurs when automatic_configuration changed from “no” to “yes” and also when the EFN node restarts with no permanent configuration.)This is used for EFN as Embedded Node.

Default Setting

method is **dhcp**.

Command Usage

The command is used to set IP parameters that are necessary for the EFN324 to work in the network.

Note: Resetting the IP address endangers communication with the system over the network.

Example:

```
efn# set cpu ip_address 71.22.33.4 net_mask 255.255.255.0
default_gateway 71.22.33.1
```

13.8.13 set cpu restart_dhcp

Use this command to force the cpu to restart the DHCP IP address request. The command **`get cpu restart_dhcp`** is used to get the current status of DHCP restart. In order for this command to work, the method (get cpu method) should be dhcp. If the method is static and the restart_dhcp command is executed then error will be thrown.

Syntax

```
set cpu restart_dhcp < param>
```

Arguments:

`<param>` **–** Values allowed are failed, start and success.

success – to indicate DHCP restart success.

start – to restart DHCP.

failed – to indicate DHCP restart failure.

Only a value of 1”start” can be used for the `set cpu restart_dhcp command`. On setting it to 1”start” DHCP procedure on EFN shall be restarted. The get command will display the current status of DHCP restart.

Note: When the EFN is in IPSec mode, the communication between the ECN and the embedded nodes is protected by IPSec and the local serial management interfaces disabled.

Example:

```
efn# set cpu restart -dhcp start
```

Note: Since the IPSec mode is forced by the DHCP message, it is possible to check whether the node is working in IPSec mode by asserting the `get cpu` command.

Example:

```
efn# get cpu
                     Key Value
........................ .................
                  method static
             mac_address 00:13:5E:78:c5:99
              ip_address 10.66.16.13
                net_mask 255.255.255.128
         default_gateway 10.66.16.1
            restart_dhcp success
>>>>>>>>>>> ipsec_status disabled <<<<<<<<<<<<<<<<<<<
 automatic_configuration no
       broadcast_address
  dns_primary_nameserver
       dns_search_domain
dns_secondary_nameserver
           syslog_server
                  uptime 99 days
                   users
```

13.8.14 set ethernet_port

Use this command to configure parameters for the Ethernet port.

Syntax

```
set ethernet_port <port> [auto_negotiation {no|yes}]
[crossover {auto|no|yes}]
[description] [duplex {full|half}]
```

```
[enabled {no|yes}]
[link_trap_enabled {no|yes}]
[scheduling {none|sfq|sp|wfq}]
[speed {10|100}]
```

Arguments:

ethernet_port *<port>* – The number of the Ethernet port. Range 1-26.

auto_negotiation no/yes – Set up the line automatically (yes) or not.

crossover auto/no/yes – Auto: The system does it automatically. No: Straight through connection. Yes: Crossover set.

description – Description.

duplex full/half – The line is set up as full duplex or half duplex connection.

enabled no/yes – Operational state set by operator.

link_trap_enabled no/yes – Defines whether changes in link state (link up/down) for the port are sent as SNMP traps.

scheduling none/sfq/sp/wfq – Scheduling algorithm deciding the order between packets sent over the egress port:

- none = first in, first out
- sfq = a combination of sp/wfq (Modified Deficit Round Robin)
- sp = strict priority
- wfq = weighted fair queuing (Deficit Round Robin)

speed 10/100 – 10 or 100 Mbps for Fast Ethernet (FE).

Note: In case the user needs to change the scheduling policy, e.g. asserting the command `set ethernet_port <port> scheduling {none|sfq|sp|wfq}` and on that <`port`> connections are configured, then the configuration asserted will be visible in case a `get ethernet_port <port>` is asserted but the configuration will be active on the hardware only after a `config save` and then a `restore`. This is outlined on the CLI by the following message:

```
*** WARNING!!!!
```

```
ethernet_port                                              Warning message
------------- -----------------------------------------------------------
           10   "Cannot change scheduling for a Ethernet Port having active
               connections. For scheduling to be applied in Hardware either
              disconnect the connections and set the scheduling or save the
                                               configuration and restore it."
```

Default Settings

auto_negotiation: yes
crossover: auto
duplex: full
enabled: yes
link_trap_enabled: yes
scheduling: sp
speed: 100

Example:

```
efn# set ethernet_port 2 enabled yes link_trap_enabled yes
scheduling sfq
```

13.8.15 set filter_profile

Use this command to define filters and actions that optionally may be added to the switching rule collection in the network processor. Use the command **reset filter_profile** to reset to default values.

Syntax

```
set filter_profile <filter-profile>
global_filter_<global-filter>
{change_da <mac-address> |drop|forward|send_to
 {ethernet_port <port>|host_port <host-port>
 |vlan <vlan>}}
```

Arguments:

<filter-profile> – Filter profile number. Range 1 to 8.

<global-filter>* change_da *<mac-address>* /drop/forward/send_to ethernet_port *<port>*/host_port *<host-port>*/vlan *<vlan> – Action to be taken when the packet matches with the global filter. 8 global filters can be defined (or none) and inserted.

The actions specified above have the following meanings:

change_da ***<mac-address>*** **–** The destination MAC address in the packet header is replaced with the specified address.

drop - The packet is discarded.

forward – The packet is let through.

send_to ethernet_port <port>/host_port *<host-port>*/vlan *<vlan>* – The packet is sent to the specified port or switching domain.

Default Setting

Forward for all filters.

Command Usage

When an ingress connection is defined, see section 13.8.6 on page 114, one of the eight predefined instances of filter_profiles may be allocated to the ingress connection.

Each filter_profile object has 8 attributes, global_filter_1, … global_filter_8, referring to one and each of the 8 global_filter objects, global_filter 1 … global_filter 8.

Matching starts with global_filter_1; if the matching result is positive, that is the packet header content is consistent with the global_filter 1, then actions that are specified at global_filter_1 are taken. When the matching gives a positive result, the other global filters are skipped, otherwise matching with global_filter_2 is performed.

In case matching with global_filter_N gives a negative result then matching with global_filter_N+1 is done and so on until either a positive match is made or all 8 global_filter have been tested. In the latter case, actions defined for global_filter_none are performed.

Example:

```
efn# set filter_profile 1 global_filter_1 send_to
ethernet_port 2
```

13.8.16 set global_filter

Use this command to define the global filters that are used in `filter_profile` definitions.

Syntax

```
set global_filter <global-filter> da {integer|mac-address|
all|broadcast|local|multicast}

set global_filter <global-filter> da_mask {integer|mac-
address}

set global_filter <global-filter> enabled {no|yes}

set global_filter <global-filter> sa {integer|mac-address|
all|local}

set global_filter <global-filter> sa_mask {integer|mac-
address}

set global_filter <global-filter> type {<type>|all|arp}

set global_filter <global-filter> type_mask <type>
```

Arguments:

<global-filter> **–** Global filter number. Range 1 to 8.

da integer/mac-address/all/broadcast/local/multicast/da_mask – Destination address. **integer:** decimal figure. **all**: corresponding mask is set to all zeros. **broadcast**: both da and da_mask are set to all ones. **local**: second bit in da and da_mask are set to ones, all others to zeros. **multicast**: first bit in da and da_mask are set to ones, all others to zeros.

da_mask integer/mac-address – Address mask of the destination.

enabled no/yes – Enabled or disabled by the operator.

sa integer/mac-address/all/local – Source address. **integer:** decimal number. **all**: corresponding mask is set to all zeros. **local**: second bit in da and da_mask is set to ones, all others to zeros.

sa_mask integer/mac-address – Address mask of the source.

type *<type>*/all/arp – Type. Range: 0 to 65535 (arp = hex 0806 = dec 2054, all = dec 65535). **all**: corresponding mask is set to all zeros. **arp**: type is set to 08:06 (INTEGER 2054), type_mask to ff:ff.

type_mask *<type>* – Type mask.

Note: The type that is set, for example **`all`**, overrides the mask that is seen with the **`get`** command.

Default Settings

da: all
da_mask: ff:ff:ff:ff:ff:ff:ff
enabled: no
sa: all
sa_mask: ff:ff:ff:ff:ff:ff:ff
type: all
type_mask: ff:ff

Command Usage

Each global filter defines matching conditions for destination address, source address and type in the Ethernet packet header. The result of the matching against an Ethernet packet is positive when the packet header content is in harmony with the filter definition, otherwise the result is negative.

For each of these three items, a corresponding mask may also be defined. A mask defines which bits are considered at matching.

Furthermore, each filter may individually be enabled or disabled by an operator. When it is disabled all match results are negative, that is, the global filter in question does not filter out any packets at all.

MAC addresses may be given in MAC address format, that is in colon separated pairs of hexadecimal numbers, for example, 11:12:13:14:15:16. Alternatively, the MAC address may be given in decimal numbers (integer). 11:12:13:14:15:16 must then be written: 18769327166742.

Example:

```
efn# set global_filter 1 da broadcast type arp
```

13.8.17 set node_control

Use this command to set global parameters. **`reset node_control`** sets all the node control parameters to default values.

Syntax

```
set node_control
[default_vlan vlan <1-200>]
[eda_vmac_format {yes|no}]
[flexible_block_id <switch_id>]
[network_element_id <0-8191>]
[relay_agent_eda_ip <ip_address>]
[relay_agent_eda_sid <sid_value>]
[vmac_address_node_id <0-8191>]
[transfer_protocol <ftp/ftps/sftp/tftp]
[username <undefined>]
[password <undefined>]
[telnet_service <yes|no>]
```

Arguments:

`default_vlan vlan <1-200>` – this configures the switching domain for the transit traffic in an embedded daisy chain. All traffic received on an uplink port with an unknown service (for example, an unknown VLAN ID), is forwarded on the transit_link port. Use **`vlan 2`** as the **`default_vlan`** to be compatible with the EMP and PEM.

`eda_vmac_format {yes|no}` – **`no`** selects stand-alone EFN324 VMAC address format, and **`yes`** selects embedded EFN324 VMAC address format.

`flexible_block_id <switch_id>` – The flexible block identification number for an embedded node. **`switch_id`** is a number from 1 to 254. Zero and 255 are reserved values. A value of zero causes the DHCP option 60 to not include the Switch ID.

`network_element_id <0-8191>` – Set the network element ID to a single integer value, from 0 to 8191. The value is inserted into the 13-bit Network ID field in the VMAC frame.

`relay_agent_eda_ip <ip_address>` – Set an IP address as the the relay agent EDA IP, to be used in EDA and TR101 DHCP option 82 formats. The IP address is not the EFN's IP address, but a configurable address representing the IP address of the Ethernet Access Node (EAN).

`relay_agent_eda_sid <sid_value>` – Set the relay agent EDA SID, to be used in EDA and TR101 DHCP option 82 formats. Range is 0 to 65535.

vmac_address_node_id <0-8191> – Set the VMAC address Node ID to a single integer value, from 0 to 8191. The value is inserted into the first 13 bits of the Port ID field in the VMAC frame.

[Transfer_protocol <ftp|ftps|sftp|tftp>] – configures the SFTP (Secured FTP) and FTPS(Secured using SSL) Protocols which are used for the Software upload/download , upload/download configuration and automatic configuration download.

[username <undefined>] – configures the authenticated user with the name (string) that is going to do the Software upload/download , upload/download configuration an ainly automatic configuration downloa nd backup using SFTP/FTPS protocols.

[password <undefined>] – configures the password for the user, that is going to do the Software upload/download , upload/download configuration and mainly used for automatic configuration download and backup using SFTP/FTPS protocols which is encrypted by EFN324.

telnet_service <yes|no> – Enable or disable the Telnet services on EFN324. If this is set to no, then the EFN will not connected successfully through telnet session by the user.

Note: Reset node_control sets all the node control parameters to default values.

Default Settings

eda_vmac_format is **no**.
flexible_block_id is **0** (zero).
network_element_id is **0** (zero).
relay_agent_eda_ip is **0.0.0.0**.
relay_agent_eda_sid is **0** (zero).
vmac_address_node_id is **0** (zero).
transfer_protocol is tftp (default)
username <undefined>.(no default value)
password <undefined>. (no default value)
telnet_service is **yes**

Command Usage

The command is used to set global parameters.

Example:

```
efn# set node_control flexible_block_id yes 234

efn# set node_control transfer_protocol ftp

efn# set node_control username ericsson

efn# set node_control password ericsson

efn#set node_control telnet_service yes
```

13.8.18 set rapid_spanning_tree

Use this command to define a Rapid Spanning Tree (RSTP) instance. The rapid spanning tree function is activated with the **`add rapid_spanning_tree`** command, see section 13.8.4 on page 110. Use the command **`reset rapid_spanning_tree`** to reset to default values.

Syntax

```
set rapid_spanning_tree <id> [forward_delay <delay>]
[hello_time <time>]
[ max_age <max-age>]
[priority <priority>]
[protocol_version {ieee8021d_1998| ieee8021w_2001}]
```

Arguments:

> ***`<id>`*** – 10 different RSTP instances can be defined. The range is 1 to 10.
>
> **`forward_delay`** ***`<delay>`*** – Delay before forwarding RSTP state changes. Used only in STP mode. Range 4 to 30 seconds.
>
> **`hello_time`** ***`<time>`*** – Set how often BPDUs are sent. Range 1 to 10 seconds.
>
> **`max_age`** ***`<max-age>`*** – The maximum time a device can wait without receiving a configuration message before attempting to reconfigure. Range 6 to 40 seconds. If a bridge does not get a Hello BPDU after max_age, the bridge assumes that the link to the root bridge is down. This bridge then initiates negotiations with other bridges to reconfigure the network to re-establish a valid network topology.
>
> **`priority`** ***`<priority>`*** – Priority of the bridge. Range is 0 to 61440, in steps of 4096, in other words: 0, 4096, 8192, 12288, 16384, 20480, 24576,

28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344 or 61440. Priority affects which node becomes root. The node with lowest priority value becomes root.

`protocol_version {ieee8021d_1998|ieee8021w_2001}` – Defines the RSTP standard. The range is ieee8021d_1998 or ieee8021w_2001.

Default Settings

forward_delay: 15
hello_time: 2
max_age: 20
priority: 36864
protocol_version: ieee8021w_2001

Command Usage

The Rapid Spanning Tree function is relevant only when the EFN324 is located in a network with alternative or redundant links. For example, when there are two redundant ‘uplinks’, or when the EFN324 is one of several daisy chained switches with an ‘uplink’ at each end of the chain.

Up to ten different RSTP configurations may be defined.

The function is activated or deactivated on relevant ports using the **`add`** or **`remove`** command.

Setting of **`priority`** defines the place of the node in the spanning tree.

Example:

```
efn# set rapid_spanning_tree 1 forward_delay 4 hello_time
1 max_age 6 priority 12288 protocol_version ieee8021d_1998
```

13.8.19 set real_time_clock

Use this command to handle the systems real time clock. Use the command **`reset real_time_clock`** to reset to default values.

Syntax

```
set real_time_clock [date <date>] [time <time>]
[ntp_version <version>]
```

[ntp_client {disabled|broadcast|multicast|unicast *<IP-address>*}]

Arguments:

<date> – Year – month – day, for example, 2010-09-23.

<time> – hour:min:sec. For example, 03:53:39.

<version> – NTP version.

disabled/broadcast/multicast/unicast *<IP-address>* – The IP address of the NTP server.

Default Setting

ntp_client: disabled

Command Usage

The command is used to set parameters for using the Network Time Protocol. Thereby information about date and time (hours, minutes, seconds) is available.

Example:

```
efn# set real_time_clock time 12:10:01 date 2005-11-02
ntp_version 4 ntp_client multicast
```

13.8.20 set snmp

Use this command to configure SNMP. Use the command **reset snmp** to reset to default values and **unset snmp** to reset to undefined values.

Syntax

```
set snmp [read_community <read-com>]
[sys_contact <string>]
[sys_location <sys-loc>]
[sys_name <sys-name>]
[trap_community <trap-com>]
[trap_receiver1 <IP-address>]
[trap_receiver2 <IP-address>]
[trap_receiver3 <IP-address>]
[write_community <write-com>]
```

[version < ***snmpv3|snmpv2|snmpv3_v2>*****]**

Arguments:

read_community ***<read-com>*** **–** SNMP variable read access rights. An arbitrary text string, compare to a password.

sys_contact ***<string>*** **–** Information of whom to contact. Phone number, mail address and so on.

sys_location ***<sys-loc>*** **–** Information about the physical location of the system.

sys_name ***<sys-name>*** **–** System name.

trap_community ***<trap-com>*** **–** SNMP variable for access rights to traps. An arbitrary text string, compare to a password.

<IP-address> **–** IP address to a trap receiver.

version <snmpv3|snmpv2|snmpv3_v2> **–** SNMP version with which the EFN324 is configured. There is three options:

- ***<snmpv3>*** **–** SNMPv3 version on the EFN324
- ***<snmpv2>*** **–** default SNMP version value on the EFN324.
- ***<snmpv3_v2*** **–** V3 in read(get) and write(set) mode and v2 in read(get) mode and not in write(set) mode for the MIB object instances.

Note: When EFN is in SNMPv3_v2 mode and MIB browser in V3 mode, all the access permissions as just as SNMPv3.
When EFN is in SNMPv3_v2 mode and MIB browser in v2 mode, all v3 access permissions and only v2 read permissions are acceptable to the End-user.

Default Setting

read_community: public
sys-contact: undefined
sys-location: undefined
sys_name: EFN324
trap_community: standard trap
write_community: public
trap-receiver1: undefined
trap-receiver2: undefined

trap-receiver3: undefined
version: snmpv2

Command Usage

The command is used to configure SNMP access rights and IP addresses to trap receivers. Up to three receivers of traps can be defined. All defined receivers will receive the same traps.

Example:

```
efn# set snmp read_community public sys_location Site46
trap_community trap_receiver1 172.1.1.1
```

```
efn# set snmp read_community public sys_location Ericsson
trap_community standard_trap  trap_receiver1 192.168.106.72
version snmpv3
```

EFN will be configured with SNMPv3 Successfully

```
efn# set snmp read_community public sys_location Ericsson
trap_community standard_trap  trap_receiver1 192.168.106.72
version snmpv3_v2
```

EFN will be configured with SNMPv3_v2 successfully.

```
efn# set snmp read_community public sys_location Ericsson
trap_community standard_trap  trap_receiver1 192.168.106.72
version snmpv2
```

EFN will be configured with default SNMPv2 mode successfully.

13.8.21 set software

Use this command to set the maximum time for trying to upload a software release. Use the command **reset software** to reset to default values.

Syntax

```
set software load_timer <time>
```

Arguments:

<time> – The maximum time for trying to upload a software release. Range 10 to 120 minutes.

Default Setting

load_timer: 20

Command Usage

This is the time that the EFN CLI process will wait for a response from the upgrade process after the upload is initiated. If no response has been received after the specified time, the EFN will restart.

Example:

```
efn# set software load_timer 10
```

13.8.22 set spanning_tree

Use this command to define the Spanning Tree (STP) function. The command is activated using the **add spanning_tree** command, see section 13.8.5 on page 112. Use the command **reset spanning_tree** to reset to default values and **unset spanning_tree** to reset to undefined values.

Syntax

```
set spanning_tree <tree> [forward_delay <delay>]
[hello_time <time>][ max_age <max-age>]
[priority <priority>]
```

Arguments:

<tree> – 10 different STP configurations can be defined.

<delay> – Delay for forwarding state changes on STP. Range 4 to 30.

<time> – Configure the spanning tree bridge hello time. Range 1 to 10 seconds.

<max-age> – The maximum time a device can wait without receiving a configuration message before attempting to reconfigure. Range 6 to 40 seconds.

<priority> – Priority of the bridge. Range 0 to 65535.

Default Settings

forward_delay: 5
hello_time: 2
max-age: 20
priority: 32768

Command Usage

The command defines the Spanning Tree (STP) function. STP is the older of STP and RSTP and should only be used if the EFN is used in a context where collaborating nodes lack RSTP support.

The Spanning Tree (STP) function is relevant only when the EFN switch is located in a network with alternative or redundant links. For example, when there are two redundant ‘uplinks’, or when the EFN is one of several daisy chained switches with an ‘uplink’ at each end of the chain.

Up to 10 different STP configurations may be defined although usually only one or two are needed. The function is then activated or deactivated on relevant ports using the add or remove commands specified below.

Setting of **`priority`** might in exceptional cases be an exception to that rule in order to affect which node becomes root (the one with lowest value on priority). In an aggregation network the most central node is the root.

Example:

```
efn# set spanning_tree 1 forward_delay 10 hello_time 4
max_age 10
```

13.8.23 set vlan

Use this command to configure parameters of the switching domains. Use the command **`reset vlan`** to reset to default values and **`unset vlan`** to reset to undefined values.

Syntax

```
set vlan <vlan>
[allow_anonymous_multicast_subscriber {no|yes}]
[arp_and_dhcp_tag <tag>] [arp_and_dhcp_second_tag <tag>]
[check_gateway_timer <timer>]
[check_gateway_source_address {no|yes}]
```

```
[description <string>]
[gateway {auto| ip_address <IP-address>| mac_address
 <mac-address>}]
[ip_address {<IP-address>|auto]
[mac_address_learning {no|yes}] [max_dynamic_ip_addresses
<max-dyn-ip>] [max_virtual_mac_addresses <max-vir-mac>]
[multicast {igmp_proxy|igmp_snooping|igmpv3_snooping|
 no|yes}]
[proxy_ip_address <IP-address>]
[igmp_immediate_leave {no|yes}]
[igmp_query_interval <interval>]
[igmp_query_response_interval <interval>]
[option_82 {no|circuit_id_eda|circuit_id_tr101|
 remote_id_eda|remote_id_tr101|configurable|
 vlan_port_mac|vlan_port_sysname}]
[real_mac_dhcp_option <0, 128..254>]
[switching_rule {broadcast|ip_validation|normal|pppoe|
 virtual_mac}]
[transit_link {ethernet_port <port>|none}]
[uplink {ethernet_port <port>|none}]
```

Arguments:

vlan ***<vlan>*** – Set the number of the Switching Domain. Range 1 to 200.

allow_anonymous_multicast_subscriber {no|yes} – When the switching_rule is configured to ip_validation or virtual_mac and multicast is configured to yes, igmp_snooping or igmp_proxy, then this setting determines whether EFN324 will validate source IP address in multicast packets.
The default value is ‘no’ which implies that the EFN324 will validate the source address. Configure allow_anonymous_multicast_subscriber to 'yes' only when a client needs to send multicast traffic and it uses an IP address unknown by the EFN as source address.

arp_and_dhcp_tag ***<tag>*** – The inner tag used for upstream ARP and DHCP messages (on downstream VLAN from gateway). Range 1 to 4095. This defines a parallel VLAN.

arp_and_dhcp_second_tag ***<tag>*** – The outer tag used for upstream ARP and DHCP messages (on downstream VLAN from gateway). Range 1 to 4095. This defines a parallel VLAN.

check_gateway_source_address {no|yes} – Set this parameter to ‘no’ to avoid discarding frames with a destination address that is not equal to the MAC address of the gateway. Using this option is not recommended and it may be deprecated later.

check_gateway_timer ***<timer>*** **–** Time between polling of the gateway with an ARP request. Range 1 to 3600.

description ***<string>*** **–** Description.

gateway auto/IP-address/MAC-address – See Table 13 on page 143.

ip_address ***<IP-address>*/auto** **–** See Table 13 on page 143.

mac_address <*mac-address*> – Table 13 on page 143.

Table 13 Connection between Gateway, IP-Address and MAC-Address

gateway	ip_address	mac_address	Description
Auto	auto (*)	auto (*)	**This is the recommended configuration**. The IP address of the gateway is snooped from a client DHCP Ack. The source IP/MAC address used when resolving the MAC address of the gateway is borrowed from the client. Note: This configuration requires at least one active DHCP Client.
Auto	IP-address	MAC-address	The IP address of the gateway is snooped from a client DHCP Ack. The supplied IP-address and MAC-address are used when resolving the MAC address. This configuration is not recommended.
IP-address	auto (*)	auto (*)	The IP address of the gateway is the one supplied. The source IP/MAC address used when resolving the MAC address of the gateway is borrowed from the client. This configuration is recommended for networks where all clients use static IP.
MAC-address	Don’t care	Don’t care	The MAC address of the gateway is supplied. No ARP is sent towards the gateway, thus the ip_address and mac_address values are not used.

gateway	ip_address	mac_address	Description
Auto	“undefined”	“undefined”	The IP address of the gateway is snooped from a client DHCP Ack. The EFN management IP-address and MAC-address are used when resolving the MAC address. If no management IP address is defined then “0.0.0.0” is used. This configuration is not recommended.
IP-address	“undefined”	“undefined”	The IP address of the gateway is the one supplied. The EFN management IP-address and MAC-address is used when resolving the MAC address. If no management IP address is defined then “0.0.0.0” is used. This configuration is not recommended.

(*) Default value

`mac_address_learning` ***`no/yes`*** **–** Defines whether MAC address learning is active.

`max_dynamic_ip_addresses` ***`<max-dyn-ip>`*** **–** Maximum number of dynamic IP addresses per port. Range 0 to 65535.

`max_virtual_mac_addresses` ***`<max-vir-mac>`*** **–** Maximum number of virtual MAC addresses per port. Range 0 to 255.

`multicast igmp_proxy/igmp_snooping/igmpv3_snooping/ no/yes` **–** Defines whether multicast is allowed.

- **`igmp_proxy`** – activates IGMP version 2 proxy.
- **`igmp_snooping`** – activates IGMP version 2 snooping.
- **`igmpv3_snooping`** – the EFN processes IGMP version 3 packets, but discards IGMP version 1 and IGMP version 2 packets.
- **`yes`** – If no uplink is defined, multicast packets are broadcast. Multicast packets from non-uplinks are forwarded to the current uplink, and multicast packets from the current uplink are forwarded to all non-uplinks.
- **`no`** – multicast packets are discarded.

proxy_ip_address ***<IP-address>*** **–** Defines the IP address that is used by the multicast proxy both upwards and downwards. The default (which is also set by the unset command) is 0.0.0.0.

igmp_immediate_leave ***no/yes*** **–** Activates or deactivates the immediate leave function. Immediate leave can only be activated when the proxy is used.

igmp_query_interval ***<interval>*** **–** Defines the time interval between two queries. Also used to calculate the membership time interval. The range is 1 to 255 seconds.

igmp_query_response_interval ***<interval>*** **–** Defines the time interval that the EFN expects a response after a query. Also used to calculate the membership time interval. The range is 1 to 15 seconds.

option_82 no|circuit_id_eda|circuit_id_tr101|remote_id_eda|remote_id_tr101|configurable|vlan_port_mac –

- See section **8.5 on page 70 for details on DHCP option 82 header formats.**
- **no –** DHCP option 82 is not used.
- **circuit_id_eda –** the EDA format used in the Circuit ID field of DHCP option 82.
- **circuit_id_tr101 –** the TR101 format is used in the Circuit ID field of DHCP option 82.
- **remote_id_eda –** the EDA format is used in the Remote ID field of DHCP option 82.
- **remote_id_tr101 –** the TR101 format is used in the Remote ID field of DHCP option 82.
- **configurable –** option 82 with the Circuit ID and Remote ID Suboptions defined is used (see **set connection** in section 13.8.9 on page 120)
- **vlan_port_mac –** option 82 with information about the VLAN Tag, port number and EFN324 MAC address is used.
- **vlan_port_sysname –** option 82 with information about the VLAN Tag, port number and EFN324 SNMP SYS_NAME is used.

real_mac_dhcp_option <0, 128..254> - The option “0” means that the real MAC option is not enabled. If it is configured to any value from 128 to 254 then the real MAC would be inserted in DHCP packet with that specific option.

switching_rule broadcast/ip_validation/normal/pppoe/ virtual_mac – Define the type of switching. For example, normal switching according to bridging table or for forced forwarding, and so on.

transit_link ethernet_port *<port>*/none – Ethernet_port to which underlying, daisy chained, EFN is connected. Range 1 to 26.

uplink ethernet_port *<port>*/none – Destination port for forced forwarding. Range 1 to 26.

Default Settings

description: undefined
check_gateway_timer: 60
check_gateway_source_address: yes
gateway: undefined
uplink: undefined
transit_link: undefined
ip_address: auto
mac_address: auto
arp_and_dhcp_tag: undefined
mac_address_learning: yes
max_dynamic_ip_addresses: 65535
max_virtual_mac_addresses: 255
multicast: yes
multicast proxy IP address: 0.0.0.0
igmp_immediate_leave: no
igmp_query_interval: 125 seconds
igmp_query_response_interval: 10 seconds
option_82: no
real_mac_dhcp_option: 0
switching_rule: normal

Command Usage

Together with **ethernet_port** and **host_port** the **vlan** command defines connection and switching rules in the switch.

When **switching_rule** = **normal** and uplink is undefined, no forced forwarding mechanisms are activated. Forced forwarding may be activated in three levels:
Level 1: uplink and gateway are set. Packets are now forced up to the gateway.

All downwards directed traffic must have the gateway as Layer 2 source address.
Level 2: **switching_rule** = **IP validation**. Either static or dynamic or both types of IP addresses define which traffic is let through.
Level 3: **switching_rule** = **Virtual MAC**. In addition to the level 1 and 2 functions, the end user's MAC addresses are also exchanged with internal MAC addresses selected and controlled by the system.

If **switching_rule** = **PPPoE** only packets with Ethertypes 0x8863 and 0x8864 are let through. All other packets are discarded.

If IP validation is selected, and at the same time **max_dynamic_ip_addresses** is set to zero, then static IP addresses must be defined too. Note that static IP addresses may be defined even if dynamic IP addresses are allowed. It is suggested that **max_virtual_mac_addresses** is set to **max_dynamic_ip_addresses** plus the number of static IP addresses that are defined.

The **arp_and_dhcp_tag** attribute is used to define a parallel VLAN ID for the uplink traffic to or from a switching domain (**vlan**). Upstream traffic on the uplink is tagged according to the ordinary configured VLAN ID in the switching domain (**vlan**) resource. Downstream traffic from an uplink, marked with this arp_and_dhcp_tag VLAN ID tag, is also accepted by this switching domain.

Option_82 makes it possible for system to add specific end-user information in DHCP messages from end-users so that the DHCP server may include end user identity in the process that allocates the IP address.

Example:

```
efn# set vlan 10 multicast igmp_snooping
```

13.9 System Configuration

Table 14 System Commands

Command	Description	Page
cli	Set parameters for autologout, heartbeat and prompt.	148
copy	Copy a configuration file from a server to the EFN324.	149

execute_file	Execute a file containing a sequence of CLI commands.	150
list	Print a list of all configurations.	151
make_permanent	Make a saved configuration file to be loaded at reboot.	151
main_board	Set the alarm limit for the temperature of the main board.	152
release	Handle the software versions in the memory.	155
remove	Remove a saved configuration file.	153
remove_permanent	Remove the permanent configuration file used at reboot.	153
restore	Restore a saved configuration file.	154
save	Save the current attributes as a configuration file.	157

13.9.1 set cli

Use this command to set parameters for autologout, heartbeat and prompt. Use the command **`reset cli`** to reset to default values and **`unset cli`** to reset to undefined values.

Syntax

```
set cli [autologout <time>] [heartbeat {no|yes}] [prompt
<string>]
```

Arguments:

`autologout <time>` – Set an idle interval after which the CLI auto-logs out. Range 0 to 1000 minutes. At zero, autologout is turned off.

`heartbeat no/yes` – A rotating bar is shown during execution of commands.

`prompt <string>` – Type what must be displayed in the prompt. The new prompt is shown after next login.

Default Settings

autologout: 30 min.

heartbeat: yes.

prompt: “switch#” or by telnet: the IP address followed by an integer starting with one, representing the serial number of the actual command in the session.

Command Usage

The **`set autologout`** command is used to set the idle timeout. By default the CLI will log out after 5 minutes if there is no user input. The **`heartbeat`** is used to activate a rotation bar shown during execution of commands. The **`prompt`** command is used to set the prompt and, for example, make it easier to identify a node.

Example:

```
efn# set cli autologout 60

efn# set cli heartbeat no

efn# set cli prompt 172_30_87_14
```

13.9.2 copy

Use this command to copy a configuration file from a server to the EFN324 using FTP, TFTP, SFTP, FTPS, or to copy a configuration file from the EFN324 to a server.

Syntax

```
config copy <source> <destination>
```

Arguments:

`<source>` – The URL defining the remote file to be copied, or the name of the local configuration file.

`<destination>` – The name of the resulting local file copy, or the URL to copy the file to.

Default Setting

None

Example:

```
172_30_87_14# config copy
tftp://172.30.87.6/EFN_config/172_30_87_14 primary

efn# config copy ftp://username:password@abc.net/
EFN_config/LN01 xyz777

172_30_87_14# config copy primary
tftp://172.30.87.6/EFN_config/172_30_87_14

efn# config copy  primary
ftps://username:password@192.168.106.72/EFN_images/primary.

efn# config copy primary
sftp:/username:password@192.168.106.72/EFN_images/primary.

efn# config copy
ftps://username:password@192.168.106.72/EFN_images/seconda
ry secondary.

efn# config copy
sftp:/username:password@192.168.106.72/EFN_images/secondar
y secondary.
```

13.9.3 execute_file

Use this command to execute a file containing a sequence of CLI commands.

Syntax

execute_file *<URL>*

Arguments:

<URL> – URL defining the file to execute.

Default Setting

None.

Command Usage

Issuing this single command instead of a series of CLI commands may sometimes be attractive. For example, a file can contain a sequence of commands for downloading and restarting the system with a new SW version. In the following example, File_1 contains commands for downloading and restarting the system with a new SW version; File_2 holds commands to be issued, say 15 minutes later, when the new version is found to work all right, to install the new version as permanent.

Example:

```
efn# execute_file tftp://108.112.260.278/File_1

efn# execute_file tftp://www.ericsson.dk/File_2

efn# execute_file ftp://username:password@abc.net/eda2
```

13.9.4 list

Use this command to print a list of all currently locally saved configurations. See also `get configuration` in section 13.11.1 on page 161.

Syntax

```
config list
```

Default Setting

None.

Example:

```
efn# config list
```

13.9.5 make_permanent

Use this command to define which configuration is used if there is a reboot.

Syntax

```
config make_permanent <File name>
```

Arguments:

`File name` **–** The name of the configuration file. Note that the configuration file that PEM has configured is named `primary`.

Default Setting

None.

Command Usage

When using this command, the currently permanent configuration file, if any, will lose its status of being permanent.

Example:

```
efn# config make_permanent test
```

13.9.6 set main_board

Use this command to set the alarm limit for the temperature of the main board. Use the command **`reset main_board`** to reset to default values.

Syntax

```
set main_board temperature_limit <limit>
```

Arguments:

`<limit>` **–** Limit for the temperature, setting when a temperature alarm is issued. Range 20 to 80 °C.

Default Setting

80

Example:

```
efn# set main_board temperature_limit 50
```

13.9.7 remove

Use this command to remove a saved configuration file.

Syntax

config remove <*File name*>

Arguments:

File name – The name of the configuration file. Note that the configuration file that PEM has configured is named `primary`.

Default Setting

None.

Command Usage

The command is used to remove a configuration file that has been saved. The file appointed as permanent cannot be removed using this command. To remove this file use the command **remove_permanent**, see section 13.9.8 on page 153 . All configuration files can be displayed using the command **list**, see section 13.9.4 on page 151.

Example:

```
efn# config remove test
```

13.9.8 remove_permanent

Use this command to remove the permanent configuration file used at reboot.

Syntax

config remove_permanent

Arguments:

–

Default Setting

None.

Command Usage

The command is used to remove a configuration file used at reboot. By removing the file, the factory default values are restored. If no configuration file is designated as permanent, then the default values defined in the SW release are used.

The command **`list`** is used to see all the configuration files, see section 13.9.4 on page 151. The command **`get configuration permanent`** will display the boot file, see section 13.11.1 on page 161.

Example:

```
efn# config remove_permanent
```

13.9.9 restore

Use this command to restore configuration parameters according to a saved configuration file.

Syntax

```
config restore {cancel|<File name>} [after <Time>]
```

Arguments:

`cancel` – Cancel a scheduled restore operation.

`File name` – The name of the configuration file. Note that the configuration file that PEM has configured is named `primary`.

`Time` – The restore operation is delayed by specified number of minutes.

Default Setting

None.

Command Usage

The command is used to restore a configuration file. All resources are reset and reconfigured with parameters according to the specified file.

All configuration files can be displayed using the command **`list`**, see section 13.9.4 on page 151. Using the argument **`after`** ***`<minutes>`*** will delay the restore for the number of minutes entered. This enables the testing of “dangerous” configurations. A delayed restore can be aborted after it has started by using the command **`config restore cancel`**.

Example:

```
efn# config copy tftp://www.server/conf_file new_conf
efn# config restore existing_conf after 100
efn# config restore new_conf

efn# config restore cancel
efn# config make_permanent new_conf
efn# config remove existing_conf
```

13.9.10 release

Use this command to handle the software versions in the memory.

Syntax

`release load` ***`<URL>`***

`release remove` ***`<version>`***

`release make_permanent`

`release start` ***`<version>`***

`release start_permanent`

`release transfer_configuration` ***`<version>`***

Arguments:

> **`release load`** ***`<URL>`*** – Fetch a release from a remote server. The format of the URL is one of following:
> "ftp://user:passwd@host/path"
> "ftp://user@host/path"
> "ftp://host/path"

"tftp://host/path"
“ftps://user:password@hostname/filename”
“sftp://user:password@hostname/filename”.

`release make_permanent` – Appoint the current executing software version to be the permanent version, that is, the version to be executed by default at restart.

`release remove` <***`version`***> – Remove (delete) <***`version`***> from memory.

`release start` <***`version`***> – Restart the system by executing <***`version`***>.

`release start_permanent` – Restart the system by executing the permanent software version.

`release transfer_configuration` <***`version`***> – Copy all configuration files stored on the disk of the currently executing software version to the other disk. The configuration file that is designated as permanent, if any, will keep its status as permanent configuration file in its new location too.

Default Setting

None.

Command Usage

The switch may simultaneously hold two software versions in memory, since there are two memory areas, called Disk 0 and Disk 1, reserved for software and associated configuration files.

In the commands, **`release`** refers to software release.

New software versions may be downloaded from a server using this command. There is room for one alternative program version besides the running current software version. Use the command **`get software`** to see the software status, see section 13.11.1 on page 161.

If two software versions are loaded, the command can be used to define the *permanent* software version, in other words, the one that by default is executed at restart.

Example:

```
efn# release remove R2A

efn# release transfer_configuration CXP_901_0022_P4C04

efn# release start P4C04

efn# release make_permanent

efn# release load sftp://test:test123@192.168.106.72/
CXP_901_0022_R954.tar.gz

efn# release load ftps://test:test123@192.168.106.72/
CXP_901_0022_R954.tar.gz
```

13.9.11 save

Use this command to save the current configuration parameters as a configuration file.

Syntax

config save ***<file>***

Arguments:

<file> – Insert the file name to save the present configuration under.

Default Setting

None.

Command Usage

The command is used to save the current configuration as a configuration file. A saved configuration file can be restored whenever appropriate.

The saved configuration file can be displayed using the command **list**, see section 13.9.4 on page 151.

Example:

```
efn# config save test1
```

13.10 Debugging Commands

The commands listed in Table 15 on page 158 are used when debugging the system. The `error_logger` is automatically enabled and its contents can be viewed using the `get` command described in section 13.11 on page 161.

The `set log` command is used together with the debugging commands.

Table 15 Debugging Commands

Command	Description	Page
packet_logger	Configure, start, stop and reset the packet_logger.	158
trace_logger	Start, stop and reset the trace_logger.	160

13.10.1 set log packet_logger

Use this command to specify the ports, switching domains and protocols for packet logging.

`reset log packet_logger` disables all logging by setting all the packet logger parameters to default values. It also deletes all entries in the packet log.

Syntax

```
set log packet_logger
[ports ethernet_port <ports>]
[vlans vlan <vlans>]
[protocols protocol {arp|igmp|dhcp|rstp_or_stp|all}]
[enabled {yes|no}]
[capture {start|stop}]
```

Arguments:

`ports ethernet_port <ports>` – Specify the port, or range of ports. Range 1 to 26. If `enabled yes` is selected, the specified ports are added to list of the ports for logging, for the specified switching domain(s) and protocol(s). If `enabled no` is selected, the specified ports are removed from the list of the ports for logging, for the specified switching domain(s) and protocol(s).

`vlans vlan <vlans>` – Specify the switching domain, or range of switching domains. Range 1 to 200. If `enabled yes` is selected, the specified switching domains are added to list of the switching domains for logging, for the specified port(s) and protocol(s). If **enabled no** is selected, the specified switching domains are removed from the list of the switching domains for logging, for the specified port(s) and protocol(s).

protocol {arp|igmp|dhcp|rstp_or_stp|all} – arp selects ARP traffic. **igmp** selects IGMP traffic. **dhcp** selects DHCP traffic. **rstp_or_stp** selects both RSTP and STP traffic. **all** selects all of the listed protocols. If **enabled yes** is selected, the specified protocols are added to list of the protocols for logging, for the specified port(s) and switching domain(s). If **enabled no** is selected, the specified protocols are removed from the list of the protocols for logging, for the specified port(s) and switching domain(s).

enabled {yes|no} – yes: this command enables logging on the specified ports, switching domains and protocols. If no ports, switching domains or protocols are specified, logging is enabled for all ports, switching domains and protocols. **no:** this command disables logging on the specified ports, switching domains and protocols. If no ports, switching domains or protocols are specified, logging is disabled for all ports, switching domains and protocols.

capture {start|stop} – This command starts or stops logging for the specified parameters (ports, switching domains, protocols), if enabled for logging. If no parameters are specified, logging is started or stopped for all parameters enabled for logging.

Default Settings

ethernet_port is 1 to 26
vlan is 1 to 200
protocol is **all**
enabled is **yes**
capture is **stop**

Command Usage

The command is used to select the parameters for packet logging, and start and stop logging. A maximum of 1000 packets can be logged. If 1000 logs exist, and an additional packet is to be logged, the first log is deleted, and the new packet is stored as the last log.

Use the **get log packet_logger {parameters|log [<range>|<value>]}** command to view the logging results. The following results are displayed, depending on the option chosen:

- **`parameters`** – Displays a table, with an index number, protocols, switching domains, Ethernet ports and capture status, for all the parameters where logging is enabled.
- **`<range>`** - Displays a table, with summary information (time, switching domain, port, direction (r is received, s is sent), protocol type, source MAC, destination MAC) for each log in the range. If no range is given, the table is displayed for all the logs.
- **`<value>`** - Displays all the information for the specified log, including packet fields, header contents, and packet itself.

Example:

```
efn# set log packet_logger protocol arp enabled yes
capture start
```

13.10.2 set log trace_logger

Use this command for advanced debugging. **`reset log trace_logger`** disables the trace logger on all switching domains and ports and deletes all the existing log entries.

Syntax

```
set log trace_logger enabled {yes|no}
```

Arguments:

`enabled {yes|no} –` **`yes`** enables the trace logger, while **`no`** disables it.

Default Setting

`enabled` is **`no`**

Command Usage

The command is used to start and stop the trace logger, for advanced debugging. Use the **`get log trace_logger`** command to view the log.

Example:

```
efn# set log trace_logger enabled yes
```

13.11 Display Commands

The **get** commands listed in section 13.11.1 on page 161 display information about the configuration and the system. Type **get** in front of the commands listed in the table, for example, **get bandwidth_limitation**

13.11.1 get

To read information about the displayed parameters and values, refer to the command where the parameters are configured (click the page number in the right column). If there can be multiple configurations or statuses for a specific parameter (for example, the status of a port) and multiple ports are shown, the parameters value is empty.

Note: Displayed parameters that are not explained where they are configured, are explained in the table below.

Table 16 Configuration commands

Command	Description	Page
bandwidth_limitation	Display bandwidth limitation in connections.	118
Cli	Display parameters for autologout, heartbeat and the prompt.	148
Configuration	**configurations** - List the configuration files. **latest_restored** – Display the latest restored configuration file. **permanent** – Display the configuration file loaded at reboot.	-
Connection	Display the configuration of a Switching Domain at an IP-port. **dynamic_ip_addresses –** The IP addresses that have been allocated automatically and that are used for IP validation during forced forwarding. These addresses are set independently by the system. **virtual_mac_addresses –** virtual MAC addresses as used during forced forwarding. These addresses are set independently by the system. **Multicast -** Display information about multicast.	107, 120

Command	**Description**	**Page**
connection_flow	**connection_flow node_level flow <*/[1-4]>** - displays the status of the connection flows.	114, 121
Cpu	Display basic IP parameters. **mac_address –** The MAC address of the node. **uptime –** Time in days since last restart. **users –** Number of CLI users logged in. ipsec_status – Specifies if IPSec is enabled or disabled.	124
ethernet_port	Display the configured parameters for the Ethernet port. **actual_duplex –** Full or half, determined by auto-negotiation. **actual_speed –** 10 or 100, determined by auto-negotiation. **auto_negotiation_complete –** yes or no, auto-negotiation process completed. **auto_negotiation_link_partner –** yes or no, depending on whether the link partner has autonegotiation or not. **disabled_by -** Undefined or spanning tree if port is disabled by spanning tree. **egress_connections -** All switching domains connected for outgoing traffic. **ingress_connections –** Switching domains connected for incoming traffic. **ip_destinations** – IP-address, single or a range. **link -** Up or down. **type -** Gigabit or Fast Ethernet.	114, 126
filter_profile	Display defined filters profiles.	129
global_filter	Display defined global profiles.	130
host_accesslist	Display hosts that are allowed to access the management interfaces.	108
host_port	Display the host port, that is the Ethernet internal interface between the network and the host processors. **egress_connections** - list of egress connections, including attributes. **ingress_connections** - list of ingress connections, including attributes.	
Log	Display the **error_logger**, **packet_logger** and **trace_logger**. This information is useful in debugging situations when submitting trouble reports. See section 13.10.1 on page 158 for details on viewing the **packet_logger** results.	158, 160

Command	Description	Page
main_board	Display information about the main board. **name –** For example, *1*. **product_number –** For example, *ROA1178565*. **serial_number –** For example, *59*. **temperature** - Current temperature of the board (°C).	152
network_processor	Display information about the current layer 2 switching table of the node. The bridging table is managed by the network processor. It is re-built after restart. **ethernet_port** - Entries depending on Ethernet Port. **ip_address** - Entries depending on IP Address. **mac_address** - Entries depending on MAC Address.	-
node_control	Displays the global parameters, set in `set node_control`. **network_element_id** **relay_agent_eda_ip** **relay_agent_eda_sid** **vmac_address_node_id**	132
rapid_spanning_tree	Display the defined Rapid Spanning Tree (RSTP) parameters. **bridge_id** - Status. **designated_root** - ID for designated switch of the LAN segment **ports** – The RSTP status of the port (learning / forwarding / blocked). **root_path_cost** - Cost of path from own switch to Master switch. **root_port_id** - ID of port connected to Master switch. **time_since_topology_changed** - Status. **topology_change** - True or False. **topology_change_count** - Number of changes.	135
real_time_clock	Display parameters for using the Network Time Protocol.	136
running_config	Display or save all the configuration data from ELN/EFN.	

Command	Description	Page
Snmp	Display the configuration parameters for SNMP. **System name** – The configured system name **System location** – The configured system location **System contact** – The configured system contact **Read community** – The SNMP community for read (get) operation **write_community** – The SNMP community for write (set) operation **trap community** – The SNMP community for a trap **Trap receiver 1** – The IP address of trap receiver 1 **Trap receiver 2** – The IP address of trap receiver 2 **Trap receiver 3** – The IP address of trap receiver 3 **Version** – The SNMP version	137
software	Display information about the software. **current -** For example, *CXP_901_0022_R3K03*. **release_time** - For example, *2006-12-01 12:16.* **load_timer [min]** - For example, *20.* **loaded -** For example, *CXP_901_0022_R3K03*, *CXP_901_0022_R3D.* **permanent** - For example, *CXP_901_0022_R3K03.* **disk** - *0* or *1* (disk partition). **disks –** For example, *0,1.*	139
spanning_tree	Display the defined Spanning Tree (STP) parameters.	140
statistics	Display statistics information about the traffic. **connection vlan <vlan> ethernet_port <port> ingress flow <flows> -** flows is *, range or list of values. This command returns the number of packets and octets out that have passed policing, and that have been discarded. **connection vlan <vlan> ethernet_port <port> egress flows <flows> -** flows is *, range or list of values. This command returns the number of packets and octets out that have passed policing, and that have been discarded. **in_octets** - Total bytes received. **in_pkts** - Total Unicast, Multicast, Broadcast frames received. **in_errors** - *FE ports*: Total frames received and discarded	-

Command	Description	Page
	due to – oversized (>1530 bytes), undersized (<64 bytes), alignment or FCS errors. *GE ports*: Total frames received and discarded due to – oversized (>1530 bytes), undersized (<64 bytes) and CRC errors. **out_octets** - Total bytes transmitted. **out_pkts** - Total Unicast, Multicast, Broadcast frames sent. **out_errors** - *FE ports*: Number of outgoing frames discarded due to FCS error, Oversized or Undersized error. *GE ports*: Number of outgoing frames discarded due to FCS error, frames sequence error or jam bit error (collisions). **mac_undersize** - Number of received and discarded frames with undersize error (<64 bytes). **mac_oversize** - Number of received and discarded frames with oversize error (>1530 bytes). **phy_in_error** - Number of received and discarded frames due to errors in symbol, or delimiter (both relate to errors in the physical transmission). Note: The statistic counters are 32-bit values (0-4294967295). When a counter value reaches its maximum (4294967295), the counter resets and starts counting from 0 (zero).	
vlan	Display information about the switching domain configuration. **borrowed_ip_address** - The currently used own IP address. **borrowed_mac_address** - The currently used own MAC address. **gateway_ip** - The currently used gateway IP address. **incoming_port -** Number of incoming ports. **outgoing_ports** - Number of outgoing ports. **multicast** – Multicast addresses active (only for multicast set to igmp_snooping or igmp_proxy).	141

14 Software Components under Open Source Licences

The EFN324 software is built using Open Source Licensed software. This section gives an overview of the different components.

14.1 Boot Loader

The boot loader is u-boot version 0.3.2, downloadable from the following Ericsson FTP server:

`ftp-hotel.ericsson.net`

username: **`eda-gpl`**

password: **`q5prst`**

The boot loader is free software under the terms of the GNU General Public License Version 2.

14.2 Linux Distribution

The Linux Kernel and platform applications are derived from Wind River Linux version 1.4. Some components are distributed under the GNU General Public License. The EFN324 makes use of the following components:

- atftp
- bash
- busybox
- dhcp
- net-snmp
- ntp
- openssl

14.3 EFN324 Application

The EFN324 core application is built on Erlang’s Open Source Distribution R11B-2 available at http://www.erlang.org/download.html. The Erlang component is distributed under the Erlang Public License.

Glossary

ARP
Address Resolution Protocol

BPDU
Bridge Protocol Data Unit

BRAS
Broadband Remote Access Server

CLI
Command Line Interface

CPE
Customer Premises Equipment

DHCP
Dynamic Host Configuration Protocol

DHCP server
Dynamic Host Configuration Protocol server. A configuration server, capable of configuring hosts with a variety of information required for their operation.

EAN
Ethernet Access Node. In EDA 1200, this includes an ECN330 or ECN430 and all the embedded nodes controlled by the ECN.

ECN
Ethernet Controller Node. In EDA 1200, this includes ECN330 and ECN430.

EMP
EDA Management Proxy. This is part of the ECN330 and ECN430.

FE
Fast Ethernet. Up to 100 Mbits per second.

GE
Gigabit Ethernet. Up to 1000 Mbit per second.

GUI
Graphical User Interface

HW
Hardware

ID
Identification

IGMP
Internet Group Management Protocol

Internet Group Multicast Protocol (IGMP)

Used to establish host memberships in particular multicast groups on a single network. The mechanisms of the protocol allow a host to inform its local router that it wants to receive messages addressed to a specific multicast group.

IP
Internet Protocol

ISP
Internet Service Provider

LAN
Local Area Network

LED
Light-Emitting Diode

MAC address
Media Access Control address. The unique hardware address of an Ethernet interface unit.

MIB
Management Information Base

PEM
Public Ethernet Manager

QinQ
VLAN stacking allowing multiple VLAN tags in a single Ethernet frame

QoS
Quality of Service

RFC
Request for Comments. A memoranda series describing research, innovations, and methods applying to Internet technologies.

RSTP
Rapid Spanning Tree Protocol

SID
Switch ID

SNMP
Simple Network Management Protocol

SNTP
Simple Network Time Protocol

SP
Service Provider

SSH
Secure Shell

STP
Spanning Tree Protocol

SW
Software

TCP
Transmission Control Protocol

VLAN ID
A numerical value identifying a certain VLAN.

VLAN
Virtual LAN. A method used to separate and group traffic within a physical LAN.

VMAC
Virtual MAC address

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