



GFN SDN Controller User Manual

L2 VPN Service

Release 2.3.0

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1. Acronyms

AD	–	Administrative Domain
AI	–	Artificial intelligence
ASIC	–	Application Specific Integrated Circuit
BGP	–	Border Gateway Protocol
BNG	–	Border Network Gateway
BRAS	–	Broadband Remote Access Server
BSS	–	Business Support System
CBS	–	Committed Bust Size
CEN	-	Carrier Ethernet Network
CG-NAT	–	Carrier Grade Network Address Translation
CIR	–	Committed Information Rate
CLI	-	Command Line Interface
CPU	–	Central Processing Unit
CRM	–	Customer Relationship Management
CRUD	-	Create, Read, Update, Delete
DB	-	Database
DC	–	Datacenter
DPI	–	Deep Packet Inspection
DPID	–	Data Path Identifier
E2E	–	End-to-End (services)
E-Access	-	OVC-based service with at least one UNI OVC End Point and one ENNI End Point
EBS	–	Excess Burst Size
EIR	-	Excess Information Rate
E-LAN	–	multipoint-to-multipoint EVC
E-Line	–	point-to-point EVC accordingly to MEF
EMS	–	Element Managements System
ENNI	–	External Network-to-Network Interface

EP-LAN – Ethernet Private LAN

EPL – Ethernet Private Line

E-Transit - OVC-based Carrier Ethernet service in which all OVC End Points are at ENNIs

E-Tree – point-to-multipoint EVC

ETSI – European Telecommunications Standards Institute

EVC – Ethernet Virtual Circuit

EVPL - Ethernet Virtual Private Line

IGMP – Internet Group Management Protocol

LAN – Local Area Network

LPM - Longest Prefix Match

MEF – Metro Ethernet Forum

MPLS – Multiprotocol Label Switching

NAT – Network Address Translation

NBI – North Bound Interface

NE – Network Element

NPU – Network Processing Unit

NVF – Network Functions Virtualization

NFVI – Network Functions Virtualization Infrastructure

OAM – Operations, Administration and Management

OF – OpenFlow protocol

OF-DPA – OpenFlow Data Plane Abstraction

ONF – Open Networking Foundation

OSS – Operation Support System

OVC – Operator Virtual Connection

OVS – Open vSwitch

PNE – Physical Network element

PNF – Physical Network Element

PoP – Point of Presence, see also Datacenter

QinQ – IEEE 802.1ad standard

QoS – Quality of Service

RFC – Request for Comments

SBI – South Bound Interface

SDN – Software Defined Network

SLA – Service Level Agreement

SQL – Structured Query Language

SR – Segment Routing

SRAM – Static Random Access Memory

TAP – Terminal Access Point

TCAM – Ternary Content Addressable Memory

TE – Traffic Engineering

T/T – Troubleshooting

TTP – Table Type Pattern

UDF - User-Defined Field

UNI – User Network Interface

VLAN – Virtual Local Area Network

VIM – Virtual Infrastructure Manager

VM – Virtual Machine

VNE – Virtual Network Element

VNF – Virtual Network Function

VNFD – Virtual Network Function Descriptor

VNFM – Virtual Network Function Manager

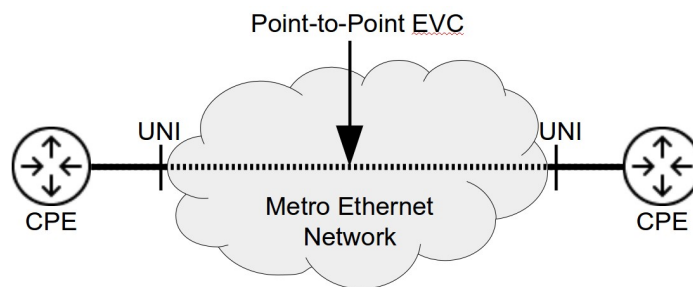
VPLS – Virtual Private Area Network

WAN – Wide Area Network

ZTP – Zero Touch Provisioning

2. L2 VPN Service Review

L2 VPN service is Point-to-Point service which provides Ethernet tunnel between two end points in Metro Ethernet network. This is targeted for establishing B2C and B2B services and can be used either as standalone service or as a part of triple-play. L2 VPN service correspond to MEF 6.2 and MEF 10.3 E-Line specifications. It can be used in both scenarios: port based EPL (Ethernet Private Line) and VLAN based EVPL (Ethernet Virtual Private Live).



L2 VPN service can span a lot of switches. Operations of L2 VPN is fully protected service, thus its path will be automatically recalculated in case of link/node failure if backup path exists.

L2 VPN Service Attributes

L2 VPN service has the following general attributes:

- L2 VPN ID
- Priority
- Path
- Active

L2 VPN ID is unique service identifier which is represented as string.

Priority attribute defines a place in queue for this exact L2 VPN as it will be recalculated in case of intermediate link/node failure. Priority value directly impacts service convergence time. The value can be in a range from 0 to 7. The lower priority value is the faster service will be recalculated.

Path attribute defines an algorithm of calculating L2 VPN path in the network. Its value can be one of three types:

- NORMAL - normal path calculation on Dijkstra algorithm based on links speed, cost, latency and current utilization, targeted for Internet or 5G eMBB services
- LOW LATENCY - path is to be calculated on Dijkstra algorithm using links latency only, targeted for voice or 5G URLLC services
- BEST EFFORT - path is to be calculated on Dijkstra algorithm using current utilization only, targeted 5G mMTC services

Active attribute switches L2 VPN from active to stand by state and vice versa. L2 VPN in stand by mode is just defined inside SDN Controller only and not deployed into network. L2 VPN service contains strictly two end points.

In case of end point failure L2 VPN cannot be recovered and Active attribute will be set in Error state in read only mode.

Besides the attributes above L2 VPN has FEC (Forwarding Equivalence Class) attribute. It cannot be set manually. It is calculated internally in SDN Controller and is available as read only.

L2 VPN End Points' Attributes

L2 VPN service has strictly two end points each of which has the following attributes:

- DPID
- Port
- VLAN
- CIR
- CBS

DPID (Data Path ID) attribute identifies a device on which end point is defined.

Port attribute identifies device port on which end point is defined.

VLAN field is optional. It has to be set in range from 1 to 4095 for EVPL service and has to be left unset for EPL service.



Note that while one of the L2 VPN service end points VLAN attribute can be set the other end point VLAN attribute can be left unset. In this case one can define a combo version of EPL/EVPL. This kind of L2 VPN is not defined in MEF E-Line specifications. But this kind of L2 VPN adds flexibility in network configuration and can help reduce CapEx/OpEx for ISP.

CIR (Committed Information Rate) and CBS (Committed Burst Size) define a standard MEF bandwidth profile. If they are set then traffic shapers will be switches on on both end points of L2 VPN. If CIR and CBS are unset then shapers are not implemented.



Note that even if traffic shapers are not needed in L2 VPN service it is recommended to set estimated non-zero value of CIR while set CBS to zero. This is important because CIR value even w/o shapers is used by Topology Manager of SDN Controller for calculation of links' utilization which is important for load balancing in ECMP Topology.

L2 VPN Service Statistics

L2 VPN service statistics section provides 64-bit counters' values of amount of packets processed by this very policy:

- Packets
- Bytes


Statistics counters are a good tool for troubleshooting a L2 VPN service.

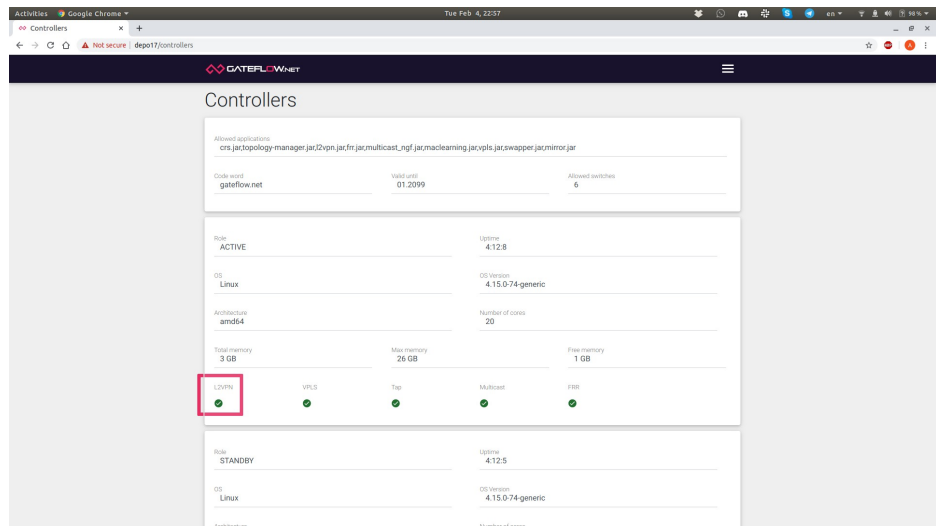


Note that due to hardware limitations of some ASICs statistics counters can be reset to zero not on all hardware switch platforms.

3. Prerequisites

To use L2 VPN service L2VPN application has to be running on SDN Controller. Check L2VPN application is running can be done in two ways:

- In Command Line Interface of the controller with a command *app show*, L2VPN application status has to be *running*.
- In Web UI Menu->Inventory->Controller page L2VPN application should be  marked with icon



4. Operation of L2 VPN Service

There are three generic ways to operate L2 VPN service:

CLI

REST API

Web UI

These interfaces are described in details in sections below.

CLI

CLI provides a limited set of commands of L2 VPN service management. They are targeted for viewing and deleting of existing policies only:

- tap show
- tap delete

For creating and updating of L2 VPN service please use either Web UI or REST API call.

REST API

REST API of L2 VPN service implements a standard CRUD (Create, Read, Update, Delete) data manipulation paradigm. Any REST API call operates with data in JSON format. Below is an example of JSON file for REST API call of L2 VPN service:

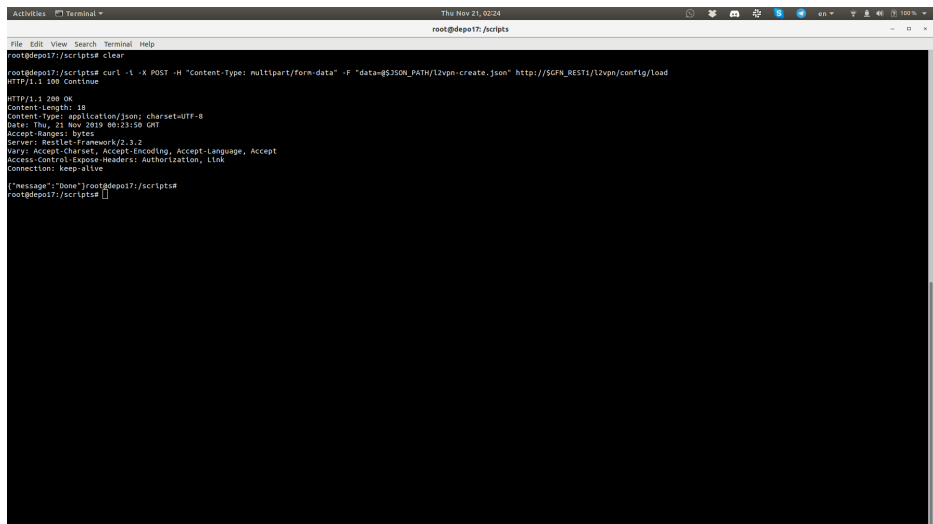
```
{
  "id": "b2c-1-2"
  "fec": 1
  "active": false,
  "priority": 1,
  "path": "NORMAL",
  "endpoint": [
    {
```

```

        "dpid": "00:00:00:00:00:00:04",
        "port": 4,
        "vlan": 10,
        "cir": 100000,
        "cbs": 10000
    },
    {
        "dpid": "00:00:00:00:00:00:02",
        "port": 3,
        "vlan": 20,
        "cir": 150000,
        "cbs": 15000
    }
]
}

```

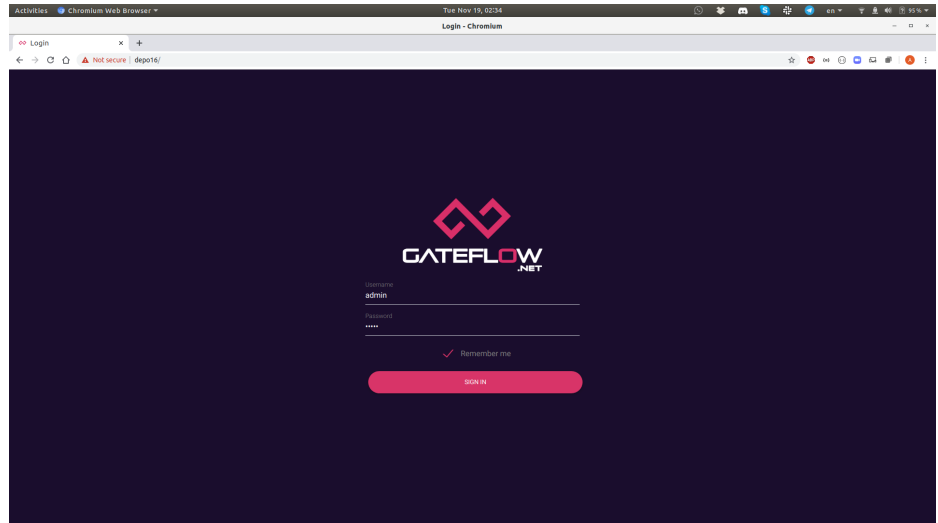
For invoking of REST API call from Linux command line a utility curl can be used as show below:




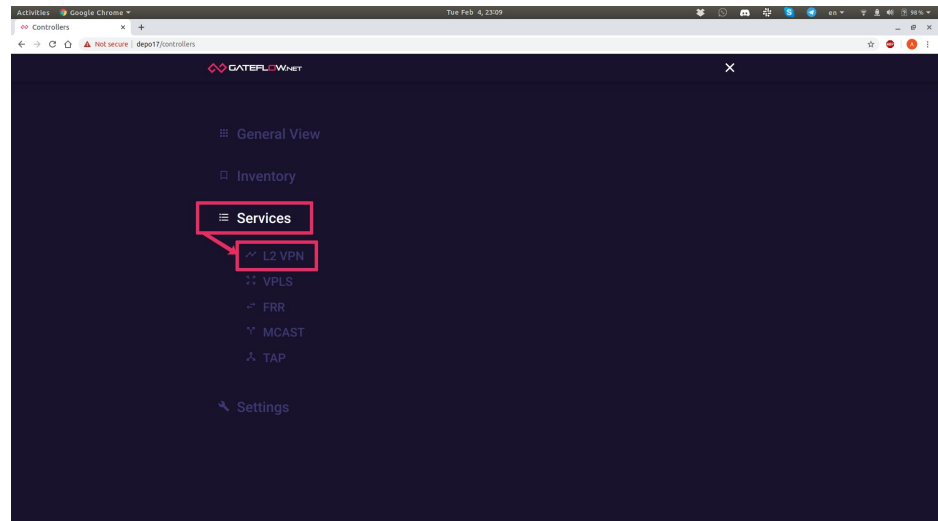
For detailed description of all L2 VPN service JSON file fields format and constraints please refer to GFN SDN Controller Admin Manual.

Web UI

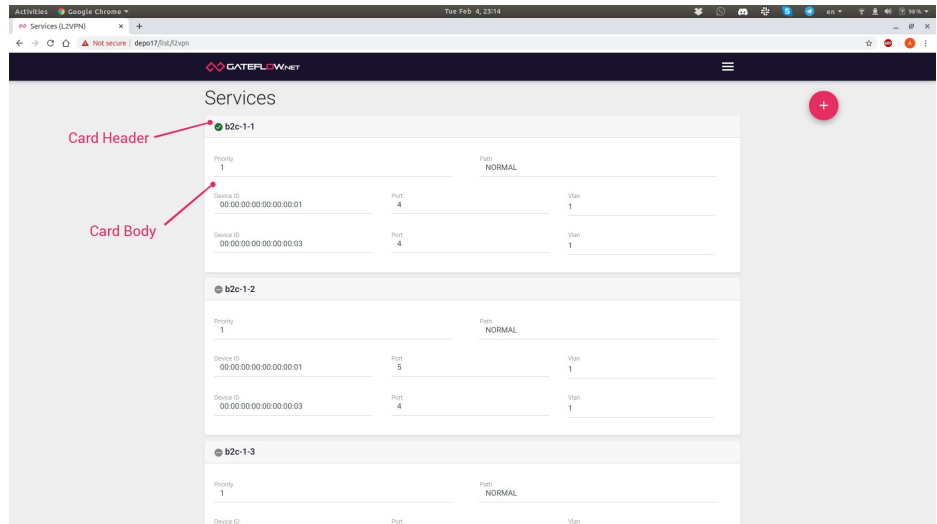
For access of L2 VPN management graphic interface via web browser one has to logon to GFN SDN Controller Web UI first as show in the example below:



After logon one has to open a full screen menu using icon  the top bar and choose drop-down Menu->Services->L2VPN section as show below:

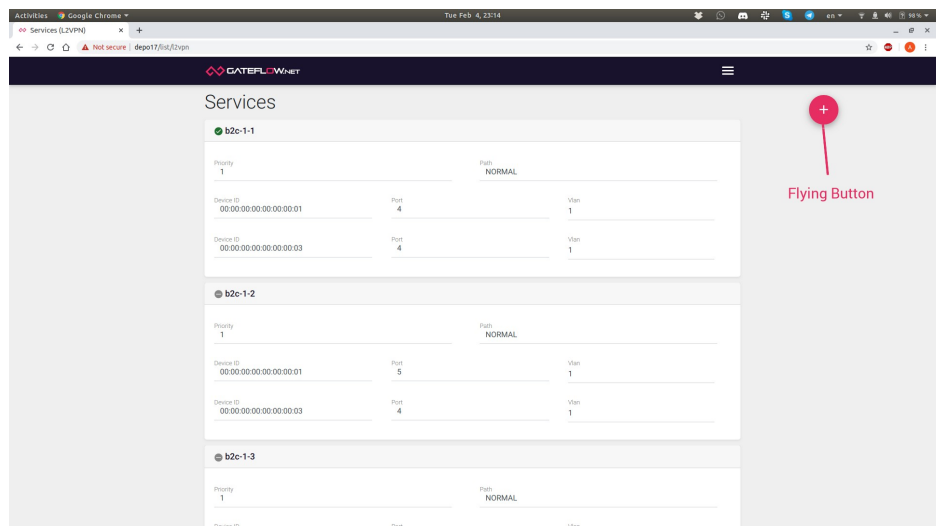


A L2 VPN services list screen will open. On this list every service is represented as a card:



Each card has header containing a service ID and body containing brief set of service parameters. Clicking on card header one can open/close a card body thus adjusting an outlook of the list at his own convenience.

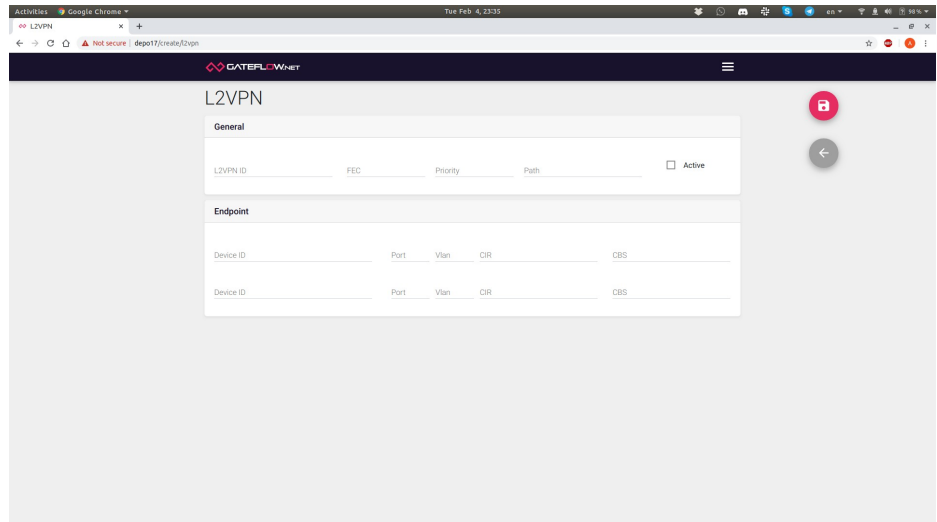
In the top-right area of the screen is flying button as show below:



There are two ways to navigate from L2 VPN services list screen to L2 VPN service form screen:

- Clicking flying button will open L2 VPN services form screen in adding policy mode
- Clicking on the body of any L2 VPN service card will open L2 VPN service form screen in view only mode.

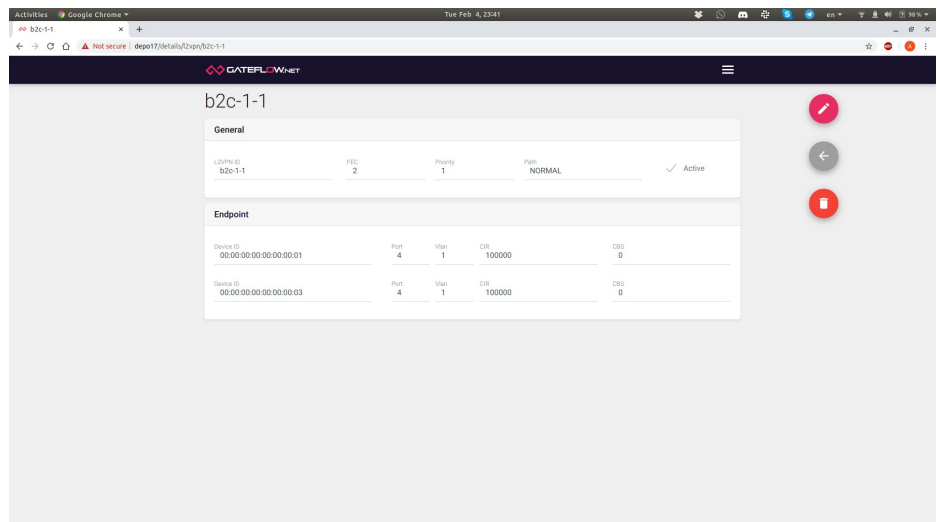
L2 VPN service form screen add service mode is show below:



There are two card on this form: general L2 VPN attributes and end points attributes. After finishing of filling the form the new L2 VPN service has to be saved with pressing ping flying button with diskette icon. When new policy is saved pink flying button icon will be changed to pencil and all fields of the form will be grayed and became unavailable for editing.

A gray arrow flying button lets exit back to L2 VPN services list screen without saving a new L2 VPN service.

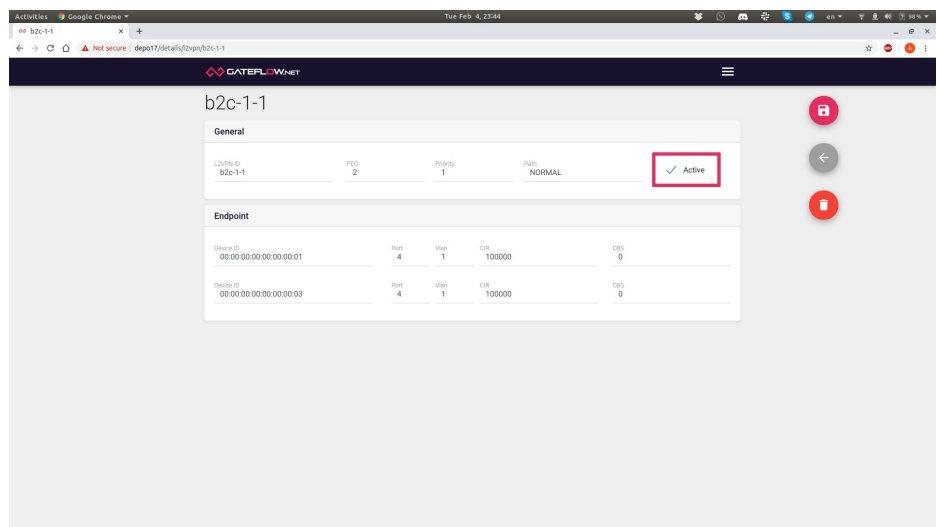
When entering L2 VPN service form in view mode there is one more flying button on the screen which allows deleting of the service:



In view mode one has four options for navigation:

- Get back to L2 VPN services list screen (gray arrow button)
- Delete service and then get back to L2 VPN services list screen (trash button)
- Edit existing policy (pink pencil button)
- Any other screen via full screen menu (burger button on the top bar)

Clicking pink pencil flying button one can enter a L2 VPN service editing mode. In this mode only Active field is available for editing and pink flying button will change its icon to diskette:



After editing of L2 VPN service pink button has to be clicked to save updated service.

Note that in edit mode Active field only is available for editing. If some other parameter of L2 VPN service has to be edited then entire L2 VPN service has to be deleted and recreated with new parameters.

