# Service Overview and Implementation

Section 1

## Telecommunication Services Technologies

Service Provider Telecommunications Network:

- Internet Protocol (IP) is now the most used
- Ethernet Layer 2 transportation is also common
- Frame Relay and Asynchronous Transfer Mode (ATM) are less common
- Time Division Multiplexing (TDM) technologies are used in older networks.
- Sonet transportation is not common, now replaced with direct optical networks.

## Converged Network Infrastructure Requirements

Service providers consolidate the delivery of multiple service types onto a single network technology because of:

- High cost of maintaining and operating legacy networks
- The need to continue support high revenue legacy services (Frame Relay , Sonet, TDM)
- Consumer demand for new services that require higher bandwidth service at decreasing prices.

## Nokia solution: Nokia 7750 Service Router



A single network device using IP/MPLS core network to support a range of Virtual Private Network (VPN) services.

## VPN Service

VPN is a network built over a shared infrastructure to provide private services to its users.

- Virtual - VPN to service provider is a virtual Network
- Private - VPN to customer is a private Network
- Network - A collection of devices that communicate with each other

Service:

- Logical entity that refers to a type of connectivity
- Each service is uniquely identified by a service ID.

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# Provider Terminology CE, PE and P
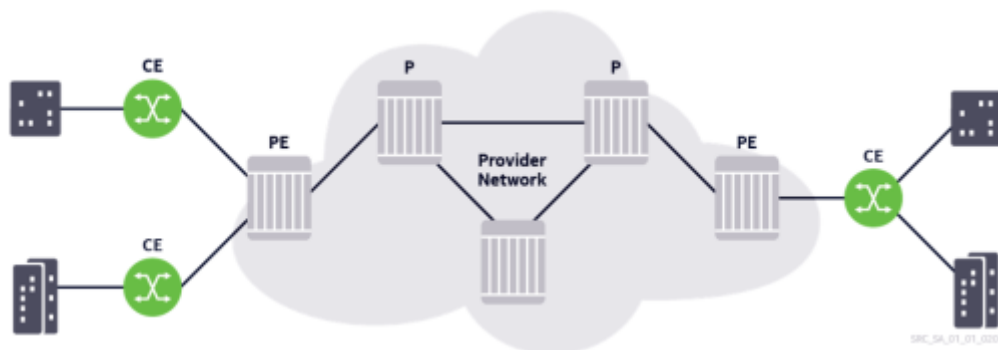
Customer Edge (CE) Routers:

- Located at customer premises
- Service unaware
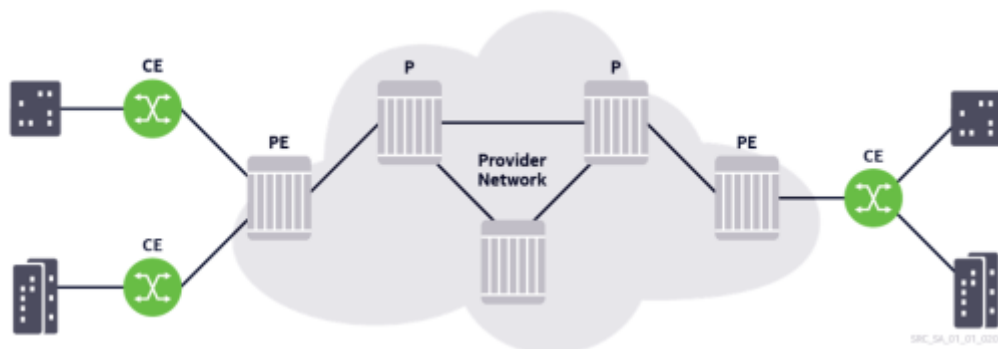
Provider Edge Routers (PE):

- Have at least one interface outside the provider domain facing the customer

Provider Core (P) Routers:

- Have all interfaces internal to the provider domain
- Service unaware, focus on forwarding packets through the tunnel with minimal configuration



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# Typical IP/MPLS Serice Network Components



- Service router functions as the PE router in a service Network
- PE router provides the itnerface beteween the customer network and the core service provider network.

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# Nokia 7750 SR Service types

- VPN services:
    - Virtual private wire service (VPWS) - provides point-to-point service that emulates a leased line
    - Virtual private LAN services (VPLS) - provides a multipoint Ethernet service similar to an Ethernet switch
    - Virtual private router network services (VPRN) - provides a multipoint IP routed service
- Internet Enhanced Service (IES)
    - Provides the customer with a Layer 3 IP int to send and receive internet traffic
- Mirroring Services

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# Virtual private wire service (VPWS)

- Layer 2 point-to-point service also known as Virtual Leased Line (VLL) Service
- defines a virtual point-to-point service that emulates a private leased line connection
- encapsulates customer data and transports it across the service provider's network in a Generic Routing Encapsulation (GRE) or MPLS tunnel
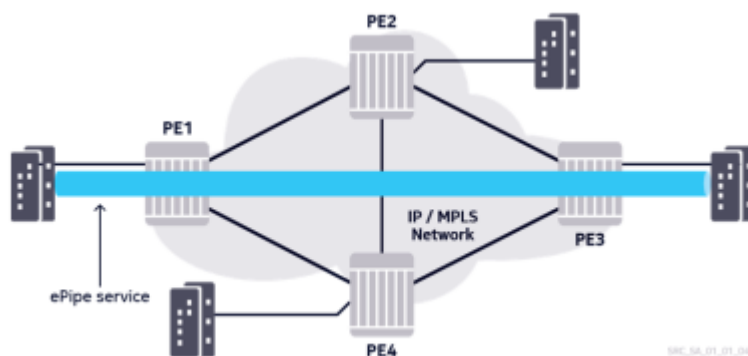


Types of VPWS:

- ePipe - emulates a point-to-point Ethernet service
- aPipe - emaulates a point-to-point ATM service
- fPipe - emulates a point-to-point Frame Relay circuit
- cPipe - emulates a point-to-point TDM circuit
- iPipe - provides IP interworking capabilities between different L2 technologies.
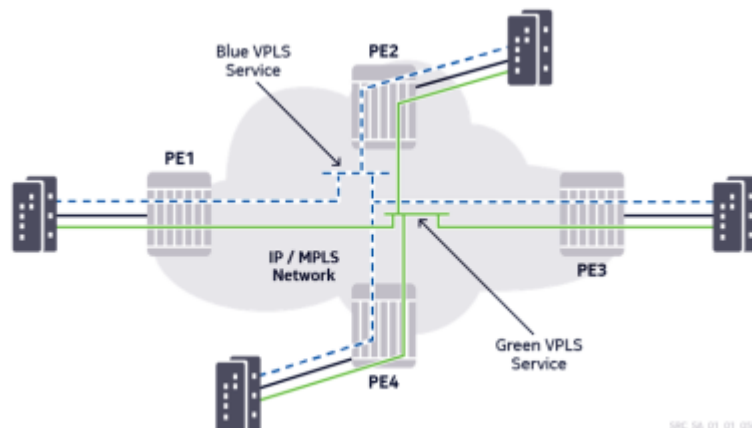
VPWS Advantages: Customer perspective:

- Supports ATM, Frame Relay, TDM or Ethernet
- Service provider (SR) network appears as a leased line between the two customer locations
- Transparent to customer data.

Service provider perspective:

- Only the PE device is aware of the service
- Scalability & flexibility
- Apply QoS, billing, ingress/egress traffic shaping, and policing on a per-service basis.

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# Virtual Private LAN Service

VPLS is an Ethernet service that connects multiple sites in a single switched domain over a provider-managed IP/MPLS network.
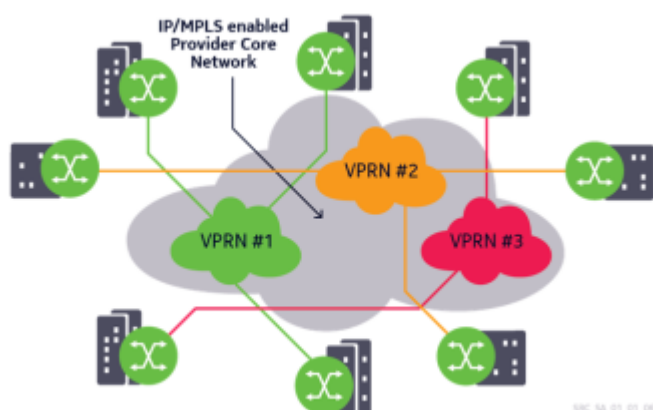


VPLS Advantages: Customer perspective:

- It appears as if all sites are connected to a single-switched VLAN
- Transparent to the customer's data
- Can operate over a single local site or over multiple sites in different geographic locations
- Frames are only forwaded across the required links in the network

Service Provider's perspective:

- Similar to VPWS

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# Virtual Private Router Network (VPRN)

Layer 3 service that connects multiple sites in a routed domain over a provider-managed IP/MPLS network.



VPLS Advantages: Customer perspective:

- Sites are connected to a private routed network that is administered by the service provider for that custmer only.
- There are separate and independent IP address plans for each VPRN

- VPRN can operate over a single local site or over multiple sites in different geographic locations.

Service Provider's perspective:

- Similar to VPWS or VPLS service

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# Internet Enhances Service (IES)

- IES provides customers with direct Internet access through a Layer 3 IP interface
- Customers see IES as providing a direct connection to the Internet
- Service provider can apply all billing, ingress/egress shaping, and policing to the customer.



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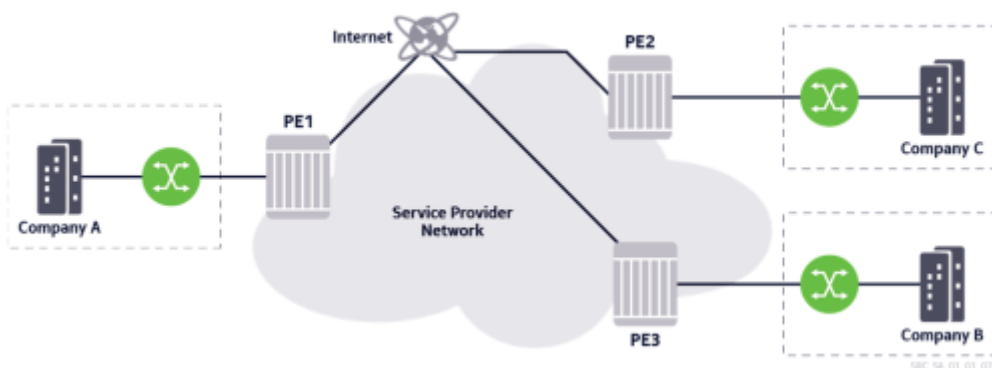
Section 2

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# Transport Tunnels and Service Tunnels

- Transport tunnels are used to transmit customer data acros the service provider Network
- Either MPLS or GRE tunnels can be used as transport tunnels
- Service tunnels are used to transmit customer data for a specific service
- Multiple transport tunnels can be carried over a single network port
- Multiple service tunnels can be bound to the same transport tunnel
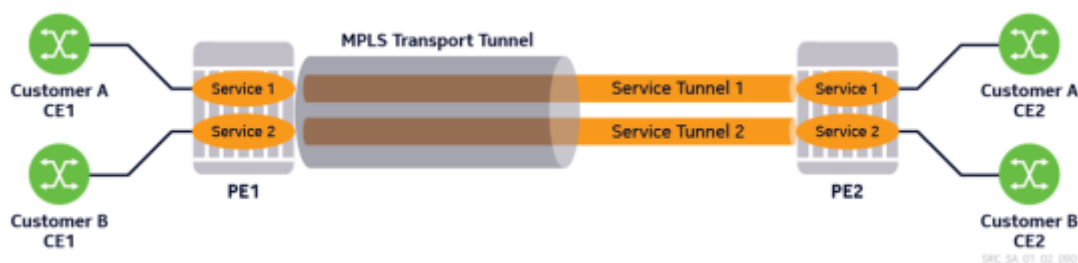


*Transport tunnels:* MPLS

- Labels are signaled using the Resrouce Reservation Protocol - Traffic Engineering (RSVP-TE) or Label Distribution Protocol (LDP)
- Customer Data is MPLS encapsulated and forwarded to egress PE

GRE

- Customer Data is IP encapsulated and forwarded to egress PE
- The source IP address is the ingress PE router, and the destination address is the egress PE router
- this is typically used when some routers in the transport network do not support MPLS

*Service tunnels*

- Multiprotocol-Border Gateway Protocol (MP-BGP)
- Targeted-Label Distribution Protocol (T-LDP)

## Transport and Service Label Encapsulation

*MPLS Encapsulation of VPN Service Traffic*

**MPLS Packet Format**

| DLC Header | Transport Label | Service Label | Control Word | Service Packet |
|---|---|---|---|---|

SRC_SA_01_02_100

- DLC header - Layer 2 header used to transport the MPLS packet
- MPLS transport (outer) label - label signaled by the next-hop router
- Service (inner) label - The service, or virtual circuit (VC) label identifies the service that the packet belongs to
- Control word - optional and primarily used for ATm or Frame Relay services
- Service packet - The customer data being transported by the service

GRE encapsulation of VPN service traffic

**GRE Packet Format**

| DLC Header | IP Header | GRE Header | Service Label | Control Word | Service Packet |
|---|---|---|---|---|---|

SRC_SA_01_02_110

- IP header and the GRE header are used instead of the MPLS transport label
- A service label is still required to demultiplex the packet to the appropriate service.
- The service provider routers use the IP header to route the packet across the network.

## MPLS Transport and Service Label Signaling

- LDP or RSVP-TE is used to establish label-switched paths (LSPs)
- LSPs can carry multiple service tunnels
- Service labels, or VL labels, are used to encapsulate and identify customer traffic that belongs to a particular service
- A service label is applied to the customer traffic before the transport label, or LSP label, is applied
- VPLS and VPWS service labels are signaled using T-LDP
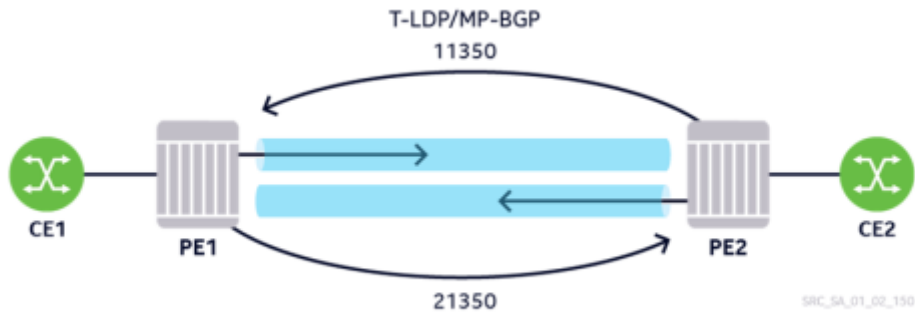- VPRN service labels are signaled using MP-BGP
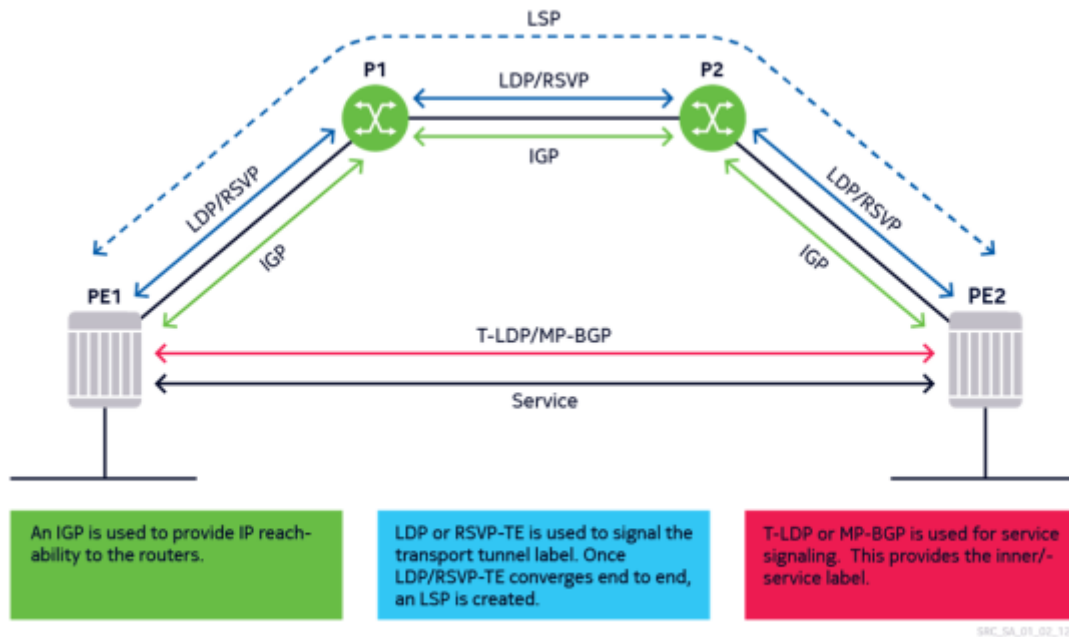
## Transport Label Signaling PE2 to PE1
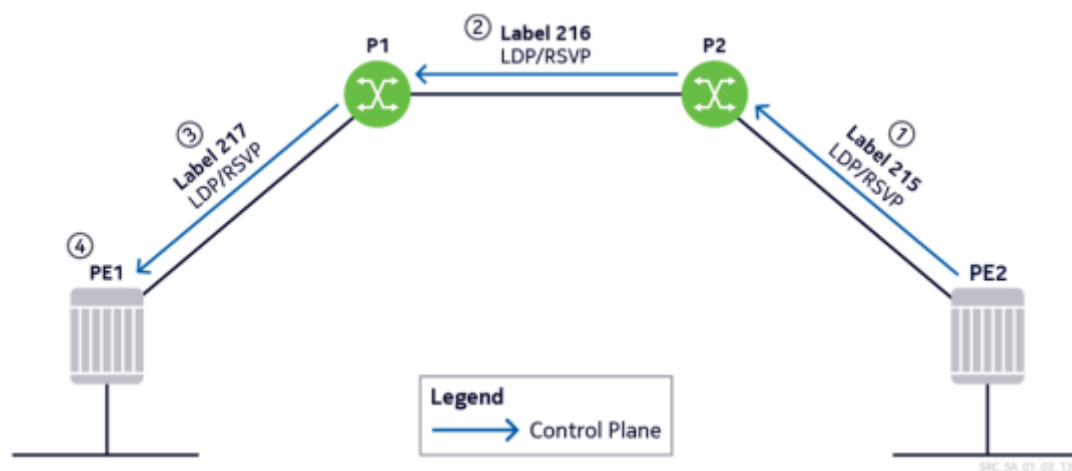


Transport labels are exchanged when the MPLS protocol (LDP/RSVP) is enabled:

1. PE2 advertises Label 215 to P2
2. P2 advertises Label 216 to P1
3. P1 advertises Label 217 to PE1
4. A unidirectional LSP is now established from PE1 to PE2
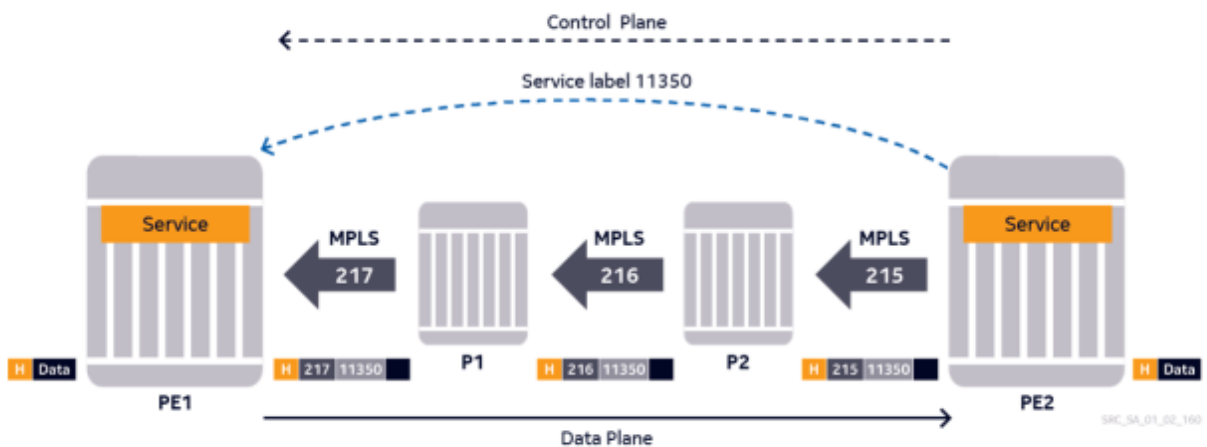
## Service Label Signaling

Service labels are exchanged when the service is created:

1. PE2 sends PE1 a service label (11350)
2. PE1 sends PE2 a service label (21350)
3. Unidirectional service tunnels are created
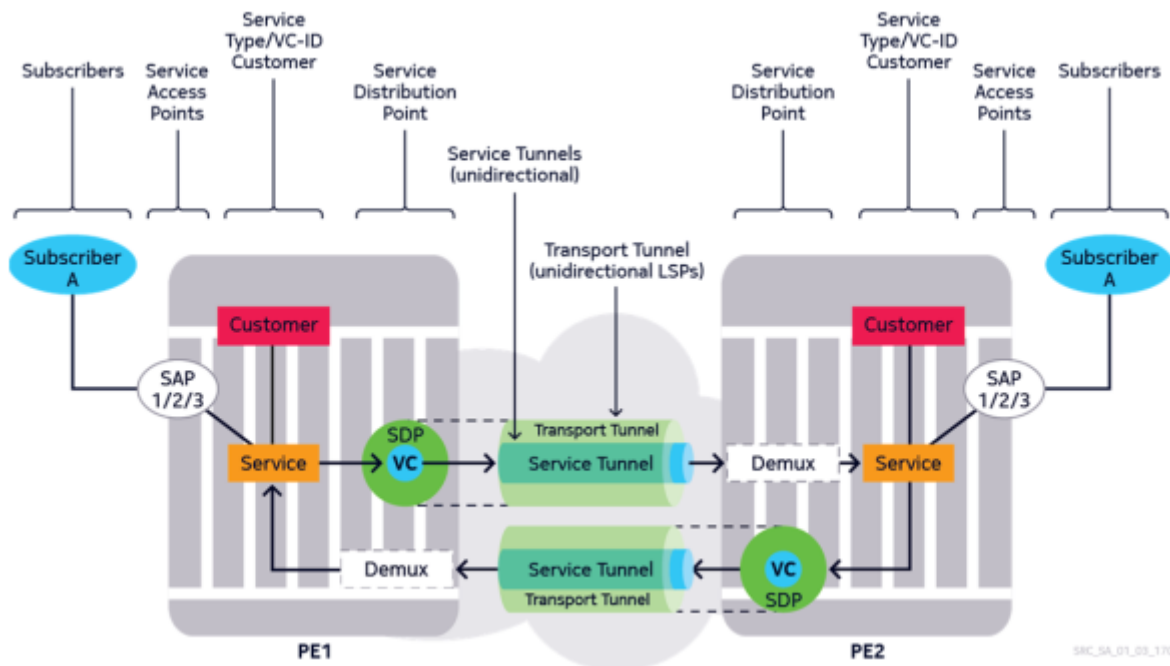
# Transport Label and Service Label Use Case



Section 3

# Service Components

## Customers and Subscribers

Customers: those responsible for the service from an administrative standpoint.

- Customer ID is assigned when the account is created
- ID must be associated with the service at the time-of-service creation
- can be associated with multiple services
- ID *CANNOT* be changed once the service is created

Subscribers: users of the service (CE)
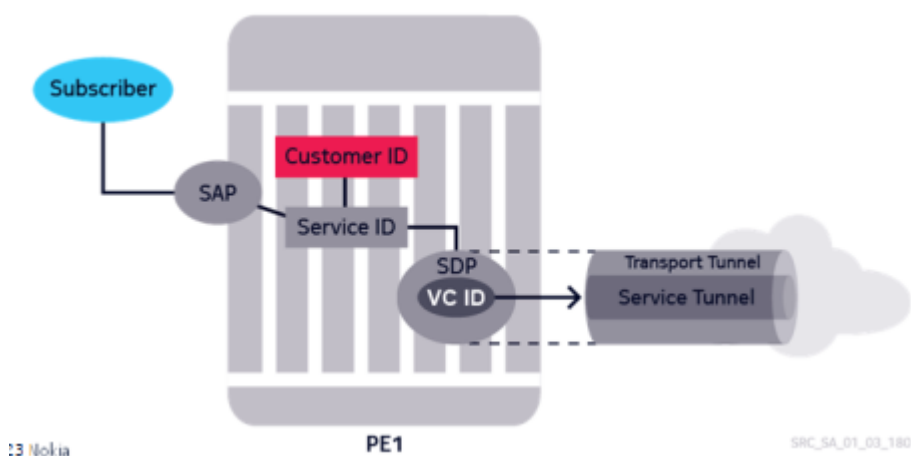


## Customer Creation Configuration

```
(MD-CLI)
*(gl)[/configure]
service customer 100
```

```
*(gl)[/configure service customer '100']
description *VPWS_Customer"

*(gl)[/configure service customer '100']
phone 1-111-111-1111

*(gl)[/configure service customer '100']
commit

(My Guess on Classic CLI)

configure service customer 100

description VPWS_Customer

phone 1-111-111-1111

exit

admin save

(SHOW COMMAND)

show service customer
```

## Service Identifiers

- Service ID - numeric value used on the Nokia router to identify the service
  - A service is associated with a customer ID
  - Service must be created unsing a unqieu service ID on that router

## Service creation

```
(MD-CLI)
*(gl)[/configure]
service epipe 50

*(gl)[/configure service epipe '50']
customer 100

*(gl)[/configure service epipe '50']
admin-state enable

*(gl)[/configure service epipe '50']
commit

(My Guess on Classic CLI)
```

```
configure service epipe 50

customer 100

no shutdown

exit

admin save

(SHOW COMMAND)

show service id 50 base
```

## Service Access Point (SAP)

- SAP is the Subscribers point of interface to the service network
- Belongs to a single service
- Specified as a physical port and an encapsulation identifier
- To be used, a port must be configured as an access or hybrid port

## SAP ID (page 52 on architectures PDF)