Ethernet over OTN from a Provider View

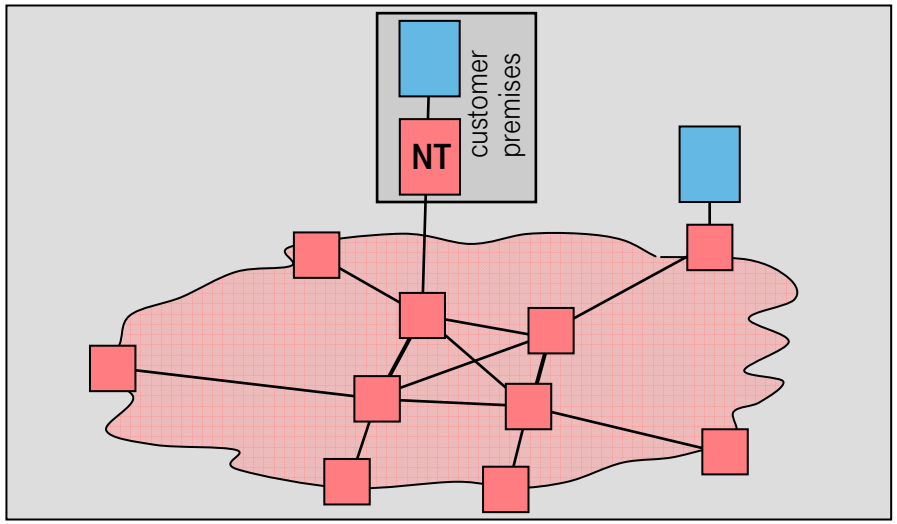
Ethernet over OTN

Introduction

- MEF 6.2 specifies the Ethernet services E-Line, E-LAN and E-Tree.
- MEF 10.2 specifies attributes of these services.
- MEF intentionally does not specify implementation of these services
- The following pages present some application of these services as well as some requirements of a service provider

Ethernet over OTN Services

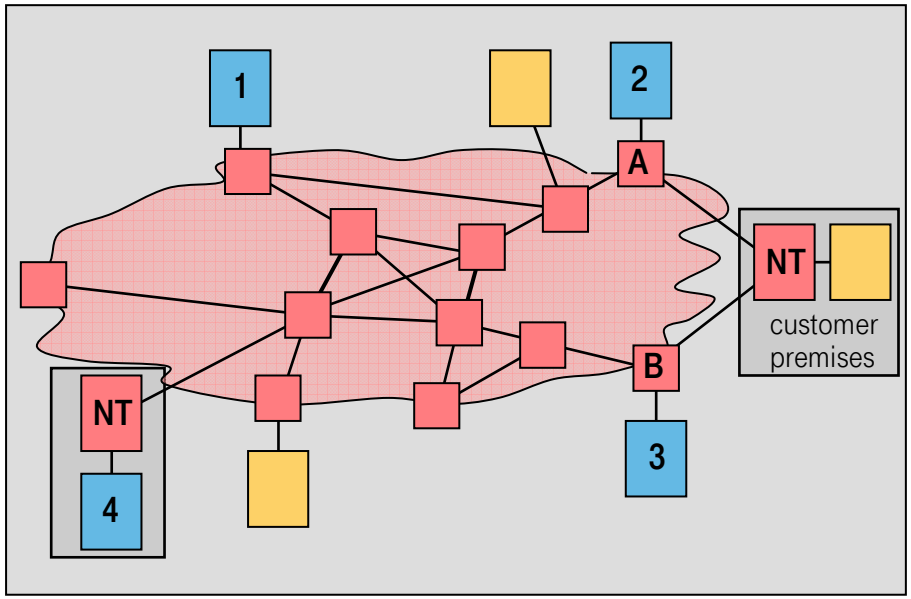
Services could be terminated at any Switch



- A provider network is typically partitioned, e.g. into metro networks and a core network.
- Customer equipment is either directly interconnected with a switch or interconnected with a small device called NT (network termination) at customer premises.
- Customer equipment or NTs could be interconnected with any switch of the network, i.e. with any switch in the metro network or core network.
- Customer reside either in their own buildings or a multi-tenement buildings. In the first case a small device (NT) is used to terminated the services. Such NTs provides one or two NNIs towards the network and one or more UNIs towards customer equipment. For these reasons TPMRs could be used just in some cases.

Ethernet over OTN Services

Routing Constrains



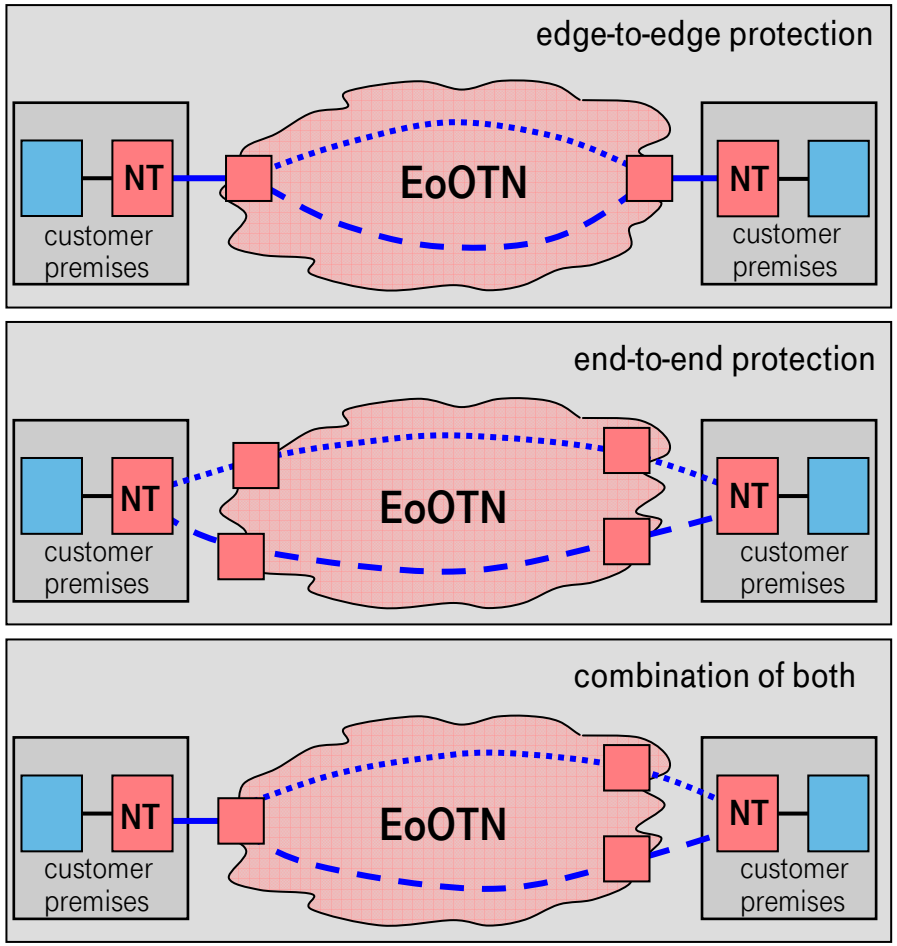
- The shortest path between switches A and B goes via the NT.
- However, for security reasons the service (e.g. E-LAN) provided for customer equipment 1 to 4 must not use the route via the NT on the right hand side. This NT is used exclusively for the service of another customer.

Ethernet over OTN Services
Management of NTs

- A secure management access is required for any NT.
  - A customer must not be able to access the management channel from the UNI
  - A customer may disconnect the NT and connect a PC or another device to the line
  - A customer must not have management access to any device of the provider
  - A provider needs remote and local management access to any NT
  - A provider must be able to manage an NT in cases of failure (disaster)
- For security reasons P2P VLANSs are used to provide the management channel rather than a MP2MP VLAN.
- NTs form two providers may be cascaded when provider A provides a backhauling service for Ethernet service provider B. In this case the management channels must be fully independent, i.e. assignment of VIDs for the management VLANs should not require agreements among the providers.

Ethernet over OTN Services

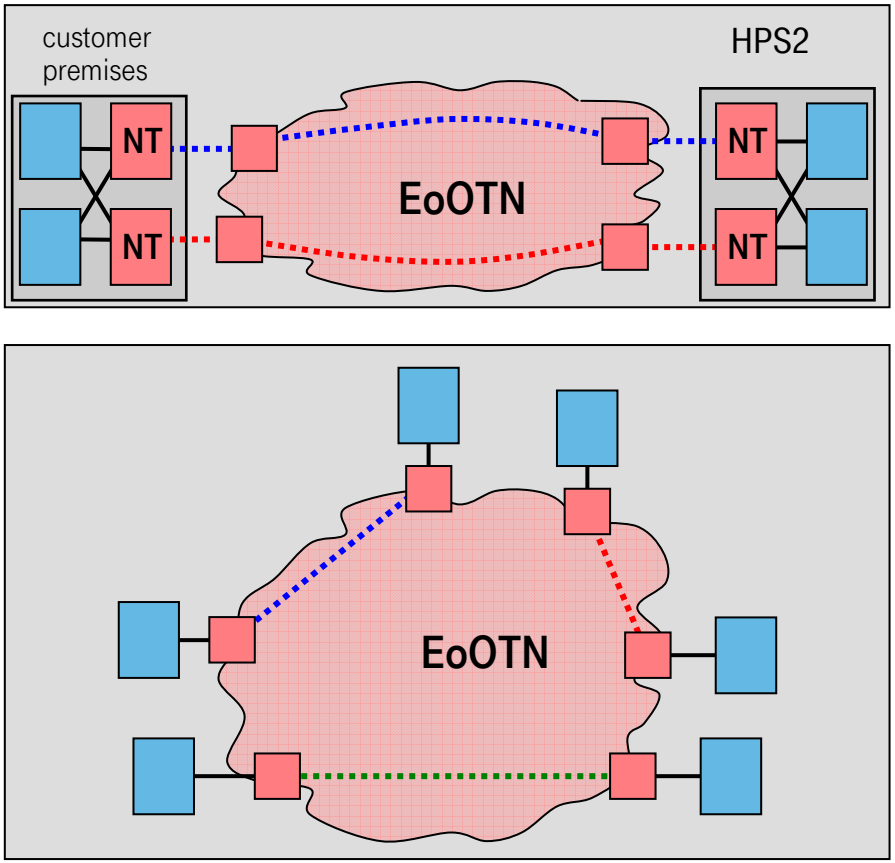
Protection of Ethernet Services



- A number of services are protected from edge-to-edge since there is just a single fiber available from the network to a customer premises, i.e. the local loop is unprotected.
- End-to-end protections requires two disjoint local loops from customer premises to two different network elements.
- A combination of edge-to-edge protection and end-to-end protection must be supported.
- Services are monitored by using end-to-end OAM/CFM.
- Protection switching requires OAM/CFM from edge-to-edge or from end-to-end.
- Edge NE and NT at customer premises have to provide the same OAM/CFM functions

Ethernet over OTN Services

Disjoint P2P EVCs



- Some customers asked for two or more P2P EVCs, which must be disjoint to each other. In this cases resilience (protection switching or re-routing is carried out by customer devices.
- Interconnection of nodes of an customer network requires a number of disjoint P2P EVCs which are typically unprotected.
- Disjoint P2P EVC do not require particular functions at switches or NTs. The OSS has to ensure of that these EVCs are diverse over entire lifetime of the service. The EVCs must, therefore use disjoint, switches, wavelengths, fibers, cables, pipes, ducts, etc.

Ethernet over OTN Services

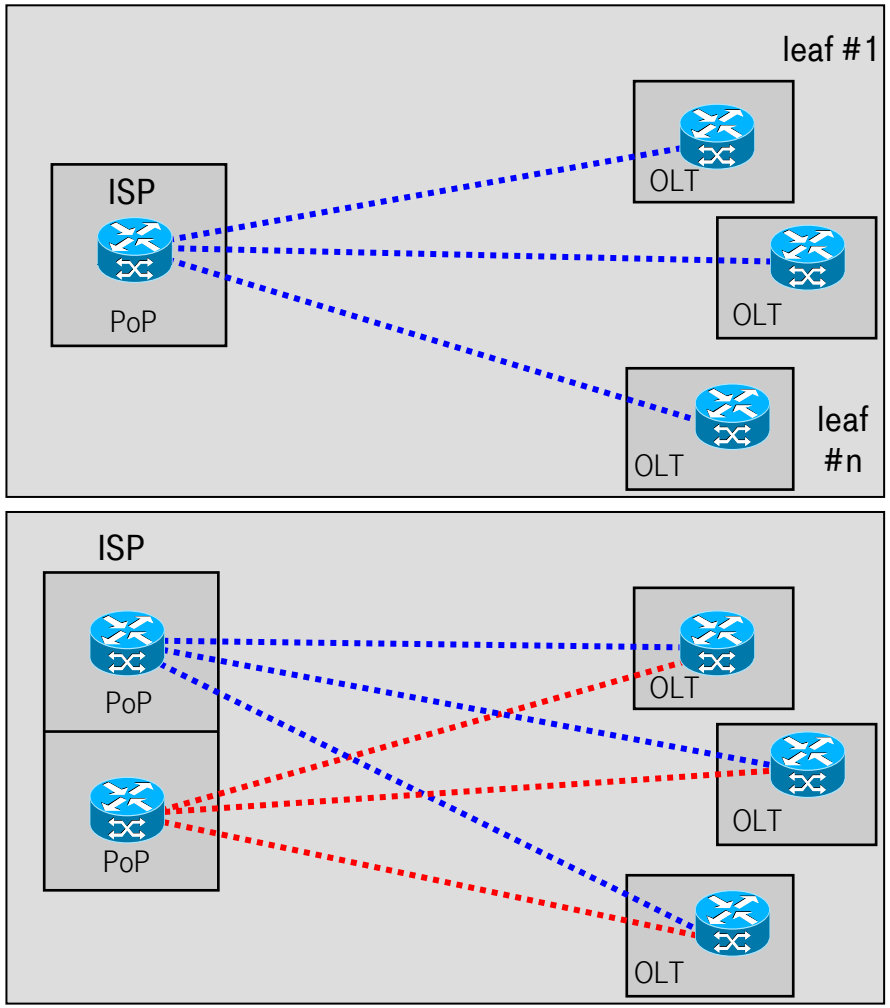
Conclusion

- Service edge is a particular role of an switch of a provider network, i.e. any switch in the metro network and core network must be able to provide UNIs. Service edge and network edge are distinct.
- NTs are small switches, which basically must provide the same service related functions than switches in the network.
- End-to-end service monitoring, protection switching, etc. requires one layer for OAM/CFM.
- OAM/CFM must be independent of the services, i.e. a unique layer used for service monitoring is required for port based service, C-VLAN based services, S-VLAN based services, etc. Any kind of services should be mapped to such an unique transport layer. The adaptation is carried out from UNI to NNI and vice versa.
- In many cases the layer used for service monitoring shall be as independent as possible from the customer signals. For instance, a customer may add C-VLANs or S-VLANs respectively. Dependent on the service this should not require subsequent actions at the provider network.

E-Tree
Application Examples

Access to OLTs (PON Systems)

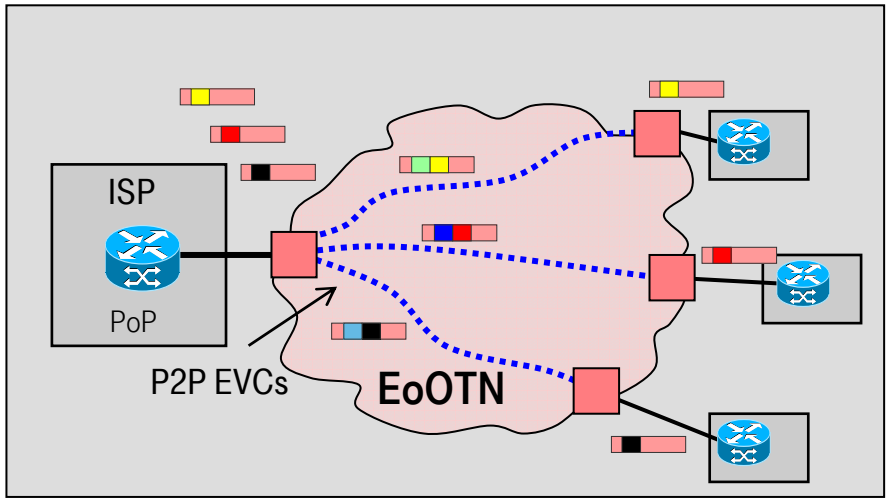
Requirement



- Backhauling requires a connectivity between the PoP of the ISP and the locations of the OLTs.
- A direct communication between leafs must be prevented by the backhauling service.
- OLTs may be connected to two disjoint PoPs or to two disjoint access router in a PoP for highly reliable services.
- The OLTs use double tagged Ethernet interfaces, it the frames are C-tagged and S-tagged. S-VID and C-VID are given by the ISP and the OLT provider.

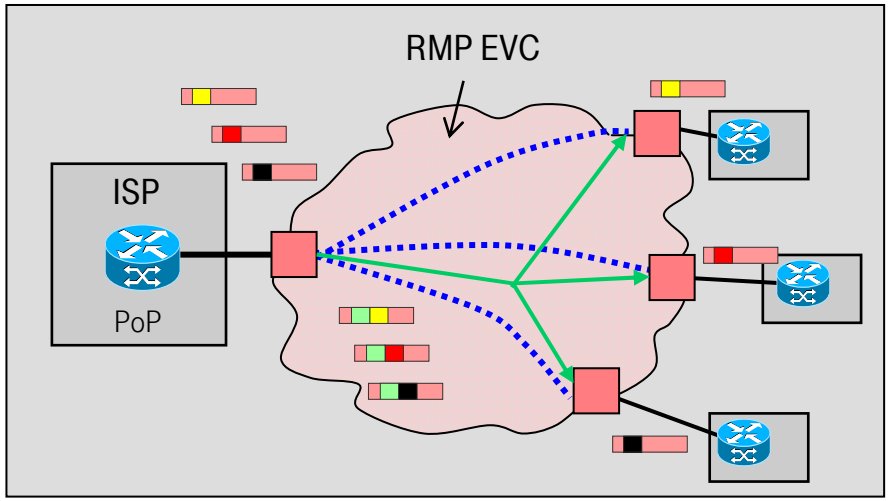
Access to OLTs (PON Systems)

Application Example – Without Backup PoP



Backhauling by using multiple P2P EVCs

- Backhauling could be supported by a hub & spoke topology of multiple P2P EVCs, i.e. one P2P EVC per customer location.
- One S-VID is needed per OLT. The S-VID is defined by the ISP.
- A further internal tag may be needed. In this case each EVC requires then an internal VID.

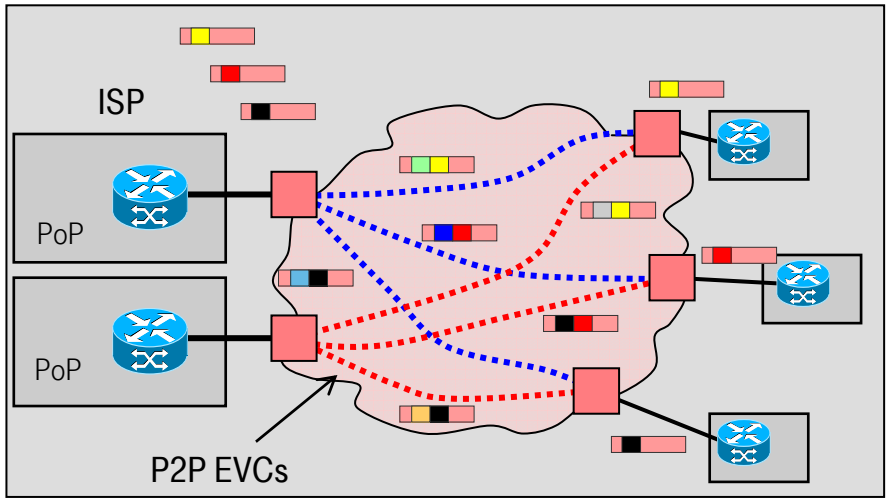


Backhauling by using one RMP EVC

- Backhauling could be supported by a single RMP EVC (E-Tree).
- The RMP EVC prevents communication between customers (leafs).
- The RMP EVC delivers the frames on bases of MAC addresses. Tag types and VID don't have to be agreed. The ISP is responsible for unique MAC addresses of the customers.

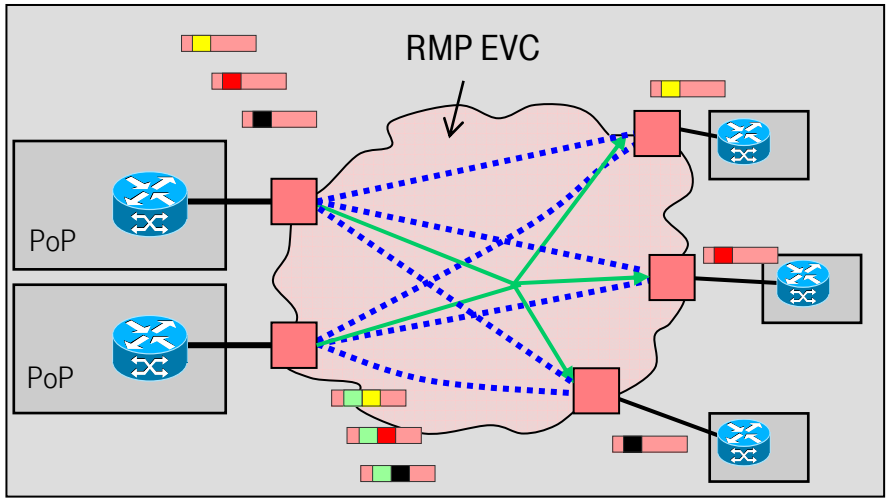
Access to OLTs (PON Systems)

Application Example – With Backup PoP



Backhauling by using multiple P2P EVCs

- The use of a backup PoP doubles the number of P2P EVCs.
- Resilience is provided by a back-up PoP, i.e. the Ethernet service just provides two disjoint P2P EVC from leaf to root
- Two P2P EVCs must be configured per OLT.



Backhauling by using one RMP EVC

- An backup PoP requires just a further access (UNI) to the RMP EVC.
- Resilience is provided by a back-up PoP, i.e. the RMP EVC just provides two disjoint outes from leaf to root
- One access to the RMP EVC (UNI) must be configured per OLT, i.e. little configuration when OLT are added or removed.

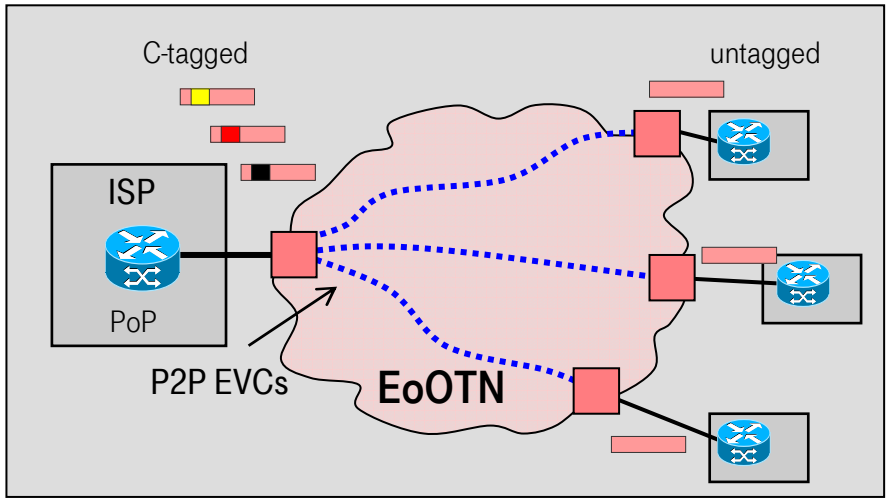
Application of E-Tree Services

Conclusion

- E-Tree services could be used instead of multiple P2P EVCs
- E-Trees could be used for many applications. For instances, for backhauling of IP services, where IP routers at customer premises are interconnected with an edge router at a PoP of an ISP. The edge router may use an “channelized” interface, which is based on C-tags (see next page)
- The tag format at the root UNI (e.g. S-tagged) must be identical for all leaves, but the leave UNIs may use different formats (e. g. untagged, C-tagged and S-tagged)
- For a provider point of view E-Tree services have the following advantages against multiple P2P EVCs:
  - Less configuration and less parameters to be agreed.
  - Friendly against changes of the customer network. For instance, new sides (UNIs) can easily be added.
  - RMP EVCs with dual roots provide resilience when divers routes are configured. Unlike for P2MP services, dual-homing is a regular function of a dual root RMP EVCs.

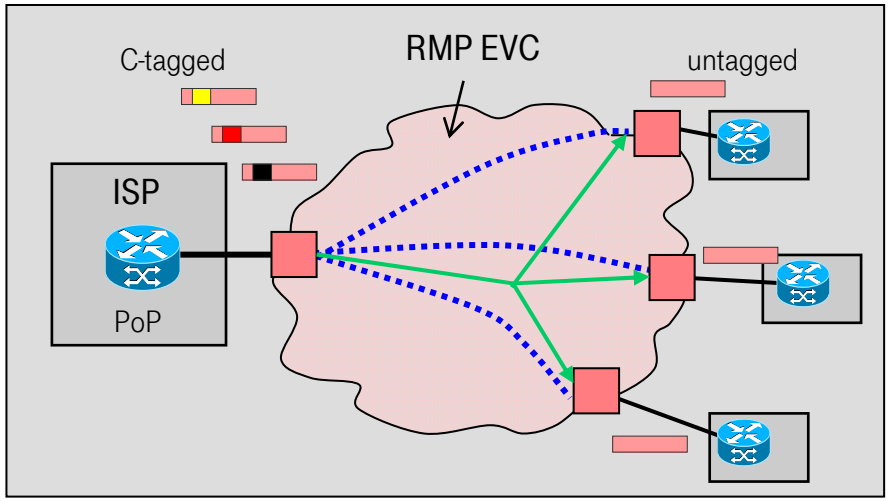
Backhauling for ISPs

Asymmetrical Service



Backhauling by using multiple P2P EVCs

- Backhauling could be supported by a hub & spoke topology of multiple P2P EVCs, i.e. one P2P EVC per customer location.
- One C-VID is needed per customer location. The VID must be agreed with the ISP or is defined by the ISP.
- The routers at customer premises use untagged interfaces, while the edge router in the PoP uses a C-tagged interface to address the a customer's router.



Backhauling by using one RMP EVC

- Backhauling could be supported by a single RMP EVC (E-Tree).
- The RMP EVC prevents communication between customers (leafs).
- The RMP EVC forwards the frames on bases of MAC addresses..