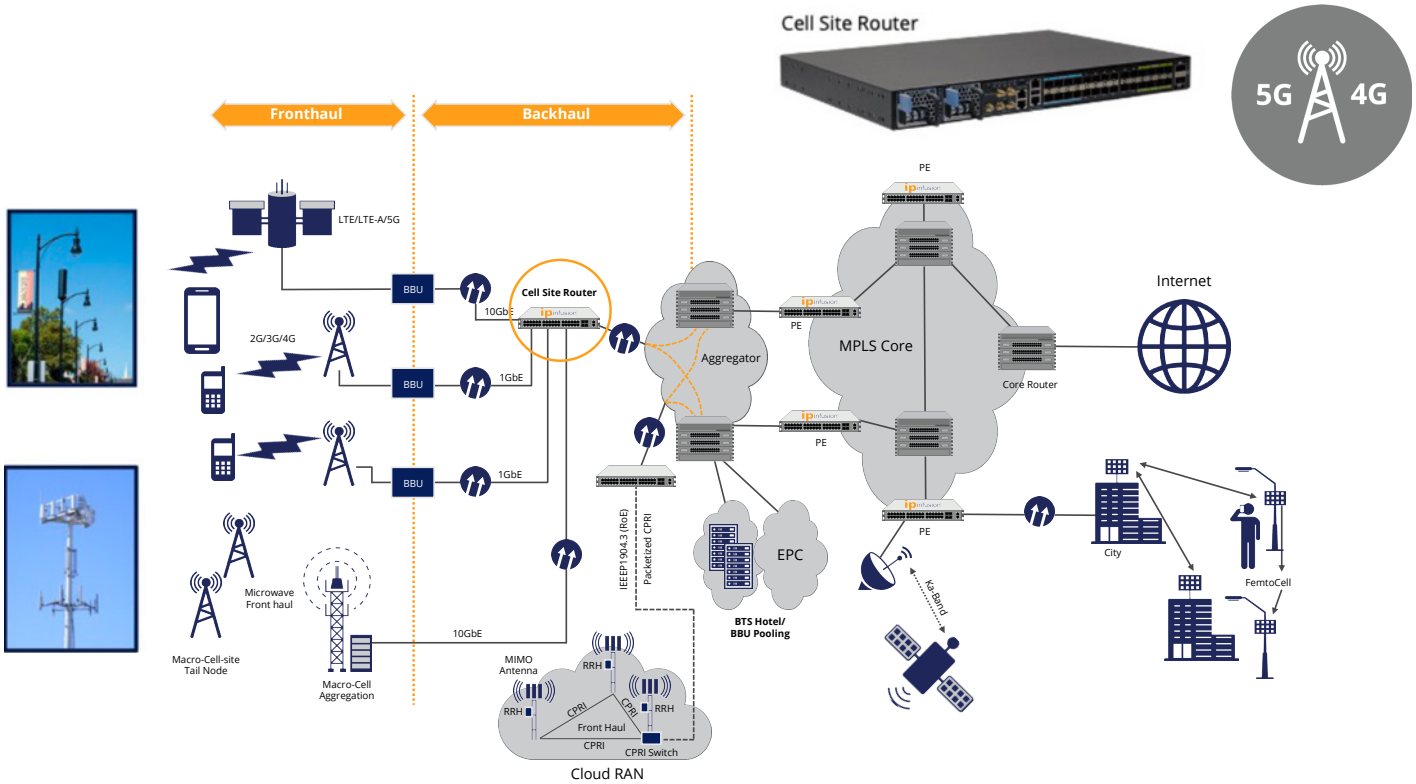
OcNOS® Service Provider Solution

Application Note

1.0 OcNOS-SP-CSR Disaggregated Cell Site Gateway System (DCSG)

IP Infusion's OcNOS-SP-CSR is a complete carrier class, Cell Site Router (CSR) solution, aligning with the Telecom Infra Project's (TIP) Disaggregated Cell Site Gateway1 (DCSG) technical specification. The technical specification provides detailed requirements for CSR device that operators can deploy in current and future generations of wireless transport networks. The OcNOS-SP-CSR solution is a smart converged integrated access platform which enables service providers to deliver next-level business and entertainment experiences.

To meet the Timing requirements OcNOS-SP-CSR has extensive support for Precision Time Protocol (Time Synchronization) and Synchronous Ethernet (Frequency Synchronization).



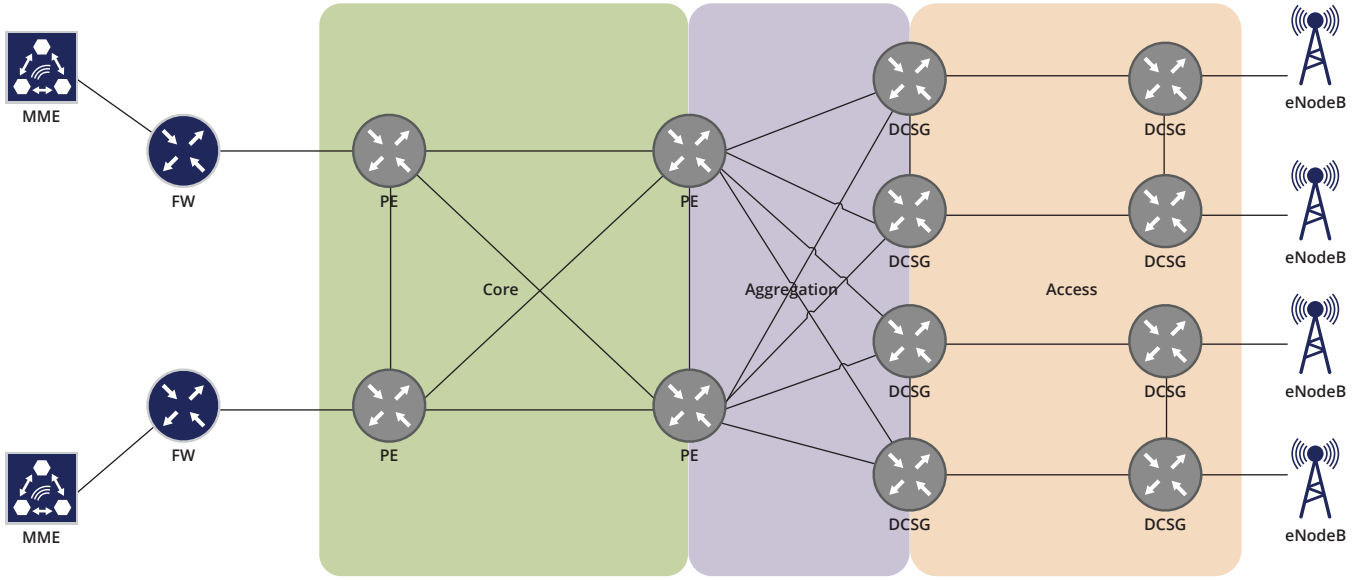
2.0 Mobile Backhaul Network Architecture

A Mobile backhaul network can be broadly divided into following network segments:

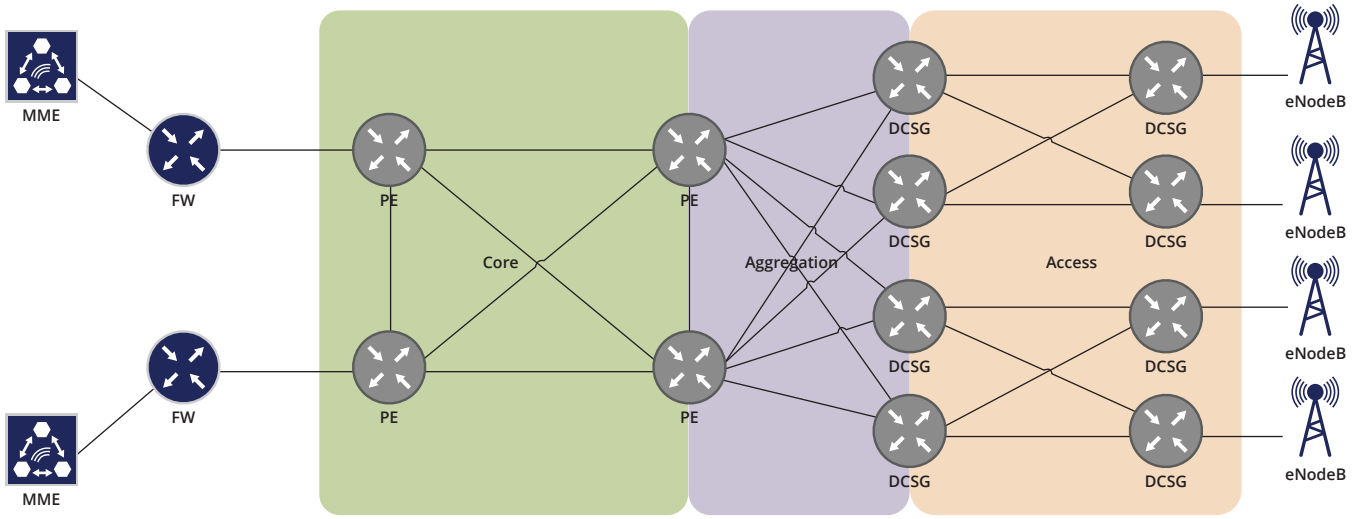
- Access
- Pre-aggregation
- Aggregation
- Core

The Access segment connects the base stations to packet network. DCSG devices are parts of access segment. The pre-aggregation and aggregation segment aggregates multiple access segments and provide upstream connectivity for traffic handoff to regional point of presence (POPs).

Following diagrams below depicts the ring and hub and spoke topologies in the access segment of a mobile network.



Ring Topology



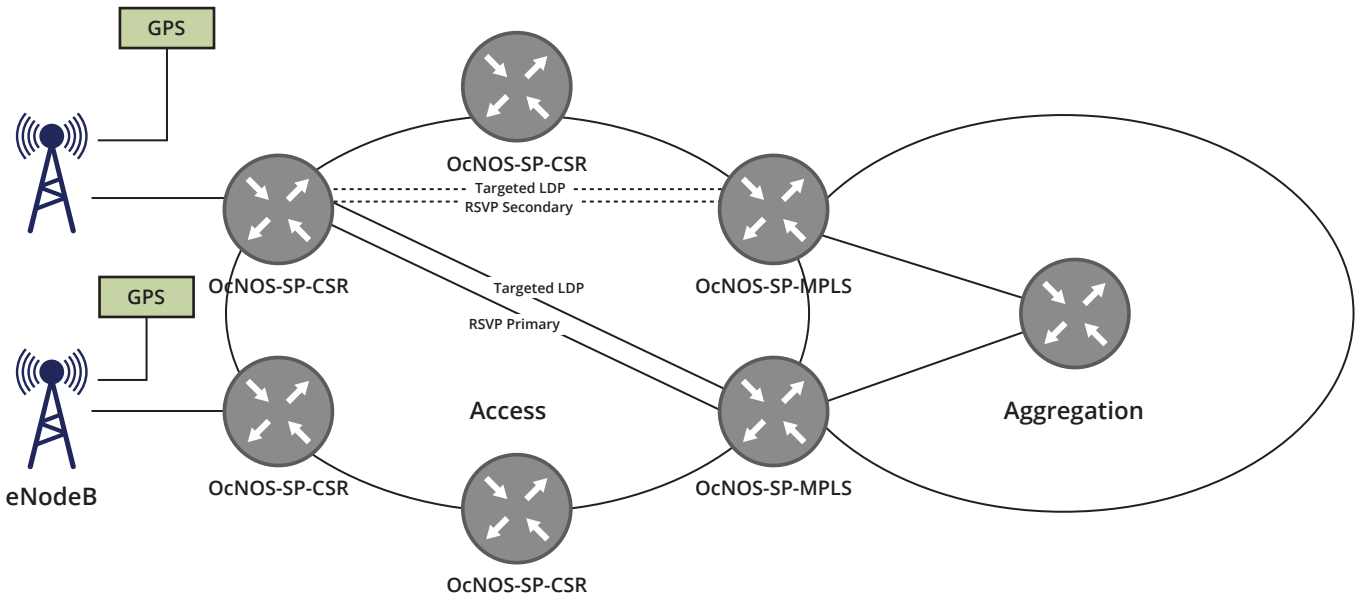
Hub and Spoke Topology

3.0 OcNOS SP CSR Applicable Use-Cases:

OCNOS-SP-CSR nodes are used in designing the access segment of a mobile backhaul network. The feature rich network operating system provides flexibility to the network operators to design the access/aggregation segments of the network in multiple different ways suited for a specific purpose. Following sections below describes few use cases where a OcNOS based CSR can be deployed.

3.1 L2 PWs in Access and IP in Aggregation and Core

This use case is applicable in the scenarios in which remote cell sites needs to be connected to the aggregation network segment over a pair of pseudowires. The time sync functions are not required in access and aggregation nodes and cell sites must synchronize its clock using a GPS receiver.



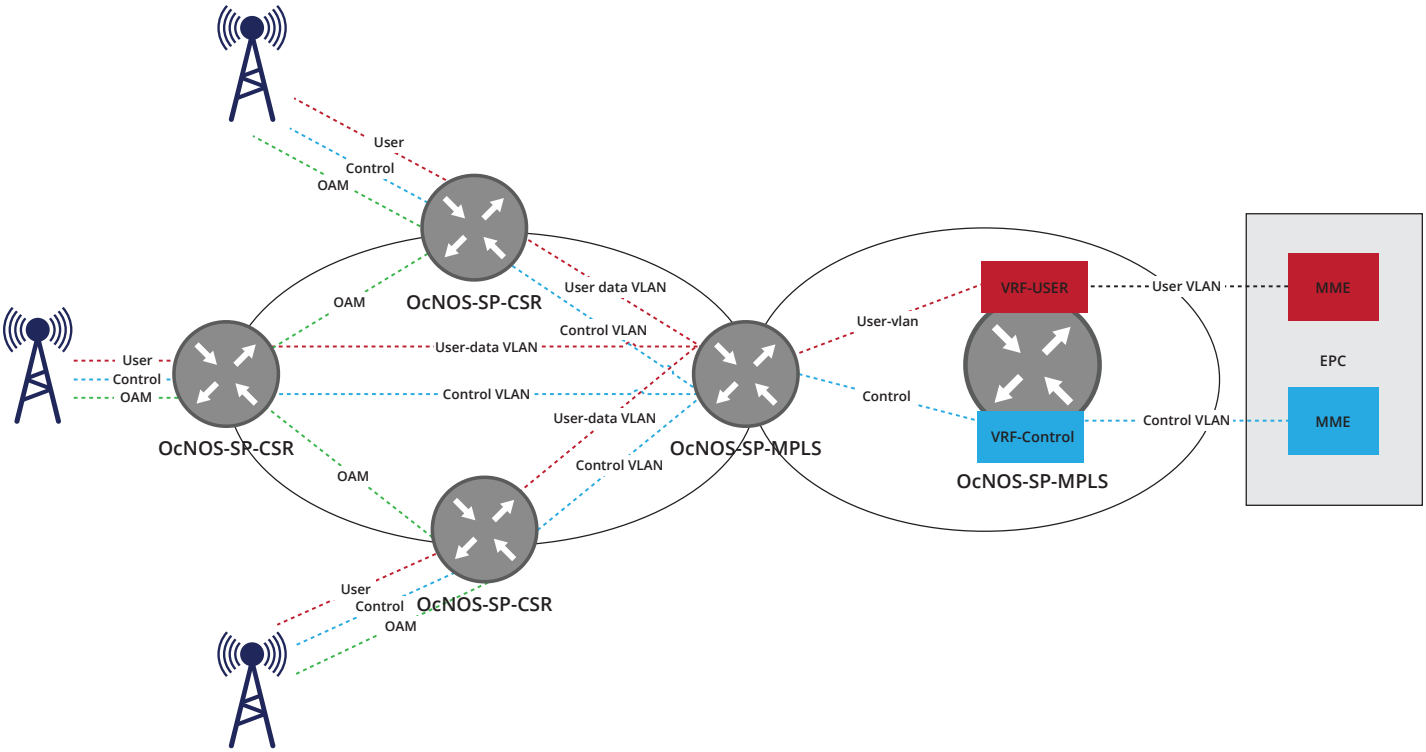
An access ring is created using OcNOS-SP-CSR and OcNOS-SP-MPLS nodes. OcNOS-SP-CSR nodes provide IP connectivity to eNodeBs and connect to a pair of OcNOS-SP-MPLS nodes using PWs. The PWs are configured in active/standby mode providing redundancy. The OcNOS-SP-MPLS routers further connect to an edge router in the aggregation network segment which in turn provides connectivity towards the core network.

The following features are extensively used to realise this use-case:

- QinQ
- IP Backbone
- LDP and Targetted LDP
- RSVP with FRR (1:1 Protection)
- MPLS VPWS
- Inter-AS Options – A, B, C
- BGP-LU

3.2 End to End L3VPN

This solution is applicable for the use case scenarios where end to end L3VPN is used for connecting Cell sites to EPC. Whether a mobile network operator requires upgrading his 4G-LTE access domain to offer more bandwidth or he wishes to deploy a new 5G network, the solution is applicable in both these cases. L3VPN is configured between OcNOS-SP-CSR and OcNOS-SP-MPLS acting as a remote PE device.

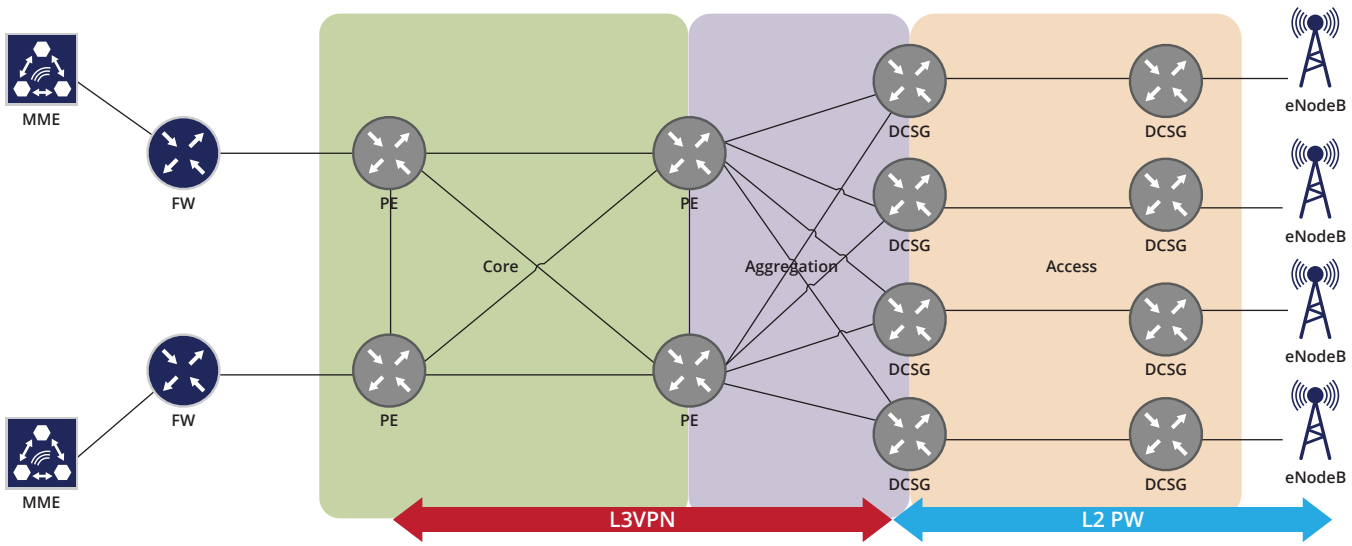


The following features are extensively used to realise this use-case:

- VLAN interfaces
- IP VRF
- IGP (OSPF, ISIS, iBGP)
- MPLS L3VPN
- Frequency and Time Synchronization
- Inter-AS Options – A, B, C
- BGP-LU

3.3 L2VPN in Access and L3VPN in Aggregation and Core

In this design CSRs are connected to aggregation domain using a L2 PW and aggregation domain connects to the mobile core using L3VPN.



When the traffic from NODEB arrives to DCSG, the DCSG pushes two labels – the L2VPN label and the transport label for the LSP and forwards it to AGGR router. AGGR router pops out the L2VPN label and pushes a new L3VPN label and forwards the packet to the remote PE node which in turn forwards it to RNC or packet core.

The following features are extensively used to realise this use-case:

- Vlan/Vlan Queuing/Vlan Shaping
- IGP (OSPF, ISIS)
- LDP, Targeted LDP
- L2VPN (LDP Signaling)
- L3VPN
- IP VRF
- Inter-AS Options – A, B, C
- BGP-LU

3.4 Frequency and Time Synchronization

Clock synchronization in a mobile backhaul network is an essential requirement for handoff support. DCSGs are required to provide frequency and time synchronization to the base stations which are connected to it.

There are primarily two methods of clock distribution in a mobile backhaul network:

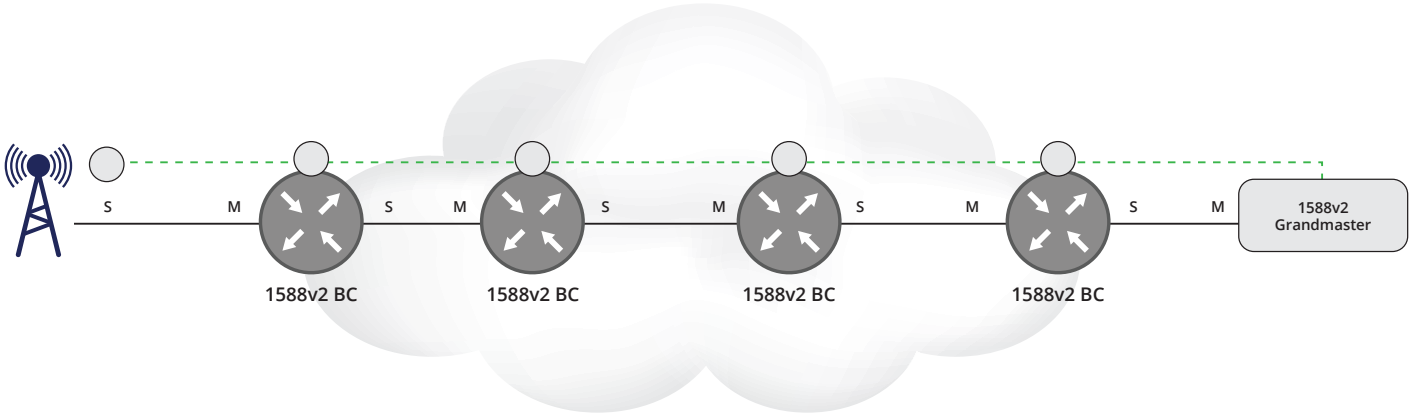
- Synchronous Ethernet as defined in ITU-T G.8262
- Precision Time Protocol(PTP) as defined in IEEE-1588v2

3.4.1 Synchronous Ethernet (SyncE)

OcNOS supports following ITU-T specifications that defines complete hop by hop frequency distribution architecture.

- ITU-T G.8261 – Specifies the maximum network limits of jitter and wander that shall not be exceeded.
- ITU-T G.8262 – Specifies requirements for timing devices used in synchronizing network equipment. It defines requirements for bandwidth, frequency accuracy, holdover and noise generation.
- ITU-T G.8264 – Specifies synchronization status messages (SSM) protocol and formats for use with SyncE. Adherence to the SSM format specified in specification ensures the interoperability between SyncE equipment vendors involved in frequency transfer.

3.4.2 Precision Time Protocol (PTP)



To meet the time synchronization performance needs, OcNOS supports following specifications

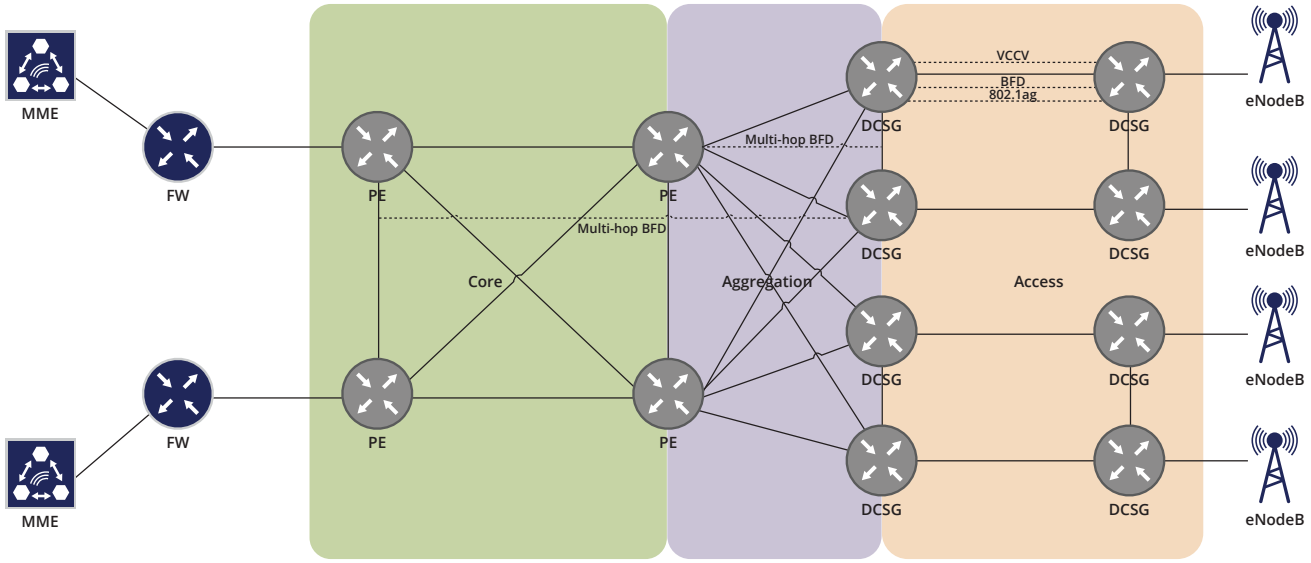
- Network Quality model as per ITU-T G.8271.1 network conditions and reference models for boundary clock.
- Node performance (noise generation, tolerance, transfer and holdover) as per ITU-T G8273.2 sections 7.1, 7.2, 7.3 and 7.4
- Node performance as per ITU-T G.8273.2 boundary clock quality objectives in holdover mode.
- Interoperability based on IEEE 1588 profile defined in ITU-T G.8275.1 with boundary clock and SyncE support for holdover purposes and Grandmaster redundant source support. This corresponds to support of IEEE 1588v2 profile for telecoms – Precision Time Protocol and includes SyncE support in Ethernet interfaces as per ITU-T G.8262 and G.8264.
- OcNOS supports T-GM (GrandMaster).

3.5 Operations and Maintenance (OAM)

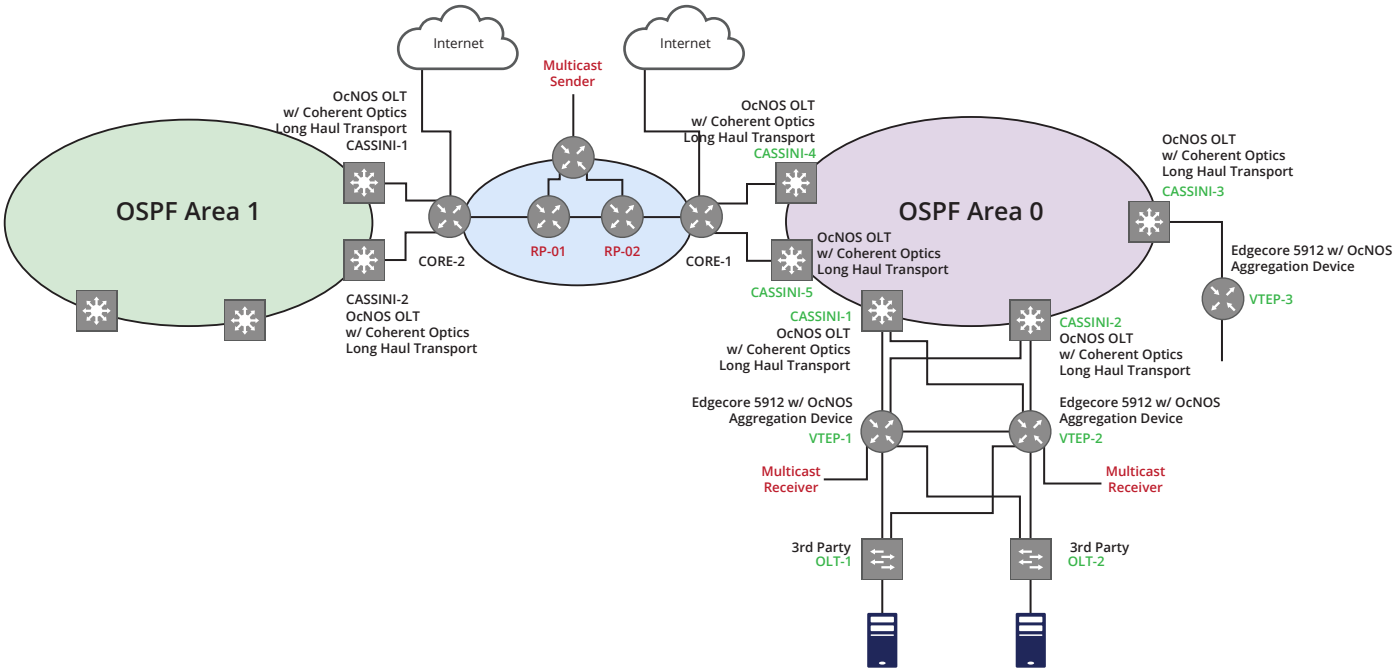
A mobile backhaul network may consist of multiple network segments – Access, Pre-aggregation, aggregation and core. A fault can occur within a network segment or across the network segments. The purpose of the OAM is to determine, isolate and diagnose the fault so that corrective action can be taken.

OcNOS supports BFD, multi-hop BFD and IEEE 802.1ag CFM which can be used to detect, isolate and diagnose the faults either within or across the network segments of a mobile backhaul network.

The following diagram below depicts uses of different OAM tools in the different network segments of mobile backhaul network.



3.6 Service Delivery (L2/L3 VPN Services) using VxLAN



The solution uses the concept of using different VRFs for segregating services. Each service is mapped to a VLAN and the incoming L2 traffic is mapped to per service VRF. For IP traffic OSPF is running as a Dynamic Protocol in default VRF or some specific VRF with BFD for fast link failure detection.

The VxLAN is used primarily for providing L2/L3 VPN services to enterprise customers.

More Information

For more information about the OcNOS Service Provider solution, contact your IP Infusion sales representative.

ABOUT IP INFUSION

IP Infusion, a leader in disaggregated networking solutions, delivers enterprise and carrier-grade software solutions allowing network operators to reduce network costs, increase flexibility, and to deploy new features and services quickly. IP Infusion is headquartered in Santa Clara, Calif., and is a wholly owned and independently operated subsidiary of ACCESS CO., LTD. Additional information can be found at **http://www.ipinfusion.com**

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