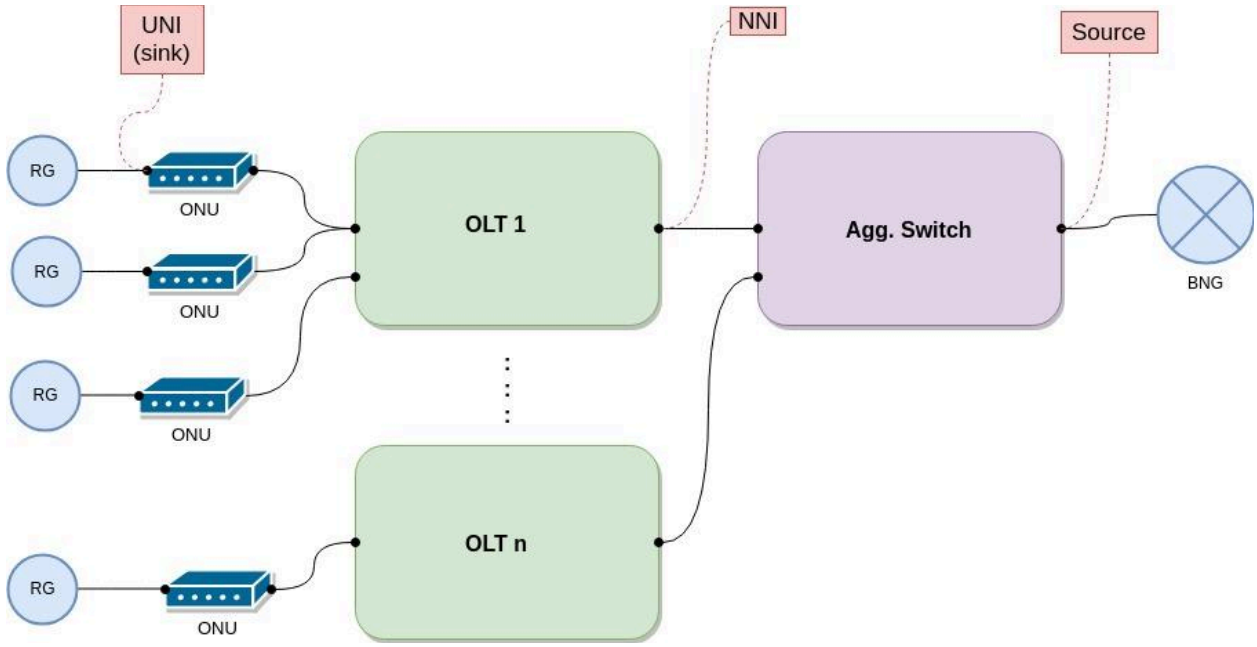
Multicast in SEBA



Context

Trellis already supports dual-homed source and sink for both IPv4 and IPv6. We are trying to revisit the multicast requirement in SEBA, taking both aggregation switches (Trellis) and access devices (OLT) into account. We have also accounted for use-cases where Trellis is not used.

High-level Packet Flow

1. RG sends IGMP join message
2. IGMP join gets intercepted by ONOS at OLT
    a. ONOS updates internal store to keep track on subscriber location
    b. ONOS forwards the IGMP to BNG, depending on configuration in the IGMP proxy app
        i. In a SEBA pod, this will happen on a pod level, if and only if the subscriber is the **first of the pod** that requests the channel.
        ii. For non-SEBA use cases, this will happen **on an OLT level**, and the assumption here is that it is the job of the AGG switch control software (possibly non-SDN) to choose to forward it or not.
3. BNG will request the stream in the background and send it back to agg switch

4. Agg switch and OLT will be programmed accordingly to replicate and forward the mcast stream to the subscriber.
5. IGMP leave should be processed in a symmetric way. In other words:
    a. In a SEBA pod, only the **last of the pod** leaving will trigger IGMP leave message to BNG.
    b. For non-SEBA use cases, leaves will be forwarded by the IGMP proxy app on the OLT level. It is assumed that the AGG switch control software (possibly non-SDN) is responsible for choosing to forward the leave or not.

ONOS Apps

The following will be required for mcast. Some other apps are still required to plumb regular traffic but they will not be listed here.

In ONOS repo

/apps/**mcast**

This is the (new) multicast store that keeps track on mcast info e.g. sink location

/apps/**segmentrouting**

It programs AGG switch to replicate and forward mcast traffic according to the mcast info from the mcast store

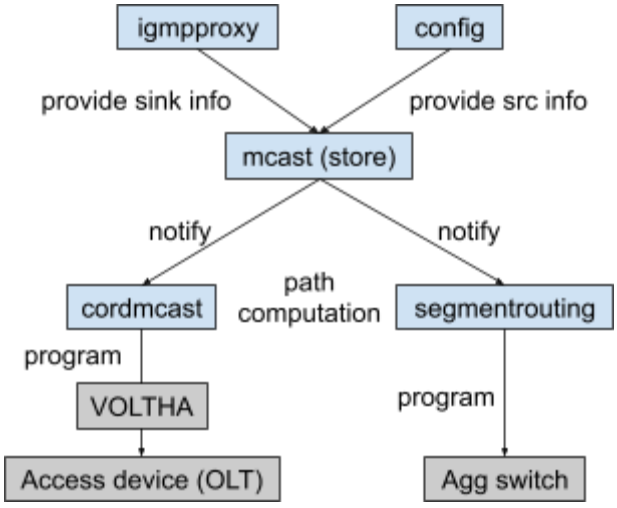
In CORD repo

/onos-apps/**mcast**

It programs access device to replicate and forward mcast traffic according to the mcast info from the mcast store. To avoid confusion, this app will be referred to as **cordmcast** for the rest of this document.

/onos-apps/**igmpproxy**

It intercepts IGMP packets from RG and forward it to BNG if necessary



Some of them will need to be modified as described below.

Netsia -> igmproxy, cordmcast
Sterlite -> VOLTHA and below
Infosys -> mcast, segmentrouting

Design Facts

- **Link between OLTs and AGG switch are discovered as infrastructure links**
- **About sources and sinks…**
    - The **source** will be the port on agg switch facing BNG. It will be configured via mcast app api (REST or CLI)
        - Only mcasthandler in segmentrouting needs source connect point while cordmcast programs per device
    - The **sink** will be the UNI port on OLT. It will be learnt from IGMP join

Changes to be made in ONOS apps

1. **Igmpproxy, cordmcast app improvements in general SEBA-640, SEBA-641**
    - Need to be run in a distributed ONOS cluster <lower priority>
    - Need to handle failure scenarios
2. **igmpproxy needs to use the new mcast store SEBA-642**
    - We want to use only one mcast store
    - Both source and sink will use **ConnectPoint** instead of HostId
3. **Igmpproxy needs to update the store upon failure SEBA-643**
    - E.g. remove sink when UNI port goes down
4. **igmpproxy needs to be modified to forward IGMP to BNG on a per pod basis or a per OLT basis SEBA-644**
    - (Current) IGMP join will be sent per OLT per channel
    - (Desired) Add the option to send IGMP join on a per entire pod basis since the WBNG is now external to the pod.
    - Similar change for IGMP leave
5. **igmpproxy needs to have an option to send packet out directly to BNG port SEBA-645**
    - This should be an option -- something we have in DHCP and the community thinks it will be nice to have such symmetry
6. **cordmcast needs to listen to mcast event from the new mcast store SEBA-646**
    - program OLT accordingly
7. **cordmcast and oltpipeliner need to support IPv6 SEBA-647 SEBA-648**
    - Some changes need to be done to support IPv6
8. **segmentrouting should not program multicast tree on unconfigured devices (OLT) SEBA-636**

- segmentrouting should still consider OLT as part of topology when calculating the mcast tree, but let the cordmcast program the OLTs.env
-

9. **segmentrouting McastHander need to be extended to support ConnectPoint based programming SEBA-637**
    - A work in progress can be found here: https://gerrit.onosproject.org/#/c/21409/
        - Modification for sinks is done. Need to do the same for source.

IPTV Service

1. IPTV service is considered as a composition of two sub-services in Türk Telekom (TT) use-cases: VideoOnDemand (VoD) and Multicast. In contrast to Multicast service, VoD works in unicast manner. For a subscriber who is willing to purchase the IPTV service, VoD and Multicast service definitions shall be provided in the profile of the subscriber defined in SADIS. At the subscriber provisioning phase, all flow rules and traffic components required for both of these sub-services shall be created on related OLT and ONU devices. Flow rule creation shall be triggered from the OLT application in the following order.

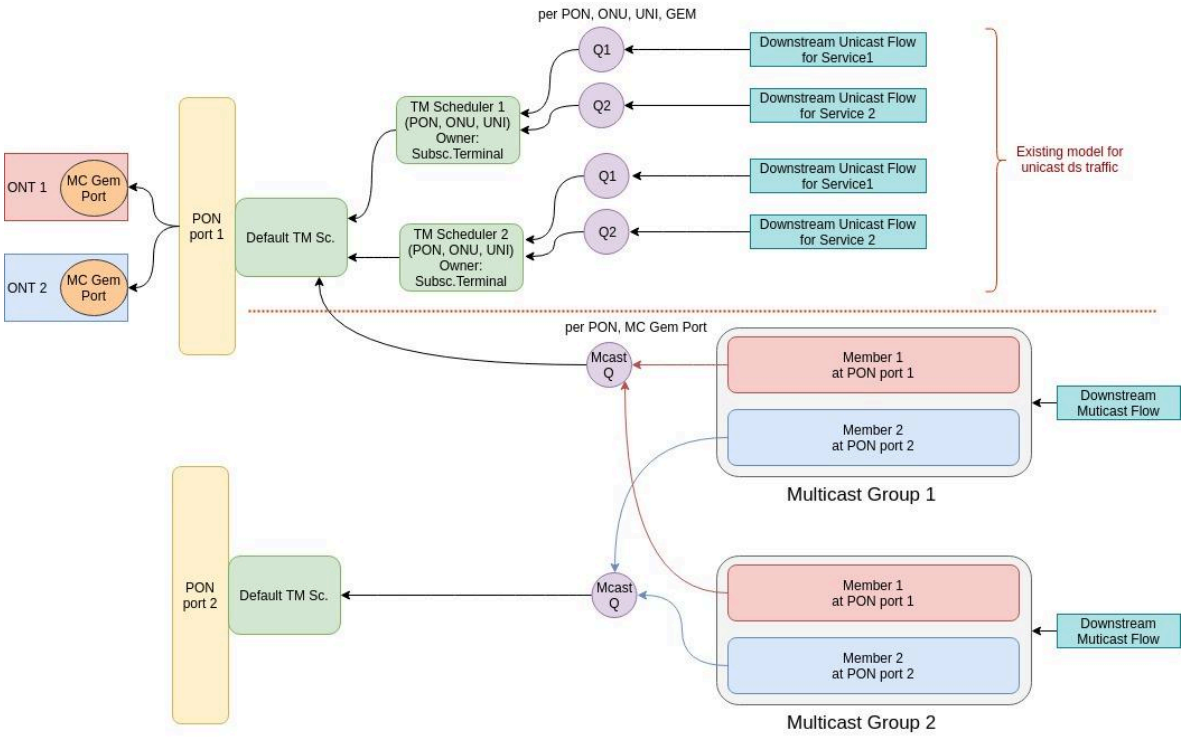
    1.1. VoD upstream flow: it shall be decomposed into two flows by OltPipeline of ONOS; one for Open OLT Adapter and the other for Open OMCI Adapter. Having installed to the OLT by Open OLT Adapter, the former flow shall trigger Open OMCI Adapter and this trigger shall lead to creation of OMCI ME entities on the ONU device.
    By the time the latter flow arrives at Open OMCI Adapter, it shall trigger the vlan_filtering_task whose purpose is to fill in the VLAN Tagging Filter Data ME with necessary VLAN filtering rules.

    1.2. IGMP upstream flow: It shall be installed to the OLT by Open OLT Adapter

    1.3. VoD downstream flow (if mac learning is not enabled)

    1.4. VoD DHCP upstream flow: It shall be installed to the OLT by Open OLT Adapter

1. In the upstream direction, IGMP packets shall be received through the VoD GEM port.
2. A downstream traffic queue shall be created per PON port for multicast service. A generic overview of the traffic model (for both multicast and unicast traffics) is depicted in the diagram below.



Changes to be made in VOLTHA

1. OpenOLT will need to map multicast IP addresses to multicast MAC address Vol-1601
    a. This is due to current BAL implementation which uses multicast MAC based forwarding not multicast IPIt will mean that the IPTV channels need to be on non-overlapping addresses (ie. the channel IPs should not map to the same multicast MAC address)
2. Need to ensure that VOLTHA 1.x core does the right flow decomposition vol-1600
3. IGMP and Multicast flow and group handling in openolt adapter vol-1594 vol-1595 vol-1596
4. Multicast ONU configuration needs to be done using OMCI -- should this be triggered by IGMP trap flow for a particular ONU -- need to ask Chip to help (maybe CIG) vol-1599
5. Changes needed in OpenOLT driver and GRPC to OpenOLT adaptor vol-1598 vol-1597
6. BreBSim extension in the futu for scale testing of multicast control channel (IGMP) vol-1603
7. Ponsim in SiaB has to upgrade to multicast functionality ~~vol-1602~~ seba-660

Changes to be made in VOLTHA/Open OMCI Adapter

1. OMCI Managed Entities (MEs) for multicast according to G.988:
    a. Multicast GEM IW TP

   b. MC Subscriber config
   c. MC operations profile
   d. MC subscriber monitor
2. Broadcom supports three of them (MC GEM IW TP, Subscriber config, operations profile). We should create three of them at the multicast service initialization state for an ONU. vol-1599
3. Most of the attributes of the Multicast MEs shall be filled with the values taken from the technology profile. Thus, technology profile id should be delivered to Open OMCI adapter at the beginning of the multicast service initialization phase of an ONU.
4. Multicast GEM port configurations shall be defined in the technology profile as a GEM port in downstream_gem_port_attribute_list. A multicast GEM port shall be differentiated from the other GEM port definitions by the value of “is_multicast” flag. The flag shall be true for the multicast GEM port; it shall be false otherwise.
5. Multicast GEM port configuration shall also include some additional fields which are necessary to create and configure multicast related OMCI MEs on an ONU. These fields are dynamic_access_control_list, static_access_control_list, and multicast_gem_id. A sample multicast GEM port definition is shown below. The first entity in “Downstream_gem_port_attribute_list” indicates a GEM port definition for VOD service and the second one indicates a GEM port definition for Multicast service.

```
"Downstream_gem_port_attribute_list":[
  {
    "pbit_map":"0b00000100",
    "aes_encryption":"True",
    "scheduling_policy":"WRR",
    "priority_q":5,
    "weight":20,
    "discard_policy":"TailDrop",
    "max_q_size":"auto",
    "discard_config":{
      "max_threshold":0,
      "min_threshold":0,
      "max_probability":0
    }
  },
  {
    "pbit_map":"0b00100000",
    "discard_policy":"TailDrop",
    "aes_encryption":"True",
    "scheduling_policy":"WRR",
    "priority_q":3,
    "weight":10,
    "max_q_size":"auto",
    "discard_config":{
```

```
          "max_threshold":0,
           "min_threshold":0,
           "max_probability":0
       },
     "is_multicast":"True",
     "dynamic_access_control_list":"224.0.0.0-239.255.255.255",
     "static_access_control_list":"225.3.3.3",
     "multicast_gem_id":4069
  }]
```


Changes to be made in VOLTHA/Open OLT Adapter

Flow mod messages should be handled by the adapter; it should support handling of group create, modify and delete actions. Vol-1596 vol-1597

IGMP Trap Rules by OLT Application

Olt application of CORD should be responsible for managing IGMP trap rules. It should create a single IGMP rule per an ONU (subscriber). SEBA-638

1. Considering the above requirements for Open OMCI and OLT adapters, a single IGMP rule for a particular subscriber should convey technology profile id and upstream profile id.
2. Technology profile id and c tag should be embedded into the metadata of the IGMP flow.
3. Upstream bandwidth profile id should be embedded into the meter Id field of the IGMP flow.

An IGMP flow should look like the following before being passed to OltPipeline of ONOS:

```
ip_proto criterion=2, metadata: techprofile_id, meterId: upstream_bw_profile_id,
c tag and p bit instructions, action goto CONTROLLER
```

Possible Improvements and Open questions

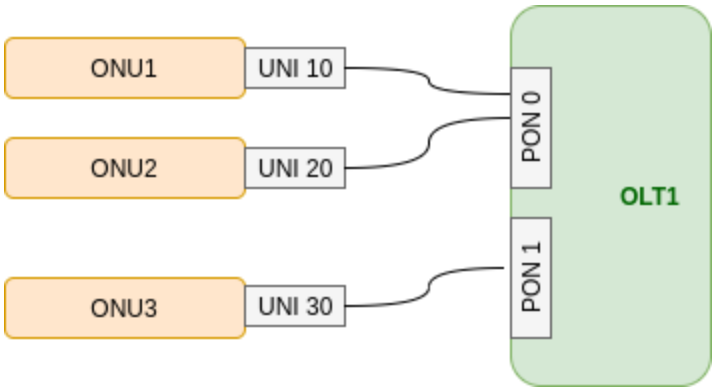
1. ~~Trap flows can be reduced just to one in the igmpproxy app instead doing per inport.~~
    a. This is done probably because people only want to trap IGMP messages on the authenticated ports ? Yes this is correct. We try to keep the apps generic by pushing a single trap flow from apps (without inport info) -- these flows are rejected by the voltha-driver in ONOS. The trap flow with inport info is sent by the olt app which knows which ONUs have been authenticated and therefore can accept dhcp/igmp etc - so the right place is there. The voltha driver will allow this flow.

b. Should we move trap flows programming away from igmpproxy to CORD olt application ? No need to move -- let the igmp app do what it does -- the voltha driver will reject it.
c. I think the idea is that we want to disallow the packets to come in the first place. Some rogue unauthenticated RG may create flood of IGMP packets, all of which will go to the control plane and create bottlenecks. Yes we can reduce the number of flows (good for scale) and reject in the control plane, but for that apps like igmpproxy and dhcpl2relay will need to reach out to the aaa app to ensure if an RG has been authenticated or not - doable - but creates dependencies between the apps. We may need to do it anyway for scaling reasons, but for now lets stick to what other apps are doing.

2. ~~How do we want to handle non-SEBA environments~~ ? Accounted for in the high-level packet flow description above

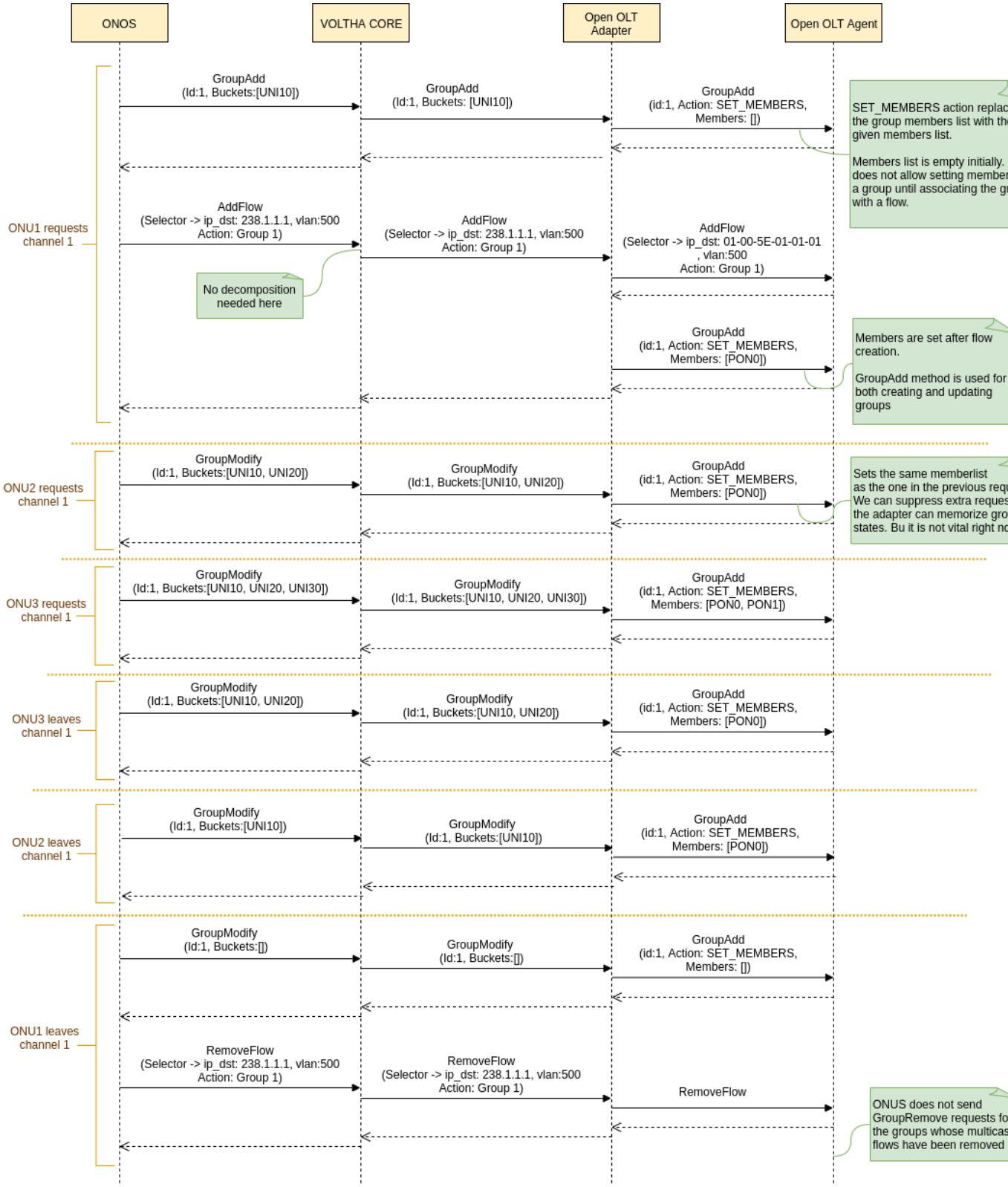
Diagrams for multicast flow decomposition

Multicast setup



Sequence diagram for multicast group join/leave handling

Multi-TCONT (TT Workflow) Implementation Details



Multi-TCONT details are covered here:

https://drive.google.com/drive/u/1/folders/13irS31F-mpRrZShSQtfnbaQchwlVMoKm

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