



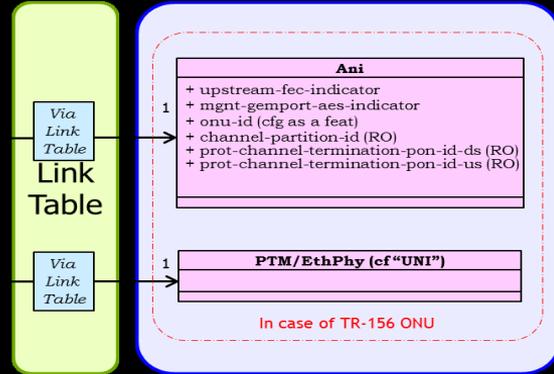
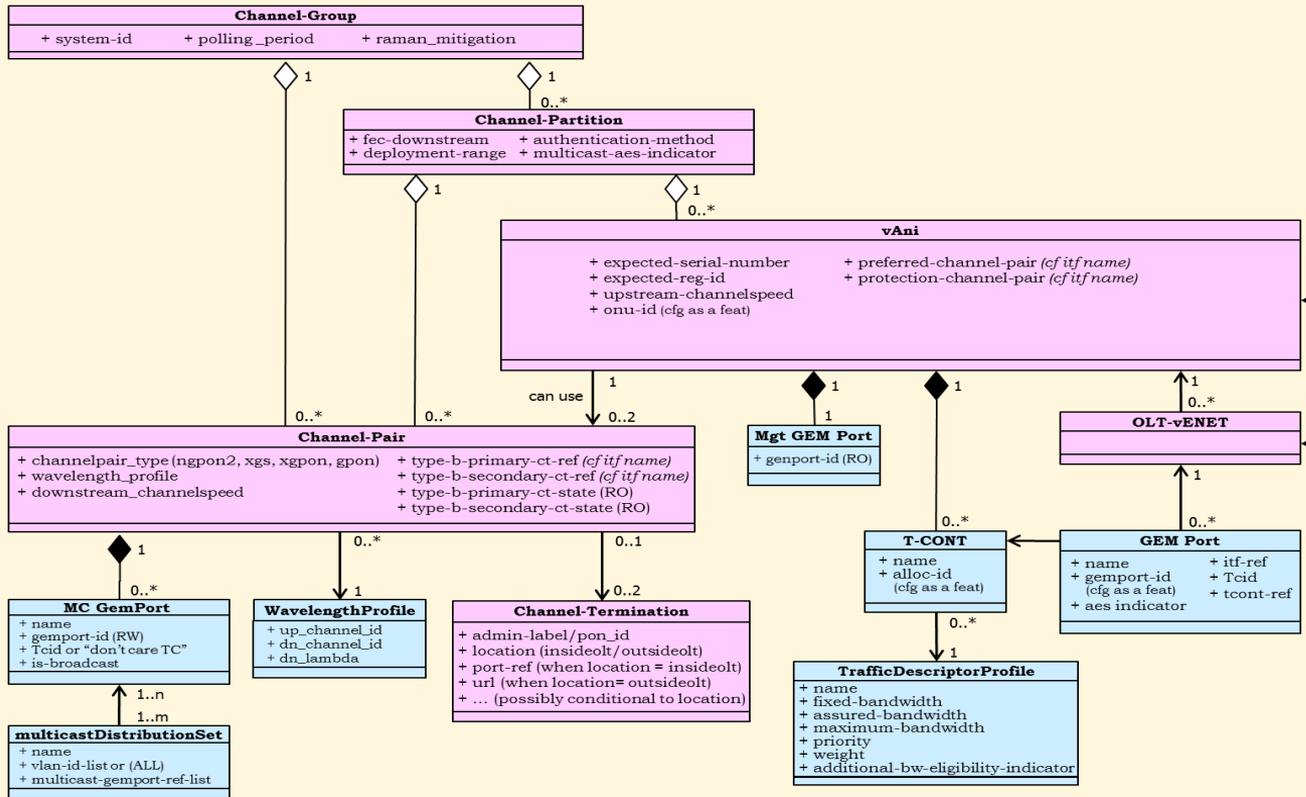
# Technology Profile and Speed Profile Implementation

Shaun Missett (System Architect)  
Radisys

# VOLTHA Technical Lockdown Jan, 2018 AT&T Facility San Ramon CA

- Much discussion around how addition of Specific XPON Technology had migrated into VOLTHA Core and general desire to make VOLTHA Core Technology Agnostic to allow for support of a variety of Access Technologies and Access Node Adapters.

# WT-385 model support added



# VOLTHA Technical Lockdown Meeting at AT&T Dallas Facility April 2018

- Radisys and ONF propose a 'Technology Profile' and 'Bandwidth Profile' model to allow creation of a set of Profiles, containing Access Technology specific information, which are loaded into the VOLTHA database and referenced by OpenFlow for each Upstream and Downstream Flow created.
- Voltha Core neither sees nor interprets the 'Technology Profile' contents only the OLT and ONU Adapters do that.
- Bandwidth (Speed) Profiles are maintained separately from the Technology Profile as they can be highly variable.
- OpenFlow Meters and their Meter Bands are used to implement the Subscriber Bandwidth (Speed) Profiles.

# OpenFlow and Technology Profiles

XPON Technology Profile:

1. ITU: G.989.3/G.988 +
2. BBF: WT-385/TR-383+
3. Instance Control +
4. ~~OF Table ID (64-255 Metadata~~

16-Bit Value)

**Tech. Profile Identifiers**

1. Name
2. ~~OF Table Tech Profile ID~~
3. Profile Type
4. Profile Version

**Common Instance Control**

1. ONU: Single/Multi
2. UNI: Single/Multi
3. # GEM Ports(Queues)

- Instance Control =
- 1) TR-156 4+1
  - 2) TR-280

**U/S Scheduler**

1. Additional Bandwidth {None | NA | BE | Auto}
2. ~~T-CONT; Fixed-Bandwidth-RF~~
3. T-CONT; Priority
4. T-CONT; Weight
5. Queue Scheduling Policy

**D/S Scheduler**

1. Priority
2. Weight
3. Queue Scheduling Policy

Enhanced QoS

**U/S GEM Config & Sched Attributes**

1. Per GEM Port Attributes:
 

I. P-Bit Map	V. Weight
II. AES Encryption	VI. Discard Policy
III. Scheduling Policy	a. Min Threshold
IV. Priority	b. Max Threshold
	c. Max Probability

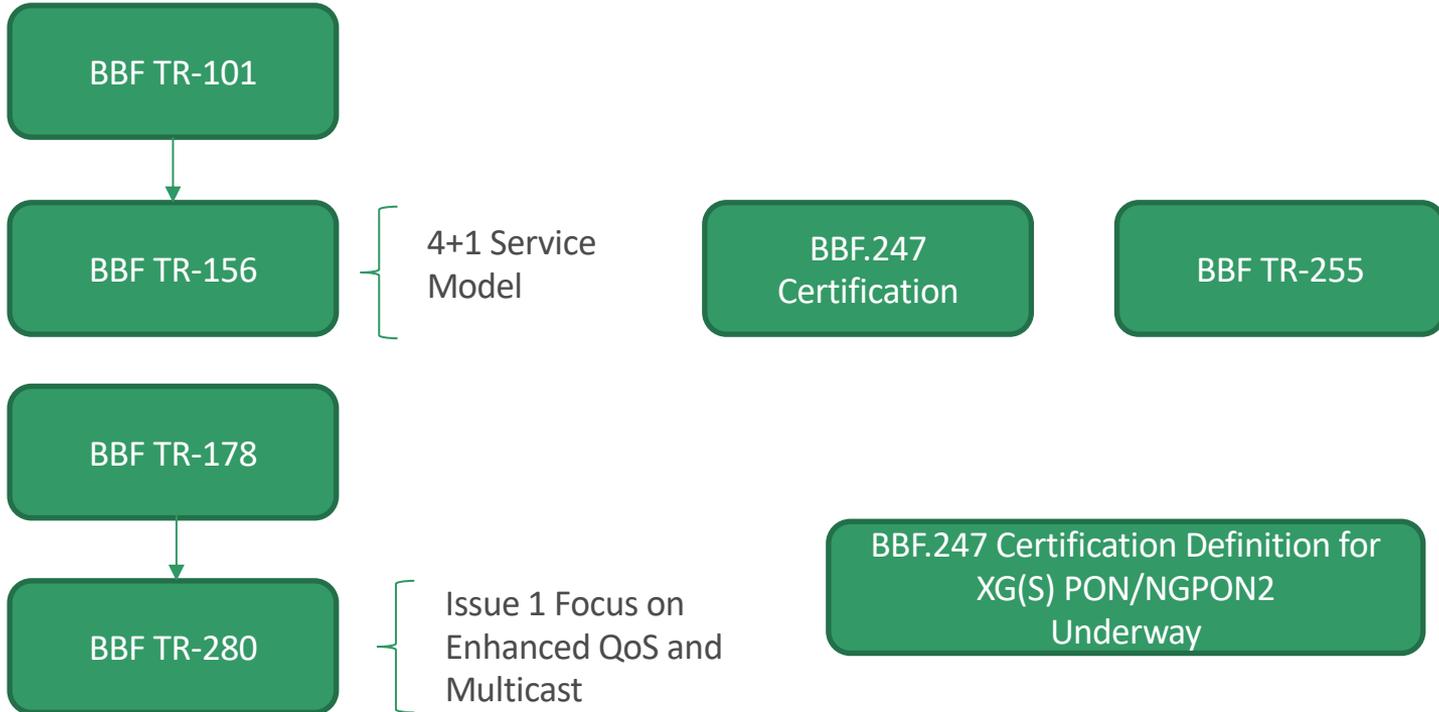
**D/S GEM Config & Sched Attributes**

1. Per GEM Port Attributes:
 

I. P-Bit Map	V. Weight
II. AES Encryption	VI. Discard Policy
III. Scheduling Policy	a. Min Threshold
IV. Priority	b. Max Threshold
	c. Max Probability

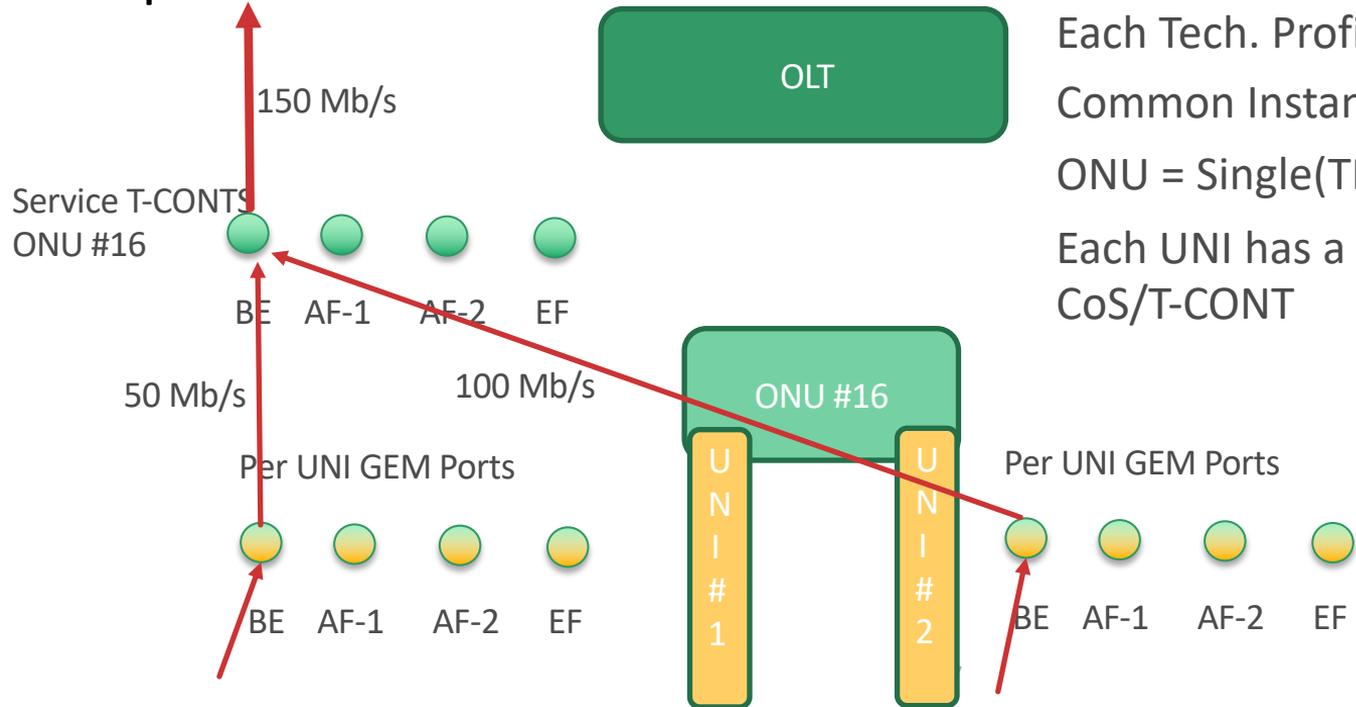
# BBF Standards and xPON Service Models

- Access Service Definition and Compliance Testing: N:1, 1:1, VBES, Multicast, Wholesale Model



# BBF TR-156 4+1 Service Model

- TR-156 – OLT Allocates 4 Service T-CONTs(Alloc-IDs) per ONU + 1 default T-CONT(Alloc-ID) for OMCI. Each UNI gets 4 GEM Port-IDs, 1 per T-CONT.



Each Tech. Profile is a PON CoS:

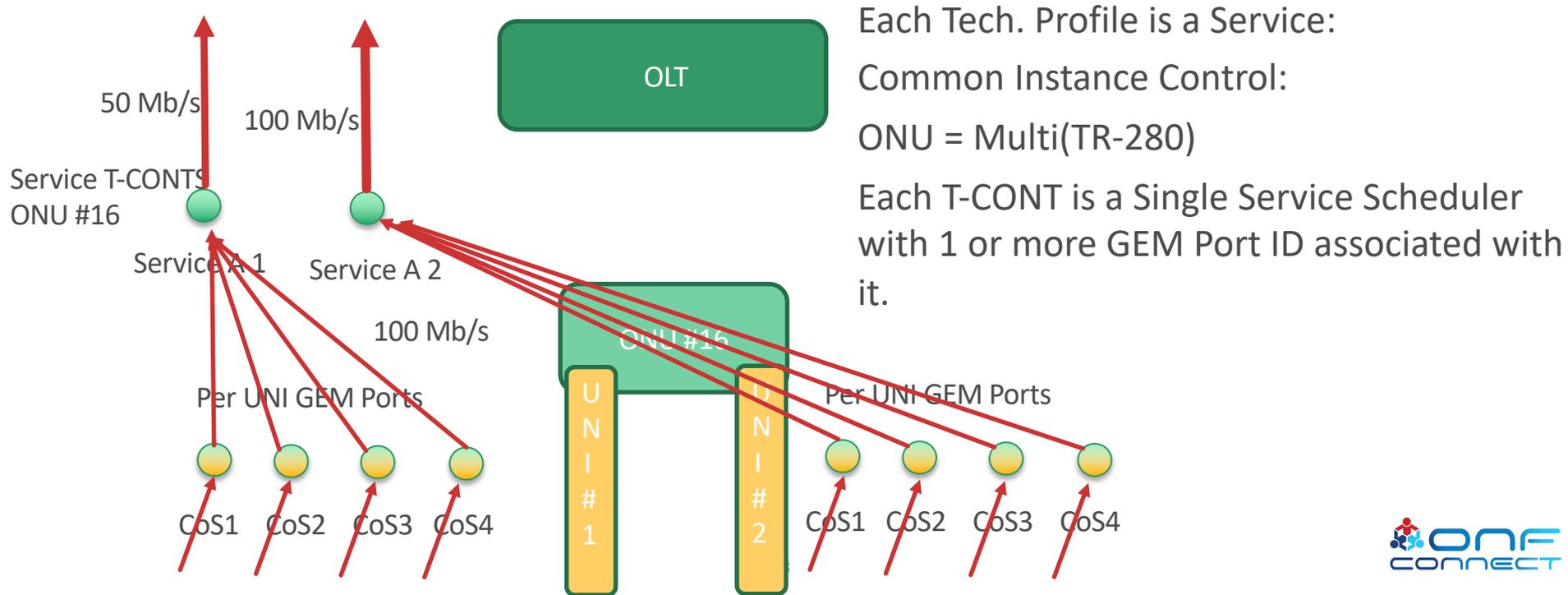
Common Instance Control:

ONU = Single(TR-156)

Each UNI has a single GEM Mapped to each CoS/T-CONT

# BBF TR-280 Service Model

- TR-280 Enhanced QoS Model – OLT Allocates 1 Service T-CONT(Alloc-ID) per ONU per Service. Each Service gets up to 8 GEM Port-Ids allocated.



# OpenFlow Meters and Upstream/Downstream Bandwidth Profiles

The Meter referenced in the OpenFlow message are used to generate the Downstream Bandwidth(Speed) Profile for the Service and also the Upstream DBA Bandwidth Parameters.

Each OpenFlow Meter contains an unordered list of meter bands, where each meter band specifies the rate of the band, burst size and the way to process the packet

Using the MEF (MEF 10.3 ) Service definitions we can allow for a Flow Bandwidth to have the following attributes:

**CIR** – Committed Information Rate, **CBS** - Committed Burst Size

**EIR** - Excess Information Rate, **EBS** - Excess Burst Size

And for Upstream Bandwidth only the DBA parameters allow for an **AIR** component.

An Openflow Meter will have up to three Meter Bands. Initially we had up to two bands but since the Fixed Bandwidth was moved out of the Technology Profile we ended up with three.



# Upstream Bandwidth Profile Representation

$$\text{CIR/CBS} = \text{Fixed}, \text{AIR} = \text{Assured}, \text{EIR/EBS} = R_M$$

In general, the bandwidth and eligibility components of the Alloc-ID traffic descriptor may have different interrelations with each other. The five combinations of Alloc-ID traffic descriptor parameters that, in practical terms, appear more important than the others are identified and associated with the specific T-CONT types. The definition of the five T-CONT types is given in the Table below:

Traffic descriptor component	Type 1	Type 2	Type 3	Type 4	Type 5
Fixed bandwidth (BW)	$R_F$ Meter Band 1 (CIR) Burst == 0				$R_F$ Meter Band 1 (CIR)
Assured BW		$R_A$ Meter Band 1 (AIR)	$R_A$ Meter Band 1 (AIR)		$R_A$ Meter Band 2 (AIR)
Maximum BW	$R_M = R_F$ Meter Band 1 (CIR) Burst == 0	$R_M = R_A$ Meter Band 2 (AIR)	$R_M > R_A$ Meter Band 2 (PIR)	$R_M$ Meter Band 1 (PIR) Burst > 0	$R_M \geq R_F + R_A$ Meter Band 3 (PIR)
Additional BW eligibility	None	None	NA	BE	Any (Tech. Profile Specified)

# Downstream Bandwidth Profile Representation

$$\text{CIR/CBS} = \text{CIR/CBS}, \text{EIR/EBS} = \text{EIR/EBS}$$

**CIR** – Committed Information Rate, **CBS** - Committed Burst Size

**EIR** - Excess Information Rate, **EBS** - Excess Burst Size

# AT&T HSIA Example(TR-280 Service Model)

Single T-CONT with Four GEM Ports Example (4QueueHybridProfileMap1)

The AT&T Open OMCI document describes an High Speed Internet Access (HSIA) Service with a Single T-CONT and Four Gem Ports (Queues):

Service GEM	Traffic Class	Priority Queue	PBIT	Scheduling Policy	Upstream Weight	Downstream Weight	Traffic Type
GEM4	TC6	Q1(Higher Priority)	6,7	Strict Priority	N/A	N/A	NC, H1 (voice)
GEM3	TC4	Q2	5	Strict Priority	N/A	N/A	EF (igmp)
GEM2	TC2	Q3	1,3,4	WRR	75%	90%	H2, L1 (vod/icc)
GEM1	TC0	Q4(Lower Priority)	0,2	WRR	25%	10%	BE,AF (HSIA)

# Technology Profile Example(AT&T HSIA Service)

Name: '4QueueHybridProfileMap1'

OpenFlow Table ID; 64

Profile Type: xPON, Profile Version: 1.0

Upstream Aggregate Scheduler Attributes:

- T-CONT; Single Instance per ONU or multi-instance: Multi-instance(BBF TR-280)
- ~~T-CONT; Single Instance per UNI or multi-instance: Single-instance~~
- ~~T-CONT; xPON Fixed Bandwidth upstream guaranteed bandwidth  $R_r$  (Section 7 G.989.3): 0 b/s~~
- T-CONT; xPON Priority (DBA Scheduling Priority): 0
- T-CONT; xPON Weight (DBA Scheduling weight): 0
- Queue Scheduling Policy; {WRR | Strict Priority | Hybrid}: Hybrid

Upstream GEM Port configuration and scheduling attributes:

- GEM Ports (Queues) per Service: 4

# AT&T HSIA Upstream GEM Port Configuration

- **GEM Port 1 Attributes:**
  - i. P-Bit Map to GEM Port: **PBit Mask (00000101)**, PBits 0 and 2
  - ii. AES Encryption: **True**
  - iii. GEM Port Scheduling Policy; {WRR | Strict Priority}: **WRR**
  - iv. GEM Port (Queue) Priority: **0**
  - v. GEM Port (Queue) Weight: **25%**
  - vi. Queue Discard Policy; {Tail-drop | WTail-drop | RED | WRED}: **Tail-drop**
- **GEM Port 2 Attributes:**
  - i. P-Bit Map to GEM Port: **PBit Mask (00011010)**, PBits 1, 3 and 4
  - ii. AES Encryption: **True**
  - iii. GEM Port Scheduling Policy; {WRR | Strict Priority}: **WRR**
  - iv. GEM Port (Queue) Priority: **1**
  - v. GEM Port (Queue) Weight: **75%**
  - vi. Queue Discard Policy; {Tail-drop | WTail-drop | RED | WRED}: **Tail-drop**
- **GEM Port 3 Attributes:**
  - i. P-Bit Map to GEM Port: **PBit Mask (00100000)**, PBit 5
  - ii. AES Encryption: **True**
  - iii. GEM Port Scheduling Policy; {WRR | Strict Priority}: **Strict Priority**
  - iv. GEM Port (Queue) Priority: **2**
  - v. GEM Port (Queue) Weight: **0**
  - vi. Queue Discard Policy; {Tail-drop | WTail-drop | RED | WRED}: **Tail-drop**
- **GEM Port 4 Attributes:**
  - i. P-Bit Map to GEM Port: **PBit Mask (11000000)**, PBits 6 and 7
  - ii. AES Encryption: **True**
  - iii. GEM Port Scheduling Policy; {WRR | Strict Priority}: **Strict Priority**
  - iv. GEM Port (Queue) Priority: **3**
  - v. GEM Port (Queue) Weight: **0**
  - vi. Queue Discard Policy; {Tail-drop | WTail-drop | RED | WRED}: **Tail-drop**

# AT&T HSIA Downstream Scheduler Configuration

- Priority (Scheduling Priority) : 0
- Weight (Scheduling weight) : 0
- Queue Scheduling Policy; {WRR | Strict Priority | Hybrid}: Hybrid

# AT&T HSIA Downstream GEM Port Configuration

- **GEM Port 1 Attributes:**
  - i. P-Bit Map to GEM Port: PBit Mask (00000101), PBits 0 and 2
  - ii. AES Encryption: True
  - iii. GEM Port Scheduling Policy; {WRR | Strict Priority}: WRR
  - iv. GEM Port (Queue) Priority: 0
  - v. GEM Port (Queue) Weight: 10%
  - vi. Queue Discard Policy; {Tail-drop | WTail-drop | RED | WRED}: Tail-drop
- **GEM Port 2 Attributes:**
  - i. P-Bit Map to GEM Port: PBit Mask (00011010), PBits 1, 3 and 4
  - ii. AES Encryption: True
  - iii. GEM Port Scheduling Policy; {WRR | Strict Priority}: WRR
  - iv. GEM Port (Queue) Priority: 1
  - v. GEM Port (Queue) Weight: 90%
  - vi. Queue Discard Policy; {Tail-drop | WTail-drop | RED | WRED}: Tail-drop
- **GEM Port 3 Attributes:**
  - i. P-Bit Map to GEM Port: PBit Mask (00100000), PBit 5
  - ii. AES Encryption: True
  - iii. GEM Port Scheduling Policy; {WRR | Strict Priority}: Strict Priority
  - iv. GEM Port (Queue) Priority: 2
  - v. GEM Port (Queue) Weight: 0
  - vi. Queue Discard Policy; {Tail-drop | WTail-drop | RED | WRED}: Tail-drop
- **GEM Port 4 Attributes:**
  - i. P-Bit Map to GEM Port: PBit Mask (11000000), PBits 6 and 7
  - ii. AES Encryption: True
  - iii. GEM Port Scheduling Policy; {WRR | Strict Priority}: Strict Priority
  - iv. GEM Port (Queue) Priority: 3
  - v. GEM Port (Queue) Weight: 0
  - vi. Queue Discard Policy; {Tail-drop | WTail-drop | RED | WRED}: Tail-drop

# AT&T HSIA Service: Mapping to Service profile '4QueueHybridProfileMap1' Using OpenFlow Table ID

- The '4QueueHybridProfileMap1' Service Profile is assigned the Table ID value of 64, and assume that the Service Flow associated with Table ID 64 is a HSIA and the Customer C-TAG to be used is 122, with an S-Tag of 2.
- The Customer has signed up for a 1G Upstream and 1G Downstream Service.
- OpenFlow will create a Meter in the Meter Table for the Customer HSIA Downstream Service Flow: Single Meter Band:
  - Band Type : NA(No actions on the Packet when Band Exceeded) (Best Effort Service)
  - Rate: 1Gb/s (EIR)
  - Burst: 384 Kbits (EBS)

# AT&T HSIA Service: Mapping to Service profile '4QueueHybridProfileMap1' Using OpenFlow Table ID

- The Customer has signed up for a 1G Upstream and 1G Downstream Service.
- OpenFlow will create a Meter in the Meter Table for the Customer HSIA Upstream Service Flow: Single Meter Band:
  - Meter Band 1:
    - Rate: 1Gb/s (EIR)
    - Burst: 384 Kbits (EBS)

# Flow Decomposition Issue

***When ONOS Configures an Upstream or Downstream Flow the Flow is Split into Two Parts:***

- *Table 0 ;Ingress/Egress Port and Match Action Rule and Transition to Table 1*
- *Table 1; Ingress/Egress Port Match Action Rules and Transition to Tech Profile Table with Meter Band*

***The Flow Decomposer in the vCore sends each Table Data to either the ONU or OLT Adapter:***

- *Upstream ONU gets Table 0 (No Tech Profile or Meter Ref), OLT gets Table 1*
- *Downstream OLT get Table 0 (No Tech Profile or Meter Ref), ONU gets Table 1*

# Transition from Table ID Reference to Tech. Profile ID to Using Metadata

OpenFlow Customer 2/122 Downstream Messages:

Table 64 (The Service Profile Reference) contains a Default Rule of Match-All, No Action.

ADDED, bytes=0, packets=0, table=0, priority=1000, selector=[IN\_PORT:129, METADATA:15, VLAN\_VID:2], treatment=[immediate=[VLAN\_POP], transition=TABLE:1]

ADDED, bytes=0, packets=0, table=1, priority=1000, selector=[IN\_PORT:129, VLAN\_VID:122], treatment=[immediate=[VLAN\_ID:0], deferred=[OUTPUT:21], meter=ID, ~~transition=TABLE:64~~]

OpenFlow Customer 2/122 Upstream Messages:

ADDED, bytes=0, packets=0, table=0, priority=1000, selector=[IN\_PORT:21, VLAN\_VID:0], treatment=[immediate=[VLAN\_ID:122], transition=TABLE:1]

ADDED, bytes=0, packets=0, table=1, priority=1000, selector=[IN\_PORT:21, VLAN\_VID:122], treatment=[immediate=[VLAN\_PUSH:vlan, VLAN\_ID:2], deferred=[OUTPUT:129], meter=ID, ~~transition=TABLE:64~~]

# Transition from Table ID Reference to Tech. Profile ID to Using Metadata

Ingress Packet at OLT NNI (In Port = 65536), STAG = 4, CTAG = 2, Match on Tags 4, 2 POP outer Tag(4), modify Inner Tag to be 0(Priority Tagged; 2->0); Apply Technology Profile Reference = 1, and Downstream Meter Reference = 2, Egress Port =30736, Downstream Metadata to write : CTAG = 2, TPID = 1, Egress Port = 30736; 0x0002000100007810 (02/01/30736)

Ingress Packet at ONU UNI (In Port = 30736), Priority Tagged, QTAG = 0, Match on Tag 0, Change Outer Tag to be 2 (CTAG; 0->2), PUSH STAG 4; Apply Technology Profile Reference = 1, and Upstream Meter Reference = 1, Egress Port =65536 Upstream Metadata to write : STAG = 4, TPID = 1, Egress Port = 65536; 0x0004000100010000 (04/01/65536)

Metadata 8 bytes:

Most Significant 2 Bytes = Inner VLAN

Next 2 Bytes = Tech Profile ID(TPID)

Least Significant 4 Bytes = Port ID

Downstream Flow Example:

-----

(OLT Flow) id=ac0000d0fc7486, state=ADDED, bytes=0, packets=0, duration=4, liveType=UNKNOWN, priority=1000, tableId=0, appId=org.opencord.olt, payload=null, selector=[IN\_PORT:65536, VLAN\_VID:4], treatment=DefaultTrafficTreatment{immediate=[VLAN\_POP], deferred=[], write metadata=METADATA:02/01/30736}, transition=TABLE:1, meter=[METER:2], cleared=false, StatTrigger=null,

(ONT Flow) id=ac00001801d6d1, state=ADDED, bytes=0, packets=0, duration=4, liveType=UNKNOWN, priority=1000, tableId=1, appId=org.opencord.olt, payload=null, selector=[IN\_PORT:65536, VLAN\_VID:2], treatment=DefaultTrafficTreatment{immediate=[VLAN\_ID:0, OUTPUT:30736], write metadata=METADATA:0/01/0, transition=None, meter=[METER:2], cleared=false, StatTrigger=null}

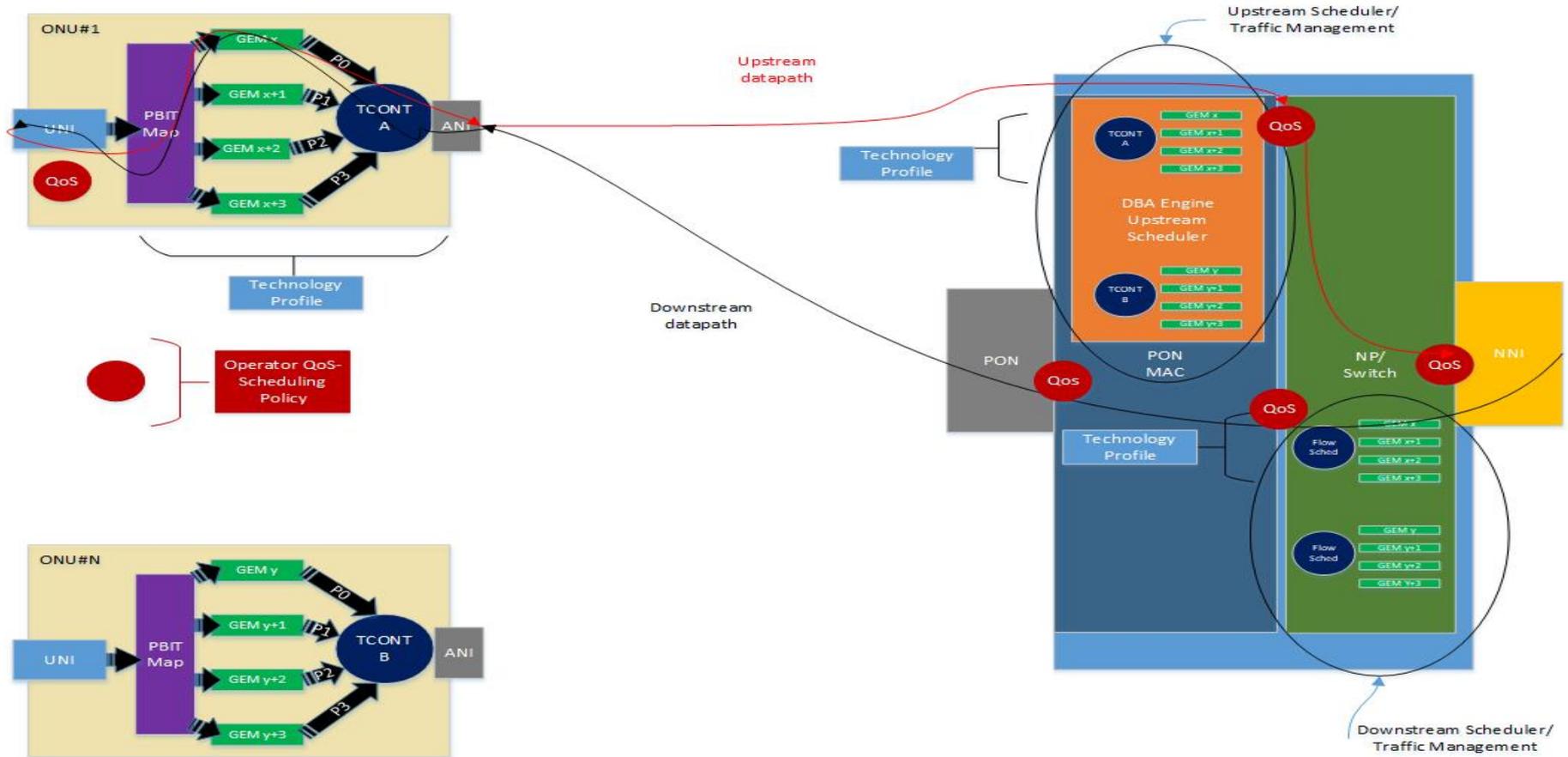
Upstream Flow Example:

-----

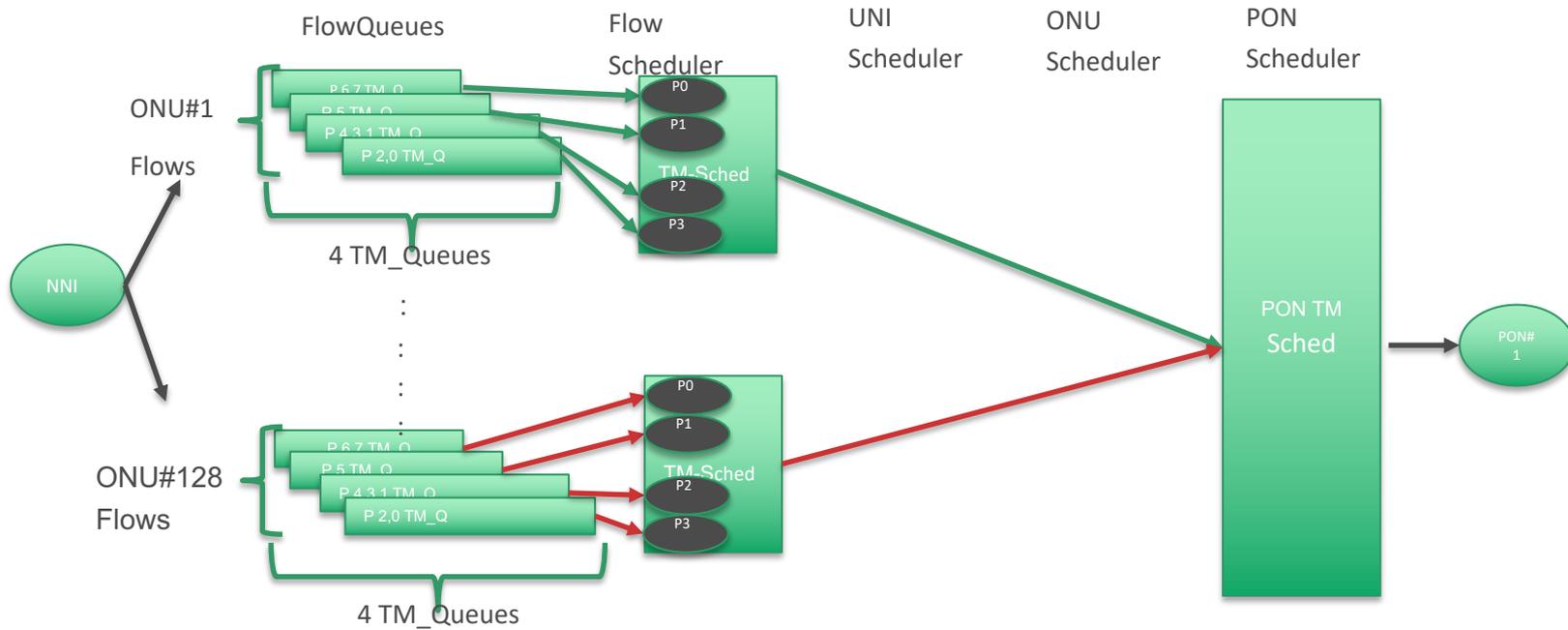
(ONT Flow) id=ac000000f780f6, state=ADDED, bytes=0, packets=0, duration=4, liveType=UNKNOWN, priority=1000, tableId=0, appId=org.opencord.olt, payload=null, selector=[IN\_PORT:30736, VLAN\_VID:0], treatment=DefaultTrafficTreatment{immediate=[VLAN\_ID:2], deferred=[], write metadata=METADATA:04/01/65536, transition=TABLE:1, meter=[METER:1], cleared=false, StatTrigger=null}

(OLT Flow) id=ac0000c9fd17bf, state=ADDED, bytes=0, packets=0, duration=4, liveType=UNKNOWN, priority=1000, tableId=1, appId=org.opencord.olt, payload=null, selector=[IN\_PORT: 30736 , VLAN\_VID:2], treatment=DefaultTrafficTreatment{immediate=[VLAN\_PUSH:vlan, VLAN\_ID:4, OUTPUT: 65536 ], write metadata=METADATA:0/01/0, transition=None, meter=[METER:1], cleared=false, StatTrigger=null}

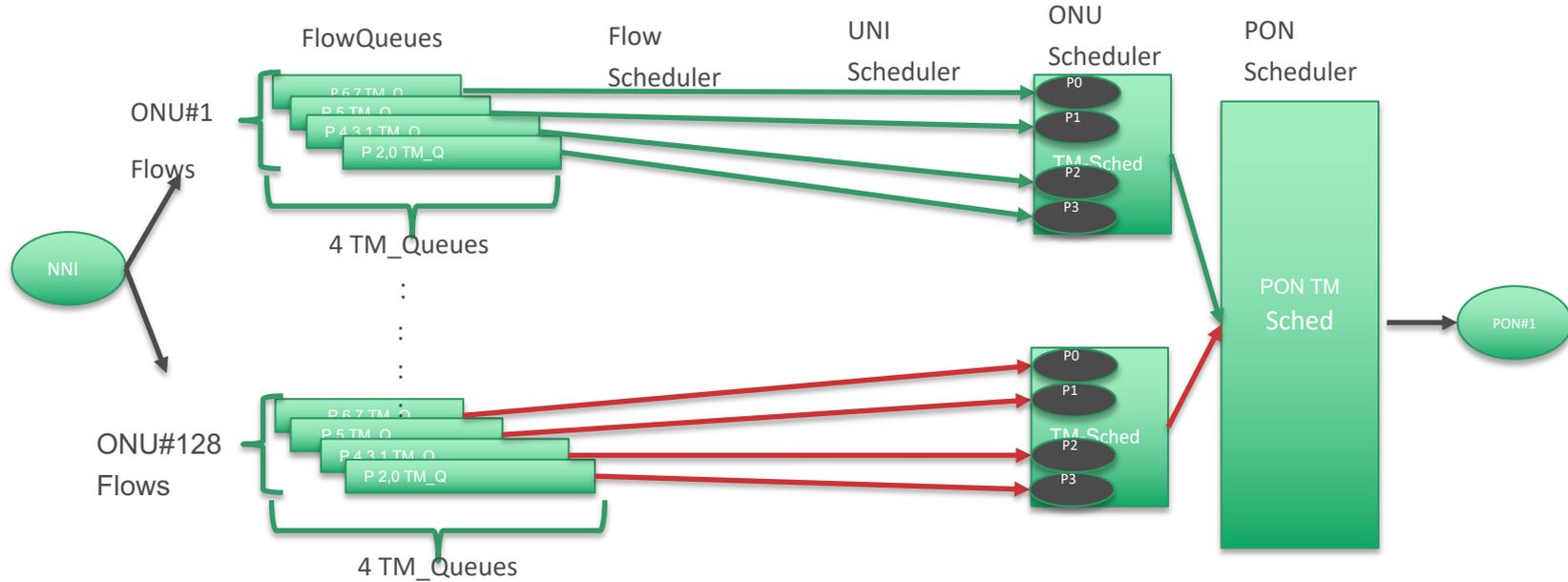
# Traffic Management: BAL 2.6 Edgecore



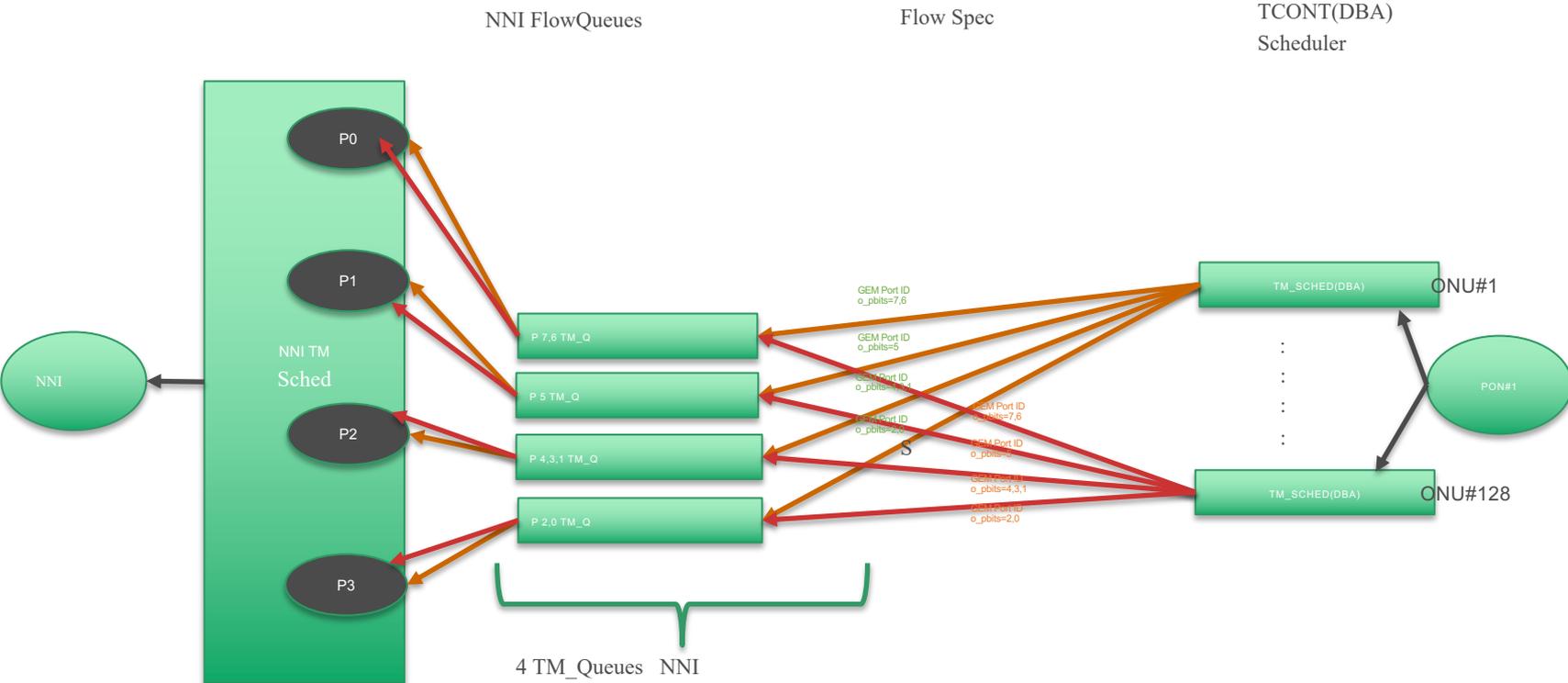
# BAL 2.6 Downstream Queue Scheduling Limitation - Desired



# BAL 2.6 Downstream Queue Scheduling Limitation - Actual



# Technology Profiles; AT&T Service Model-OLT ;Upstream - Desired – BAL 2.6



# Technology Profiles; AT&T Service Model-OLT ;Upstream – Actual BAL 2.6

