Joint ITU-T/IEEE Workshop on Next Generation Optical Access Systems

End-to-end QoS for Ethernet & IP-Based Services in NGNs: implications for NG Optical Access

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Outline

- Acknowledges
- The QoS Problem Space
- End to End Architecture
- Network Congestion Points
- GPON QoS (DSL Forum WT-156)
- Home Network QoS
- HGI (Home Gateway Initiative) work
- Summary

Acknowledges

- Lot of the work done to solve QoS problems is done by DSL Forum (broadband forum) from an access point of view and by HGI (Home gateway Initiative) for Home Network point of view.

- As active member of both Fora, I will summarize in this presentation these works.

Business Issues from Service Provider

- **Use QoS where necessary to deliver premium/managed services to the end-devices**
- **Get no support calls**

Managed service - the SP provides preferential treatment (that can include QoS) e.g. IPTV, Voice

Unmanaged service - the SP has no (QoS) commitment to the customer e.g. Internet access, peer-peer, in-home LAN flows

Network Issues

- QoS only becomes an issue when instantaneous network demand exceeds the available resource

  On the Access link

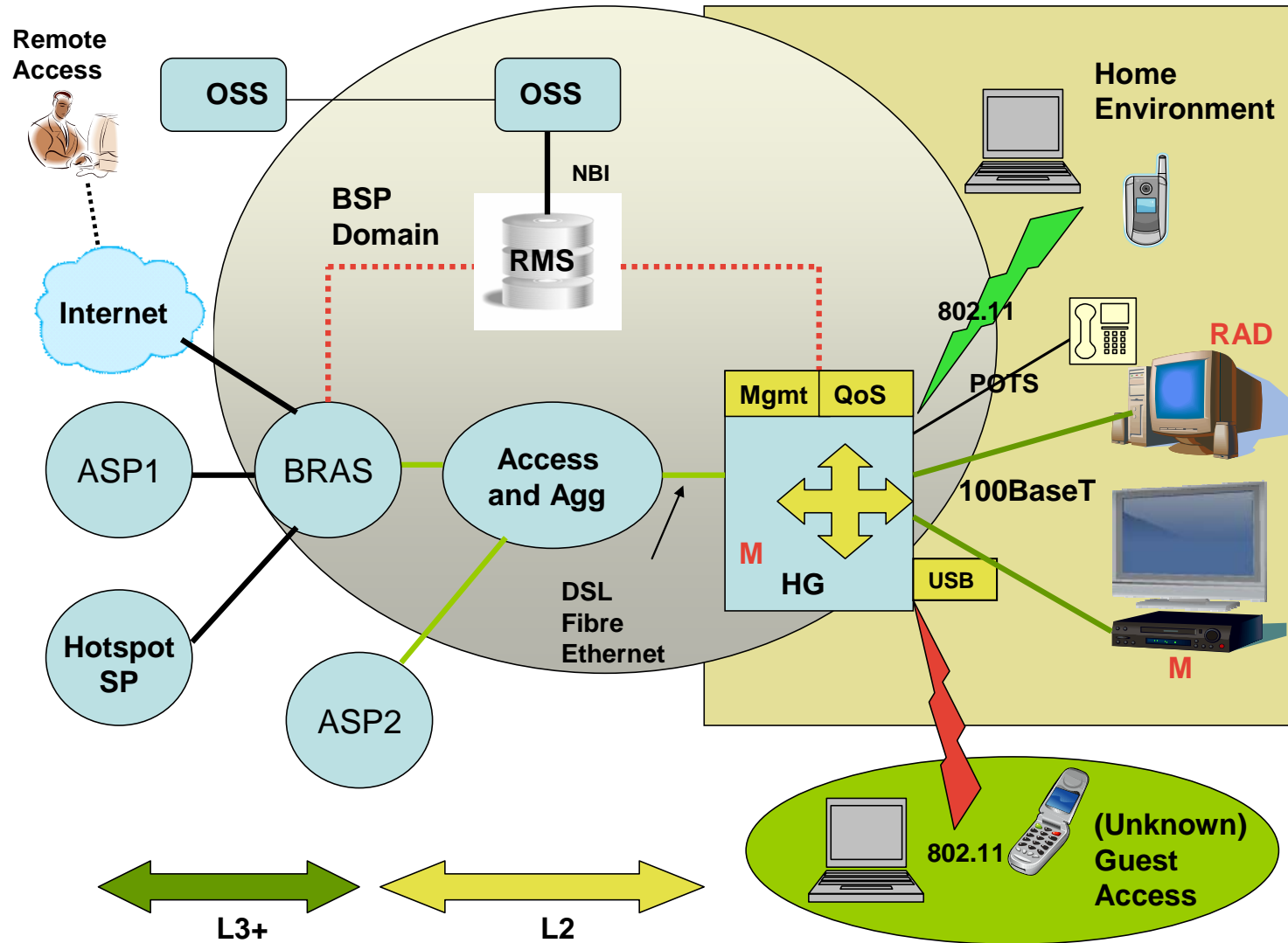   - especially in the upstream direction

  In the aggregation network
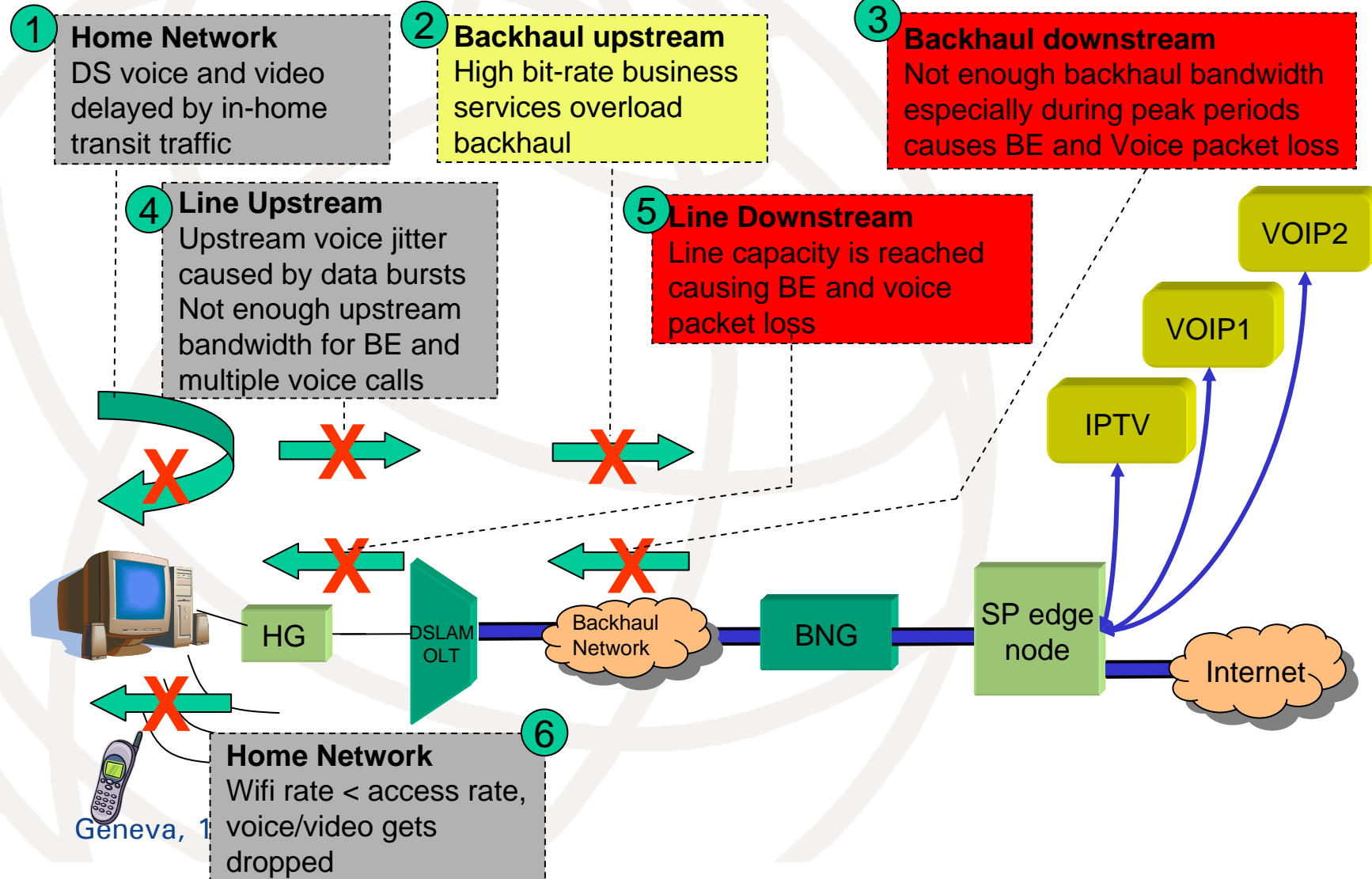
    where backhaul is contended

  In the Home network

    - when there is a mix of access traffic and local LAN traffic

End to end architecture

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Network Congestion Points

1 **Home Network**
DS voice and video delayed by in-home transit traffic

2 **Backhaul upstream**
High bit-rate business services overload backhaul

3 **Backhaul downstream**
Not enough backhaul bandwidth especially during peak periods causes BE and Voice packet loss

4 **Line Upstream**
Upstream voice jitter caused by data bursts
Not enough upstream bandwidth for BE and multiple voice calls

5 **Line Downstream**
Line capacity is reached causing BE and voice packet loss

6 **Home Network**
Wifi rate < access rate, voice/video gets dropped

VOIP2

VOIP1

IPTV

HG

DSLAM OLT

Backhaul Network

BNG

SP edge node

Internet

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GPON QoS
DSL Forum WT-156

- In general the goals for QoS remain those defined in TR-101 (Migration to Ethernet-Based DSL Aggregation). The high level goals for the QoS architecture include the following:

- Efficient use of the resource

- Statistical multiplexing is a key requirement for QoS architecture

- Low latency for flows

- Bandwidth allocation schemes should not sterilize unused bandwidth
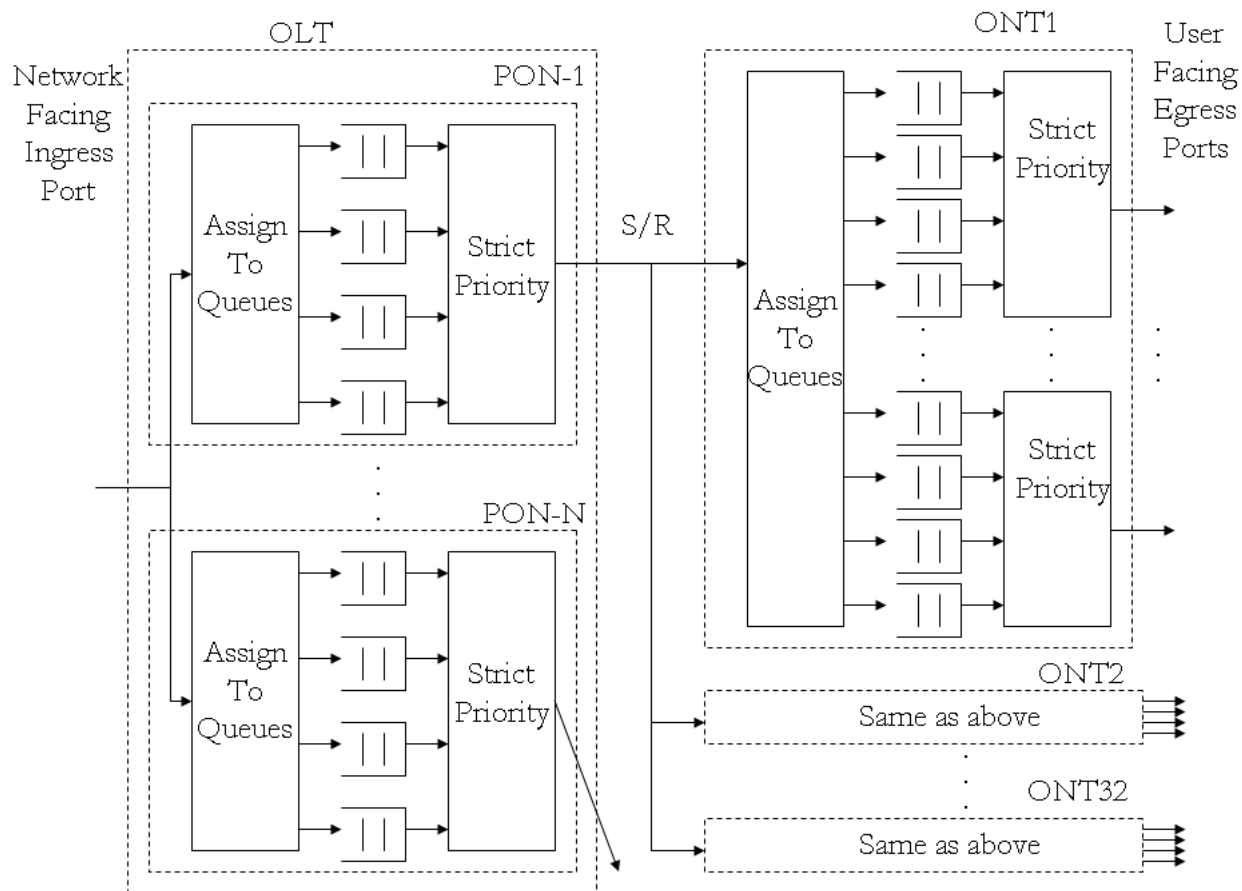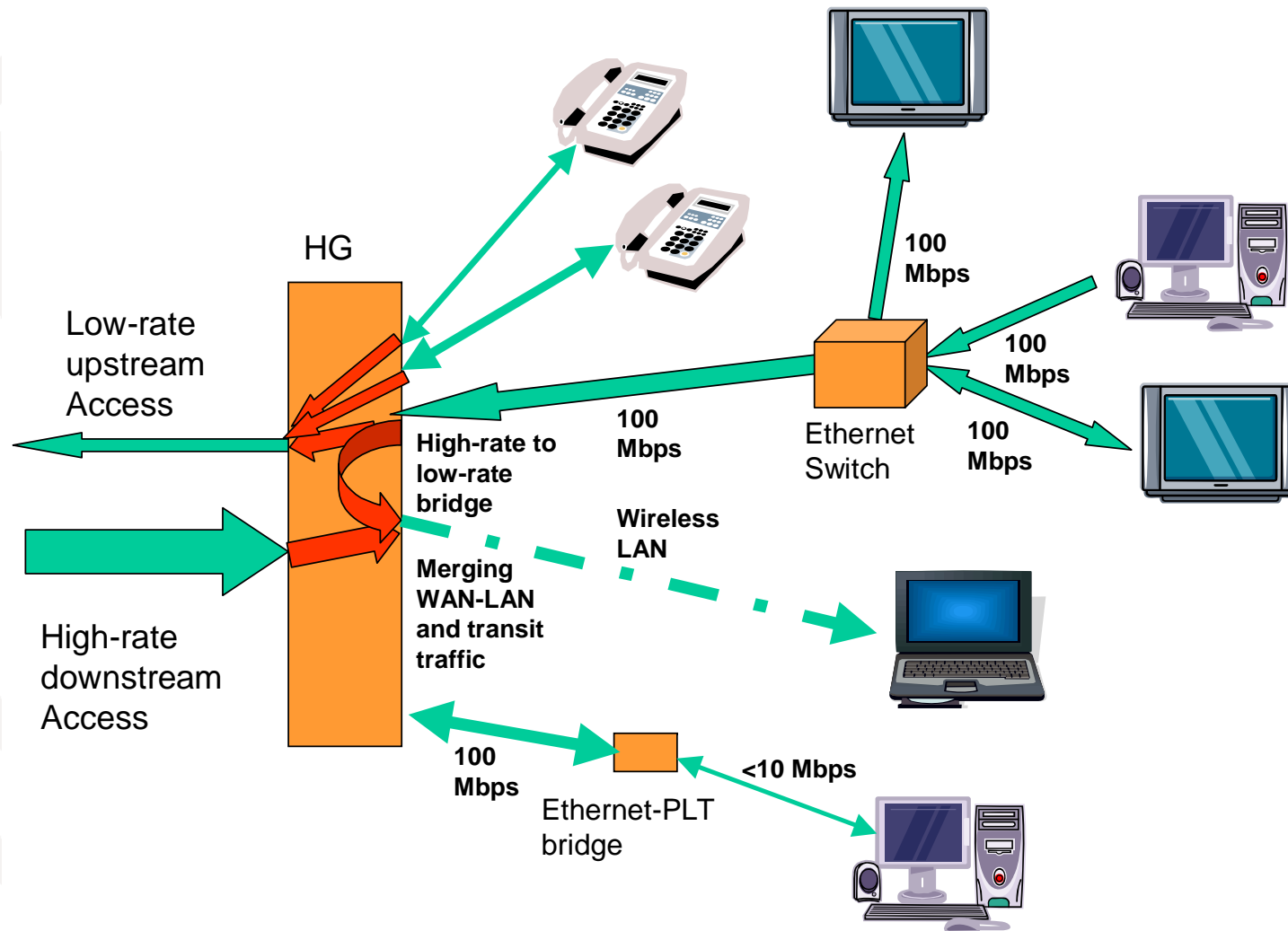
GPON GEM adaptation of Ethernet WT-156
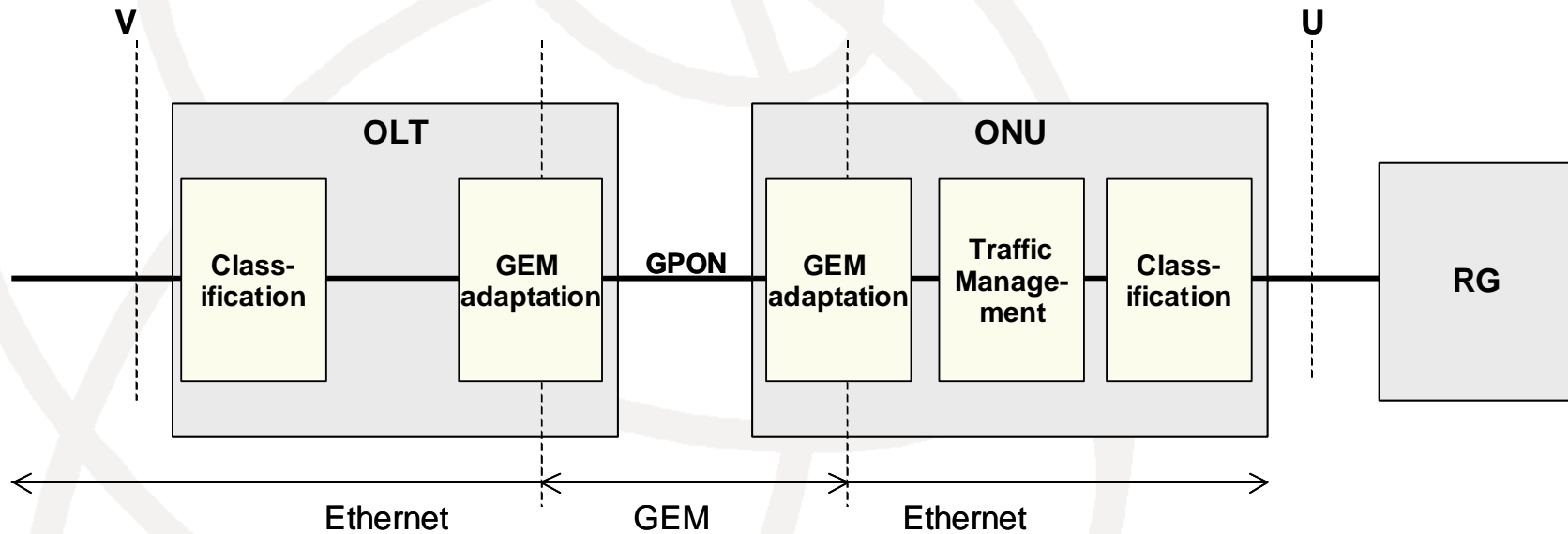
Upstream Queuing and Scheduling Model Example
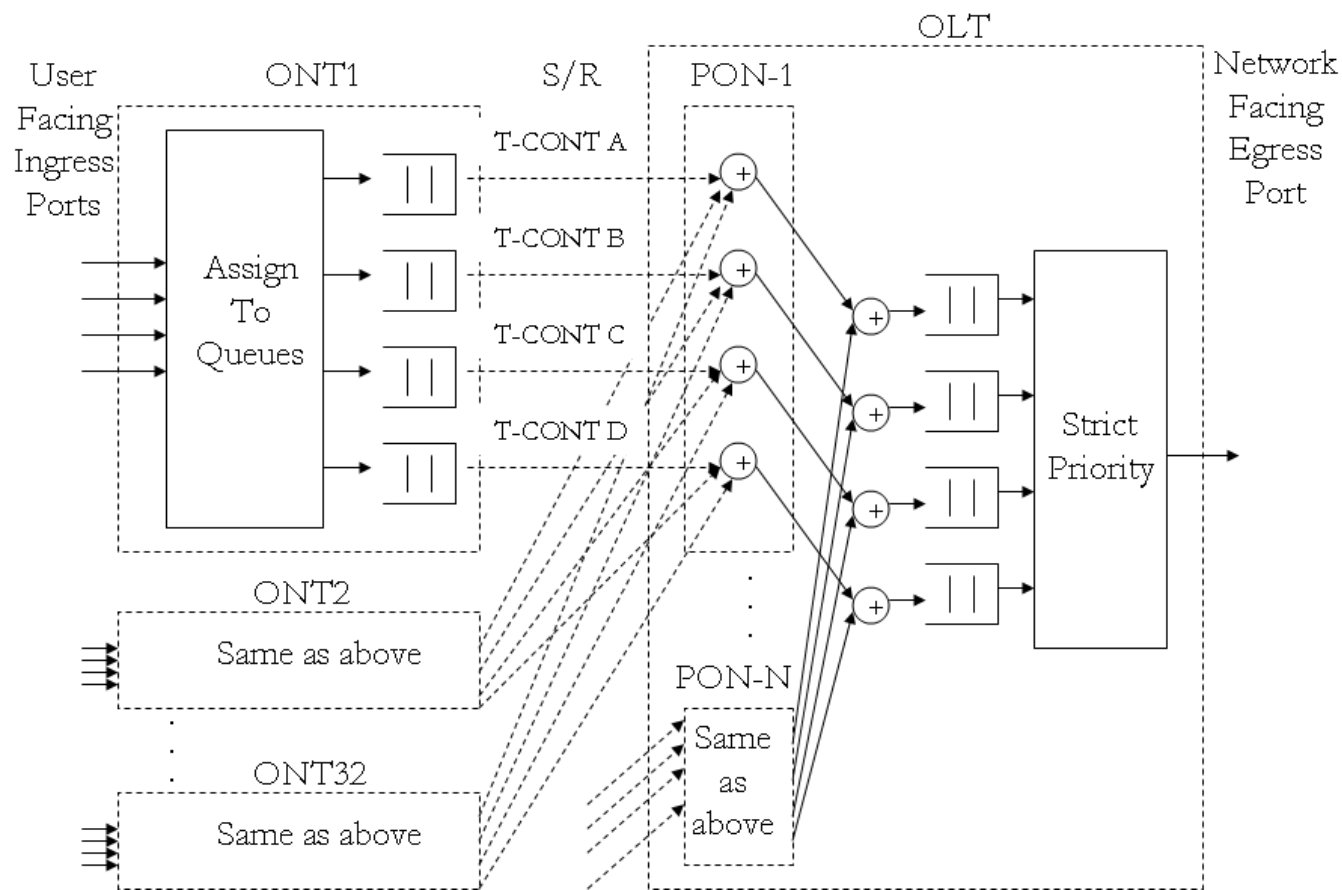
Downstream Queuing and Scheduling Model Example

Home Network Potential traffic congestion points

HG

Low-rate
upstream
Access

High-rate to
low-rate
bridge

Merging
WAN-LAN
and transit
traffic

High-rate
downstream
Access

100
Mbps

Wireless
LAN

100
Mbps

Ethernet-PLT
bridge

<10 Mbps

100
Mbps

Ethernet
Switch

100
Mbps

100
Mbps

100
Mbps

Home Network QoS Goals

- Management of key congestion points
- Traffic classification and prioritization
  - Telco-managed services vs unmanaged services
  - Special attention for voice/video
- Handle Diverse flows in the HG:
  - WAN→LAN (downstream)
  - LAN→WAN (upstream)
  - LAN-LAN (transit)
- Focus on QoS handling within the HG
  - With guidelines for LAN component

Home Gateway is the central point to manage Home Network QoS

HGI (Home Gateway Initiative) QOS Approach

- Overall approach based on identifying services on a packet by packet basis as pass through the HG - then sending to the appropriate one of multiple priority queues

- Enables management of the QOS of all traffic that transits the HG

- Addresses all 3 traffic directions:
  - HN-WAN
  - WAN-HN
  - HN-HN

- Service 'signature' based

- Simple configuration, by the SP only

- No dependence on other nodes

HGI Service Classification

- Based on service signatures

  all service instances (e.g. VOIP) are not equal
- Each packet is classified on ingress and then:
  allocated to the appropriate queue

    can be marked/remarked

    can be dropped
- Wide range of classifiers (L1-L4) which can be used in arbitrary combinations
- Do not use VLANs/.1p in the HN

HGI : Service Classifiers

General

- IP SA, DA, subnet
- TCP/UDP S/D port or range
- MAC SA/DA
- LAN interface type (Ethernet, Wifi)
- Physical port (e.g. FXS)
- Wifi SSID
- Packet length (for tunneled applications)
- DSCP value
- IP Protocol type
- ATM VC, Ethernet VLAN (WANside only)
- *Any combination of the above*

LAN-LAN

- Typically a simple bridge
- Use a device-based scheme, MAC addresses

HGI : Configuration and marking

- Service classifiers are downloaded as a ruleset by the SP

- Individual EU preference can only be accommodated by the use of profiles i.e. done via the SP not directly by the end-user

- There are some tools to automatically set rule 'parameters' on the basis of local information e.g. private IP addresses using DHCP options

- This is a point solution, but packets can be DSCP marked on the basis of the classification

  - could be used to disseminate information to HN infrastructure devices

  - do not use VLANs/.1p in the HN (legacy equipment and configuration concerns)

HGI : Queuing

- Multiple queues per logical/physical interface (4-8)
- (Programmable) Mixture of Strict Priority and WRR queues
- Class-based (c.f. flow-based) queuing
    - to keep the number of queues small/constrained
- One or more services per queue
- Allocation of service to queue done by the Service Provider on the basis of static (pre)configuration
- Typically use the SP queues for real-time, low latency services which are source rate-policed
    - e.g. voice, IPTV ACKs
    - no policing or shaping of these queues (to avoid jitter and config concerns)
- Use the WRR to support differentiated data services
    - e.g. work at home, guest access
    - can shape the WRR queues/L2 interface

Additional HGI Functionality

Local Admission control (optional)

- Overload protection

  before admitting a new 'managed' flow to a high priority queue, capacity first checked by trying it in a lower priority queue – automatically promoted or not

  prevents a new flow adversely impacting established ones

  requires identification of a flow instance as part of the classification

- CAC

  local (i.e. in the HG) Connection Admission Control (CAC) function for SIP based voice

  signalling participation (not snooping)

  call-counting against a configurable class limit

- Performance monitoring

  monitoring of all queues

  PHY rate monitoring of time variant interfaces

  - troubleshooting
  - could form part of a centralised CAC system

Summary

- Access & Home Network are the most difficult parts to achieve an end to end QoS
- DSL Forum (broadband forum) is working on access with WT-156 (Using GPON Access in the context of TR-101).
- GPON GEM mechanism is key to achieve this QoS
- HGI (Home Gateway Initiative) is working on Home Network side.
- Home Gateway is the central point to manage Home Network QoS
- Power consumption (OLT, ,ONT,.) must be evaluated carefully
- HGI: Home Gateway Technical Requirements: Residential Profile available at:

  http://www.homegatewayinitiative.org/
- DSL Forum (broadband forum)

  http://www.broadband-forum.org/