# Carrier Ethernet H.QoS

Service Assured Access with Sophisticated Traffic Management Tools for Ethernet SLAs

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# Agenda

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- Carrier Ethernet Traffic Management: Purpose and Must-Haves
- H.QoS Feature-Set
- Why Does it Matter?
- H.QoS in RAD's Carrier Ethernet Solutions
- Conclusion

# Carrier Ethernet Traffic Management for Service Assured Access

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# The Purpose of Traffic Management

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- SLA terms dictate different service quality for different applications over multi-service networks
- Network must handle various traffic types separately to ensure latency, jitter and packet delivery performance for each flow
- Traffic "handling" must begin at the hand-off point = at the Carrier Ethernet demarcation device, or NID
- Need to ensure predictable performance and create scheduling "fairness" with better utilization of network resources

# Carrier Ethernet H.QoS Must-Have Feature Set

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- To support multi-priority, multi-flow and bursty traffic, NIDs have to include a certain set of capabilities:

**Classification**
of incoming traffic into flows

→

**Metering & Policing**
to regulate traffic with different bandwidth profiles

→

**Hierarchical Scheduling & Queue Management**
to ensure minimal latency and jitter

↓

**Shaping**
to smooth out bursts and avoid buffer overruns in subsequent network elements

←

**Packet Editing & Marking**
handling instructions for subsequent network elements

# H.QoS Feature Set

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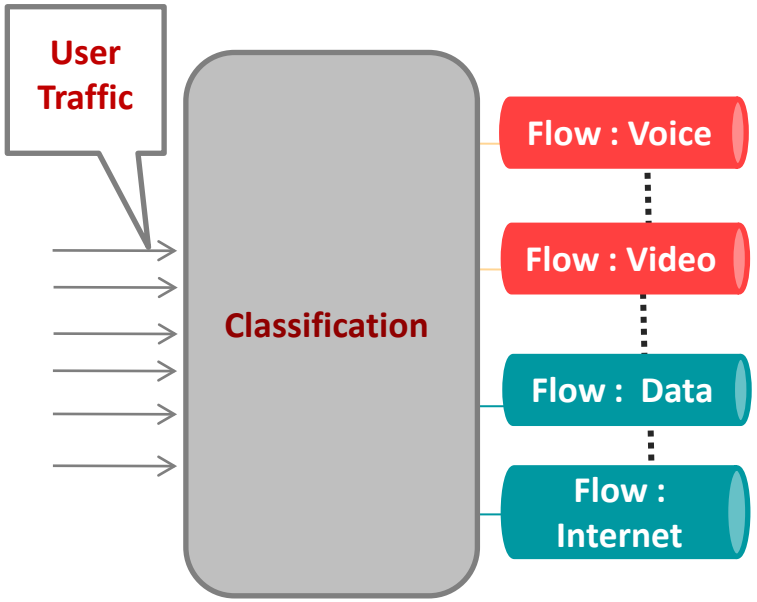
# 1. Classification

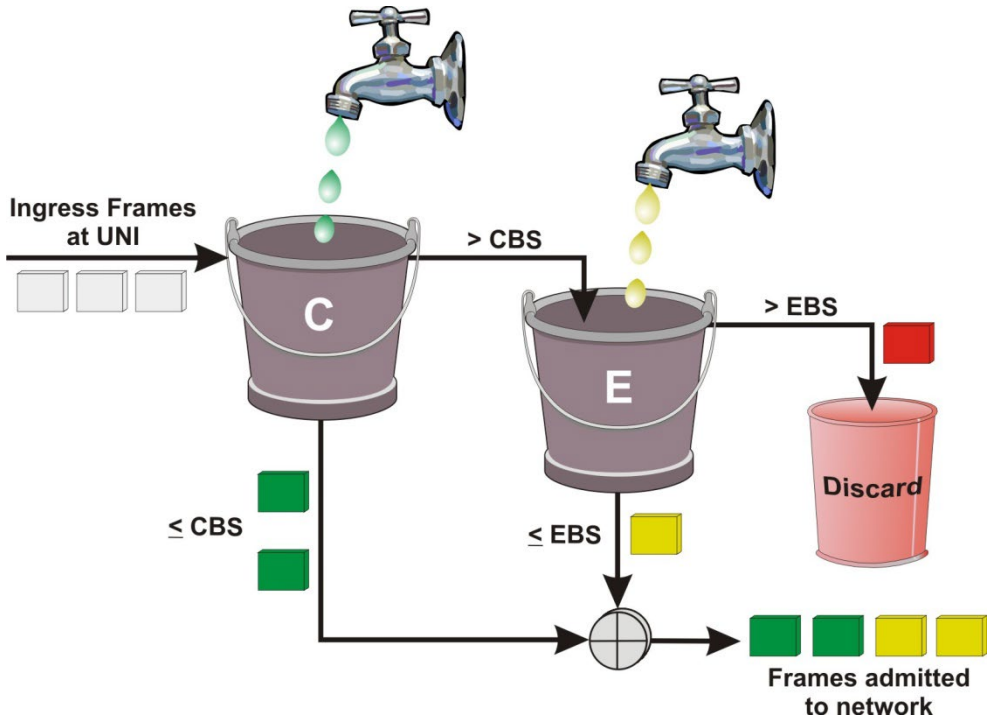
- User traffic is classified into flows based on the following criteria:
  - VLAN ID
  - 802.1p
  - DSCP
  - IP precedence
  - EtherType
  - MAC address
  - IP address
  - Combinations




- Support for a wide variety of sorting criteria allows service providers to identify various traffic types at fine granularity and ensure appropriate quality of service for each flow

# 2. Metering & Policing

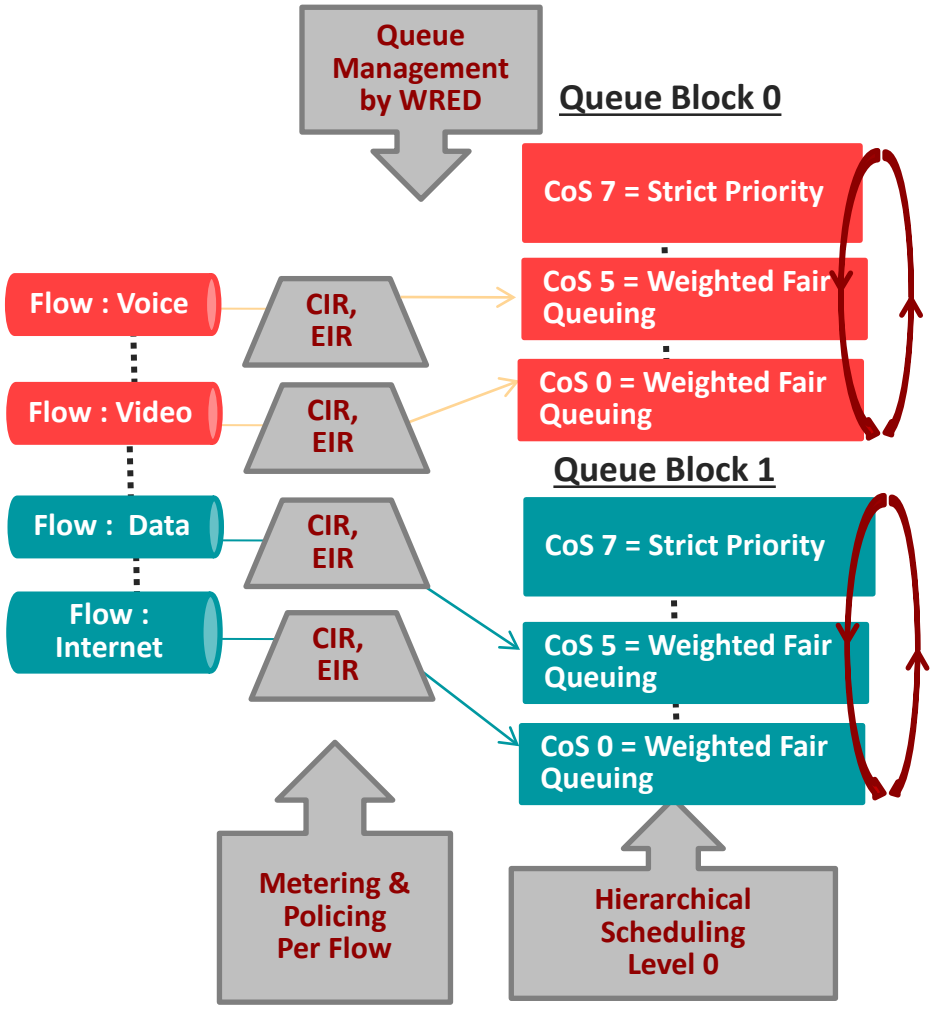
- A metering and policing function is applied to each flow to regulate traffic according to the contracted bandwidth profiles (CIR, EIR, CBS, and EBS)
- Rate limitation is typically performed using a trTCM (two-rate-three-color-marker) algorithm:




- **C:** Committed Information Rate (CIR)
- **E:** Excess Information Rate (EIR)
- **Green:** Frames admitted to network
- **Yellow:** Frames admitted to network on a "best effort" basis
- **Red:** Discarded frames

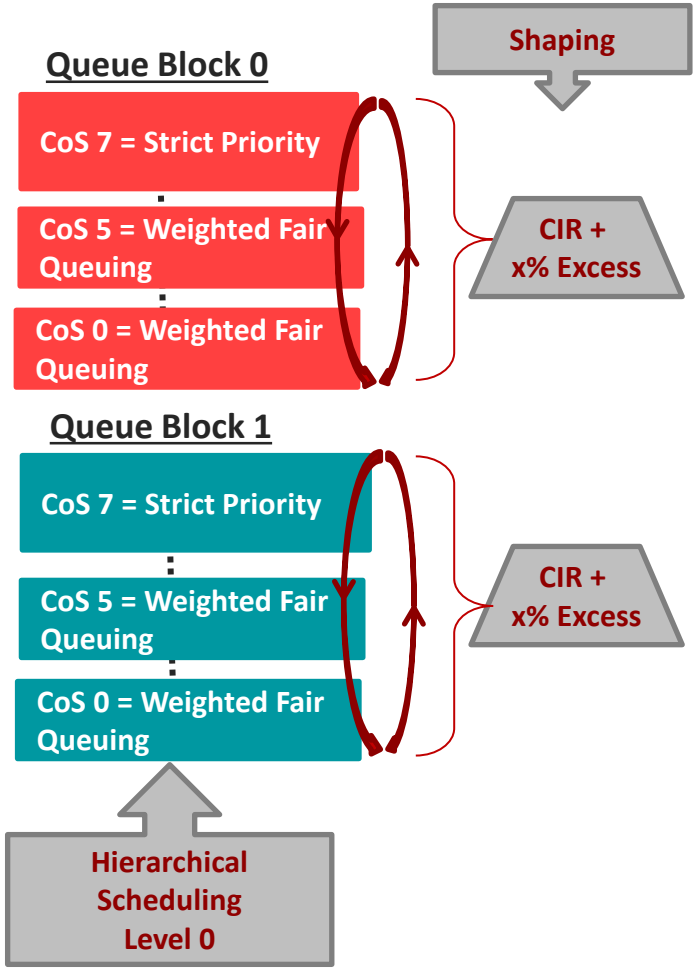
# 3. Hierarchical Scheduling (Level 0)

- Two-step scheduling to ensure each flow receives desired priority
- In “level 0”, flows are mapped to scheduling queue blocks per CoS (Class of Service) priorities
- Queue blocks correspond with EVCs (Ethernet Virtual Connections)
- A combination of scheduling techniques: SP, WFQ
- Special queue management tools (e.g., WRED) are used to avoid queue “starvation”



# 4. Shaping

- Shaping smoothens out bursts and avoids buffer overruns in the network
- Ensures that the overall traffic volume from each block/EVC does not exceed a preset bandwidth value
- Shaping is performed according to the accumulated CIR values of all the flows mapped to the relevant queue block + a certain allowance of excess rate to avoid congestion



# 5. Hierarchical Scheduling (Level 1)

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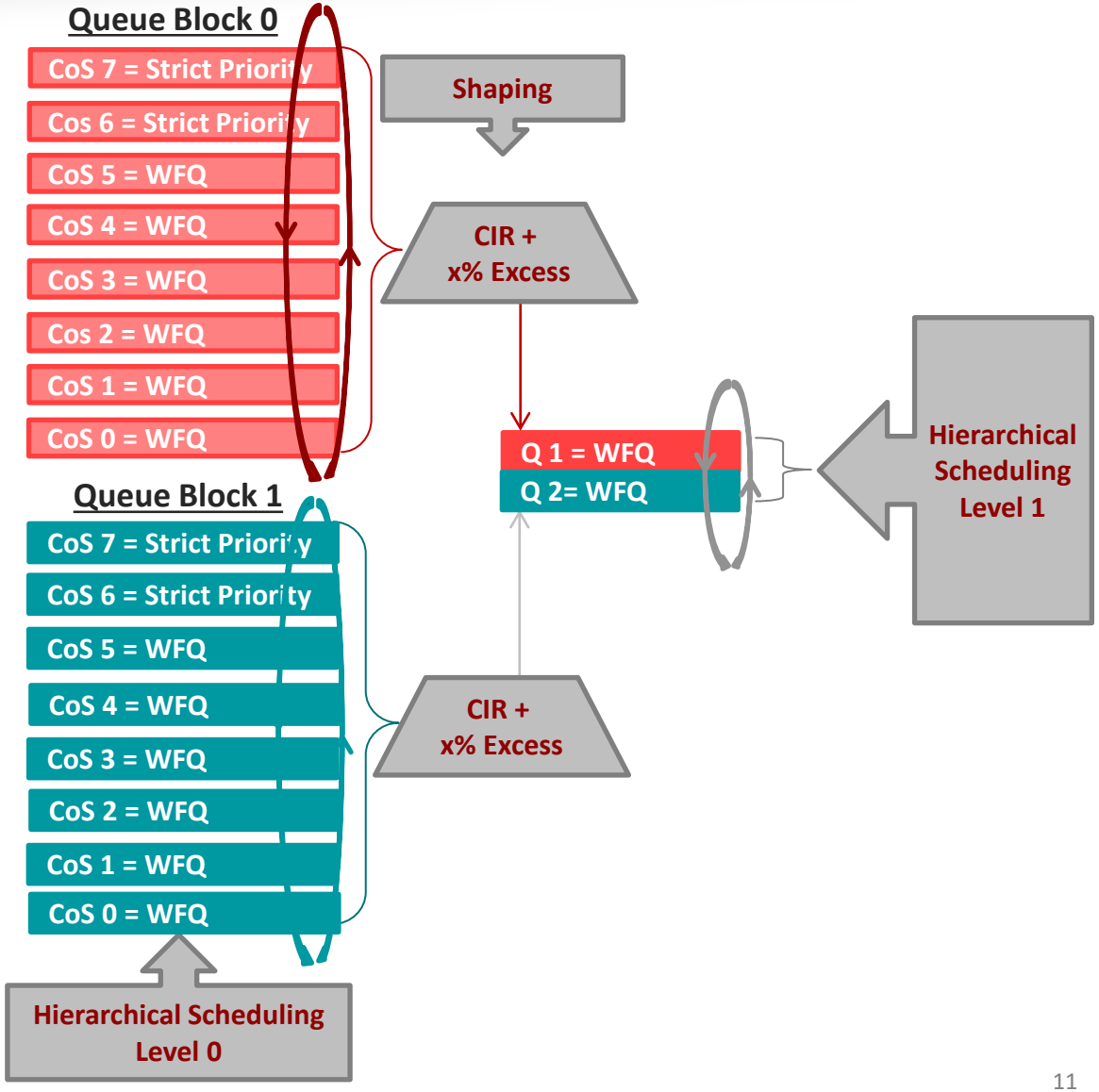
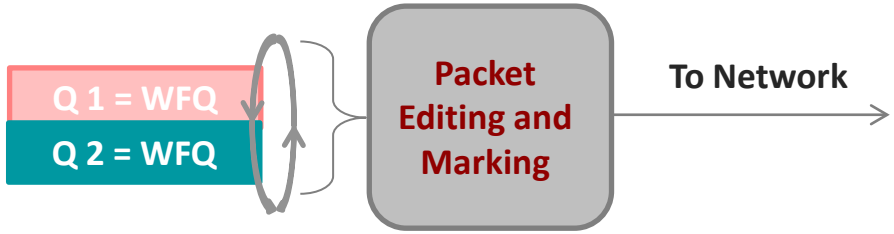
- Each "Level 0" queue cluster receives a "Level 1" queue slot
- Scheduling priorities define EVC priority at network ingress
- Scheduling and buffering affect traffic delay and must take into account SLA commitments, even if network port rate is higher than the total bandwidth of all EVCs

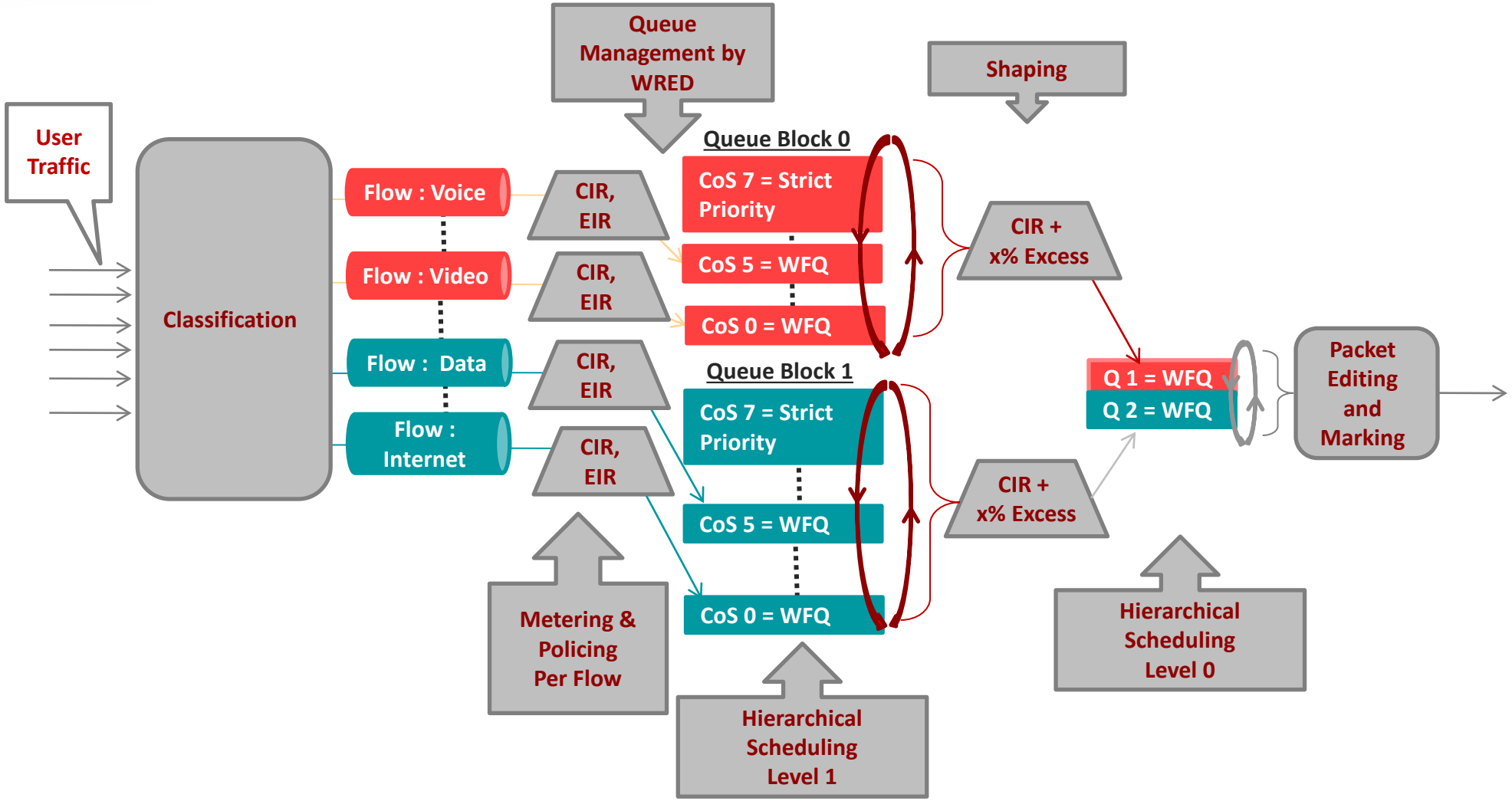


# 6. Packet Marking & Editing

- The final stage in preparing user traffic to network transmission involves the addition of service provider VLAN tags (“packet editing”) according to EVC mapping
- SP-VLAN P-bits denote the priority each EVC.CoS receives while in the network
- P-bit color re-marking for metering continuity in the network: Using the P-bit field to signal a packet’s color so that it has a greater chance of maintaining its status and priority throughout the transmission



# H.QoS Mechanisms



# Why H.QoS is Critical for Carrier Ethernet Services

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# How H.QoS Reduces TCO & Increases Service Revenues

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- Allows carriers to offer multi-priority services over the same network
- Cater to the QoS needs of each user at a premium
- Efficient use of network resources by sharing unused bandwidth
- Enables oversubscription by managing priority and congestion
- Provides tools to fix congestion issues reported by OAM
- Increases usable bandwidth by delaying non real-time packets
- Shapes traffic at demarc to avoid overflowing downstream or upstream network elements
- Dynamic compensation for overhead to ensure accurate traffic shaping

# How H.QoS Effects Carrier Ethernet Service Offering and Operations

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- **No H.QoS**
  - Best effort or basic CIR offering
  - Inability to consistently maintain SLA guarantees
  - Performance KPIs aren't met when network is congested
- **With H.QoS**
  - Automatic handling of traffic priorities in fine granularity
  - Regulate traffic with different bandwidth profiles
  - Intelligent traffic prioritization to ensure KPIs over time

# How H.QoS Reduces TCO & Increases Service Revenues

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- **Increase Revenues**
  - Introduce SLA-based and sophisticated (e.g., E-LAN) services @ a premium
  - Run more services over same infrastructure = more revenues
  - Reduce customer churn by improving quality of experience
- **Reduce TCO**
  - Improve network efficiency
  - Reduce SLA violation fines

# H.QoS in RAD's Service Assured Access Solutions

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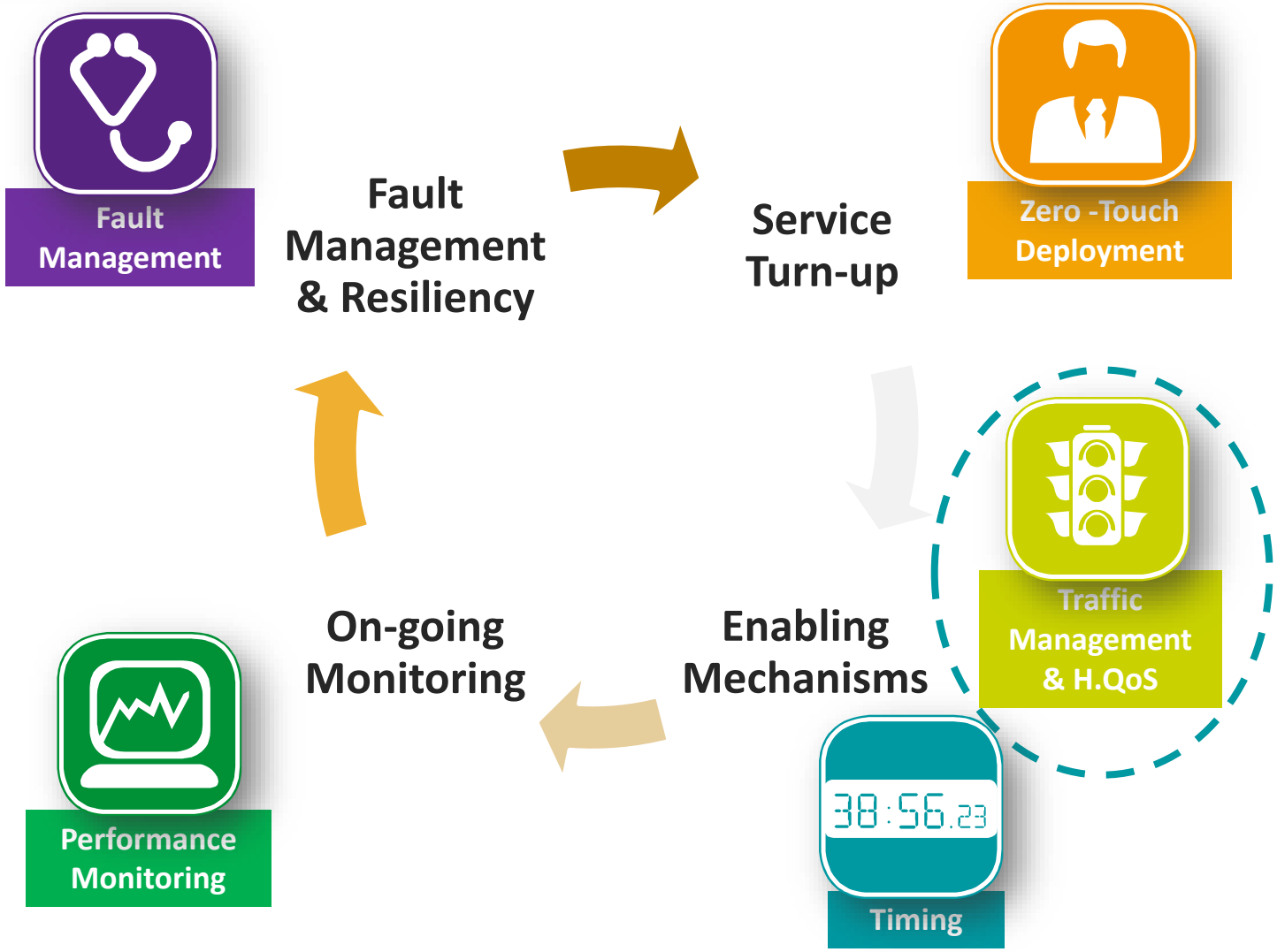
# Service Assurance Throughout the Service Life Cycle



# EAD/NIDs for L2 Business and Wholesale Services

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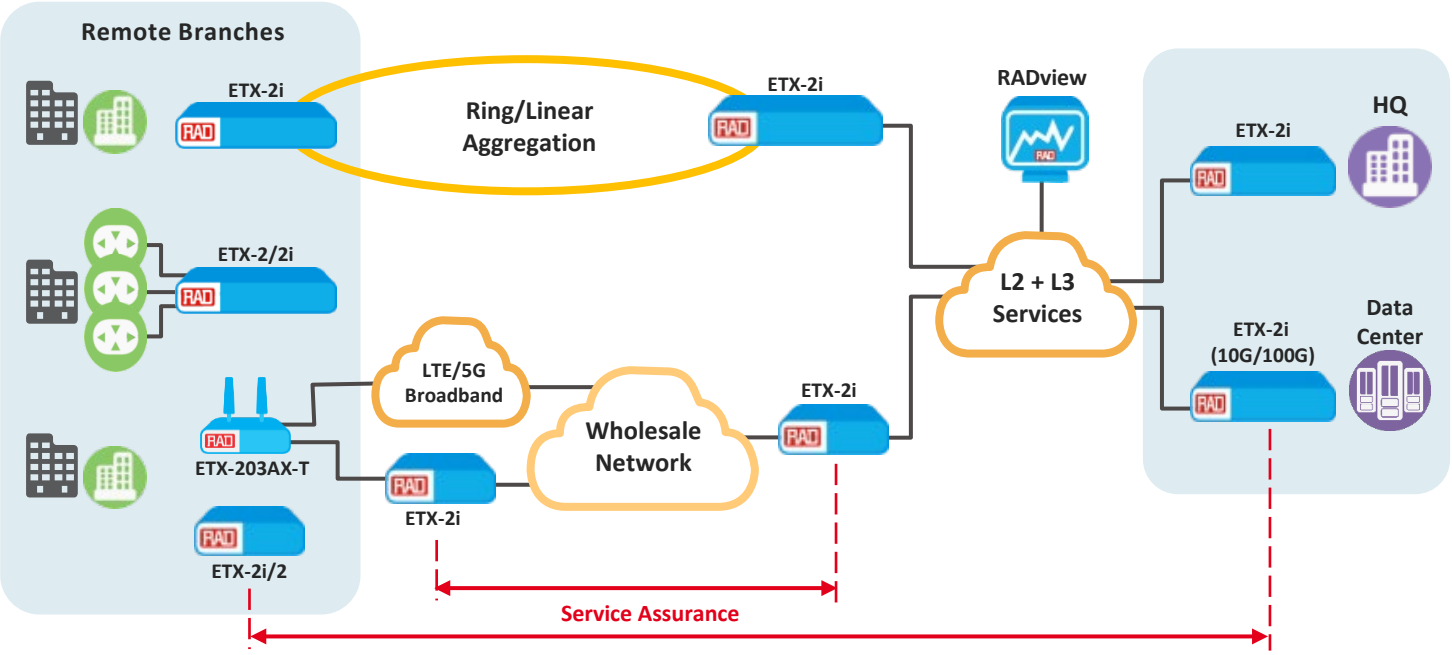
- Carrier Ethernet originated by RAD
- 1G/10G/25G/40G/100G port offering
- Any access, including over LTE/broadband
- SDN-ready, NETCONF/YANG enabled, MEF 3.0 certified
- FPGA-based, future-proof architecture
- ZTP for low-touch deployments




**ETX-2/ETX-2i**
EADs with LTE/5G and Broadband Options

**MiNID**
Miniature Programmable Network Interface Device

**BiDi QSFP28 DD Adaptor**
100G/400G Dual to Single Fiber Adaptor

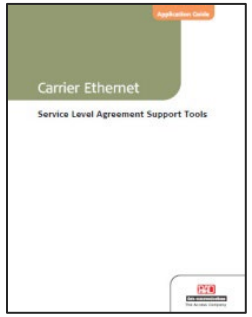
**RADview**
Management and Domain Orchestration

**RAD among top 3 EAD/NID vendors, outstepping the market with supply-chain stability**

# Conclusion

- To meet SLA requirements, Ethernet service providers must implement H.QoS capabilities in their service demarc devices
- A standard set of H.QoS capabilities includes classification, metering & policing, hierarchical scheduling, shaping and packet editing
- H.QoS can be used for TCO reduction, service differentiation and improved customer experience
- RAD's award winning Carrier Ethernet demarcation and aggregation solutions feature the most advanced H.QoS techniques

- For more information, download this comprehensive white paper:




**Application Guide: Carrier Ethernet SLAs**
Service delivery and service assurance support tools

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# Thank you

For your attention