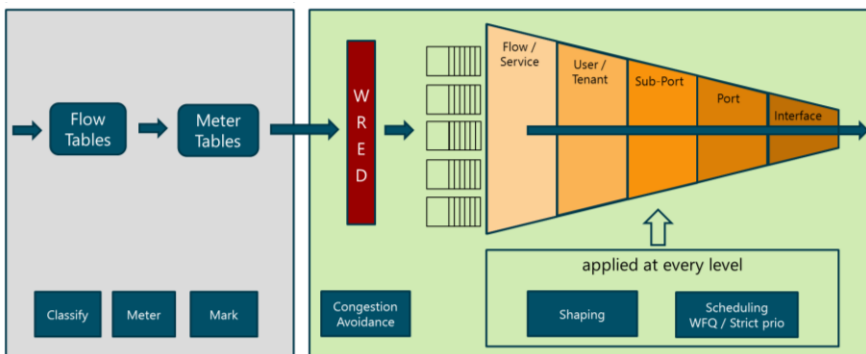


NoviWare™ FlowShaper H-QoS Feature

NoviFlow's **NoviWare H-QoS Feature** is a software option that adds fully programmable, state-of-the-art Traffic Management and Hierarchical Quality-of-Service (H-QoS) to NoviFlow NoviWare's already impressive list of features. H-QoS Feature enables NoviWare compatible switches (such as NoviFlow's NoviSwitches) to deliver differentiated network services under resource constrained network situations by applying selective metering, buffering and otherwise shaping traffic via the powerful Mellanox EZChip NP-5 Traffic Manager. This is the same Traffic Manager already deployed in hundreds of networks around the globe as part of large chassis-based routing solutions, but made available by NoviFlow in a simple, scalable pizza-box form factor, at a fraction of the price!



NoviWare's FlowShaper H-QoS feature is ideal for implementing Broadband Network Gateway (BNG) triple-play services. It's also great for segmenting traffic between end-users or business users sharing the same link while assuring minimum / maximum bandwidth allocation to each user over PBB, QinQ, VxLAN or MPLS networks. Also, it enables more control and increased optimization of networks via allocation of Committed/Excess/Peak rates to specific users/services, as well as allocation of specific scheduling

priorities. Last but not least, traffic shaping (buffering) improves the overall quality of the network as packet drops would usually trigger re-transmission. The feature is accessed via a CLI and the OpenFlow Experimenter feature API, allowing applications fine-grain control of NoviWare's extensive traffic management capabilities, and at up to 800 Gbps line-rate.

NoviWare FlowShaper Feature is add-on option for NoviFlow's **NoviWare™**, the SDN industry's most complete and highest performance implementation of the OpenFlow 1.3/1.4/1.5 standard for use in switches, WAN IP/MPLS routers, network appliances and other high-performance forwarding planes. It is deployed around the World in NoviFlow's NoviSwitch products and also offered via software license to OEM and ODM switching platform suppliers.

NoviFlow Inc.™ aims to change the traditional approach to networking by making switching and routing smarter. The company was founded to deliver upon the promise of OpenFlow and SDN by delivering solutions that can handle complex flow processing and be field upgradable via software updates, making it possible for data centers and WANs to keep up with today's exponentially growing networking demand.

NoviFlow FlowShaper provides all these components at line-rate:

- The most flexible classification through the most complete set of OpenFlow match fields in the SDN industry
- Up to 1 million meters on NoviSwitch and associated policies (Drop, DSCP Remark) compliant with RFC2697 srTCM and RFC2698/ MEF 5 trTCM (1 million meters for NoviSwitch 2000 series only. Actual numbers may differ on other hardware platforms.)
- 16 queues per class and a maximum of 46000 classes for a total of 736,000 queues. Flows placed in these queues are then forwarded through a 4-level hierarchy where traffic shaping is applied based on priority and rate limits.
- 1 GB of deep DRAM buffer memory is used for traffic shaping. This memory is shared between all queues.
- Weighted Random Early Detection (WRED) provided for congestion avoidance

NoviWare FlowShaper H-QoS capabilities:

1. Classification
2. Traffic policing (meter and marking)
3. Congestion avoidance
4. Traffic shaping
5. Traffic scheduling

Classification:

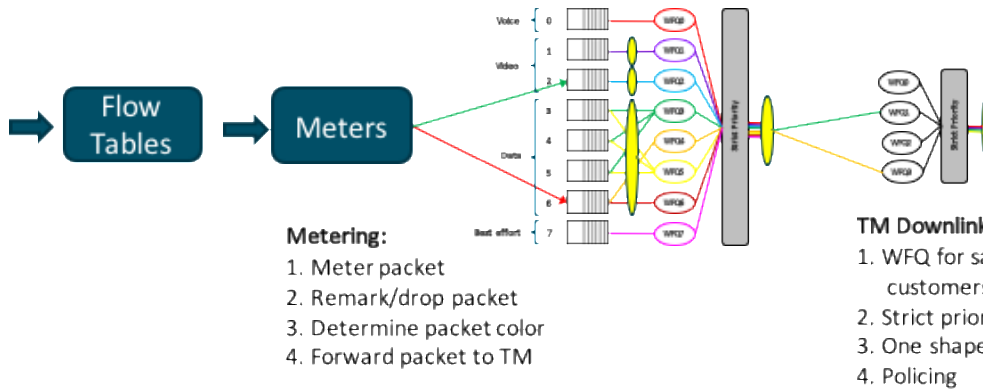
1. Identify customer
2. Apply ACL (may require TCAM)
3. Identify traffic type
4. Apply priority (untrusted)
5. Assign a meter
6. Assign a queue

TM Customer level:

1. 32k customers
2. 8 priorities/customer
3. Multiple levels of shapers
4. Strict priority processing
5. Policing

TM Uplink Ports:

1. WFQ for same priority traffic from all customers
2. Strict priority between traffic types.
3. One shaper per port/slice of port
4. Policing



Metering:

1. Meter packet
2. Remark/drop packet
3. Determine packet color
4. Forward packet to TM

TM Downlink Ports:

1. WFQ for same priority traffic to N customers
2. Strict priority between traffic types
3. One shaper per port/slice of port
4. Policing

Figure 1: NoviWare FlowShaper H-QoS Feature capabilities

NoviWare FlowShaper H-QoS Feature Summary:

Requires NoviFlow NoviWare 400.2 or later.

Classification

- Full OpenFlow match-action capabilities available to associate specific traffic into common flow where specific differentiated services can be applied
- All OpenFlow mandatory and optional 1.3/1.4/1.5 match-fields are available and NoviFlow specific experimenter match-field can be used to classify packets.
- The new experimenter action SET_CLASS action is used to direct flows into specific queues where specific traffic shaping and priority scheduling will be applied.
- The standard OpenFlow action SET_QUEUE is also used to select the queue within the class

Traffic policing (metering and marking)

- Up to 1 million meters and associated policies (Drop, DSCP Remark) compliant with RFC2697 srTCM and RFC2698/ MEF 5 trTCM

Congestion avoidance

- Weighted Random Early Detection (WRED) provided for congestion avoidance

Traffic shaping & Traffic scheduling

- A CLI provides the capability to configure 16 queues for 46000 classes into a 4-level hierarchy
- Statistics per queue and per class are provided
- Traffic queued for shaping and scheduling are buffered in 1 GB of storage.
- Scheduler is a combination of strict priority and weighted round-robin (WRR) scheduling policy.

NoviFlow's *NoviWare FlowShaper* Feature offers carrier-grade Traffic Management and Hierarchical Quality-of-Service control over the industry's most complete and proven OpenFlow 1.3/1.4/1.5 implementation for Mellanox NP-5 network processors. For more information, please visit www.noviflow.com™ or e-mail us at contact@noviflow.com