

## Delivering Quality of Service in 40Gbps and 100Gbps Networks

### Introduction

The convergence of IP-based voice, video and data on next-generation 40Gbps and 100Gbps networks is driving the need for high-speed SRAM solutions. These high-speed SRAMs help to address issues such as providing Quality of Service (QoS) in congested networks.

This paper will explore the QUAD and DDR-II SRAM product families and explain their roles in helping to provide QoS in 40Gbps and 100Gbps networks. By providing more predictable traffic patterns, QoS helps guarantee end-to-end service level agreements (SLAs) in congested or oversubscribed networks.

Additional applications such as link-list queue management, statistics gathering and lookup tables will also be discussed.

### The Need for QoS

As line rates continue to increase to 40Gbps and 100Gbps, Quality of Service (QoS) is required to manage network congestion and to guarantee that applications sensitive to packet delay and packet loss are prioritized.

For example, voice applications are sensitive to delay and video applications are sensitive to packet loss. Thus applications such as IPTV, video on demand and VoIP require QoS.

As can be seen in Figure 1, QoS enforcement is required throughout the network.

### Implementing QoS with Shaping and Policing

Traffic engineering in the form of traffic shaping and traffic policing is a widely used method of providing QoS. Traffic shaping and policing are commonly applied at the edges of the network but can also be applied at the traffic source.

Traffic shaping regulates the flow of packets, delaying certain packets to ensure that they conform to a committed rate. Packets are buffered in a queue for later transmission, resulting in a smoothing out of the packet rate.

Traffic shaping uses a counter to count tokens. When a packet arrives, a token counter is checked to see if there are enough tokens in the counter for the packet to be sent. If there are insufficient tokens, the packet must wait for enough tokens to accumulate before it can be sent.

Traffic policing uses a similar method as traffic shaping of counting tokens, however it differs from shaping in that policing drops packets instead of delaying them. Policing restricts traffic to ensure that subscribers do not send traffic beyond their committed rate and excess traffic is dropped. Figure 2 compares traffic shaping to policing.

### Building High Speed Counters with QUAD SRAM

As previously mentioned, both shaping and policing require the counting of tokens. This counting mechanism requires a read-modify-write function. In the read-modify-write sequence a counter value is first read, then

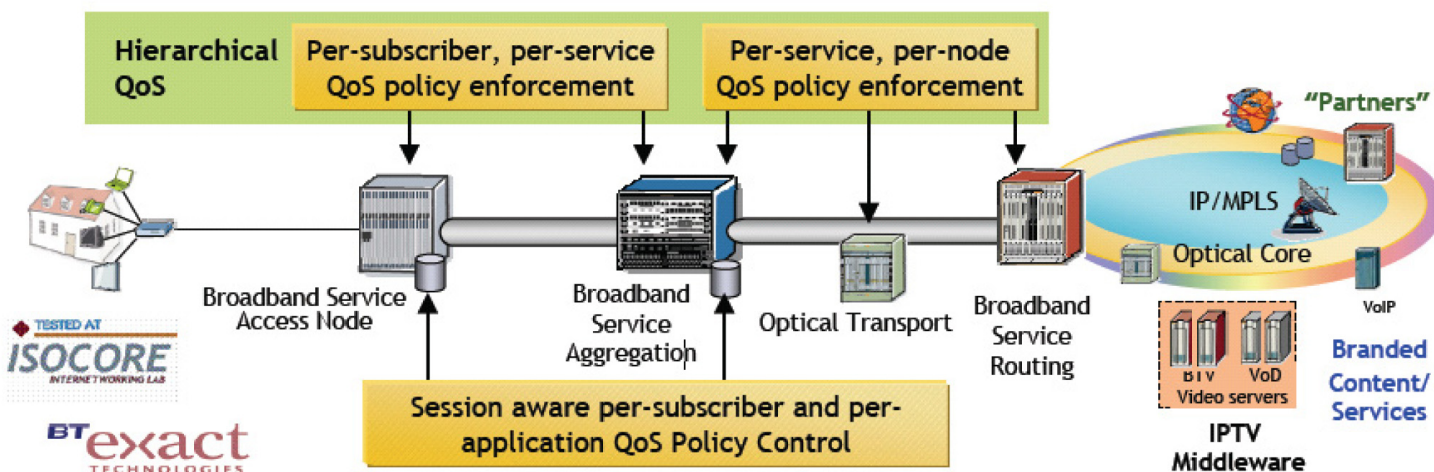
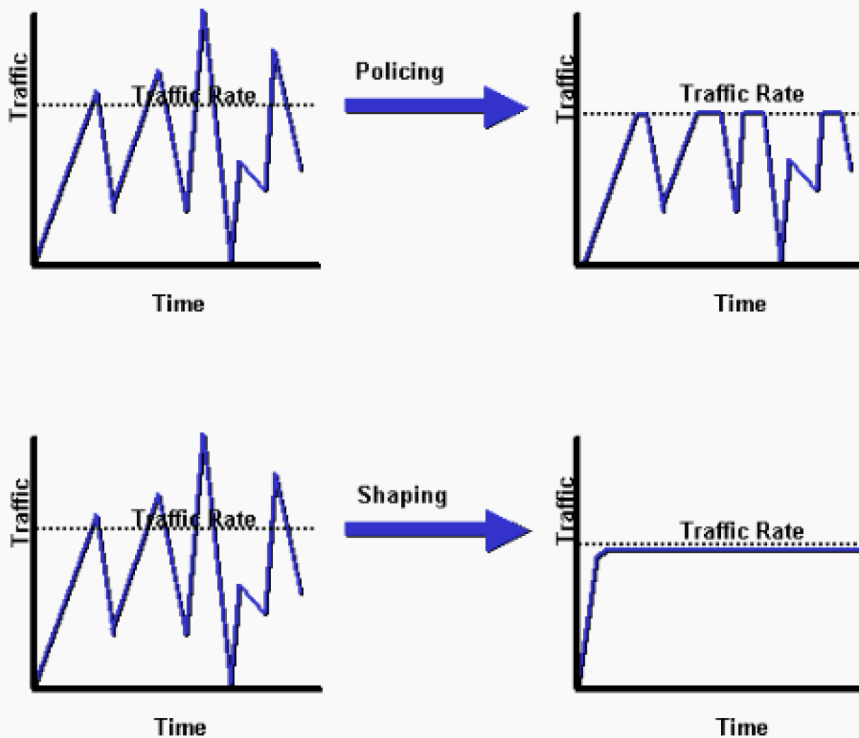


Figure 1. Hierarchical QoS (Source: Alcatel-Lucent)



**Figure 2. Traffic Shaping Versus Traffic Policing (Source: Cisco)**

incremented (modified) and the updated counter value is updated (written). This requires a balanced 1:1 ratio of read to writes.

QUAD SRAMs are the ideal solution for counters requiring this 1:1 ratio as they provide separate double data rate (DDR) data-in and data-out ports which can operate simultaneously.

While one port is reading a counter value for a packet stream, the other port can simultaneously be writing an

updated counter value for another packet stream. By allowing for DDR transactions on two ports simultaneously, four transactions can occur per clock period, hence the name QUAD SRAM. Figure 3. Illustrates this principle.

### Link-List Queue Management and Statistics Gathering with QUAD SRAMs

Routers and switches typically use DRAM buffers to store packets during times of congestion. A linked-list queue is stored in SRAM in order to manage this DRAM buffer.

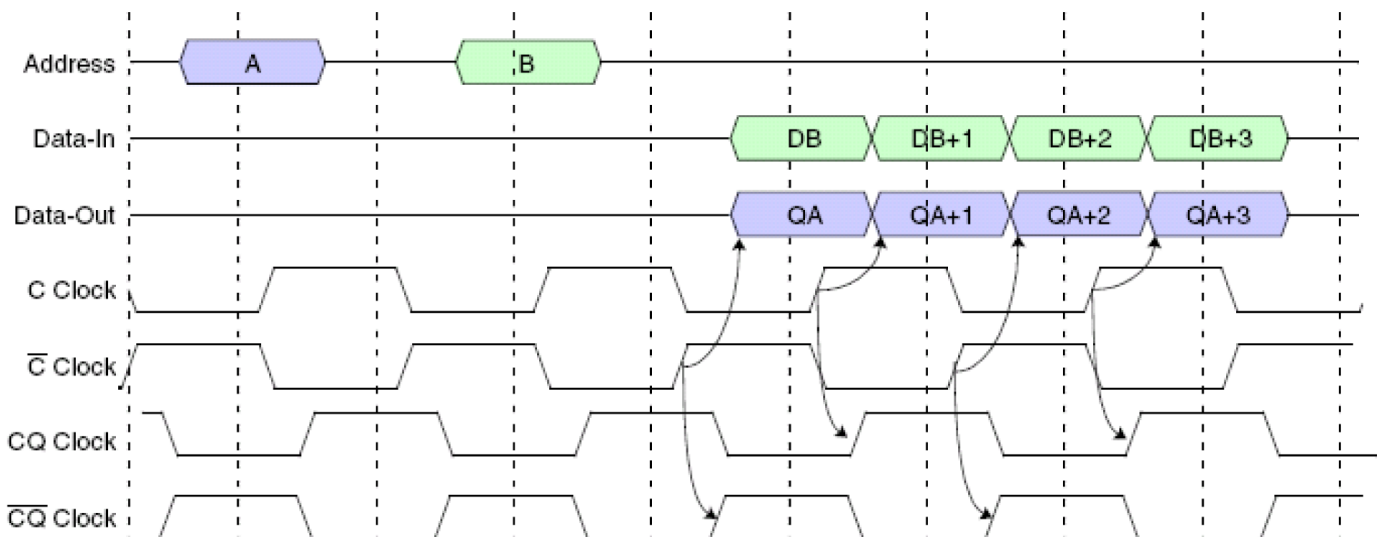
Statistic counters are commonly used in networks for measuring such things as: number of packets sent to a specific destination or each TCP connection, number of dropped or

fragmented packets, plus numerous other activities.

Both statistics counters and linked-list queuing structures tend towards a 1:1 read/write ratio and thus are ideal candidates for QUAD SRAMs.

### DDR-II SRAM Memory for Read:Write Ratios Greater than 1:1

If the read to write ratio is greater than 1:1 then DDR-II SRAM is generally a better option than QUAD SRAM. For example, if the ratio of reads is much greater than the number of writes, then the separate write port would



**Figure 3. QUAD SRAM Function**

not be used the majority of the time, leading to an inefficiency of usage. In that case, the common I/O DDR-II device can keep its single port occupied for greater efficiency.

An example application where the ratio is not 1:1 is lookup memories used for table searches.

Lookup tables are used by routers and switches to determine where to forward a packet. In many cases a network processor (NPU) or ASIC implements lookup tables by algorithmically traversing a lookup tree consisting of DDR-II SRAM. In this case, there are many more reads than writes, and thus a 1:1 ratio does not exist.

### Applications Using QUAD and DDR-II SRAMs

Many of today's wireless and wireline telecommunication and data communication infrastructure products use QUAD and DDR-II SRAMs for the look-up tables, link-list management, traffic policing and shaping functions outlined earlier in this paper.

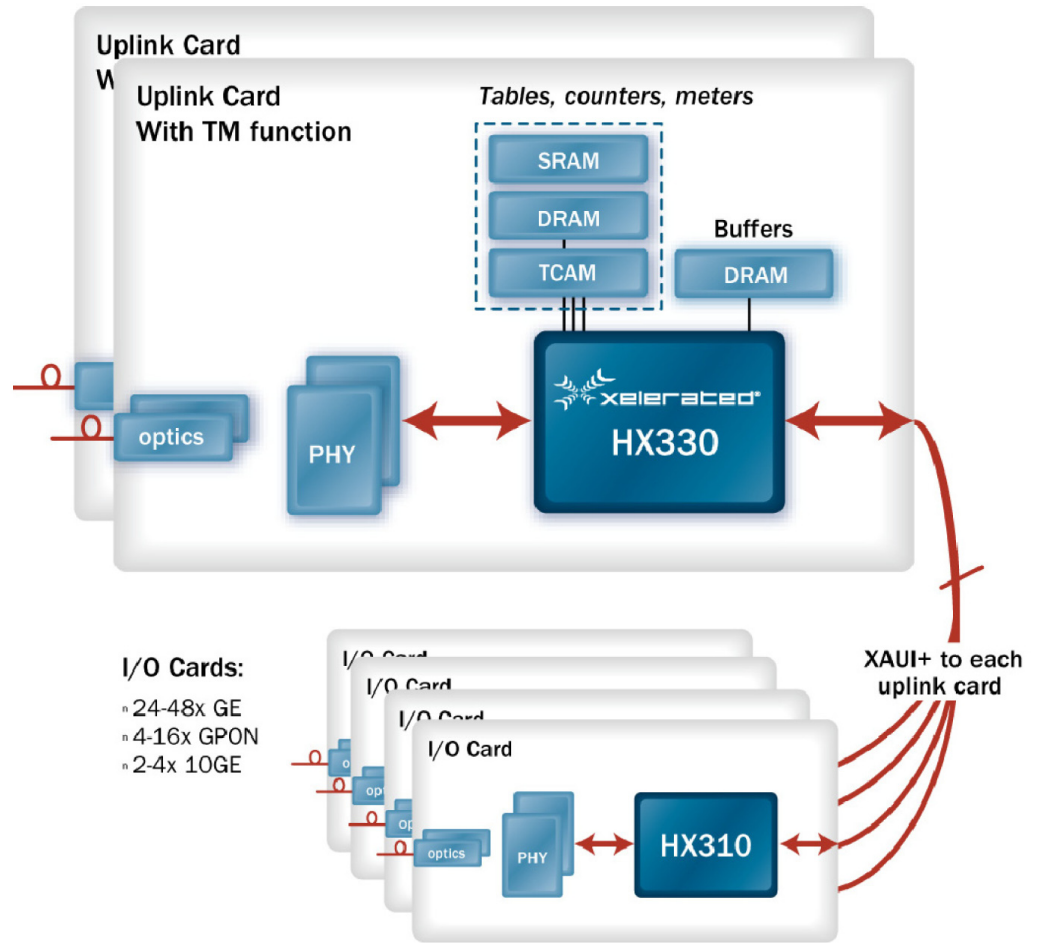
These infrastructure products include but are not limited to: Broadband Aggregation Nodes ( DSLAM, PON OLT, CMTS and Base Station), Enterprise Backbone Switches, Metro Switches, Edge and Core Routers.

Figure 4 is an example where both DDR-II and QUAD SRAMs can be used. In this example the SRAMs are used on the Uplink Card to the network for tables and counters. As mentioned previously, DDR-II SRAMs can be used for the lookup tables and QUAD SRAMs can be used for the counters.

### ISSI's Broad DDR-II/DDR-IIP and QUAD/QUADP SRAM Product Offering

ISSI has a broad DDR-II/DDR-IIP and QUAD/QUADP SRAM product offering with some of the industry's fastest devices and a roadmap to 144Mb devices. DDR-IIP and QUADP SRAM devices will provide speeds up to 400MHz.

Many telecommunication and data communication applications require Industrial grade support and ISSI



- I/O Cards:**
- 24-48x GE
  - 4-16x GPON
  - 2-4x 10GE

**Figure 4. OLT Design With SRAM for Tables and Counters (Source: Xelerated)**

is able to meet that requirement. Additionally, these applications have long life-cycles of up to 10 years and thus require long-term product support. One of ISSI's key differentiators is our commitment to long-term product support which makes ISSI a key supplier to customers in the telecommunications and data communications markets.

Many of these customers also need extended support for leaded packages and ISSI is one of the few suppliers still supporting leaded packages.

Customers can rest easy knowing that ISSI will support them with their long-term product requirements and with support for leaded packages.

For further questions regarding ISSI's offerings please contact [sram@issi.com](mailto:sram@issi.com).