Solace, Solarflare and Arista Demonstrate Market Data Distribution with Low, Consistent Latency

The drive towards low latency trading systems, and market data delivery in particular, means IT professionals on Wall Street are constantly on the lookout for innovative new techniques and technologies. The picture goes well beyond just raw speed, however, as market participants understand that consistency and predictability are just as important. With more trading decisions and order execution processes being automated, it is critical to make sure information flows quickly and consistently through the front, mid and back office.

One of the biggest shifts companies are embracing to ensure this consistently low latency is the move to purpose-built hardware. They're using network interface cards (NICs) that have been purpose-built for performance, and they are discovering that middleware appliances can distribute data with greater performance and predictability than software-based solutions. The fact that hardware-based solutions also reduce complexity and TCO is icing on the cake.

This paper describes how a system based on message routers from Solace Systems, 10 GigE adapters from Solarflare Communications and 10GigE switches from Arista Networks can deliver lower and more consistent latency than software-based solutions. To document the capabilities of such a system, the companies conducted tests that measured latency at rates as high as 5 million messages per second. This paper provides average and 99.9[th] percentile figures at a variety of rates.

In all tests the platform demonstrated latency that was both low and consistent. When routing 1,000,000 messages per second the platform exhibited average latency of 24 microseconds and 99.9th percentile latency of 27 microseconds. At five times that volume, rates that represent substantial performance headroom for most firms, latency was still low with minimal jitter: average latency was 35 microseconds and 99.9[th] percentile latency was 46.

Solace Systems™ **SOLARFLARE**® Communications

ARISTA

Architectural Overview

In traditional ultra-low-latency architectures, messaging software runs on the publisher and subscriber servers, network protocol stacks are implemented in the operating system and network connectivity is via store-and-forward layer 2 switches that often use 1GigE links.

The architecture shown here removes the bottlenecks that exist in real-world, high-volume scenarios.
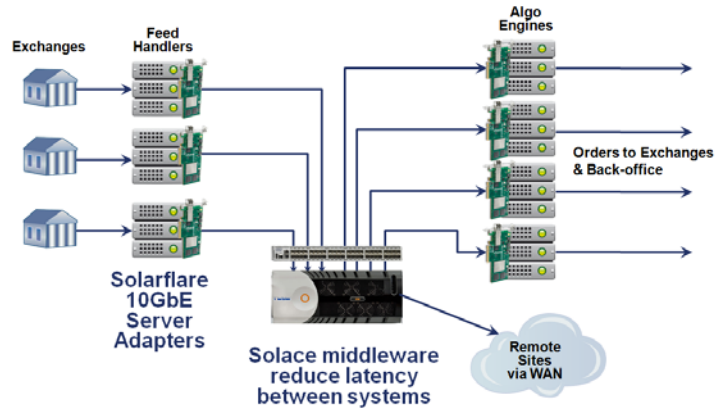
o The Solace message router implements message routing and filtering in purpose-built hardware using 10GigE links.

o The Arista 10GigE cut-through Ethernet switch accelerates packet delivery by streaming packets instead of performing store and forward.

o The Solarflare Adapter accelerates the process of moving Ethernet packets from the wire to the host CPU over PCIe.

o The Solarflare Enterprise OnLoad provides kernel bypass capabilities, so the TCP/IP stack runs in user space rather than in the kernel, which then avoids expensive interrupts and context switching.

Since message filtration and forwarding is in hardware, this configuration delivers remarkably low, consistent latency.

## Test Configuration, Methodology and Results

The tests were designed to approximate a real-world system and scenario, and independent testing by actual customers has validated the results, so firms can expect to see similar numbers in their own systems assuming similar parameters. The test system consisted of a Solace 3260 Message Router, an Arista Ethernet Switch, a Solarflare 10 GigE Network Adapter and Enterprise OpenOnload, on Nehalem CPUs.

The tests were run with 100 byte messages and 12-byte topics to approximate real-world market data payloads and topics, and run for 10 minutes to detect any short-lived variance (none of which was observed). Latency measurements were taken from the time the publishing application calls the Solace API send function to when the subscribing application receives the message from the Solace API, so it is the latency a typical application would experience. The publisher and subscriber applications performing the measurements are located on separate CPU cores of the same server in order to ensure both accurate clock synchronization and accurate one-way latency measurements, rather than deducing one-way latency from a two-way latency measurement as the latencies are rarely symmetrical.

Test System and Parameters

- Solace 3260 Content Router w/ 2x10 GigE NAB
- Arista Networks DCS-7148SX
- Solarflare Solarstorm SFN4112F 10GbE SFP+ server adapters
- Enterprise OpenOnload™
- Pub/Sub servers: Intel Xeon Nehalem 5550 quad core, 2.67 GHz running CentOS 5.2 X86 64 bit
- 100 byte messages with 12 byte topics
- 10 minute duration
- 10 publishers, 10 topics, 10 subscribers
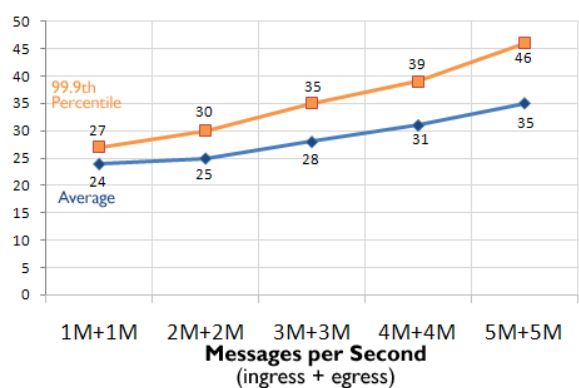
Note that these results do not represent the maximum capabilities of each product, just their performance in this scenario.

Solarflare 10 GigE Server Adapters

Solarflare Communications is delivering the next level of high-performance 10 Gigabit Ethernet (10 GigE). The robust and power-efficient server adapter and silicon solutions make possible next-generation applications such as low-latency networking, cloud computing, server virtualization, and network convergence.

Solarflare Server Adapters provide the highest possible line-rate performance, excel in small message processing, and have demonstrated performance leadership in the most demanding application environments.

Solarflare Solarstorm 10 GigE server adapters provide the following benefits:

- The single-port SFN4112F offers 20 Gbps throughput (full-duplex) so full 10G bandwidth is available to critical applications. The dual-port SFN 5122F server adapters support PCIe 2.0 and offer 40 Gbps.

- Offloads for critical compute-intensive tasks to insure that minimum burden is placed on the server CPU, freeing up processor cycles for customer applications

- Fully compatible with Solarflare's OpenOnload™ software, which provides direct socket connections to applications

Solace 3260M Message Router

The Solace Message Router is a middleware appliance that enables organizations to increase the speed of their application infrastructure by 10 to 100 times, improve the manageability of their systems and reduce costs. It supports reliable messaging and non-persistent JMS, as well as guaranteed message delivery, persistent JMS and message caching. All of its capabilities and services are accessible and manageable through Solace's unified API and administration framework.

- **High Performance:** A hardware datapath with no OS handoffs or context switching enables latency that is as consistent as it is low — just tens of microseconds even at very high rates and to the 99.9th percentile.

- **Low Complexity and TCO:** By supporting many messaging types and capabilities (reliable, guaranteed, persistent and non-persistent JMS, and message caching), and by offering the "out of the box" simplicity of a purpose-built appliance, the Solace Message Router is resource efficient in terms of rack space and power, as well as easy to deploy, operate, upgrade and scale.

- **Scalability:** Modular architecture enables the customization of features and capacity to meet specific requirements, and supports the addition of capacity or functionality over time without increasing the solution's footprint.

- **High Availability:** Redundant components and connectivity provide built-in high-availability, and support for paired deployment provides out-of-the-box fault tolerance without requiring additional equipment or software.

- **Manageability:** The use of discrete TCP connections instead of multicast make it easy for administrators to find and fix faults thanks to visibility into client-specific metrics such as connections, queue depths and message rates, all with no impact on system performance. The Solace Message Router is based on flexible FPGA chips so administrators can upgrade them with a single command.

Arista High-speed Ethernet Datacenter Switches

The Arista 7100 Series is a family of high performance, very low latency layer 2/3/4 10 Gigabit Ethernet datacenter switches. They support up to 960 gigabits per second, 720 million packets per second, with latency as low as 600 nanoseconds. Offered with 24 and 48 ports in a compact 1U chassis with redundant power and cooling, the Arista 7100 Series features front-to-rear airflow when mounted in either direction for flexible rack-top server aggregation deployments.

All ports accommodate the full range of 10GbE SFP+ or GbE SFP optical or copper physical layer options, allowing for maximum flexibility and investment protection as customers of all sizes migrate their server connections from Gigabit to 10 Gigabit Ethernet.

Arista EOS™

The Arista 7100 Series runs Arista EOS™, a datacenter-class operating system with a fine-grained modular protected memory architecture that ensures the highest levels of reliability and availability. Each process is monitored and restarted automatically in response to failure, while in-service software upgrades (ISSU) allow individual software components to be updated without disrupting system operation. Arista EOS can be extended to support virtualized environments and is customizable to meet specific customer functionality requirements.