Accelerating Application Delivery with Compute Integrated Networking

QFX5100-24Q-AA Application Acceleration Switch and QFX-PFA-4Q Module for Financial Services Environments
Table of Contents

Executive Summary .................................................................................................................... 3
Introduction ........................................................................................................................................ 3
Challenges........................................................................................................................................ 3
  Escalating Bandwidth Demand ....................................................................................................... 3
  Diminishing Latency Gains ............................................................................................................... 4
  Growing Regulatory Requirements ................................................................................................. 4
  Operational Complexity .................................................................................................................. 4
Solution: QFX5100-24Q-AA Application Acceleration Switch .......................................................... 4
  Application Delivery Use Cases ..................................................................................................... 6
  Market Data Feeds ......................................................................................................................... 6
  Exchange Gateway .......................................................................................................................... 6
  Order Routing and Execution ......................................................................................................... 7
  Pre-Trade Risk with Inline Credit Controls .................................................................................... 7
  Risk Analytics ................................................................................................................................. 7
Conclusion ....................................................................................................................................... 8
About Juniper Networks .................................................................................................................. 8

List of Figures

Figure 1: The QFX5100-24Q-AA switch with the QFX-PFA-4Q module .............................................. 4
Figure 2: The QFX5100-24Q-AA switch data center connectivity - support for IP fabric and IP capabilities ......................................................... 5
Figure 3: MPLS shared network transport with L3VPNs to support multitenant environments .................. 6
Figure 4: QFX5100-24Q-AA with the QFX-PFA-4Q module in an exchange trade plant environment .......... 7
Executive Summary
The financial services industry has long used technology innovation to find new ways to outperform rivals, create new business value, and change the rules of competition. Over the last several years, the focus in financial markets has been on leveraging technology to enhance algorithmic trading, stay ahead of the markets, and deliver new value-added services for better customer satisfaction while meeting regulatory requirements. Social media, mobile devices, and cloud usage are all causing disruptive innovation. Mobile banking, in particular, will experience significant growth as more than 1 billion unbanked people worldwide are brought into the banking subsystem over the next 10 years. Across the financial services industry, firms are incorporating real-time natural language processing and sentiment analysis into trading decisions, calculating credit risk in real time, conducting deep analysis of insurance subscribers, and transforming their digital business processes across the financial services industry. The commonality is the need for distributed, high-performance, compute-intensive environments to support applications to run the business. The smartest, fastest firms will gain a competitive advantage, and an intelligent, high-performing, scalable network is an indispensable component of this success.

As an innovation leader in the networking industry, Juniper Networks has a proven track record of helping financial services firms gain a competitive advantage through high-performance networking solutions, including routing, switching, and security. Juniper continues to support the evolving business requirements of financial services customers with the introduction of a new compute-integrated switch that accelerates application delivery while offering high performance, scale, and reliability. The Juniper Networks® QFX5100-24Q-AA Application Acceleration switch, in conjunction with the QFX-PFA-4Q Packet Flow Accelerator field-programmable gate array (FPGA) module, enables financial services firms to accelerate mission-critical applications, leverage high-performance, scalable networking, and simplify the operations of data center networks.

This white paper describes how to leverage the QFX5100-24Q-AA switch and QFX-PFA-4Q module to improve the performance of both networks and application delivery in the data center as well as in private clouds.

Introduction
Technology and financial services have long been tightly interrelated. The widespread adoption of social media, mobile, and cloud are driving new business models that enable financial services firms to engage with customers to deliver differentiated value-added services using nontraditional methods. Such models rely heavily on applications and big data analytics to make the decisions that drive business growth and reduce time to market. As a result, the emerging trends of hyper-contextual trading, digital banking, and the expanded use of risk analytics are driving yet another transformation of the financial services industry.

Hyper-contextual trading: In the case of capital markets, significant business advantage can be gained from making faster, smarter, and better trading decisions based not only on market data, industry news, and company press releases, but also understanding how social media and public sentiment drive the market. The ability to scout far and wide to identify the most credible intelligence—and bring that insight into the decision stream in an instant—is an immeasurable advantage that also reduces risk exposure. The move to hyper-contextual trading, however, demands a new level of performance to cope with massive volumes of data while ensuring the predictability of transaction execution.

Digital banking: The traditionally conservative banking industry is set for a massive disruption with competition from nontraditional players and mobile banking. As banks continue to modernize and deliver the services demanded by customers today, they are fully digitizing their business processes from end to end and leveraging big data analytics and mobile banking. Rationalizing their business processes not only will allow banks to function more efficiently and effectively, but will also help them stay competitive and relevant in the face of millennials and the unbanked. For example, banks can use analytics to enhance customer targeting through location-based services or to adjust pricing and resource allocation in real time.

Risk analytics: Predictive analytics can be used to determine risk and influence the decision making of investment bankers, hedge fund managers, and insurance firms. Firms need to consider the complex web of risks, including market risk, credit risk, liquidity risk, and operational risk, both short-term and long-term, while staying within a growing regulatory framework. Having a high-performance, compute-integrated infrastructure to analyze risk in real time or on demand—and to guide future decisions—is a critical success factor.

Challenges
As financial services firms embrace social, mobile, and cloud, they are turning to hyper-contextual trading, digitization of banking, predictive risk analytics, and other new technologies that drive competitive advantage. They need a data center infrastructure that will achieve higher levels of performance, scale, and reliability while providing a flexible foundation for the future.

Escalating Bandwidth Demand
The proliferation of social media and news sites, coupled with the explosion of market data volume, means that financial firms have access to a lot more data on market trends and activity. While the ability to process these data feeds and sources fuels business success, it also leads to market volatility and more transactions, which in turn translates into higher network bandwidth demands and high data volumes.
Diminishing Latency Gains

While the number of banking and trading transactions has been growing rapidly, there has been a corresponding need to lower the latency. This has long been a trend as firms first moved to faster switching platforms, followed by better networking ASICs and the deployment of field-programmable gate arrays (FPGAs), to process and fulfill transactions faster. As the silicon advantages in switching speed taper off, though, low latency has become table stakes. Exchanges and financial information providers are seeking new ways to process orders and market data to be first in the market.

Growing Regulatory Requirements

The financial services industry is fiercely competitive and highly regulated. In the U.S. alone, firms must follow the rules and guidelines set forth by the Federal Reserve Board, Security Exchange Commission, Financial Industry Regulatory Authority, U.S. Commodity Future Trading Commission, and the office of the Comptroller of the Currency, as well as numerous state regulators. As part of the regulatory requirements, these bodies provide oversight on how transactions or market orders need to be tracked, credit risks need to be processed, and so on. To stay compliant, businesses need to ensure fairness, consistency, time-stamping of transactions, and fulfill requirements such as storing application or transactional data. It all translates to additional demands on the data center infrastructure.

Operational Complexity

The quest for better technology can sometimes result in operational complexity that actually slows down the business. Hence, operational efficiency continues to be a focus across the industry, and technology leaders continue to seek innovative ways to meet high-performance, mission-critical application requirements in ways that are also efficient and scalable. Data center infrastructure and cloud networks must be designed to deliver the highest levels of performance, reliability, and flexibility while supporting business agility. Automating network functions allows IT to build a more flexible infrastructure that adapts instantly as business needs change. Automation also simplifies network operations while mitigating the inherent risks and delays of making manual changes and reconfigurations.

Solution: QFX5100-24Q-AA Application Acceleration Switch

With the introduction of the QFX5100-24Q-AA Application Acceleration switch and the QFX-PFA-4Q Packet Flow Accelerator module, Juniper is integrating compute technology with the network to improve and accelerate application delivery. This enables customers in the financial services industry to leverage technology for business success.

The QFX5100-24Q-AA switch with the QFX-PFA-4Q module is the industry’s first compute-integrated, high-performance data center switch in a small form factor that delivers applications at two levels:

- On the switch, through natively hosted, virtualized, network-centric applications
- On the QFX-PFA-4Q module, which accelerates performance by offloading processing of deterministic, real-time, business-critical applications logic

The QFX5100-24Q-AA switch combines powerful compute, networking, and customizable FPGA logic to deliver accelerated data processing, all in a small form factor. With its breakthrough design, the QFX5100-24Q-AA enables organizations to leverage network functions and performance as well as accelerate real-time, business-critical applications. The QFX5100-24Q-AA achieves industry-leading terabit performance through an innovative design that connects compute directly with the network, and its 1U form factor means businesses don’t have to make tradeoffs for size, performance, and capabilities.
The QFX5100-24Q-AA can run virtualized network applications natively, allowing network applications and functions to be integrated holistically into the data center infrastructure. Routing, firewall, performance monitoring, network analytics, and other network functions can be virtualized and run directly on virtual machines natively available on the switch. Hadoop Map Reduce and Docker Platforms are examples of applications that can be hosted in this environment.

The QFX-PFA-4Q is an optional add-on module that contains a 320 Gbps full-duplex FPGA. The FPGAs can be programmed with custom logic and are ideal for compute-intensive, deterministic, latency-sensitive, and business-critical application environments. Firms can offload processing of real-time, deterministic applications such as market data feeds, exchange gateway functions, and risk analytics to the FPGA for accelerated processing, which reduces latency transaction times and significantly improves performance. Additionally, the QFX-PFA-4Q module enables financial firms to comply with evolving regulatory technical standards such as Markets in Financial Instruments Directive (MiFID) II, which requires every transaction to be time-stamped.

While capital market firms have long used switches with FPGA modules to accelerate processing, some banks are considering using FPGAs for credit card processing and real-time fraud detection. However, programming the FPGAs is not a core competency for most financial services organizations and can take time, effort, and expertise. In contrast, the FPGA logic on the QFX-PFA-4Q can be optimized to fit specific application needs using Java. Application processing on the FPGA can be programmed using MaxCompiler, a Java-based GUI tool provided by Juniper’s technology partner Maxeler Technologies. This vastly simplifies development efforts and reduces the time needed to program the application logic while still meeting high-performance processing requirements. The ability to optimize and program the way applications are processed helps financial firms respond faster and more easily adapt to business and market changes. In addition, an Application Gallery portal hosted by Maxeler Technologies offers downloads for market data feed analysis; these applications can be reused or customized based on requirements. The QFX-PFA-4Q programmability aspect is flexible—customers who prefer to write applications in Verilog and VHDL, or C/C++ and other languages, can continue to do so.

Extensive use of technology and innovation also requires simplicity of operations. The QFX5100-24Q-AA switch simplifies operations through connectivity, reliability, network analytics, and management and automation capabilities.

The QFX5100-24Q-AA switch delivers seamless connectivity, with support for IP fabric, MPLS, and Layer 3 VPN capabilities that enable applications to be delivered as part of the existing solution framework, both within and across data centers. The switches can be configured as part of an IP fabric using a spine-and-leaf architecture in which each spine device is interconnected to each leaf device. This enables connectivity with predictable latency while reducing the need for a large number of ports—and the connections between them (see Figure 2). Using a combination of QFX5100-24Q-AA switches as leafs and Juniper Networks QFX10000 switches as spines in the IP fabric greatly enhances scale and future-proofs the high-bandwidth requirements within the data center.

![Figure 2: The QFX5100-24Q-AA switch data center connectivity - support for IP fabric and IP capabilities](image-url)
Support for MPLS ensures ubiquitous network transport for high data volumes, with a built-in resiliency mechanism for fault recovery. L3VPNs can be used to partition the physical network into multiple, separate logical instances, which is critical to providing the required segregation in a multitenant environment. Both MPLS and L3VPN are proven standards-based technologies that can be used to meet regulatory requirements for the segmentation of data or network transport, while ensuring continuous network operations (see Figure 3).

Figure 3: MPLS shared network transport with L3VPNs to support multitenant environments.

Designed to deliver very consistent performance, the QFX5100-24Q-AA is capable of handling microburst traffic, reducing retransmissions, and mitigating the risk of data loss. Microbursts can occur during periods of market volatility or when large volumes of data are being transferred across the network. Microbursts can cause latency spikes and saturation, which are especially harmful in trading environments, since they reduce the predictability of results and hamper the ability to respond instantly to market dynamics. Microbursts can also affect banking networks, especially when the transactions peak during prime shopping days. The intelligent buffer mechanism in the QFX5100-24Q-AA effectively absorbs traffic while providing deterministic performance.

The QFX5100-24Q-AA provides greater visibility into network performance with monitoring and analytics. Juniper Networks Cloud Analytics Engine, which runs virtually on the QFX5100-24Q-AA, includes data collection, analysis, correlation, and visualization, giving IT greater visibility into the behavior of physical and virtual workloads and applications across the infrastructure.

The QFX5100-24Q-AA runs Juniper Networks Junos® operating system, providing a rich, intelligent feature set that delivers the carrier-grade reliability essential in financial markets. IT staff can configure, manage, and maintain the QFX5100-24Q-AA using familiar tools such as Juniper Networks Junos Space Network Director and its APIs. In the data center, IT staff can use Network Director to manage and synchronize both physical and virtual environments, ensuring that network policies are enforced as workloads move from server to server or from virtual machine to virtual machine.

Many financial services firms have adopted the core principles of DevOps, with close collaboration between development and operations staff through all stages of the development life cycle. The DevOps approach helps these firms roll out software applications much faster, keeping IT related costs in check while improving customer experience. With DevOps, IT processes can become more programmatic and dynamic, making them more predictable, efficient, and secure. The QFX5100-24Q-AA supports automation capabilities that help provision, manage, and orchestrate the network infrastructure in the data center or in cloud environments. Some of these capabilities include zero touch provisioning (ZTP) and orchestration with OpenStack, CloudStack, Puppet, and Chef, in support of the move to DevOps.

Application Delivery Use Cases
The QFX5100-24Q-AA is ideal for a broad variety of high-performance computing applications, including market data feeds, exchange gateways, order execution and routing, and risk analytics.

Market Data Feeds
Market data feeds are growing rapidly in size and complexity. A market data feed may access hundreds of global data sources, which must be consolidated at each hosting center at lightning fast speeds and unyielding accuracy for distribution to customers. Exchanges and financial information providers can leverage the QFX5100-24Q-AA switch to ensure fast, scalable, and consistent performance for market data feeds. The market data feed application can run directly on the QFX-PFA-4Q accelerator to allow firms to consolidate, process, and distribute massive feeds and intelligently direct quotes only to the appropriate trading strategy servers.

Exchange Gateway
Exchanges need to process a staggeringly large amount of information at the highest performance and lowest latency possible—literally billions of new messages every second. At the same time, they must ensure predictable performance as orders are priced, filled, and routed, especially during peak trading periods. Using the QFX5100-24Q-AA with QFX-PFA-4Q module in the trade plant can improve the performance, predictability, and consistency of order routing and execution and support inline credit controls to minimize pre-trade risk.
Figure 4 is an example of an exchange gateway trade plant. This type of trade plant typically includes exchange gateways and multiple server farms that execute stock ticker symbol processing, risk management, credit checks, and other related applications. Such a compute-intensive environment is both complex to manage and also has latency overhead associated with it. In addition, the challenge is in the ability to ensure predictable, consistent processing across all of the servers farms. With the introduction of the QFX5100-24Q-AA and QFX-PFA-4Q module, symbol routing, risk management, and the exchange gateway functionality can be integrated onto the switch. This reduces latency, increases performance, improves predictability, and consistency of order routing and execution and support inline credit controls to minimize pre-trade risk while simplifying the environment to use 40% fewer ports.

Order Routing and Execution
Exchanges are always on the lookout for ways to improve the performance and consistency of the order routing and execution process while ensuring accuracy and market fairness. The QFX5100-24Q-AA with QFX-PFA-4Q module ensures consistent performance with first-in, first-out message handling from the trading engine to the order gateway, eliminating the need to focus on performance variability across sessions.

Pre-Trade Risk with Inline Credit Controls
Firms can better manage pre-trade risk by performing inline credit controls within the data path. Firms can offload the inline credit control checks to the QFX-PFA-4Q accelerator module, mitigating the risk of invalid or otherwise problematic trades. Orders can be checked against key risk parameters, such as quantity limits, price collars, or execution thresholds; invalid trades can be rejected while valid trades can be quickly sent to the respective matching engine to process the order.

Risk Analytics
The need to analyze and determine risk in real time and on demand is common across the financial industry, including banks, insurance providers, and capital market firms. The demands on risk analytics have grown significantly, driven by new products as well as regulatory requirements. Firms may need to consider tens of thousands of risk factors in an instant to make split-second decisions. Even small improvements of risk in risk management models can yield big payoffs. The QFX5100-24Q-AA with QFX-PFA-4Q is ideal for accelerating market risk analytics, allowing firms to perform highly sophisticated calculations quickly so that they can adapt to market decisions and provide their end customers with better value-added services while meeting regulatory requirements.
Conclusion
The world is demanding more from the network, and the financial services industry leads the way in building better networks that fit today’s need for performance, agility, and automation. The QFX5100-24Q-AA switch with QFX-PFA-4Q module allows firms to build data center and cloud networks that will deliver greater performance and agility with the virtualization of network functions and integrated compute to accelerate the most demanding applications. With Juniper Networks as a technology partner, financial services firms can continue to innovate and gain a competitive advantage with the latest technologies.

About Juniper Networks
Juniper Networks is in the business of network innovation. From devices to data centers, from consumers to cloud providers, Juniper Networks delivers the software, silicon and systems that transform the experience and economics of networking. The company serves customers and partners worldwide. Additional information can be found at www.juniper.net.