



Bivio 2000 **Network Appliance**

Uncompromising performance. Unmatched flexibility.

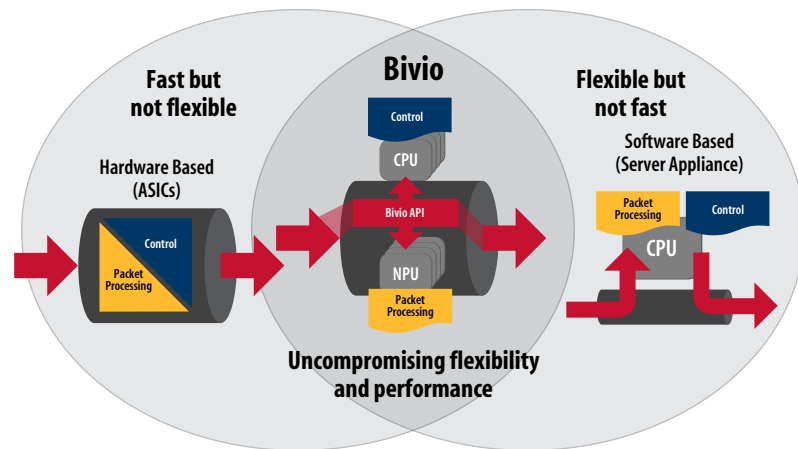


The Bivio 2000 Network Appliance

Today's networking applications require network appliances to accomplish deterministic multi-gigabit line rate throughput while allowing deep packet processing by the application layer and consolidation of multiple applications on the same system. Neither general-purpose server platforms nor specialized ASIC-based systems provide the performance and flexibility to be the foundation of a scalable, adaptable, and modular hardware platform that provides customers superior cost-performance, investment protection, and flexible upgrade paths.

The Bivio 2000 Network Appliance platform masters these challenges through its unique hardware architecture, Linux-based operating system, open APIs, and system integration support which will quickly catapult the performance of a networking application to the top of the competition without spending the costly development cycles associated with custom ASIC or network processor development.

Figure 1:
Bivio Network Appliance Platforms combine flexible computing with high-speed networking.



By porting their networking applications to the Bivio platform, application developers, network appliance vendors, and system integrators can deliver

- market-leading performance
- unmatched scalability
- platform continuity

all in a compact network appliance form factor.

Architecture Overview

The Bivio 2000 Platform is a high-performance, programmable network appliance that combines a groundbreaking scalable hardware architecture with a software platform that includes a standard Linux-based execution environment and a comprehensive set of networking features. Specifically optimized for deep packet processing at wire speeds, the Bivio 2000 architecture fuses flexible computing and high-speed networking to deliver uncompromising performance and unmatched flexibility.

The major hardware components of the platform are the Network Processor Card (NPC), Application Processor Card (APC), Network Interface Modules (NIM) and the stack bus technology. Application Processors are connected to the Network Processor via a 10 Gbps stack bus. The stack bus enables linear scaling of application processing power, throughput, and I/O ports via additional APC, NPC, and NIM modules that are housed in the appropriate number of 2 RU chassis. This innovative technology also allows internal failover communication for redundant configurations.

The result is a power-packed network appliance in a convenient 2 RU base unit with the ability to tailor the computational and network resources to the application profile. OEM Partners can configure their product with 2 to 30 Application CPUs depending on the application needs. The flexibility of the platform to scale in multiple dimensions allows an optimum matching of various system resources for the desired performance. Furthermore, should end-users' performance requirements grow in the future, the platform enables cost-efficient incremental addition of system resources to relieve any developing bottlenecks without replacing the entire device.

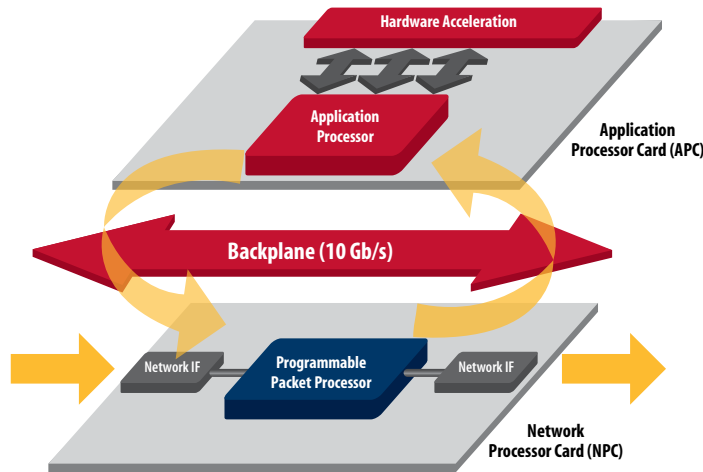


Figure 2.
Bivio Network Appliance Architecture.

In side-by-side performance tests with industry-leading firewall and IDP/IDS applications, the Bivio 2000 platform outperformed standard server appliances by a factor of 10X at 64-byte packets and 3X for large packets.

The Bivio 2000 Network Appliance achieves its breakthrough performance and flexibility by combining a Linux-based environment with three key architectural design elements:

1. High computational power with extensive scalability
2. Strict architectural separation of network and application processing
3. Hardware acceleration

Each of these architectural principles will be explored in further detail in the following sections.

Computational Power and Scalability

The Bivio 2000 Network Appliance is a multi-processor platform offering the highest processing power in the industry, delivering up to 18,000 MIPS in a standard 2U chassis. This high computational power enables an appliance solution for multi-gigabit processing at wire-speed of any IP network service such as IDS/IDP, firewall, VPN, application traffic management, load balancing as well as several others. In other words, the Bivio 2000 platform can execute off-the-shelf Linux applications at gigabit line rates, eliminating the historic performance advantage that ASIC-based networking products had over computing platforms.

Each CPU sub-system is a completely independent system, allowing internal load sharing of application processing and optimized redundancy and fail-over mechanisms. Each CPU subsystem has 512MB standard (expandable to 2GB) associated memory for applications and packet buffering. For IPsec VPNs, SSL Acceleration, RegEx content processing and other well-defined computational tasks, a hardware acceleration module can be added to each CPU subsystem.



In a unique approach to scalability, Bivio's stacking technology enables application processing to scale linearly with the number of APCs in a stacked system, providing network application developers with the flexibility of tailoring their product to the desired price/performance targets and allowing end-customers to grow incrementally with increasing traffic demands while preserving their initial investment in the system. In contrast to a cluster of independent appliances, the stacked Bivio system configuration is accessed as a single addressable system with one IP address. An example of a system with 3 APCs is shown below.

Figure 3.
APC Scaling with the Bivio 2000
Network Appliance.



Separate Network and Application Processing

The second architectural principle the Bivio 2000 platform follows is to separate application-level processing from network layer processing. At the heart of the NPC is a multi-gigabit Network Processor that combines the performance of an ASIC with the programmability of a general-purpose server.

Bivio's patent-pending technology incorporates Application Programming Interfaces (APIs) that transform Linux software commands into hardware packet manipulation instructions at multi-gigabit speeds. Applications can leverage performance-enhancing functions of the Network Processor such as fast path acceleration, QoS, or blocking of packets at the network layer through an API that is easy to incorporate. The de-coupling of the network layer processing and application processing also improves the resiliency of the system by adding an extra layer of protection against DoS/DDoS attacks.



The Network Processing Card provides important features in the Bivio 2000 platform including multi-gigabit throughput (even at 64 byte packets), real-time programmability of per-flow behavior through the API, dynamic programming based on service type, application resource load sharing, and flexibility for physical network connections.

In addition, the NPC implements system management functionality, and also hosts optional dual SCSI hard drives that can be configured in RAID-1 redundancy for additional application storage, network statistics, and system logging.

Hardware Acceleration

Bivio provides a selection of accelerator cards to offload a number of compute-intensive and repetitive tasks from the Application CPUs in the Bivio 2000 Network Appliance platform. These tasks include:

- IPSec
- SSL
- XML
- Regular Expressions (Regex)
- Compression / Decompression
- Character Conversion

A selection of Bivio Acceleration Cards are available that are optimized for offloading and processing cryptographic functions and content analysis. Each CPU subsystem in the Bivio platform operates independently of the others, allowing the network services developer to assign different applications to different CPU subsystems and only populate accelerator cards with the CPU subsystems that require offload functionality.

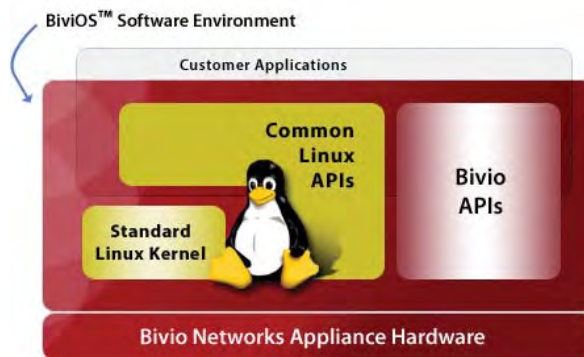
In addition to standard hardware encryption and content acceleration modules that offload encryption tasks and content acceleration functions from the application CPUs, Bivio's hardware acceleration options also extend to the network layer. The Network Processor is essentially a TCP offloader and provides programmable hardware acceleration of payload traffic that can be controlled by the host application through the Bivio API.

For example, an application might identify the service and session of a flow based on the first packet. Next, the application rules are cached and instructions dynamically programmed into the forwarding layer so that all remaining packets in the stream are forwarded in the network layer at full wire-speed.

BiviOS™ and Application Integration

At the foundation of the Bivio platform is a standard Linux execution environment that allows any Linux-based networking application to run on the appliance with little porting effort. The Bivio software environment is called BiviOS™ and includes a comprehensive set of networking and management features in addition to the Linux kernel and common APIs.

By basing the Bivio network appliance on a standard, pre-ported Linux distribution with full API compatibility, the software developer can quickly and easily run their application within hours of unpacking the device. BiviOS is transparent to the programmer but immediately allows applications to take full advantage of the performance, flexibility, and scalability inherent in the Bivio platform.



BiviOS also supports a rich set of software infrastructure components that allow developers to quickly realize advanced capabilities of the Bivio network appliance. These components provide a variety of critical services including robust traffic management, load distribution across the multiple Application Processor CPUs, and wire-speed Quality of Service (QoS) functionality. Bivio Application Programming Interfaces (APIs) enable further customization and optimization of the Bivio architecture to the specific application requirements

The installed BiviOS consists of a collection of individual RPMs. RPMs may be added or removed from the system at any time during the operational life of the BiviOS. Customer- and application-specific RPMs would be added to the Bivio RPMs to generate the complete software image of a specific product.

All software must be compiled for the Linux PowerPC architecture. Software applications can either be compiled directly on the Bivio 2000 platform or on a separate PowerPC based computing platform. Bivio also makes development builds of its OEM Software Bundle available to OEM partners.

Traffic Management and Bivio APIs

Bivio APIs enable system developers to utilize several advanced capabilities of the Bivio architecture as well as offer unique value-added capabilities for custom product differentiation. Bivio APIs include advanced capabilities for traffic modes, system scaling, management and high availability functions on the Bivio network appliance.

Traffic Management

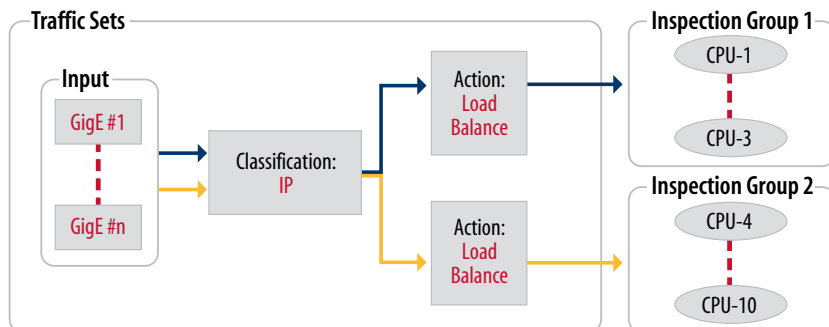
The Bivio platform can be configured to support network operation in multiple traffic modes depending on the deployment requirements.

- **Inline Tap Mode:** In this mode, the platform operates as a transparent inline device while packets are being copied from the “wire” to the application. Therefore, packets can be sniffed at wire speed and without the need for mirror-ports on a switch.
- **Parallel-Processing with Packet Copy:** Sometimes, different applications need to inspect the same packet, but would normally experience resource contention when running on the same processor or shared memory. The Bivio platform avoids these resource contentions by copying packets in hardware to parallel applications without sacrificing throughput or latency. The scalable processing architecture ensures sufficient resources for each application even at full line rate processing.
- **Network-Layer CPU-Offload:** In this mode the Application decides which flows to process at the Application Layer and which ones to offload to the programmable Network Layer. This functionality increases the effective capacity of the device full stop. For latency sensitive traffic like VoIP, applications can tap into control flows while data flows get forwarded on an accelerated inline path through the network layer, thereby keeping latencies of the data path to an absolute minimum.

Inspection Groups

Configurable Inspection Groups (CIG) are the foundation for expanding the Bivio network appliance into multiple virtual systems and consolidating complimentary applications on a single platform. The basic function of CIG is to bind specific interfaces to classification policies and distribute incoming traffic to the assigned computational resources according to the classification. In the example below, IP traffic is classified into two groups which are then load balanced among a dedicated Inspection Group, or group of CPUs. Different applications or configurations can be run on different Inspection Groups, allowing complete flexibility in applying the platform’s resources to different tasks.

Figure 4.
Implementation Example for Bivio
Configurable Inspection Groups.



Zero-Copy User Space Access

A common technique for accelerating computing systems is to provide direct I/O access to the application user space. These zero-copy drivers are often customizable to the specific application and the Bivio implementation supports the Linux “IPTables” packet filter.

Device Management

The Bivio platform supports a command line interface (CLI) as well as a web-based graphical user interface (GUI). The Bivio CLI provides auto-completion, tab completion and context-sensitive help. The Bivio GUI is an easy-to-navigate web-based interface that includes various system monitor and inventory monitor views. Configuration and management of the Bivio 2000 Network Appliance is typically a combination of calling Bivio-specific CLI commands and application-specific configuration such as policies, users, etc. The Bivio Configuration API can be used to call CLI commands from within a third-party application.

High Availability

Besides standard hardware-based HA features such as dual hard drives and power supplies, the Bivio system offers additional HA functionality such as internal redundancy of Application Processors with failure-adaptive load balancing, external system redundancy configuration, software- and hardware based failopen (bypass), DoS-attack protection, and the independent control processor with management ports. The Bivio architecture ensures sufficient resources for each application even at full line rate processing.

Summary

The Bivio 2000 Network Appliance Platform enables customers to achieve disruptive improvements in deep packet processing performance, scaling, reliability and deterministic traffic management capabilities that network equipment manufacturers, independent software developers, service providers, enterprises, and federal agencies demand in their emerging networking infrastructure. Customers are now enabled to rapidly develop innovative, market-leading networking solutions, speeding time-to-market and time-to-solution with minimal integration effort.

About Bivio Networks

Bivio Networks has developed an award-winning, deep-packet inspection and processing platform that combines unparalleled scaling of network performance, processing power, and application agility. Bivio's network appliance platform features a groundbreaking architecture specifically optimized for wire-speed execution of emerging network services that increasingly demand deep packet processing combined with high network throughput. Based on open industry standards, Bivio Networks fuses unmatched flexibility with uncompromising performance to enable its customers to overcome existing bottlenecks and deliver the foundation of the next generation network infrastructure.

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