



## Technical Brief

ActiveArmor and NVIDIA  
Hardware-Based Firewall  
A Secure Networking Solution



Computers are an integral part of everyday life and the proliferation of high-speed Internet connections means that most PCs are now connected to public or private networks. PCs also contain extraordinarily valuable information (banking or business data, MP3s, or digital movies) with much of this information now accessed from online banking sites or music download services. The fact that millions of PCs are now connected to the Internet gives PC users remarkable access to information on Web sites around the world. Conversely, this also gives computer hackers access to these networked PCs. Whether their reasons are malicious or recreational, hackers are constantly probing for unprotected PCs. NVIDIA research has found that hackers will find a new PC on a public network within minutes of being connected. Plus, spyware applications are surreptitiously loaded on unprotected PCs, and communicate information on the PC's use to unauthorized viewers. This reality is why computer security is one of the most important issues facing users today.

One of the main reasons PCs are vulnerable to security breaches and attacks is that they are connected to *shared* networks—homes with multiple PCs; workplace environments; or the Internet, where millions of PCs are simultaneously connected. Within these environments, most computer attacks occur and harmful data packets reach an unprotected PC to wreck havoc.

Many solutions exist for protecting PCs from attacks. A common characteristic of most PC-based security solutions is that they are *software based*. However, software solutions are very CPU intensive, which affects overall system performance and degrades the user experience. And contrary to popular belief, adding more CPU cycles does not solve the problem, because many attacks are sophisticated and bypass or disable software-only security solutions.

This paper details the benefits of the NVIDIA® secure networking solution, an integrated part of NVIDIA nForce™ 4 media and communication processors (MCPs). The NVIDIA secure networking solution includes hardware-based NVIDIA Firewall 2.0 and the NVIDIA ActiveArmor™ technology, the industry's first dedicated secure networking engine.

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## NVIDIA ActiveArmor Secure Networking Engine

NVIDIA ActiveArmor is a secure networking engine integrated into the new NVIDIA nForce4 MCP family. A dedicated portion of the silicon that enhances networking security while reducing CPU overhead, ActiveArmor provides deeper levels of networking and traffic inspections at full-duplex gigabit Ethernet speeds.

ActiveArmor delivers the highest system performance by offloading CPU-intensive packet filtering tasks in hardware, providing users with a PC networking environment that is both fast and secure.

## NVIDIA Firewall Powered by ActiveArmor Secure Networking Engine

Computer security has three independent components: a firewall, intrusion detection, and antivirus protection. (For more information on the computer security components, please refer to the following technical brief: “NVIDIA Security–Personal Firewall and Antihacking Technologies,” TB-00982-001).

A firewall is the core component of a computer security solution. It ensures that only data packets that comply with the defined policies get through. To provide this protection, the firewall examines each data packet that attempts to pass through and determines if the packet has permissible attributes; if it doesn't, the firewall blocks the packet. *This is a very CPU-intensive process and can dramatically degrade system performance.*

The solution to the CPU-intensive problem is the introduction of a hardware engine into the process. When firewall functionality is coupled with a dedicated hardware engine, there is no performance degradation.

The industry's first true hardware-based PC firewall is NVIDIA Firewall 2.0, which is now powered by the NVIDIA ActiveArmor secure networking engine. The combination of NVIDIA Firewall and the ActiveArmor secure networking engine (Figure 1) improves network throughput (at full-duplex gigabit Ethernet speeds), lowers CPU utilization, and performs deep packet inspection, thereby improving overall network security.

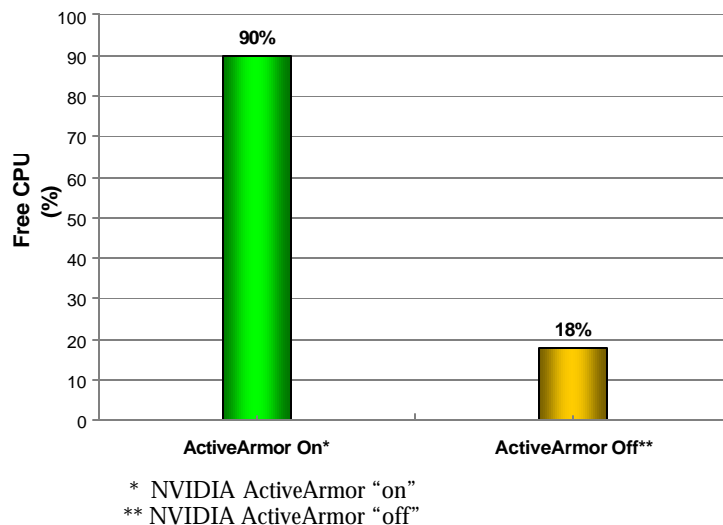


Figure 1. Software Firewalls Are CPU Intensive

## Reduced CPU Utilization

In traditional networking environments, inspecting packets is laborious and affects CPU overhead, memory bandwidth, and overall system latency (Figure 2). For example, packets move from MAC to driver; driver to stack within kernel space; and from stack to application, which involves crossing the kernel-/user-space boundary. All those memory copy operations are CPU intensive and time consuming, and the driver and stack processing that occurs between the copies uses an excessive number of CPU cycles.

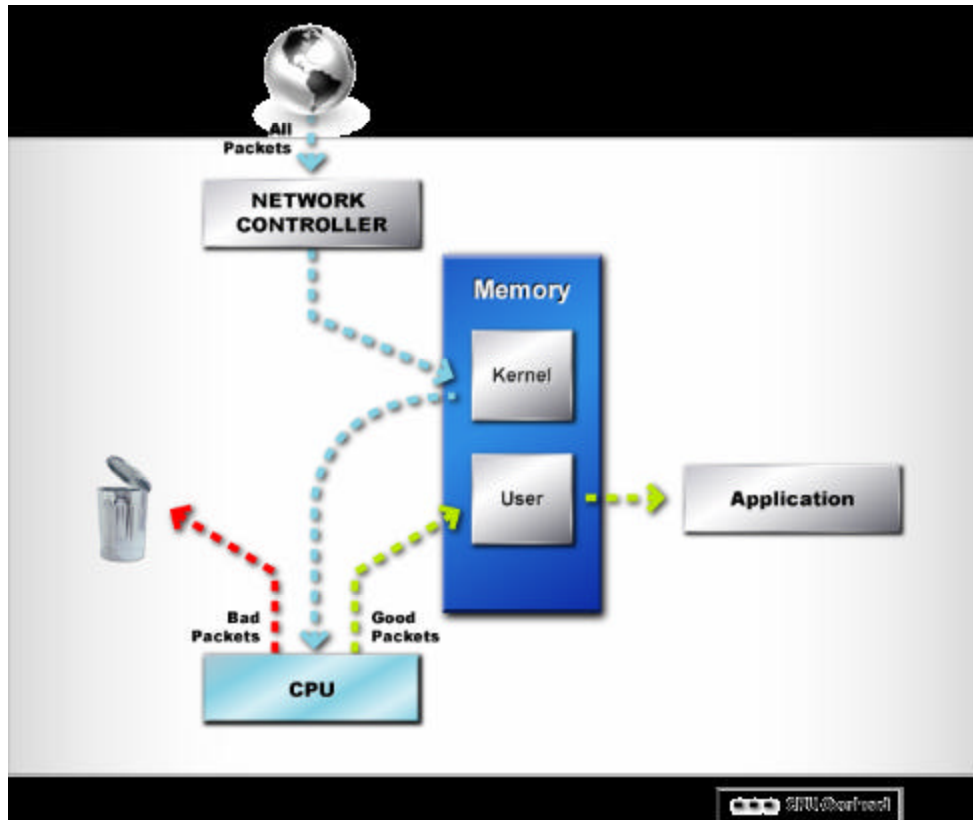


Figure 2. Current Packet Processing

In comparison, the ActiveArmor secure networking engine discards bad packets before the CPU ever sees them. Plus, good packets take an “express lane” and bypass the traditional “network stack” process, improving overall throughput and lowering CPU utilization (Figure 3). With ActiveArmor, the payload of all good packets is placed directly into application memory, which avoids up to three CPU-intensive copy operations (from MAC to driver; driver to stack within kernel space; and from stack to application, which involves crossing the kernel-/user-space boundary).

The ActiveArmor secure networking engine processes all the relevant protocol headers and validates them against the list of allowed connections and the most recent connection state so that only valid packets are accepted from (or allowed onto) the network.

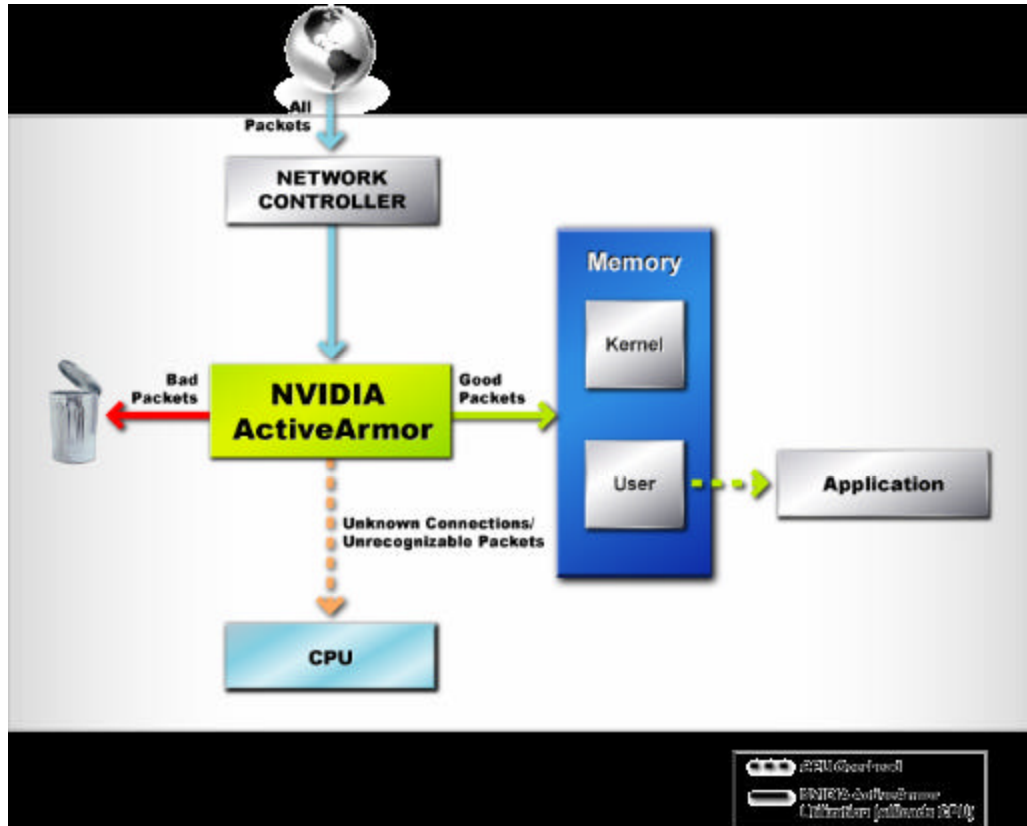


Figure 3. NVIDIA ActiveArmor Packet Processing

By examining the packets in hardware and placing the packet data directly into the application's buffers, ActiveArmor provides the highest performance and most efficient networking security solution available for any PC platform.

In addition to its packet inspection efficiencies, ActiveArmor provides three other major features: instant-on protection, tamper-resistance functionality, and support for Microsoft TCP Chimney architecture.

## Instant-On Protection

The NVIDIA secure networking solution provides “instant-on” protection by delivering a PC network connection that is secure the moment your PC is powered on. No security gap exists between the moment the PC is turned on and the availability of firewall protection on that PC. This instant-on protection is achieved by *integrating* an embedded driver and firewall processing into the NVIDIA nForce MCP.

In contrast, all other software solutions have a time gap between when the PC is turned on and when the security software is loaded into memory. This is all that hackers, who constantly are scanning the networks for unprotected PCs, need to make their move and attack.

## Enhanced Security and Tamper Resistance

Unlike other security solutions, NVIDIA ActiveArmor security settings deliver a deeper level of inspection to your networking traffic by allowing your data to be closely checked to filter out any unauthorized or suspicious traffic.

This higher level of inspection and filtering can only be achieved by using a dedicated hardware engine. The advantages of using a dedicated hardware engine are threefold:

- ❑ It provides an enhanced level of security by offering deep packet inspection in hardware.
- ❑ The higher level of security comes at no cost to the CPU and does not degrade system performance.
- ❑ It's tamper resistant. Any attempt to disable or manipulate firewall policy control and filtering disables the network connection, protecting the PC from any unauthorized access.

## Support for Microsoft TCP Chimney Architecture

NVIDIA ActiveArmor fully supports the new Microsoft TCP Chimney architecture, allowing for protocol acceleration of TCP/IP. By integrating a firewall policy into the TCP/IP Chimney architecture, NVIDIA creates two powerful advantages— reduced CPU overhead in processing TCP/IP traffic, and a security policy enforcement engine that ensures only authorized traffic is allowed into (or out of) the PC.

NVIDIA ActiveArmor and the NVIDIA nForce4 MCP family are one of the first products in the industry to incorporate support for the new Microsoft API, solidifying NVIDIA's leadership position in this area.

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## Conclusion

Current PC security solutions are software based and consume a lot of CPU cycles. This approach is a compromise that tries to balance security and performance.

*When it comes to security, however, there should be no compromise.* PC users deserve to have the highest system performance without any security compromise!

The dilemma of how to address these two competing requirements has been resolved by the introduction of the NVIDIA secure networking engine. NVIDIA's dedicated hardware engine enhances network security because it provides hardware-based deep packet filtering while offloading CPU-intensive firewall and networking packet processing. The result is enhanced security with improved overall system performance.



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