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@FlowInspector Virtual Network Traffic Monitoring System Employs Intel® Programmable Acceleration Card with Intel® Arria® 10 GX FPGA

The @FlowInspector Virtual Network Traffic Monitoring System from the NTT Advanced Technology Corporation (NTT-AT) identifies packets encapsulated in multiple stages, measures and visualizes traffic volume for each flow, and automatically records packets before and after the occurrence of incidents

Overview

The explosive growth of big data continues to improve our quality of life through further advances in artificial intelligence (AI), the transition of the worldwide communications grid to 5G networks, and the Internet of Things (IoT). With the advent of various new data services, the types of data flowing through the network become increasingly diverse. However, the need to deal with this increased traffic of various types can also increase network operating costs.

The @FlowInspector Virtual Network Traffic Monitoring System developed by NTT-AT provides a solution that streamlines traffic monitoring operations for networks that transport the ever-increasing data traffic. The @FlowInspector Virtual Network Traffic Monitoring System takes full advantage of Intel® FPGA features to achieve wire-rate traffic collection while filtering and capturing targeted traffic for each communications provider and recording the statistical information for each captured traffic flow. Furthermore, the @FlowInspector Virtual Network Traffic Monitoring System captures and stores traffic data before and after a trigger event so that analysts can easily understand the event in context. This capability reduces the workload for network operators and reduces the cost of the IT infrastructure needed to store the data.

The @FlowInspector Virtual Network Traffic Monitoring System relies on the acceleration capabilities of the Intel® Programmable Acceleration Card with Intel® Arria® 10 GX FPGA (Intel® PAC with Intel® Arria® 10 GX FPGA) to capture and analyze network traffic in real time. The Intel PAC with Intel Arria 10 GX FPGA is a PCIe-based FPGA card for data centers supported by the Acceleration Stack for Intel® Xeon® CPU with FPGAs. This platform allows the @FlowInspector Virtual Network Traffic Monitoring System to provide a variety of service menus, functions, application programming interfaces (APIs), and application links that improve network operation efficiency and provide additional solutions.

Business Challenge: Responding to Explosive Network Traffic

For stable network operation, conventional traffic monitoring measures the number of packets flowing through router and switch interfaces. It then combines information about packet destinations through these interfaces, and optimizes the routers, switches, and the connecting line capacity. It measures various traffic parameters such as switching routes to deal with temporary congestion. Finally, it provides a macro view of the traffic. The increasing diversity of services using data on the Internet results in a growing need to view the packets both macroscopically and microscopically.

Deep Packet Inspection (DPI) technology has been implemented in firewalls and used to respond to security threats since the earliest days of networking. Further advances in DPI technology now provide organizations with expanded traffic data usage capabilities such as ensuring fairness in bandwidth, enforcing detailed rate plans to mobile services, and enabling targeted advertising based on user behavior analysis. Increases in Internet traffic and the growth of various Internet services demand improved solutions that can efficiently collect, store, visualize, and analyze the traffic data to deliver additional value for businesses.

Solution: NTT-AT @FlowInspector Virtual Network Traffic Monitoring System Utilizing Intel PAC with Intel Arria 10 GX FPGA

Based on the knowledge of carrier network operation, NTT-AT has developed a traffic monitor called the @FlowInspector Virtual Network Traffic Monitoring System, which uses Intel PAC with Intel Arria 10 GX FPGA on a commercially available Linux* server. This product is not limited to general 5-field flow identification. It can also be used for 17-field[1] flow identification in the virtualized network using VXLAN network virtualization technology used by carriers and data centers.

The @FlowInspector Virtual Network Traffic Monitoring System uses the Intel PAC with Intel Arria 10 GX FPGA to analyze packets in real time and to generate statistical information based on research results from the NTT Device Innovation Center. The Intel PAC with Intel Arria 10 GX FPGA card's performance makes packet processing at the full 10 Gbps wire rate possible. The Intel PAC with Intel Arria 10 GX FPGA generates statistical information such as the number of packets and bytes for each flow generated and these statistics are stored in a database via the Open Programmable Acceleration Engine (OPAE) and displayed in real time by visualization software. Figure 1 shows the system configuration of the @FlowInspector Virtual Network Traffic Monitoring System. Figure 2 shows the block configuration instantiated in the Intel PAC with Intel Arria 10 GX FPGA.

The use of FPGA-based packet processing delivers additional benefits besides full wire-rate support. One example is the ability to measure the exact timing of packet reception and instantaneous bandwidth utilization. The @FlowInspector Virtual Network Traffic Monitoring System detects a burst of packets over a short period of time as a microburst. The @FlowInspector Virtual Network Traffic Monitoring System forms a ring buffer with the DDR4 DRAM on the Intel PAC with Intel Arria 10 GX FPGA to store received packets and transfers these packets to the software running on a server when triggered by the microburst detection. This makes it possible to store only those packets before and after the incident. In addition, the @FlowInspector Virtual Network Traffic Monitoring System can measure jitter and latency for RTP packets.

Capturing usage status in real time, collecting additional necessary information, and responding as quickly as possible when incidents are detected are essential elements during network operation. The @FlowInspector Virtual Network Traffic Monitoring System accomplishes all these tasks simultaneously.
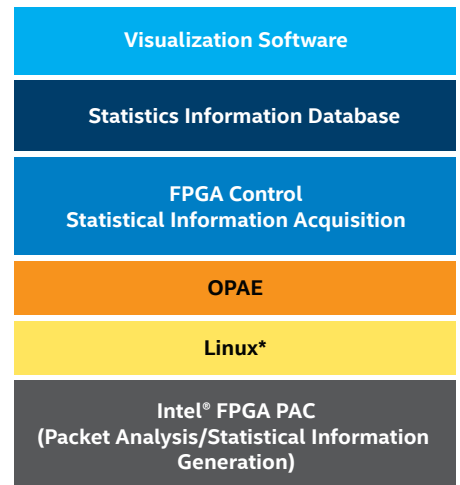
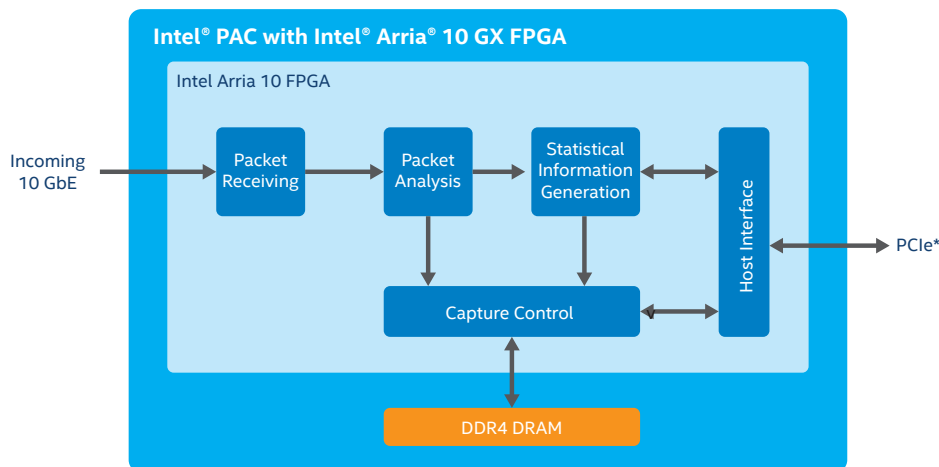**Figure 1.** @FlowInspector Virtual Network Traffic Monitoring System structure

Figure 2. Block diagram of the @FlowInspector Virtual Network Traffic Monitoring System instantiated in an Intel PAC with Intel Arria 10 FPGA

Used for Data Center Network Operation Monitoring

Because data center services are provided to end users through the data center network, network performance is likely to affect the quality of the service itself. In addition, various data center service flows come and go through the data center network.

For example, one provider using these data center services can use the @FlowInspector Virtual Network Traffic Monitoring System to manage network operations and to maintain the quality of service by collecting and visualizing the traffic flows. Network monitoring using the @FlowInspector Virtual Network Traffic Monitoring System not only collects 10 Gbps traffic, but also monitors the traffic volume and usage rate for each customer (tenant) in the data center and detects incidents such as bursts. This is accomplished by instantiating logic circuits in the Intel PAC with Intel Arria 10 GX FPGA to analyze traffic and to compute real-time statistics for 17 fields[1] used in the VXLAN/VLAN on the hardware side.

It is now possible to take advantage of the flexibility of Intel FPGAs to also meet monitoring requirements that depend on services provided by the data center. Previously, traffic was copied from a tap point in the network and collected by a packet broker. Then, the traffic was filtered or processed, and the statistical processing and visualization of output data was performed separately by other systems.

By adopting the Intel PAC with Intel Arria 10 GX FPGA, the functional equivalent of a packet broker can be implemented with the one PCIe card mounted in the general-purpose IA server to implement a low-cost, compact, and detailed traffic-monitoring system. Figure 3 shows a comparison of this new system with the conventional technology.

Solution Values: Monitors the Entire Network without Affecting the Main Communication Path and Requiring Additional Equipment

Because this solution analyzes the packets copied by the mirroring setup of the network switch at the monitoring target, there is no effect on the main communication route and there is no need to change the network configuration. Even when communication is performed by encapsulating packets from virtual machines, it is only necessary to monitor at the point where traffic is aggregated. Also, there is no need to install monitoring equipment or add a network packet broker for each virtual machine.

Real-Time Visualization Function Makes It Easy to See Traffic Changes

Complex encapsulated packets are identified using a powerful filter with as many as 17 fields[1] and 10,000 entries, then measured, and visualized in real time. It is possible to display the traffic volume for each tenant as well as the total traffic volume for each monitored location and the traffic volume for each flow.

Automatic Recording of Conditions Before and After Incidents

When an incident such as a microburst is detected, the solution stores only the packets before and after the incident, which enables fast analysis and response due to the narrowed scope surrounding the incident. In the past, large-capacity storage and enormous amounts of analysis time were required, but this new solution enables quick analysis and reduces costs.
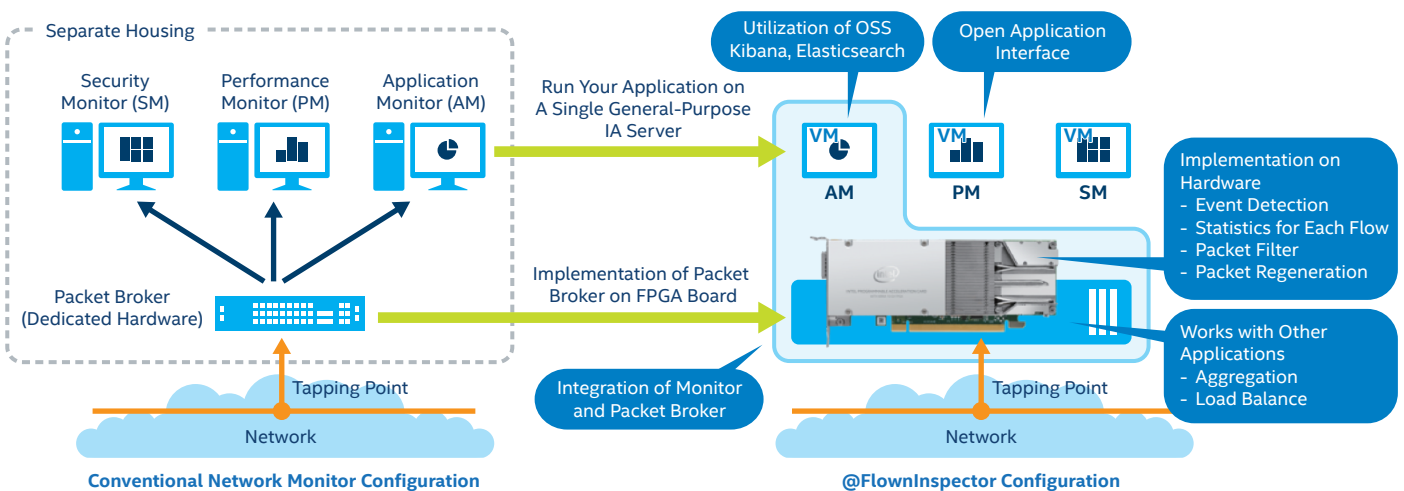

Figure 3. Comparison with Conventional Technology

Easy Integration with Data Analysis Applications

The @FlowInspector Virtual Network Traffic Monitoring System also has an interface to provide data to other applications, so it can be easily integrated with many other applications such as data analysis, incident detection, and traffic prediction.

Scalability Utilizing the Features of FPGA

The @FlowInspector Virtual Network Traffic Monitoring System uses the Intel PAC with Intel Arria 10 GX FPGA for fast packet processing. FPGAs are hardware devices with logic circuits that can be reconfigured for specific functions. The reconfigurable nature of the Intel PAC with Intel Arria 10 GX FPGA means that the @FlowInspector Virtual Network Traffic Monitoring System will be able to respond to future expansion needs with ease.

Conclusion

The diversification of IT services will continue to increase as will the amount of data used by these services. Software alone is no longer sufficient to handle the expected explosion of data traffic. Specialized hardware is needed to fill in the gap.

The @FlowInspector Virtual Network Traffic Monitoring System utilizes the Intel PAC with Intel Arria 10 GX FPGA to implement fast packet processing, which previously required dedicated hardware. Compared to dedicated hardware, the single-board, reconfigurable Intel PAC with Intel Arria 10 GX FPGA embedded in a general-purpose IA server can significantly reduce system costs[2]. Further, these reconfigurable features make it is possible to quickly respond to an increasing demand for diverse services. Going forward, NTT-AT and Intel plan to work closely together to accelerate packet processing, enable traffic management over 100 Gbps, and provide even more detailed visibility of services regardless of the type. In addition, these two companies will keep pace with the rapidly changing tide of this new networking era by cooperating with cutting-edge AI applications.

About NTT-AT

Since its inception in 1976, NTT Advanced Technology Corporation has been a core technology company of the NTT Group. It adopts a wide variety of leading-edge technologies developed by NTT Laboratories or elsewhere in Japan or abroad, including network technology, media processing technology, Japanese language processing technology, environmental technology, and optical device and nanodevice technologies, and integrates them to offer solutions to problems confronting its customers. It thus continues to provide value to its customers.

www.ntt-at.co.jp/

Detailed Information

Intel® FPGA Acceleration Hub webpage

www.intel.com/content/www/us/en/programmable/ solutions/acceleration-hub/overview.html