

# Network Application Platforms – Part 1

## General Purpose or Specialized Processors?

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The Network Applications Platform (NAP) is fast becoming the ubiquitous workhorse of both infrastructure and enterprise networks. While NAPs often take on many guises, IP traffic is at the core of all applications. Maximizing reuse and development efficiency, while creating innovative and feature rich solutions is crucial for success. This paper, part one in Advantech's Network Application Platform series, examines the challenges of processor selection.

We all have a tendency to look at the past through "rose tinted spectacles." The traditional networks all seemed so simple and straight forward. There were clear demarcation lines between the voice and data networks of the core infrastructure. Even as enterprise networks evolved from basic Ethernet backbones to major data centers and farms of web servers, the PBXs running the phone network were in a whole different world.

Each element and piece of equipment, whether a voice switch, DSLAM, router or PBX, was designed based on the type of traffic and physical interfaces required. Specialized boards, chipsets, software and connectors were all required. Architecting the platforms required all these elements to be considered and the hardware concerned nearly always required dedicated, discrete circuitry and support chips.

Next generation networks and convergence have changed the game significantly. As we move closer and closer towards the all IP network the distinctions between network elements are significantly more in software and application than the underlying hardware or interconnection media. This has led to new challenges and design considerations.

### *Architectural Evolution*

General purpose processors (GPPs) played a significant role in the underlying architecture of all communications equipment. GPPs however were always designed to be a flexible computing "workhorse." However, as the applications became more specific and demanding, new breeds of specialized processing engines began to emerge. With the data and voice elements of the network still separate two key devices were used to boost performance and capacities, the Digital Signal Processors (DSP) and Network Processors (NP).

The DSP catered to the specific needs of the voice network. The key application function was to handle the analogue signals. These needed to be converted backward and forward to digital, and relatively simple (linear) processing performed very rapidly. The mathematical engine was optimized towards greater performance for floating point operations as distinct from a GPPs primarily integer based core. Yes, a GPP could do it but a DSP was more efficient, performant and cost effective. The other key

difference between DSPs and GPPs is their deterministic nature. In time critical applications where delays, even in the milliseconds will be noticed, DSPs were the clear winner. When talking on the phone the conversation must be processed in real time where even minute delays will be noticed as stuttering or gaps in the conversation.

Similar scenarios were applicable to the development of the Network processor. The early needs of switching and routing were handled through software running on a GPP. As the multilayered protocols became more complex the first processors dedicated to specific layers were created. The first key development was the Ethernet switch focusing on only the requirements of layer 2. This led to a revolution in specialized chips and ASICs (Application Specific Integrated Circuits) each with specialized architectures, memory configurations and low level microcode, streamlined and optimized for the application and protocols for which it was designed. Again GPPs could manage the same tasks but the specialists did a better job. A GPP would need to apply “brute force” which usually meant more processors and more power.

Although products from different manufacturers may have even more specialized functions a NP would typically be optimized around the following features:

- Queue management – Managing any form of communications protocol requires a lot of organization typically done in queues. The packets are shunted from queue to queue as they are received, processed and stored ready for onward transmission.
- Pattern matching – Specific protocol functions can be identified by certain bit stream sequences. The ability to find specific patterns of bits or bytes within packets in a stream is a key function.
- Key lookup (for example, address lookup) – The ability to quickly undertake a database lookup using a key (typically an address on a packet) to find a result, typically routing information.
- General processing – Even given its specialist nature general computation and processing is required so a NP will have a computing core.
- Data manipulation – As packets traverse the various node and network functions, certain data fields will need to be modified.
- Control processing - The micro operations of processing a packet are controlled at a macro level which involves communication and orchestration with other nodes in a system.

In the case of both examples (DSP & NPUs) the attributes to be considered at the system design architecture phase were (and still are):

- Cost – How many processors and associated support chips will be required and at what price per relevant metric e.g. \$/channel?
- Capacity – Practical limitations of power envelope, size and costs dictate ultimate capacities. The specialized processors would allow for greater capacity in single units, leading to a smaller system footprint

- Complexity – The GPPs could be made to perform the appropriate functions but a lot of application software would be required. With the specialized chips designed and groomed for often single tasks the software was in microcode leaving the application programmer a simpler and less complex task
- Power – As previously mentioned, the streamlining of software and internal HW architecture meant less instruction cycles and the elimination of unneeded parts of the core resulting in a smaller power envelopes

A simple analogy would be to consider the cars we drive. They all are capable of moving people and things from place to place. However, if you want to go really fast, a race tuned sports car with high performance suspension and carbon fiber, to reduce weight, is the way to go. Can you move house in the family car, sure but you will need to make multiple trips and how will you fit in that large table or dresser. Perhaps a truck or van would do better job.

### *GPPs are back in the game*

What goes around, comes around. To say that today's GPPs are simply faster than their earlier counterparts that created the first routers and switches would be a gross understatement. We are talking many orders of magnitude. Coming back to our car example it's like considering a family car that has an excess of power than can be used for speed or load carrying. There are now many SUV/truck hybrids and "crossovers" that combine passenger comfort and hauling capacity. And although a panel truck would still be the choice for moving house, there's many a family saloon today that could outperform the sports cars of yesteryear! When we look at the bottom line the case for specialized processors is not as clear cut as it used to be with the new breed of super powerful multi core general purpose processors.

The developers and manufacturers of the latest multi core processor based GPPs are pitting them head to head with Network Processors. Multi core architectures are not limited to the GPP and many NPs employ multiple cores to gain similar benefits. With the continued addition of networking specific internal architectures and tightly optimized micro coded software for specific applications there will still be a series of trade offs and decisions to be made.

At one level the decisions are not related directly to the technological distinctions. GPPs, being more widely used, are likely to already be being used in other parts of the platform. This in turn means greater familiarity by the engineering staff, less training and more reusability of code. Sticking to one processor type will increase the volume with one supplier and have the effect of reducing pricing. On the other side of the equation is overall performance, bandwidth/capacity and power consumption. As we have previously mentioned it is the increased speed and clock rates of the GPPs that are making them more capable of supporting network applications. With sometimes double the power consumption when compared to a Network Processor this can be an issue if power envelope constraints are a major design consideration. With certain physical sizes (and associated power envelopes) to be maintained when

using industry standard form factors the attributes of channel capacities and performance per square area and/or Watt must be considered.

### *Application Solutions*

So what are the key applications today where these architectural choices are coming into play? Undoubtedly “Triple Play” application platforms that can support voice, data and video are a major industry focus. With all the major functions in the mix that might previously have been tailor made for specific processors, (high speed processing – GPP, voice and codec processing – DSP, network and IP packet management NP) the design and cost considerations can become more complex. With everything traveling together on high speed IP networks, “wire speed” deep packet inspection application platforms for firewalls, encryption and other security devices are growing rapidly.

There are numerous examples of both general purpose and specialized processors that can fit the bill for these types of applications. Here are a few:

#### **Intel® Quad-Core Xeon (5000 series) Processors**

With a 45nm core micro architecture these processors are designed for high performance, data demanding applications. The multi core processing engine is especially suited to multi threaded software architectures making them a great choice for use in networking platforms. There are specific low power options that provide greater performance per/watt making them eminently suitable for matching with the power envelope constraints of industry standard form factors. As Intel themselves say, this family of processors can fit a wide range of application including “storage area networks, network attached storage, routers, IP-PBX, converged/unified communications platforms, sophisticated content firewalls, unified threat management systems, medical imaging equipment, military signal and image processing, and telecommunications (wireless and wireline) servers.”

#### **Cavium Network’s OCTEON™ Plus CN58XX Multi-Core MIPS64 Processor**

A flexible multi core design using MIPS64 processors, the Octeon family can support up to 16 cores. A state of the art Network Processor, it is designed for the needs of next generation networking applications. Including specialized functions for security and networking acceleration with very low power consumption, built directly into the hardware (with supporting software), these processors are designed to maximize throughput for a multitude of protocols all the way to layer 7. Key application uses for the Octeon are routers, switches, unified threat management (UTM) appliances, content-aware switches, application-aware gateways, triple-play gateways, WLAN and 3G/4G access and aggregation devices, storage arrays, storage networking equipment, servers, and intelligent NICs.

#### **Intel® EP80579 Integrated Processor**

More of a hybrid design than the previous two examples the EP80579 is an integrated system-on-a-chip (SOC) solution. Utilizing software based DSP functionality the Intel EP80579 integrates TDM for analog phones and T1/E1 interfaces to the network, Ethernet MACs for VoIP SIP phones, and security &

encryption accelerators. Voice signal processing and packet processing are performed by the Intel architecture processor core.

With GPPs, NPUs and hybrid processors such as these the design decisions become more complex. The balance of performance, flexibility, power consumption and basic economics need to be considered. Undoubtedly there are performance break even points that will differ from application to application. A variety of test results have shown that for more straight forward IP forwarding types of applications General Purpose Processors hold their own with Network Processors up to mid range bandwidth capacities e.g. 2Gbps. Above this the NPs start to show their true benefit. For more complex IP Security (IPSec) scenarios, NPs with built in microcoded security algorithms tend to outperform GPPs. Even with these performance differences the other attributes of cost and flexibility can make GPP or hybrid solutions highly attractive. Combining GPP and NPU blades in a single chassis e.g. ATCA, is another alternative that we will examine in a future paper. One of the many benefits of working with Advantech is that we can supply readymade platforms that support both architectures and can provide advice and guidance on the solution that best fits your application.

### *Network Application Platforms – The Advantech Solution*

We have seen that dedicated Network processors still have a healthy role to play and, with the advances GPPs have made in terms of performance and suitability for specialized applications along with the development of hybrid SOCs, one has a multitude of choices any one of which will create an outstanding platform capable of supporting a plethora of network applications. There may be a multitude of reasons why one development organization chooses one architecture over another. It may be specific technical features, supportability, software investment, power requirements or plain economics but rest assured that Advantech can supply state of the art solutions to match any architectural choice. Here are a selection of Advantech Network Application platforms that utilize GPPs, NPs and SOC chips and architectures.

#### **FWA-6500 Network Application Platform with Dual Quad Core Intel Xeon Processor 5500**

The FWA-6500 is an innovative and versatile multi-gigabit network application platform based on similar core design blueprints as Advantech's MIC-5320 AdvancedTCA (ATCA) Blade. It comes with two quad-core Intel® Xeon® Processor 5500's in an enterprise server form factor aimed at the next wave of high performance networking applications.

Network connectivity is fast and flexible with up to 16 front accessible GE ports supported by 4 quad Ethernet modules based on the Intel 82576 or with multiple dual 10GE modules based on the brand new Intel 82599 dual 10 GbE controller. The modules plug in to a 32-way PCI Express (PCIe) mid-plane providing the high speed interconnects to the IO controller hub which makes the system fly. Both RJ45 or SFP based modules can be supported and can be mixed and matched as required.

Two further PCIe x4 slots are available internally for standard add-in cards for offload purposes or NPU co-processing.

The combination of the latest Intel processors, chipset and ethernet controllers in one platform providing acceleration and off-loading features gives customers the combination of performance and IO scalability they have been waiting for. The system incorporates up to 96GB of DDR3 memory making it perfect for extreme speed, persistent, in-memory database applications where performance and reliability are key.

To increase the FWA-6500's flexibility and fault tolerance level, two swappable SATA hard drives and a 2U redundant power supply are integrated into the base model. An internal remote management board provides Serial and USB connectivity as well as two LAN ports for remote & out of band management. IPMI 2.0 is supported along with remote monitoring and power cycling and the ability to access the console via the LAN (SOL). The system has been designed with NEBS in mind to address more stringent telecom environments extending beyond the enterprise and data center.



**Figure 1 Advantech FWA-6500**

### **FWA-3240 Network Security Appliance Platform**

The FWA-3240 incorporates Intel's EP80579 System-on-Chip which combines Intel's QuickAssist Technology and integrates an Intel Pentium M class core, memory controller and I/O controller. The high-performance CPU core supplies the horse power needed to perform deep packet inspection and other complex operations and is optimized for entry to mid-range network security appliances. Due to backward code compatibility with earlier Intel processors, security applications can run existing x86 software applications.

Typical appliance workloads which require IP-SEC encryption, acceleration and compression of content can offload processing on to the QuickAssist Integrated Accelerator which increases the effective data throughput and performance and reduces the overall power consumption of a given application.

The FWA-3240 features a low-power design, and supports up to 2 GB DDR2 on one single-channel SO-DIMM. It provides a total of four GbE LANs, three of which are from the EP80579 on-chip MACs (Intel 82574-derived) and the fourth from a PCIe-based Intel 82574 Ethernet controller.



**Figure 2 Advantech FWA-3240**

### **NCP-5120 Network Applications Platform with Dual 16 Core Octeon**

The NCP-5120 is a 1U rackmount network applications platform designed for mission-critical performance-demanding applications. With the increasing demand and complexity in networking environments, system integrators and solution providers are seeking platforms that can manage high-speed packet processing. Based on a new generation high-performance OCTEON network processors, the NCP-5120 offers up to sixteen cores. The chipset supports a variety of I/O interfaces from Gigabit Ethernet interfaces and SPI 4.2 to PCI-X. The built-in security and compression/decompression engine provides reliable security functions at top speed. The NCP-5120 comes with specially designed platform features, including redundant power supplies and a front-accessible HDD bay. In addition a uniquely designed thermal mechanism and hot-swappable fan modules enhance platform reliability. The single 16 core Octeon based NCP-3108 is also available with similar characteristics.



**Figure 3 Advantech NCP-5120**

For more information on these products and Advantech's range of communications and computing solutions visit <http://www.advantech.com/NCG>