Chapter 1.

Introduction

1.1. Why IPv6

As the Internet users are rapidly increasing in recent years, the problem of anticipating exhaustion of address of Internet protocol version 4, IPv4, is exposed to view in coming years. Based on this motivation, IETF has already proposed a new generation Internet protocol, Internet protocol version 6, named IPv6, [1][2][3][4][5][6], to solve the fatal problem of IPv4 resulted from the enormous expansion of the Internet. While the rate of address depletion has been slowed by using NAT and CIDR, the other virtues of IPv6 (routing, network auto-configuration, enhanced support for IP security (IPsec), and IP mobility) encourage its deployment in lately years. However, it is generally agreed that it may take a long time for migrating from IPv4 to IPv6 because of some commercial concerns and user's habits. Thus we need some transition mechanisms [7][8][9][10] for making IPv4-based users and IPv6-based users can communicate with each other conveniently and stably during the inevitable coexistent stage. There are some transition mechanisms employed to make IPv4 and IPv6 environment coexist with different ways, such as NAT-PT [11][12], Tunneling [13][14][15][16], Dual Stack [17], etc. A brief introduction of these mechanisms mentioned above will be given in the next chapter.

1.2. Why Network Processor

In recent years, we have witnessed an explosive growth of Internet service which has created a demand for higher transmission speed. Some of the services offered are more complicated and

demanding in terms of hardware: the networking infrastructure itself has to become an active component for delivering these new services, which mostly concerns the quality of service. Moreover, we have also witnessed that more and more standards and protocols were proposed or changed to be adapted for operating on the network environment. In order to meet these demands, wire-speeds have increased explosively and are currently reaching OC-192 (40 Gigabit per second) without any signs of a slowdown. Since the transmission speed is so high that we need more computational power to process such massive data at this speed.

In the past few years, we have two solutions to solve the problem. First, a hardware-based solution, application specific integrated circuits (ASIC) were used for eliminating the gap between wire-speeds and computational power of processors. But they become too expensive, and slow to adapt to new requirements for the fast-changing network environment as they take a long time to develop and have a short endurance in the market. Second, a software-based solution, general purpose processor provides the desired flexibility to satisfy the demands. But they are deficient in computational speed for processing a surfeit of incoming data. Consequently, a new kind of device has sparked the emergence for meeting the demands of the capricious network environment, named network processor-based platform [18][19][20][21][22]. We are giving an evolution of network processor and comparisons of the computational devices mentioned earlier in Figure 1.1.

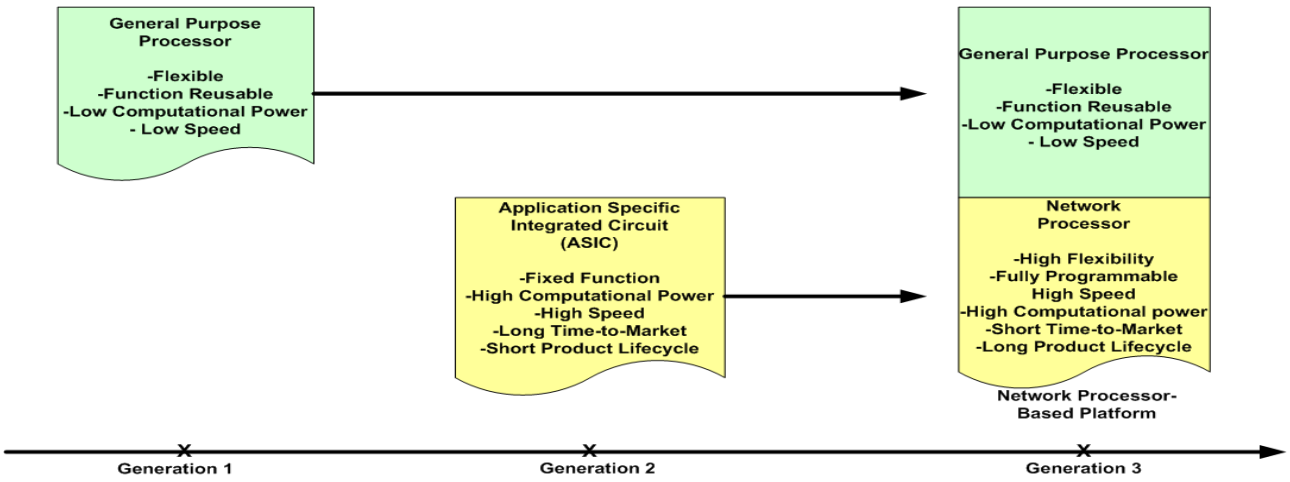

Figure 1.1 Evolution of Network Processor Platform

A network processor-based platform is a specialized system which is generally portrayed as two parts: host processor and network processor. The host processor is usually supported by an embedded operating system like VxWorks or Embedded Linux and devoted to deal with exceptional packets which are difficult or obscure for the network processor to tackle. The network processor is generally consisted of several parallel programmable processing elements with optimized instruction sets and some special purpose hardware designs like co-processor or packet buffer to do the firsthand data processing when packets get into. We usually give a division into control plane (slow path) and data plane (fast path) for host processor and network processor respectively. Figure 1.2 illustrates the packet data flow when packets enter the network processor-based platform. Network processor handles the simple tasks which should be time-critical and routine. Host processor copes with the advanced functions that are not time critical and non-wired speed.

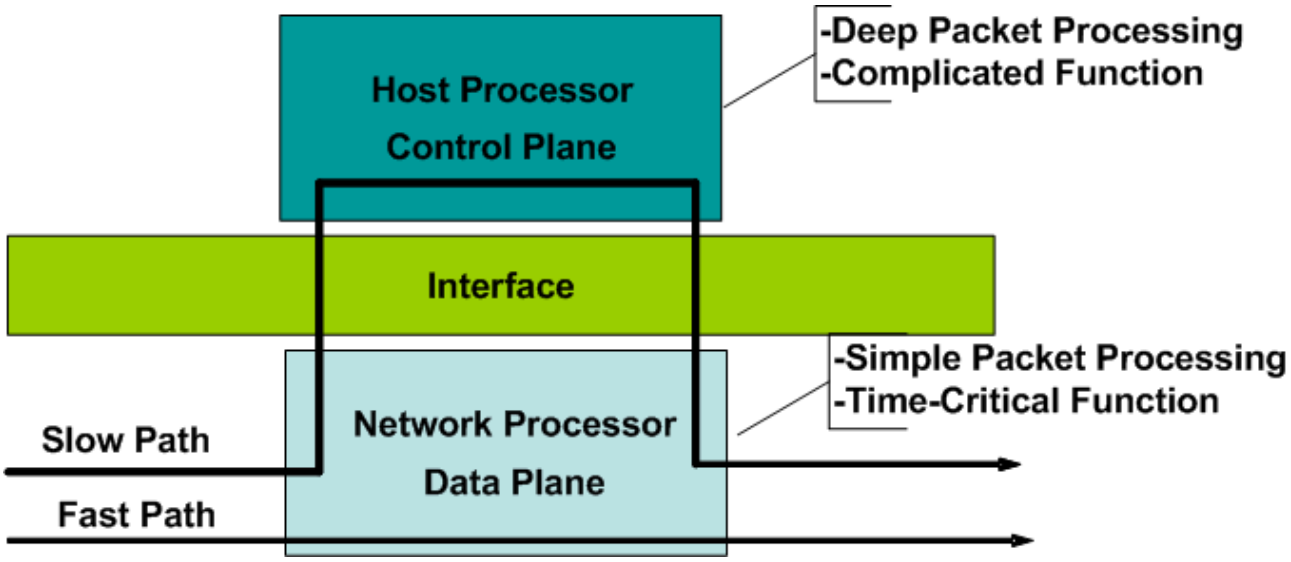

Figure 1.2 Data Flow in the Network Processor-Based Platform

There are two main benefits of using network processor platform for implementation. First, it provides a more flexible way than a hardware-based design like ASIC by upgrading software for host processor. Since the network processor is a programmable device so that we can implement all kinds of functions according to our needs. Second, the optimized hardware design and instruction sets make the process of incoming data more efficient to meet the demands of the fast-changing network environment and the unremittingly increasing Internet traffic. There are several venders of network processor nowadays like Vitesse [23], Intel [24] and IBM [25]. In our implementation, we choose Vitesse IQ2000 as the platform. Based on the design for Vitesse IQ2000, we make it as a module embed into a chassis-based platform.

This thesis is organized as follows. Chapte2 gives a brief introduction to the various transition mechanisms for IPv4/IPv6 coexistence during the migration from IPv4 to IPv6 and the hardware architecture of Vitesse IQ2000 used to implement our system. We will show you the detail description of our system design and implementation in chapter3 and chapter4. System analysis and performance comparison will be illustrated in chapter5. Finally, we conclude our thesis in chapter6.