Active Services to improve Quality of Service in Networking using Network Processor

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Summary
QoS refers to the capability of a network to provide better services to selected network traffic over various technologies. The advent of high-speed networking technology has enabled many multimedia applications like video conferencing, Medical imaging and VOIP. These applications have different performance requirements of bandwidth, delay, jitter and loss rate which leads to an important issue of how to support QoS on the modern high-speed networks. The concept of active networks was introduced in 1994 by Defense Advanced Research Projects Agency (DARPA). In addition to packet forwarding mechanism in traditional IP network, active networks allow the network nodes to perform user or application specific computations on user data passing through them. In active networks, normal packets are replaced with active packets containing small programs and possible data. Network nodes are substituted by active nodes capable of performing computations on packets as requested by the application. In this article, we are using these active network approach to improve the QoS in Networking using Network Processor (IXP 2400).

Key words:
Quality of Service, Active networks.

1. Introduction

Quality of service (QoS)
QoS refers to the capability of a network to provide better service to selected network traffic over various technologies, including Frame Relay, Asynchronous transmission Mode (ATM), Ethernet and 802.1 networks and IP routed networks that may use any or all of other underlying technologies.

Quality of Service (QoS) is a major issue in networks. While there are a lot of works in “classical” networks, there are far fewer in active networks. Until then, QoS in active networks followed two directions: the first one proposes mechanisms of QoS close to the adaptability : in case of congestion, QoS takes in to account the data transported in order to obtain a behavior adapted to the contents of flow. Packets to be dropped will not be randomly chosen, but will be chosen according to their importance. The second approach uses the QoS provided by IP layer (active network is deployed on). The mail advantage of this approach is the re-use of existing QoS mechanisms.

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1.1 Goal of QoS

The primary goal of QoS is to provide priority including dedicated bandwidth, controlled jitter and latency (required by some real time and interactive traffic), and improved loss characteristics.

1.2 Need for QoS

It is particularly important during periods of congestion that traffic flows with different requirements be treated differently and provided a different Quality of Service (QoS). QoS enables you to provide better service to certain flows. This is done by either raising the priority of a flow or limiting the priority of another flow.

1.3 Importance QoS

1.3.1 Media Quality of Service Demands :

With the emergence of multimedia information exchange, stronger requirements are being placed upon communications support.
Multimedia is characterized particularly by continuous media (e.g., voice, video, high quality audio and graphical animation) which place greater demands on communication than still media such as text, images and graphics. Different types of continuous media require different levels of latency, bandwidth and delay jitter and they also require guarantees that levels of service can be maintained.

1.3.2 Internet ‘Base Service’ :

During the same time the internet only permitted the specifications of qualitative QoS hints to the IP base service (using the type of service field in the IP header) such as ‘low’ delay, ’high’ throughput and ‘high’ reliability. Even these limited QoS specifications are rarely honor by the underlying network. Furthermore, the internet architecture was based on a best effort performance model which was never designed to support quantitative QoS needed for a full range of multimedia communication. In the internet, the support of the reliable data transfer was a primary design goal.

1.3.3 ATM Networking:
The ITU-TS in their ‘I-series’ recommendations recognized the need for QoS configurability in the emerging ATM standards for the Broadband Integrated Services Digital Network(B-ISDN) and also defined a fairly comprehensive set of parameters and reference model. These recommendations did not consider how the traffic characterization at the ATM layer was to be derived from the user QoS needs at the transport layer above. Below the service interface, the state of ATM standardization suffered from a lack of QoS management support comparable to that found in the OSI field. At that time there was no consensus on how resources would be allocated and how requested QoS levels could be maintained, policed and re-negotiated

2. Active Networks

In an active network, the router or switches of the network perform customized computation on the messages flowing through them. For example, the user of an active network could see a “trace” program to each router arranged for the program to be execute when their packets are processed.

2.1 Active Network pproaches

A number of different approaches have been proposed to implementing an active networks architecture.

1. There will be some standard services or modules in the network node, which will be selected and invoked through options carried in the user’s packets. The rest of the user’s packets will be treated as data to be processed by the invoked routine. The current IP processing modules can be thought of as an example of such an approach.

2. The “programmable switch” model: this approach allows user code to execute on the network nodes. The code is downloaded into the nodes out-of-band, and the normal flow packets are treated as data are input to this node. Depending upon the node’s security policy, such code downloads can be restricted only to system administrators.

3. The “Capsule” model: Each packet is treated as a full-fledges program, to be executed at each intermediate nodes. This is the most general of the three approaches discussed.

3. Why use the IXP 24000 Network Processor

The IXP2400 processors and network processors In general, enable to add, through software, the latest-and-greatest network services while maintaining high packet throughput and low packet latency. Simply put, the IXP2400 processors offer performance and flexibility for implementing network services. It is this promise of performance and flexibility that differentiates network processors, including IXP2400, from general-purpose processors and hardware-based solutions, such as Application Specific Integrated Circuits (ASICs). Network Processor meet network performance and flexibility requirements through highly parallel, programmable architectures. The parallel nature of the IXP2400 processors allows processing of multiple packets simultaneously, which can greatly increase the throughput of the Processor.

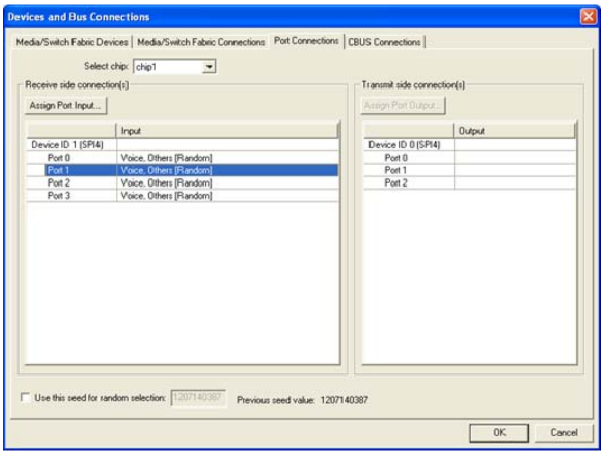

Fig 1. Creating Data Stream

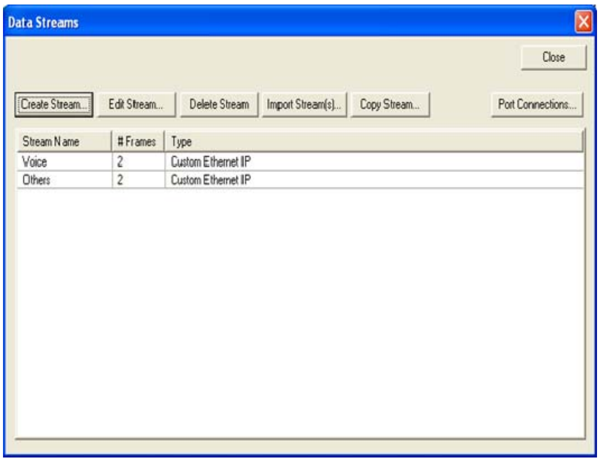

Fig 2. Assigning inputs to each ports

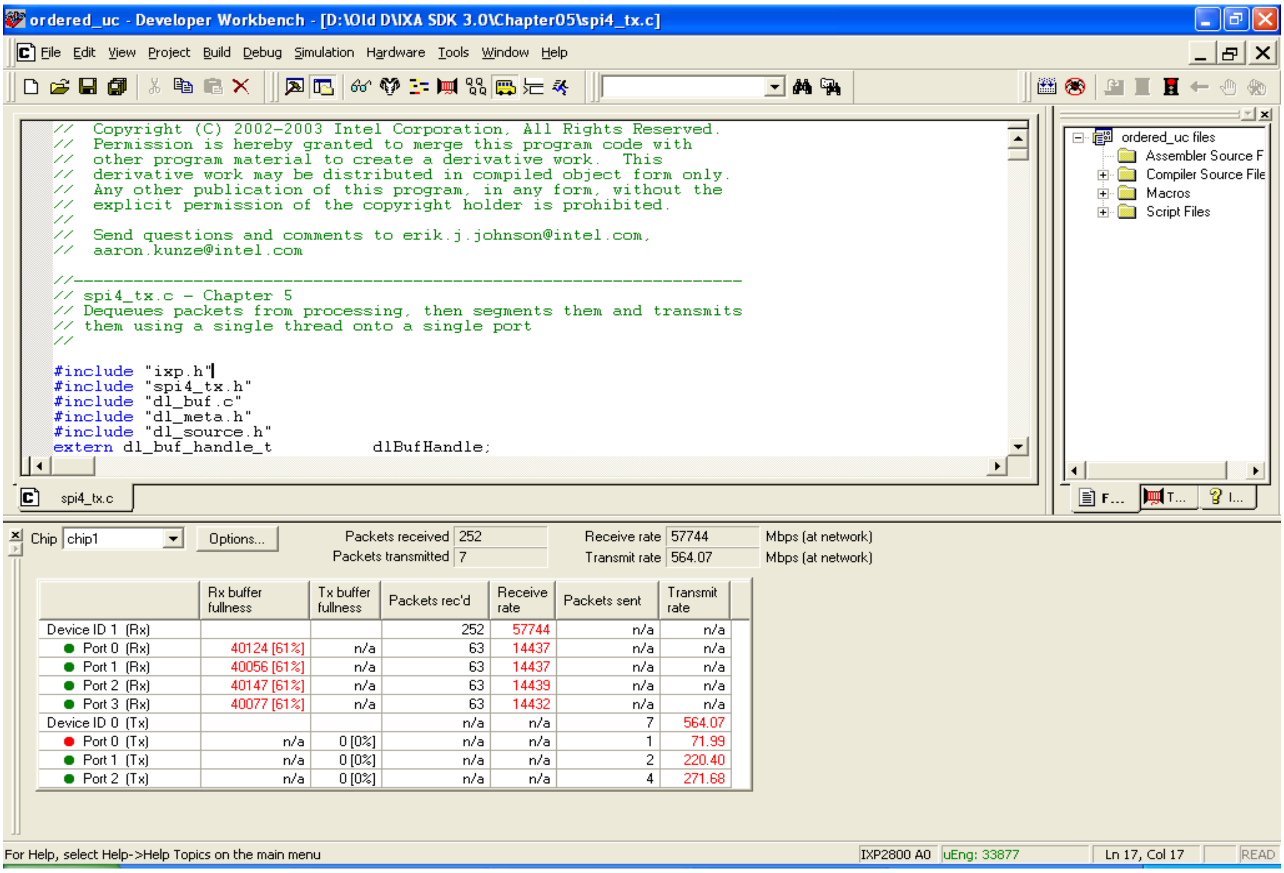

Fig 3. Simulation of QoS Routing

4. Implementation

We have implemented the active network concepts in network processor simulation software for improving QoS for multimedia application. For our experimental work, we have created Four number of input ports and 3 number of output ports to the processor. We have assumed that one system is connected to the each port. Fig. 1 shows that the generation of data stream for network traffic. These data will be voice data or others. Others may be data, image etc., Each type of data is added with some code (active packets). Consider all the packets are Ethernet IP.

All type of packets (voice & others) is assigned to all the input ports as per the Fig .2. As per our aim, this processor is designed in a single thread mode to give the maximum priority to the multimedia packets like voice. In the single thread mode, the processor will receive the incoming data up to the capacity of receiver buffer and then process them and transmitted to the output ports. As per the active network concepts, the processor will receive the active packets and forward them as per the code inserted into the packets.

Fig. 3, shows the results of one traffic. Here, the processor was received 252 packets and sent 7 packets. These 7 packets may be voice and others. As per the intelligence given, the processor will forward all voice data into port 2 and all the audio into port 1 and all other data into port 0. As per the Fig. 3, the processor will give maximum priority to the multimedia packets (port 2). So that, we can improve the QoS for multimedia application.

5. Conclusion

The variety of QoS techniques are available for variety of applications. Depending on the application scenarios and service requirements, some approaches and techniques appear more attractive than others.

In this article, we used Active Network as a tool for improving QoS in Networking. This AN based techniques ensure that delay constraints are compatible with the requirements of real-time video / audio. We are proposed to use this AN based technique to improve the QoS in

Routing and Congestion Control Application. This approach will improve the QoS when compare to other techniques. If we designed the processor in multithread mode, the data receiving and transmitting by the processor will be fast.

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