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Author(s)	矢野, 大機
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Speed-up of Network Layer Protocol Processing with Hardware

Hiroki Yano

School of Information Science,
Japan Advanced Institute of Science and Technology

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The Internet is the set of the autonomous distribution network and it has developed as an infrastructure of digital media. Various communication is performed by using the Internet. Since a circuit is becoming high speed and broad-band in this several years, the number of packet increases by the increase of the traffic. Furthermore, it pays attention to the multimedia communication such as the image and voice. Multimedia communication may do a Quality of Service (QoS) guarantee. In order to offer QoS using protocols, such as RSVP and Diff-serv, the processing to one packet is increasing. The transfer speed of a router becomes a bottleneck by such complication of packet transmission, and increase of the number of packets. Therefore, in order to use the Internet comfortably, the improvement in the transmission speed of a route is required.

There is a characteristic that a Network layer protocol has advanced parallelism. It is very useful to make protocol processing hardware to make use of this characteristics. In this paper, we propose the methodology of the hardware design, for the purpose of speed-up transfer processing of a router, examined the hardware which is suitable for the protocol processing.

The hardware designed by this paper enables processing on a pipeline and realizes processing like VLIW system, to catch that datagram is a huge order. A Network layer protocol is divided into two or more groups without a dependency. To make use of these characteristics, the view of VLIW system is used. This system, adopting a very long order form, and incorporating the order which one or more parallel execution is possible, carries out one or more operation at the same time. On the other hand, since datagram has been independent mutually and does not have a dependency, the execution of it on a pipeline is possible. The procedure of the technique proposed by this research is shown below.

Extraction of information required for hardware The specification of the protocol of a network is collected into RFC. From those protocol specifications to information required for hardware implementation is extracted.

Division of a processing unit The field of a protocol is divided into the processing unit called module. A pipeline is designed on the basis of this module.

Grasp of a data dependency The data dependence between modules is extracted and their modules with the relations are collected in one group. With regulating the execution order of the module in a group, the data hazard within one pipeline is avoided.

Grasp of a event dependency The module which generates a branch order is extracted and grasp of the module which must be performed on speculation.

Evaluation of the processing time of a module In order to determine the time of each module of operation, in the first time it is decided the processing which serves as a standard.

Made a pipeline In the first evaluation of the time between the header of packet arrival and the packet is input to the hardware. Next design on a pipeline for every group.

Optimize of pipeline It unifies and optimizes as one pipeline, what made a pipeline by every group.

It verified by applying the proposed methodology to IPv6 protocol stack. IPv6 is studied and developed in place of IPv4 used at present. IPv6 is proceeded with three major simplifications. simplifications are Assign a fixed format to all headers, remove the header checksum, remove the hop-by-hop segmentation procedure. Such an IPv6 which has these characteristics, according to the method proposed by this research was able to design the pipeline satisfactory. It was proved that the proposed methodology has validity.

When the improvement in the speed required with the pipeline of hardware processing is considered, three points, a data hazard, a control hazard, and a structure hazard, become the conditions which restrain processing speed. However, since there is no dependency between packets in the case of a Network layer protocol, it is guaranteed that there are not data dependence and control dependence. Resource conflict is dependence of resource used by hardware. In order to avoid resource conflict is just to multiplex the resource. Thus, The Network layer protocol guaranteed no restrictions of a data hazard and no restrictions of a structure hazard is very suitable for hardware. It can be said that the proposed methodology is appropriate as the technique of designing so that resources may be multiplexed as much as possible, and hardware a Network layer protocol.

A future work is described below.

- It is to the hardware designed by the proposed technique by this paper. The further improvement in the speed is attained by adding technology, such as cache.

- The functional design of hardware was performed by the technique proposed by this research. By the time hardware is actually completed, the stage of a system test remains a circuit design, synthesis, Place and Route, Working System. Performs consideration to the remaining stage.