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Executed on January 27, 2017, in Berkeley, California.

A handwritten signature in blue ink, reading "Lisa Rowilson de Ortiz", written over a horizontal line.

Lisa Rowilson de Ortiz

Protocols High Speed Networks

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PREFACE

Welcome to the fourth IFIP workshop on protocols for high speed networks held in Stockholm (1993) respectively. We received a large number of contributions. This year, forty papers were received of which twenty were presented as poster papers. Although the program committee decided to keep the number of papers to accommodate more discussion in keeping with the format of the workshop follows three very successful workshops held in 1990, 1991 and 1992 respectively.

Many people have contributed to the success of this workshop. We are thankful to all the authors of the papers that were presented and to the organizations which have contributed financially to this workshop. We are also grateful to the following organizations: CICS, UBC, MPR Teltech and Newbridge Networks.

Mabo Ito
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A Reduced Operation Protocol Engine (ROPE) for a multiple-layer bypass architecture

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Abstract — The Reduced Operation Protocol Engine (ROPE) presented here offloads critical functions of a multiple-layer protocol stack, based on the "bypass concept" of a fast path for data transfer. The motivation for identifying this separate processing path is that it involves only a small subset of the complete protocol, which can then be implemented in hardware. Multiple-layer bypass also eliminates some inner-layer operations such as queue and buffer management, context switching and movement of data across layers, all of which are a significant overhead. ROPE is intended to support high-speed bulk data transfer. The paper describes the design of a ROPE chip for the OSI Session and Transport layer protocols, using VHDL. The design is practical in terms of chip complexity and area, using current gate array technology, and simulation shows that it can support a data rate approaching 1 gigabit per second, in a connection attached to an end-system.

Keyword codes: C.2.2, B.4.1

Keywords: Network Protocols, Data Communications Devices

1 Introduction

The advent of Fibre Optic technology, which offers high bandwidth and low bit error rates, has shifted the performance bottleneck from the communications channel to the communications processing in the end-points of the system [26]. Other trends such as improved quality-of-service guarantees will reinforce this effect. The heavy processing load is due to a combination of operating system overhead, protocol complexity, and per-octet processing on the data stream. To alleviate the end-system bottleneck one may consider new protocols [10], improved software implementation of existing protocols [5, 35], parallel processing techniques [14, 21, 38], special protocol structures [15, 30] and hardware assist [22] by offloading all or part of the protocol functions to an adaptor. This paper takes the latter approach.

The key problems associated with offboard processing include:

- Partitioning the functionality between the host and the adaptor is difficult and may easily lead to a complex additional protocol between the two parts, which may cancel out or offset the potential gain from offloading. For example, the buffer management task [36] may be offloaded, but this leaves the problem of control for accessing it within the full protocol logic.

¹ This research was done while Dr. Thia was at Carleton University

ROPE for a multiple-layer bypass

- Non-protocol-specific processing is a large part of the protocol stack. Examples include interrupt handling, context switching and in deeply layered protocol stacks.
- The choice of hardware for the adaptor depends on the protocol supports. In [2, 22] where the transport protocol layer is bypassed, the full protocol stack can be offloaded, general purpose hardware because of the complexity of existing protocols, VLSI data link layer has been disappointing so far. In [8] a support TCP checksums. Also, some newer lightweight protocols designed for VLSI implementation [1, 3].
- There is a tradeoff between performance, flexibility and the frequently executed portion of the protocol. The frequently executed portion of the protocol remains a significant advantage in providing hardware support for tasks in the host software for flexibility.
- As host processing speed continues to outpace memory bandwidth approaches the processor memory bandwidth, movement on the workstations down to the minimum.

This paper presents a feasibility study for a new approach that combines the relatively simple operations needed for data transfer provides a hardware "fast path" for them, which will be based on the "protocol bypass concept" [37] which is a "good Prediction" algorithm [20] for TCP/IP. Bypass solves the problem of how to may limit the use of offboard processing, by implementing bypass layers for certain cases. This simplifies the interface between the bypass layers and minimizes their interaction, which is supported by an interface and a simple command protocol. The chip design based on the Reduced Operation Protocol Engine. The contribution of the interface and the chip operation, and to report on a VLSI chip design. It appears to be feasible to support an end-system approaching 1 Gbps.

The next section introduces the bypass concept, its implementation. Section 3 analyzes the key protocol processing overheads for a bypass VLSI implementation. Sections 4, 5 and 6 describe the chip using the industry standard hardware description language. Section 7.

2 The Bypass Concept

A bypass adds an additional path for certain operations to the original software. Conformance to the protocol is maintained through the normal "heavyweight" path. A bypass path can be used or for both together, and is compatible with other end-systems.

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