Evolution of the Virtual Interface Architecture

The recent introduction of the VIA standard for cluster or system-area networks has opened the market for commercial user-level network interfaces. The authors examine how design decisions in prototype interfaces have helped shape this industry standard.

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To provide a faster path between applications and the network, most researchers have advocated removing the operating system kernel and its centralized networking stack from the critical path and creating a *user-level network interface*. With these interfaces, designers can tailor the communication layers each process uses to the demands of that process. Consequently, applications can send and receive network packets without operating system intervention, which greatly decreases communication latency and increases network throughput.

Unfortunately, the diversity of approaches and lack of consensus has stalled progress in refining research results into products—a prerequisite to the widespread adoption of these interfaces. Recently, however, Intel, Microsoft, and Compaq have introduced the 'Virtual Interface Architecture,' an emerging standard for cluster or system-area networks. Products based on the VIA have already surfaced, notably GigaNet's GNN1000 network interface (http://www.giganet. com). As more products appear, research into application-level issues can proceed and the technology of user-level network interfaces should mature.

Several prototypes—among them Cornell University's U-Net[1]—have heavily influenced the VIA. In this article, we describe the architectural issues and design trade-offs at the core of these prototype designs, including

- How to provide applications with direct access to the network interface hardware, yet retain sufficient protection to ensure that applications can't interfere with each other.
- How to design an efficient, yet versatile programming interface. Applications must be able to access the network interface and still control buffering, scheduling, and addressing. The programming interface, on the other hand, must

accommodate a wide variety of hardware implementations.

- How to manage resources, in particular memory. Applications must consider the costs of DMA transfers that map a virtual address to a physical one. At the same time, implementation-specific details must be hidden from the application, and the operating system must ultimately control all resource allocation.
- How to manage fair access to the network without a kernel path which, in traditional protocol stacks, acts as a central point of control and scheduling.

PERFORMANCE FACTORS

Network performance is traditionally described by the bandwidth achieved when an infinite stream is transmitted. However, an increasing number of applications are more sensitive to the network's round-trip time, or *communication latency*, and the bandwidth when sending many small messages.

Low communication latency

Communication latency is due mainly to processing overhead—the time the processor spends handling messages at the sending and receiving ends. This may include managing the buffers, copying the message, computing checksums, handling flow control and interrupts, and controlling network interfaces.

As Figure 1 shows, the round-trip times for a remote procedure call with a user-level network interface can actually be lower than for a local RPC under Windows NT. The remote call uses Microsoft's distributed component object model (DCOM) with the VIA on the GNN1000 interface. The local call uses Microsoft's component object model (COM). The figure also shows the round-trip latency of raw messages over the VIA, which we used as a baseline in estimating the DCOM protocol overhead.

Virtual Interface Architecture

Anne Marie Merritt

Virtual Interface Architecture:

The Virtual Interface Architecture Don Cameron,Greg Regnier,2002 Providing an overview of the motivation benefits and history of the Virtual Interface Architecture and a guide to the syntax and semantics of the VI Provider Library API this reference allows engineers to use the VIA to develop high performance systems **Communication Management Using the Virtual Interface Architecture** Archana Shyam Samtani,2001 **A Simulation Study of the Virtual Interface Architecture** ,1999 The Virtual Interface Architecture VIA is an emerging standard for interconnecting commodity computing nodes into a cluster Since VIA protocol operations are implemented outside the operating system kernel often entirely in hardware VIA transfers can be performed at very low delay high throughput and minimal CPU overhead This makes VIA ideal when building large clusters that perform complex simulations of physical events However the scaling properties of VIA are less clear This paper describes the design and results of a simulation model developed in OPNET to investigate VIA s ability to scale to clusters of 1000 nodes An Implementation and Analysis of a Virtual Interface Architecture Philip Buonadonna,1999 **Implementation of Virtual Interface Architecture on Shared Memory** Salma Ayub,2000 **Comparison and Evaluation of Design Choices for Implementing the Virtual Interface Architecture (VIA).** International Business Machines Corporation. Research Division,Mohammad Banikazemi,Bulent Abali,Dhabaleswar K. Panda,1999 Abstract The Virtual Interface Architecture VIA specification has been developed to standardize user level network interfaces that provide low latency high bandwidth communications Few hardware and software implementations of VIA exist Since the VIA specification is vague different choices exist for implementing various components of VIA such as doorbells address translation methods and completion queues Although previous studies have evaluated the overall performance of different VIA implementations there has not been a comparative study on the performance of VIA components In this paper we evaluate and compare the performance of different implementations of essential VIA components We discuss the pros and cons of each design approach and describe the required support for implementing each of them As a user application we use the NAS Parallel Benchmarks to study the effect of caching the address translation tables on the NIC and to study completion queues As a hardware platform we use the IBM Netfinity SP cluster running the NT 4 0 operating system and a Myrinet connected cluster of PCs running the Linux operating system **An Implementation of MPI on the Virtual Interface Architecture** Madhusudhan Rangarajan,2000 **Fibre Channel** ,2002 **Recent Advances in Parallel Virtual Machine and Message Passing Interface** Dieter Kranzlmüller,Peter Kacsuk,Jack Dongarra,Jens Volkert,2003-08-02 This book constitutes the refereed proceedings of the 9th European PVM MPI Users Group Meeting held in Linz Austria in September October 2002 The 50 revised full papers presented together with abstracts of 11 invited contributions were carefully reviewed and selected The papers are organized in topical sections on Corss Grid Par Sim application using MPI and PVM parallel algorithms using message passing programming tools for MPI

and PVM implementations of MPI and PVM extensions of MPI and PVM and performance analysis and optimization **Simple Network Management Protocol Management Information Base for Virtual Interface Architecture Specification 1.0** Anne Marie Merritt,1998 Advanced Parallel Processing Technologies Xingming Zhou,2003-09-09 This book constitutes the refereed proceedings of the 5th International Workshop on Advanced Parallel Processing Technologies APPT 2003 held in Xiamen China in September 2003 The 57 revised full papers and 21 revised short papers presented were carefully reviewed and selected from 191 full paper submissions All current aspects in parallel and distributed computing are addressed ranging from hardware and software issues to algorithmic aspects and advanced applications The papers are organized in topical sections on architecture software and theory grid and network and applied technologies **Network Algorithmics** George Varghese,2005 In designing a network device you make dozens of decisions that affect the speed with which it will perform sometimes for better but sometimes for worse Network Algorithmics provides a complete coherent methodology for maximizing speed while meeting your other design goals Author George Varghese begins by laying out the implementation bottlenecks that are most often encountered at four disparate levels of implementation protocol OS hardware and architecture He then derives 15 solid principles ranging from the commonly recognized to the groundbreaking that are key to breaking these bottlenecks The rest of the book is devoted to a systematic application of these principles to bottlenecks found specifically in endnodes interconnect devices and specialty functions such as security and measurement that can be located anywhere along the network This immensely practical clearly presented information will benefit anyone involved with network implementation as well as students who have made this work their goal FOR INSTRUCTORS To obtain access to the solutions manual for this title simply register on our textbook website textbooks elsevier com and request access to the Computer Science subject area Once approved usually within one business day you will be able to access all of the instructor only materials through the Instructor Manual link on this book s academic web page at textbooks elsevier com Addresses the bottlenecks found in all kinds of network devices data copying control transfer demultiplexing timers and more and offers ways to break them Presents techniques suitable specifically for endnodes including Web servers Presents techniques suitable specifically for interconnect devices including routers bridges and gateways Written as a practical guide for implementers but full of valuable insights for students teachers and researchers Includes end of chapter summaries and exercises **Storage Networks Explained** Ulf Troppens,Rainer Erkens,Wolfgang Müller,2005-08-05 Storage Networks Explained has much to recommend it ararity in the literature of digital data storage a completeexposition of both the base subject matter and its applications which at the same time offers a level of readability making itsuitable as an introduction to the subject Storage NetworksExplained is also flexible It can be read cover to cover browsed or used as a reference I recommend Storage NetworksExplained as an essential component of any active informationtechnology library Paul Massiglia Technical Director VERITASSoftware Corporation Storage networks will become a basic technology likedatabases

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the application the Virtual Interface Architecture VIA can accelerate the deployment of such clusters VIA can also serve as the underlying platform to develop conventional protocol stacks for LAN WAN communication While there have been several previous efforts at optimizing the latency and throughput of ULN including VIA there has not been any prior indepth investigation into the scalability issue Scalability is an important consideration as multiprogramming levels continue to grow and application environments keep one or more communication channels open to avoid setup tear down costs The performance on a channel should not degrade significantly with the increasing number of channels that are created and used This paper addresses this crucial issue examining and proposing different hardware and software options at the network interface host software and firmware on the network interface to study their impact on the scalability of VIA The different design alternatives are investigated indepth using a detailed simulation model to draw revealing insights from the scalability perspective   Encyclopedia of Microcomputers Allen Kent,James G. Williams,2000-12-05 This is the 26th volume in the Encyclopedia of Microcomputers series It covers topics such as volume graphics and an automatic fuzzy rule generation method for handwriting recognition   *Implementation and Design Analysis of a Network Messaging Module Using Virtual Interface Architecture* Gregory McLane Amerson,2003   Recent Advances in Parallel Virtual Machine and Message Passing Interface ,2002   **MPI Application and Analysis on Virtual Interface Architecture** Hailin Luo,2003   *Workshop Proceedings* ,1989

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