

# Porting the Tenet Real-Time Protocol Suite to a HIPPI Network

Bruce A. Mah and Domenico Ferrari  
{bmah, ferrari}@CS.Berkeley.EDU

The Tenet Group  
University of California at Berkeley  
and  
International Computer Science Institute



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# Credits

## Support

Corporation for National Research Initiatives

US Department of Energy

## Researchers

Lawrence Berkeley Laboratory, Imaging Technologies Group

University of California at Berkeley, RAID Group

University of California at Berkeley, Tenet Group

International Computer Science Institute, Networks Group

# Synopsis

The Goals

The Network

Implementation Challenges and Problems

Sun 4 and SparcStations

RAID-II

Psitech HFB Frame Buffer

MasPar MP-2

HIPPI-XUNET Adapter (HXA)

Current Status

# Goals

## Facilities

Provide a high-speed data path between UC Berkeley (Cory and Evans Halls) and Lawrence Berkeley Laboratory (Building 50A)

## Research Issues

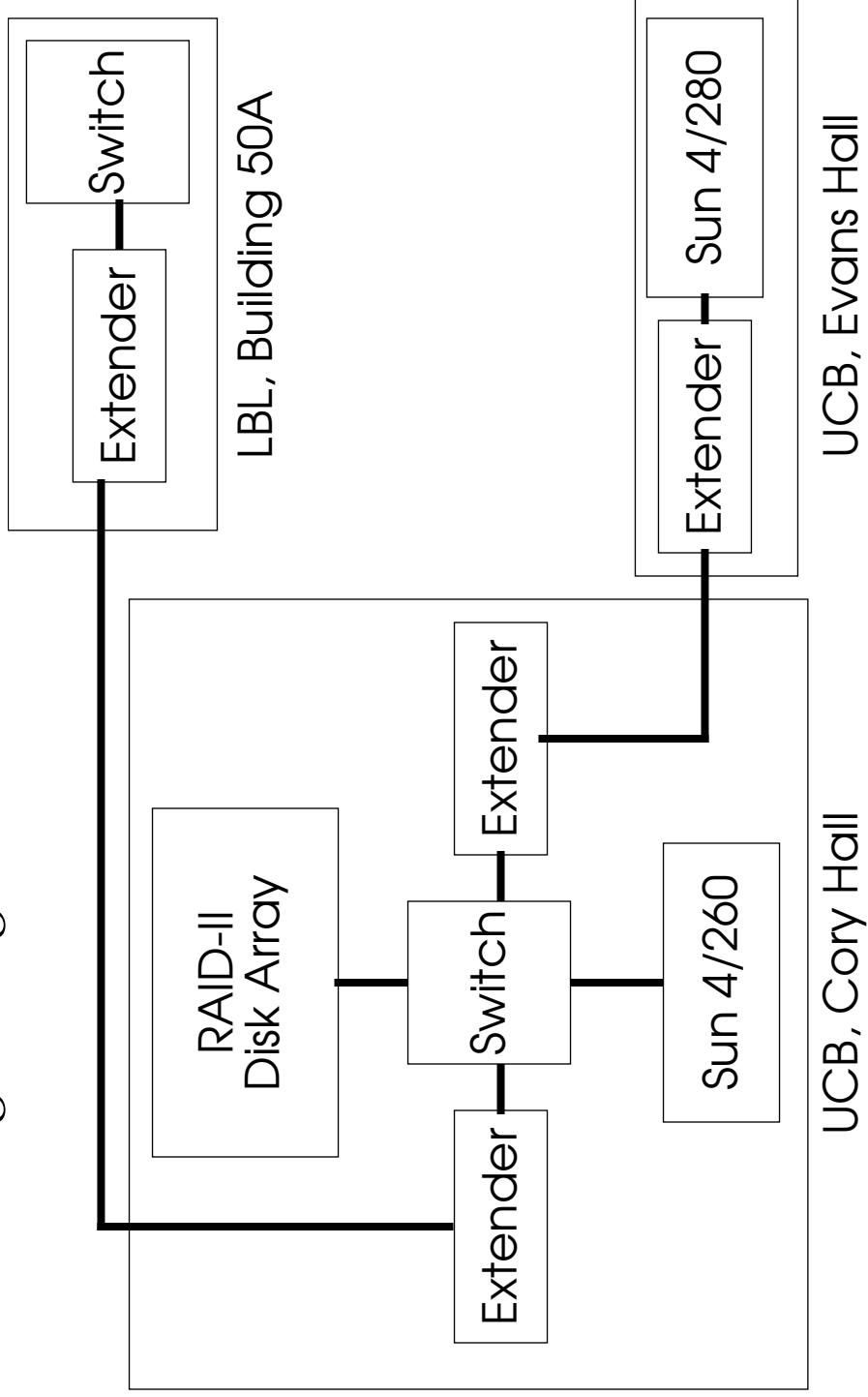
- What kind of real-time guarantees can be supported by a HIPPI network?
- What changes need to be made to the Tenet Real-Time Protocol Suite?
- Performance of the Tenet Real-Time Protocol Suite at gigabit speeds
- Implementation on non-workstation host architectures

## Applications

- Real-time transfer and display of video and animation
- Image storage and retrieval using RAID-II disk array

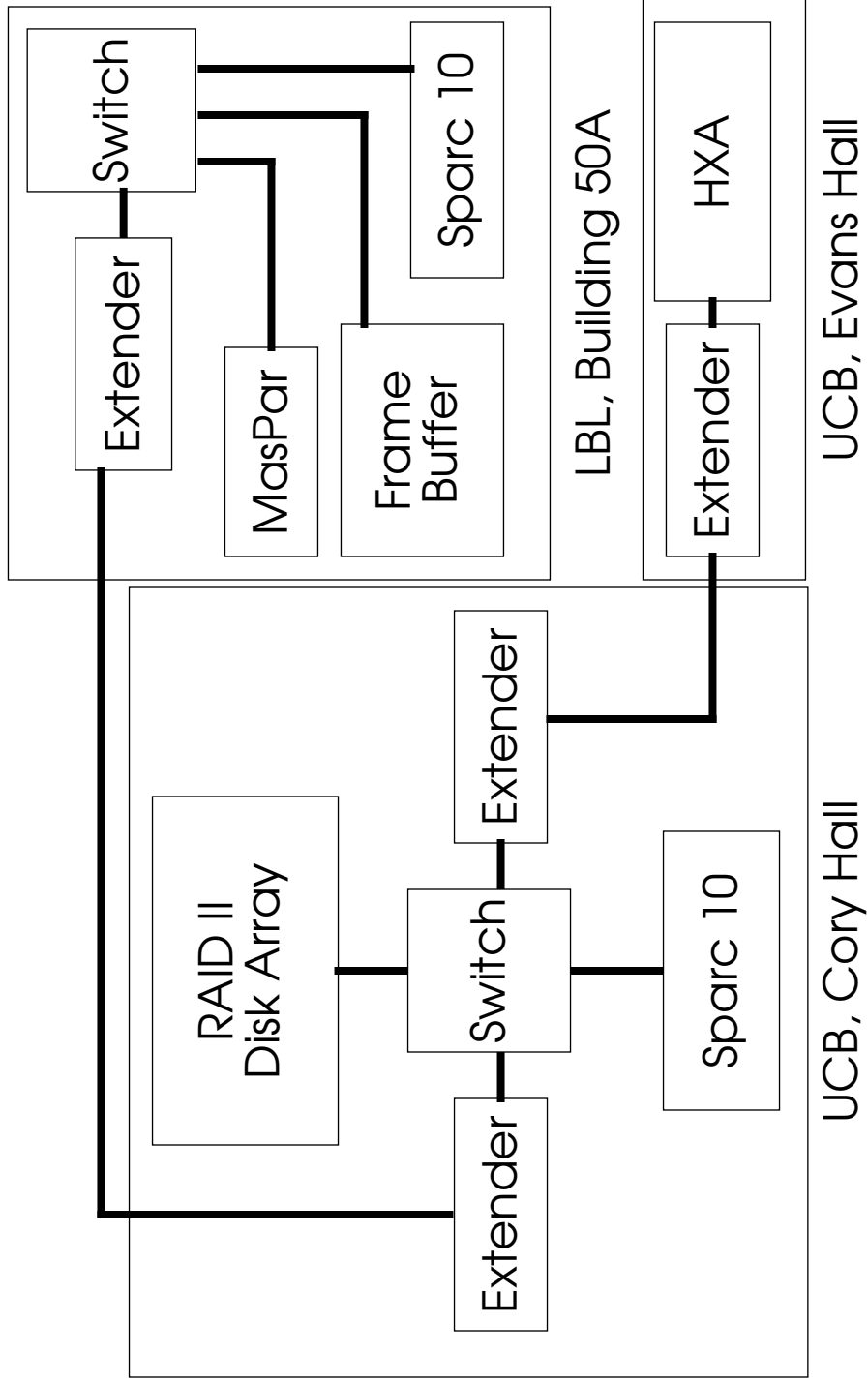
# The Network

## Initial Testing Configuration



# The Network

## Final Configuration



# HIPPI

High Performance Parallel Interface

800 Mbps, 32-bit parallel, point-to-point links

Optional 64-bit parallel datapath for 1.6 Gbps

Circuit Switching

No buffers in switches

Low latency (~propagation time)

Blocking of ports, links

Physical layer

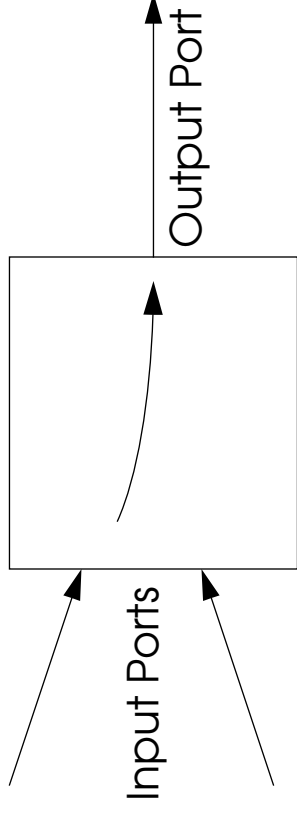
Parallel copper (< 25 m)

Serial fiber or copper using Serial HIPPI for longer distances

# HIPPI

Circuit-switching technology

Blocking in network switches



Need to hold all links on path from source to destination

“Camp on” feature allows switch to arbitrate among contending ports

Real-Time Guarantees?



# The Tenet Scheme for Real-Time Communication

*Real-Time = Performance Guarantees*

Goal: Provide performance guarantees on network performance

Bandwidth

Delay

Delay jitter

Allocation of network resources to individual conversations

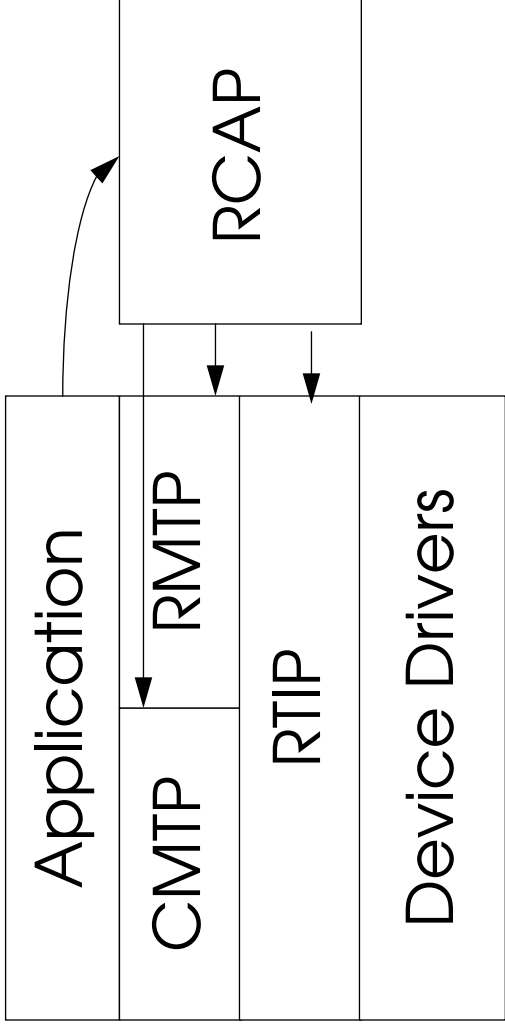
Connection-oriented network layer

Admission control to preserve guarantees

Environment: Packet-switching, point-to-point, internetwork

# The Tenet Real-Time Protocol Suite

Guaranteed performance in packet-switching networks



Continuous Media Transport Protocol (CMTP)

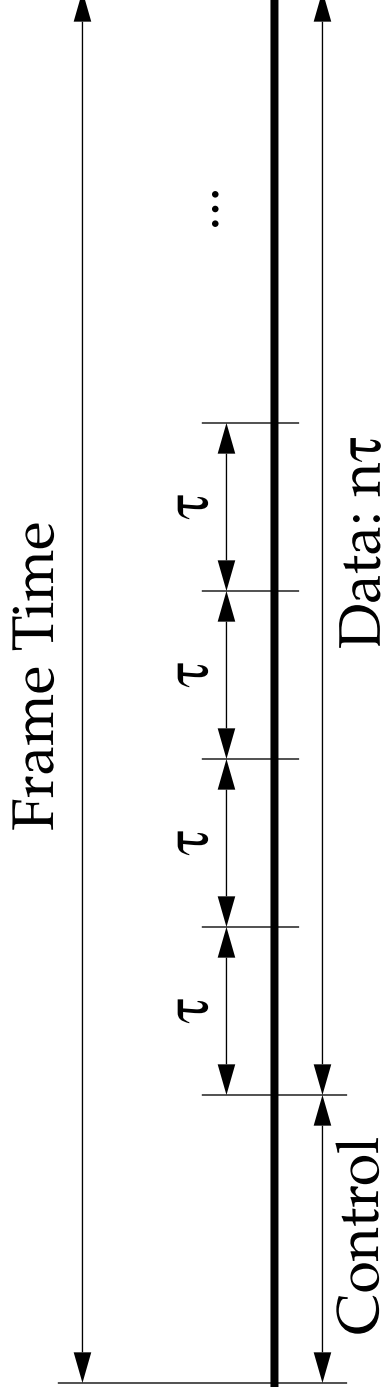
Real-Time Message Transport Protocol (RMTP)

Real-Time Internet Protocol (RTIP)

Real-Time Channel Administration Protocol (RCAP)

# Real-Time Multiplexing on HIPPI

Idea: Short HIPPI connections, scheduled to avoid contention  
TDM approach for multiplexing each link



Frame time  $\sim 0.5$  sec

$\tau \sim 5$  msec

Schedule for each frame sent by a central resource manager

## Sun 4s and Sparcstations

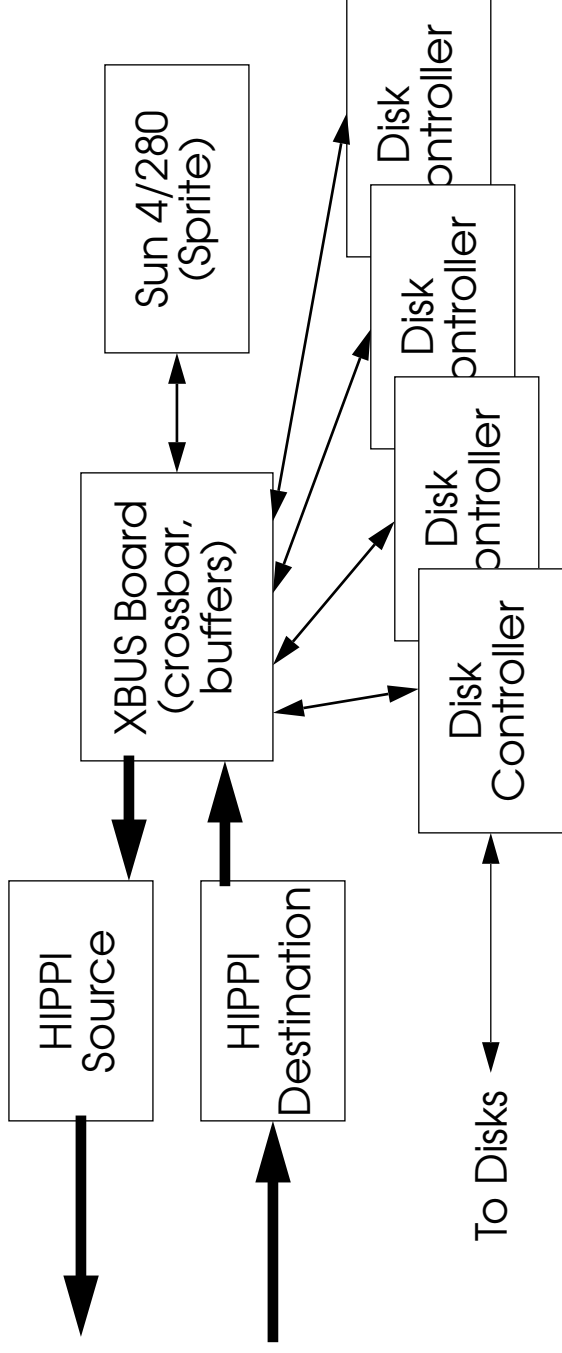
“Normal” workstation architectures

Port Tenet Real-Time Protocol Suite to SunOS 4.1.3

Based heavily on existing prototype Suite on DEC Ultrix 4.2A

Cannot utilize full HIPPI bandwidth, but useful for testing

# RAID-II



AMD 29000 processors on HIPPI adapters

Some protocol processing on outboard processors

Network support for filesystem (LFS in Sprite kernel)

How can we support protocol processing on outboard processors?

## PsiTech HIPPI Frame Buffer

HFB-110 supports digital video input and output.

Support for real-time communication to and from frame buffer

Implementation of Real-Time Protocol Suite to run on on-board Sparc processor

- Operating system?

- Datapath bandwidth to and from CPU

How to do protocol implementation in the absence of a traditional operating system?

## MasPar MP-2

Lawrence Berkeley Laboratory MasPar MP-2

How to make the Tenet Real-Time Protocol Suite run efficiently on parallel processors?

How can the Tenet Real-Time Protocol Suite best support the kind of network I/O required by parallel machines?

# HXA

## HIPPI-XUNET Adapter (HXA)

Convert HIPPI frames into ATM cells for transmission and back

XUNET 3 segment will use 622Mbps line card to connect HIPPI segments of network to XUNET 2 ATM switch at UC Berkeley

How well can the Tenet Real-Time Protocol Suite provide performance guarantees in heterogeneous internetworks?

What kind of performance can our data delivery protocols provide in such an internetwork?



## Current Status

Network connectivity achieved

SunOS version of Real-Time Protocol Suite operational

RAID II/Sprite port of Suite in testing

RMTP /RTIP to split between network interfaces and server CPU

RCAP on server CPU

HIPPI network checked out

Stored video between RAID II and Sparcstations using early RTIP

Development of network scheduling algorithms underway