The Tenet Real-Time Protocol Suite

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Synopsis

Introduction: The Tenet Approach

The Suite

- Overview
- The Real-Time Internet Protocol
- The Real-Time Message Transport Protocol
- The Continuous Media Transport Protocol
- The Real-Time Channel Administration Protocol

More Real-Time Channel Administration Protocol

Implementation

Future Work

The Tenet Approach

"Real-Time" = "Guaranteed Performance"

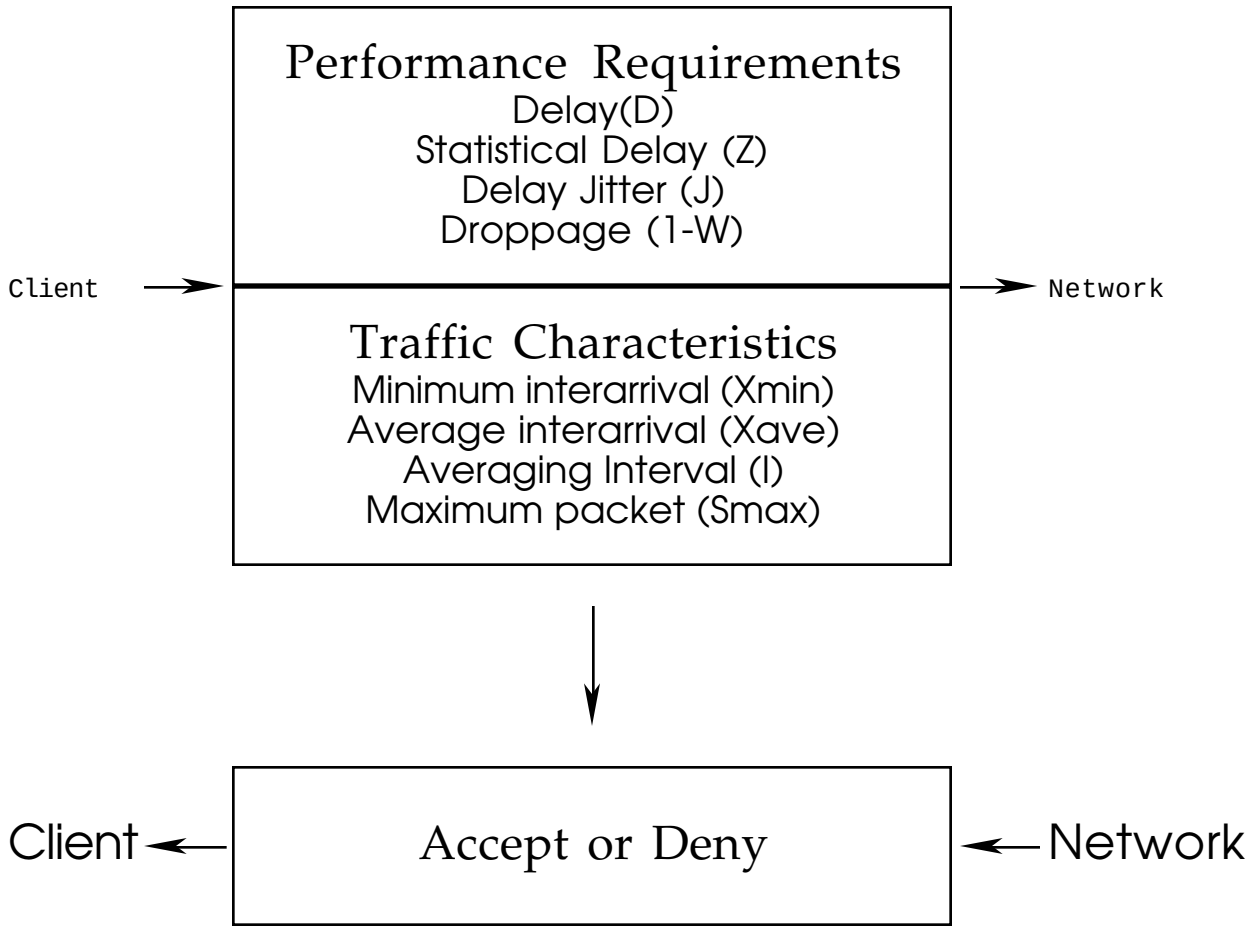
Performance

- Delay (deterministic, statistical)
- Throughput
- Delay jitter
- Packet droppage

Guarantees

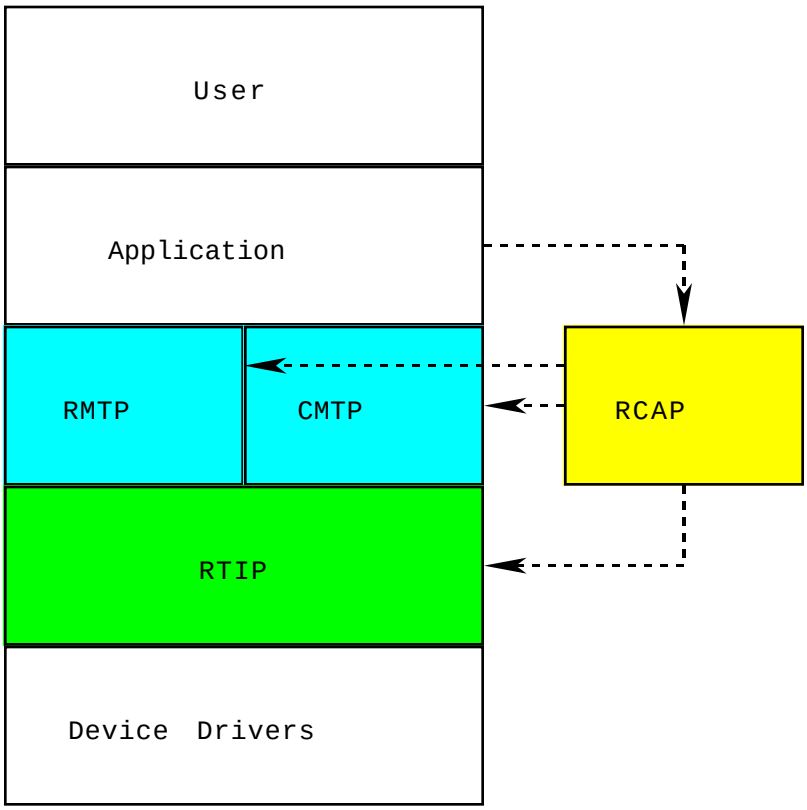
- Worst-case analysis
- Mathematically rigorous
- Admission control

Real-Time Performance Contract



Contract: If client adheres to its traffic characteristics, network must provide quality of service specified in performance requirements.

The Tenet Real-Time Protocol Suite



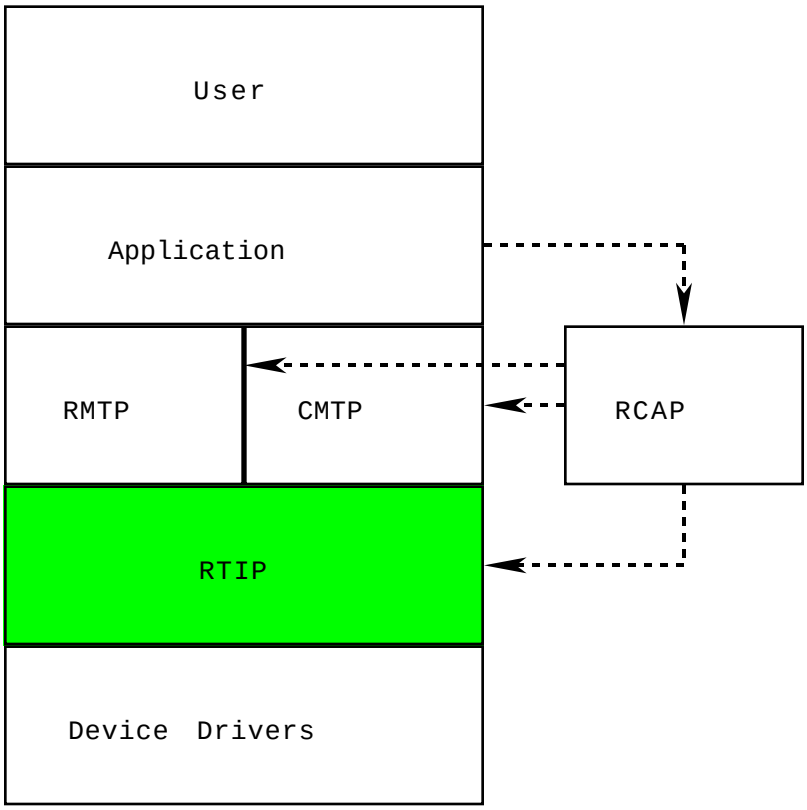
RTIP: Real-Time Internet Protocol

RMTP: Real-Time Message Transport Protocol

CMTP: Continuous Media Transport Protocol

RCAP: Real-Time Channel Administration Protocol

The Real-Time Internet Protocol
(D. Verma and H. Zhang)



The Real-Time Internet Protocol

Packet Delivery Service

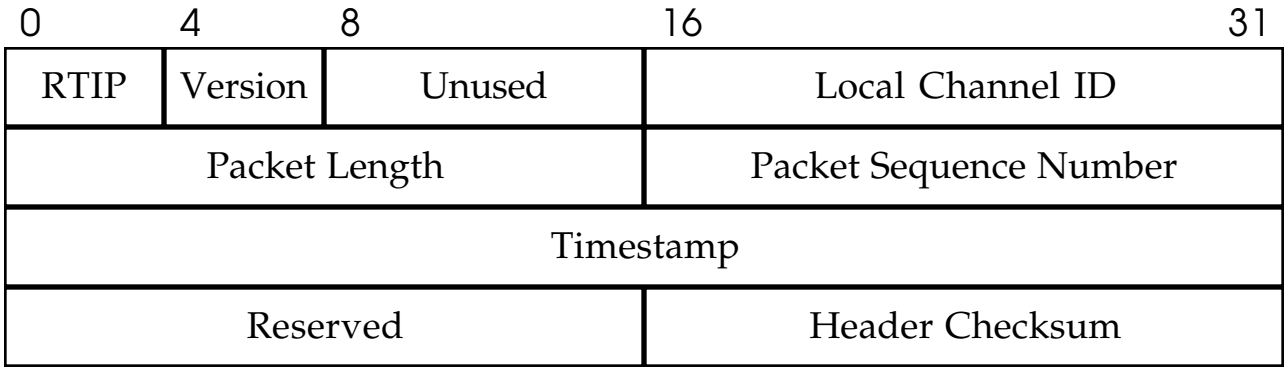
- Simplex, unicast connections
- Sequenced
- Unreliable
- Guaranteed performance

Functions

- Rate control
- Jitter control
- Packet scheduling (prototype uses Delay-EDD or Jitter-EDD)
- Data transfer

The Real-Time Internet Protocol

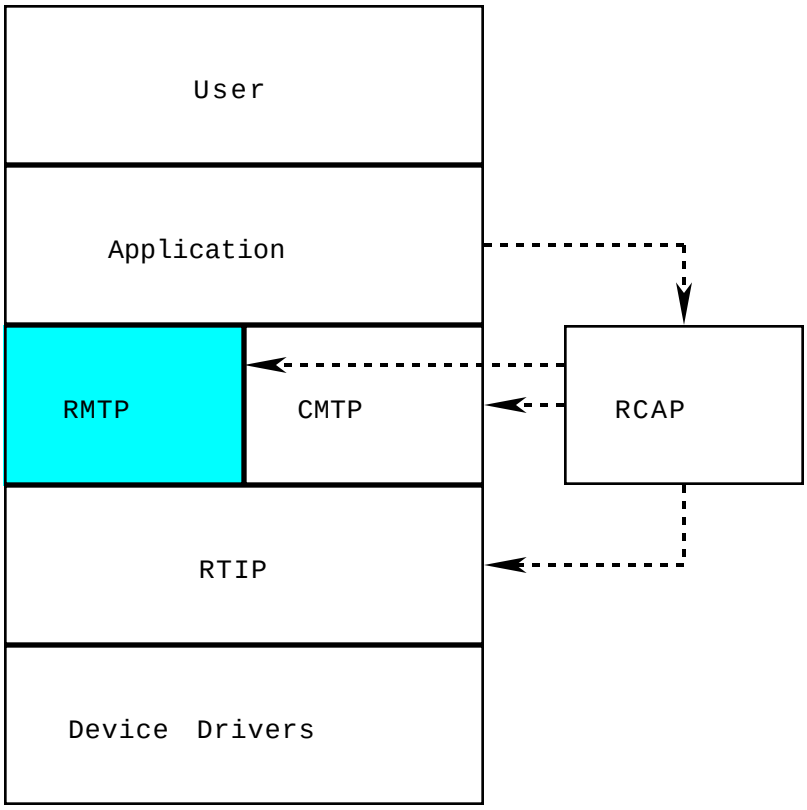
Protocol Header



Coexistence with Internet Protocol (IP) stack

The Real-Time Message Transport Protocol

(D. Verma and H. Zhang)



The Real-Time Message Transport Protocol

Message Delivery Service

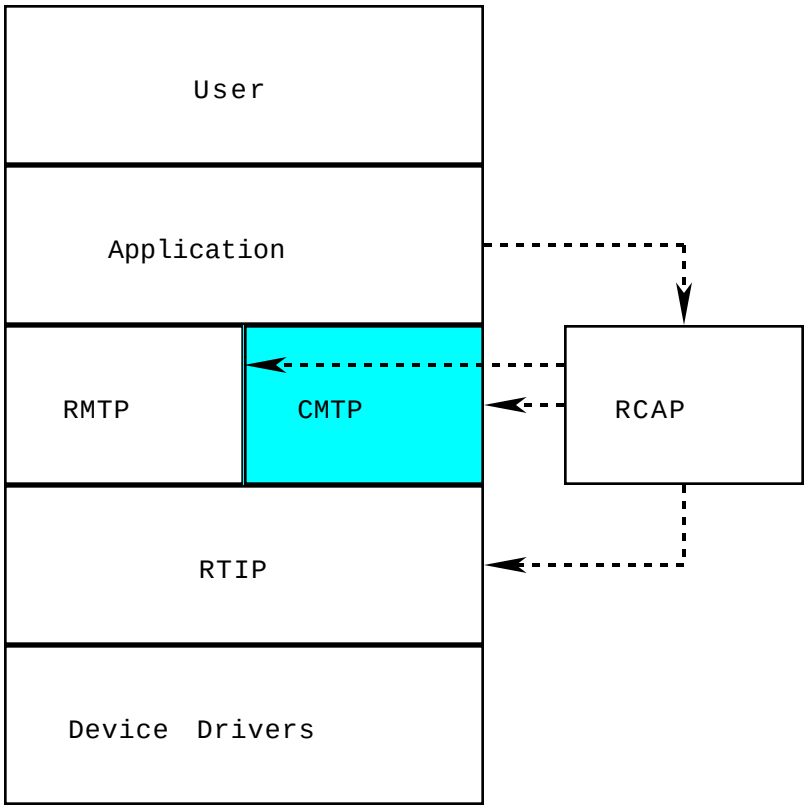
- Simplex, unicast connections
- Sequenced
- Unreliable
- Guaranteed performance

Functions

- Segmentation
- Reassembly

The Continuous Media Transport Protocol

(M. Moran and B. Wolfinger)



The Continuous Media Transport Protocol

Intended for "Continuous Media" applications: Those that require transmission of data at regular intervals.

Delivery of Stream Data Units (STDUs)

- Simplex, unicast connections
- Sequenced
- Unreliable (optional partial delivery)
- Guaranteed performance

What's different?

- Traffic characterization (oriented towards periodic traffic)
- Implicit initiation of data transfer (no send or receive)
- Support for logical streams
- Partial delivery in case of corrupted or missing data

The Continuous Media Transport Protocol

Use of periodicity

More effective traffic characterization, leading to greater network utilization

Implicit initiation of data transfer (no explicit send/receive): Communication via shared buffers eliminates some kernel calls.

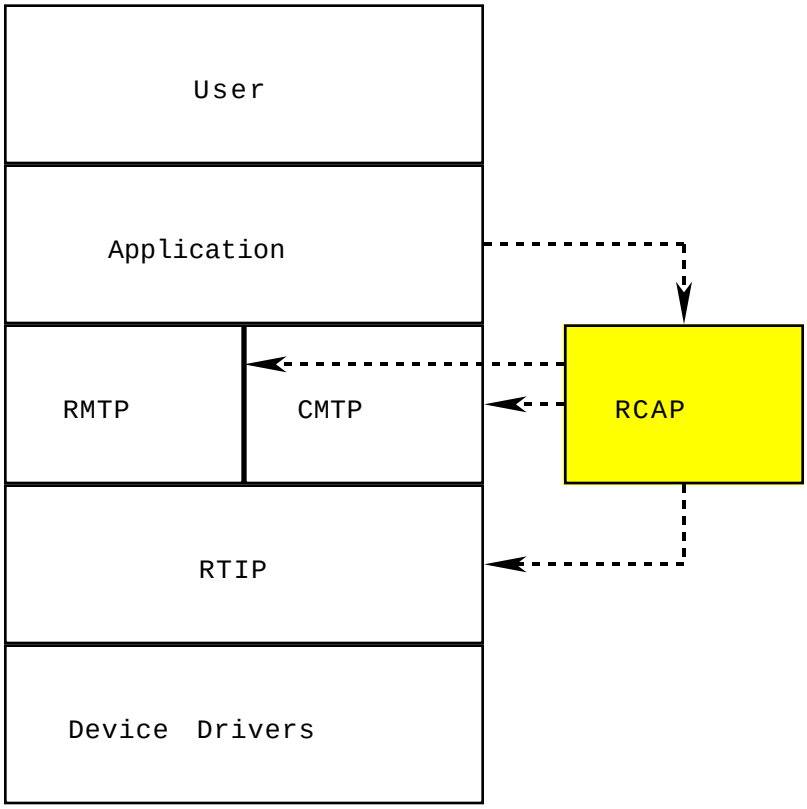
Needs of clients

Logical streams

Error handling (partial delivery of STDUs in case of corrupted or missing data)

The Real-Time Channel Administration Protocol

(A. Banerjea and B. Mah)



The Real-Time Channel Administration Protocol

Channel Administration

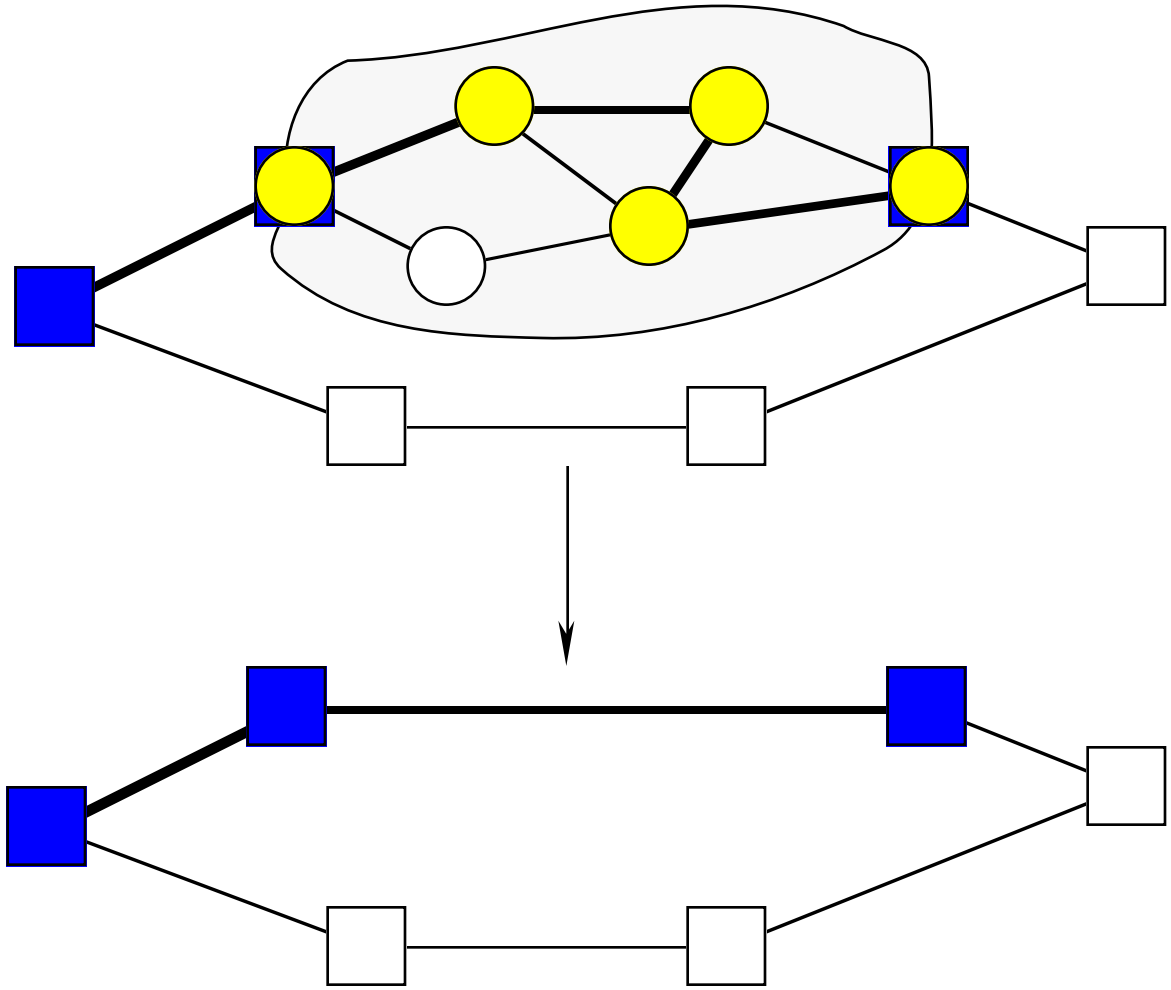
- Establishment of real-time channels (network and transport layer) with admission control
- Channel teardown
- Status reporting

The Real-Time Channel Administration Protocol

Features of RCAP

Admission control

Hierarchical approach to internetworks



Control messages passed between adjacent entities

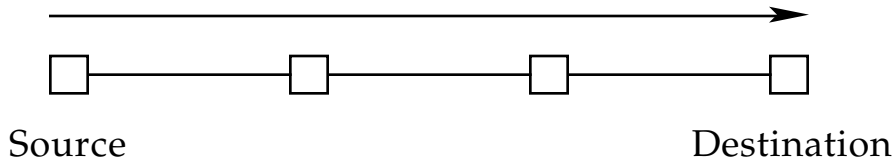
Separation of control and delivery mechanisms

The Real-Time Channel Administration Protocol

Channel Establishment

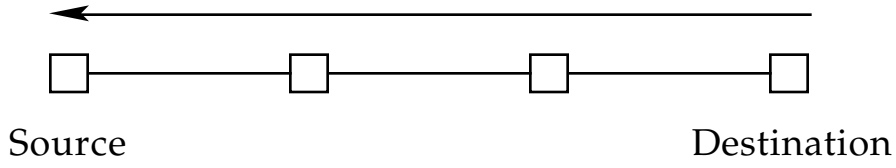
One round trip along channel path

Forward Pass



- Admission control tests
- Routing
- Tentative resource allocation

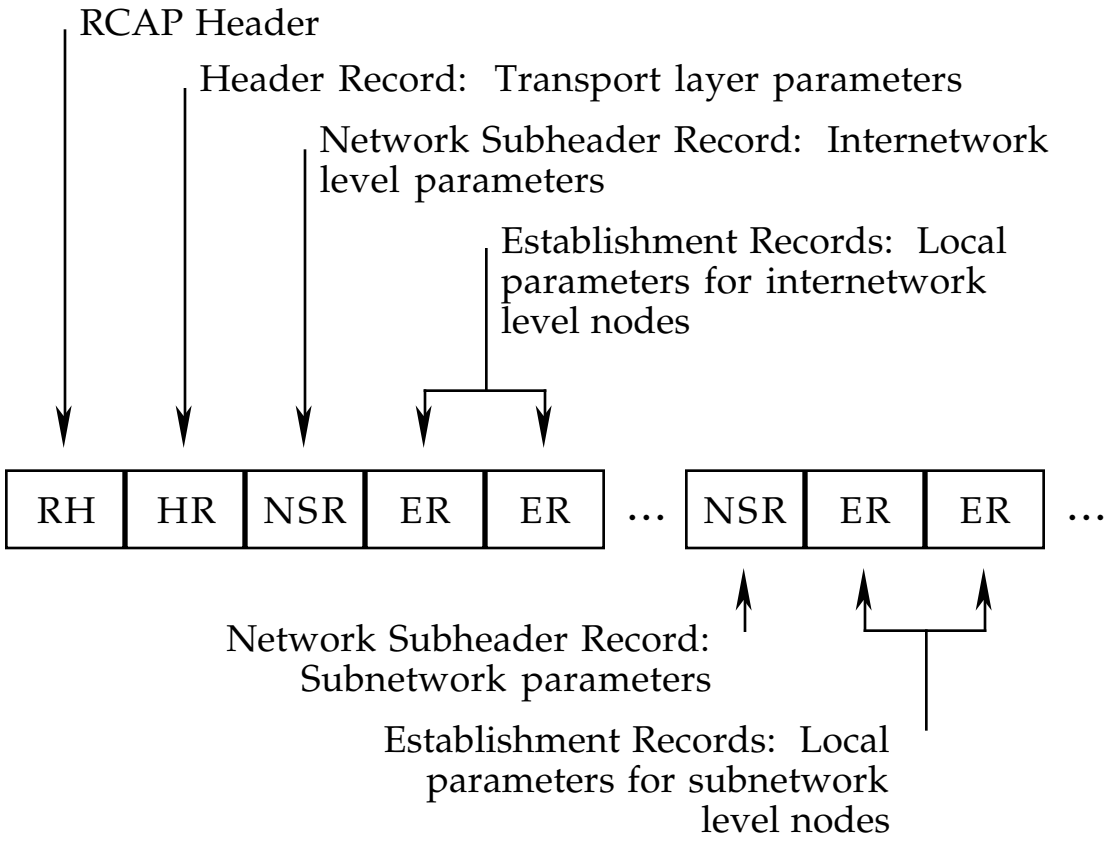
Reverse Pass



- Relaxation of resource allocation if possible
- Allocation confirmed
- Channel established

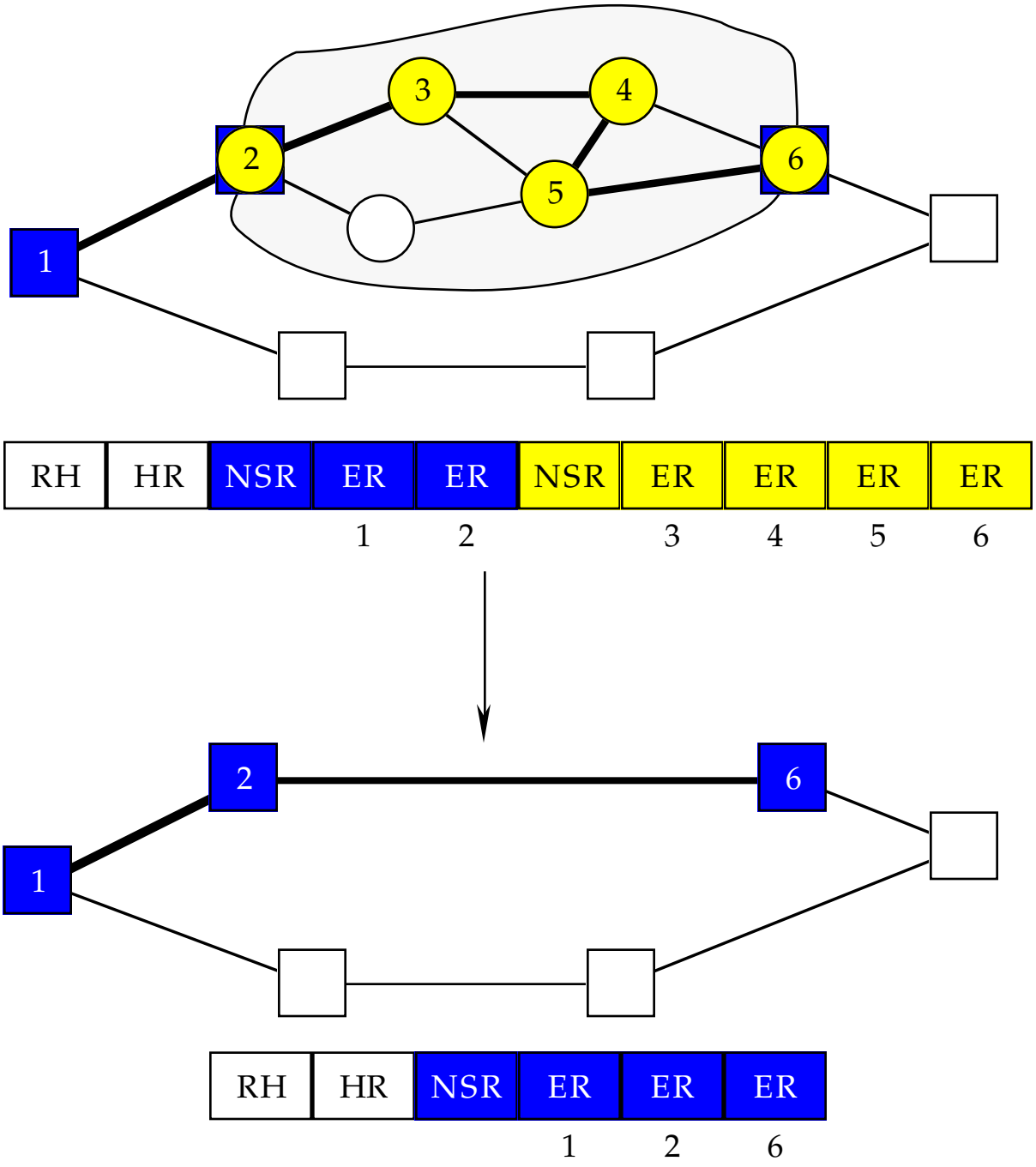
The Real-Time Channel Administration Protocol

Structure of a Channel Establishment Message



The Real-Time Channel Administration Protocol

Abstraction in an Internetwork



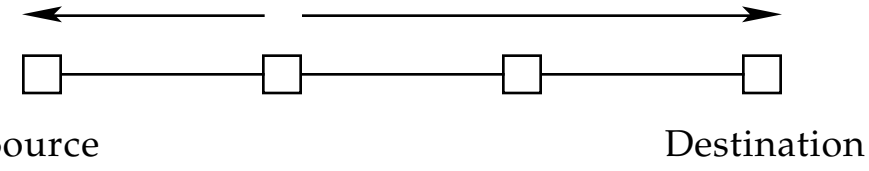
The Real-Time Channel Administration Protocol

Channel Teardown

Application-initiated

- Initiated by either source or destination application
- Resources released along route
- State and routing information discarded

System-initiated



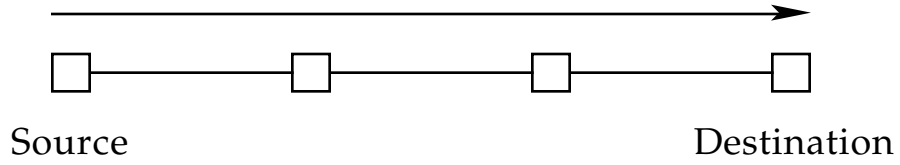
- Initiated by any node along path in response to failures in network
- Resources released along route
- State and routing information discarded

The Real-Time Channel Administration Protocol

Channel Status

One round trip along channel path

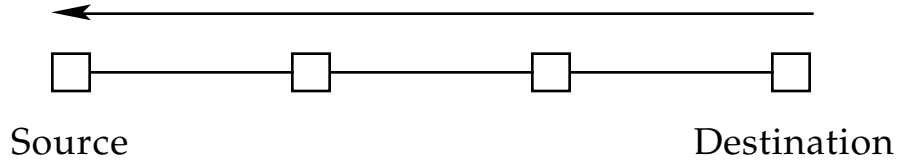
Forward pass



Nodes add status information to RCAP control message

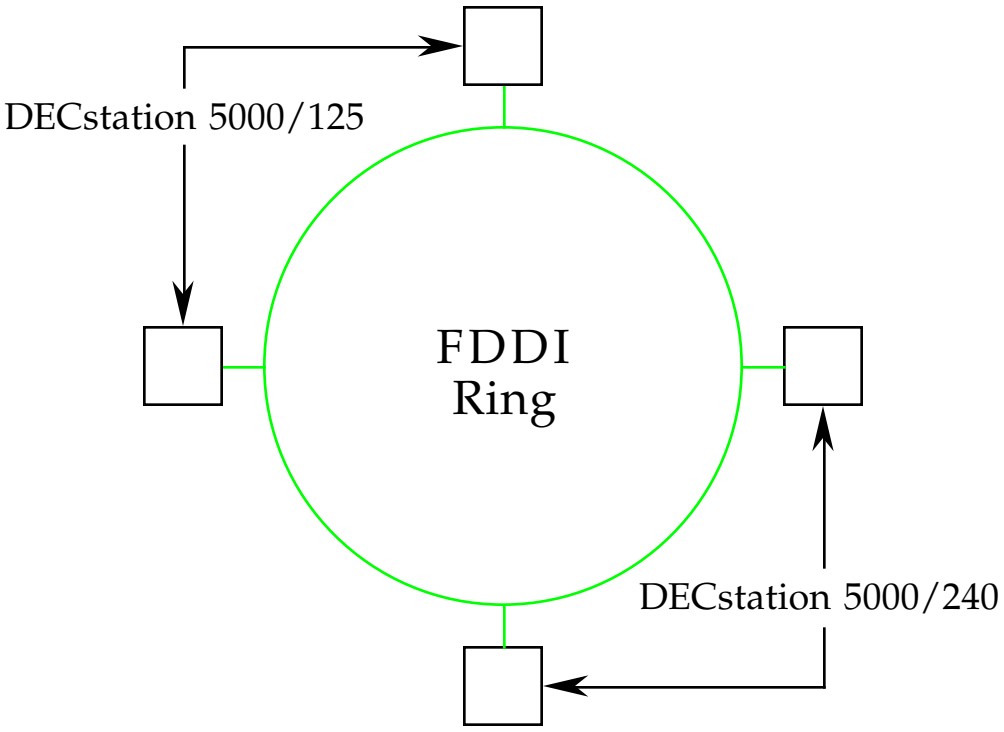
No subnetwork abstraction: status for lower-level nodes retained

Reverse pass



Nodes return status report to source unchanged

Implementation
Local Area Testbed



A simple environment for testing a prototype implementation.

Can we really make real-time performance guarantees work?

Implementation
Local Area Testbed

RMTP/RTIP in Ultrix 4.2A kernel (H. Zhang)

- User creates RMTP sockets like TCP or UDP sockets

CMTP as daemon process plus kernel modifications (A. Gupta and F. Maiorana)

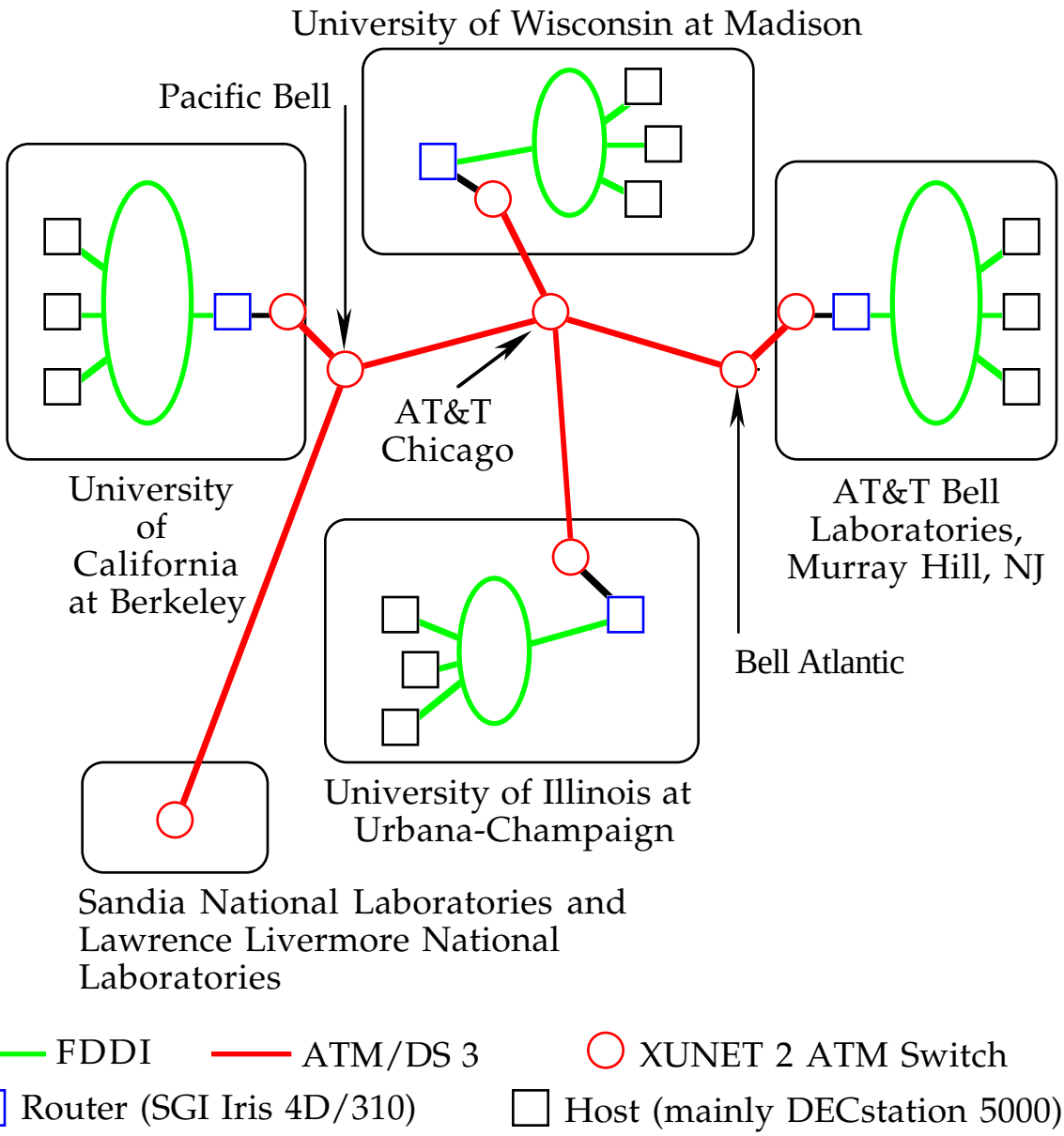
RCAP as user-level daemon process per node and library per client process (A. Banerjea and B. Mah)

- User makes calls to an RCAP library to manage channels

RMTP/RTIP/RCAP tested together

CMTP "almost working"

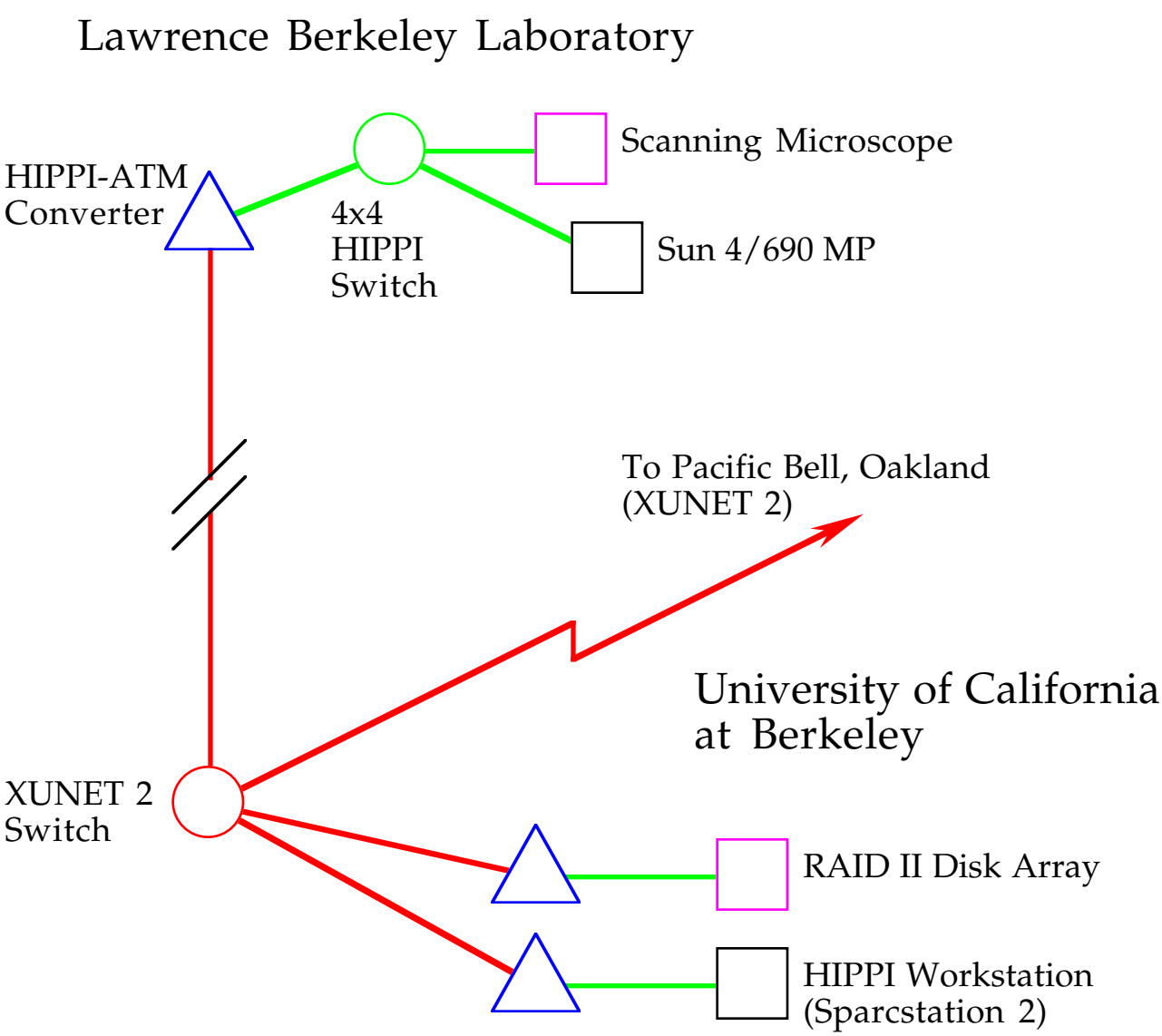
Implementation
XUNET 2



A heterogeneous network

ATM switches using a restricted form of Hierarchical Round Robin (HRR)

Implementation
XUNET 3

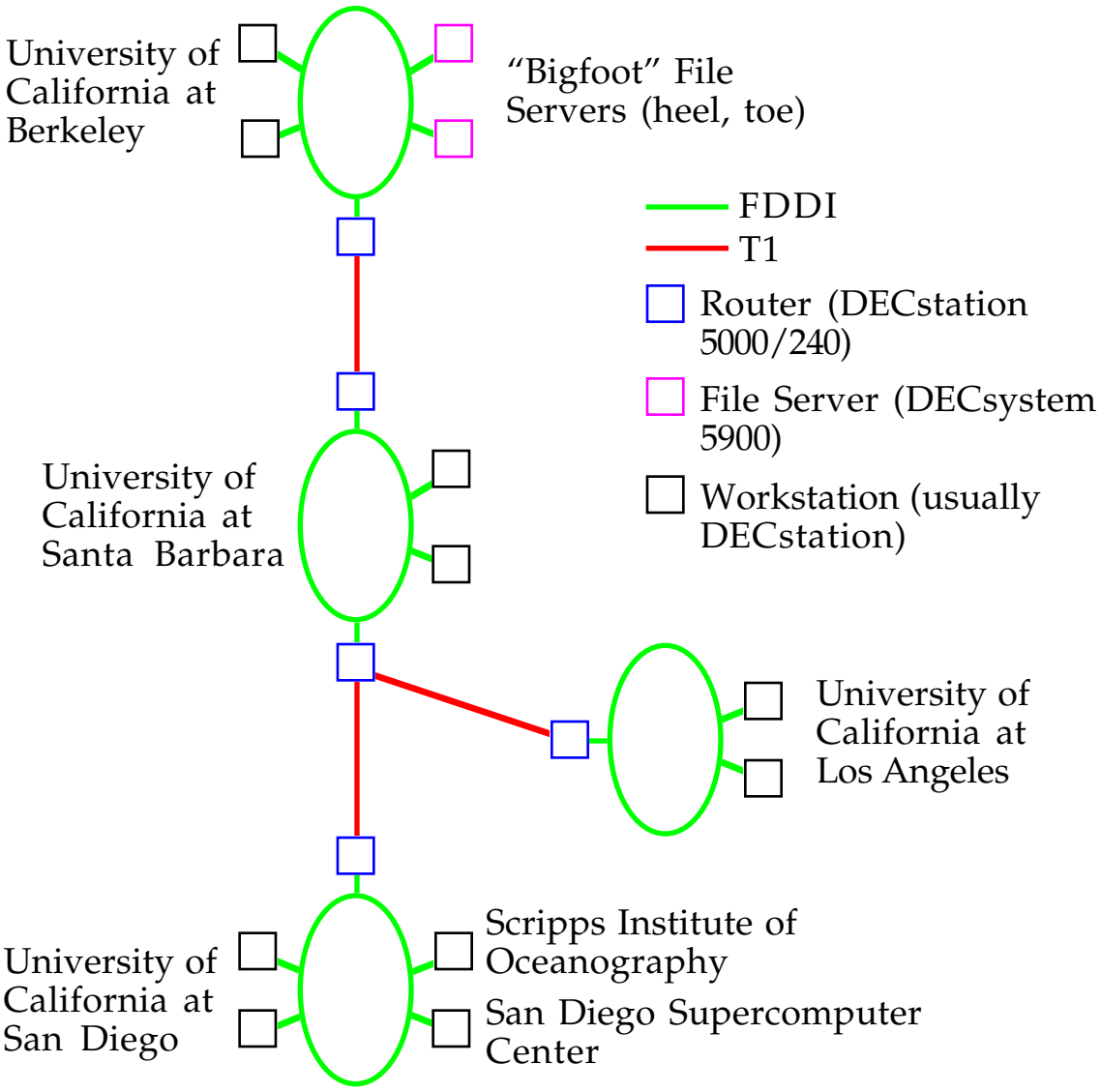


First "high speed" environment

Connection to XUNET 2

Protocols on SunOS and RAID II

Implementation
Sequoia 2000



A heterogeneous internetwork

Similar to local testbed: all machines running DEC Ultrix.

Future Work

Get prototype debugged and get implementations done!

Multicast

Negotiation of channel parameters

Dynamic rerouting or channel modification

Intelligent routing

Applications