Efficient Signaling Algorithms

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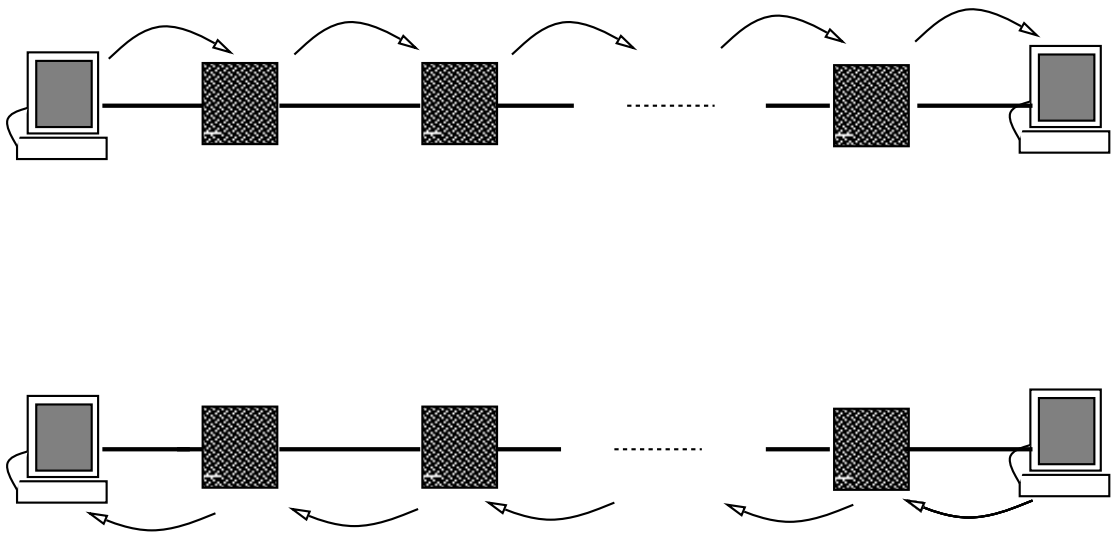
Introduction

Switched virtual circuits require a *call setup* procedure.

Traditional signaling follows the *linear* call setup procedure.



With n switches in the path, there are

- $2(n+1)$ messages
- $2(n+1)$ rounds

Current Methods

In the current standard,

- Each adjacent pair of switches share one signaling channel.
- Control software send signaling messages only to software on physically adjacent switches.
- The signaling topology follows the physical network topology.
- All current protocols such as
  - **GULP**,
  - **Q.93b** and
  - **SPANS**

  work within the simple linear model.

Approach

Explore call setup algorithms in which physically non-adjacent switch controllers may communicate directly.

- Any arbitray signaling topology can be overlaid on the physical network.
- Simplest interconnection strategy is fully connected.
- Other topologies are being studied.

Properties & Assumptions

Assume that:

- A host can only communicate with the control software on the switch it is directly connected to.

It must be that:

- Before the initial switch sends a message to the source host indicating a successful call setup,
  - The destination has accepted the call, and
  - All intermediate switches have accepted the call.
- Some pairwise communication between physically adjacent switches must occur.

Rounds and Messages

Signaling algorithms communicate by exchanging control *messages*.

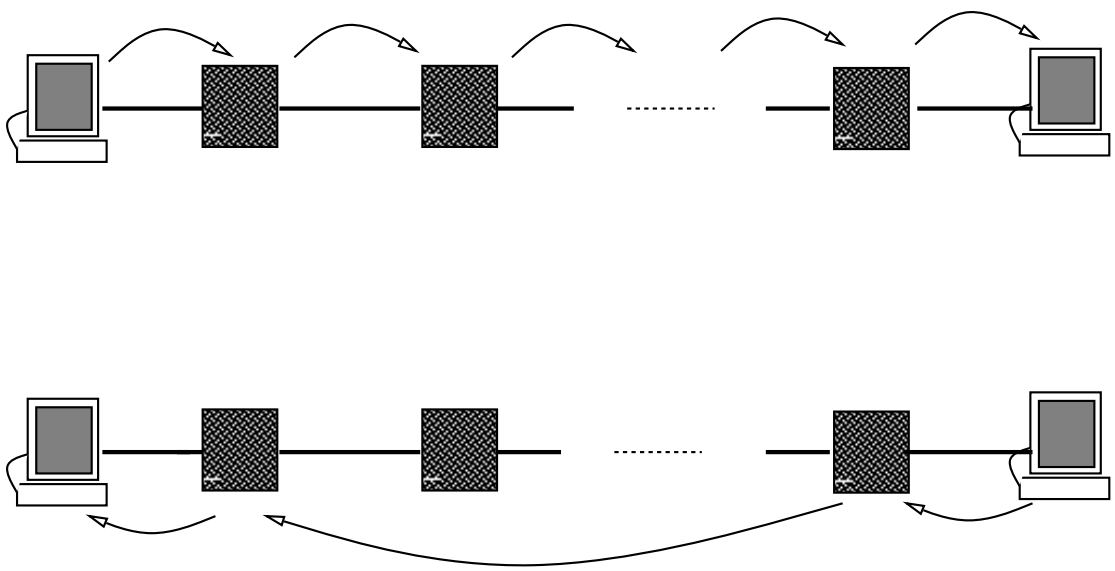
A round is defined as a step in the algorithm where a node

1. receives one message,
2. processes it and
3. sends another message.
4. For the initiator node, we discount condition 1 and 2, since the initiator begins the algorithm by sending a message without needing to first receive a message.

Efficient signaling algorithms should minimize:

- the number of messages.
- the number of rounds.

Enhanced Linear Setup



- Request in the forward direction as usual.
- Short circuit backward reply.
- $n + 4$ messages.
- Same number of rounds.
- A dual algorithm would be
  - short circuit forward request
  - but reply in the simple linear manner.

Multicast Call Setup

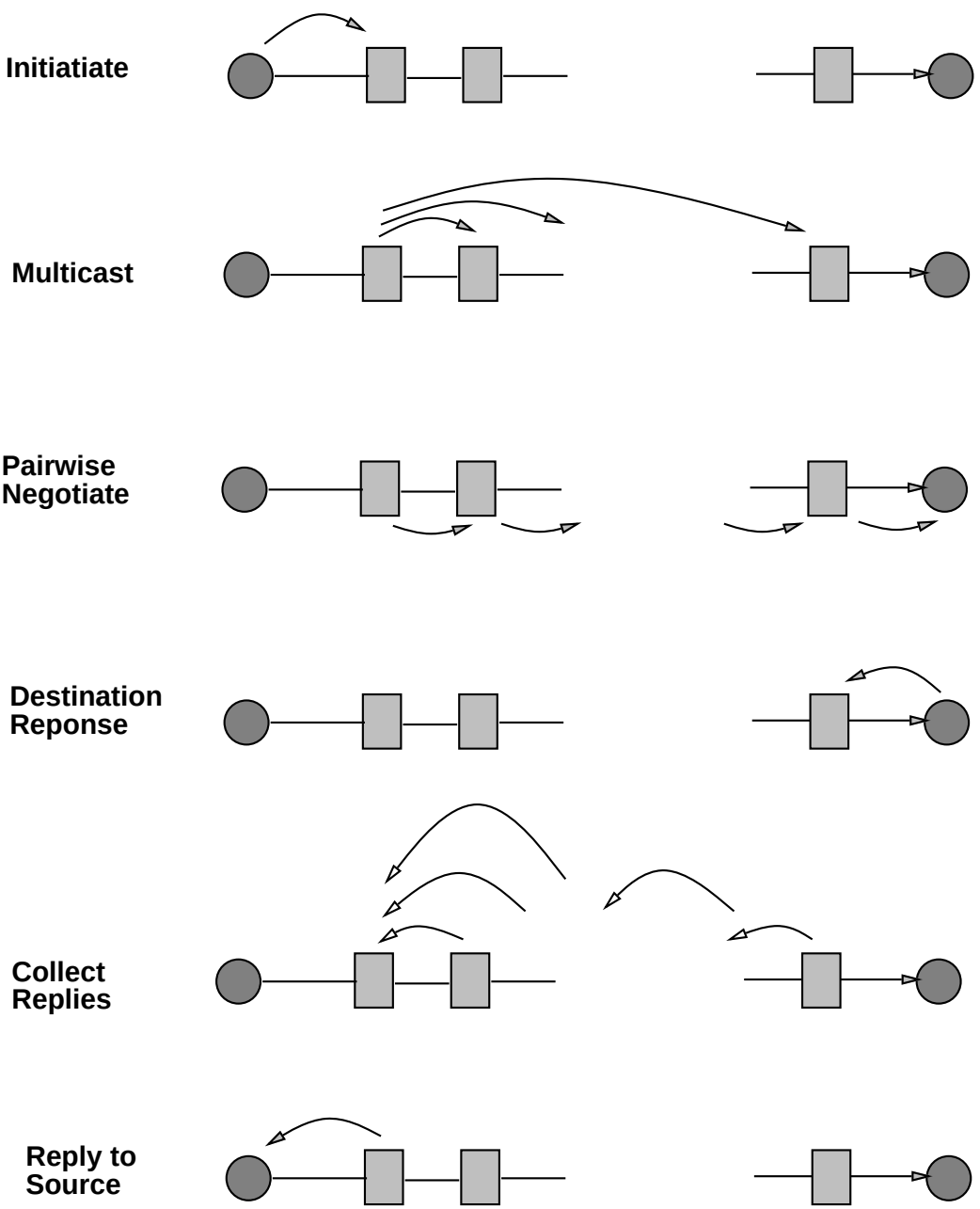
If control software can multicast to many destinations at once, then in one round, some *set* of nodes:

- receive at most one message each
- process that message, and
- send one or more messages (perform a multicast).

6 phases:

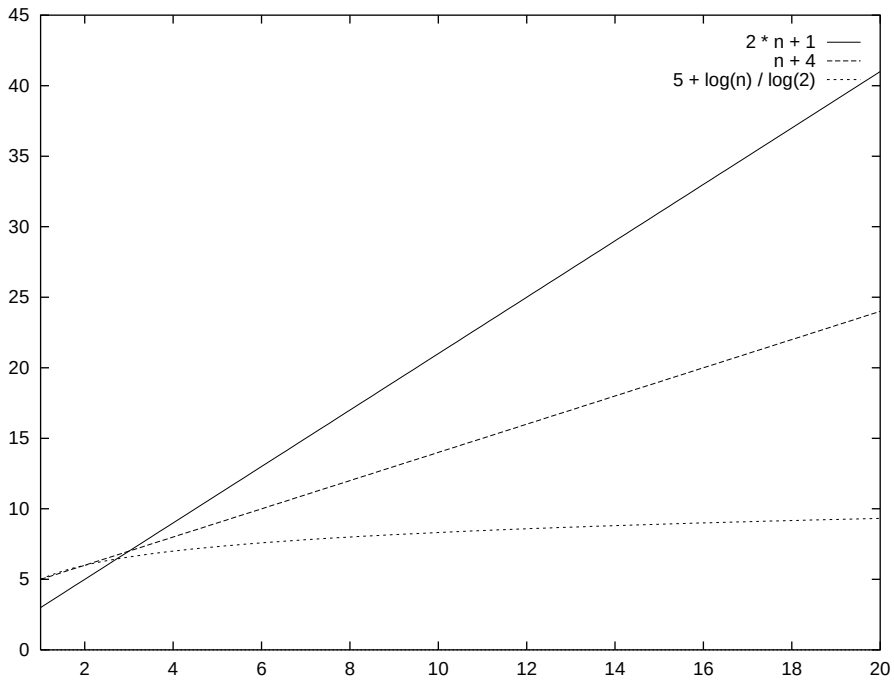
- Initiate
- Multicast request
- Pairwise negotiate
- Destination response
- Collect replies
- Reply to source

Multicast Call Setup (continued)



- $\log(n) + 5$ rounds
- $3n + 2$ messages

Performance Comparison
of rounds vs. # of switches



Current Work

- Using the x-kernel[1] as a network framework to implement GULP and MULP.
  - x-kernel is a portable networking framework providing efficient protocol layering.
  - Embeddable as a monitor in another operating system.
    * User process in SunOS.
    * Kernel task in Mach.
    * *Choices* kernel[2].
    * SGI port is relatively easy.
- Protocols implemented using state machines[3]. This allows definition of new protocols by inheritance of protocols defined earlier.
- Working implementation in sim and real modes on XUNET, Fore and Adaptive platforms by April.
- Exploring other interconnection strategies and algorithms.

[1] Larry Peterson, University of Arizona
[2] Brett Terry, *work in progress*, University of Illinois
[3] Aamod Sane, *Inheritance and Object State*, University of Illinois