Multipoint ABR Connections over ATM - Recent Research Results

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Overview

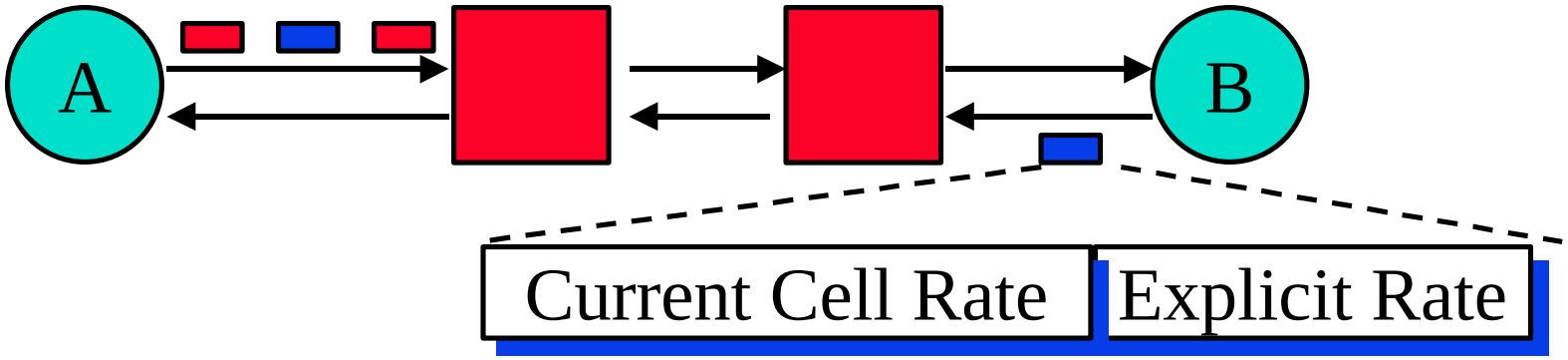
- Introduction to point-to-multipoint ABR
- Basic ABR pt-mpt Resource Allocation
- Extension/optimization of pt-mpt algorithms
- Mpt-pt: What should be the goal of allocation?

Our Recent ATM Forum Presentations

This presentation is based on the following contributions:

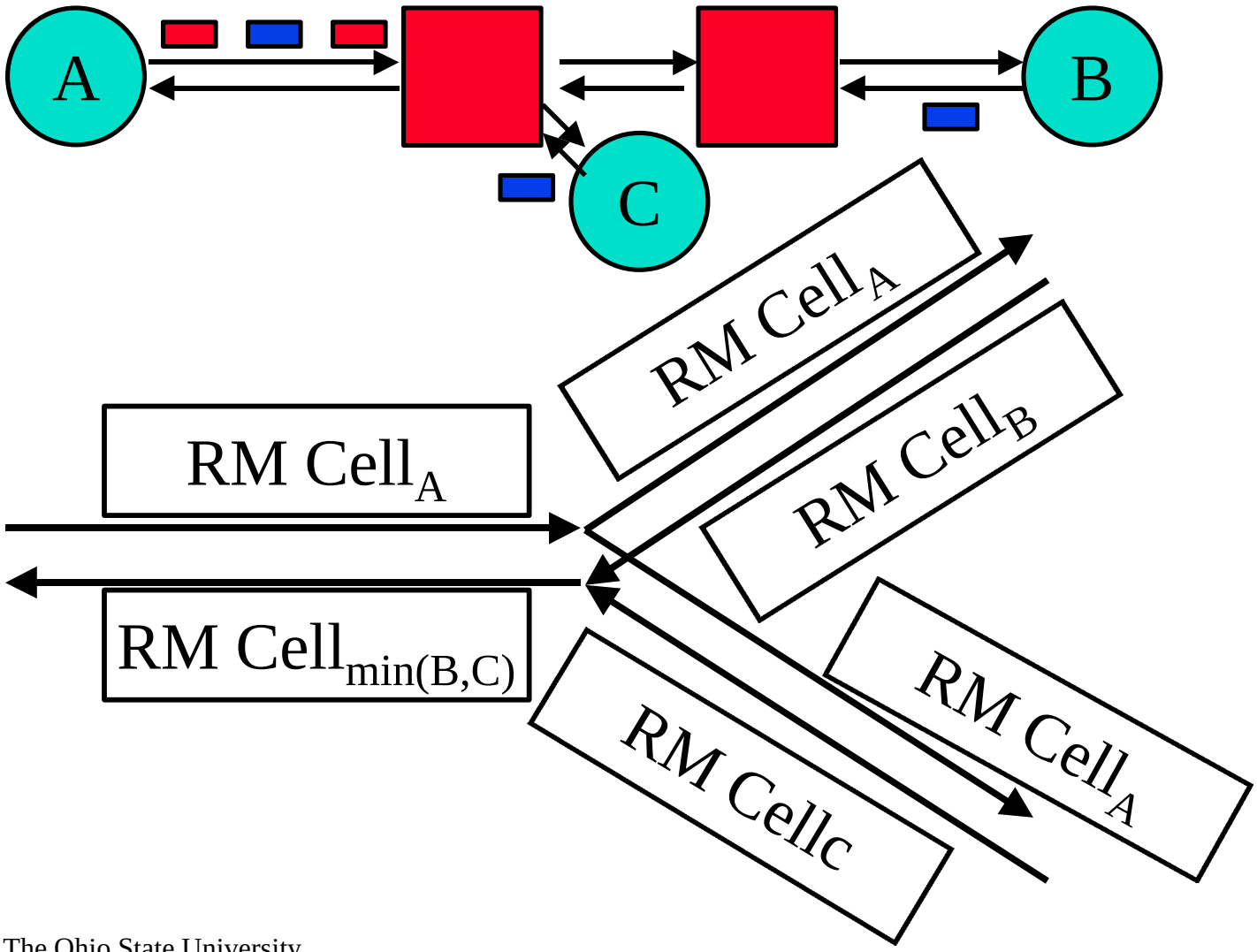
- "Fairness for ABR multipoint-to-point connections," ATM Forum/97-0832, Sep 1997, http://www.cis.ohio-state.edu/~jain/atmf/a97-0832.htm
- "Feedback consolidation algorithms for ABR point-to-multipoint Connections," ATM Forum/97-0615, July 1997, http://www.cis.ohio-state.edu/~jain/atmf/a97-0615.htm
- "Performance analysis of ABR point-to-multipoint connections for bursty and nonbursty traffic with and without VBR background," ATM Forum/97-0422, April 1997, http://www.cis.ohio-state.edu/~jain/atmf/a97-0422.htm

Point-to-Point ABR



- Sources send one RM cell every n cells
- The RM cells contain "Explicit rate"
- Destination returns the RM cell to the source
- The switches adjust the rate down
- Source adjusts to the specified rate

Point-to-Multipoint ABR



1. Point-to-Multipoint Connections: Issues

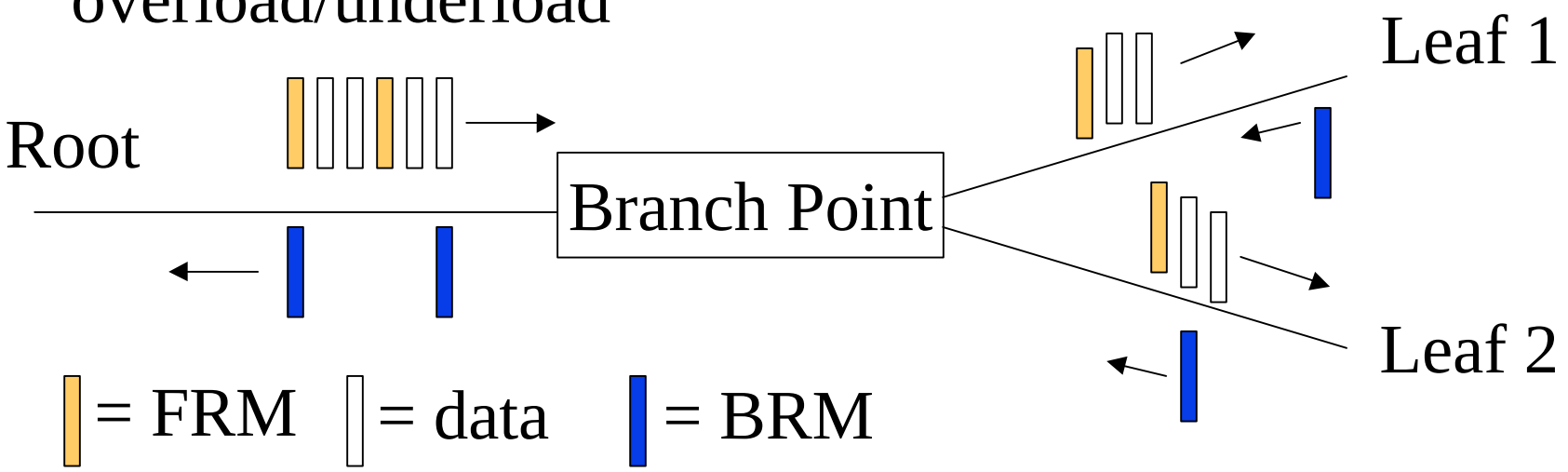
- Minimum of ER from branches is sent upstream. Should we wait for all branches?
- If you send BRM on every FRM, you may give feedback without receiving any
  ⇒Need to ensure that at least one feedback has been received before sending a BRM.
  Otherwise, you may give PCR
- Not all downstream feedbacks in an upstream feedback ⇒Consolidation noise

Basic Pt-Mpt: Results

- ABR with ERICA (extended for multipoint) works ok
- Efficiency, fairness, responsiveness is maintained
- Consolidation noise due to asynchronous arrival of feedback from different leaves appears as oscillations
- Additional delay due to FRM wait and BRM consolidation
  ⇒slower transient response than point-to-point
- Minimum of all paths is allocated
  ⇒Some links are underutilized
- Queue control (ERICA+) is required for stability

2. Mpt Consolidation

- Wait for feedback from all branches?
- Consolidation delay and scalability?
  Ratio of BRMs to FRMs
- Handling non-responsive branches and timeouts?
  Algorithm should not halt nor cause overload/underload



Performance Comparison

- Studied 4 existing and 3 new algorithms.

Algorithm	1	2	3	4	5	6	7
Complexity	**High**	**High**	Low	Med	>Med	>Med	>>Med
Transient Response	Fast	Med	Med	**Slow**	Fast for overload		Very fast for overld
Noise	High	Med	**High**	Low	Low	Low	Low
BRM:FRM	1	< 1	≤ 1	≤ 1	**may>1**	lim=1	lim=1
Sensitivity to branch points and levels	High	High	Low	Med	>Med	Med	Med

Multipoint Consolidation: Results

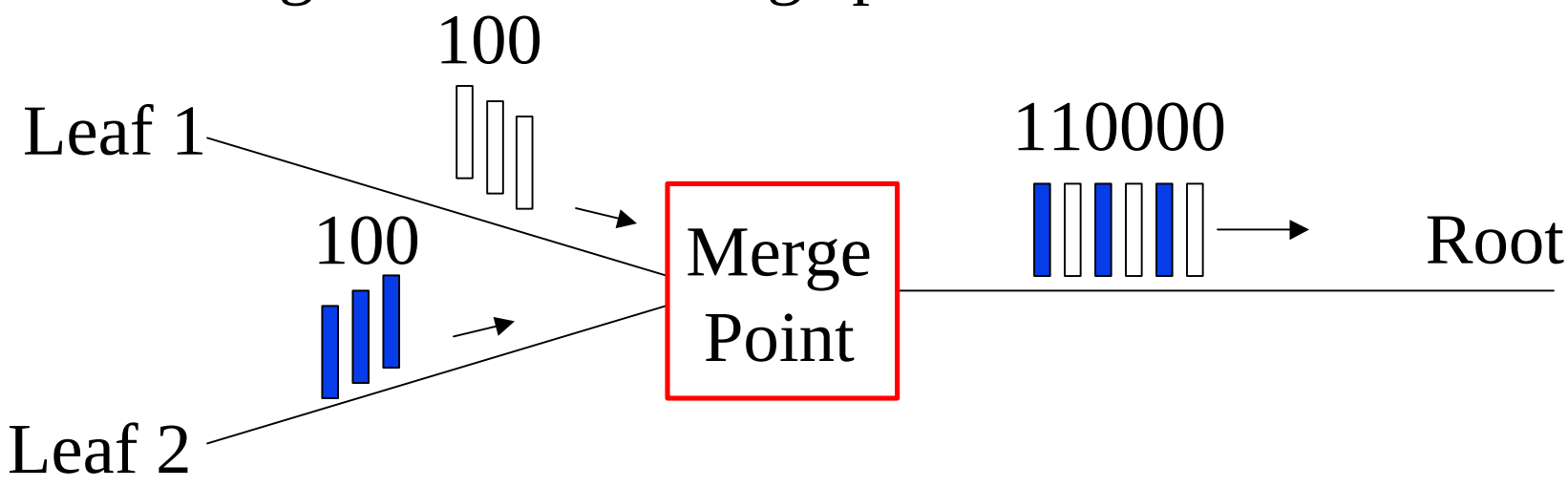
- Consolidation algorithms offer tradeoffs between complexity, transient response, noise, overhead and scalability
- The new algorithms 6 and 7 speed up the transient response, while eliminating consolidation noise and controlling overhead

Impact I

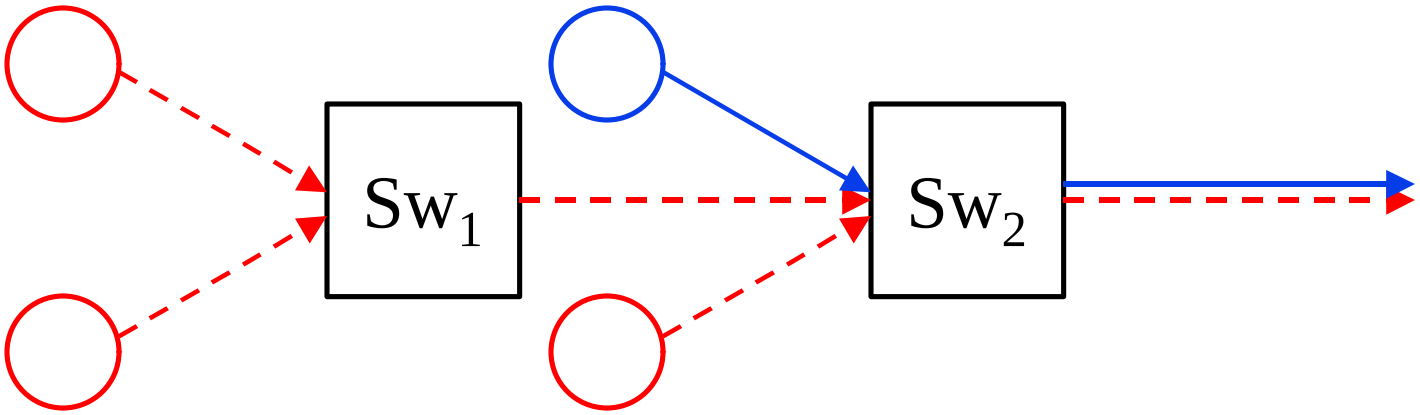
- A summary of our ATM Forum contribution 97-0615 was adopted for inclusion in the "Living List" of issues to be included in the next phase (TM 5.0) of ATM Forum Traffic Management
- Several leading industry members expressed interest in results

3. Multipoint-to-Point VCs

- How can bandwidth be allocated fairly?
  Depends upon the solution to cell interleaving.
- VP merge: VCI = sender ID
  VPs are used for other purposes.
- VC merge: Buffer at merge point till EOM bit = 1.



Sources, VCs, and Flows



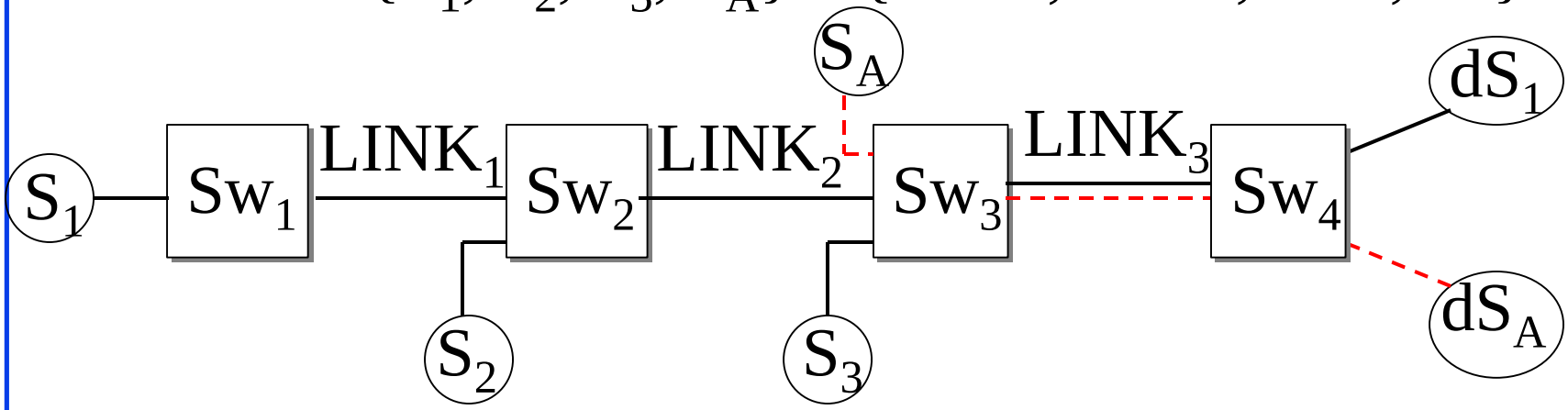
- Sw_2 has to deal with
  - Two VCs: Red and Blue
  - Four sources: Three red sources and one blue source
  - Three flows: Two red flows and one blue

Fairness Definitions

- Source-based:
  N-to-one connection = N one-to-one connections $\Rightarrow$ Use max-min fairness among sources
- VC/Source-based: Allocate bandwidth among VCs
  For each VC, allocate fairly among its sources
- Flow-based: Flow = VC coming on an input link.
  Switch can easily distinguish flows.
- VC/Flow-based:
  1. Allocate bandwidth fairly among VCs
  2. For each VC, allocate fairly among its flows

Example

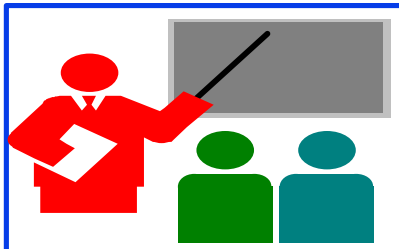
- How is the bandwidth of $LINK_3$ allocated?
- Source: $\{S_1, S_2, S_3, S_A\} \leftarrow \{37.5, 37.5, 37.5, 37.5\}$
- VC/Source: $\{S_1, S_2, S_3, S_A\} \leftarrow \{25, 25, 25, 75\}$
- Flow: $\{S_1, S_2, S_3, S_A\} \leftarrow \{25, 25, 50, 50\}$
- VC/Flow: $\{S_1, S_2, S_3, S_A\} \leftarrow \{18.75, 18.75, 37.5, 75\}$



All links are 150 Mbps

Impact II

- The summary section of our ATM Forum contribution 97-0832 was adopted for inclusion in the "Living List" of issues to be included in the next phase (TM 5.0) of ATM Forum Traffic Management



Summary

- ERICA+ modified for pt-mpt works ok
- Additional delay due to FRM wait and BRM consolidation ⇒slower transient response than pt-pt
- Two new algorithms 6 and 7 speed up the transient response, while eliminating consolidation noise and controlling overhead
- Achievable goals of mpt-pt ABR depend upon the solutions adopted for cell interleaving (VP merge vs VC merge)
- Fair resource allocation based on sources, VCs, or flows

Our Contributions and Papers

All our contributions and papers are available on-line at http://www.cis.ohio-state.edu/~jain/

- See Recent Hot Papers for tutorials.

Thank You!

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