ABR
Traffic Management Specs

Raj Jain

Raj Jain is now at
Washington University in Saint Louis
Jain@cse.wustl.edu
http://www.cse.wustl.edu/~jain/

- Forward and Backward RM cells
- In-Rate and Out-of-rate RM cells
- RM Cell Format
- Source behavior

Parameters

- PCR: Peak Cell Rate
- MCR: Minimum Cell Rate
- ICR: Initial Cell Rate
- RIF: Rate Increase Factor. ACR = ACR+RIF*PCR
- Nrm: Number of cells per RM cell. Nrm-1 data + 1 RM
- Mrm: Minimum # of cells per RM. Fixed at 2.
- RDF: Rate decrease factor. ACR = ACR(1-RDF)
- ACR: Allowed Cell Rate
- CRM: Missing RM Cell count
- ADTF: ACR Decrease Time Factor (Maximum idle time)
- Trm: Maximum time between RM cells

Parameters (cont)

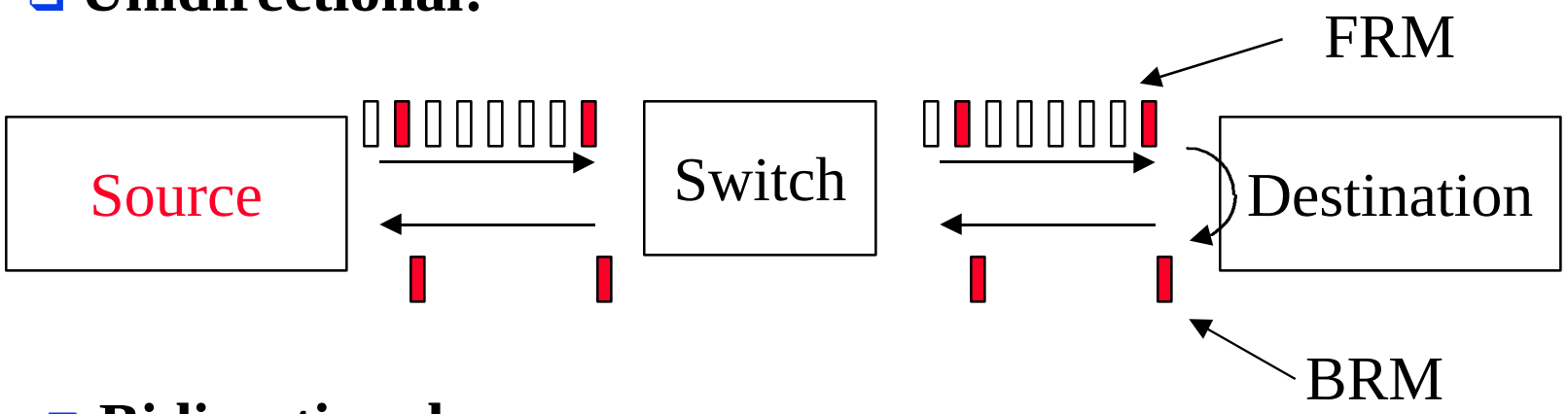
- FRTT: Fixed Round-trip time
- TBE: Transient buffer exposure. Maximum number of cells that can be sent before first RM cell returns.
- CDF: Cutoff decrease factor.
  If no RM cell is received after Crm RM cells have been sent
  ACR = ACR(1-CDF)
- TCR: Tagged cell rate. Fixed at 10 c/s.
  Maximum rate at which a switch can generate BECNs
  or a source/destination can generate out-of-rate RM cells.

In-Rate and Out-of-Rate RM Cells

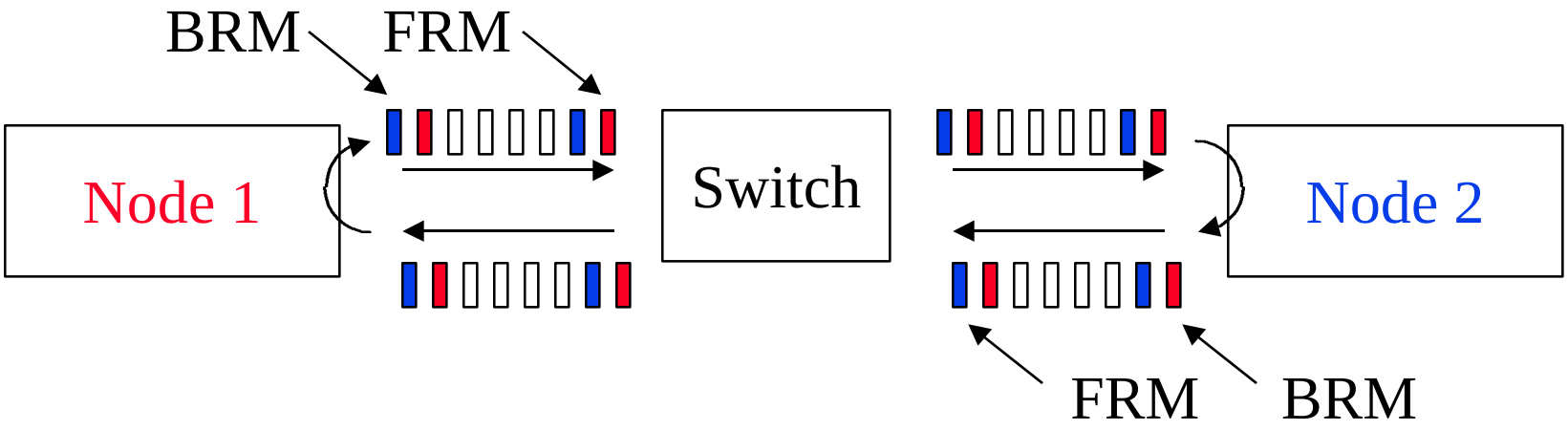
- In-Rate:
  - Cells counted in the user's rate
  - Can send as many as allowed by source rules
  - Have CLP = 0
- Out-of-Rate:
  - Not counted in the user's rate
  - No more than 10 cells per VC per second
  - Have CLP = 1 $\Rightarrow$ Can be discarded by the network
  - Not Optional: The only way to get out of ACR=0
- ABR data cells can't have CLP =1.

Forward and Backward RM Cells

- **Unidirectional:**



- **Bidirectional:**



RM Cell Format

ATM Header	5 Bytes	
Protocol ID	1 Byte	1 = ABR
Direction	1 bit	0 = Forward
Backward Notification	1 bit	1 = Switch/dest generated
Congestion Indication	1 bit	1 = High Congestion
No Increase	1 bit	1 = Mild congestion
Request/Acknowledge*	1 bit	
Reserved	3 bits	
Explicit Rate	2 Bytes	
Current Cell Rate	2 Bytes	
Minimum Cell Rate	2 Bytes	
Queue Length*	4 Bytes	
Sequence Number*	4 Bytes	
Reserved	30.75 Bytes	
CRC-10	10 bits	

*Fields defined by ITU but not used by ATM Forum

RM Cell Format

- Header: PTI=110. For VPC, VCI=6.
- Protocol ID = 1 for ABR service
- BN = BECN RM cell = 1 ⇒ Switch/destination generated
- NI = 1 ⇒ Don't go up! Network is congested.
  CI = 1 ⇒ Go down! Network is (more) congested.

NI	CI	
0	0	ACR ← Min(ER, ACR + RIF*PCR)
0	1	ACR ← Min(ER, ACR - ACR*RDF)
1	0	ACR ← Min(ER, ACR)
1	1	ACR ← Min(ER, ACR - ACR*RDF)

- Fields not used are set to zero or set in accordance with I.371 upon generation. Are set to zero, preserved, or set in accordance with I.371 at other points.

Source Behavior

1. *Allowed Cell Rate* (ACR) is adjusted between the *minimum cell rate* (MCR) and the *peak cell rate* (PCR)

$$MCR \leq ACR \leq PCR$$

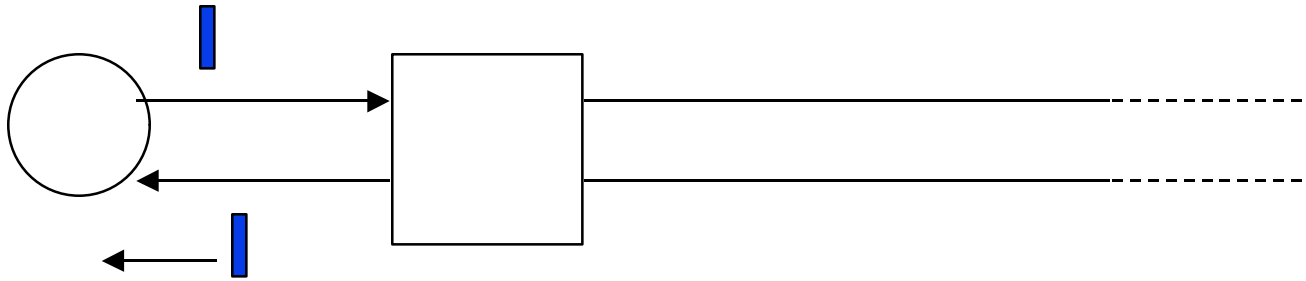
2. Start at *Initial Cell Rate* (ICR) and send an RM Cell first
3. Every Nrm^{th} cell is an RM cell. Nrm = 32.
   Send an RM cell if 100 ms have expired since the last RM cell was sent and one other cell has been sent.
4. Cells sent under rules 1-3 shall have CLP=0
5. If the time T since last FRM cell was sent is greater than ADTF (ACR decrease time factor) and ACR is greater than ICR then reset to ICR.
6. If no RM cells are received after sending Crm RM cells, reduce ACR = ACR(1-CDF)

Source Behavior (Cont)

7. Place new ACR in the CCR field of the next RM cell.
8. If Congestion Indication (CI) = 1:
   ACR = ACR(1-RDF)
   ELSE if NI =0 THEN ACR = ACR +RIF*PCR
9. ACR is not decreased below MCR or increased above ER
   ACR = Max{MCR, Min{ER, ACRcomputed}}
10. When sending an RM cells, set
    CCR=ACR, ER $\leq$ PCR, DIR=0, BN=0, CI=0, NI=0 or 1
11. No more than 10 Out-of-rate RM cells/sec.

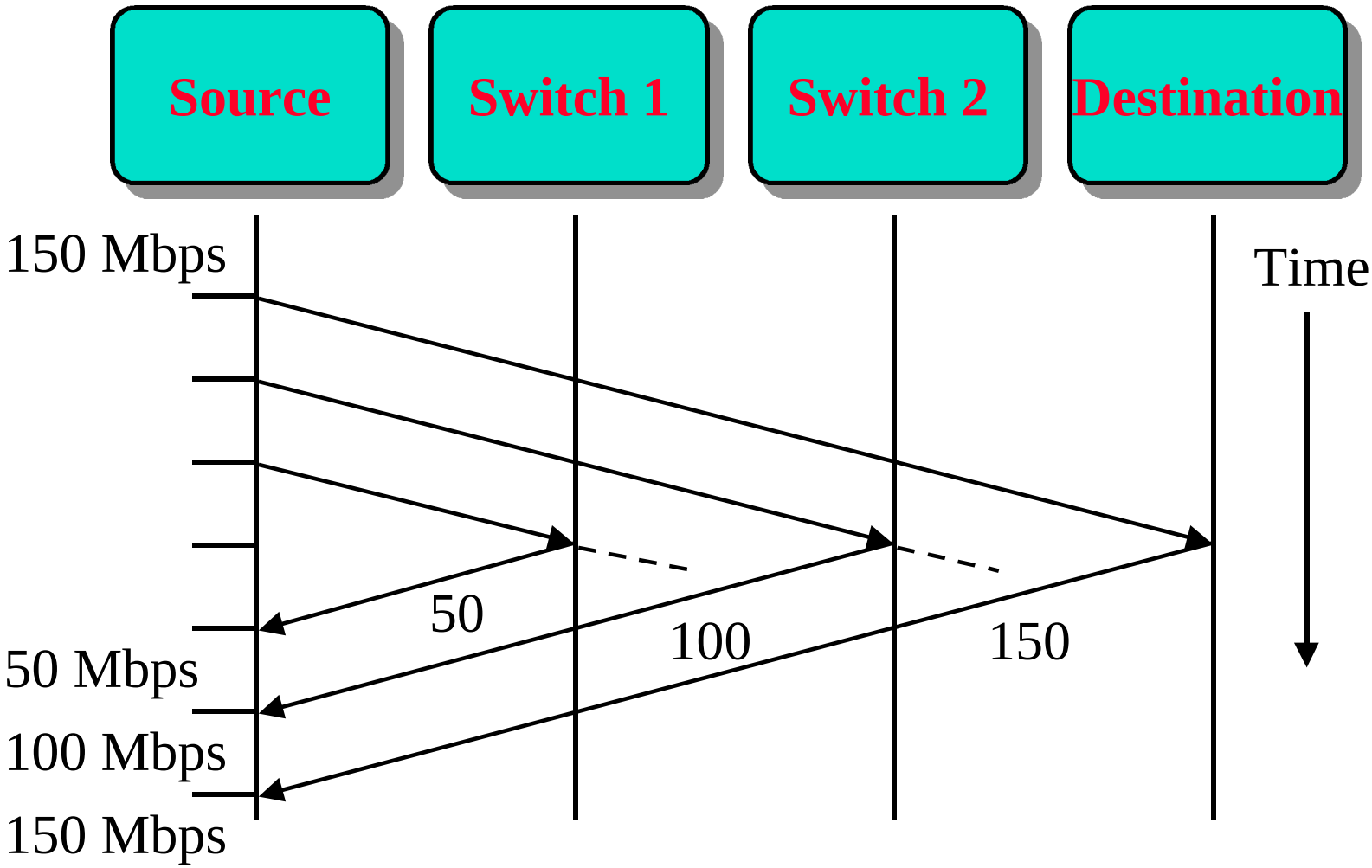
    All out-of-rate RM cells should have CLP=1
12. When sending data cells, set EFCI = 0
13. Optional Use it or loose it policy:

BECN



- BECN are particularly helpful for long delay paths, low rate sources, or on first round-trip.
- Our Result:
  - A source should not increase the rate on receiving a BECN
  - A switch cannot use BECN to increase the rate
- Switch/destination generated BECN's have CI or NI=1.

Backward Explicit Congestion Notification



Summary

- ADTF protects the network from sources not using their allocated shares
- CRM protects the sources from broken networks

Thank You!