98-0407: Effect of RM Cell Interval on ABR Feedback: A Simulation Study Using OPNET

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Overview

- Effect of Nrm on Video over ABR
- OPNET ABR Model
- Simulation Configuration
- Simulation Results

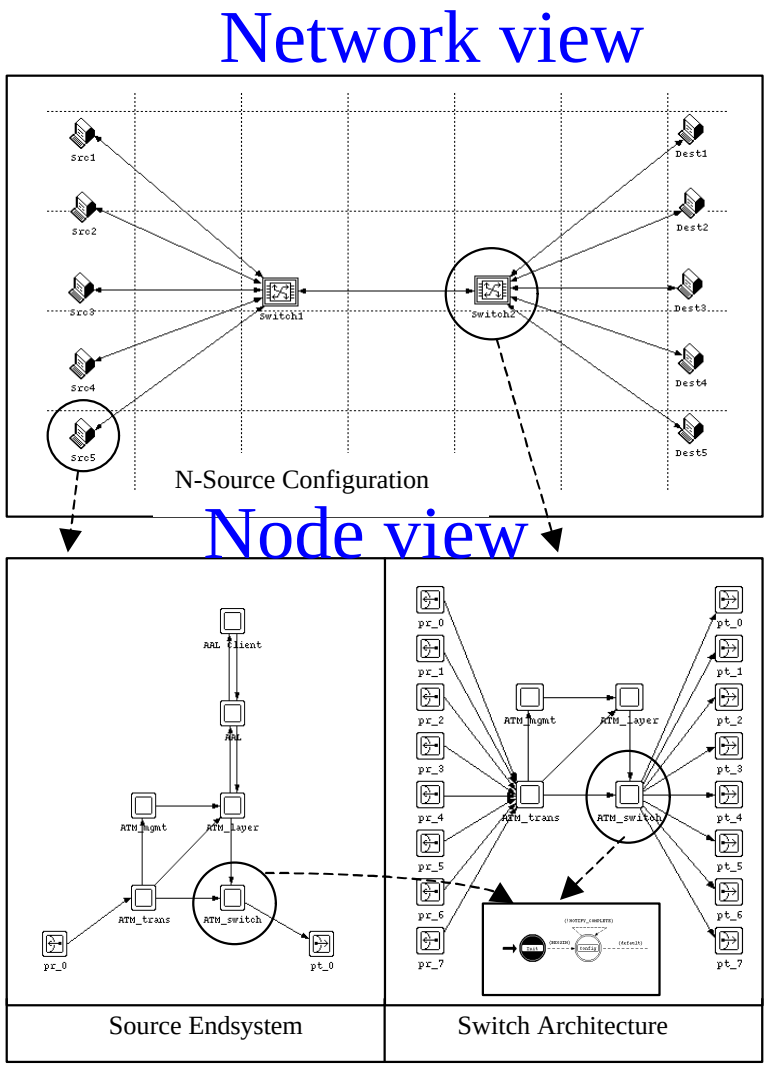
Video Over ABR

- Default Nrm = 32
- High rate and small Nrm ⇒ high rate variations due to frequent feedback. May be undesirable for smoothed video.
- Two methods of reducing variations in feedback
  - Use large Nrm ⇒ Less frequent feedback
  - Use large averaging interval for feedback control algorithm (ERICA+) ⇒ less frequent changes in feedback, since only one feedback value in one interval.
- Goal: To study the effect of Nrm on ABR feedback

ABR Model in OPNET

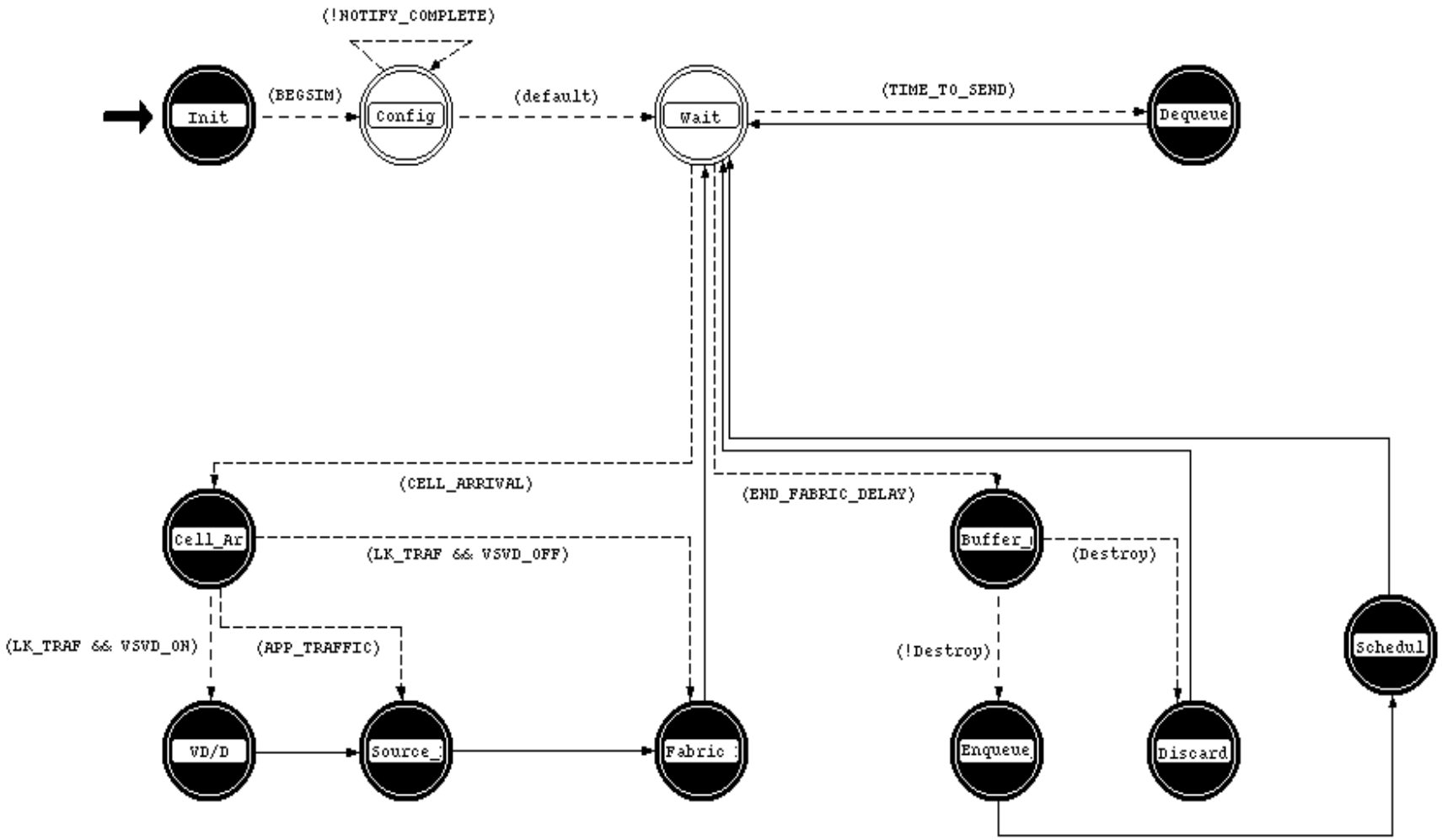
- New model implemented in OPNET.
- Supports multiple QoS classes and service categories.
- Supports ABR with ERICA.
- Planned support for
  - VS/VD
  - Scheduling
  - Buffer Management
- Can easily add modules for different schemes/algorithms.

ATM Model Views



- Network view
  - Topology of network
- Node view
  - Components of each network node (e.g., protocol layers within a node)
- Process view
  - State diagram of each process, (e.g. ATM traffic management, TCP state diagram)

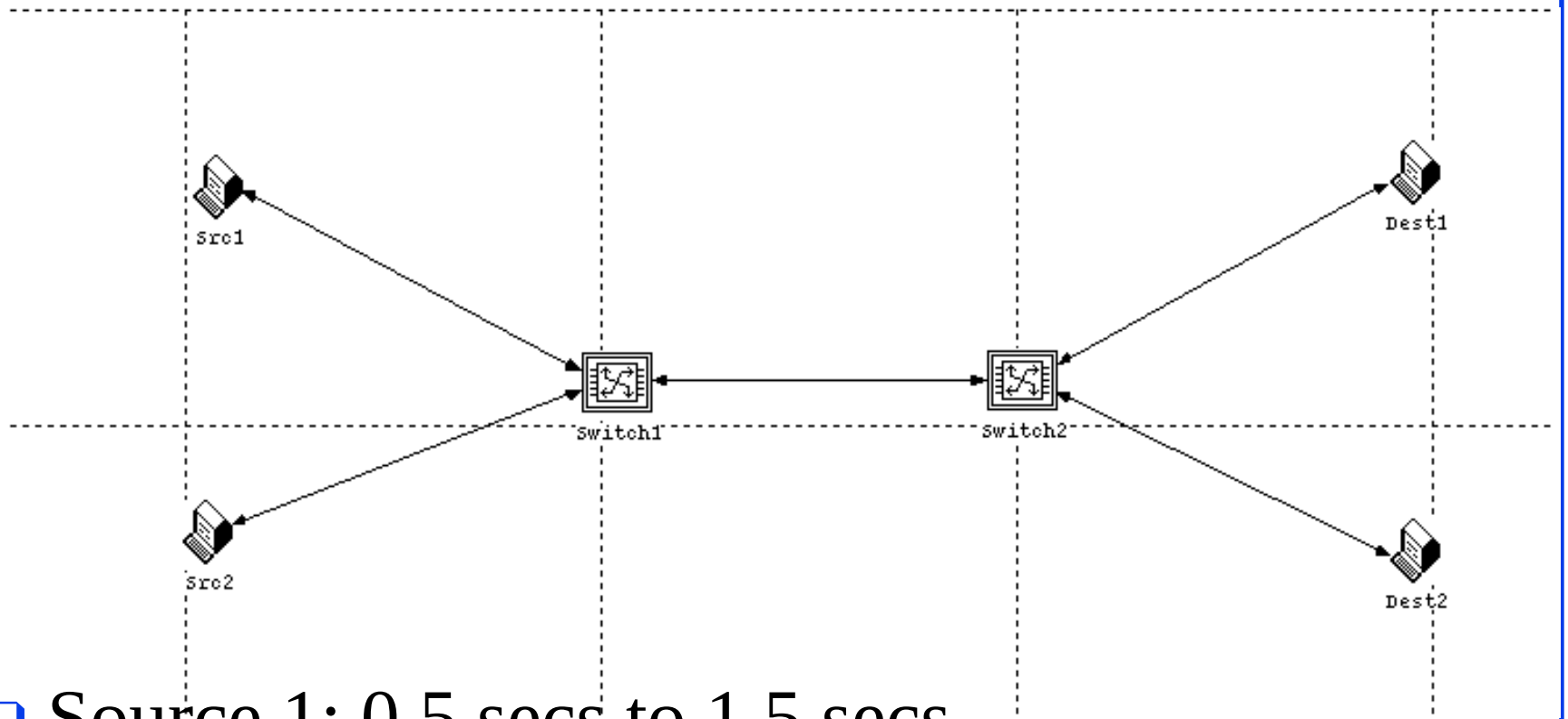
ABR Process Model



Simulation Experiment

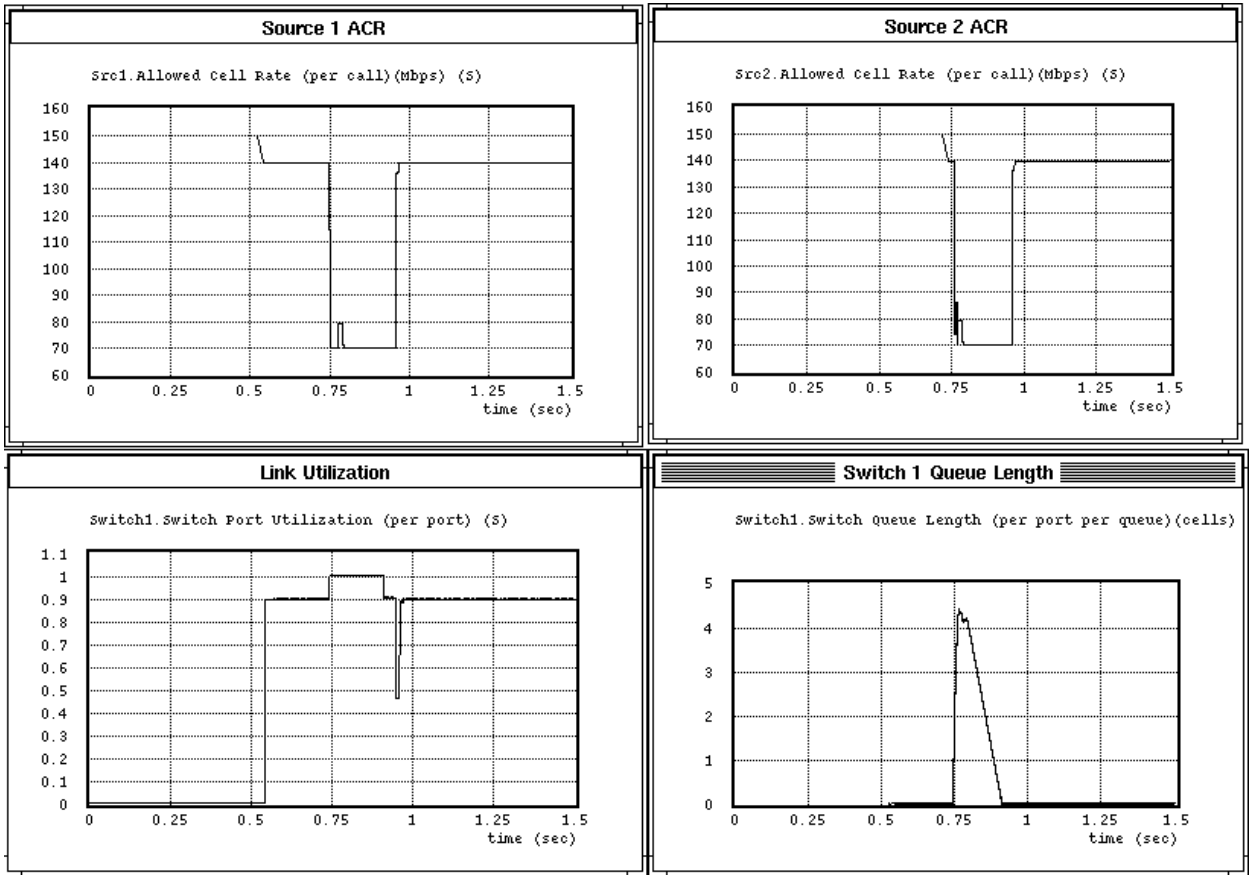
- Nrm = 8, 32, and 256
- All links = 155.52 Mbps
- ICR = 150 Mbps
- ERICA Averaging Interval = 5 ms
- ERICA Target Utilization = 0.9
- RIF = 1/16
- All other ABR parameters are set to default values
- All sources are persistent sources

Two Source Transient Config.

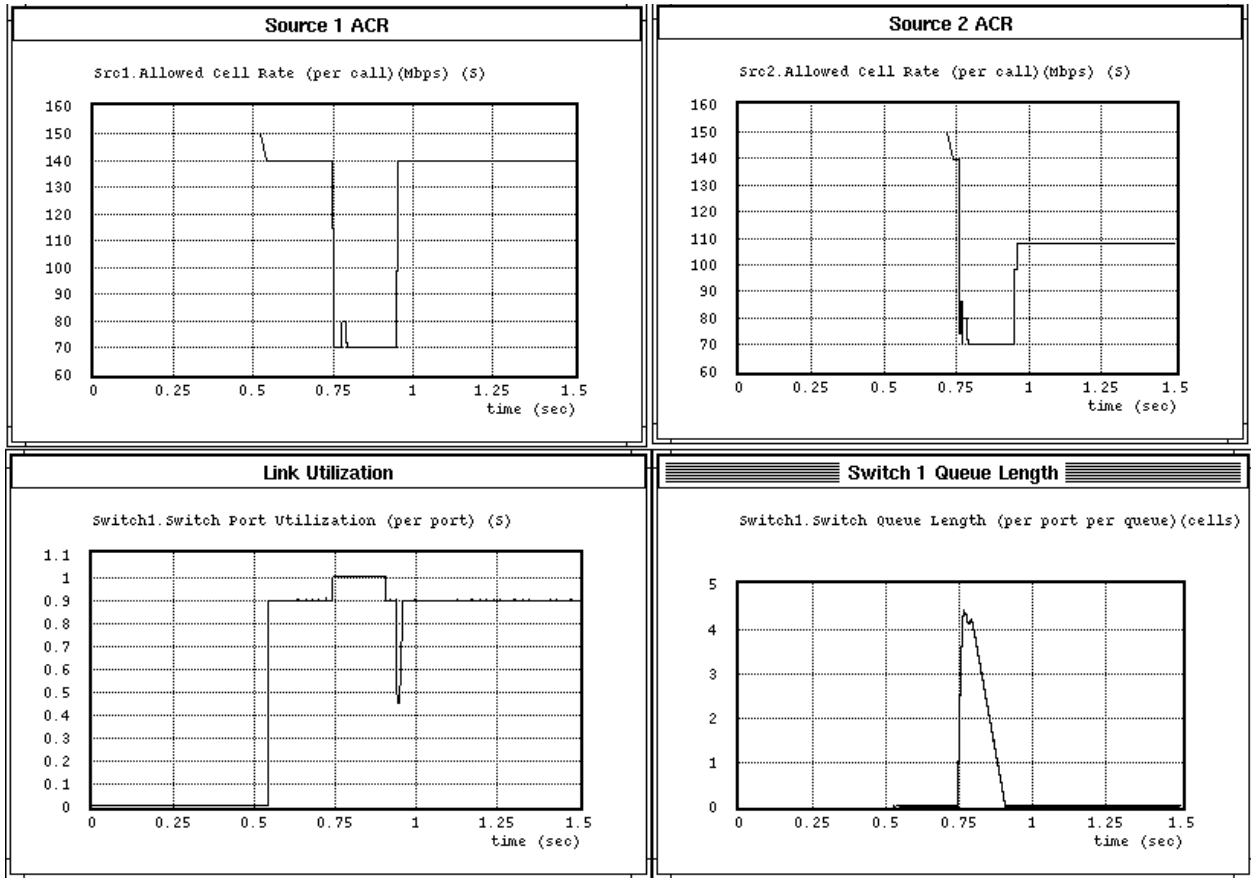


- Source 1: 0.5 secs to 1.5 secs
- Source 2: 0.7 secs to 0.9 secs
- RTT ≈ 23 ms.

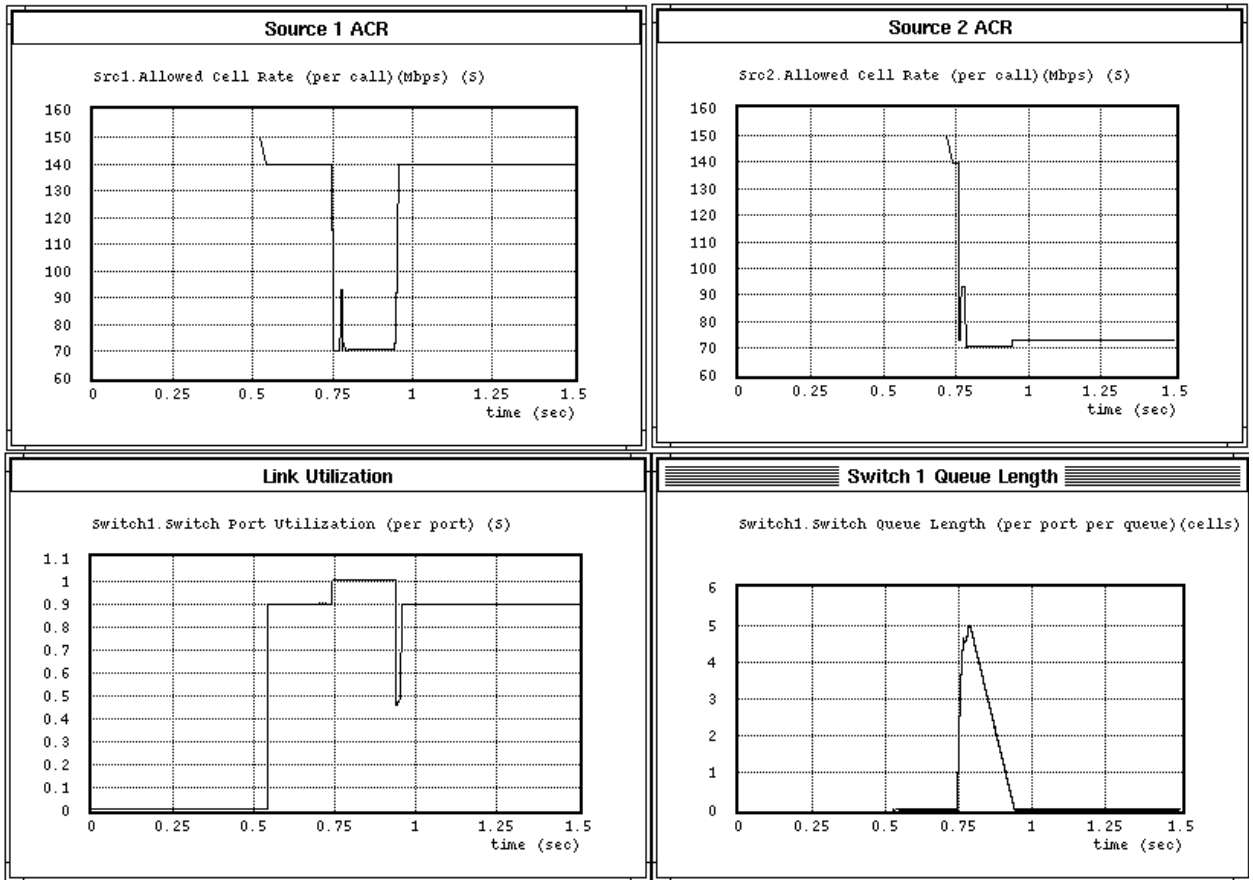
Simulation Results: Transient



Nrm = 8

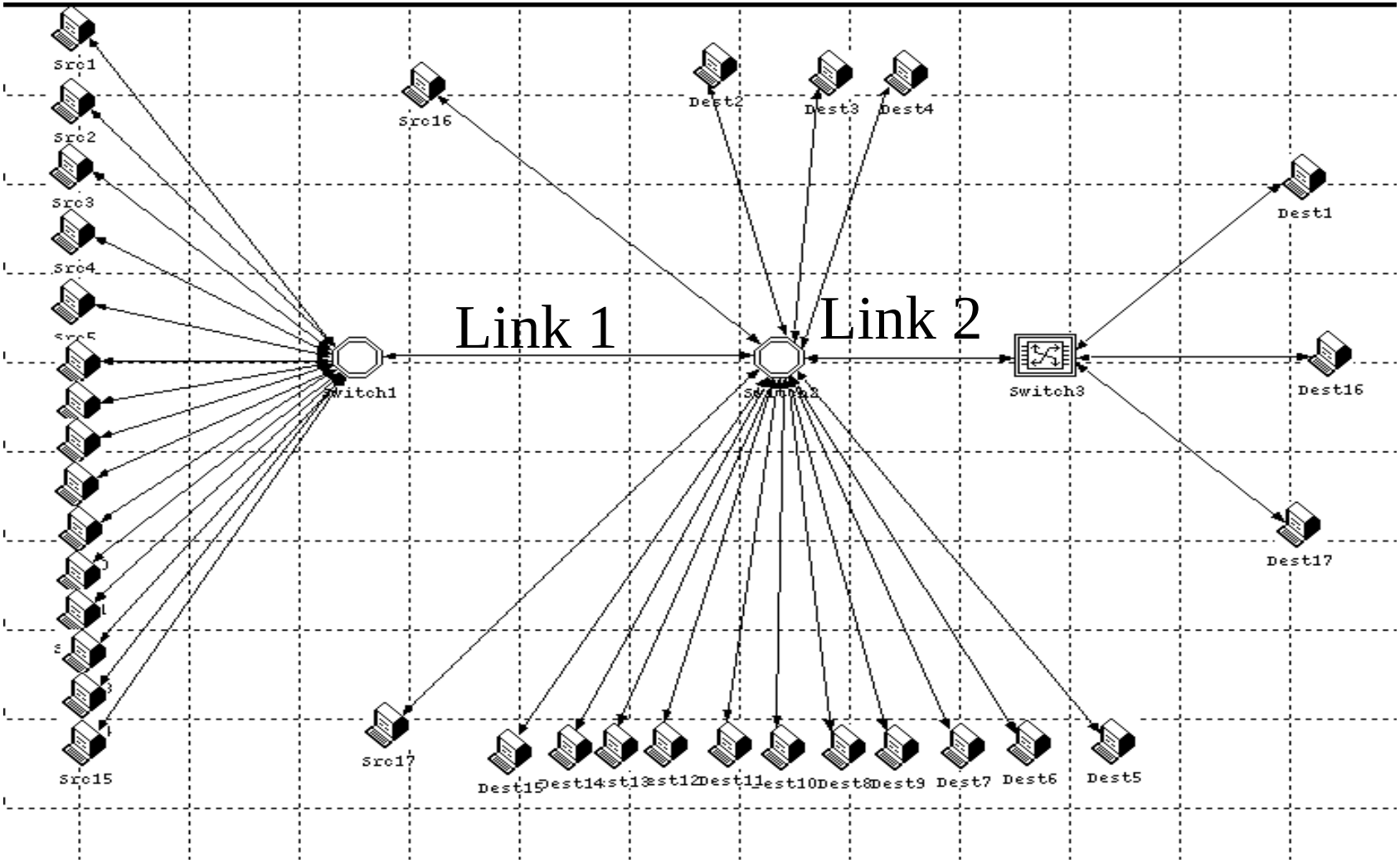

Source 1 ACR
Src1.Allowed Cell Rate (per call)(Mbps) (S)
160
150
140
130
120
110
100
90
80
70
60
0
0.25
0.5
0.75
1
1.25
1.5
time (sec)
Source 2 ACR
Src2.Allowed Cell Rate (per call)(Mbps) (S)
160
150
140
130
120
110
100
90
80
70
60
0
0.25
0.5
0.75
1
1.25
1.5
time (sec)
Link Utilization
Switch1.Switch Port Utilization (per port) (S)
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.25
0.5
0.75
1
1.25
1.5
time (sec)
Switch 1 Queue Length
Switch1.Switch Queue Length (per port per queue)(cells)
5
4
3
2
1
0
0
0.25
0.5
0.75
1
1.25
1.5
time (sec)

Nrm = 32


Source 1 ACR
Src1.Allowed Cell Rate (per call)(Mbps) (S)
160
150
140
130
120
110
100
90
80
70
60
0
0.25
0.5
0.75
1
1.25
1.5
time (sec)
Source 2 ACR
Src2.Allowed Cell Rate (per call)(Mbps) (S)
160
150
140
130
120
110
100
90
80
70
60
0
0.25
0.5
0.75
1
1.25
1.5
time (sec)
Link Utilization
Switch1.Switch Port Utilization (per port) (S)
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.25
0.5
0.75
1
1.25
1.5
time (sec)
Switch 1 Queue Length
Switch1.Switch Queue Length (per port per queue)(cells)
6
5
4
3
2
1
0
0
0.25
0.5
0.75
1
1.25
1.5
time (sec)

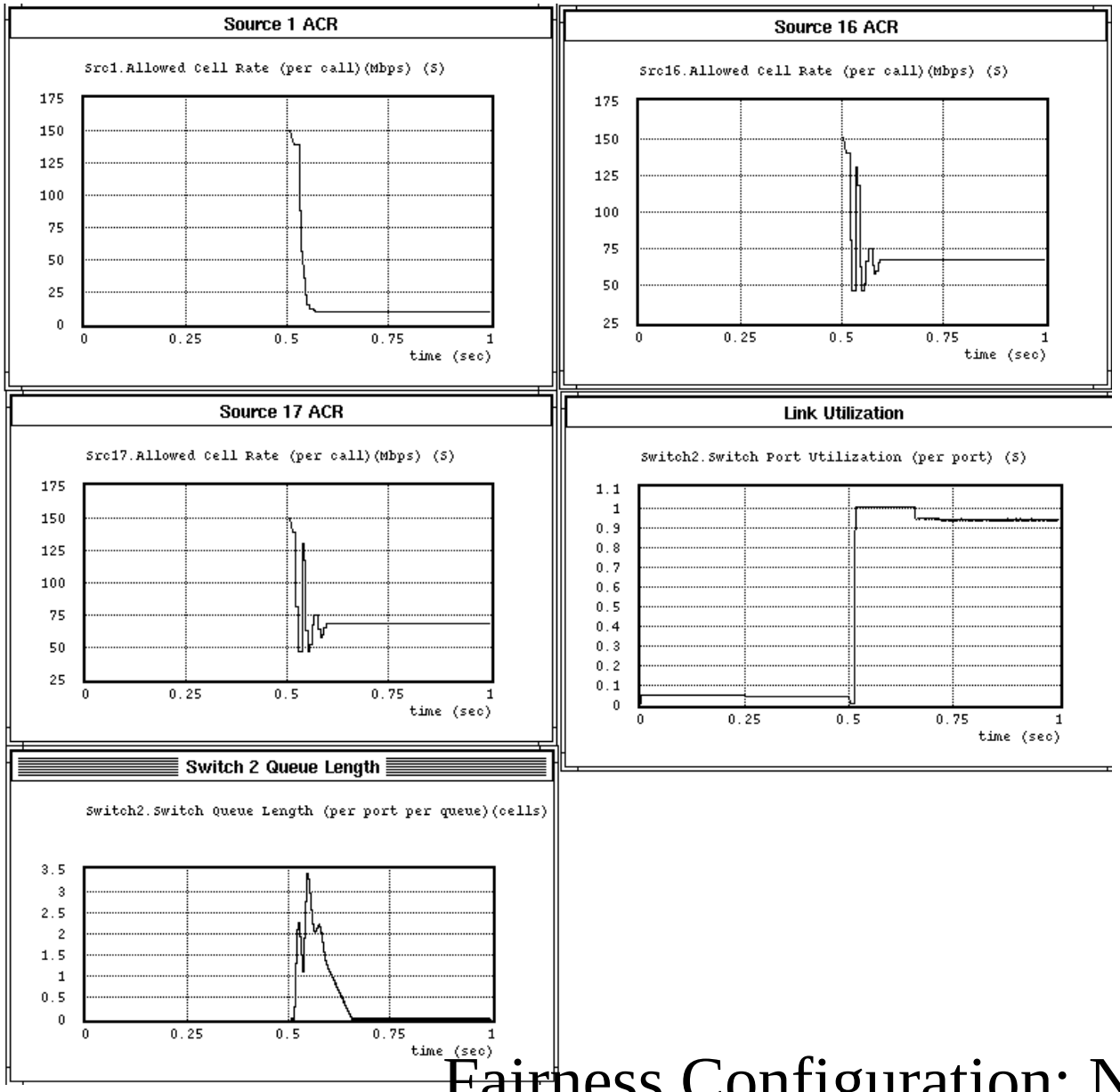
Nrm = 256

The Fairness Configuration

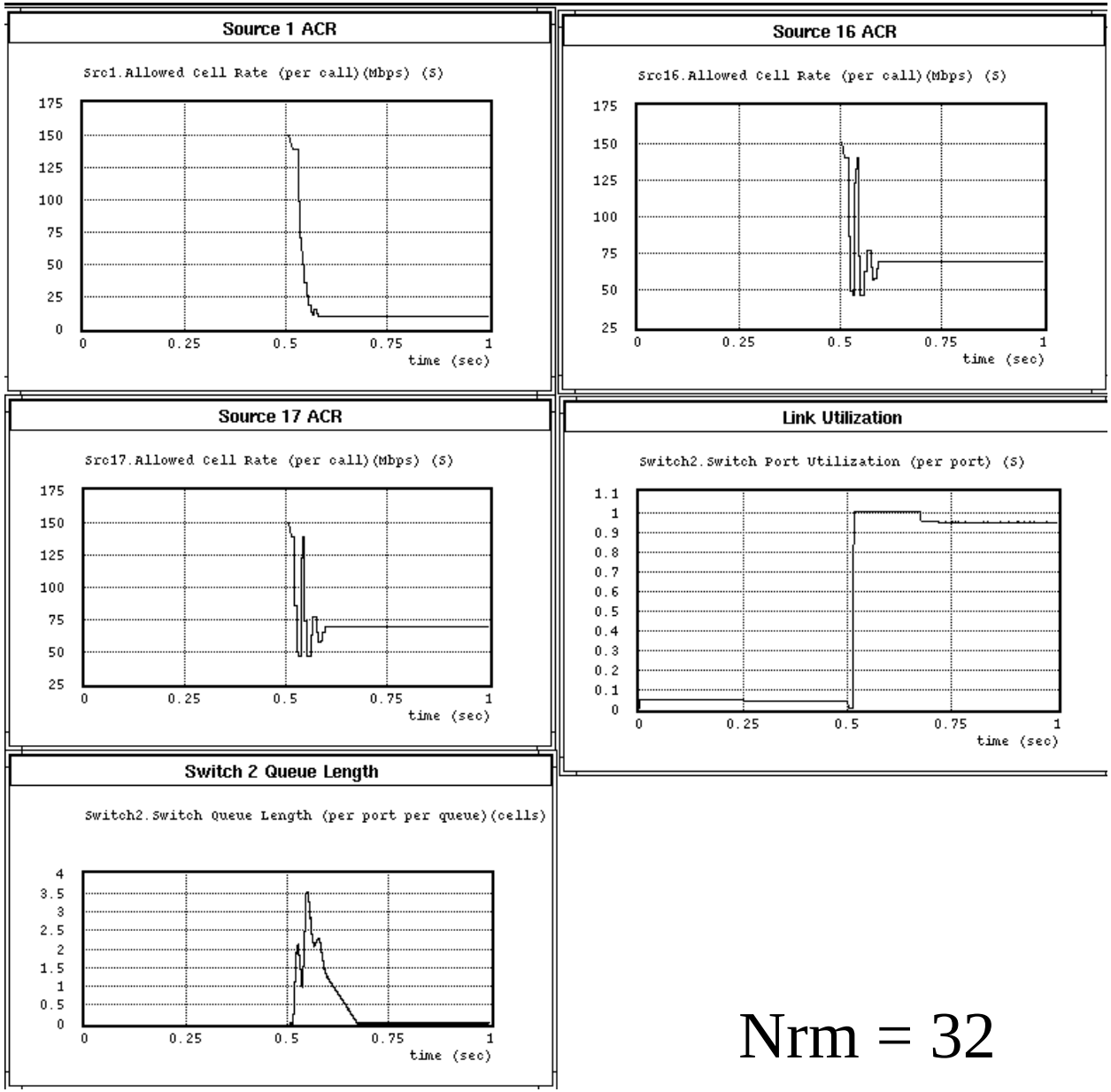


Fairness Configuration

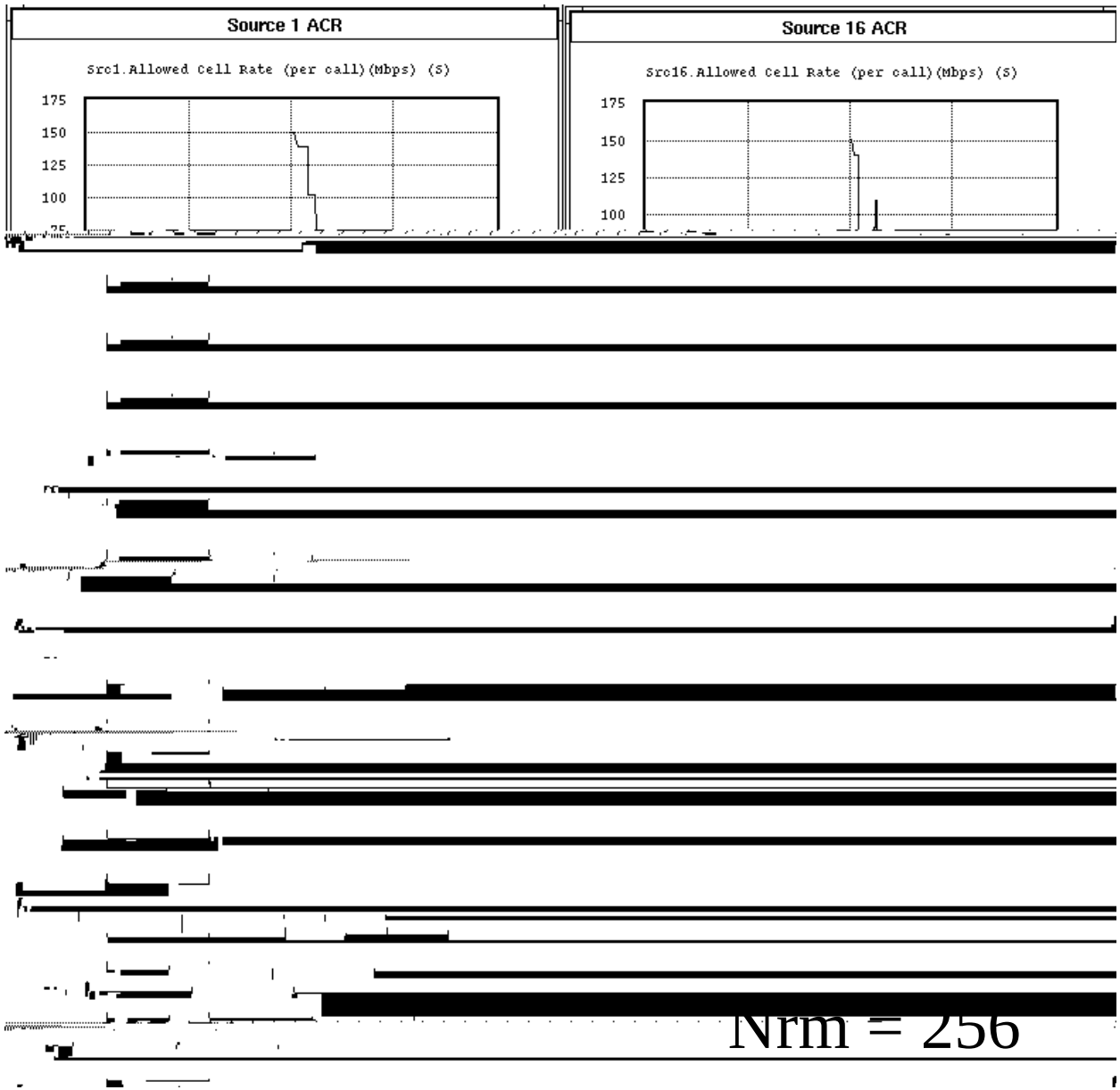
- Upstream bottleneck
- Link 1 shared by 15 connections
- Link 2 shared by 3 connections
- Sources 1 … 15 bottlenecked at 10 Mbps
- Sources 16, 17 sending at 100 Mbps load
- All sources send from t=0.5 sec to t=1.5 sec.



Fairness Configuration: Nrm = 8


Source 1 ACR
Src1.Allowed Cell Rate (per call)(Mbps) (S)
175
150
125
100
75
50
25
0
0
0.25
0.5
0.75
1
time (sec)
Source 16 ACR
Src16.Allowed Cell Rate (per call)(Mbps) (S)
175
150
125
100
75
50
25
0
0.25
0.5
0.75
1
time (sec)
Source 17 ACR
Src17.Allowed Cell Rate (per call)(Mbps) (S)
175
150
125
100
75
50
25
0
0.25
0.5
0.75
1
time (sec)
Link Utilization
Switch2.Switch Port Utilization (per port) (S)
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.25
0.5
0.75
1
time (sec)
Switch 2 Queue Length
Switch2.Switch Queue Length (per port per queue)(cells)
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.25
0.5
0.75
1
time (sec)

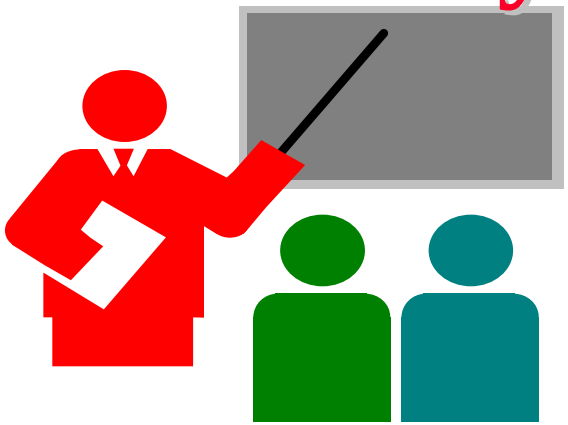
Nrm = 32


Source 1 ACR
Src1.Allowed Cell Rate (per call)(Mbps) (S)
175
150
125
100
Source 16 ACR
Src16.Allowed Cell Rate (per call)(Mbps) (S)
175
150
125
100
Nrm = 256

Simulation Results

- Transient configuration
  - When source 2 finishes transmission, with Nrm=8, source 1 reaches the optimal rate in a shorter time than with Nrm=256, especially when RIF=1/16
  - Lower Nrm ⇒ Large RM overhead
    ⇒ Lower application throughput
    ⇒ Source 2 finishes transmission in a longer time
- Fairness configuration
  - Faster convergence for lower Nrm

Summary



- New OPNET ABR model
- Simulation study of effect of Nrm on ABR feedback
- Lower Nrm results in faster convergence
- Lower Nrm results in higher RM cell overhead
- Varying ABR capacity not studied yet