

# Simulation Results for 3sm

draft-babiarz-pcn-explicit-marking-01

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69<sup>th</sup> IETF, July 25, 2007

# Update

> Added additional explanation of simulation setup that is used to verify performance of admission control and flow termination.

- Moved metering and marking to 3sm draft.

## > **Flow Termination**

- Performance in single and multi domain network
  - Large and small number of flows; CBR and VBR traffic mix.

## > **Admission Control**

- Summarized results with 2x overload, Poisson arrivals, 20 minutes (10 x 2)

Graphical results at <http://standards.nortel.com/pcn/3sM-Simulation-1.pdf>

# Flow Termination Summarized Results.

## Convergence time for overload removal in response to a step overload

Fast Reroute with 200% overload.					% Overload; time in sec.				Bandwidth in Mbps			
Sim#	SR	Traffic	RTT	"S"	150%	125%	110%	100%	AVG	Max	Min	Var
JB372	40Mbps	G.711CBR	50	1064	0.15	0.2	0.25	0.5	40	40	40	0
JB373	40Mbps	3VBR+CBR	50	1064	0.15	0.2	0.3	~2	38.9	41.7	36.7	5
JB370	0.8Mbps	G.711CBR	50	1064	0.2	0.25	0.3	0.4	0.8	0.8	0.8	0
JB371	0.8Mbps	3VBR+CBR	50	1064	0.25	0.35	0.40	~2	0.74	1.07	0.50	0.57
JB360	40Mbps	G.711CBR	50	2064	0.15	0.3	0.45	1.2	40	40	40	0
JB361	40Mbps	3VBR+CBR	50	2064	0.2	0.35	0.85	~3	38.9	41.8	36.3	5.5
JB364	0.8Mbps	G.711CBR	50	2064	0.3	0.4	0.6	0.65	0.8	0.8	0.8	0
JB365	0.8Mbps	3VBR+CBR	50	2064	0.3	0.35	0.45	~4	0.74	1.05	0.51	0.54
JB268	40Mbps	G.711CBR	200	4064	0.45	0.65	0.9	1.6	40	40	40	0
JB367	40Mbps	3VBR+CBR	200	4064	0.45	0.75	1.7	~4	38.9	42.3	36.1	6.2

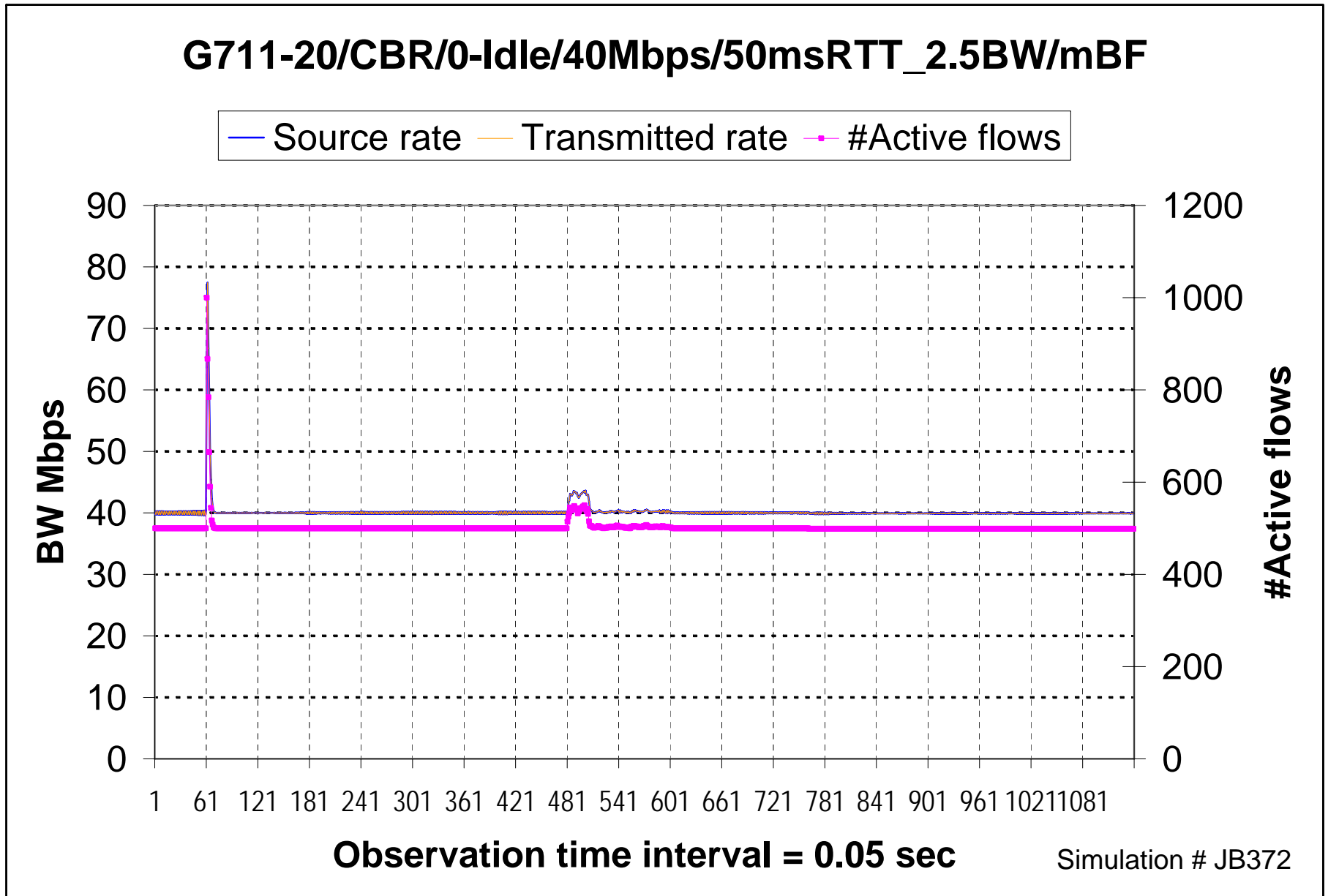
Fast Reroute with 150% overload.					% Overload; time in sec.				Bandwidth in Mbps			
Sim#	SR	Traffic	RTT	"S"	150%	125%	110%	100%	AVG	Max	Min	Var
JB326	40Mbps	G.711CBR	50	2064	-	0.2	0.35	1.05	40	40	40	0
JB327	40Mbps	3VBR+CBR	50	2064	-	0.2	0.4	~2	38.7	41.6	35.4	6.3

Average rate was measured over 12 seconds.  
"s" is in bytes

SR = 40 Mbps; TB size = 50K bytes  
SR = 0.8 Mbps; TB size = 10K bytes

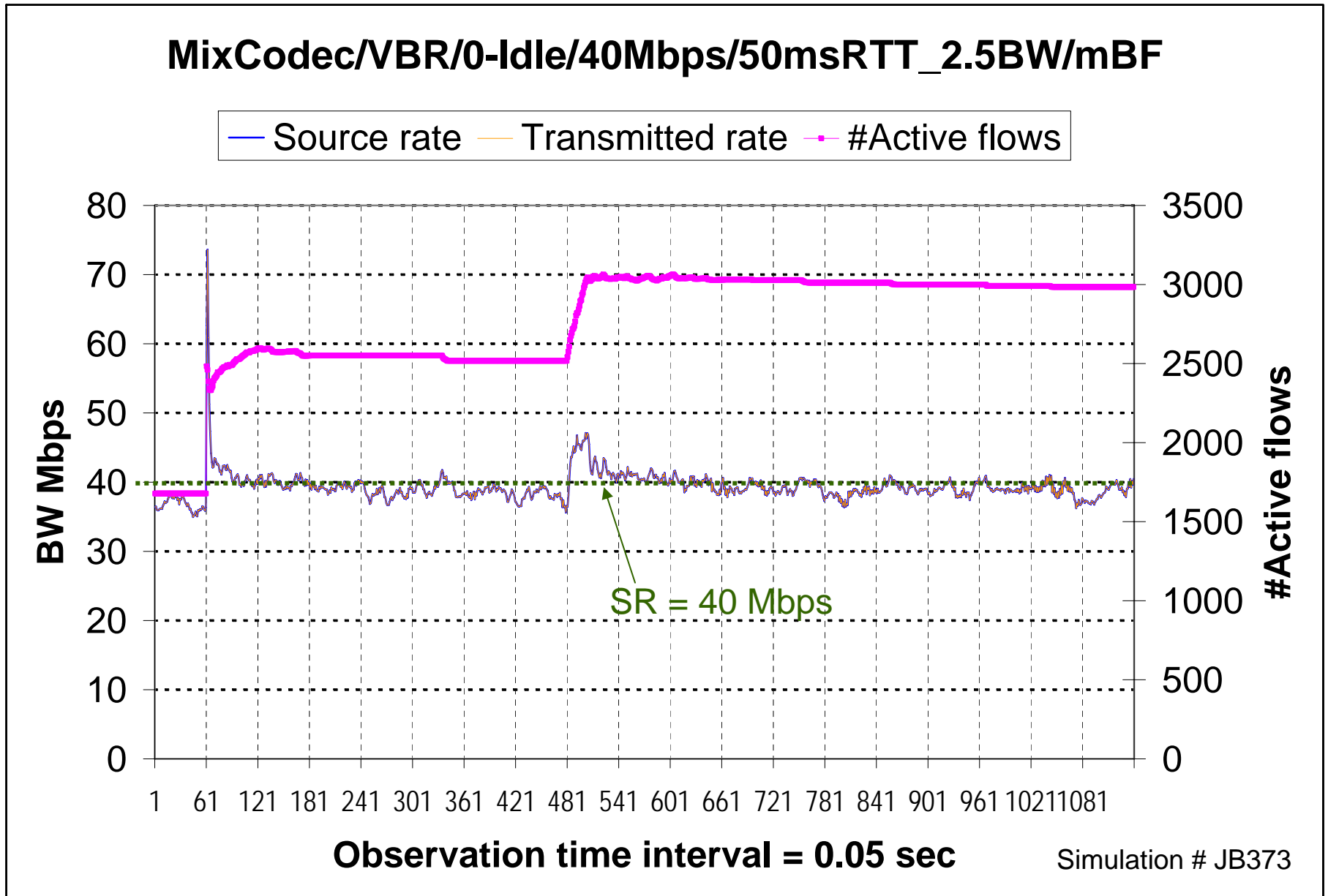
Token Bucket Parameter Setting  
TB size = 50K bytes  
"s" = 1.064K bytes

Supportable Rate = 40 Mbps  
Service Class BW limit = 100 Mbps  
Buffer size = 10,000 bytes



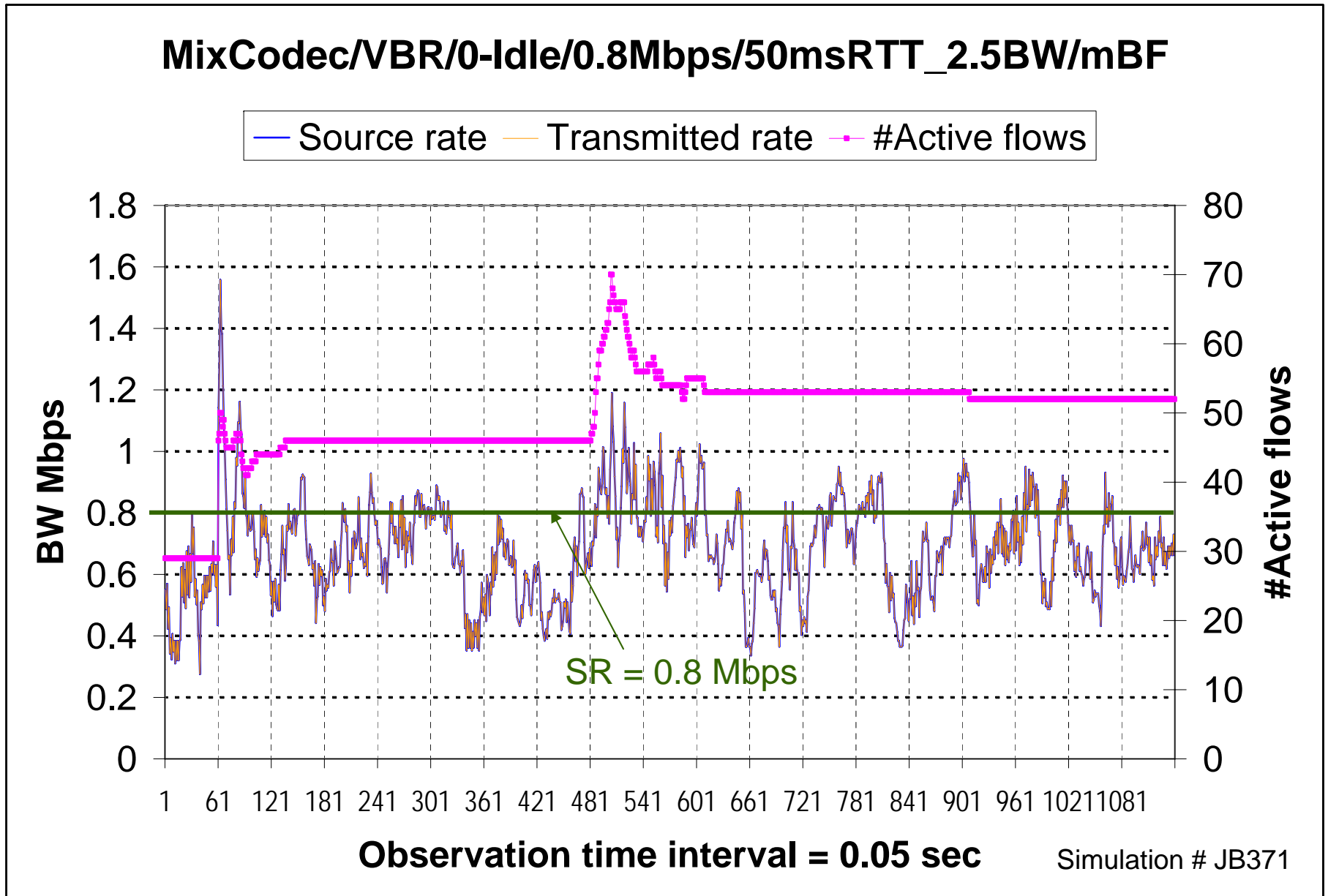
Token Bucket Parameter Setting  
TB size = 50K bytes  
"s" = 1.064K bytes

Supportable Rate = 40 Mbps  
Service Class BW limit = 100 Mbps  
Buffer size = 9,250 bytes



Token Bucket Parameter Setting  
TB size = 10K bytes  
"s" = 1.064K bytes

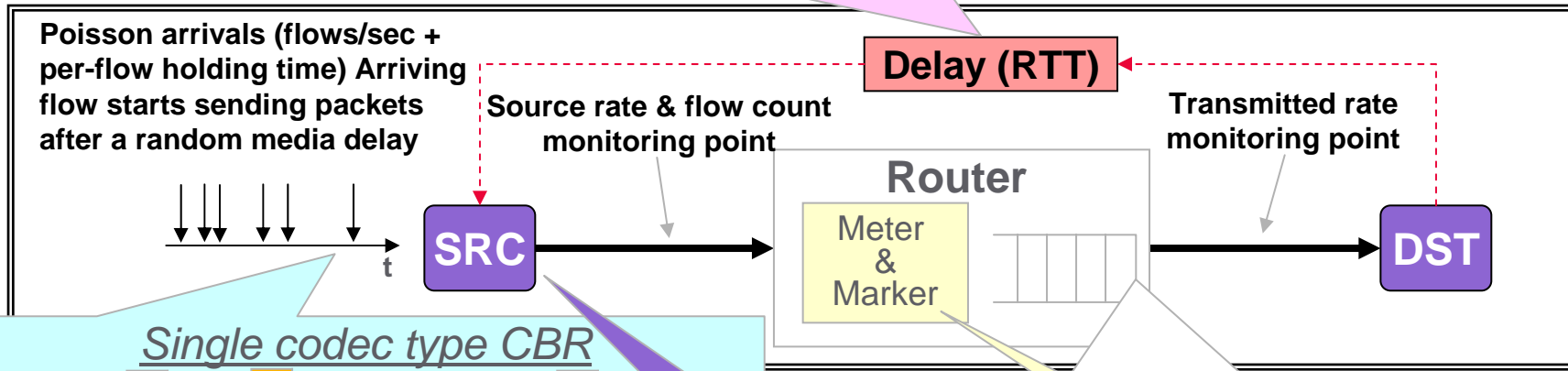
Supportable Rate = 0.8 Mbps  
Service Class BW limit = 2 Mbps  
Buffer size = 9,250 bytes



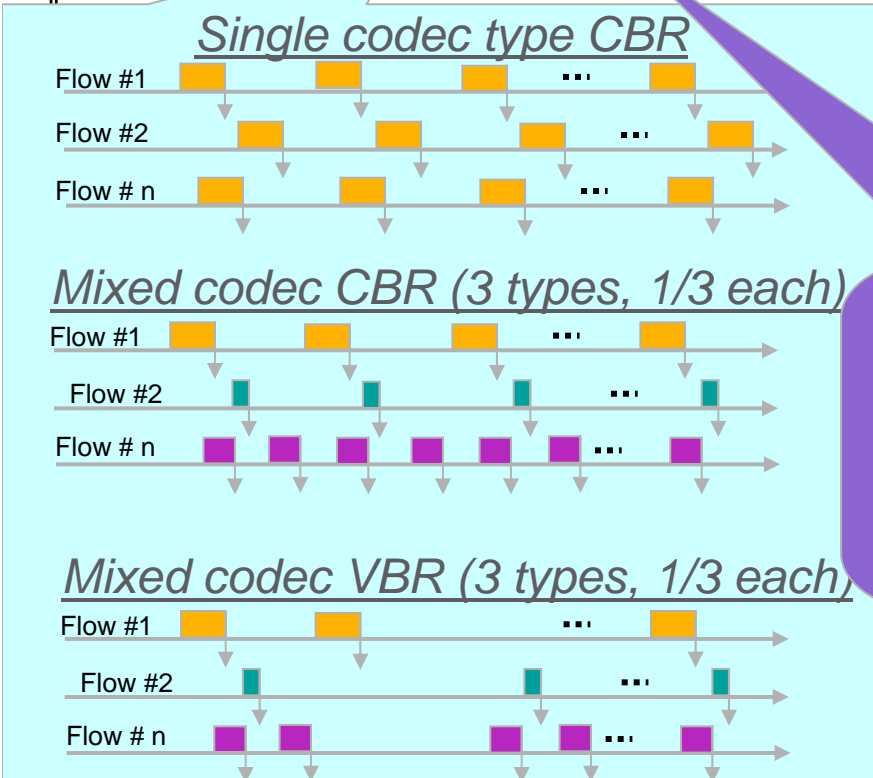
# Admission Control Simulation Setup for Voice

Updated July, 2007

## Simulation Model



**“AS” Flag with Delay = RTT (2, 50, 200 ms)**



**Forwarding Rate and Queue Size**  
 Rate: X times AR; Queue: unlimited or configurable

**AC algorithm:**

- Block admission on 1st AS-marked packet
- Resume admission on timeout if not receiving more AS flags in timeout

**3sM & parameters:**

- AR in Mbps;**
- TB.size in K bytes;**
- TB.thershold in K bytes**

## Simulation Parameters for Admission Control

- > Test the proposed 3sm AR-meter/marker with fixed TB size and threshold and AR proportional to traffic load
  - Target flows: 10 and 200
  - RTT: 2 ms and 200 ms
  - Delay to media start: 0 and random up to 10 seconds
  - Codec: CBR vs. VBR (silence suppression)



# Admission Control Summarized Results

Case	Target: Data Rate (Mbps) / Flows	AR (Mbps)	Flow Arrival Rate (flows/s)	Offered Load (Mbps)	RTT (ms)	Max Media Delay (s)	% Flow Blocked	Avg Flow Over- shoot	Max Flow Over- shoot	Data Rate to Target Rate Ratio	% Time Peak Rate Over- shoot	Avg Peak Rate Over- shoot (kbps)
CBR-10-a	0.8 / 10	0.72	0.375	1.8	2	0	56%	1.03	2	88%	5%	81.4
CBR-10-c	0.8 / 10	0.72	0.375	1.8	200	0	57%	1	1	88%	4%	79.4
CBR-200-a	16 / 200	15.92	7.5	36	2	0	57%	1.75	5	98%	15%	135.8
CBR-200-c	16 / 200	15.92	7.5	36	200	0	56%	2.419	8	98%	19%	189.5
VBR-10-a	0.32 / 10	0.28	0.375	0.7	200	0	60%	1.43	4	88%	0.3%	35.8
VBR-200-a	6.32 / 200	6.29	7.5	13.95	200	0	58%	3.765	13	95%	0.0%	47.3
CBR-10-b	0.8 / 10	0.72	0.375	1.8	2	10	54%	1.84	5	90%	17%	110.0
CBR-10-d	0.8 / 10	0.72	0.375	1.8	200	10	48%	1.798	5	90%	20%	108.1
CBR-200-b	16 / 200	15.92	7.5	36	2	10	55%	19.30	49	99%	43%	711.6
CBR-200-d	16 / 200	15.92	7.5	36	200	10	54%	20.33	53	99%	44%	804.2
VBR-10-b	0.32 / 10	0.28	0.375	0.7	200	10	57%	1.91	5	87%	0.4%	31.4
VBR-200-b	6.32 / 200	6.29	7.5	13.95	200	10	58%	13.87	56	96%	0.2%	122.7
In above table: AS-clear timer = 1sec.					In below table: AS-clear timer = 0.1sec.							
CBR-200-c*	16 / 200	15.92	7.5	36	200	0	56%	2.344	10	99%	30%	183.6
CBR-200-d*	16 / 200	15.92	7.5	36	200	10	54%	20.72	57	100%	48%	778.8
VBR-200-a*	6.32 / 200	6.29	7.5	13.95	200	0	56%	6.025	25	100%	0.2%	98.5
VBR-200-b*	6.32 / 200	6.29	7.5	13.95	200	10	55%	18.4	49	100%	0.4%	157.0

In all cases: TB size=20 Kbytes; Threshold=10 Kbytes;  
 CBR=G.711/20ms-80kbps; VBR=G.711/20ms-silence suppression-32kbs; Mean Holding Time=60 s

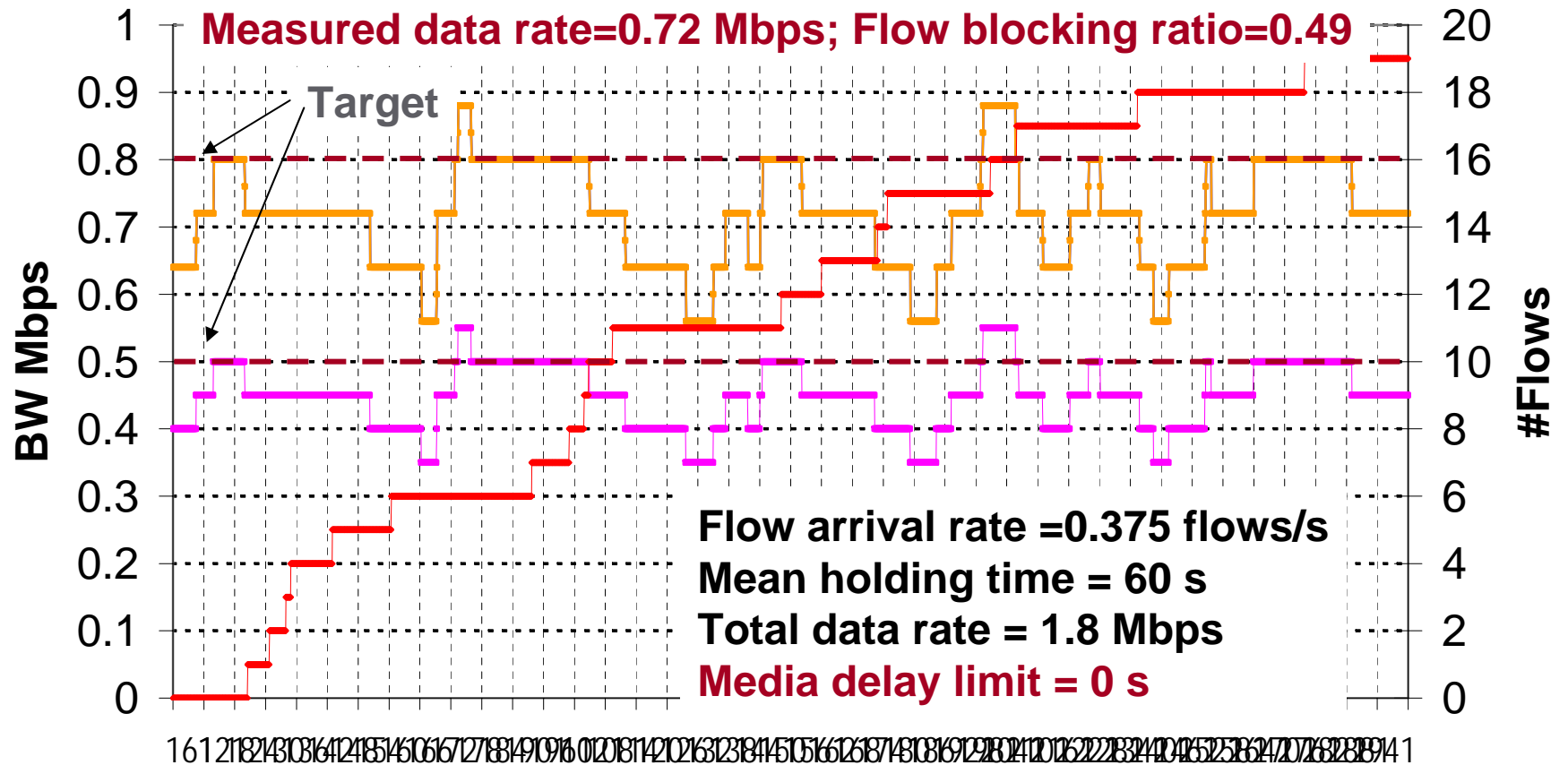
Stats based on 10 two-minute-runs = 20 minutes

Token Bucket Parameter Setting  
 TB size = 20K bytes  
 Threshold = 10K bytes

Admissible Rate = 0.72 Mbps  
 Target Data Rate = 0.8 Mbps = 10 flows  
 Link BW = 1.6 Mbps Buffer size unlimited

### G711-20/CBR/0.8Mbps/2msRTT\_2BW/IBF

— Source rate — Transmitted rate — #Active flows — #Blocked flows

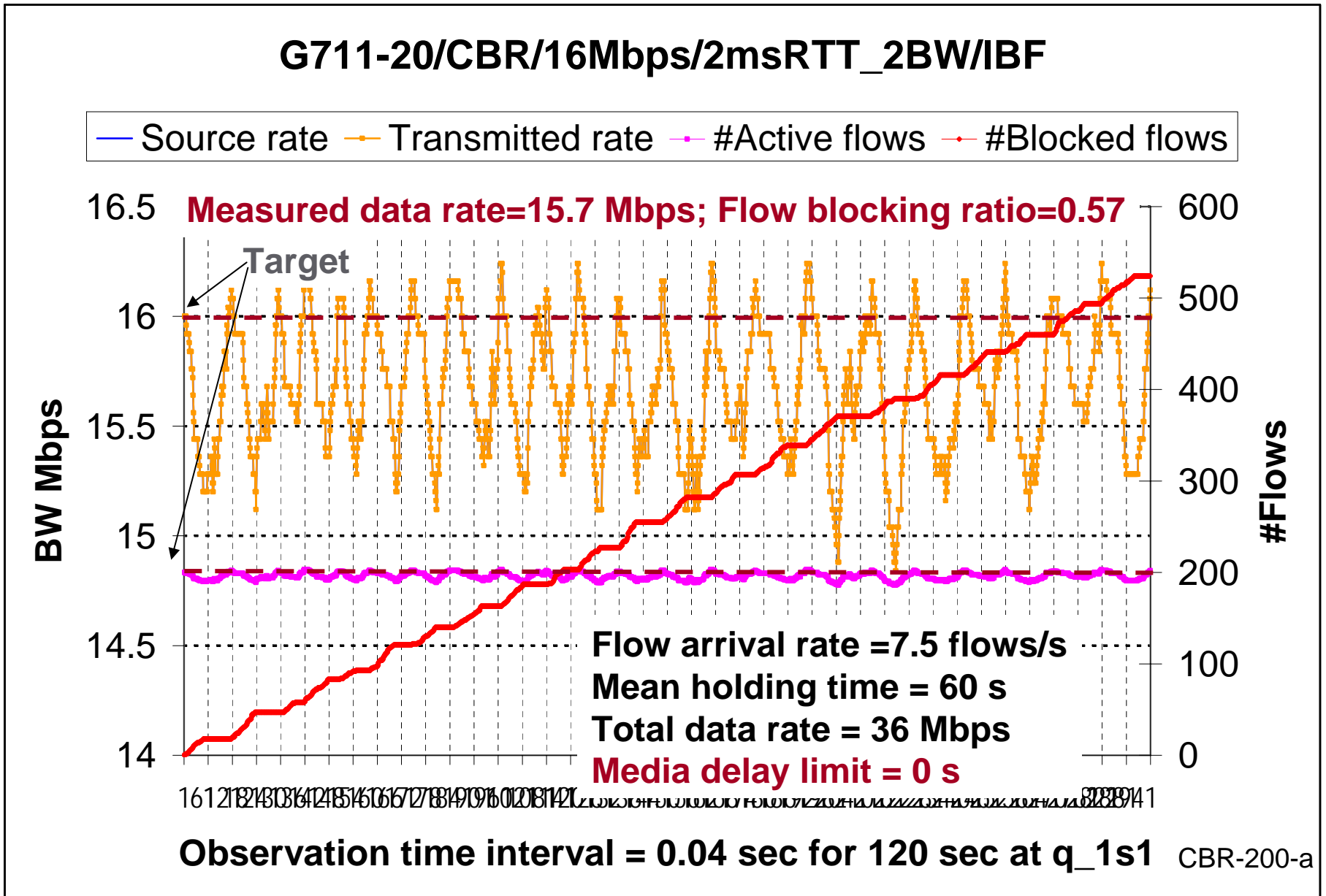


Observation time interval = 0.04 sec for 120 sec at q\_1s1

CBR-10-a

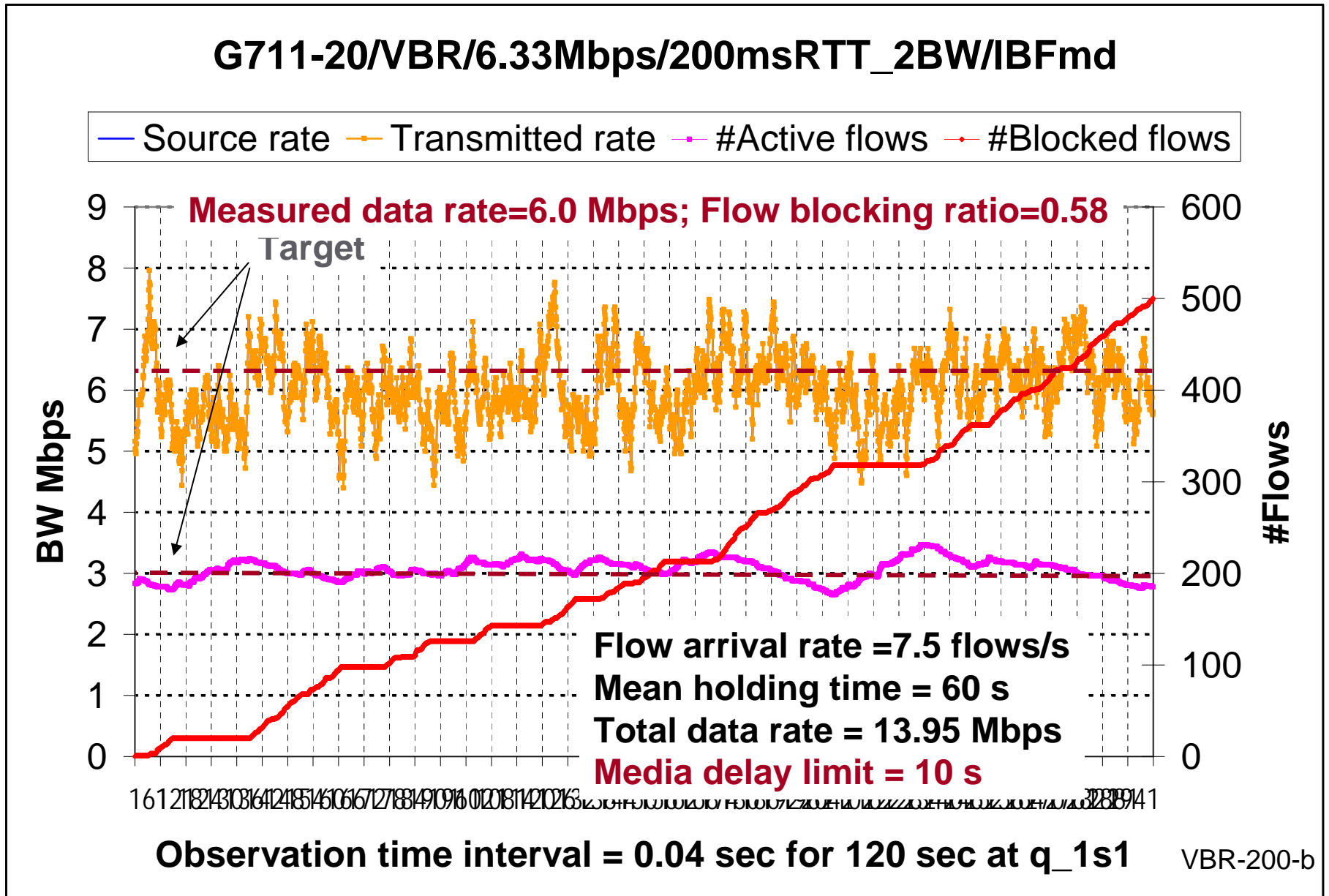
Token Bucket Parameter Setting  
TB size = 20K bytes  
Threshold = 10K bytes

Admissible Rate = 15.92 Mbps  
Target Data Rate = 16 Mbps = 200 flows  
Link BW = 32 Mbps Buffer size unlimited



Token Bucket Parameter Setting  
TB size = 20K bytes  
Threshold = 10K bytes

Admissible Rate = 6.29 Mbps  
Target Data Rate = 6.32 Mbps = 200 flows  
Link BW = 12.64 Mbps Buffer size unlimited



# Observation

## > Flow Termination

- Token bucket size:
  - Filters out burstness
- “s” FT-marking reduction factor:
  - $S = \text{“average?” rate of flow} \times \text{RTT} \times 2$
  - It has the biggest impact on how fast or slow excess traffic is reduced
  - Setting “s” too small will cause over flow termination
- Is effective when there are large or small number of flows at the congestion point

## > Admission Control

- Is effective in blocking new flows once in stop-admit state
- Over admission is an issue
  - mostly due to delay in start of media (telephony application)
  - and  $\text{TB.size} - \text{TB.treshold}$  that is used to filter out burstness
- $\text{TB.size} - \text{TB.treshold}$  needs to be scaled to admissible rate (AR)
- Multiple pre-congestion points and cross traffic (parking lot) had very little to no effect on AS-marking and admission control.

# Further Work

## > Flow Termination

- Verify performance with multi congestion points and cross traffic “parking lot”
- Provide guidelines on how to compute value for “s”

## > Admission Control

- Investigate if probing during flow setup can address the over admission issue.
- Investigate performance when there are low number of highly variable flows at the pre-congestion point.