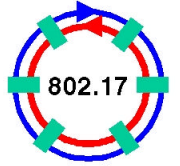


Single and Dual Transit Buffer Interactions

Necdet Uzun and Carey Kloss

Goals

- Standard shall allow single and dual transit path implementations
- Same fairness algorithm shall be used for both
- Nodes should interoperate with minimum effects on fairness, utilization and HP delay jitter

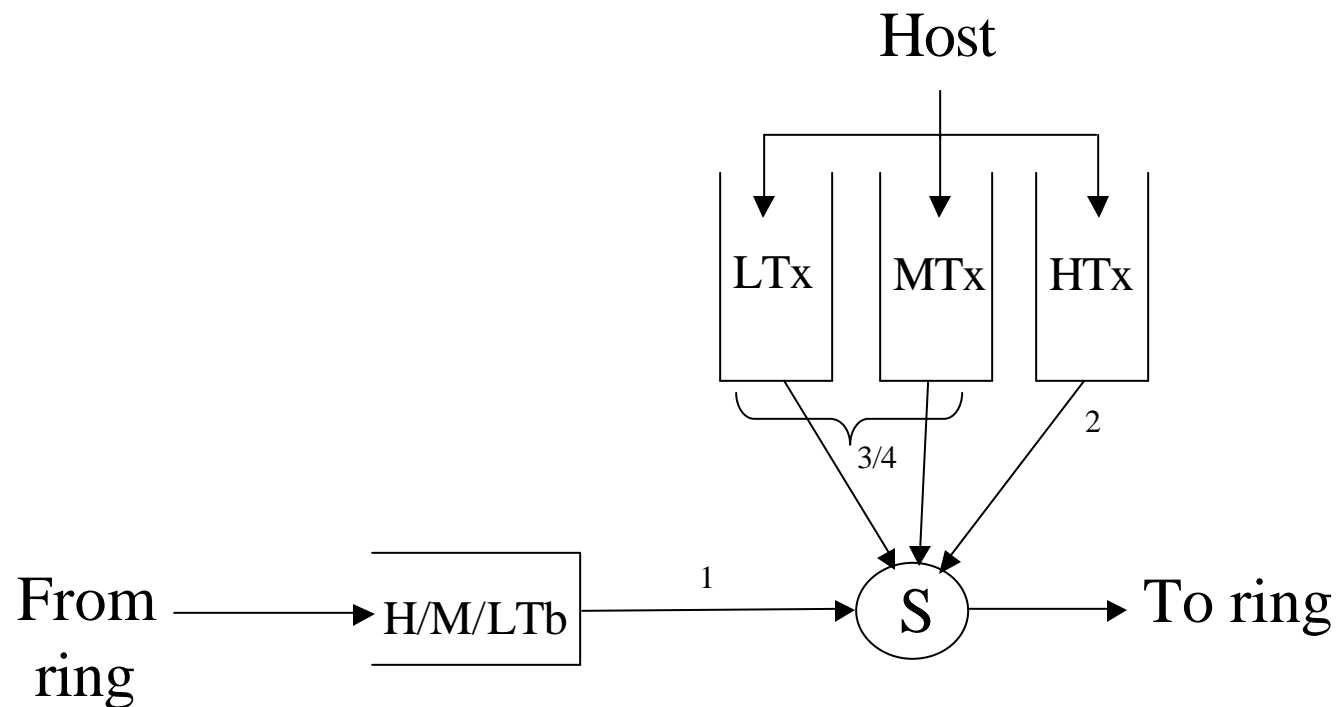


Requirements for Single Buffer

- Basic RPR fairness scheme
- Congestion detection:
 - Outgoing link utilization threshold reached
- Dynamic rate shapers on add traffic
- Rate Limiter on low priority add traffic

Node Model 1TB

- Single transit buffer
- Three transmit buffers
 - 3 token bucket counter for HP, cMP, eMP+LP

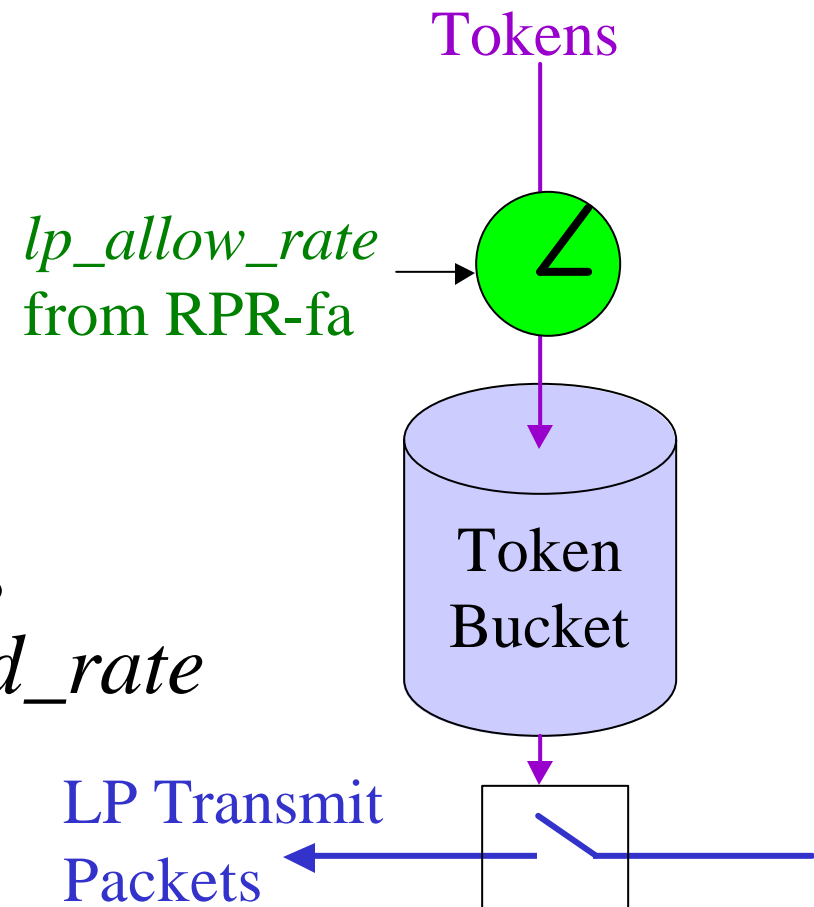


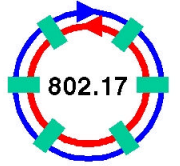
Congestion Triggers

- Outgoing link utilization based
 - Byte counter on outgoing link ($util_cnt$)
 - Low pass filtered:
$$lp_util_cnt = lp_util_cnt + (util_cnt - lp_util_cnt)/k$$
 - Congestion state *entered* when:
 - $lp_util_cnt > (high_congestion_th * LRATE)$
 - Congestion state *left* when:
 - $lp_util_cnt < (low_congestion_th * LRATE)$

Dynamic Rate Shaper

- Smoothes bursts thus improves delay jitter
- Simple leaky bucket
- Rate based on low pass filtered RPR-fa *allowed_rate* value



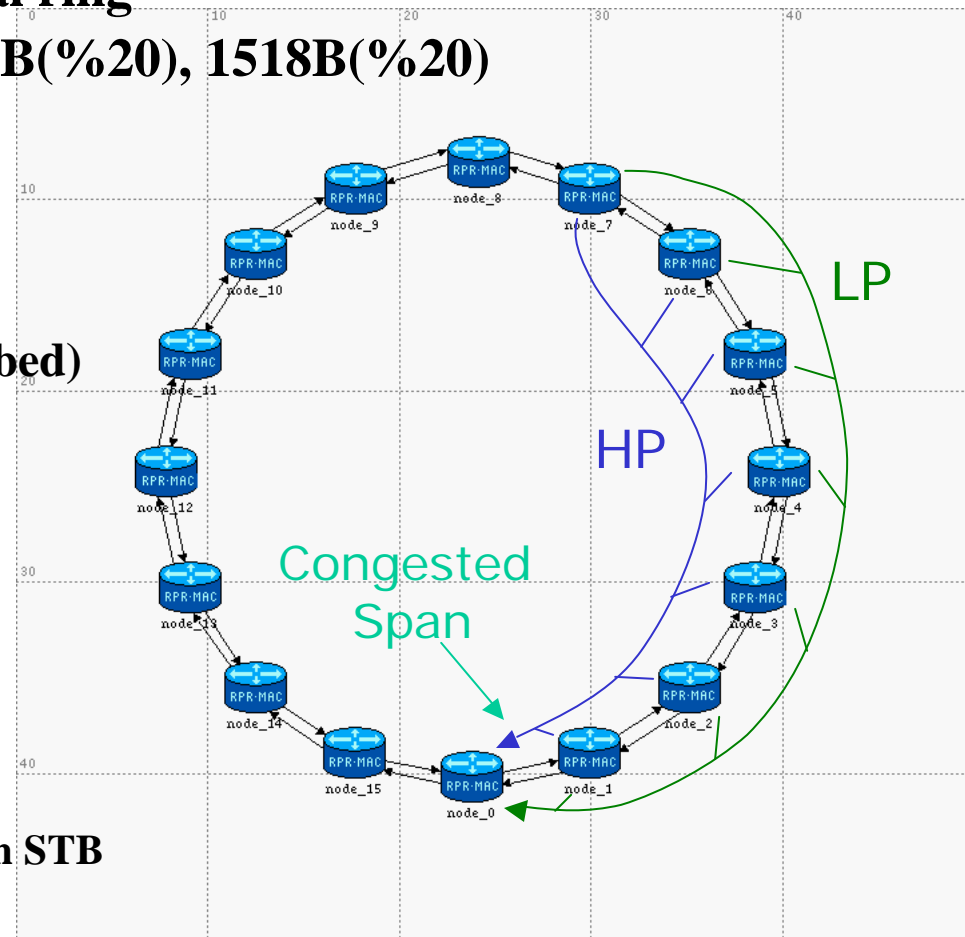


Fixed Rate Limiter (BW reservation)

- Reserves percentage of outgoing link
 - Needed to ensure packet train does not stall HP add traffic for long periods of time on SPB nodes
- Single Transit Buffer (STB) implementation
 - Limits LP add traffic if: $util_cnt > (pct * LR)$
- Dual Transit Buffer (DTB) implementation
 - Limits LP add traffic & LP transit traffic.

Scenarios

- 16 node, 100Km, OC12 dual ring
- Packet size: 64B(%60), 512B(%20), 1518B(%20)
- Each node sources:
 - 31.3Mbps HP
 - Starts at 0.22s
 - 711Mbps LP (oversubscribed)
 - Starts at 0.2s
- Single TB
 - Tb = 32KB
- Dual TB
 - HTb = 32KB
 - LTb = 256KB
 - 95% util cap when mixed with STB
- **Last span congested**



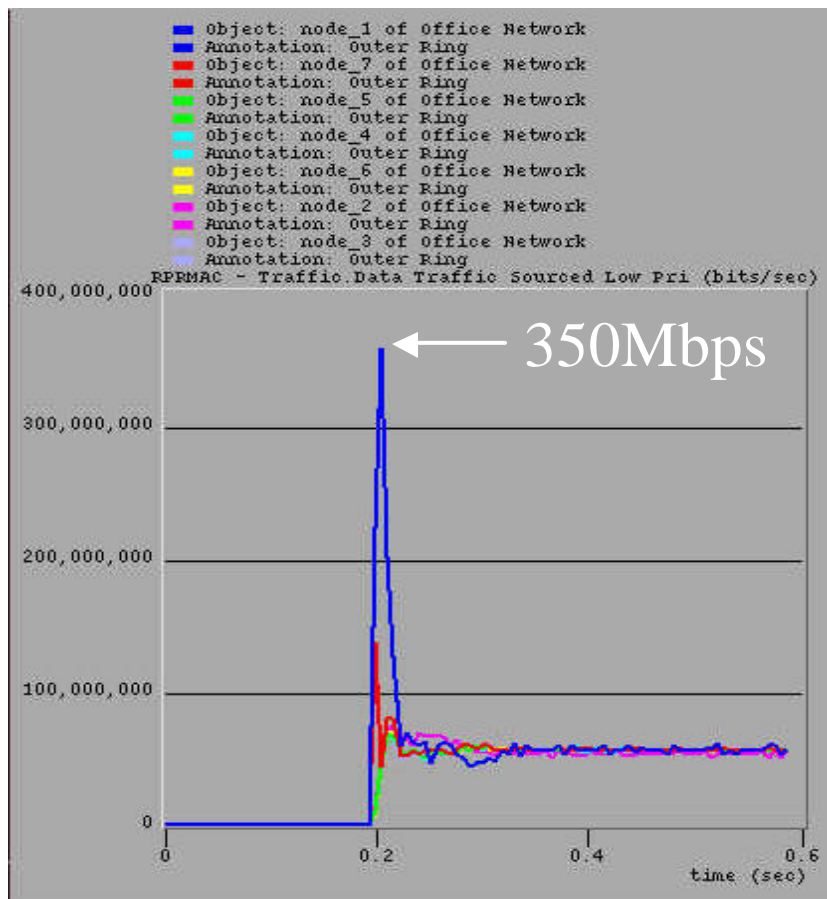
Configurations

Name	DTB Nodes	STB Nodes
AllDTB	All	
AllSTB	All	
DTBinBack	7,6,5*	4,3,2,1
STBinBack	4,3,2,1*	7,6,5
Mixed	6,4,2*	7,5,3,1

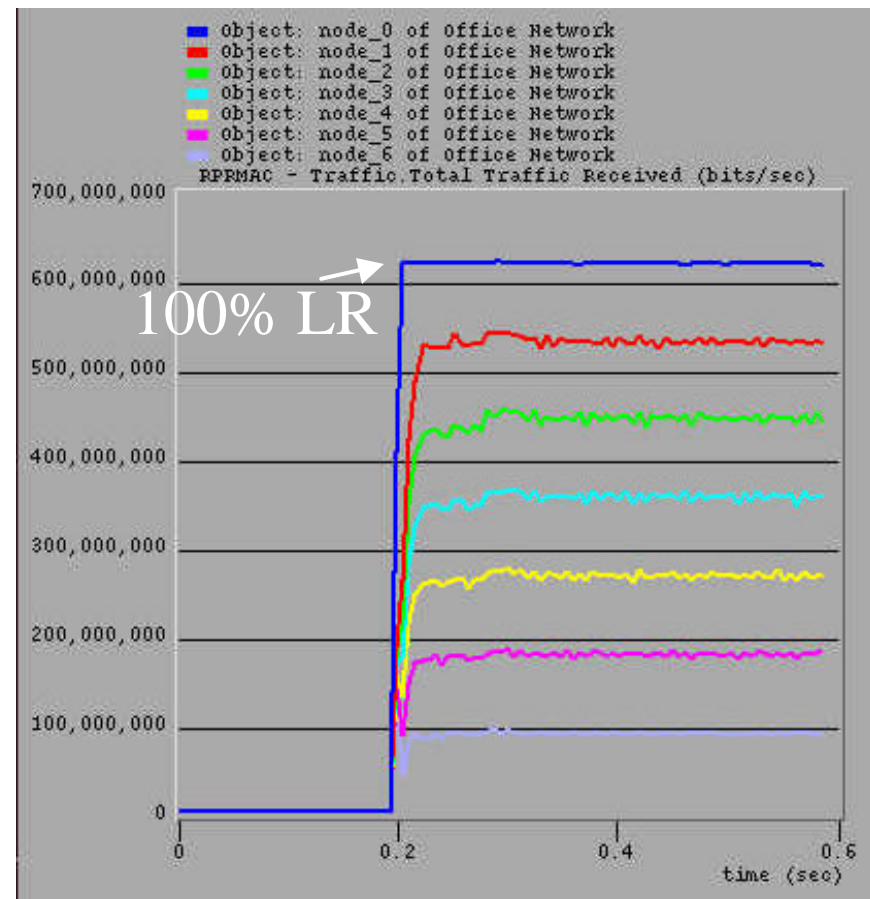
* 95% outgoing LP link utilization cap on DTB nodes

AllSTB Bandwidth – No Shapers

Low Pri Sourced Traffic

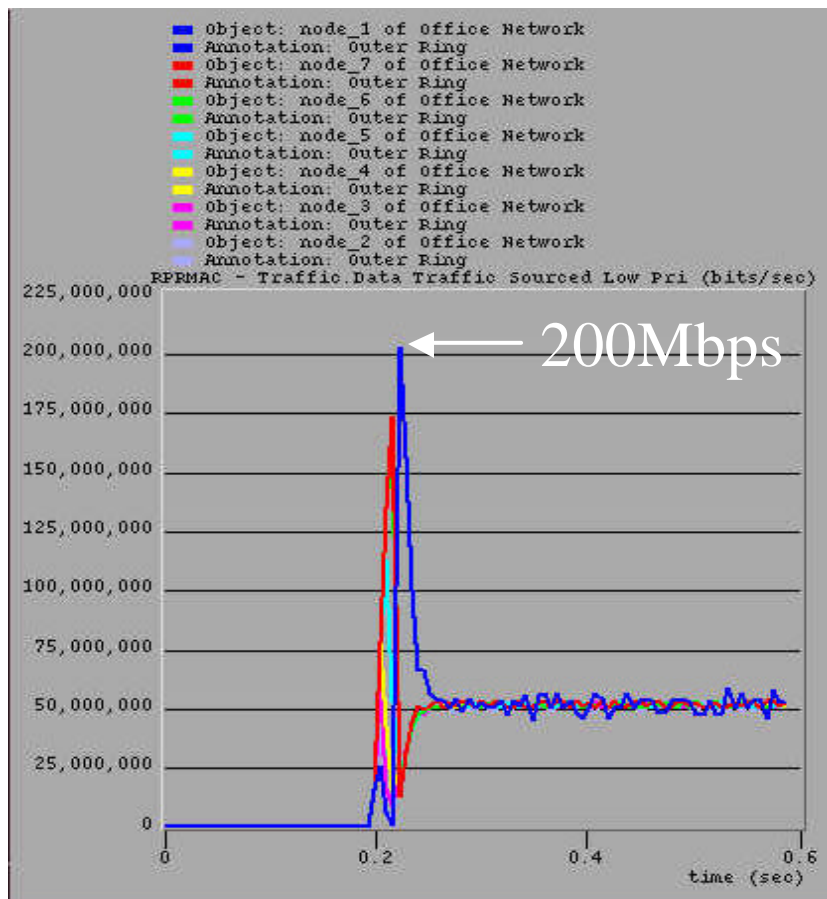


Received Bandwidth

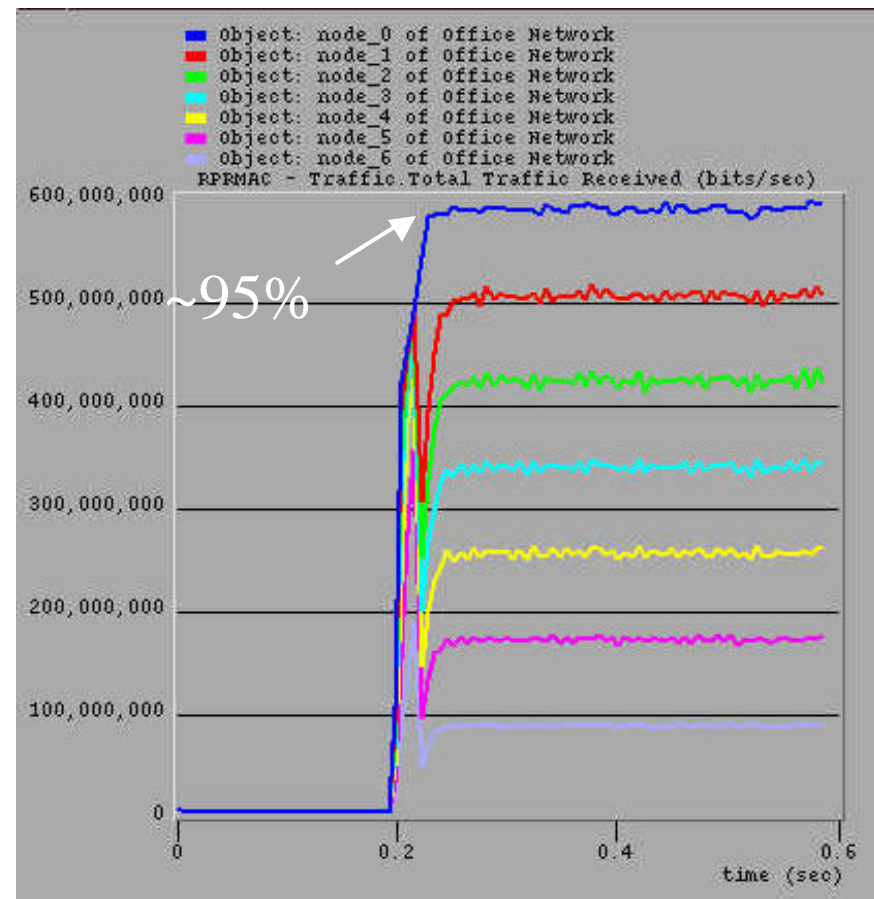


AllSTB Bandwidth – Shapers

Low Pri Sourced Traffic



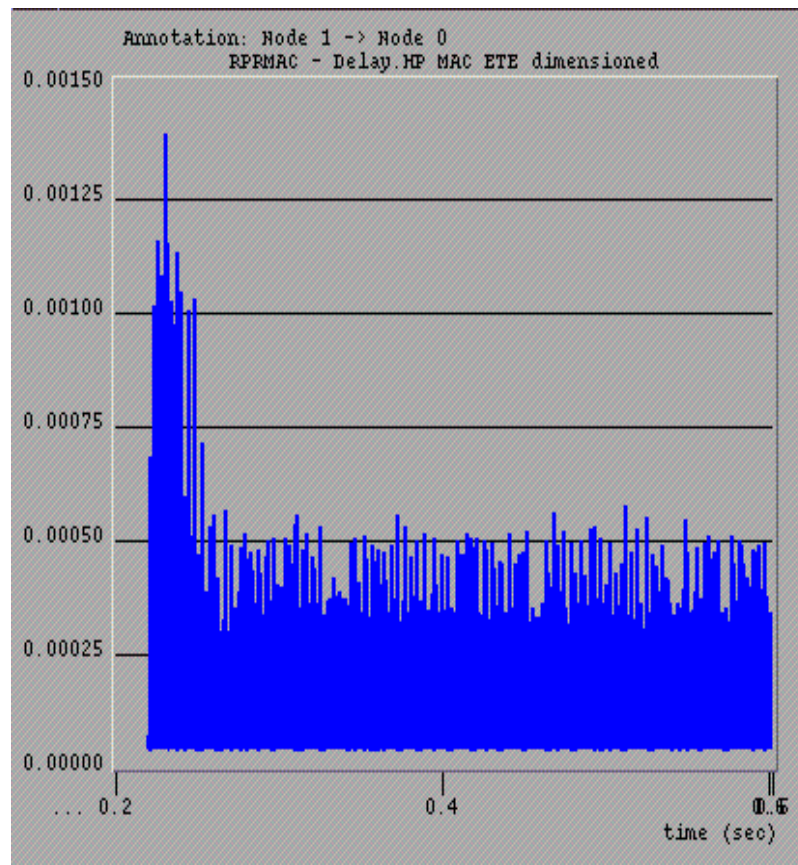
Received Bandwidth



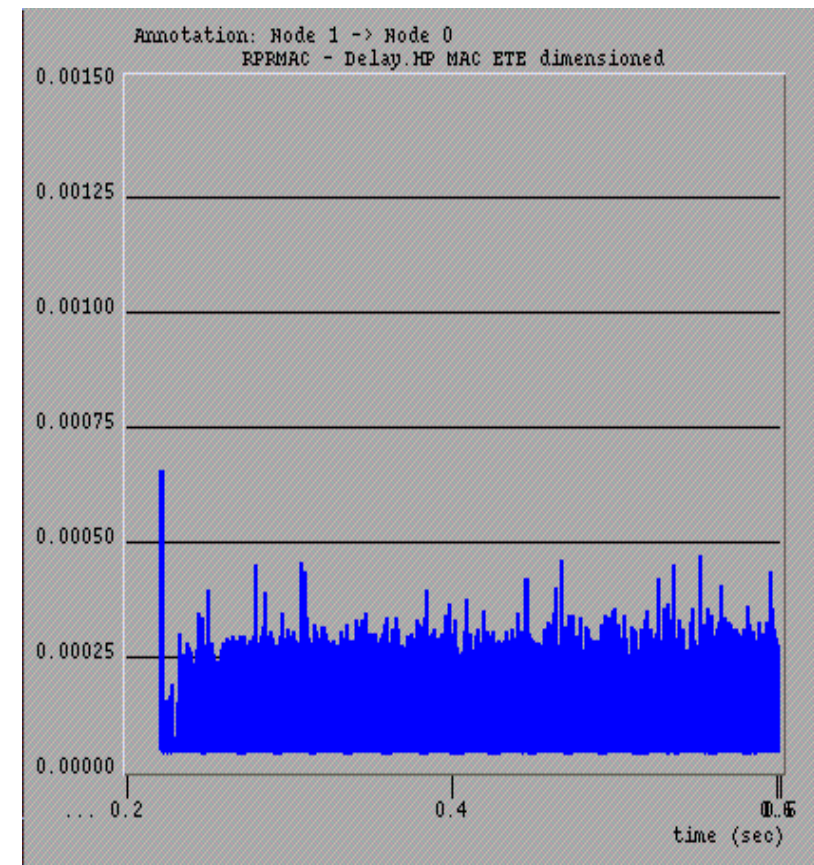
Effects of Shapers on STB Delay

HP MAC ETE Delays

No Shapers



Shapers



Effect of Shapers - MAC ETE Delay

AllSTB Configuration - No Shapers

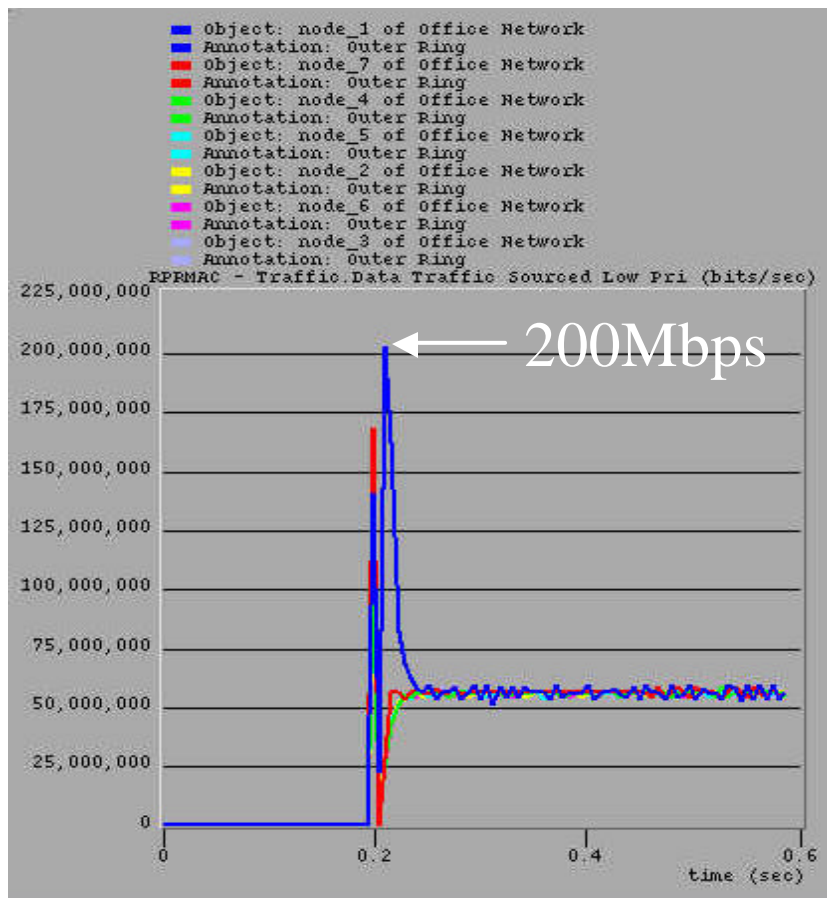
	Minimum	Average	Maximum	Std Dev	Jitter (Max-Min)
Node 7 -> Node 0	0.0002270	0.0003180	0.0004400	0.00004100	0.0002130
Node 6 -> Node 0	0.0001950	0.0002800	0.0003800	0.00003400	0.0001850
Node 5 -> Node 0	0.0001620	0.0002430	0.0003300	0.00002800	0.0001680
Node 4 -> Node 0	0.0001290	0.0002050	0.0003300	0.00002500	0.0002010
Node 3 -> Node 0	0.0000980	0.0001630	0.0004900	0.00003200	0.0003920
Node 2 -> Node 0	0.0000650	0.0001190	0.0005400	0.00005700	0.0004750
Node 1 -> Node 0	0.0000320	0.0000610	0.0013800	0.00013300	0.0013480

AllSTB Configuration - Shapers

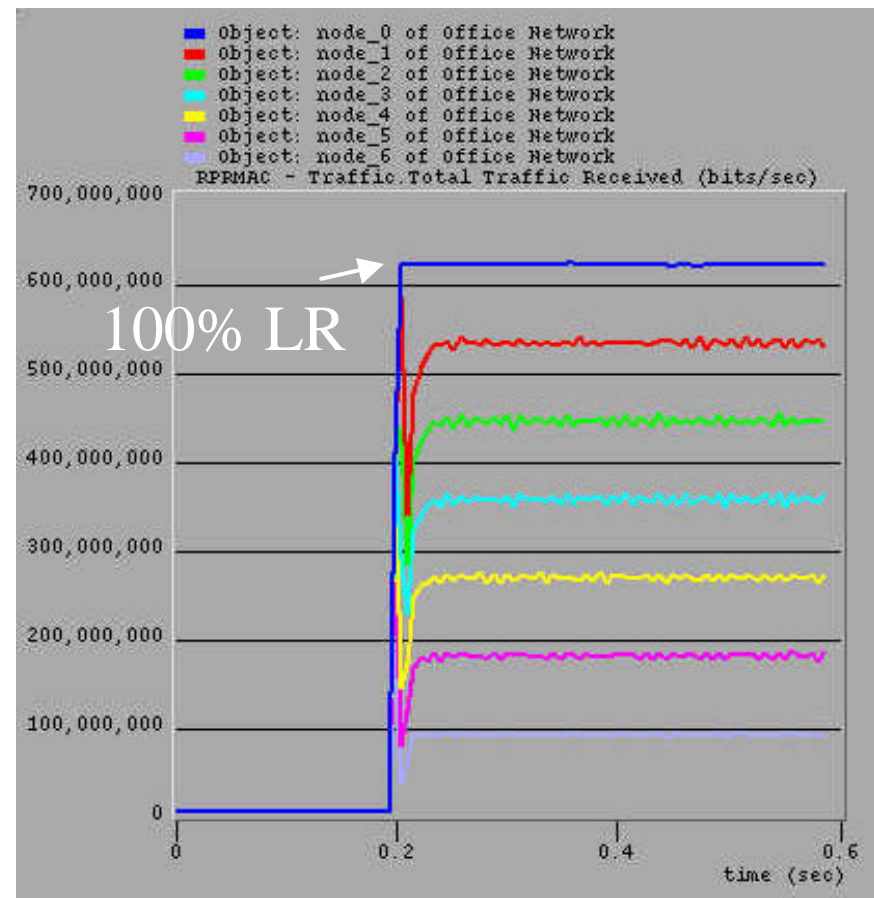
	Minimum	Average	Maximum	Std Dev	Jitter (Max-Min)
Node 7 -> Node 0	0.0002260	0.0003070	0.0004310	0.00004400	0.0002050
Node 6 -> Node 0	0.0001940	0.0002720	0.0003950	0.00003740	0.0002010
Node 5 -> Node 0	0.0001620	0.0002340	0.0003390	0.00003140	0.0001770
Node 4 -> Node 0	0.0001290	0.0001990	0.0003450	0.00002660	0.0002160
Node 3 -> Node 0	0.0000970	0.0001560	0.0003960	0.00002850	0.0002990
Node 2 -> Node 0	0.0000650	0.0001110	0.0004600	0.00004610	0.0003950
Node 1 -> Node 0	0.0000320	0.0000600	0.0006490	0.00008790	0.0006170

DTB Bandwidth – No Shapers

Low Pri Sourced Traffic



Received Bandwidth



HP MAC ETE Delay: Base Cases

AllDTB Configuration – No Shapers

	Minimum	Average	Maximum	Std Dev	Jitter (Max-Min)
Node 7 -> Node 0	0.0002270	0.0002900	0.0004540	0.00005140	0.0002270
Node 6 -> Node 0	0.0001940	0.0002530	0.0003840	0.00004320	0.0001900
Node 5 -> Node 0	0.0001620	0.0002200	0.0003260	0.00003310	0.0001640
Node 4 -> Node 0	0.0001290	0.0001900	0.0002660	0.00002740	0.0001370
Node 3 -> Node 0	0.0000970	0.0001450	0.0002310	0.00002420	0.0001340
Node 2 -> Node 0	0.0000650	0.0000970	0.0001790	0.00001960	0.0001140
Node 1 -> Node 0	0.0000320	0.0000490	0.0001060	0.00001110	0.0000740

AllSTB Configuration - Shapers

	Minimum	Average	Maximum	Std Dev	Jitter (Max-Min)
Node 7 -> Node 0	0.0002260	0.0003070	0.0004310	0.00004400	0.0002050
Node 6 -> Node 0	0.0001940	0.0002720	0.0003950	0.00003740	0.0002010
Node 5 -> Node 0	0.0001620	0.0002340	0.0003390	0.00003140	0.0001770
Node 4 -> Node 0	0.0001290	0.0001990	0.0003450	0.00002660	0.0002160
Node 3 -> Node 0	0.0000970	0.0001560	0.0003960	0.00002850	0.0002990
Node 2 -> Node 0	0.0000650	0.0001110	0.0004600	0.00004610	0.0003950
Node 1 -> Node 0	0.0000320	0.0000600	0.0006490	0.00008790	0.0006170

HP MAC ETE Delay: Mixed

DTBinBack - Shapers

	Minimum	Average	Maximum	Std Dev	Jitter (Max-Min)
Node 7 -> Node 0	0.0002270	0.0003080	0.0004230	0.00004220	0.0001960
Node 6 -> Node 0	0.0001940	0.0002720	0.0003870	0.00003590	0.0001930
Node 5 -> Node 0	0.0001620	0.0002350	0.0003210	0.00002900	0.0001590
Node 4 -> Node 0	0.0001290	0.0001990	0.0003450	0.00002590	0.0002160
Node 3 -> Node 0	0.0000970	0.0001550	0.0004440	0.00002860	0.0003470
Node 2 -> Node 0	0.0000650	0.0001120	0.0003840	0.00004650	0.0003190
Node 1 -> Node 0	0.0000320	0.0000590	0.0005460	0.00009110	0.0005140

STBinBack – Shapers on STD nodes

	Minimum	Average	Maximum	Std Dev	Jitter (Max-Min)
Node 7 -> Node 0	0.0002270	0.0002890	0.0004430	0.00005210	0.0002160
Node 6 -> Node 0	0.0001940	0.0002530	0.0004020	0.00004420	0.0002080
Node 5 -> Node 0	0.0001620	0.0002200	0.0003640	0.00003430	0.0002020
Node 4 -> Node 0	0.0001300	0.0001900	0.0002630	0.00002770	0.0001330
Node 3 -> Node 0	0.0000970	0.0001450	0.0002300	0.00002450	0.0001330
Node 2 -> Node 0	0.0000650	0.0000980	0.0001840	0.00001990	0.0001190
Node 1 -> Node 0	0.0000320	0.0000490	0.0001060	0.00001110	0.0000740

HP MAC ETE Delay: Mixed (cont)

Mixed - Shapers

	Minimum	Average	Maximum	Std Dev	Jitter (Max-Min)
Node 7 -> Node 0	0.0002270	0.0003030	0.0004310	0.00004450	0.0002040
Node 6 -> Node 0	0.0001940	0.0002660	0.0003700	0.00003780	0.0001760
Node 5 -> Node 0	0.0001620	0.0002270	0.0003230	0.00003180	0.0001610
Node 4 -> Node 0	0.0001290	0.0001940	0.0002620	0.00002490	0.0001330
Node 3 -> Node 0	0.0000970	0.0001520	0.0003070	0.00002640	0.0002100
Node 2 -> Node 0	0.0000650	0.0001030	0.0001900	0.00001720	0.0001250
Node 1 -> Node 0	0.0000320	0.0000600	0.0004940	0.00008910	0.0004620

Conclusions

- RPR fairness scheme works with single transit buffer nodes
 - *Small modifications to congestion trigger & rate limiter*
- Single and dual TB nodes can coexist on the same ring
 - *Good HP latency and Jitter*