IEEE 802.17
RPR Performance
(Corner Cases)

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Motivation

- **Need to simulate corner case scenarios and ensure that the proposed standard works under these conditions**
- **Ensure that we find a solution that has no fundamental weaknesses**
- **Compare some performance aspects of Gandalf to VoQ**

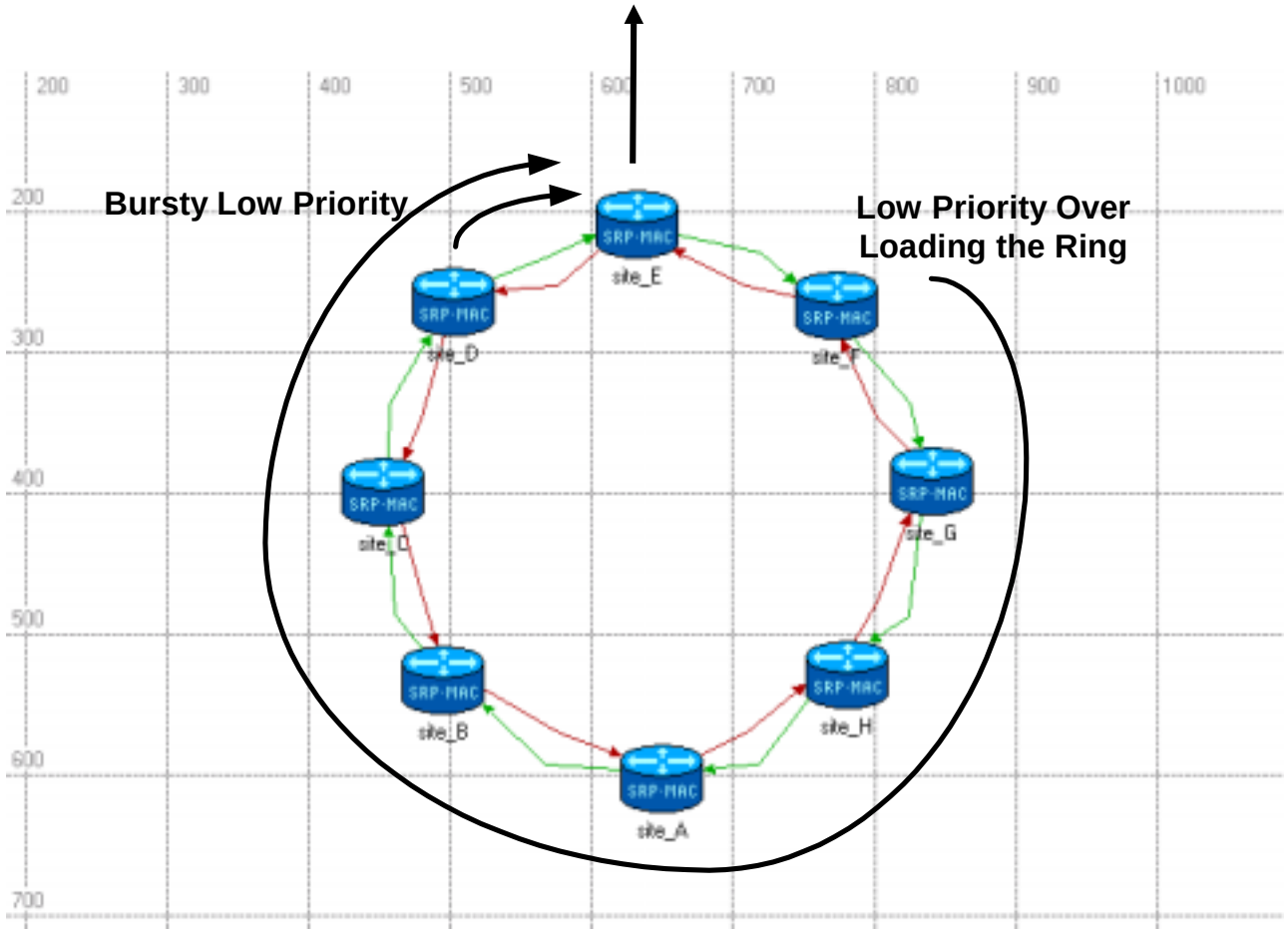
Performance problems

- **Oscillations due to reactive flow control**
- **Low bandwidth utilization with bursty traffic**

Scenario #1
Dealing with Low priority Bursty Traffic

- **Assume loaded ring**
- **Bursty traffic is being injected**
- **Bursty traffic will be modeled as periodic pulses**

Scenario #1 Simple Hubbing with bursty traffic



Scenario #1 Parameters

Traffic Generation Parameters

	Site F (Heavy Loaded)	Site D (Bursty)	
Start Time	0.1	0.1	seconds
ON State Time	10	0.001	seconds
OFF State Time	0	0.02	seconds
Packet Size	1500	1500	bytes
Traffic generated	800 Mbps	600 Mbps	(OC12)
	3 Gbps	600 Mbps	(OC48)

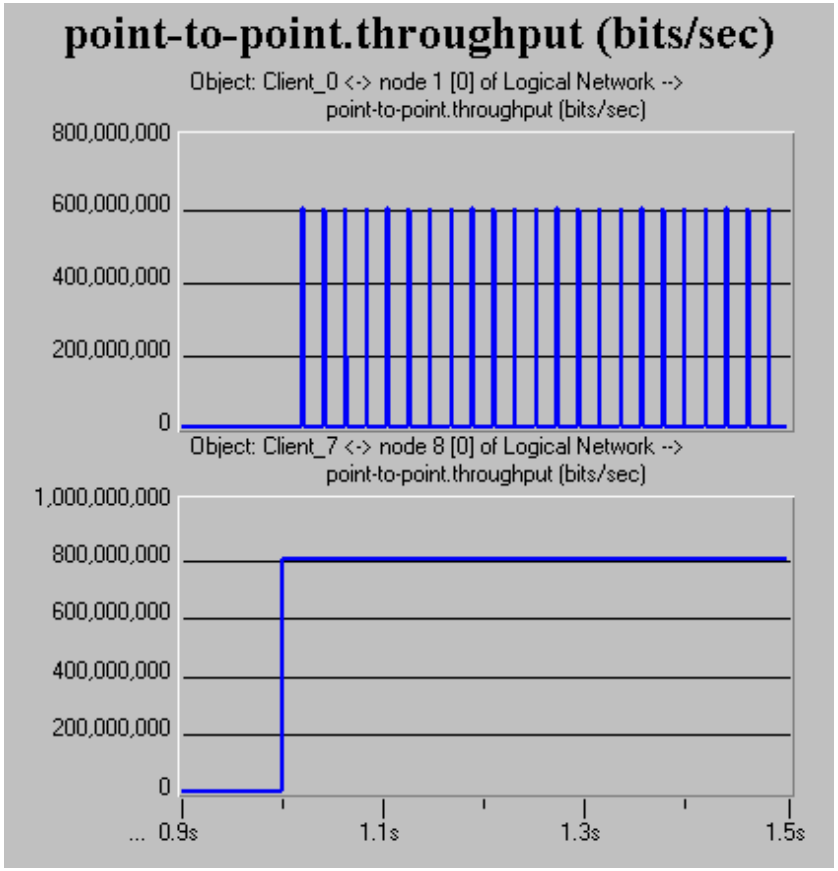
For Gandalf

Decay Interval 102.88 usec

Scenario #1
Traffic Generated for OC-12

Low priority bursty traffic generated at downstream node

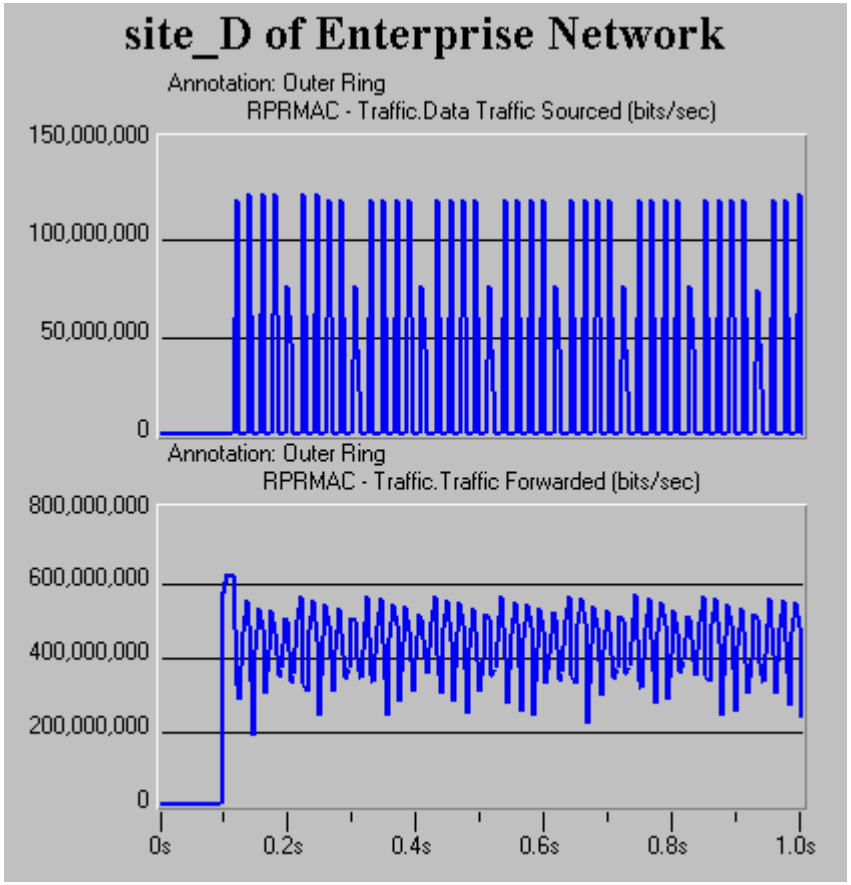
Low priority heavy traffic generated at upstream node



Scenario #1 (Gandalf) Waveforms at Node D

Traffic inserted at Node D

Traffic forwarded at Node D



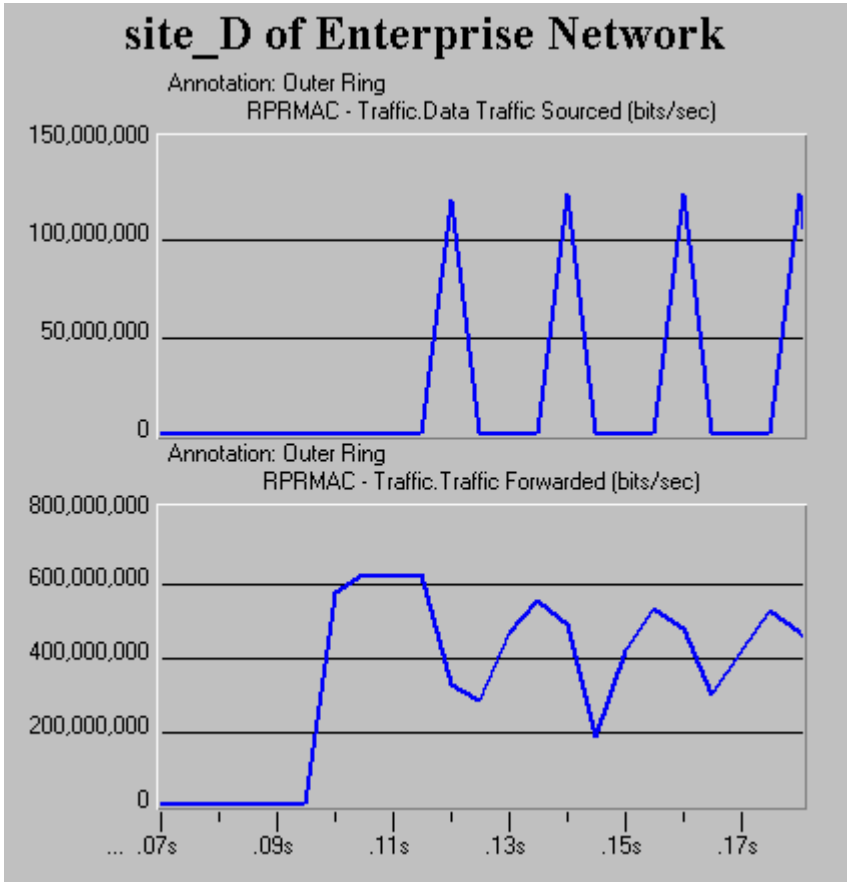
Ring Size 100 Km

Ring Speed OC-12

Scenario #1 (Gandalf) Waveforms at Node D (zoom in)

Traffic inserted at Node D

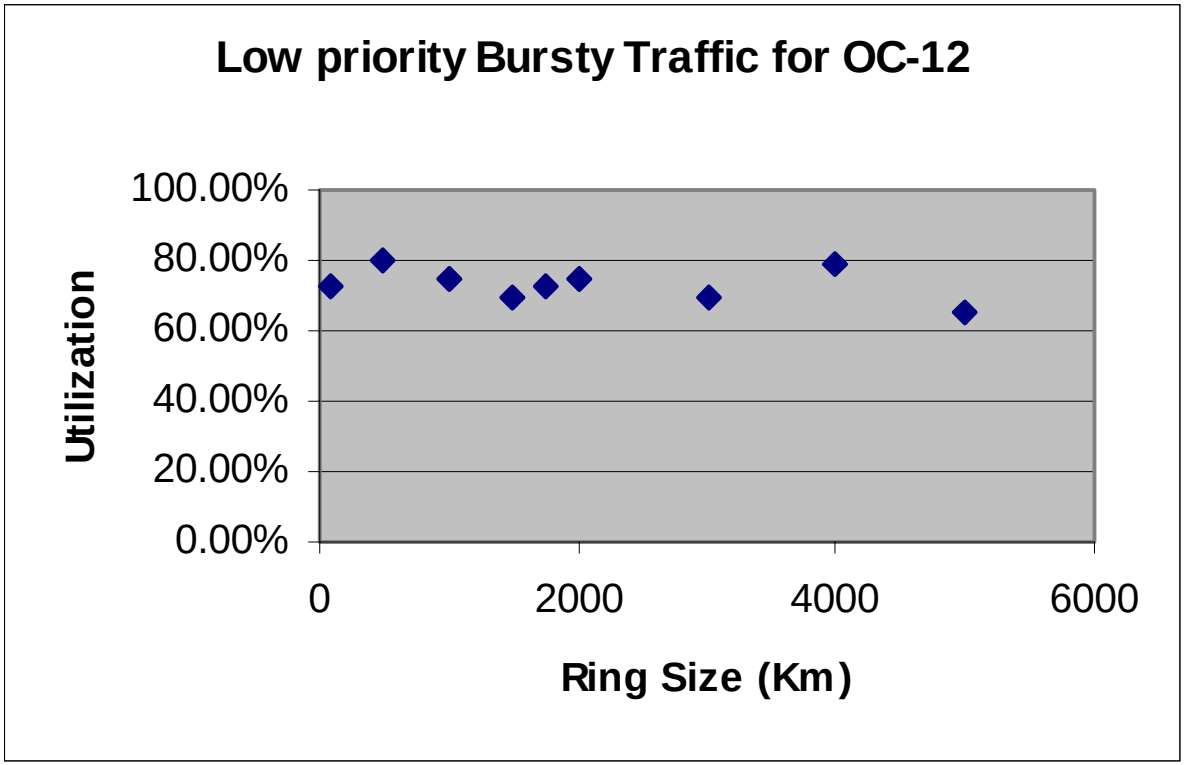
Traffic forwarded at Node D



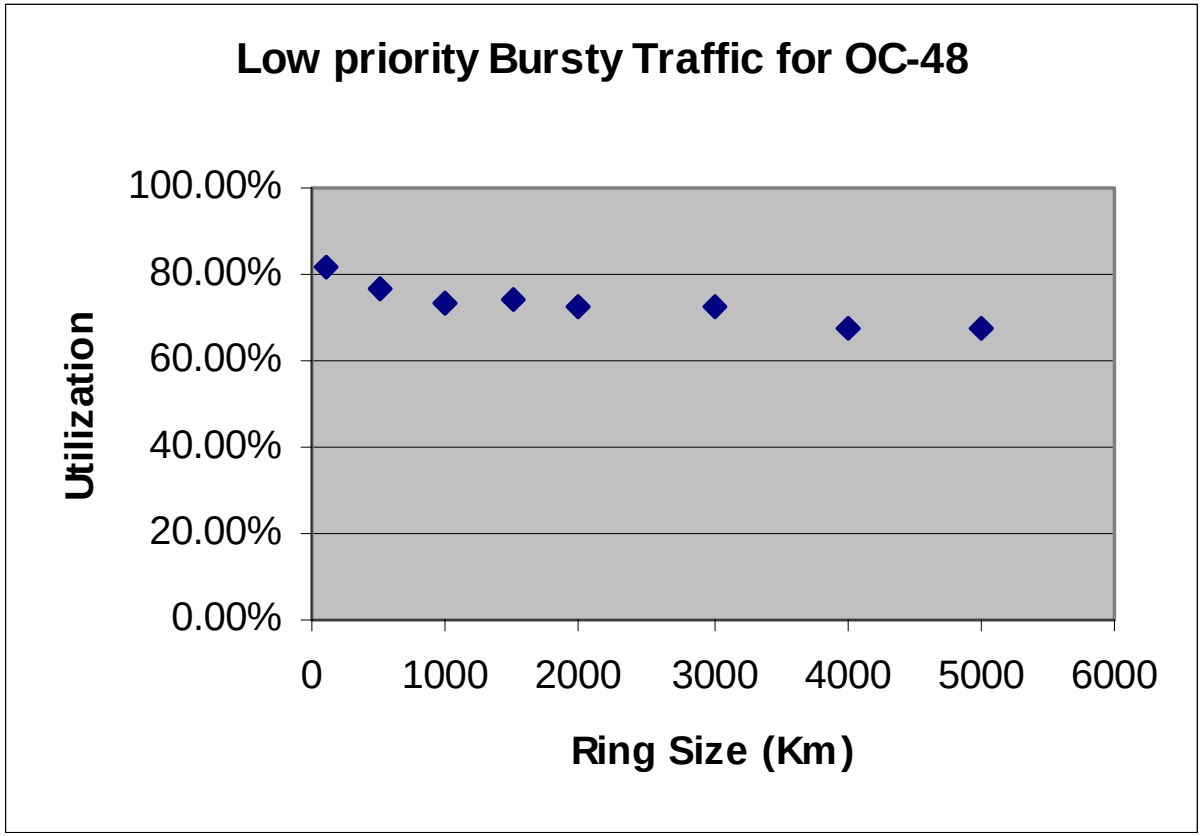
Ring Size 100 Km

Ring Speed OC-12

Scenario #1
Gandalf Utilization Results



Scenario #1
Gandalf Utilization Results



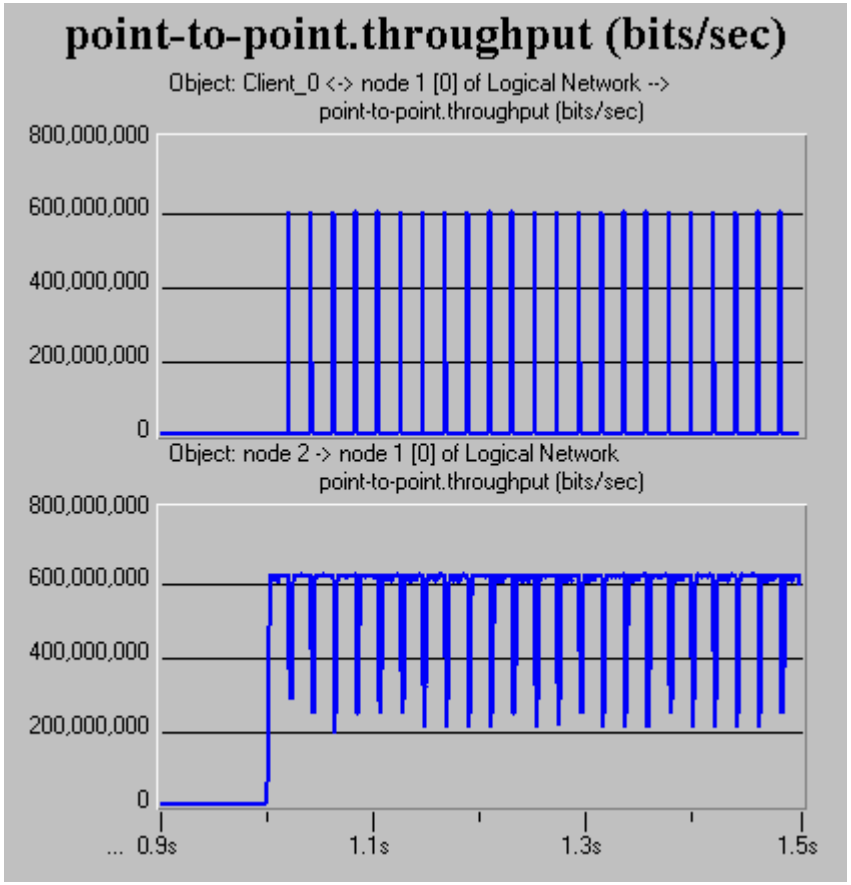
Explanation of Problem

- **Burst of inserted traffic causes congestion**
- **This triggers reactive flow control message**
- **Panic backoff throttles upstream source to low value even though burst is gone**
- **Slow ramp up mechanism independent of traffic conditions**
- **Result: Low BW efficiency**

Scenario #1 (VoQ) Waveforms at Node D

Traffic inserted at Node D

Traffic forwarded at Node D



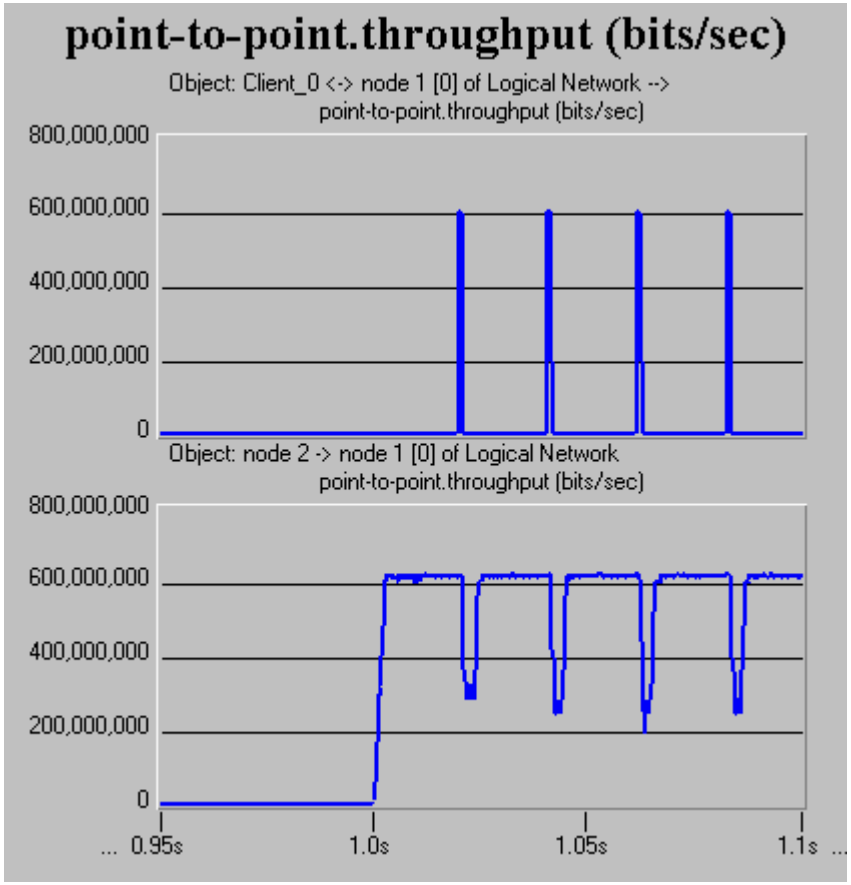
Ring Size 100 Km

Ring Speed OC-12

Scenario #1 (VoQ) Waveforms at Node D

Traffic inserted at Node D

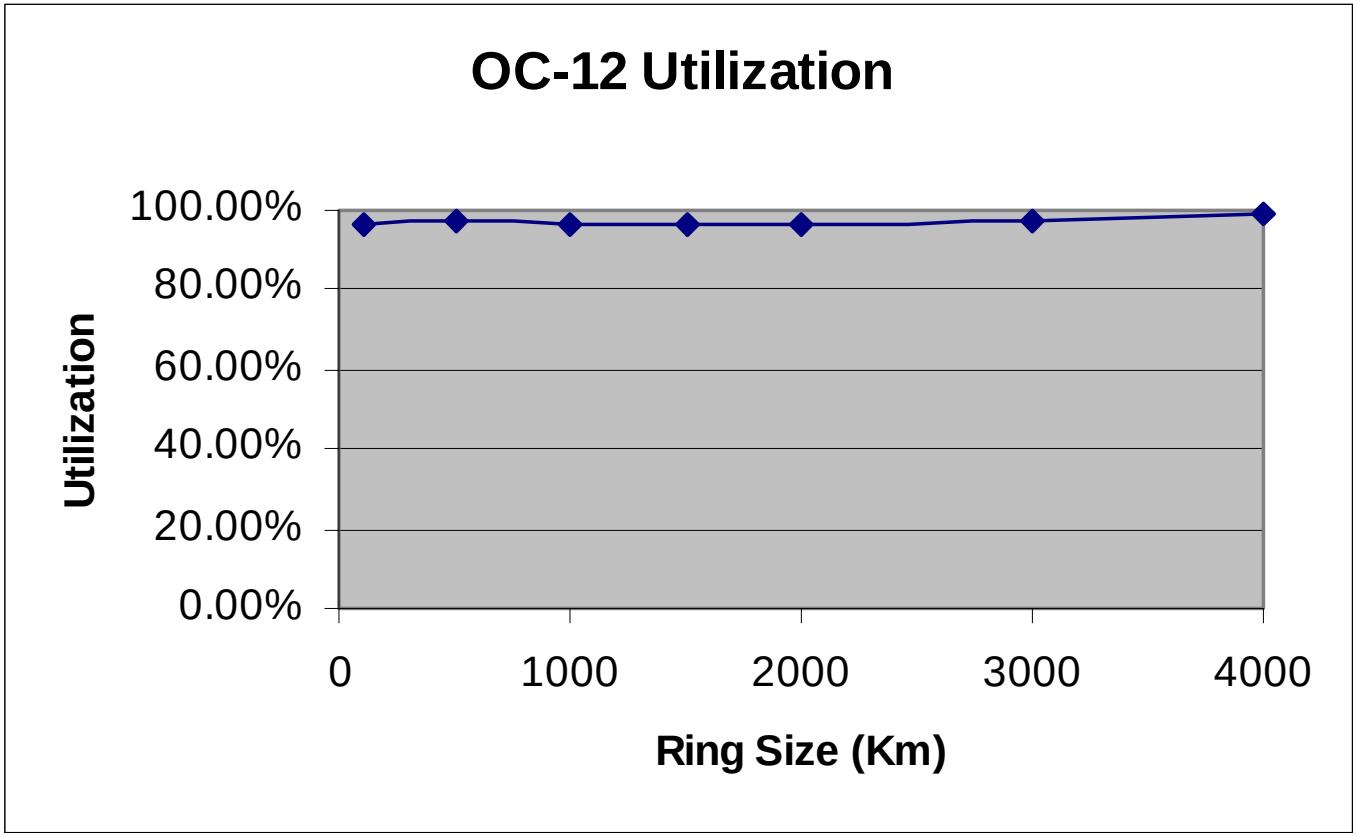
Traffic forwarded at Node D



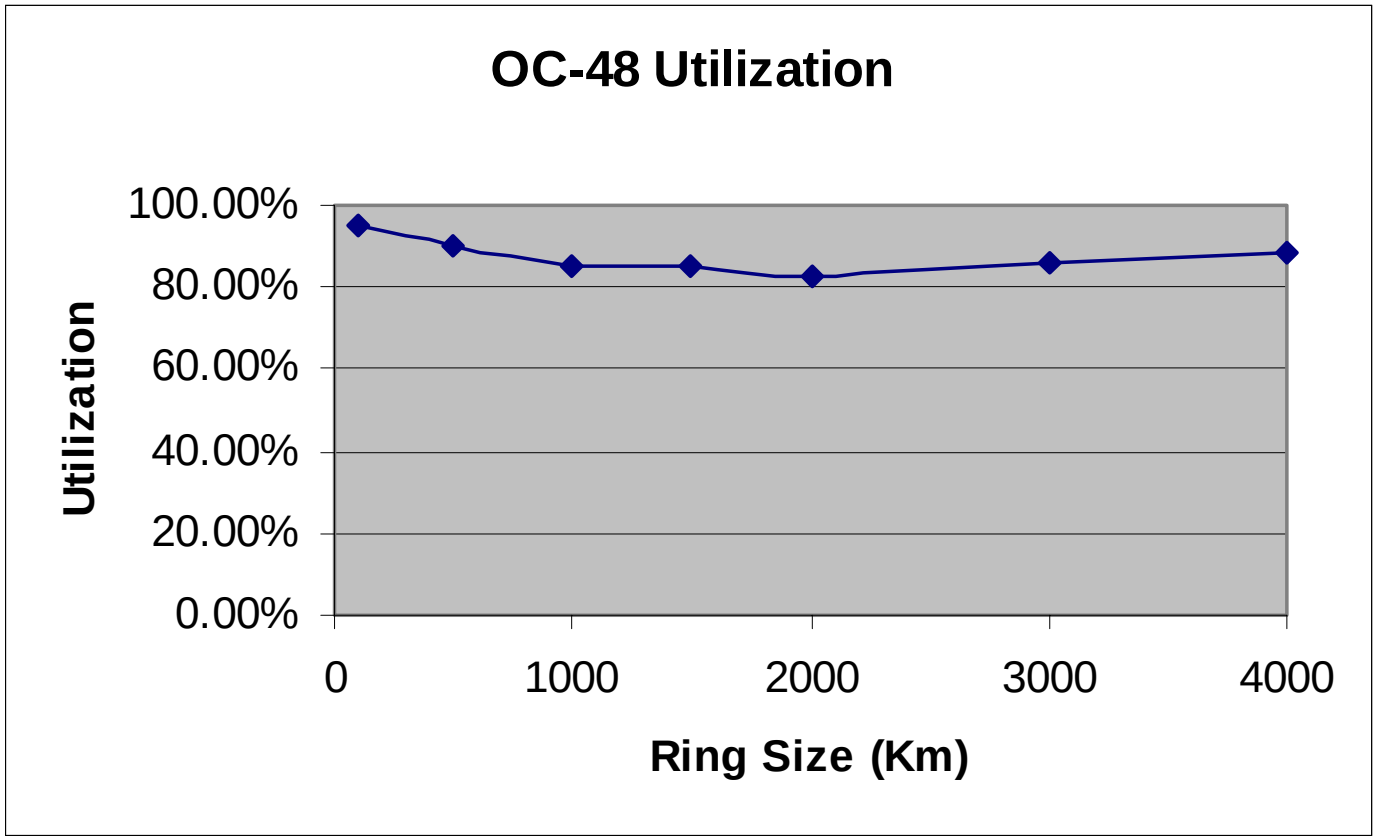
Ring Size 100 Km

Ring Speed OC-12

Scenario #1
VoQ Results



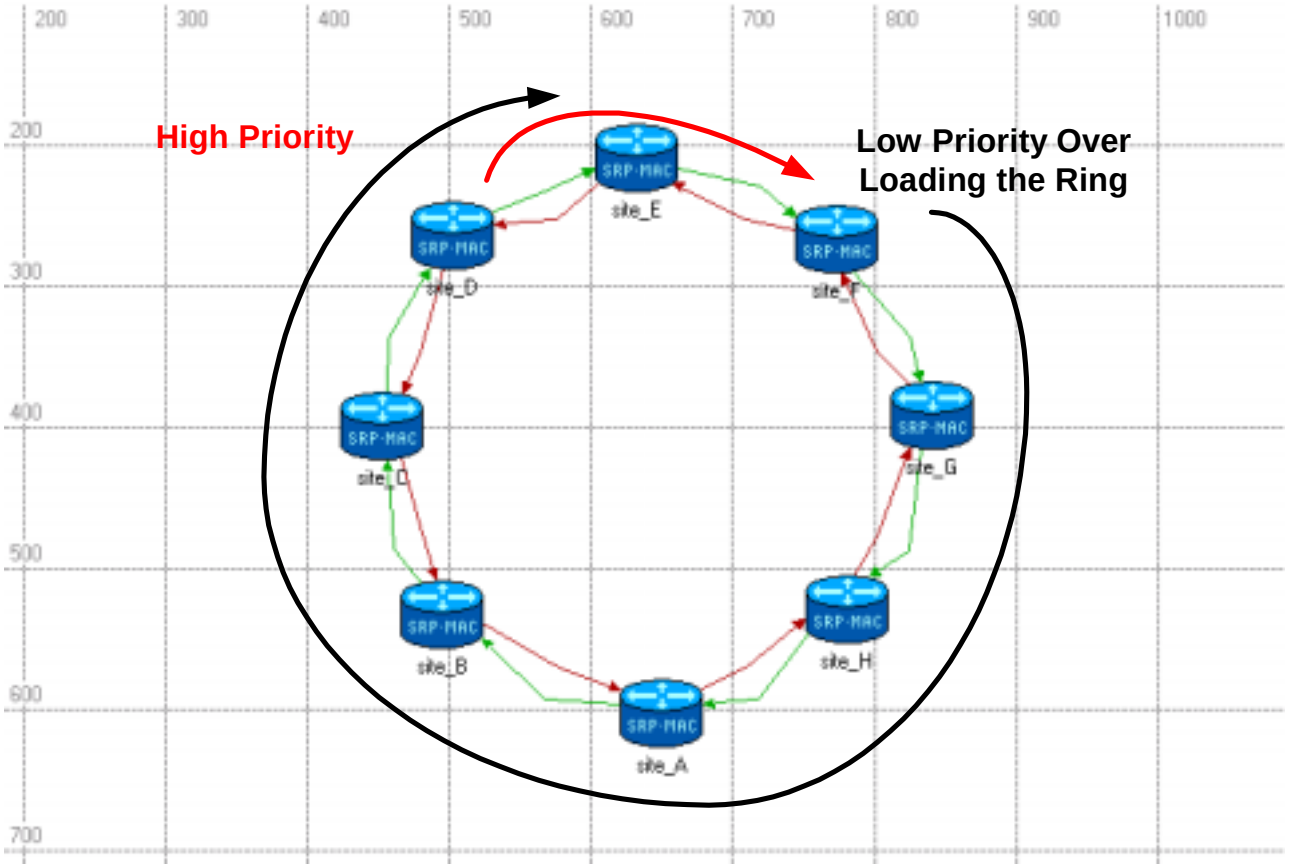
Scenario #1
VoQ Results



Scenario #3: High priority low intensity

- **Assume loaded ring**
- **Add high priority traffic**
  - **Low intensity**
  - **Constant dist**

Scenario #3 Setup



Scenario #3 Parameters

Traffic Generation Parameters

	Site F (Low priority)	Site D (High Priority)	
Start Time	0.2	0.1	
ON State Time	10	10	
OFF State Time	0	0	
Packet Size	1500	1500	
Traffic generated	800 Mbps	50 Mbps	(OC12)
	3 Gbps	50 Mbps	(OC48)

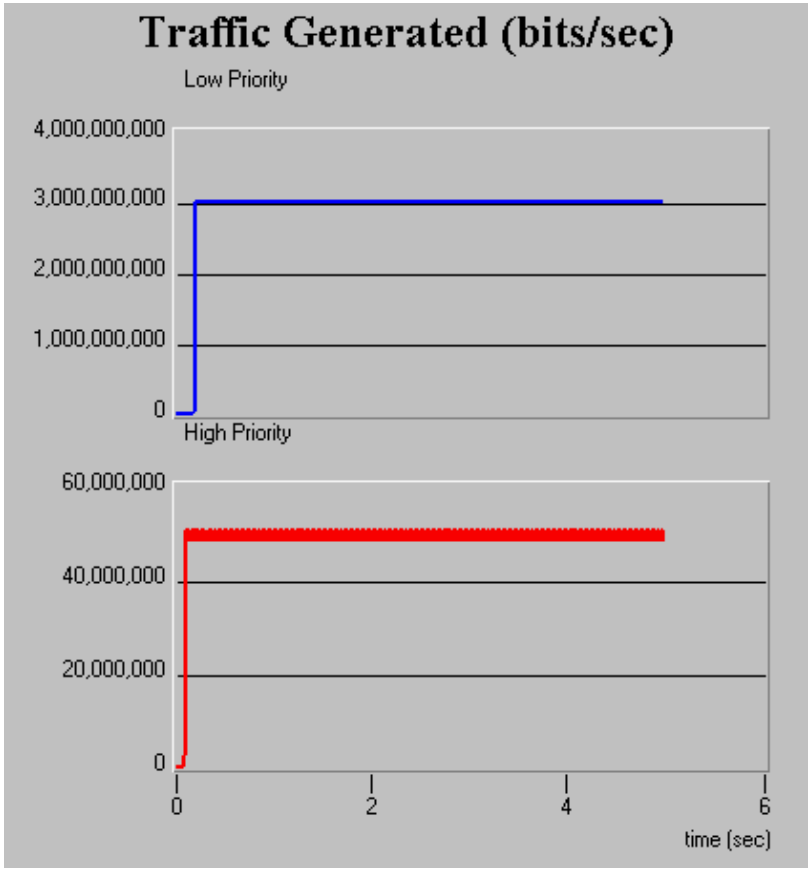
For Gandalf

Decay Interval 102.88 usec

Scenario 3: Traffic Generated for OC48

Low priority traffic generated at upstream node

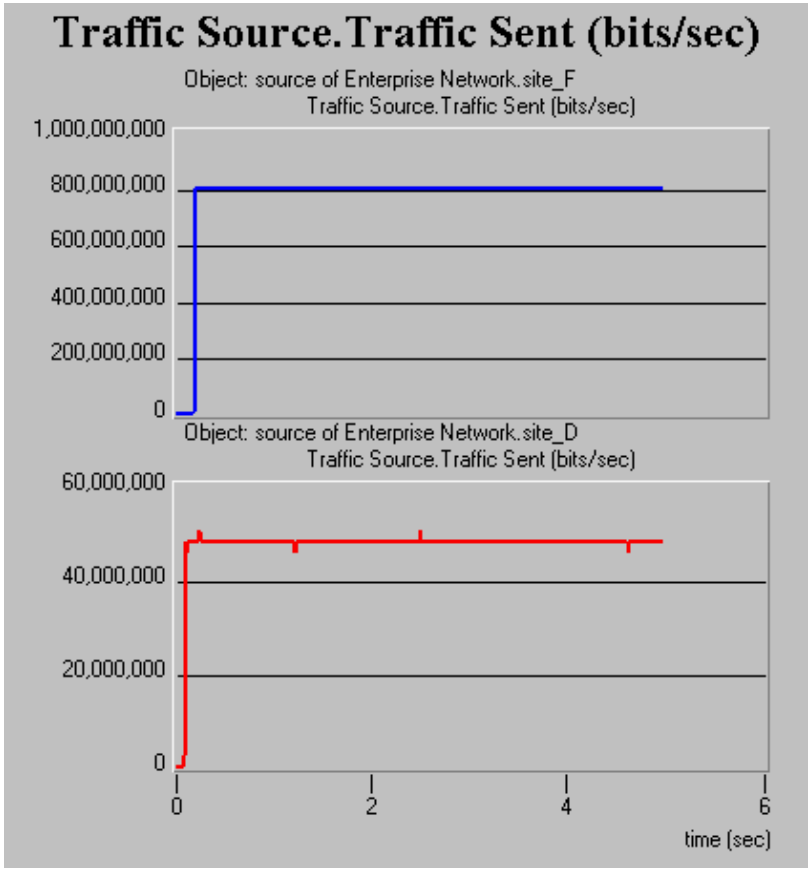
High priority traffic generated at downstream node



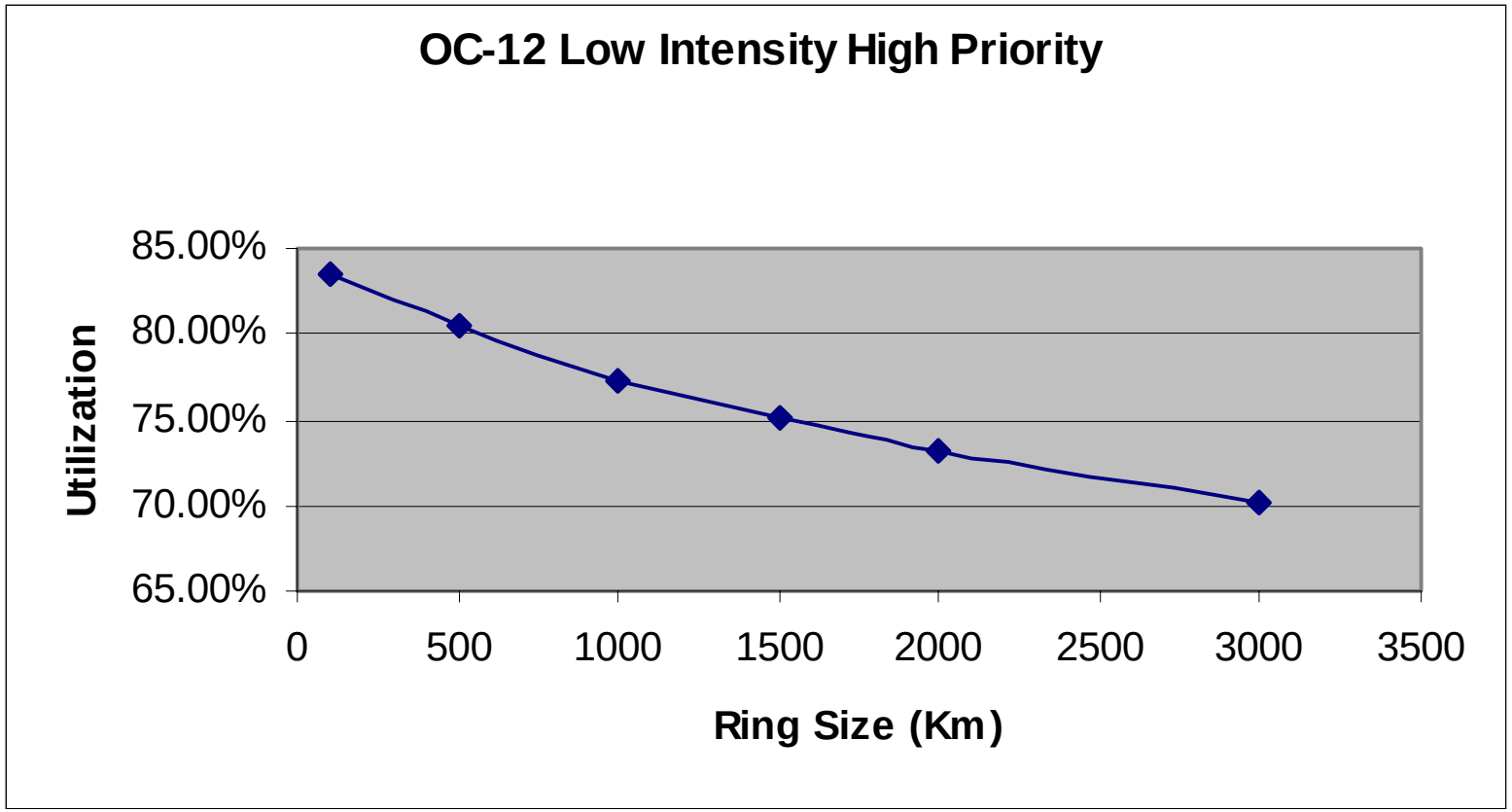
Scenario 3: Traffic Generated for OC12

Low priority traffic generated at upstream node

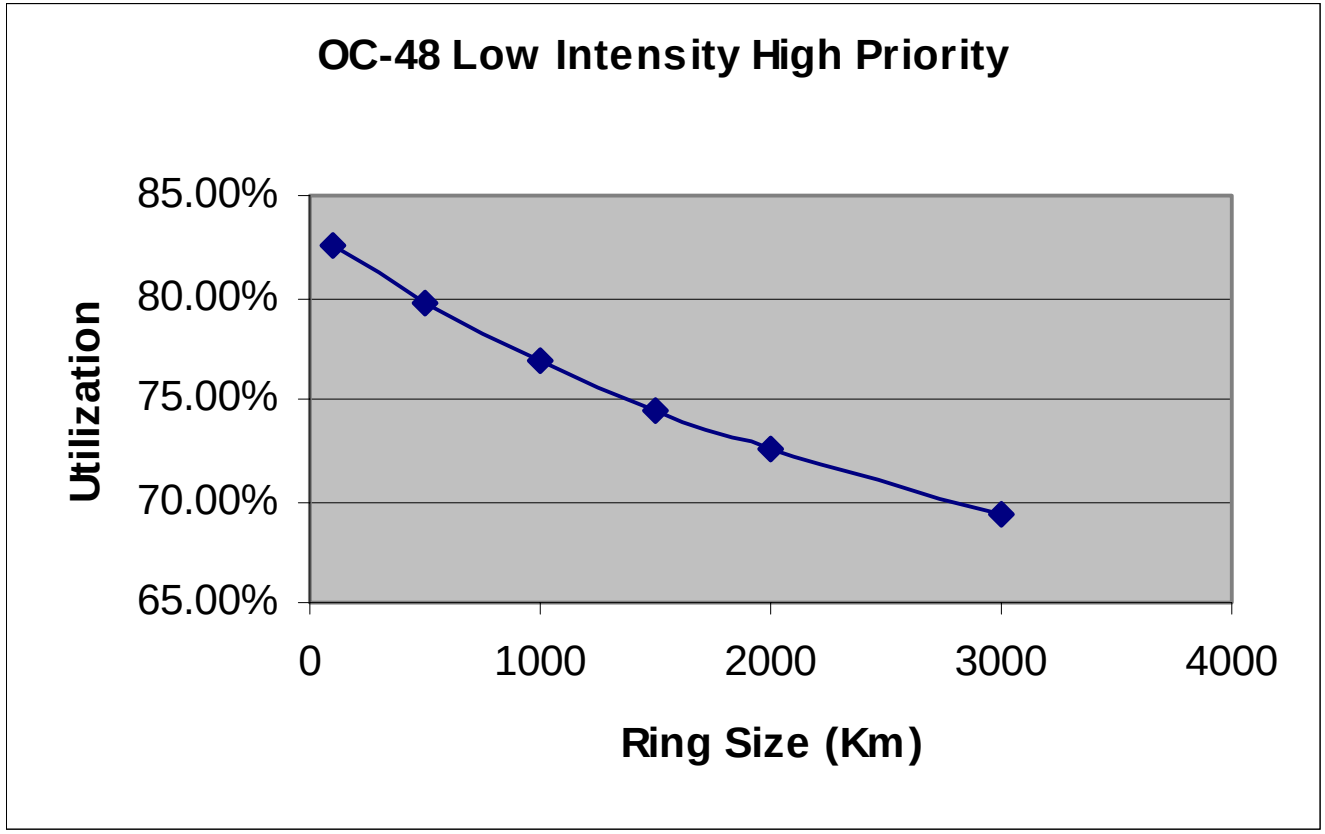
High priority traffic generated at downstream node



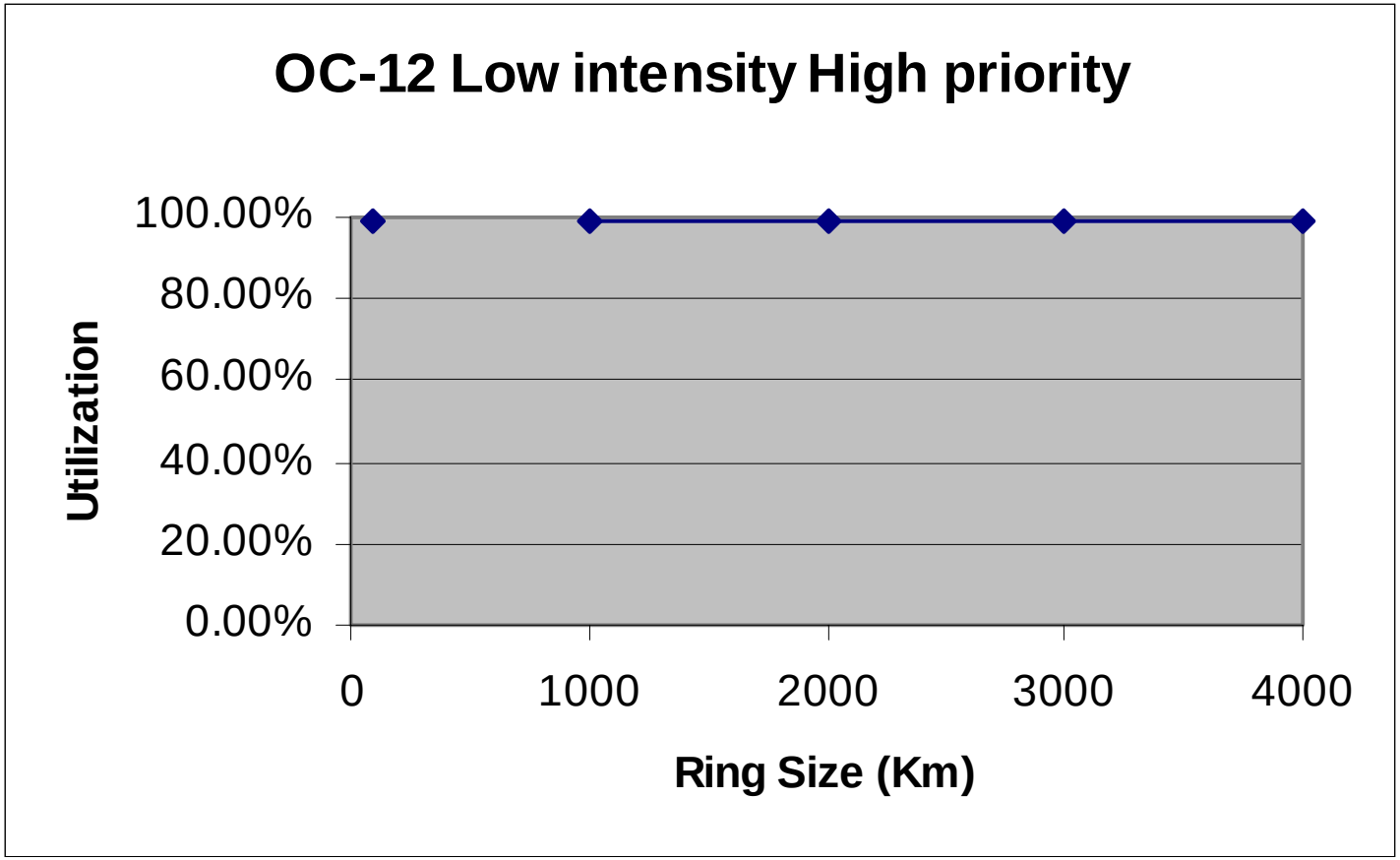
Scenario #3
Gandalf Results



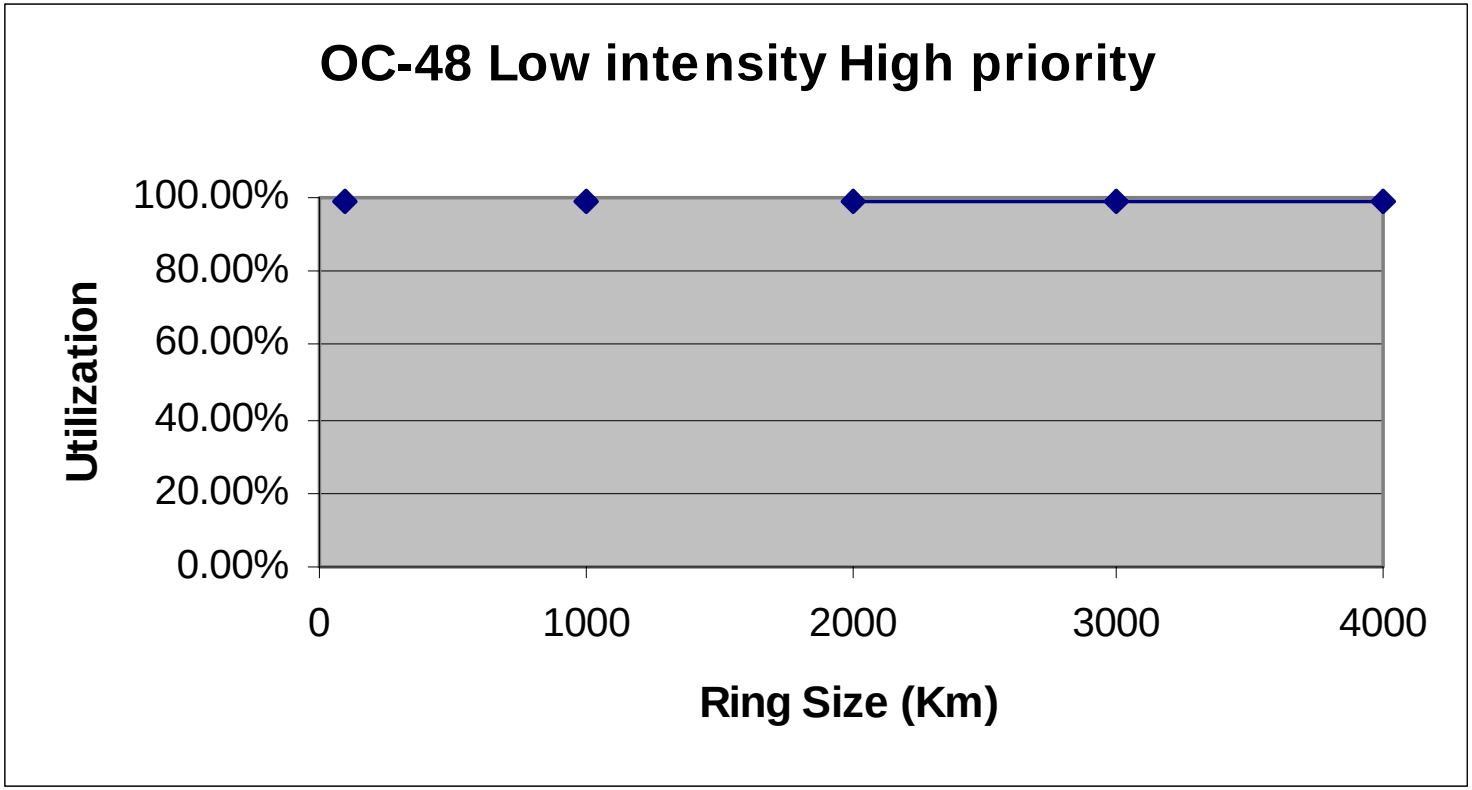
Scenario #3
Gandalf Results



Scenario #3
VoQ Results



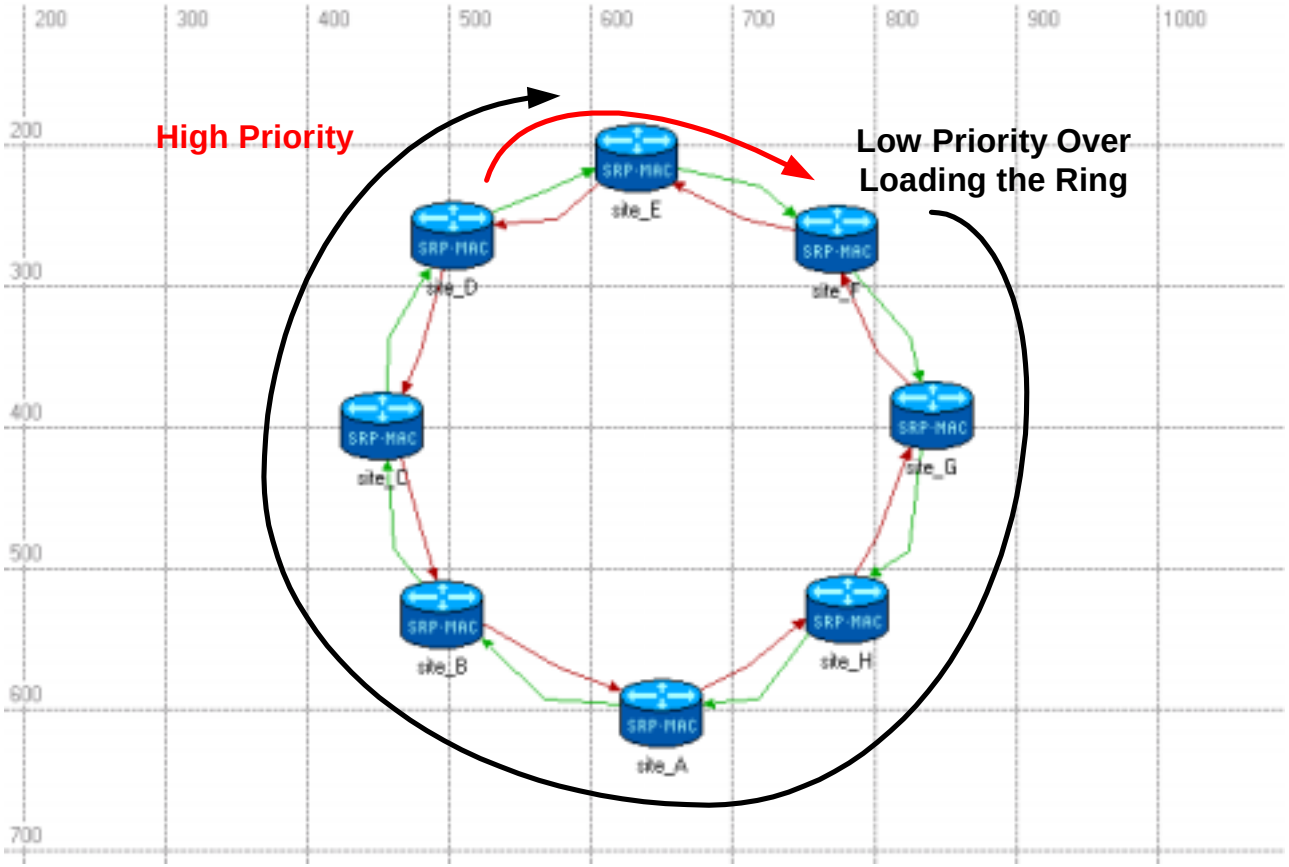
Scenario #3
VoQ Results



Scenario #4: Bursty High Priority

- **Assume loaded ring**
- **Add bursty high priority traffic**

Scenario #4 Setup



Scenario #4 Parameters

Traffic Generation Parameters

	Site F (Low priority)	Site D (High Priority)	
Start Time	0.1	0.2	
ON State Time	10	0.001	
OFF State Time	0	0.02	
Packet Size	1500	1500	
Traffic generated	800 Mbps	600 Mbps	(OC12)
	3 Gbps	2.4 Gbps	(OC48)

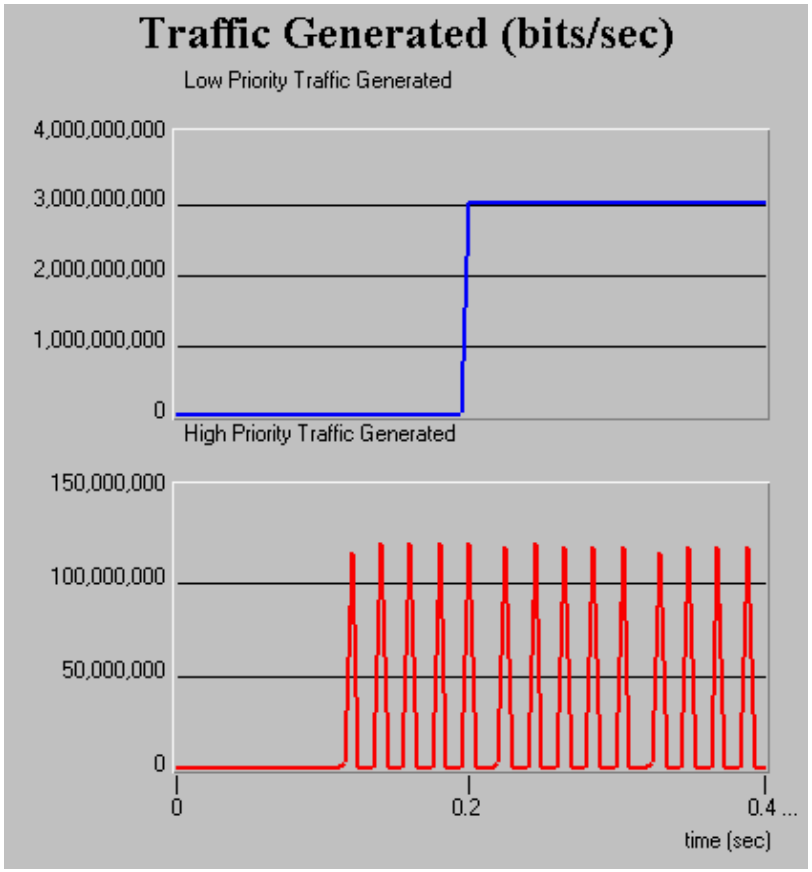
For Gandalf

Decay Interval 102.88 usec

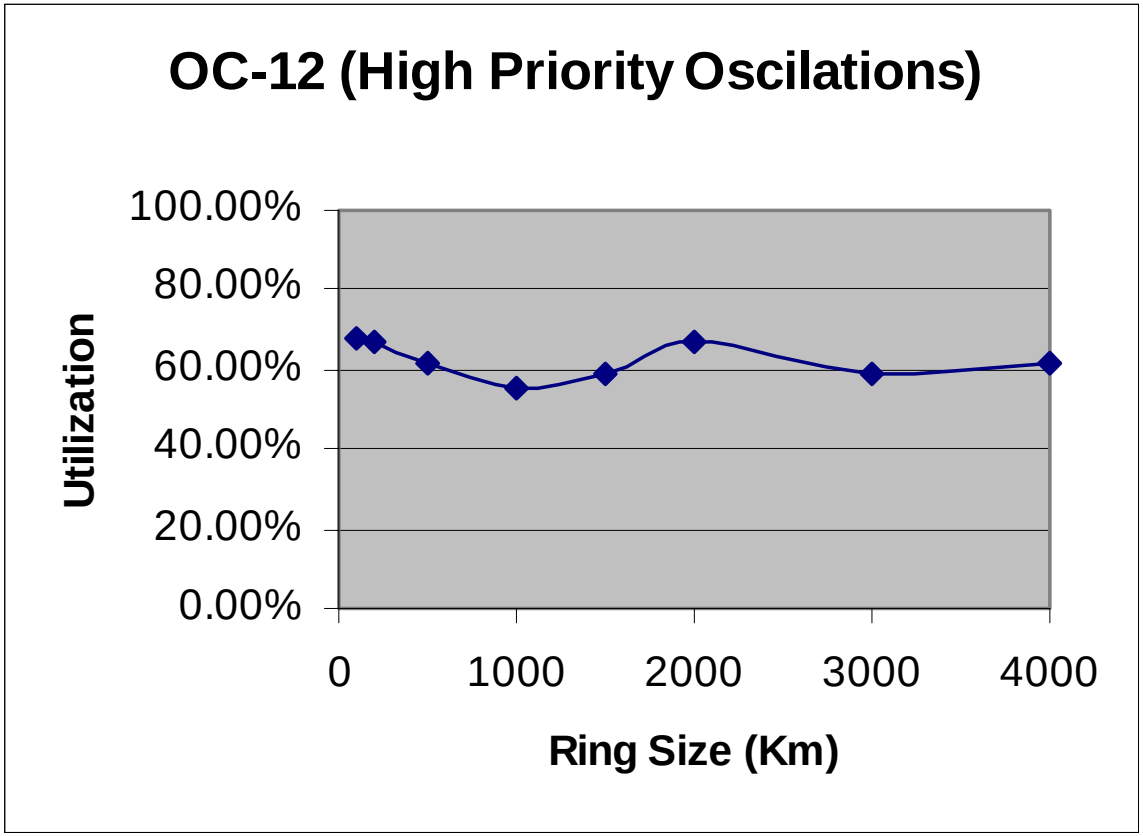
Scenario 4: Traffic Generated

Low priority traffic generated at upstream node

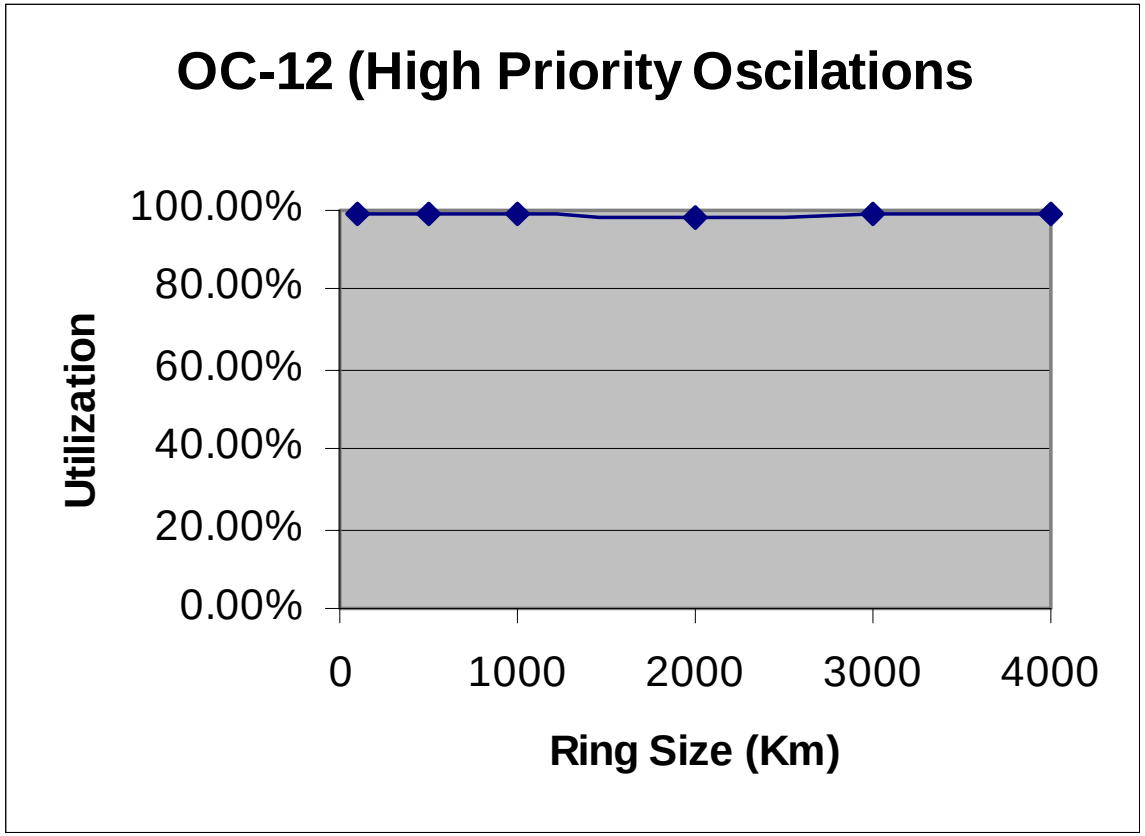
High priority traffic generated at downstream node



Scenario #4
Gandalf Results



Scenario #4
VoQ Results



Conclusions

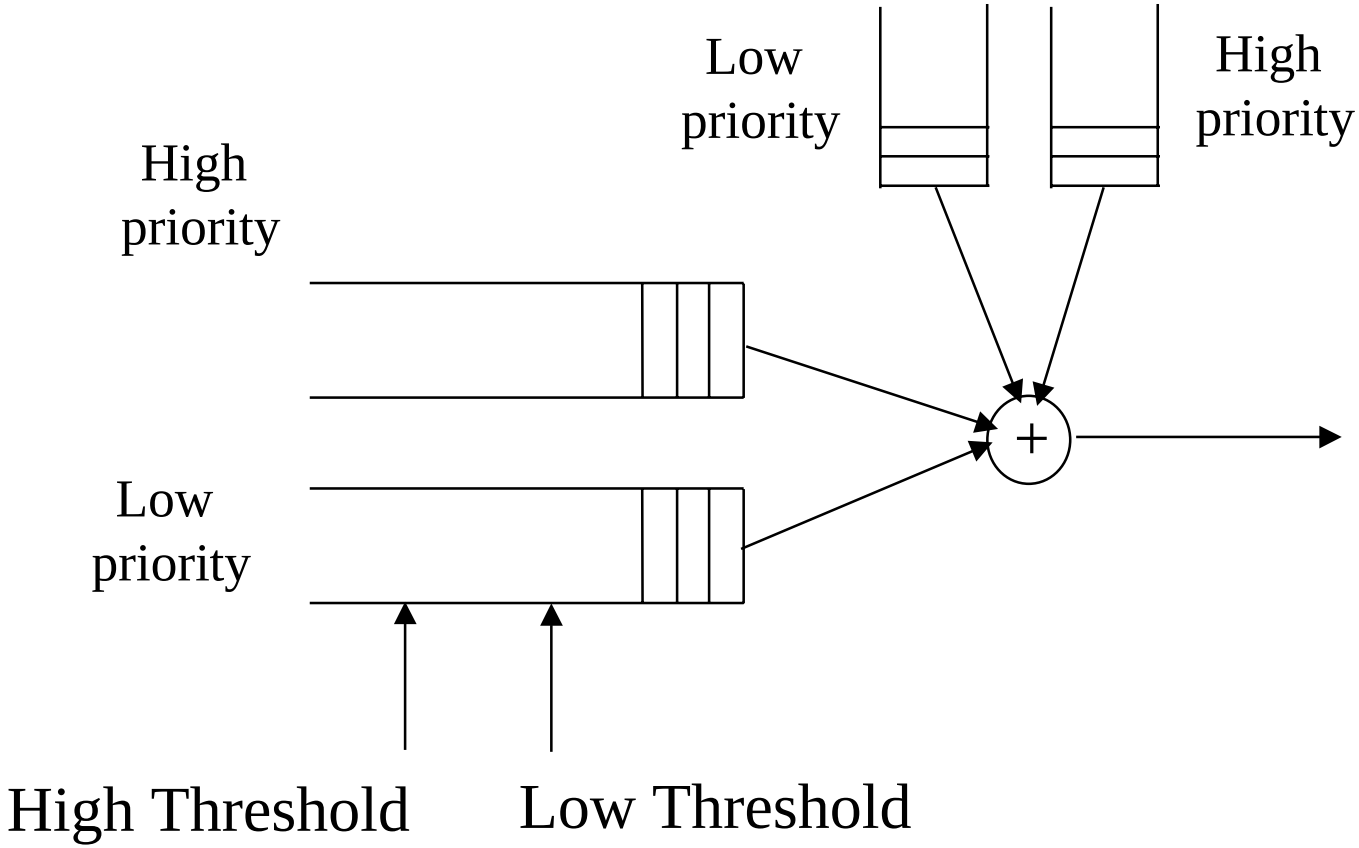
- **Special attention needs to be given to selection of the flow control mechanism because of:**
  - **Dramatic effect on bandwidth utilization (can be as low as 55%!)**
  - **Interaction of low priority traffic and high priority traffic**

Conclusions ...

- **Found some simple traffic patterns that cause these problems**
  - **Are there others?**
- **Need further investigation by WG**
  - **Extent of the problems not clear**

Backup Charts

Transit Buffer Analysis (SRP-fa)



Mechanisms used for Throttling Traffic

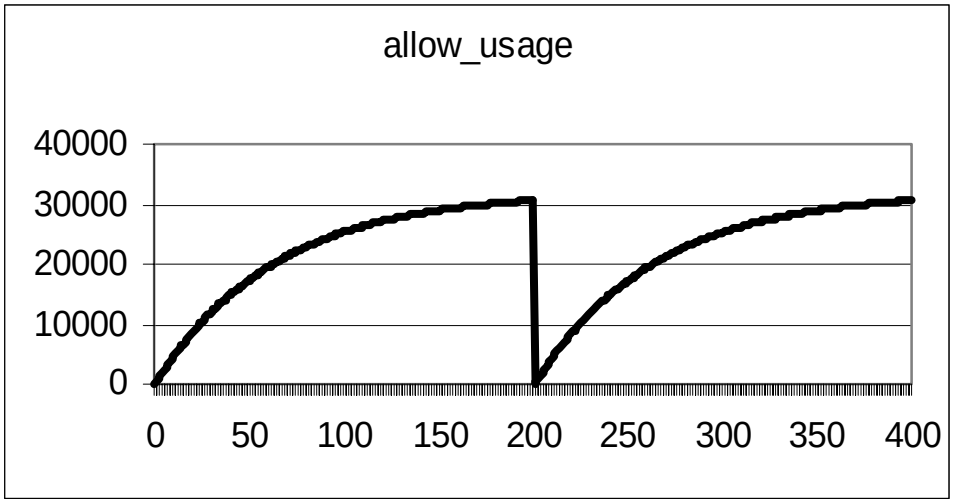
- **Gandalf**
  - **Reacts to congestion**
  - **My-usage mechanism**
- **VOQ**
  - **Continually monitors utilization and throttles accordingly**
  - **Rate control messages (RCM)**

Mechanisms used for Restoring Traffic

- **Gandalf**
  - **Ramp up algorithm**
  - **Independent of traffic conditions**
- **VOQ**
  - **Rate control messages (RCM)**
  - **Restores BW based on traffic conditions**

SRP-fa Ramp up Mechanism

- **allow_usage = allow_usage + $\frac{\text{MAX\_LINE\_RATE - allow\_usage}}{\text{LP\_ALLOW}}$**



VoQ Mechanism for throttling and ramping up

- **AvailableRingBW = link capacity – SUM ri**
- **RCF = AvailableRingBW / SUM wi**
- **Total allocated bandwidth = committed bandwidth + station weight *RCF (fi = ri + wi*RCF_min)**