

Smart Queuing: An Adaptive Approach

By

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Overview

- ❖ Motivation
- ❖ Queuing Schemes
- ❖ Smart Queuing
- ❖ Implementation
- ❖ Summary

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Motivation

- ❖ Explosive growth of Internet
- ❖ Need to utilize network efficiently
- ❖ Control congestion & provide QoS
- ❖ Use queuing schemes
- ❖ Dynamic/chaotic Internet
- ❖ Answer: Smart Queuing

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Queuing Schemes (1)

- ❖ FIFO
 - ✓ Simple and predictable
 - ✗ Cannot provide differentiated service
- ❖ Priority Queuing
 - ✓ Provide differentiated service
 - ✗ Starving of low priority traffic

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Queuing Schemes (2)

- ❖ WFQ
 - ✓ Fair
 - ✗ Complex and low-speed
- ❖ Custom Queuing (CBQ)
 - ✓ Guaranteed output bandwidth for each class
 - ✗ Problem with misbehaving user in same class

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Smart Queuing

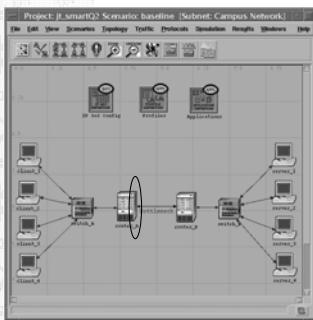
- ❖ Maintain a set of parameter
 - Number of flows
 - Quality of Service
 - Rates, packet size
- ❖ Decide which queuing is the best
 - Fairness, loss, delay
- ❖ Dynamically switch to it

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Implementation (1)



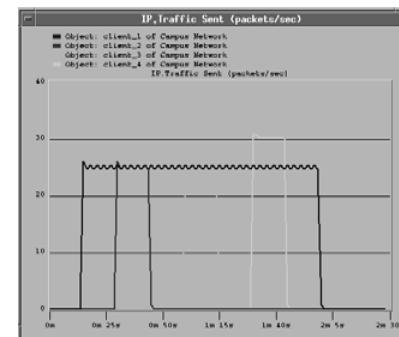
- ❖ Simple IP network
- ❖ UDP traffic with QoS
- ❖ Different characteristics
 - C1: 25 pkt/s (Hi Pr.)
 - C2: 25 pkt/s (Hi Pr.)
 - C3: 20 pkt/s (Low Pr.)
 - C4: 30 pkt/s (Hi Pr.)
[misbehaving]
- ❖ Link capacity
 - 56 kbps, ~42 pkt/s

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Clients Send Rates



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Smart Settings

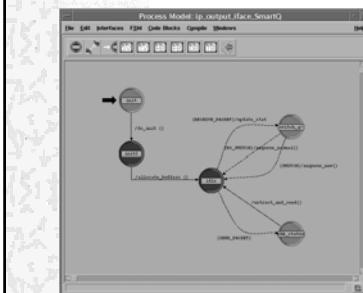
The screenshot shows the 'IP QoS Config > Attributes' dialog. In the left pane, under 'Attribute' column, there is a list of QoS profiles: CAR Profile, Custom Queue, FIFO Profile, Priority Queue, RSVP Flow, RSVP Profile, Smart Queue, and WFQ Profile. The 'Smart Queue' option is selected. In the right pane, under 'Value' column, the 'Profile Name' is set to 'ToS Based'. A sub-dialog titled '(Smart Queueing Profiles) Table' is open, showing a single row for 'ToS Based' with the following details:

Attribute	Value
Smart Switching	Yes
Activity Timeout (sec)	0.1
Switching Sensitivity (pkts)	20

At the bottom of the dialog, there are buttons for 'Details', 'Promote', 'OK', and 'Cancel'. A checkbox 'Apply Changes to Selected Objects' is checked. The footer of the window displays the date 'April 9, 2002' and the text 'Project Demo: Smart Queuing'.

Implementation (2)

- * Modify "ip_output_iface" process model
- * Create multiple queuing structure (qm_info)
- * Examine current traffic
- * Is current method ideal?
 - No: enqueue to new method
- * Synchronization issues



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Original ip_output_iface

This screenshot shows the original 'ip_output_iface' process model. It includes a 'SPLIT' node followed by a 'SMALL' node. From the 'SMALL' node, multiple parallel regions branch out, each containing a 'CREATE_IPV4_QOSx' action followed by an 'enqueue_ipq_x' action. The regions then converge back to a 'JOIN' node. Finally, the process ends at an 'output' node. A note in the bottom right corner states: 'This child process is called by each IP interface in order to model a FIFO, WQ, priority queueing custom enqueue method.' The footer indicates the file is 'Opened File: (design)teamwork_model\ip_output_iface.prj'.

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Modified ip_output_iface

This screenshot shows the modified 'ip_output_iface' process model. It features a 'SPLIT' node followed by a 'SMALL' node. From the 'SMALL' node, a single transition leads to a 'switch' node. The 'switch' node has multiple outgoing paths, each leading to a 'CREATE_IPV4_QOSx' action followed by an 'enqueue_ipq_x' action. The paths then converge back to a 'JOIN' node. Finally, the process ends at an 'output' node. A note in the bottom right corner states: 'This child process is called by each IP interface in order to model a FIFO, WQ, priority queueing custom enqueue method.' The footer indicates the file is 'Opened File: (design)teamwork_model\ip_output_iface_to_task.prj'.

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Switching Module (do_stat)

- At each packet received record statistics
- if $1/(\text{curr_pkt_time} - \text{last_pkt_time}) > \text{allow_rate}$ then misbehave = true
- for each row, if $\text{curr_pkt_time} - \text{last_pkt_time} > \text{timeout}$ then active = false
- Note: allow_rate is fixed according to tos

source address	tos	last pkt time	allow rate	active	misbehave

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Switching Module (switch?)

- for all active users
 - if misbehave then use WFQ
 - else if users with multiple tos then use CQ
 - else use FIFO
- if need to switch
 - increment pkt_counter until it is greater than sensitivity, then switch
 - else reset pkt_counter

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Switching Module (enqueue)

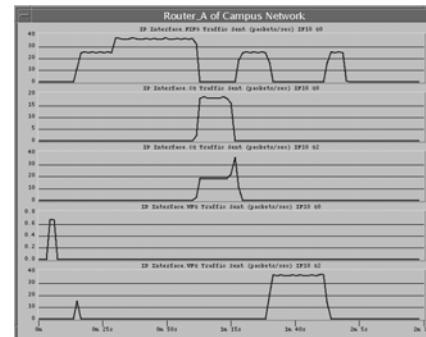
- Attempted
 - if curr_queue is not empty, put pkt to buffer
 - else if curr_queue is empty && buffer is not empty, flush buffer contents to next_queue
 - else put pkt to next_queue, set curr_queue = next_queue
- Implemented
 - if old queue is not empty, drop packet
 - else put pkt to next_queue, set curr_queue = next_queue
- dequeue: retrieve pkt from current queue and send

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Smart Queuing In Action (1): Packets send from each queue

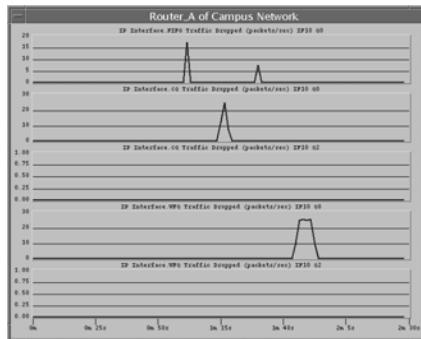


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Smart Queue In Action (2): Packet dropped by each queue

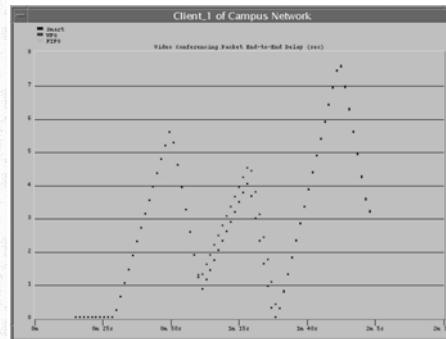


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Delay Comparison: Client 1

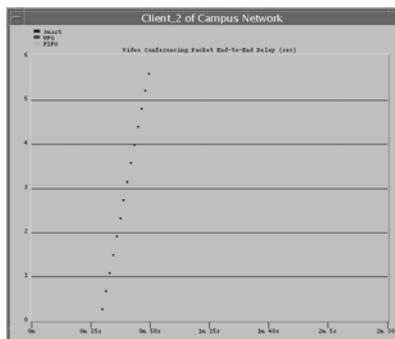


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Delay Comparison: Client 2

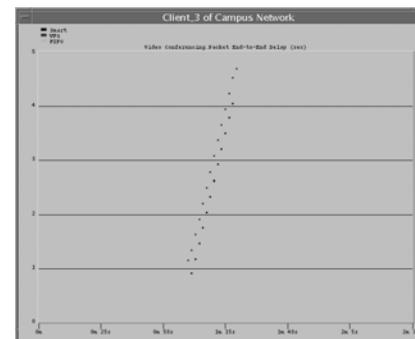


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Delay Comparison: Client 3

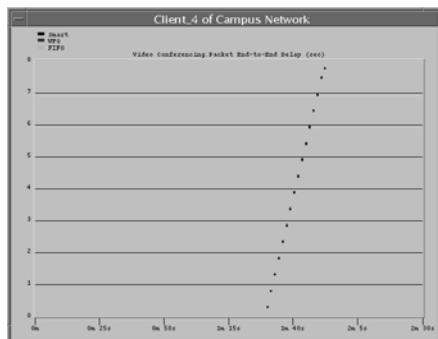


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Delay Comparison: Client 4



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Conclusion

- Is “Smart Queuing” better?

– Yes!

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Future Works

- More Verification
- Transition Buffer
- Switching:
 - Lookup tables, Pre-processing via simulation
- Traffic:
 - Incorporate TCP traffic, active queue management (RED)
- Queuing Mechanisms:
 - Incorporate other queuing schemes (i.e. DWRR, VClock)

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- Chuck Semeria, “[Supporting Differentiated Service Classes: Queue Scheduling Disciplines](#)”, White Paper, Juniper Networks.
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- Costin Iancu, Anurag Acharya, “[A Comparison of Feedback Based and Fair Queueing Mechanisms for Handling Unresponsive Traffic](#)”. Proceedings of ISCC’ 2001 – Sixth IEEE Symposium on Computers and Communications, Hammamet, Tunisia, July 3-5, 2001.
- Goncalo Quadros, Antonio Alves, Edmundo Monteiro, Fernando Boavaida, “[How Unfair Can Weighted Fair Queueing Be?](#)”, Proceedings of ISCC’ 2000 – Fifth IEEE Symposium on Computers and Communications, Antibes, France, July 4-6, 2000.

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