Performance evaluation of hose bandwidth allocation method using feedback control and class-based queueing for VPNs

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Outline

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Background: VPNs

- As a *ubiquitous environment* develops, the importance of data transmission increases.
  - More secure, easy, and stable
- Virtual Private Networks (VPNs) enable us to transmit important data securely.
  - Many global companies have strong interest in constructing *large-scale VPNs.*
- Subscribers and the amount of traffic will increase continuously.
  - A *starvation* of network resources will occur.
  - Scalable QoS mechanism will be needed.

Background: Hose model

- Conventional model versus hose model

Model	Conventional model	Hose model
Contract	*Pipes* (destination sites)	*Hose* (aggregation of pipes)
Flexibility	*Low* (static allocation to pipes)	*High* (dynamic allocation among pipes)
Utilization	*Low* (Resources are uselessly needed)	*High* (Reduce required resources)

- Components of VPN hose model
  - Provisioning method
    - To allocate long term bandwidth to meet subscriber requirements with the minimum bandwidth consumption
  - Bandwidth allocation method
    - To control bandwidth allocation parameters in response to the traffic changes

Our objective

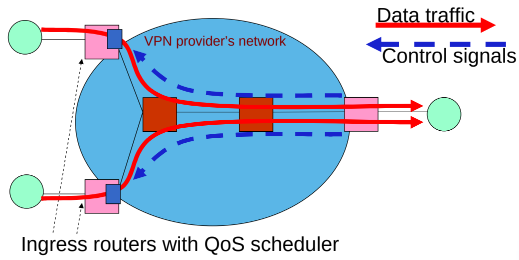
- To meet *QoS assurance* and *high utilization*, we produce a hose bandwidth allocation method.
  - Without this method, instantaneous changing traffic cannot be accommodated.
- Our requirements in terms of QoS assurance
  - Proportional fair bandwidth allocation among subscribers
  - Fair bandwidth allocation among active sites with in the allocated bandwidth for the subscriber
  - High utilization

An example of fair bandwidth allocation (%)

Time		0	1	2	3
Subscriber X	Site X1	0	100	50	25
	Site X2	0	0	0	25
Subscriber Y	Site Y1	0	0	50	50

Hose bandwidth allocation method: Key idea

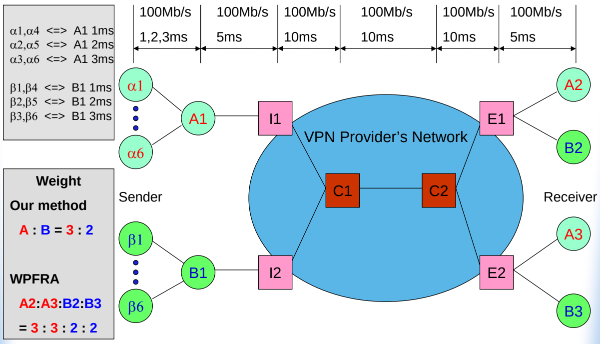
- Key idea
  - Integration of feedback-driven traffic control and QoS scheduler installation at ingress router



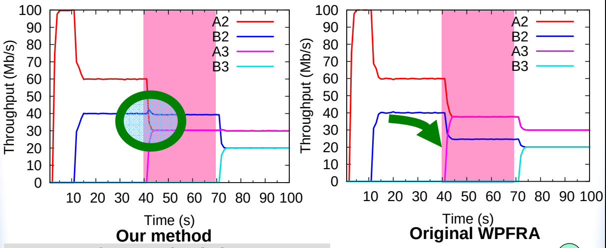
Hose bandwidth allocation method: Components

- Two components of our method
  - Feedback-driven traffic control: *WPFRA*
  - Hierarchical packet scheduler: *CBQ*
- *Weight Proportional Fair Rate Allocation*
  - Ingress router: receive control packets
  - Egress router: send control packets
  - Core router: update congestion information
- *Class-Based Queueing (CBQ)*
  - Set up classes at subscriber and site levels

Simulation: Model



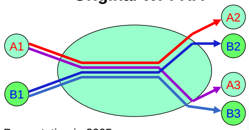
Simulation: Transitional state



40 to 70s after run simulation

Throughput to B2 is not much affected when traffic to A3 is started.

=>Requirements about fair allocation are satisfied even when another flow arrives.



Conclusion

- We proposed a hose bandwidth allocation method for QoS-enabled VPN services which meets three requirements.
  - Proportional fair bandwidth allocation among subscribers
  - Fair bandwidth allocation among active sites
  - High utilization
- Two components of our method
  - Feedback-based traffic control
  - Modified QoS scheduler at ingress router
- Simulation results showed
  - Our method achieved all three requirements in time progress scenario.
- Future work
  - Stability evaluations in large scale scenario

Fin.

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