MANAGEMENT

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Services Offered

- *ENTERPRISE*: best performance, offers bounded delay guaranties, making it ideal for delay sensitive applications such as videoconferencing. This service is normally implemented using the DiffServ Expedited Forwarding (EF) PHB.
- *STANDARD*: cheaper than ENTERPRISE, performs better than LIGHT. This service offers minimum QoS guaranties, whereby the network seems lightly loaded. It is normally implemented using the DiffServ Assured Forwarding (AF) PHB.
- *LIGHT*: characterised by the occupation of whatever network resources are left. It is implemented using the DiffServ Best Effort (BE) PHB.

OF DIFFERENTI WITH ACTIVE

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Refinement

- Start with high-level policies, specifying QoS requirements to be offered to users.
- Successively refine these requirements down to equipment level, enforcing them with policies.
- Several policy layers correspond to different abstraction levels, forming a hierarchy.
- The refinement is done by analysing each QoS parameter dependencies, and building a policy that enforces the contracted requirements.
- Active policies are active objects that act on managed objects to enforce a contract.
- Possible different semantics: best-effort, statistic, deterministic.

IATED SERVICES POLICIES

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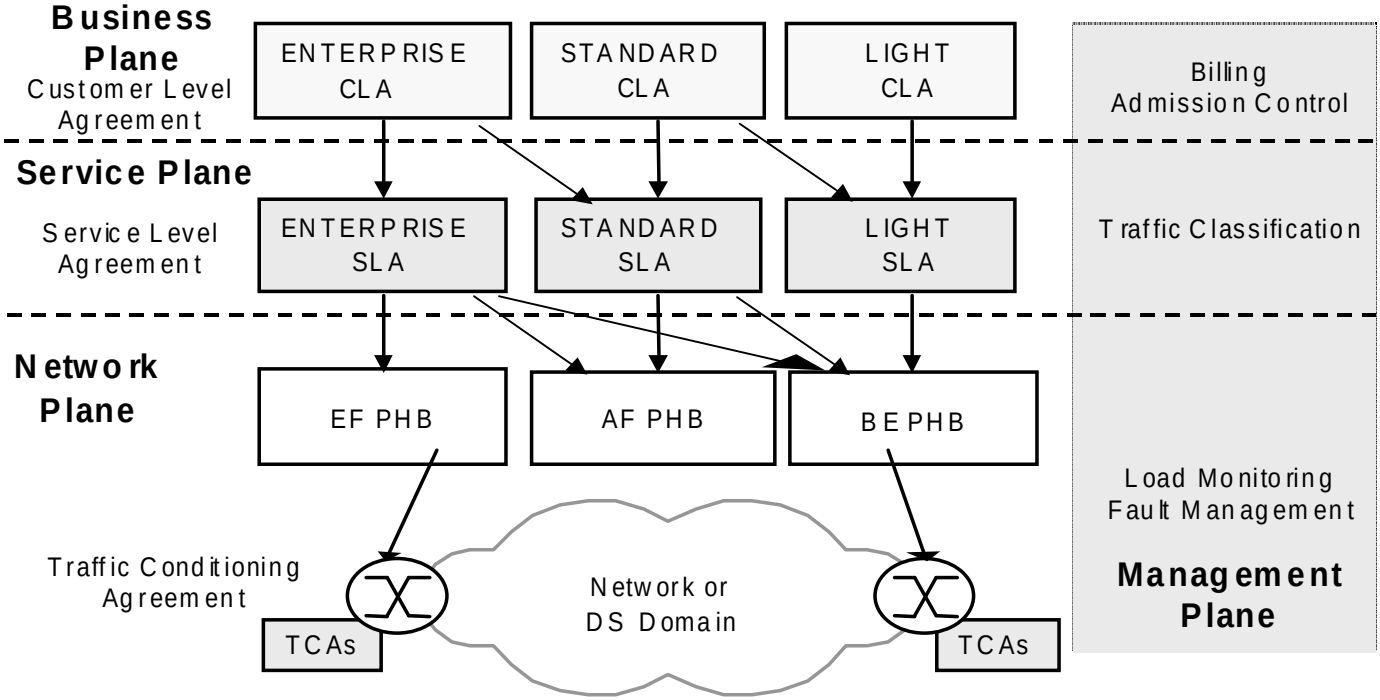
System Architecture



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Business Policies

USER ADMISSION POLICIES

a. Users are accepted until a fixed maximum number of users is reached for each PoP.
b. Users are accepted until a fixed maximum number of users is reached for each class, (Enterprise, Standard), after which the users get a lower available class, possibly Light.
c. Similar to **a**, but the maximum number of users depends on the current PoP load.
d. Combination of **b** and **c**: all maximums depend on current PoP load.

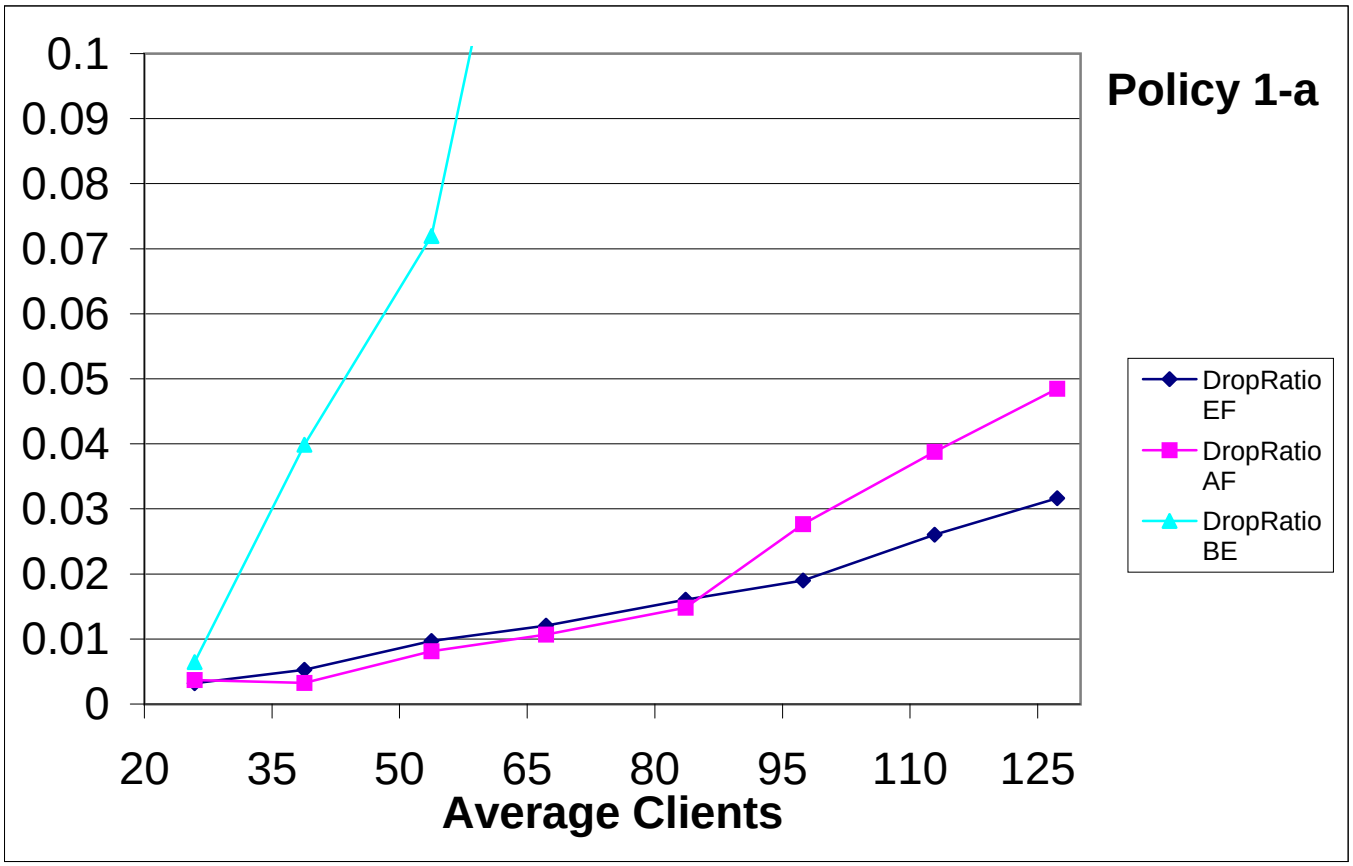
Service Policies

RESTRICT MAPPING OF TRAFFIC TO PHB ACCORDING TO APPLICATION

Policy	telnet/TCP	CBR/UDP	OnOff/UDP	http/TCP	ftp/TCP
1	any	any	any	any	any
2	any	any	any	AF BE	BE
3	EF AF	EF AF	EF AF	AF BE	BE
4	EF AF	EF AF	EF AF	BE	drop

PROBLEM with no Policy:

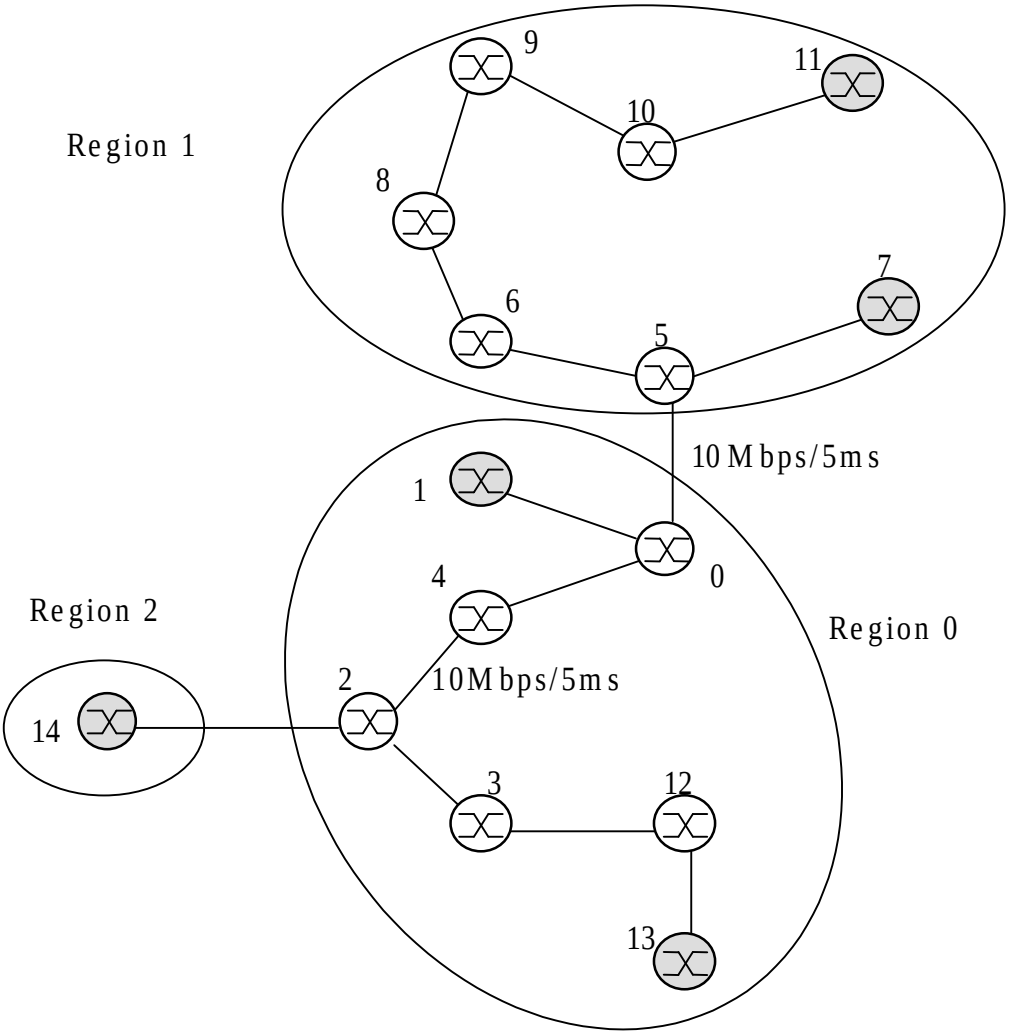
Significant packet drops, even for low traffic loads.

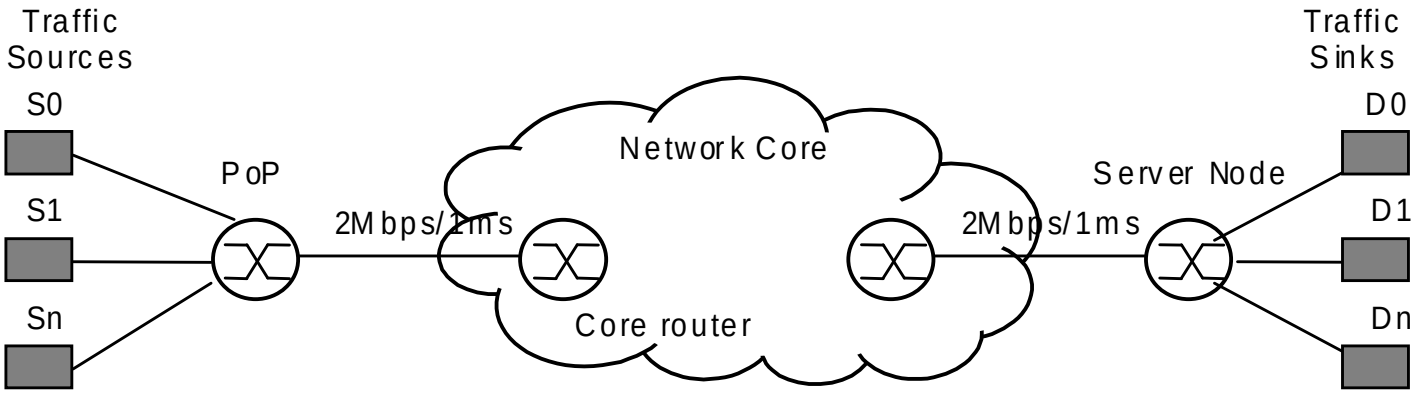


Policy **d** Operation

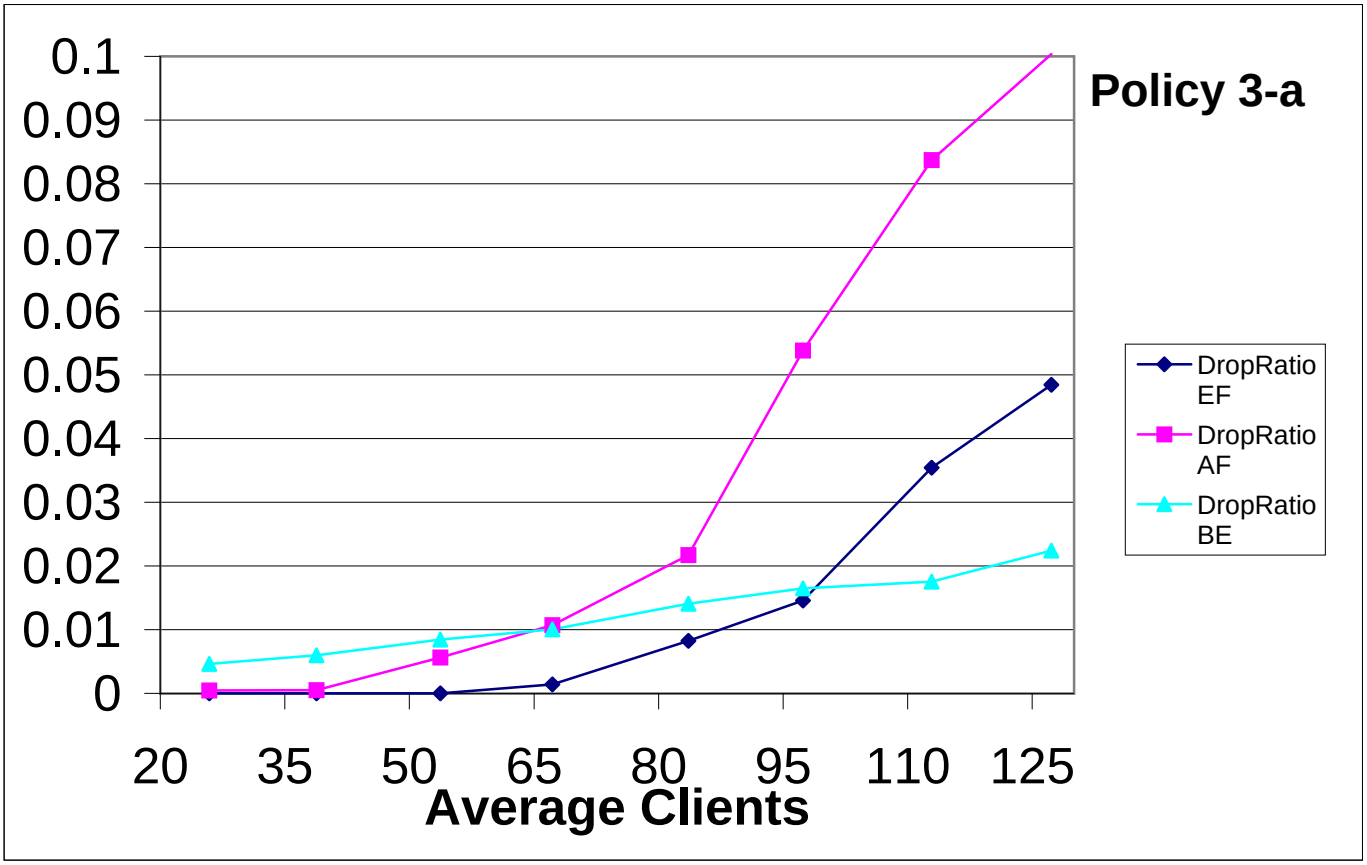
- This is an **active policy** that dynamically adjusts the maximum number of users for each PoP, and the maximum number of users allowed in each class.
- It monitors the packet drops in each PHB for each 2 seconds period.
- If there are any EF, or 5 AF packet drops, the maximum number of clients in their class is set to the current number of clients minus 3, keeping a minimum of 5 clients.
- Current users remain active, but new users are refused access or downgraded, to prevent further network overload.
- The maximum total number of clients (all classes) is reduced by 10 if there are more than 50 packet drops in a 2 seconds period.
- The maximum number of clients in each class is increased back to allow 3 new clients, if there are no packet drops, growing until its normal value.

Network Topology





Drop Ratio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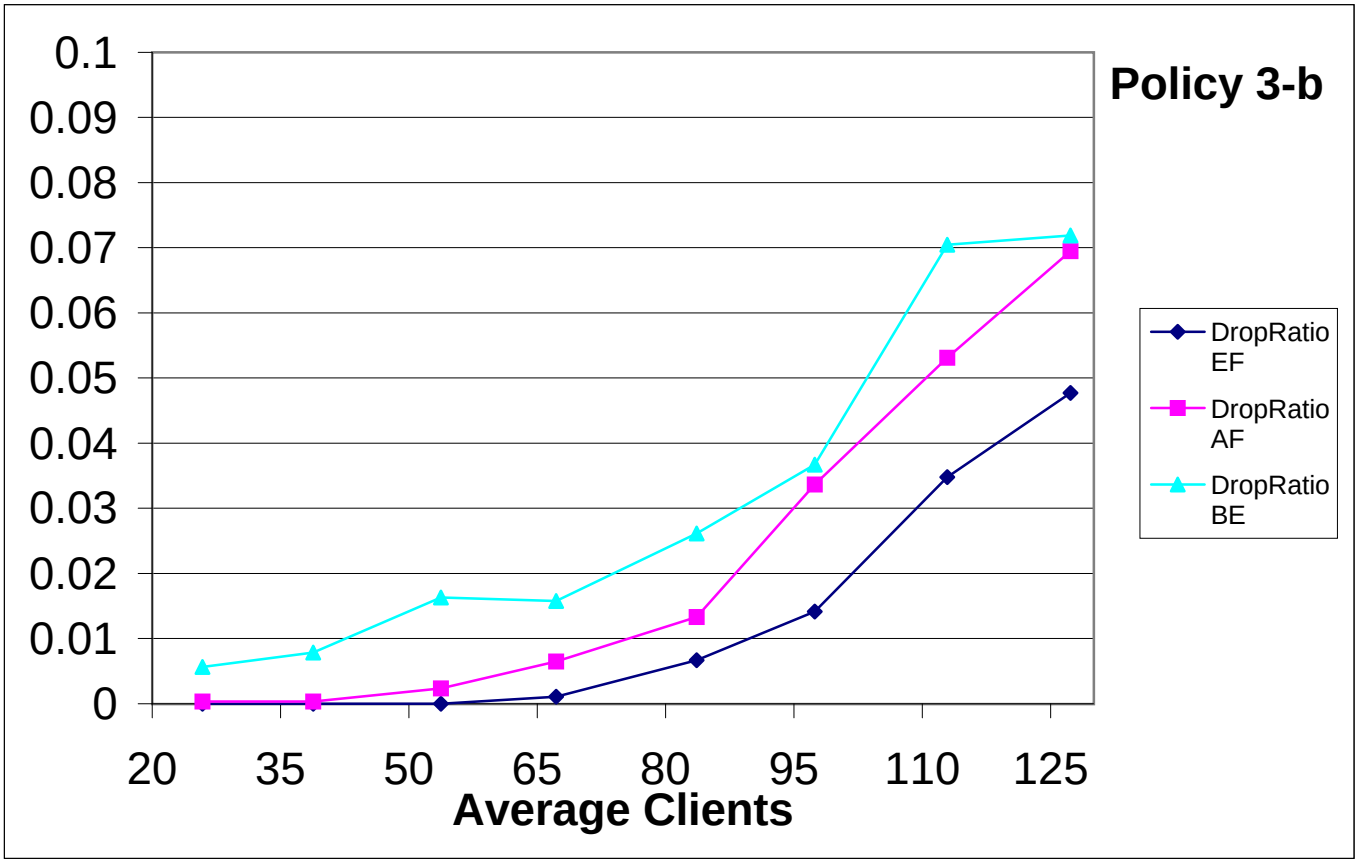
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
20
35
50
65
80
95
110
125
Average Clients
DropRatio EF
DropRatio AF
DropRatio BE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0.07
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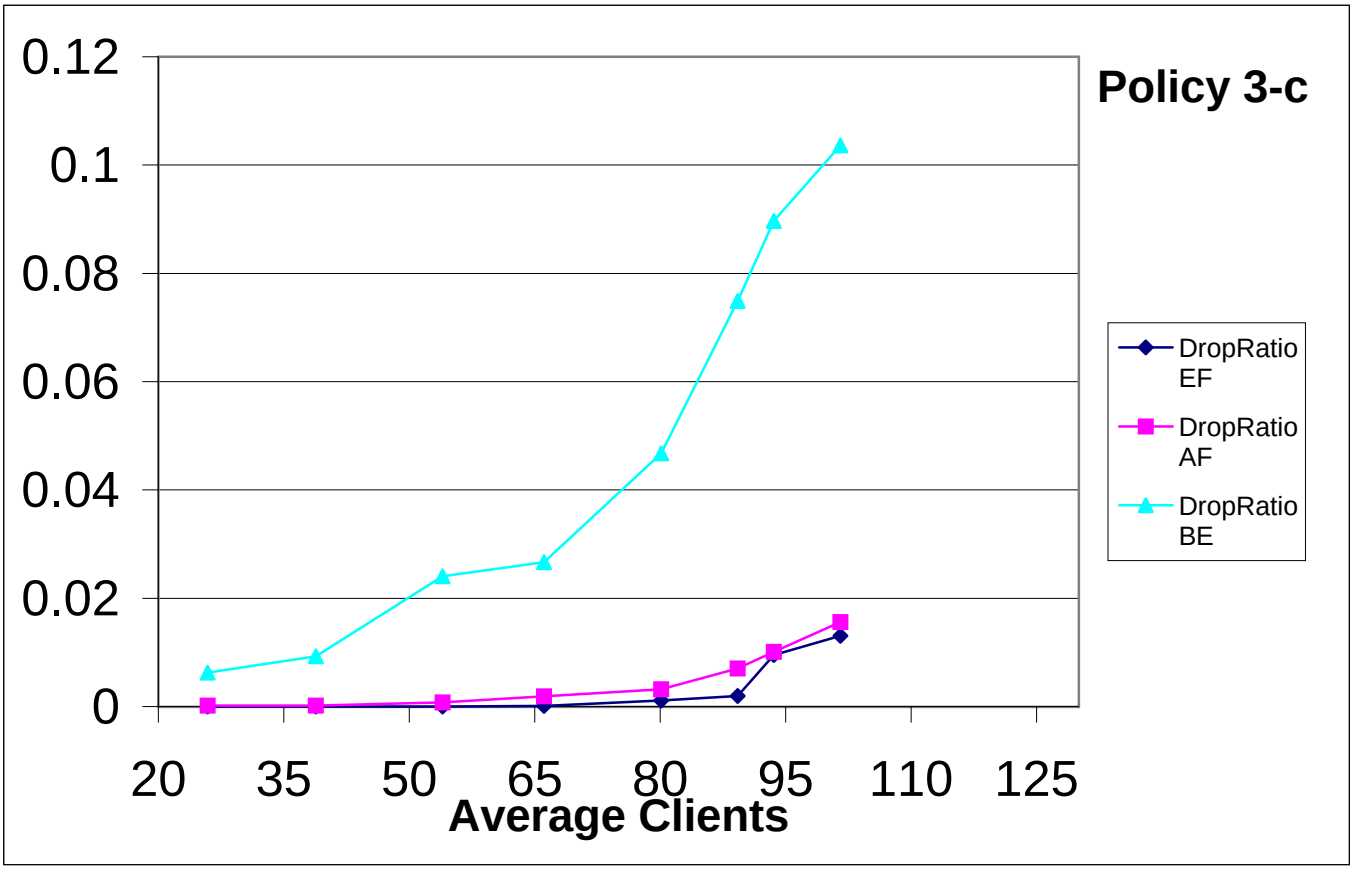
0.04
0.03
0.02
0.01
0
20
35
50
65
80
95
110
125
Average Clients
DropRatio EF
DropRatio AF
DropRatio BE

Drop Ratio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0.1
0.08
0.06
0.04
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0
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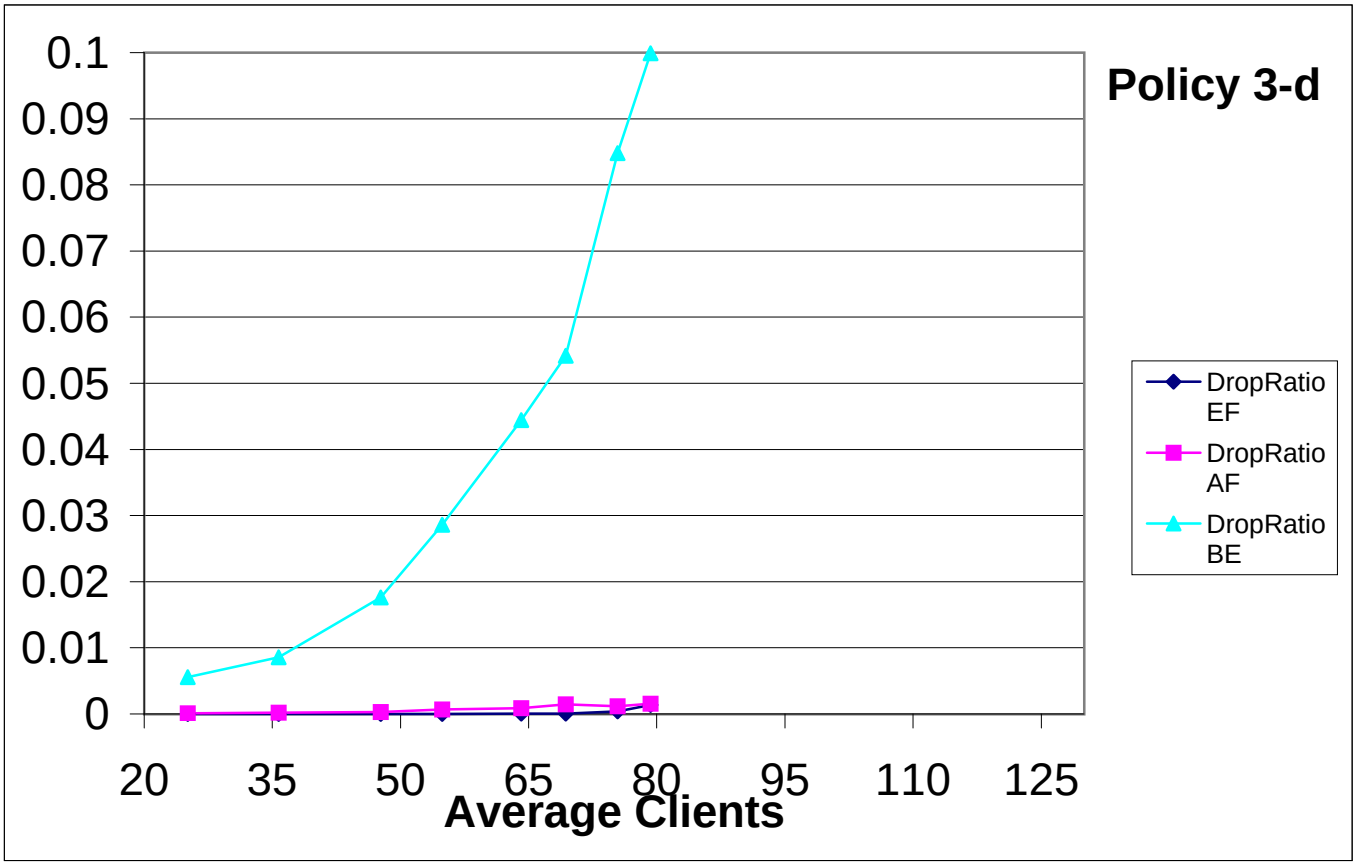
50
65
80
95
110
125
Average Clients
DropRatio EF
DropRatio AF
DropRatio BE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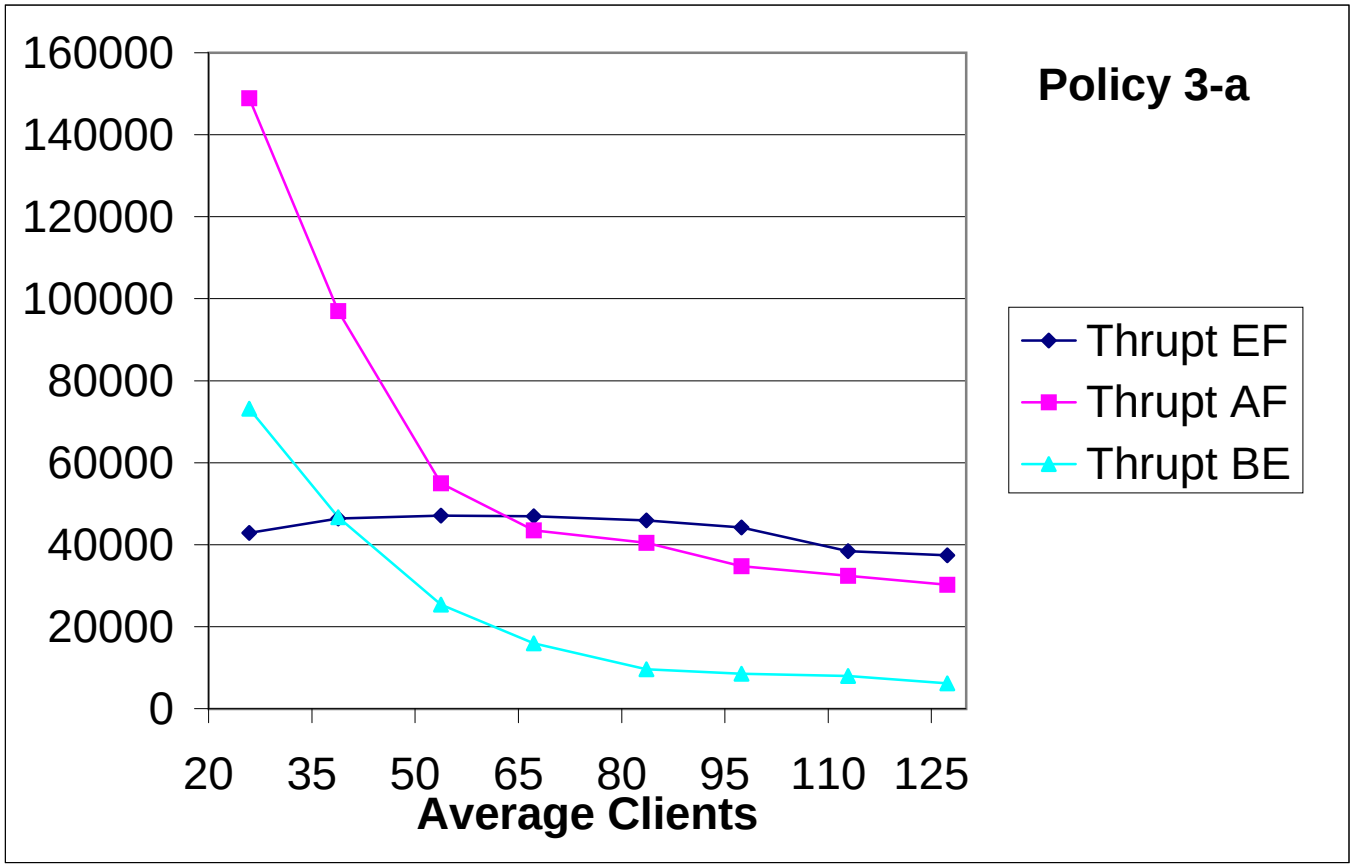
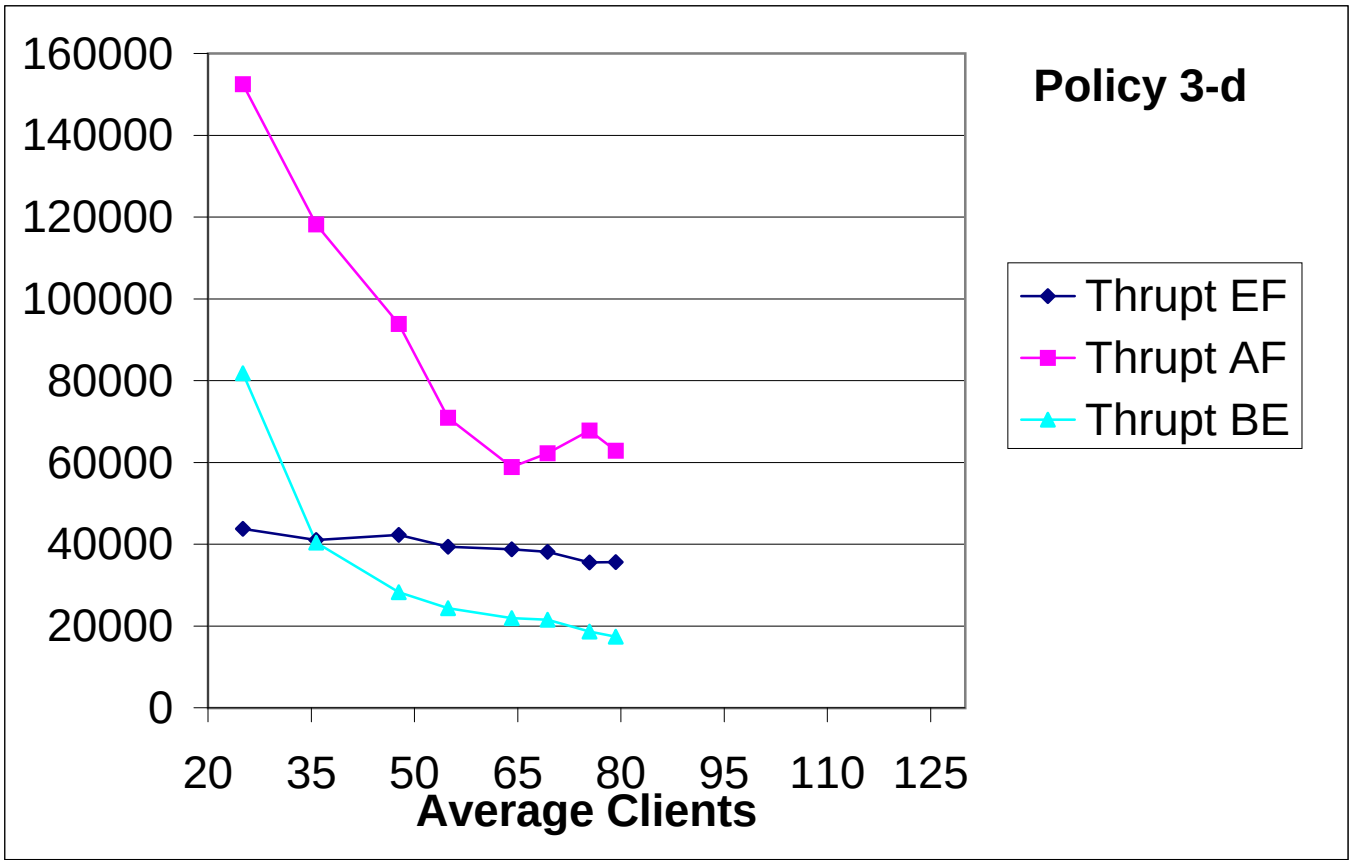
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
20
35
50
65
80
95
110
125
Average Clients
DropRatio EF
DropRatio AF
DropRatio BE

Throughput


160000
140000
120000
100000
80000
60000
40000
20000
0
20
35
50
65
80
95
110
125
Average Clients
Policy 3-a
Thrupt EF
Thrupt AF
Thrupt BE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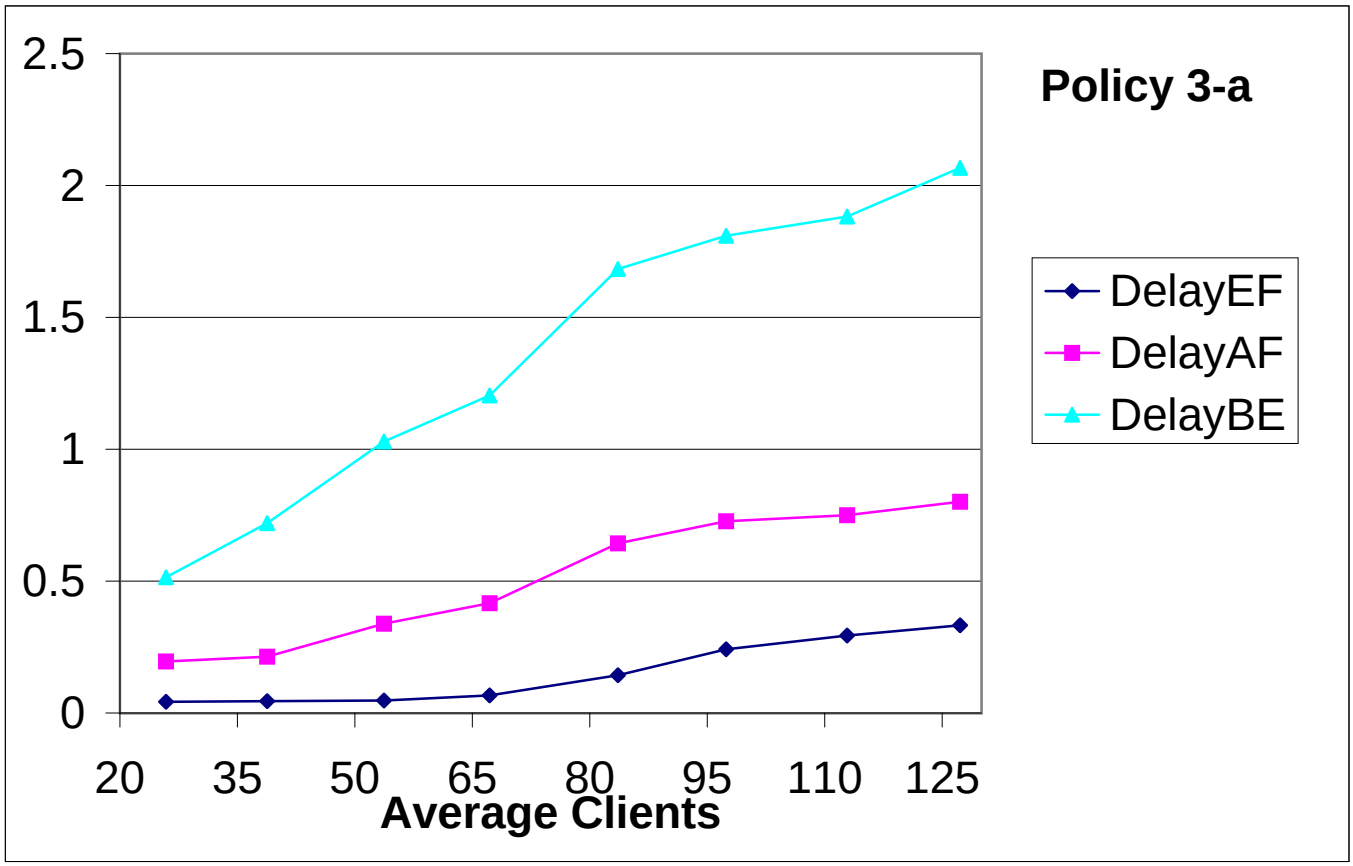
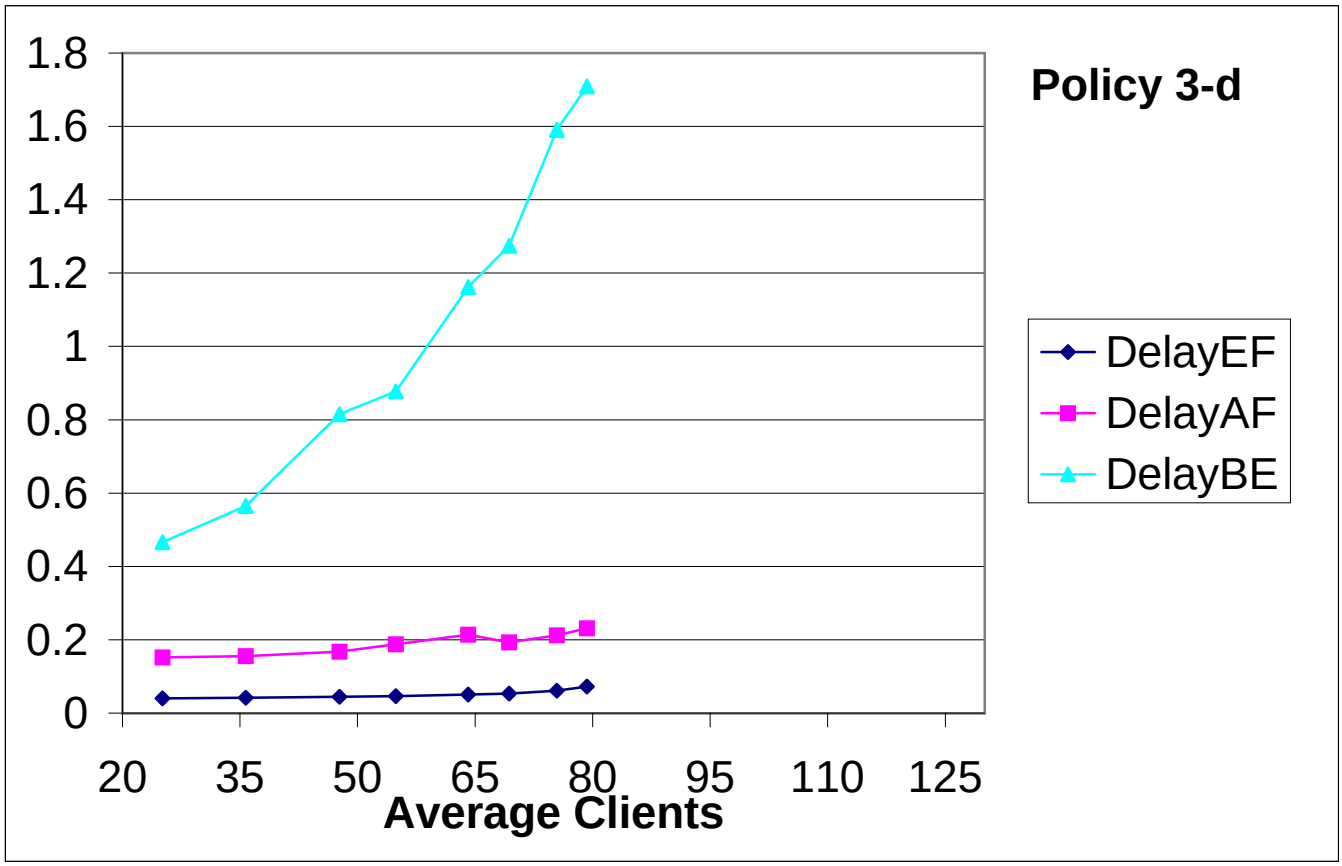
140000
120000
100000
80000
60000
40000
20000
0
20
35
50
65
80
95
110
125
Average Clients
Policy 3-d
Thrupt EF
Thrupt AF
Thrupt BE

Delay


Policy 3-a
2.5
2
1.5
1
0.5
0
20
35
50
65
80
95
110
125
Average Clients
DelayEF
DelayAF
DelayBE


Policy 3-d
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1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
20
35
50
65
80
95
110
125
Average Clients
DelayEF
DelayAF
DelayBE

Conclusions

- QoS offered to users is refined to different abstraction levels down to the equipment.
- Policies enforce the QoS requirements.
- A policy hierarchy is used to manage the system, supporting the different abstraction levels, and a distributed system.
- Experimental results show that active policies adapt to network state improving the QoS offered to users, and perform better than non active policies.
- Some active policies can be reused to control different parameters, by associating them with the correct variables, and adjusting the thresholds.

References

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[2] Paulo Pereira, Paulo Pinto, “Algorithms and Contracts for Network and Systems Management”. IEEE Latin American Network Operations and Management Symposium, Rio de Janeiro, Brazil, 3-5 December 1999, pp.385-396. ISBN: 85-900382-3-8.

[3] VINT Network Simulator (version 2). http://www-mash-cs.berkeley.edu/ns

[4] J. Heinanen et al, “Assured Forwarding PHB Group”, RFC 2597, June 1999.

[5] V. Jacobson et al, “An Expedited Forwarding PHB”, RFC 2598, June 1999.