IP Telephony over Differentiated Services

Torsten Braun and Matthias Scheidegger

Computer Networks and Distributed Systems
(Rechnernetze und Verteilte Systeme)

Institute of Computer Science and Applied Mathematics

University of Berne, Switzerland

www.iam.unibe.ch/~rvs

Dagstuhl, October 30, 2002

Overview

- Introduction
- Basic Concept
- Adaptive DiffServ Phone Implementation
- Performance Evaluation
- Conclusions
- References

Introduction

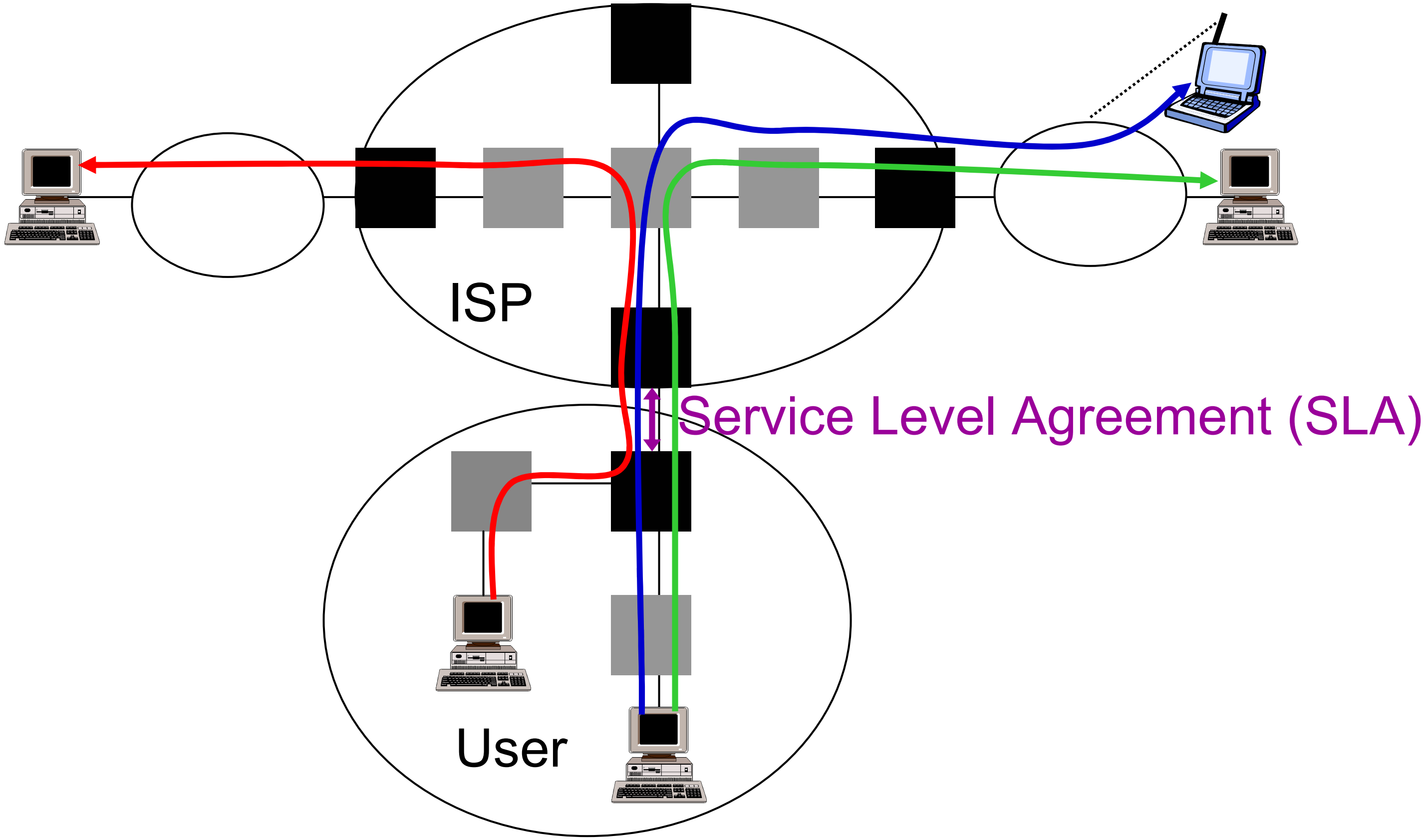
- Real-time applications are sensitive to QoS changes in the network.
- Network bandwidth and delay may be very dynamic.
- Applications can adapt themselves based on RTCP feedback.
- Differentiated Services (DiffServ) as scalable mechanism to provide QoS.
- Approach: Combination of adaptive applications and DiffServ

DiffServ Classes

- RFC 2474
  - ... PHBs selected by a Class Selector Codepoint SHOULD give packets a probability of timely forwarding that is not lower than that given to packets marked with a Class Selector codepoint of lower relative order ...
- Assumption: DiffServ classes can be ordered with respect to their QoS / price.
  - Price/quality of service offered by a higher class ≥ price/quality of service offered by a lower class

Basic Concept

- Monitor QoS feedback information and always select cheapest class that provides sufficient QoS guarantees
- Application Scenarios
  - Charging is based on used DiffServ traffic
  - SLAs with multiple egress points
  - Congestion in access networks



Monitoring and Service Class Selection

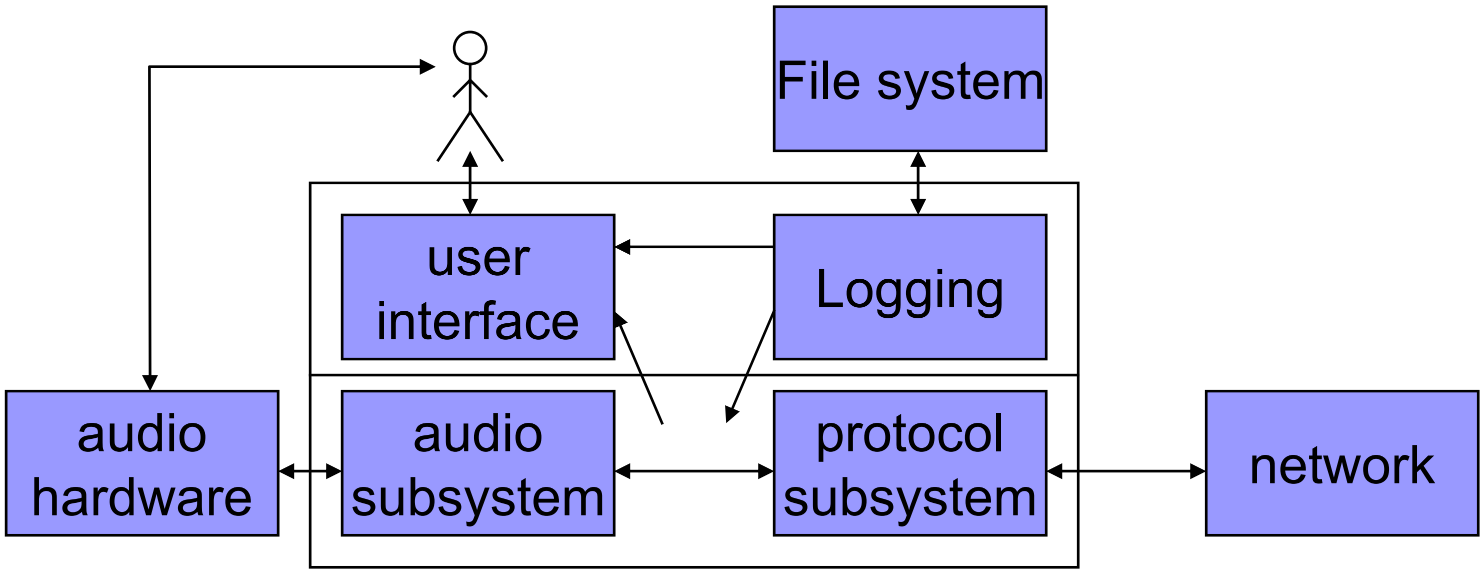
- QoS parameters of DiffServ classes might vary
  → selection must be updated continuously
- Monitoring the used class and the next lower one might be sufficient, because service classes are ordered.
- Monitoring the next lower class by active probing using application-specific RTCP packets
  - Certain fraction of bandwidth for probing traffic (2 %)
  - Probing period needs to be long enough
  - Why not probing for next higher class ?
    - Minimize network load
    - Switching to higher class does not decrease quality
- If current QoS is bad: switch to next higher class
- If current QoS is good and probing of next lower class shows good results: switch to next lower class
- Oscillations → random probing periods, hysteresis

Switching between Service Classes

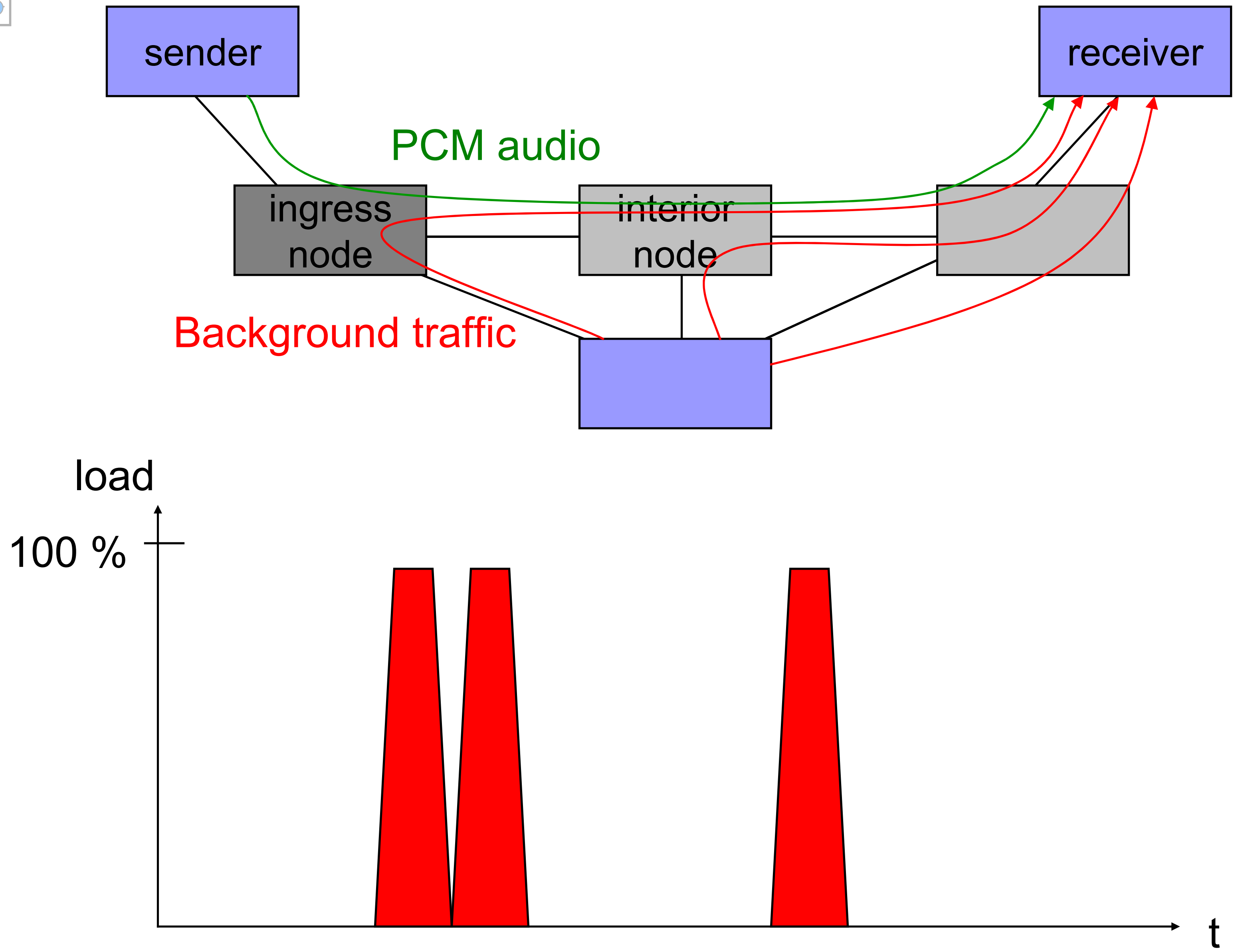
```
FOREVER
   wait for new QoS monitoring
   create list L of requirements that cannot be met
   IF L is empty
        perform QoS monitoring for next lower class
        IF monitoring results are sufficient
                select next lower class
        ELSE
                keep current class
        ENDIF
   ELSE
        search next higher class with respect to L
        IF found
                select this class
        ELSE
                keep current class
        ENDIF
   ENDIF
LOOP
```

Adaptive DiffServ Phone Implementation

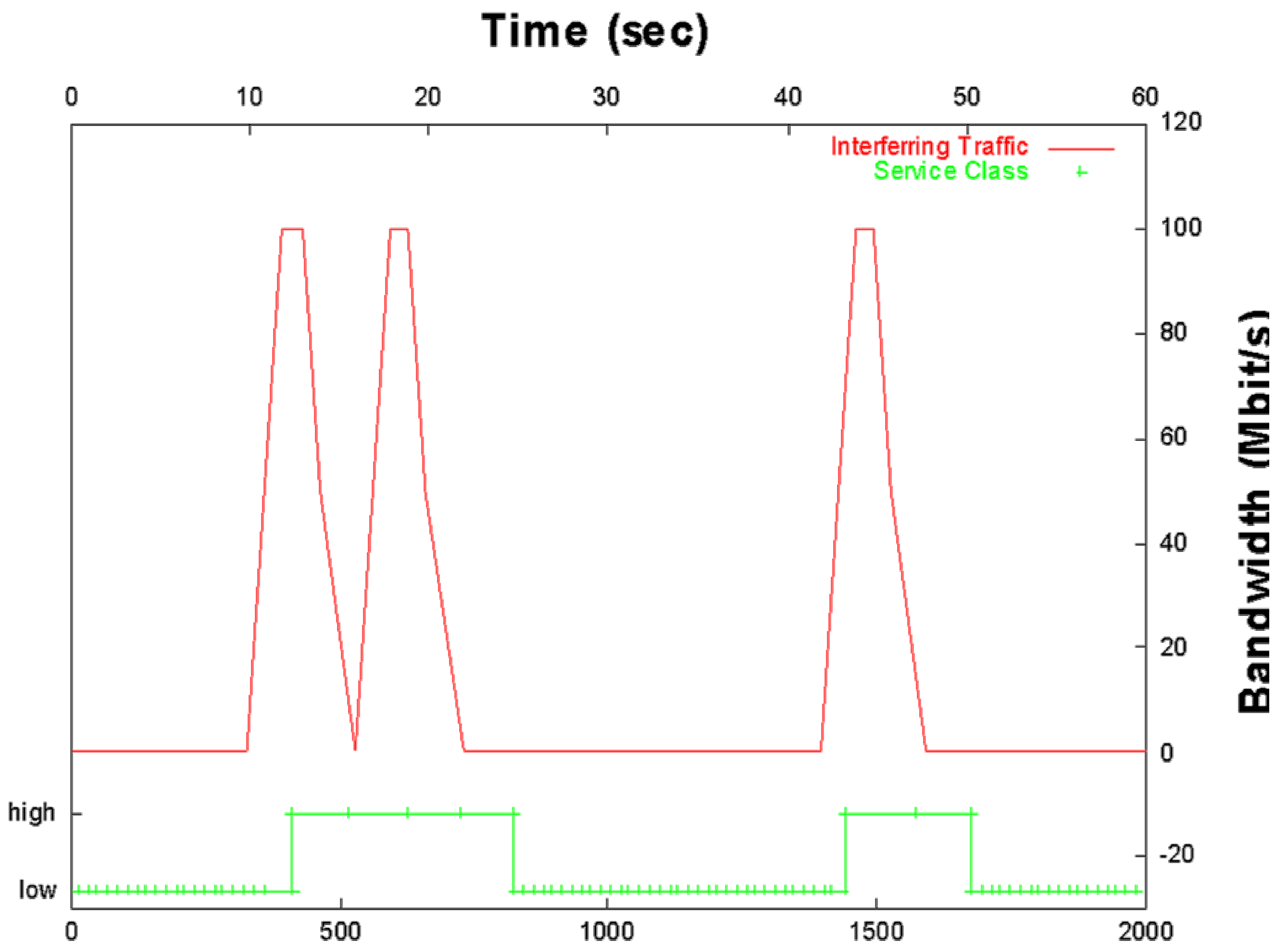
- DiffServ Phone (DSPhone) application
  - supports audio file I/O to support tests that can be reproduced
  - C++ implementation
- Supported DiffServ classes
  - Best-Effort
  - Assured Forwarding 1-4
  - Expedited Forwarding
- Probing based on application specific (APP) RTCP packets
- Ordering: BE ≤ AF1 ≤ ... ≤ AF4 ≤ EF
- Experiments in a Linux DiffServ test-bed (U Bern / NEC DiffServ implementation)



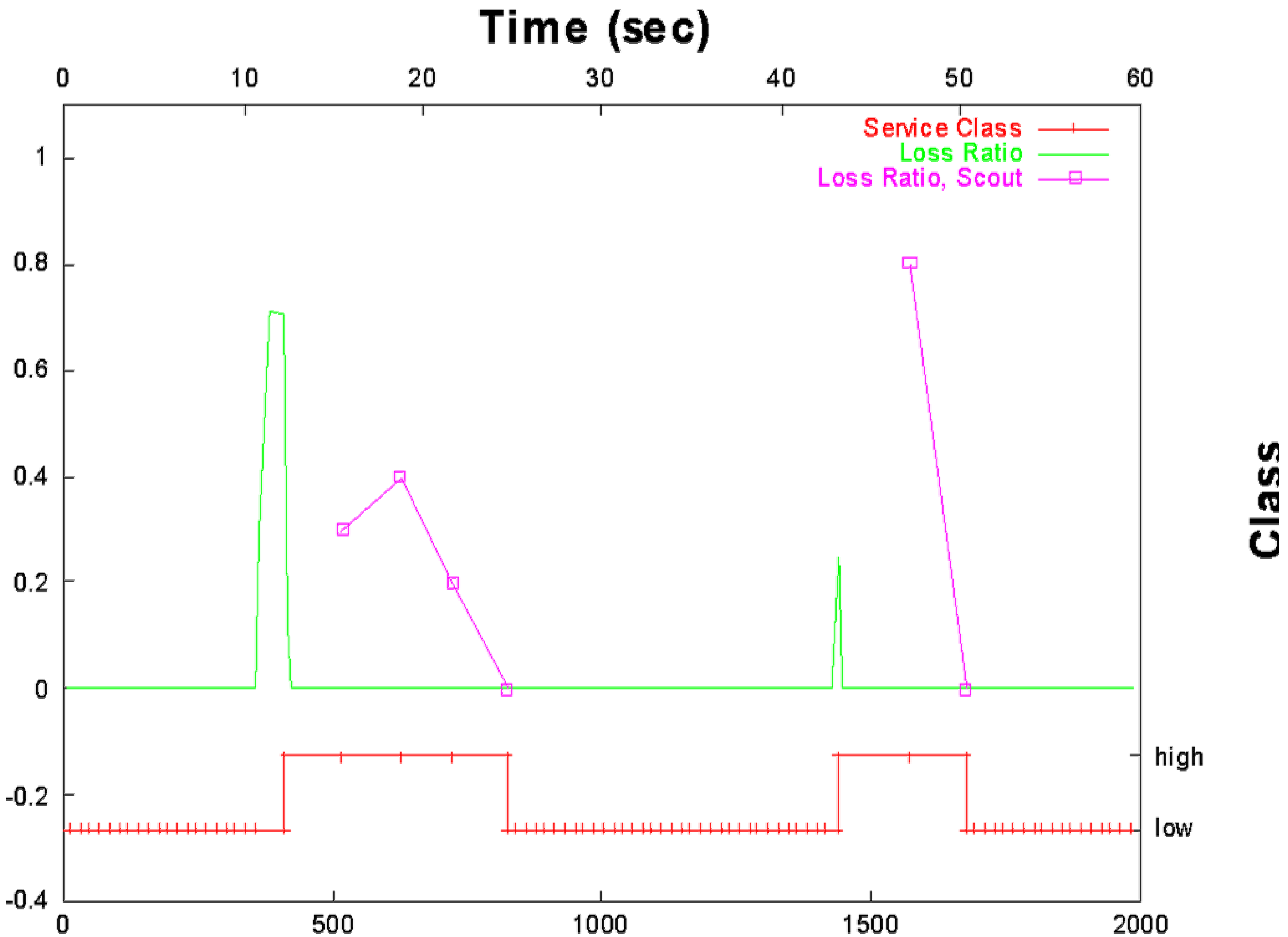
Performance Evaluation



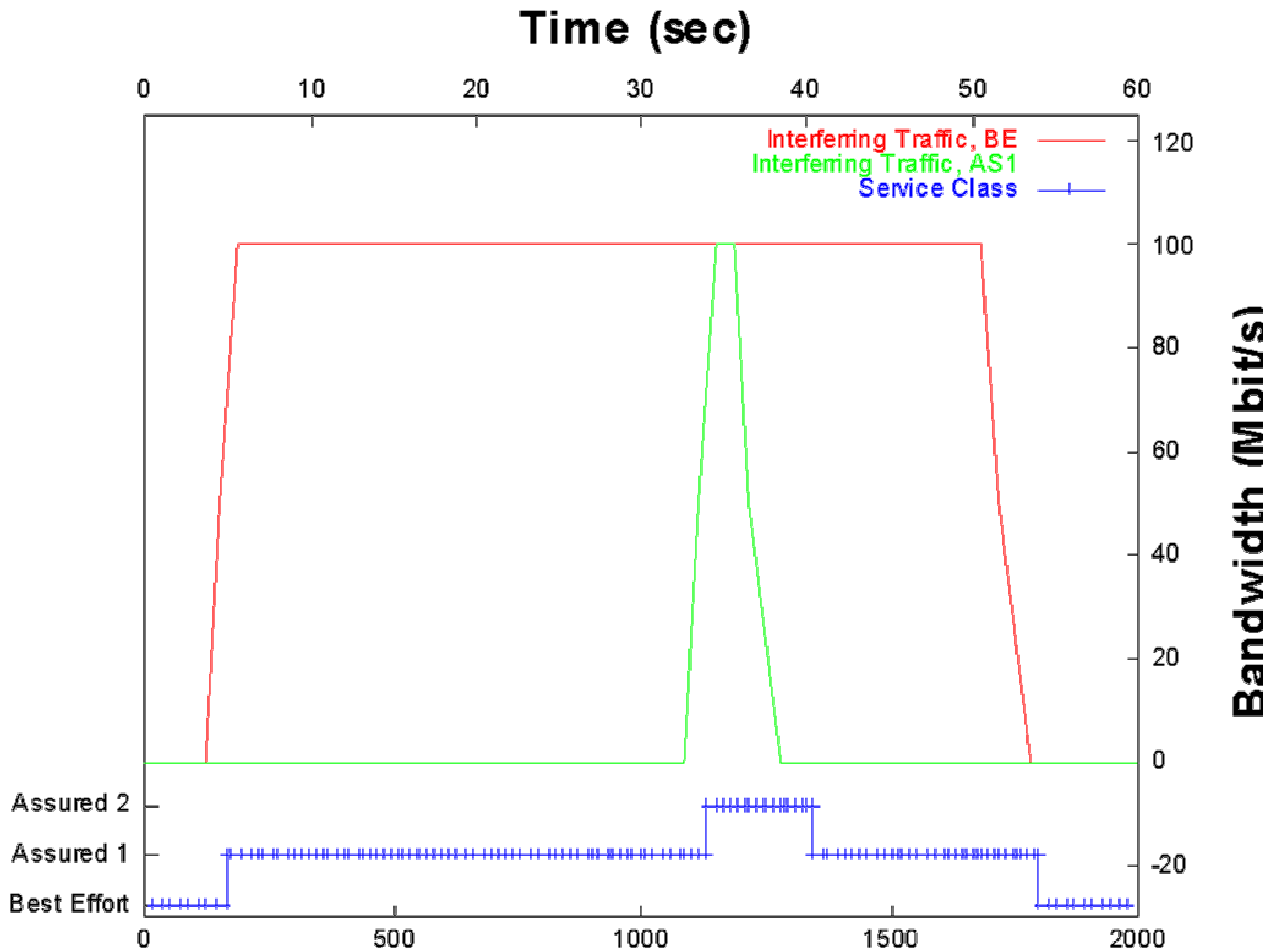
Switching between 2 Classes



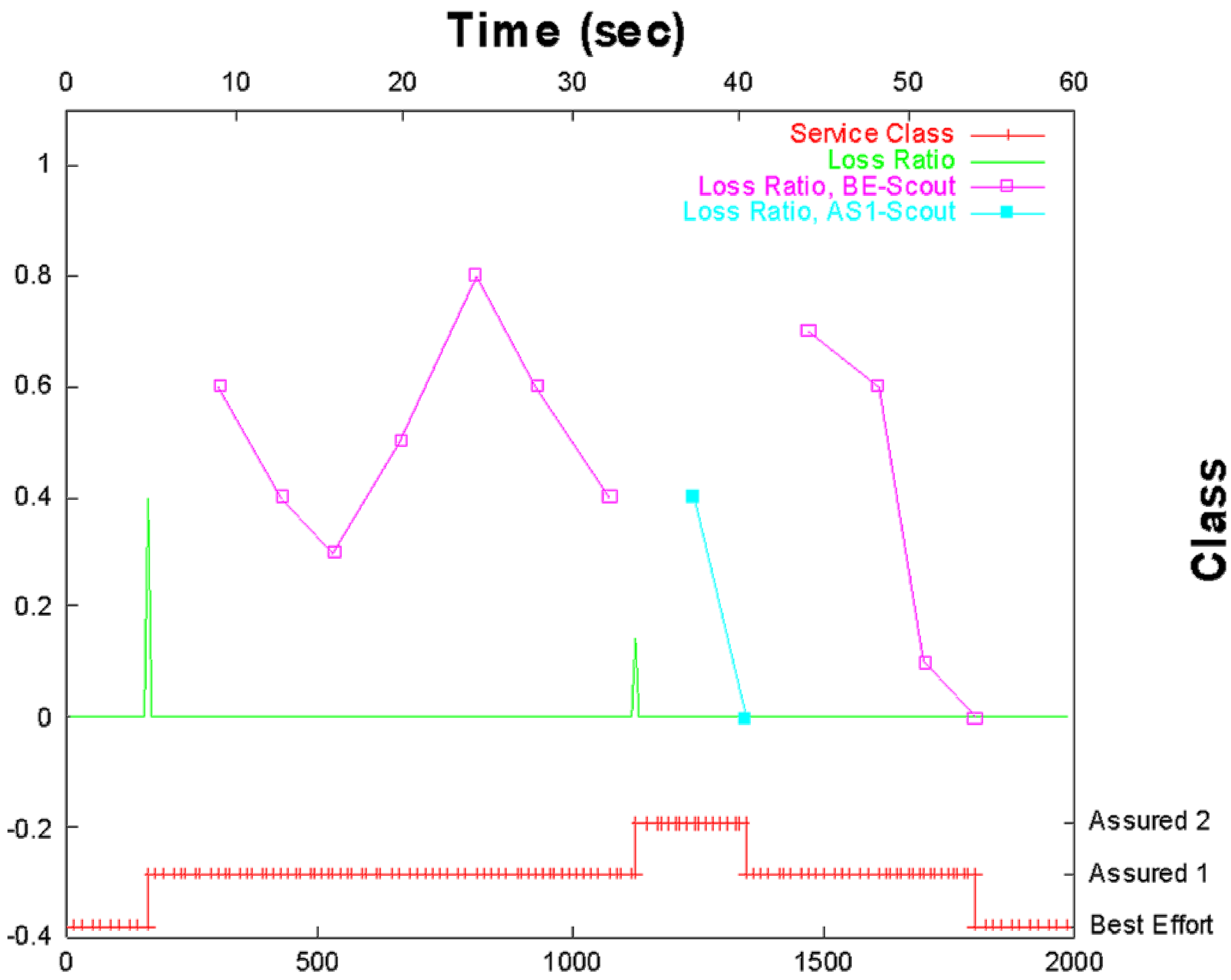
Switching between 2 Classes



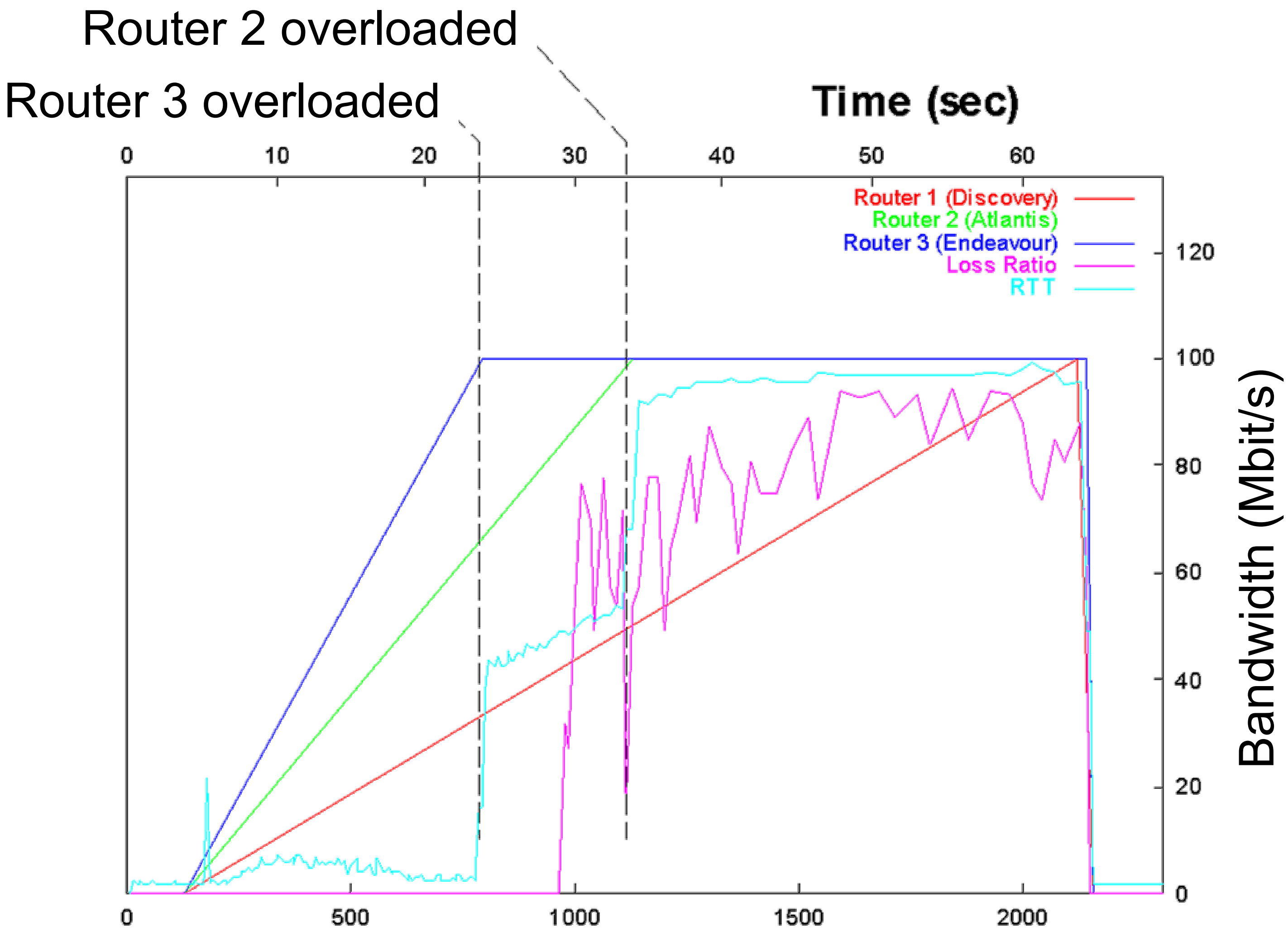
Switching between 3 Classes



Switching between 3 Classes



Delay and Loss Rate



No DiffServ support for IP telephony application !

Conclusions

- Application reacts rather quickly and selects cheapest sufficient service class.
- Concept might be useful in several scenarios
- Congestion could be detected earlier by detecting increase of delay in order to avoid short loss peaks.

References

- M. Scheidegger and T. Braun:
  An Adaptive IP Telephony Application
  over Differentiated Services,
  21st IEEE International Performance,
  Computing, and Communications Conference,
  Phoenix, AZ, April 3-5, 2002, pp. 361 - 368

- UDPgen
  - time variant UDP traffic generator for experimentation networks
  - www.iam.unibe.ch/~rvs/software