ARP: Active Reservation Protocols

featuring

ACC: Active Congestion Control

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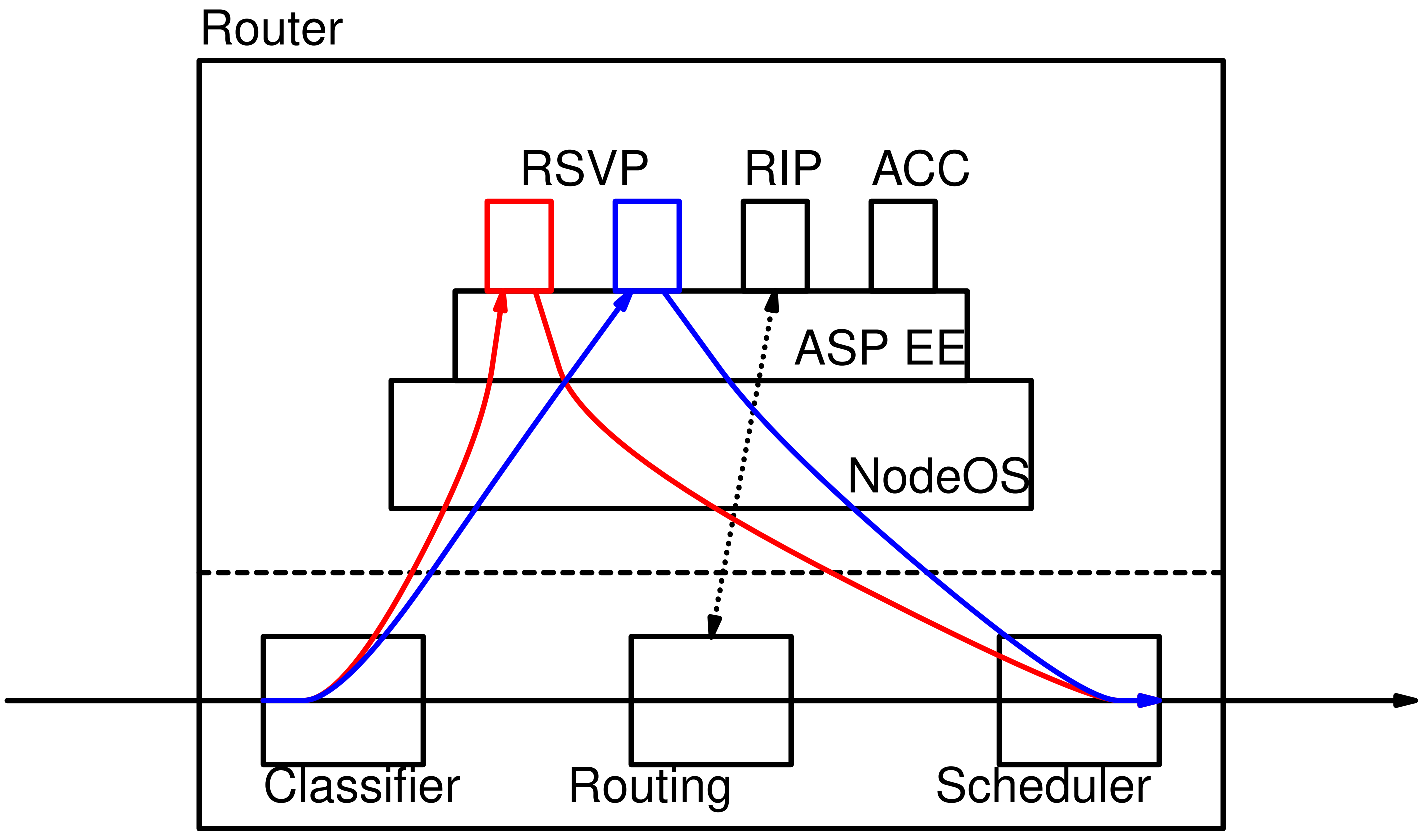
ARP Goals

- Apply Active Networking (AN) to signalling
  - control plane
- Support changing software
  - emerging protocols
  - customization
- Infrastructure
  - ASP EE design for protocol customizations
  - virtual networks
  - experiments (ABONE)

Active Signalling

- Signalling (state in routers), e.g. :
  - RSVP resource reservations
  - label switching paths
  - diffserv provisioning information
- Why should AN be used for signalling?
  - performance
  - distribution
  - customization

An Active Signalling Architecture



Active Signalling Applications

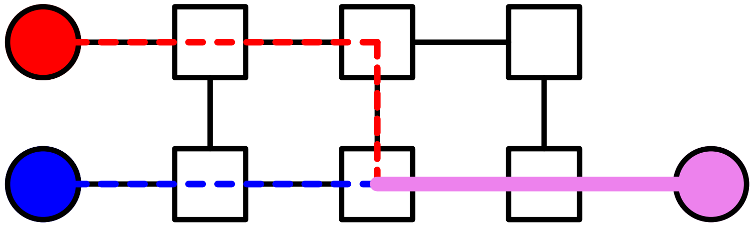
- Jrsvp
  - 90% complete RSVP implementation
  - tested in CAIRN w/legacy implementations
  - EE requirements:
    - soft state
    - access to routing system (RSRR)
- Jrip
  - RIP for our virtual network
  - same packet format & protocol as RIP

ACC: Active Congestion Control

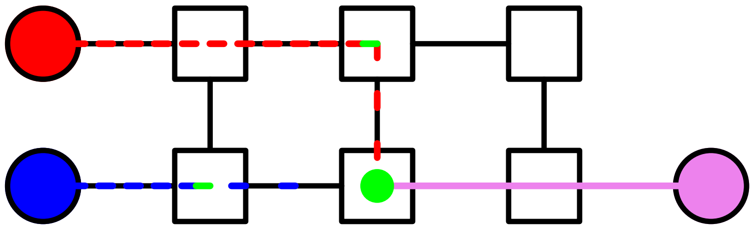
- Show that active networking techniques can improve feedback-based congestion control
- Expand the ASP framework to support congestion control
- Explore the design space of active feedback congestion control

Feedback and Active Nets

- Passive (w/o ACC):



- Active (w/ACC):



ns Simulation Studies

- Simple TCP style algorithms
  - Notify host
  - Filter one window of traffic
- Results
  - As much as 18% throughput improvement on high BW-delay paths with bursty traffic
  - Detailed discussion at http://www.isi.edu/~faber/pubs/active.ps

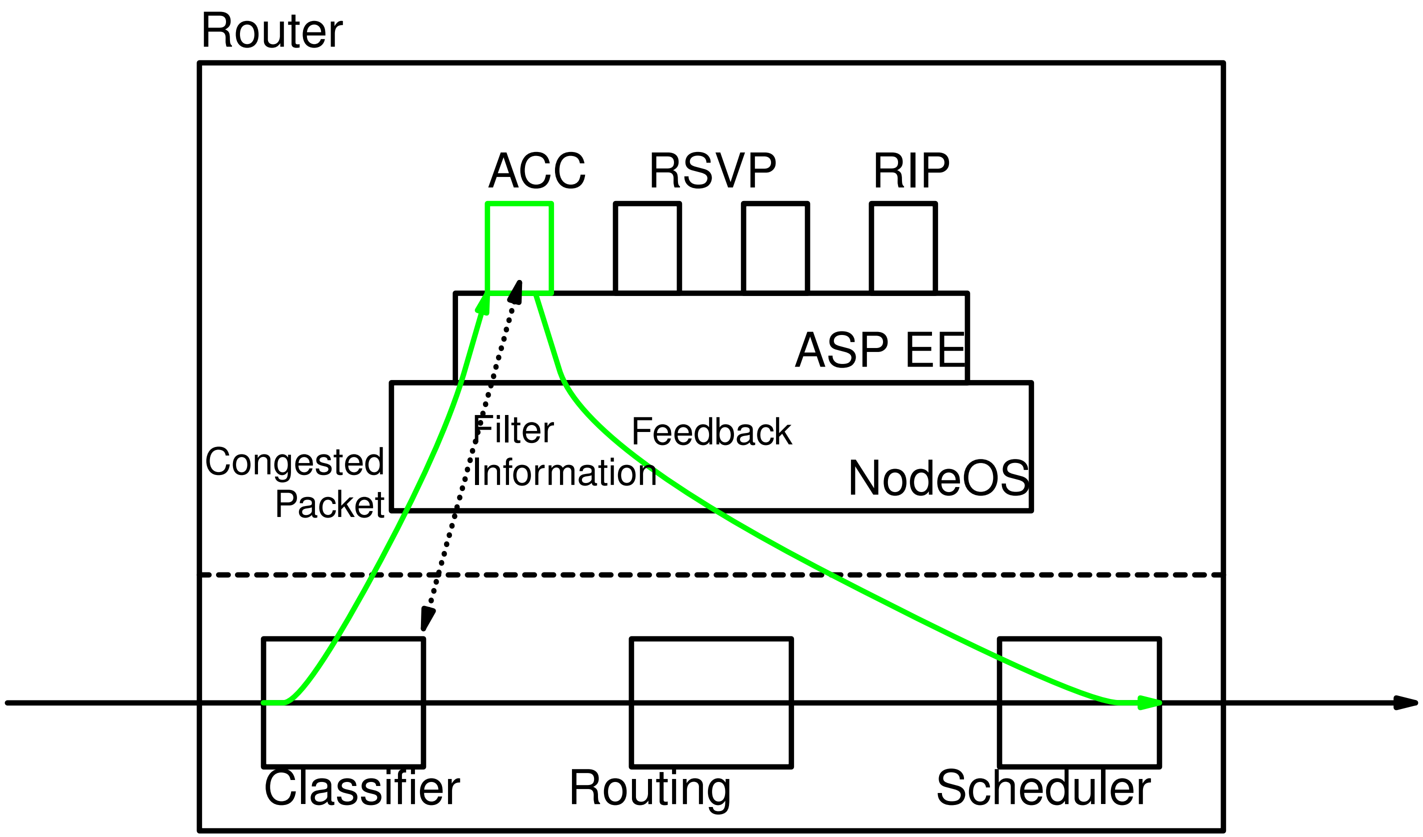
ACC and ARP

- ACC:
  - reacts to congestion events
  - installs filters
  - sends feedback

- Low per-packet CPU overhead
- CPU intensive work is signalling

- ACC fits in a signalling framework (ASP)

ACC Implementation



ACC Implementation

- Using ARP's internal classifier/scheduler
- Ported Partridge's RDP to Java
- Activating RDP

Protocol Customization

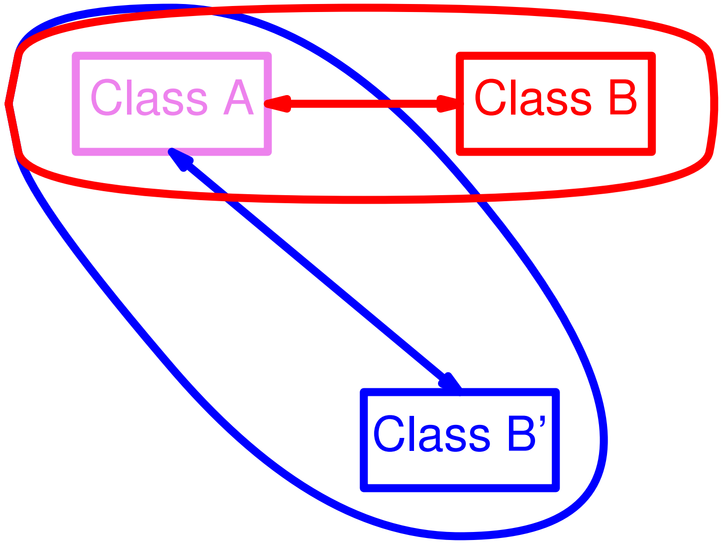
- Customize code for:
  - new feature sets
  - algorithm changes (authentication)
  - bug fixes

- Multiple customizations must coexist

- Active Signalling Protocol (ASP) EE

ARP Customizations

- AA :
  - set of classes working together
  - packet context → class bindings



Customized Implementations

- Three custom versions of RSVP on one router
  - base
  - base + SCOPE
  - base + CONFIRM

  (SCOPE and CONFIRM are new features)

- Demonstrated at July PI meeting

ASP Design for Customization

- Dynamic binding
- Code sharing
- Resource protection between AAs
- (Virtual) network I/O
- Inter-AA communication
- Per-AA soft-state

Dynamic Binding

- Dynamic name binding
  - apparent → definite name (in the EE)
  - definite name → code (at remote servers)
- Transparent extension
  - first mapping: feature changes
  - second mapping: invisible changes
- Load each implementation once

Resource Protection

- ASP AAs should not interfere with each other
  - accident
  - malice
- ASP: AA-based protection
- Java: class-based protection
- Java $\rightarrow$ ASP:
  - generalize **`static`** data to per-AA data
  - prevent AA data exchange through ASP

Virtual Networking

- VNet module abstracts network
  - addressing
  - end-to-end/hop-by-hop delivery
  - routing
  - management interface
- Same interface as native code

Future Work

- AA resource limits
- Component mechanism
- Fleshing out dynamic loading
- Security and inter-AA communication
- Porting to a common NodeOS
- ACC implementation and testing