RSVP as a User Signaling Protocol in a Multi-Layer Bandwidth Broker Architecture

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Introduction

- Many applications (esp. multimedia) are QoS demanding
  - Timing and throughput requirements
- Current QoS Mechanisms
  - Integrated Services (IntServ)
  - Differentiated Services (DiffServ)
  - Bandwidth Brokers
- Gap between users/applications and the QoS network
- Motivation: to reuse RSVP as a resource request protocol in a combined DiffServ/Bandwidth Broker approach

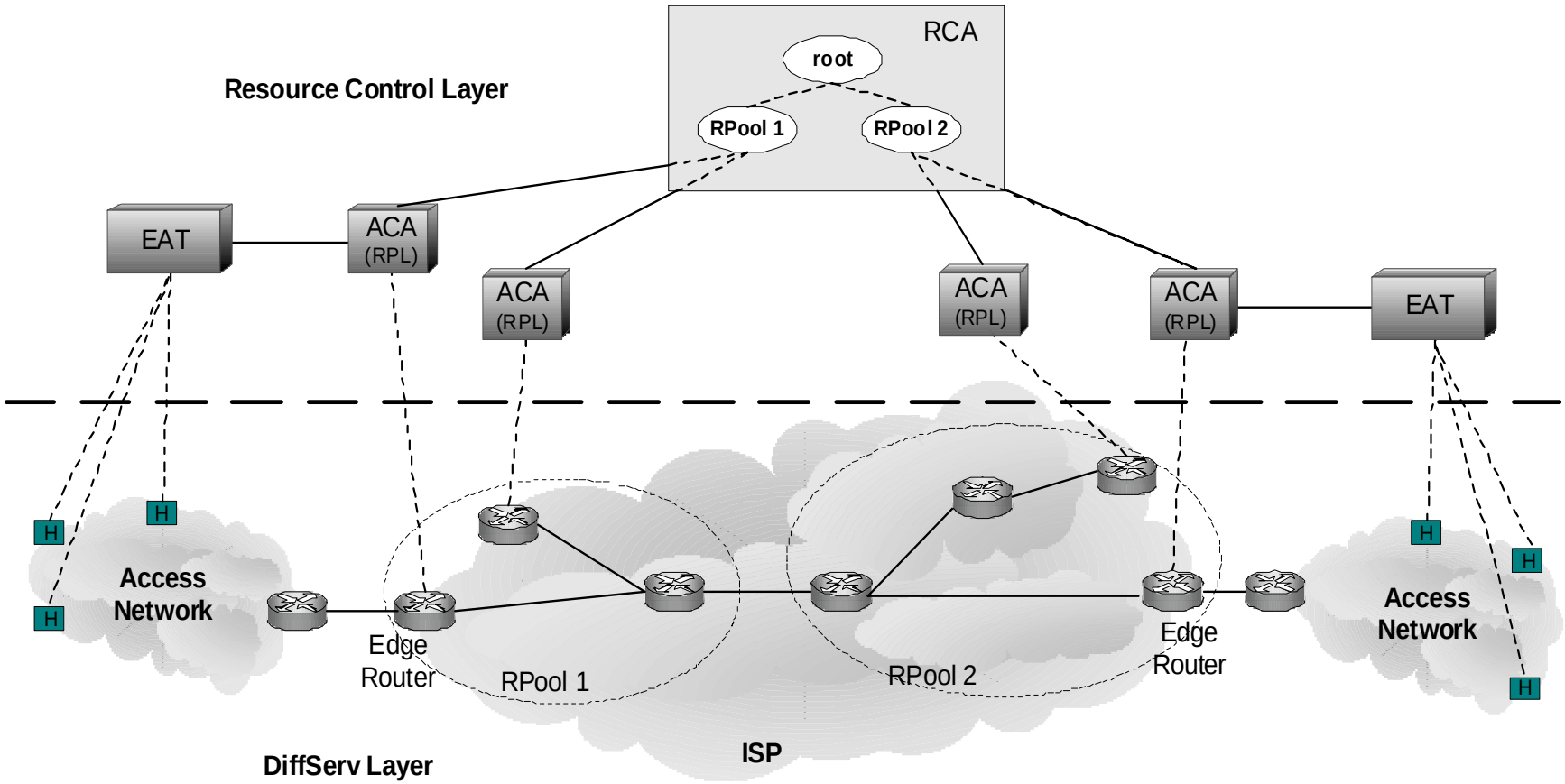
The AQUILA architecture

- Aims to provide a scalable and efficient solution for QoS provisioning in IP networks
- Based on the concepts of DiffServ and Bandwidth Brokers
- Introduces a new layer (Resource Control Layer – RCL) over the DiffServ Network
  - Distributed BB architecture
- Consists of three main entities:
  - Resource Control Agent (RCA)
  - Admission Control Agent (ACA)
  - End-user Application Toolkit (EAT)

Architectural Principles

- RCA
  - Overall view of the network
  - Management of resources, allocation to controlled ACAs
- ACA
  - Localized admission control
  - Authorization and accounting functions
  - One ACA for each Edge Router
- EAT
  - QoS portal
  - Web-based interfaces for the formulation of QoS requests by users and applications

The AQUILA architecture



Network Services and Traffic Classes

- Network Services: aggregates created by applying traffic conditioning, which experience a known PHB at each node within the DS domain
  - Premium Constant Bit Rate (PCBR)
  - Premium Variable Bit Rate (PVBR)
  - Premium MultiMedia (PMM)
  - Premium Mission Critical (PMC)
  - Best Effort (BE)
- Traffic Classes: implementation of NSs.
  - They are defined as a composition of a set of admission control rules, a set of traffic conditioning rules and a PHB.
  - Currently, five TCLs correspond one-to-one to each NS.

Network Services Details (1)

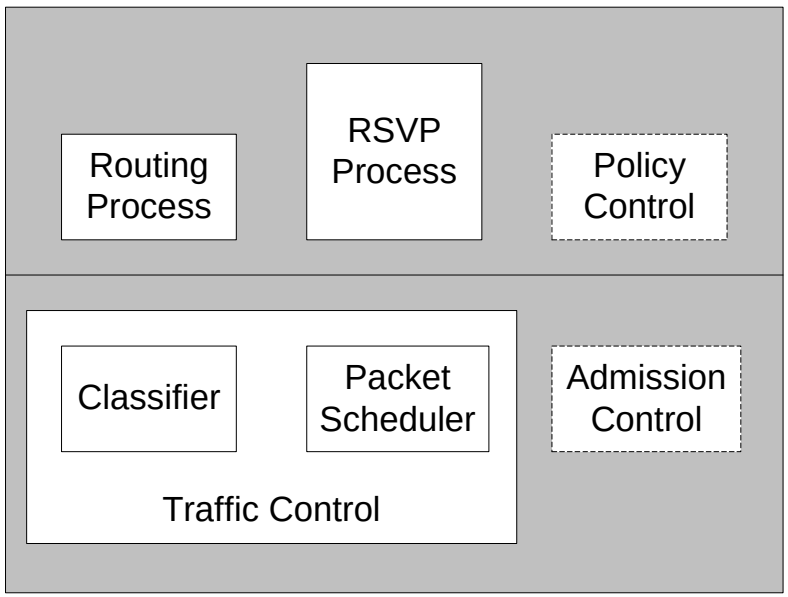
- Premium Constant Bit Rate (PCBR)
  - Intended for constant and variable bit rate applications with low bandwidth flows, e.g. IP Telephony
  - low delay, delay variation requirements
  - strict packet loss, small packet size
  - TCL1: Single Token Bucket that polices the Peak Rate.
- Premium Variable Bit Rate (PVBR)
  - appropriate for unresponsive VBR sources with medium to high bandwidth requirements, e.g. video-conferencing
  - have low delay, delay variation and packet loss requirements, but less strict than those of PCBR
  - TCL2: Dual Token Bucket. The first TB polices the sustained rate, the second one polices the peak rate to allow for burstiness.

Network Services Details (2)

- Premium MultiMedia (PMM)
  - carry a mixture of TCP and TCP-friendly traffic, e.g. video streaming and FTP
  - require minimum bandwidth, delivered with high probability
  - TCL3: single TB as a meter and marker, which polices the sustained rate
- Premium Mission Critical (PMC)
  - supports mainly transactions and database queries
  - flows are non-greedy, have short lifetimes, low bandwidth requirements and roughly homogeneous congestion control
  - TCL4: dual TB (as in PVBR), operates as meter & marker
- Best Effort (BE)
  - no quality of service guarantees

RSVP as a Signaling Protocol

- Assume a pure DiffServ core network, where core & edge routers are RSVP-unaware.
- *Enhance* the edge router to intercept RSVP messages.
- Follow the coarse internal design of an RSVP capable edge router
  - RSVP Process
  - Routing Process
  - Admission Control
  - Policy Control
  - Traffic Control



End-to-end Scenario

- Path messages are intercepted in RSVP daemon of *ingress* ER
- RSVP daemon installs Path state, and *transparently* forwards the PATH msg, until it reaches *egress* ER. Path state kept there too
- Resv msg sent by receiver intercepted in RSVP daemon of egress ER, and forwards it directly to ingress ER
- Resv msg sent by egress ER intercepted in RSVP daemon of ingress ER, which initiates AQUILA-based admission control:
  - EAT *maps* IntServ parameters to AQUILA NS
  - Admission control is performed at both ACAs that control ingress and egress ERs
  - A positive answer is returned to the EAT and the RSVP daemon
- If AC fails, REV_ERR msgs are forwarded to both directions.
- Explicit Resv_Tear, Path_Tear or timeouts initiate termination of a reservation

IntServ Mapping to AQUILA NSs

- Resv message carries a FLOWSPEC:
  - QoS control service desired (Guaranteed or Controlled-Load)
  - TSpec describing the resources to be reserved
  - RSpec describing the level of service desired
- Flowspec is transformed to AQUILA TCL specification by a *mapping algorithm*
- Purpose of the mapping algorithm:
  - To select the appropriate Network Service in AQUILA
    - Guaranteed Service to PCBR or PVBR
    - Controlled Load to PMM or PMC
  - To transform the RSpec to the traffic descriptor of the selected NS

RSpec mapping to Aquila TCLs

	Integrated Services	AQUILA Network Service	
	Guaranteed Service	**PCBR**	**PVBR**
Traffic Spec	r,b,p,m,M	PR=a*p, BSP=x*M, m, M	PR=p, BSP=x*M, SR=r, BSS=b, m, M
Transfer Delay (msec)	func(R,S)	150 maximum	250 maximum
	Controlled Load	**PMM**	**PMC**
Traffic Spec	r,b,p,m,M	SR=r, BSS=x*M, m, M	PR=p, BSP=x*M, SR=r, BSS=b, m, M
	Best Effort	**BE**	

Mapping Algorithm Details

- Main factors for mapping Guaranteed to PCBR or PVBR:
  - Maximum Packet Size (M): small -> PCBR
  - Bursty flow -> PVBR (but also PCBR under strict delay requirements)
- Main factors for mapping Controlled-Load to PMM or PMC:
  - Parameters p and r of RSpec are compared to max PR and SR of PMM and PMC

Project details

- IST Project AQUILA :

  Adaptive Resource Control for QoS Using an IP-based Layered Architecture
- http://www-st.inf.tu-dresden.de/aquila/

QUESTIONS ?