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The Siemens Bandwidth Broker

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Information and Communications

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Content

- **Introduction**
- Internet2 QoS Requirements
- Siemens Bandwidth Broker Implementation
- Evolution of the Siemens Bandwidth Broker
- Summary

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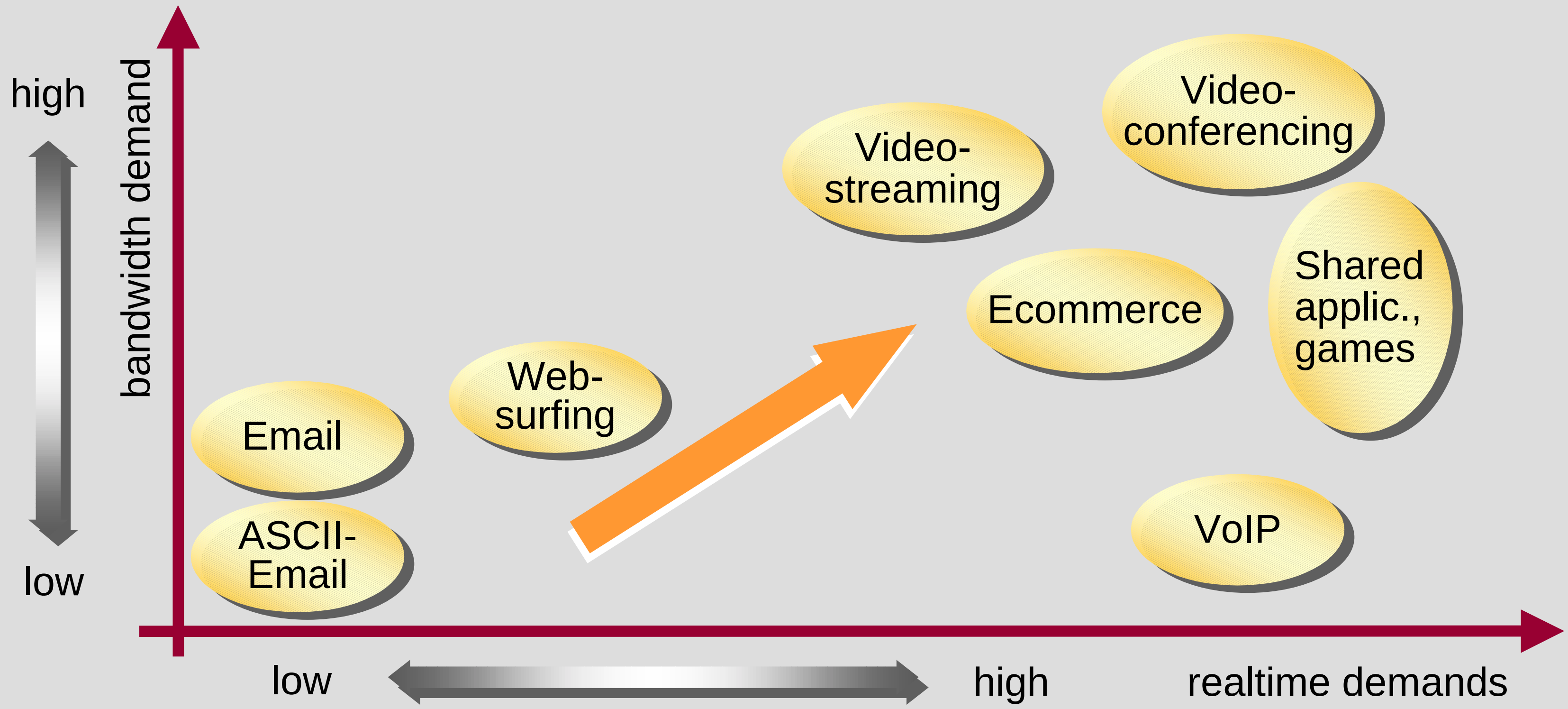
QoS-requirements of applications



Future internet applications require better QoS

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What can be done?

- Improve QoS for *all traffic* by providing „unlimited“ network resources.

→ Uncertain: Technically/economically feasible?

- Assuming limited network resources, improve QoS for *selected traffic* only: Differentiate traffic according to subscriber contract or application demand.

→ DiffServ architecture as specified within the IETF

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Basic Requirements for Internet2 QoS

- **Versatility:** Suitable for any (advanced) application
- **Administratable:** 'Easy' to install and deploy
- **Concatenatability:** Allows End to End QoS over several domains
- **Scalability:** Useful for any size of network
- **Robustness:** No single point of failure (added)
- **Measureable:** prove by measurements on data stream that the resource managament of the BB improves the service quality

Excerpt from ’QoS Requirements for Internet2 (Draft)' (Editor: Ben Teitelbaum, Ted Hanns)

Main focus of our current implementation

additional focus of our future extensions

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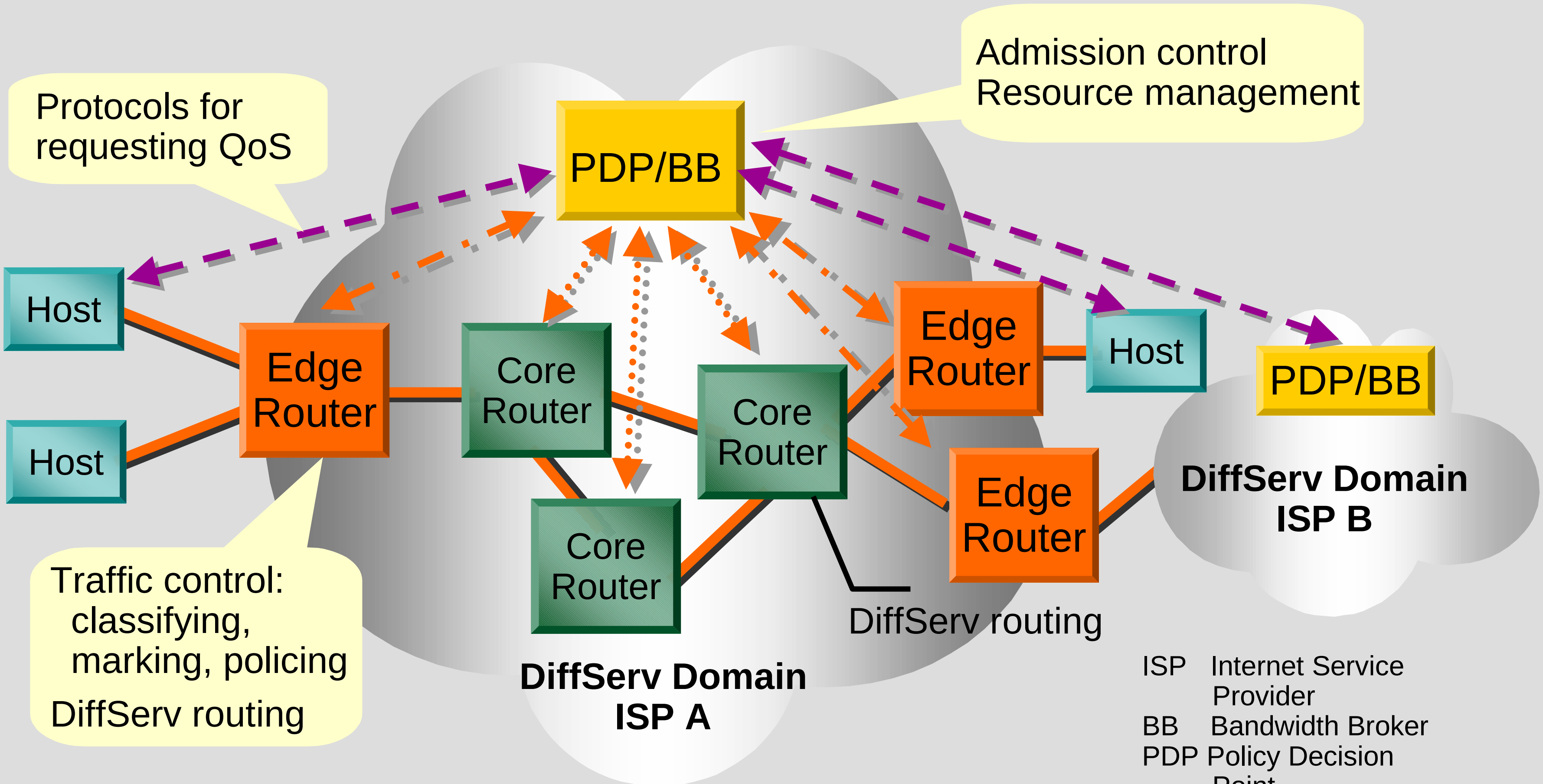
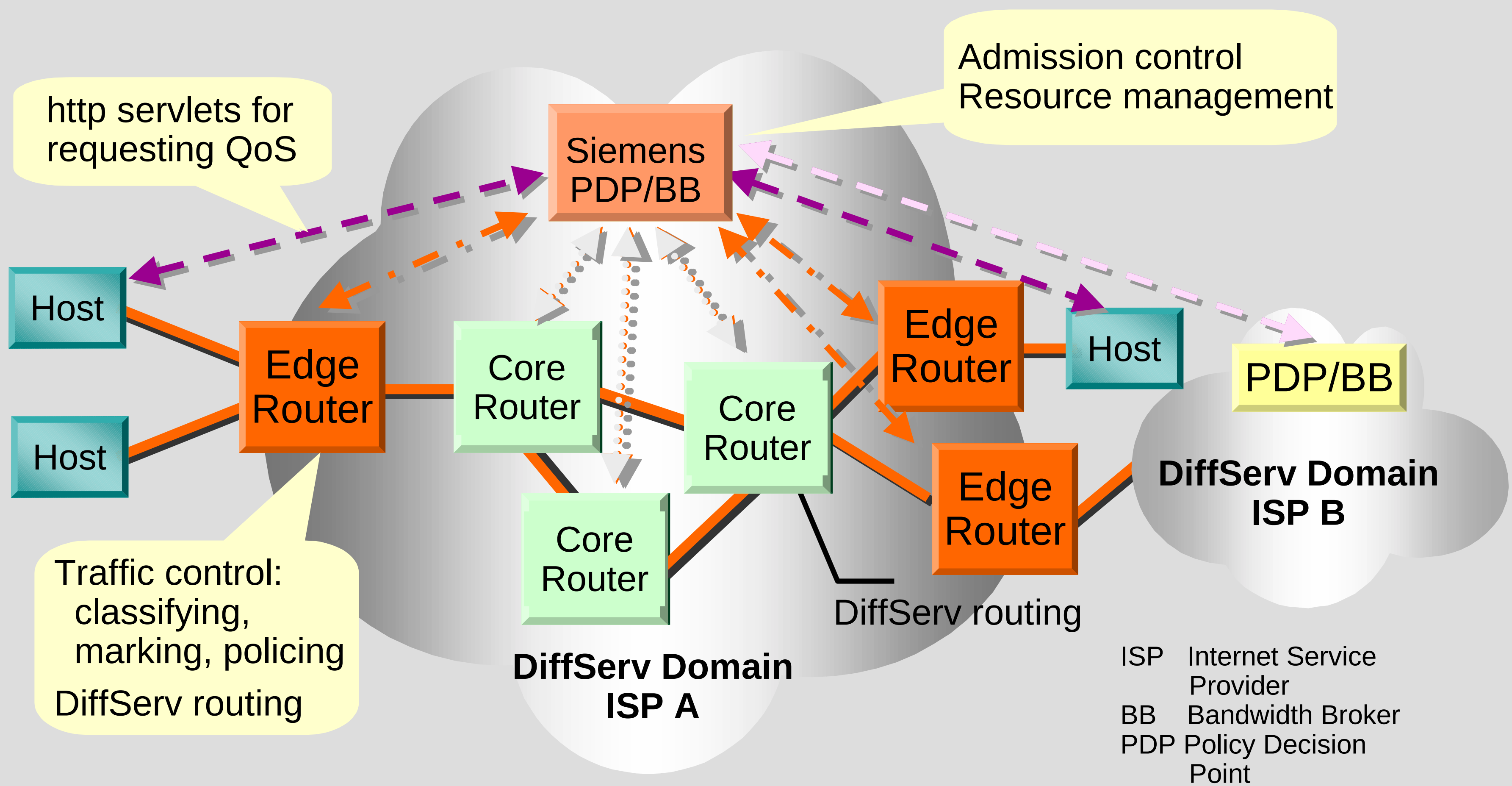
The DiffServ architecture



ISP Internet Service Provider
BB Bandwidth Broker
PDP Policy Decision Point

The Siemens Bandwidth Broker Implementation



The Siemens Bandwidth Broker : Features (1)

- Is a central policy decision point and a bandwidth broker for a DiffServ domain
- Offers a powerful „QoS-interface“ to be used by applications on hosts or Bandwidth Brokers of adjacent domains
- By using OMG‘s CORBA, the Bandwidth Broker is accessible from any platform, using many programming languages:
  - Interfaces specified in a high level Interface Definition Language (OMG IDL)
  - IIOP (Internet Inter ORB Protocol) instead of specialised protocols

The Siemens Bandwidth Broker: Features (2)

- Provides additional customized interfaces
  - WWW-Interface (servlet based) for direct operation by human users
  - simplified Java API providing basic functionality (used by HotStreams)
- Currently controls a single type of DiffServ edge router, an edge router SW implementation
- Is implemented in Java
  - Bandwidth Broker, providing the QoS-API
  - http-frontend, implemented by Java-Servlets
  - GUI implemented using Java/Swing (visualization of state/operation)

Functionality of our Edge Router

- Is a DiffServ boundary router:
  – Performs traffic classification/marking/policing
  – Applies class based queuing for IP-forwarding
- Supports also RSVP and the IntServ model
- In case of an ATM core network, it applies ATM functionality to achieve IP-QoS
- Supports usage metering and accounting
- Is based on a SUN platform, is accessible via CORBA

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Highlight

Participation at the first Internet 2 Bandwidth Broker Operability Event at Merit Networks in November 1999

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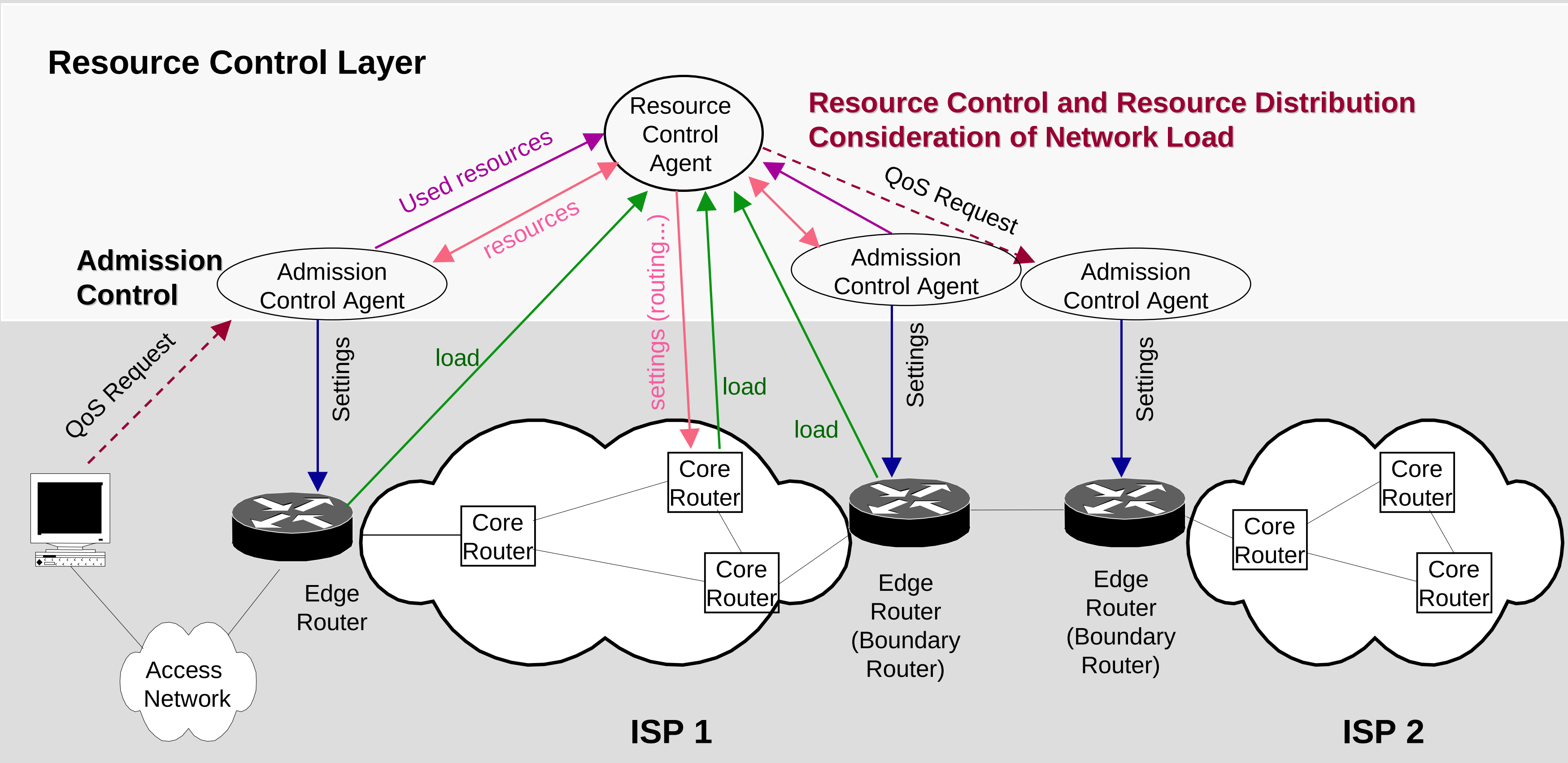
Evolution of the Siemens Bandwidth Broker: A Two Layered Architecture



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Assignments of the Admission Control Agent (ACA)

Admission control

- Handle user QoS requests (e.g. via RSVP or http servlets)
- Check available resources and admit or reject QoS request
- Setup edge router with appropriate policies
- Request additional resources from Resource Control Agent (RCA) **(not done per user QoS Request!)**
- Release resources if no longer required **(not done per user QoS request!)**

Policy control

- Check user identity and permission

Assignments of a Resource Control Agent (RCA)

Network control

- Limits the overall amount of prioritized traffic within one domain
- Controls network elements to adapt QoS reservations to network load
- Increases/decreases QoS reservation at neighboring domain sending QoS requests to Admission Control Agent (ACA) of that domain
- RCA may use simple or complex algorithms for resource management

Edge bandwidth management

- Distribute available bandwidth among Admission Control Agents (ACA), so that user QoS requests can be admitted by the ACAs with a high probability and without interaction with the RCA

RCA Network Bandwidth Control

Bandwidth Resource Control mechanisms of the RCA can evolve and become more an more complex without changing ACA functionality

Example for a simple approach:

- RCA has knowledge on ACAs and edge routers but not on core network topology
- RCA distributes administered max. bandwidth per traffic class among ACAs

➡ static approach that fits for low loads of prioritized traffic

RCA Network Bandwidth Control (2)

Example for a more complex approach:

- RCA knows network topology and collects network load information from core and edge routers
- RCA uses the network load information to adjust the max. bandwidth values that it may assign to an ACA

➡ better tradeoff between QoS guarantees and amount of prioritized traffic

In the long term the RCA may do Traffic Engineering for the core network (e.g. using MPLS or QoS routing)

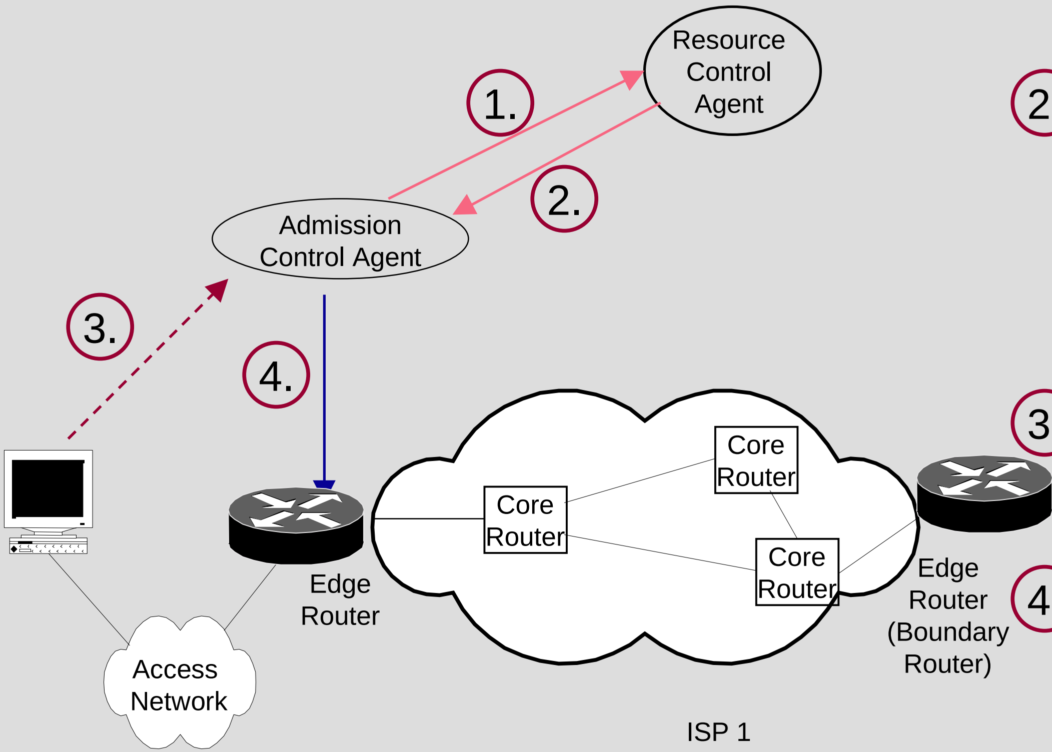
Physical split between components

- In small networks the ACA and RCA may be combined in one equipment
- An ACA manages one or more edge routers or may even be included in an edge router

Principles

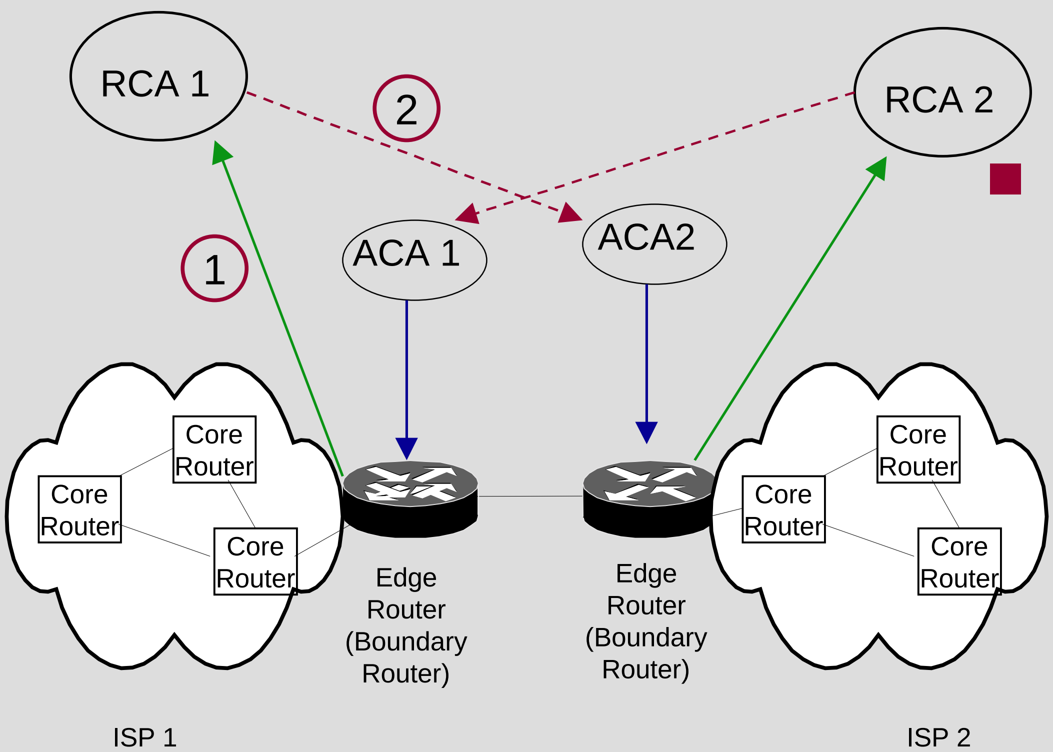
- **Strict separation of assignments**
  - The ACA is solely responsible for admission control
  - The ACA never asks the RCA to fulfill a single user QoS request
  - The RCA assigns bandwidth to the ACAs (e.g. on request of the ACAs), in a way that QoS requests received by an ACA from the users can be honored with a high probability
- **Local operation**
  - Each ACA can act independent of other components (ACA, RCA)
  - Failure of a RCA only degrades network performance, but does not affect operation of other components

ACA Operation with RCA



1. ACA requests bandwidth if a certain amount of its resources has been allocated by currently active QoS requests
2. RCA assigns bandwidth if available according to its resource management algorithm (RCA monitors bandwidth usage of its ACAs and limits the amount of prioritized traffic)
3. QoS Requests can be handled by the ACA independently from the RCA
4. ACA sets up policies in Edge Router

Inter ISP Scenario



- Monitoring
  - The RCA monitors the load on any link to another ISP (1)
- Inter ISP requests
  - The RCA requests/releases bandwidth from the ACA of the other ISP (2) if load in a DiffServ class is too high/low
  - Operation analogous to user QoS requests from a host to an ACA
  - requests only between neighboring domains, no end to end signaling (high scalability)

Further Project Information

- part of a European Union funded project
- Partners:
  - Operators/ ISPs (Bertelsmann; T-Nova, Helsinki Telephone Corporation, ...)
  - Universities (Technical University Dresden, National Technical University Athens, ...)
- Project Leader: Siemens
- Project Name: AQUILA

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Summary (1)

- **Concatenatability**
  - No special signaling between domains required
  - Each ISP may use another algorithm for bandwidth distribution and network optimization
- **Scalability**
  - Distributed architecture and inter-domain approach without signaling over several domains provide high scalability

Summary (2)

- **Robustness**
  - Local operation of ACAs possible
  - Each ACA can act independent of other components (ACA, RCA)
  - No single point of failure
- **Measureable**
  - Measurements are a basis for effective resource management by RCA; measurements can be used to prove functionality of QoS architecture (routers, resource control layer)

Summary (3)

- **Flexibility**
  - Adding features and optimizing QoS related network operation does not require changes in basic architecture
- **Strict separation of assignments**
  - ACA: admission control
  - RCA: bandwidth management

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QoS interface architecture