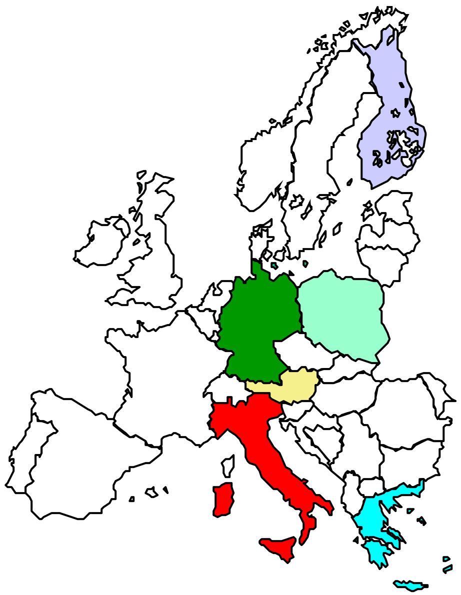
AQUILA (IST-1999-10077)

Adaptive Resource Control for QoS Using an IP-based Layered Architecture



2001 Tyrrenian International Workshop on Digital Communications, IIWDC 2001, Taormina, Italy, September 2001

Evolutionary Trends of the Internet

IP QoS at work: Definition and Implementation of the AQUILA Architecture

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http://www-st.inf.tu-dresden.de/aquila/

Outline

- Project Introduction
- AQUILA QoS Architecture
- Traffic Engineering Aspects
- IP QoS at work: the trial
- (SLS - Service Level Specification)
- Ongoing activities

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- Project Introduction
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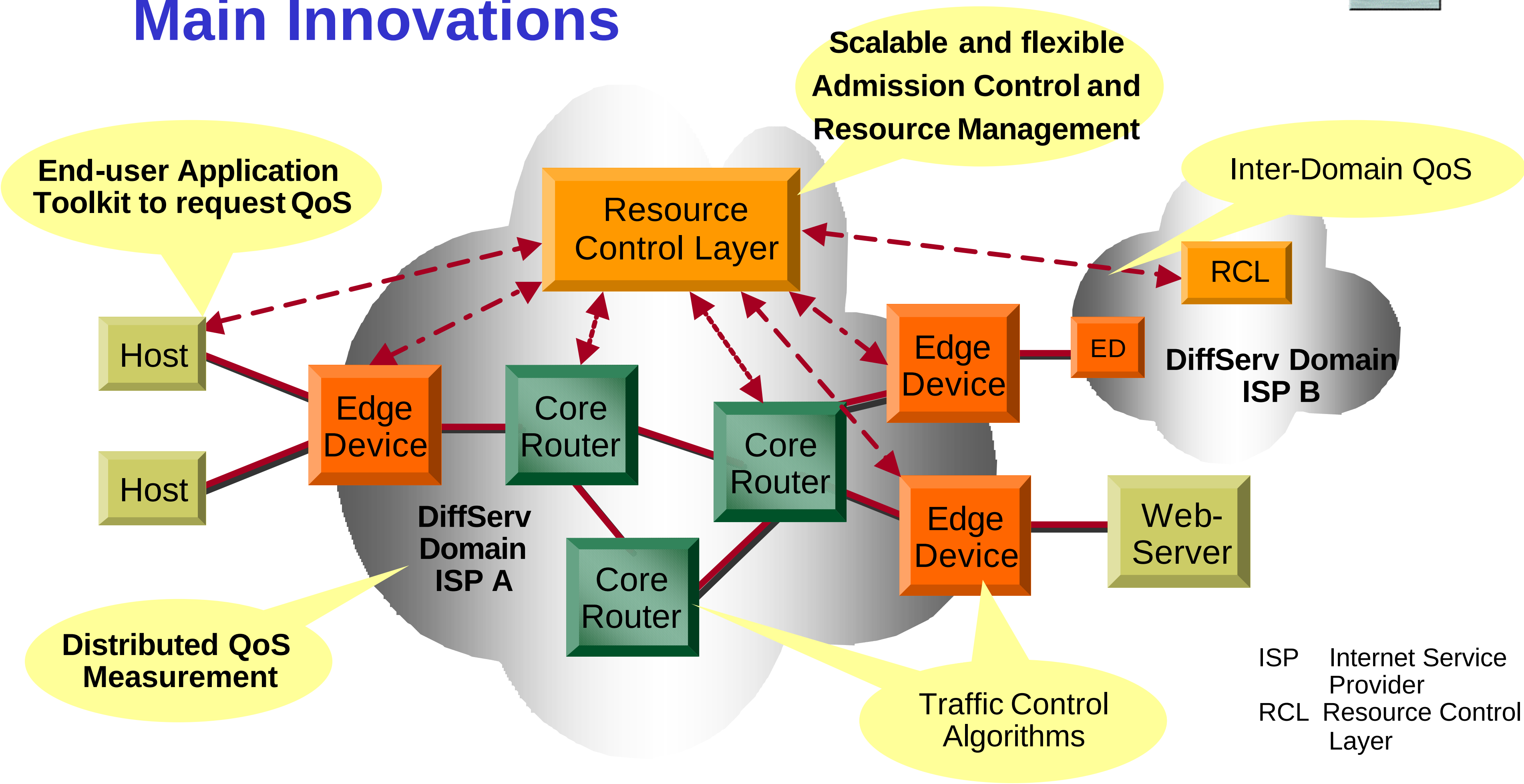
- Further Project Activities
- (SLS - Service Level Specification)
- Ongoing activities

Consortium

SAG	Siemens (Co-ordinator), Germany	I&C manufacturer
BAG	Bertelsmann mediaSystems, Germany	Internet Service Providers and Network Operators
DTA	T-Nova Deutsche Telekom, Germany	
TAA	Telekom Austria, Austria	
ELI	Elisa Communications, Finland	
TPS	Polish Telecom, Poland	
NTU	National Technical University of Athens, Greece	Universities and Research Institutes
WUT	Warsaw University of Technology, Poland	
COR	CoRiTel, Italy	
TUD	Dresden University of Technology, Germany	
SPU	Salzburg Research, Austria	
QSY	Q-Systems, Greece	Web application provider

Main Innovations



Þ **end-to-end Quality of Service**

Design Goals

Scalable Architecture

- Distributed building blocks
- Autonomous operation of elements

Based on DiffServ Network Elements

- Use of existing, commercial routers
- Enable migration path from current networks

Resilience to failures

- Failure of an element should only degrade (if at all), not disable the operation of other elements

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- Future Plans

Resource Control Layer (RCL)

Tasks of the Resource Control Layer

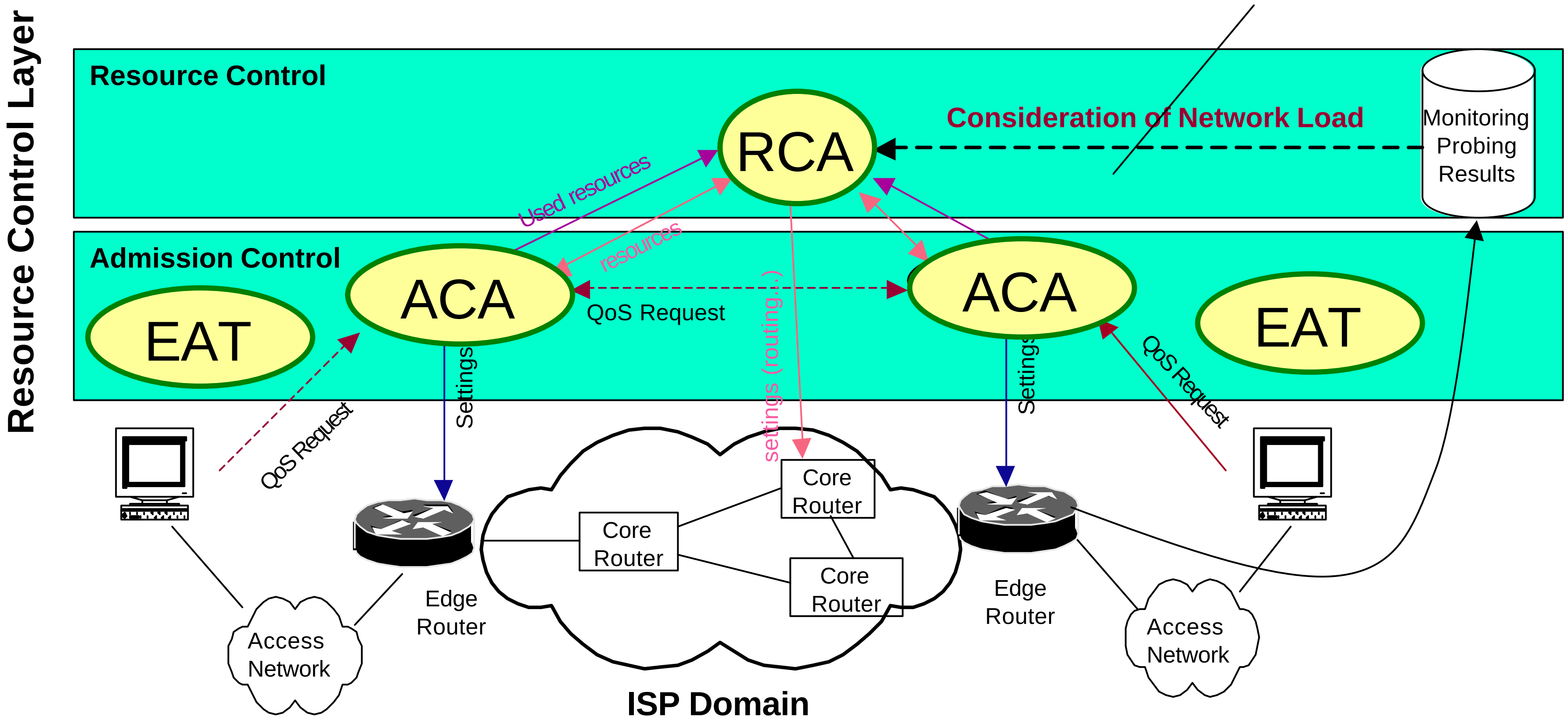
- Admission Control to limit the amount of prioritised traffic
- Resource Management
- QoS Interface

Design Goals

- Simpler than ATM / RSVP: no explicit reservation along the data path
- Scalable approach for Admission Control (distributed Admission Control, separation of Admission Control and Resource Management)

Scalable Architecture for RCL

CORBA based communications



ACA: Admission Control Agent

RCA: Resource Control Agent

EAT: End user Application Toolkit

RCL: Resource Control Layer

Resource Control Agent (RCA)

- Manages resources
- Checks availability of requested resources
- (Re-)distributes resources as needed

Admission Control Agent (ACA)

- Authenticates user
- Authorises and checks request
- Locates ingress and/or egress edge router
- Requests resources from the resource control agent
- Admits / rejects new flows
- Installs policies in ingress router

End-user Application Toolkit (EAT)

Middleware between QoS Network and Application

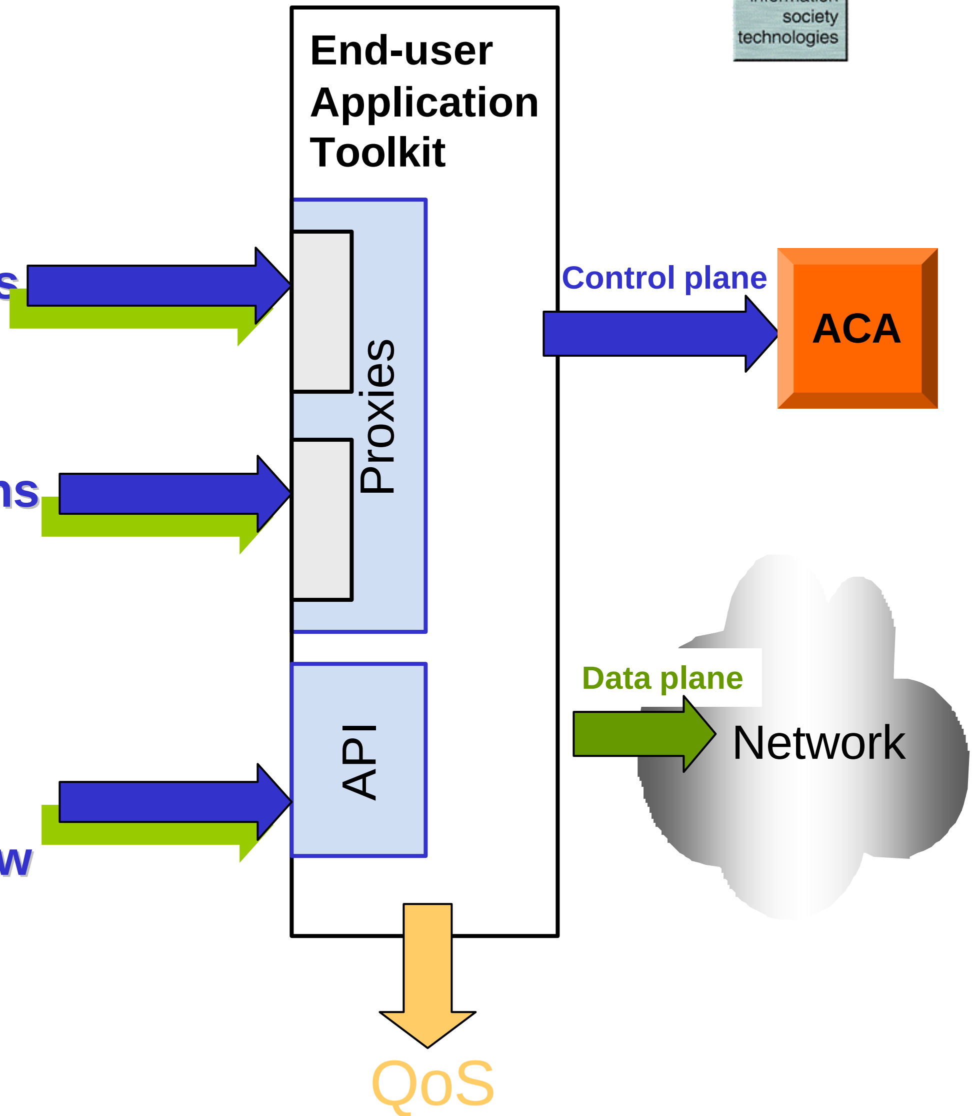
- Front end for access network
- QoS portal for application (legacy and QoS aware)
- Alternative, flexible approach for evaluating QoS reservations

EAT is requester of QoS reservation

- The requester may be the sender, receiver or a third party
- The requester initiates the reservation
- The requester is charged for the service

Objectives of EAT

- Enable Access to QoS to non QoS aware Legacy Applications
- Support QoS aware Applications (RSVP, DiffServ) / Support various QoS Request Methods
- Provide a Methodology and a Programming Interface to support the Construction of new QoS aware Applications
- Provide an End-user friendly QoS Access



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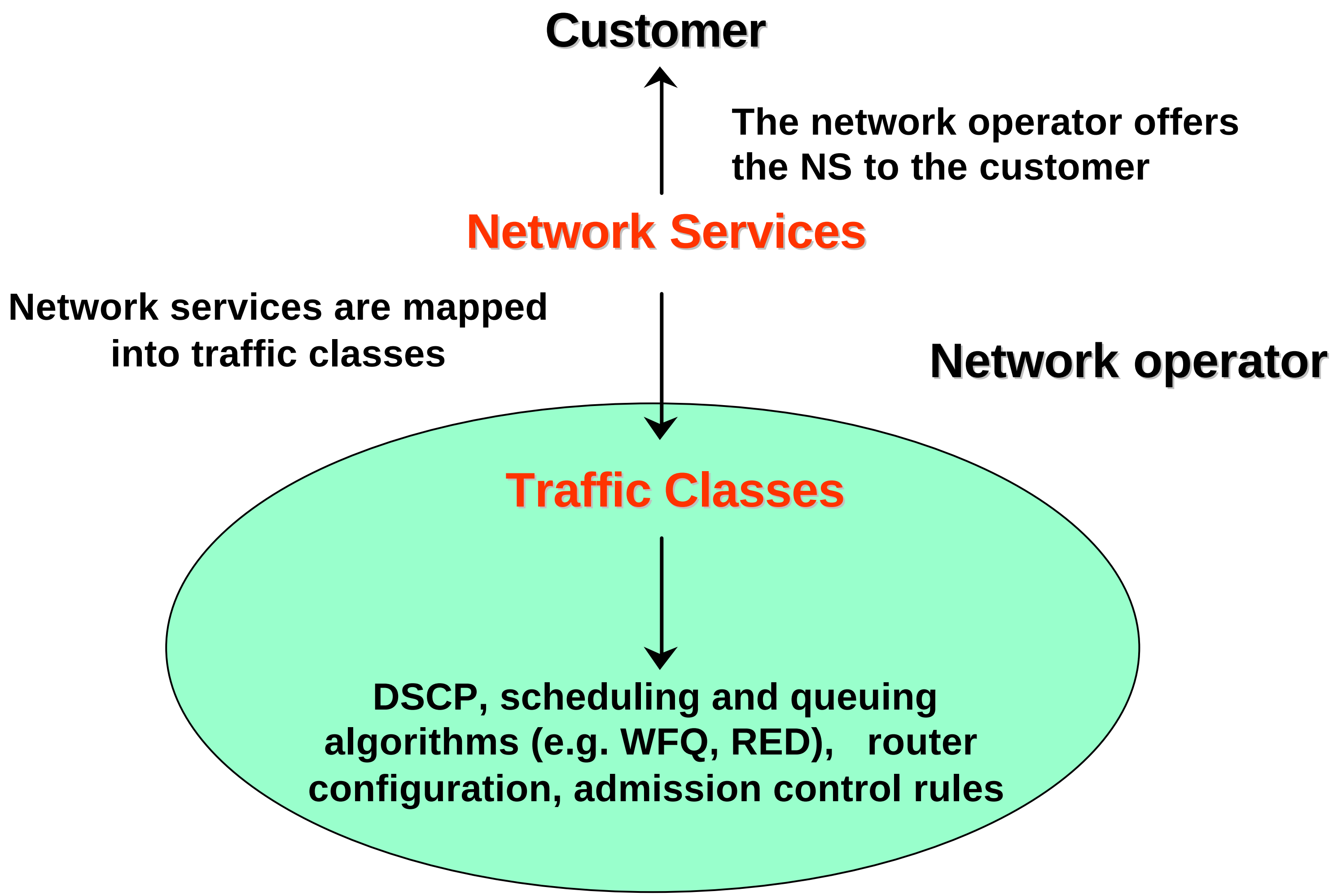
Network Services and Traffic Classes



Network Services

Characterisation

- Delivery of services to the customer
- Defined by the network operator
- Provides a specific QoS, expressed by statistical or deterministic statements about delay, loss, ...

Implementation

- Network service are implemented by *traffic classes*

Usage

- The End-user Application Toolkit maps application demands to network services

Example: Premium CBR for IP Telephony and Voice Trunking

Þ **Goal: only a few Network Services to allow clear service Differentiation (wrt QoS objectives)**

Network Services

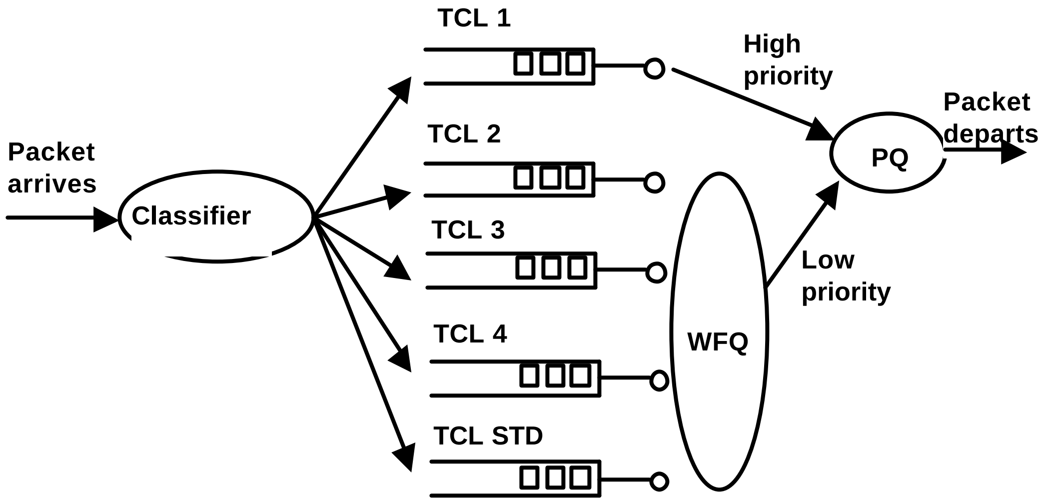
- **PCBR Premium Constant Bit Rate**
  - VoIP,Voice Trunking, VLL
- **PVBR Premium Variable Bit Rate**
  - Video (real time)
- **PMM Premium Multimedia**
  - Video (download), file sharing, web
- **PMC Premium Mission Critical**
  - Transactional application, interactive games
- **Best Effort**

Traffic Classes

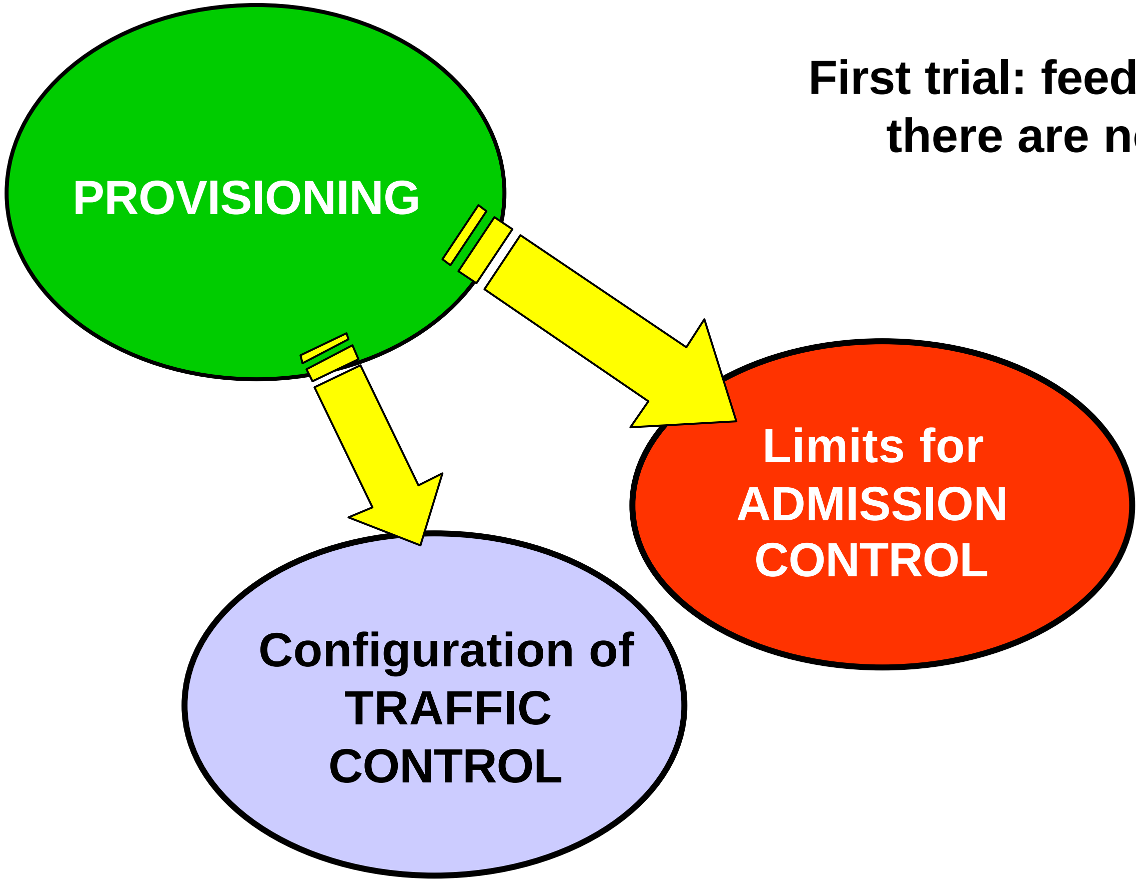
- **Five Traffic Classes have been specified**

Network service	Premium CBR	Premium VBR	Premium MultiMedia	Premium Mission Critical	Standard
Traffic class	TCL 1	TCL 2	TCL 3	TCL 4	TCL STD

- **… as well as the related Traffic Control Mechanisms in the Routers**



Overview of Traffic Handling Approach



First trial: feed-forward operations, there are no "control loops"

Admission Control

- **Declaration Based Admission Control (First Trial)**
  Traffic Characterisation based on token bucket parameters

- **Admission Control Algorithms**

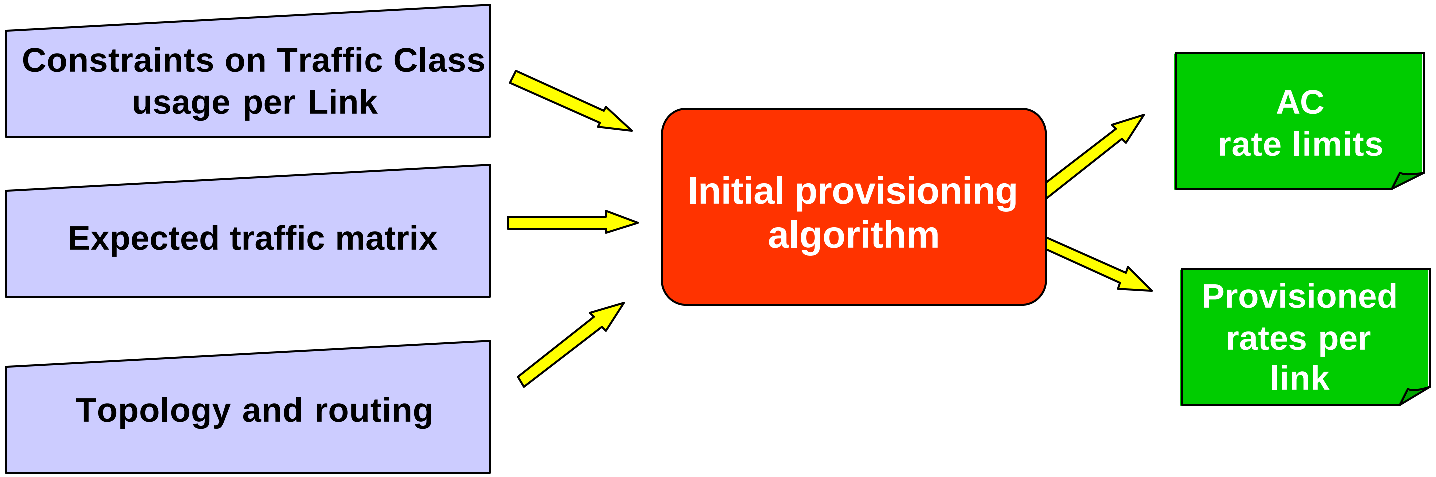
  take into account the traffic parameters specified in the reservation request and compare with the provisioned admission control rate limits and the already allocated resources.

- **Specific Admission Control Algorithms**

  have been defined for the different traffic classes and different (high speed / low speed) access links.

Provisioning

Initial Provisioning



Building Resource Pools

- Resource pools are built when it is useful to dynamically share a bottleneck link among a set of access links

Resource Pools

Resource Limits

- Limit amount of QoS traffic from each edge router

Group neighboured Routers

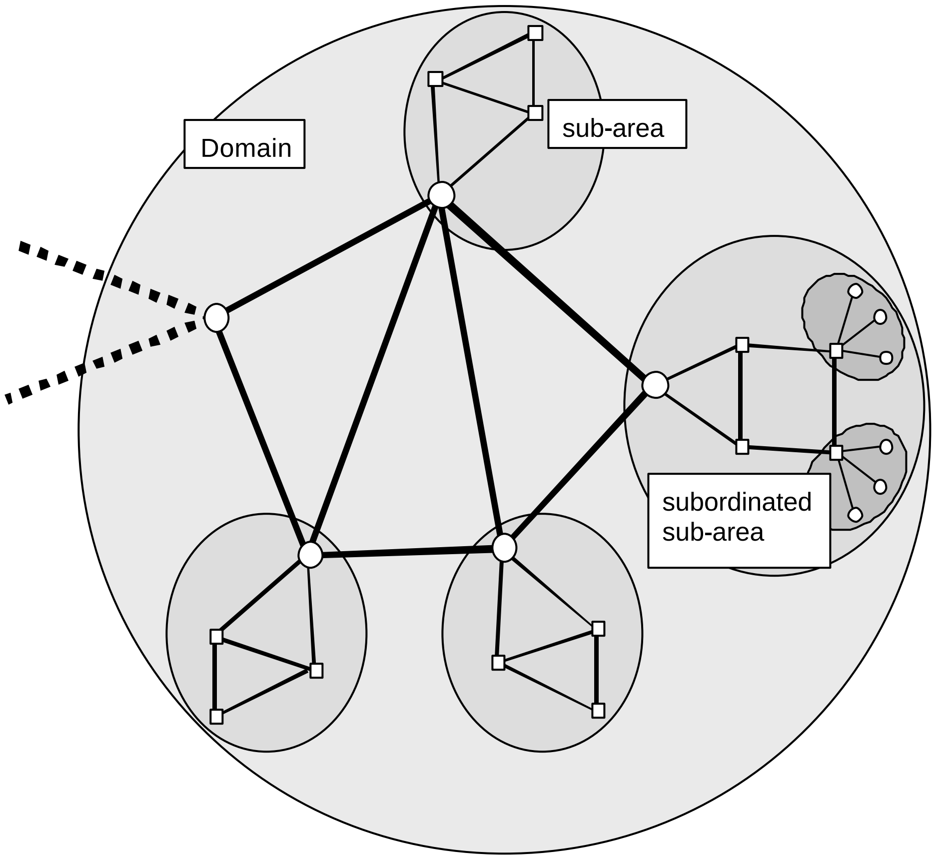
- Limit amount of QoS traffic from each group

Dynamic Distribution

- Dynamically shift resources within group

Hierarchical Structure

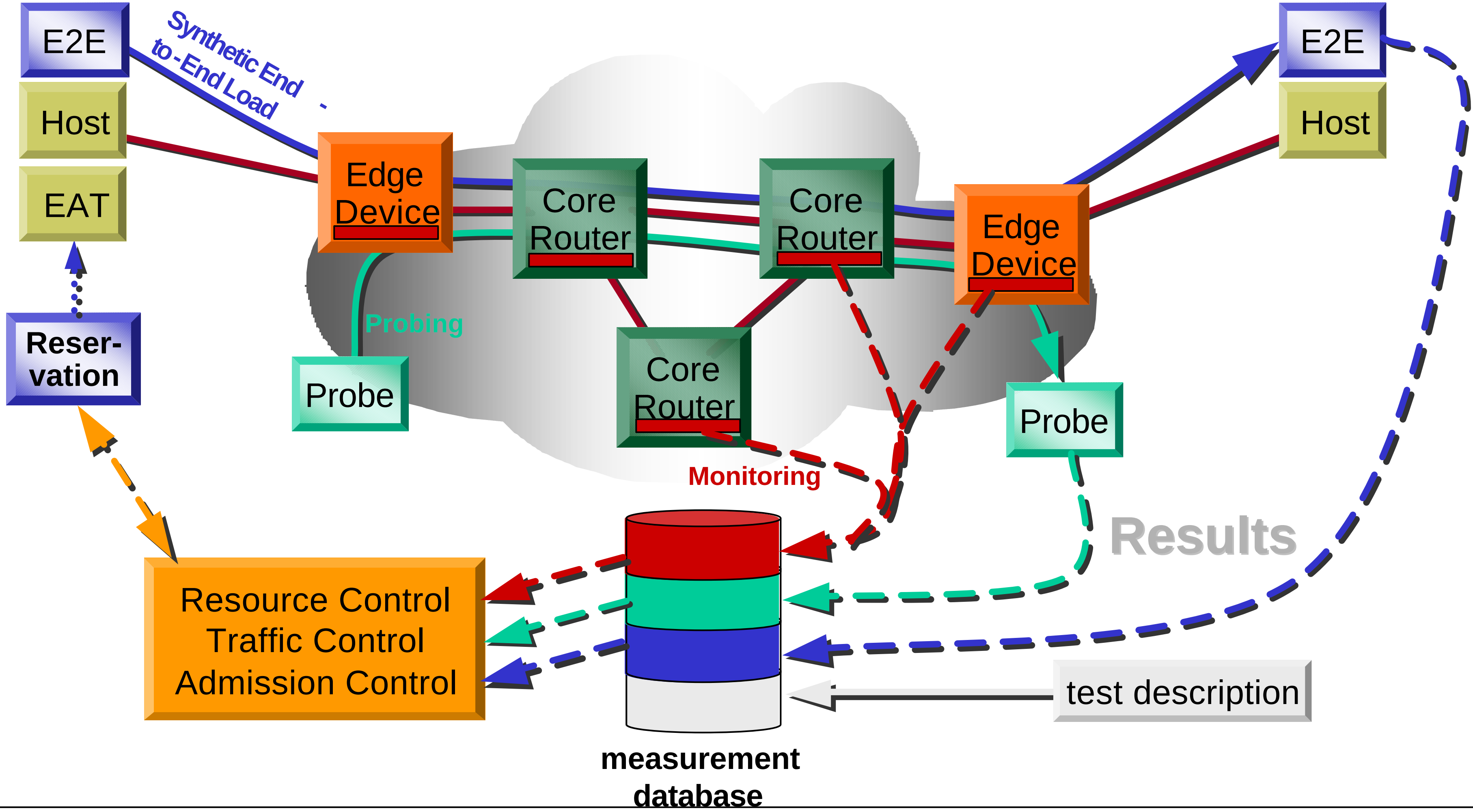
- “Groups of groups”



Dynamic aspects

- The resource reservations are dynamic
- The handling of network resource is dynamic, but distributed and scalable

Measurements



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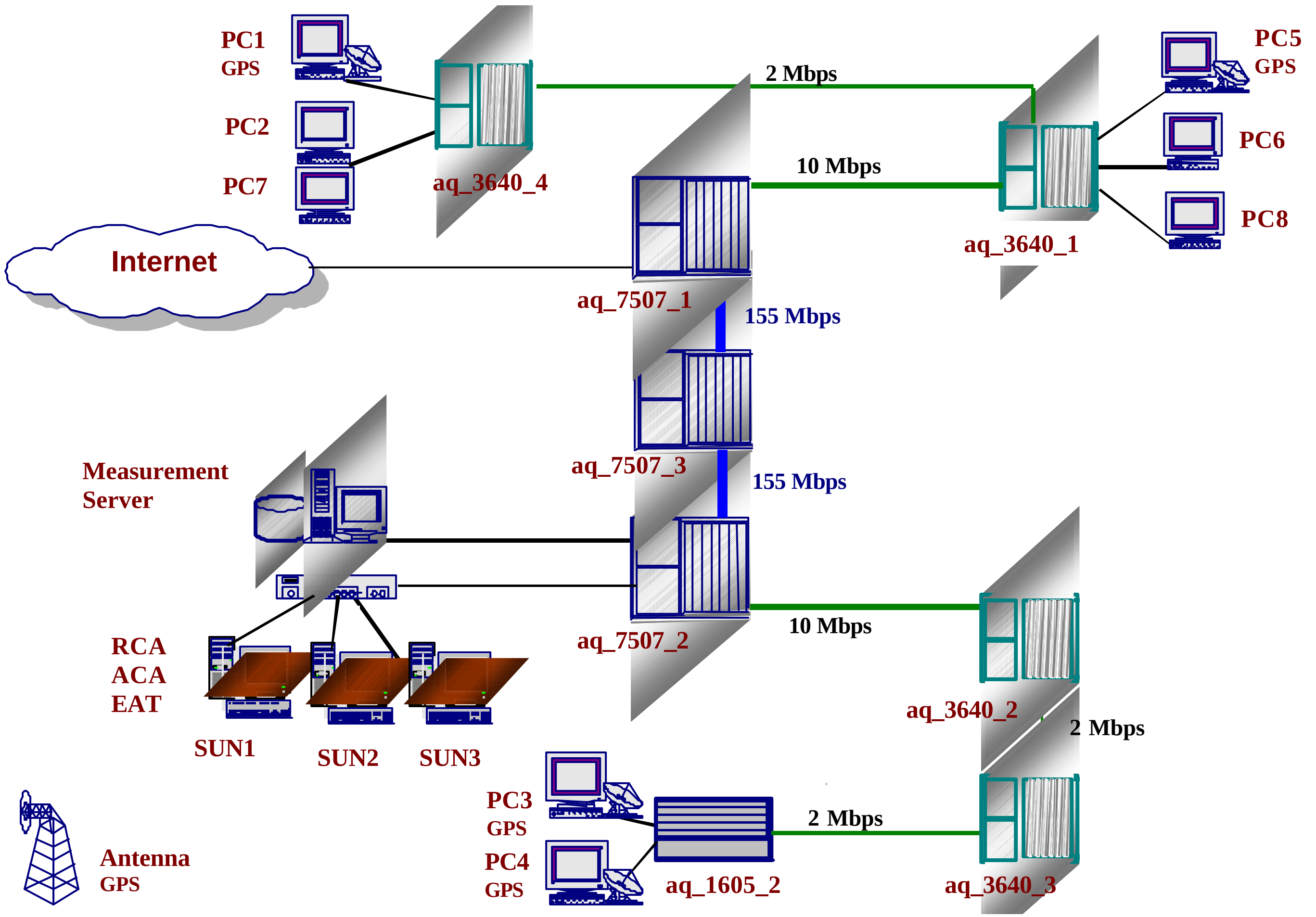
Trials at Three Different Sites

- **Warsaw (Polish Telecom)**
  - Reference Site
  - Special Focus on Streaming Media / Video on Demand
- **Helsinki (Elisa Communications)**
  - Site with various Access Technologies (ADSL, 10 Mbps Ethernet, WLAN)
  - Special Focus on realistic customer/end-user environments and different environments and usage (home, office, public access zone)
- **Vienna (Telekom Austria)**
  - Site with homogenous Layer 2 (Ethernet)
  - Special Focus on low bandwidth real-time applications, VoIP, Multi-user network games

Test-bed in Warsaw



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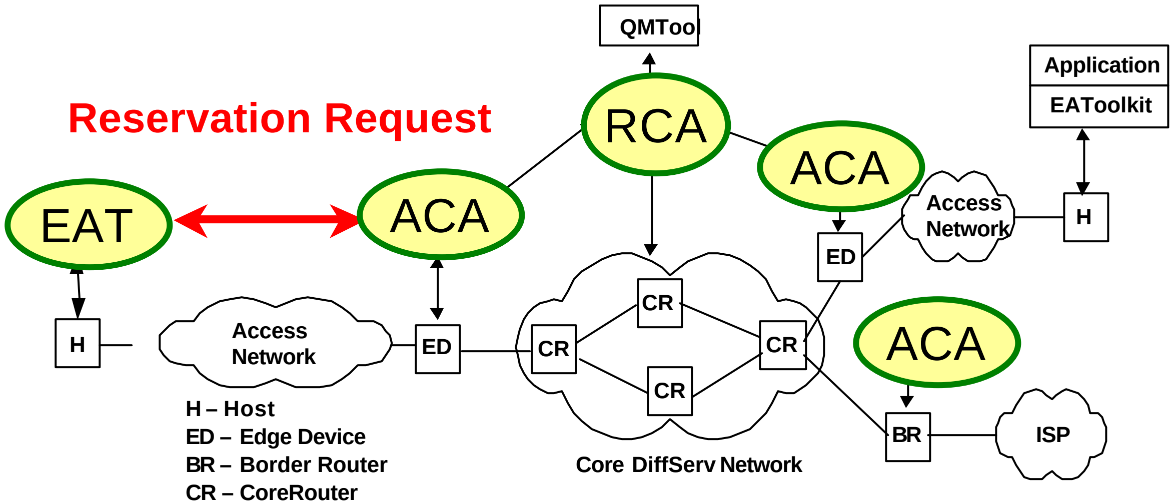
AQUILA Approach to SLS

- In the AQUILA architecture a "Reservation Request" is sent to the Admission Control Agent (ACA) by the "End-user Application Toolkit" (EAT)



- A Reservation Request contains the Service Level Specification

Semantic Content of SLS

- SLS type
- Scope
- Flow Identification
- Traffic description and conformance test
- Performance Guarantees
- Service schedule

see draft-salsano-aquila-sls-00.txt

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Ongoing activities

Inter-Domain scenarios

- Extension of “Border Gateway Reservation Protocol” BGRP proposal
- SLA/SLS between ISPs

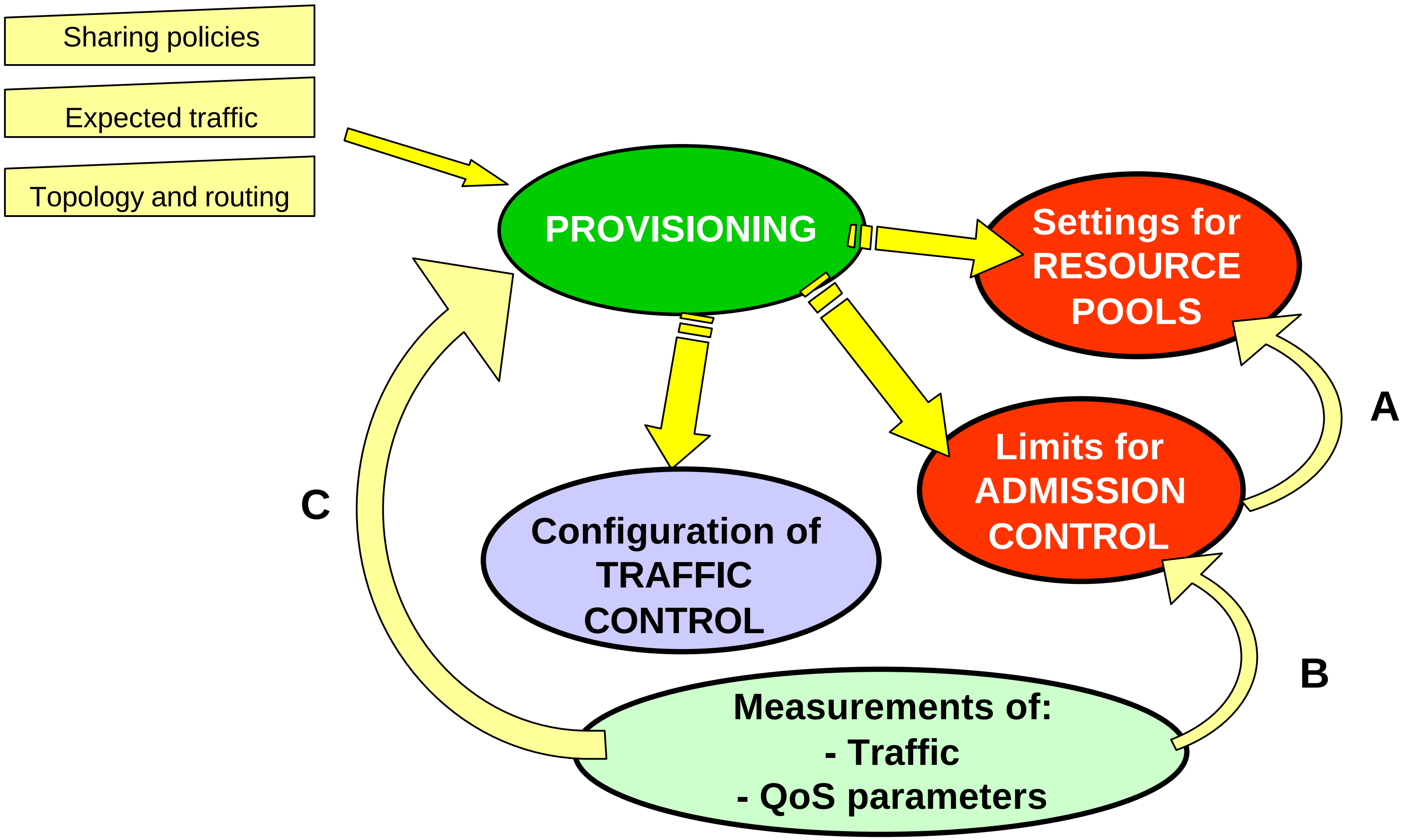
Measurement

- From Declaration-Based Admission control to Mixed Declaration and Measurement Based Admission Control
- Resource control loops at the provisioning level (feedback from measurement to resource control)

Ongoing activities

- **Support of Applications**
  - RSVP as QoS signalling protocol
  - Application Programming interface (API)
- **Management**
  - Administration of network services
  - Control of resource distribution parameters
- **Architectural extensions**
  - Impact of MPLS
    - VPN
    - MPLS-DiffServ interworking

Control Loops



Conclusions

- **IP QoS is useful**
  - Why ? In order to differentiate between applications (e.g. voice/data)
    In order to provide different level of services
  - Where ? Only on the bottleneck links: at network access

- **Scalable dynamic IP QoS is feasible (single domain)**
  - We are working on the inter-domain aspects

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information society technologies

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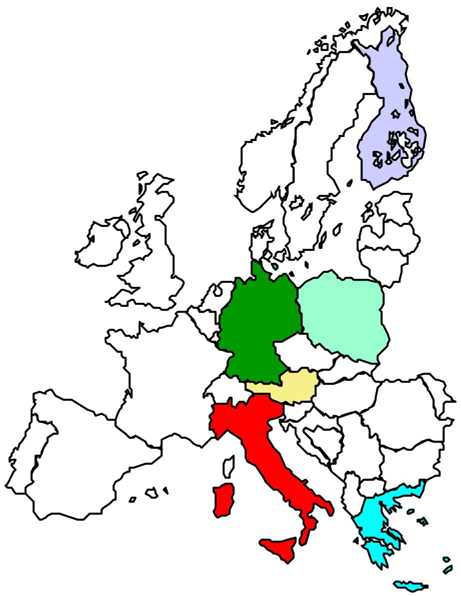

Thank you for your attention !

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