Dynamic Control of Inter-Network QoS Agreements

(IST Ambient Network project)

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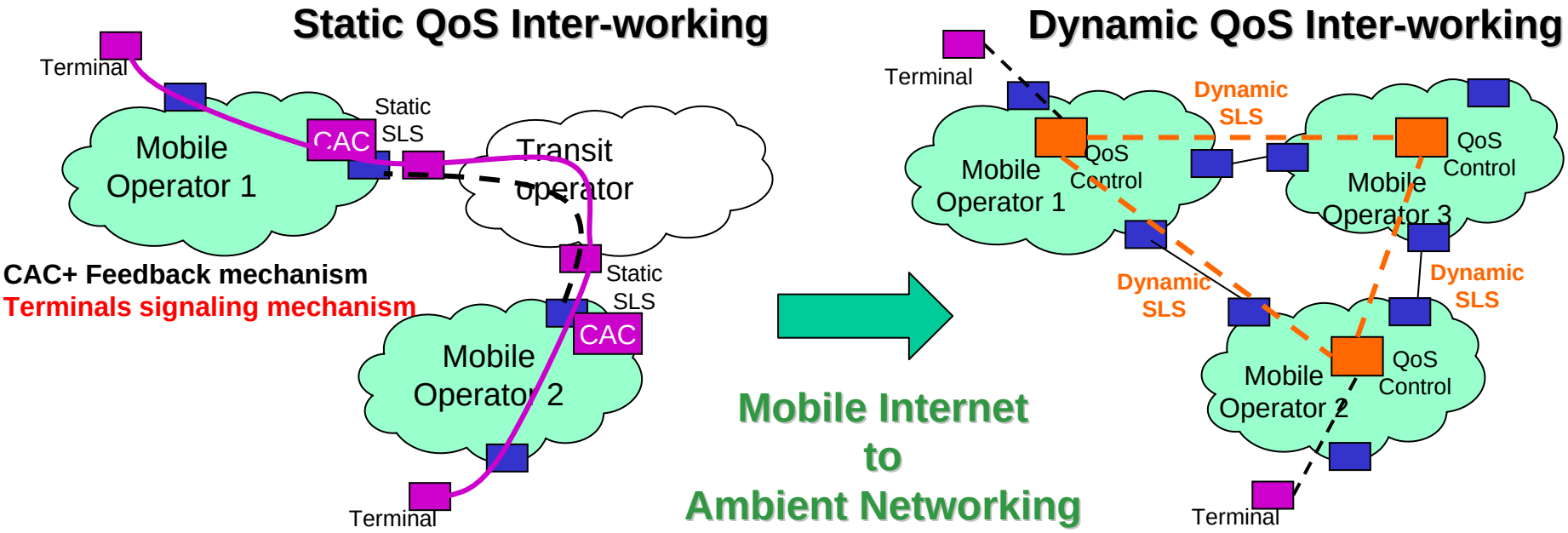
Overview

- Ambient Scenario
- Problem Statement and Requirements
- Related Approaches
- Our Solution
  - General characteristics
  - Functional and Applicability Examples
- Prototype and Evaluation
- Development Steps

Ambient Scenario



	Mobile Internet	Ambient Scenario
QoS	Homogeneous models	Heterogeneous models
Control Plane	End-to-end: No operator control	Net-to-Net: Interaction between operators' QoS control entities
Mobility	Moving terminals	Moving terminals and moving networks
Routing	Not aware of QoS	Aware of QoS
Competition	Competition with well-known neighbours.	Competition with spontaneous agreements.

Problem Statement

- **Technology Support**
  - Intra-network QoS models to differentiate traffic
  - Intra-network QoS models to assure QoS levels

- **Technology Limitation**
  - Unsuitable sheltering of intra-network heterogeneity
  - Lack of inter-network QoS control
  - Lack of support for mobile and multihomed networks

Dynamic Control of Inter-Network QoS

Dynamic Control of Inter-Network QoS

- **Novelty**
  - Clear separation of intra- and inter-network operations
  - Supports interworking among moving and multihomed networks

- **Expected Benefits**
  - Clients are able to receive QoS offers from multiple providers
  - Accommodates the increasing inter-network competitiveness
  - QoS agreements/specification described in a common form
  - Allows call blocking and fast call setup
  - Provides bandwidth guarantees
  - Maintains quality during the life-time of communication session.

Proactive Control of Bi-lateral QoS Agreements

Related Approaches

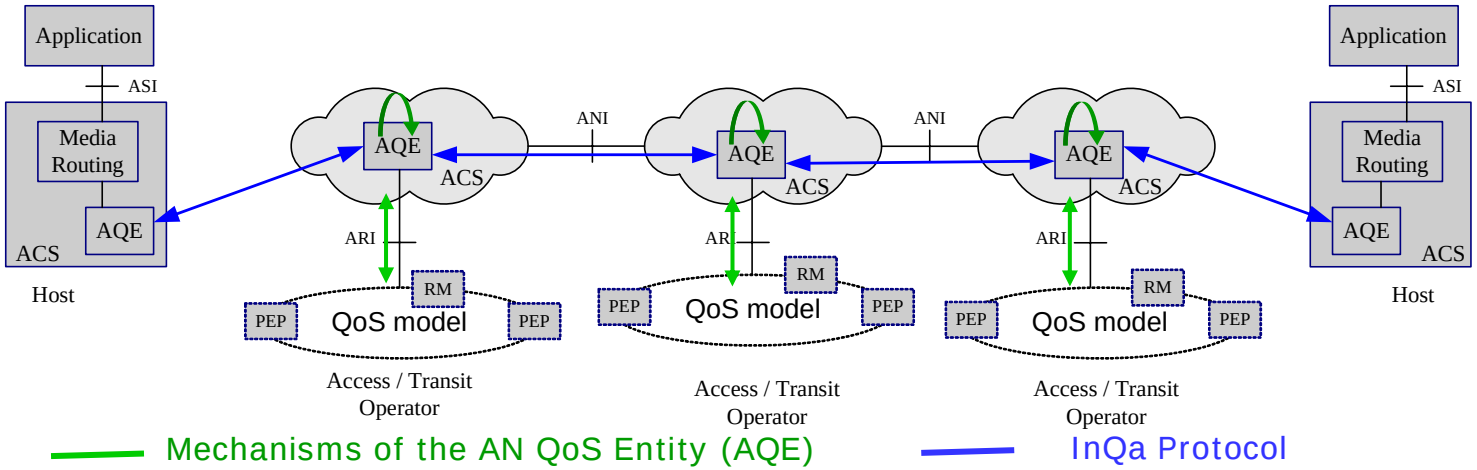
- **Path-coupled QoS signalling**
  - Easy bypass of signalling unaware networks
  - Automatic adaptation to route changes
  - Limited flexibility to integrate different QoS models
  - Normally end-to-end reactive signalling
  - E.g.: QoS-NSLP and RSVP

- **Path-decoupled QoS signalling**
  - Independent signalling and forwarding planes
  - Supports non-traditional routing
  - Problematic next-hop discovery to forward queries
  - Normally end-to-end reactive signalling
  - E.g.: SIBBS (Internet2) for resource allocation of static well-known SLSs

Do Not Satisfy all Requirements for
Dynamic Control of Inter-Network QoS

INQA

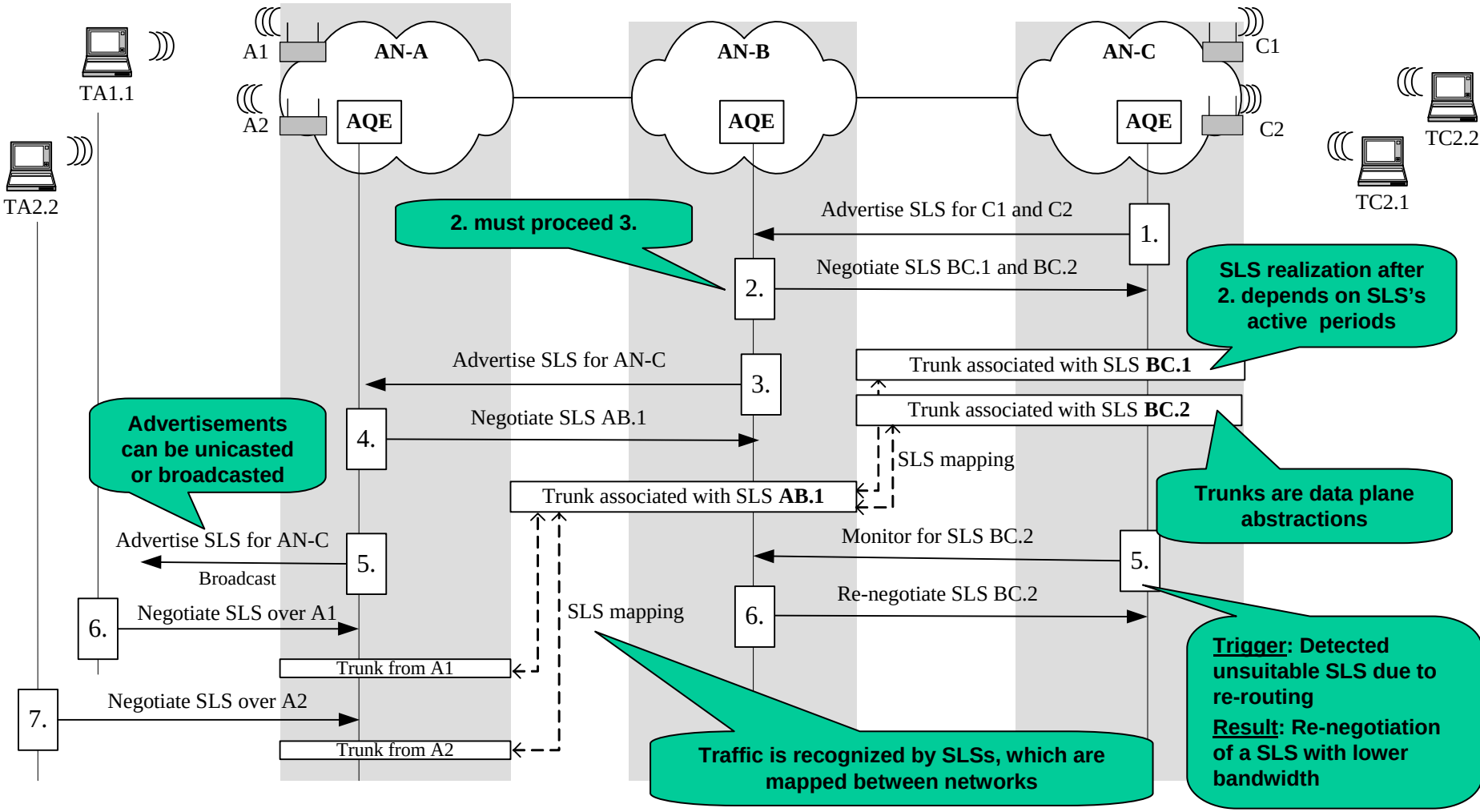
Dynamic Control of Inter-Network QoS Agreements



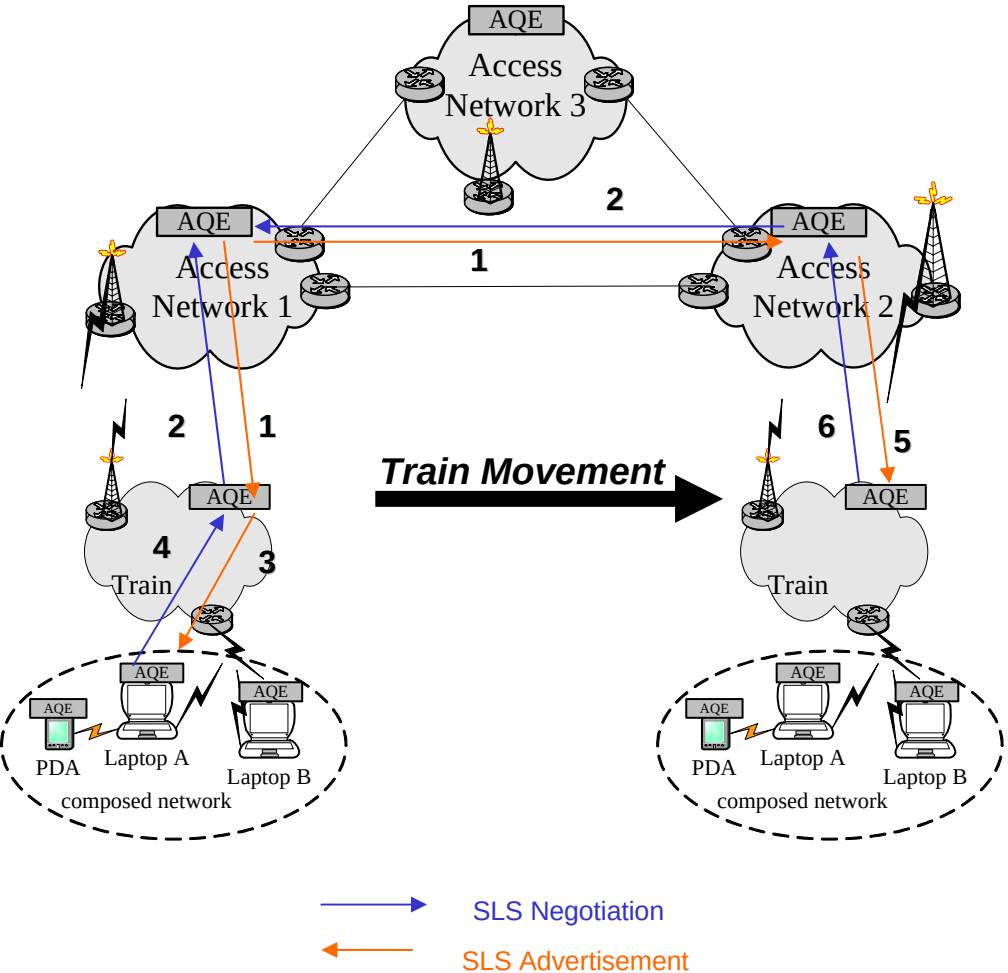
- INQA provides a **pro-active solution to control bi-lateral QoS agreements** with:
  - Controller: Ambient Network QoS Entity (AQE)
  - Mechanisms: SLS advertisement , negotiation, monitoring and aggregation
  - Protocol: Inter-network signalling to support advertisement, negotiation and monitoring of SLSs

- INQA signalling protocol (INQA-P)
  - Path-decoupled between adjacent AQEs: bi-lateral QoS signalling (not end-to-end)
  - Traffic-related signalling (SLSs)
  - Per-flow SLSs and Per-Class SLSs
  - Negotiation of SLSs based on offers from different providers
  - Definitely suitable for qualitative services. More analysis for quantitative services

Functionality Example
INQA-P for End-to-end Services



Aplicability Example (1/2)
Moving Networks Scenario



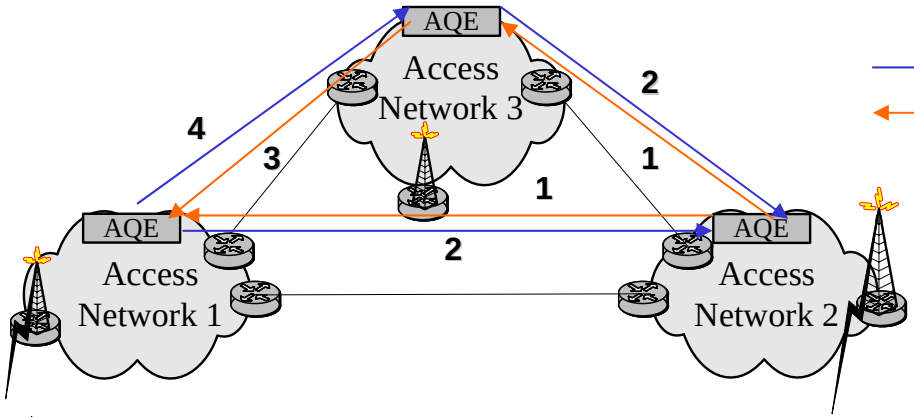
Brief Description:

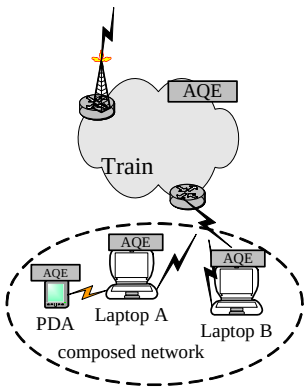
- SLS between AN1 and AN2 is suitable after movement
- SLS between Laptop A and Train is suitable after movement
- Signalling only between Train and AN2

Advantages:

- Reacts to mobility not detected by end-hosts
- Fast call-setup
- Low communication interruption times

Aplicability Example (2/2)
Multi-homed Networks Scenario





Brief Description:

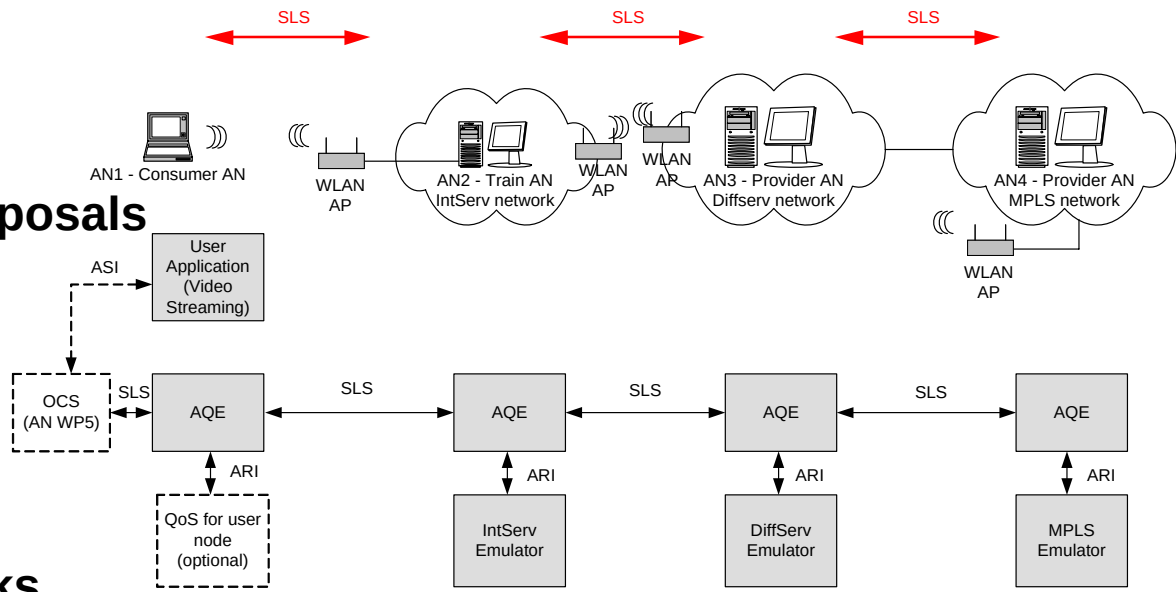
- AN1 knows that it can reach AN2 with different SLSs
- AN1 can negotiate different SLSs to reach AN2

Advantages:

- Providers: Dynamic competition for clients
- Users: Extended portfolio of available services
- Augmentation: robustness and load-balancing
- Independent from the inter-network routing protocol

INQA Evaluation

- **Scalability**
  - Handle high frequency of advertisements and negotiations
  - Handle straight guarantees based on per-flow SLSs
  - Handle mobility



- **Comparison with other proposals**
  - Session set-up time
  - Service interruption time
  - Resource usage

- **Analyse potential drawbacks**
  - Possible extra complexity to handle end-to-end services.
  - Communication overhead to maintain suitable bi-lateral QoS agreements

Steps for INQA Development and Validation

- SLS Definition:
  - Definition of an universal SLS template. (Done)
  - Definition of policies to create SLSs from the template. (Done)
  - Guidelines for mapping techniques to different QoS models. (Done)
- INQA:
  - Definition of INQA-P and AQE mechanisms. (Done)
  - Specification of INQA-P and AQE mechanisms (On-going)
  - Set-up of a test-bed (On-going)
- Analysis:
  - Scalability analysis (To be Done)
  - Integration of AQEs of neighbour networks. (Future Work)
  - Combination of INQA-P with end-to-end signalling for services with quantitative guarantees (e.g. QoS-NSLP). (Future Work)