http://www.mescal.org

The IST MESCAL project

(Management of End-to-end Quality of Service across the Internet At Large)

November 2002 to April 2005

Project partners

- Industrial partners:
  - France Telecom R&D (PM)
  - Thales Research Ltd (P)
  - Algonet SA (P)
- Academics:
  - UCL (P)
  - UniS (P)
- Equipment vendors:
  - Cisco Systems (sponsorship)
  - Alcatel Bell (standardisation)

Project objectives

- Basic objective:

To specify and validate scalable, incremental solutions that will enable the flexible provisioning of inter-domain QoS across the Internet

- Project work plan includes:
  - Specification of business models and functional architecture
  - Specification, development and validation of dynamic service management algorithms
  - Routing protocols enhancements for inter-domain traffic engineering
  - Integration of IPv6 and multicast

From TEQUILA to MESCAL

- TEQUILA addressed mainly ***intra-***domain QoS
  - SLSs for customer-ISP interactions
  - service and resource (TE) aspects for edge-to-edge QoS across a single domain
  - inter-domain studies were limited to mechanisms for conveying TE information between domains via BGP NLRI extensions
- MESCAL focuses on ***inter-***domain QoS
  - customer-ISP and ISP-ISP interactions
  - service and resource (TE) aspects and interactions across multiple ISPs for inter-domain QoS delivery end-to-end across the Internet
- MESCAL builds on TEQUILA results
  - SLS-based QoS definition
  - service and TE architectures, logic, protocols

Environment and assumptions

- No “Internet God”
  - No global view of the Internet
  - No ASs of the same (or affiliated) administration to offer global Internet coverage
- IP-based networking
  - Diffserv-capable IP networks
  - Different QoS policies per ISP
- Build-on existing, widely accepted/deployed inter- and intra-AS protocols (*e.g.* BGP, OSPF)
- Currently, SLAs between customers and ISPs are given *ONLY* within the geographical span of the ISPs…thus…

MESCAL

MESCAL principles

- Co-operation is required between ISPs
- Inter-domain QoS delivery is NOT a single optimization problem, but a set of them
- Clear distinction between services and resources
- ISP interactions based on widely accepted information templates and related exchange protocols (for services and resources)

MESCAL approach

Each ISP to:

1. Engineer the QoS capabilities

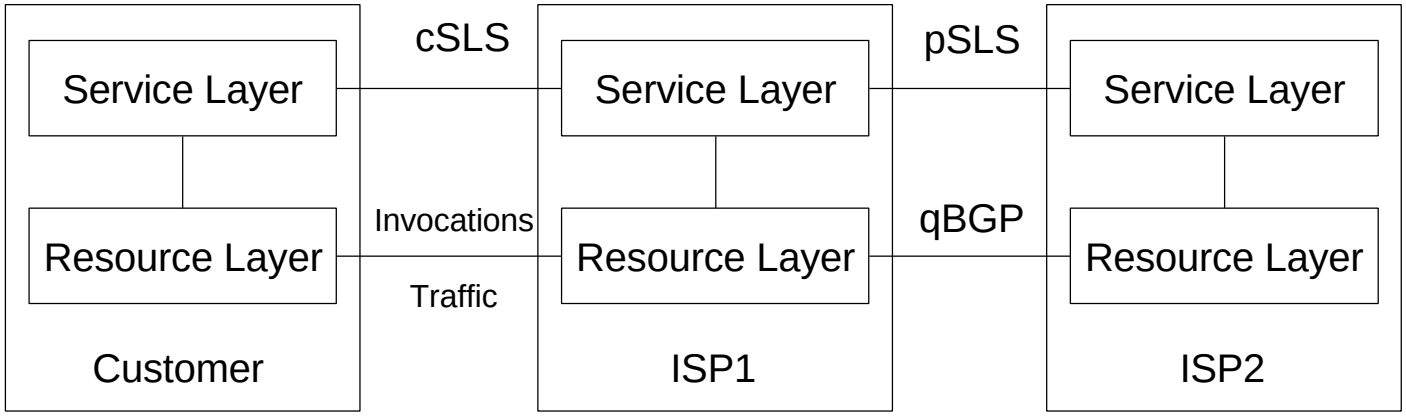
Extending QoS capabilities beyond domain, by peering SLSs with neighboring ISPs

QoS-bindings of ISP QoS capabilities with QoS capabilities of peer ISPs

2. Engineer the network

Inter-domain: To select the 'best' neighbor to route Internet traffic to

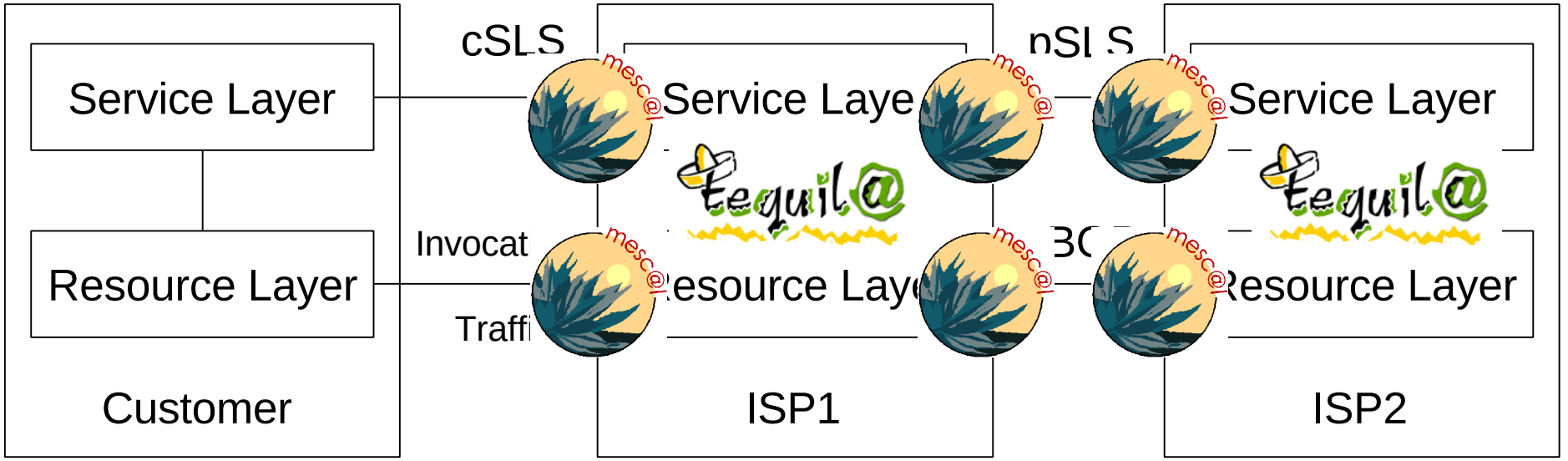
Intra-domain: To meet the QoS of the established SLSs with customers and peer ISPs



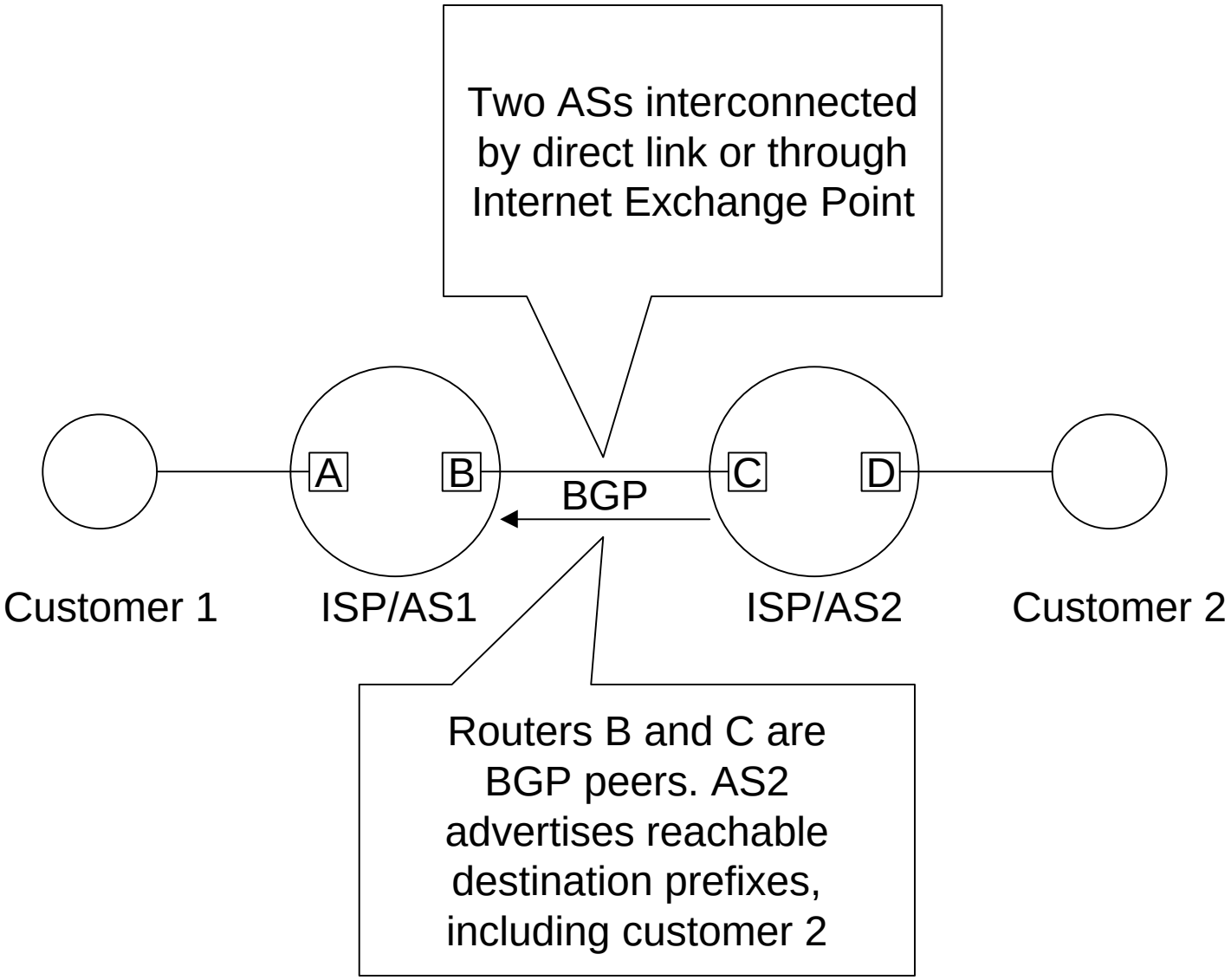
Driven by market needs and business objectives

Driven by SLS requirements

MESCAL vs. TEQUILA revisited



Inter-domain QoS example



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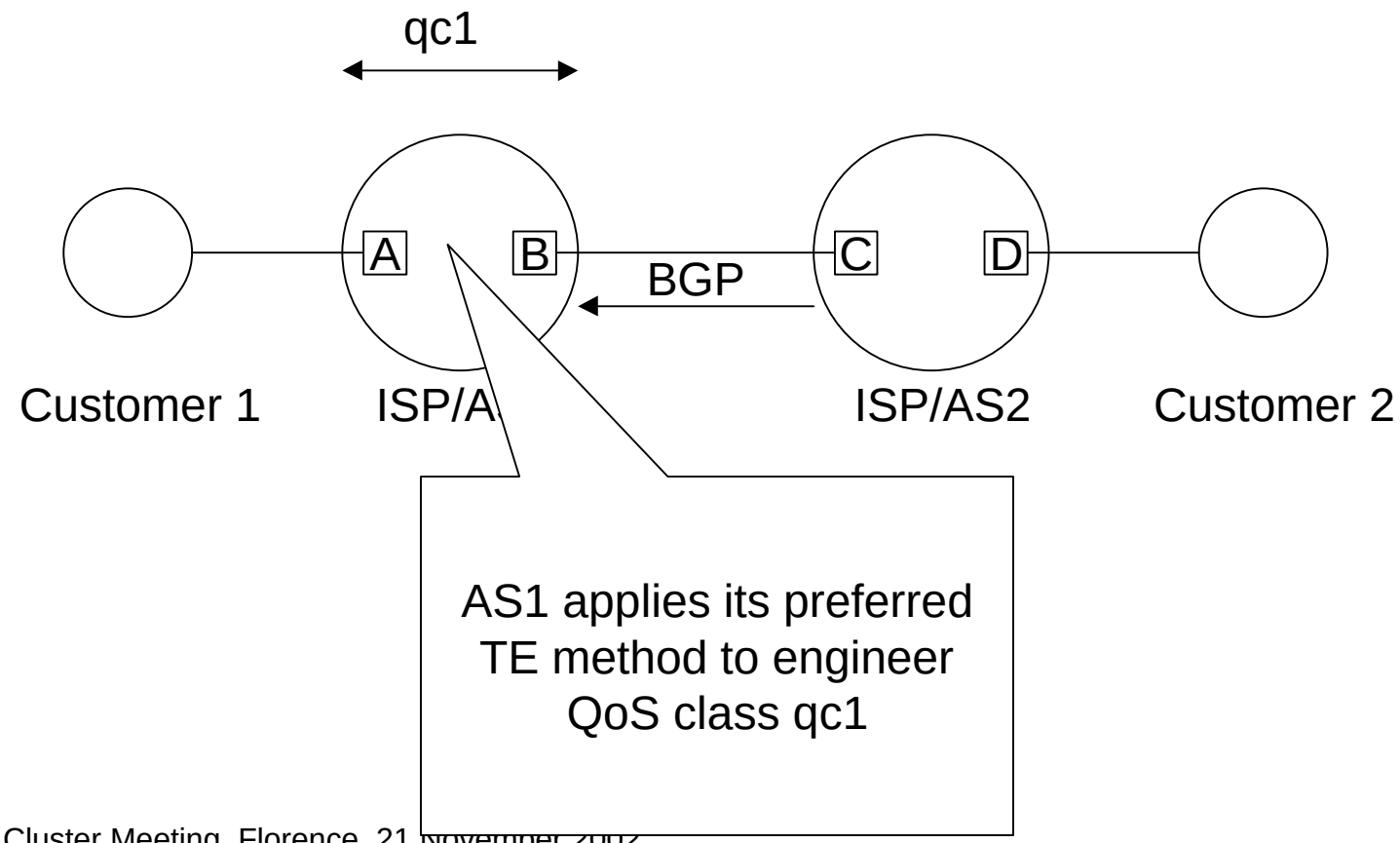

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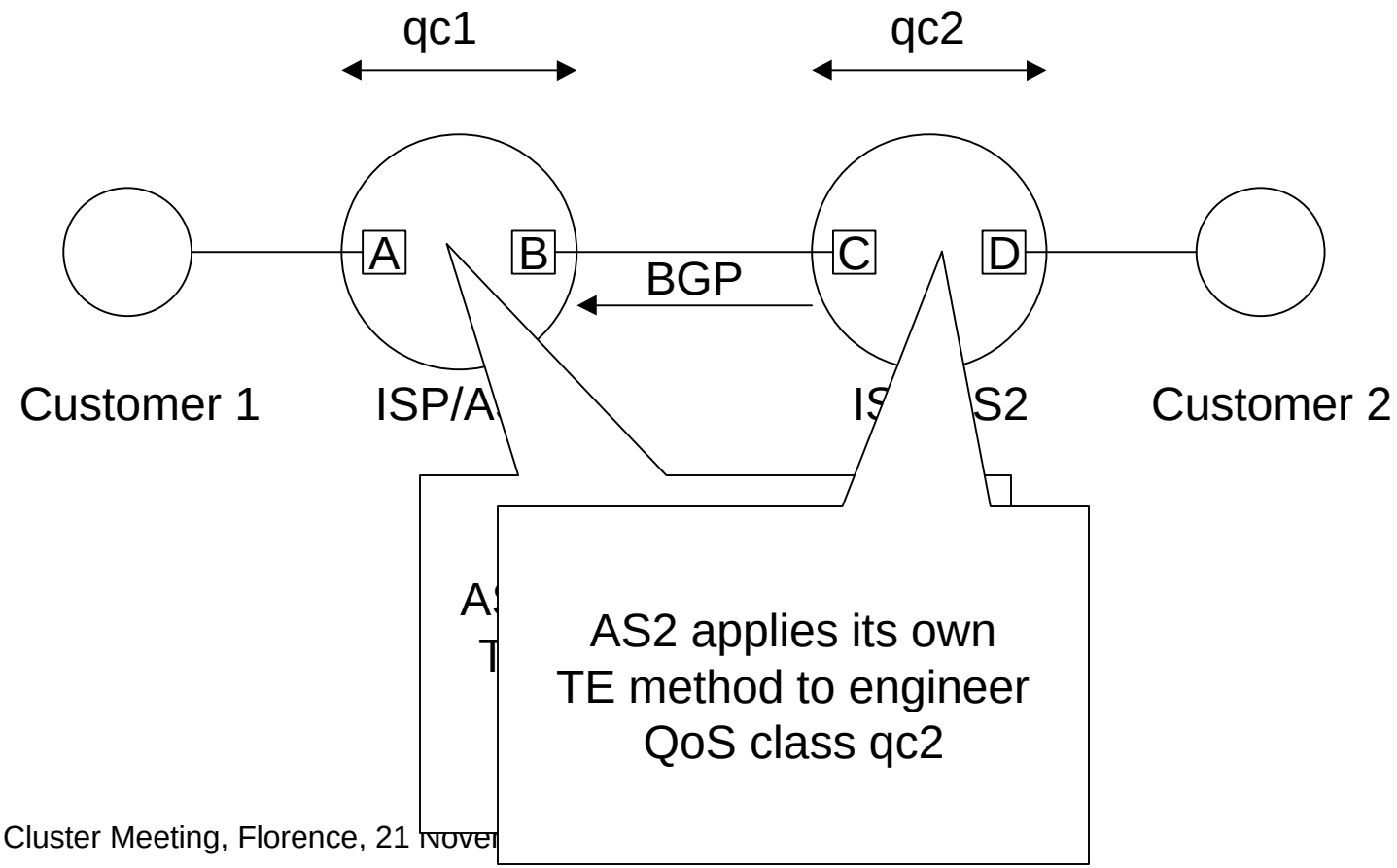

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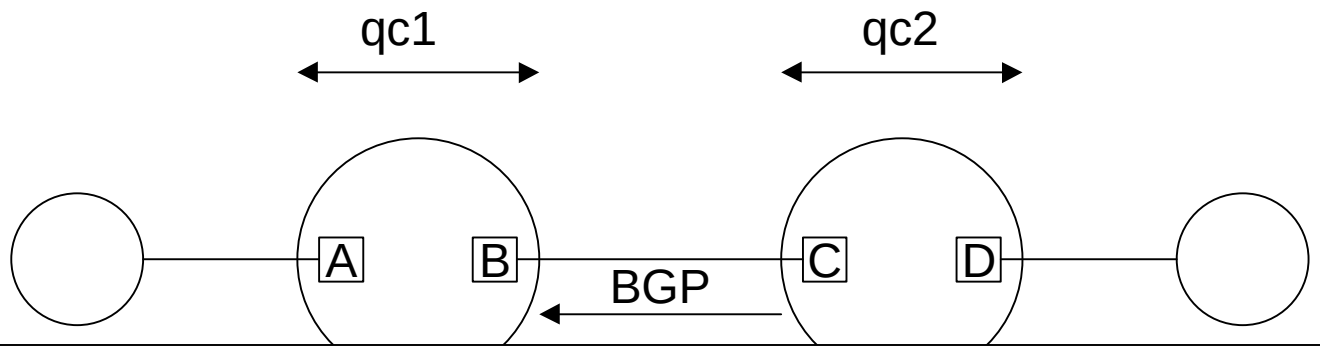


SLAs are required between ISPs and customers (or peer ISPs)
to use other than Best Effort QoS Classes: qc1 or qc2
- quantity of traffic
- topological scope
- quality parameters
- a la TEQUILA SLS template

Inter-domain QoS example

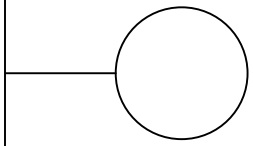
ISP1 is aware of ISP2's qc2 capability through, e.g. InterQoS marketplace.

According to its business objectives, customer requirements, ISP1 defines an *Inter-domain* QoS Class, iqc1:

iqc1 = qc1 *op* qc2

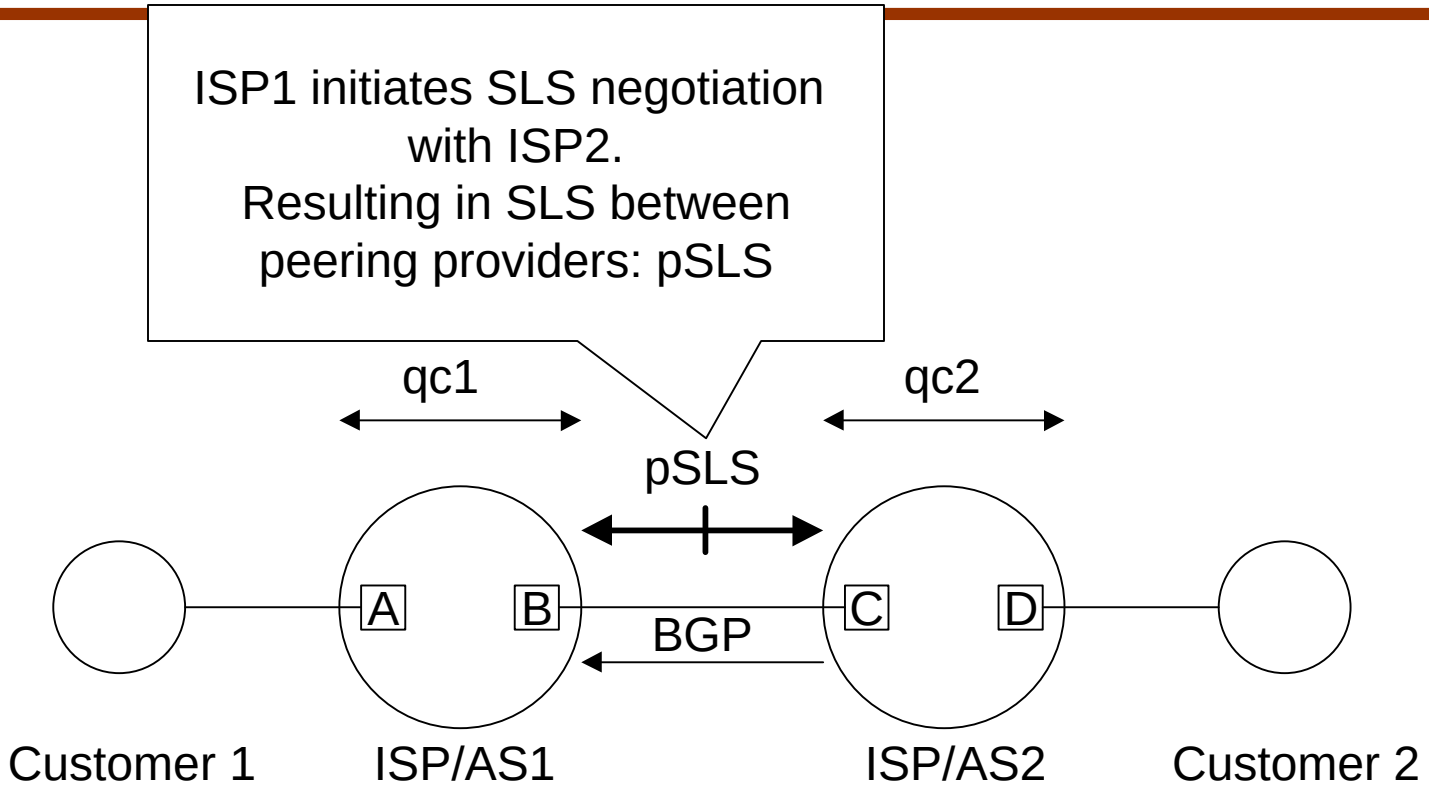
(*op*: e.g. *addition* for delay, *minimum* for throughput)

("QoS binding" in MESCAL)

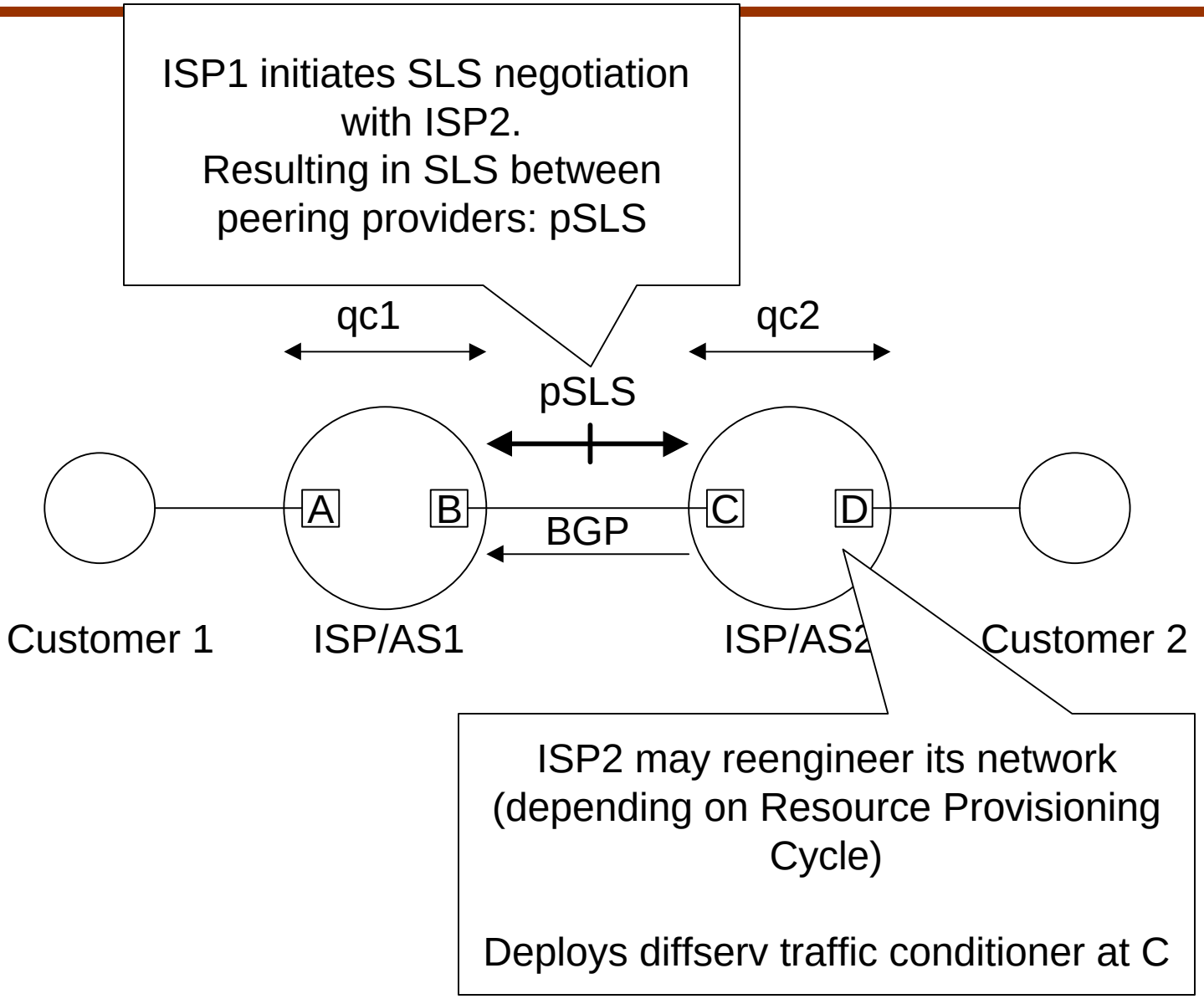


Customer 2

Inter-domain QoS example



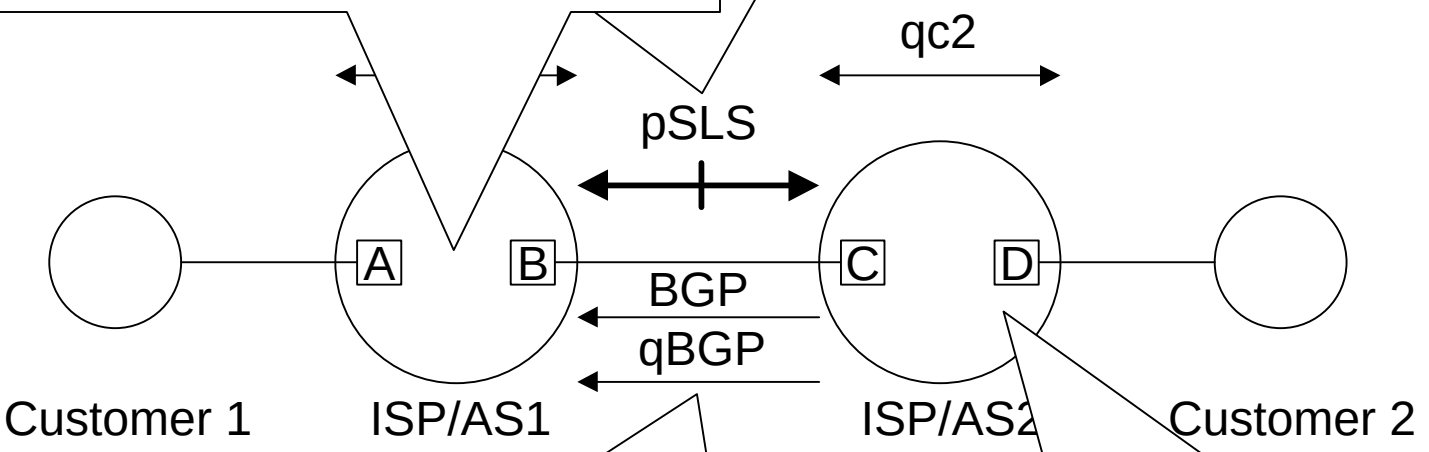
Inter-domain QoS example



Inter-domain QoS example

Routers in AS1 are updated with QoS based reachability information

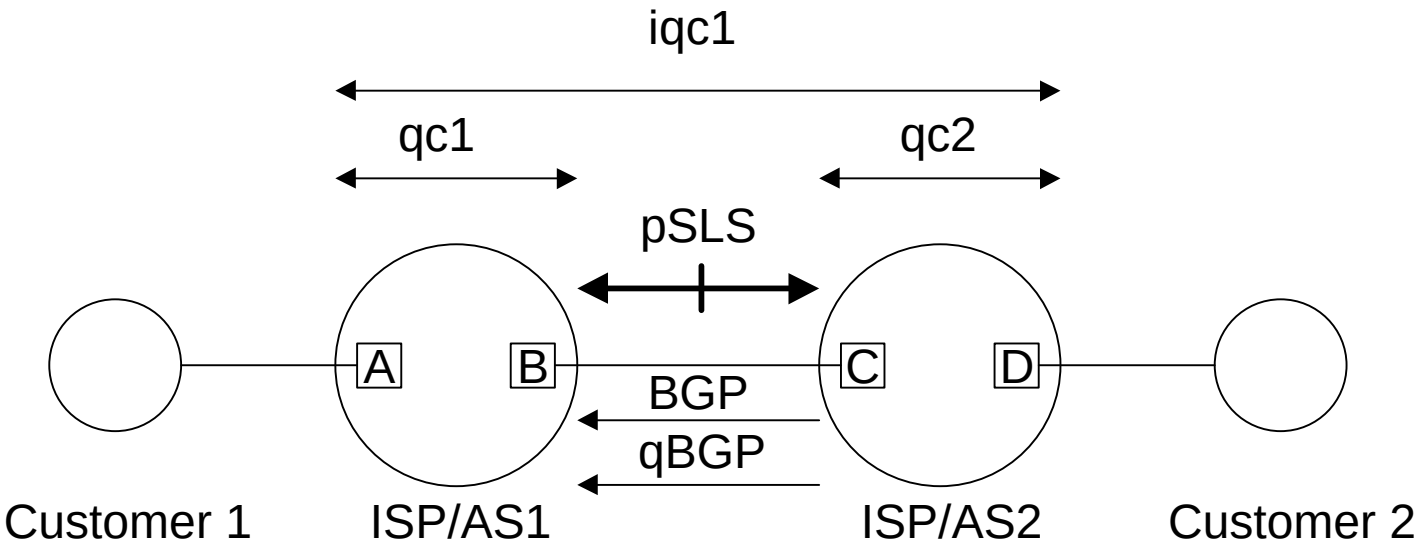
Automatic, *distributed* configuration to support business agreement (SLS)



AS2 advertises QoS capabilities to destinations defined in pSLS to AS1.

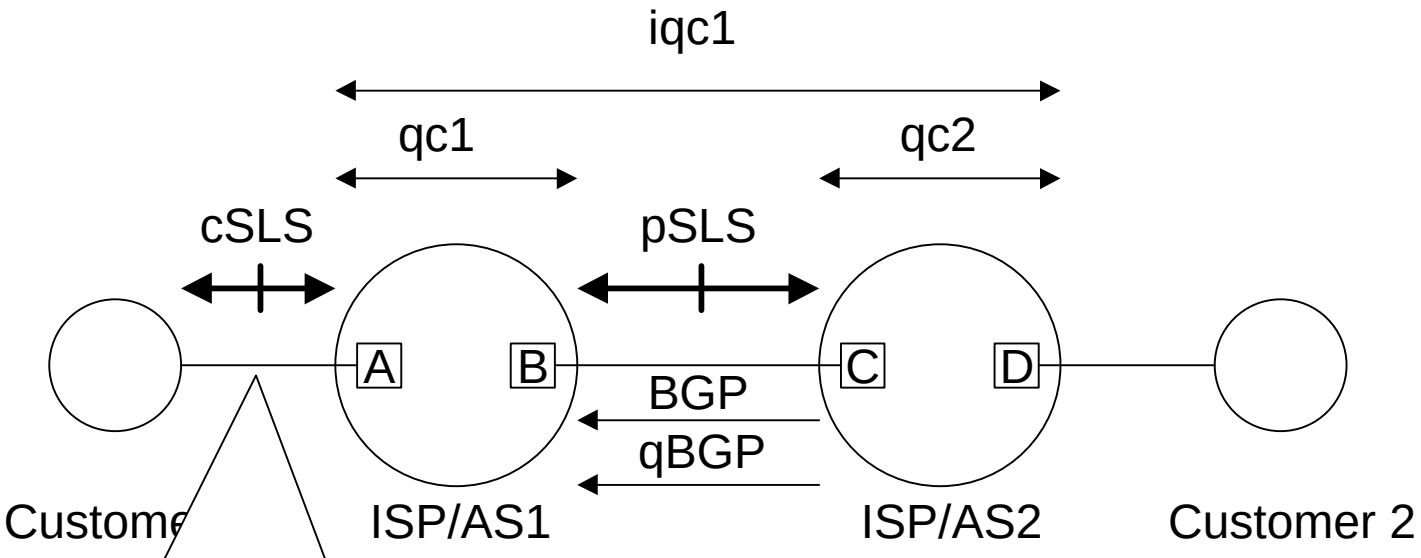
QoS extensions to BGP4 (qBGP)

Inter-domain QoS example



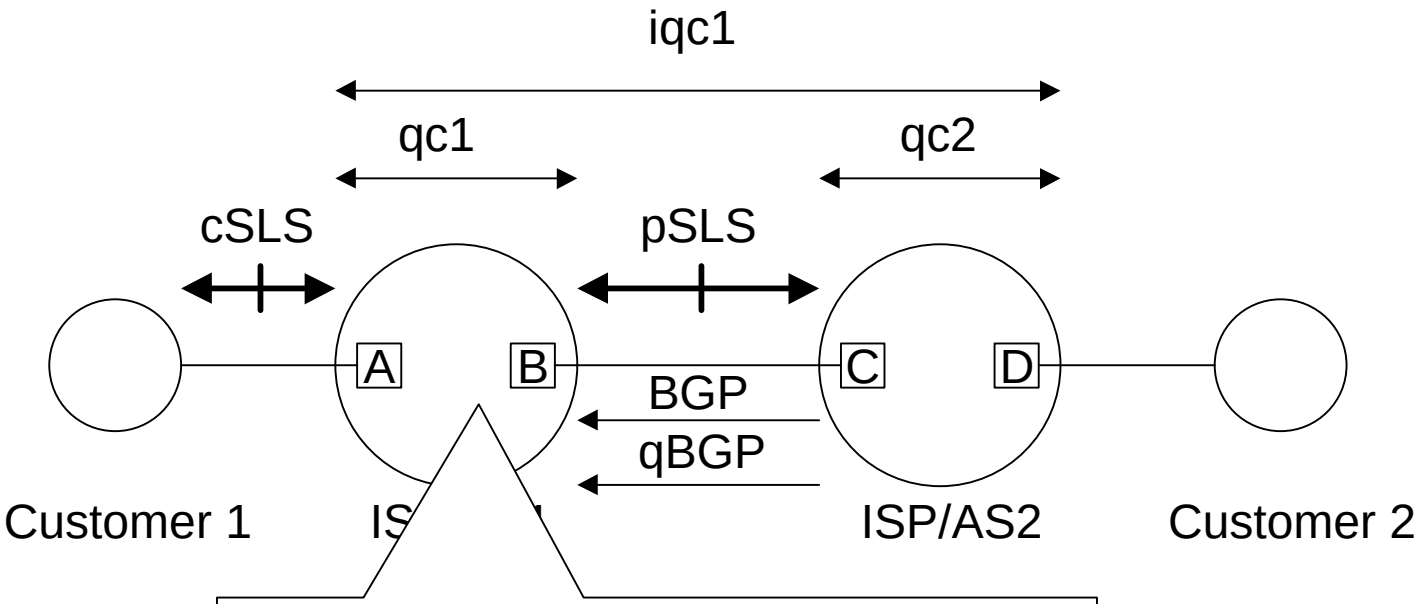
ISP1 is now in a position to offer inter-domain QoS Class iqc1 to its customers in addition to intra-domain QoS Class qc1 and BE services

Inter-domain QoS example



Customer 1 may now negotiate with ISP1 for a cSLS based on QoS Class iqc1 to customer 2

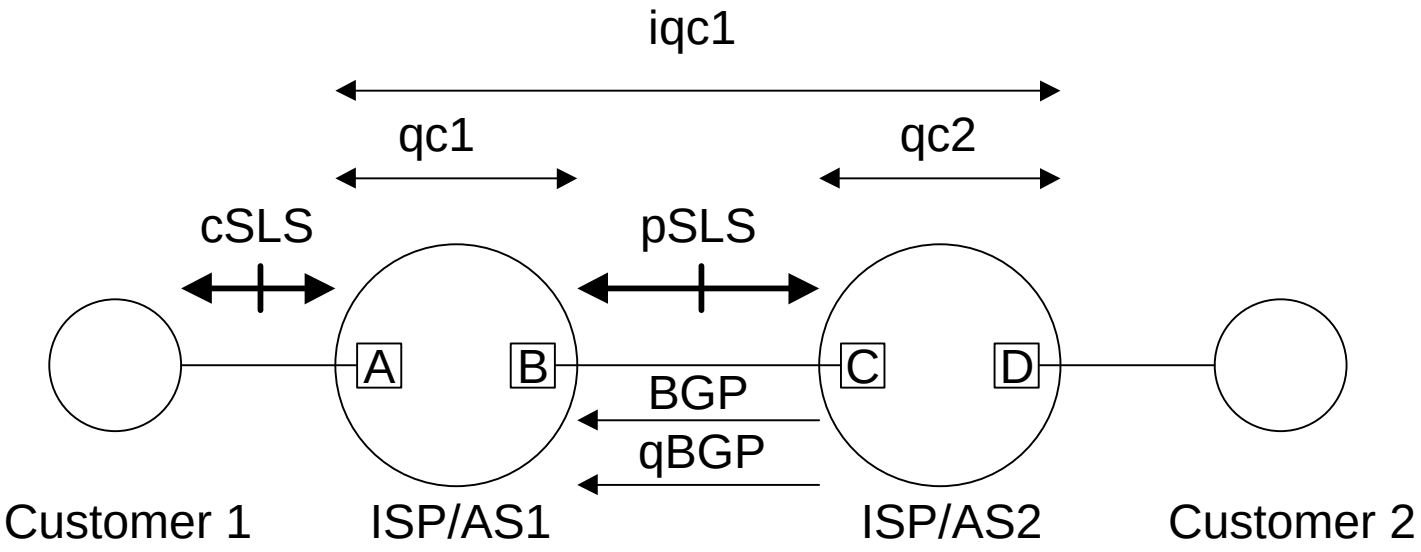
Inter-domain QoS example



ISP1 may reengineer its network to accommodate the new cSLS (depending on its Resource Provisioning Cycle)

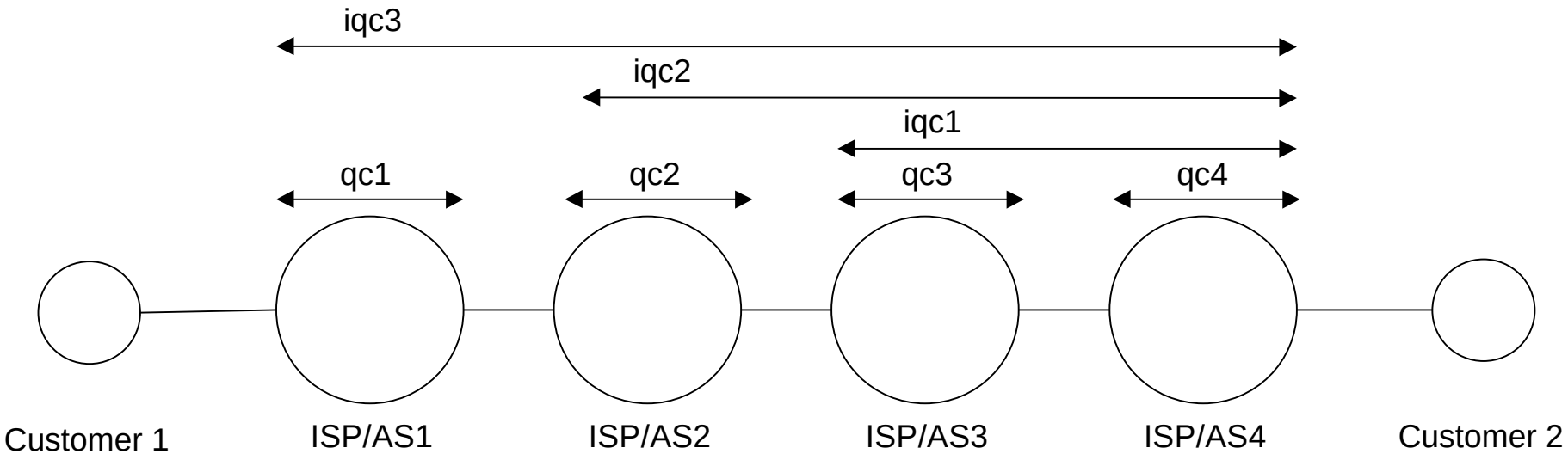
Deploys diffserv traffic conditioner at A

Inter-domain QoS example

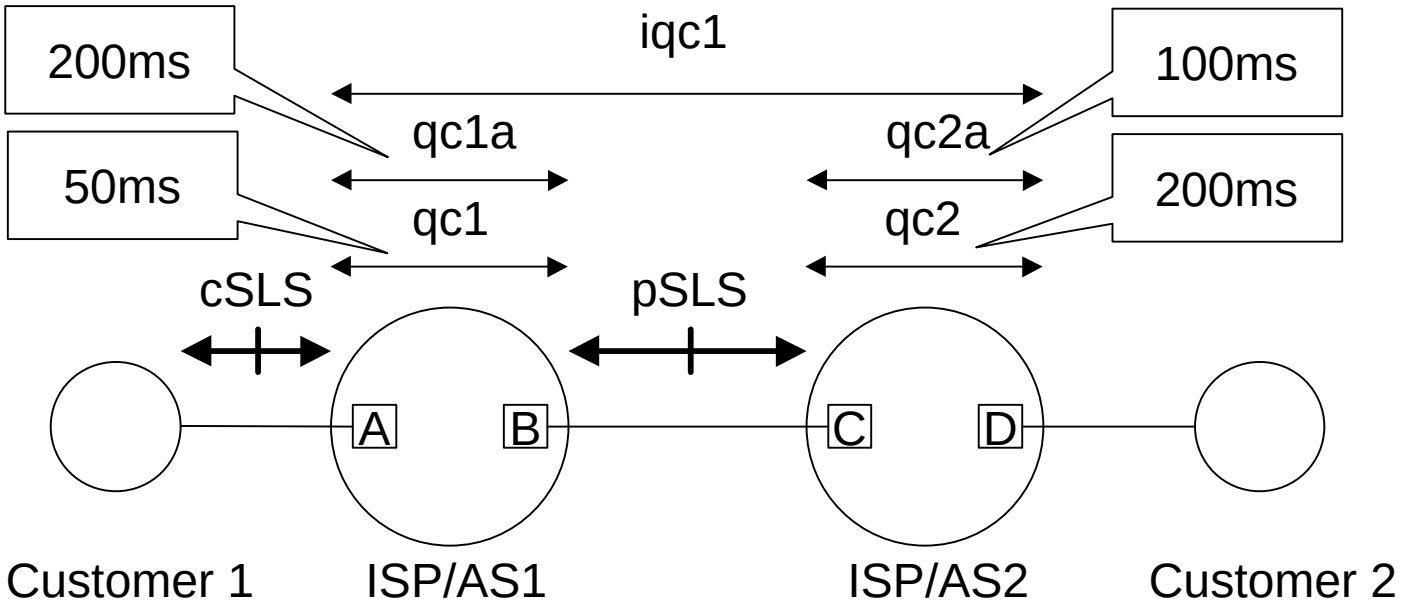


AS1 may now forward packets from customer 1 towards customer 2 via AS2 meeting QoS requirements of cSLS with customer 1 (must assume AS2 fulfils its pSLS)

Example 2: >2 ASs/ISPs



Example 3: alternative QoS bindings



- Considering one way delay only:
- Possible delay values from customer 1 to 2 of:
  - qc1 + qc2 = 50 + 200 = 250ms
  - qc1 + qc2a = 50 + 100 = 150ms
  - qc1a + qc2 = 200 + 200 = 400ms
  - qc1a + qc2a = 200 + 100 = 300ms

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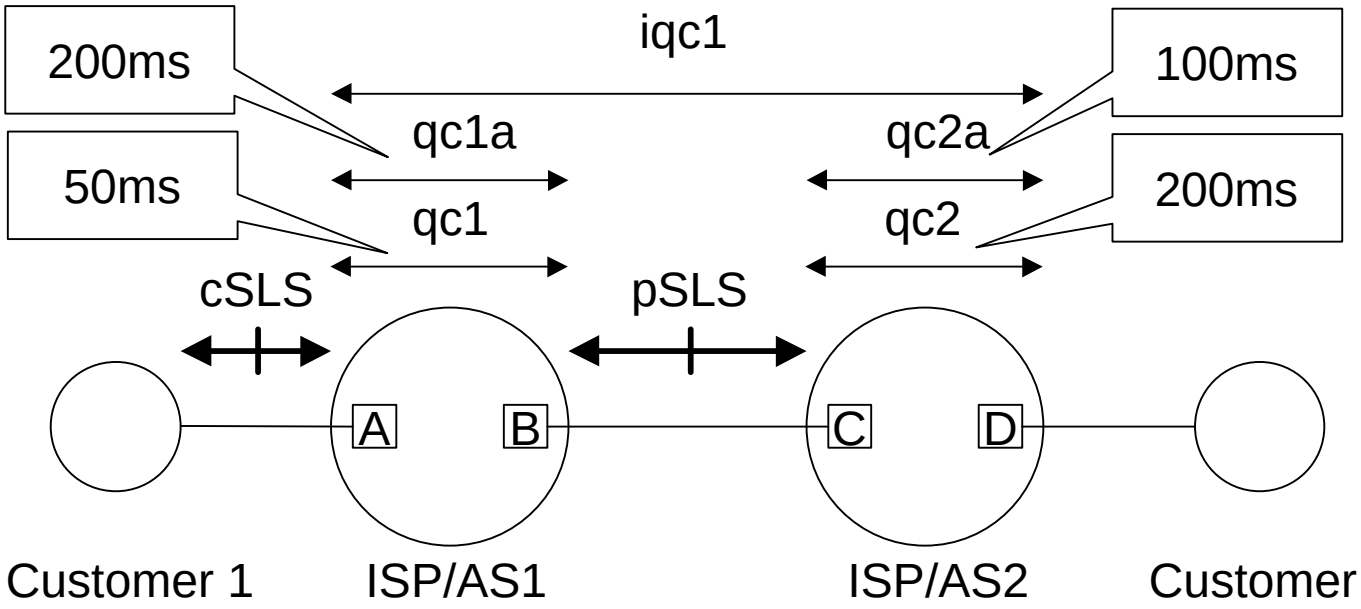

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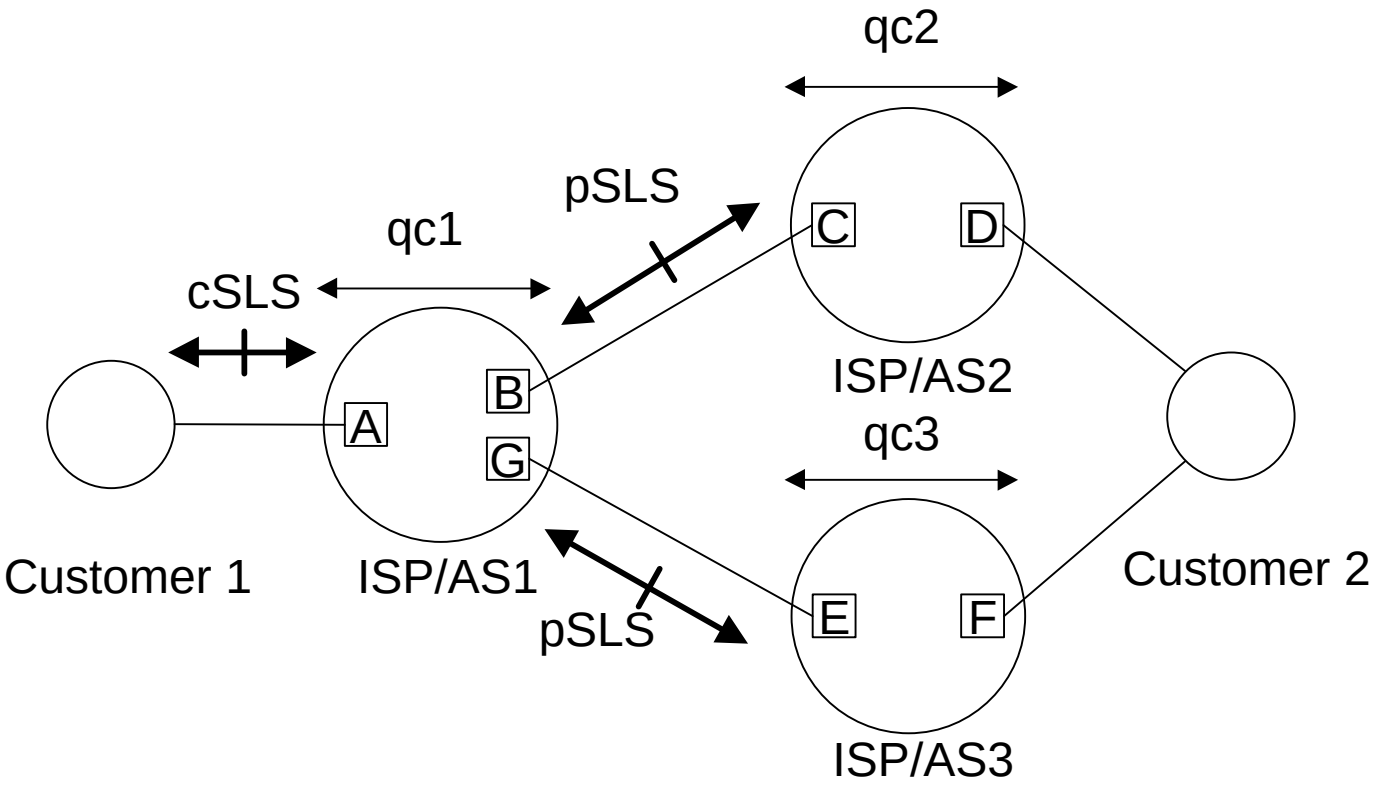
QoS bindings of:
{AS1:qc1, AS2:qc2}
{AS1:qc1a, AS2:qc2a}
for iqc1 meet max. delay of 300ms

{AS1:qc1, AS2:qc2a} may be too expensive...

Example 4: alternative AS paths



MESCAL standardisation objectives

- MESCAL proposes to contribute to standardisation in the following areas
  - SLS Management
    - nsis (next steps in signalling)
  - Traffic Engineering
    - ptomaine (prefix taxonomy ongoing measurement & inter network experiment)
    - idr (inter-domain routing)
    - tewg (internet traffic engineering
  - Policy Management
    - rap (resource allocation protocol)

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for more information