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Network Transformation using Cloud

Cloud-enabled NGN Architecture with Discovery of End-to-End QoS Resources

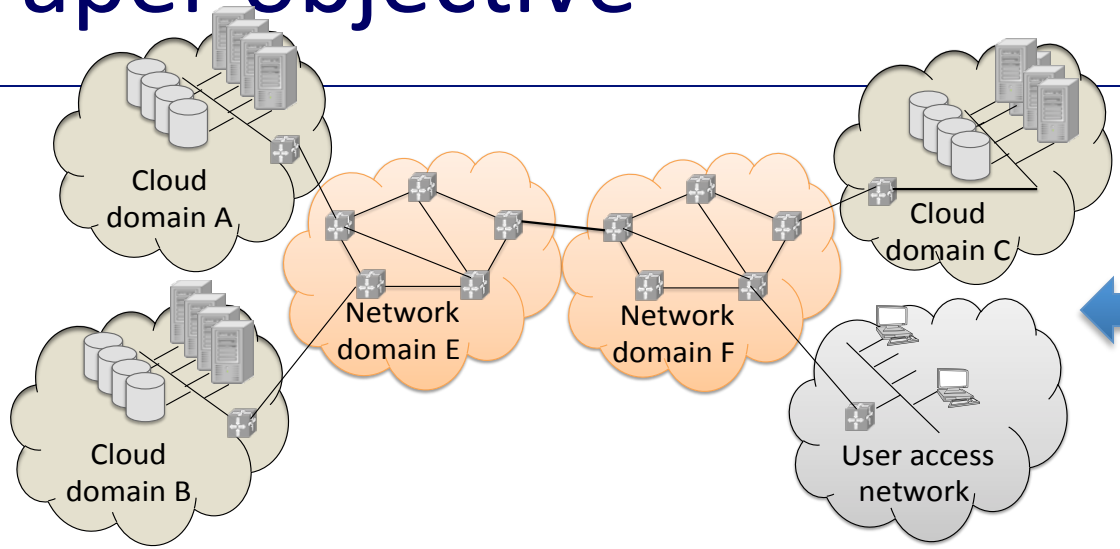
Silvana Greco Polito,
Tommaso Nicoletti,
Vincenzo Maniscalco
{silvana.grecopolito, tommaso.nicoletti, vincenzo.maniscalco}@unikore.it

Università degli Studi di Enna "Kore"-- Italy

Agenda

- Cloud provisioning scenario and motivation for joint discovery of computing/networking resources
- Quick overview of the:
  - Next Generation Network (NGN) architecture
  - Path Computation Element (PCE) framework
- Contribution: the cloud-enabled NGN architecture
- Performance and conclusion

Paper objective



Multi-cloud, multi-domain scenario:

Availability of multiple alternative resources

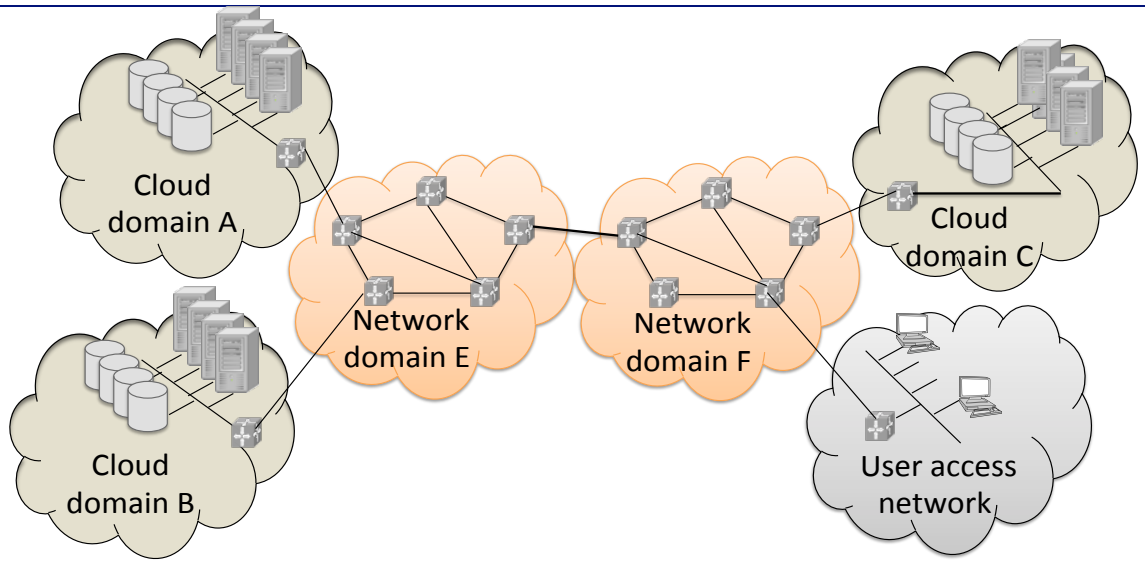
- Cloud architecture for:
  - ***Joint discovery* of QoS *computing and networking resources***
  - Provisioning of cloud services based on QoS features of both computing and networking resources

Motivation

Example:

-Cloud C has the best computing resources

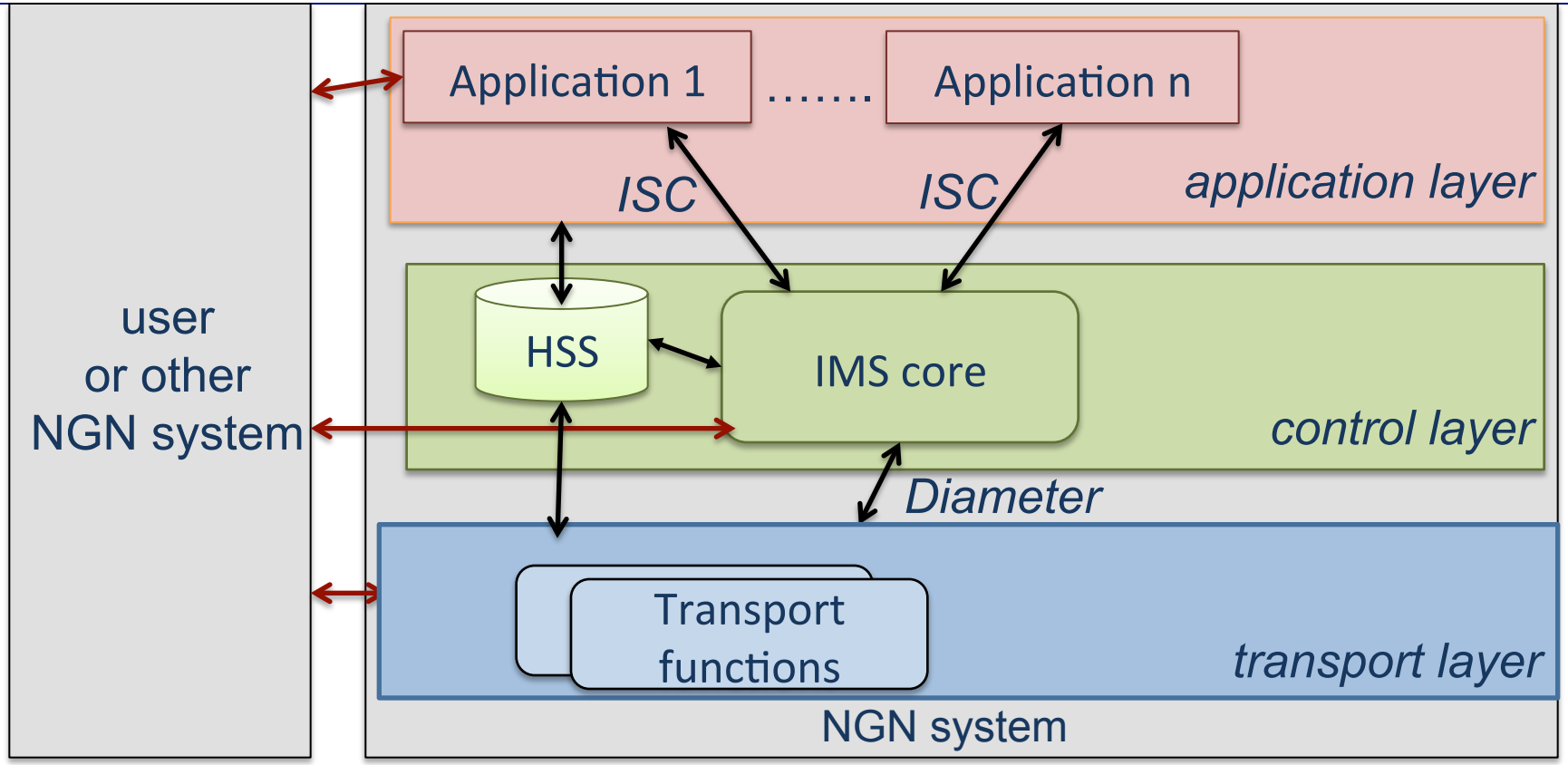
-Network F cannot provide QoS delivery



- What if Cloud A has to rent resources to scale out its infrastructure?
- It is better to use resources of cloud B delivered through network E

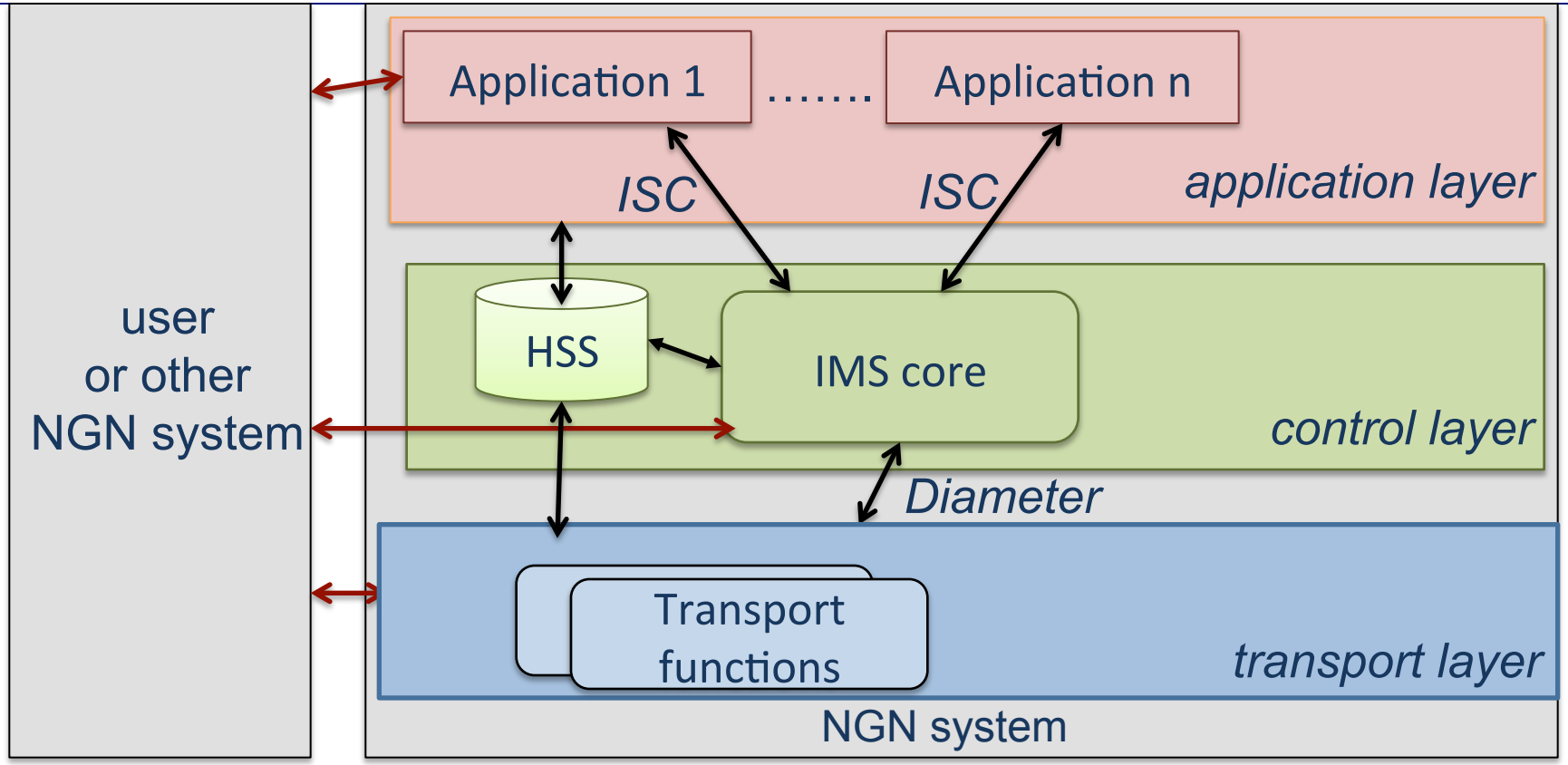
Conclusion: QoS cloud services need joint discovery of computing/network resources with QoS

The Next Generation Network (NGN) architecture



- **IMS (IP multimedia subsystem) to:**
  - Register with applications
  - Activate applications
  - Interact with remote NGN systems
- **Transport layer functions to:**
  - Provide connectivity to deliver the application service

The Next Generation Network (NGN) architecture

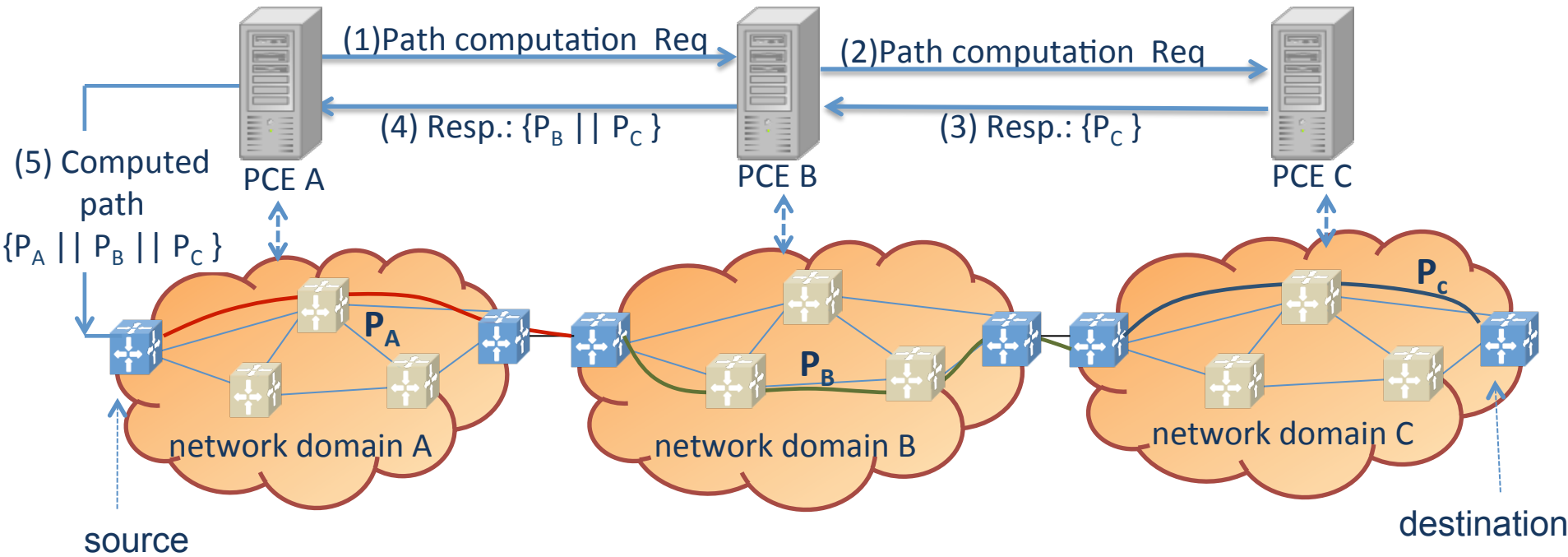


Internal Interfaces:

- **The SIP (Session Initiation Protocol)** for the IP multimedia Subsystem Service Control (ISC) Interface
- **Diameter applications** to communicate with transport functions

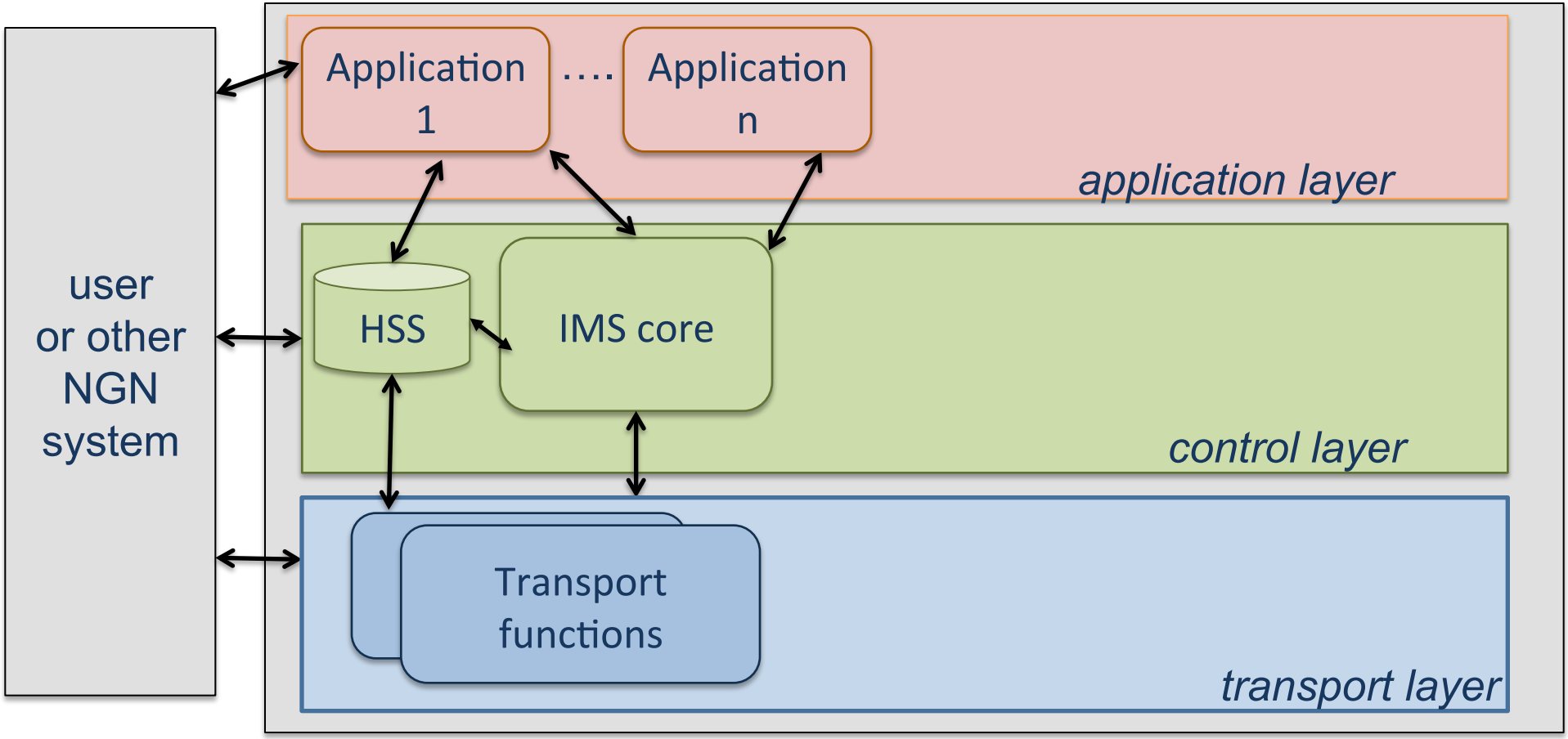
The Path Computation Element (PCE) framework

- Objective: computation of the optimal intra and inter-domain paths satisfying a set of QoS constraint

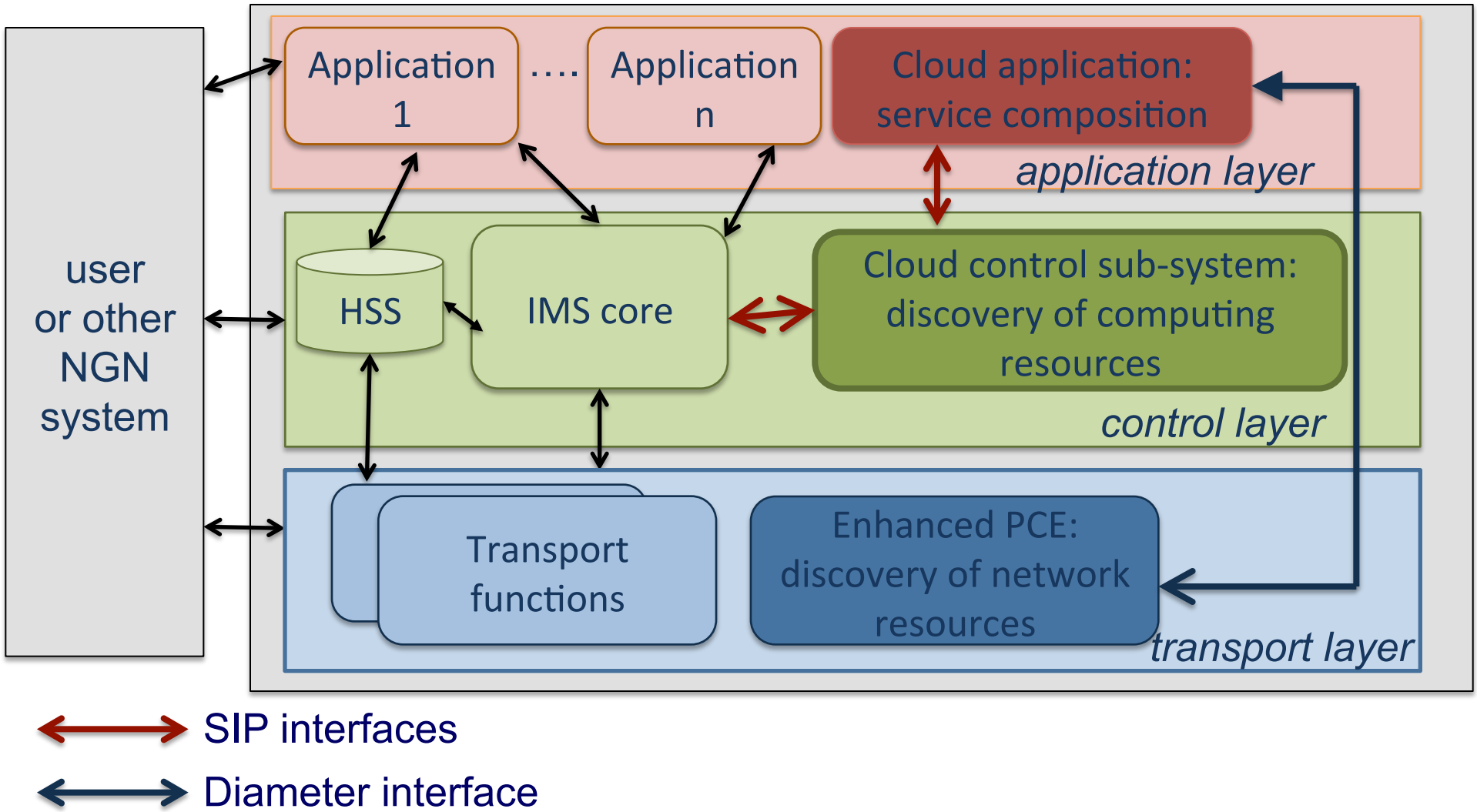


- PCE servers to compute intra and inter-domain paths

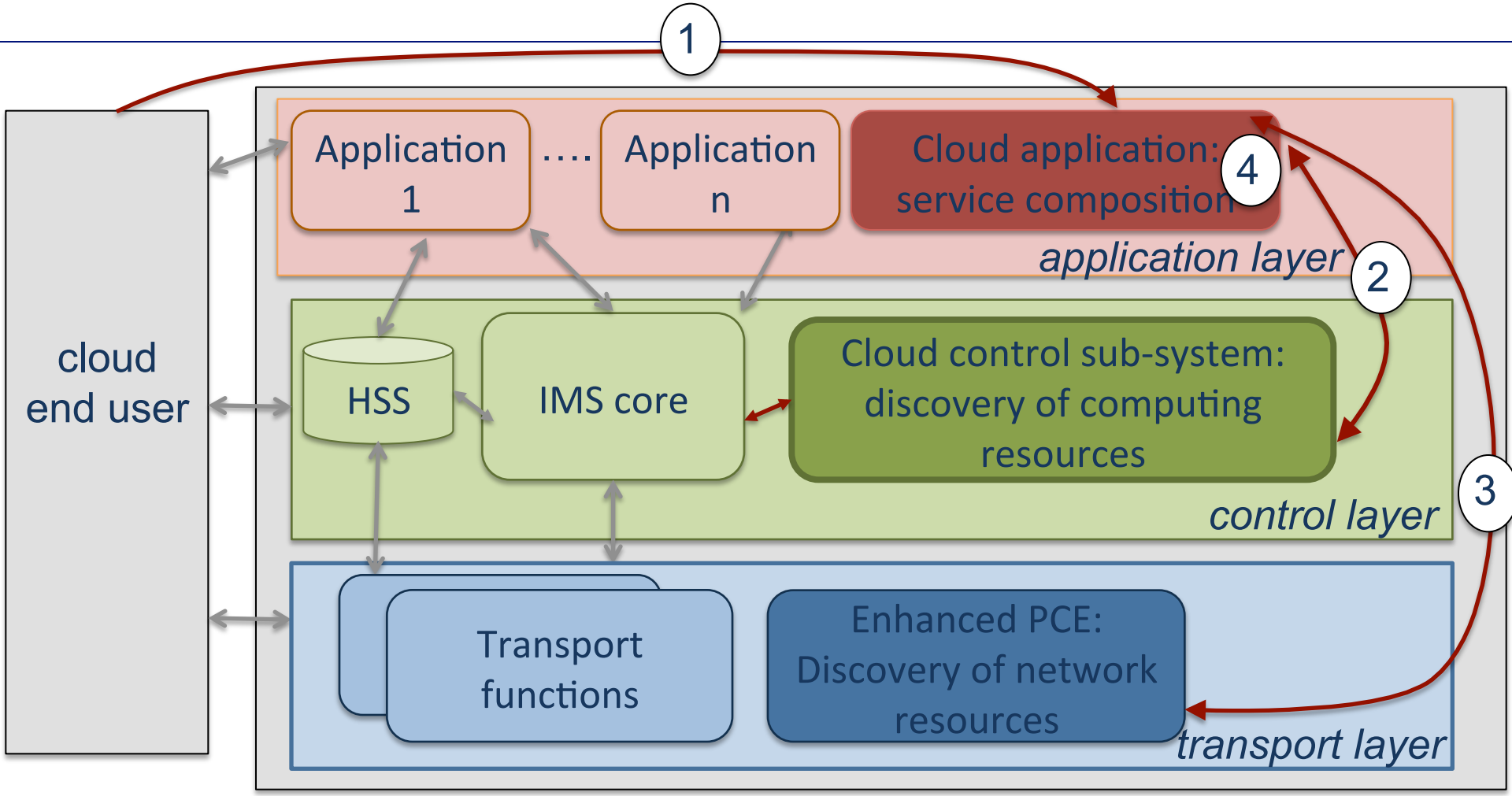
Cloud enabled NGN architecture



Cloud enabled NGN architecture



Handling users' cloud service requests



1 User's cloud service request

2 Request/response for discovery of computing resources

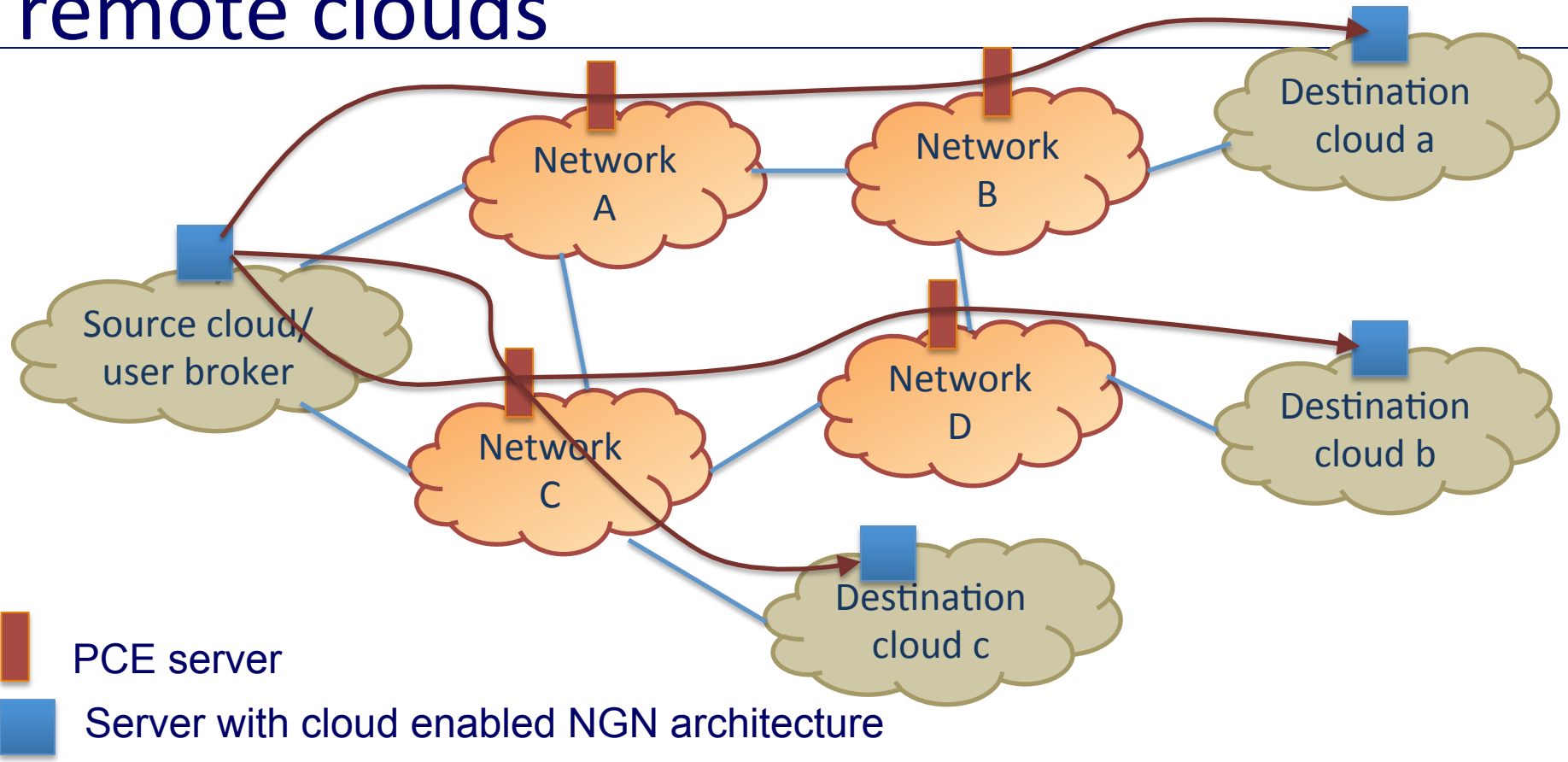
3 Request/response for discovery of networking resources

4 Service composition and selection

Local and remote discovery of computing resources

- Each cloud has local DBs with information about real-time state of local computing resources
- The cloud control sub-system can:
  - Look for resources in the local DB
  - send discovery requests to control sub-systems of remote clouds if resources have to be rent

Parallel discovery toward multiple remote clouds



- Computing and network discovery toward each destination cloud
- Composition of multiple services and selection of the best one

Resource discovery signaling

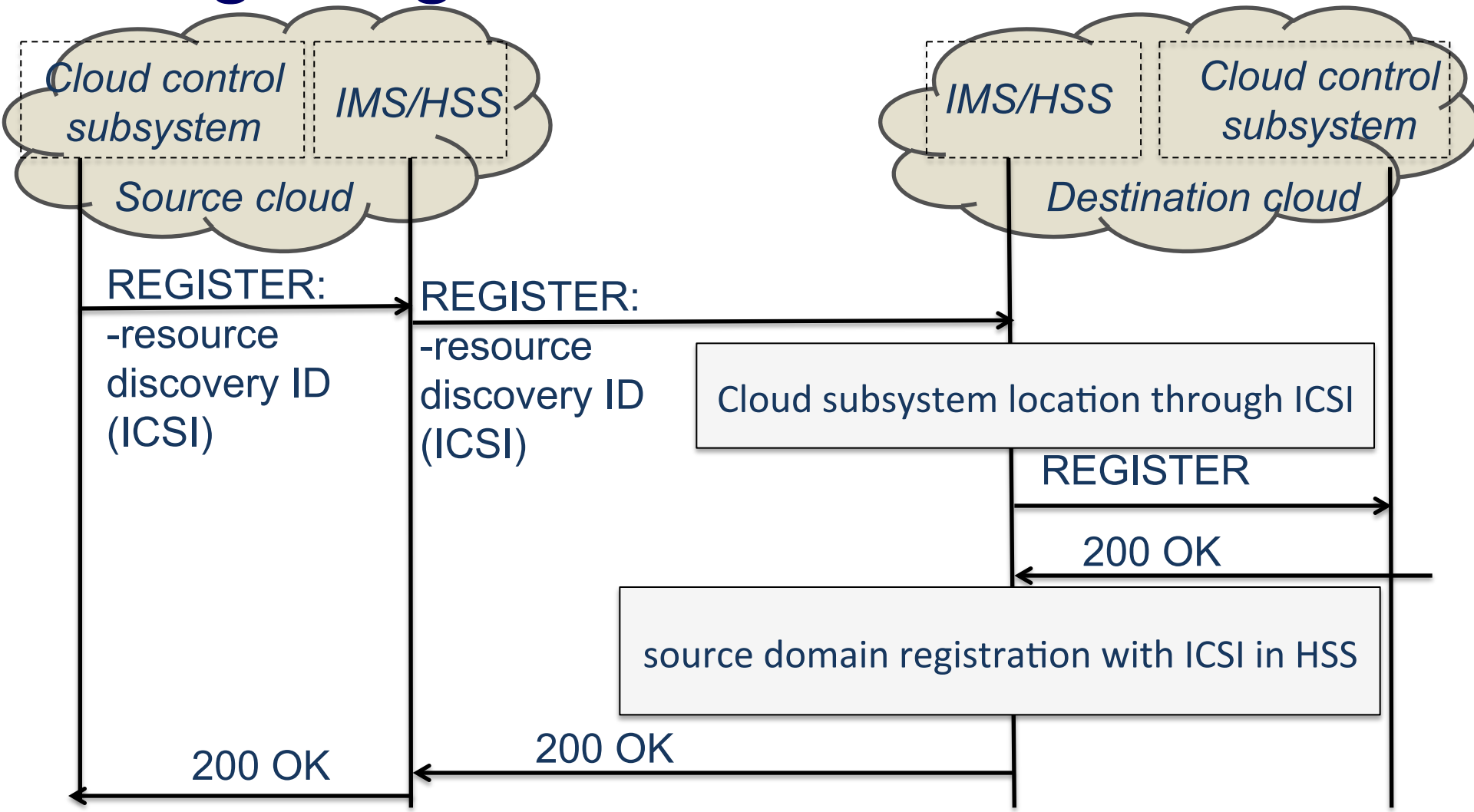
Three main steps:

1. Offline registration of the source with the remote entity (destination cloud) for discovery of computing resources

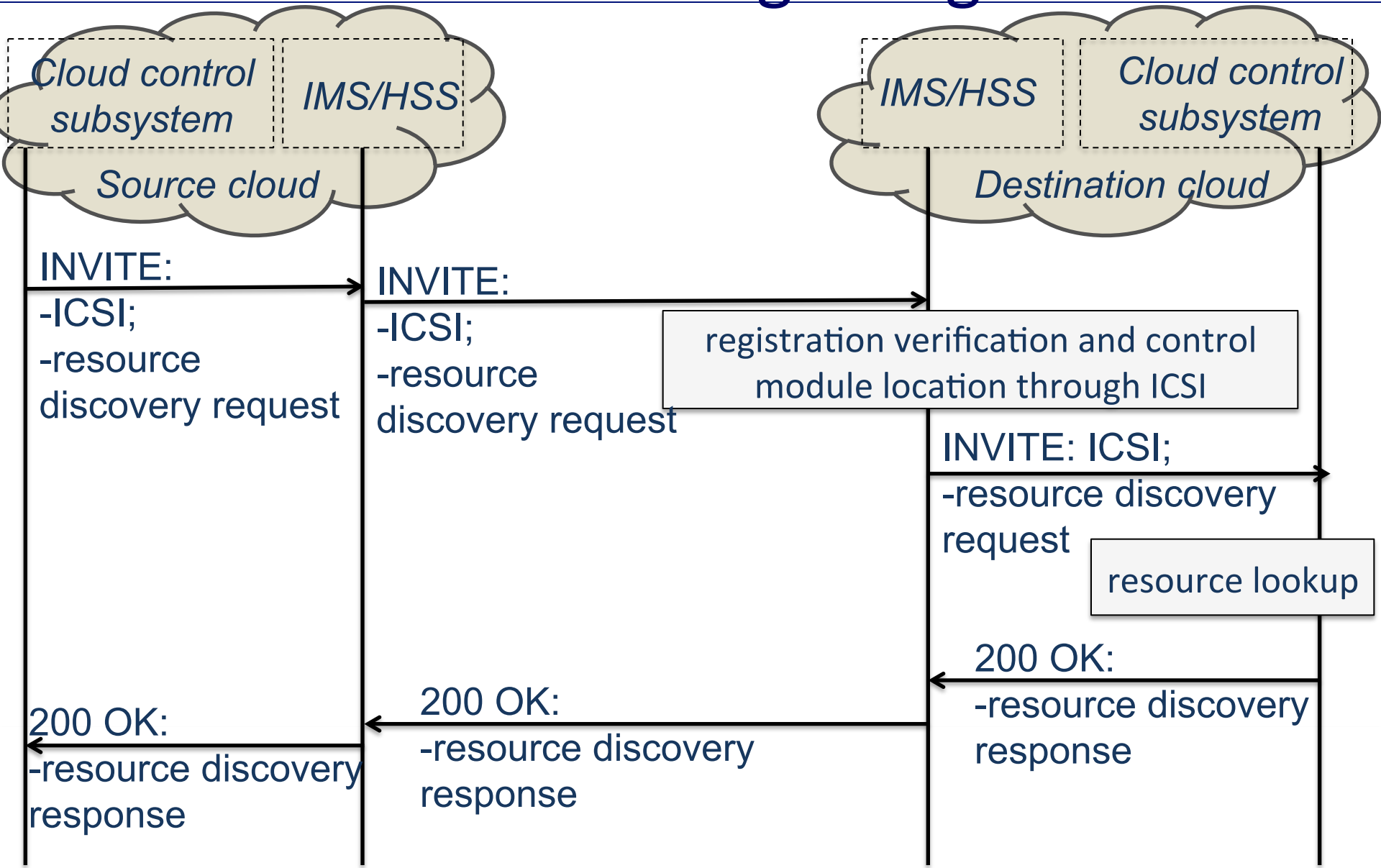
2. Online dynamic discovery of computing resources

3. Online dynamic discovery of network resources

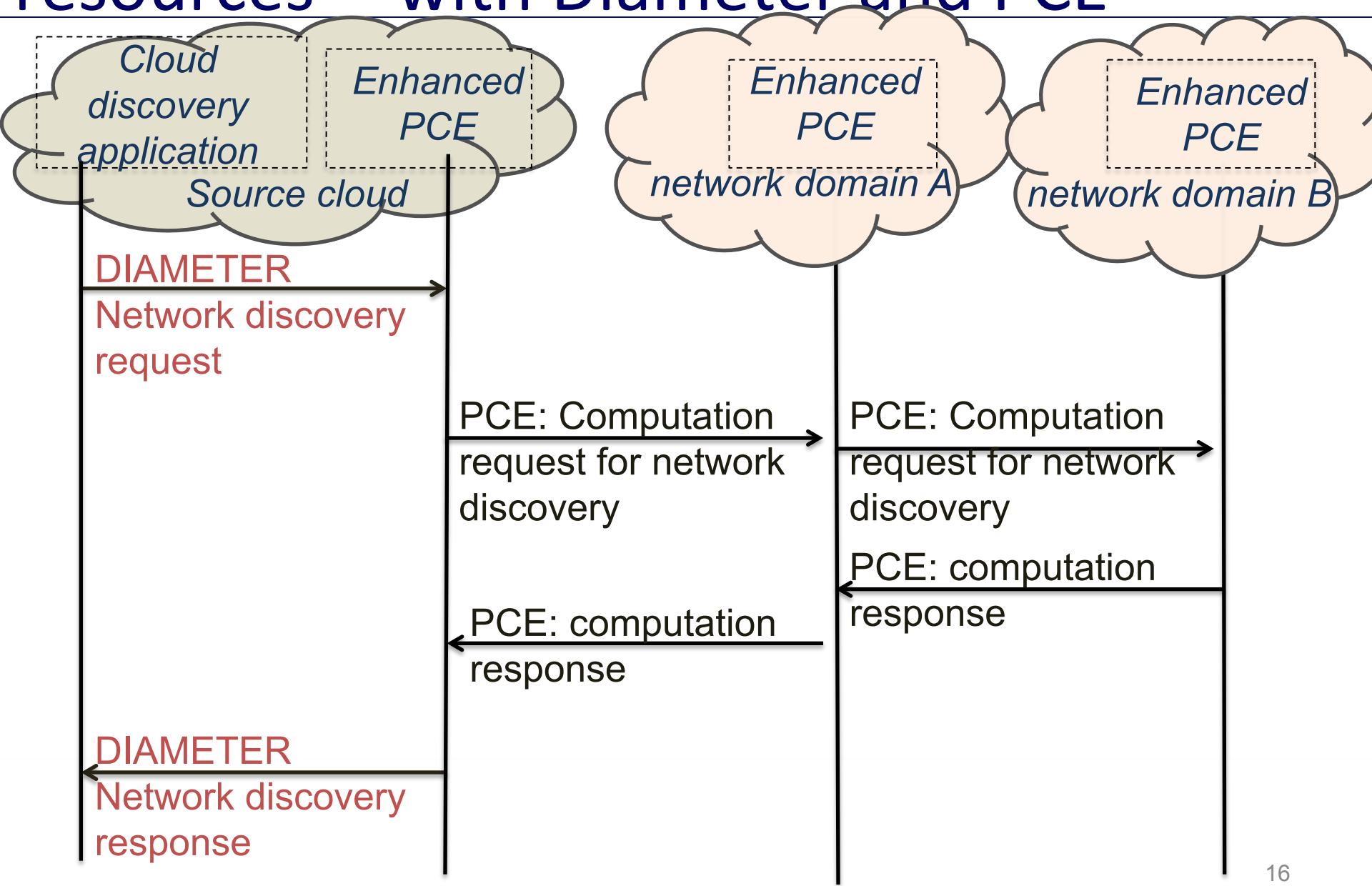
Step 1: Offline Registration -- with IMS signaling



Step 2: Online discovery of computing resources -- with IMS signaling



Step 3: Online Discovery of network resources -- with Diameter and PCE



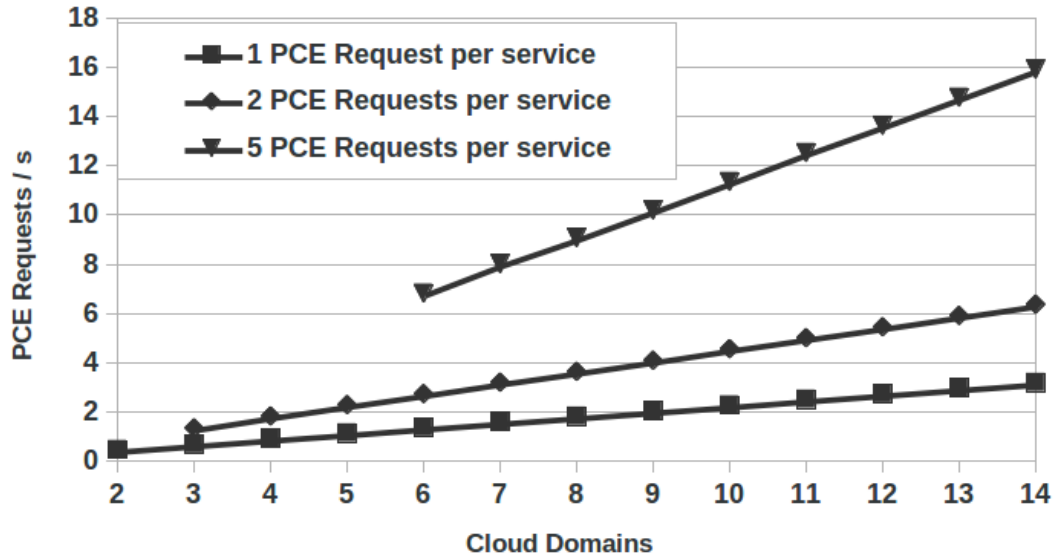
The Diameter interface: the Diameter QoS path discovery application

- A novel Diameter application with AVPs to map in PCE objects
- Implemented with Open Diameter

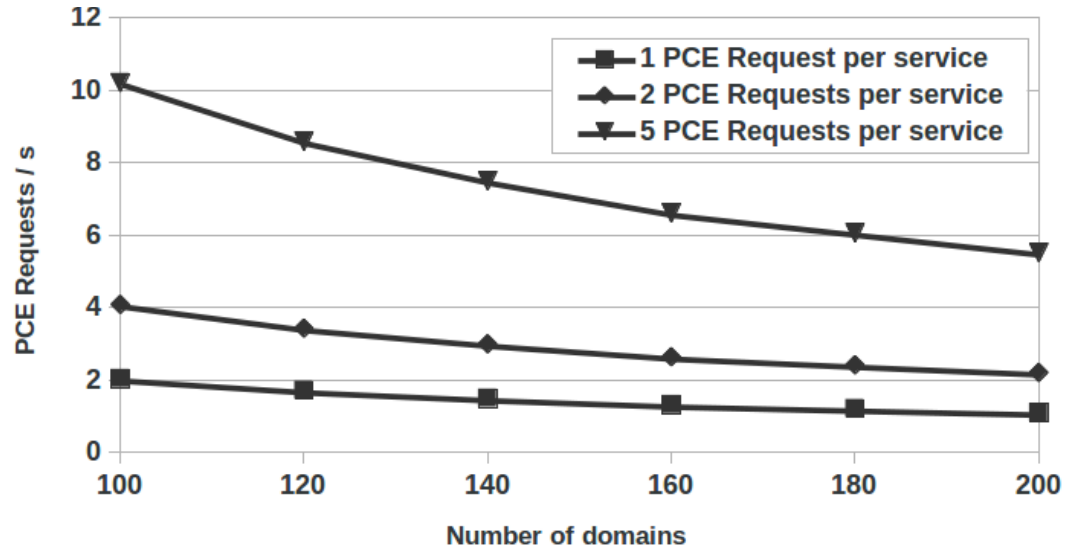
Diameter Attribute Value Pairs and PCE objects

AVP Attribute Name	Corresponding PCE object
Path-Source	End-points (Source of the PCE path)
Path-Target (target addresses with nodes or domains along one or more paths)	Include Route Object (IRO) (List of domains to cross)
	Explicit Route Object (ERO) (Set of available paths)
	End-Points
Path-Parameters	Request parameters (RP) (Path priority, etch.)
QoS-Attributes (Path constraints per target)	Bandwidth, Metric Load-Balancing, End-Points
Discovery-Failure	PCEP-Error, No-Path, Notification, Destinations

Performance: effect of parallel path discovery on the PCE servers



NSFNET:
-increasing number of clouds attached to the network
-looking for QoS paths toward 1,2 and 5 destination clouds



Internet-like networks:
-increasing number of domains
-50 clouds
-looking for QoS paths toward 1,2 and 5 destination clouds

Contribution and conclusion

- We have designed an architecture for:
  - Automatic discovery of computing and networking resources
  - Composition of cloud services based on QoS of both computing and networking resources
- It is an extension of the well known NGN architecture and makes use of the existing IMS and PCE for discovery of computing and networking resource, respectively
- We have implemented the Diameter interface to control PCE and verified scalability on the PCE systems
- In our future work we will use Open Diamter, PCE Emulator and Open IMS to build a test bed for further testing

The End

Silvana Greco Polito