CINA
Collaboration Interface between Network and Applications

Envision Project

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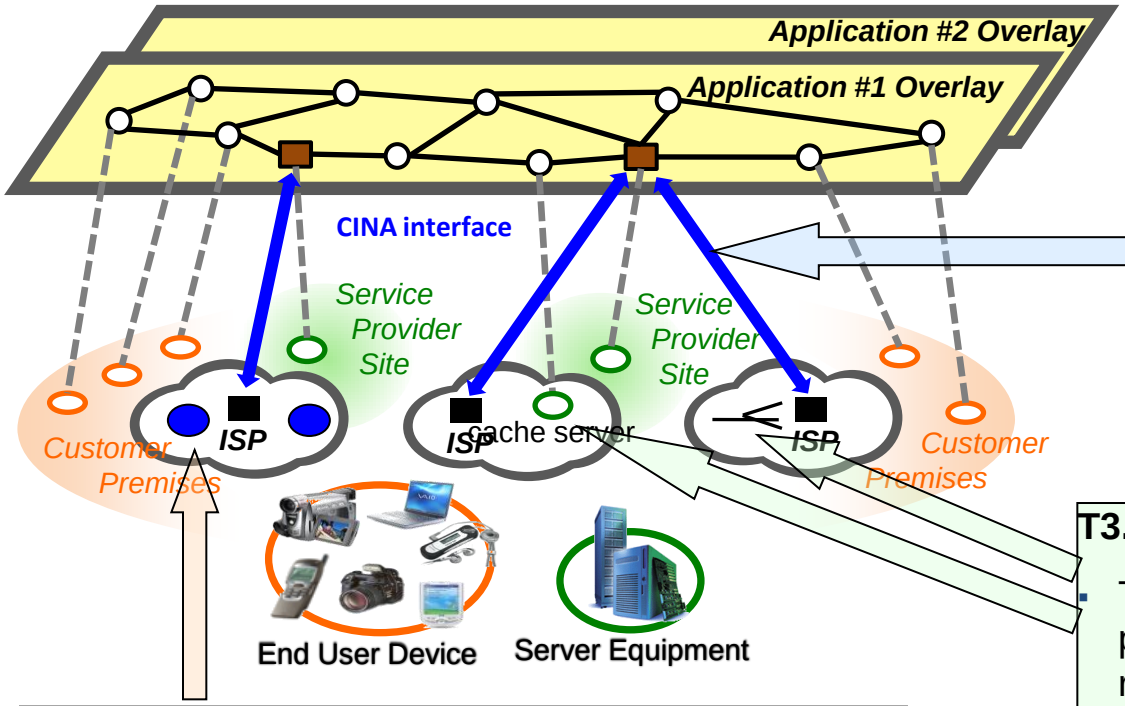
Project overview

- Future networked media applications will be multi-sourced, highly interactive distributed meshes of HD and 3D multi-sensory channels
- Major challenges:
  - higher quantities of data throughout the network
  - additional pressure at the network edge for unprecedented upload capacity in wired and wireless access networks
- Traditional solutions of throwing bandwidth cannot address these challenges:
  - pre-provisioning sufficient network resources everywhere is costly
  - upgrading the capacity of ISPs infrastructure by several orders of magnitude is practically impossible
- ENVISION solution aims to develop intelligent cross-layer techniques:
  - increasing the degree of cooperation between ISPs and the networked applications
  - optimising application overlay networks to make best use of the capabilities of the underlying networks and the participant end users
  - enabling dynamic adaptation of the content to meet the networks and users capabilities

Collaboration Interface between Network and Applications: CINA



T3.1: Specification of the ENVISION Interface

- a) enable the exchange of information (meta-data) for the network status and the application resource requirements
- b) provide access to specialised network services, e.g. multicast, traffic prioritisation or access to resilient paths, caches, etc.

T3.2: Network Monitoring

- To specify network performance parameters to be collected
- To specify functions for collecting and processing this information.
- To define network metrics to capture dynamic topological and load status

T3.3: Network Optimisation

- To specify mechanisms for the ISP to provision and control application layer resources, starting with caching resources and multicast capabilities
- To design and implement the functions and the mechanisms for provisioning and controlling the resources in the ISP

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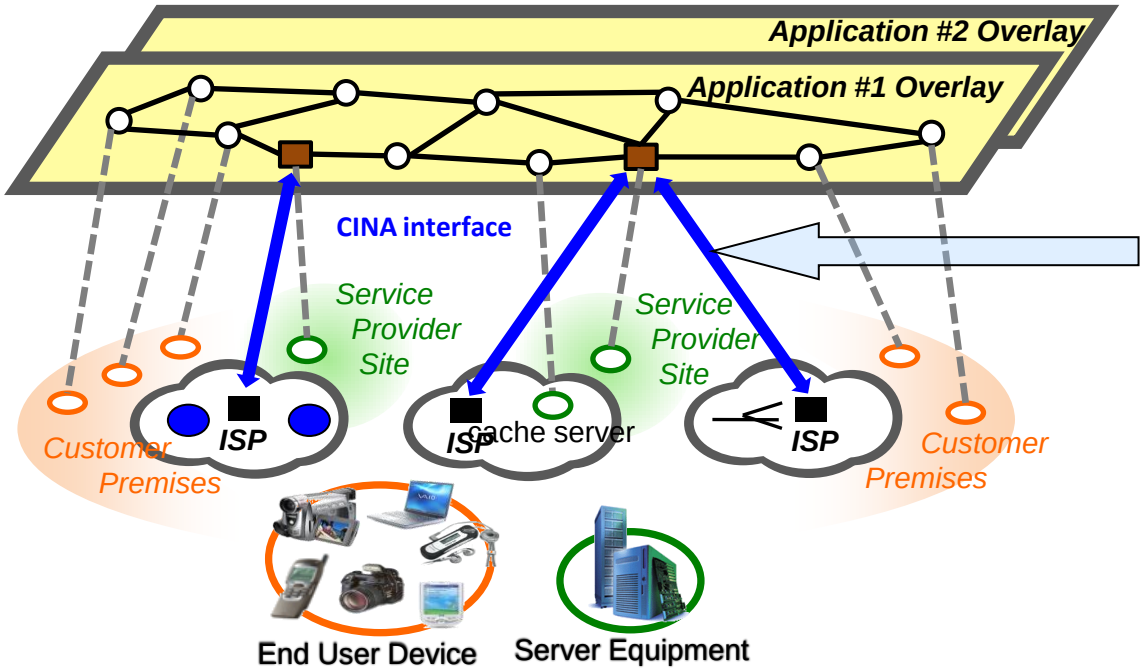

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CINA interface

- Applications can request network information from ISPs
  - Network Map, Cost Map, Delay Map, etc.
  - in order to better select peers
- ISPs can request overlay application information
  - Service map, Constraint Map
  - in order to better provision/control the network or recommend specific configurations to the application
- Applications can request the instantiation of network services
  - Multicast, caches, high capacity nodes
  - In order to optimize the data delivery to end-users, while reducing network load

CINA interface

- Extend IETF ALTO work
- Add new metrics for building maps
- Add network service instantiation
- Include security aspects
- Rely on HTTP/JSON as ALTO

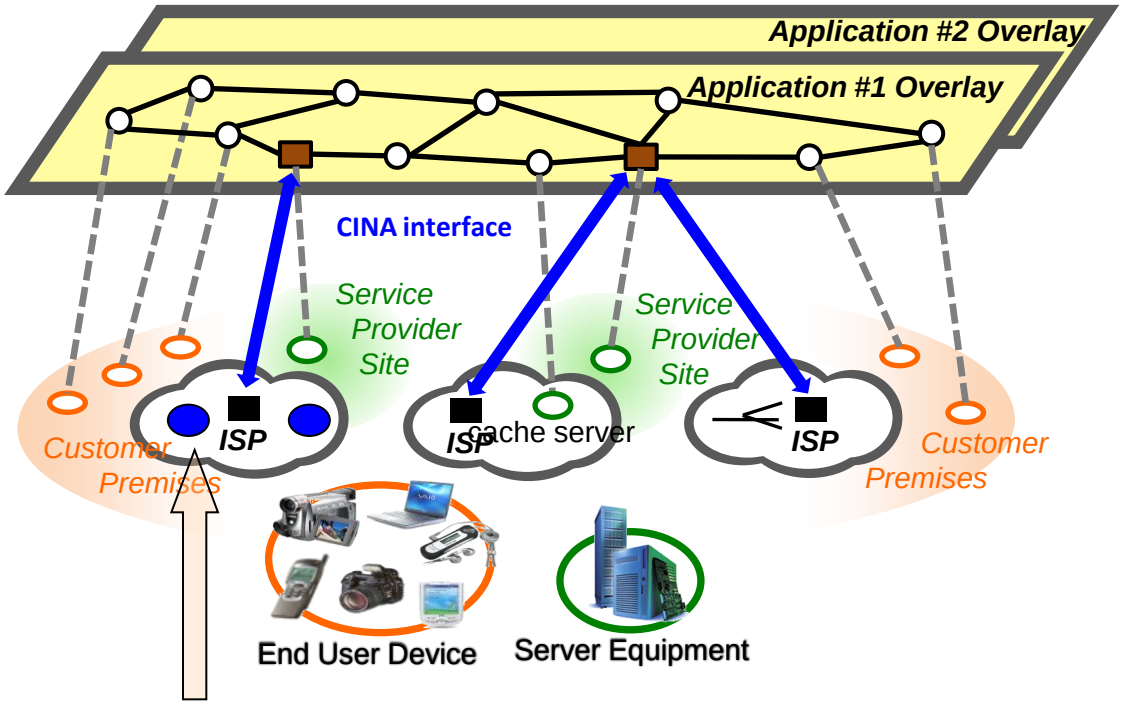
Security Issues

- Authentication
- Authorisation
- Secure Communication
  - Encryption, signing

- CINA interface : TLS

- Data exchange (.e.g, Multicast source – Multicaster) : IPsec

Collaboration Interface between Network and Applications: CINA



T3.2: Network Monitoring

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Monitoring Metrics

Metrics

Load:
State of the use of an equipment(cpu, memory).

Connectivity:
State of a peer (up/down).

Bandwidth:
Bit rate measure of available data communication resources (link, interface…).

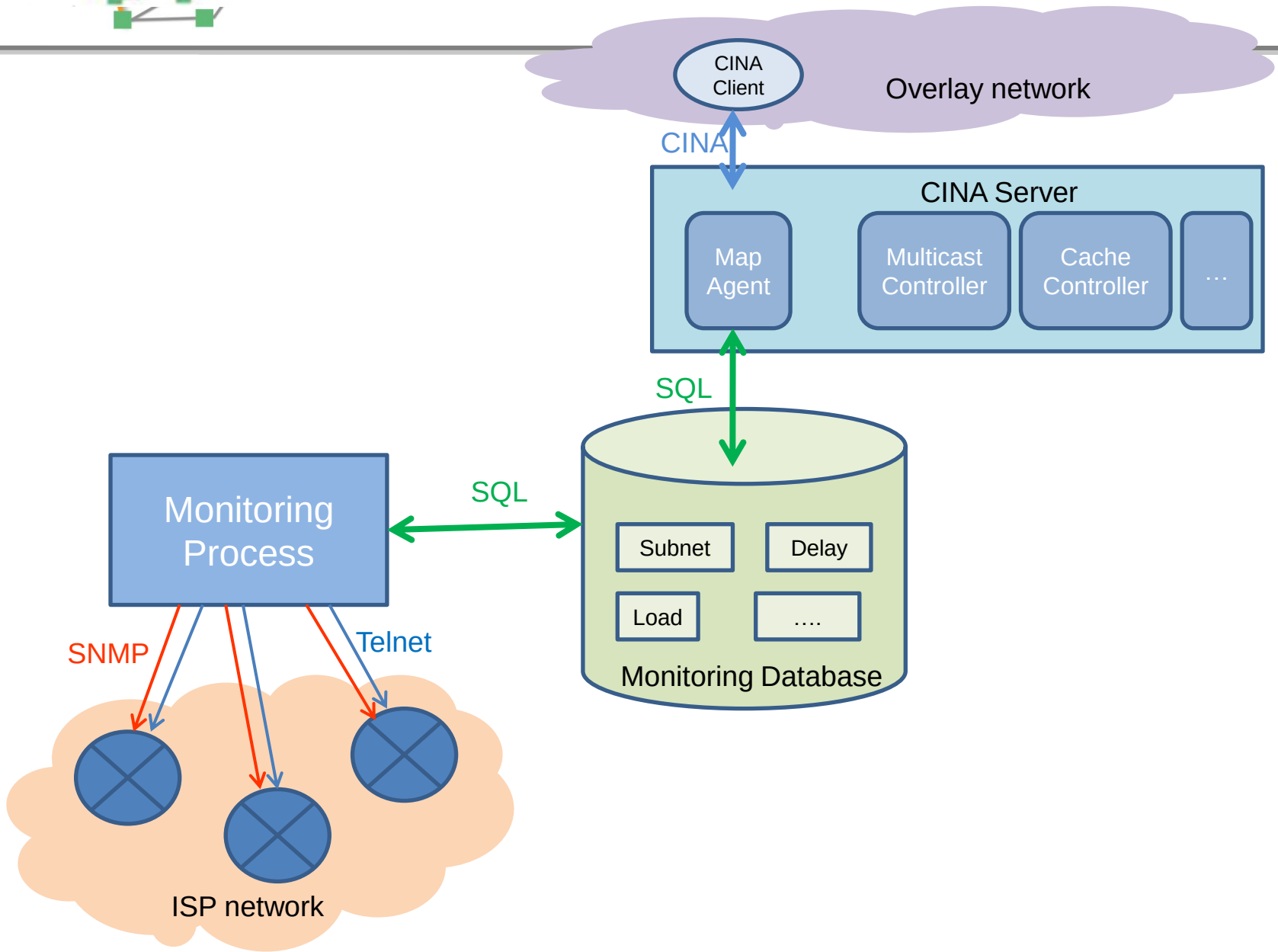
Latency:
Time from the start of packet transmission to the start of packet reception (one-way latency).

Topology:
Layout pattern of interconnections of the various elements of the network in one IPS or more and between them.

Connection Hop:
Number of hops between the peers. It can be used to determine the network topology.

Losses:
Number of lost packets.

Monitoring architecture



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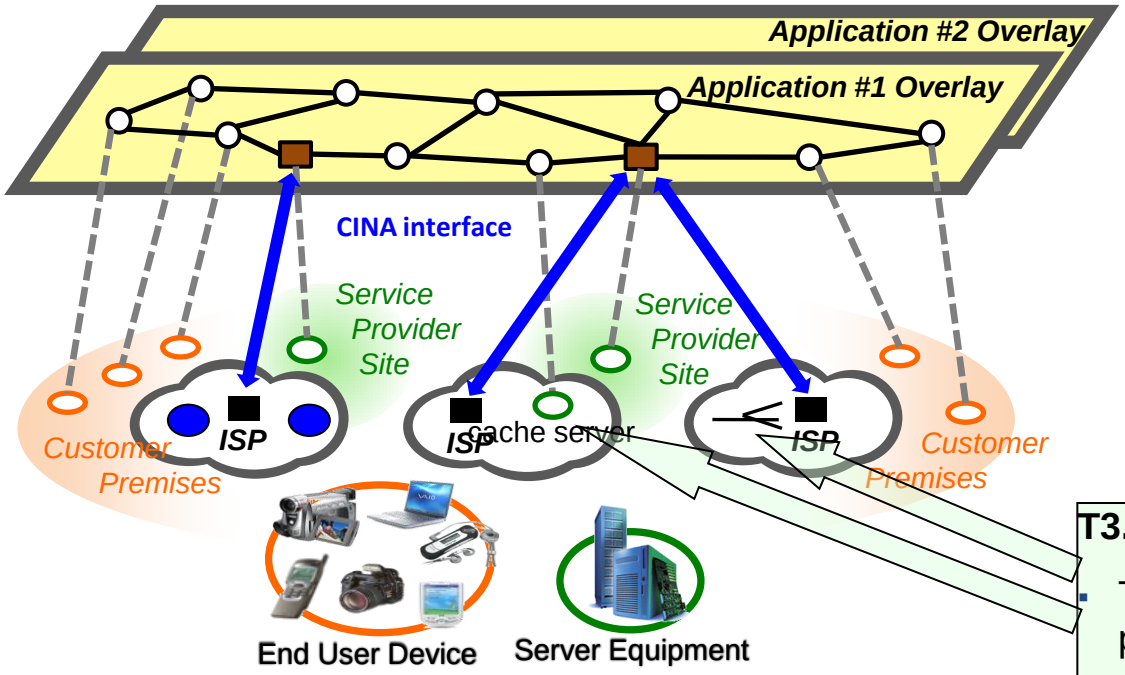

T3.3: Network Optimisation

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Possible Network services

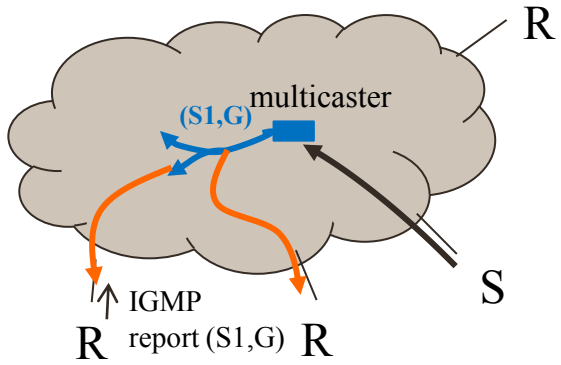
- Multicast-related delivery
- Caching
- High capacity nodes
- Content adaptation service
- QoS-based services
- Traffic prioritization
- Resource reservation
- Content aware policy and security issues
- Geolocation
- Audience measurement
- Ad/text insertion

Multicast (1/2)

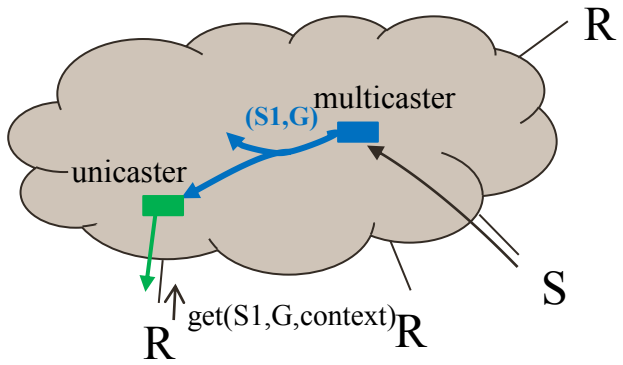
- Multicast-related delivery
  - Multicast is the most efficient way to deliver the same (live) content to a large set of receivers, but currently only used by ISPs for their IPTV managed services
  - ENVISION goal is that overlay applications could take advantage of native IP multicast capabilities where and when possible, but in a realistic way, under ISP control
  - Multicast-capable domains are learnt through the CINA interface
  - Dynamic set up of a multicast tree
    - Via the CINA interface, application overlays could dynamically request the set up of a multicast tree
    - ISP could request the overlay to stop the multicast delivery in case other services have a higher priority (more clients, higher throughput, premium clients, etc.)

Multicast (2/2)

- Multicast enablers
  - ISP helps in the multicast delivery , via the deployment of a network multicaster
    - ease of configuration & management
    - not necessary to allow upstream multicast on the customer lines
    - the multicast emission is controlled by the ISP
    - the multicast groups, and the multicast source address range, can be fixed in advance



  - A network unicaster for unicasting stream towards non-capable multicast clients



Examples of CINA usage

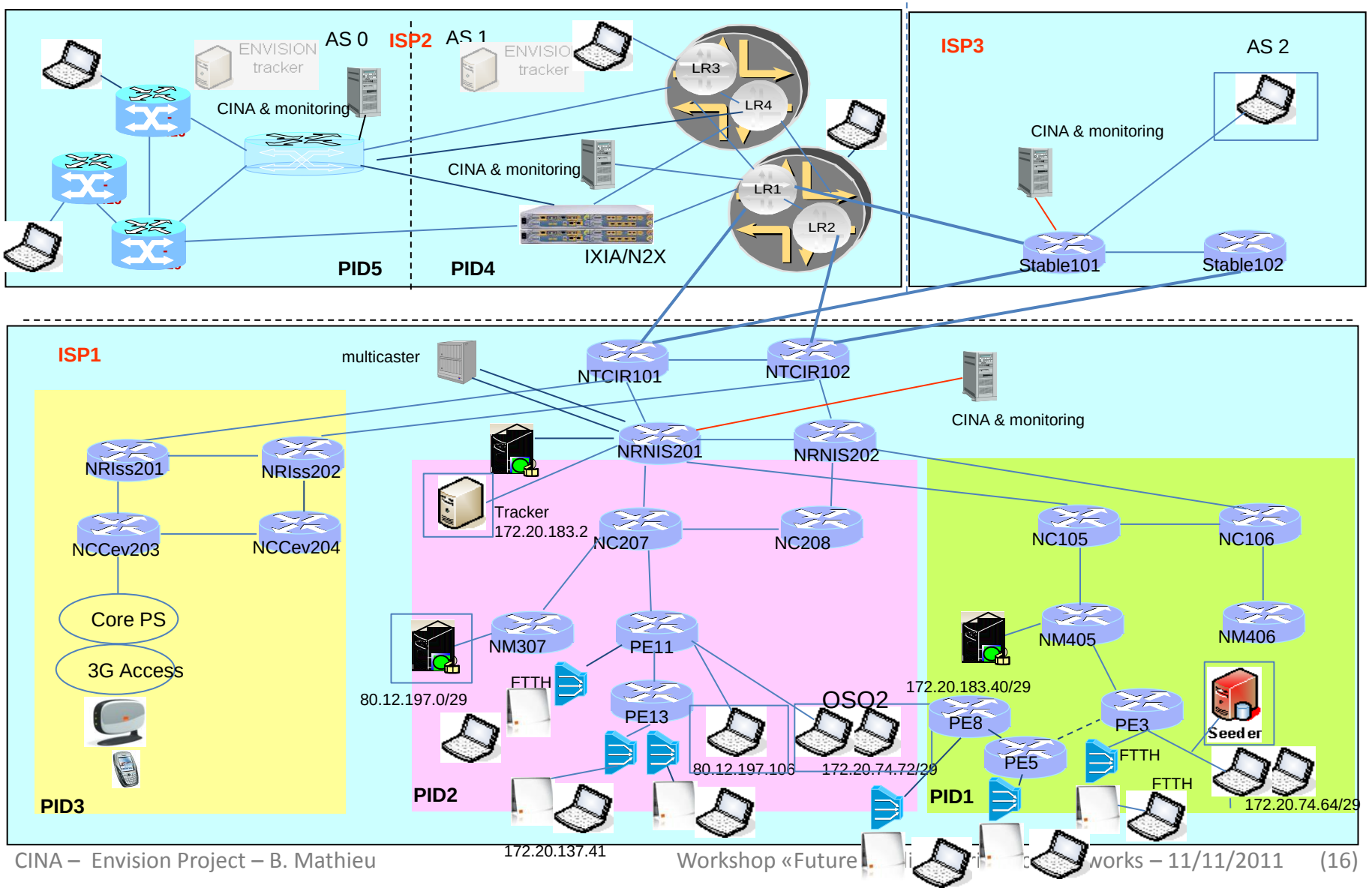
1) Network information for better peer selection

2) Instantiation of network services : example of multicast

Examples with the Orange Testbed

Orange testbed

- Emulating 3 ISPs



Use of CINA for better peer selection

- 1st option: The overlay application informs the ISP about possible peers and its metric and the ISP ranks the list of possible peers, according to the metric and the network conditions.
  - Peer are connected to each other based on the ISP recommendations and satisfying application requirements

rankpeer (joining_peer = "172.20.109.249"; peers = {"172.20.241.241"; "172.20.197.0"; "172.20.188.193"; metric = "cost"}

Monitor_ISP1.py | CINA_server1.py | cost1 | delay1 | hop1 | compare_cost

```
1 ################################### Compare (cost) ###################################
2 Source :
3 172.20.109.249
4 Destinations :
5 172.20.188.193 , 0
6 172.20.241.241 , 119
7 172.20.197.0 , 160
```

Peers ranked by ISP, based on cost metric

Use of CINA for better peer selection

- 2nd option: The overlay application gets the network map from the ISP and the map, specifying its critical metric (delay, bandwidth, cost, etc.).
  - Peer are connected to each other based on the ISP recommendations and satisfying application requirements

Network Map & Cost/Delay Map

Network Map provided by ISP

Monitor_ISP1.py | *subnet1

```
########################## PID1 ##########

PE3 :
        12.12.12.0/30
        172.20.109.248/29
        172.20.109.76/30
        172.20.109.96/27
        172.20.154.160/29
        172.20.154.168/29
        172.20.219.0/30
        172.20.4.228/30
        172.20.74.64/29
        193.252.231.8/30
PE5 :
        172.20.210.136/30
        172.20.210.240/30
        172.20.210.248/32
        172.20.212.64/28
        172.20.231.108/30
########################## PID2 ##########

PE11 :
        172.20.109.144/29
        172.20.12.240/29
        172.20.12.25/32
        172.20.241.32/27
        172.20.4.200/30
        172.20.43.224/28
        172.20.74.72/29
        172.20.87.80/28
        172.20.87.96/28
        80.12.197.104/29
PE13 :
        1.1.1.0/30
        1.1.1.16/30
        1.1.1.44/30
        1.1.2.0/30
```

Cost Map provided by ISP

Monitor_ISP1.py | delay1 | cost1

```
########################## PID1 --> PID ##########################

PID1 : 0 , PID2 : 160 PID3 : 190 , EXT : 160
########################## PID2 --> PID ##########################

PID1 : 169 , PID2 : 0 , PID3 : 139 , EXT : 109
########################## PID3 --> PID ##########################

PID1 : 190 , PID2 : 130 , PID3 : 0 , EXT : 90
########################## ISP1 --> ISP ##########################

ISP1 : 0 , ISP2 : 500 , ISP3 : 600
```

Delay Map provided by ISP

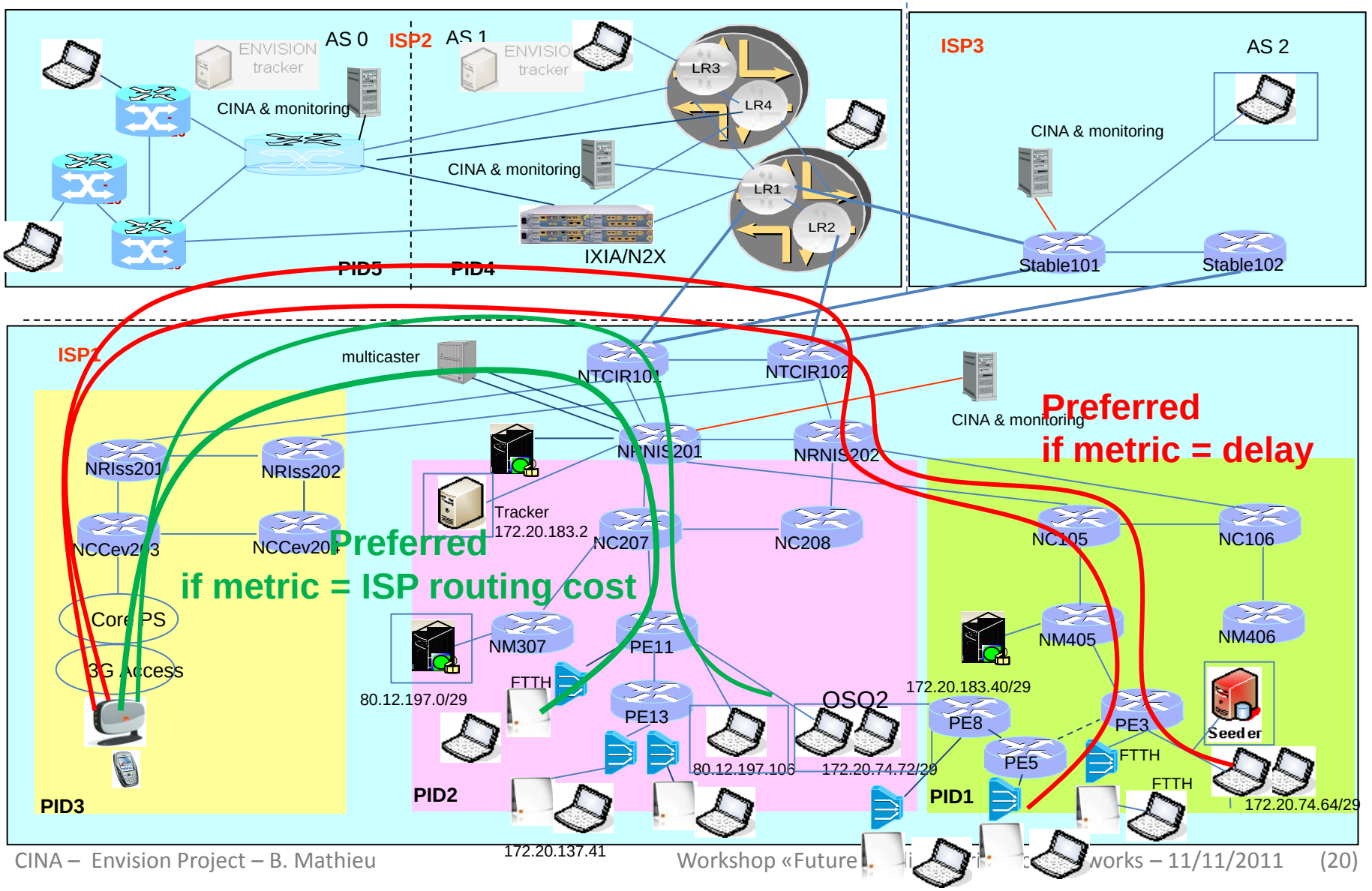
Monitor_ISP1.py | delay1 | cost1

```
########################## PID1 --> PID ##########################

PID1 : 0 , PID2 : 1.31 PID3 : 9.54 , EXT : 0.27
########################## PID2 --> PID ##########################

PID1 : 1.13 , PID2 : 0 , PID3 : 17.8 , EXT : 0.276
########################## PID3 --> PID ##########################

PID1 : 10.057 , PID2 : 15.708 , PID3 : 0 , EXT : 9.347
########################## ISP1 --> ISP ##########################

ISP1 : 0 , ISP2 : 1.0 ISP3 : 1.0
```

PID3 -> PID1 more costly but faster than -> PID2

Orange testbed

- Emulating 3 ISPs

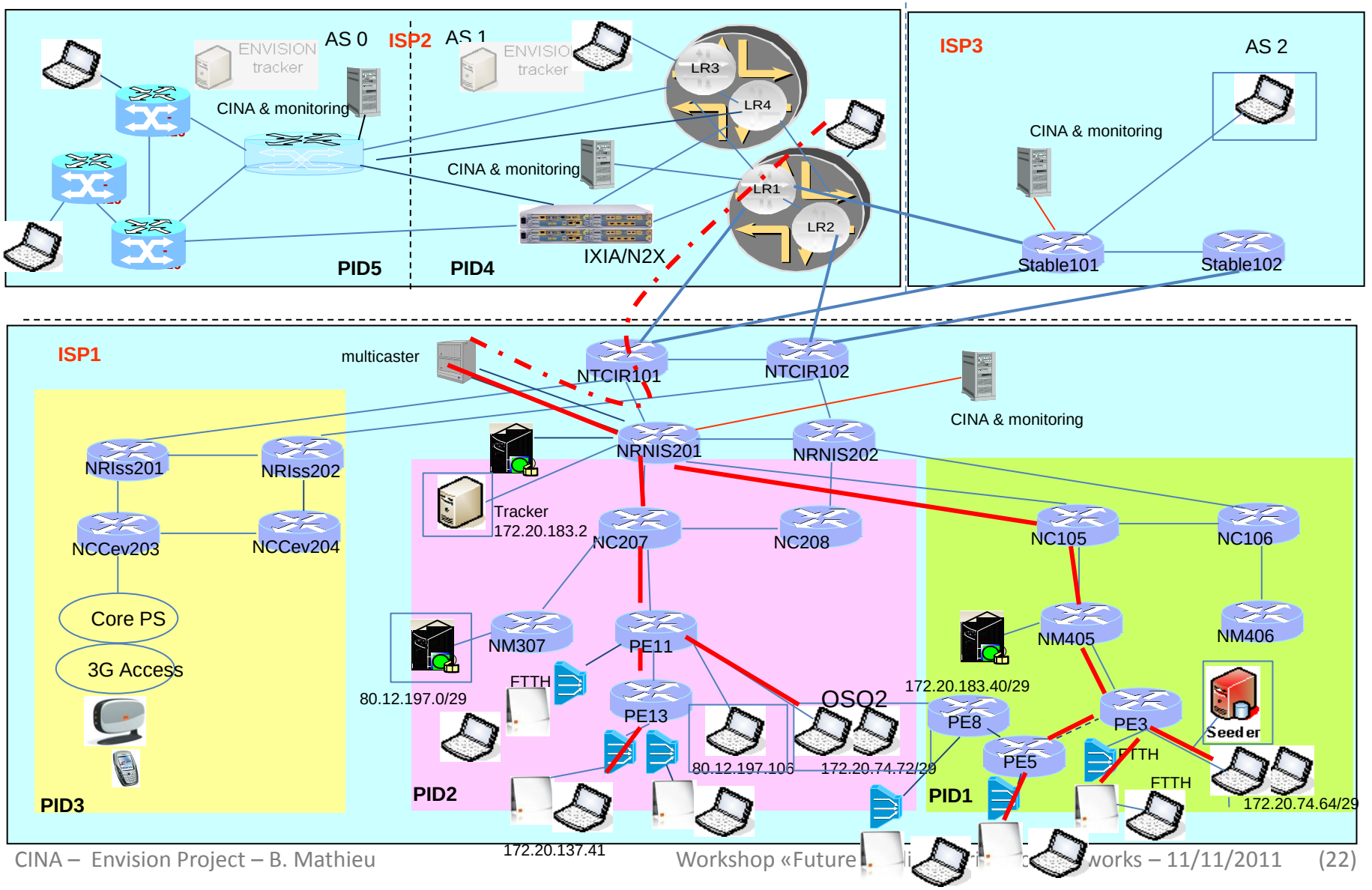


Use of CINA for network service instantiation

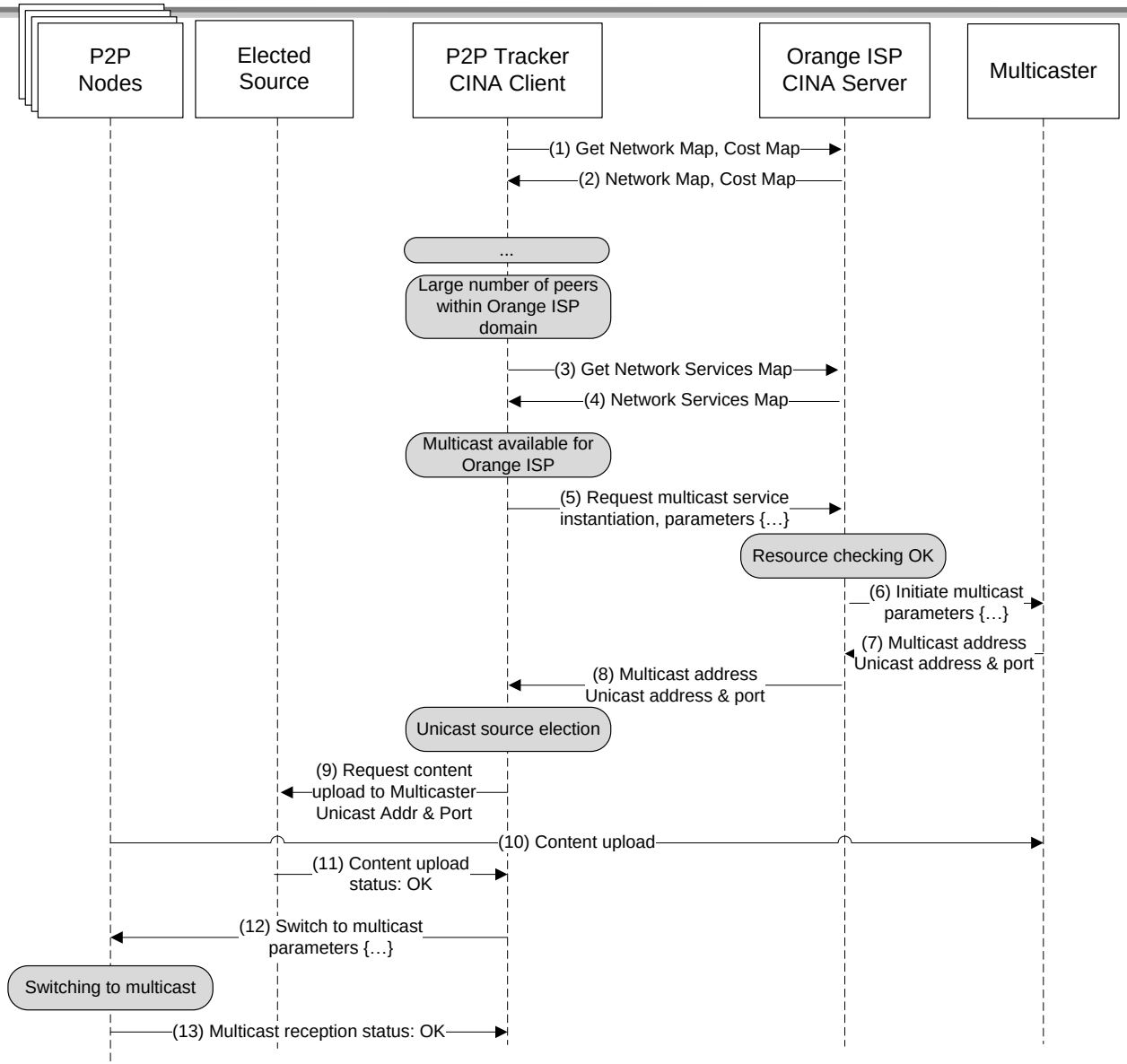
- The overlay application detects a lot of end-users in the same region and think it would be more efficient to set up a multicast delivery towards those end-users
- The overlay application requests the ISP about the feasibility to set up a multicast delivery in the specified region and the price for it.
- If feasible, the overlay application request this set up, mentioning the source of the stream.
- The ISP sets up the multicast tree and returns back the IP address of a multicaster, node in the network responisble to receive data from the sources and to forward it then in a multicast fashion
- Concerned end-users switch from a P2P reception to a multicast reception for this stream.

Orange testbed

- Emulating 3 ISPs



Network Service: Multicast



Conclusion

- Defined Collaboration Interface between Network and Applications
- Mutual exchange of information between actors
- Mutual benefit
- Demonstrators under development (for Multicast, Caching & High Capacity Node)

Historic Day

- Today is an Historic Day

Date 11 / 11 / 11

Time 11 : 11 : 11

Questions ?

- Questions ?