Experiment of network services invocation in the Orange testbed
The CINA interface

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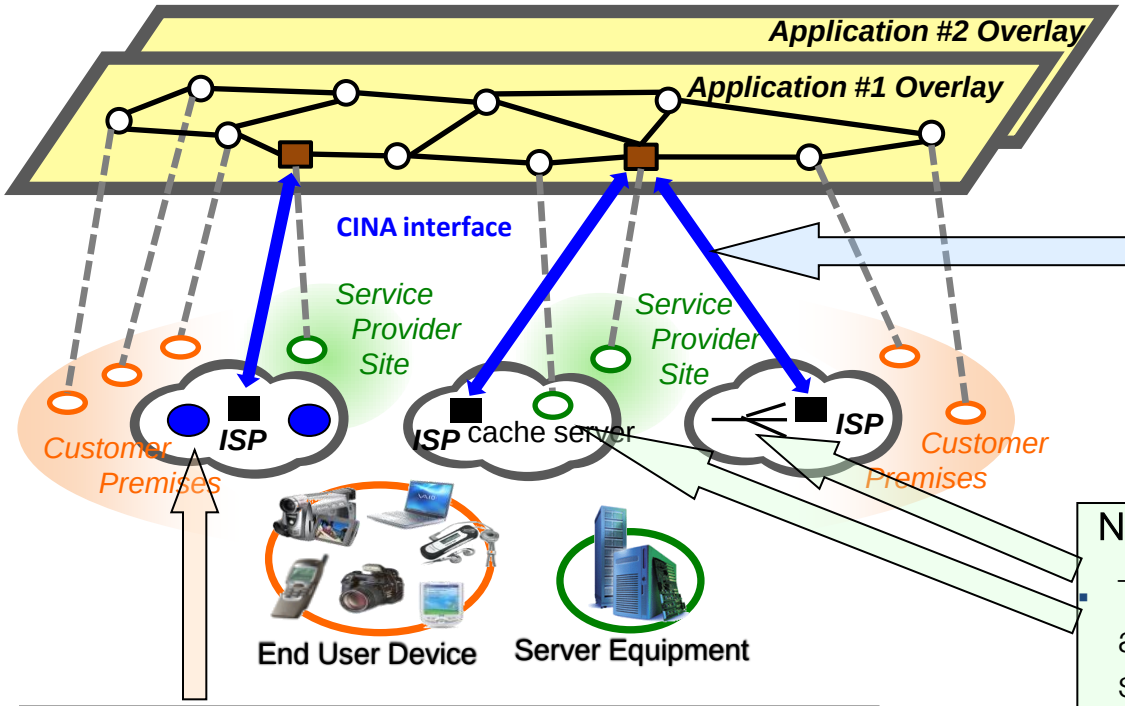
Envision Project rationale

- 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



Specification of the ENVISION Interface

- a) enable the exchange of information (meta-data) on 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.

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

Network Monitoring

- To specify network performance parameters to be collected and the functions to make it.
- To define network metrics to capture dynamic topological and load status

CINA interface

- Allowed applications can request network information from ISPs
  - Network Map, Cost Map, Delay Map, etc.
  - in order to better select application nodes
- 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
- Allowed 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

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

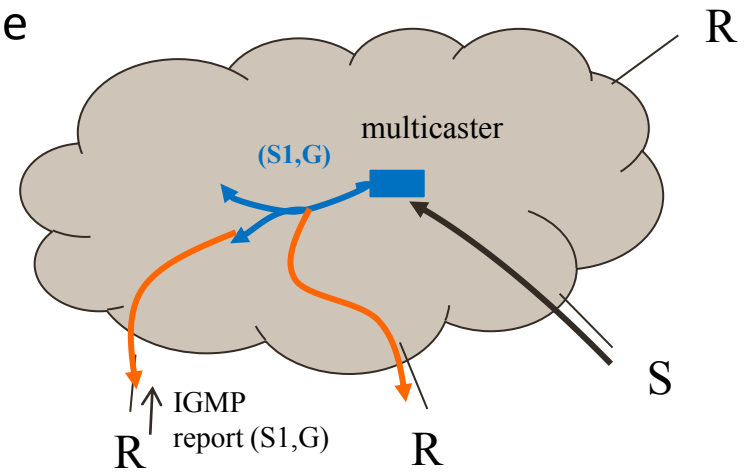
Multicast (1/2)

- 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 lease a multicast resource (multicast group)

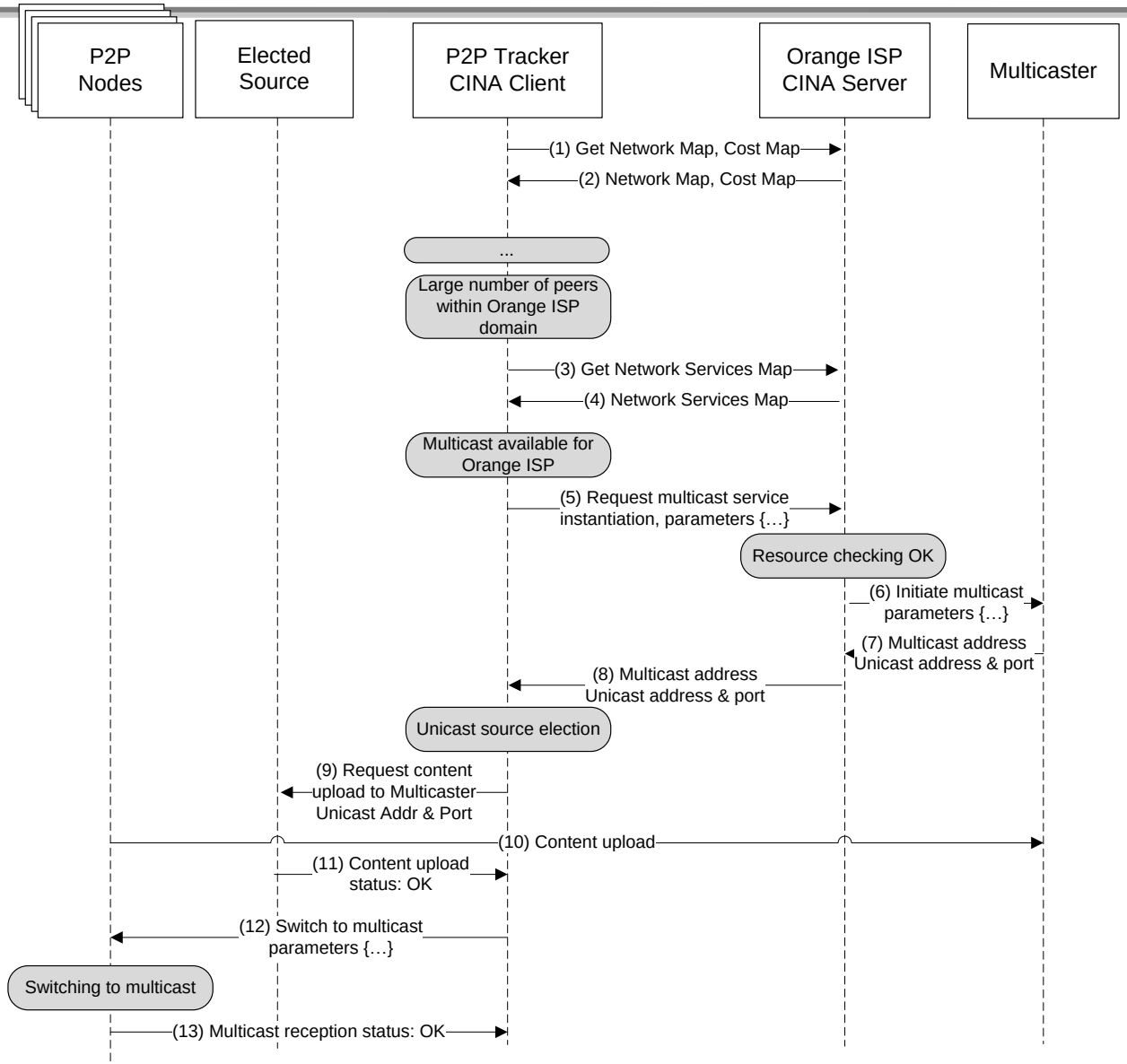
Multicast (2/2)

- Multicast enablers
  - ISP controls 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



Network Service: Multicast Call Flow



CINA: Example for Multicast

Requête

POST /multicast HTTP/1.1
Host: custom.cina.example.com
Content-Length: [TODO]
Content-Type: application/json; profile=http://www.envision-project.org/cina/multicaster-schema#AllocateRequest
Accept: application/json; profile=http://www.envision-project.org/cina/multicaster-schema#AllocateResponse

```
{
 "multicast-address-family" : "ipv4",
 "start-time" : {
  "min" : "2012-08-19T16:32:00",
  "max" : "2012-08-19T18:35:00"
 },
 "lease-time" : {
  "min" : "2012-08-19T18:45:00",
  "max" : "2012-08-19T18:59:00"
 },
 "current-time" : "2012-08-19T16:29:57",
 "srcs" : [
  {
   "src-address" : "10.20.20.12",
   "src-port" : 1111,
   "destination-port" : 1111,
   "max-bitrate" : 512
],
 "forecasted-user-number" : 555
}
```

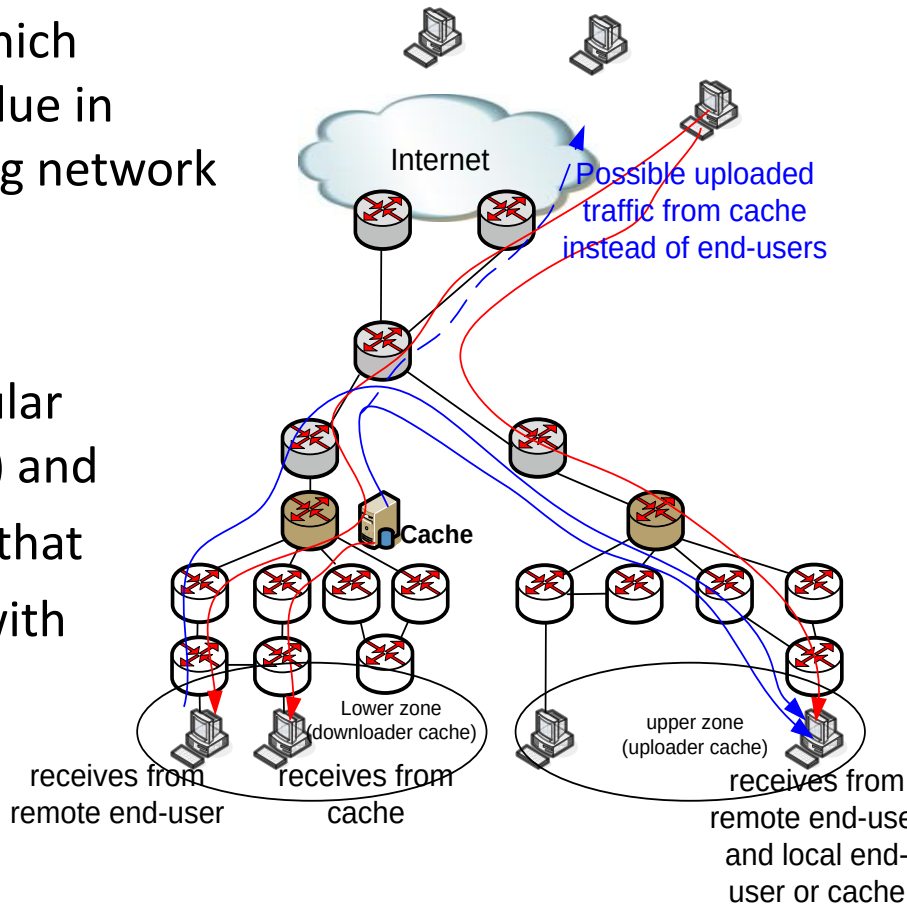
Response

HTTP/1.1 201 Created
Location: http://custom.cina.example.com/multicast/12345678
Content-Type: application/json; profile=http://envision-project.org/cina/multicaster-schema#AllocateResponse

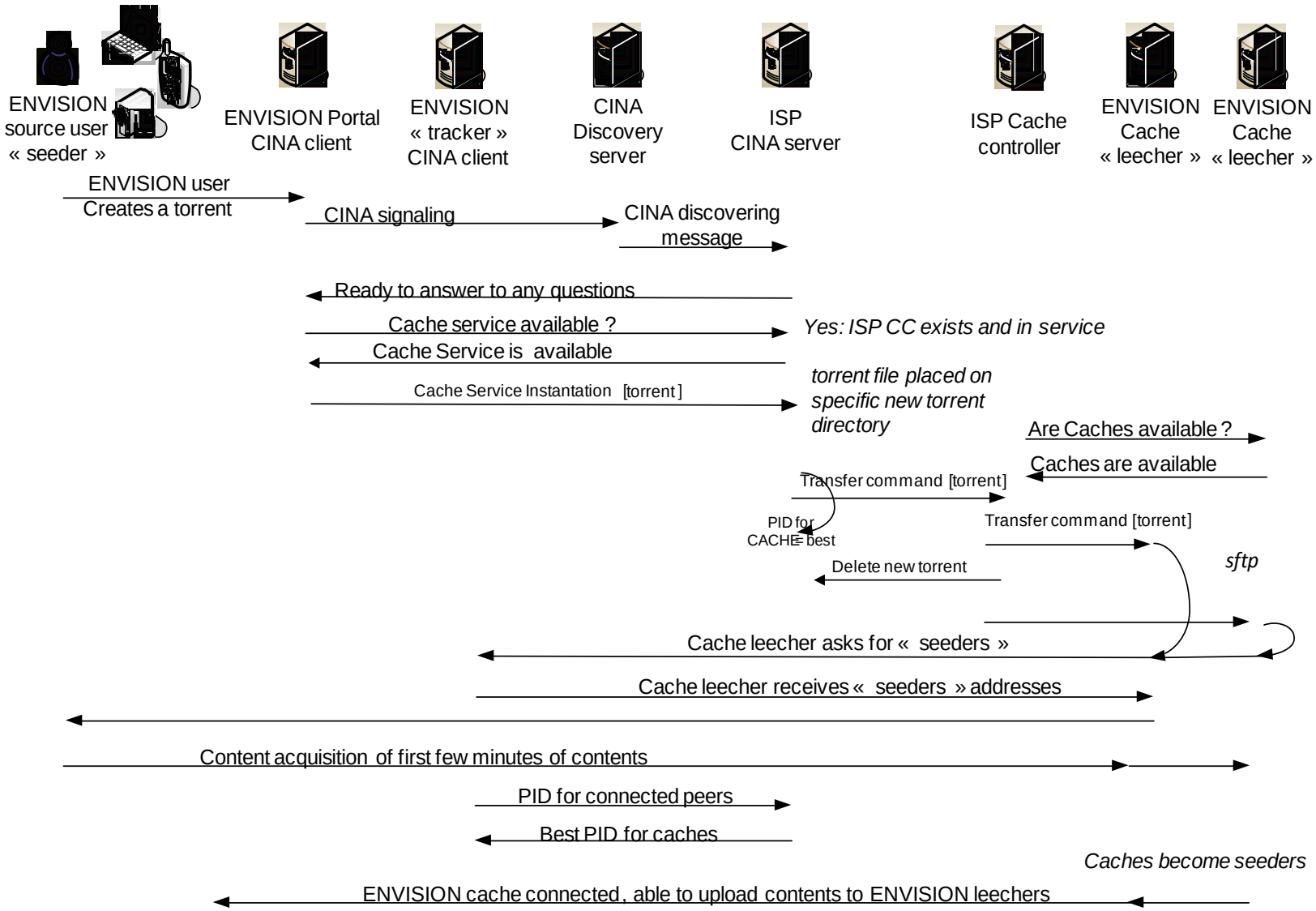
```
{
 "id" : "12345678",
 "multicast-address" : "ipv4:239.1.1.101",
 "start-time" : "2011-12-19T16:32:00",
 "lease-time" : "2011-12-19T18:45:00",
 "current-time" : "2011-12-19T16:30:11",
 "srcs" : [
  {
   "src-address" : "10.20.20.12",
   "src-port" : 1111,
   "destination-port" : 1111,
   "multicaster-port" : 2222
  },
],
 "multicaster-address" : "ipv4:10.20.20.10",
 "multicast-source-address" : "ipv4:239.1.1.10"
}}
```

Cache in the operator network

- Bandwidth savings (between the cache and the remote source)
  - Reduce the load on the core and peering networks (caching downloads)
  - but also reduce the load on aggregation and access networks (caching uploads) which presents limited uplink bandwidth value in comparison to the downlink, following network operator rules
- Server load decreasing
  - Fastest average download time (popular contents are the fastest to download) and high availability of popular contents (that may continue to be accessible even with a line or server down)



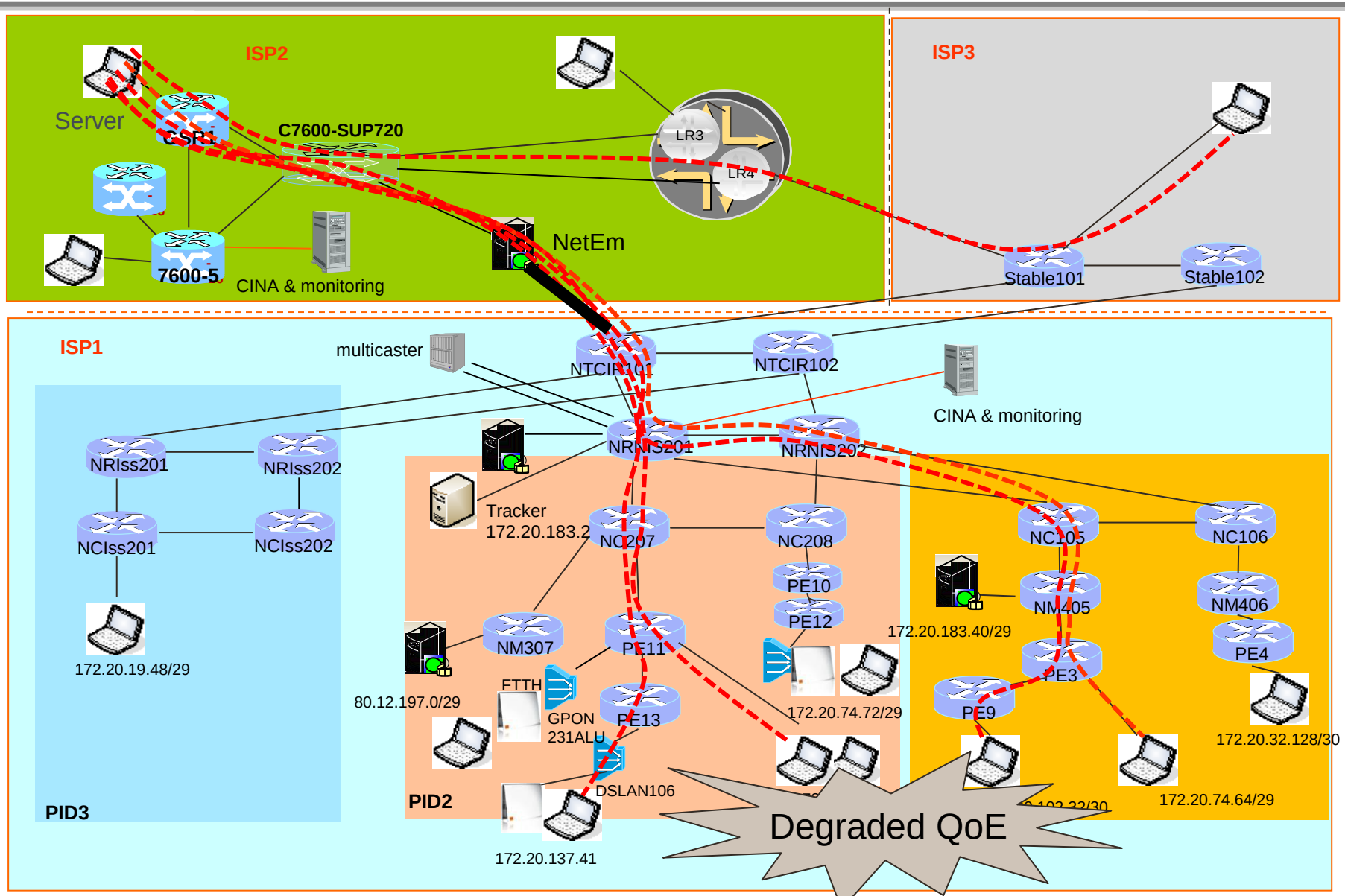
Network Service: Cache Call Flow



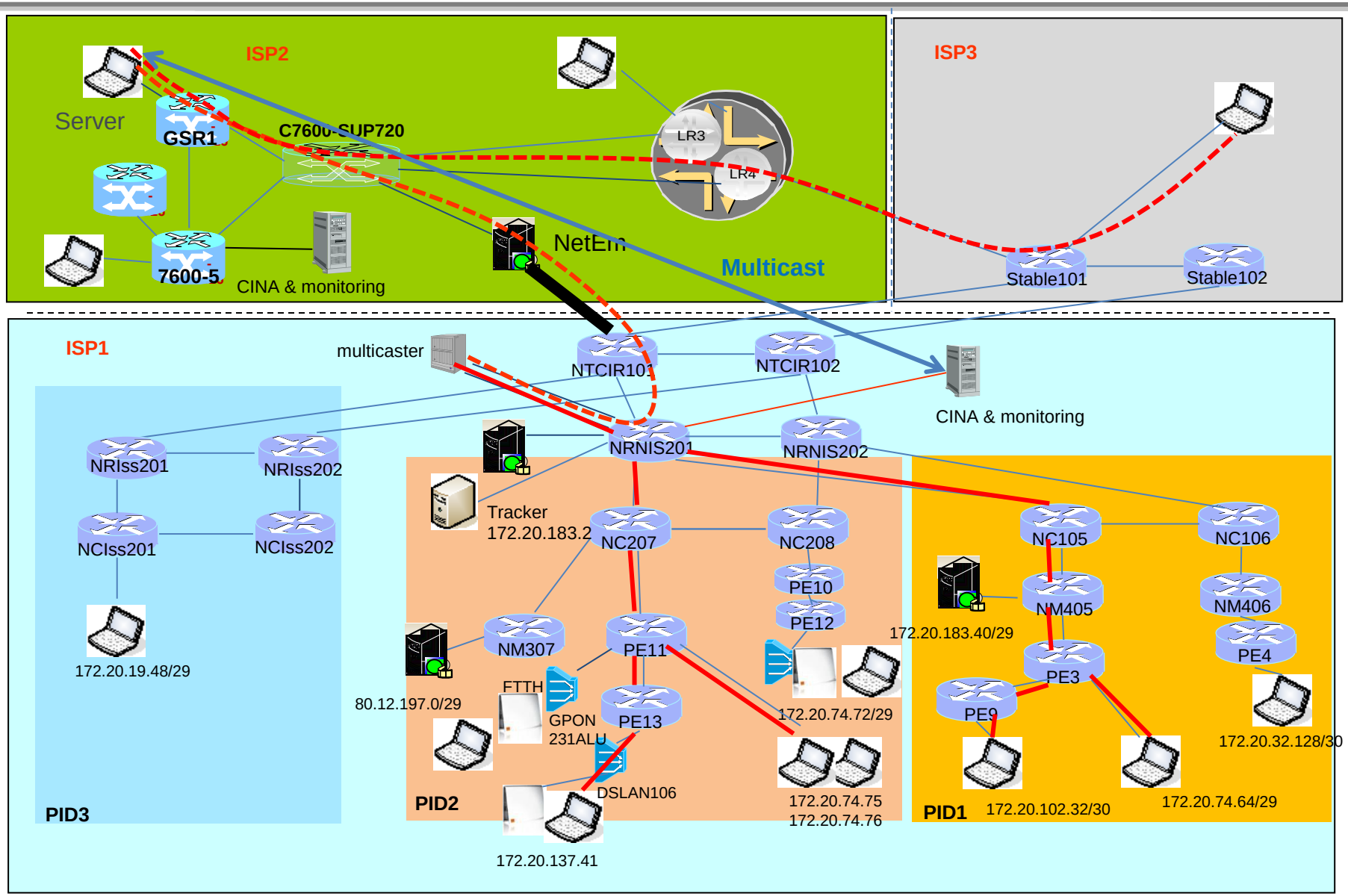
Example with the Orange Testbed

- Orange Testbed: Representative environment:
  - real network structure: Access, Aggregation, Core, Interconnection
  - Access: ADSL, FTTH, Ethernet, 3G
  - platform shared with many different projects
- Splitted in 3 ISPs: multi-ISP solution
- Peering links between ISPs, with one that can be adjusted (bandwidth, packet loss, delay)
- Scenario:
  - 1 live streaming server in ISP2, clients in ISP3 and ISP1
  - When too many end-users in ISP1 => degraded QoE
  - Instantiation of the multicast service => delivery in a multicast fashion in ISP1 => Good QoE

Instantiation of the multicast service (1)



Instantiation of the multicast service (2)



Evaluation: Performance metrics

- Multicast
  - Time to activate the service through CINA
  - stream liveness
  - stream quality
  - induced network load
- Cache:
  - Capacity to ingest content/chunk (ingest delay, delivery delay)
  - Capacity to deliver content/chunk (delay, QoE, cache influence)
  - QoE: quality of experience for end-users nodes (freeze, pixels)
  - Reduced network load

Conclusions about CINA

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

Conclusion

- Defined Collaboration Interface between Network and Applications
- On-demand network service instantiation, according to peering agreements
- Mutual benefit
- Demonstrators under evaluation (for Multicast, Caching & High Capacity Node)

Questions ?

- Questions ?