FLIPS: Flexible IP Services (over ICN)

Updates from European efforts POINT & RIFE

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July, 2016

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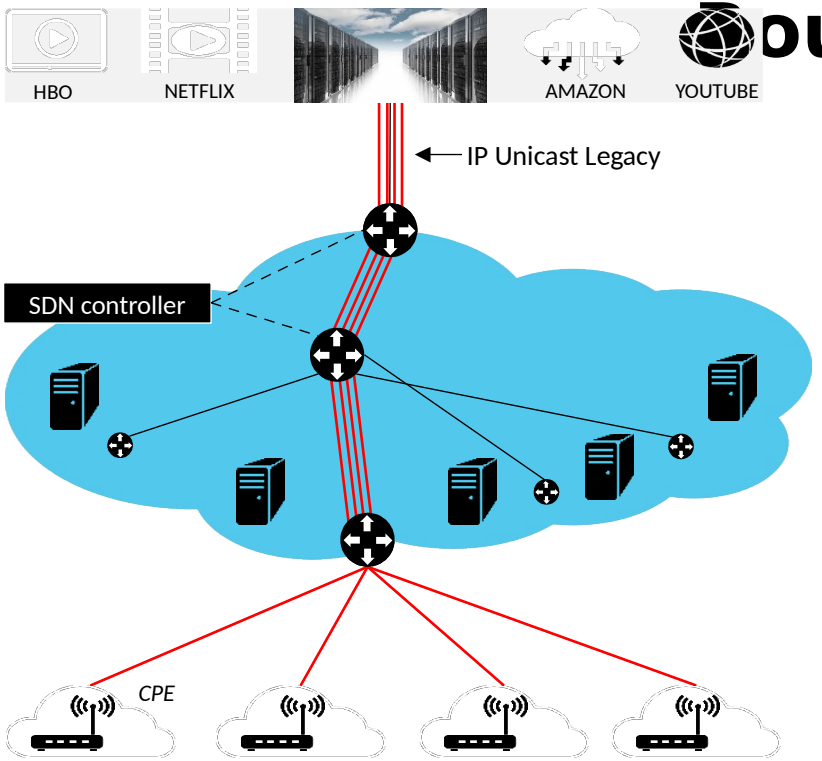
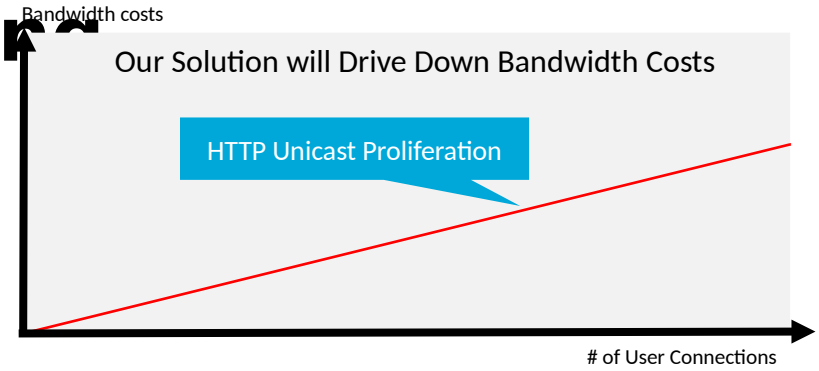
Pitch & Objectives

A Practical SDN Approach to Flexible Routing

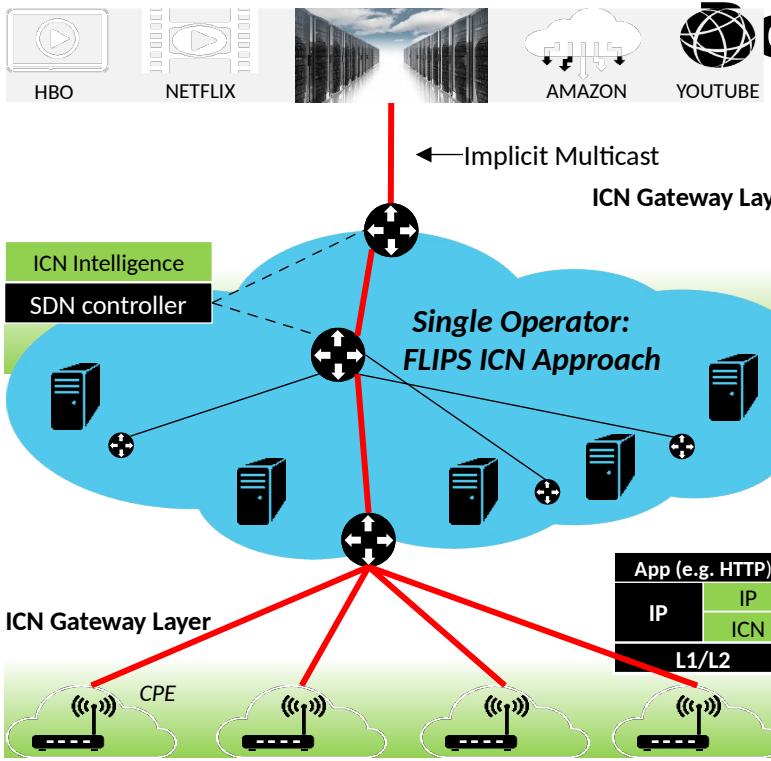


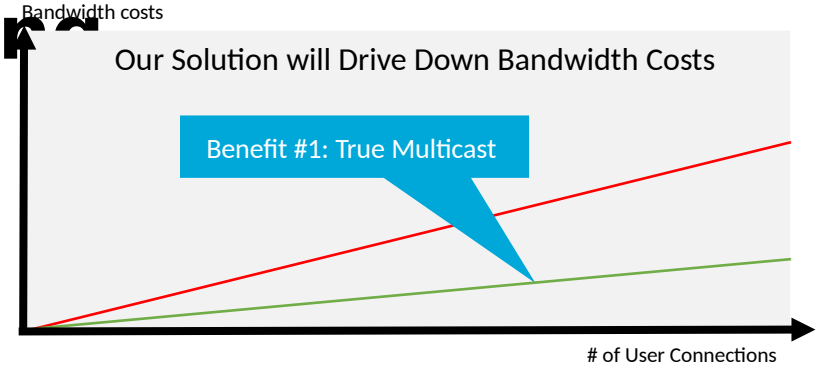


Unicast explosion simply not an option in 5G

- Single client-single host communication is well recognized as an inefficient approach
- Subject of many workarounds through the years, mostly “caching & redirection”
- POINT implicitly supports native multicast

A Practical SDN Approach to Flexible Routing

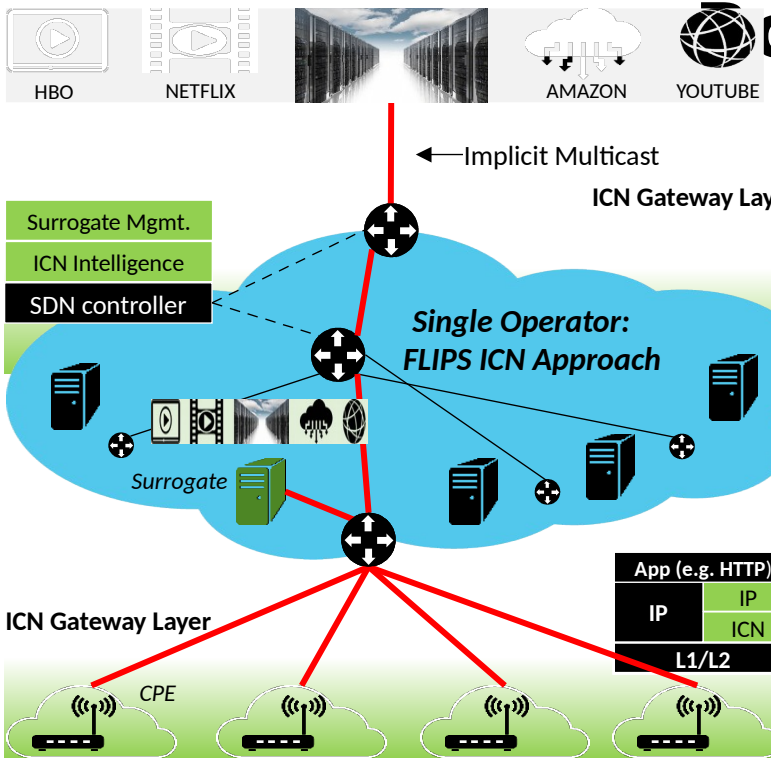


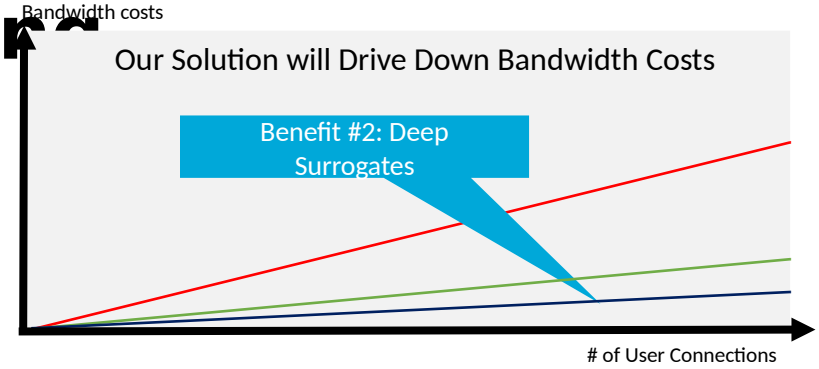


Innovative ICN technology approach for competitive 5G (or before) operator networks

- Aligns introduction of ICN concepts with SDN/NFV proliferation and growing trend to programmable infrastructure models
- Combines seamlessly and complements emerging fog/edge computing thinking

A Practical SDN Approach to Flexible Routing





The next logical step up for deep content caching is dynamic surrogates

- Surrogates are softwarized servers that bring content & services closer to mobile end users AND create new Surrogate-as-a-Service possibilities for operators
- Surrogate instances are controlled by SDN/ICN core functions which utilize ICN knowledge about **what** information is requested **where** by how many **users**

Our Ultimate Goal

A surrogate service, integrated with NFV, to flexibly and predictively place/utilize surrogate servers within in-network computing resources under dynamically changing constraints…

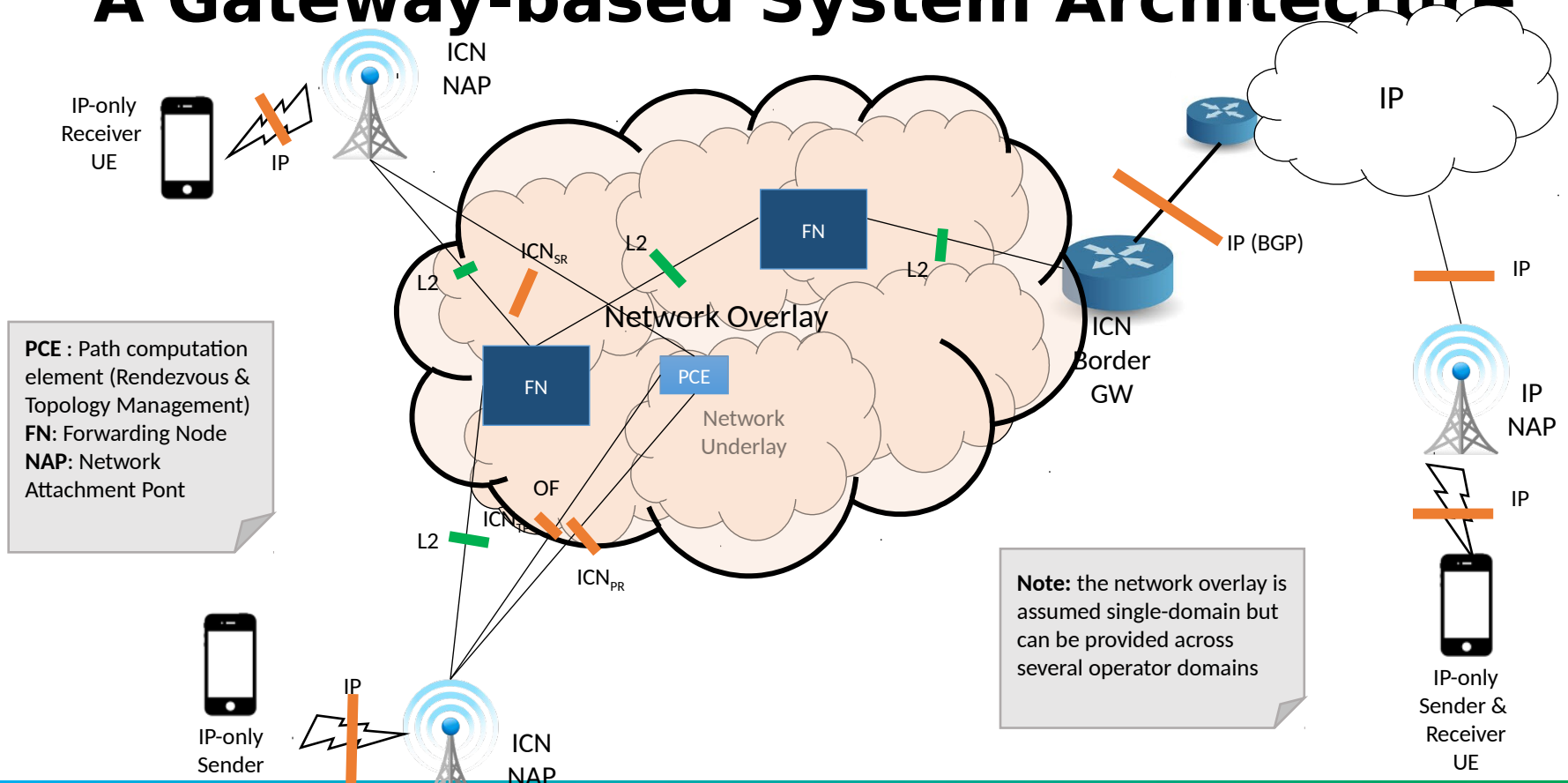
…while basing the viability of this proposition on the assumption of a near-to-zero second integration of surrogates into the routing fabric

…while building a routing fabric as an ICN-based Routing-as-a-Service (RaaS) solution directly on top of SDN-like switching networks

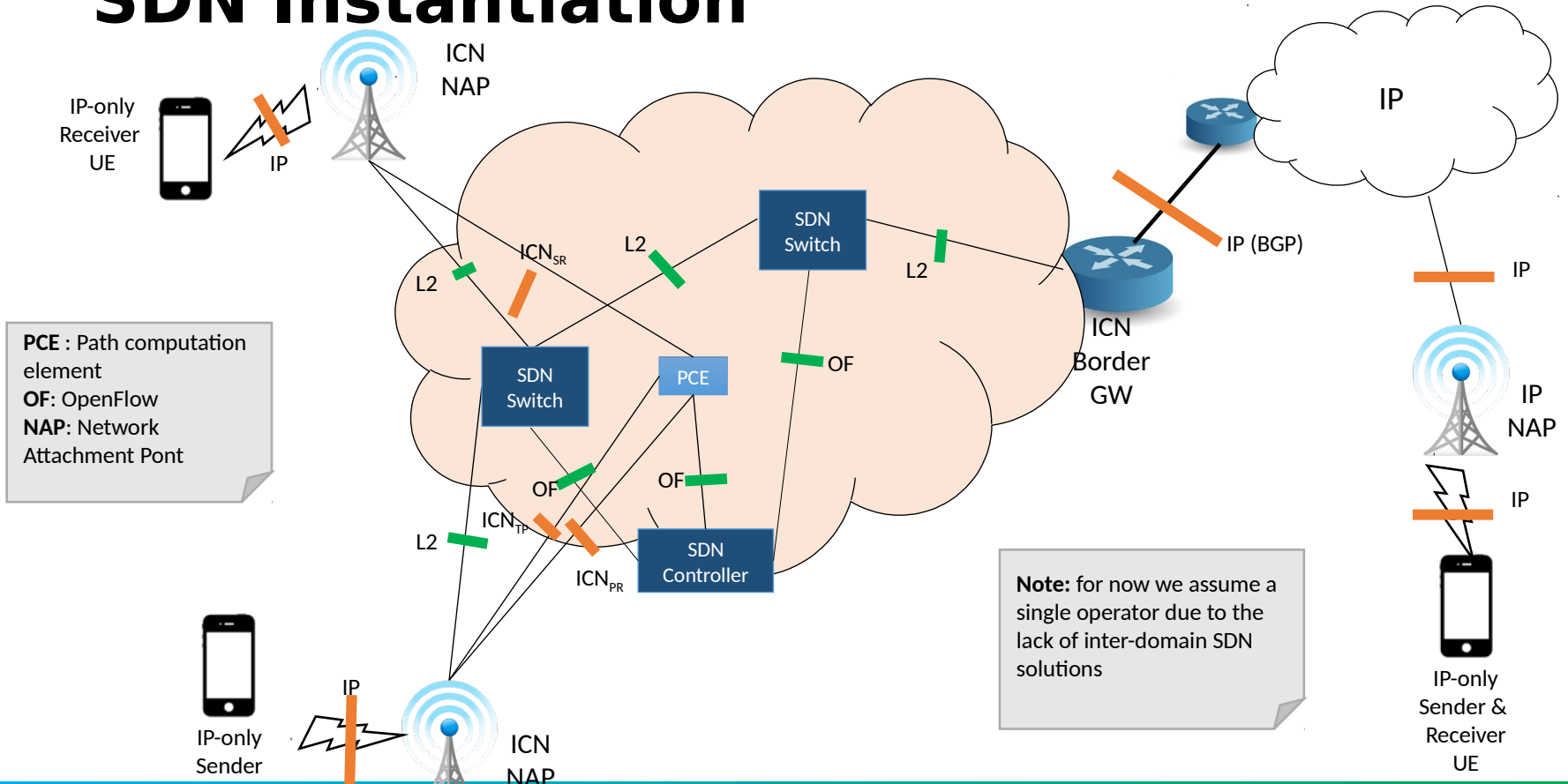
Architecture & Use Cases*

*** See HTTP-level multicast use case in BIER WG use cases draft**

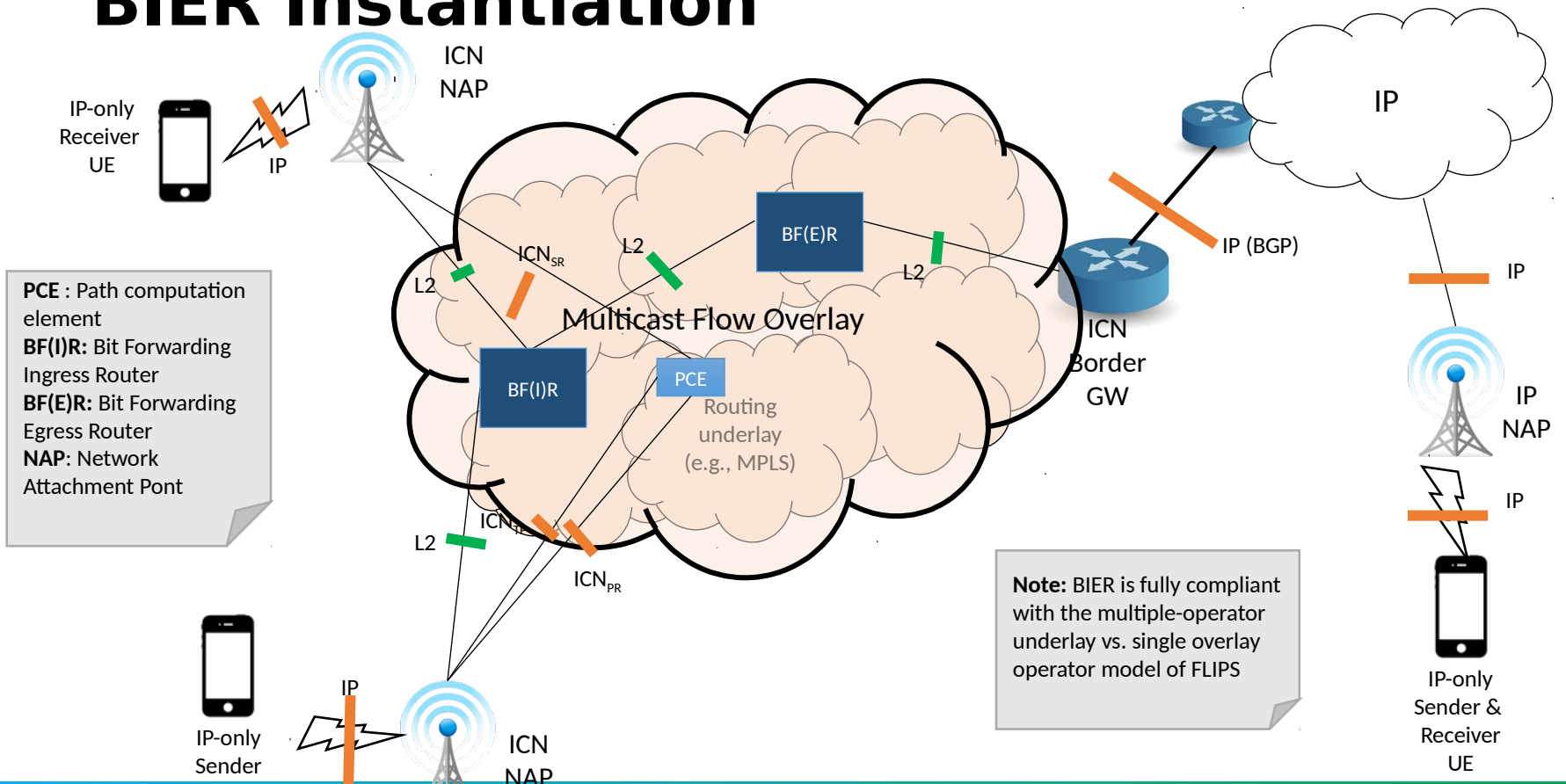
A Gateway-based System Architecture



SDN Instantiation



BIER Instantiation



PCE : Path computation element
BF(I)R: Bit Forwarding Ingress Router
BF(E)R: Bit Forwarding Egress Router
NAP: Network Attachment Pont

Note: BIER is fully compliant with the multiple-operator underlay vs. single overlay operator model of FLIPS

Multi-Site Enterprise

Site A

IP

ICN NAP

ICN_{SR}

L2

L2

L2

BF(E)R

Multicast Flow Overlay

BF(I)R

PCE

Routing underlay (e.g., MPLS)

ICN_{PR}

L2

ICN_{PR}

ICN Border GW

IP

IP (BGP)

IP Peering for extranet access

PCE : Path computation element
BF(I)R: Bit Forwarding Ingress Router
BF(E)R: Bit Forwarding Egress Router

The enterprise serves here as a BIER operator with dedicated peering for extranet access

Site B

IP

ICN NAP

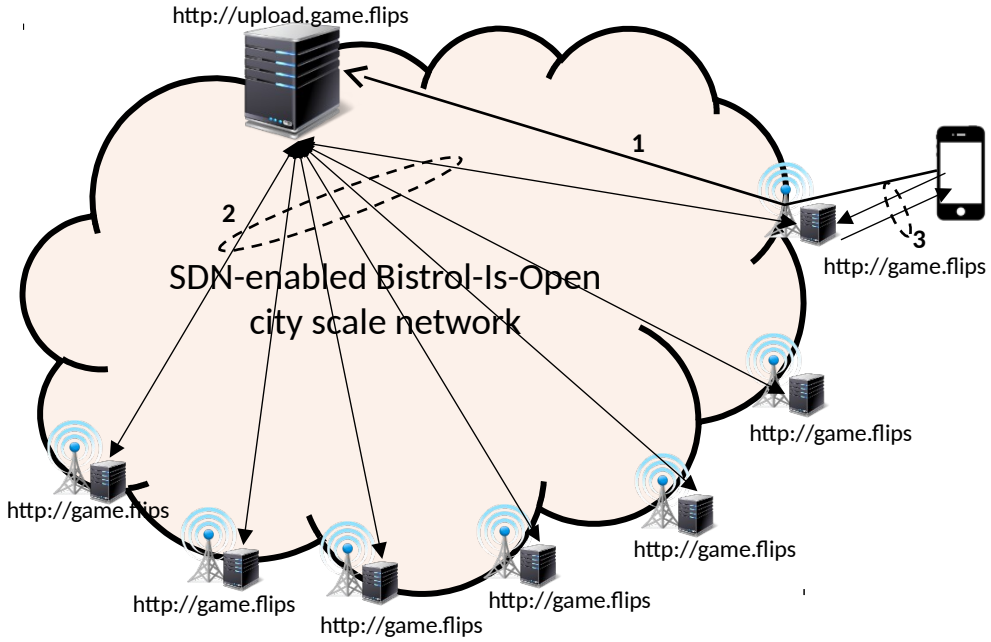
Multi-Site Enterprise: Expected Benefits

- HTTP-level synchronization could benefit from HTTP multicast capability

- Service surrogacy for intranet services could easily be supported
  - Combined with (improved) surrogate synchronization

- No need for dedicated replication infrastructure

5G & MEC: Trial at Bristol is Open
(planned for 08/2016)



- NAPs collocated at each SDN-connected WiFi AP
  - Surrogate located at each AP!
- Web-based mobile game
  - Solve tourism riddle through uploading AV content to unlock parts of the riddle
  - Upload to central site (step 1)
  - Regularly replicated to game.flips (step 2)
  - User interaction (game and content consumption) with game.flips (step 3)
- **Benefits**
  - multicast usage for replication (step 2)
  - Reduction of game latency (step 3)

5G & MEC: Expected Benefits

- Service surrogacy for latency reduction and traffic localization
  - Dynamic placement of surrogates close to (mobile) endpoints
  - Important for 5G interactive use cases, e.g., immersive experiences

- Direct path mobility
  - Needs evaluation on path management update scalability
    - Regionalisation possible for improved scalability

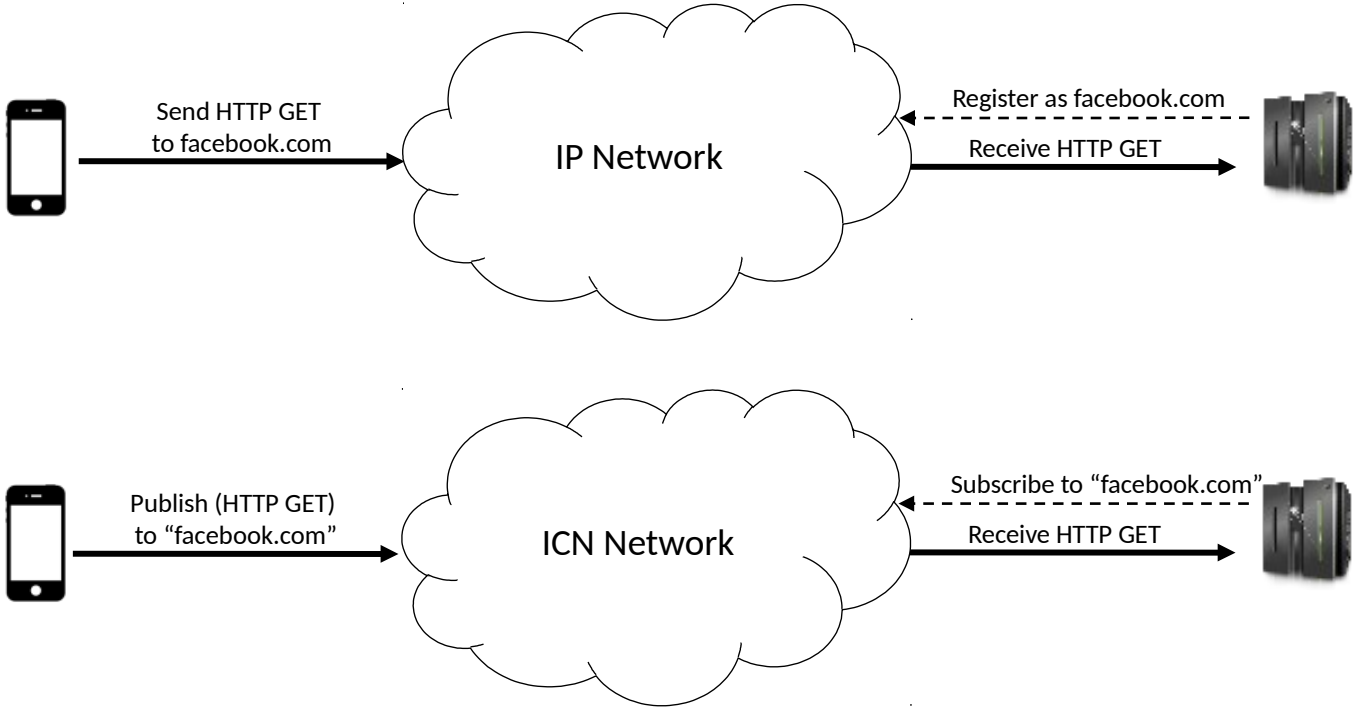
- HTTP multicast
  - Hugely important for high density viewing scenarios (stadium, …)
  - Driving replacement of RTP solutions

Solution Overview

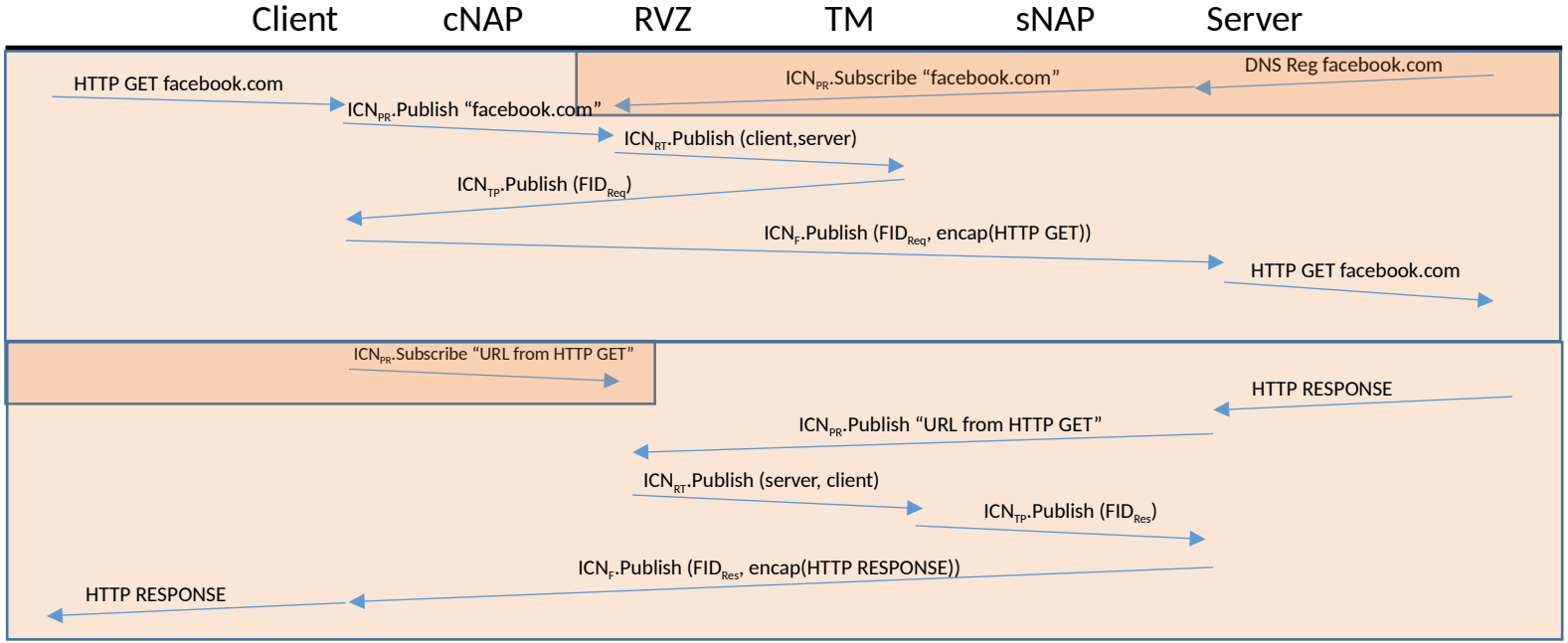
HTTP-over-ICN

Protocol Mapping - Basic Idea

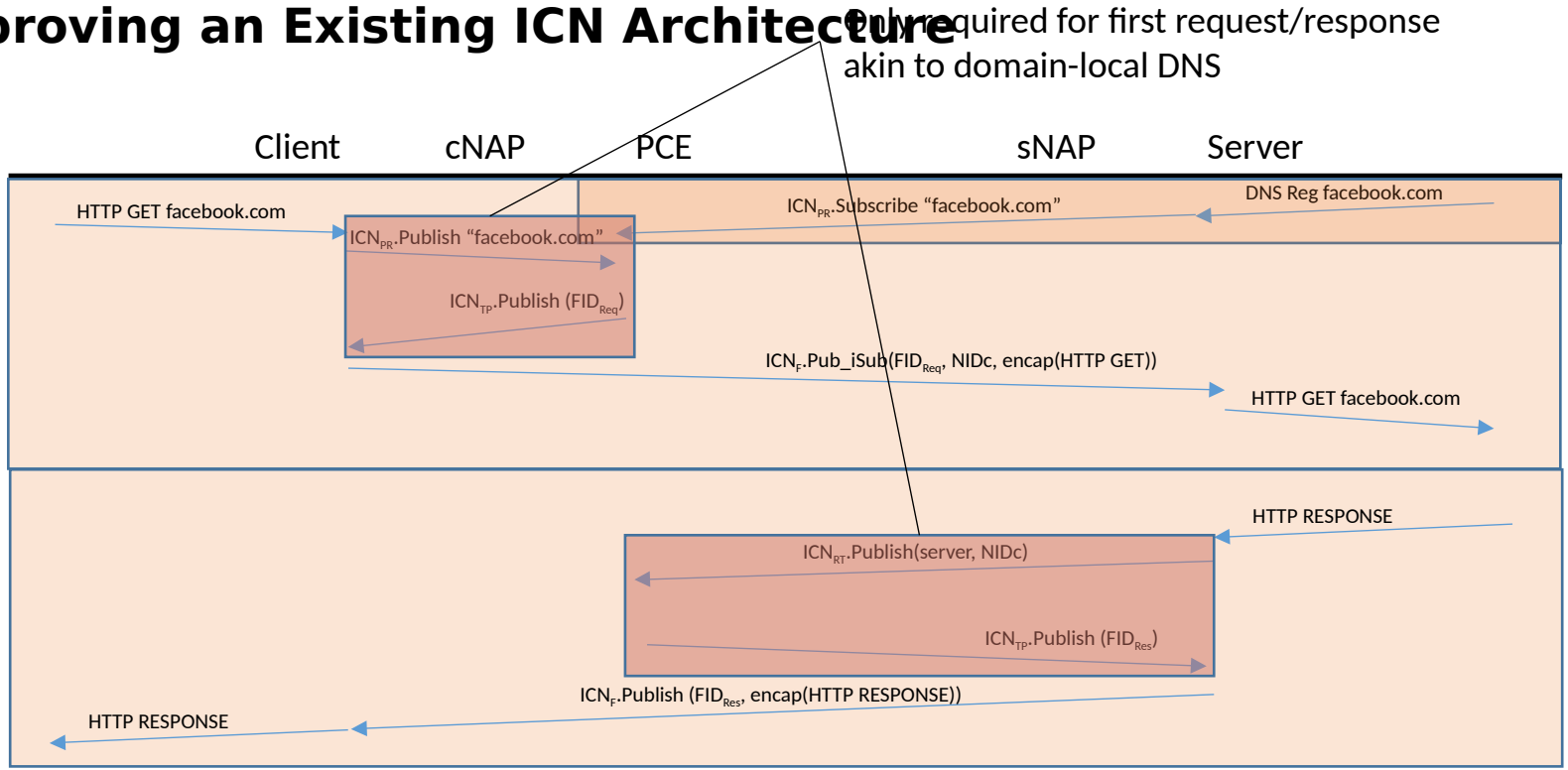
Interpret IP-based communication as Named Object Exchange



A Naïve Realization
Utilizing an Existing ICN Architecture



More Refined
Improving an Existing ICN Architecture

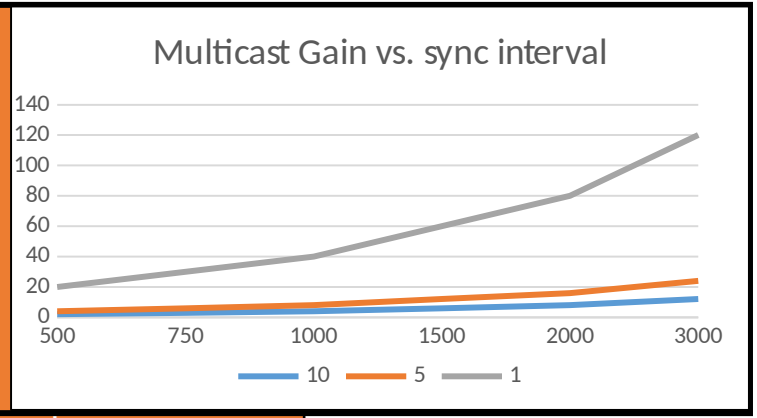


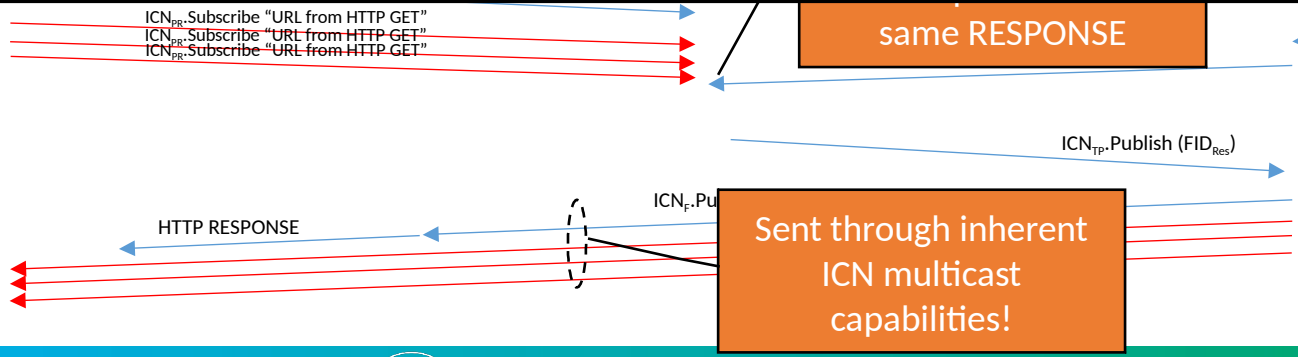
Opportunities

Re-introduce multicast for increased network utilization

Scenario:

- Live video transmission with {500, 750, 1000, 1500, 2000, 3000} viewers
- Quasi-synchronization within interval of 10s, 5s or 1s with uniform distribution of video chunk requests
  - This amounts to 250, 125 or 25 possible multicast groups being formed for each chunk request
- Multicast gain ranges from 2 to 120





Opportunities

Utilize deep and flexible service surrogacy for low delivery

Activate surrogate server due to server load, congestion, path constraints, …

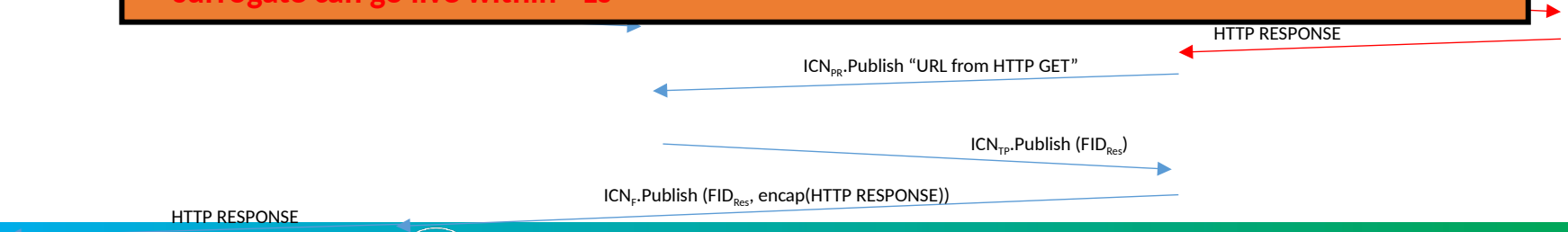
Scenario:

- Several surrogate server locations can be selected to optimize delivery
  - Surrogates can be running (but not live) or need to be spun up
- Initially, client requests are satisfied by a single server
- Then, additional server is activated, based on some constraints such as delay, congestion etc

Performance estimation for activation of surrogate server:

- Decision making: order of 100ms (incl. gathering, e.g., link state, information)
- Activation: order of 10ms
- Spinning up surrogate: order of minutes (entirely dependent on, e.g., NFV technologies)

-> surrogate can go live within <1s



Project Traction

Partners (15)

Platform provider

Vendors

Operators

SMEs

Academia

Project Duration

Jan 2015 – Dec 2017

6.5mio Euro Funding

POINT & RIFE are EUH2020 Research & Innovation Programme Funded Projects under grant Nos. 643990 & 644663 (http://www.point-h2020.eu & http://rife-project.eu)

Next Steps

- Technology development
  - SDN integration (OpenDayLight)
  - Mobility, HTTPS, resilience, CoAP support for IoT, …
- Proof-of-concepts
  - 2nd & 3rd ETSI MEC PoC event in Aug/Sep 2016
  - Planned as ITU-T IMT2020 ICN PoC
- Migration story for ICN
  - Suggested draft in ICNRG
- BIER WG use case
  - ICN-based multicast overlay
  - Edge based protocol mapping

Demo

Shown at MWC Barcelona, 5G Summit London

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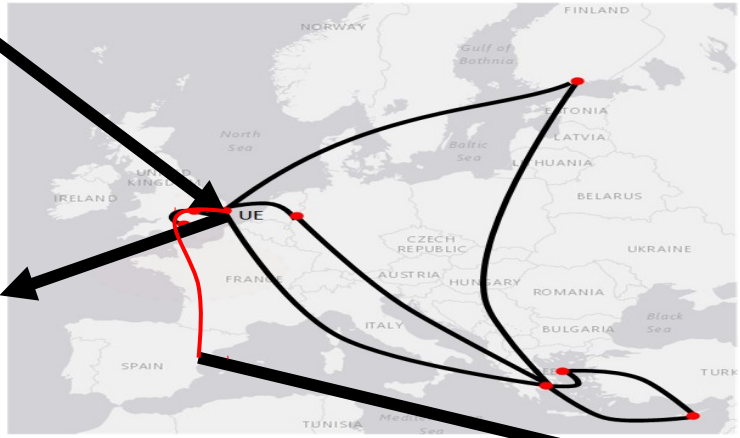
Demo Setup

Improvement:
Improved local playout quality (scale to HD quality)
(while emulated users will continue to receive SD quality from Bristol)

Remote Video Feed

30+ emulated users in data center



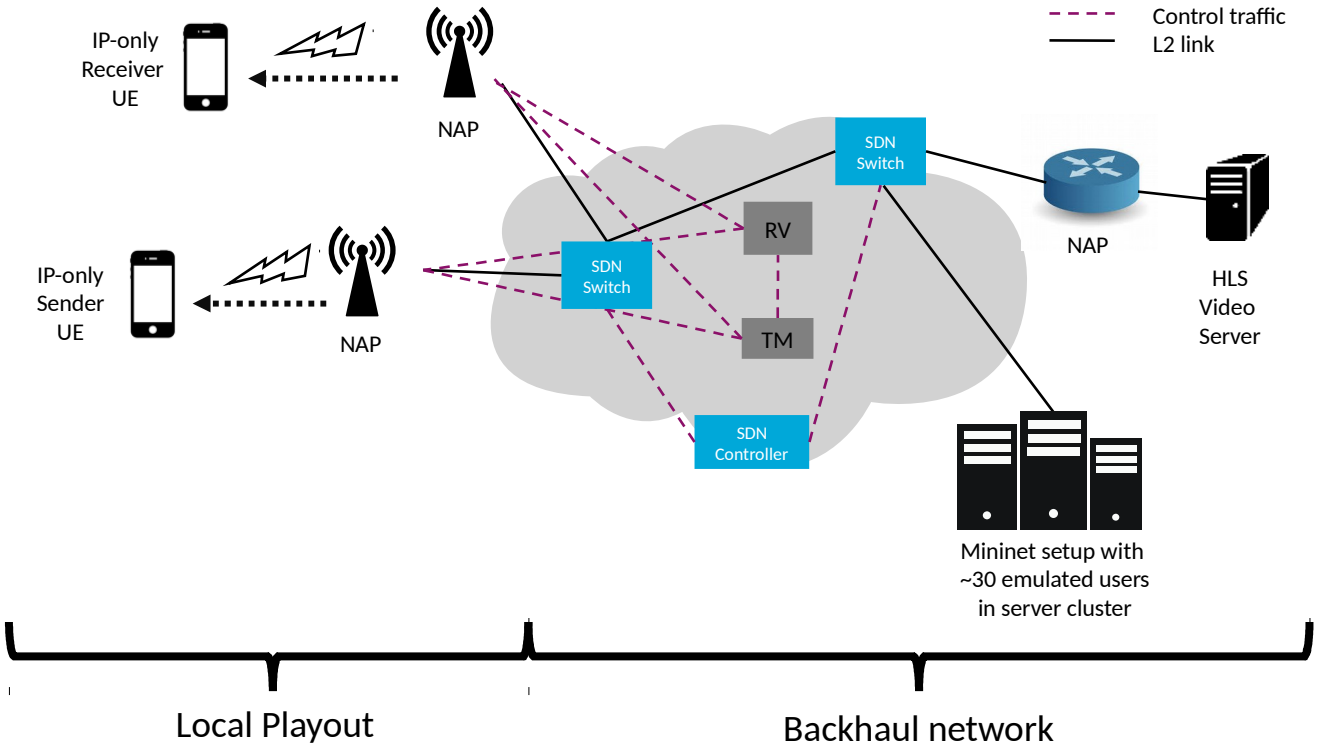
From our POINT/RIFE European Network

Local visitors using IDC-provided demo tablets or their own devices

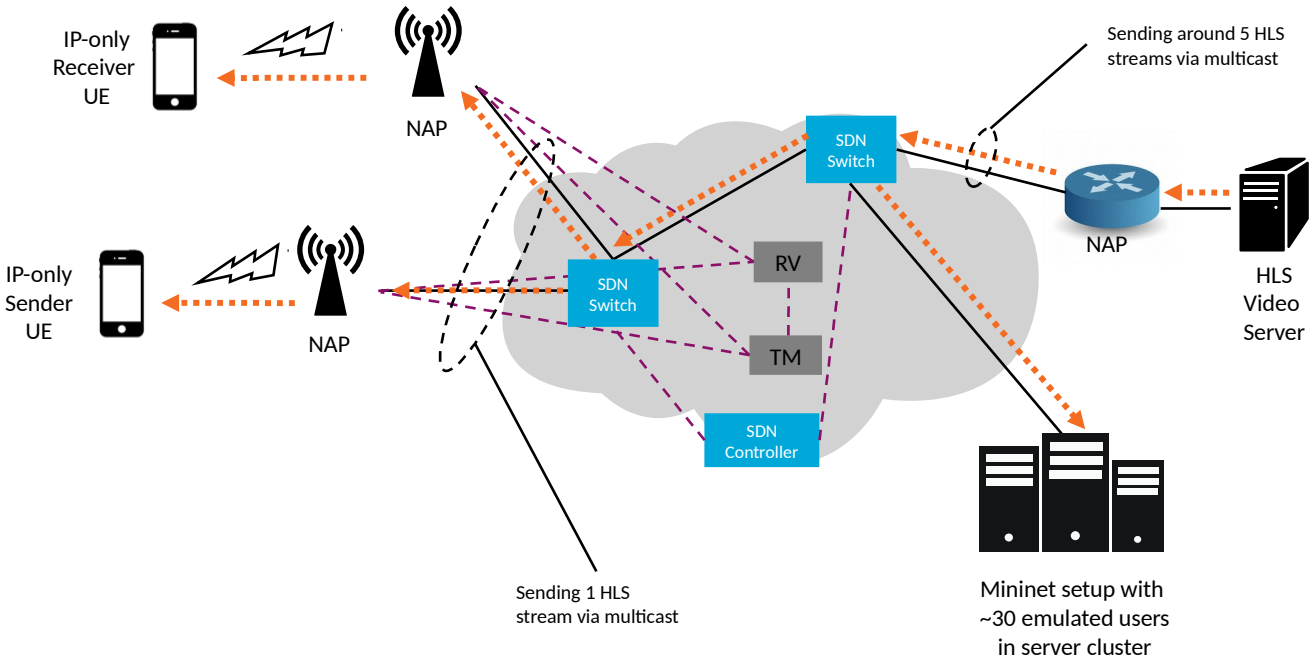
Local Video Feed

...To Our Booth in Barcelona

Schematic Setup

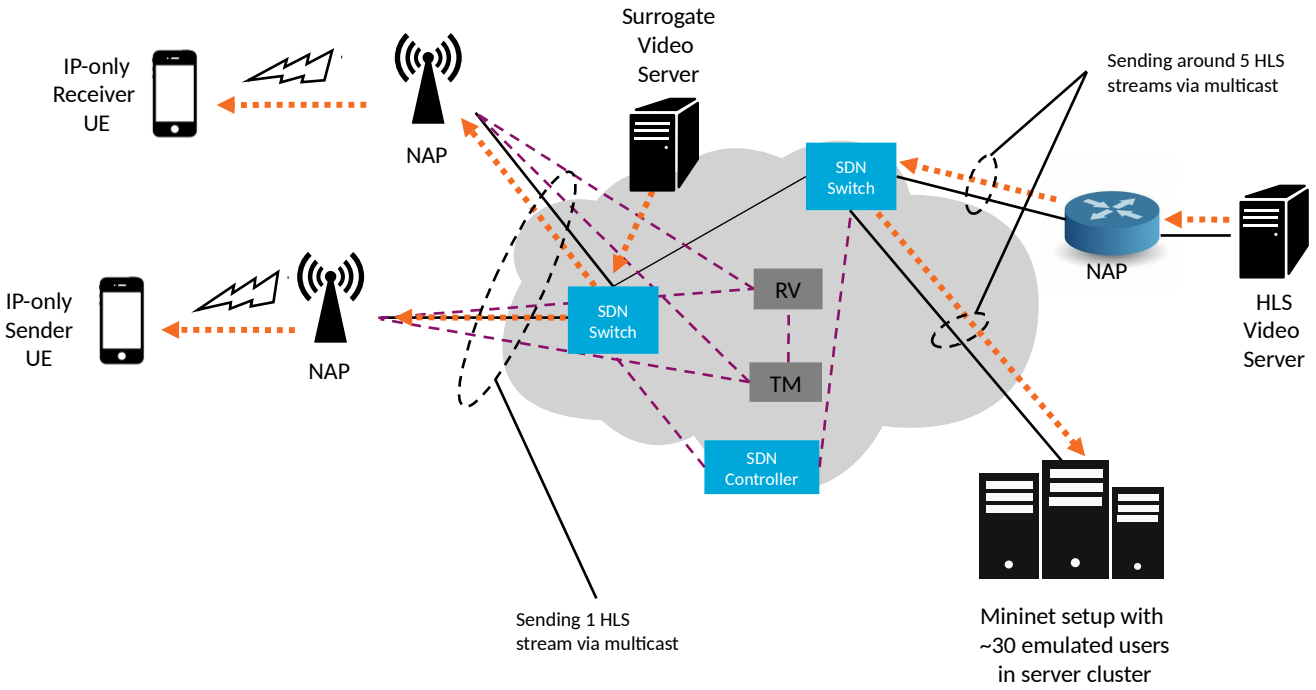


Demo Aspect 1: Multicast Gain



Aspect 1 demonstrates the **multicast gain** as well as the **reduced server load** through multicast delivery of HTTP responses in HLS video streaming scenario

Demo Aspect 2: Surrogate Server for Latency Reduction



Aspect 2 demonstrates the **latency reduction** and **video quality improvement** through surrogate server at MWC