A super-fluid, cloud-native, converged edge system

Toward Superfluid Deployment of Virtual Functions: Exploiting Mobile Edge Computing for Video Streaming

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Soft5 Workshop - First International Workshop on Softwarized Infrastructures for 5G and Fog Computing, in conjunction with ITC 29
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Outline

- Superfluidity project: goals and architecture
- Mobile Edge Computing (MEC)
- Video Streaming with Late Transmuxing (LTM)
- Combined MEC/LTM Video streaming testbed

Superfluidity project

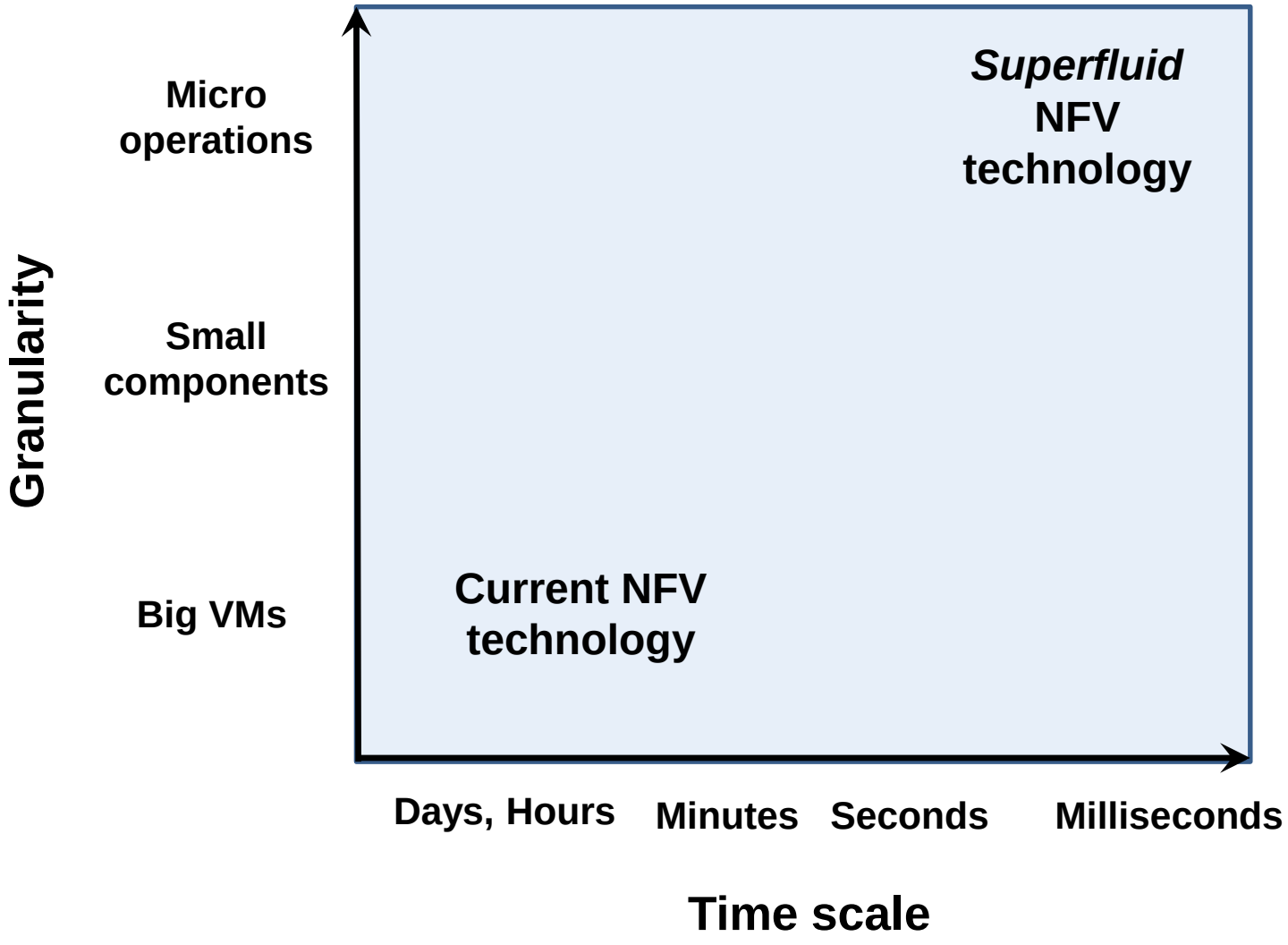
Superfluidity Goals

- Instantiate network functions and services on-the-fly
- Run them anywhere in the network (core, aggregation, edge), across heterogeneous infrastructure environments (computing and networking), taking advantage of specific hardware features, such as high performance accelerators, when available

Superfluidity Approach

- Decomposition of network components and services into elementary and reusable primitives (“Reusable Functional Blocks – RFBs”)
- Platform-independent abstractions, permitting reuse of network functions across heterogeneous hardware platforms

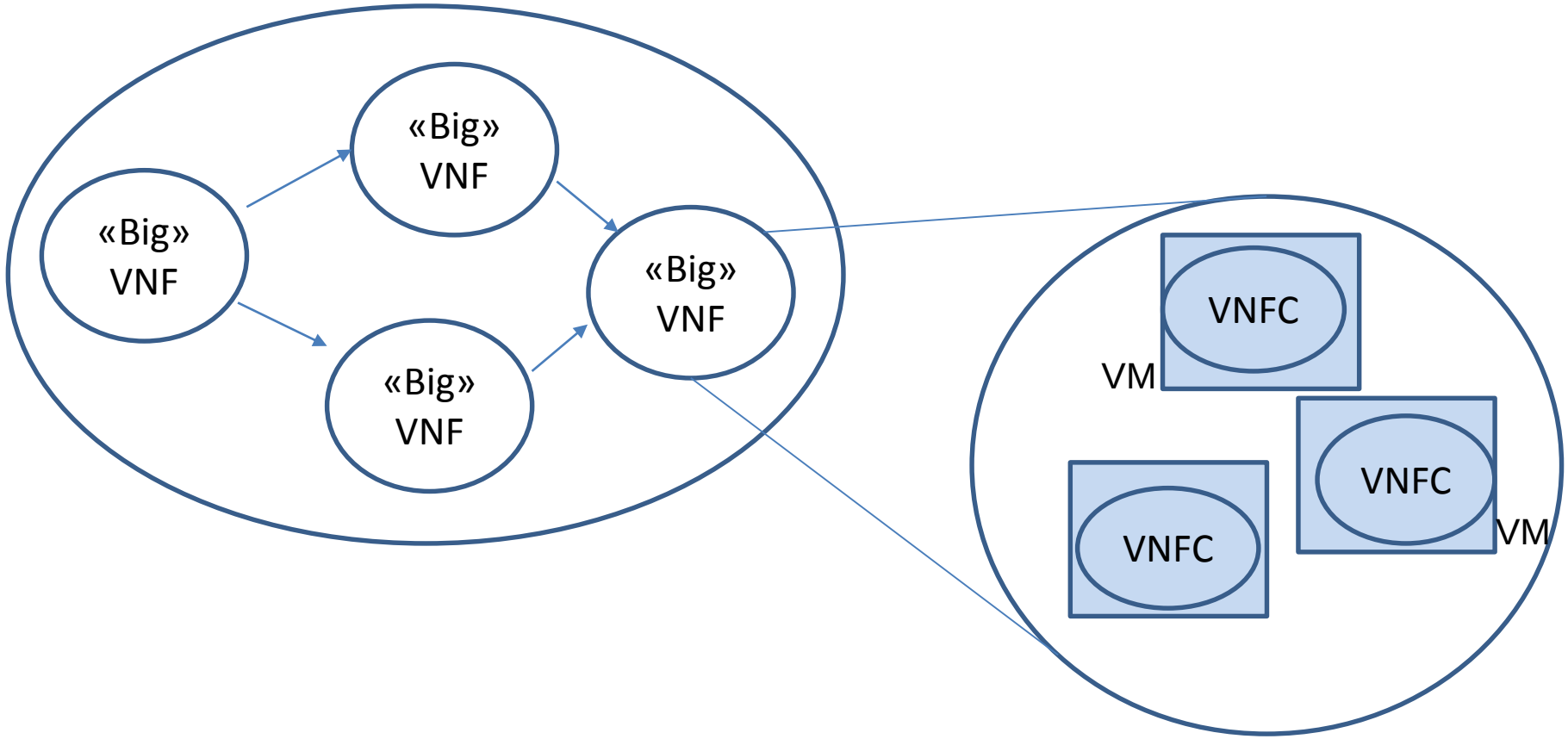
The Superfluidity vision



- From VNF Virtual Network Functions to RFB Reusable Functional Blocks
- Heterogeneous RFB execution environments
  - Hypervisors
  - Modular routers
  - Packet processors
  - …

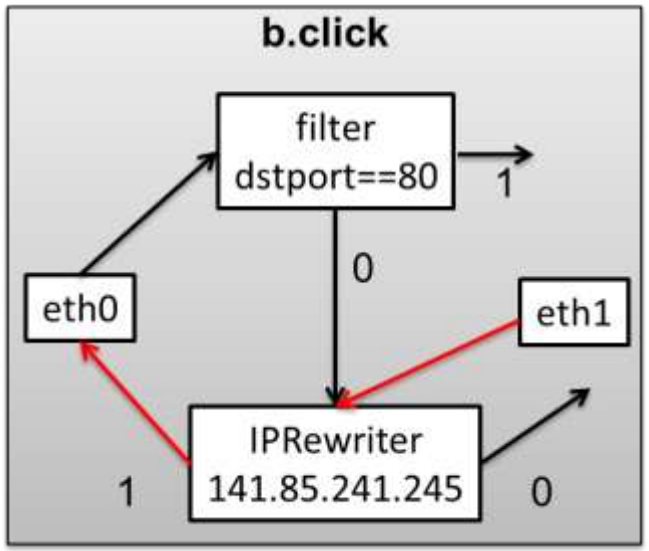
Heterogeneous composition/execution environments

- Classical NFV environments (i.e. by ETSI NFV standards)
  - VNFs are composed/orchestrated to realize Network Services
  - VNFs can be decomposed in VNFC (VNF Components)



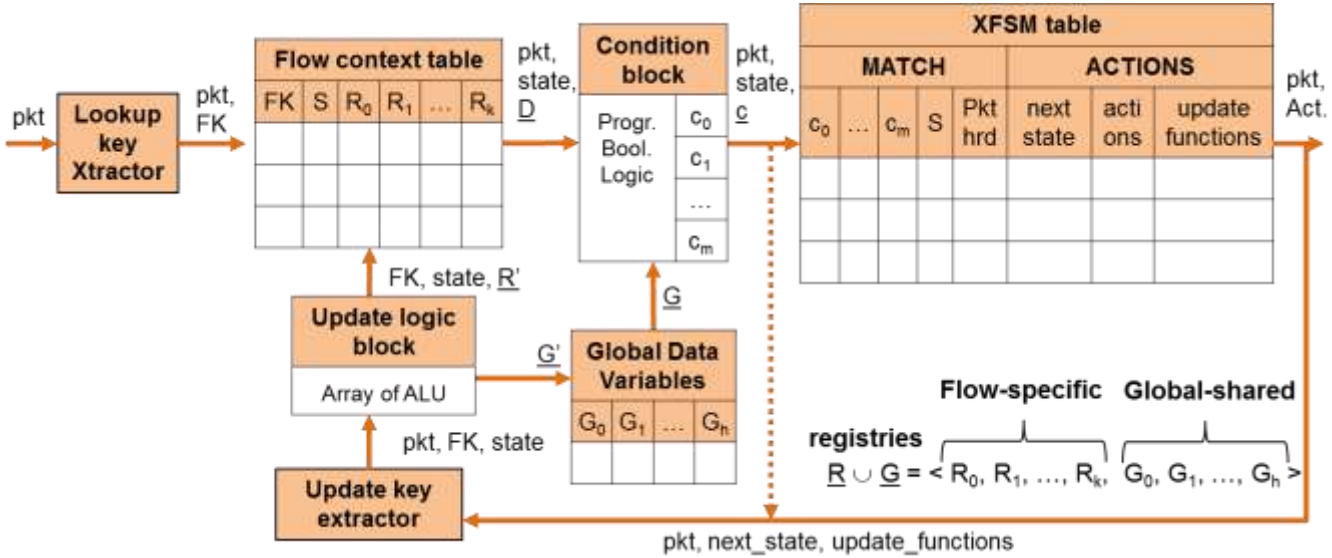
Heterogeneous composition/execution environments

- Towards more «fine-grained» decomposition…
- Modular software routers (e.g. Click)
  - Click *elements* are combined in *configurations* (Direct Acyclic Graphs)

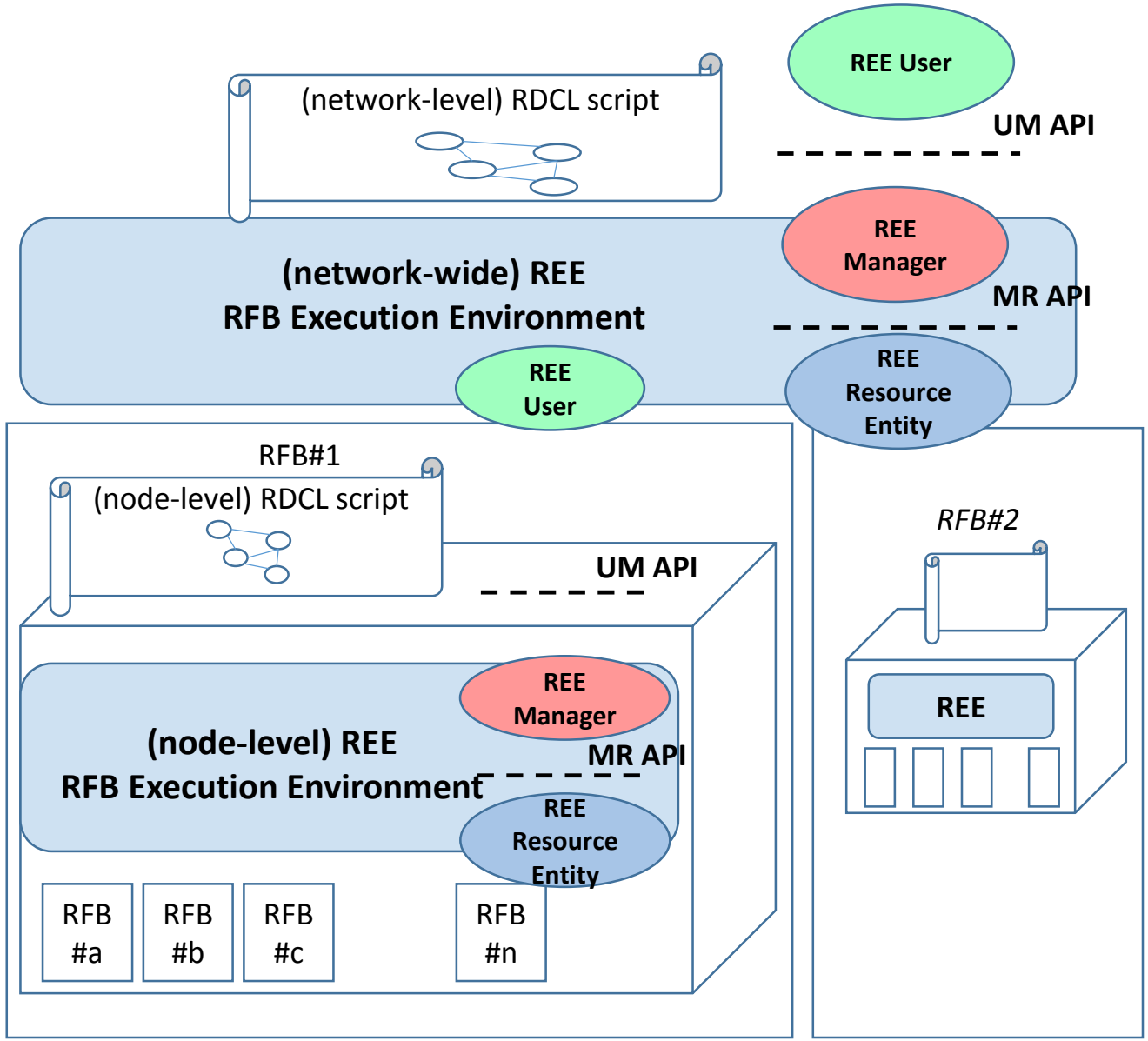


Heterogeneous composition/execution environments

- Towards more «fine-grained» decomposition…
- XSFM-based (eXtended Finite State Machine) decomposition of traffic forwarding / flow processing tasks, and HW support for wire speed execution



The Superfluidity Architecture



(Towards) Common Abstractions for Heterogeneous Environments

RFB Execution Environment(s)

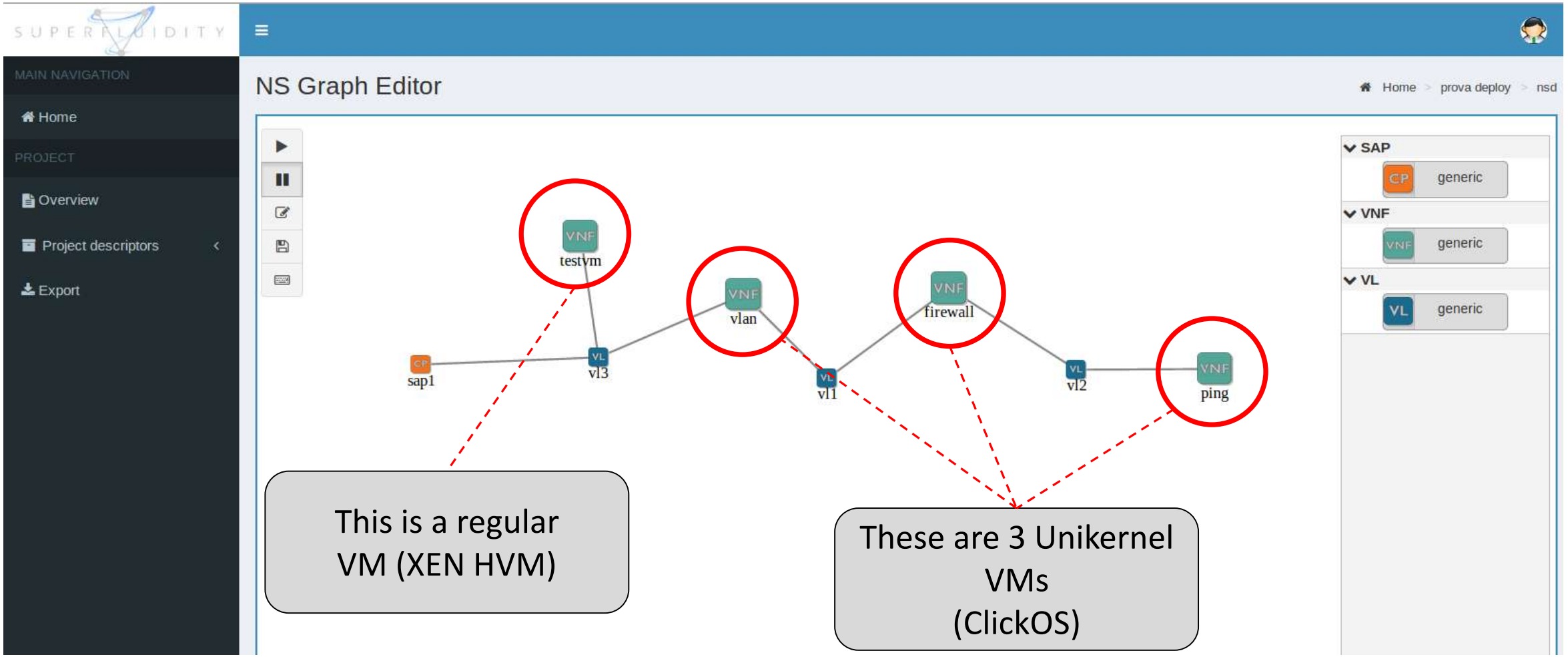
- "Traditional" NFVI infrastructure hypervisors with Full VMs
- Unikernel based virtualization
- Software modular routers environments (e.g. Click)
- Radio processing SW modules
- Hardware packet processors

RFBs Description & Composition Languages (RDCLs) and tools

- ETSI VNF descriptors / NEMO
- MISTRAL – HEAT
- Docker Compose …
- Click configurations / SEFL / Symnet
- PN (Process Networks), SDF (Synchronous Data Flow)…
- XFSMs

Working prototype

RDCL 3D: RFB Description and Composition Language Design Deploy and Direct



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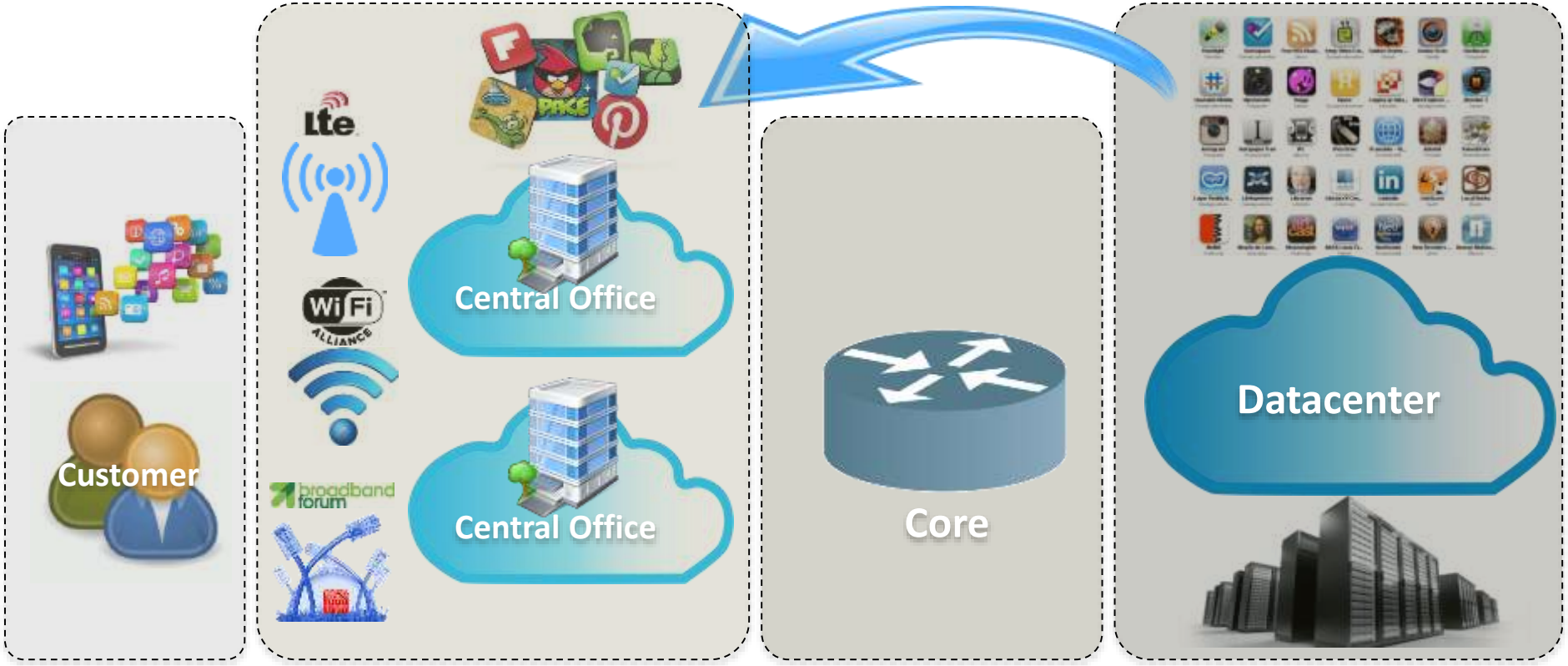
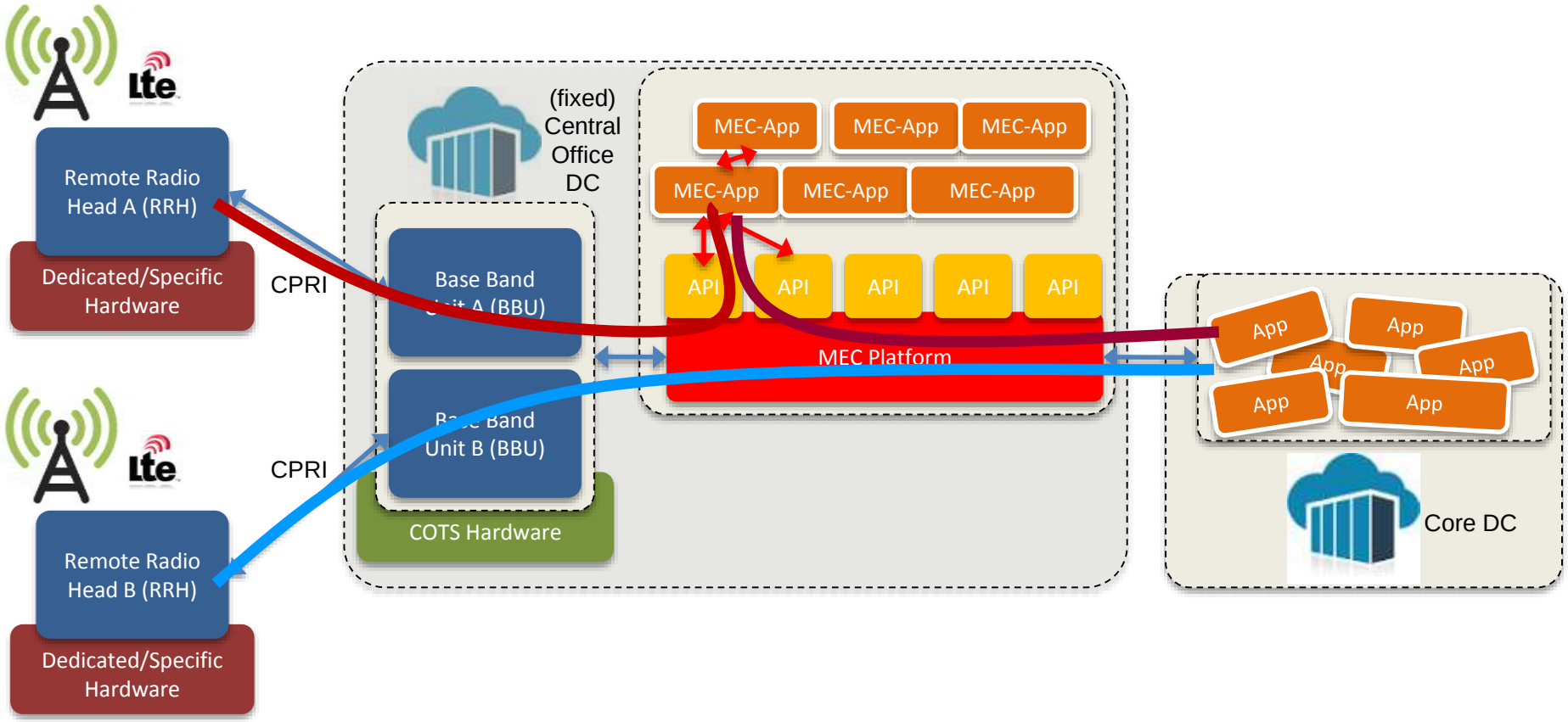
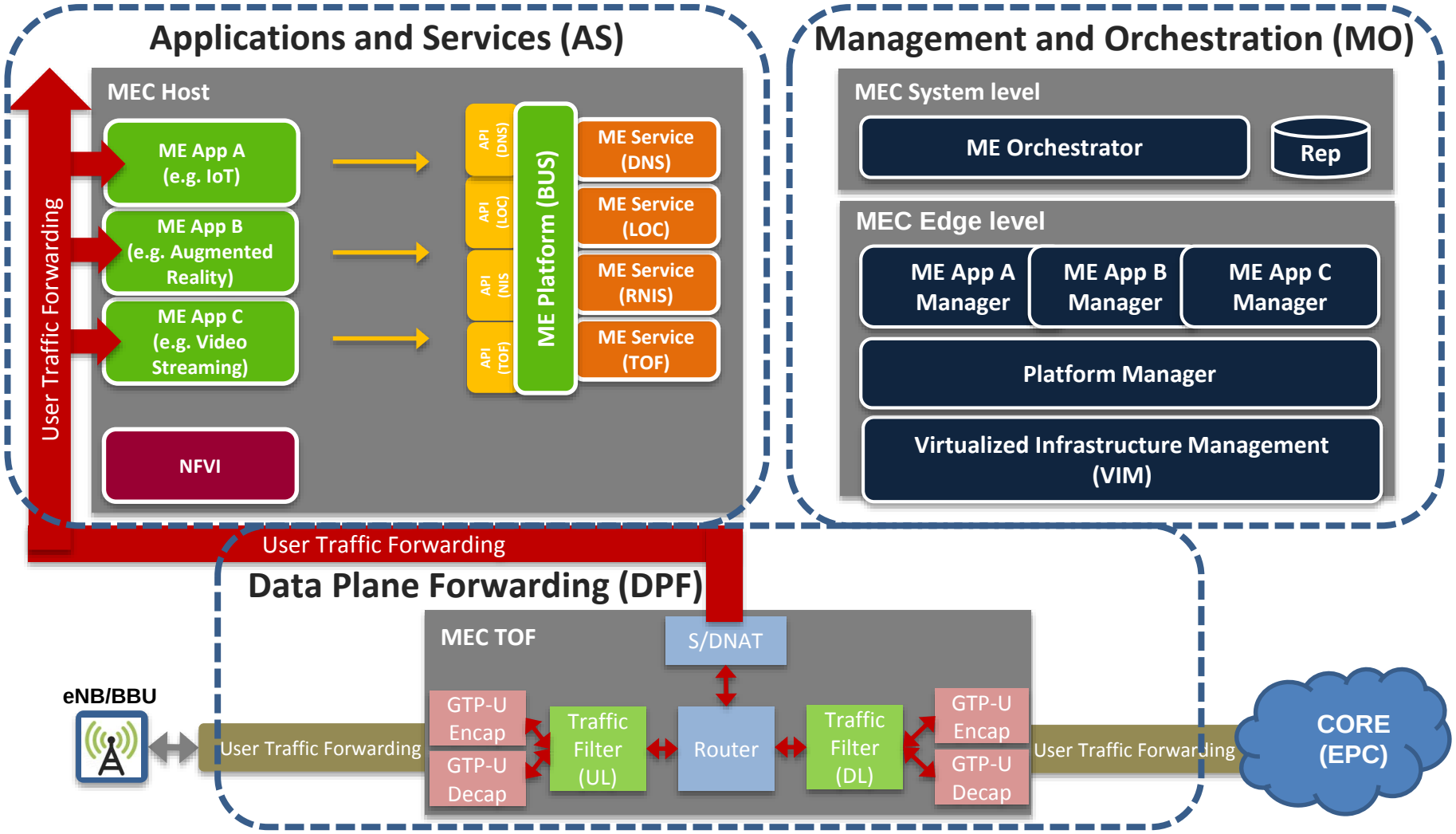
Mobile Edge Computing (MEC) Basics



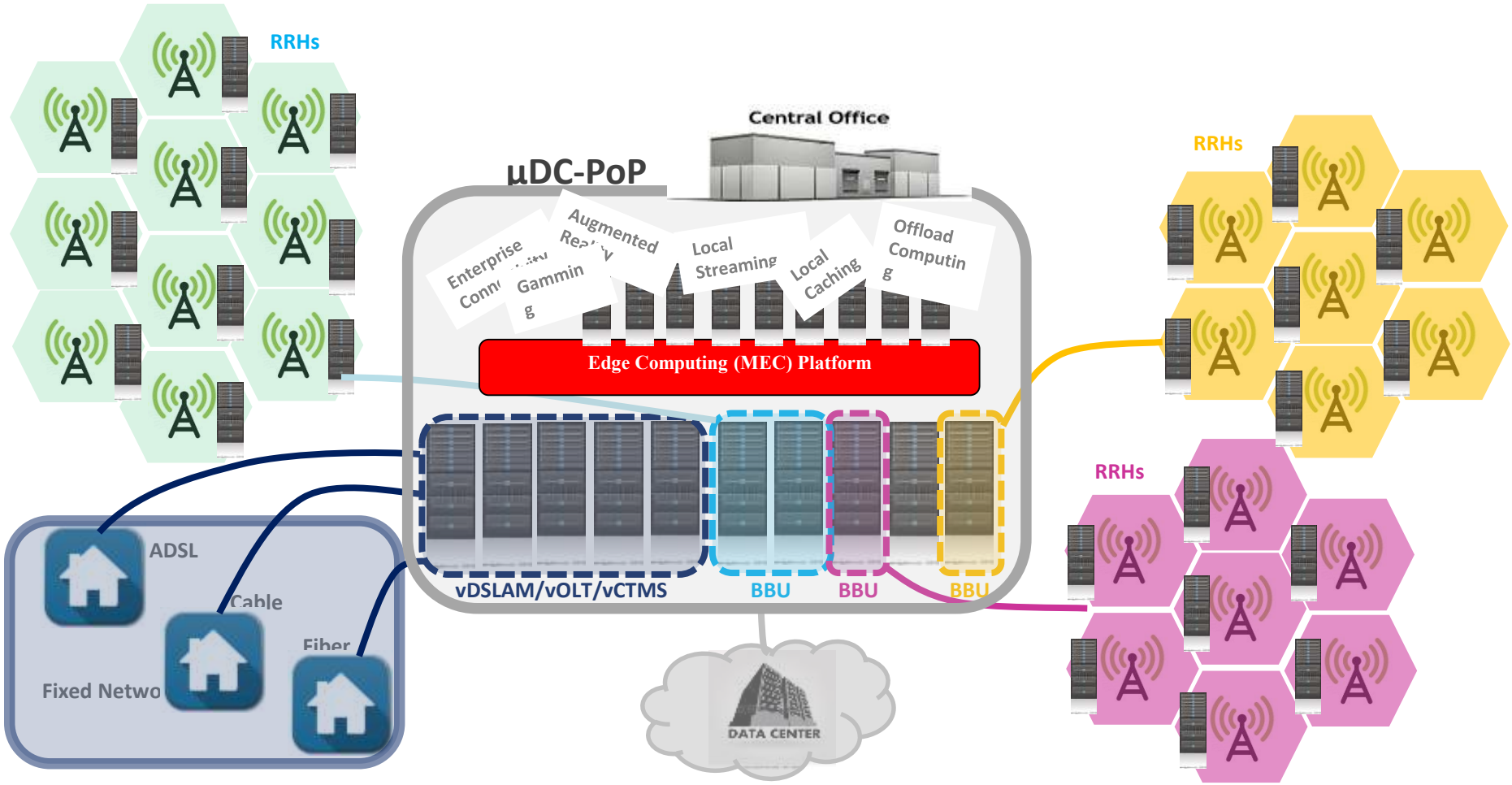
Mobile Edge Computing (MEC) Model



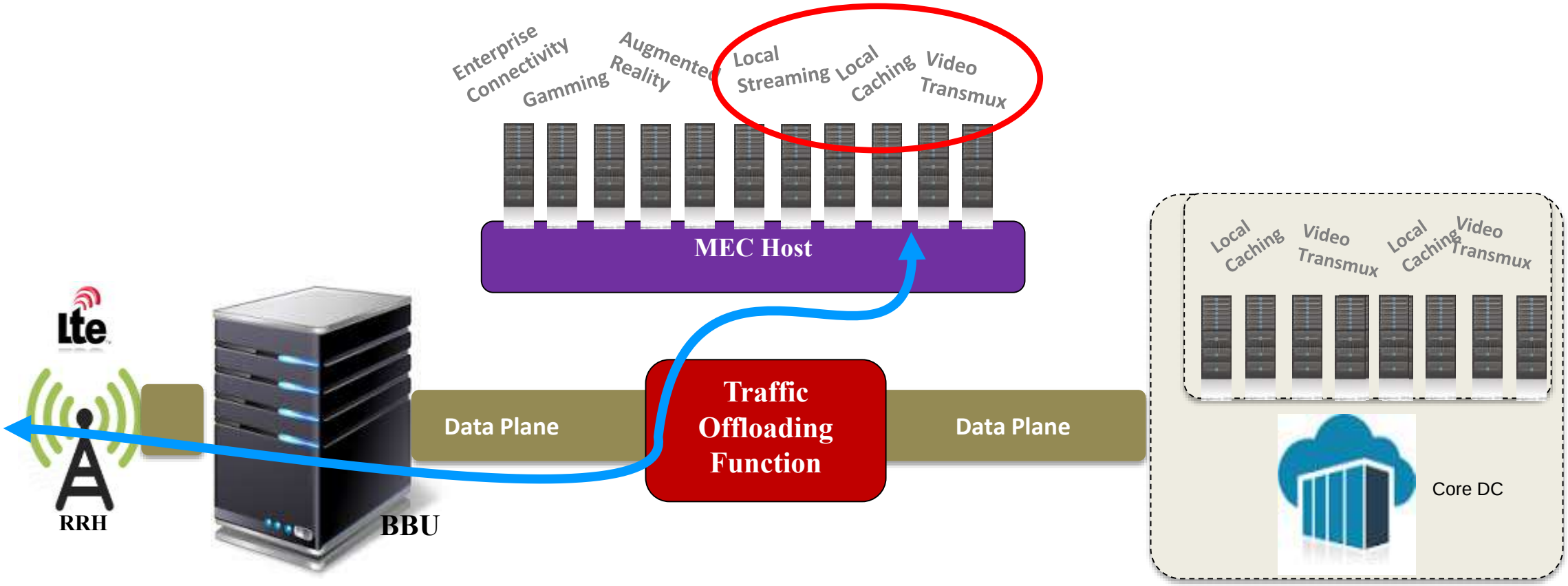
Mobile Edge Computing (MEC) Architecture



Network scenario: sharing the HW infrastructure



Service Example: Local Offloading of Video Streaming (with Late Transmuxing)



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Basic Video Streaming deployment

End-user Devices

CDN

MPEG-DASH, HLS, HSS, HSD

CDN Proxy Cache

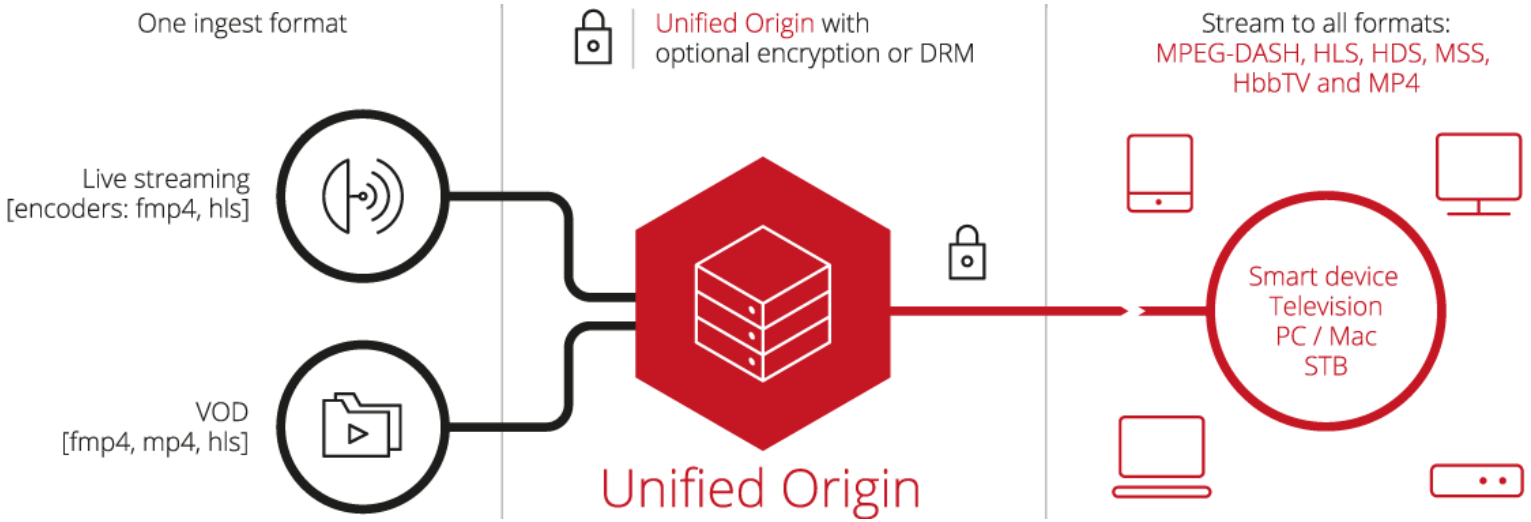
JIT PACKAGER MPEG-DASH, HLS, HSS, HSD

Origin Server

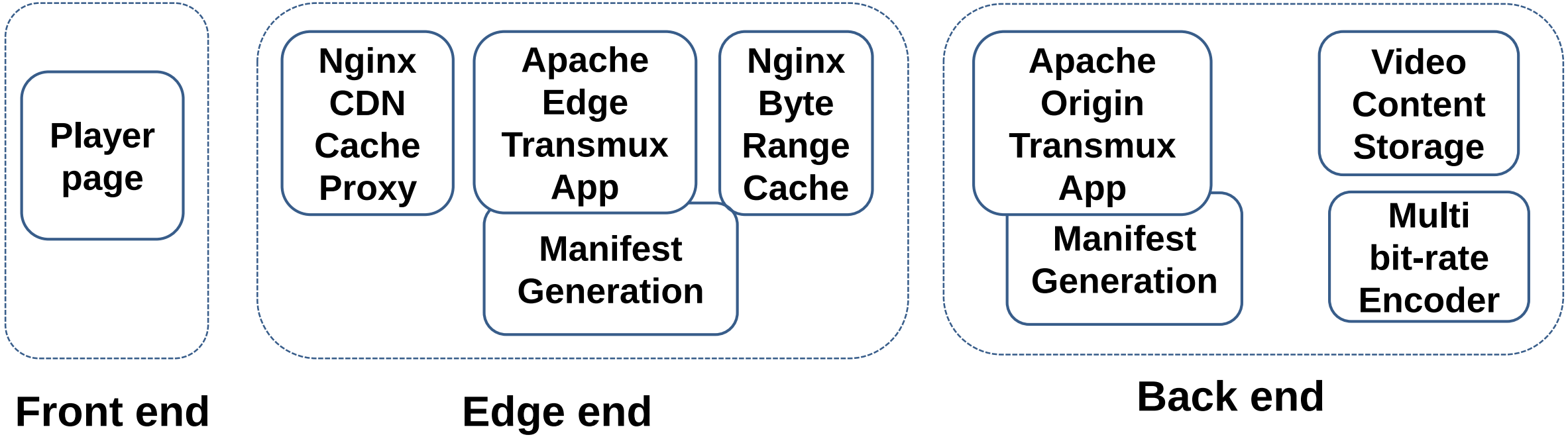
Media Storage or Live Encoder

Late TransMuxing

1. Unified Origin: one ingest format, various output formats
2. Contribution: split and move to the edge
3. How? Use an intermediate optimal media exchange format between core and edge, cache this format



Late Transmuxing Prototype
RFB based deployment



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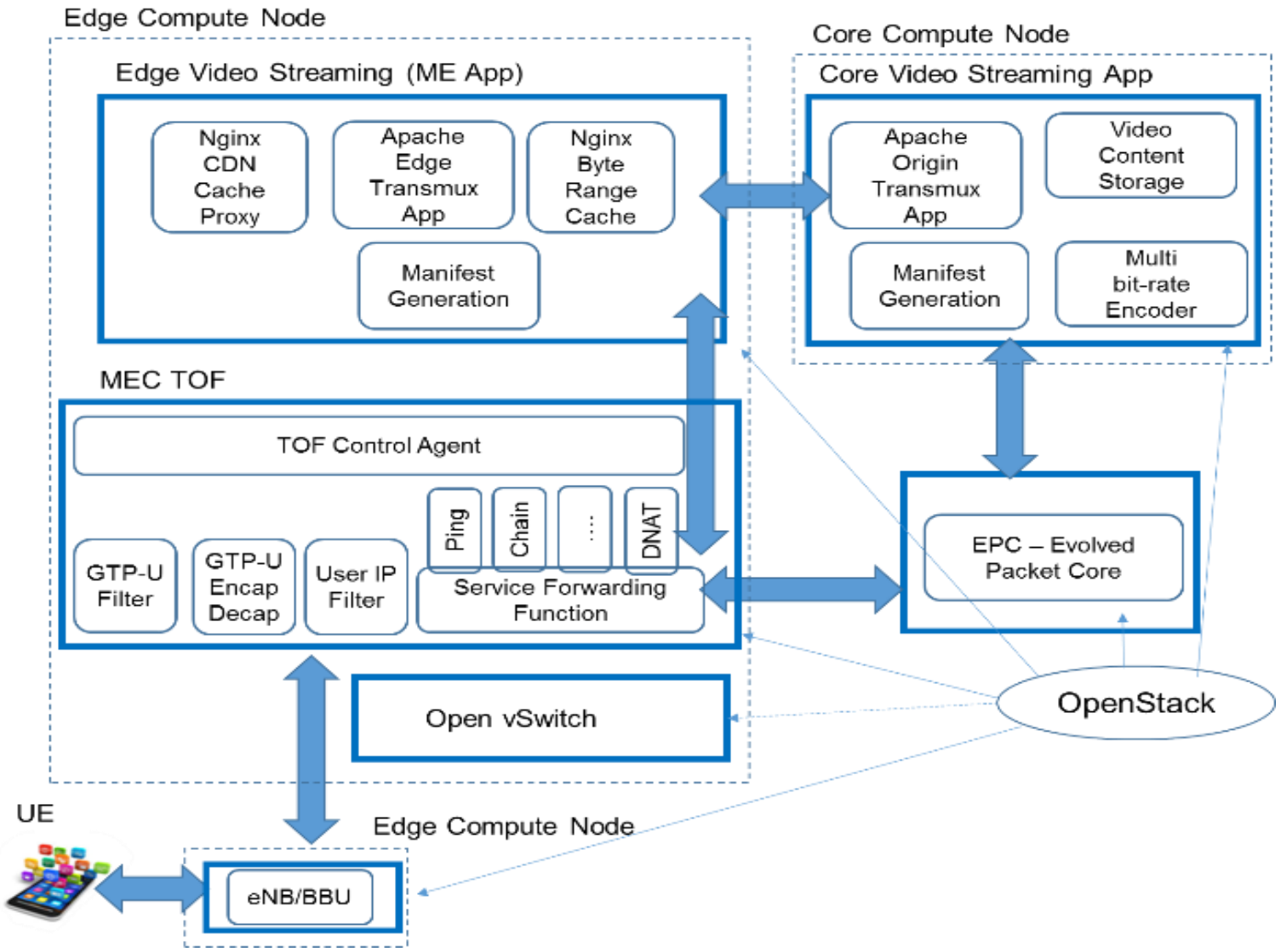
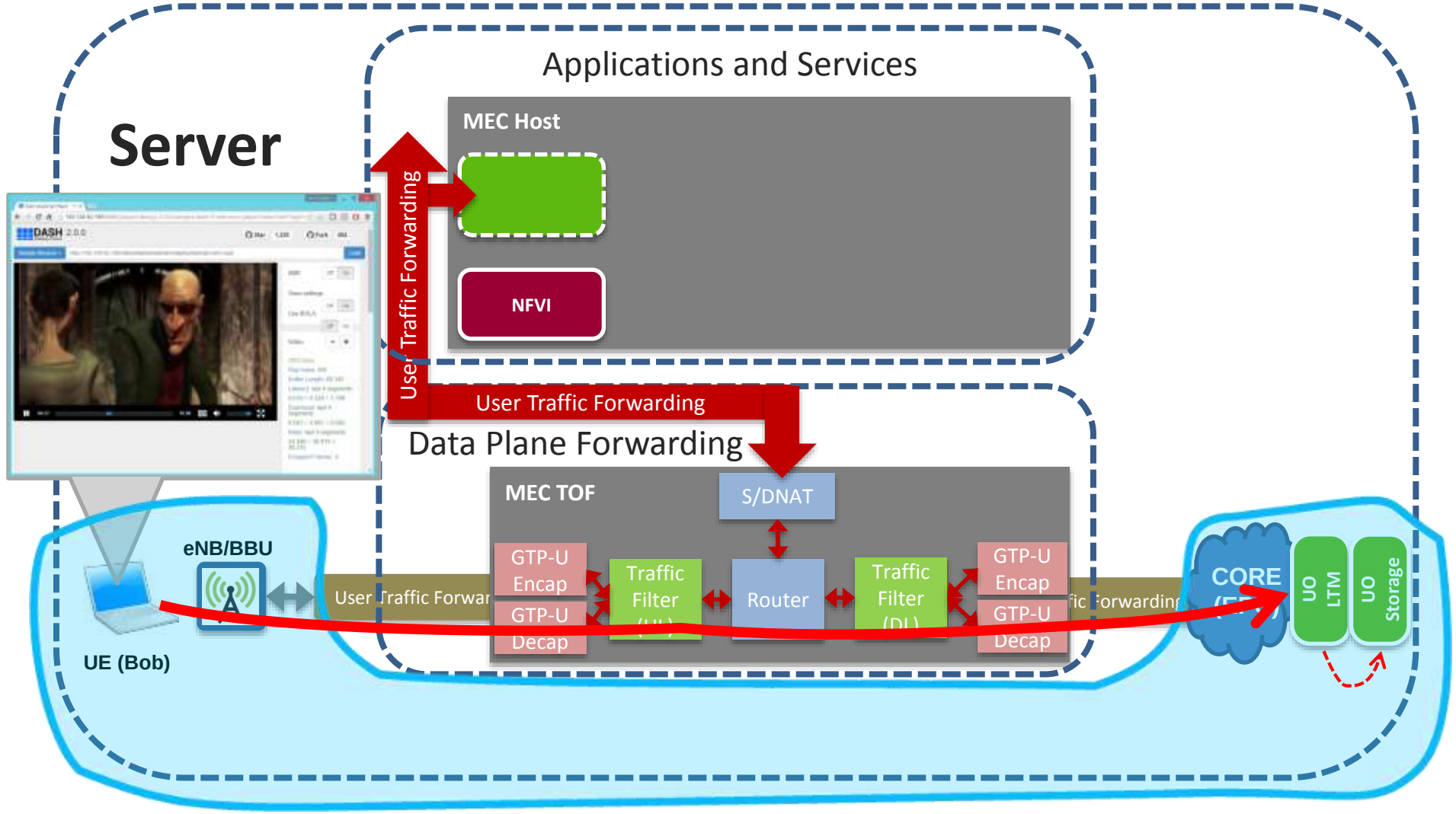
Prototype architecture



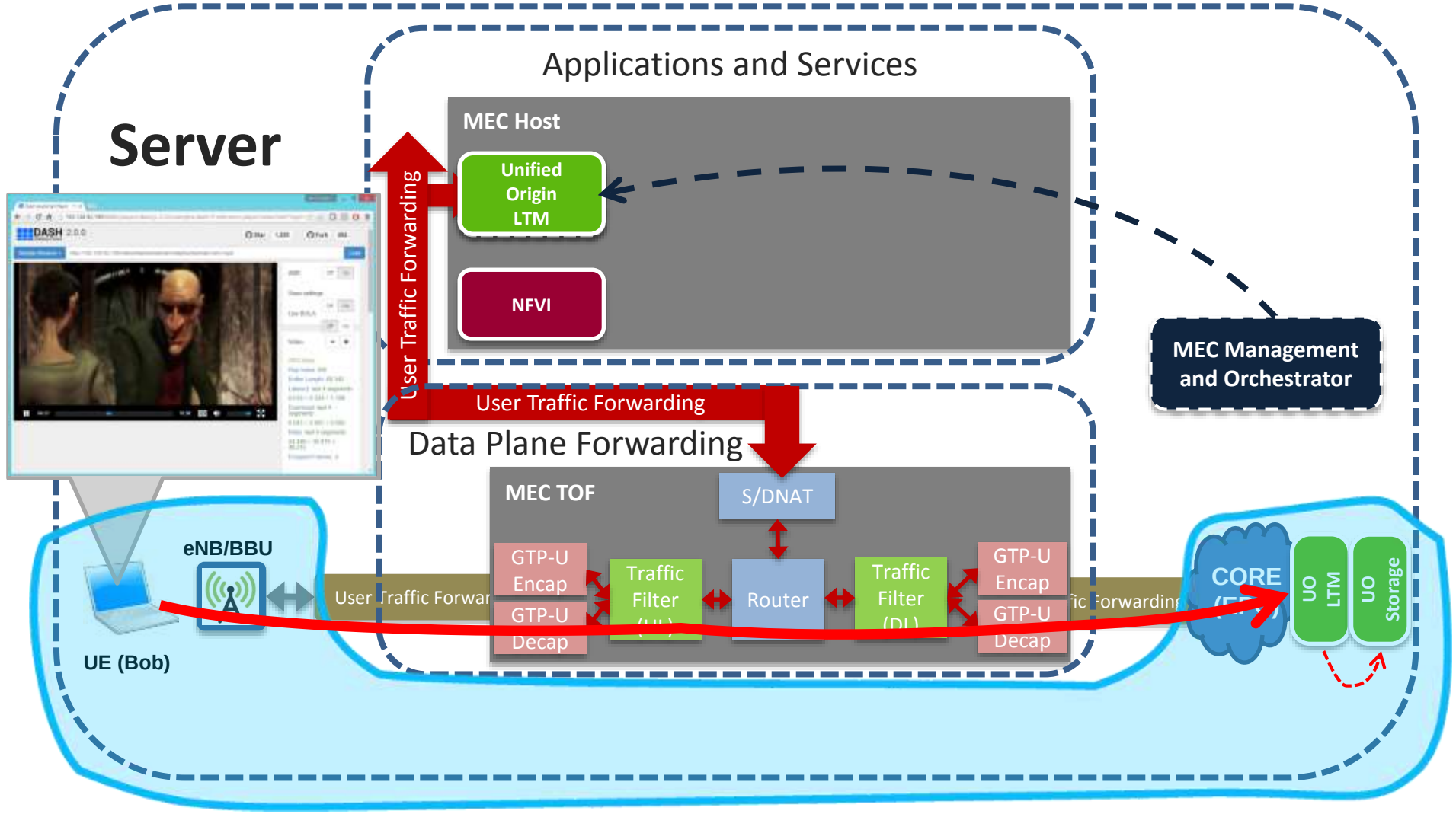
MEC/Video Streaming Demo

- The LTM server in the core is initially contacted



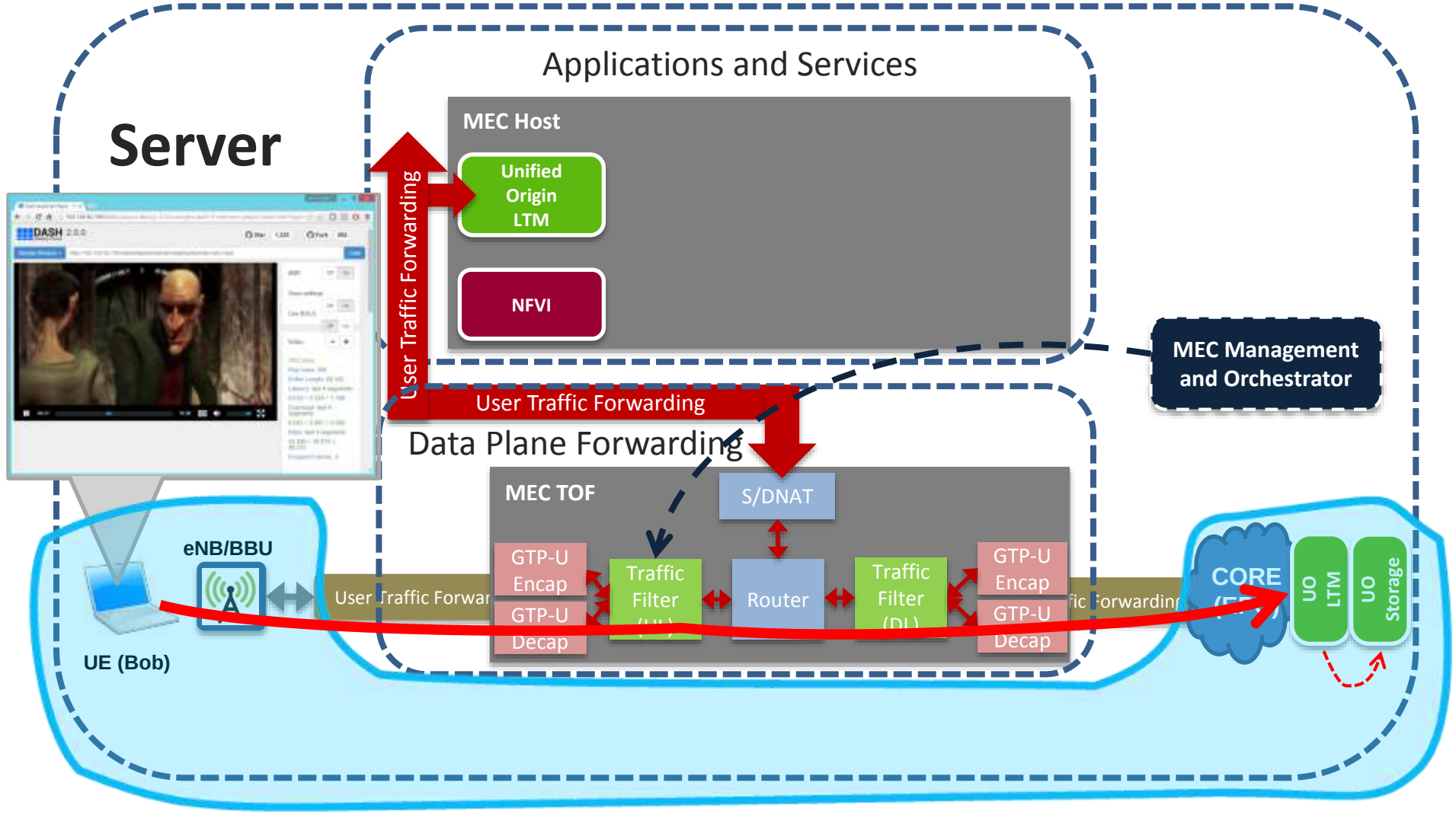
MEC/Video Streaming Demo

- The *Management and Orchestration* (MANO) layer instantiates the LTM application in the edge *(so far, MANO is just a manual script execution)*



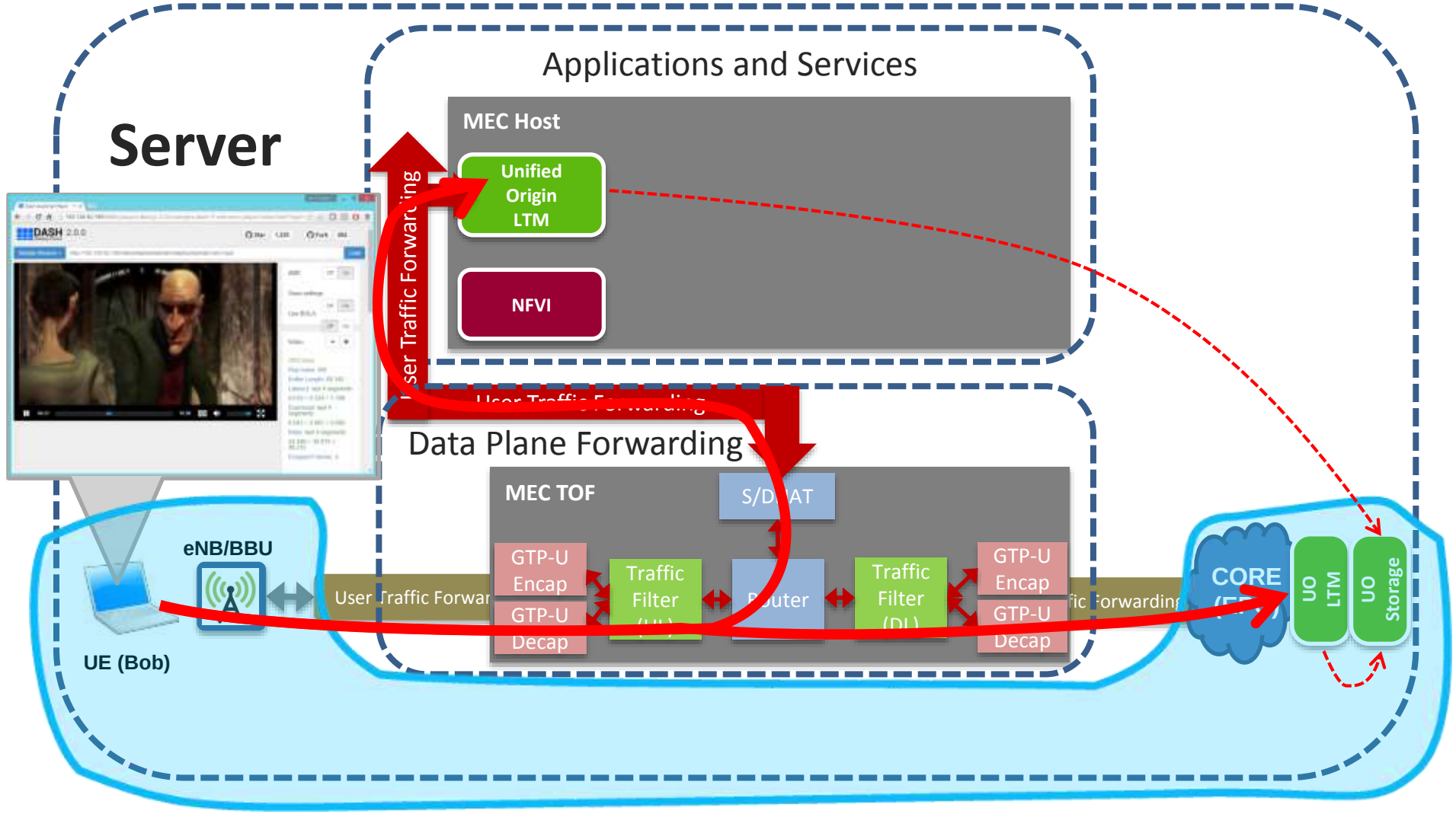
MEC/Video Streaming Demo

- After the LTM instantiation is fully operational, the MANO layer configures the TOF in order to redirect the video request to the new LTM

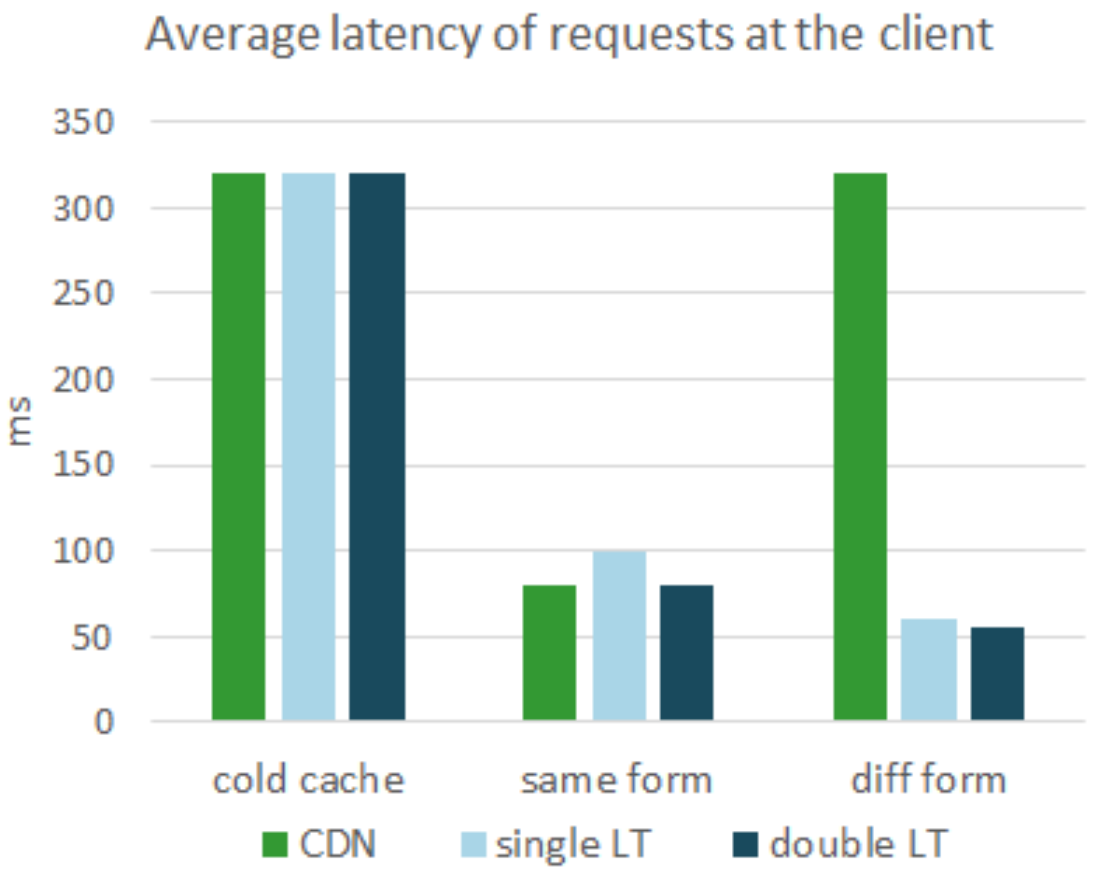


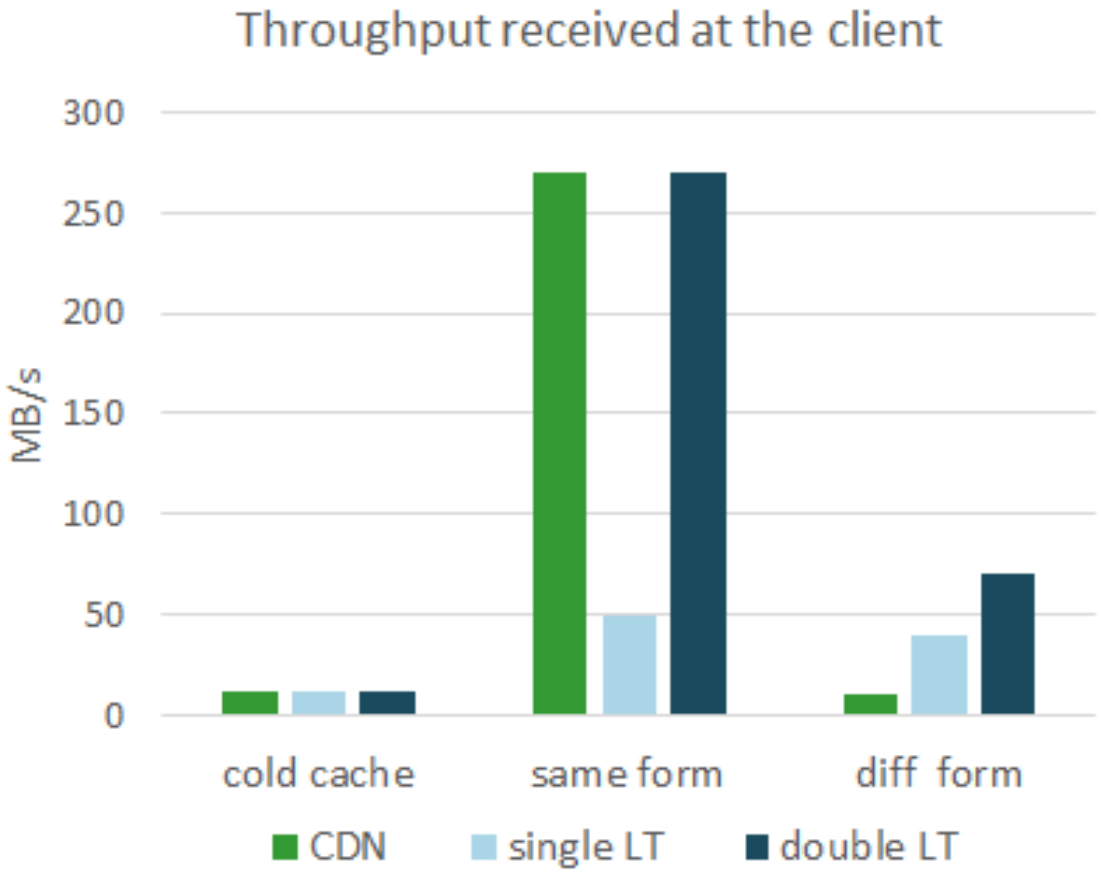
MEC/Video Streaming Demo

- The subscriber will, transparently, start getting the video service from the edge LTM, which in turn accesses the central storage for contents

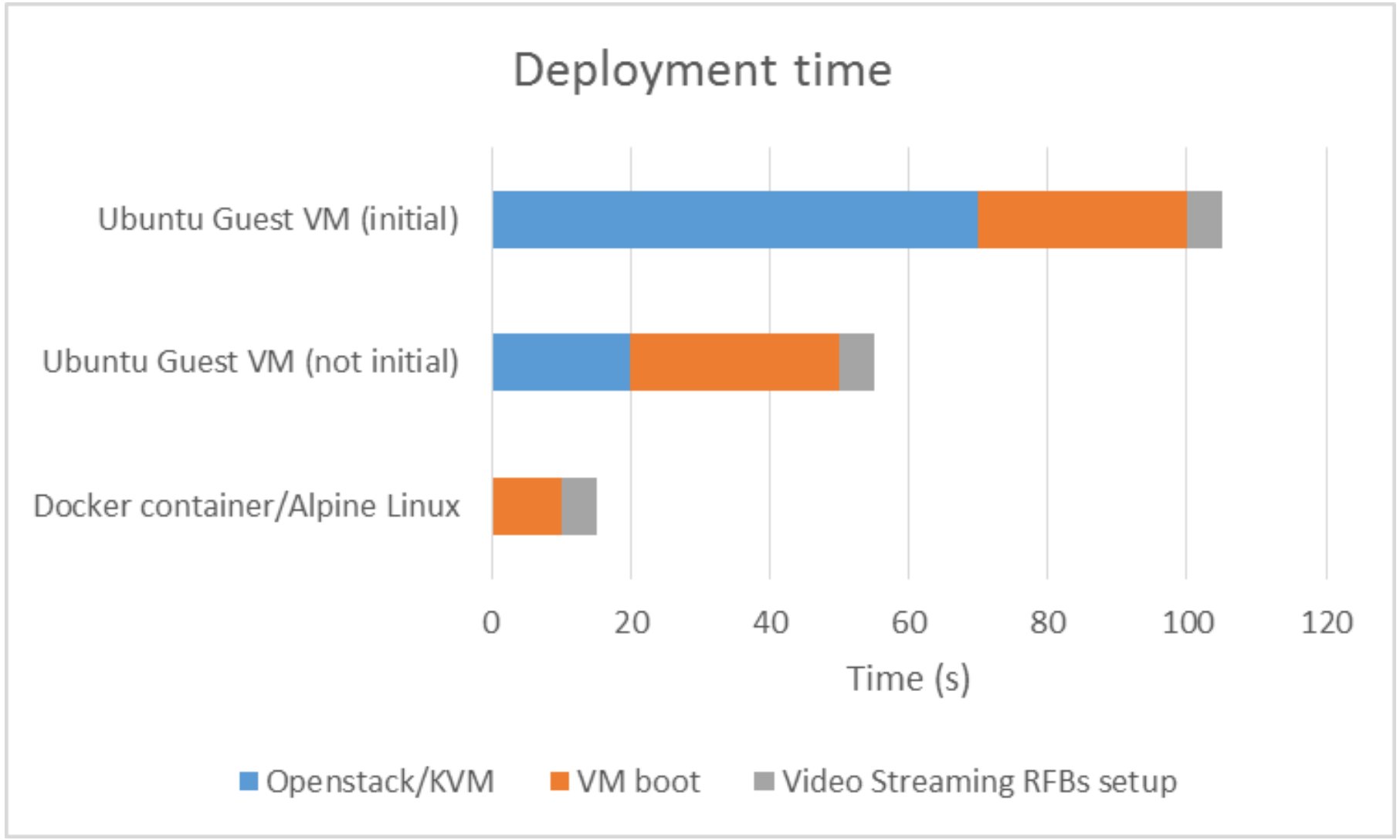


Testbed Results





Testbed Results
Deployment time of Edge Video Streaming components



Thank you. Questions?

Contacts

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http://superfluidity.eu/

The work presented here only covers a subset of the work performed in the project

References

- SUPERFLUIDITY project Home Page http://superfluidity.eu/

- G. Bianchi, et al. “Superfluidity: a flexible functional architecture for 5G networks”, Transactions on Emerging Telecommunications Technologies 27, no. 9, Sep 2016
- S. Salsano, L. Chiaraviglio, N. Blefari-Melazzi, C. Parada, F. Fontes, R. Mekuria, D. Griffioen, “Toward Superfluid Deployment of Virtual Functions: Exploiting Mobile Edge Computing for Video Streaming”, Soft5 Workshop, 1st International Workshop on Softwarized Infrastructures for 5G and Fog Computing, in conjunction with 29th ITC conference, Genoa, Italy, 8th September 2017
- S. Salsano, F. Lombardo, C. Pisa, P. Greto, N. Blefari-Melazzi, “RDCL 3D, a Model Agnostic Web Framework for the Design and Composition of NFV Services”, submitted paper, https://arxiv.org/abs/1702.08242
- L. Chiaraviglio, L. Amorosi, S. Cartolano, N. Blefari-Melazzi, P. Dell’Olmo, M. Shojafar, S. Salsano, “Optimal Superfluid Management of 5G Networks”, 3rd IEEE Conference on Network Softwarization, NetSoft 2017, 3-7 July 2017, Bologna, Italy

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