8th KuVS Fachgespräch NGSDP – "Competitive Service Delivery Infrastructures“
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KuVS
NGSDP Expert Talk

Elastic Cloud Principles applied onto Telco SDPs and NFV

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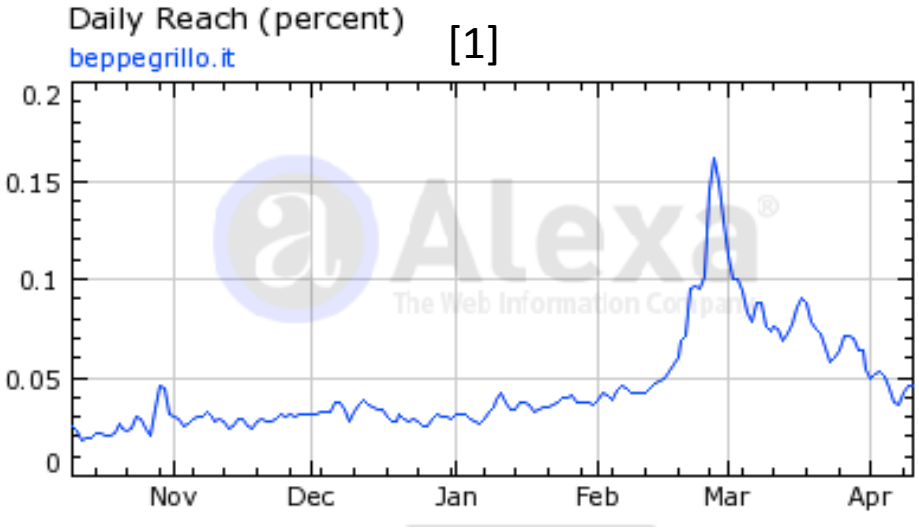
Fraunhofer FOKUS

TU berlin

Introduction

- Cloud Elasticity – some definition:
  - Elasticity has been defined by NIST as the possibility to increase or decrease available resources on demand. It is one of the most important properties of cloud infrastructures
- Network Function Virtualization
  - Introducing flexibility in network management operations
- Motivation:
  - Resources optimization
  - Traffic fluctuation

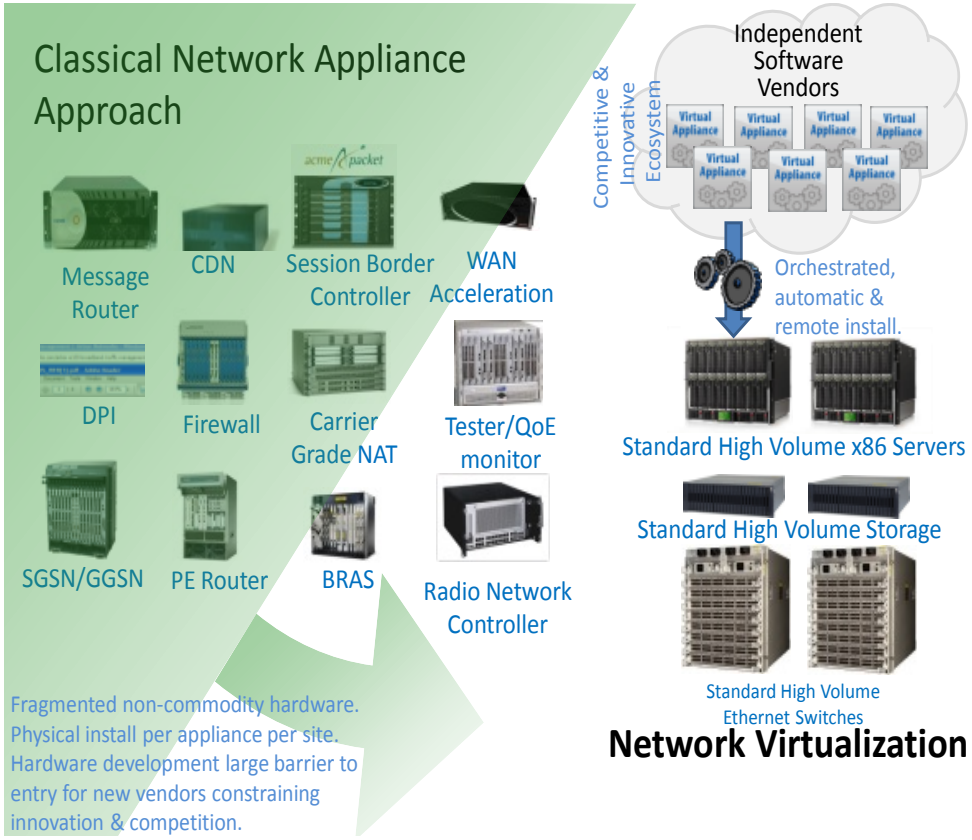


[1]

[1] http://www.alexa.com/siteinfo/beppegrillo.it

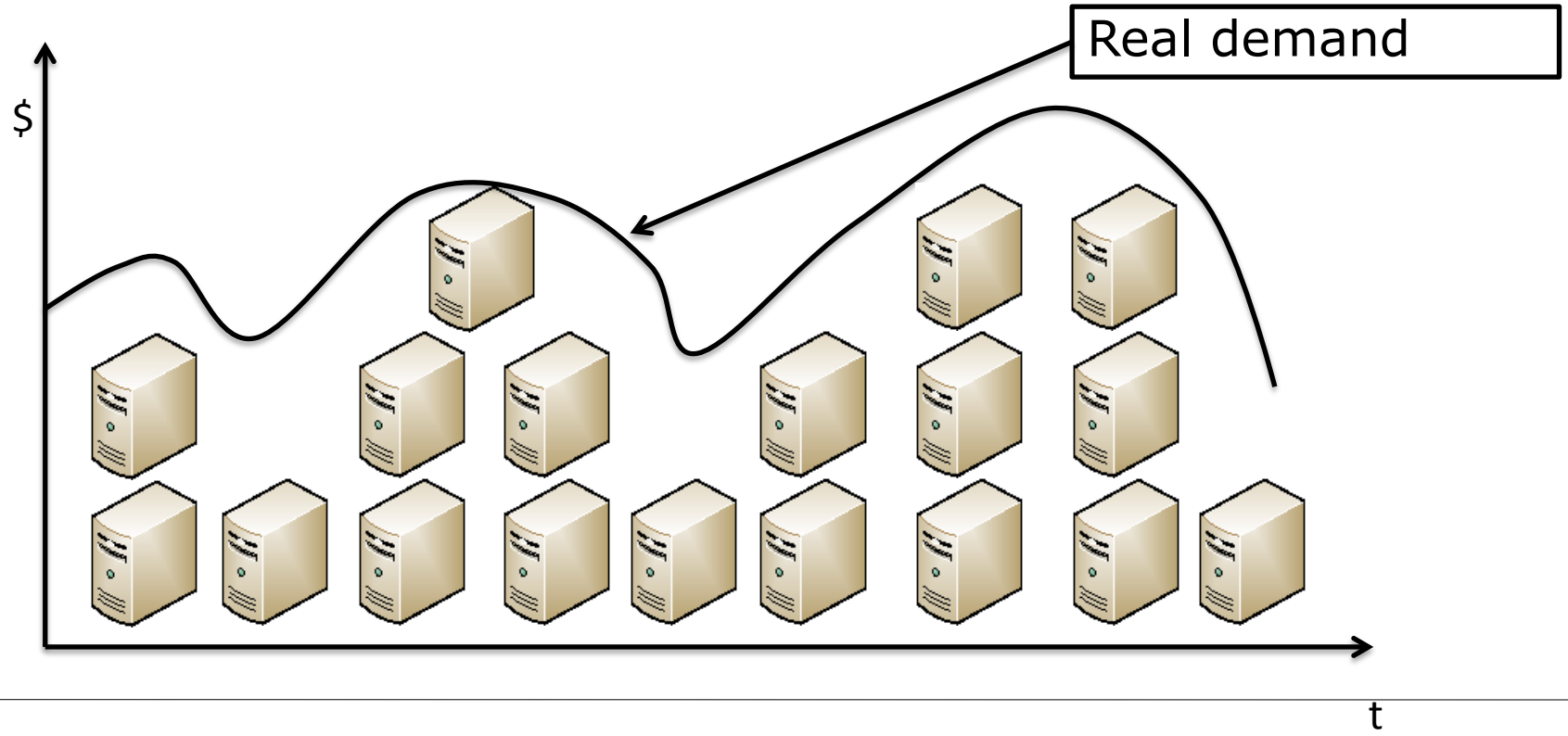
What is Network Functions Virtualization (NFV)

- Network Functions Virtualization (NFV) is a novel paradigm that presumes that the network functions:
  - Are implemented only as software (programs)
  - Can run on top of common servers
- NFV implies that network functions:
  - Can be moved as required
  - Do not require special equipment



Cloud elasticity

- Utilize applications only when are really necessary:
  - Reducing costs – pay only for what is used
  - Improving QoS without overprovisioning



SDP as a Service - SDPaaS

- The Cloud model (with its elasticity) is “the” enabler of Service Delivery Platforms
  - Reduced time to market for new services
    - Instantiation just with “a click”
  - Reduced CAPEX – only pay per use

- It enables efficiencies and scalability:
  - Those are two of the most important characteristic in telecommunication services!

Scalability of a system – a short background

- Elasticity enabler for “scalability” - the measurement of the point of failure of a system
  - In which cases the system will not work anymore efficiently?

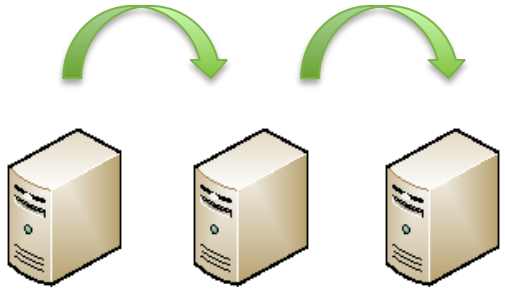
- It has been demonstrated that systems that don’t scale lose customers:
  - Google discovered that adding 500ms delay to page response time reduce the traffic of 20% [2]

[2] http://dyn.com/blog/dns-roi-5-reasons-slow-website-speed-kills-why-uptime-is-a-necessity/

Scalability approaches - two possibilities

- Vertically:
  - Increase the capacity adding new resources to an existing node

- Horizontally:
  - Increase the capacity increasing the number of nodes (in most of the case clone of a basic node)



Stateless and stateful model

- Stateful applications:
  - The client is tied to a specific instance for the duration of the all session
- Stateless applications:
  - The state of a session is stored in the client (fat client) and attached in each request or stored / retrieved by the application from an external database

Stateless applications usually scale better

Scalability approaches

- Vertically:
  - It works properly with both stateless and stateful applications
  - But it has a physical limitation due to the available hardware in a single location
- Horizontally:
  - It works properly with homogenous (stateless) nodes
  - Specific procedures are necessary for stateful application for working in this approach

Horizontally ~ infinite resources available

Scalability approaches - which one?

- It is important to identify which scalability approach to use
- Identify which metric to consider for scaling
- What procedures to apply in case of problems?

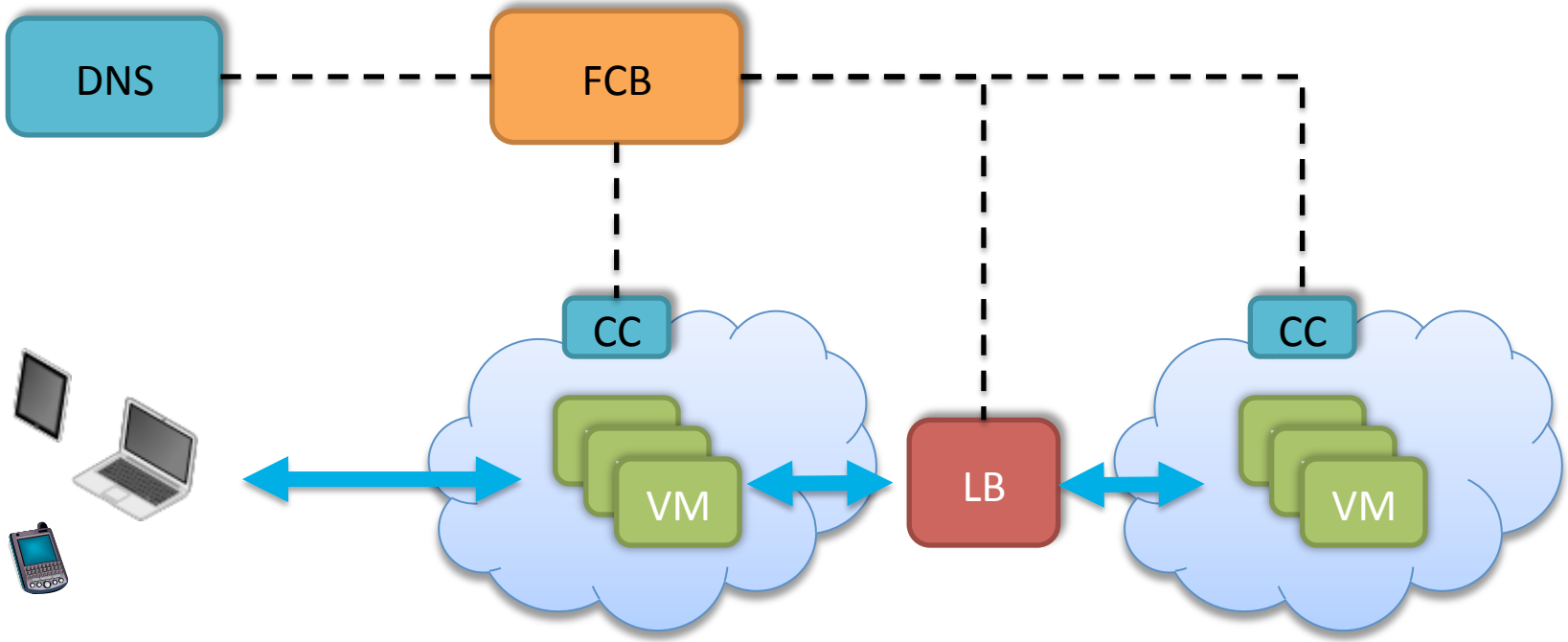
It strongly depends on the specific system

Network Function Virtualization Management

- Even more operators are moving to cloudified datacenters
  - OpenStack and OpenNebula as principles cloud controllers
- NFV and SDPaaS need specific management tools
  - There is a need of an exstensible management tool which support:
    - Monitoring of specific network KPIs
    - Different load balancing mechanisms
    - Flexible configuration of network topologies
- Commercial platforms (like AmazonEC2,Rackspace, etc.) and opensource tools are not ready for the complexity of those systems

FOKUS Cloud Broker (FCB)

- Generic framework for automatic management of resources which
  - Allows multi-tier applications management
  - Decoupled from a specific Cloud Controller (CC) API
  - Extensible interface with load balancer components (DNS/HTTP/SIP)
  - Rules engine



Application (HTTP/SIP)

Control (OCCI/proprietary)

FOKUS Cloud Broker (FCB)

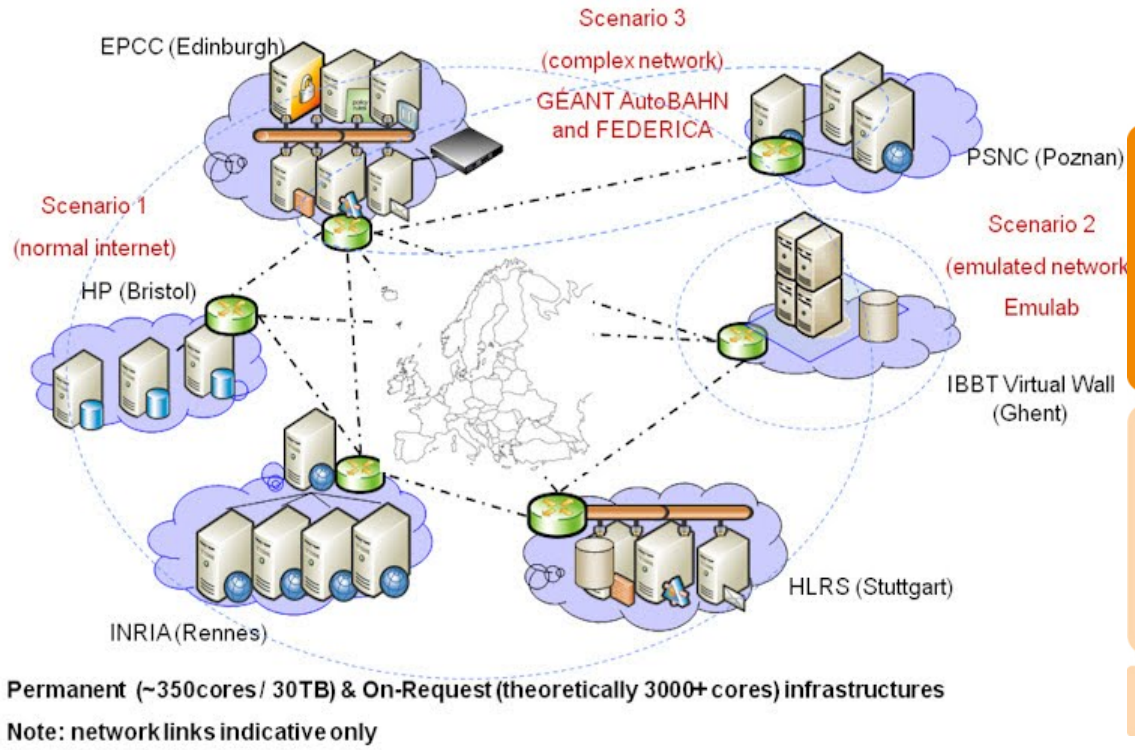
- Different strategies for solving different problems:
  - Possibility of creating rules using an XML file or REST APIs
  - By default are provided some generic strategies which solves common problems
  - Users can customize actions writing a simple JAVA class

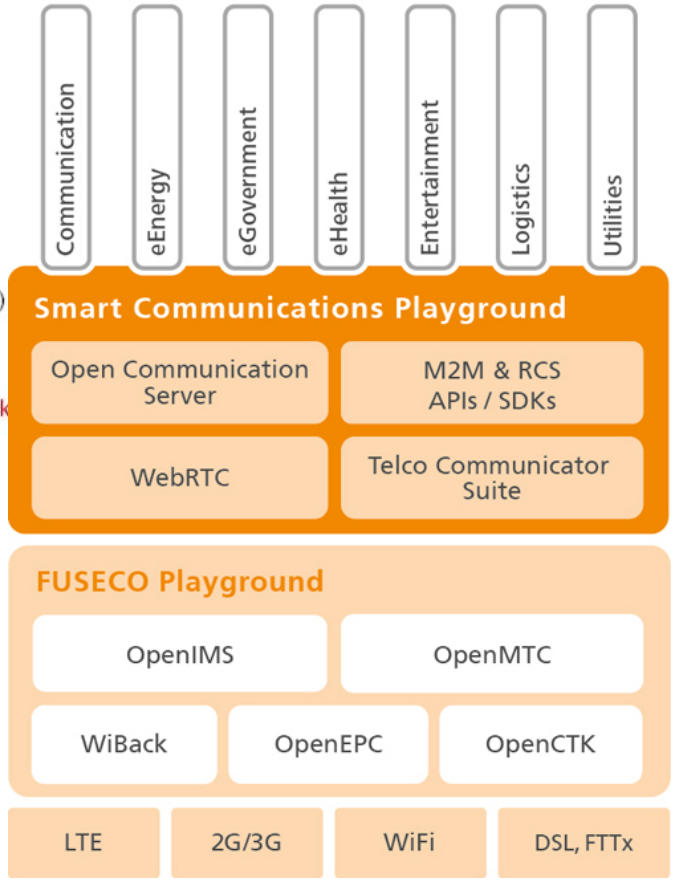
```
<trigger>
<name>upscale</name>
<type>CPU</type>
<period>90</period>
<expression>cpu>70%</expression>
<strategy>OwnStrategy</strategy>
<action>addVm</action>
</trigger>
```

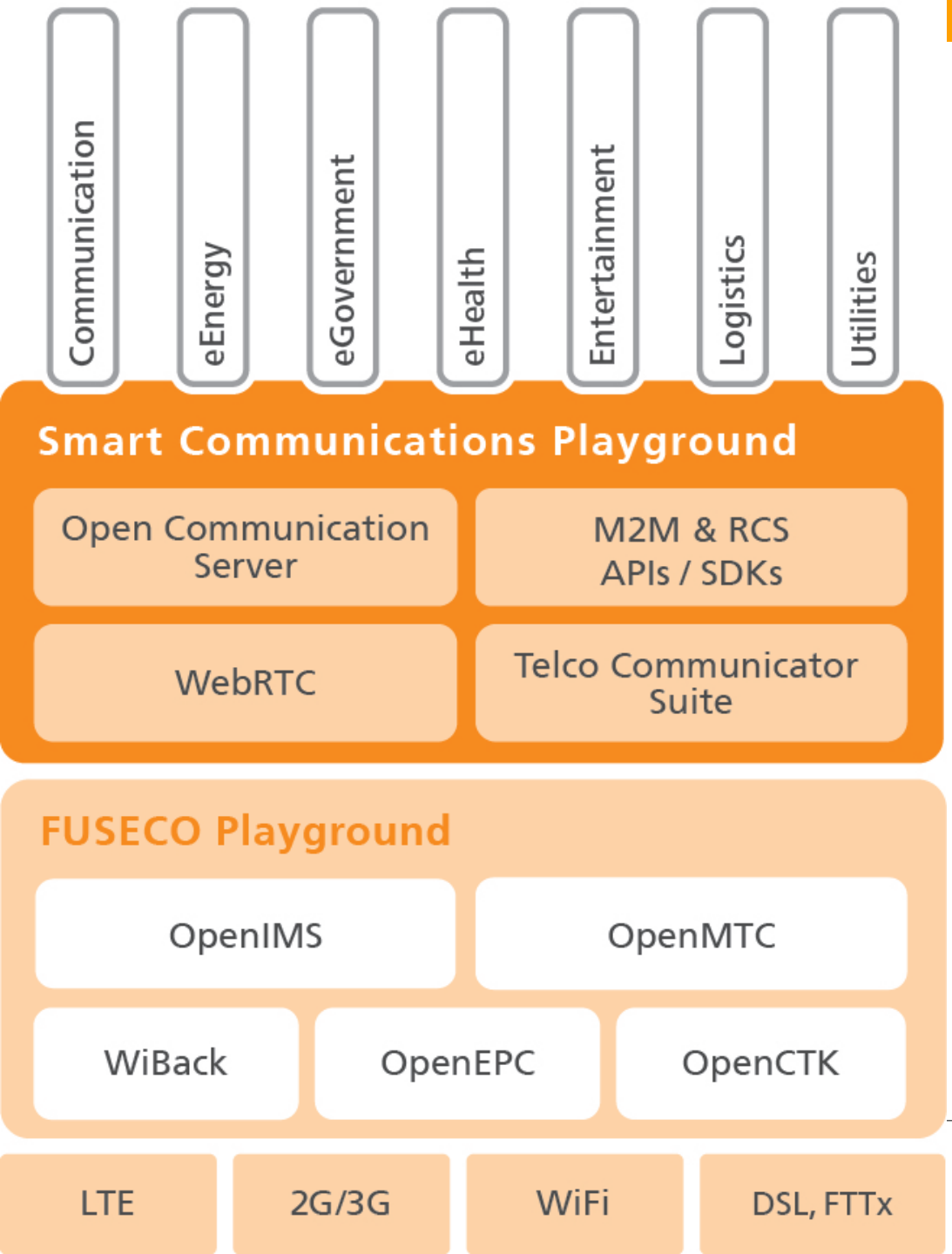
```
…
public class OwnStrategy{
      …

      if (action.equals("addVm")){
            ip = elasticGroup.addVm();
            loadBalancer.addVm(ip);
      else
      …

}
```

FOKUS Cloud Broker in Different Cloud Domains

- Currently used in EU BonFIRE project as elasticity enabler
- Already part of the FUSECO Playground for M2M and WebRTC IMS services







Smart Communications Playground

Fraunhofer FOKUS

www.SC-Playground.org

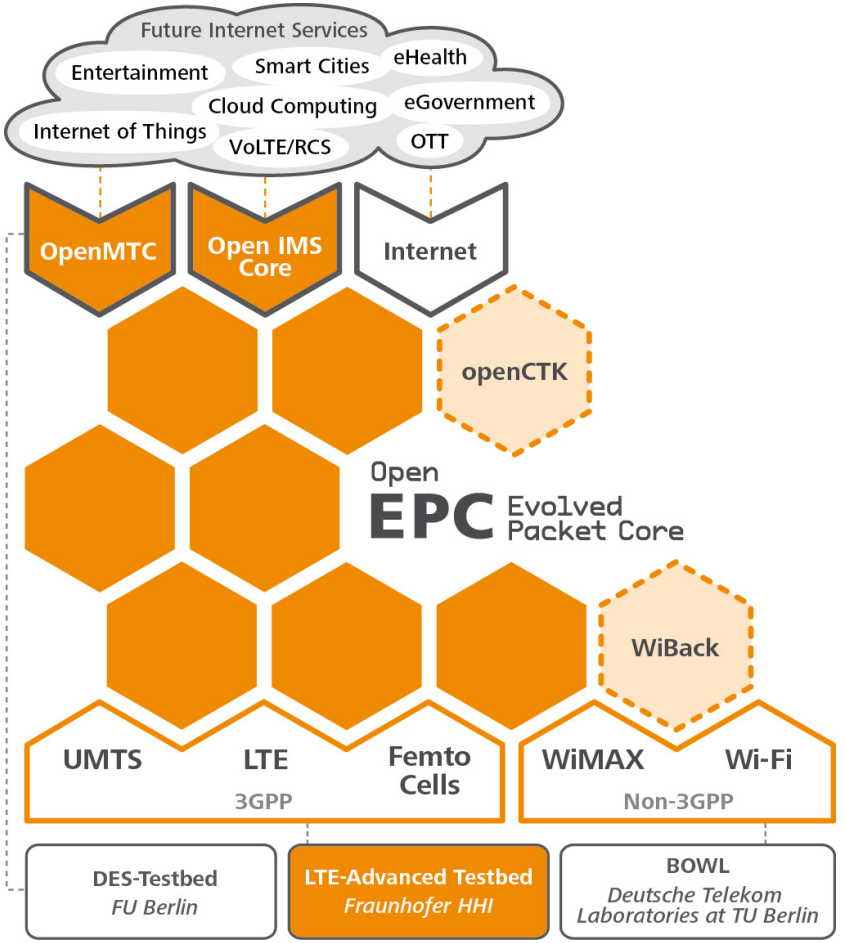
FUSECO playground

www.FUSECO-Playground.org

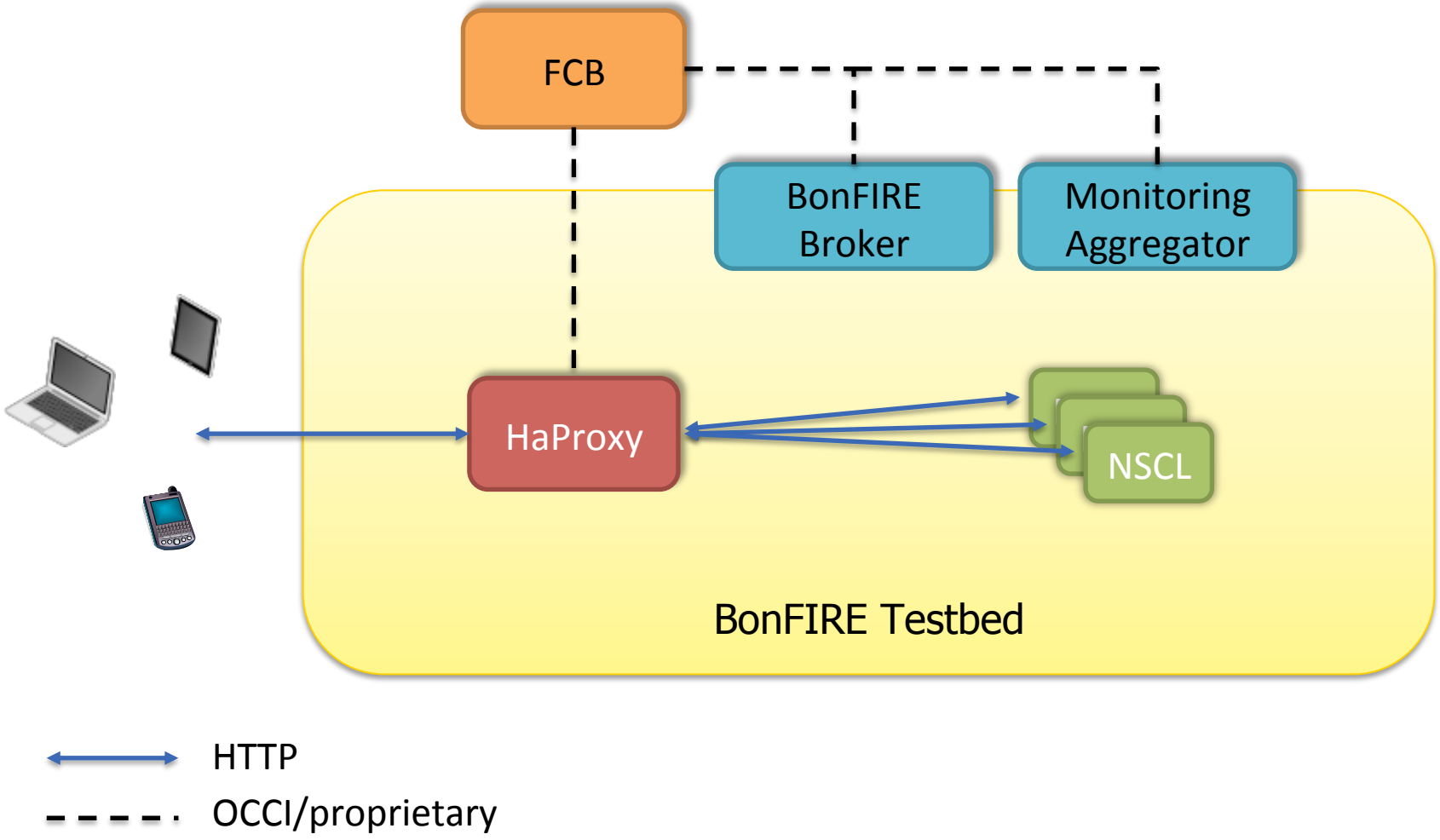
Future Seamless Communication (FUSECO) Playground

FUSECO playground

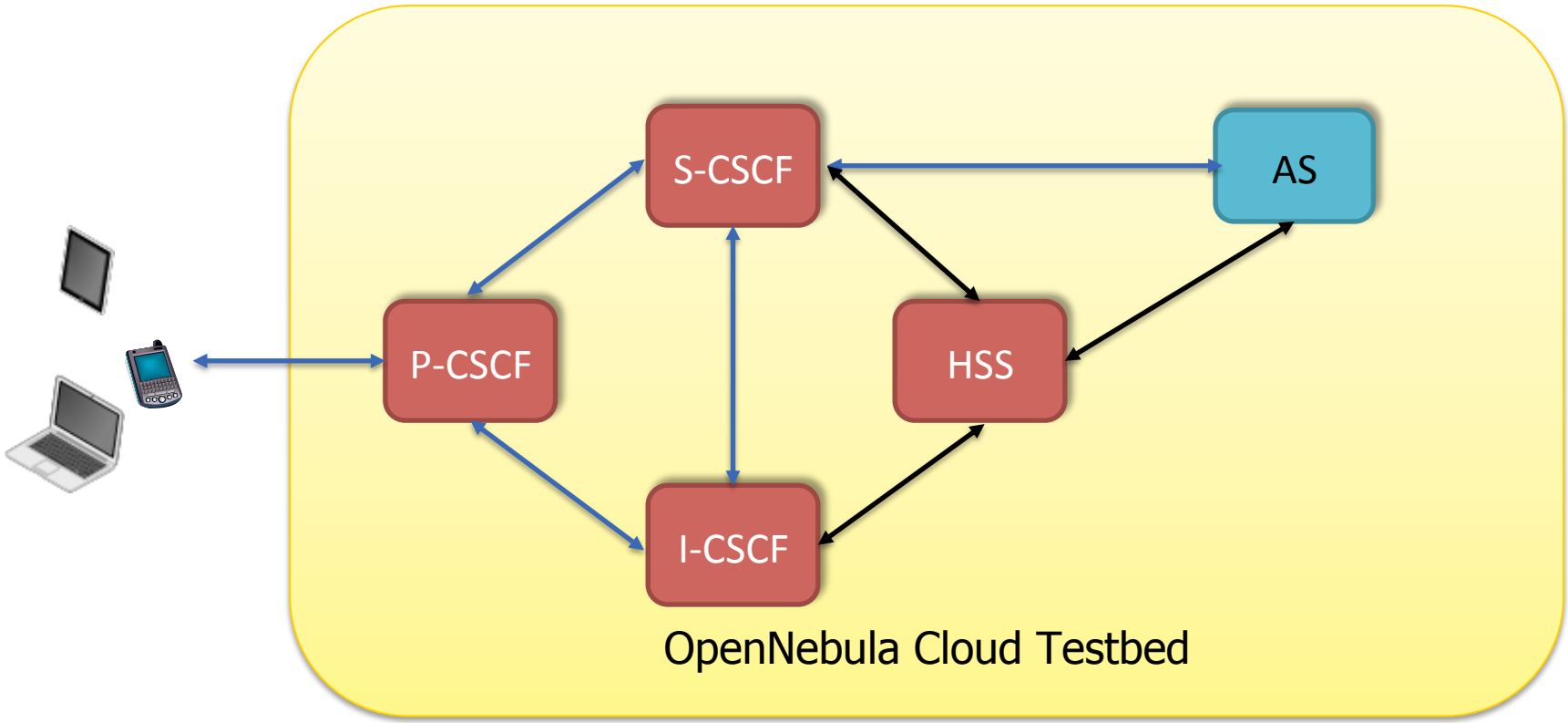
- State of the art testbed infrastructure as a cooperation of Berlin's Next Generation Mobile Network expertise for
  - **Open IMS** for H2H communications
  - **OpenMTC** for M2M communications
  - **OpenEPC** for seamless access
  - Various access network technologies
- Enabling to prototype application support for
  - handover optimization across heterogeneous networks
  - support for Always Best Connected (ABC)
  - subscriber profile based service personalization
  - QoS provisioning and related charging
  - controlled access to IMS-based services
  - controlled access to Internet/Mobile Clouds
  - ***SDN and NFV protoyping***



OpenMTC in a multi-cloud testbed



OpenIMSCore onto an OpenNebula testbed

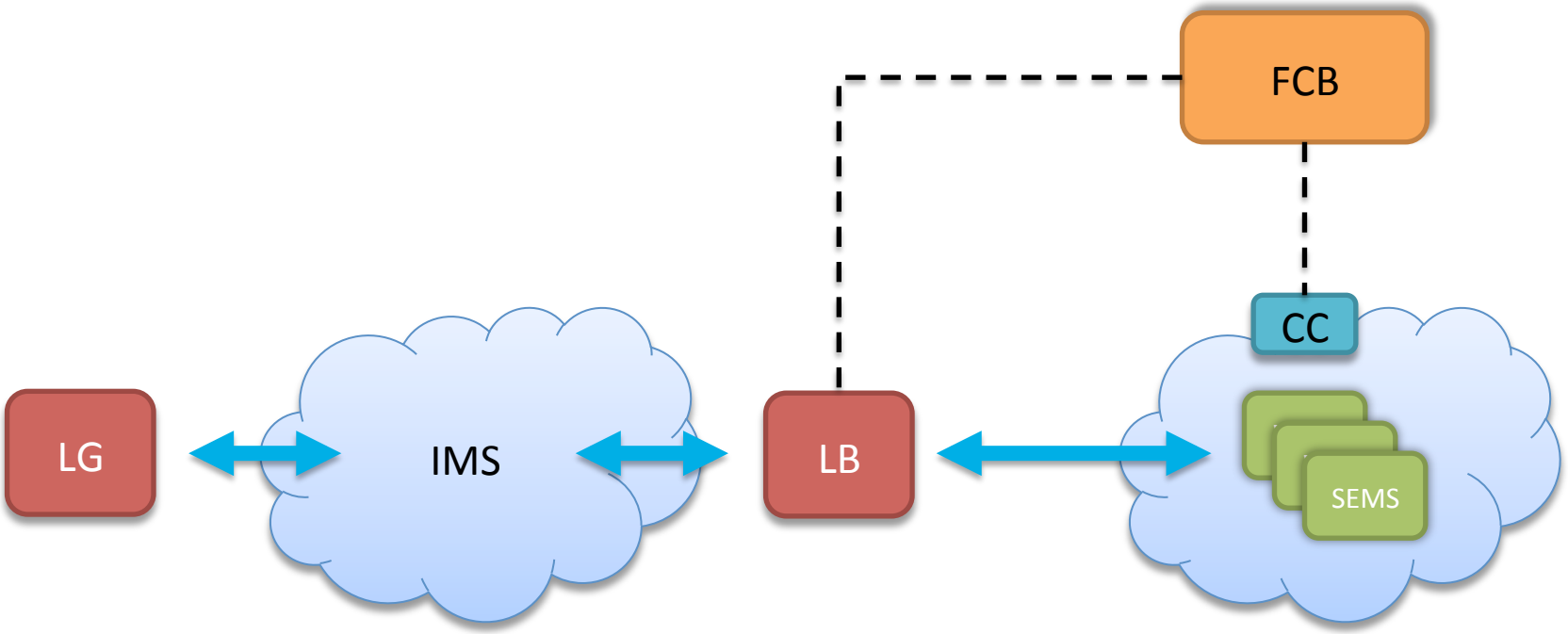


SIP

Diameter

The case of a Media Server as a SUT

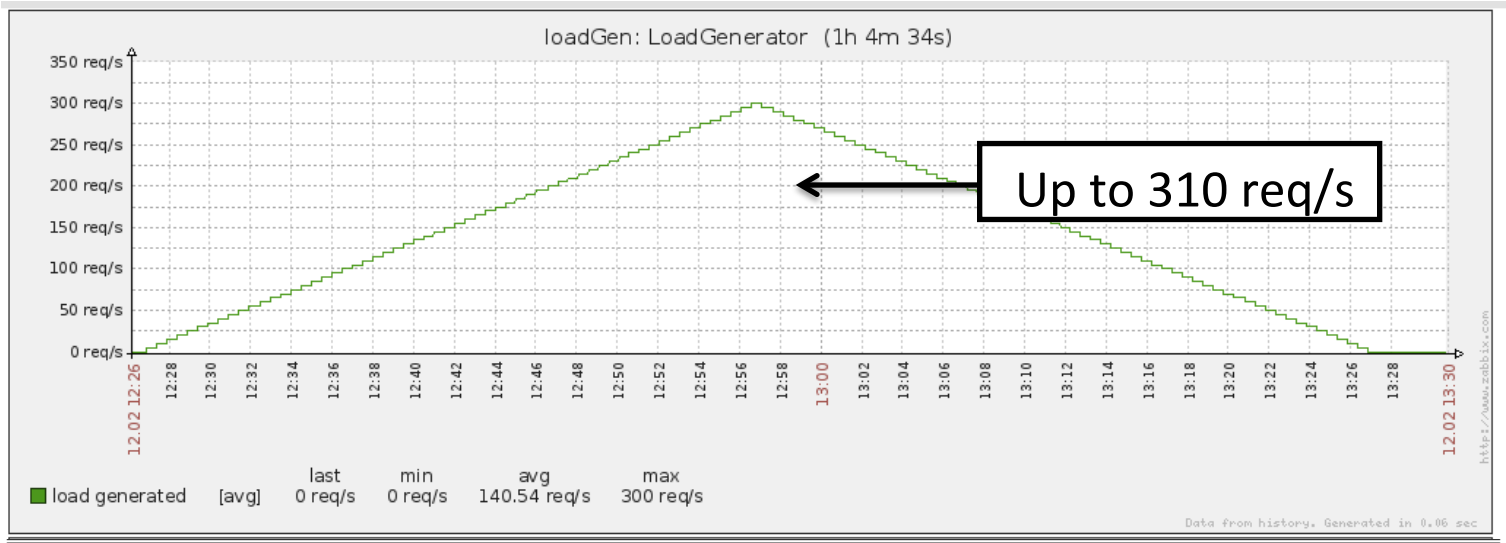
- Used SIP Express Media Server (SEMS) as a SUT:
  - Scenario of an announcement service

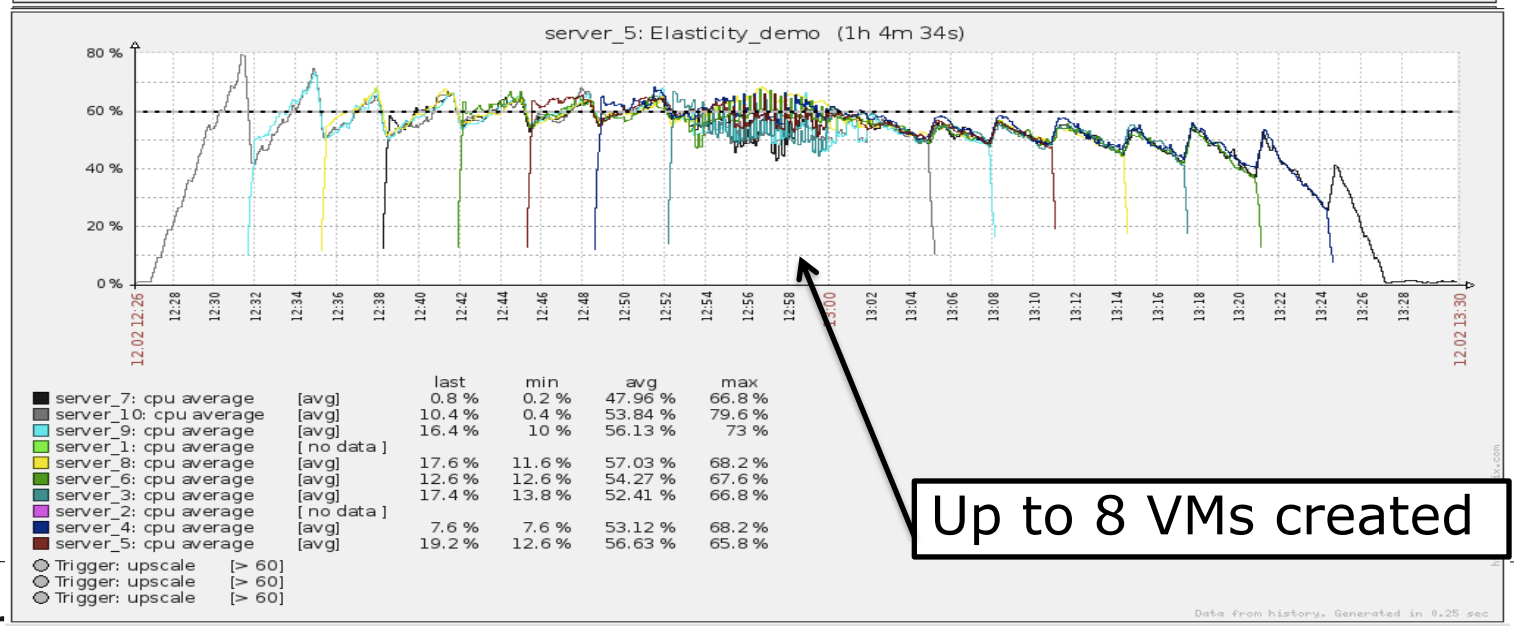


Application (SIP)

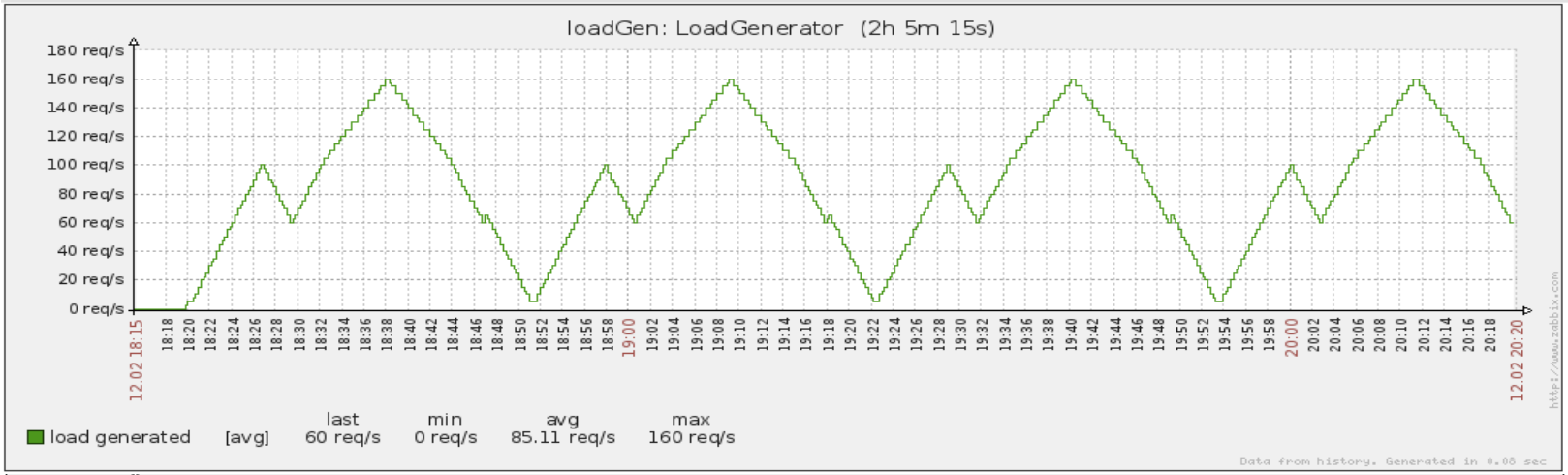
Control (OCCI/proprietary)

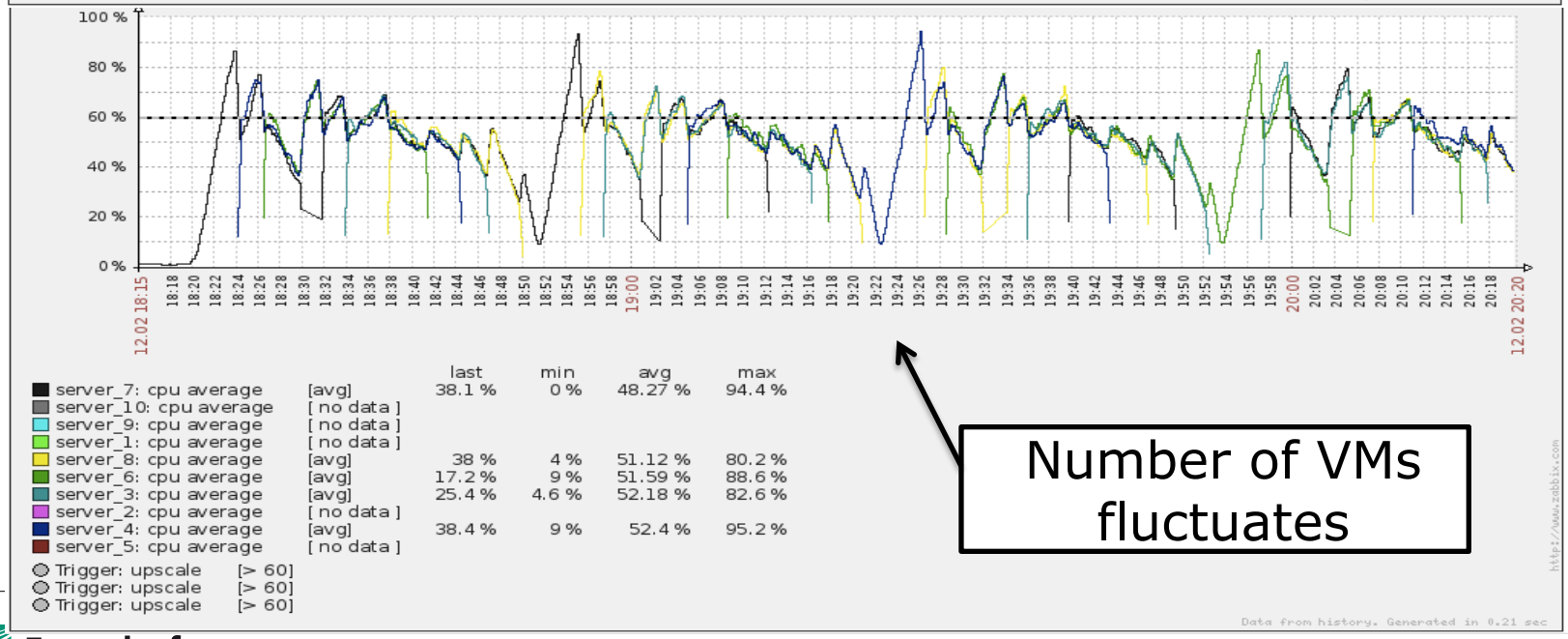
Experimental results (1/2)





Experimental results (2/2)





Number of VMs fluctuates

Conclusion and future work

- Conclusion
  - The FOKUS Cloud Broker has been evaluated in different cloud testbeds:
    - OpenNebula based testbed
    - BonFIRE multi cloud infrastructure
  - Different services have been managed by the FCB: for this work we considered a media server as example
- Future work
  - Integration with AmazonEC2
  - Provisioning and management of the OpenEPC framework

What is FOKUS OpenEPC Platform?

open epc
Fraunhofer FOKUS

- Future massive broadband communications will be realized through multi-access support (LTE, 3G, 2G, WiFi, fixed networks …) and multi-application domains (OTT, IMS, P2P, M2M, Cloud, …)
- Fraunhofer FOKUS is developing the **NON-OPEN SOURCE** OpenEPC toolkit, enabling to:
  - integrate various network technologies and
  - integrate various application platforms

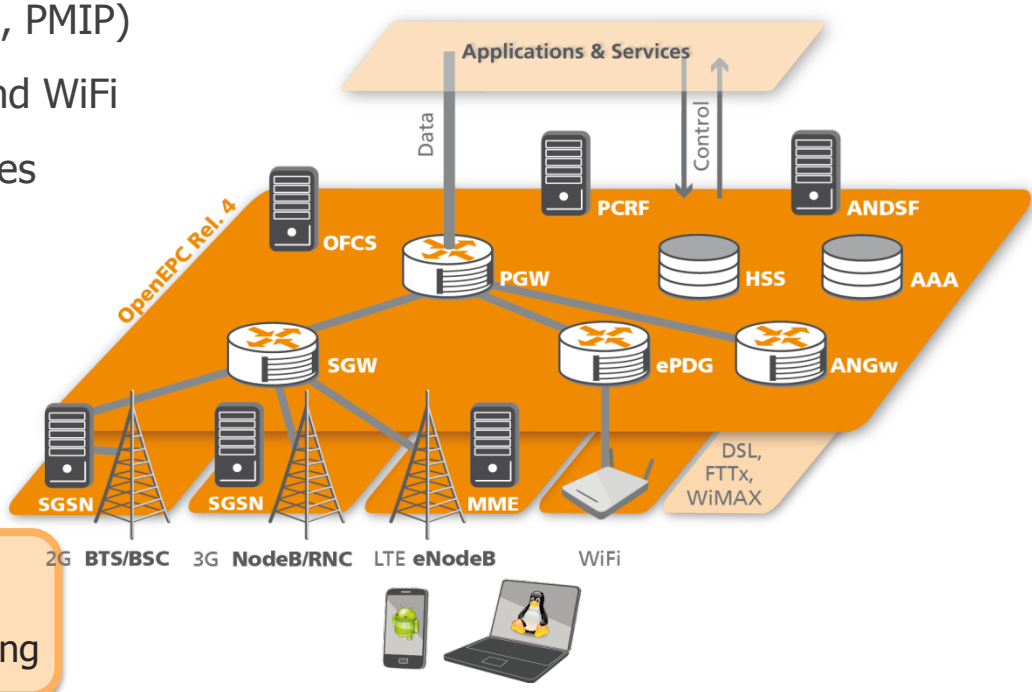
  into a single local testbed, thus lowering own development costs
- This platform can be used to perform R&D in the fields of QoS, Charging, Mobility, Security, Management, Monitoring
- OpenEPC represents a software implementation of the 3GPP EPC standard addressing academia and industry R&D:
  - Based on 3GPP standards
  - Configurable to different deployments
  - Customizable to the various testbed requirements
  - Extensible to specific research needs
  - Reliable & highly performant
- More information: www.OpenEPC.net

OpenEPC Rel. 4:
Mirroring the Future Operator Core Network

open epc

Fraunhofer FOKUS

- OpenEPC includes the almost all functions of 3GPP Evolved Packet Core Rel. 11
- The principles of standard alignment, configurability and extensibility have been respected in the overall architecture and in the specific components implemented
- OpenEPC Rel. 4 enables the establishment of small operator network testbeds including:
  - Core network mobility support (GTP, PMIP)
  - Integration with real LTE, 3G, 2G and WiFi
  - AAA for 3GPP and non-3GPP accesses
  - Policy and Charging Control
  - Access network selection
  - Common mobile equipment support



PLEASE NOTE: OpenEPC does not claim 100% standard compliance, but allows for early prototyping

OpenEPC includes all the main required functions and more

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OpenEPC

Core Network Mobility Support
3GPP LTE, 3G, 2G support
non-3GPP accesses support
Client Mobility Management
Policy and Charging Control
Accounting and Billing
Subscriber Identity Mgmt
AAA
Distribution Features

Demo. Enablers

Open IMS Core
Adaptable video streaming app
HTTP Interceptor

API for Applications

QoS and Events
Access Network Selection
Correlated Charging

Provisioning System

Subscription provisioning
Automatic component config
Automatic deployment tools

Evaluation

Packet Tracking
FlowMon
Load Monitoring Tool

Transport Networks

Data packets forwarding
QoS enforcement
Data Flow accounting

Management System

Remote Procedure Calls
Dynamic Ctrl. Plane Parameters
Subscriber management (IMSI)

Access Networks

LTE, 3G, 2G connectivity
Minimal CS support
non-3GPP connectivity

Mobile Device

Zero-packet loss handover
Android and Linux OS devices
SIM cards and single auth

OpenEPC Scales for different deployments

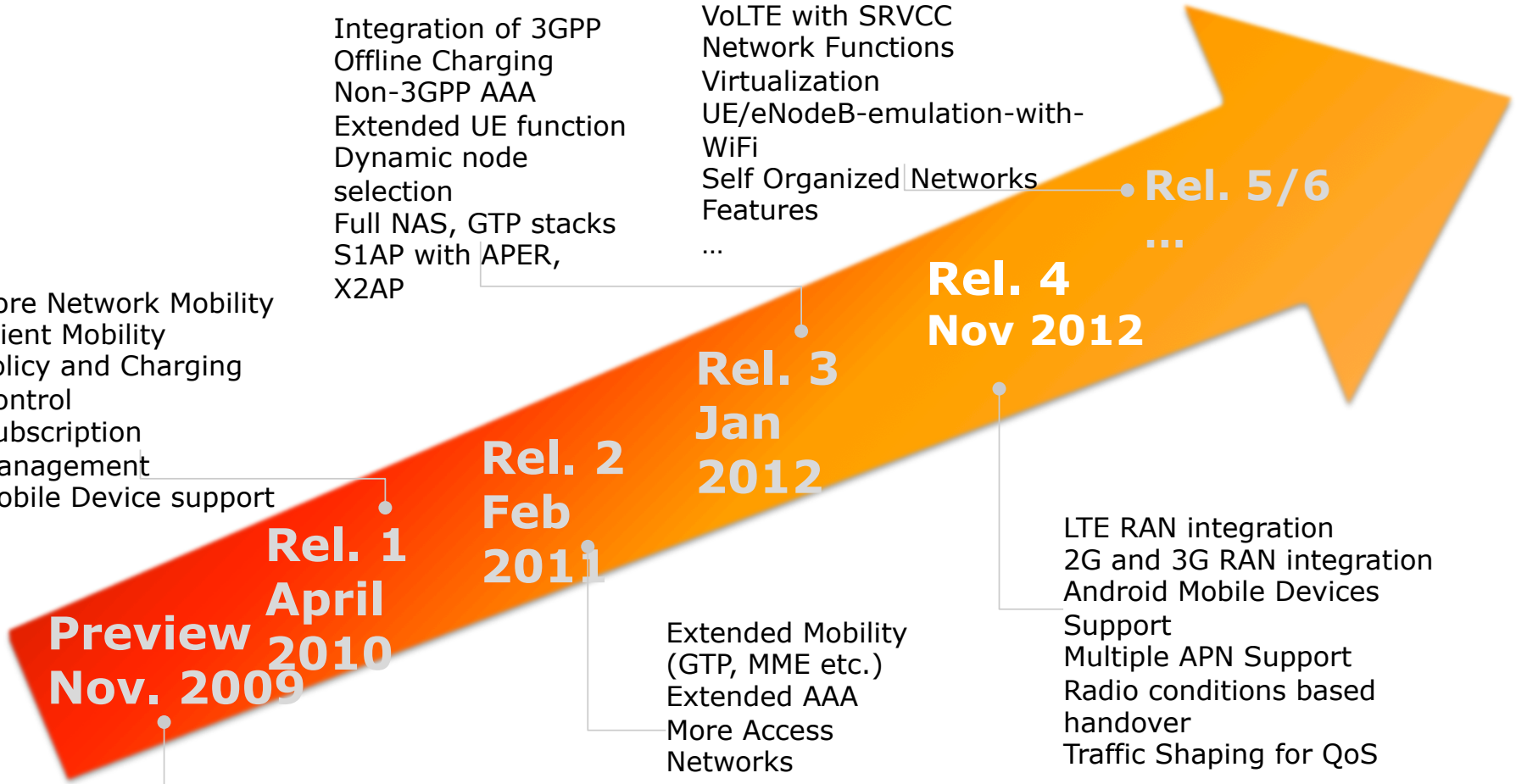
open epc
Fraunhofer FOKUS

- OpenEPC components can be deployed in almost any configuration possible
  - Large testbeds – each component on a separate machine
  - Smaller testbeds – components are grouped in same servers
  - Single box testbed – components are virtualized on the same machine
  - Minimized testbed – the OpenEPC components run as parallel programs on the same box

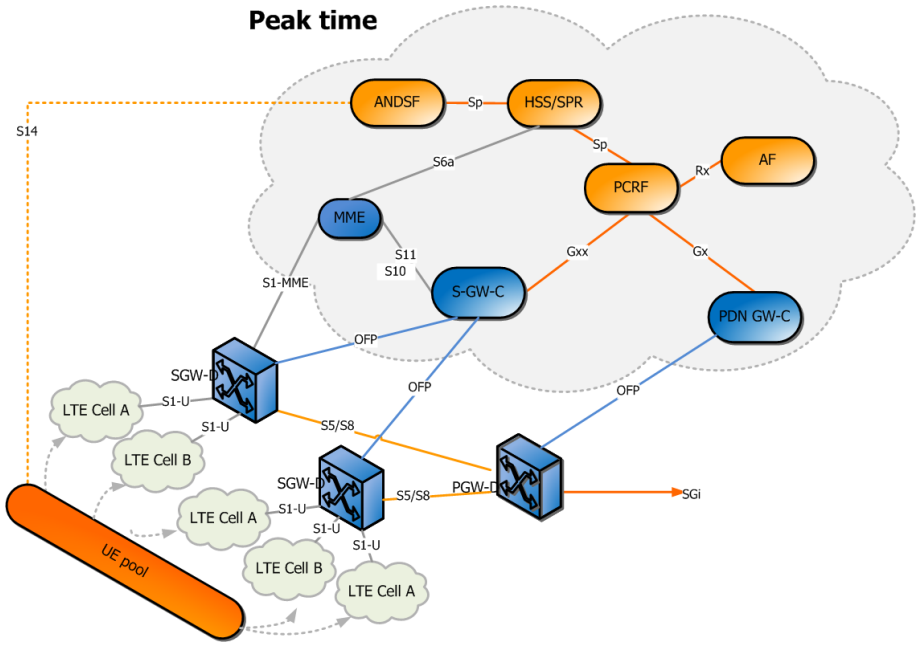
Large Testbed

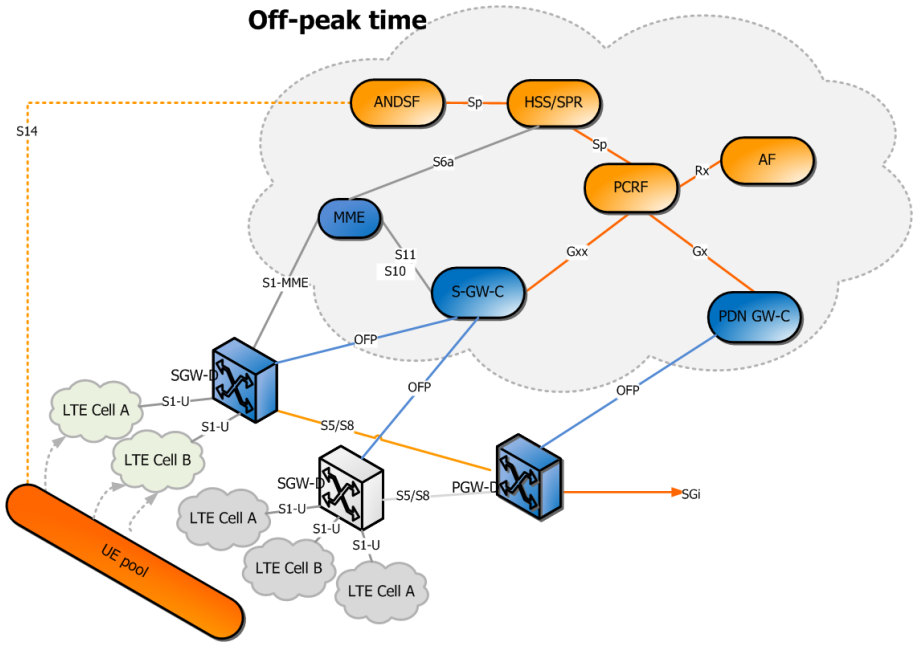
Single Box Testbed

Minimized Connectivity


Preview
Nov. 2009
Rel. 1
April
2010
Rel. 2
Feb
2011
Rel. 3
Jan
2012
Rel. 4
Nov 2012
Rel. 5/6
...
Core Network Mobility
Client Mobility
Policy and Charging Control
Subscription Management
Mobile Device support
Integration of 3GPP Offline Charging
Non-3GPP AAA
Extended UE function
Dynamic node selection
Full NAS, GTP stacks
S1AP with APER, X2AP
OpenFlow and SDN-EPC
VoLTE with SRVCC
Network Functions Virtualization
UE/eNodeB-emulation-with-WiFi
Self Organized Networks Features
...
First demo of the OpenEPC at the 5th IMS Workshop
Extended Mobility (GTP, MME etc.)
Extended AAA
More Access Networks Integration
Support for specific applications
LTE RAN integration
2G and 3G RAN integration
Android Mobile Devices Support
Multiple APN Support
Radio conditions based handover
Traffic Shaping for QoS

What's next: Elastic and Flexible Network Design - Example EPS



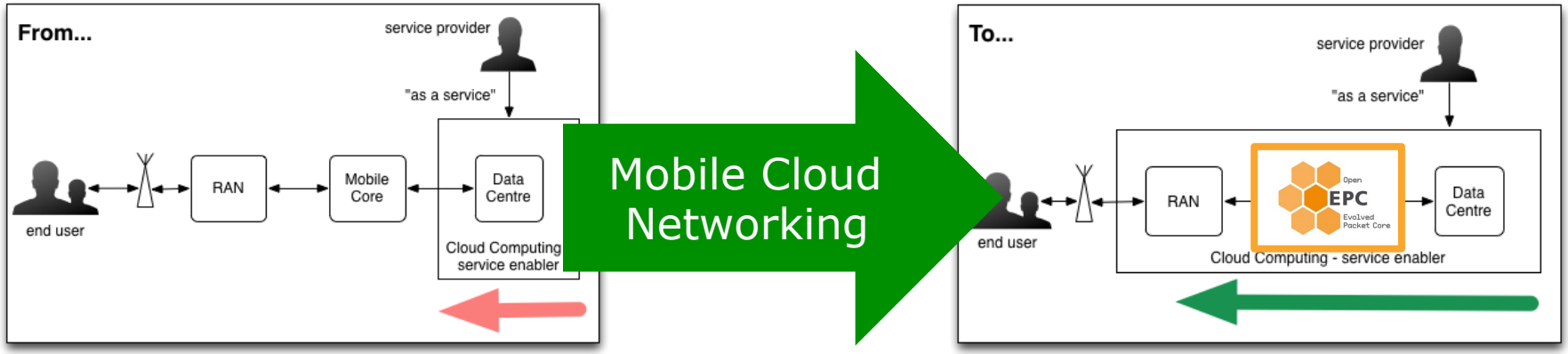


- Elastic network design aligned on real-time network load situations
- Enablement and disablement of redundant access- and core-network elements
- Optimized energy consumption of the access- and core-network
- Network Resources as a Service (NRaaS) and on demand

EU Mobile Cloud Networking Project makes use of OpenEPC for EPCaaS Prototyping

MCN
Mobile Cloud Networking

- FP7 Intergated Project started in November 2012 for 36 month targeting for bringing cloud computing features to mobile operator core networks (EPCaaS):
  - Virtualization of components
  - Software defined networks
  - Elasticity
  - Total distribution
  - Infrastructure sharing
  - Redefining roaming
- OpenEPC is used as the basis platform for mobile core network experimentation



For more: http://mobile-cloud-networking.eu

4th FOKUS „Future Seamless Communication“ Forum (FFF) Berlin, Germany, November 28-29, 2013

FUSECO Forum 2013
FUTURE SEAMLESS COMMUNICATION

- **Theme: „Smart Communications Platforms for Seamless Smart City Applications – Fixed and Mobile Next Generation Networks Evolution towards virtualized network control and service platforms and Seamless Cloud-based H2H and M2M Applications“**
- FUSECO FORUM is the successor of the famous FOKUS IMS Workshop series (2004-09)
  - FFF 2010 attracted 150 experts from 21 nations
  - FFF 2011 was attended by around 200 experts from 30 nations
  - FFF 2012 was attended again by around 200 experts from 30 nations

- See **www.fuseco-forum.org**

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