

Talk at IEEE Africon Workshop Key Enabling Communication Technologies for Emerging Smart City Applications" at IEEE Africon 2013 Conference, Le Meridian, Mauritius, September 9, 2013

# ***Towards Smart City Service Delivery and Control Platforms*** - Putting SDP, IMS, MTC, and EPC into a single context

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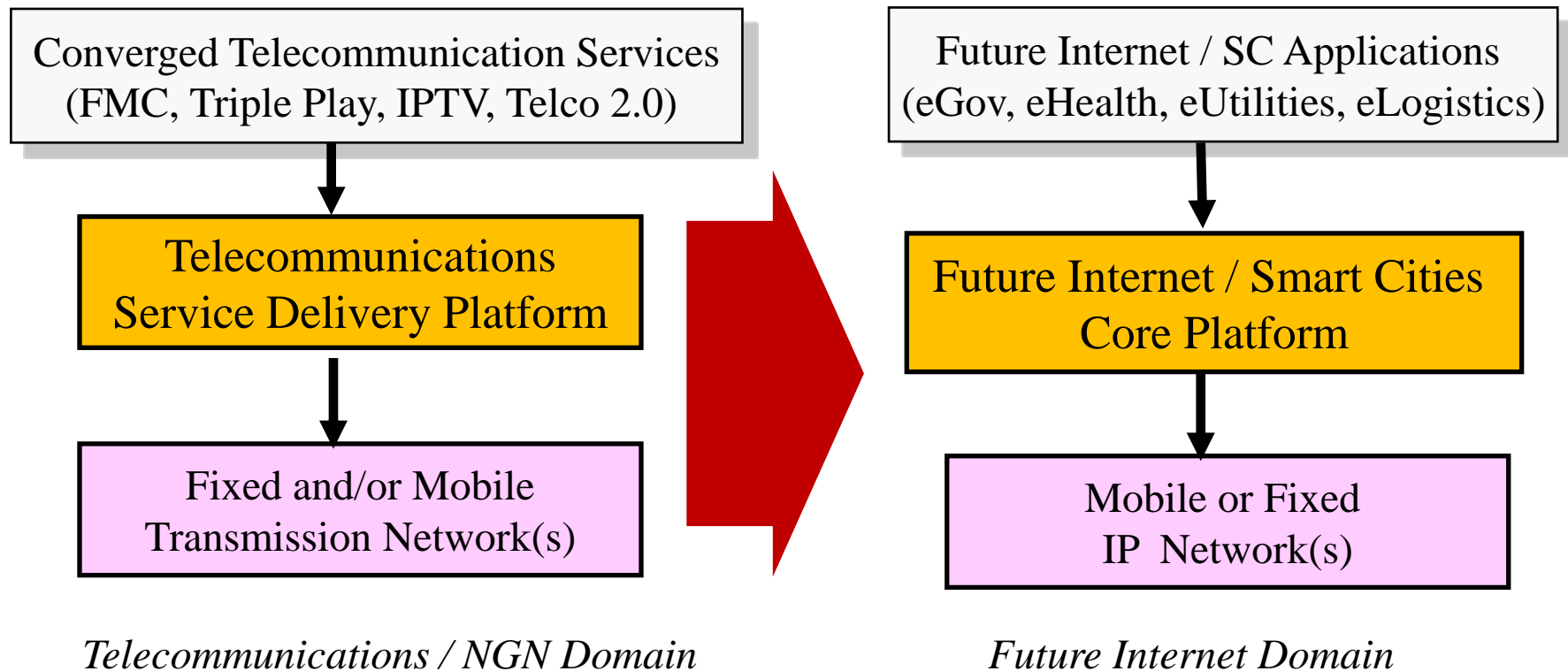


## Agenda

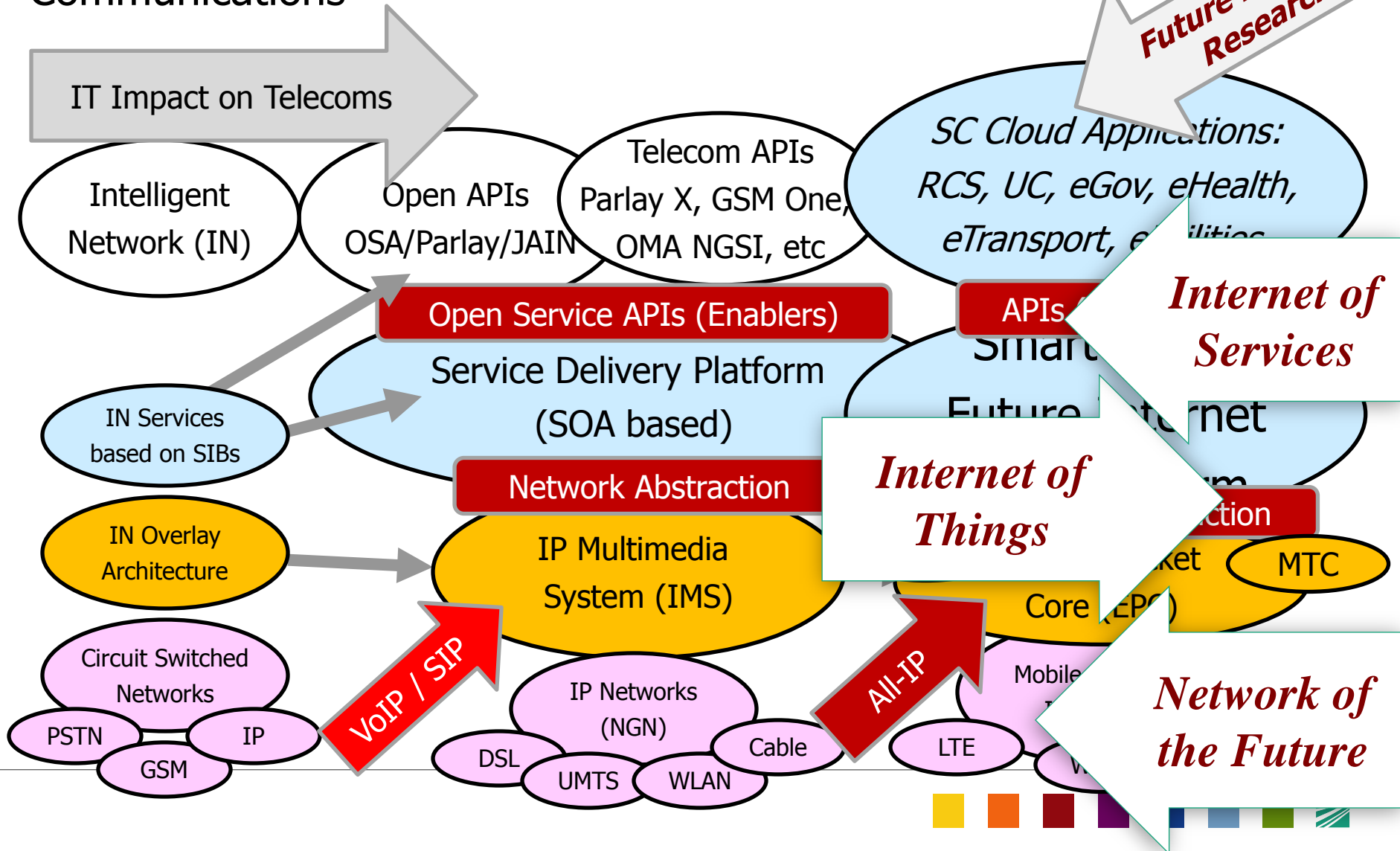
- The Role of IP Multimedia Subsystem, Machine Type Communication, Evolved Packet Core and related Open APIs within emerging Smart City SDPs
- FOKUS Toolkits and practical examples
- Summary

## A déjà vu - From NGN towards SDPs for Future Internet / Smart Cities

*Main Idea: A Core Platform provides reusable capabilities (→ Enablers) for multiple applications hiding the details of underlying technologies*



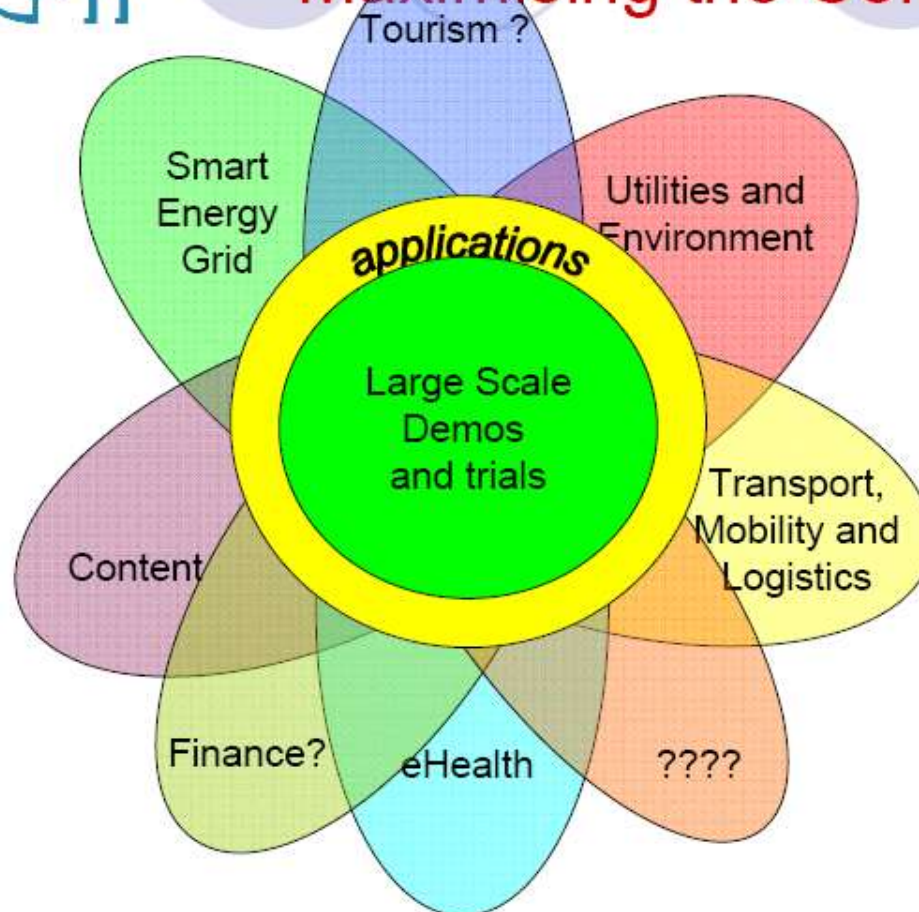
## IT Impact on Telecoms



# The Notion of Enablers within the European Future Internet Initiative



## Maximising the Common enablers



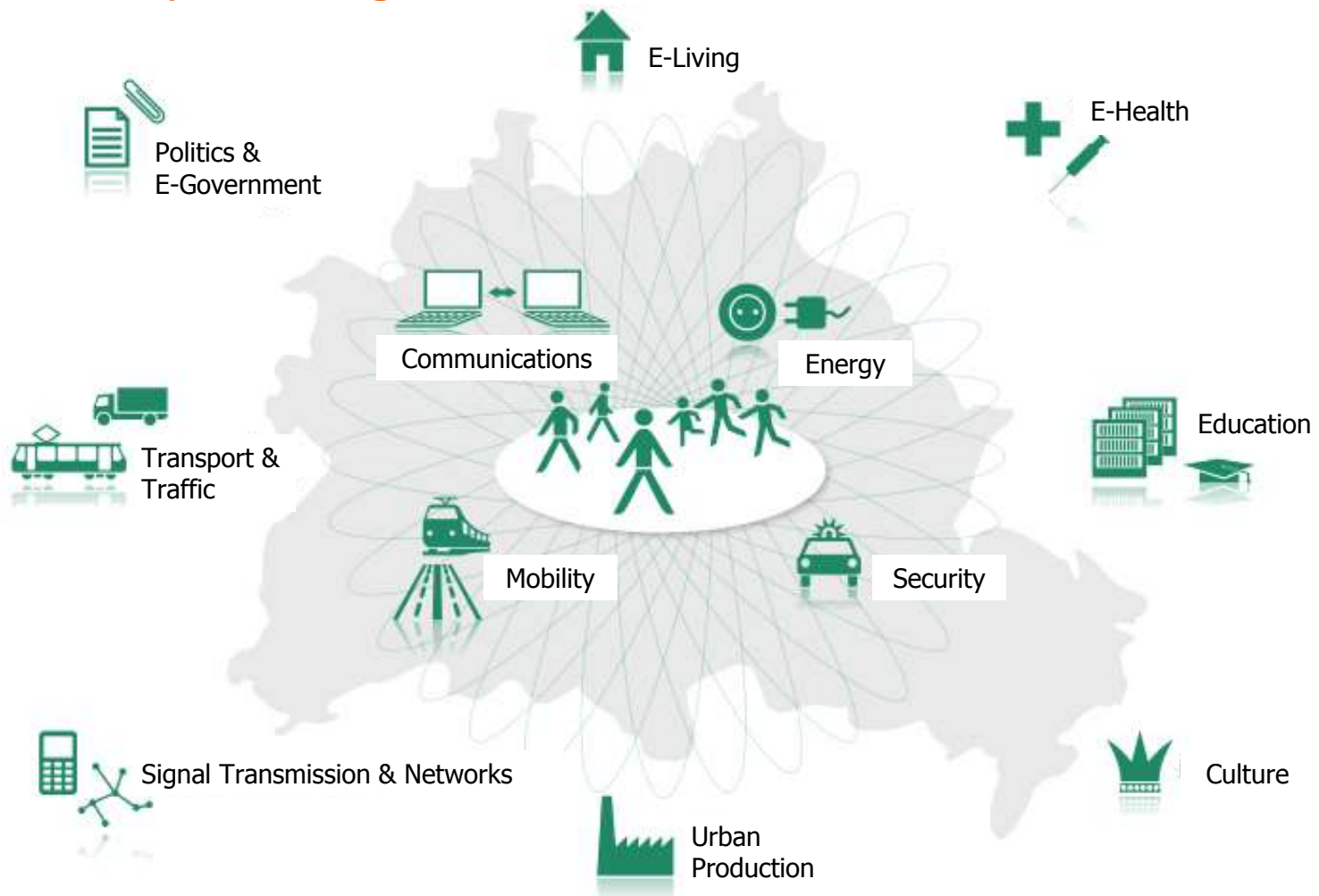
- Examine the basic enablers in each area
- Determine the common enablers
- Determine the enhanced enablers
- Work out how to provide a core platform that supports the enablers
- Build it and show the world
- Use it in large scale trials and tests
- Use existing advanced infrastructures to test future Internet function

# Agenda

- The Role of IP Multimedia Subsystem, Machine Type Communication, Evolved Packet Core and related Open APIs within emerging Smart City SDPs
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# Future Internet ... to make our cities smart

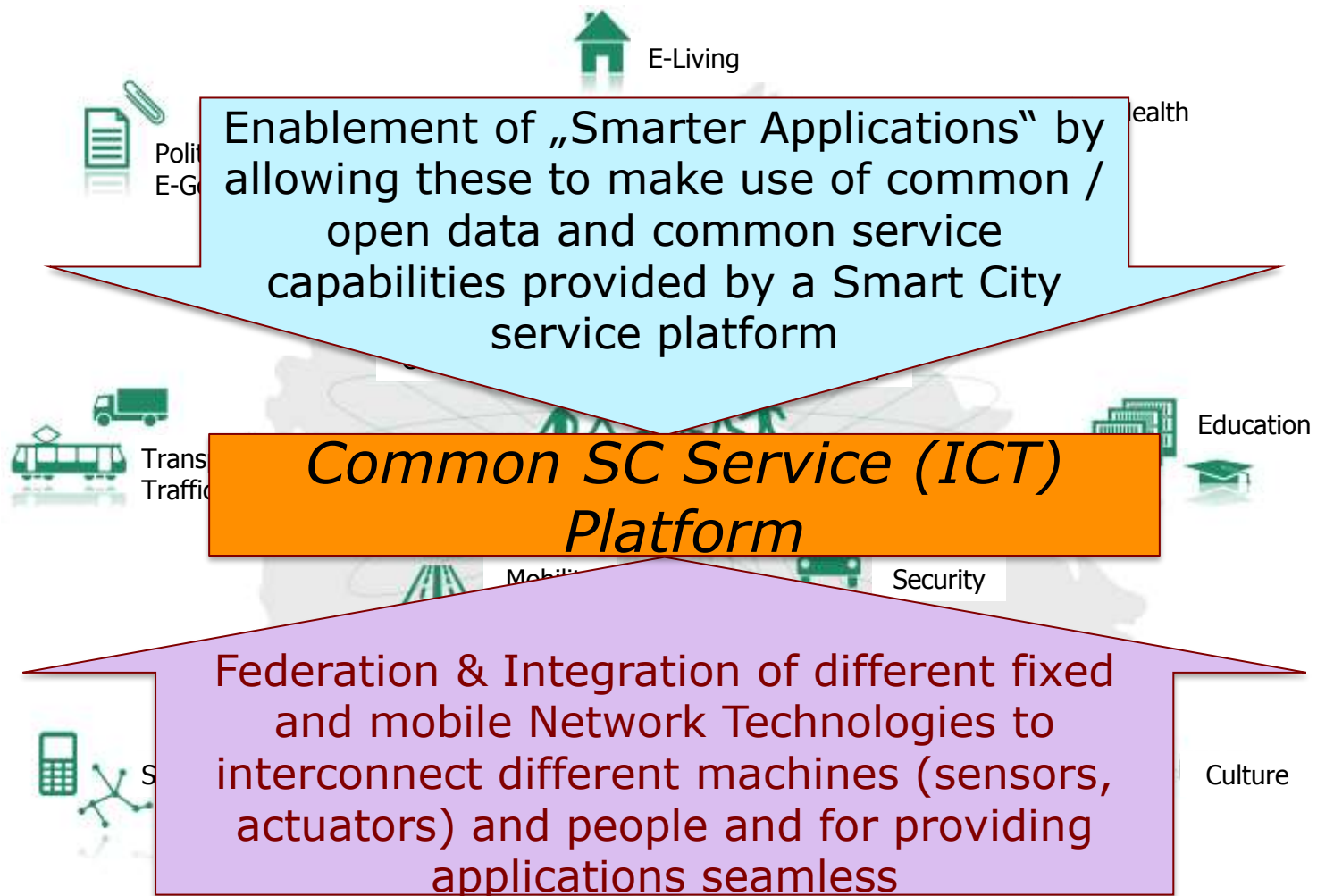
## A Smart City is a huge Future Internet Show Case





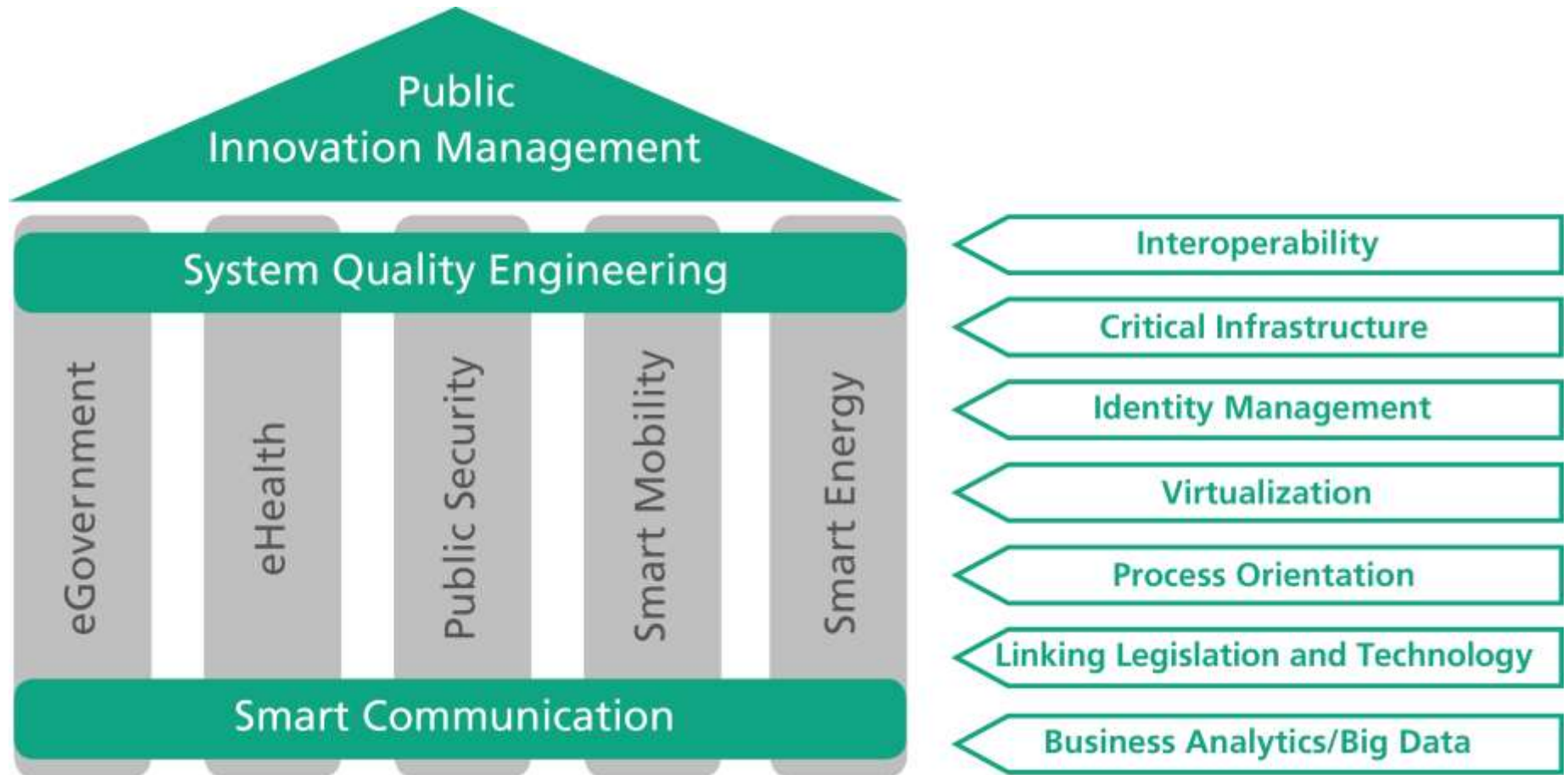
# A Smart City relies on Integration & Federation of Systems

Convergence will lead to a Common SC Service (ICT) Platform





# Fraunhofer FOKUS – Activity Domains



# Research Agenda of Fraunhofer: Smart City Vision

## Environment

Cities that produce  
**almost no more CO<sub>2</sub>-Emissions.**

## Energy

Cities that are greatly  
**energy-efficient.**

## Resources

Cities that are profoundly  
**resource-efficient.**

## Quality of life

Cities that provide the  
**best life quality** for all  
residents.



»**Morgenstadt**«

 **Fraunhofer**

## Society

Cities that **represent a**  
**post-fossil society.**

## Smart City

Cities that **intelligently**  
**interlink** all its potentials  
and city systems.

## Climate Change

Cities that can easily  
adapt to the **effects of**  
**climate change.**

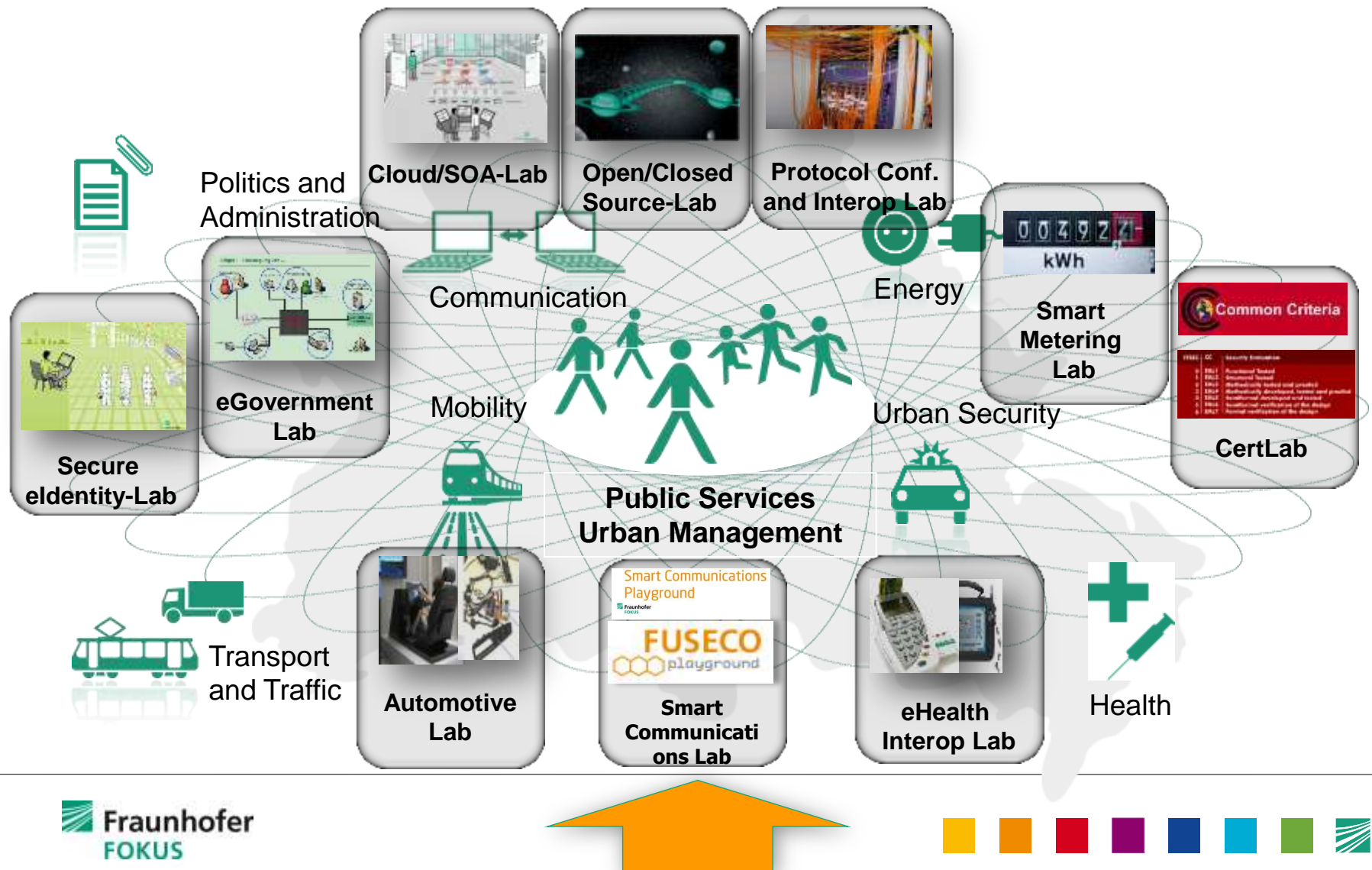
## E-Mobility

Cities that offer a **medium**  
for the **change towards**  
**electromobility.**

Quelle: www.big.dk

# Solutions made by FOKUS

## FOKUS labs on ICT in Smart Cities





# ***Smart City ICT***

## *Tools & Testbeds*



fokus broker



Smart Communications  
Playground



osims



open mtc

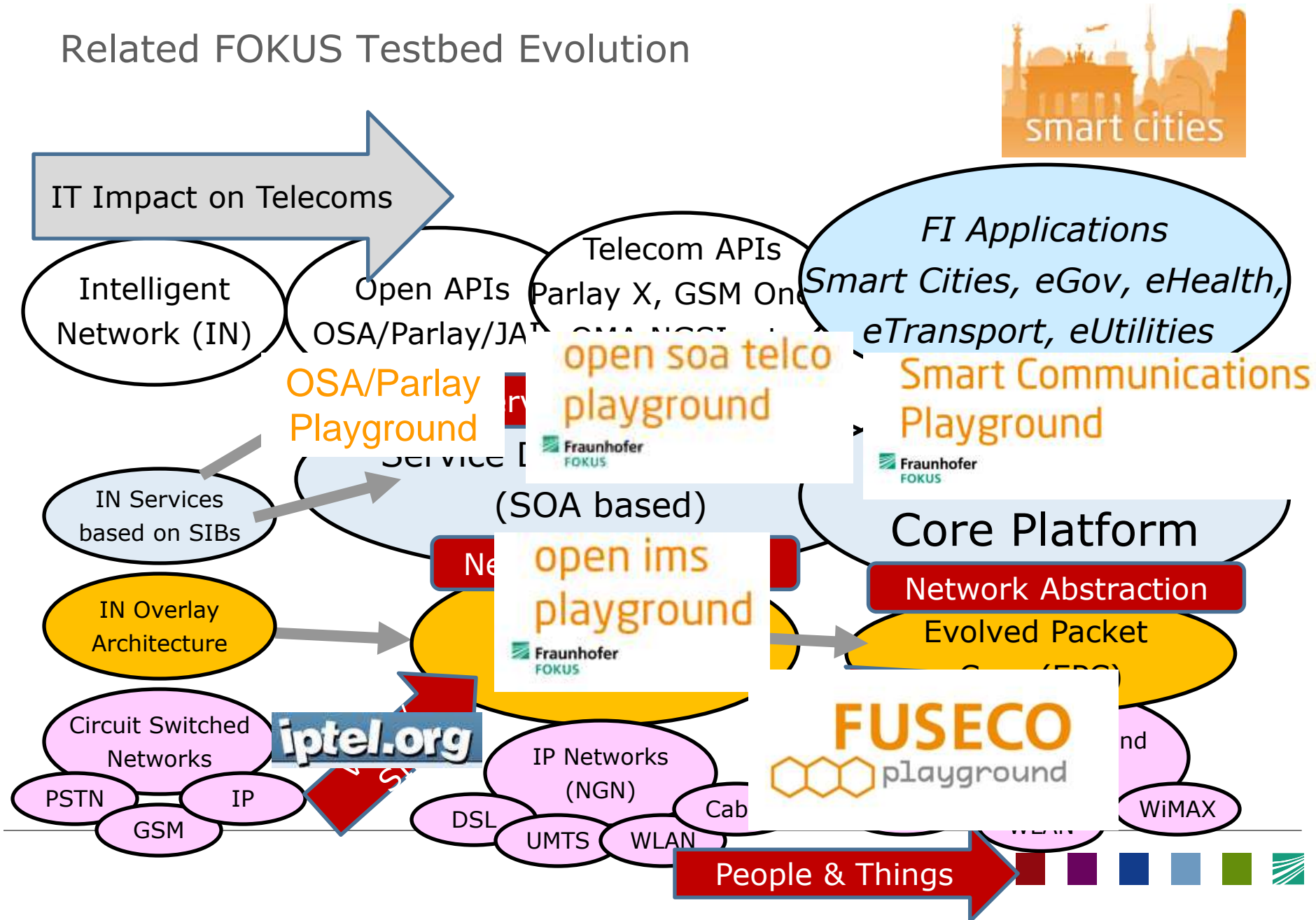


open epc





## Related FOKUS Testbed Evolution



## Stakeholders

Operators



- Be prepared for all-IP mass mobile broadband world
- Validate new technologies

Manufacturers



- Validate their products against standard compliant EPC
- Looking for the missing pieces

Application developers



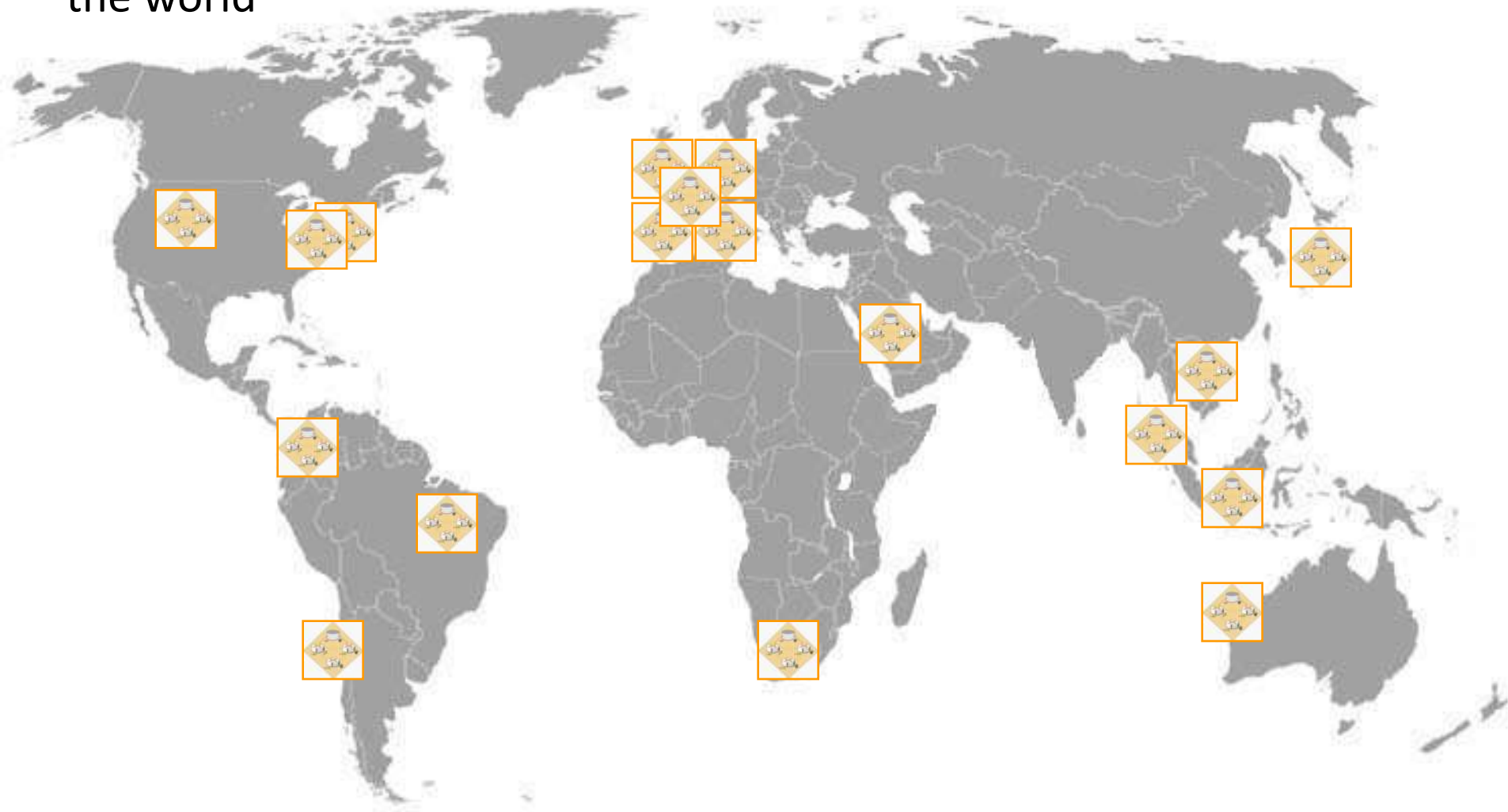
- Validating wireless applications
- Direct access to core functionalities

Research institutions and universities



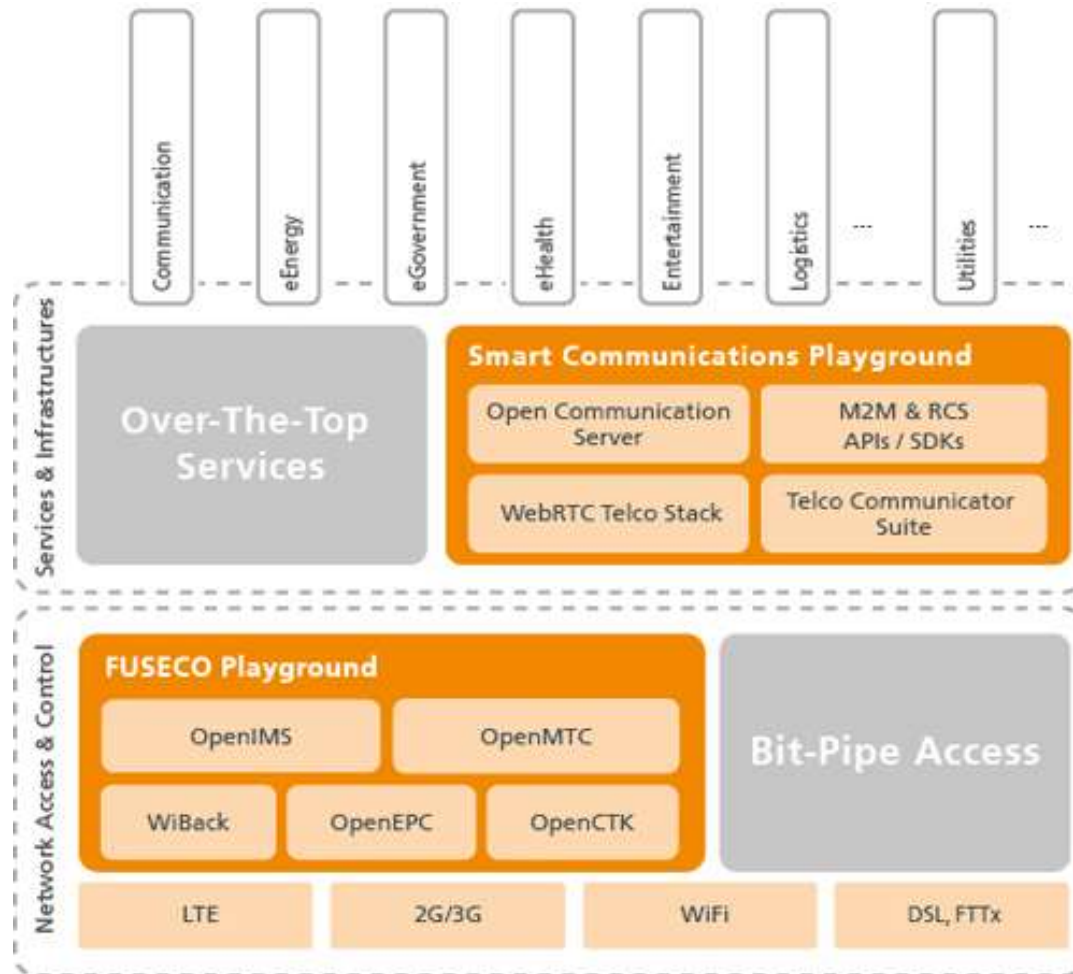
- R&D on real network conditions
- Innovating new concept and algorithms

# Commercial FOKUS NGN/IMS/EPC/SOA Testbed Deployments around the world





# Fraunhofer Testbeds / Playgrounds



## Smart Communications Playground



[www.SC-playground.org](http://www.SC-playground.org)

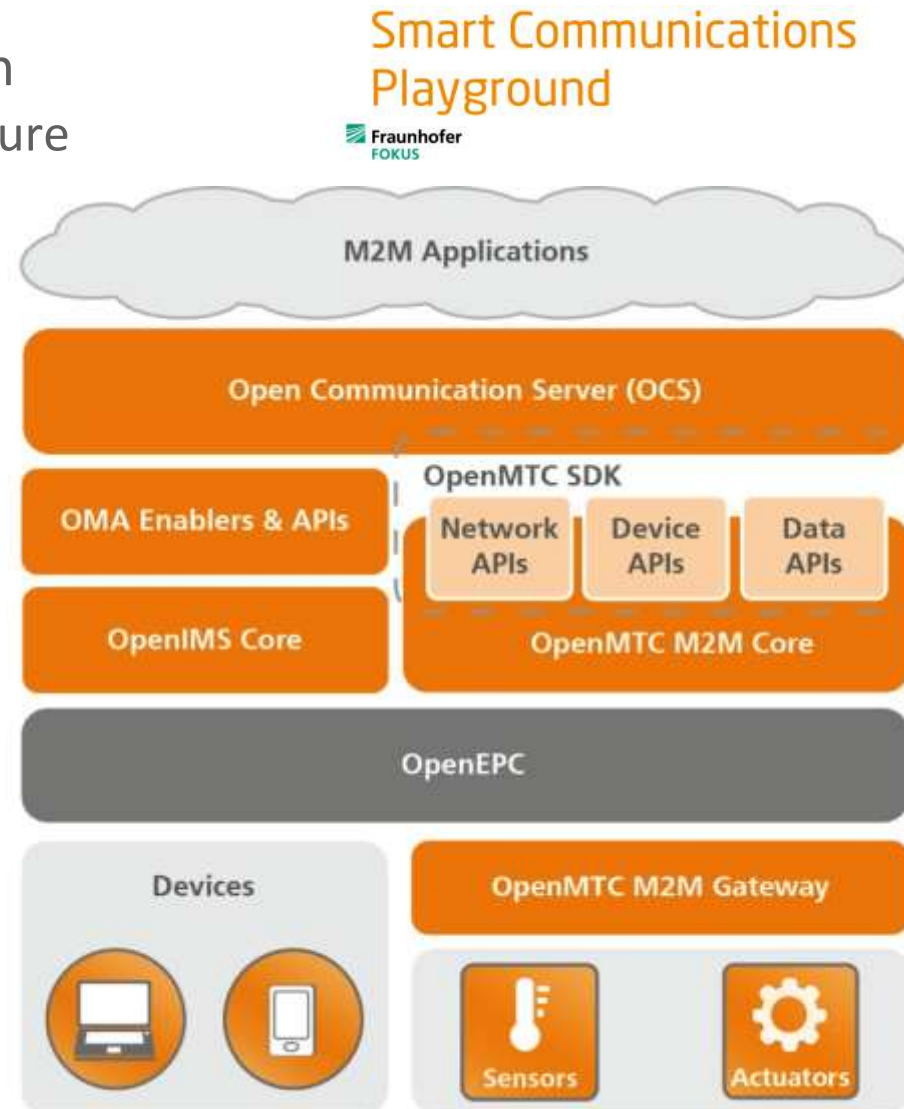
**FUSECO**  
playground

[www.FUSECO-Playground.org](http://www.FUSECO-Playground.org)



## FOKUS Smart Communication Research A Generic Smart Communication Architecture

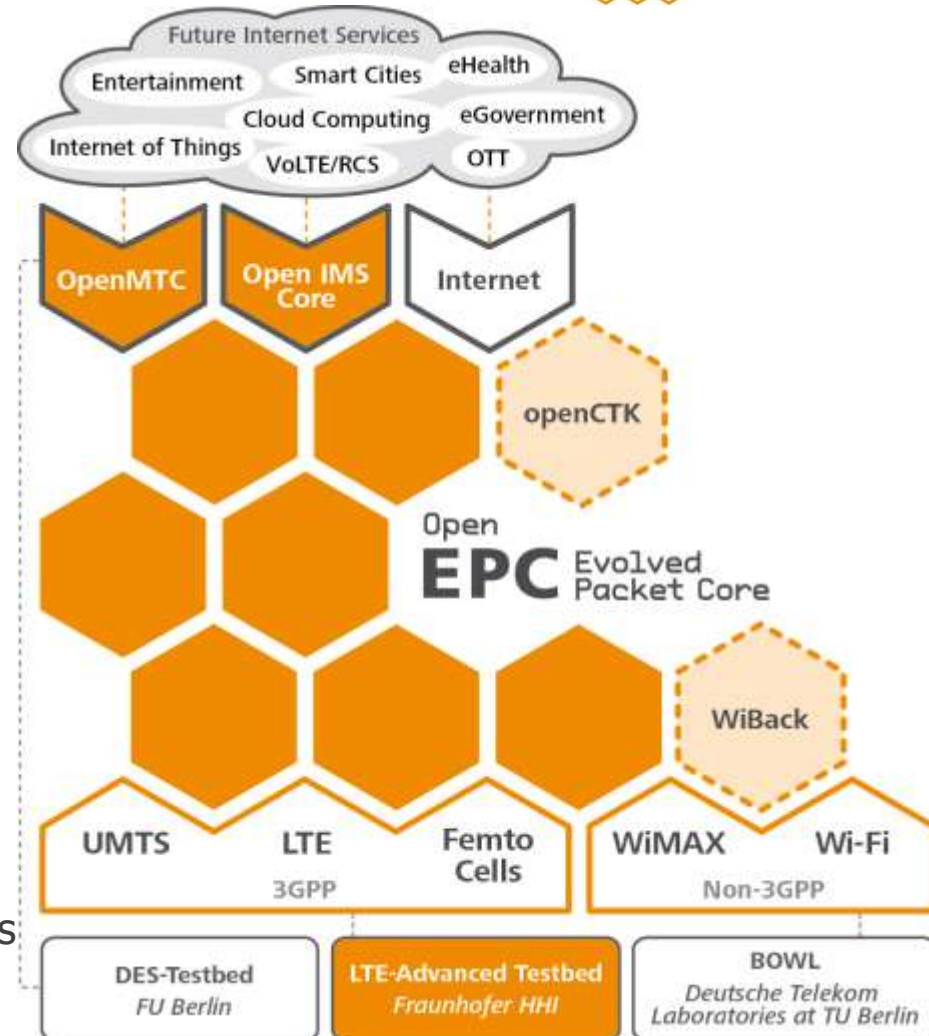
- Connecting Smart City objects across application domains
- Enabling the Internet of Things by using M2M gateways and network middleware to communicate efficiently
- Enabling multimedia communication services by integrating Telecoms APIs and platforms.
- Enable rapid application development using M2M and H2H network APIs and software development kits (SDK)
- Enable cross domain data analytics and fusion to serve the need of Smart Cities



# Future Seamless Communication (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
- More information:



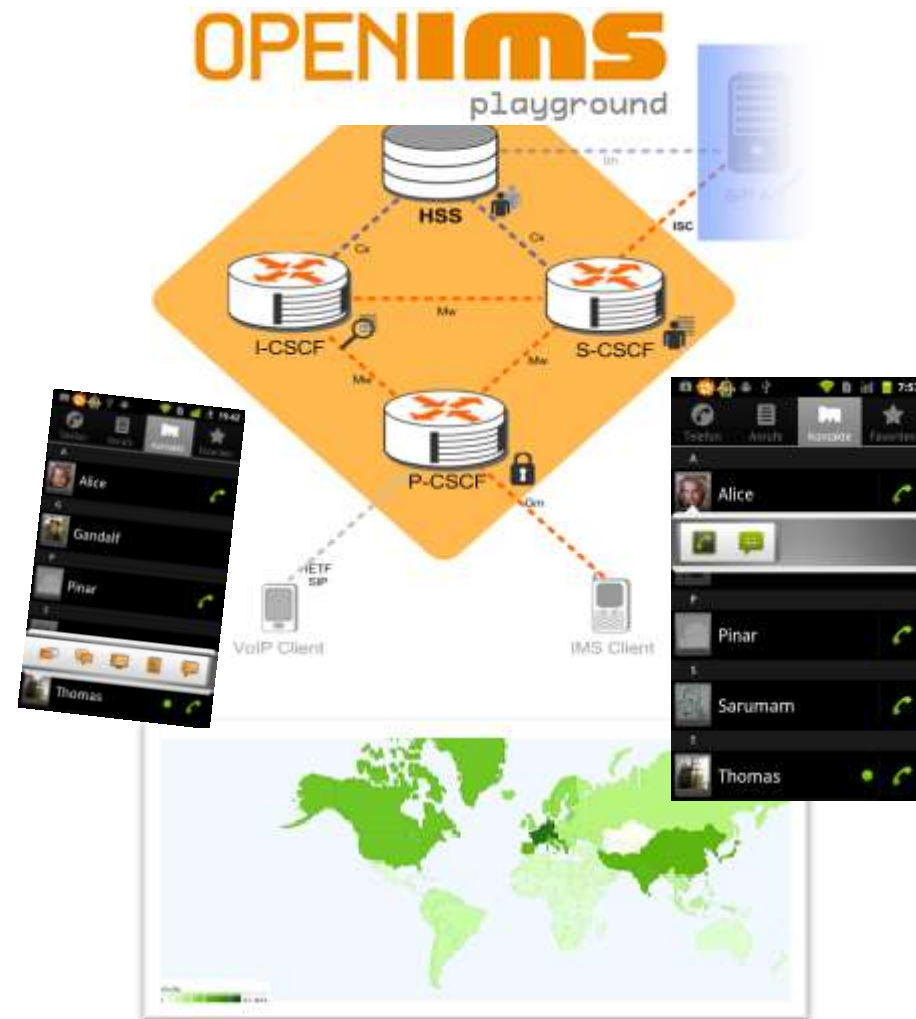
## The Start: Open Source IMS Core

- Global reference for IMS test-beds
- In November 2006 the FOKUS **Open Source IMS (OSIMS) Core** System - the core of the **Open IMS playground** - has been officially released to the general public via the BerliOS Open Source portal

[www.openimscore.org](http://www.openimscore.org)

- OSIMS allows industry and academic institutions to setup own testbeds (with or without FOKUS support and components)
- Since then OSIMS has been downloaded many thousand times from all over the world

See also [www.open-ims.org](http://www.open-ims.org)



**Note: IMS Client shown is MyMonster**  
— see [www.opensoapplayground.org/tcs](http://www.opensoapplayground.org/tcs)



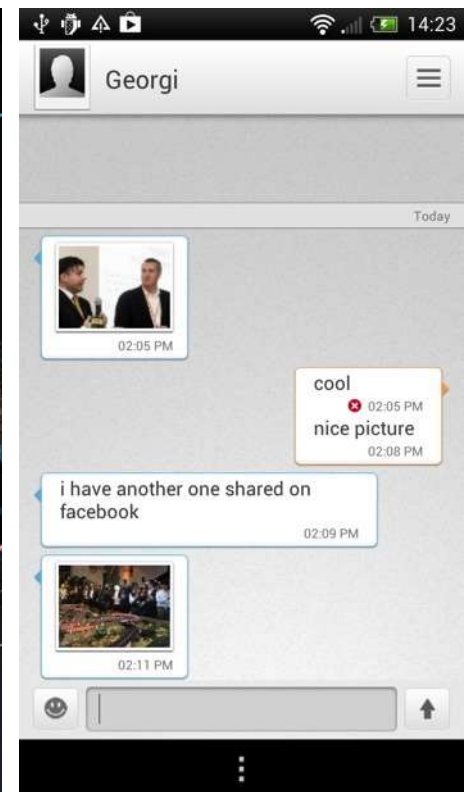
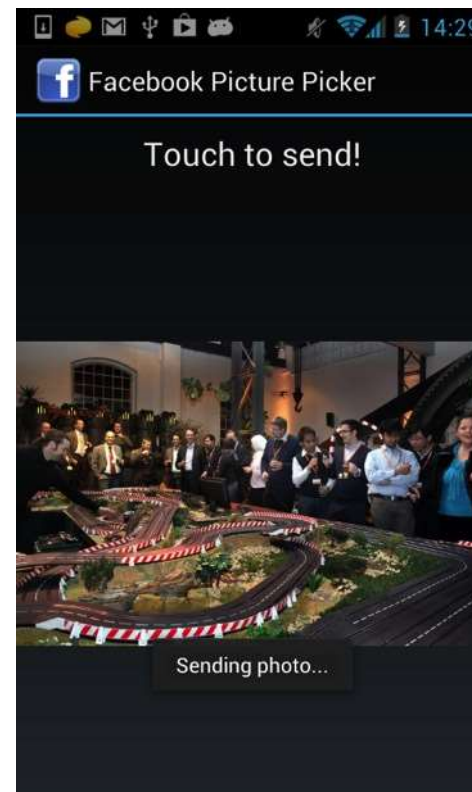
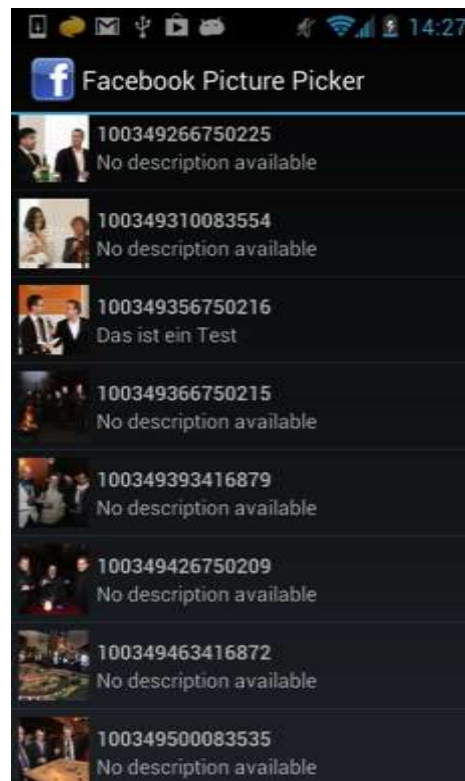


# FOKUS joyn App for Deutsche Telekom

## Extending RCS for Facebook Image sharing

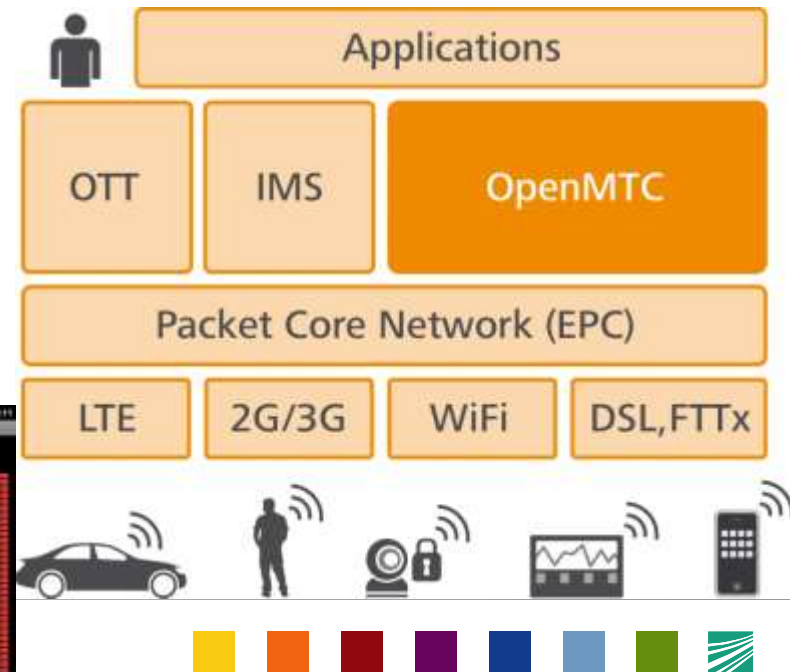


- App uses Deutsche Telekom RCS network gateway to provide mobile image sharing for Facebook images
- Extends Facebook network with mobile operator RCS network



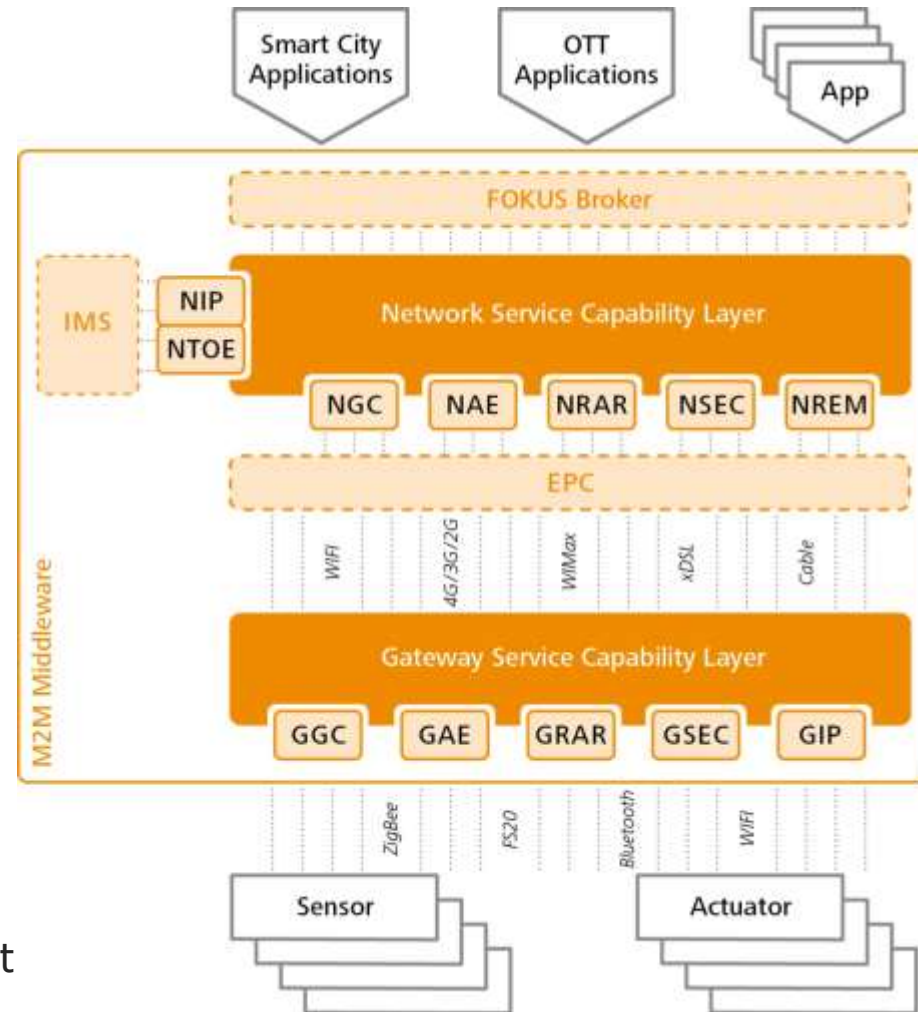
# Introducing the FOKUS OpenMTC Platform

- Based on the success of the Open IMS Core and OpenEPC Fraunhofer FOKUS has developed a **NON-OPEN SOURCE** Machine Type Communication platform, enabling academia and industry to:
  - integrate various machine devices with operator networks
  - integrate various application platforms and servicesinto a single local testbed, thus lowering own development costs
- OpenMTC is an intermediary layer between multiple service platforms, the operator network, and devices
- This platform can be used to perform R&D the fields of machine type communication
- OpenMTC implemented features are aligned with ETSI M2M specifications:
  - Adaptable to different M2M scenarios (e.g. automotive)
  - Extensible to specific research needs
  - Configurable
  - Performant
- For more see [www.open-MTC.org](http://www.open-MTC.org)



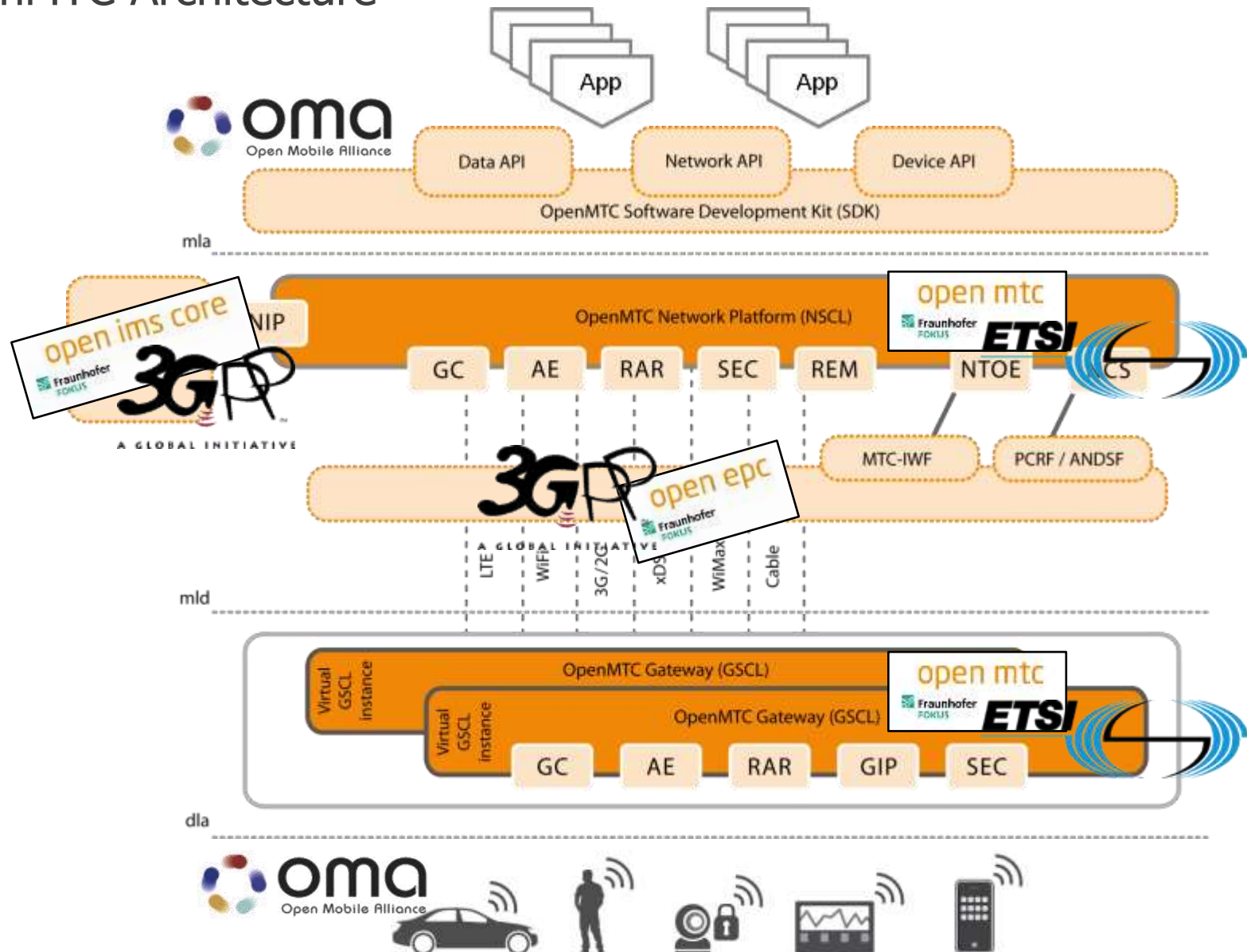
# OpenMTC Architecture – Release 1

- OpenMTC consists of the two main components
  - Network Service Capability Layer (NSCL)
  - Gateway Service Capability Layer (GSCL)
- Both SCLs contain several modules
  - e.g. NGC: Network generic communication, GSEC: Gateway security, etc.
  - Some of them are optional
- OpenMTC allows interworking with
  - OpenEPC (Evolved Packet Core)
  - OpenIMS (IP Multimedia Subsystem)
  - FOKUS Service Broker
- OpenMTC supports:
  - Various sensors and actuators (e.g. ZigBee, FS20 devices)
  - Multiple Access networks (e.g. fixed, mobile, xDSL, 3G, etc.)
  - Various Applications (e.g. Smart Cities, Smart Home, etc.)



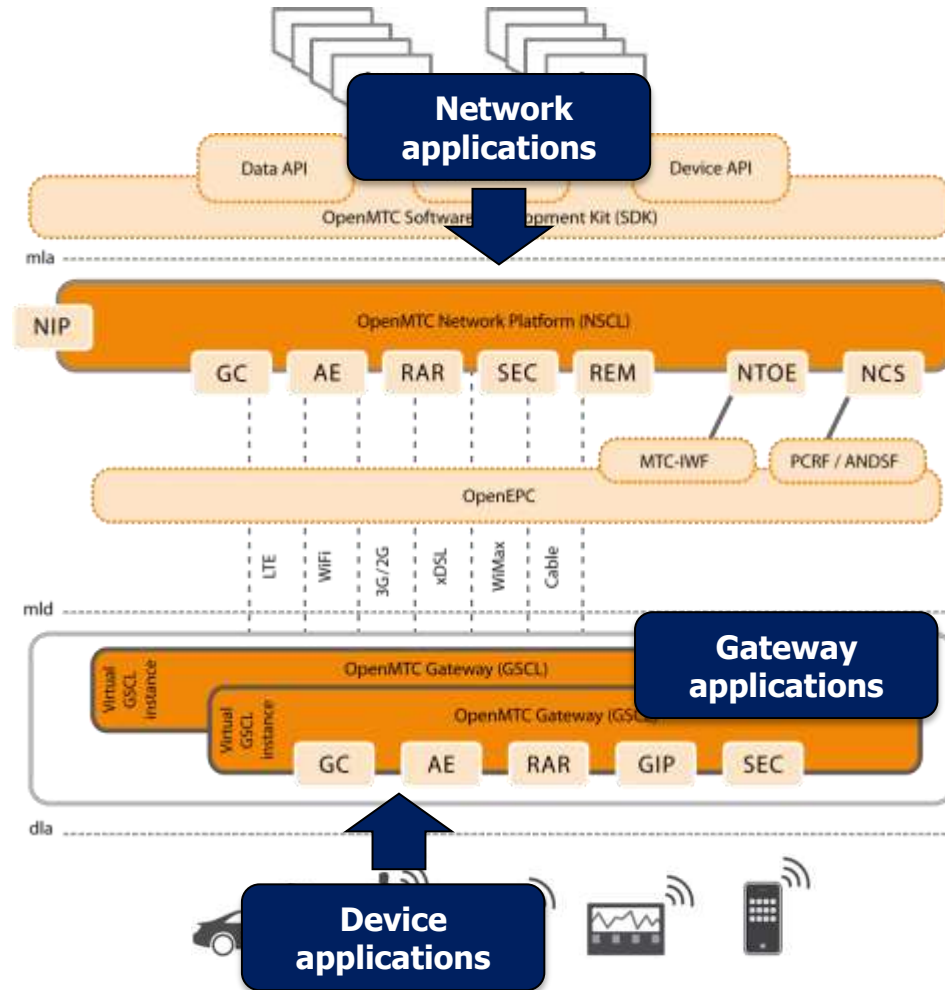


# OpenMTC Architecture



# OpenMTC Application Enablement

- Exposes functionalities implemented in the service layers (N/GSCL) via the reference points
  - mIa
  - dIa
- Single contact point for
  - Network Applications (NA)
  - Gateway Applications (GA)
  - Device Applications (DA)
- Performs routing between applications and capabilities in the N/GSCL
- Routing is defined as the mechanism by which a specific request is sent to a particular capability



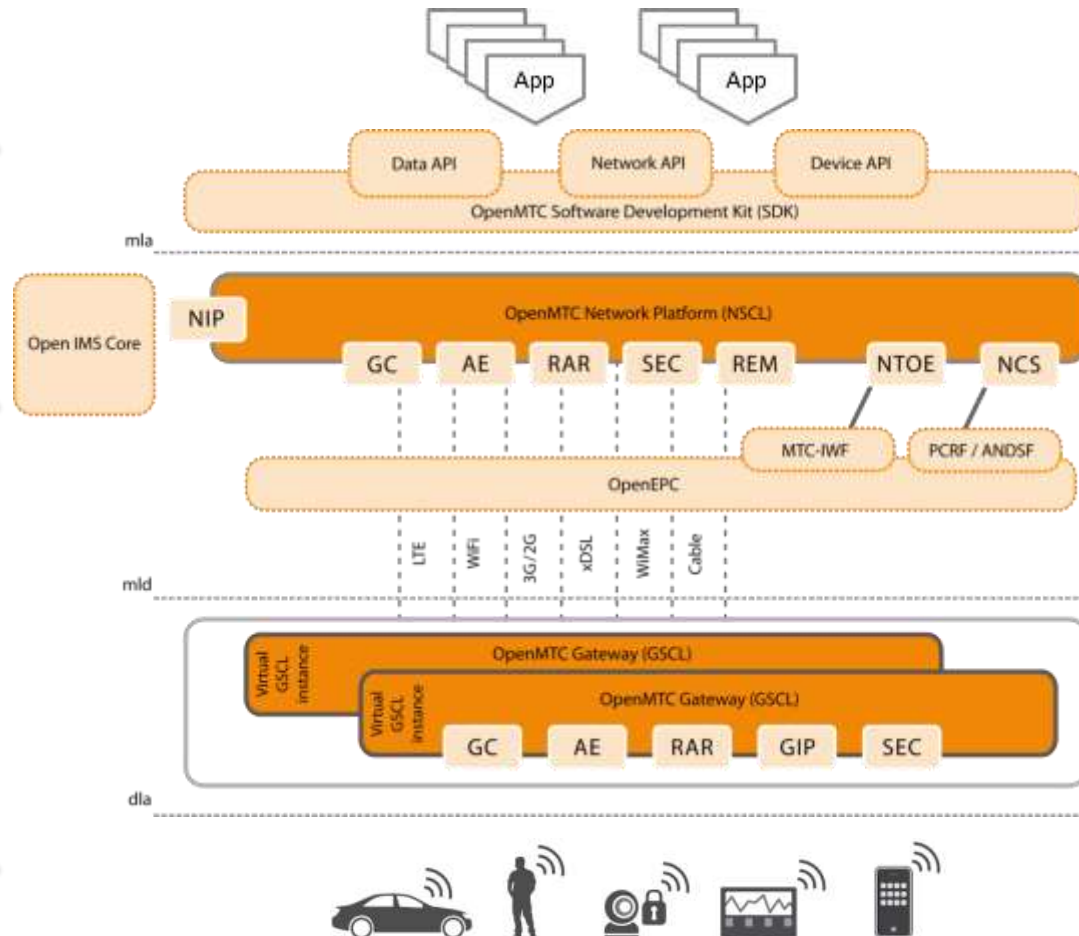
# Integration and Interworking on all layers

## Supporting Interoperability

Heterogeneous Application  
Integration

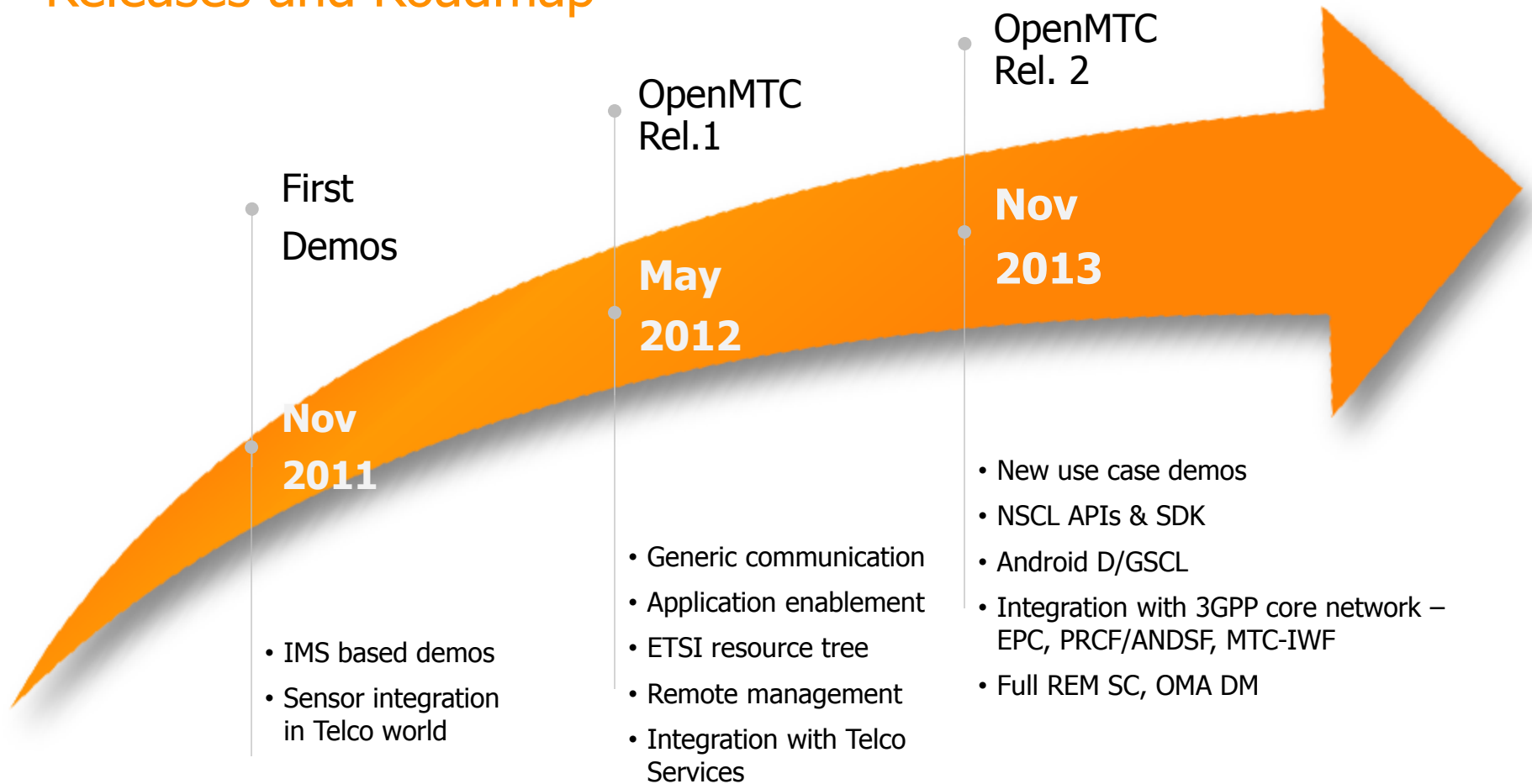
Heterogeneous System /  
Platform Integration

Heterogeneous Device  
Integration



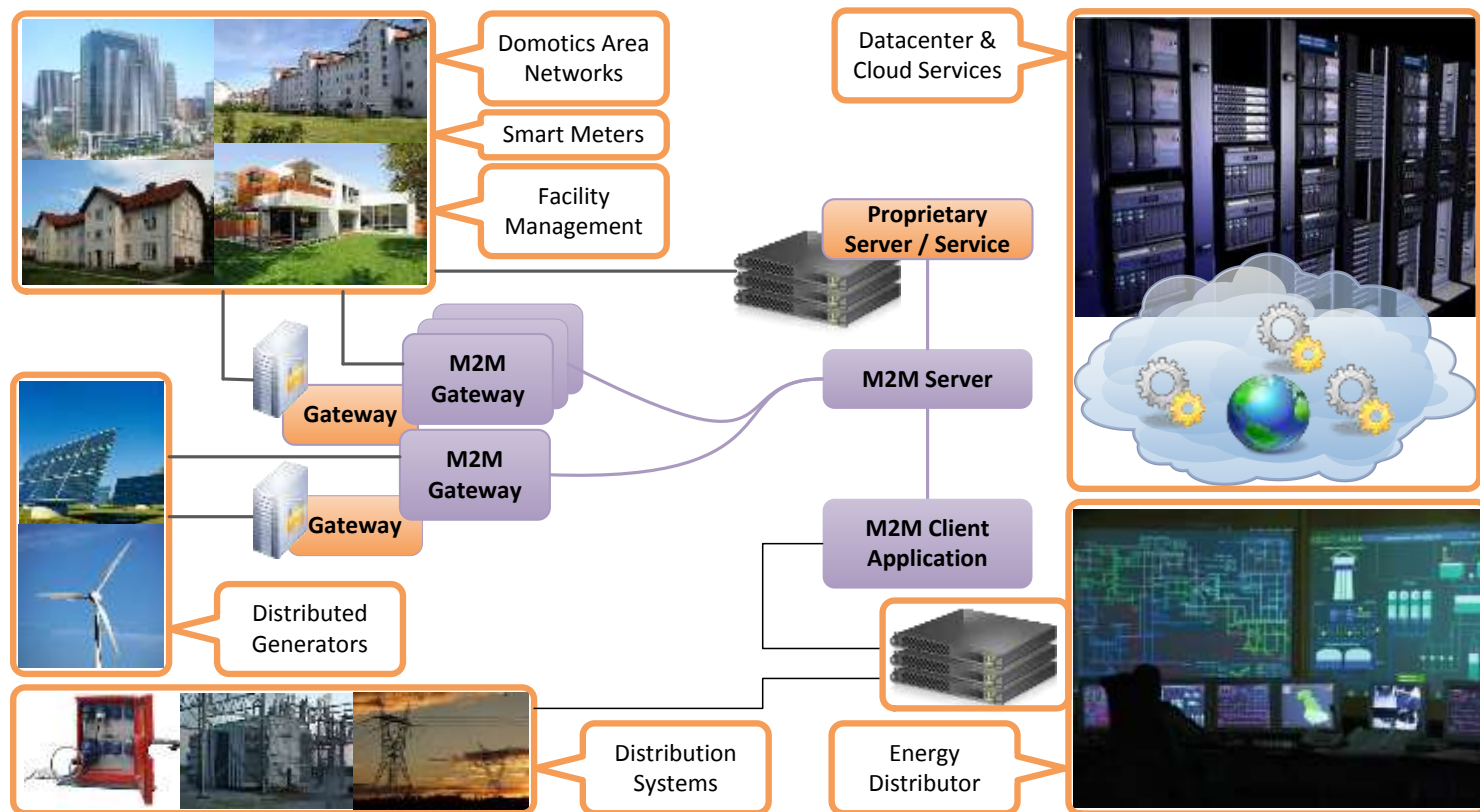
# OpenMTC

## Releases and Roadmap



# Smart City Services for Facilities and Campuses

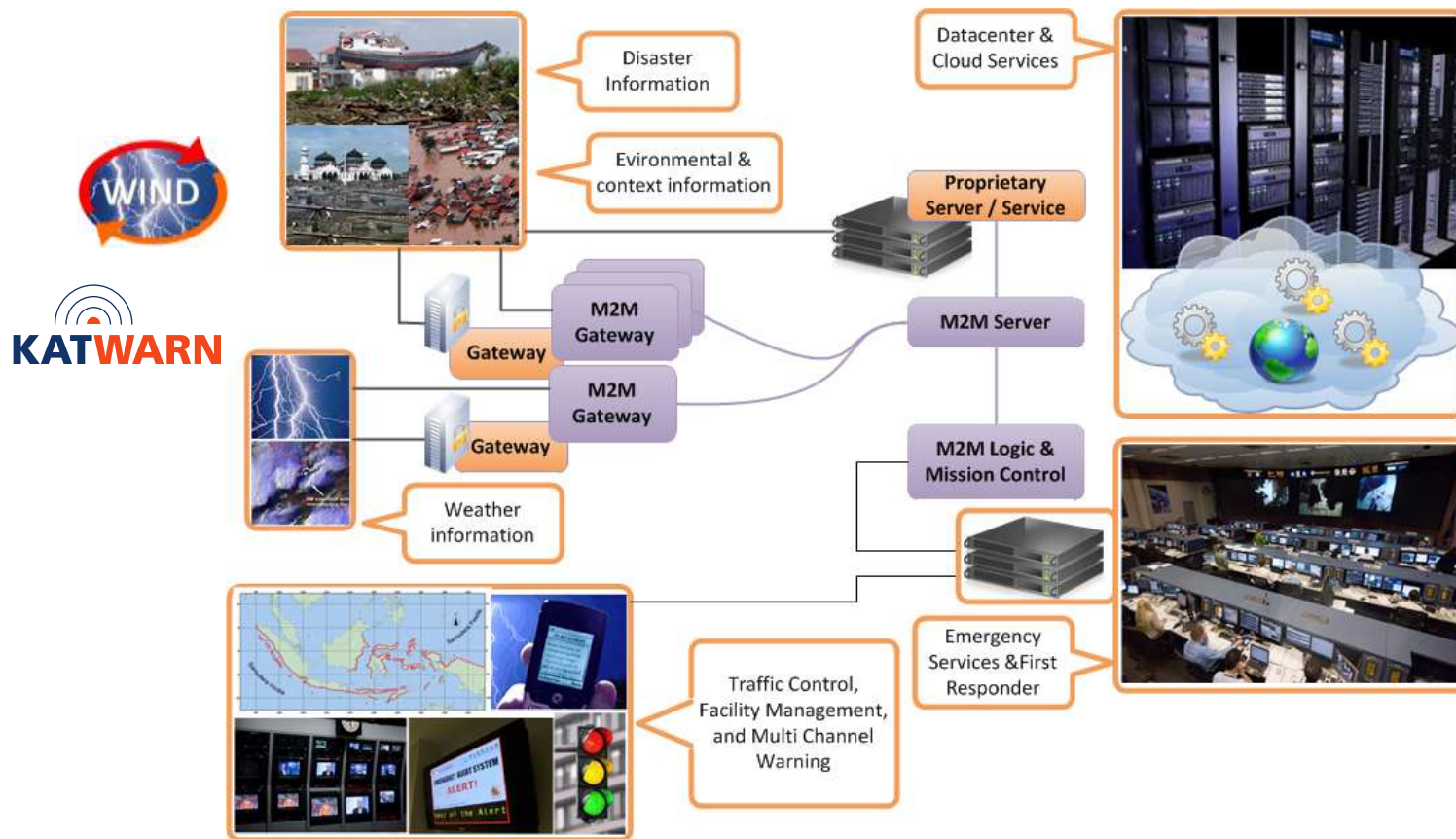
- OpenMTC hides heterogeneity across a wider facility infrastructure (i.e. sensor and actor networks), communications (i.e. wireline or wireless, fixed or mobile), and services (i.e. M2M or proprietary) enabling data fusion and joint control.





# Smart City Services for Early Warning and Emergency Management

- OpenMTC aggregates sensor information and environmental warnings, implements application logic and policies, and can automate counter-measures (e.g. multi-channel hazard warning, facility management, and traffic control) via dedicated application logic.

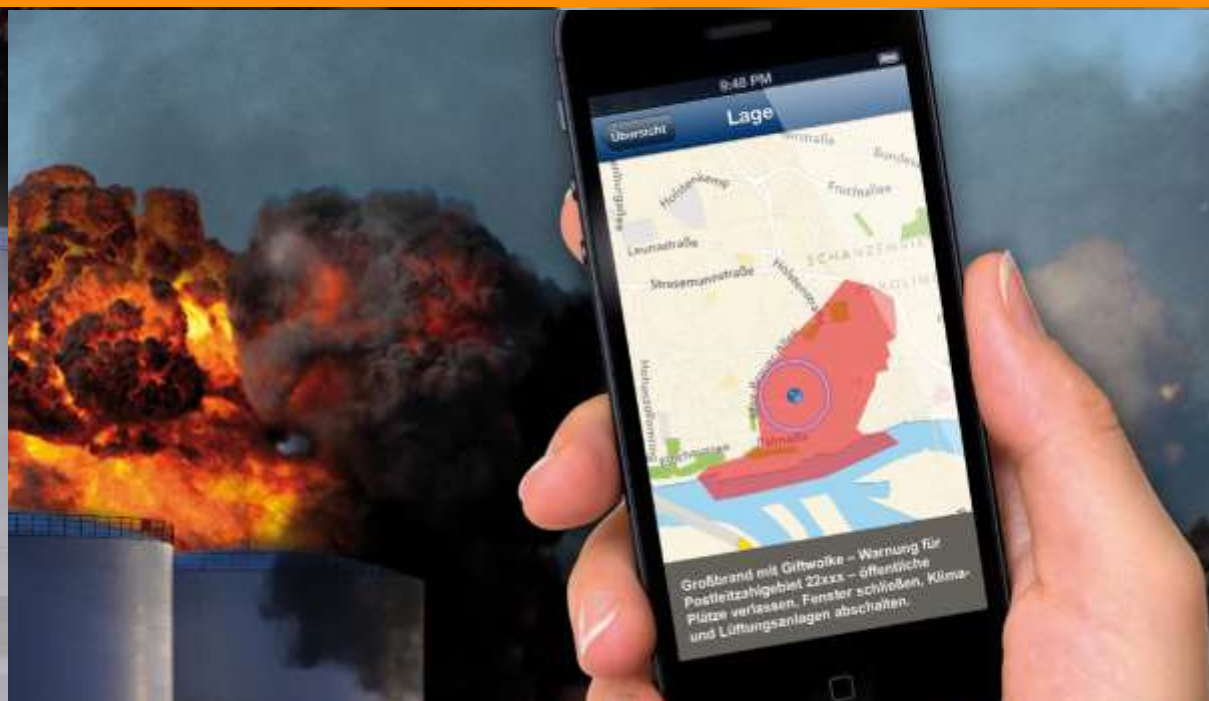


# KATWARN – An example for cost-effective solutions

An adaptable combination of existing technologies for public alerting







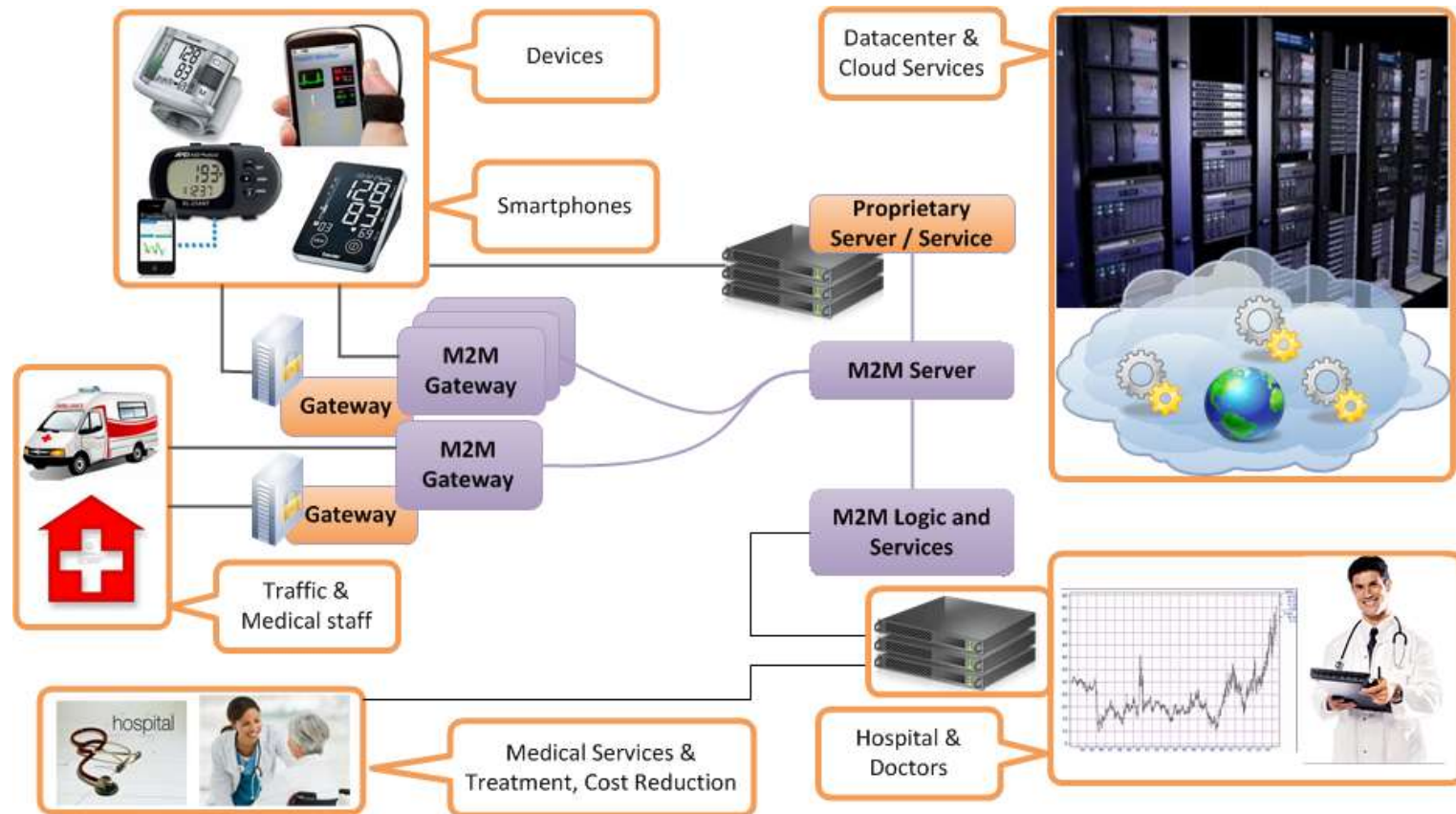
# KATWARN-App

## Top iPhone Apps in Nachrichten (gratis)



# Smart City Services for eHealth and Support of Elderly People

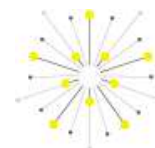
- OpenMTC supports various eHealth devices and can communicate health information to hospitals and first responders. In conjunction with traffic & location information and data about medical staff occupancy, critical time savings and cost reduction can be achieved.



## FI-star as one of the Phase 2 Use Case project of FI-Ware



OUTSMART



FUTURE  
INTERNET  
PPP



Flspace  
Business Collaboration

**fi star**  
THE FUTURE, NOW.

<https://www.fi-star.eu>  
<http://fistarblog.com/>



FIcontent



## FI-Star budget and partner structure

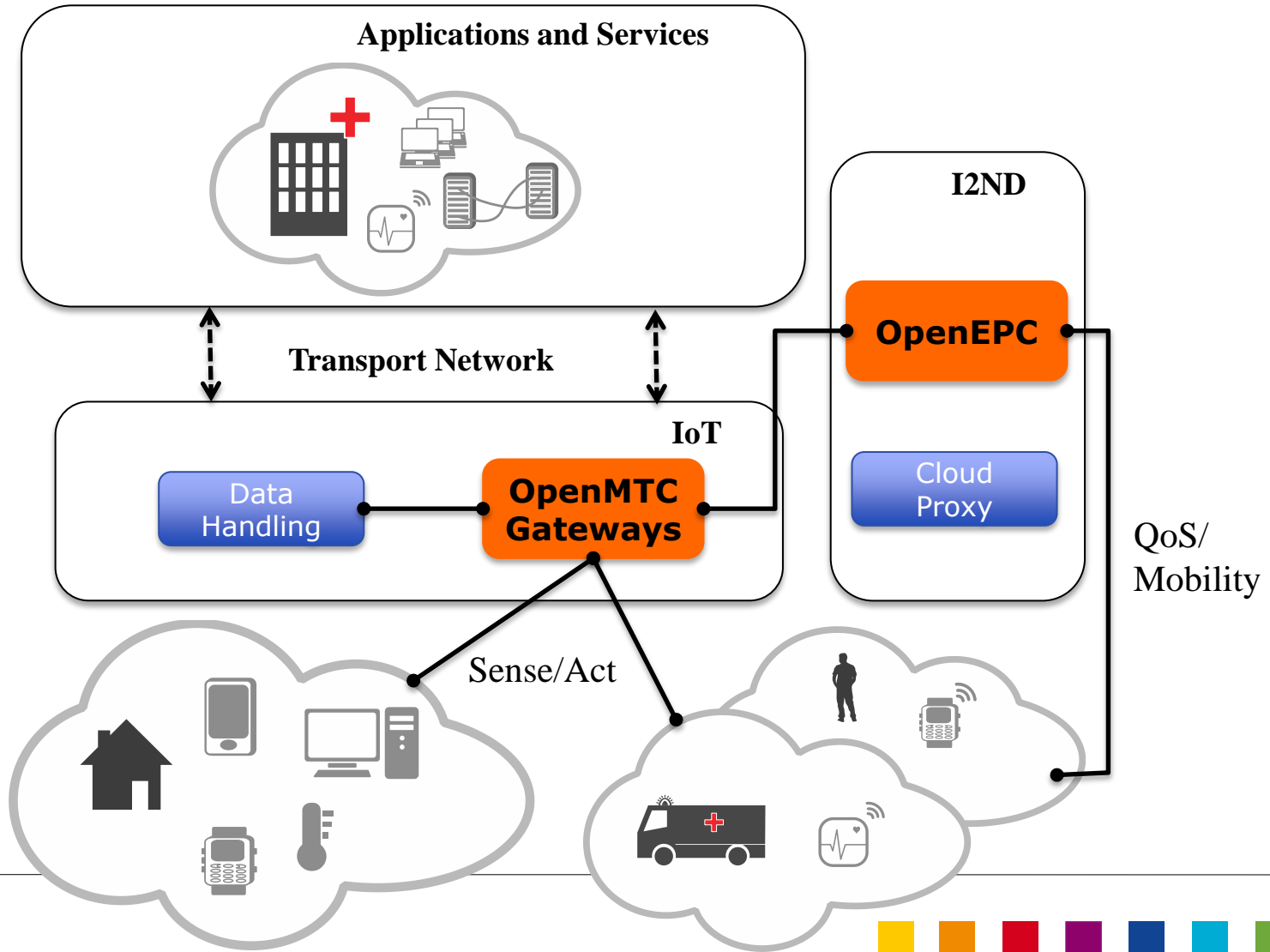


FiStar	Budget €	EU contribution €
Total	16,830,394	13,499,000
26 partners, of which:		
Fraunhofer FOKUS	634,561	488,934
TU Berlin, AV	835,204	654,228



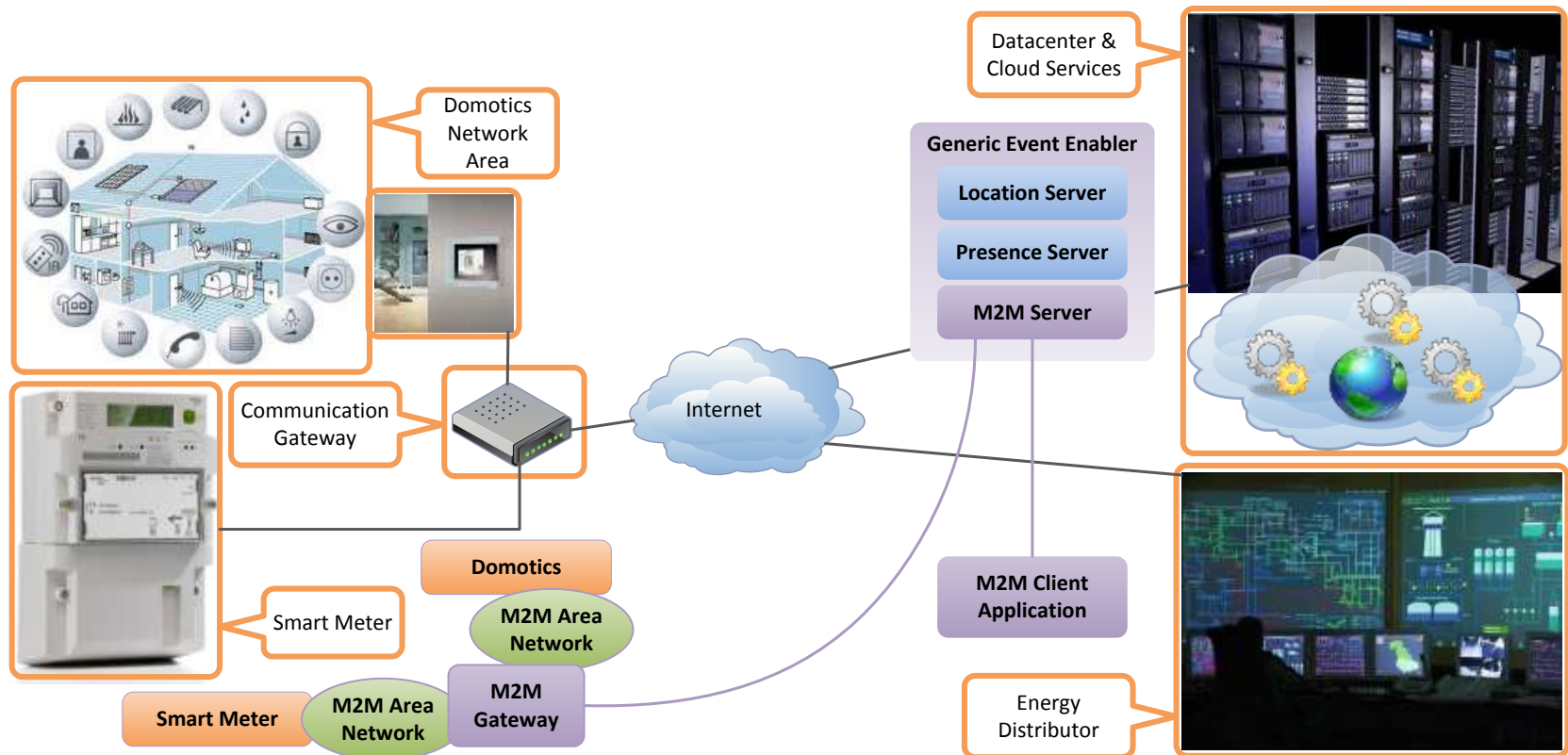


## AV/FOKUS Components in FI-Star



# Smart City Services for End Customer Domotics and Smart Metering

- OpenMTC provides a unified API to M2M client applications while hiding heterogeneity of end-customer premises equipment (i.e. domotics and smart meter) and the communication links between customer premises and M2M service center.



## Current Research

### TRESCIMO | Testbeds for Reliable Smart City Machine-to-Machine Communication

- **Context:** FP7 FIRE STREP: EU/SA collaboration
- **Motivation:** Urbanization issues in South Africa
- **Goal:** Reliable Smart City Communication Platform
- **Approach:**
  - Smart Technologies
    - CSIR: Smart Platform
    - i2CAT: Smart City Platform
    - Fraunhofer/TUB: OpenMTC / FITeagle
  - Smart Sensors
    - Eskom: Utility Load Manager
    - AirBase: Smart City Air Pollution Wireless Sensors
  - Evaluation
    - Pilots: San Vicenç dels Horts and Johannesburg
    - Testbeds: TUB and University of Cape Town
- **Web:** <http://trescimo.eu>





## Approach | Main Roles



Project Management.



OpenMTC  
developments.  
Testbed  
interconnection.



OpenMTC  
developments.



Smart device  
developments.  
Testbed setup.



Experimentation and  
evaluation.

Scenarios and  
requirements.  
Smart City platform  
developments.



Testbed setup.



Smart device  
developments.  
Testbed setup.



These partners **are not** funded by the EC.

## Approach | Collaboration between Europe and South Africa



# What is FOKUS OpenEPC Platform?



- 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, enabling:
  - integrate various network technologies and
  - integrate various application platformsinto 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:
  - Configurable to different deployments
  - Customizable to the various testbed requirements
  - Extensible to specific research needs
  - Reliable & highly performant
  - Based on 3GPP standards
- More information: [www.OpenEPC.net](http://www.OpenEPC.net)



## OpenEPC Scales for different deployments

- 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**

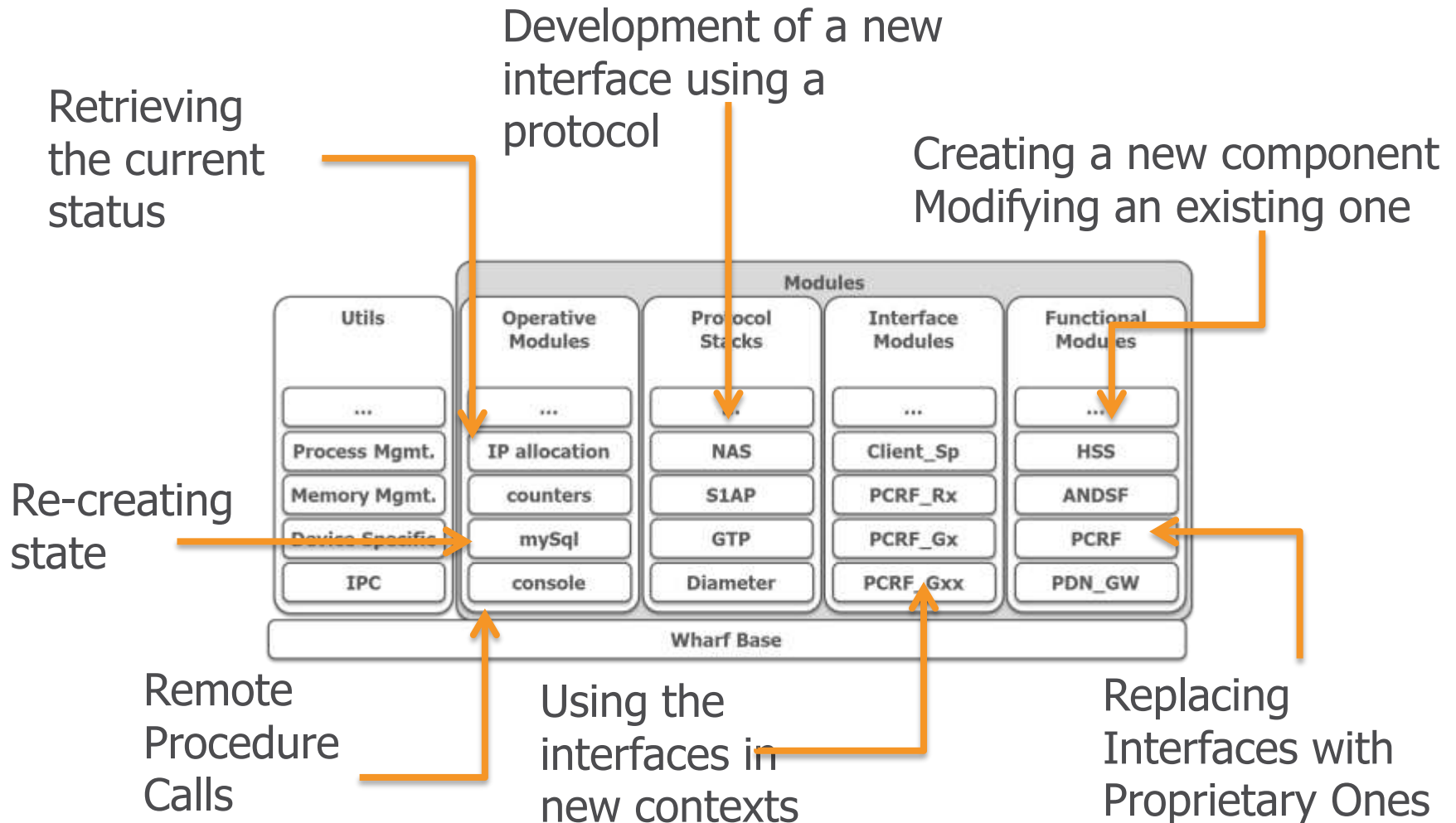


**Single Box Testbed**



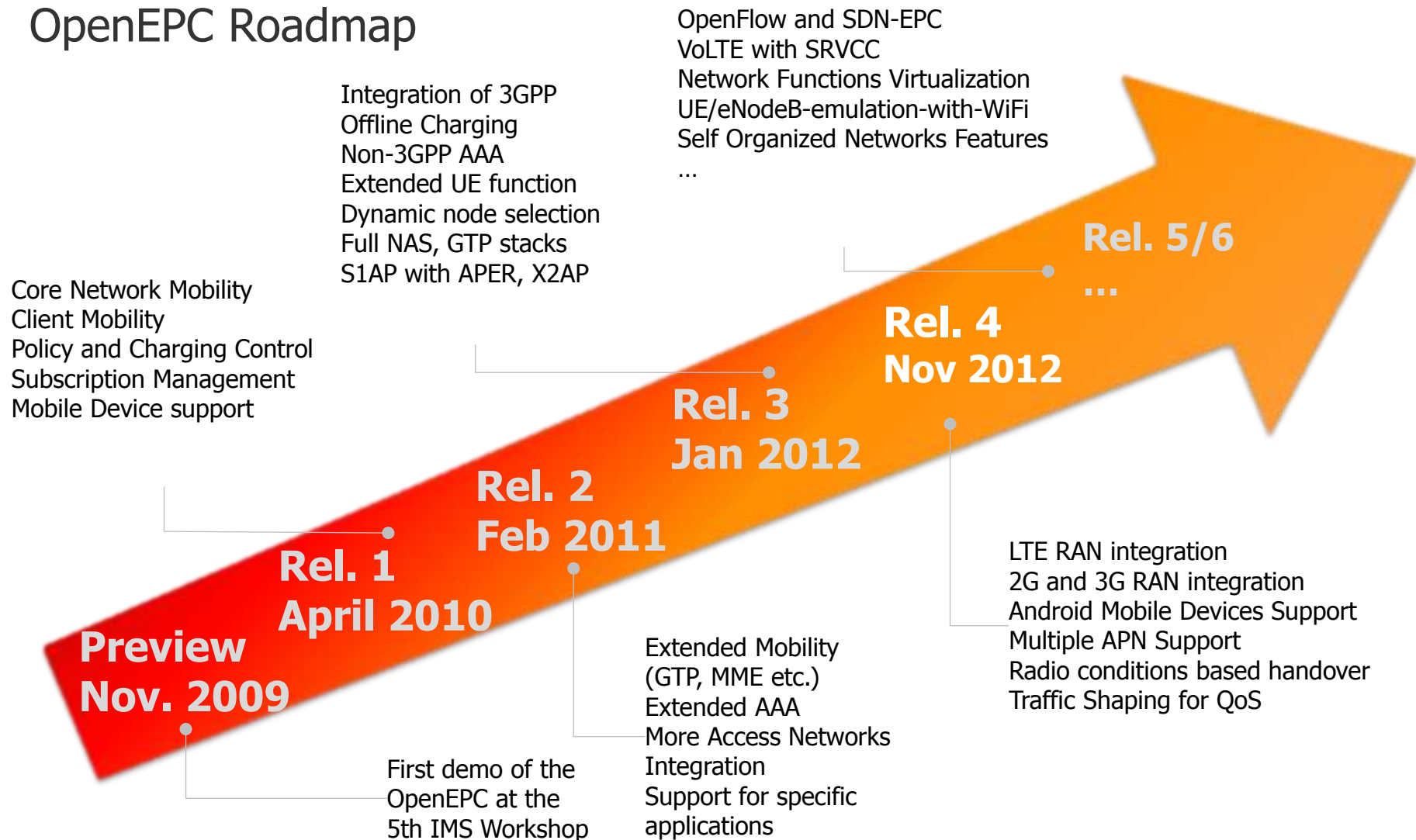
**Minimized Connectivity**

# OpenEPC is highly modular and easy to extend





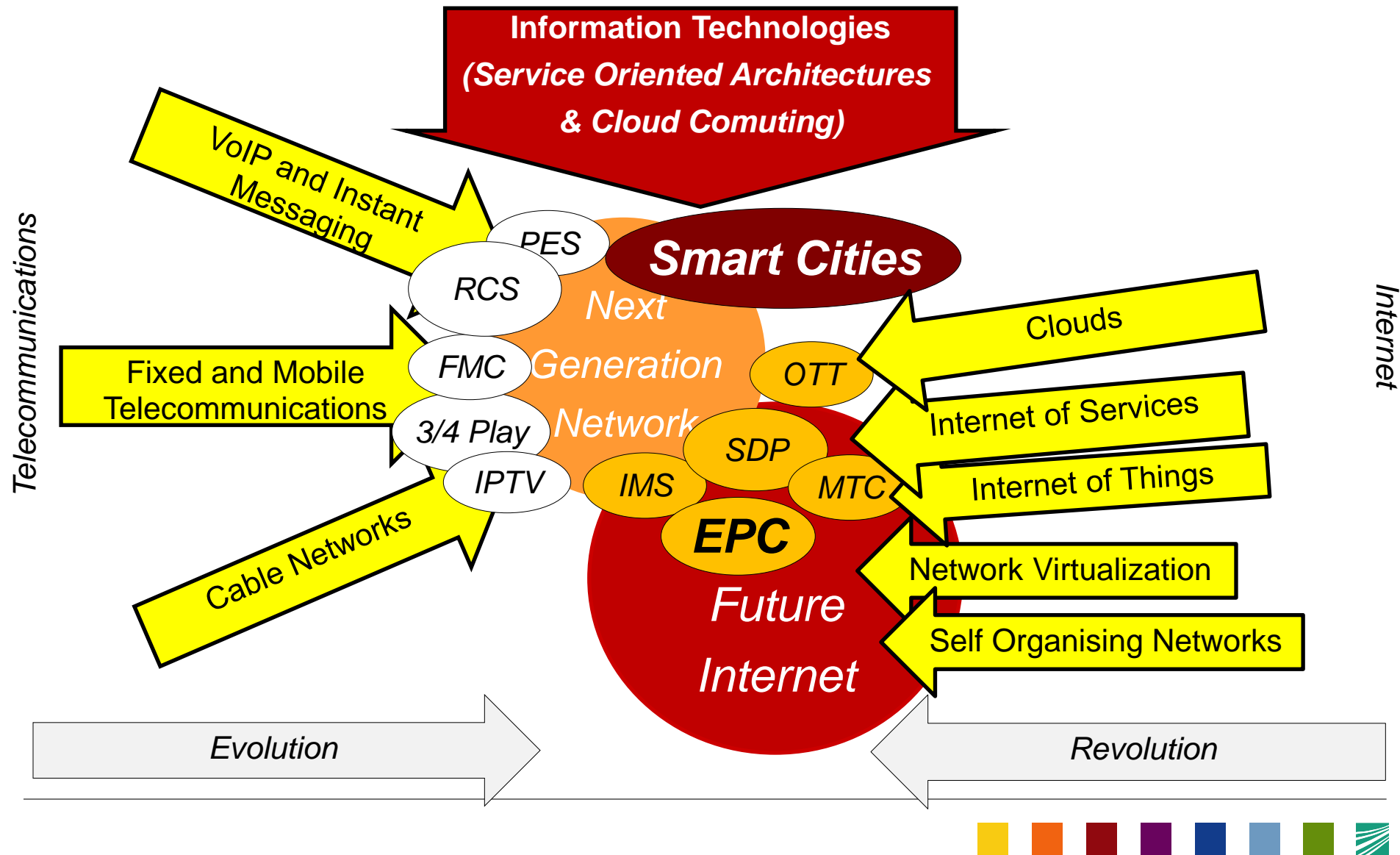
# OpenEPC Roadmap



## Agenda

- The Role of IP Multimedia Subsystem, Machine Type Communication, Evolved Packet Core and related Open APIs within emerging Smart City SDPs
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## NGN2FI Evolution is a Challenge



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



- **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](http://www.fuseco-forum.org)**

