Keynote at National Research Council of Thailand (NRCT) Annual Meeting, Bangkok, Thailand, August 25, 2013

Smart Communication Platforms for Prototyping Smart City Applications

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Agenda

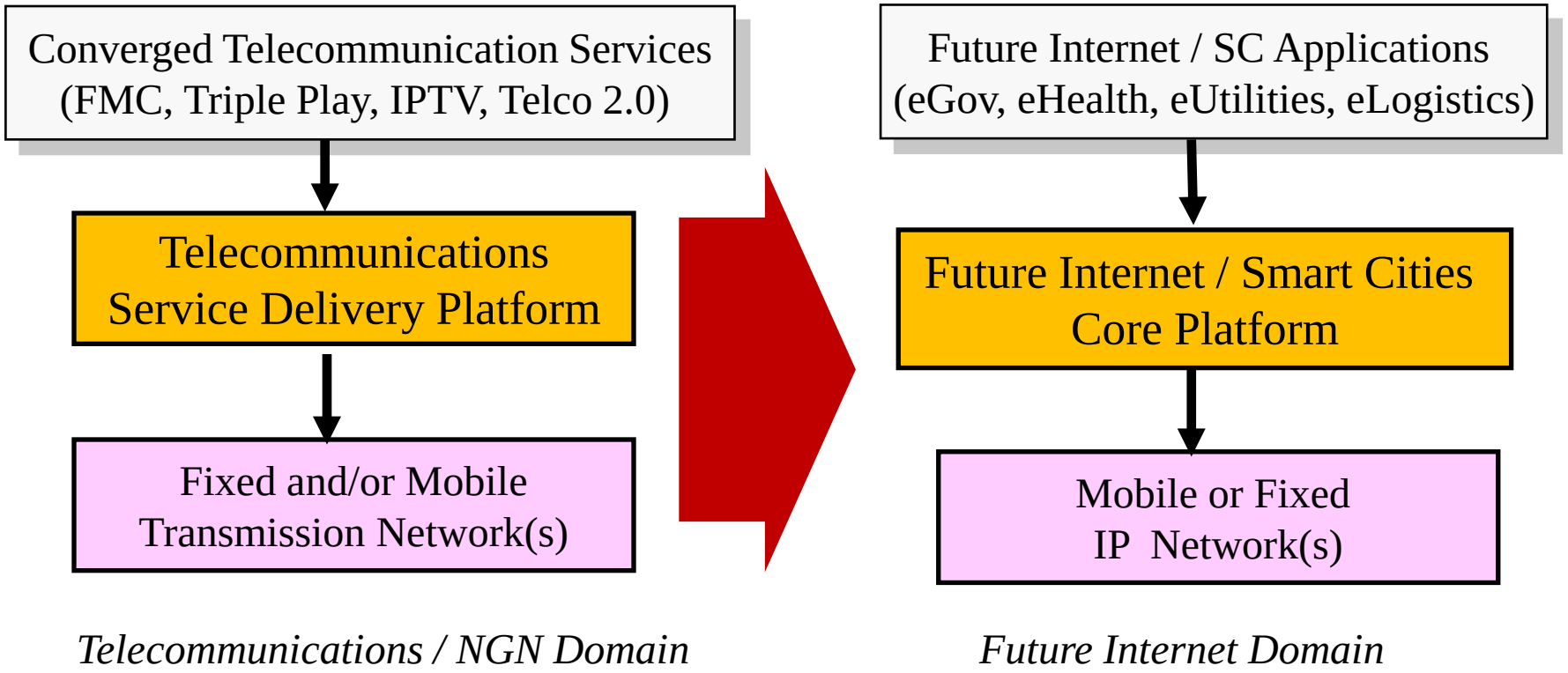
- Smart Cities as Future Internet Show Case
- Smart City communication infrastructures requirements
- *The Role of IP Multimedia Subsystem, Machine Type Communication, Evolved Packet Core and related Open APIs within emerging Smart City SDPs*
- FOKUS Toolkits and practical examples
- Summary
- *Q&A*

Main Messages of the Talk

- **Convergence** of fixed and mobile networks plus internet technologies was the driver for **Next Generation Network (NGN)**
- IMS (plus an SDP) is the common control platform of the NGN today
- Over the top (OTT) services challenge operators and IMS platforms
- Future Internet (FI) is a hot research topic and equates to emerging Smart City (SC) ICT platforms and applications
- Smart Cities relate to the domains of Internet of Things (➔ M2M) and Internet of Services (➔ SDP)
- Smart Cities are driving **even more convergence** of networks and control platforms
- Evolved Packet Core (EPC) and Machine Type Communication (MTC) platforms are becoming key pillars around IP Multimedia System (IMS) in the context of emerging Smart City ICT platforms
- Nevertheless Open APIs will abstract from the specifics of the platforms
- FOKUS tools and testbeds are designed to prototype Smart City ICT

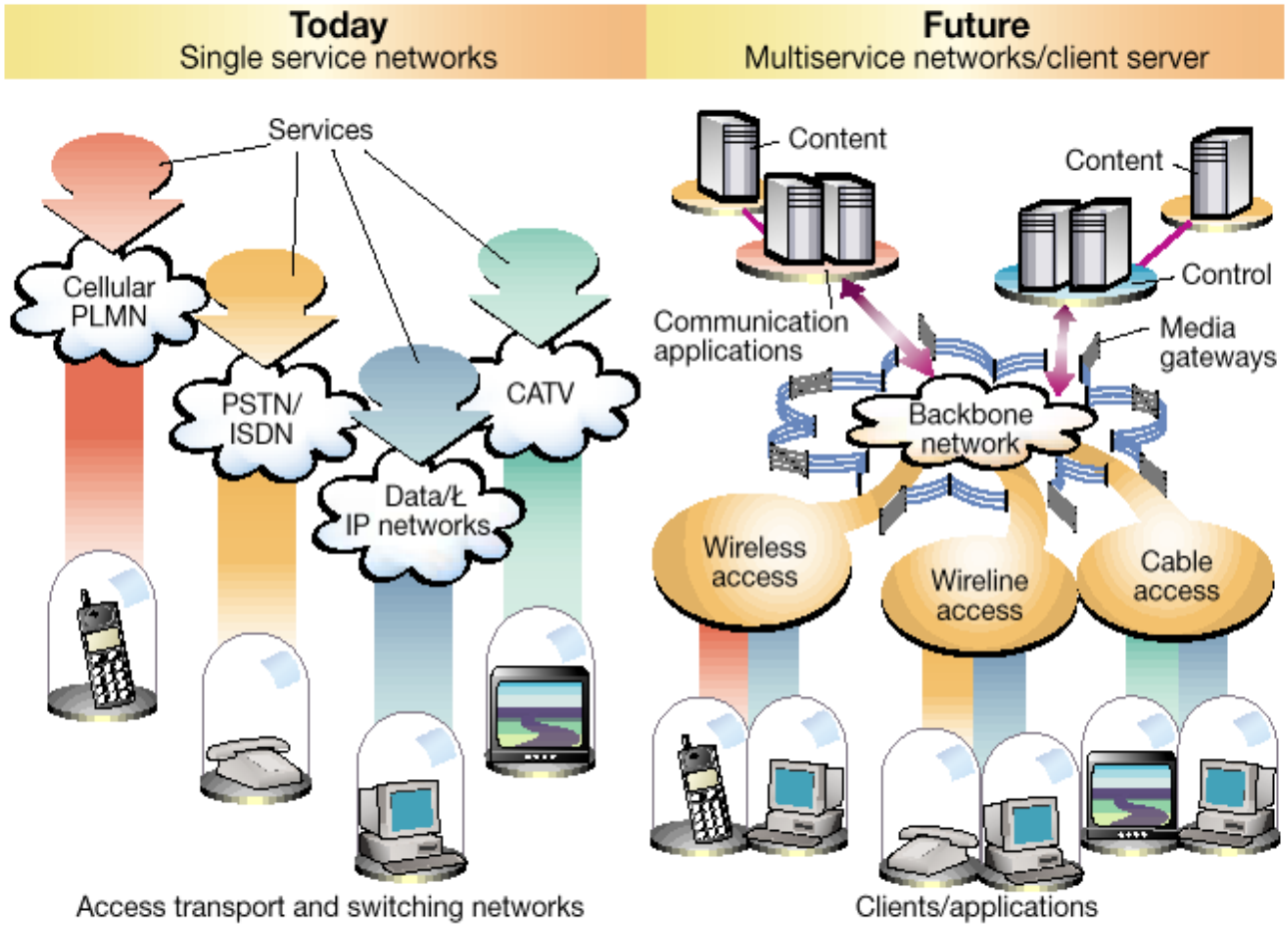
A déjà vu - From NGN towards SDPs for Future Internet / Smart Cities

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



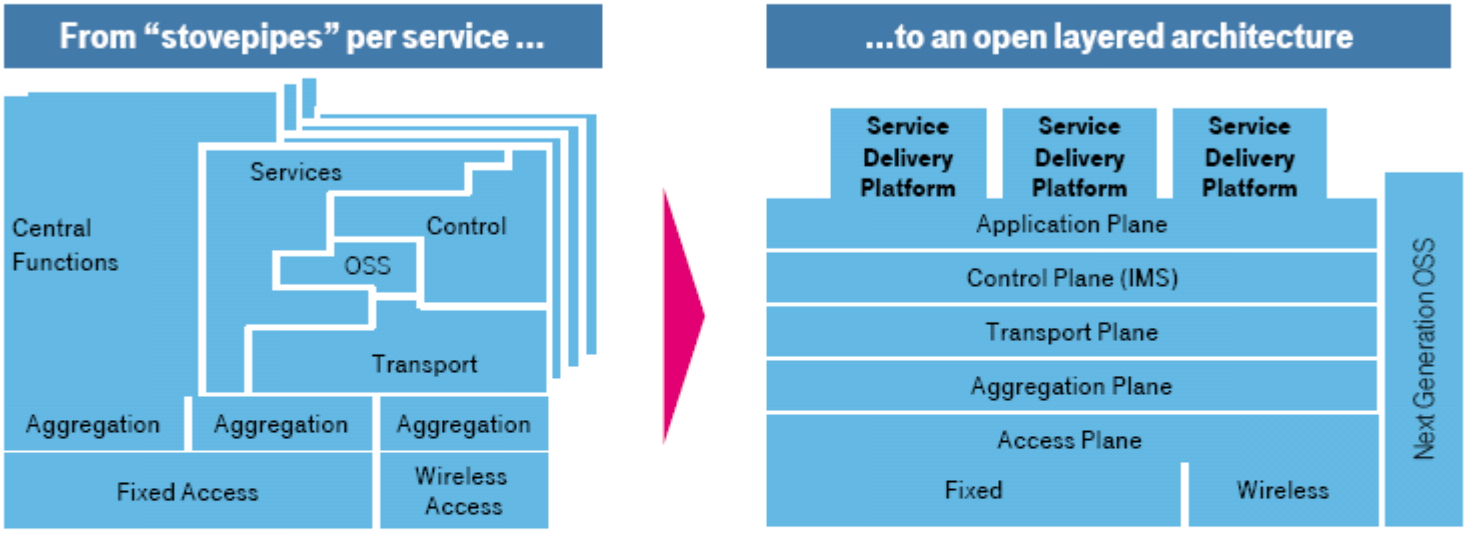
From specific to unified next generation Multi-Service networks

Individual networks = individual services vs. Multi service networks



NOTE: This slide is more than 15 Years old !

For quality and efficiency reasons, the network architecture moves from "stovepipes" to a unified production ...

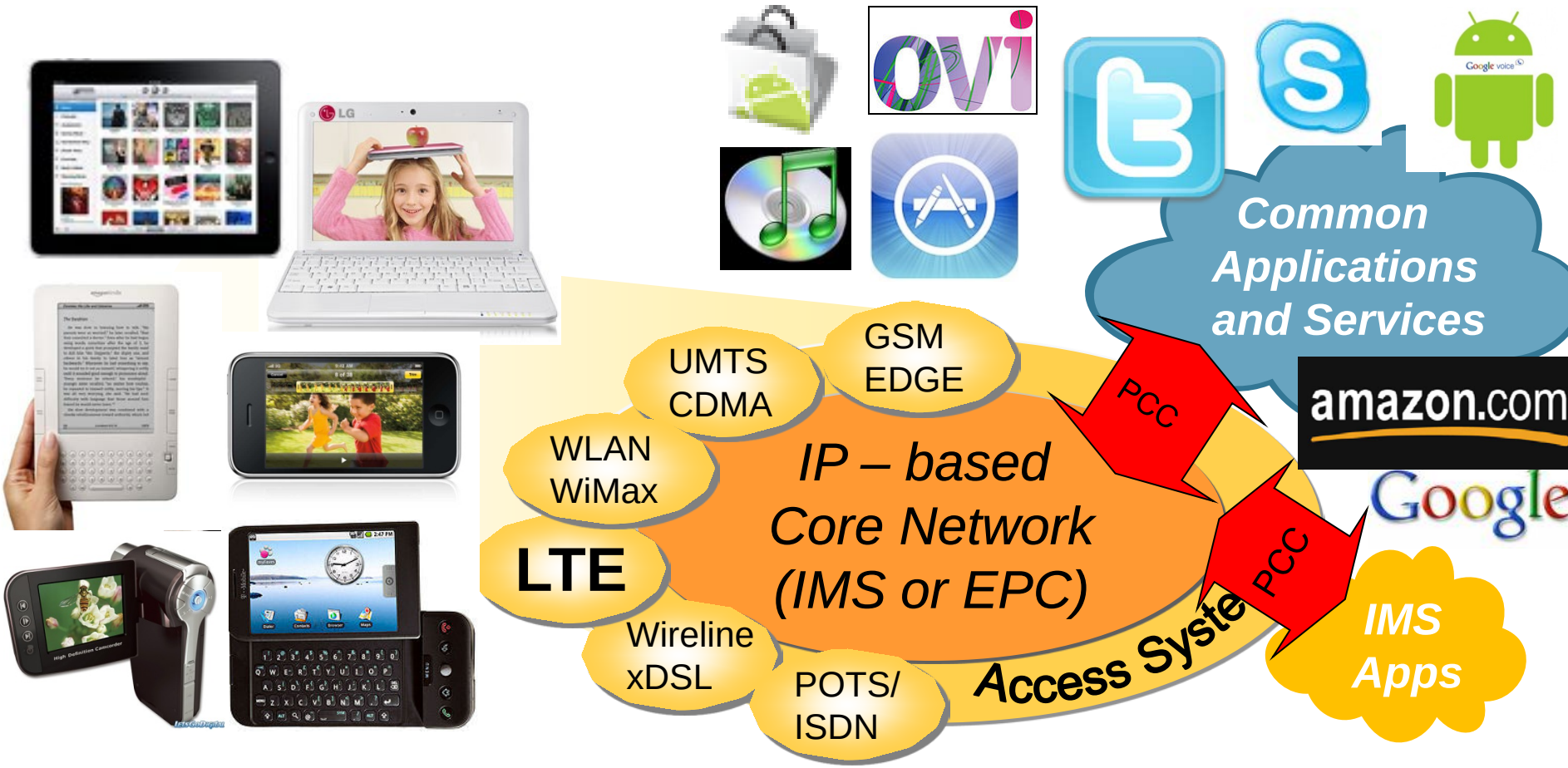


1) Optical and copper in last mile 2) OFDM = Orthogonal Frequency Division Multiplexing

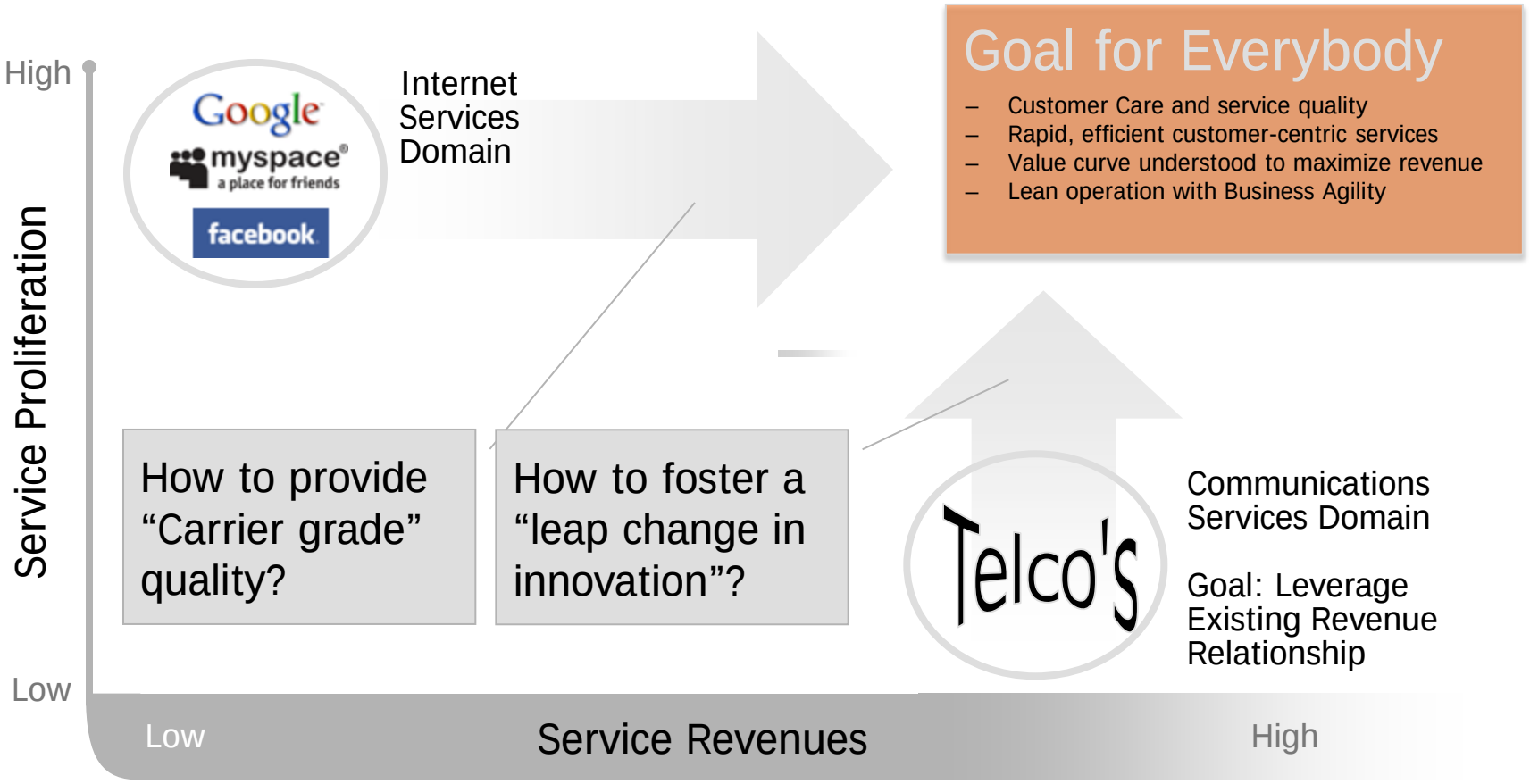
Source DTAG

Connectivity vs. Content – Where will be the Money in Mobile Broadband?

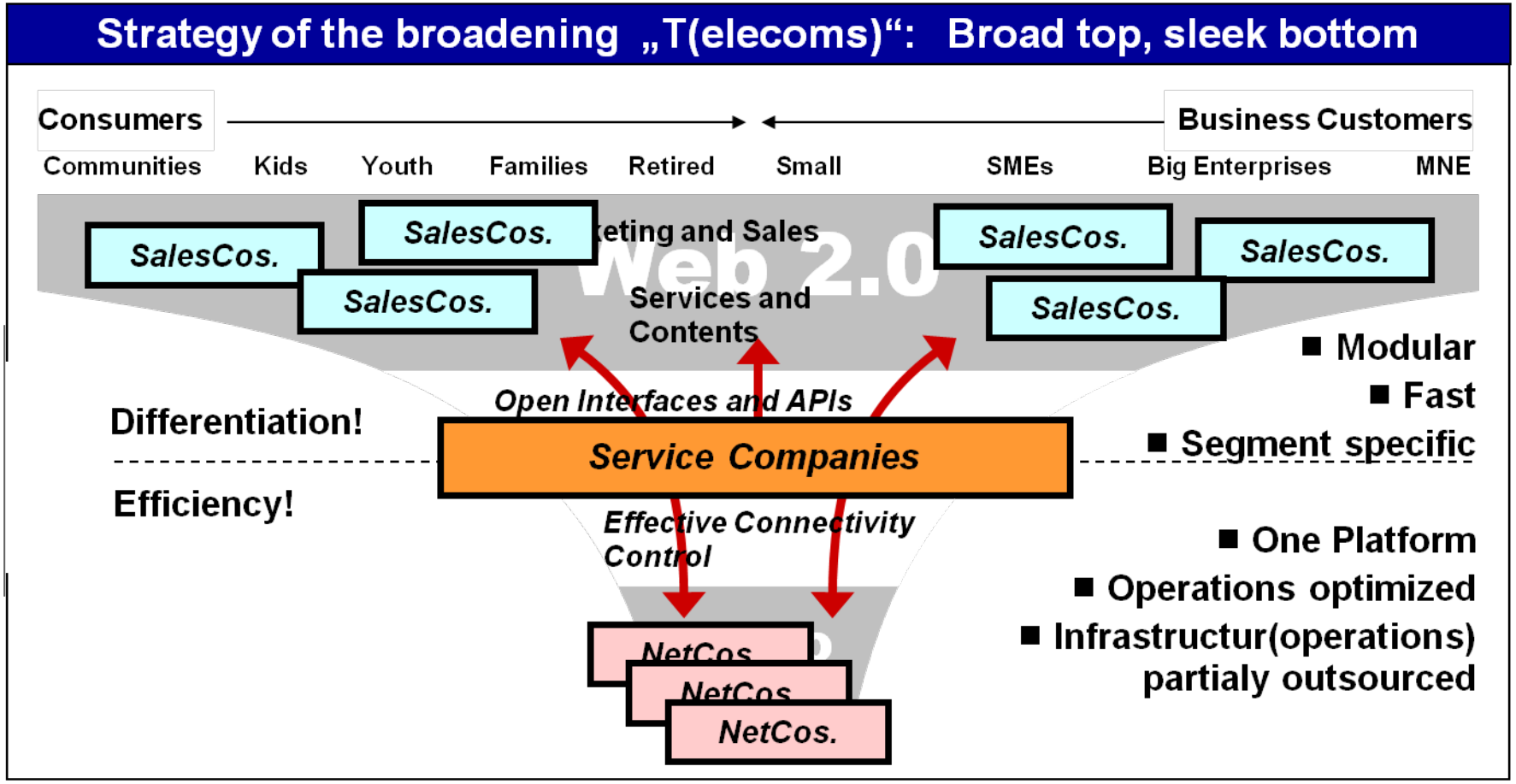
- Communications (Voice/Messaging) vs. Connectivity Services (QoS) versus Multimedia Content (Games, Videos, eBooks, Clouds, etc.)



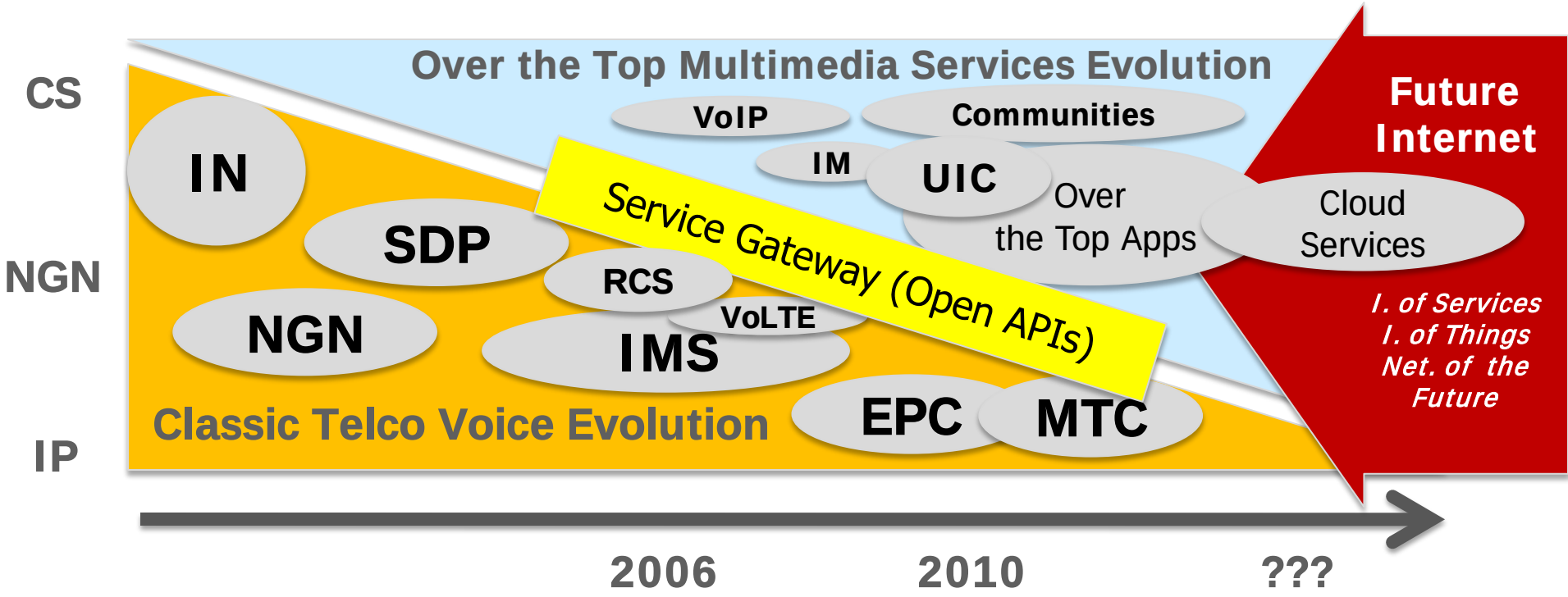
From Simple Voice to Innovative Service Platforms



New Eco System demands Federation and Open APIs

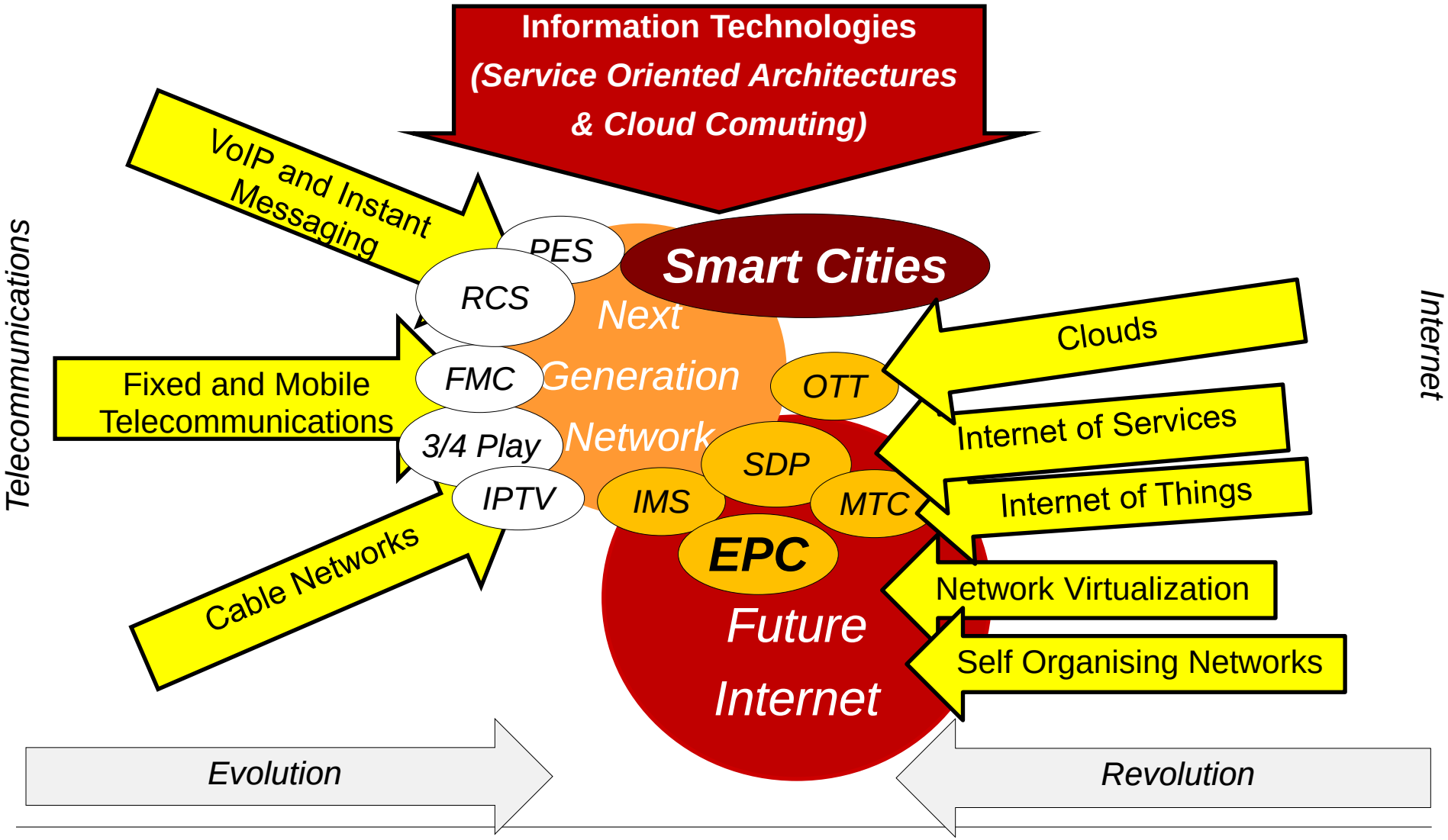


OTT vs. Telco Networks & Platforms – APIs/IMS/EPC/MTC as last resort??



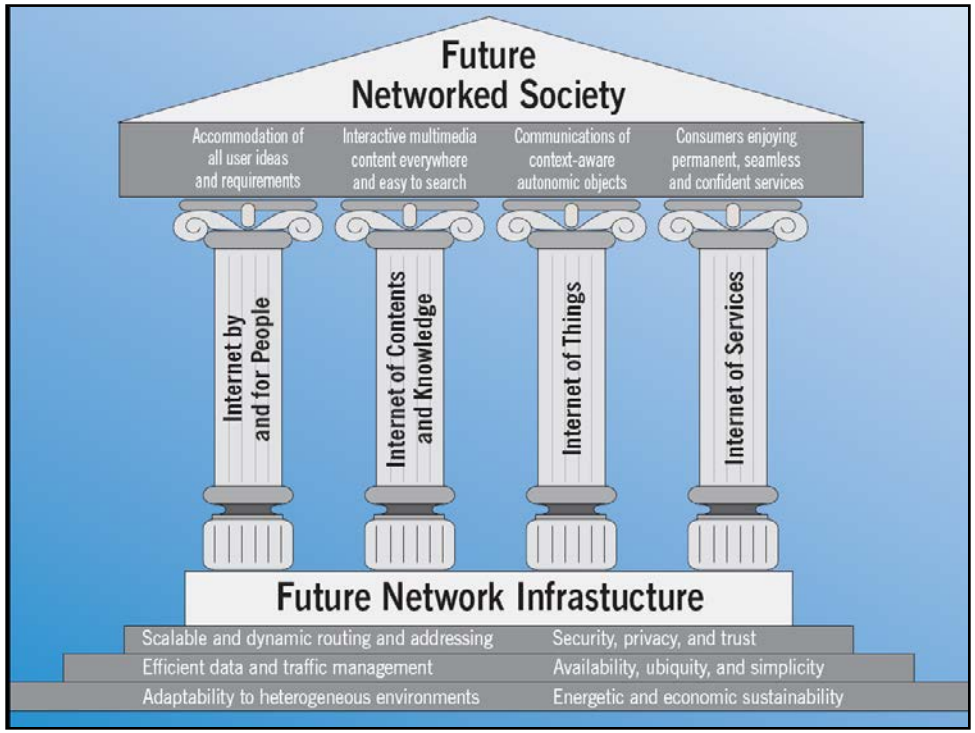
- ✓ All IP Networks will pave the road for Over the Top (OTT) Application
- ✓ Evolved telecom platforms may provide revenue potentials via Service Gateways (APIs) on top VoIP/RCS (IMS), Maschine Type Communication (MTC) and Smart Bit pipe approaches (EPC)
- ✓ *RCS will have to compete with Unified Communications (UIC) in OTT area*

NGN2FI Evolution is a Challenge



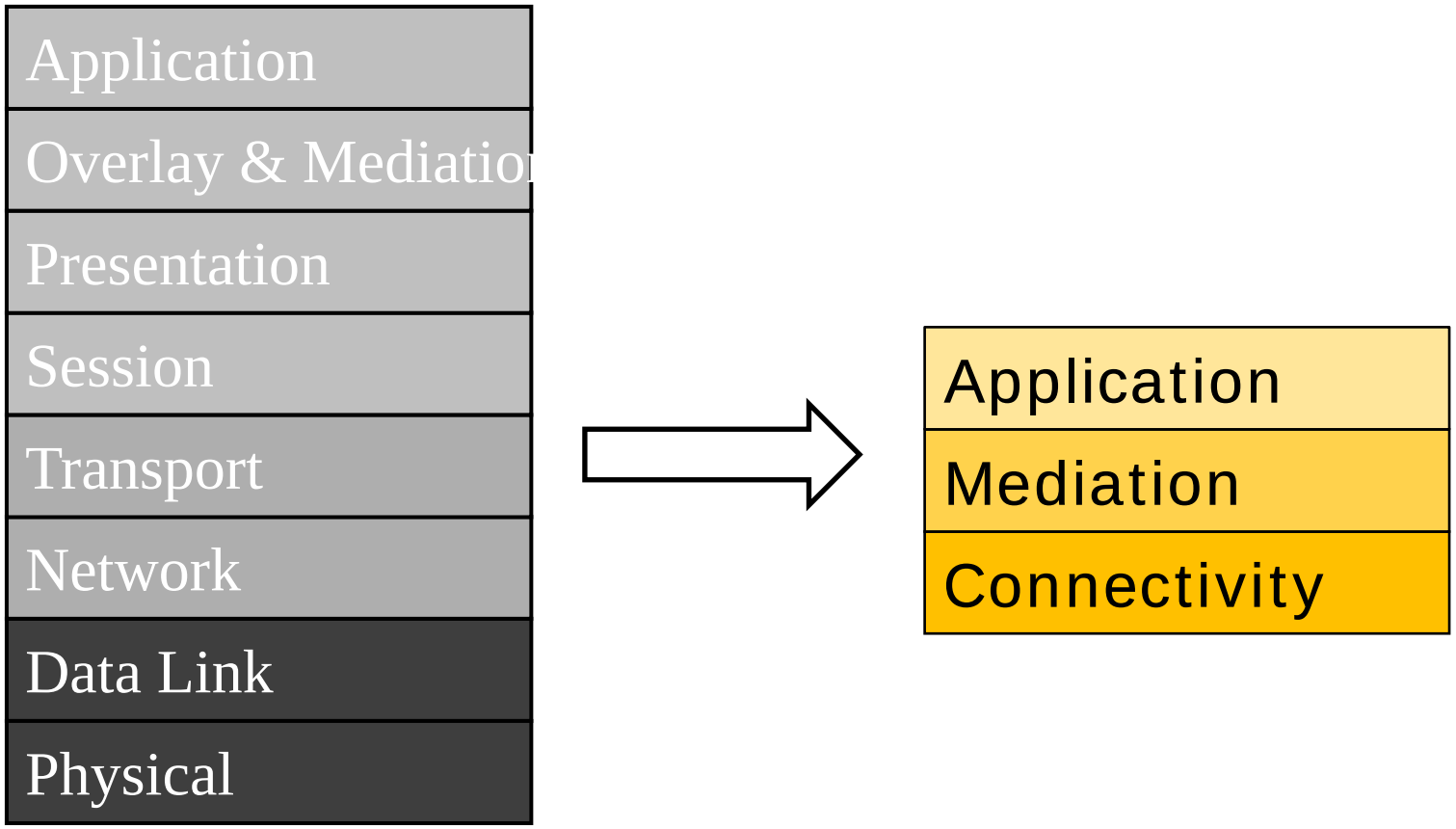
Dimensions of the Future Internet

- Future Internet Pillars
  - Network of the future
  - Internet of Content
  - *Internet of Things*
  - *Internet of Services*
- Infrastructure Foundation:
  - Network infrastructure / substrate that supports the pillars
  - Shall support capacity requirements of Future Internet



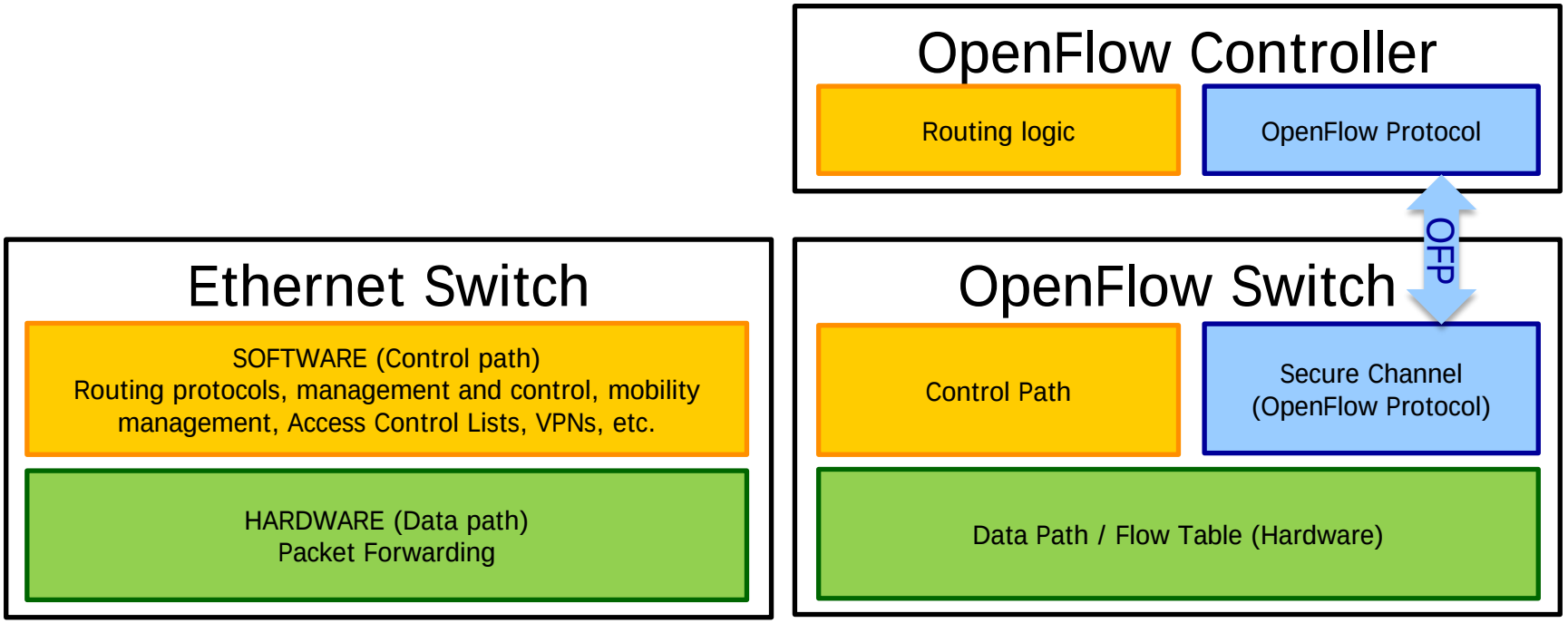
Future Internet, The Cross-ETP Vision Document, Version 1.0, 2009

FI = Towards a Thinner Protocol Stack

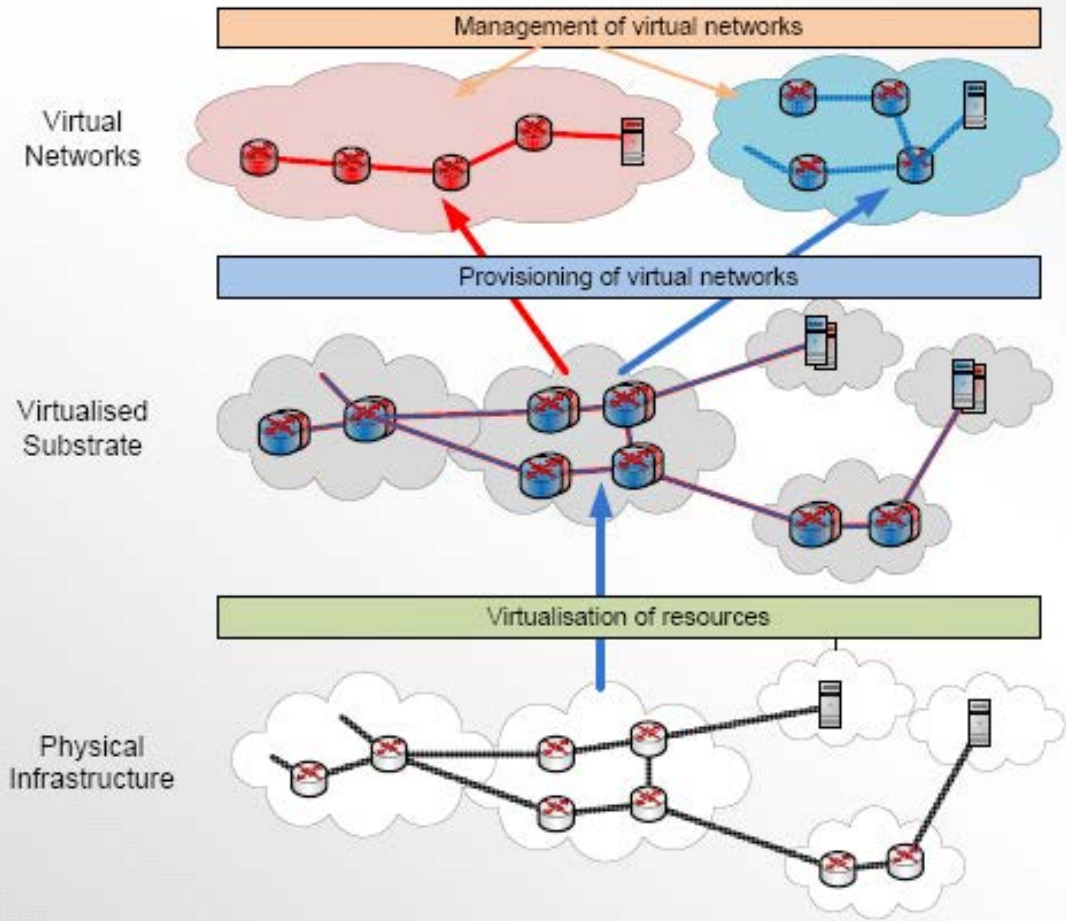


Switch Evolution towards Software-Defined-Networks (SDN)

- Ethernet Switch Architecture
- OpenFlow Switch Architecture and OpenFlow Controller interaction



Decoupling Networks from Infrastructure

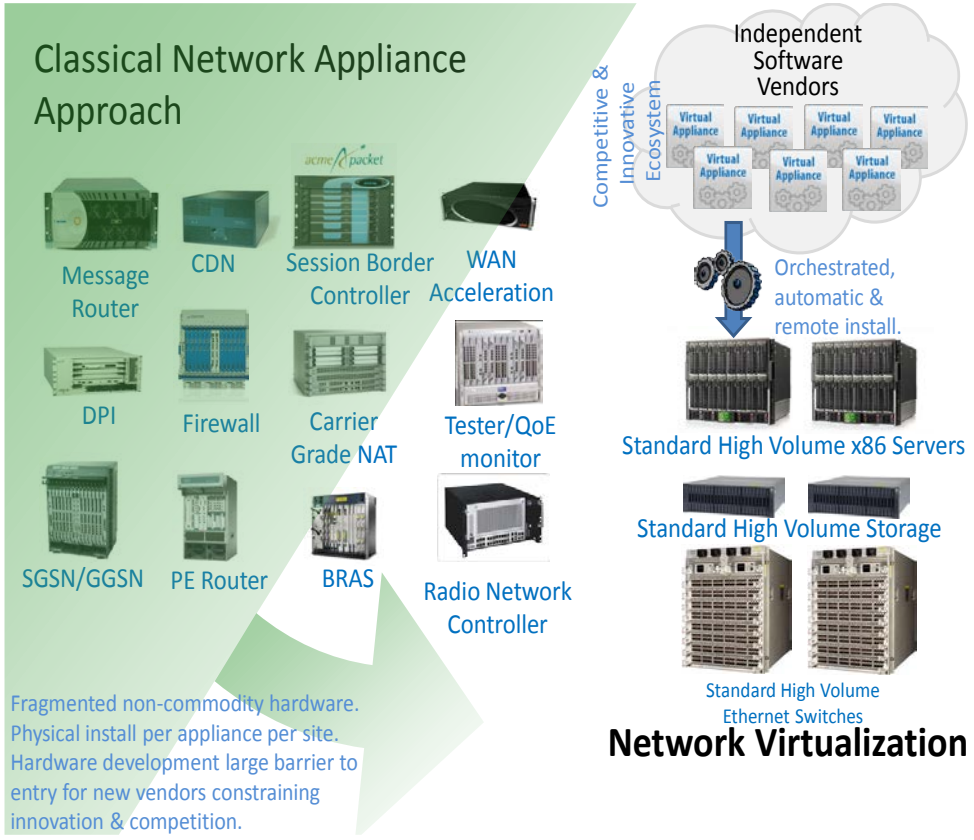


P1956 Network Virtualization – Opportunities and Challenges 5

Source: EURESCOM Project P1956

What is Network Functions Virtualization (NFV)

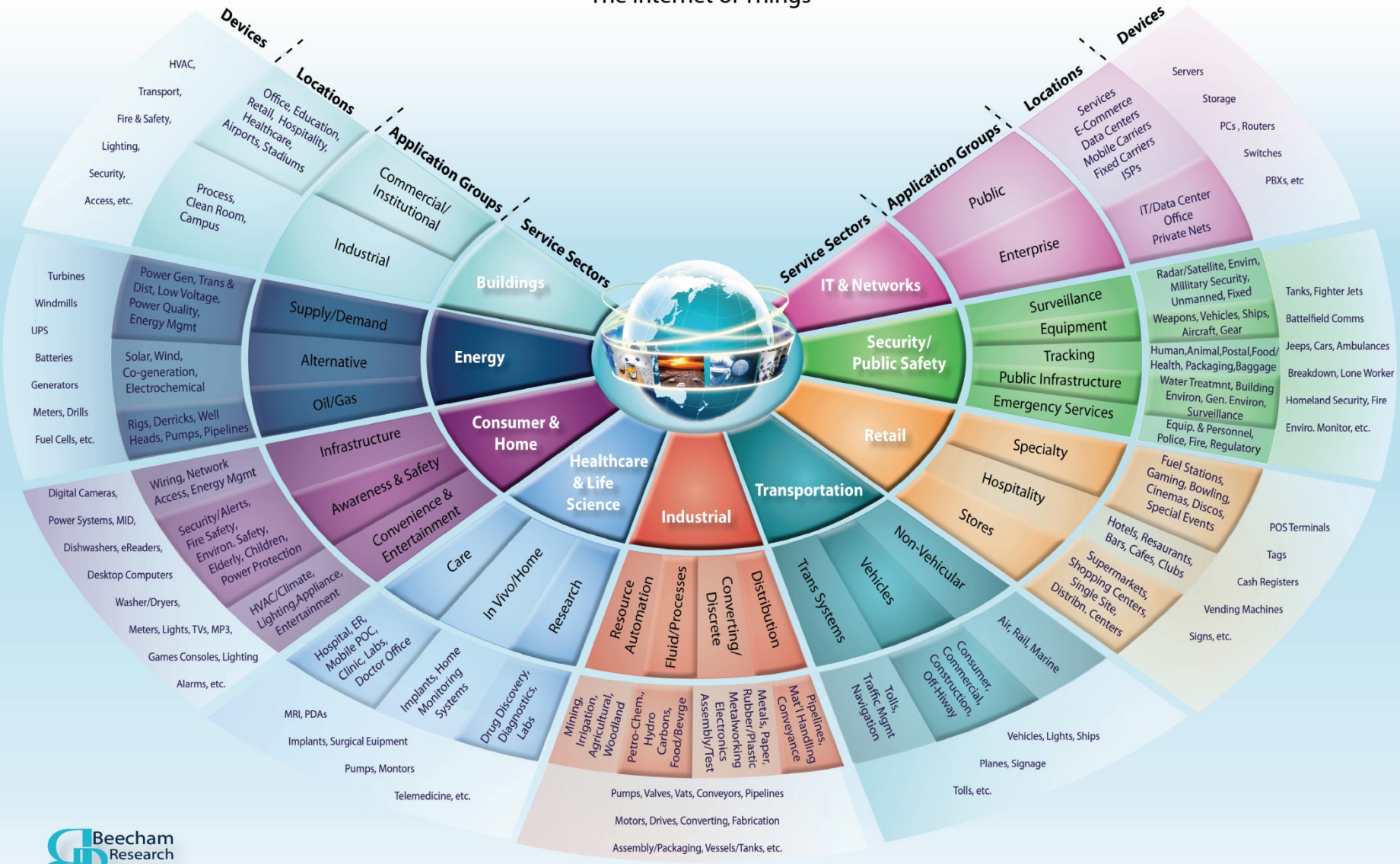
- Network Functions Virtualization (NFV) is a novel paradigm that presumes that the network functions:
  - Are implemented only as software (programs)
  - Can run on top of common servers
- NFV implies that network functions:
  - Can be moved as required
  - Do not require special equipment



© NFV White Paper presented at "SDN and OpenFlow World Congress", Darmstadt Oct 22-24, 2012

M2M World of Connected Services

The Internet of Things



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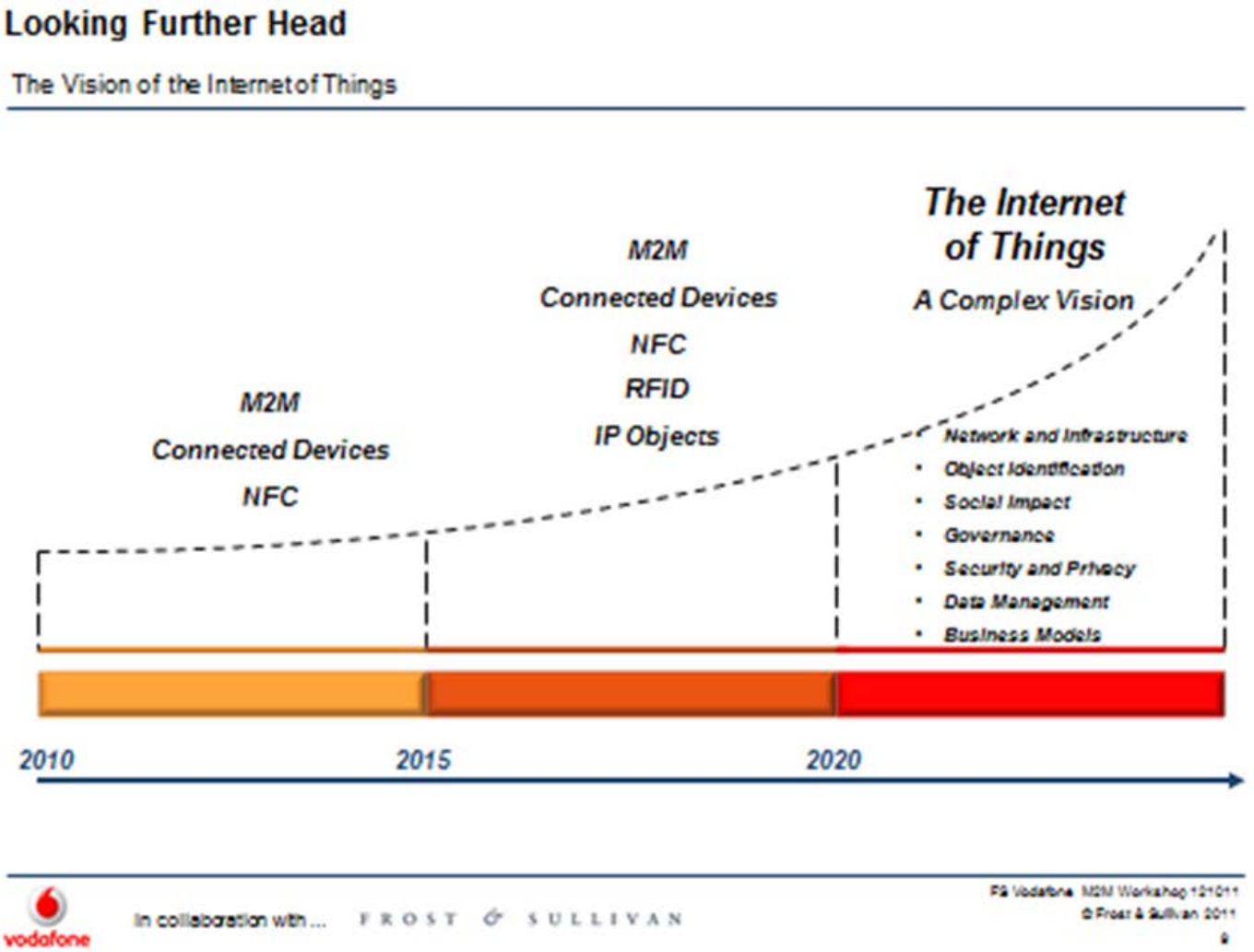
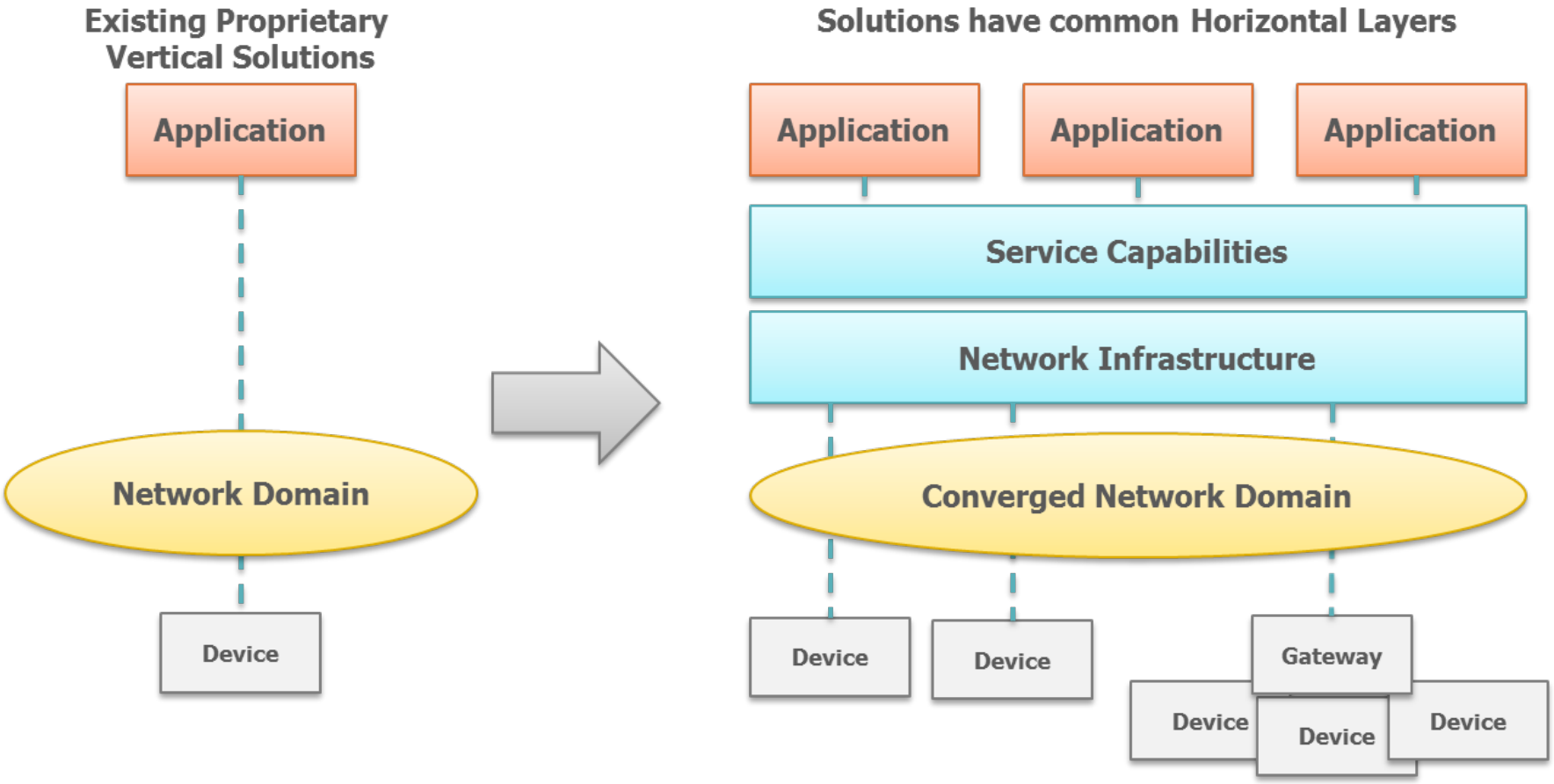
The Internet of Things



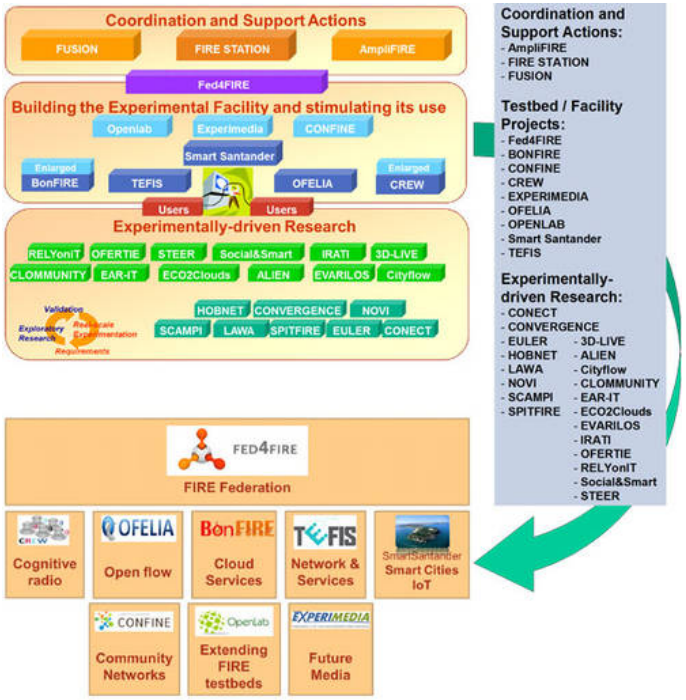
Source: Frost& Sullivan, Presentation: M2M Technologies Overview; 2011

Stop the Silo Mindset - Horizontal Approach for M2M

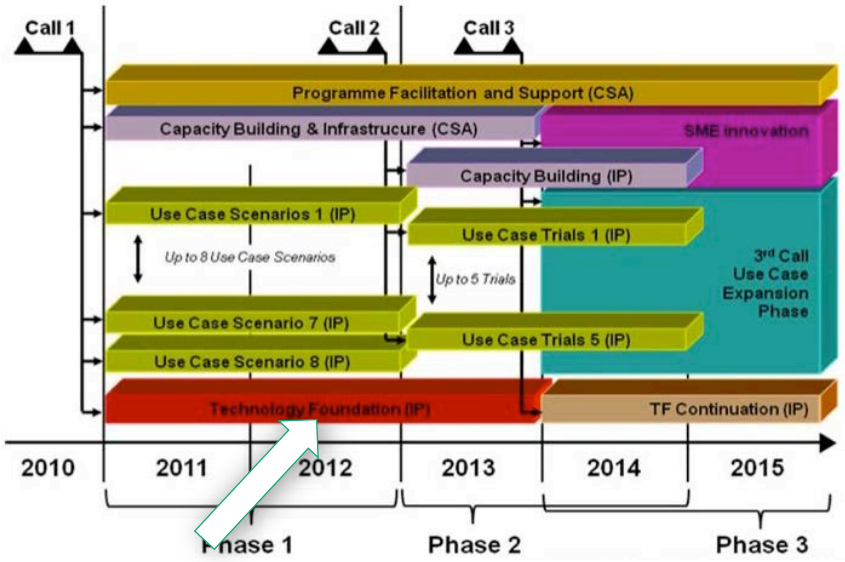


Europe's key Initiatives for Future Internet Research FIRE and the FI-PPP

- Europe's **Future Internet Research and Experimentation Initiative (FIRE)**
- Europe's **Future Internet Public Private Partnership Programme (FI-PPP)**



FIRE

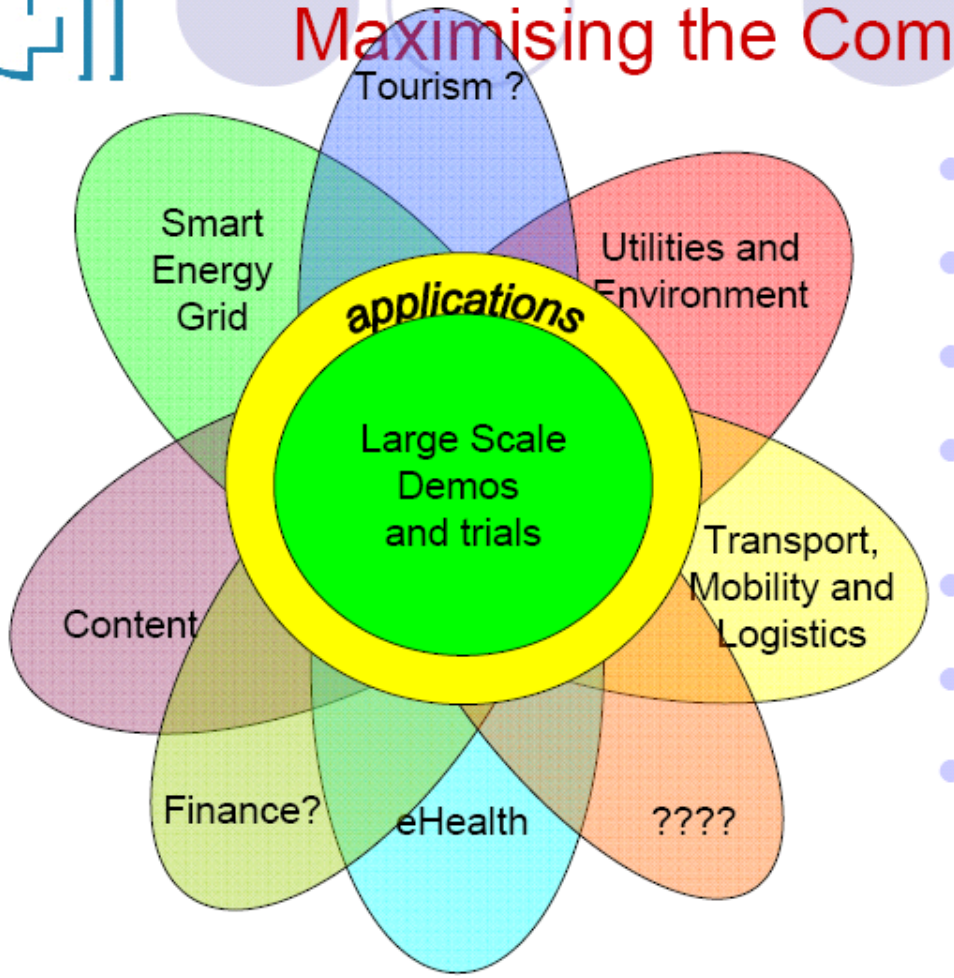


Future Internet Core Platform

FI-PPP

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

EU FI PPP Facts

FACTS & FIGURES

2x € 300 million

INVESTMENT BY THE EUROPEAN COMMISSION & PROGRAMME PARTICIPANTS

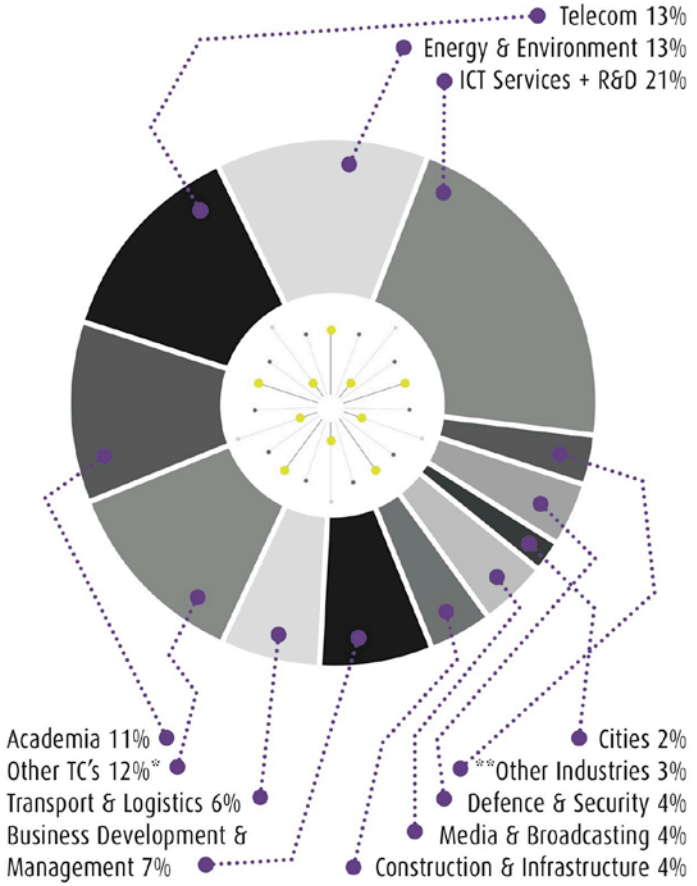
158 PARTNER ORGANIZATIONS AND COMPANIES

68% INDUSTRY SHARE IN THE PROGRAMME

18 ACADEMIC INSTITUTIONS

23

COUNTRIES REPRESENTED (2 FROM OUTSIDE EUROPE)



INDUSTRIES REPRESENTED IN THE FI PPP PROGRAMME

* Other Technology Companies, such as artificial intelligence, marine, aerial and satellite R&D, or automobile and other hardware manufacturing. ** E.g. Banks, retail stores, agriculture and food producing industries. Note: Figures are based on the number of participating organisations and approximate, since there are stakeholders with notable overlap in industries.

FI-WARE: Collaborating with Usage Area Projects

Outsmart: making public infrastructure in urban areas more intelligent and efficient

Envirofi: environmental data in the public domain

Fi-content: networked media including gaming

Finest: increasing efficiency in international logistics value-chains

Finseny: Reaping the benefits of electricity management at community level

Safety: Making cities saber

SmartAgriFood: Making the food value chain smarter

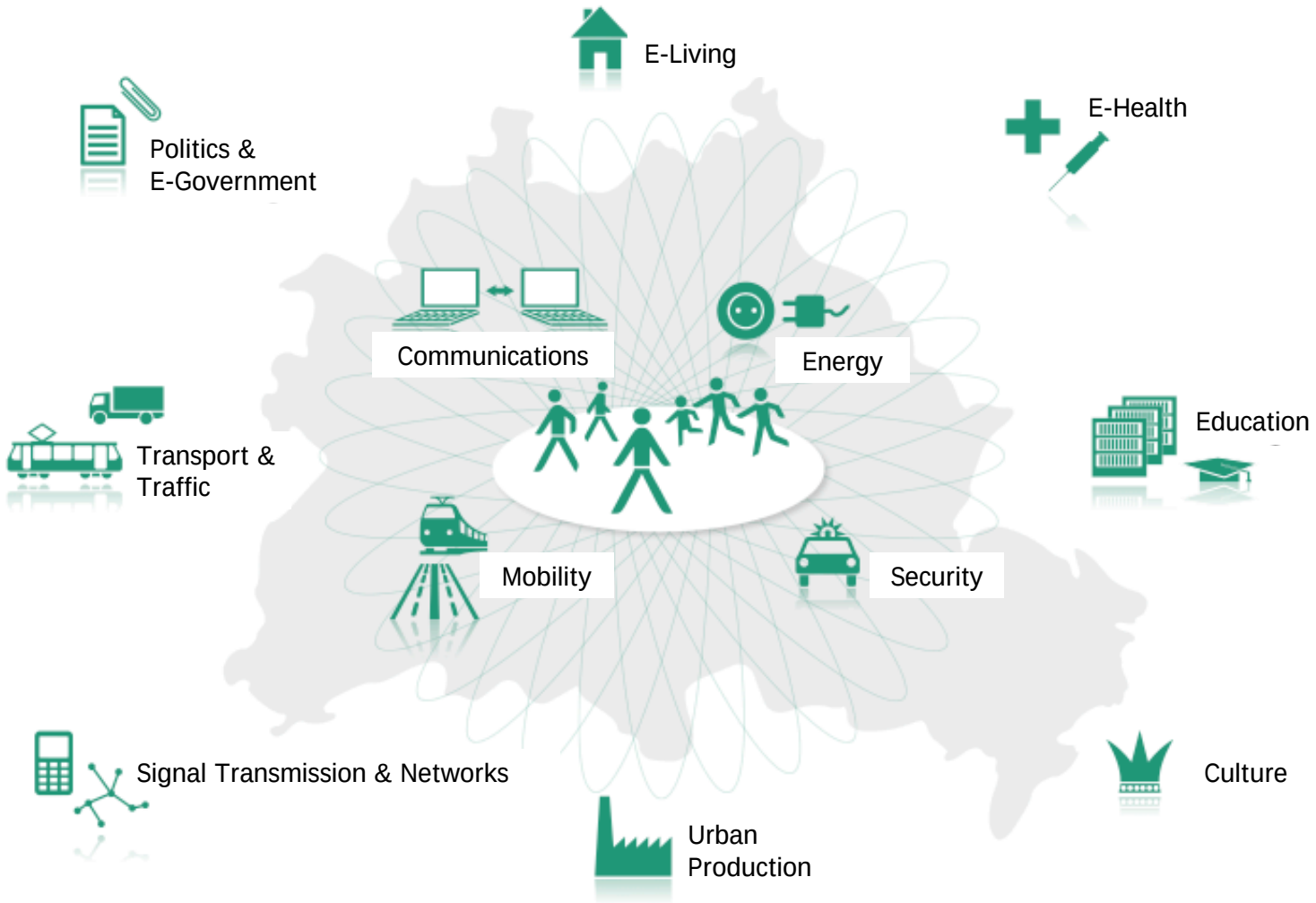
Instant Mobility: using FI in personal mobility

Future Internet vs. Smart Cities

- Future Internet is “a socio-technical system comprising Internet-accessible information and services, coupled to the physi- cal environment and human behavior, and supporting smart applications of societal importance”
- FI can transform a Smart City into an open innovation platform supporting vertical domain of business applications built upon horizontal enabling technologies.
- FI pillars for a Smart City environment:
  - The Internet of Things (IoS): defined as a global network infrastructure based on standard and interoperable communication protocols where physical and virtual “things” are seamlessly integrated into the information network
  - The Internet of Services (IoS): flexible, open and standardized enablers that facili- tate the harmonization of various applications into interoperable services as well as the use of semantics for the understanding, combination and processing of data and information from different service provides, sources and formats.
  - The Internet of People (IoP): envisaged as people becoming part of ubiquitous intelligent networks having the potential to seamlessly connect, interact and ex- change information about themselves and their social context and environment.

Future Internet ... to make our cities smart

A Smart City is a huge Future Internet Show Case



Smart Cities: The Facts

- 50% of the world's population already lives in cities and trends suggest that over 60% will live in cities by 2030
- 50% of global GDP is generated in the largest 600 cities
- There are 484 cities worldwide with populations in excess of one million
- There are 780,000 municipalities and states that are charged with the same functions as cities
- A UN report suggests that 40,000 new cities will need to be built worldwide by 2050
- The global private & public ICT market is $1580bn per annum; public sector market $423bn with $179bn of that local & regional government
- The global ICT market is 15% software and around 85% services and hardware
- Total estimated global budget for improving city ICT- $35-55bn
- Total ICT public sector city market circa $5bn software, $30bn services/hardware
- USA largest market +$12bn, Europe +$5bn, China +$3bn, Japan +$3bn, India +$1bn

Challenges for Future Cities – Global Megatrends until 2050

Demographic Change

Urban Development

Globalization

Energy and Resources

Environment

Health

Mobility

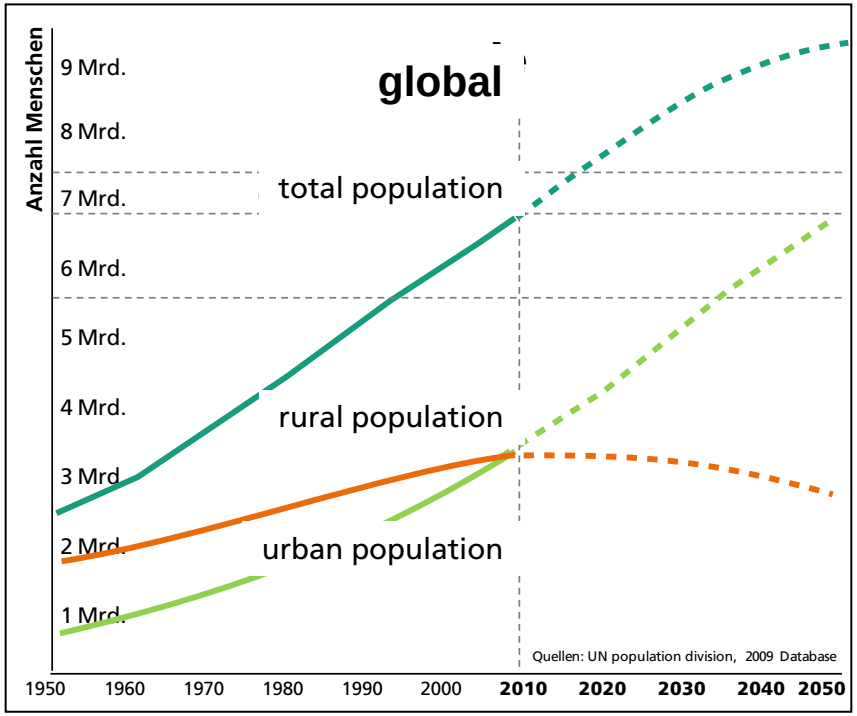
Dialog and Participation

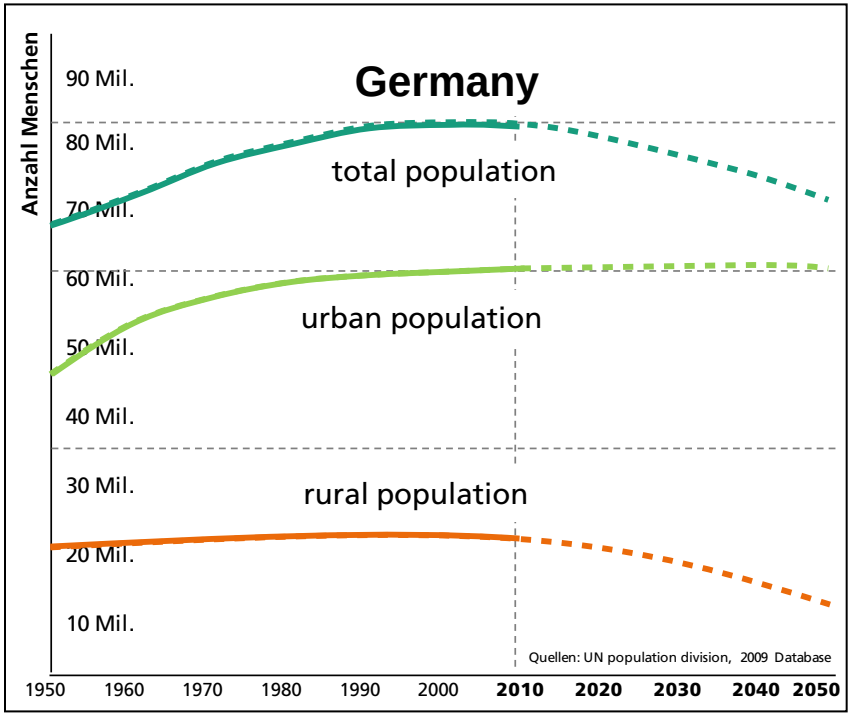
Work & Life

The challenge of the 21st century

Urban growth and sustainable development

- In 2050, 6.3 Billion people live in urban environments, almost double as many as today
- Urban environments are more resource-efficient than rural areas and consume less energy per capita
- Germany can act as archetype of highly urbanized knowledge economy





Smart Urban Environments

R&D Challenges

- Luxury needs
- New patterns of use
- New life styles

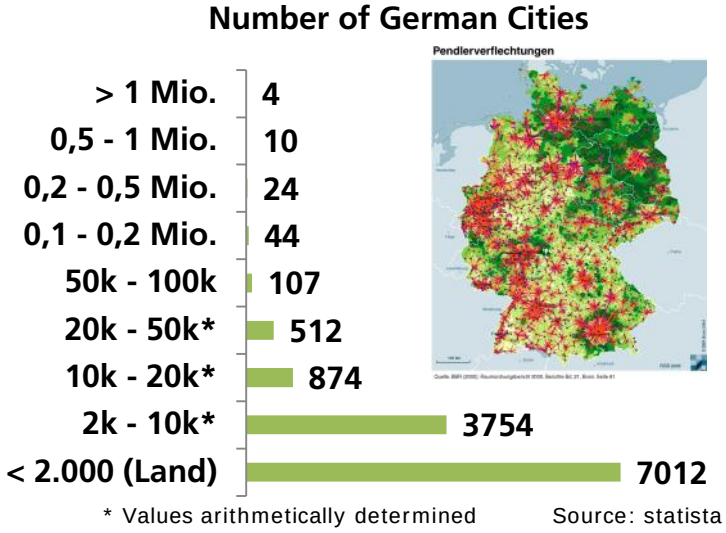
- Desire for participation
- Increasing interaction
- Participative processes

- Increasing energy consumption
- Change in energy supply
- Smart grids

- Knowledge economy
- Flexible work environments
- Work life balance

- Increasing mobility
- Global logistics
- Change to eMobility

- Demographic change
- Cultural diversity
- Social diversity



Applied R&D and Deployment

Smart Cities

- The Smart City can be defined as the integration of technology into a strategic approach to sustainability, citizen well-being, and economic development. Any adequate model for the smart city must be multi-dimensional, encompassing different aspects of “smartness” and stressing the importance of integration and interaction across multiple domains.

- “Smart Cities” are environments of open and user driven innovation for experimenting and validating Future Internet-enabled services.

- Smart Cities Technology links to FI, the Internet of Things, and M2M.

As cities are defined as ‘systems of systems’, there is no **one** Smart Cities market:
-There are Smart Cities segments, ecosystems, and subsystems

Smart Cities – Forecast by Pike Research

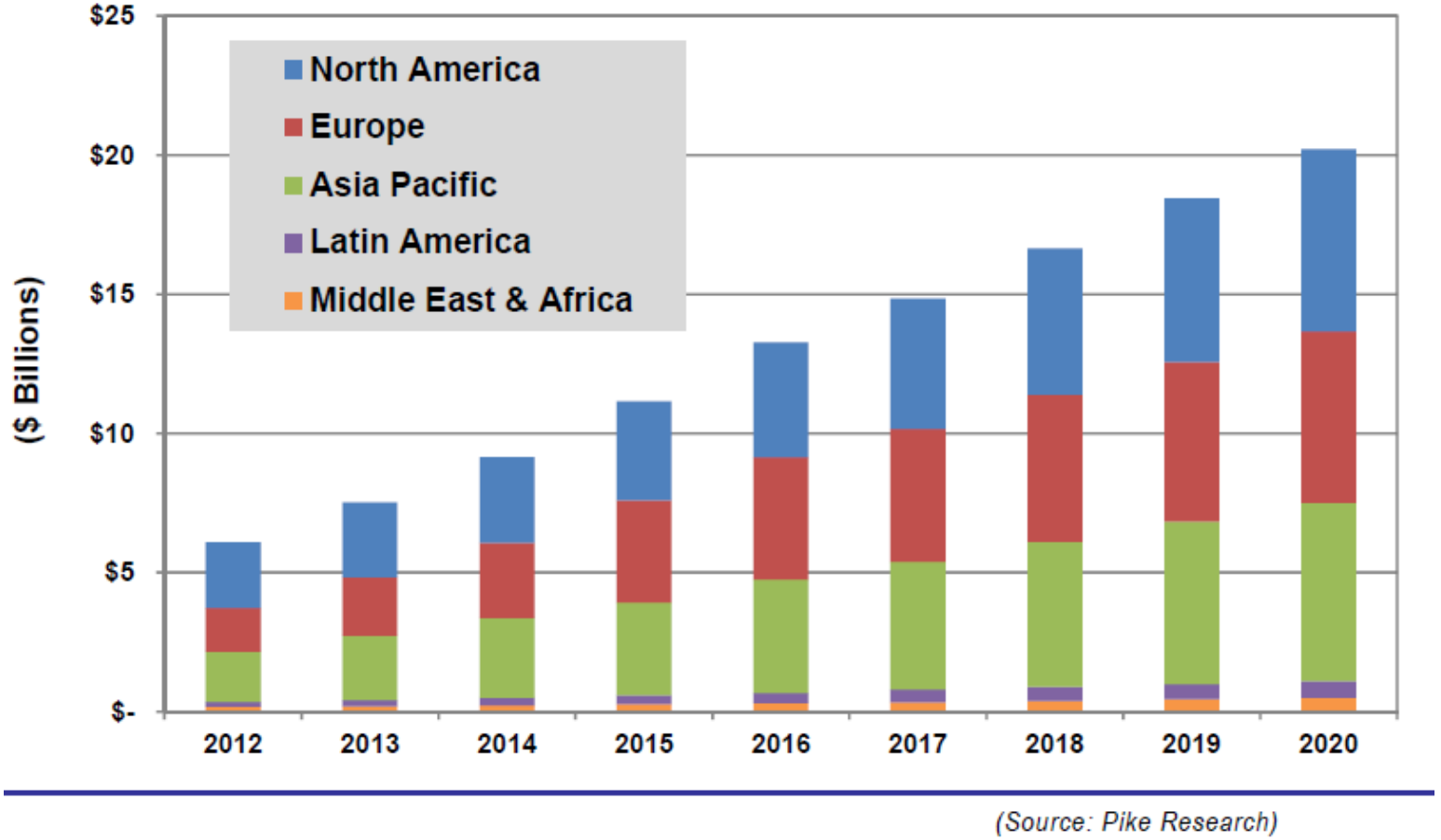
- Between 2010 and 2050, the number of people living in cities will increase from 3.6 billion to 6.3 billion. By 2025, there will be 37 megacities with populations of over 10 million; 22 of those cities will be in Asia.

- By 2020, the smart city technology market will be worth $20.2 billion annually, compared to$ 6.1 billion in 2012. This represents a compound annual growth rate (CAGR) of 16.2%.

- Pike Research analyzes the market in terms of the five “industries” that are core to the development of smart cities: smart energy, smart water, smart transportation, smart buildings,and smart government. The fastest-growing of these industries will be smart transportation,with a CAGR of 19.5% between 2012 and 2020. By 2020, the smart transportation marketrelated to smart cities will be worth $5.5 billion annually.

[Source: Pike Research:”Smart Cities Infrastructure, Information, and Communication Technologies for Energy, Transportation, Buildings, and Government: City and Supplier Profiles, Market Analysis and forecast, 2013]

Smart City Technology Annual Revenue by Region, World Markets: 2012-2020



(Source: Pike Research)

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Smart City Vision – Information and Communication is Key

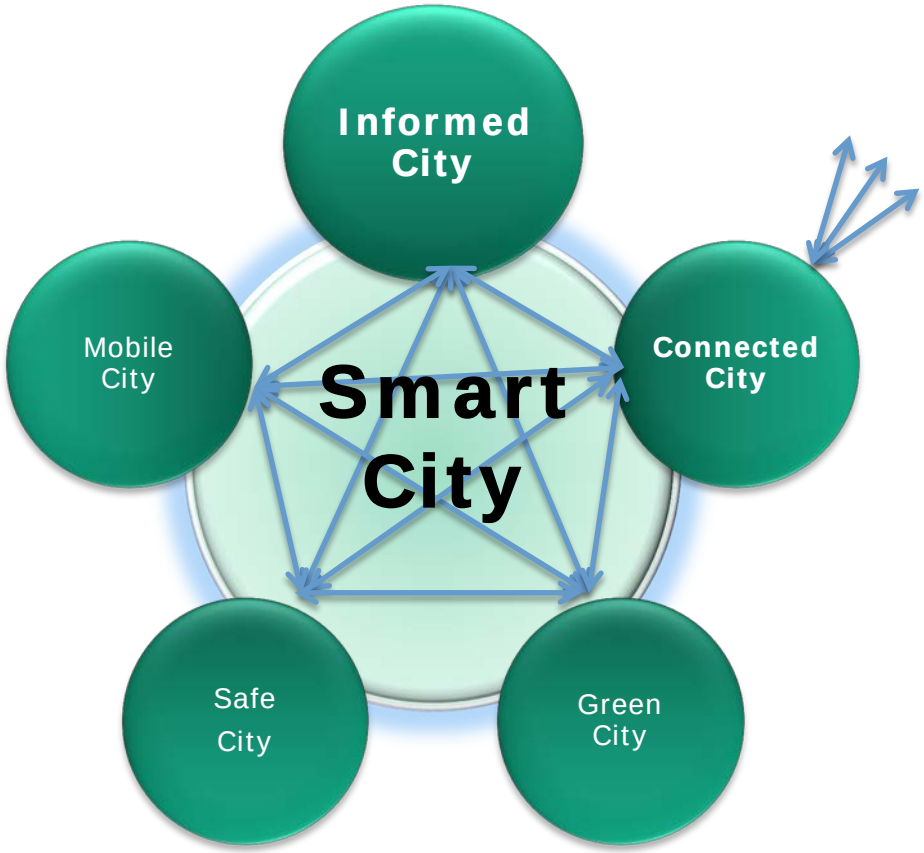
- City as **service provider**

  for citizens, enterprises, institutions, and tourists

- Smartness via

  Always Best Informed and Inter-Connected Urban Actors (Machines, Systems and People)

  Information at any need, at any place, at any device, at any time, at any preference

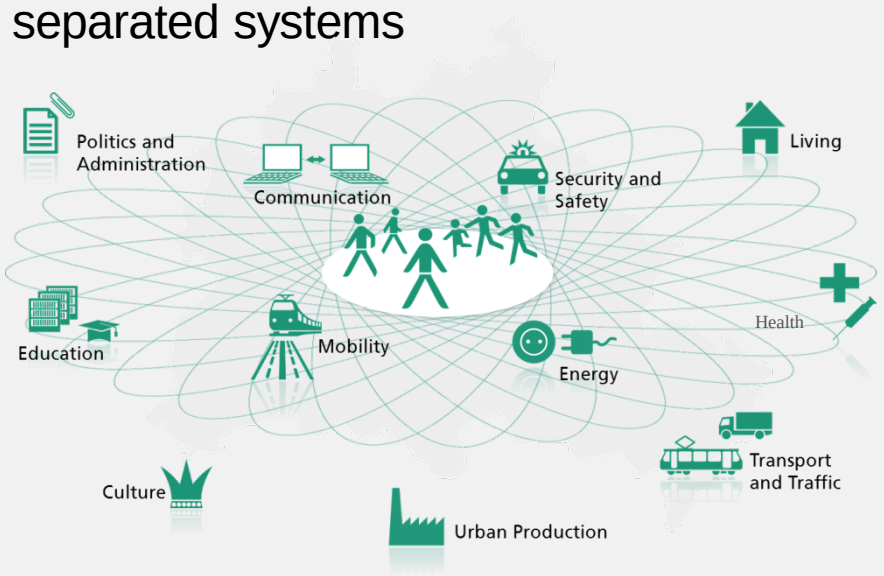


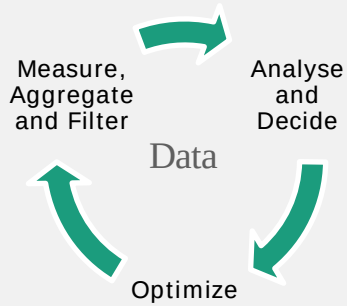
Smart Cities require a common service and network Infrastructure

City is a system of systems

Set of separate technical systems → Integrated systems

Effectivity and efficiency results from optimized integration / federation of separated systems



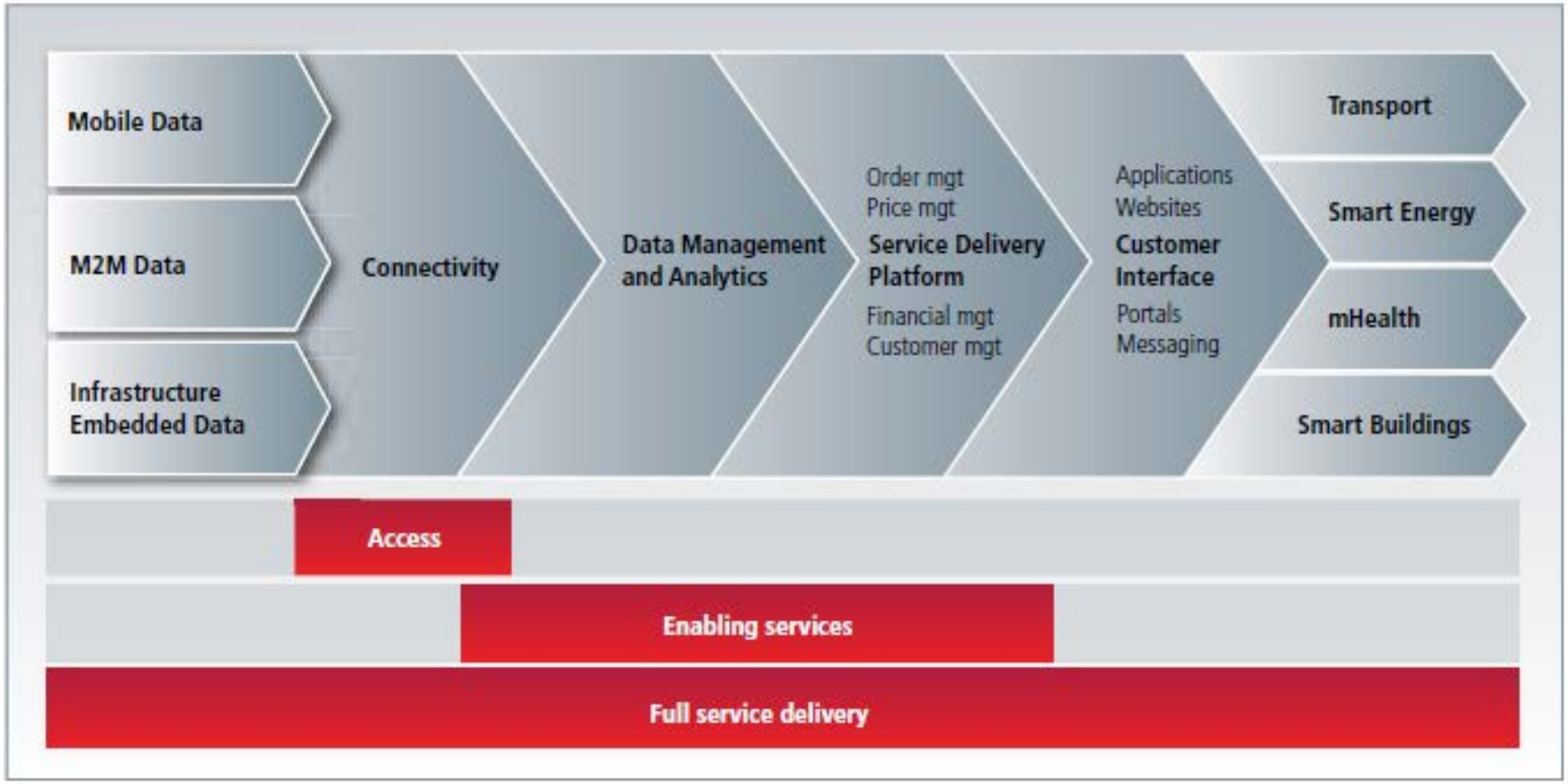


Fraunhofer FOKUS

as Enabler and Integrator for ICT-based Solutions

- FOKUS Smart Cities Portal, Sept. 2011
- acatech Position Paper: „Smart Cities“, Jan. 2011.
- Münchener Kreis Smart Cities Conference in Berlin, July 2010

The Smart Cities Value Chain



Source: Accenture

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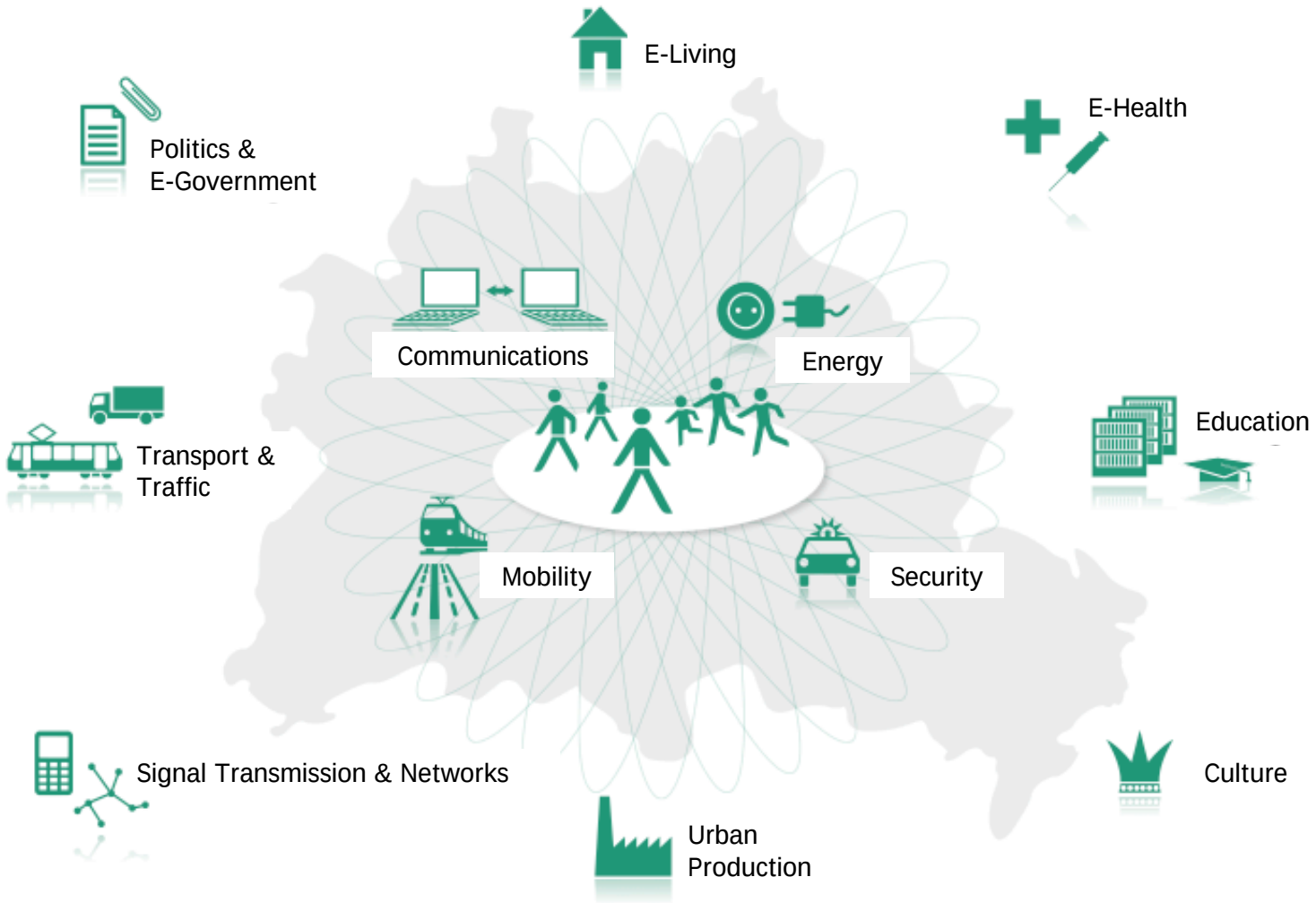
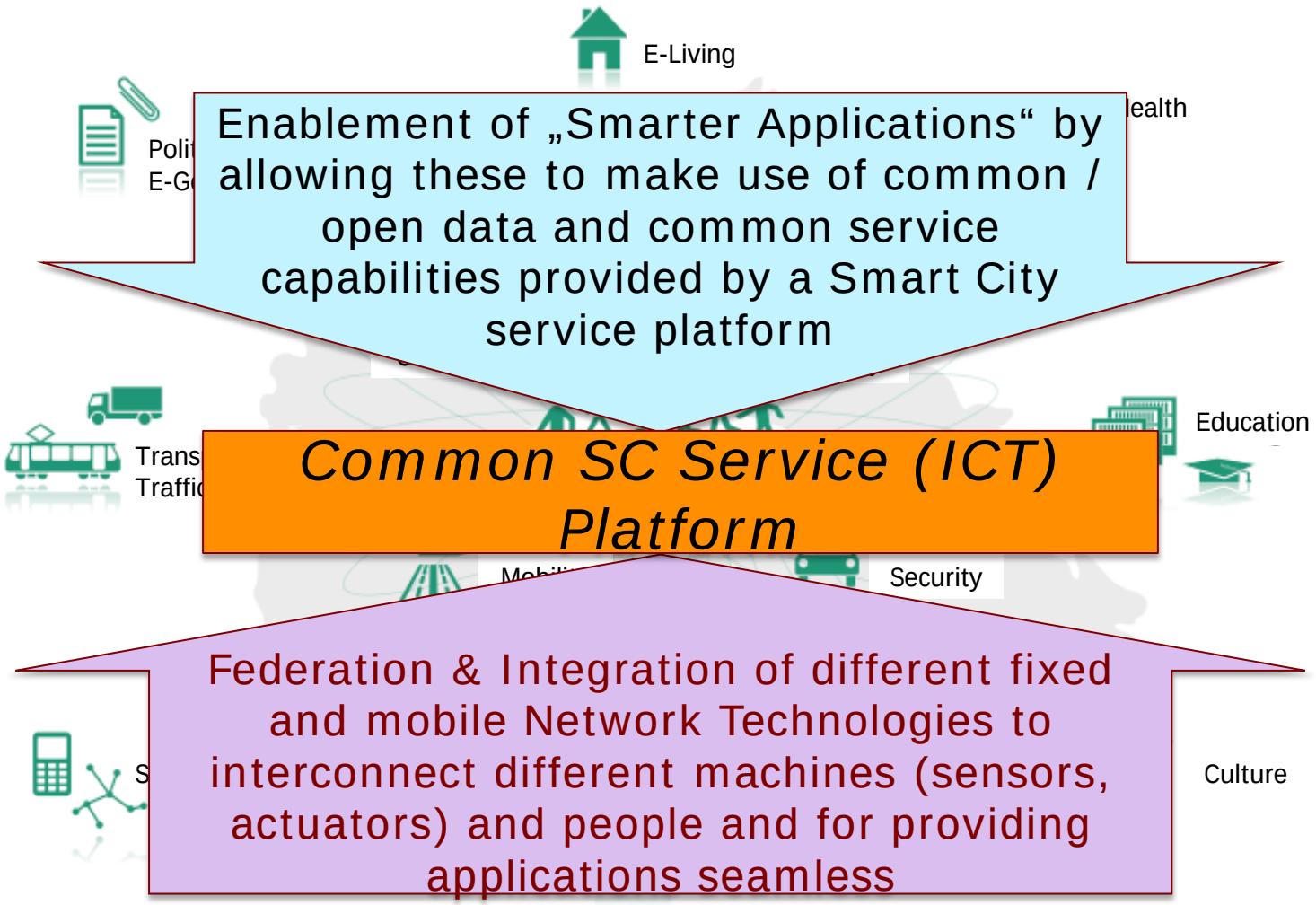
Fraunhofer SMART CITIES



A Smart City relies on Integration & Federation of Systems

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



Smart City Enablement Requirements

- Different communication patterns need to be supported for different service domains:
  - session-based human-to-human & M2M communication
  - one-to-one, multicast, broadcast and group communication
  - resource-based pull/push communication between sensors & actuators

- Generic Smart City platform needs to support many service verticals and application scenarios
- Smart Cities require federation between heterogeneous platforms
- Smart City communication platforms acts as a convergence & orchestration point for networks, services and data
- Different principles for OTT & Telecom core networks need to be supported
- A set of common requirements as QoS, security, charging, device & entity management needs to be shared to across many service domains.

Functional Requirements for a Smart City Platform
Communication Enablers & Sectors

Enabling Services		Business / Collaboration	Leisure time communication	E-Health	Utilities	Facility Management	E-Energy	Logistics
Machine-2-machine	Retrieve data			X	X	X	X	X
	Control devices			X	X	X	X	X
	Send data			X	X	X	X	X
Human-2-human	A/V Call	X	X	X	X	X		
	A/V conference	X		X	X	X		
	Messaging / File transfer	X	X	X	X	X		
	Presence	X	X			X		X
	Location	X	X	X	X	X	X	X
	Address Book	X				X		
Overarching enablers	QoS	X	X	X	X	X		
	Device/entity mgmt	X	X	X	X	X	X	X
	Security	X	X	X	X	X	X	X

Example Use Case: In-Depth Analysis Facility Management

Facility Management		Video surveillance	Utility Metering	Condition monitoring (temp., humidity, etc.)	Automation (light, air conditioning, etc.)	Alarm system monitoring
Machine-2-machine	Retrieve data	X	X	X	X	X
	Control devices				X	X
	Send data				X	X
Human-2-human	A/V Call	X				X
	A/V conference					X
	Messaging / File transfer		X			
	Presence	X				X
	Location	X	X	X	X	X
	Address Book	X		X		
Overarching enablers	QoS	X		X	X	X
	Device/entity mgmt	X	X		X	X
	Security	X	X	X	X	X

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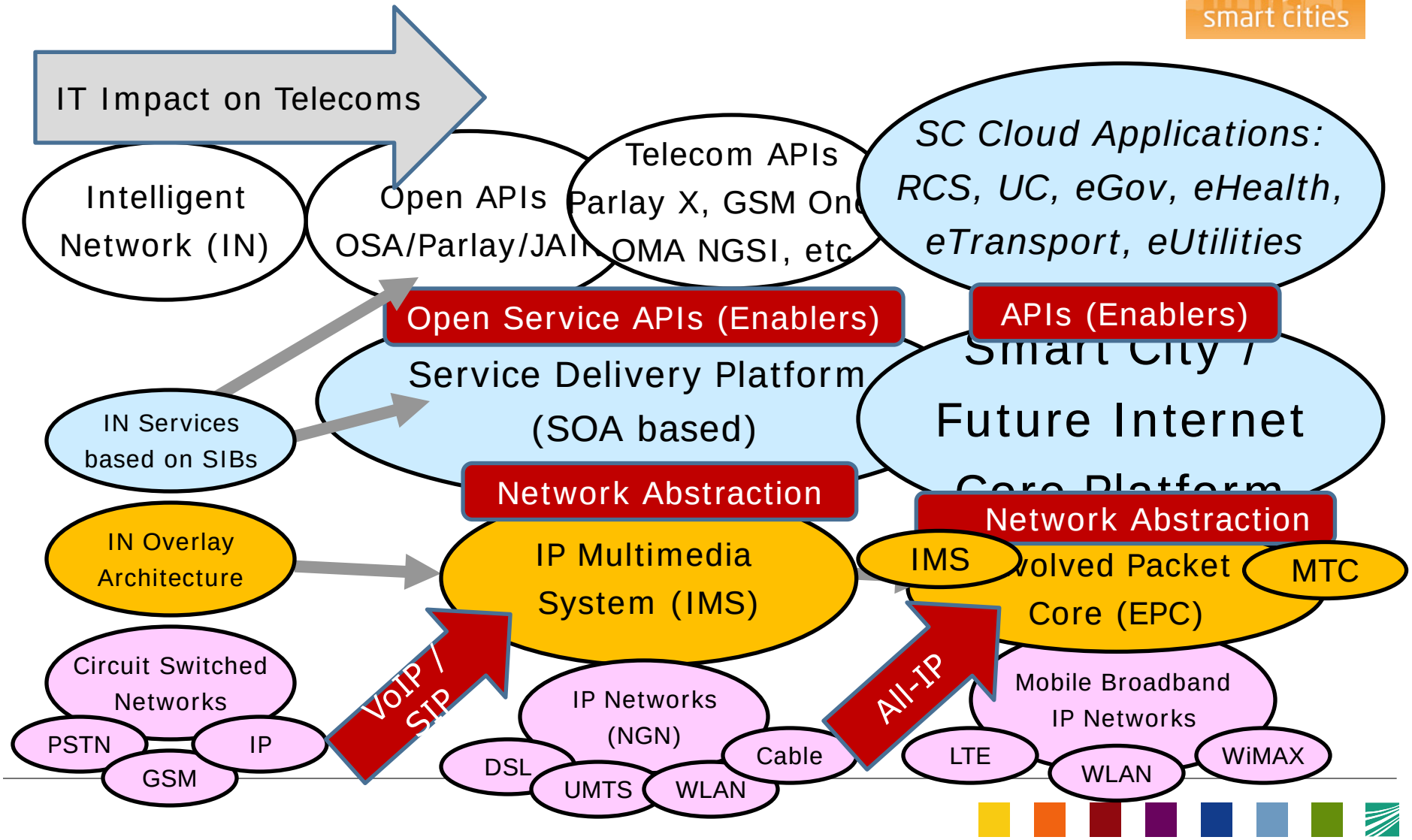
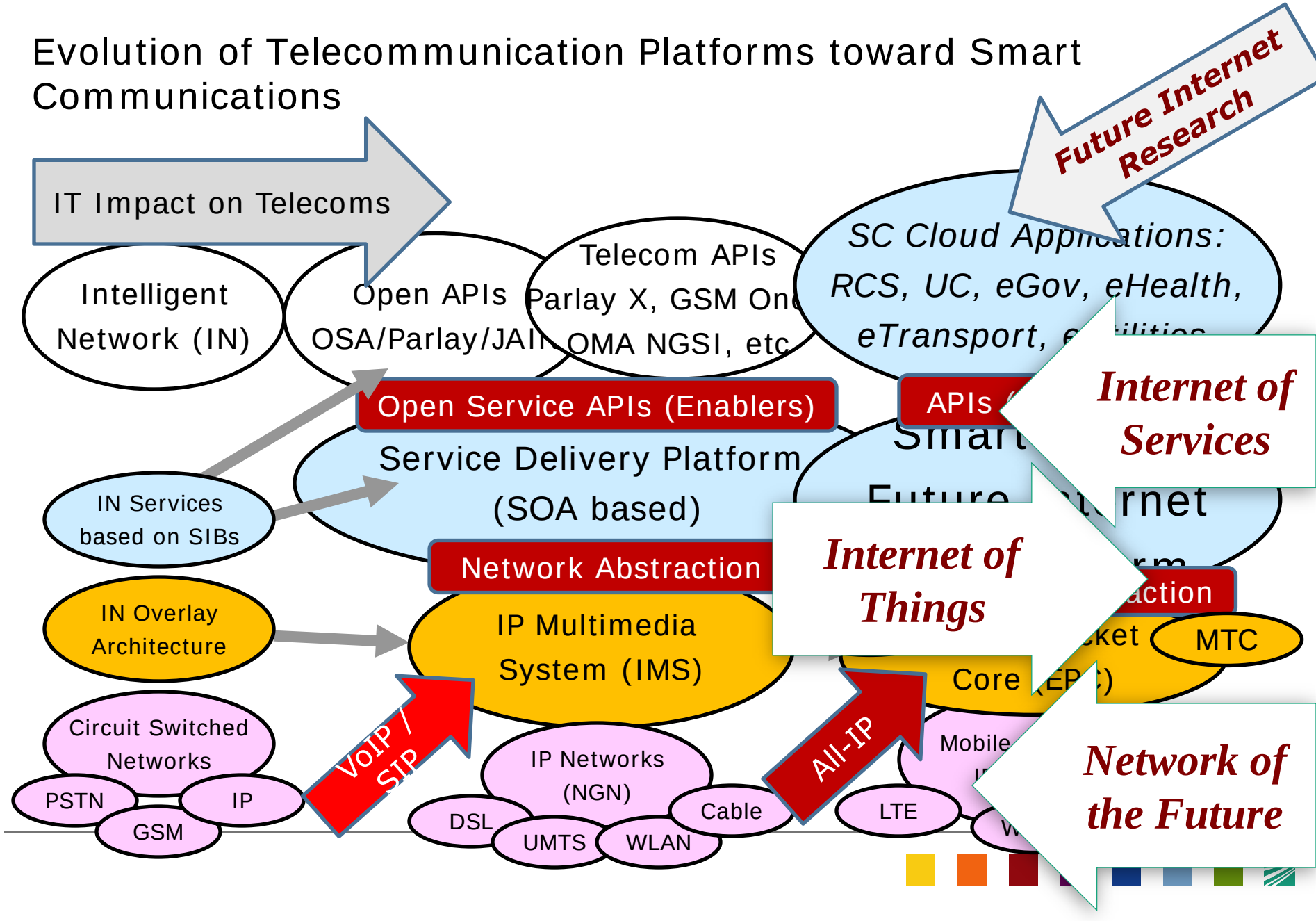
Evolution of Telecommunication Platforms toward Smart Communications

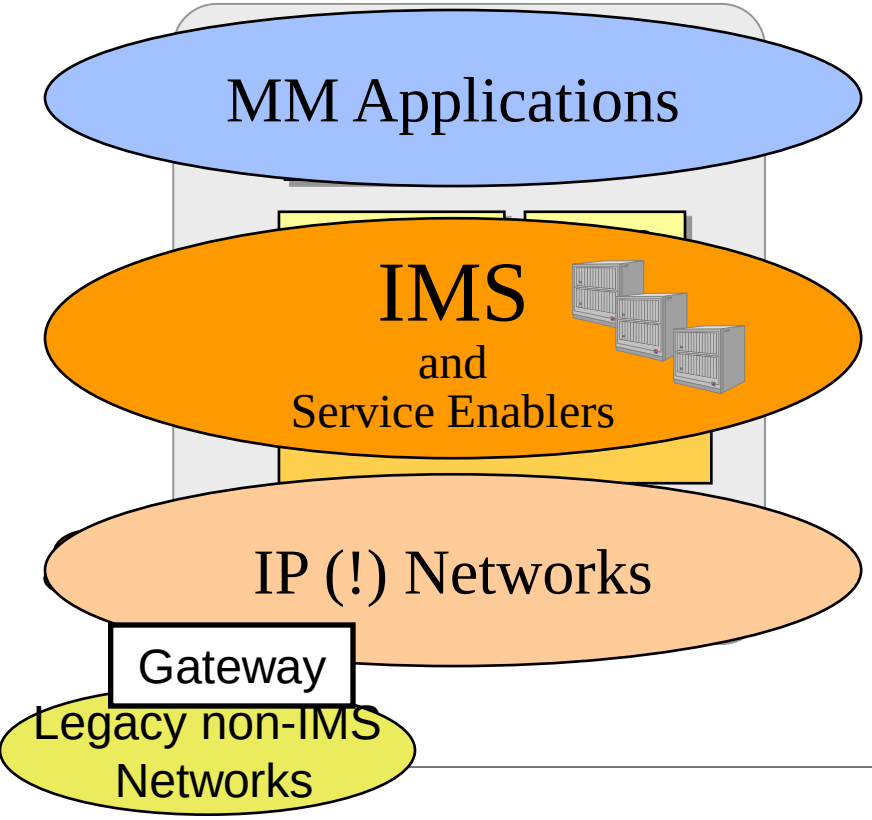


Evolution of Telecommunication Platforms toward Smart Communications



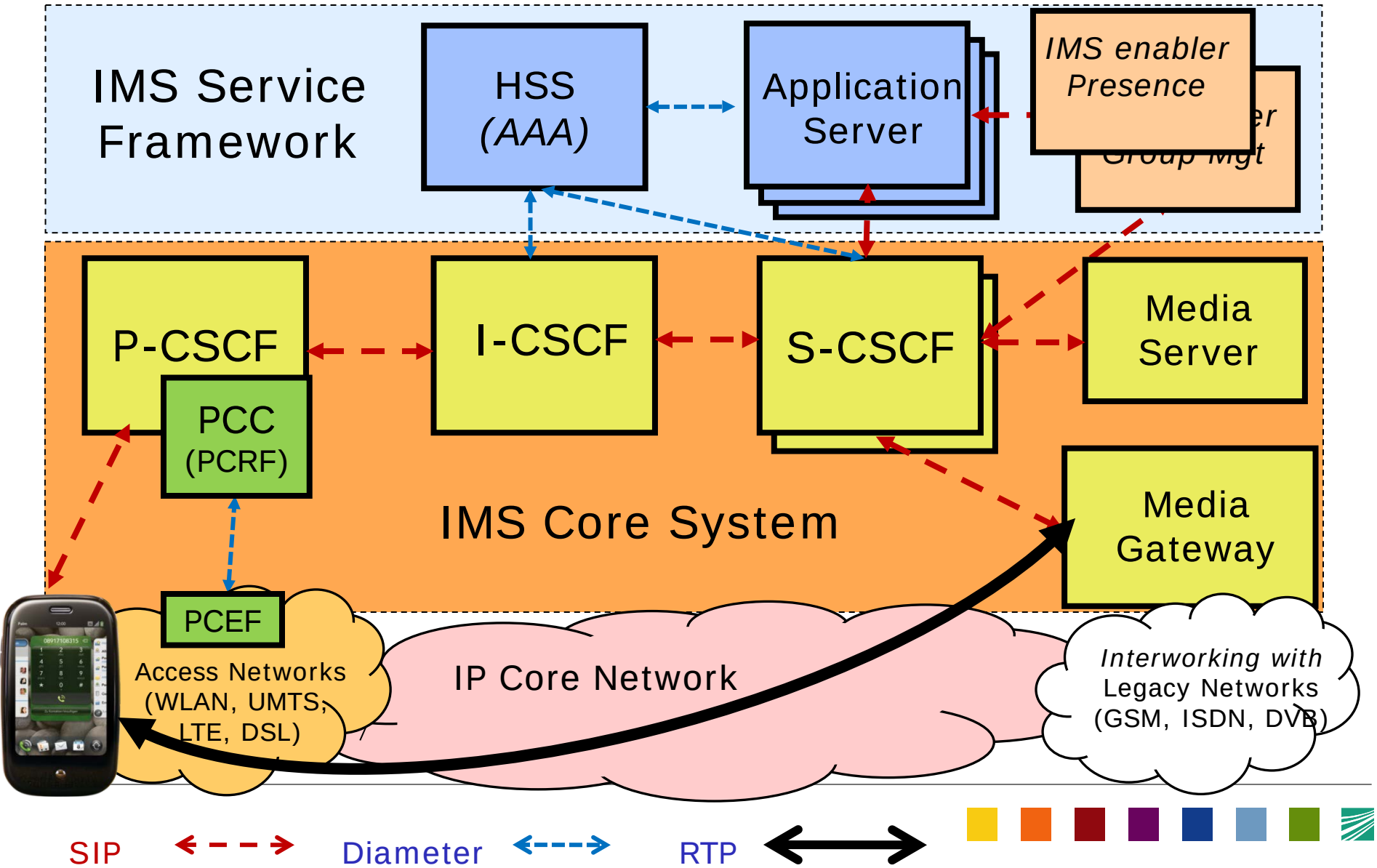
IMS Architecture Principles

- IMS does NOT standardise specific services, but enablers
- BUT supports inherently multimedia over IP, VoIP, IM, presence (SIP)
- IMS enables the flexibility in providing IP-based applications !!

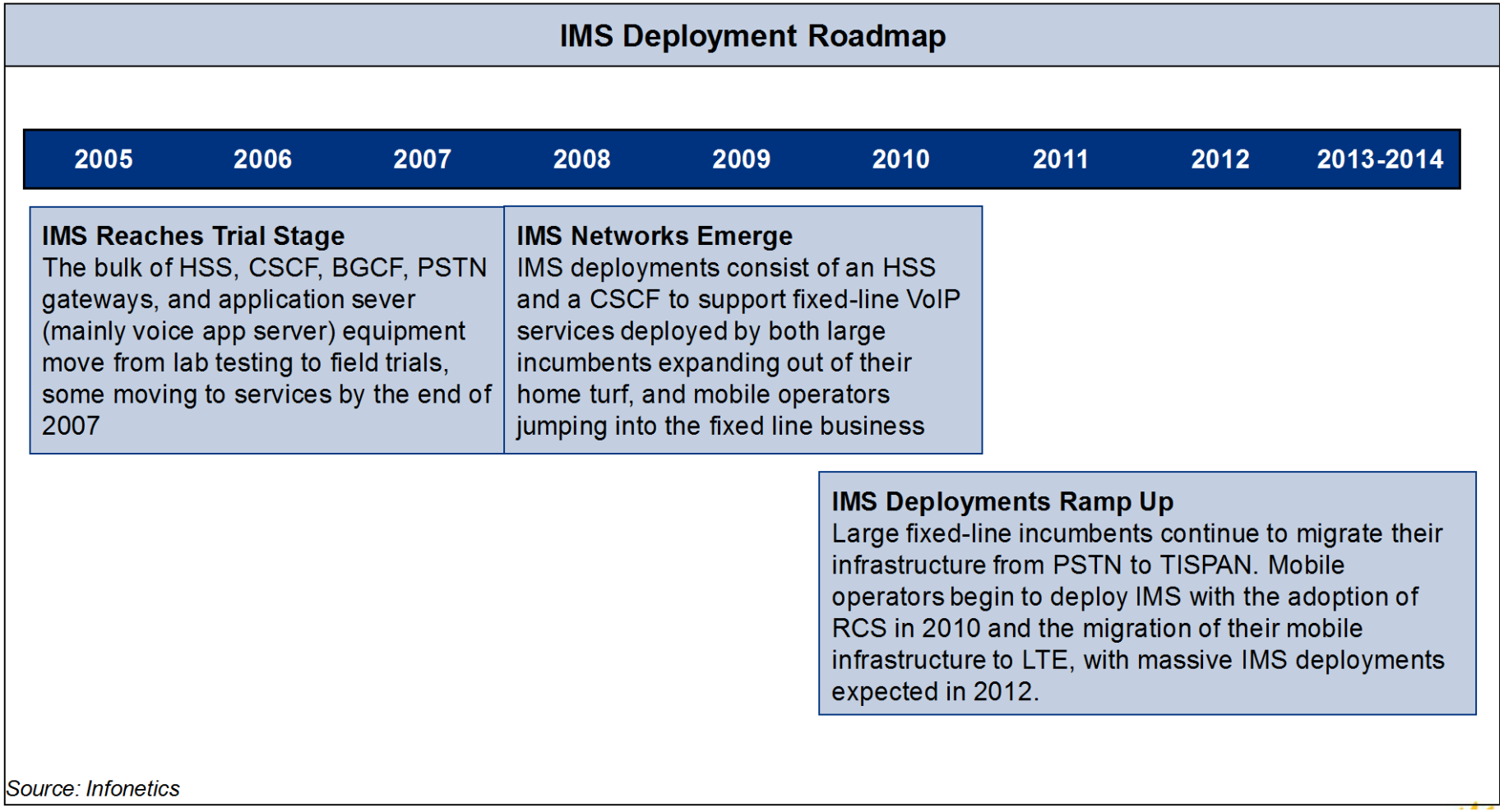


- Horizontal Architecture defining a “docking station” for applications
- Defines service enabler capabilities
- Build on existing IETF and telco SDP standards
- Provides compared to standard internet
- Better security, Service based QoS, flexible charging and single sign on

3GPP IMS Architecture: IMS Core and Application Layer

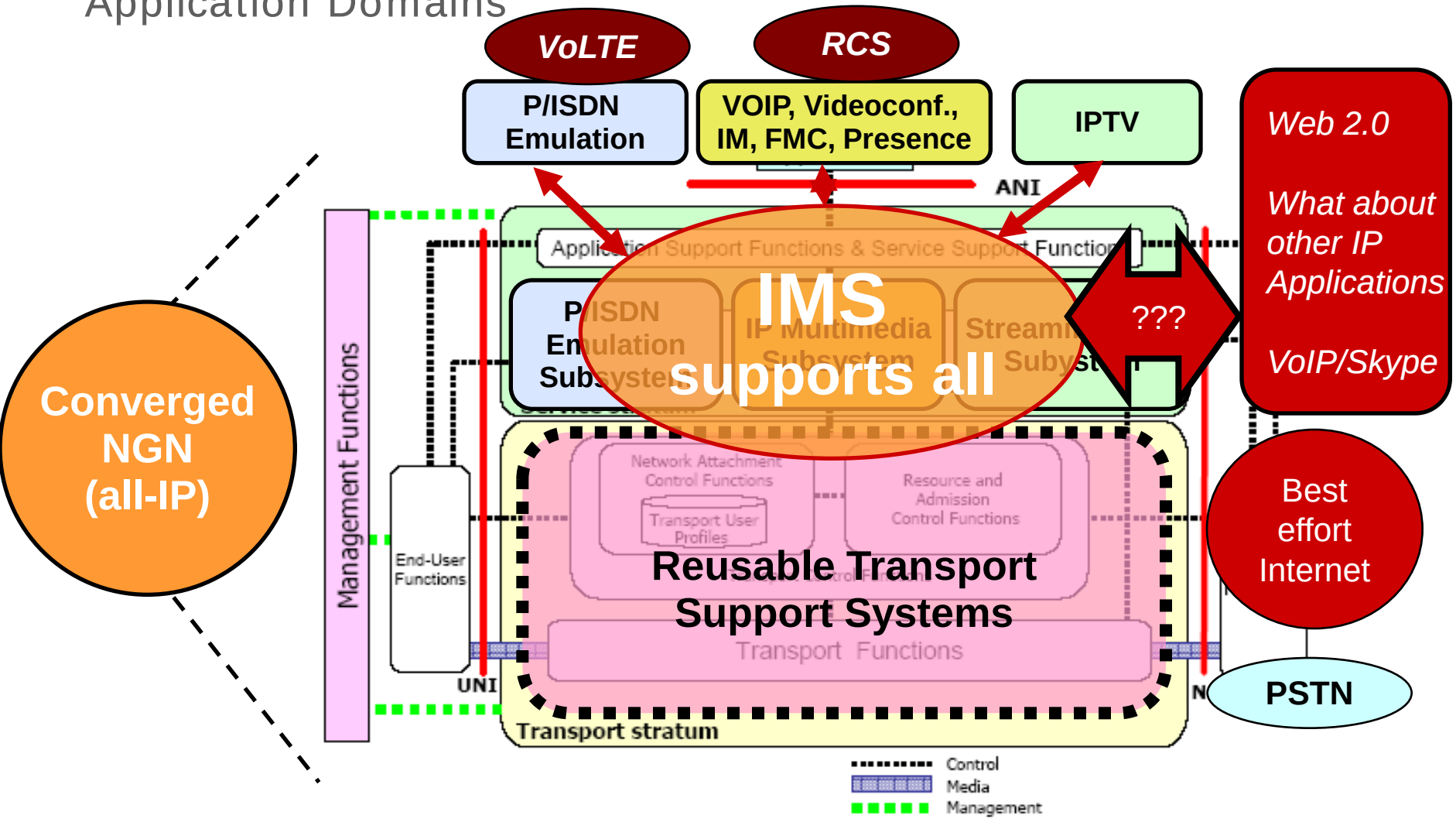


IMS Road Map



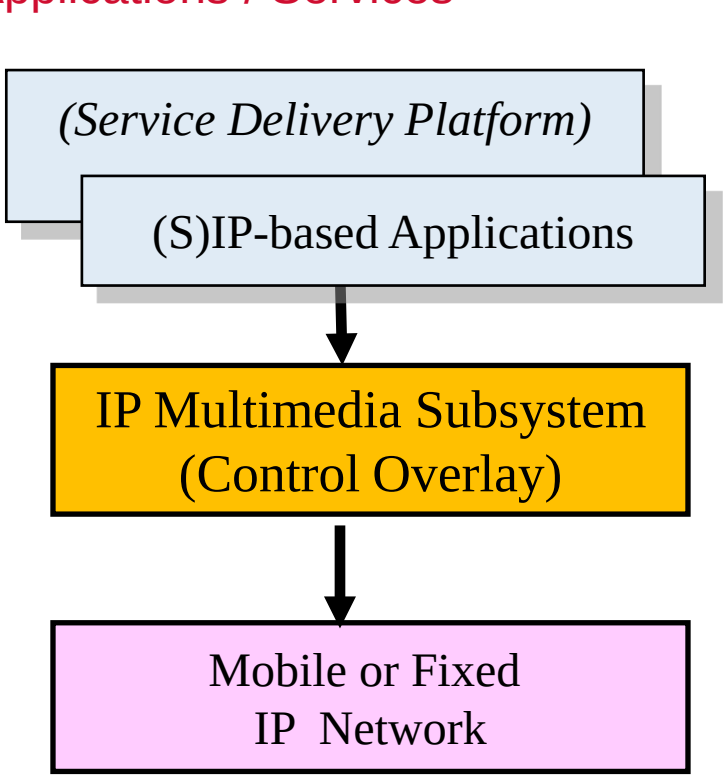
Industry expects IMS deployment to ramp up, driven by PSTN migration from fixed line operators and migration to LTE together with RCS adoption from operators

IMS is the common control platform within the NGN for many Application Domains

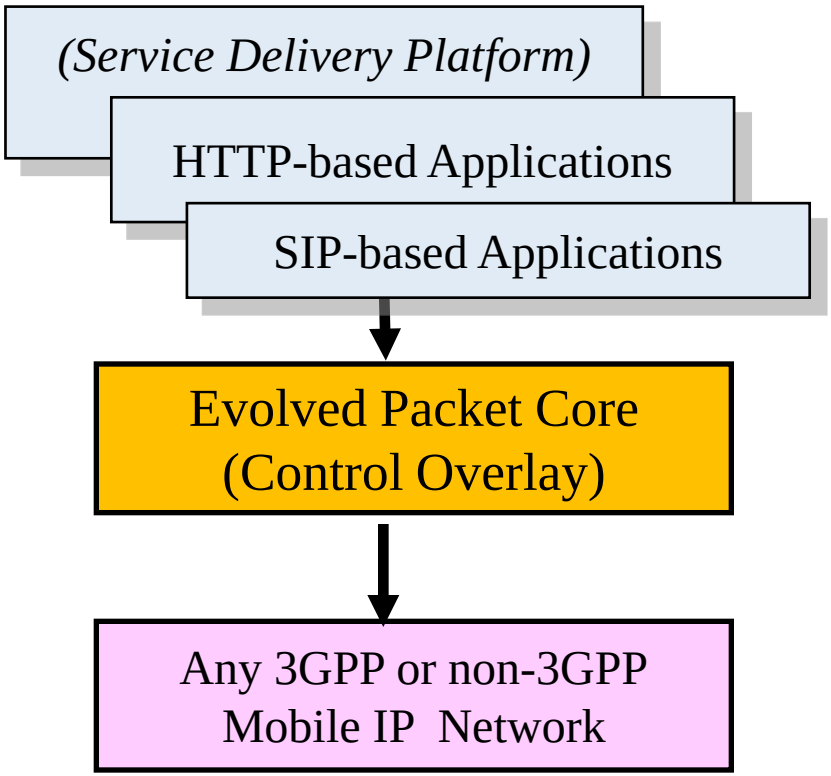


IMS Concept Evolution toward EPC

Main Idea: Common Control Overlay Architecture abstracts from underlying IP network technology and provides common platform capabilities for any IP-based Applications / Services

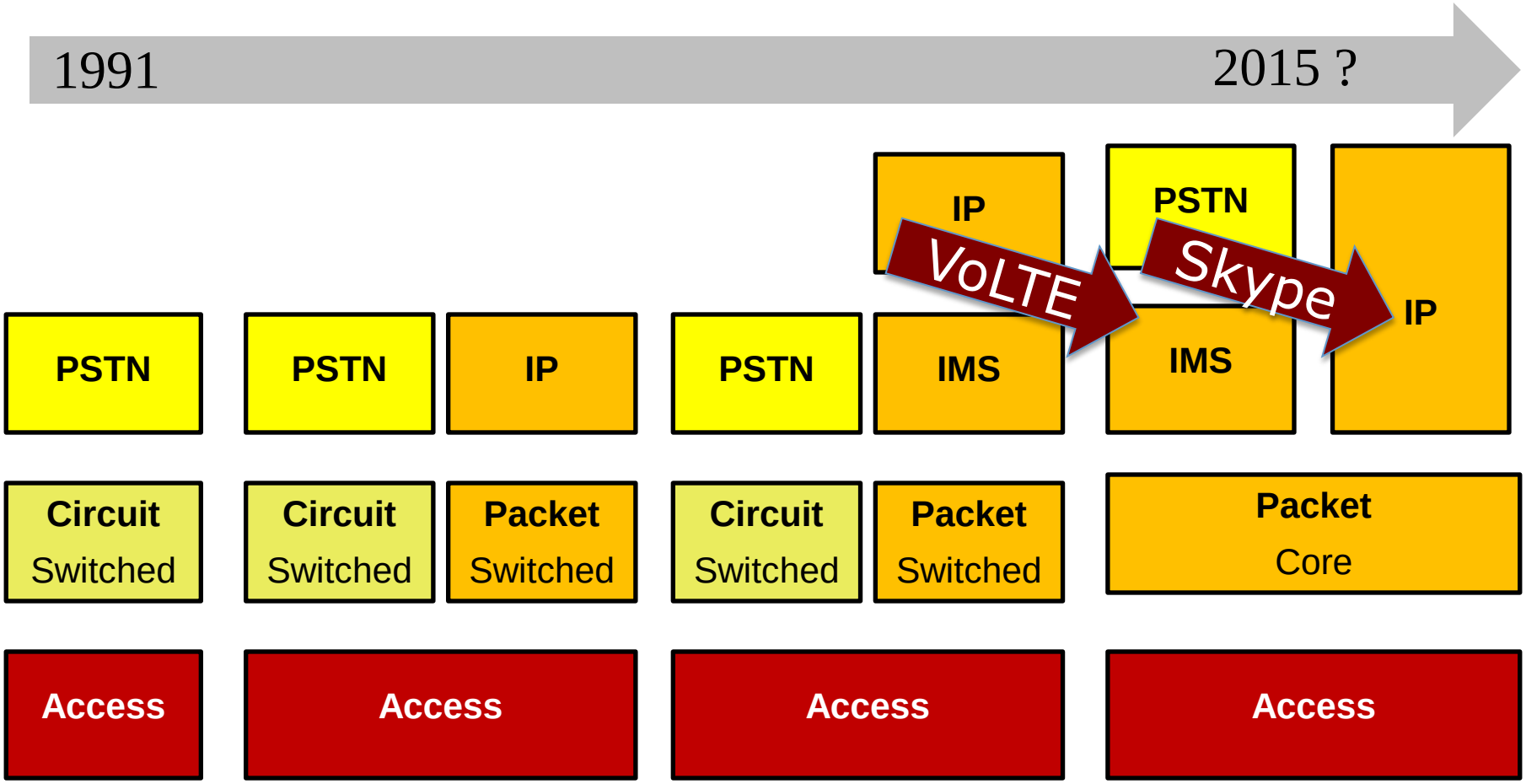


Packet Switched Telco Domain (NGN)

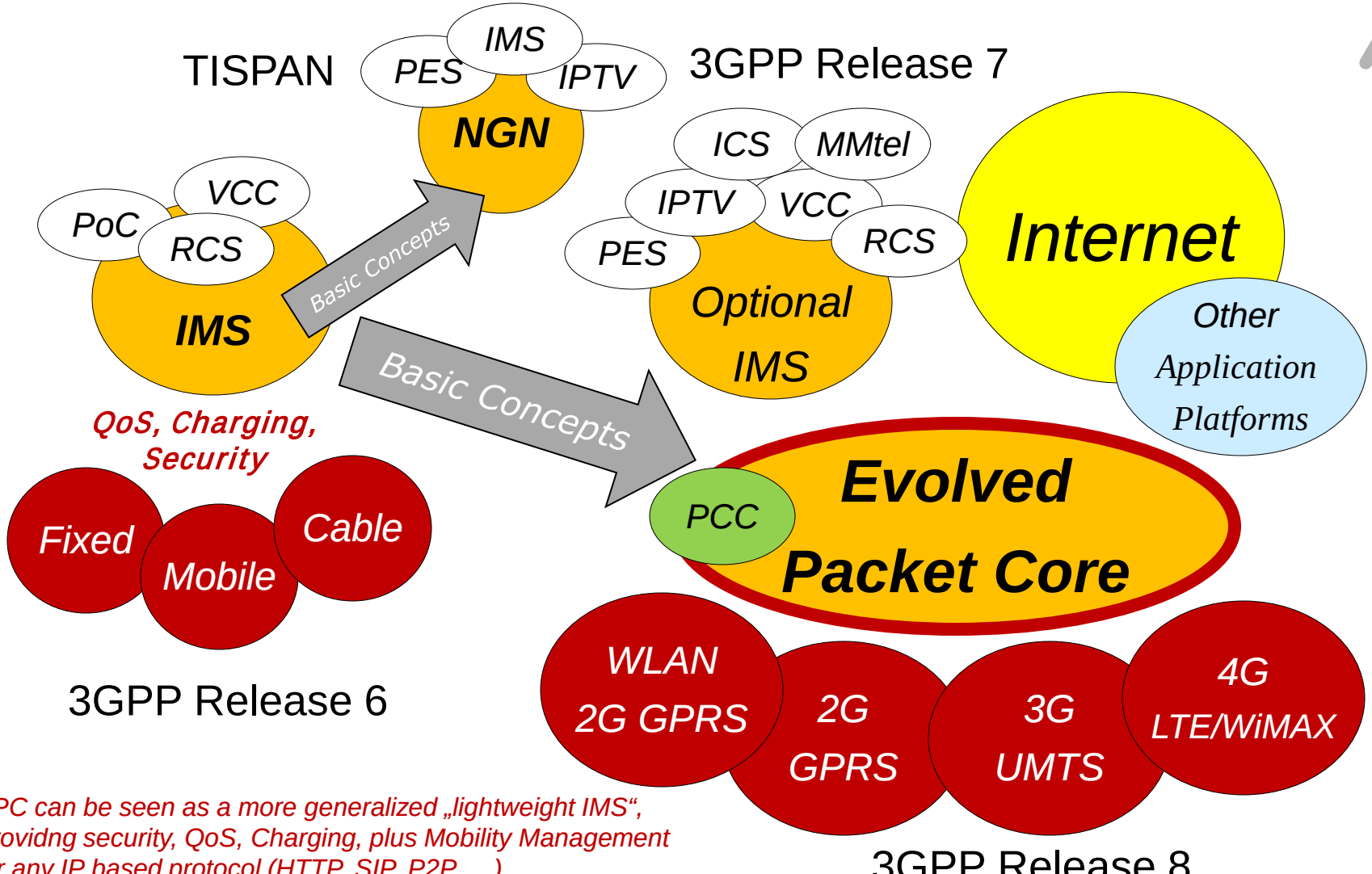


Mobile Packet Switched Telco Domain

Mobile Network Architecture Evolution



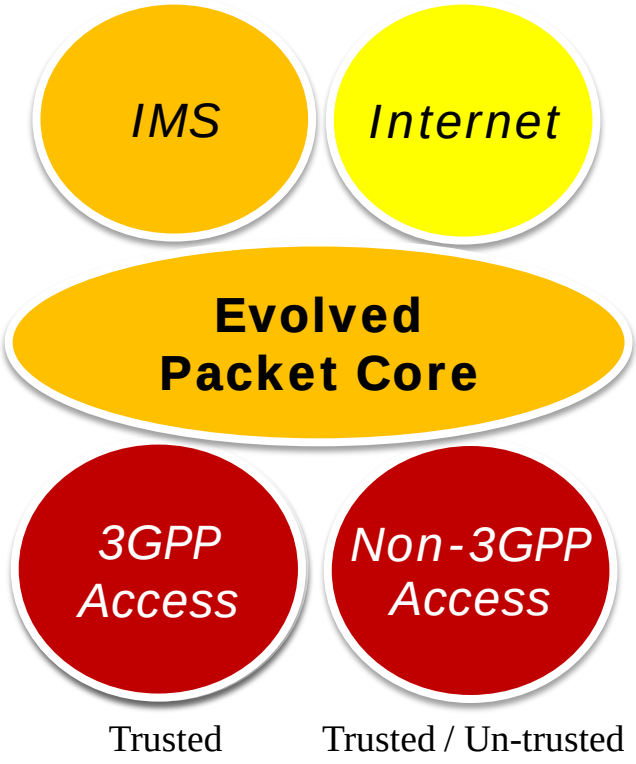
Concept Reuse: From IMS for NGN to EPC for all-IP



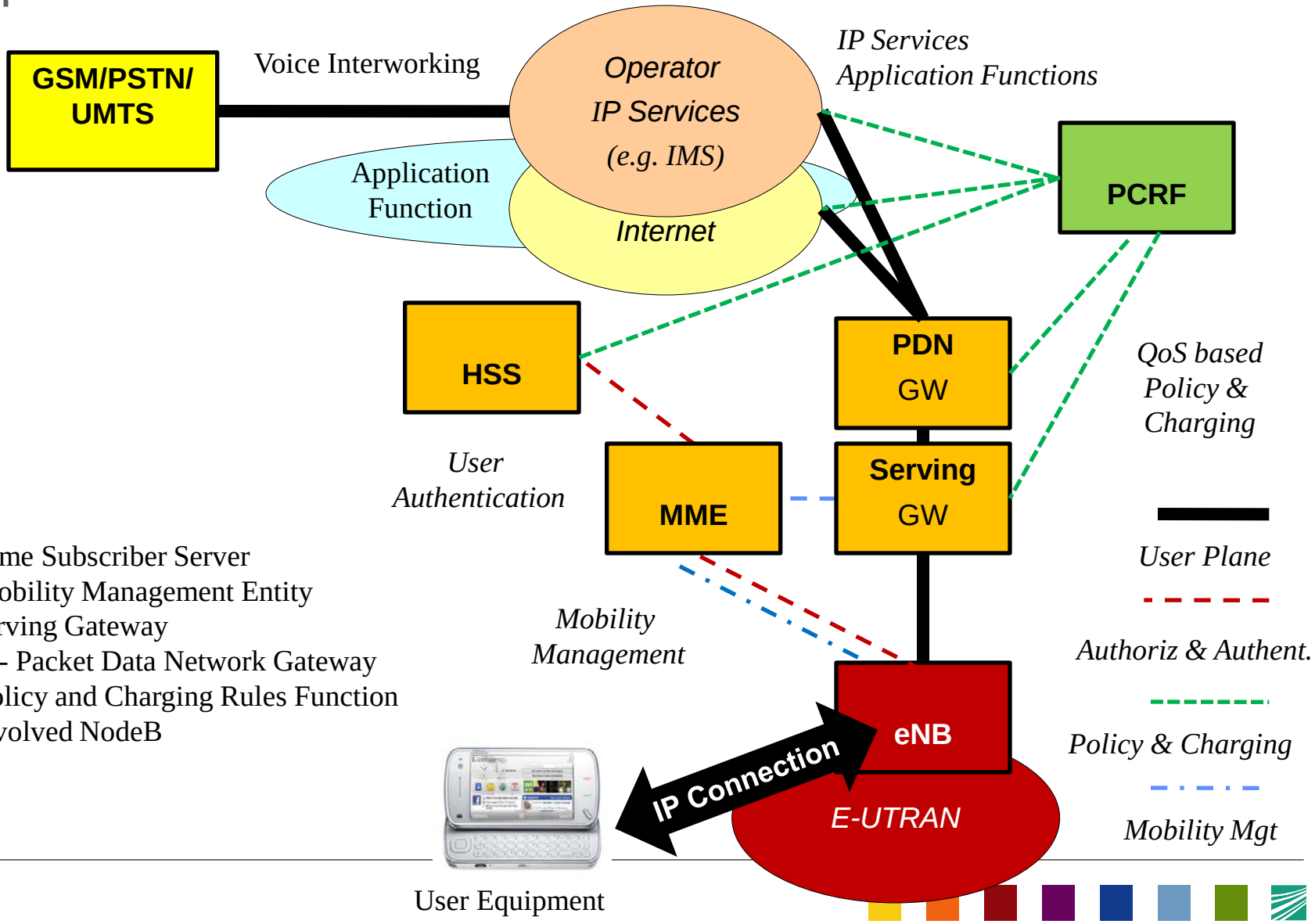
EPC can be seen as a more generalized „lightweight IMS“, Providng security, QoS, Charging, plus Mobility Management for any IP based protocol (HTTP, SIP, P2P, …)

3GPP Evolved Packet Core (EPC)

- The EPC is a multi-access core network architecture based on the Internet Protocol (IP) common for:
  - 3GPP access networks (LTE-A, LTE, HSPA+, UMTS, GPRS)
  - Non-3GPP access networks
    - Trusted networks (cdma2000, WiMAX)
    - Un-trusted networks (WiFi)
- EPC provides **connectivity** to IP service domains
  - IMS
  - Internet or other (M2M, Cloud, P2P etc.)
- The enhanced IP connectivity features include:
  - Authentication and authorization
  - Secure communication
  - Transparent mobility management
  - Connectivity management support
  - Policy based QoS and charging

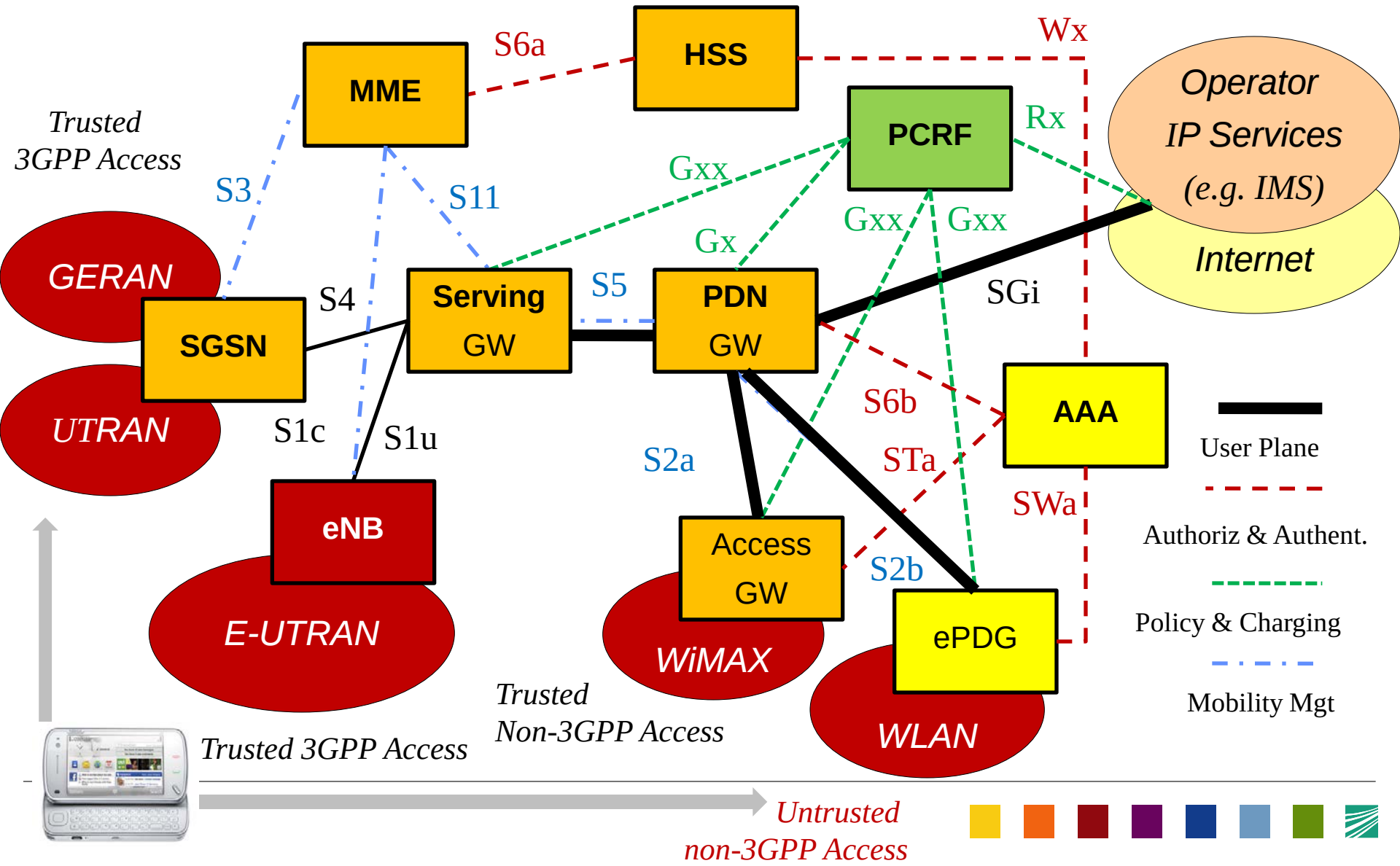


Simplified EPC Architecture



HSS - Home Subscriber Server
MME - Mobility Management Entity
SGW - Serving Gateway
PDN GW - Packet Data Network Gateway
PCRF - Policy and Charging Rules Function
eNB – Evolved NodeB

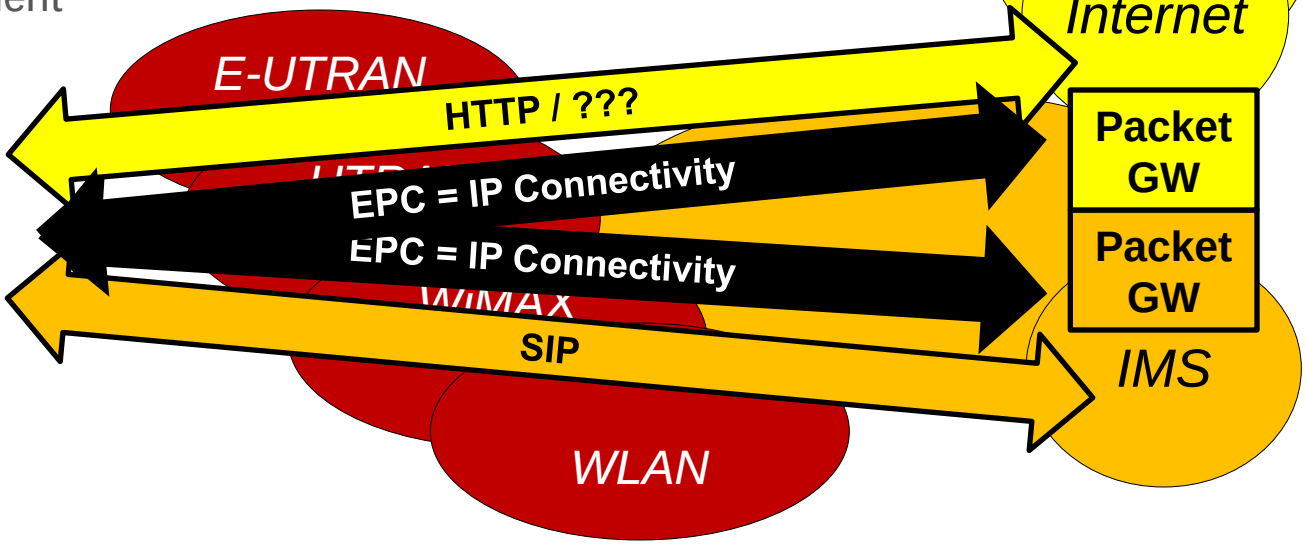
Full EPC Architecture



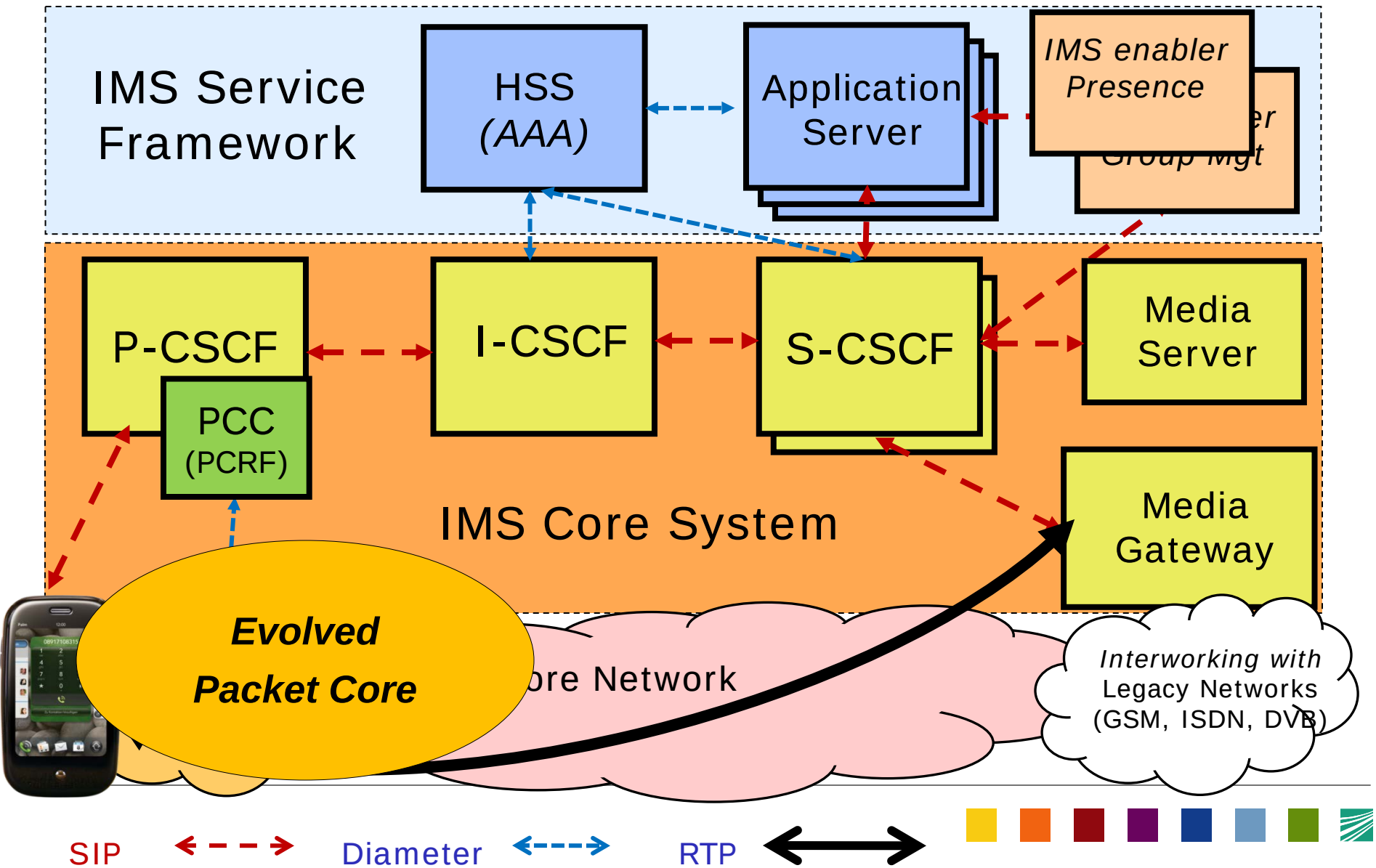
EPC Capabilities = Seamless IP Connectivity (= ABC)

- The EPC allows multiple access networks to be connected in a controlled way (secure, QoS, seamless) to either
  - the operator IP cloud (e.g. IMS or any intranet)
  - the internet or others
- Note that the EPC provides controlled IP connectivity, in regard to
  - User authentication and authorization
  - Quality of Service and related Charging
  - Mobility Management

User Equipment
may be connected to several IP service domains in parallel



3GPP IMS Architecture: IMS Core and Application Layer



M2M Segments

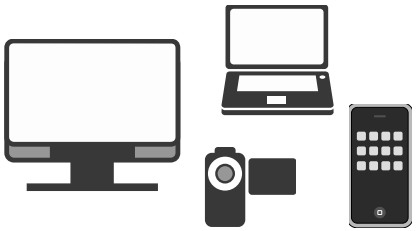
Automotive

Security

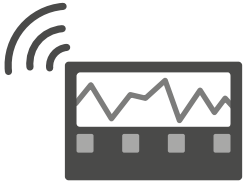
Tracking & Tracing

Payment

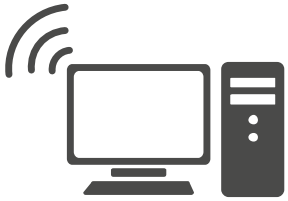
Healthcare



Consumer Electronics



Metering



Remote Maintenance and Control

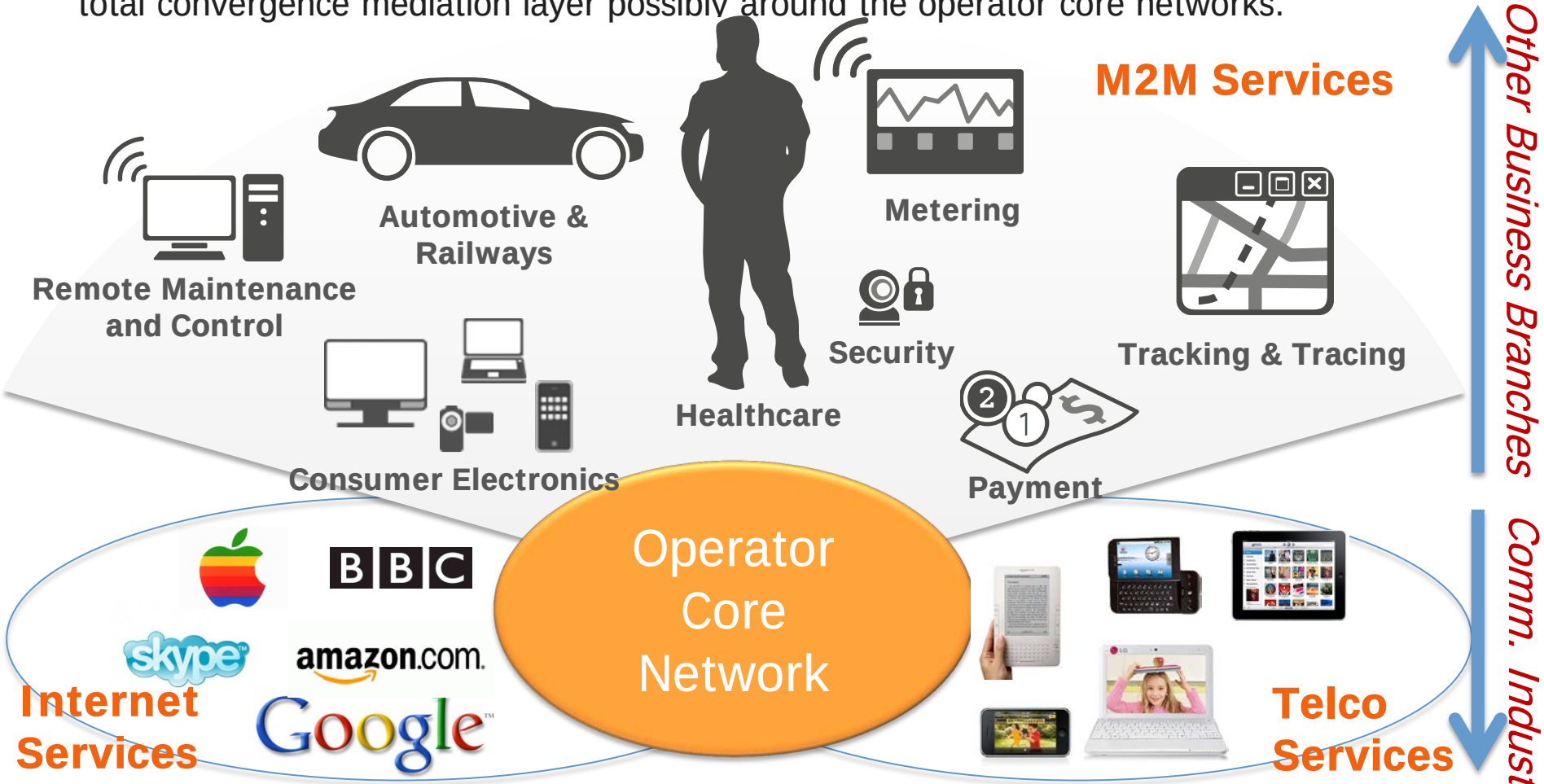
M2M – Fraunhofer FOKUS Positioning

MACHINE	-- TO --	MACHINE

Communication terminal independent of human interaction
- Acting automatically or on remote request
- Managed remotely
- Mobile and fixed terminals
- Monitoring device (sensor)
- Actuator device (e.g. switch)
- Associated order of magnitude: trillion = 10^{12}
	Network facilitating the M2M communication
	- Access & core network, backhaul, application server
	- Enabling connectivity (AAA & security, session manage-ment, QoS, charging, mobility management)
	- Supporting the data traffic of terminals (e.g. for direct and infrastructure communication)
	- Supporting the signaling of terminals
		Core network (or terminal) automating the services
		- Sensor data aggregation, processing and presentation
		- Data caching and interpretation
		- Real-time communication
		- Automatic decision, processing, control followed by communication with other machines through:
		  - Instructions
		  - Notifications

M2M – Total Convergence of Communication

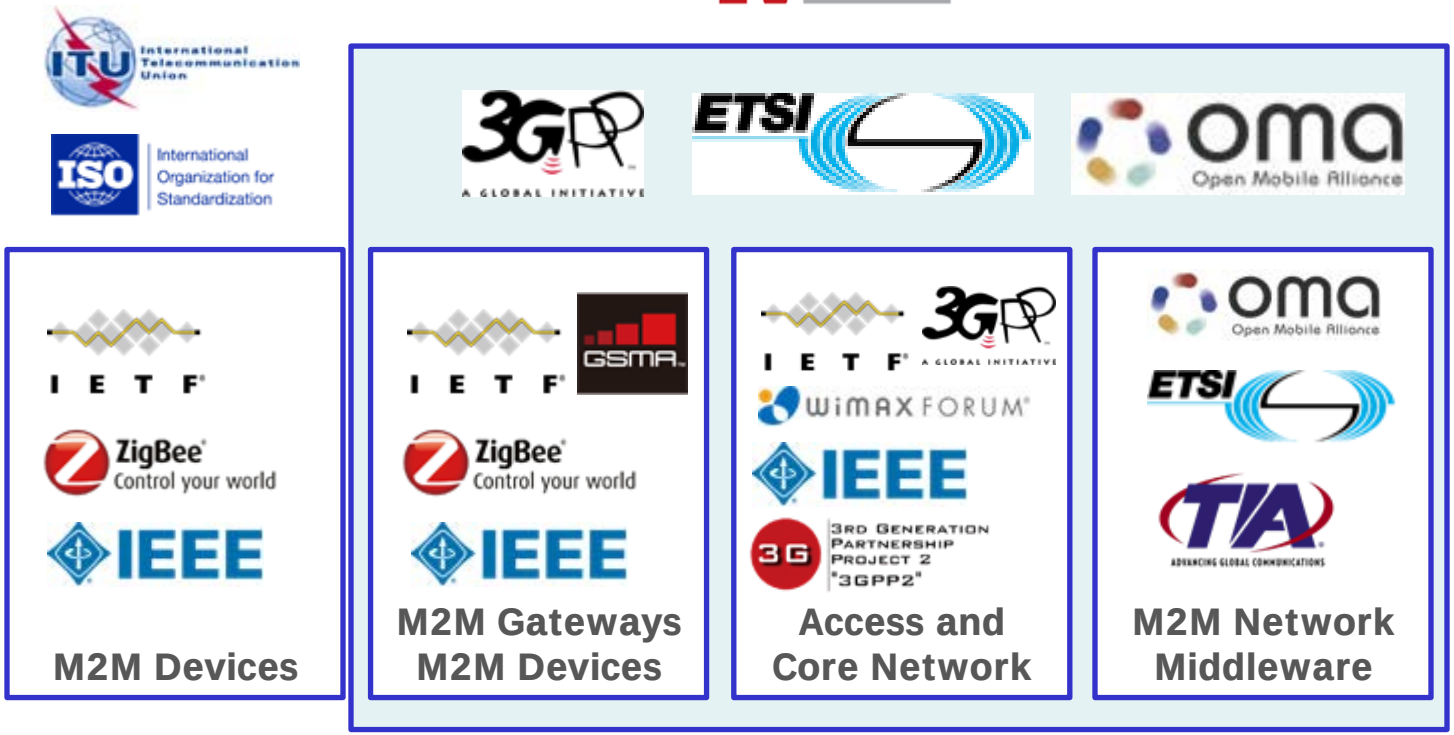
The telecommunication industry and other business branches are currently merging into a total convergence mediation layer possibly around the operator core networks.



MTC Standard Landscape

- MTC standards address in general only one part of the M2M communication
- ETSI, OMA & 3GPP standards together develop a complete network oriented M2M communication architecture
- oneM2M is about to take off

NEW: oneM2M



ETSI TC M2M Introduction

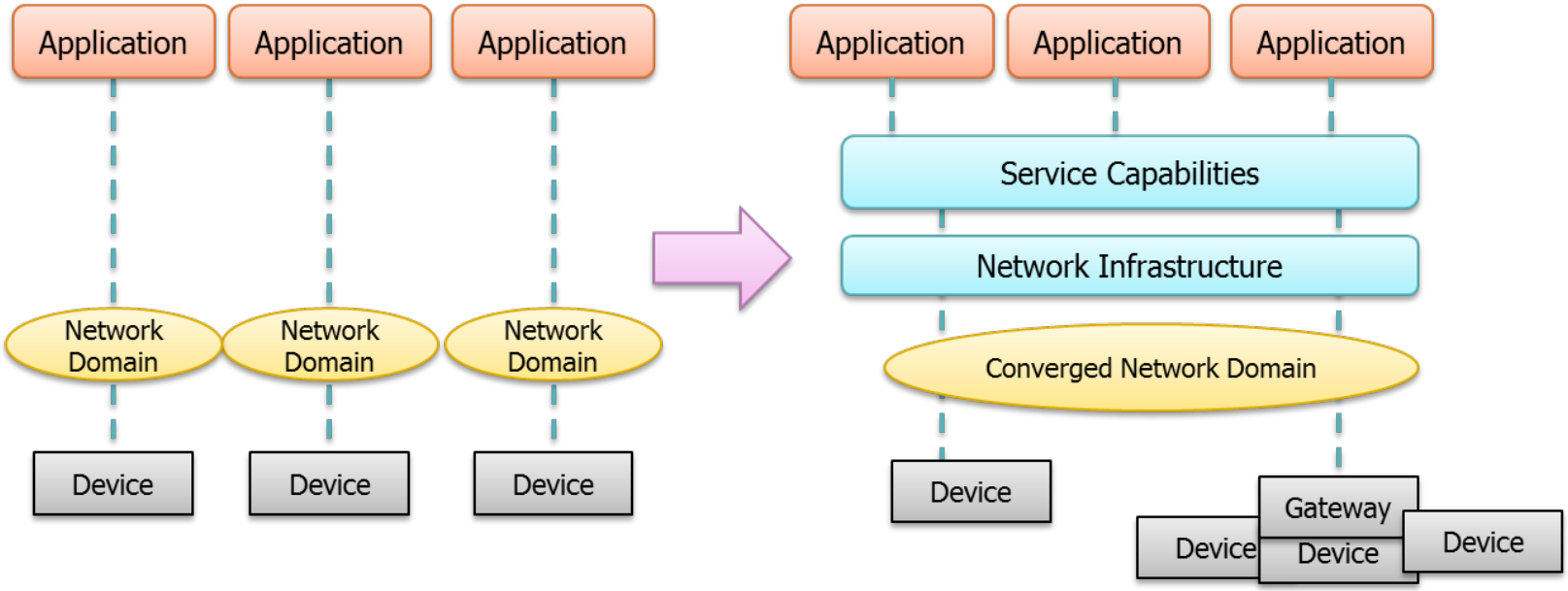
Standard need	Benefit	SDOs
Access network optimization	Reduce connectivity costs, match ARPU targets	3GPP, 3GPP2, etc.
Horizontal service platforms and related API	Faster development and deployment of applications	oneM2M member SDOs, etc.
Device lifecycle management	Cost efficient software and application management	BBF, OMA, ETSI, UPnP etc.
Data models (vertical specific)	Application level interoprability	ZigBee, DLMS, Continua etc
Device & module	Certification and interoperability, reduce costs	GSMA, etc.

ETSI scope

Source: ETSI TC M2M Tutorial Draft

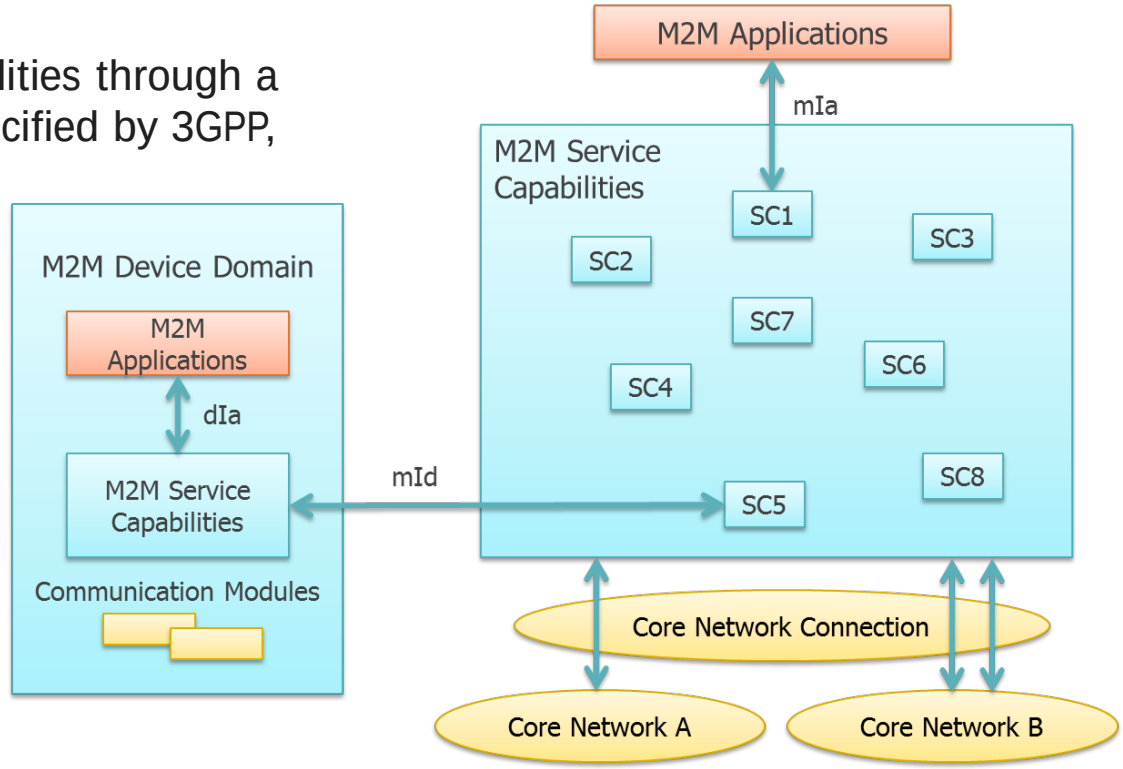
M2M Services & Applications

- Today
  - SMS based.
  - Vertical isolated systems.
  - INTRAnet of Things
- Future
  - Global horizontal approach.
  - INTERnet of Things.



Functional Architecture Framework

- **Service Capabilities (SC):** provide functions that are shared between different M2M applications
  - Can use core network capabilities through a set of exposed interfaces specified by 3GPP, TISPAN, 3GPP2
  - SC can involve other SCs (to be further studied)
  - SC can interface with CNs
- Three interfaces are defined:
  - dIa, mIa, mId



ETSI M2M Service Capabilities

- A set of standardized Service Capabilities (SC) is defined in M2M Core and M2M Device/Gateway, to provide functions that are to be shared by different M2M Applications

- M2M Service Capabilities:
  - provide recommendations of logical grouping of functions
  - expose functionalities through a set of open interfaces
  - use Core Network functionalities
  - simplified, optimized application development and deployment through hiding of network specificities from applications
  - can interface to one or several Core Networks

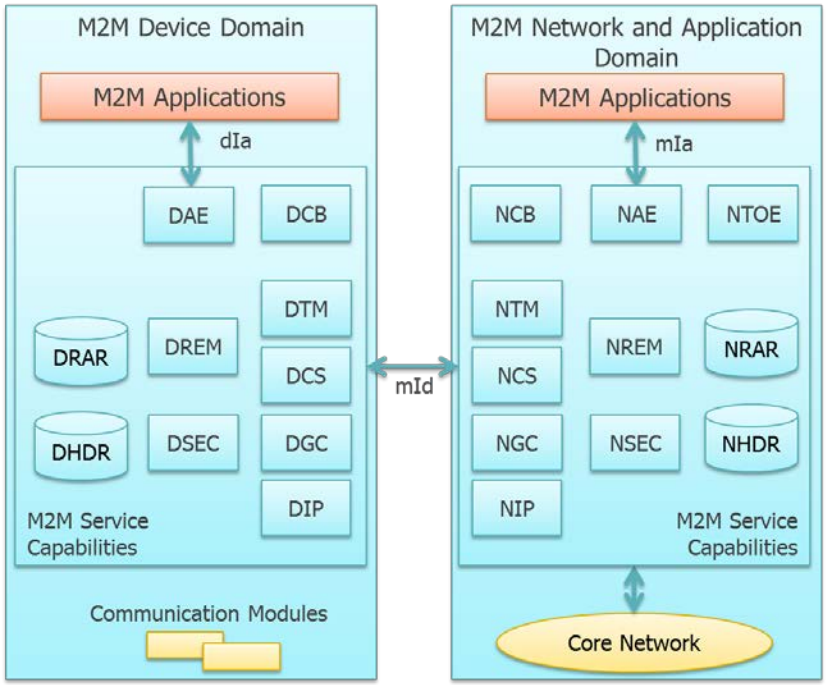
- **M2M SCs provide recommendations of logical grouping of functions**
- **M2M SCs do not mandate an implementation**

Not all M2M SCs are foreseen to be instantiated in the different parts of the system.

Only external interfaces are mandated and are required for compliance.

Service Capabilities

1. Application Enablement (xAE);
2. Generic Communication (xGC);
3. Reachability, Addressing and Repository (xRAR);
4. Communication Selection (xCS);
5. Remote Entity Management (xREM);
6. SECurity (xSEC);
7. History and Data Retention (xHDR);
8. Transaction Management (xTM);
9. Telco Operator Exposure (xTOE);
10. Interworking Proxy (xIP).
11. Compensation Broker (xCB);



where x stands for: N for Network, G for Gateway, D for Device

oneM2M – New Global Organization for M2M Standardisation

- oneM2M will develop technical specifications
  - for a common M2M Service Layer
  - to ensure the global functionality of M2M
- Allow a range of industries to take advantage of M2M technology
- Connect the myriad of devices in the field with M2M application servers worldwide
- Attract and actively involve organizations from M2M-related business domains such as: telematics and intelligent transportation, healthcare, utilities, industrial automation, smart homes, etc.

www.onem2m.org

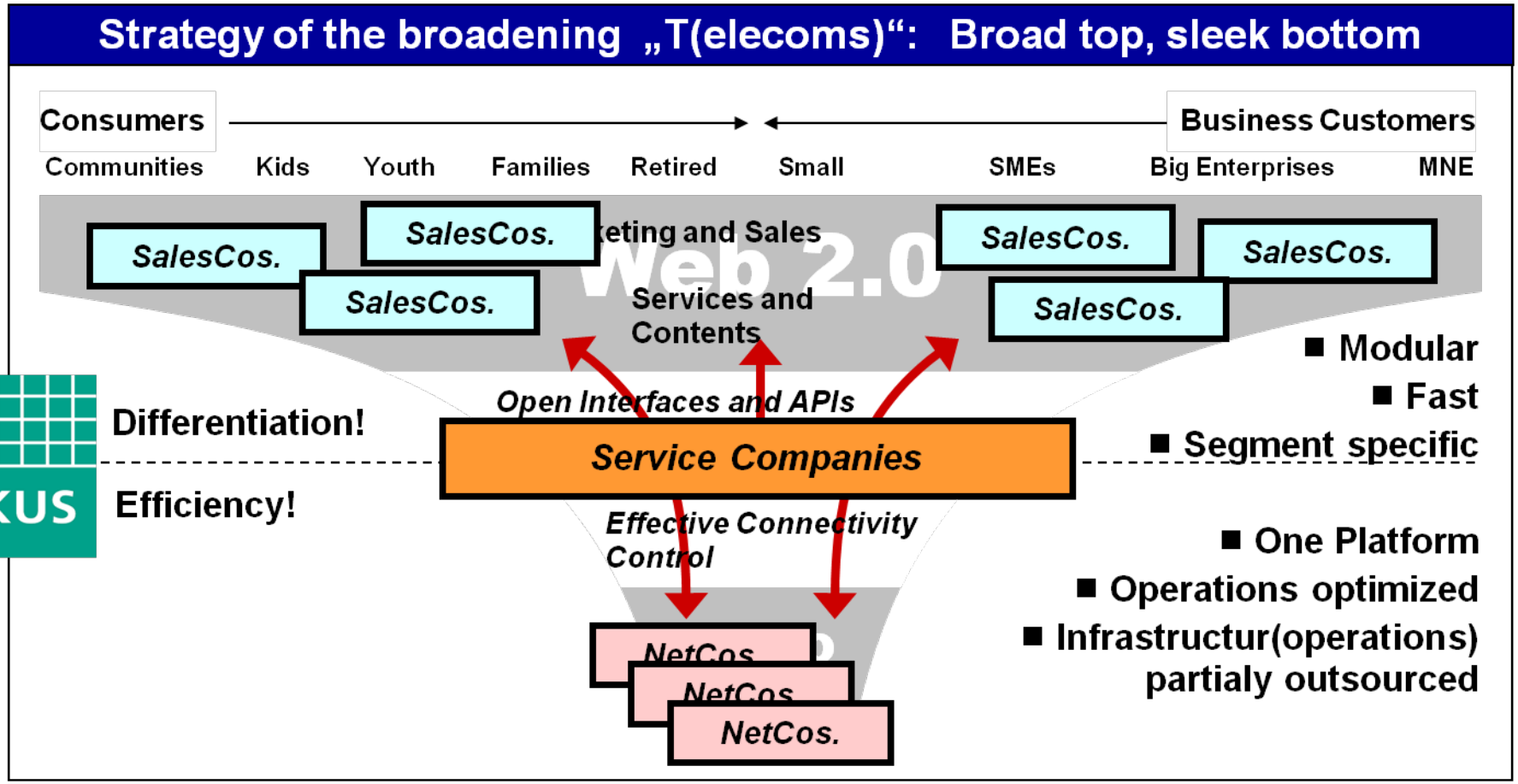
The SDOs Behind oneM2M

Founding SDOs (Partner 1 type)

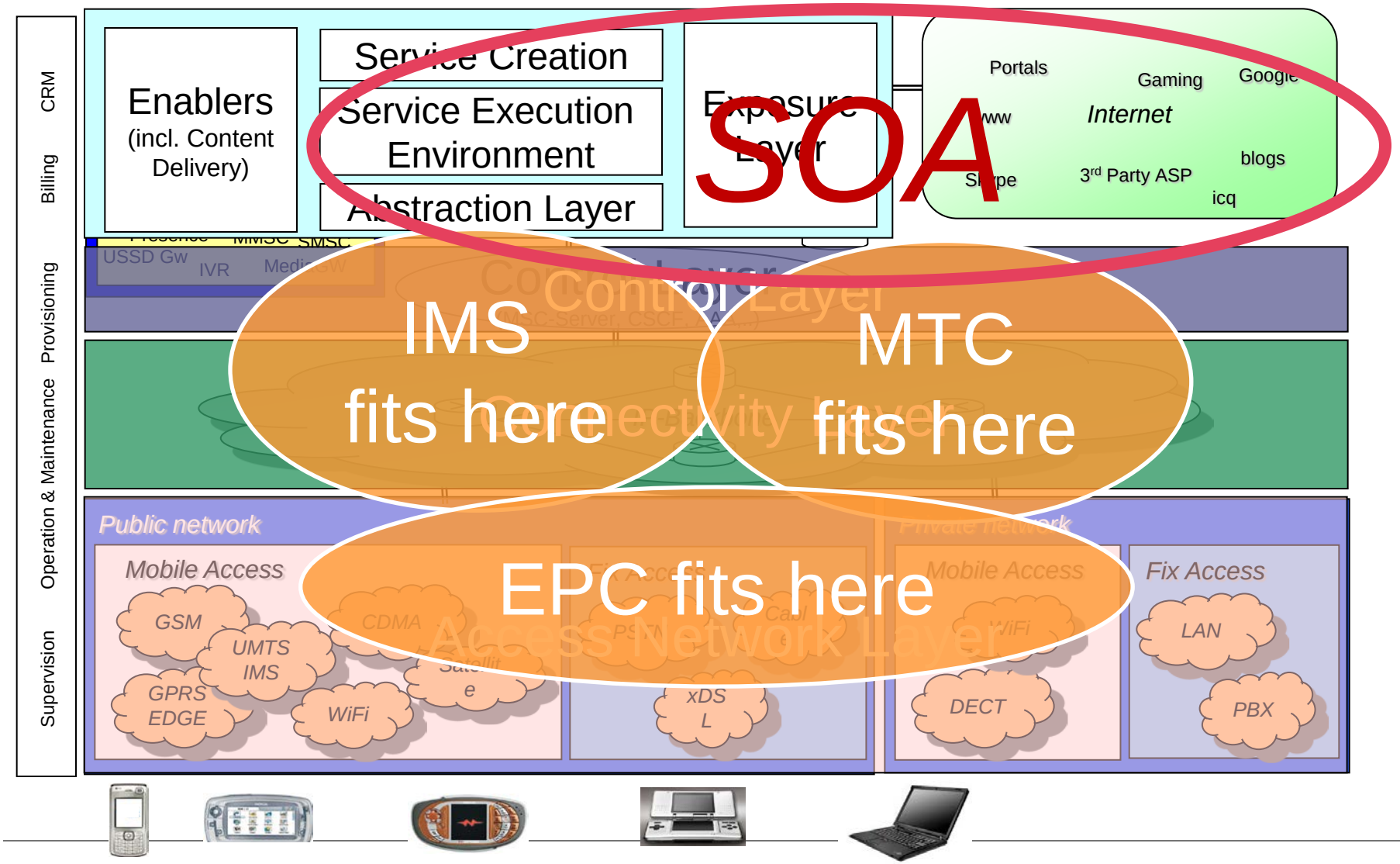
Joined since the foundation (Partner 2 type)

ARIB: Association of Radio Industries and Businesses
TTC: Telecommunication Technology Committee of Japan
ATIS: Alliance for Telecommunications Industry Solutions
TIA: Telecommunications Industry Association of the USA
CCSA: China Communications Standards Association
ETSI: European Telecommunications Standards Institute
TTA: Telecommunications Technology Association of Korea
OMA: Open Mobile Alliance

Increasing Service Diversity requires Abstractions & Partnering



IMS, MTC and EPC Positioning within an SDP Environment



Towards APIs / Enablers in the Smart City (SC) Context …

SC Application Providers and Services

(Universal Coms, eLogistics, eUtilities, eEnergy, eHealth, eGov…)

- Re-use what is publicly available
- Create recognised user interfaces

Import of SC APIs

Export Of SC Enablers

- Resell available capabilities
- Enable value added services

Service Brokering

SC Enablers provided by SC Core Platform

(RCS, information access, QoS, Charging, Identity Mgt., Security, M2M)

Network Abstraction

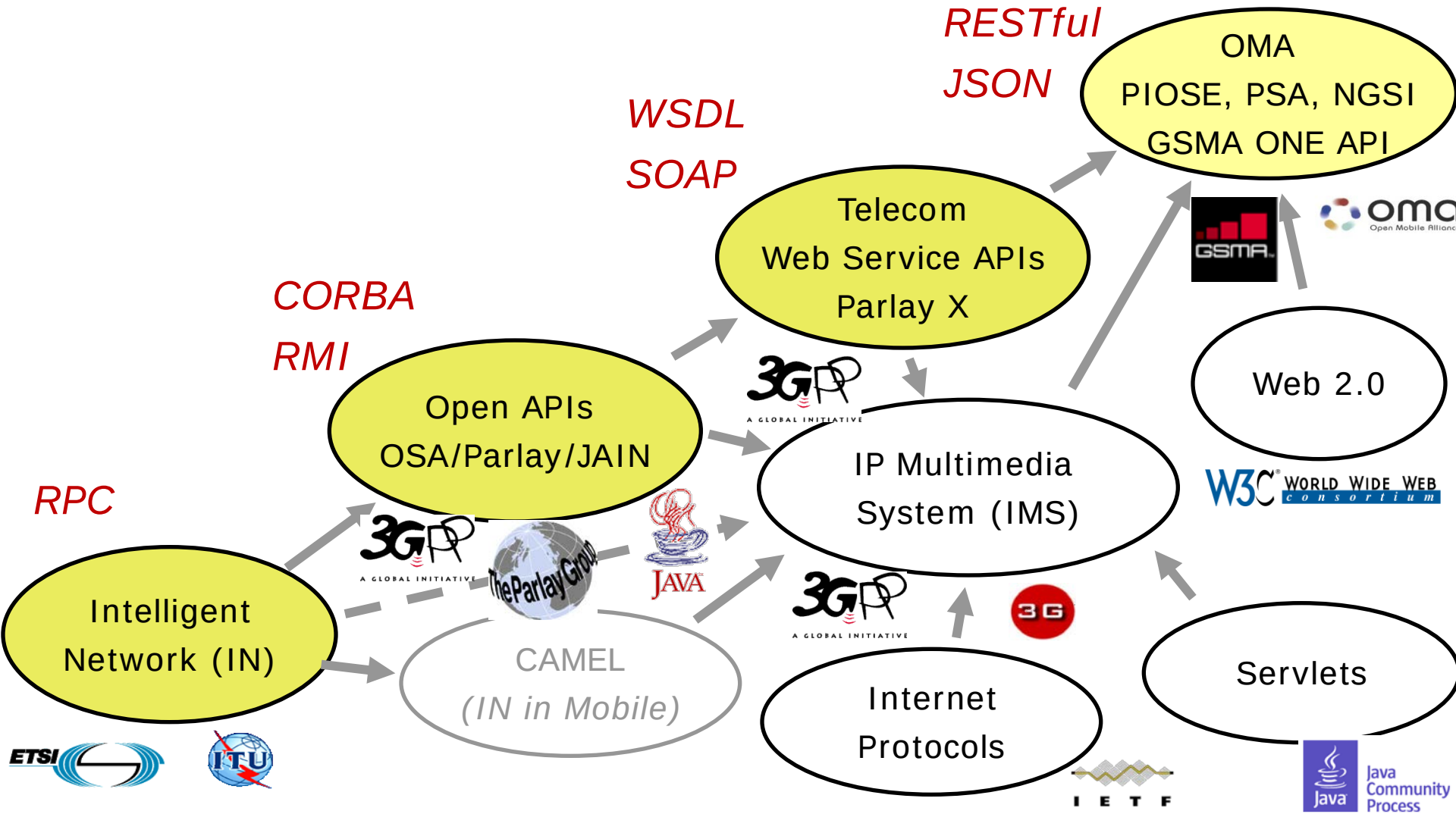
IMS + MTC + Evolved Packet Core

Sensor Networks

Mobile IP Network

Fixed IP Network

Evolution of Network API Concepts in Telecommunications



Agenda

- Smart Cities as Future Internet Show Case
- Smart City communication infrastructures requirements
- *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
- *Q&A*

Fraunhofer FOKUS

Smart City ICT

Tools & Testbeds

Smart Communications Playground
Fraunhofer FOKUS

osims
Fraunhofer FOKUS

open mtc
Fraunhofer FOKUS

open epc
Fraunhofer FOKUS

FUSECO playground
FUTURE SEAMLESS COMMUNICATION

www.fokus.fraunhofer.de/go/ngni

Research Agenda of Fraunhofer:

Smart City Vision

Environment

Cities that produce **almost no more CO_2-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.

Vision
»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**.

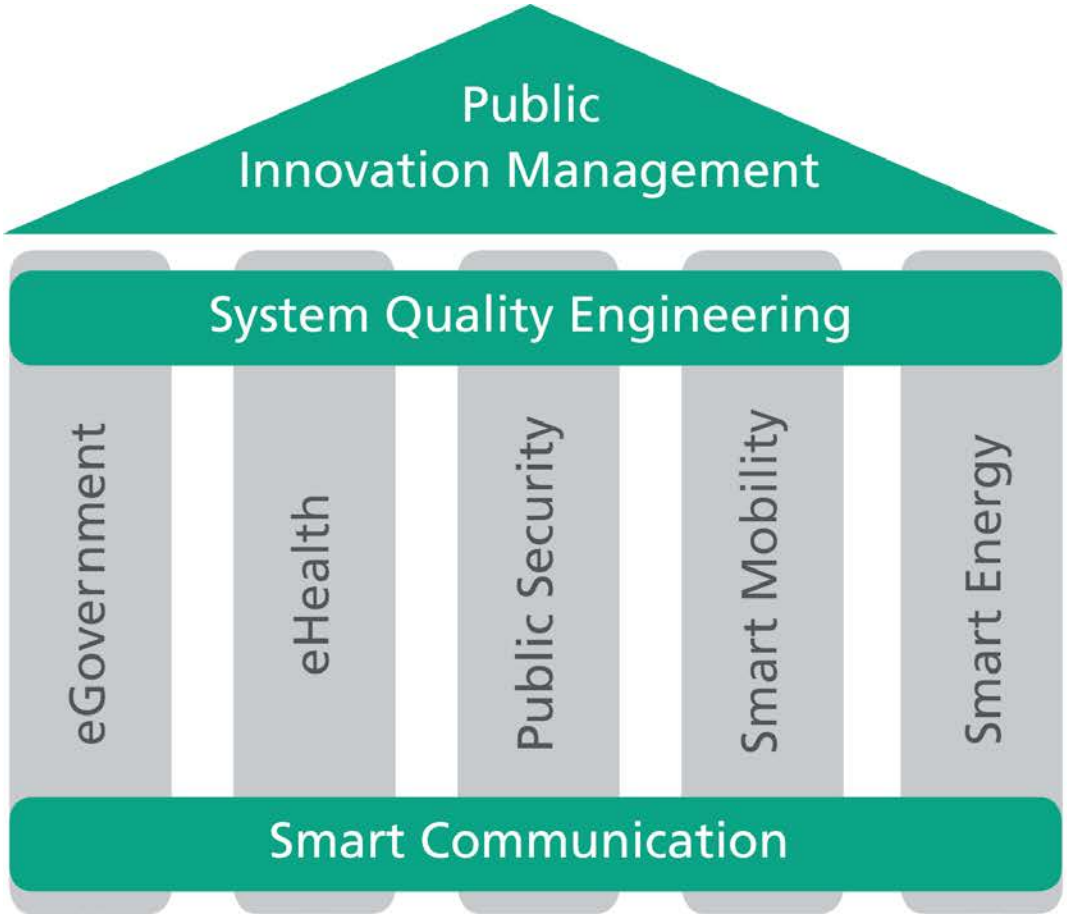
Quelle: www.pig.dk

About the Fraunhofer Gesellschaft

The Fraunhofer Gesellschaft is Europe‘s largest organization for applied research.

- Fraunhofer develops products and processes through to technical or commercial maturity
- Individual solutions are elaborated in direct contact with the customers
- The Fraunhofer Gesellschaft maintains
  - 66 self-contained Fraunhofer Institutes throughout Germany
  - with a staff of 22, 000 scientists and engineers
  - 1.9 billion Euro annual budget
- More than 70% of funding are raised through innovative development projects, license fees and contract research
- Sub-companies and representative offices all over the world

Fraunhofer FOKUS – Activity Domains



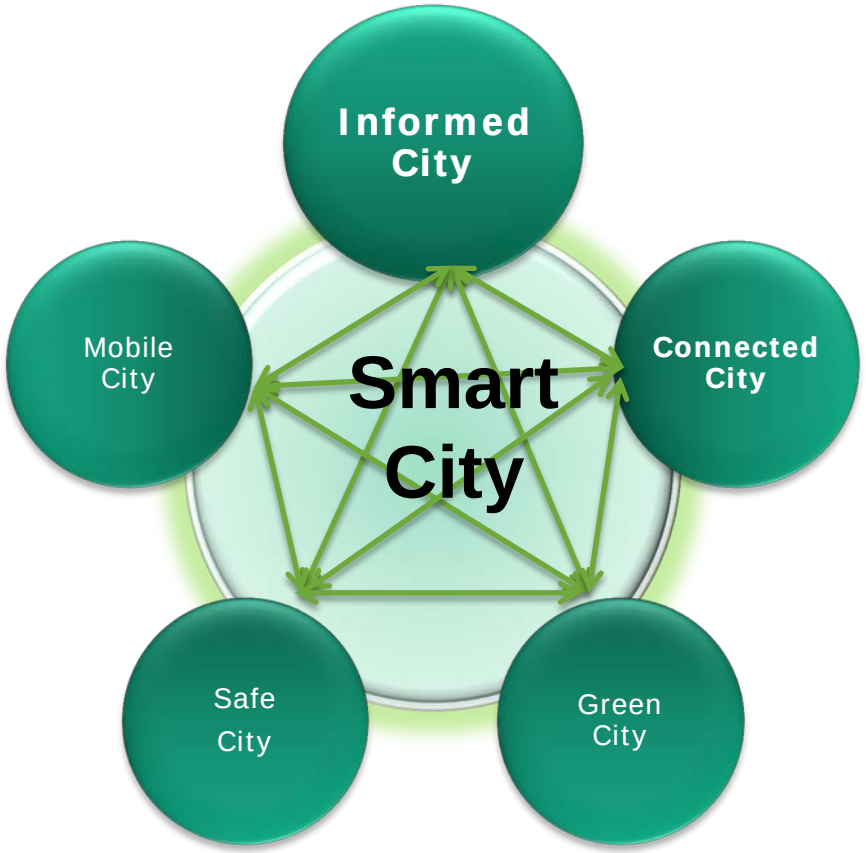
- Interoperability
- Critical Infrastructure
- Identity Management
- Virtualization
- Process Orientation
- Linking Legislation and Technology
- Business Analytics/Big Data

FOKUS Smart Cities Vision

Transforming Data into Information

- City as **service provider** for citizens, enterprises, institutions and tourists
- Smartness via

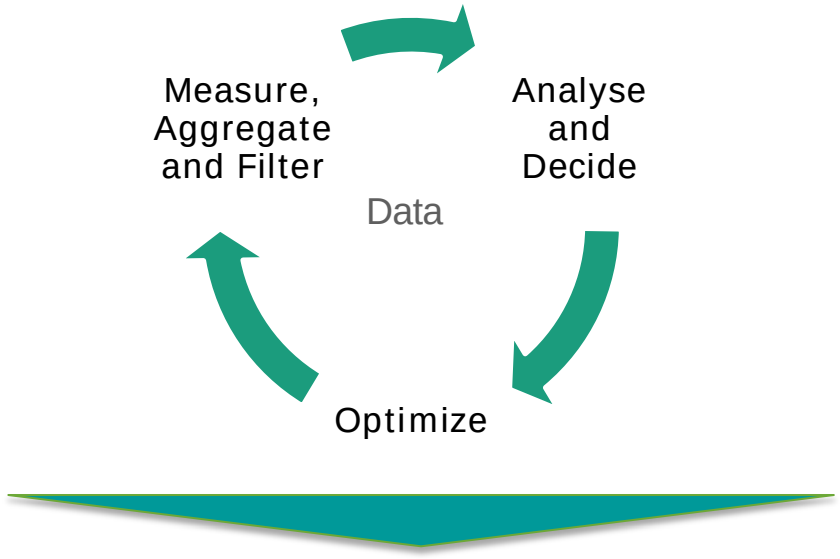
  Always Best Informed and Inter-Connected Urban Actors (Machines, Systems and People)
- Information at any need, at any place, at any device, at any time, at any preference



WHERE TO START?

- ICT Architecture

- Data sources: government, citizens utilities, traffic data, open data
- Big Data (2020 30 Zettabytes) / Analytics
- Use Cases
- Legislation
- Business models



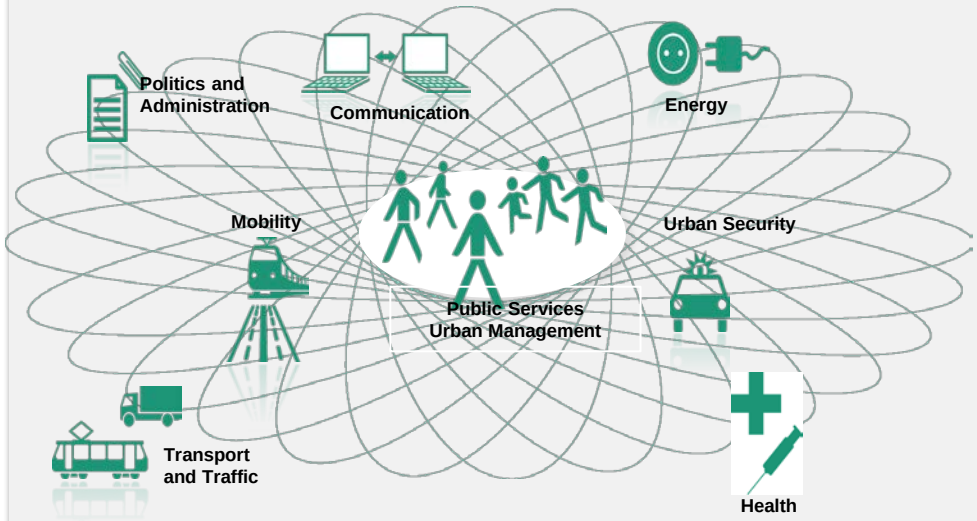
ICT in Smart Cities

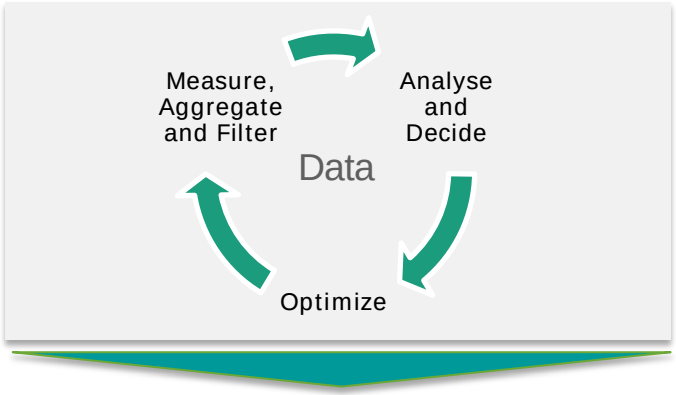
Backbone for Smart Cities

City as a system of systems

Set of separate technical systems → Integrated systems

Affectivity and efficiency results from optimized integration of separated systems



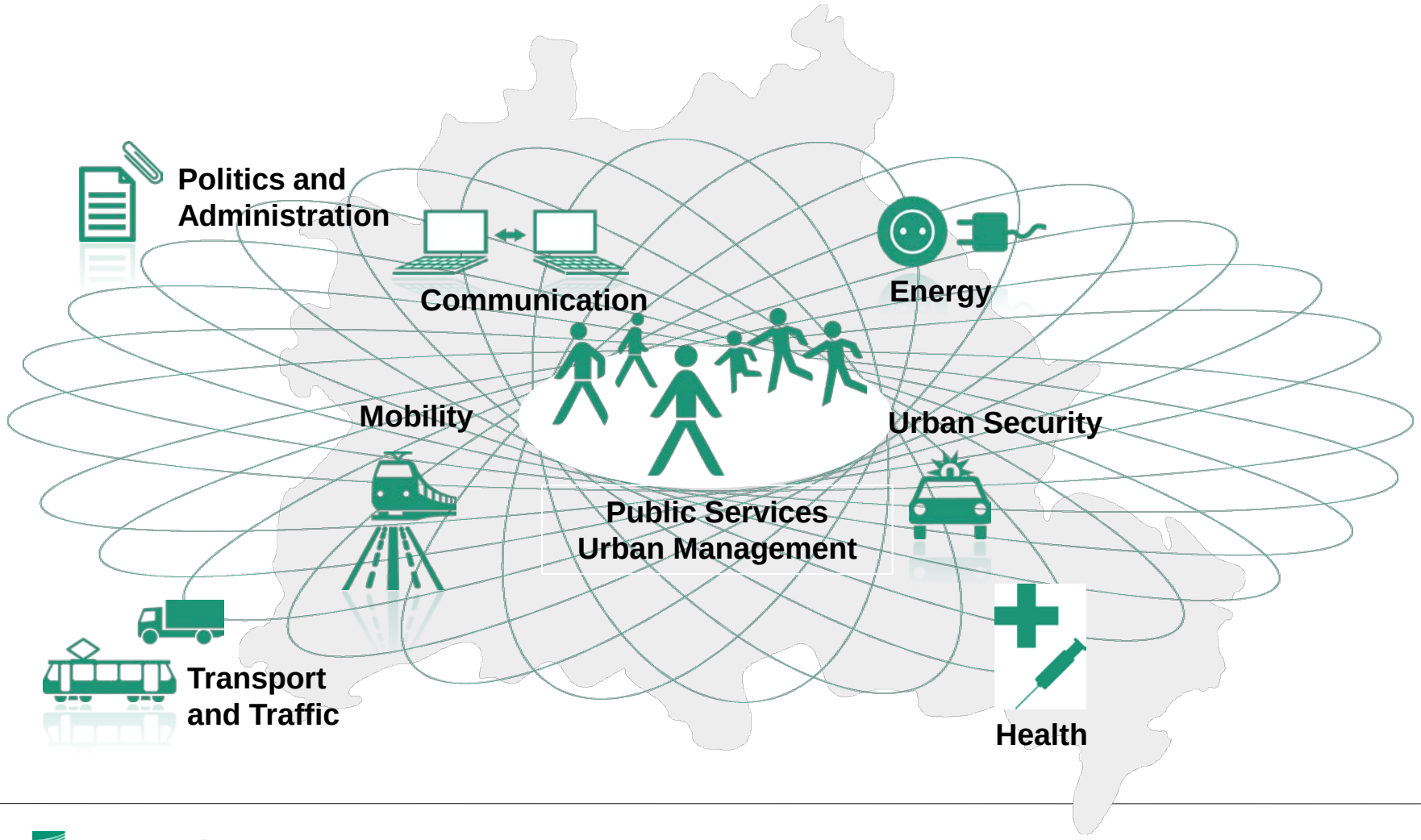


Fraunhofer FOKUS

as Enabler and Integrator for ICT-based Solutions

Topics of Concern

FOKUS labs on ICT in Smart Cities



A Smart City

A Smart City

depends on a smart

ICT Infra-structure

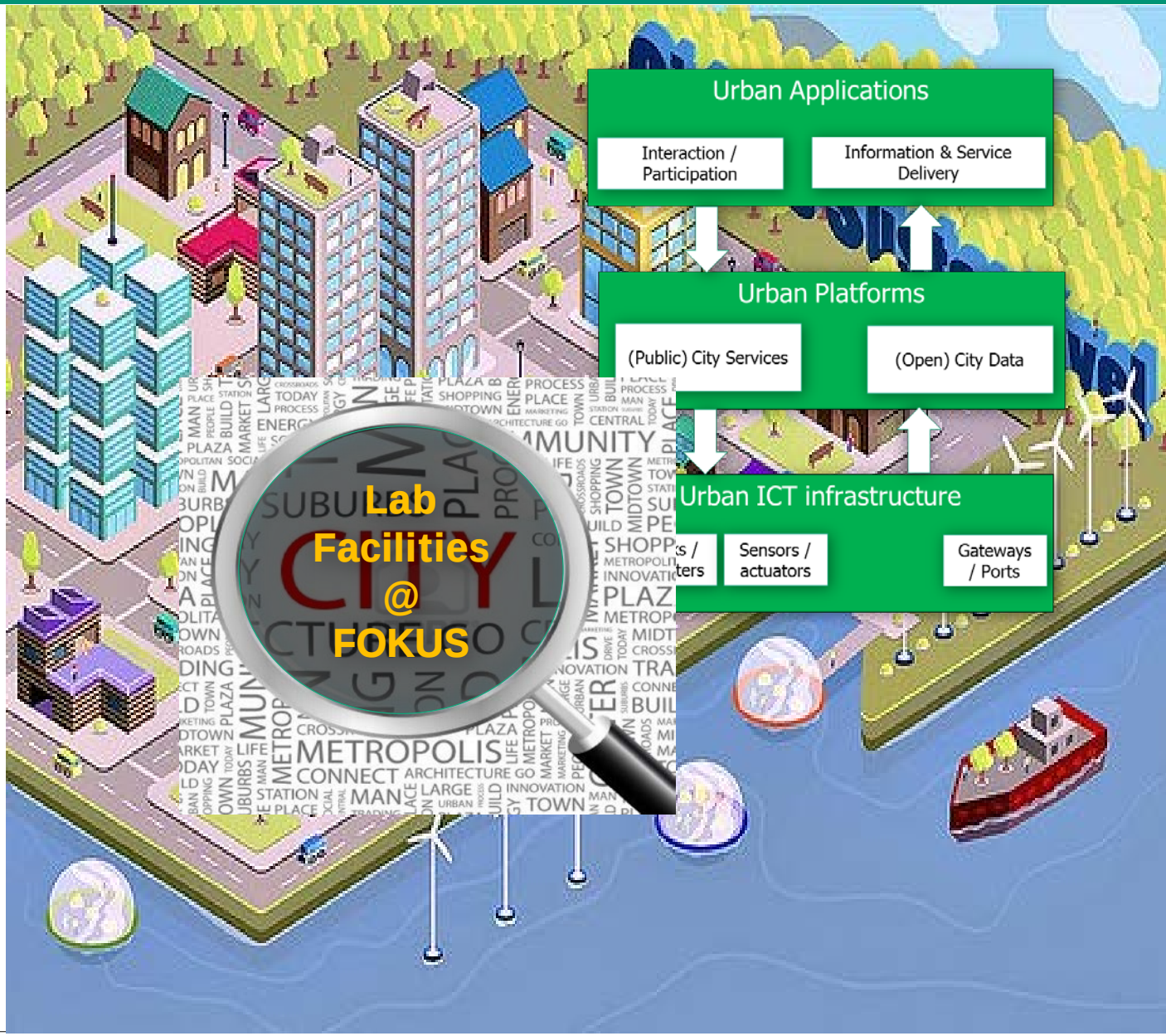
A Smart City

depends on a smart

ICT Infra-structure

that is inspired by

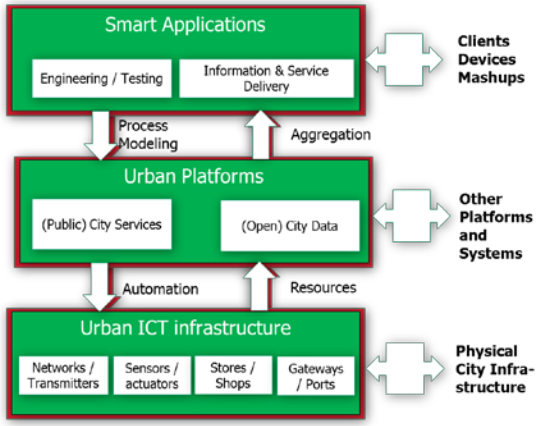
FOKUS Labs



Evolution of a Smart City ICT infrastructure

A Smart City ICT infrastructure is
- a vast distributed system of systems that is
- used for providing all kind of relevant services and data
- run by multiple actors (public and private organisations)
- continously being redesigned and improved.

Urban ICT policy

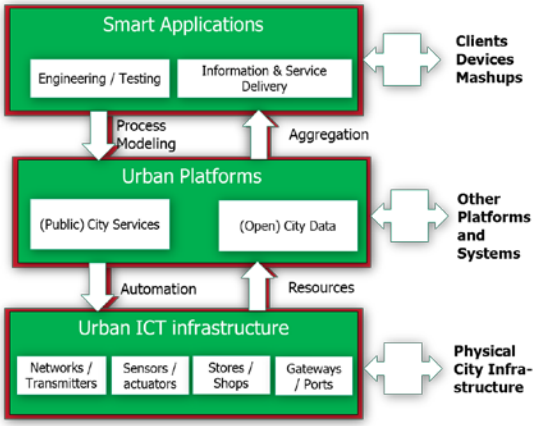


New services, improved processes

Evolution of a Smart City

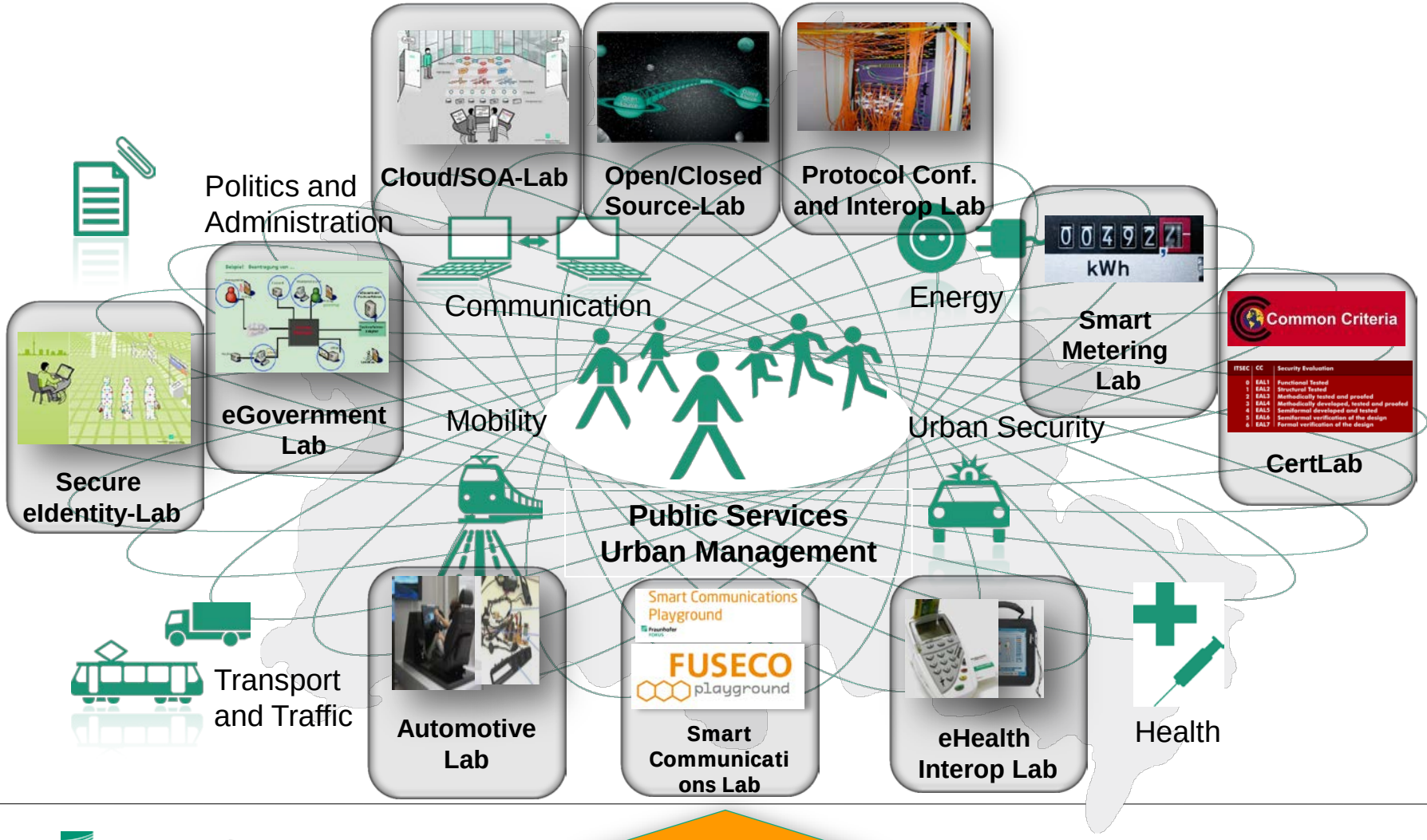
Validate your objectives
Get to know Best Practice

Test Systems & Solutions
Use Standards to integrate

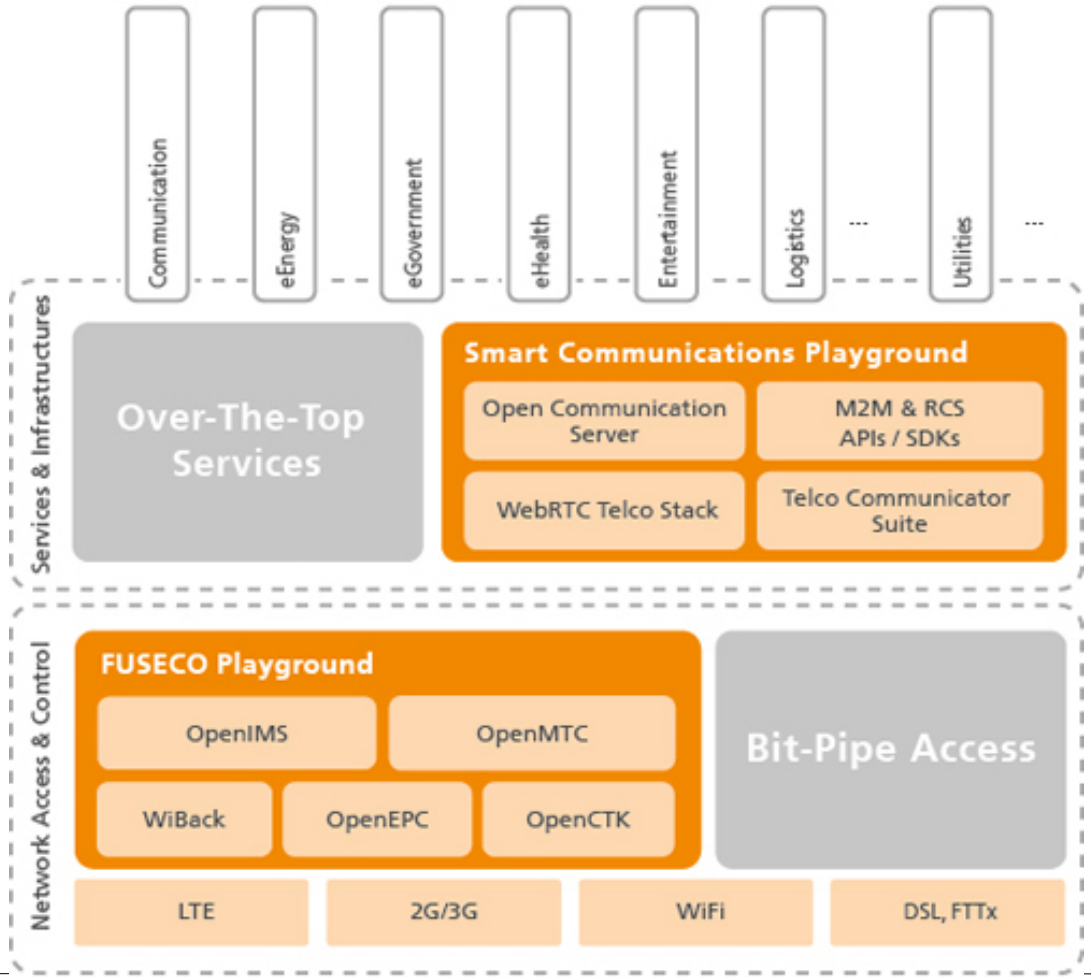


Solutions made by FOKUS

FOKUS labs on ICT in Smart Cities



Fraunhofer Testbeds / Playgrounds



Smart Communications Playground

Fraunhofer FOKUS

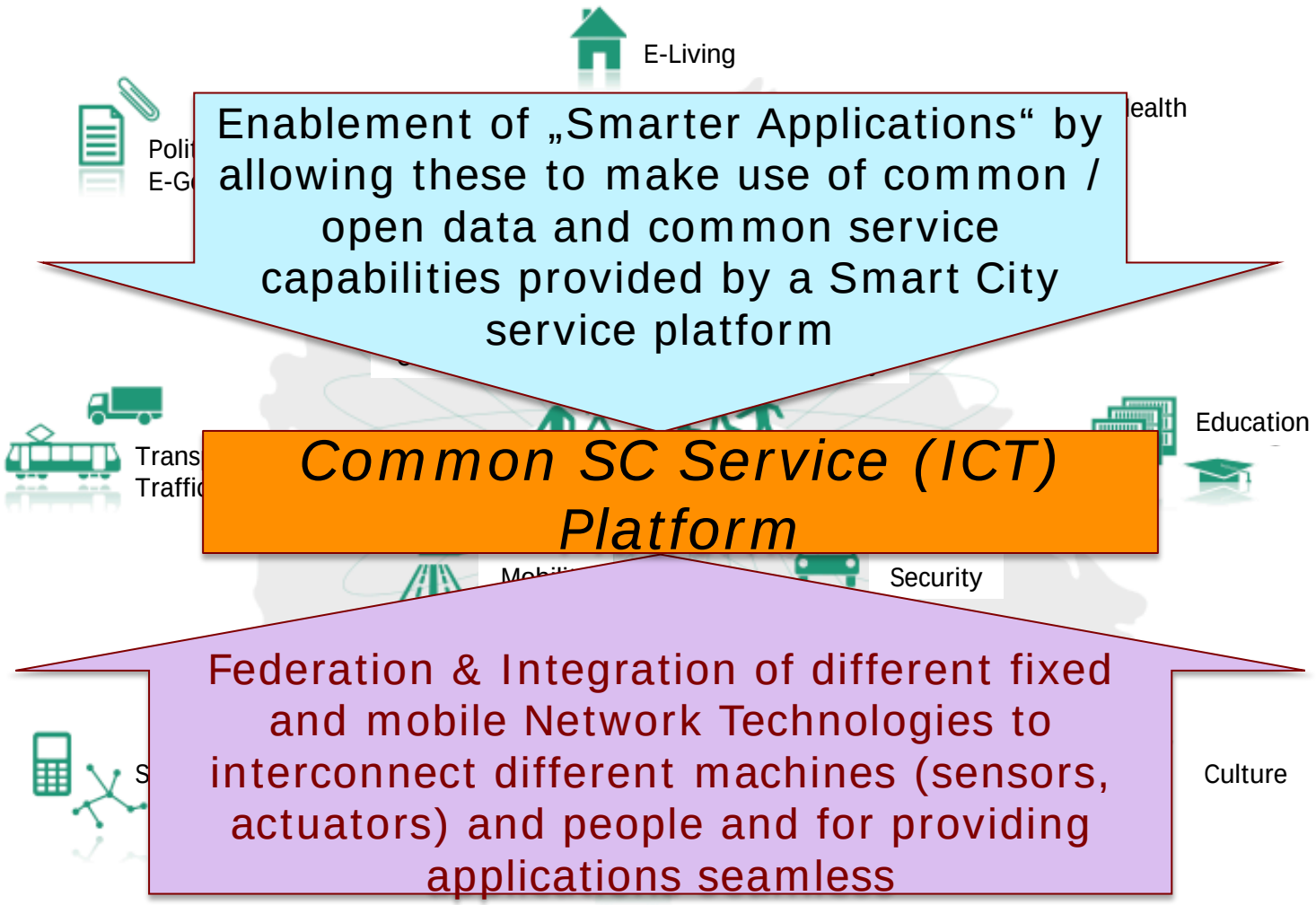
www.SC-playground.org

FUSECO playground

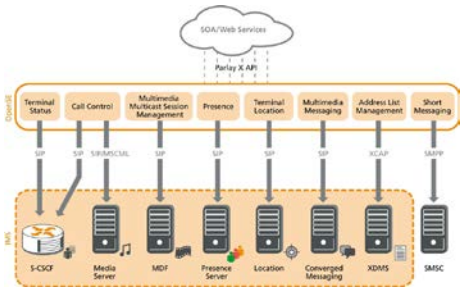
www.FUSECO-Playground.org

A Smart City relies on Integration & Federation of Systems

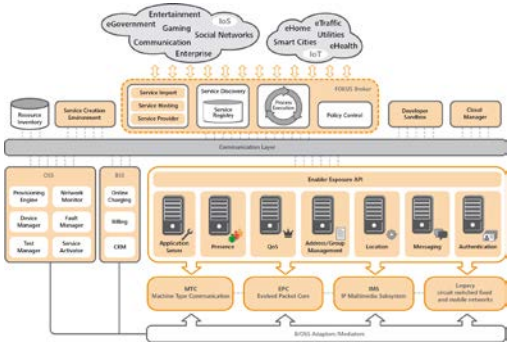
Conve



Related FOKUS Testbed Evolution

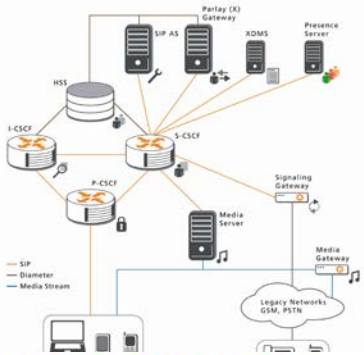


OSA/Parlay Playground



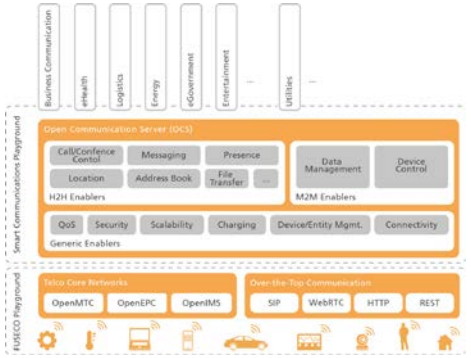
open soa telco playground

Fraunhofer FOKUS



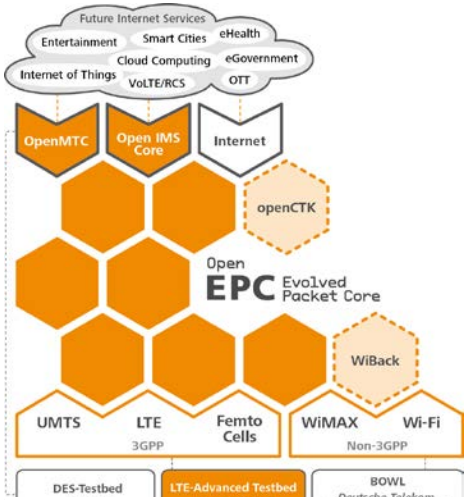
open ims playground

Fraunhofer FOKUS



Smart Communications Playground

Fraunhofer FOKUS



FUSECO playground

Related FOKUS Testbed Evolution

IT Impact on Telecoms

Intelligent Network (IN)

Open APIs OSA/Parlay/JA

Telecom APIs Parlay X, GSM On

FI Applications
Smart Cities, eGov, eHealth, eTransport, eUtilities

OSA/Parlay Playground

open soa telco playground
Fraunhofer FOKUS

Smart Communications Playground
Fraunhofer FOKUS

IN Services based on SIBs

(SOA based)

Core Platform

Network Abstraction

IN Overlay Architecture

open ims playground
Fraunhofer FOKUS

Evolved Packet

Circuit Switched Networks

PSTN

IP

GSM

iptel.org

IP Networks (NGN)

DSL

UMTS

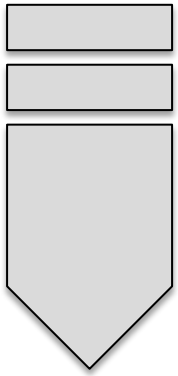
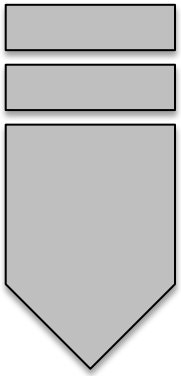
WLAN

FUSECO playground

WiMAX

People & Things

Stakeholders

Operators	Manufacturers	Application developers	Research institutions and universities
			
• Be prepared for all-IP mass mobile broadband world • Validate new technologies	• Validate their products against standard compliant EPC • Looing for the missing pieces	• Validating wireless applications • Direct access to core functionalities	• R&D on real network conditions • Innovating new concept and algorithms

Challenges

The R&D Community Faces Intense Complexity in Realizing Meaningful Testbeds

Trust in Research

- Feasibility of new developed research concepts or components
- Alignment of application requirements and network functionality
- Customizing and mirroring operator networks for supporting realistic experiments

Complexity Limits Testbed Deployments

- Heterogonous access technologies
  - 3GPP or non-3GPP access networks
- Customization and integration of distributed functionalities
- Uncertainty on which specific services will become revenue efficient

Proprietary Systems

- Make Innovation Difficult
- Most of core network components are delevered as closed box
- Challengs in customizating usage or features extenssion
- Use cost-efficient off-the-shelf hardware

Standard Components

- No easy replication of standard components
- Developers look for open interfaces
- Researchers are interested in specific component from holistic view
- Up-to-date compliant with the standard

Objectives

A Realistic Testbed answers the Challenges

Open Standard Compliant Testbeds

- Build the know-how of core network functionalities
- Easy to understand and to evaluate connectivity technologies
- Mirror end-to-end operator network with various standard compliant components
- Allow access to the source code

Configurability and Modularity

- Easy configurable software toolkit implementation
- Reduce the prototyping duration
- Software based core network toolkits
- Modular toolkit structure to select specific components

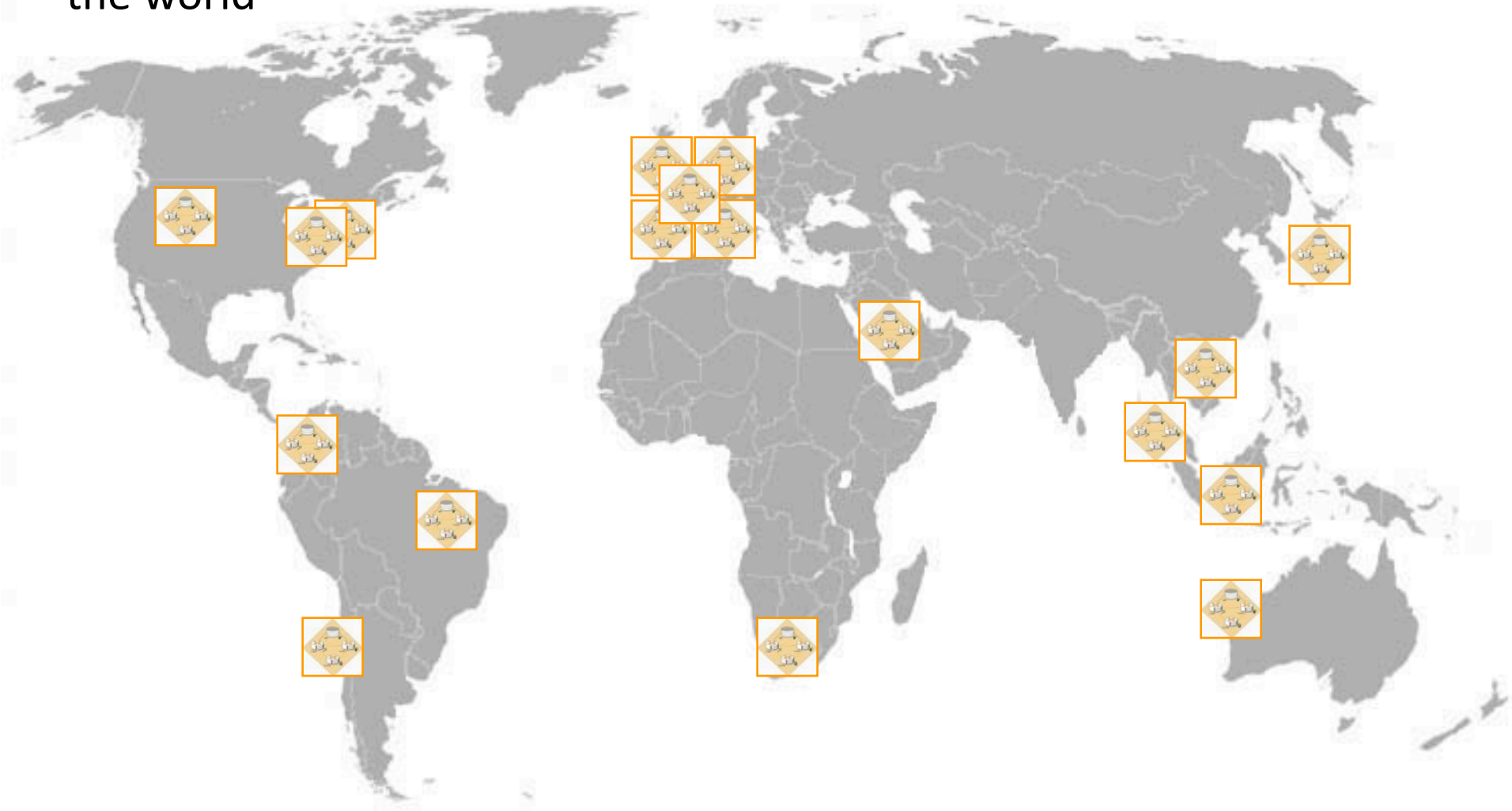
Cost Effective Development

- Provide the means for wireless ready applications
- Develop and evaluate wireless applications directly over realistic wireless networks
- Support standard compliant interfaces to enable interoperability and to reduce time
- Fast and Cost Effective Prototyping

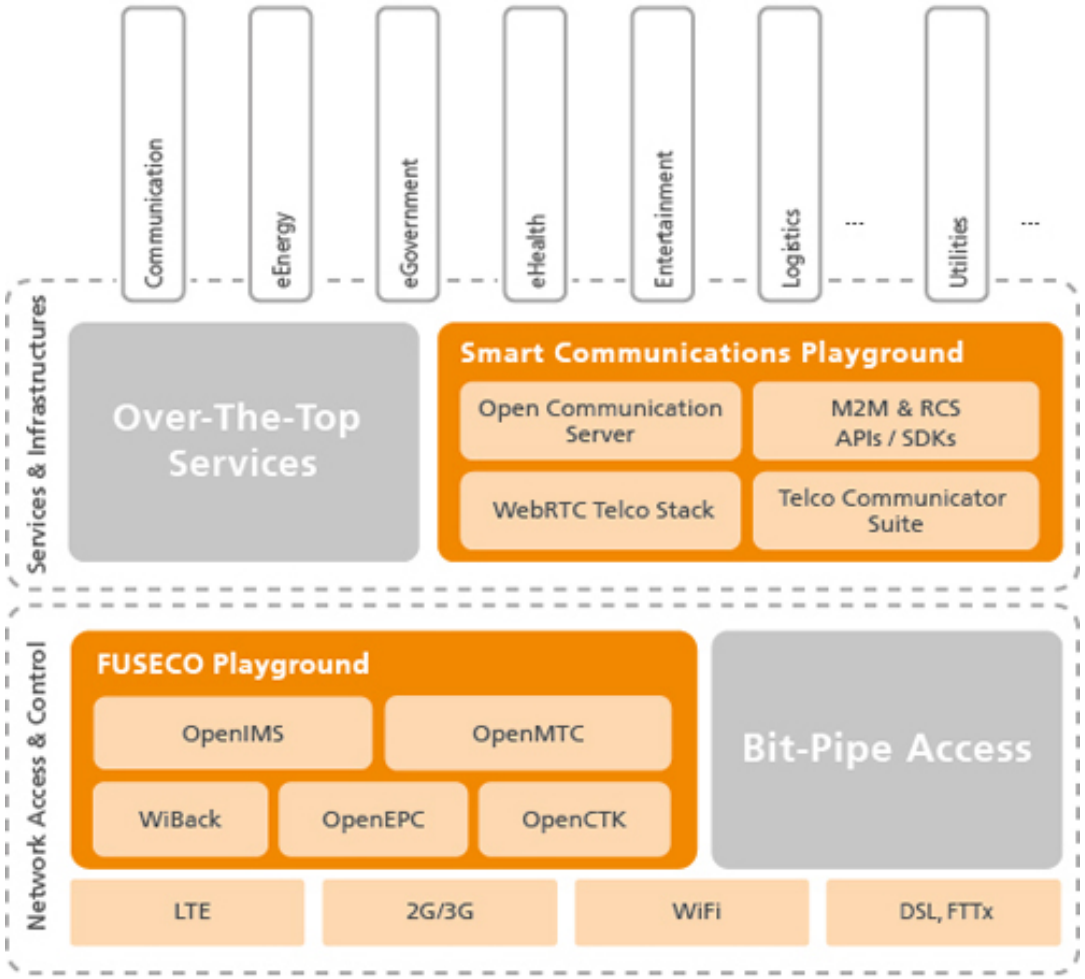
Extendibility

- Enable to validate and evaluate new technologies or additional features
- Gradual support of new core network functionalities
- Single box operator network
- Supporting and applying virtualization concepts

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



Fraunhofer Testbeds / Playgrounds



Smart Communications Playground

Fraunhofer FOKUS

www.SC-playground.org

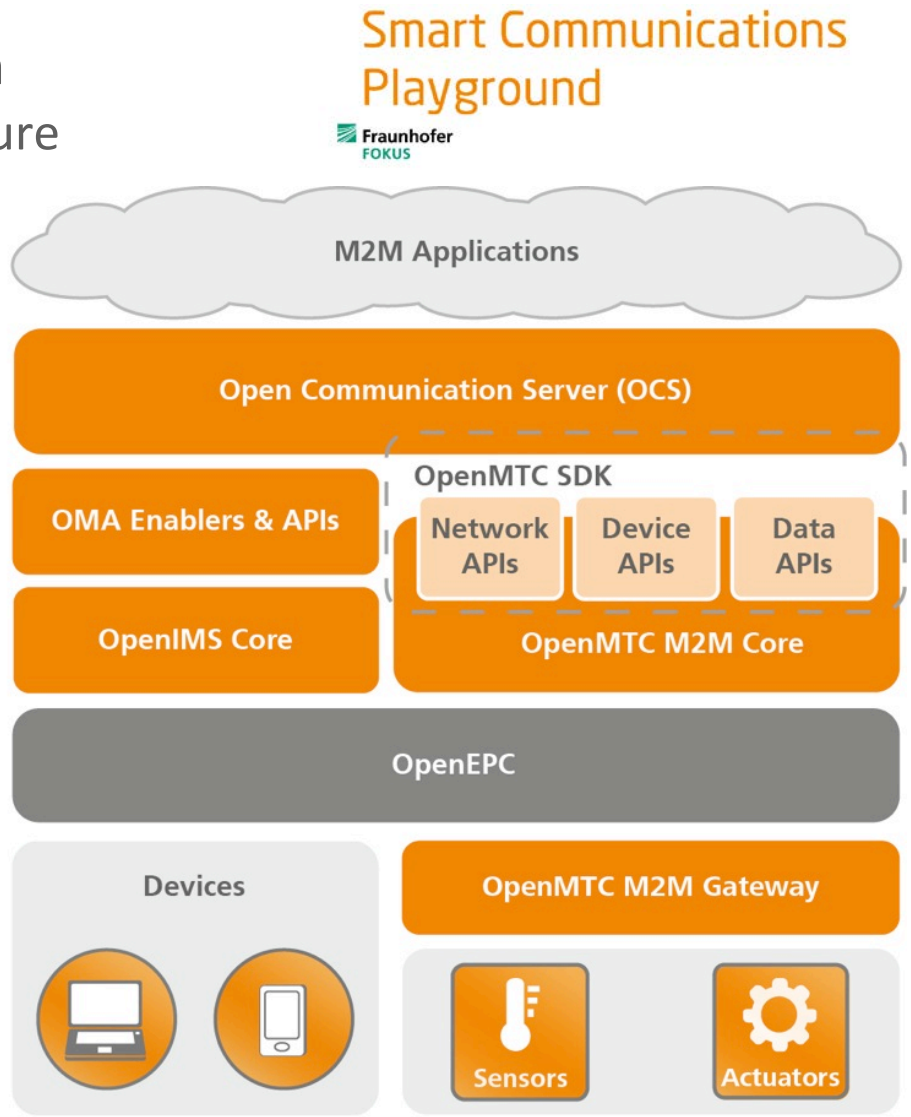
FUSECO playground

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

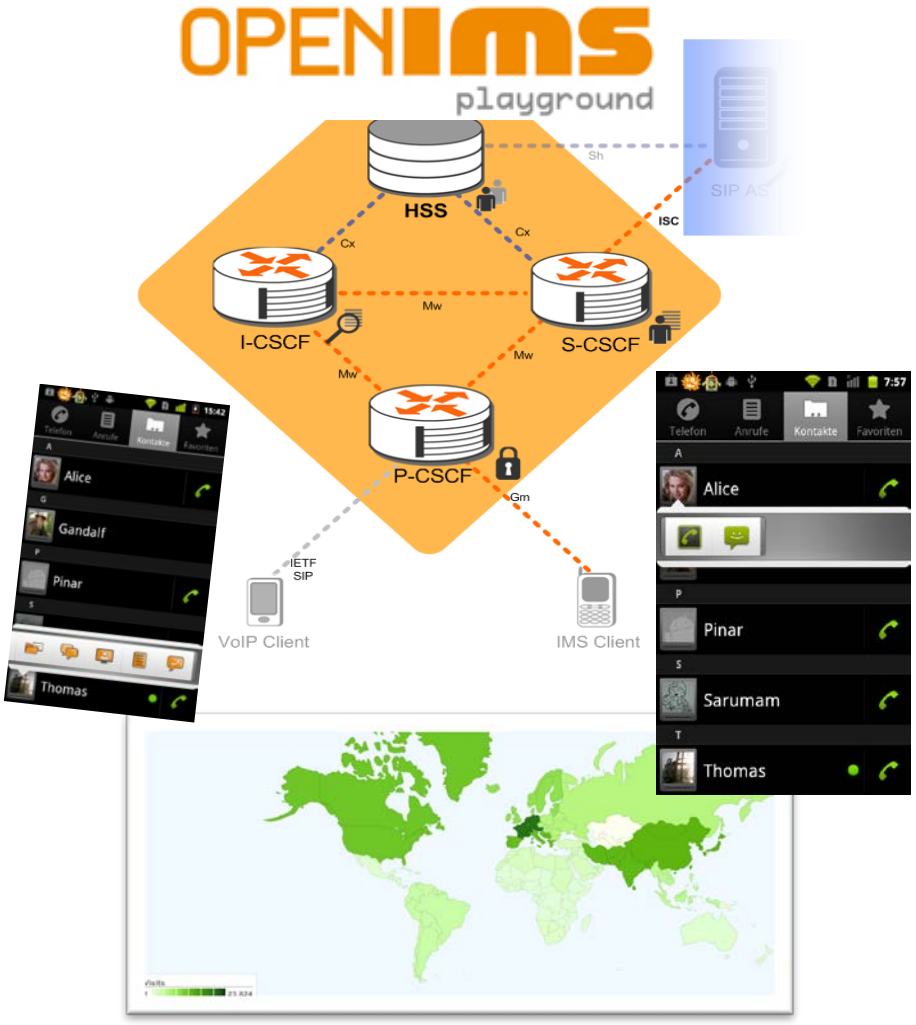


Open Source IMS Core System

- 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
- 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**

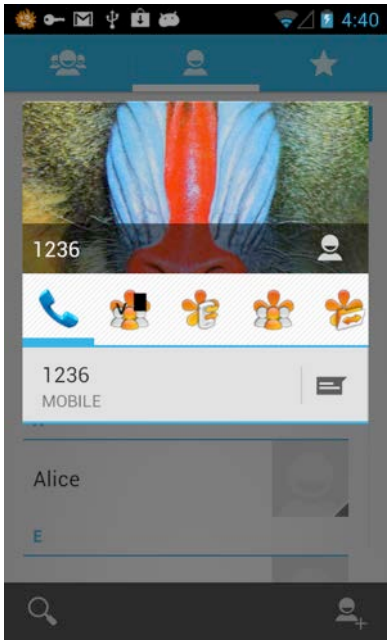


Note: IMS Client shown is MyMonster – see www.opensoaplayground.org/tcs

Telco Communicator Suite
Android Communication Client

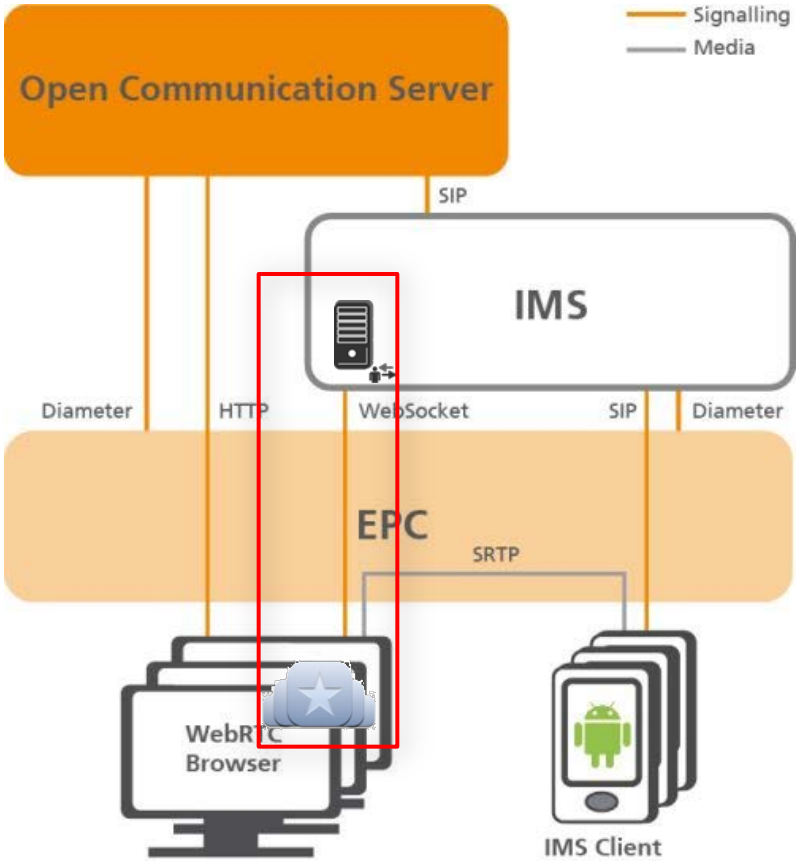
- The software stems
  - Extended RCS Stack from Orange Labs for VoLTE
  - Compliant to GSMA RCSe specification
  - Client/Server API allows easy integration with Android native application

- Supported RCS/VoLTE key features:
  - Enhanced native address book with supported service capabilities and presence info
  - Messaging
    - File Transfer
    - 1-1 chat
    - Adhoc group chat
    - Location
  - Rich Call with multimedia content sharing
    - Image Sharing
    - Video Sharing
    - Video/Audio VoIP



see www.sc-playground.org/tcs for more information

FOKUS WebRTC Telco Stack



The FOKUS WebRTC Telco Stack consists of:

- HTML5 application framework for WebRTC services.
- JavaScript library for browser apps to use SIPoverWebSocket (based on JsSIP)
- Network Gateway for providing WebSocket access to IMS-based UDP communication

- The toolkit provides end-2-end integration of WebRTC and RTCweb into operator back-end infrastructures.
- Identity management and AAA remains with the operator.

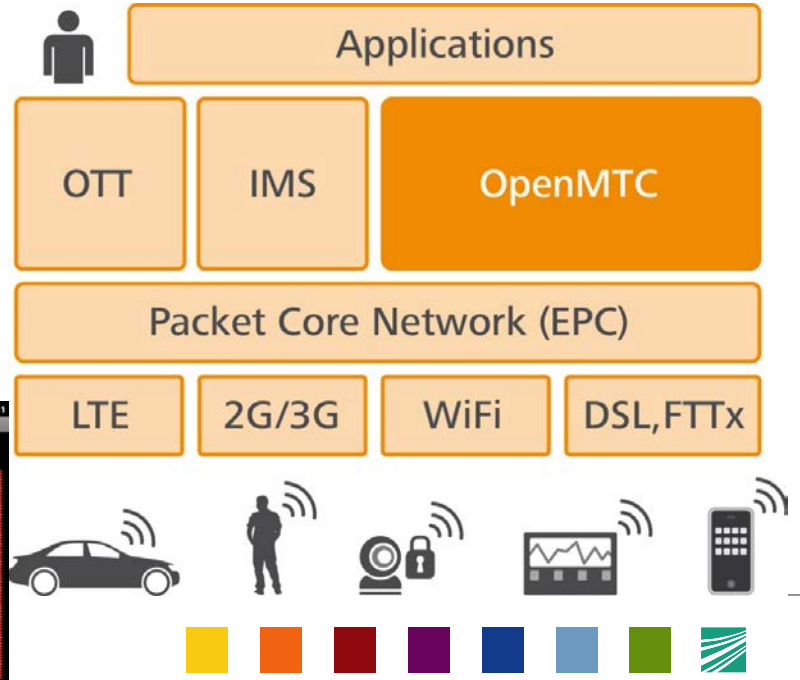
see www.sc-playground.org/webrtc for more information

Introducing the FOKUS OpenMTC Platform

open mtc
Fraunhofer FOKUS

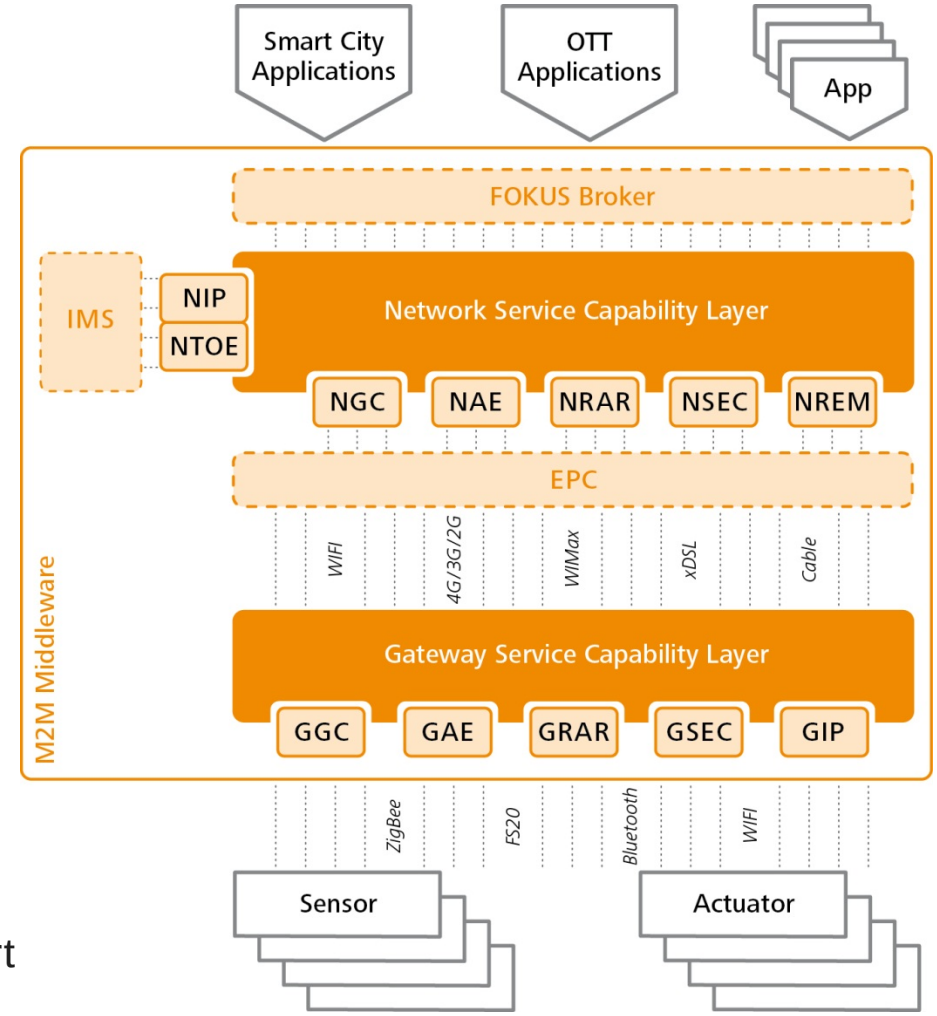
- Based on the success of the Open IMS Core and OpenEPC Fraunhofer FOKUS has developed a **NON-OPEN SOURCE** Machine Type Communication platform, enabling academia and industry to:
  - integrate various machine devices with operator networks
  - integrate various application platforms and services

  into 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 wwww.open-MTC.org

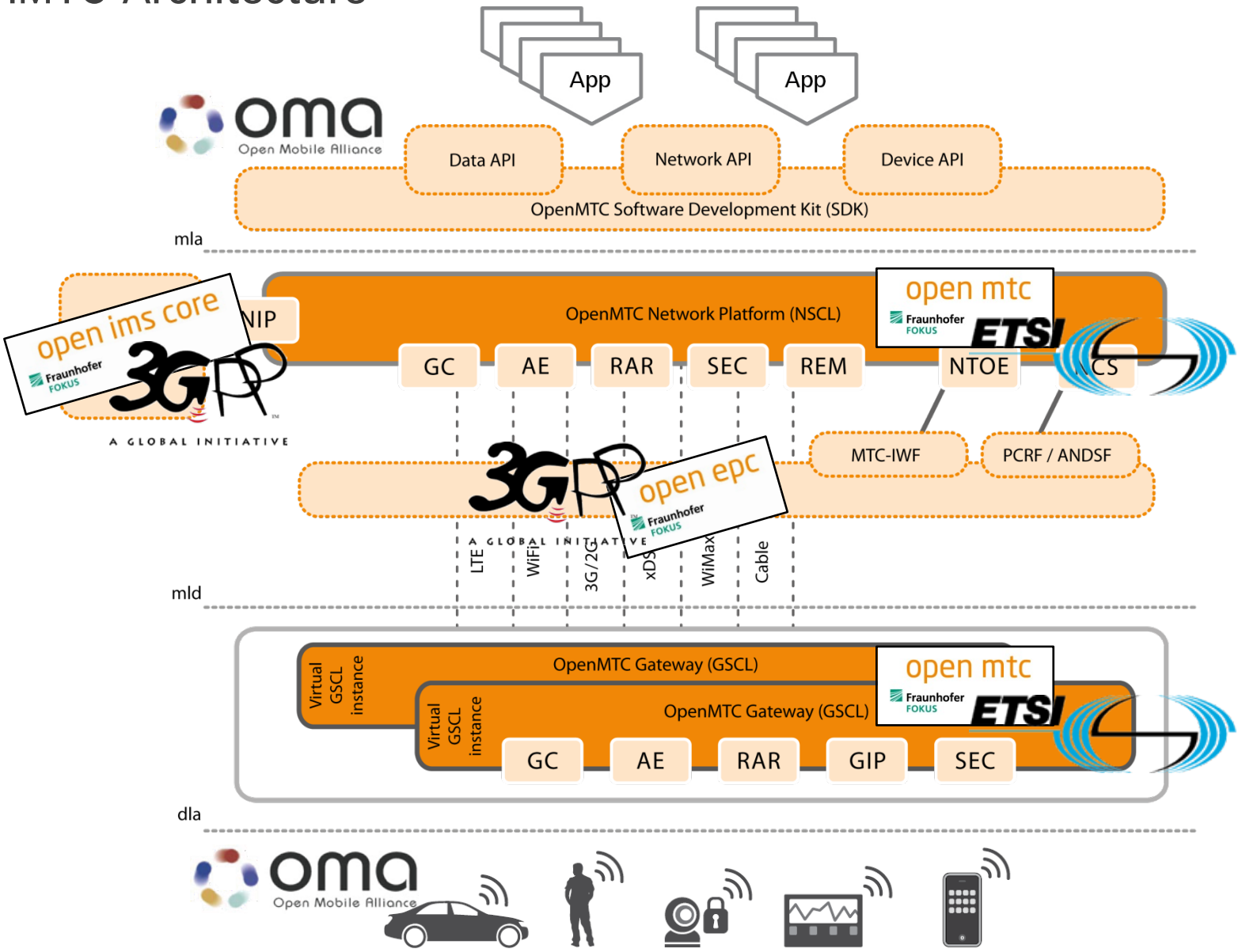


OpenMTC Architecture – Release 1

- 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.)

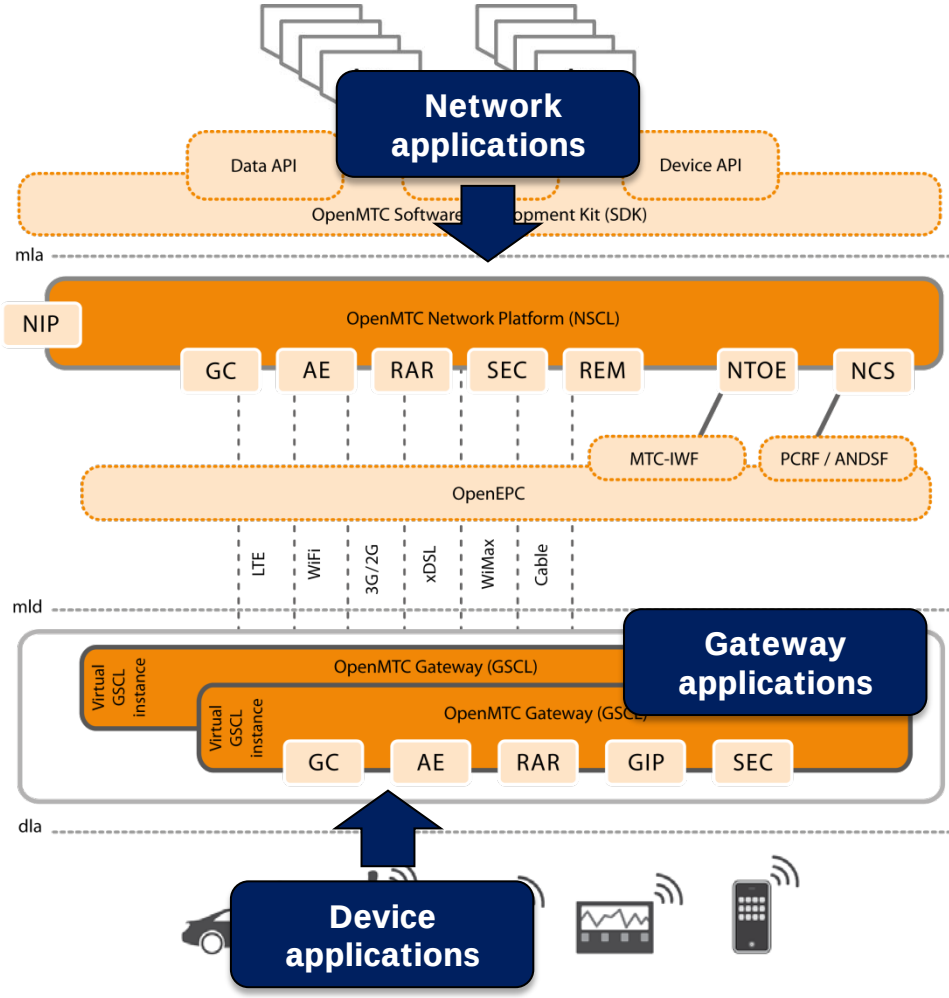


OpenMTC Architecture



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



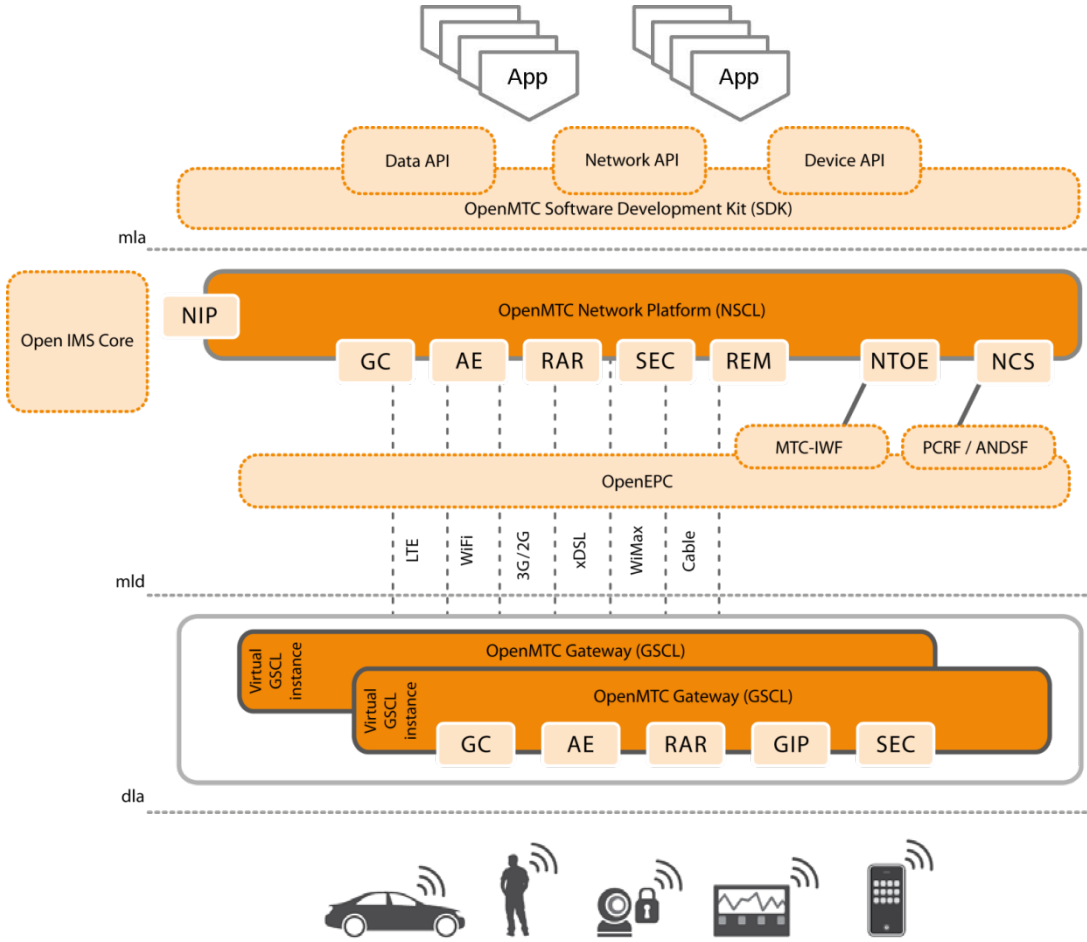
Integration and Interworking on all layers

Supporting Interoperability

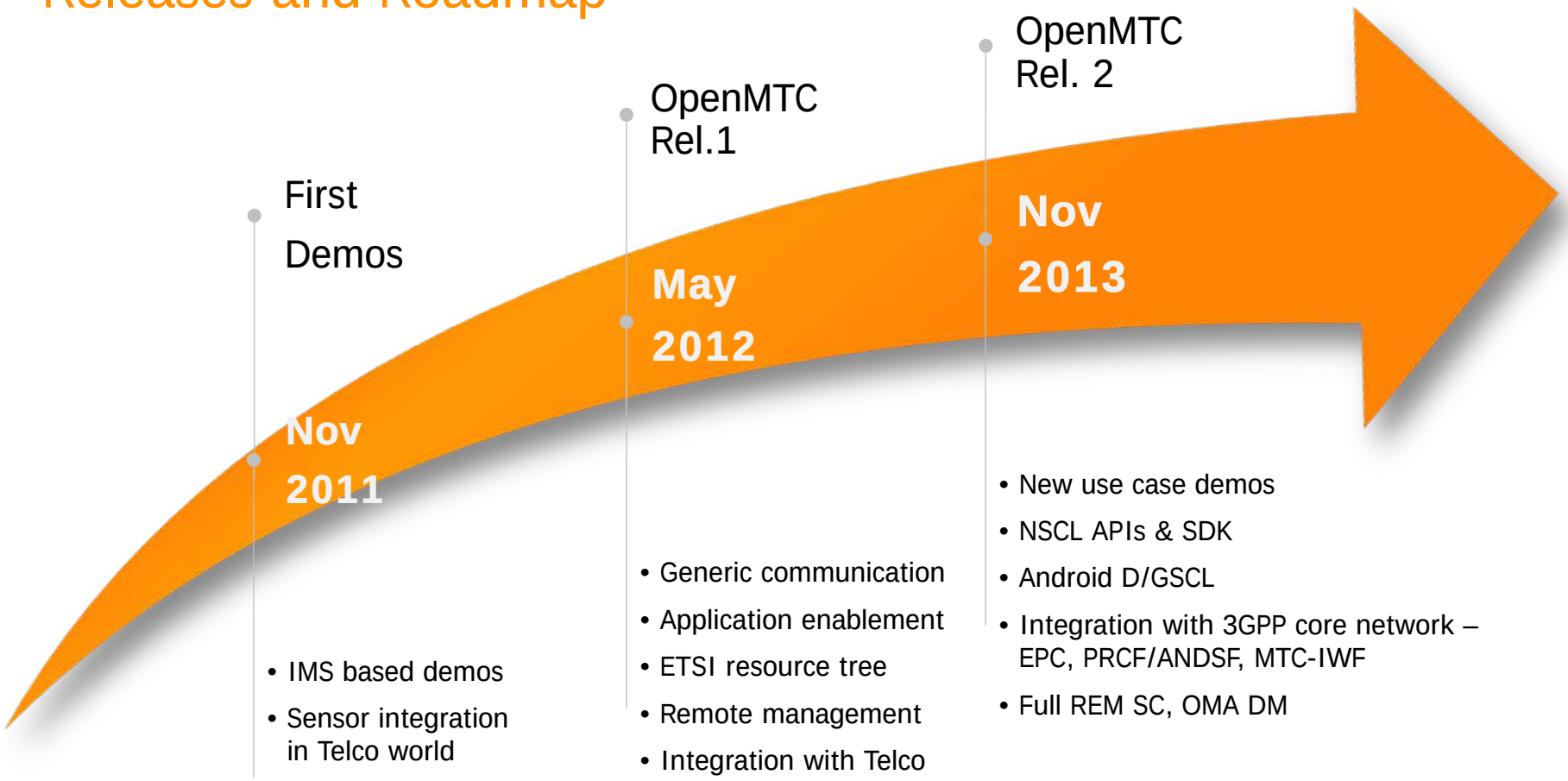
Heterogeneous Application Integration

Heterogeneous System / Platform Integration

Heterogeneous Device Integration

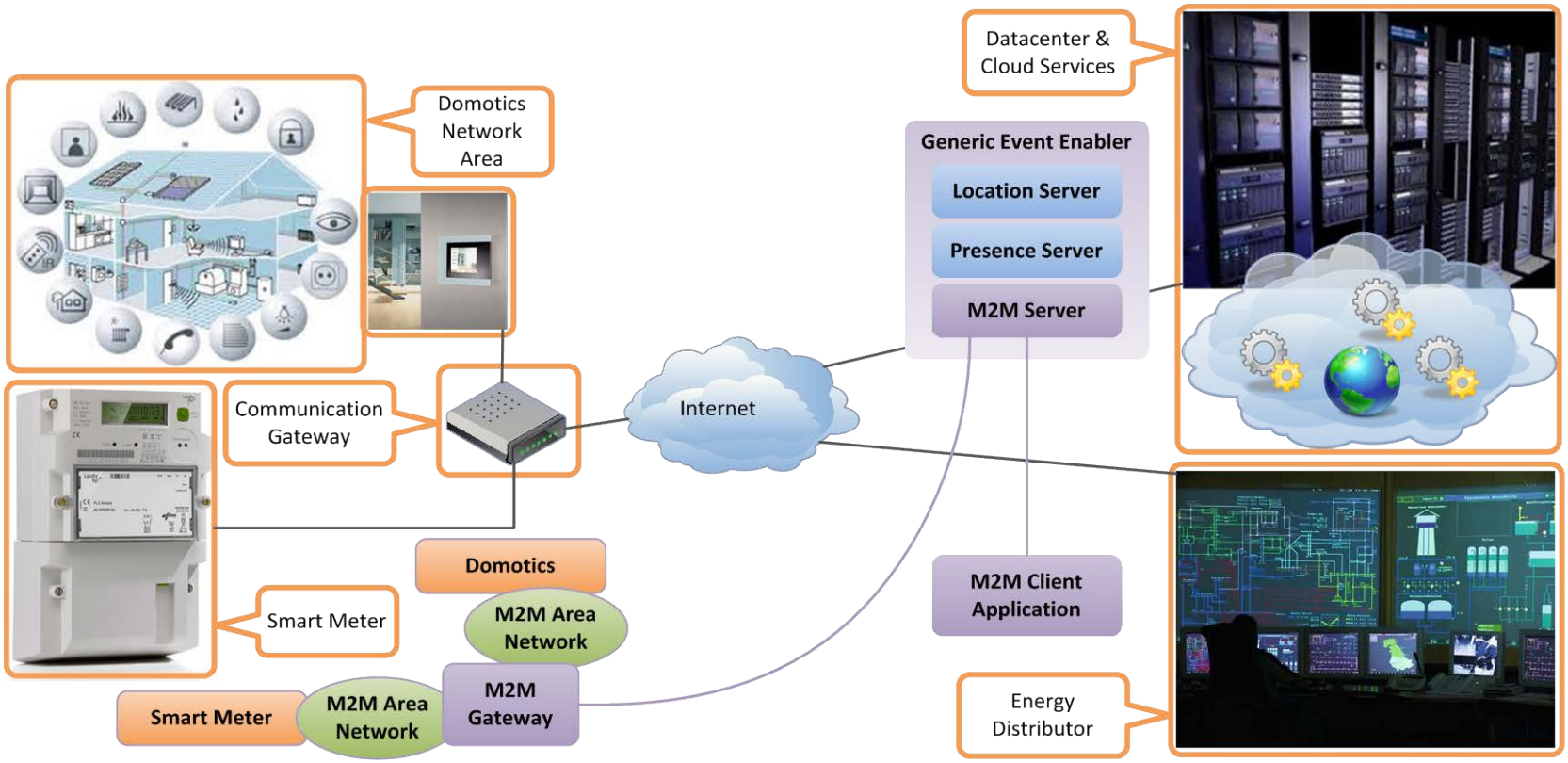


OpenMTC
Releases and Roadmap



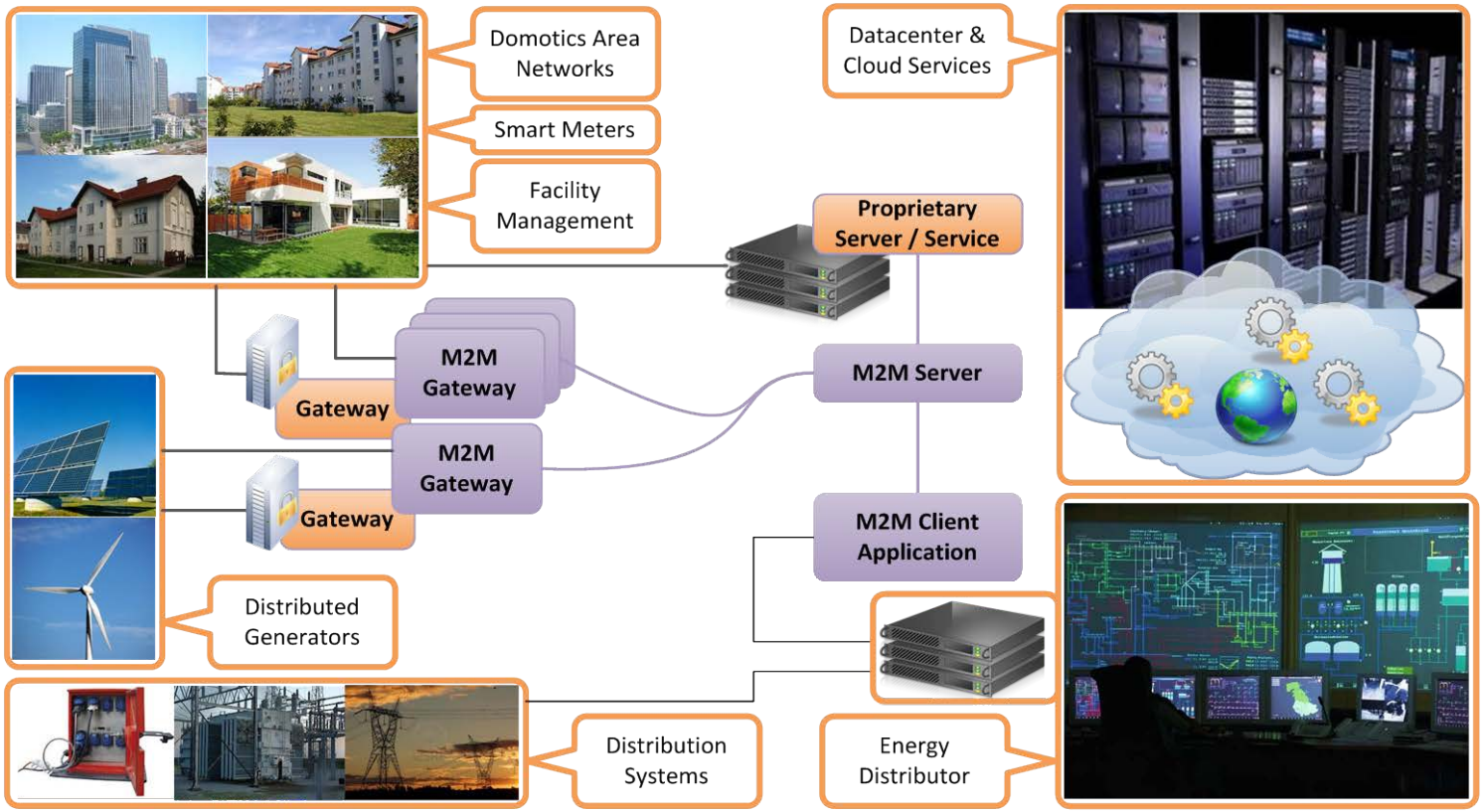
Smart City Services for End Customer Domotics and Smart Metering

- 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.



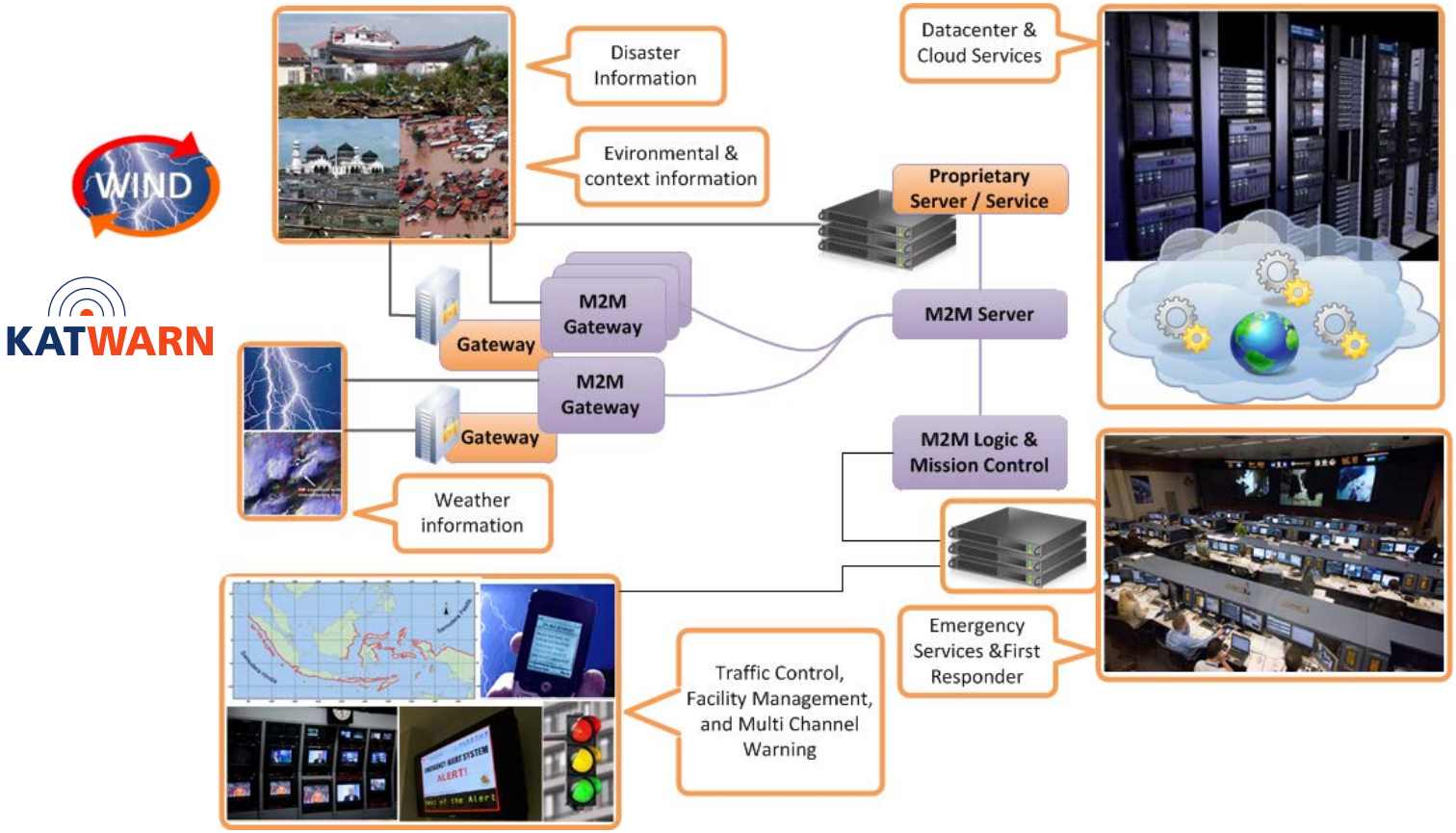
Smart City Services for Facilities and Campuses

- 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.



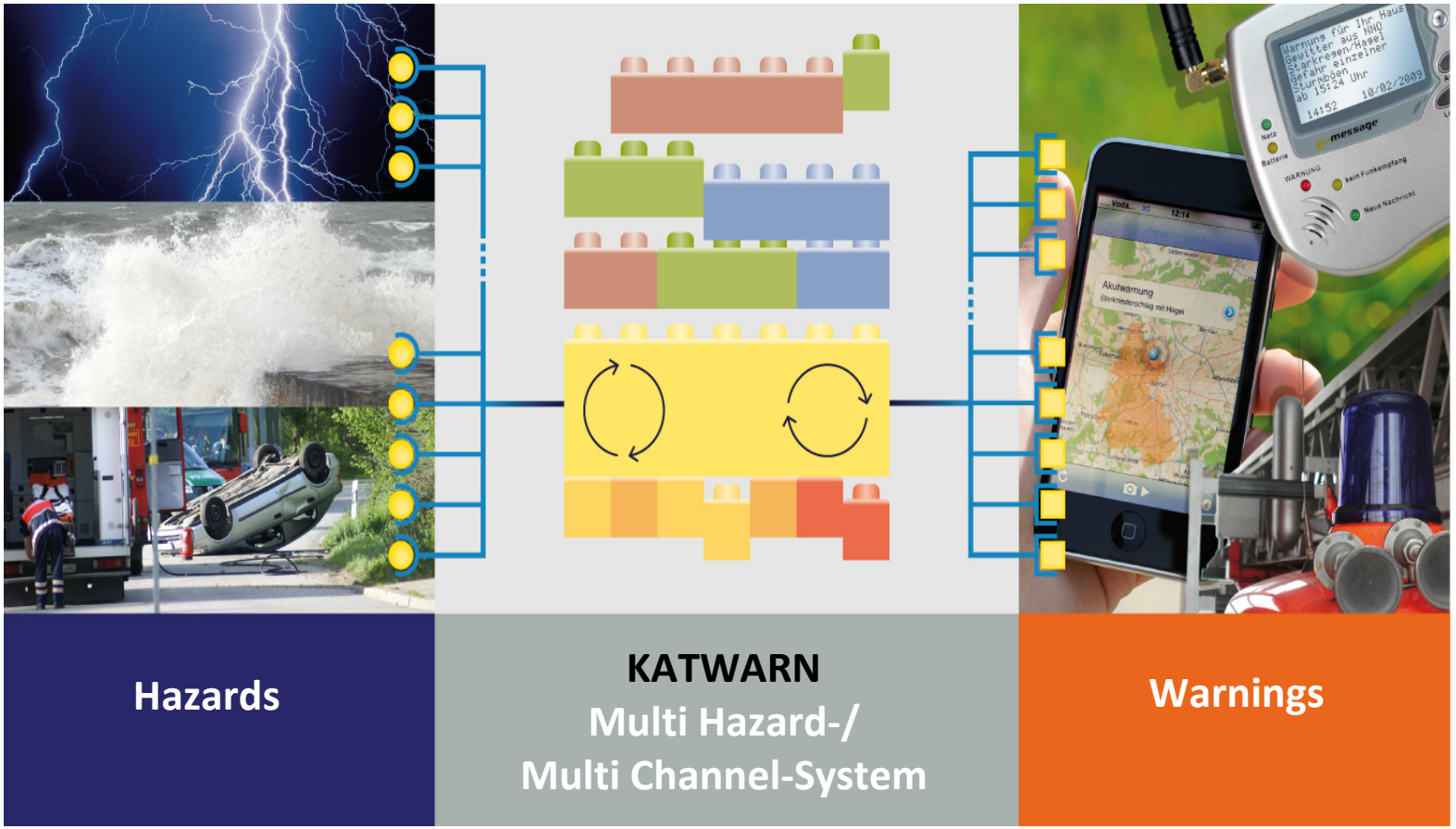
Smart City Services for Early Warning and Emergency Management

- 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



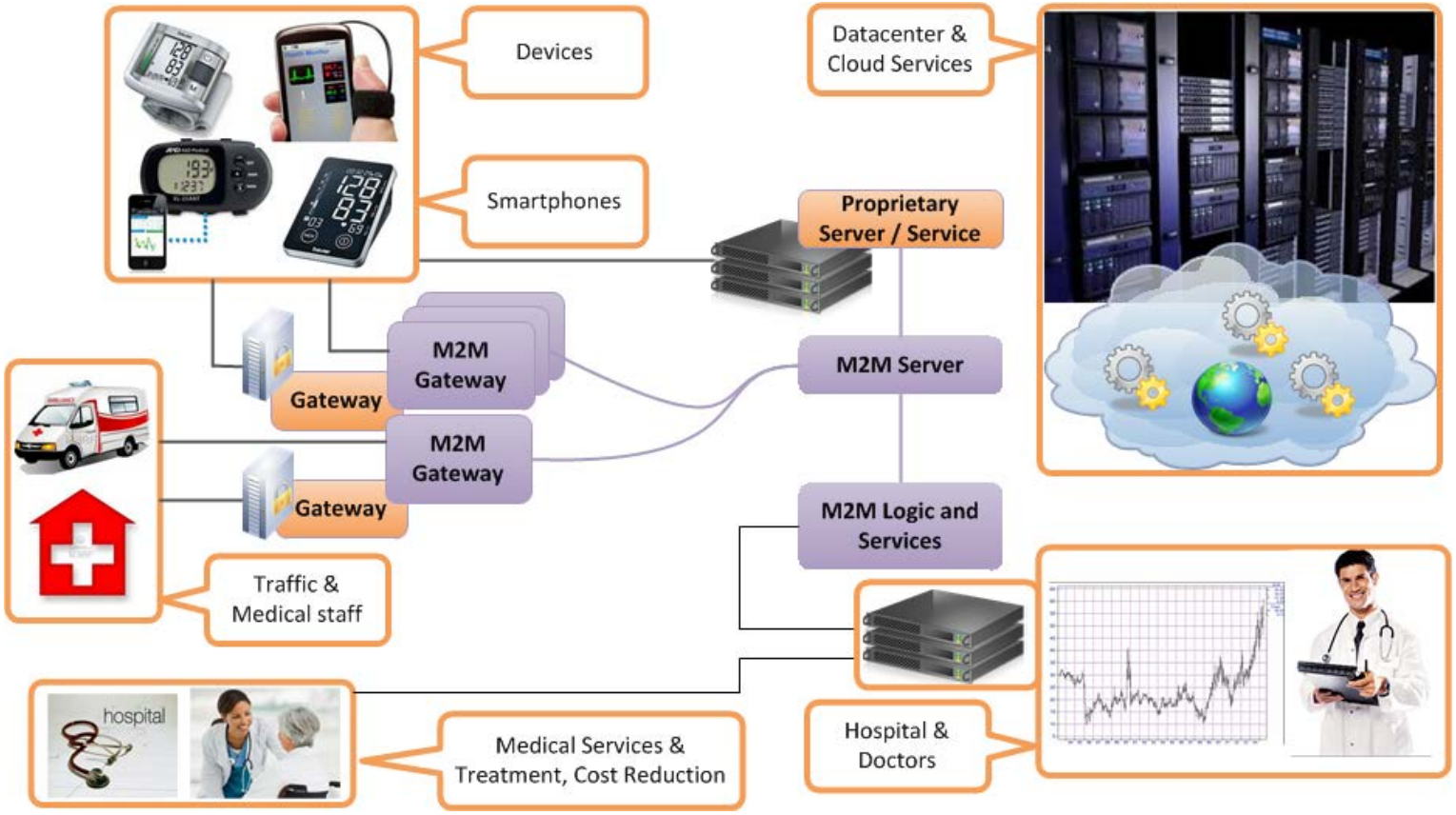

Verband
öffentlicher Versicherer
Fraunhofer
FOKUS

KATWARN-App


Top iPhone Apps in Nachrichten (gratis)
Sortieren nach: Bestseller
1. KATWARN
Nachrichten
Aktualisiert 13.11.2012
GRATIS
2. SPIEGEL ONLINE
Nachrichten
Aktualisiert 12.11.2012
GRATIS
3. Tagesschau
Nachrichten
Aktualisiert 10.11.2011
GRATIS
4. Deutscher Bundestag
Nachrichten
Aktualisiert 28.09.2012
GRATIS
5. SPORT BILD +
Nachrichten
Aktualisiert 10.10.2012
GRATIS
6. FOCUS Online - Nachrich...
Nachrichten
Aktualisiert 07.11.2012
GRATIS
7. n-tv iPhone edition
Nachrichten
Aktualisiert 12.11.2012
GRATIS
8. AUTO WORLD deutsch
Nachrichten
Aktualisiert 15.09.2012
GRATIS

Smart City Services for eHealth and Support of Elderly People

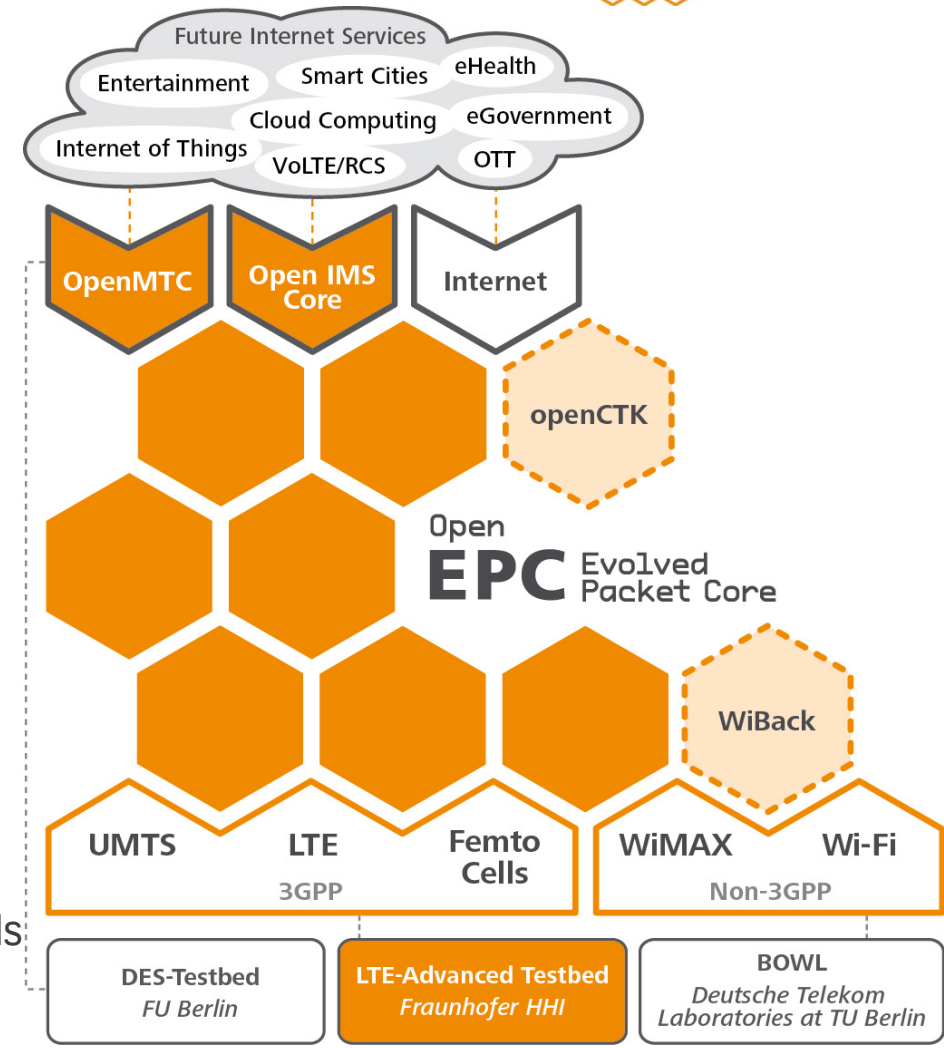
- OpenMTC supports various eHealth devices and can communicate health information to hospitals and first responders. In conjunction with traffic & location information and data about medical staff occupancy, critical time savings and cost reduction can be achieved.



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
- More information:



What is FOKUS OpenEPC Platform?

open epc
Fraunhofer FOKUS

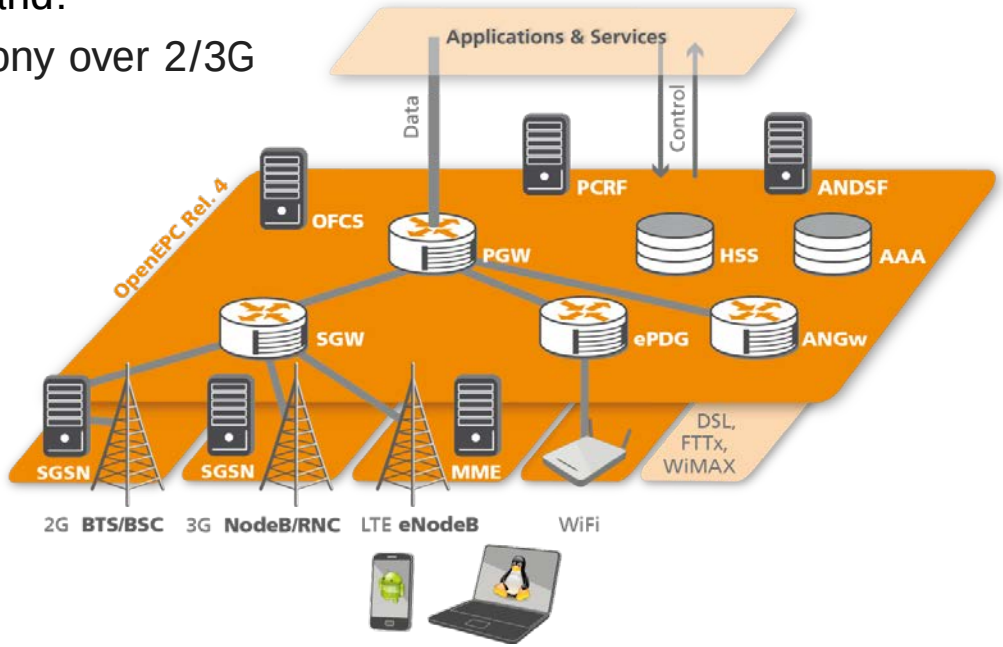
- Future massive broadband communications will be realized through multi-access support (LTE, 3G, 2G, WiFi, fixed networks ...) and multi-application domains (OTT, IMS, P2P, M2M, Cloud, ...)
- Fraunhofer FOKUS is developing the **NON-OPEN SOURCE** OpenEPC, enabling:
  - integrate various network technologies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

OpenEPC beyond Rel.4

- Today satisfying demand for test-bed prototypes
  - Complete test-beds from radio up to applications ~100K €
- OpenEPC is increasingly interesting for start-ups and telco vendors!
  - Redistribution licenses, Wharf as a starting point for carrier-grade equipment

- Current hot-topics with high R&D demand:
  - VoLTE and SRVCC – unified telephony over 2/3G and LTE
  - LTE eNodeB experimentation and productization
  - EPC for Professional Mobile Radio
    - as TETRA(POL) replacement
    - GSM-R
    - LTE in planes
  - Small cells and HetNets



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

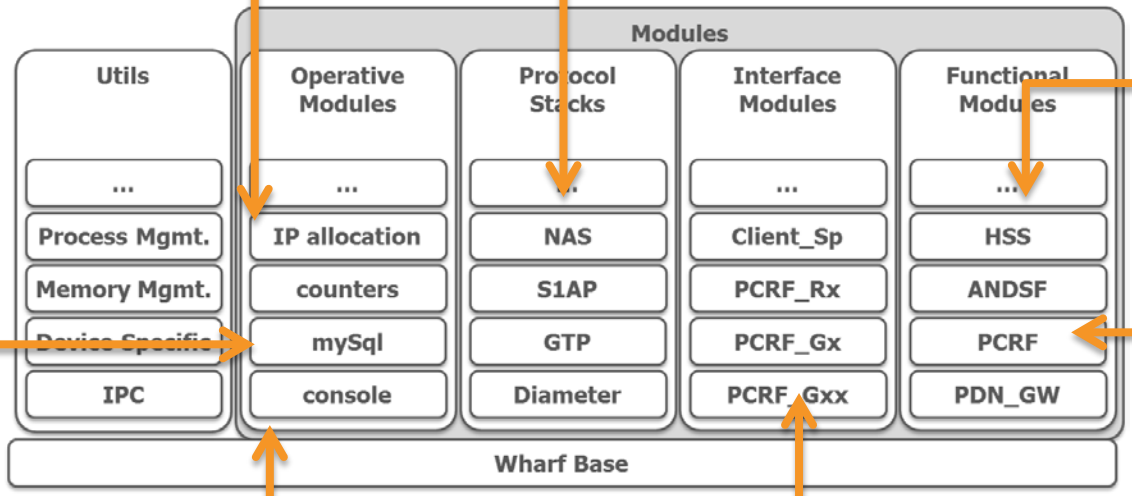
OpenEPC is highly modular and easy to extend

open epc
Fraunhofer FOKUS

Retrieving the current status

Development of a new interface using a protocol

Creating a new component
Modifying an existing one



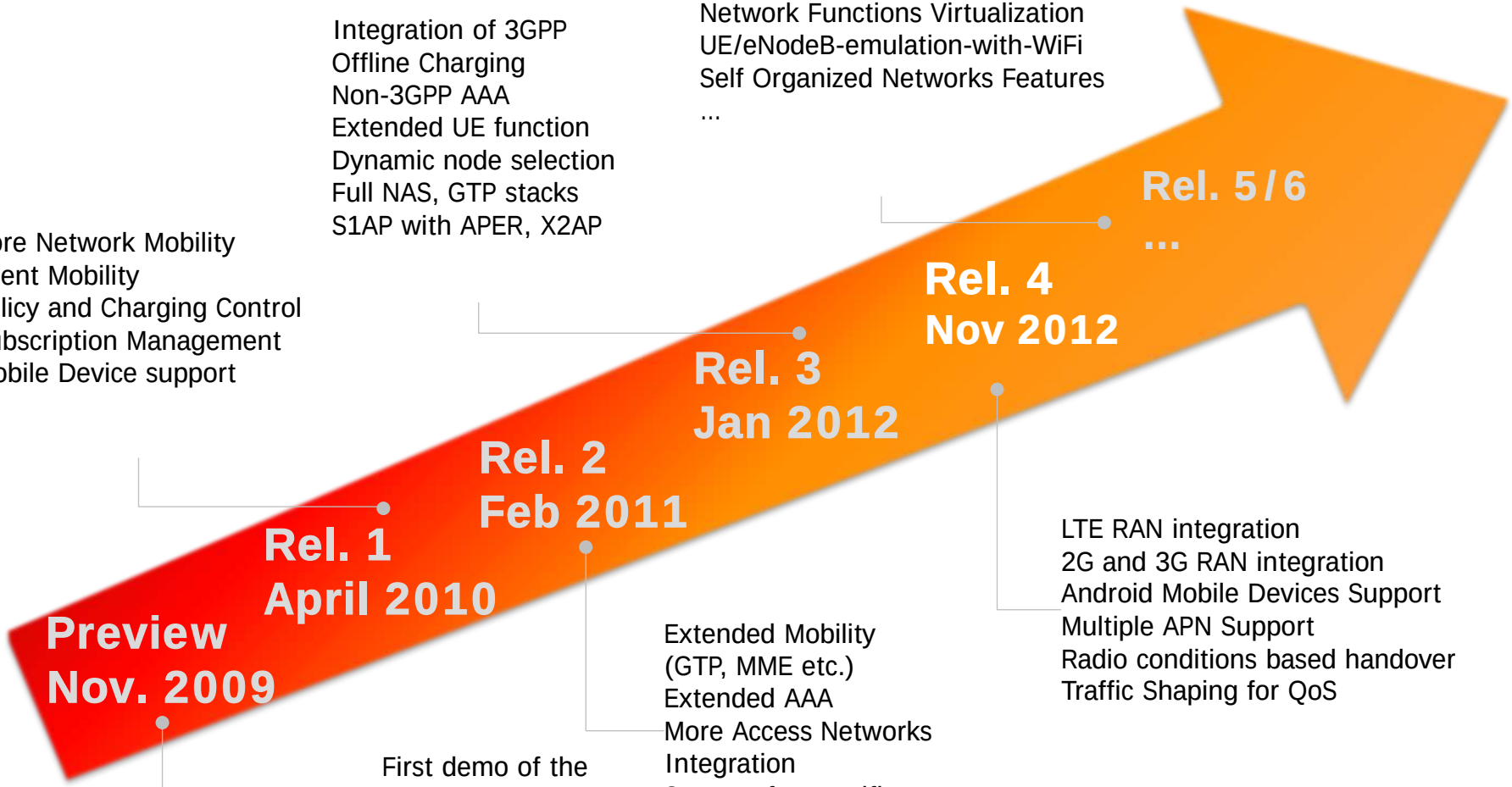
Re-creating state

Remote Procedure Calls

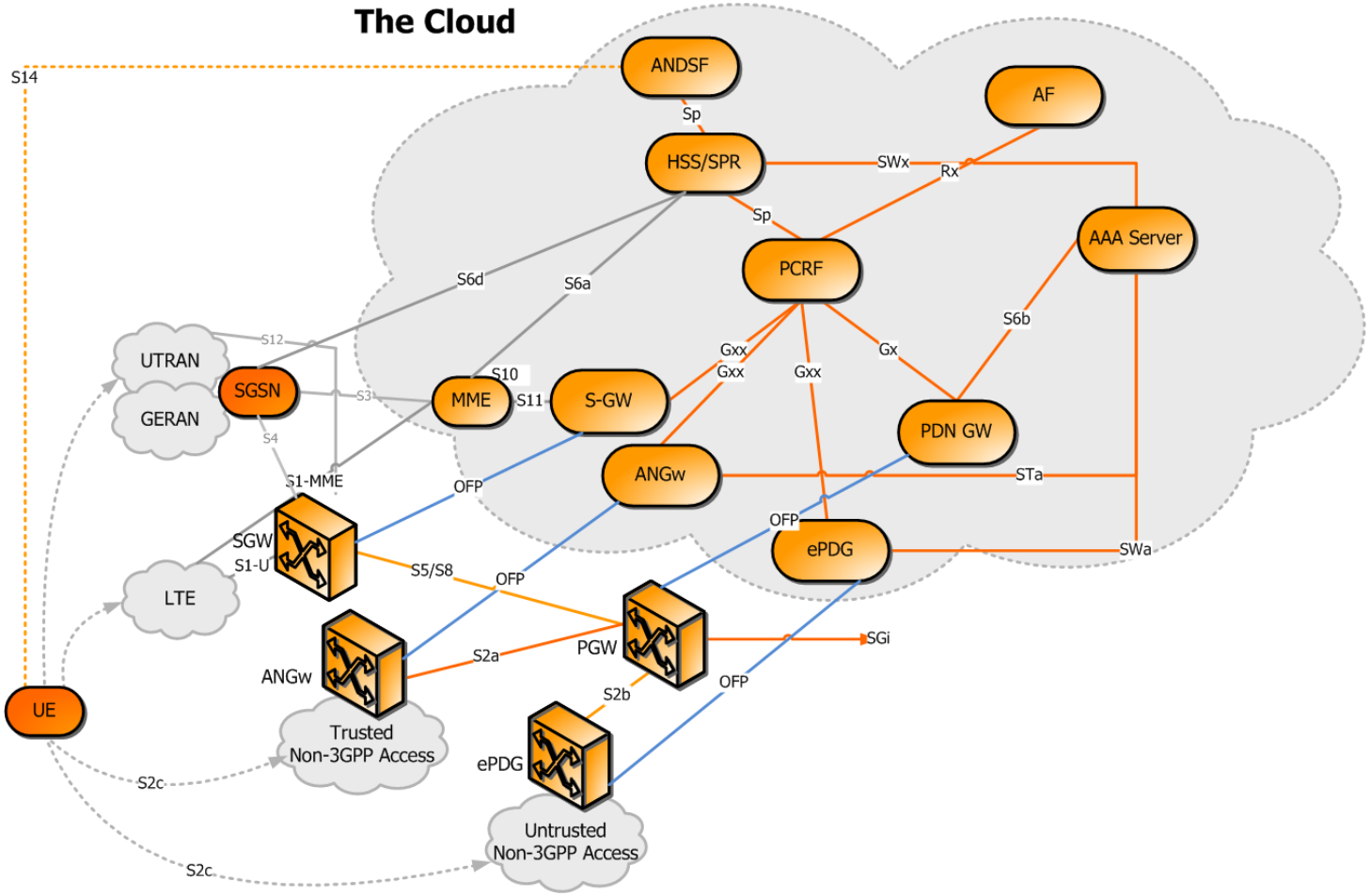
Using the interfaces in new contexts

Replacing Interfaces with Proprietary Ones

OpenEPC Roadmap



OpenEPC with OpenFlow – Clean Infrastructure/Cloud Split



- EPC Control, Mobility and all signaling can be cloudified
- But the User Data Plane stays in the infrastructure → maximum performance

Fraunhofer FOKUS Toolkits and Technology Evolution Path

open ims core

Fraunhofer FOKUS

Converged **Session control** for SIP multimedia services on top of IP networks

Evolution from Session Management to plain IP connectivity

open epc

Fraunhofer FOKUS

IP Connectivity, Charging, Security, QoS Control, Mobility, Heterogeneous Access Network support

Evolution towards flexible deploy- and mgmt

open SDN core

Fraunhofer FOKUS

Network component orchestration and management; Adaptable **distributed control** platform; **Programmable switches**

Evolution of core network functionality

open 5G core

Fraunhofer FOKUS

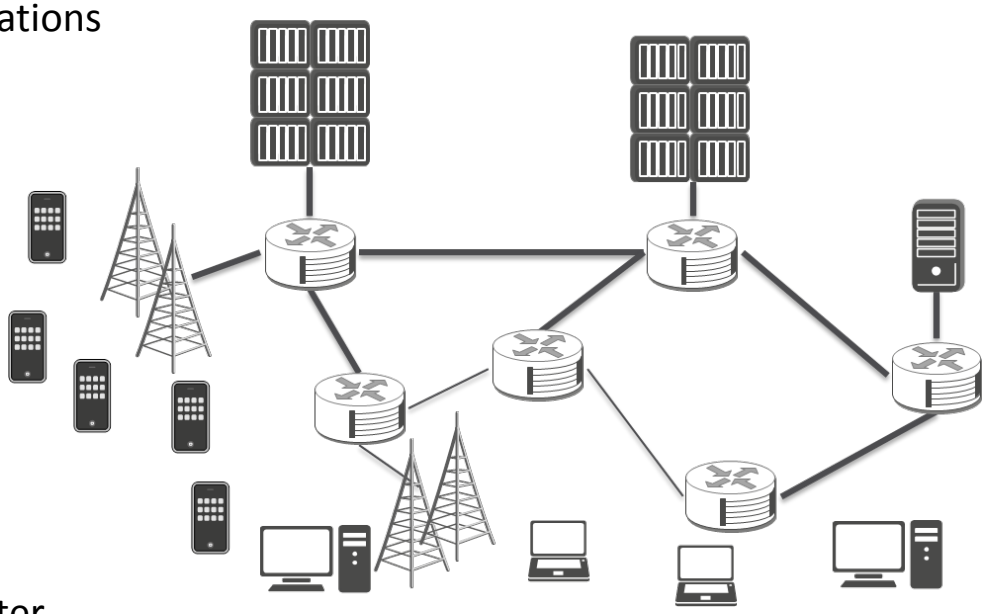
Towards **5G Core Evolution,** 5G RAN support, **SDN data path concepts**, Flatter architecture

2G (GSM/GPRS) / 3G (UMTS/HSPA(+)) 4G (LTE/LTE-A) 5G (LTE-B / 5G-RAN)

Fraunhofer FOKUS

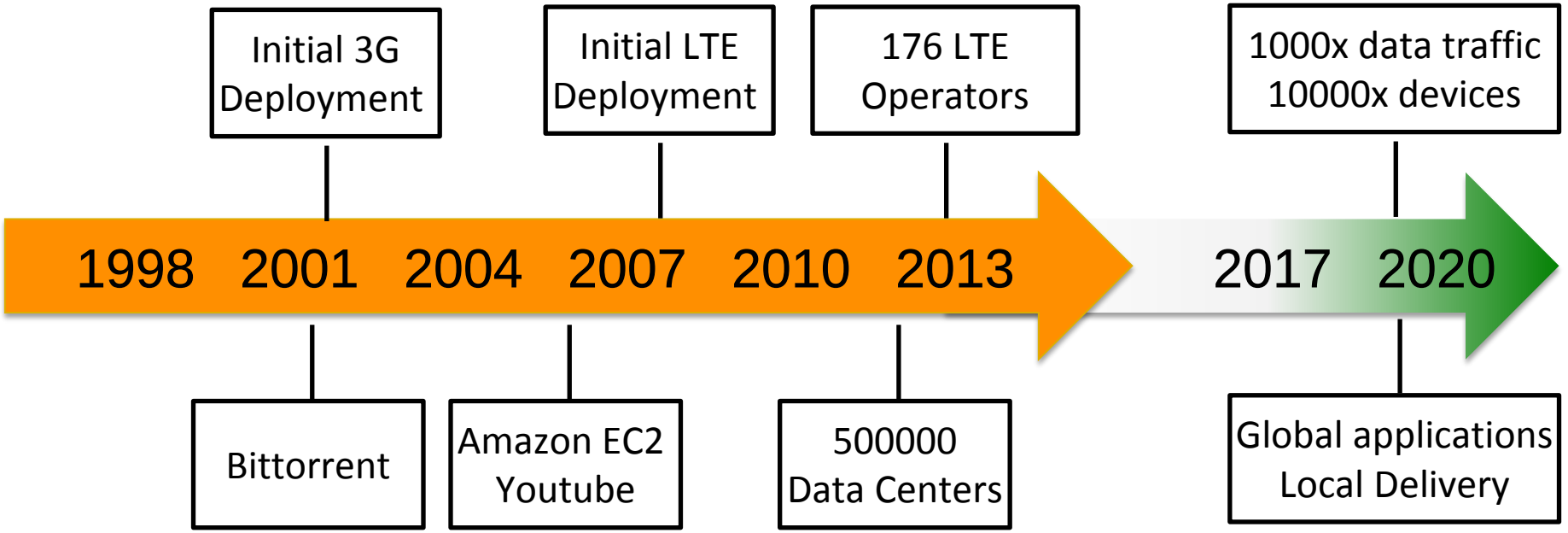
Motivation for an Integrated Evolving Toolkit

- The current network evolution cycle is coming to an end
  - LTE is in deployment
  - Fixed network reached complete maturity
  - Data Centers are available in most locations
- The technology has to be consolidated
  - Simplification of the curent system
  - Trust through usage
- A new cycle is beginning
  - More connected devices
  - Higher bandwidth/lower latency
  - Global applications
- The development cycles are becoming shorter
  - Early prototyping from the initial IPR up to friendly trials
  - Flexibile testing platforms evolving at the same speed as the technology



What are the next steps wireless broadband?

- 1000x more connected devices
- 10000x more data traffic
- Higher diversification of communication requirements
- Cloudification of applications
- Wide spread of multimedia caches

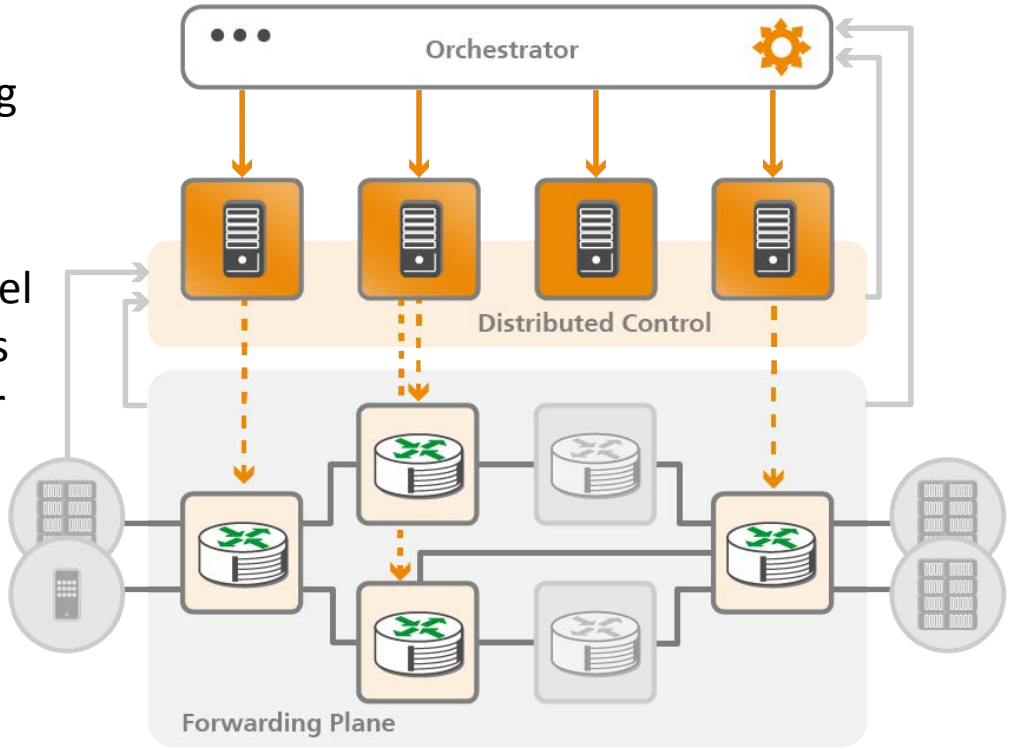


OpenSDNCore Scope

open sdn core

Fraunhofer FOKUS

- To provide self-adaptable connectivity at the following levels
  - Data Path – providing the basis for developing novel forwarding mechanisms
  - Control Plane – integrating novel Internet and Telecom principles in a simplified modular manner
  - Orchestrator – self-adaptable network deployments

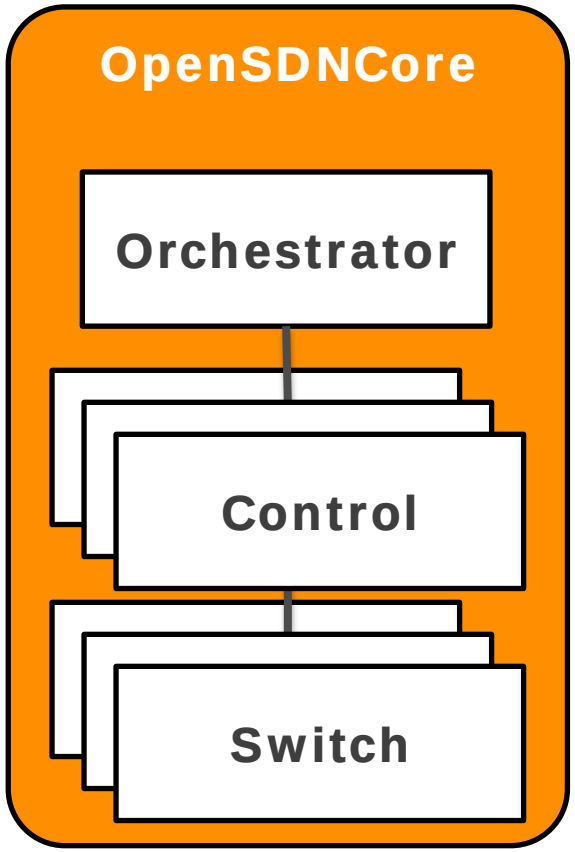


What is OpenSDNCore Toolkit?

open sdn core

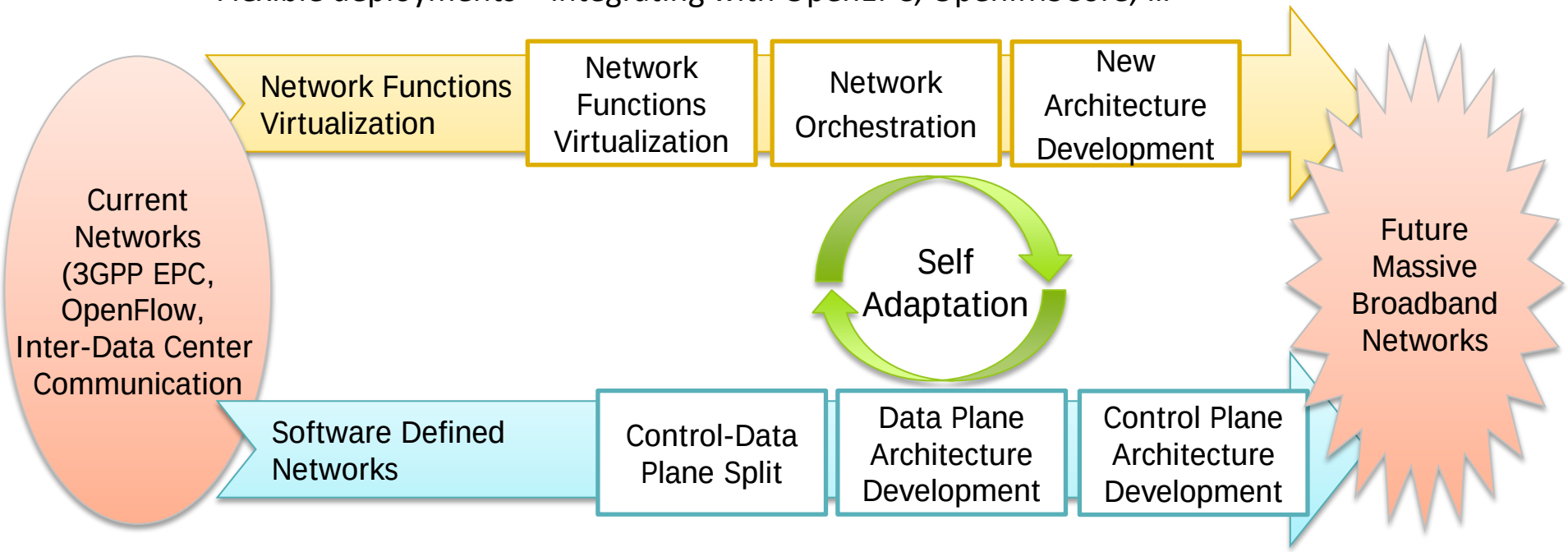
Fraunhofer FOKUS

- OpenSDNCore is a practical implementation of a future core network based on the latest network evolution paradigms:
  - Software Defined Networks (SDN)
    - Separation of control and data plane
    - Flexible forwarding mechanisms
    - Aggregated control plane
  - Network Functions Virtualization (NFV)
    - Self-orchestration of network components
    - Network topology awareness
- OpenSDNCore high level functionality:
  - Switch – providing the basis for flexible forwarding research
  - Control – simplified control plane
  - Orchestrator – enabling network functions placement
- OpenSDNCore is a non-open source, standards inspired toolkit designed for adaptable deployments



Architecture Development Options

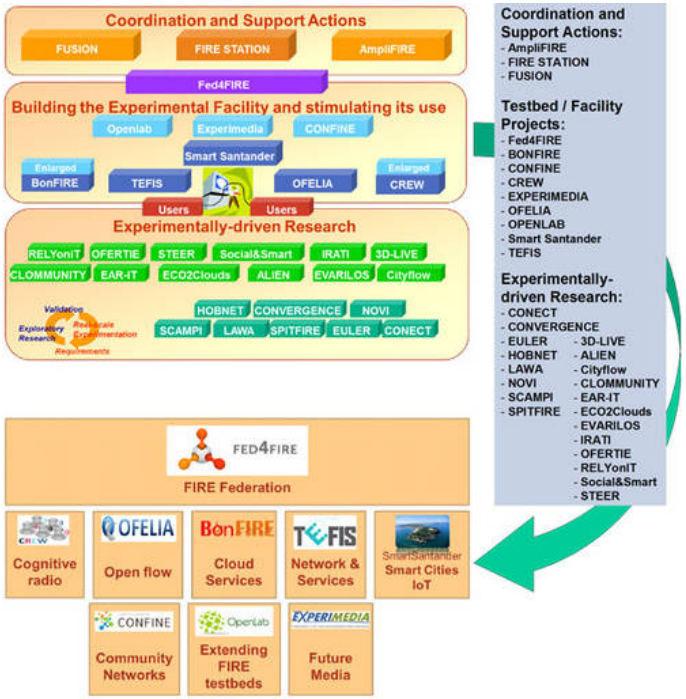
- OpenSDNCore follows the development of the Network Functions Virtualization (NFV) and Software Defined Networks (SDN) providing:
  - Early prototyping platform for novel concepts
  - Proof-of concept platform for the new features
  - Flexible deployments – integrating with OpenEPC, OpenIMSCore, …



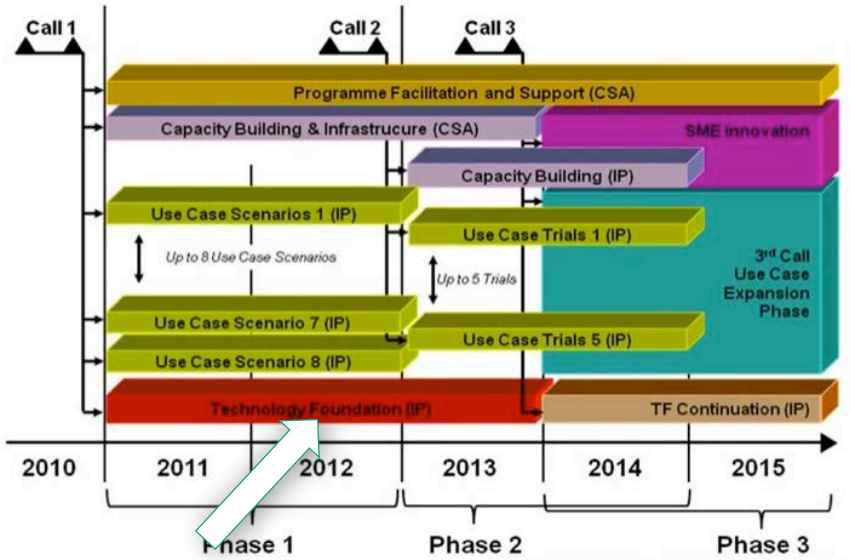
Europe's key Initiatives for Future Internet Research and Development FIRE and the FI-PPP

NGNI is one of the most active contributors to:

- Europe's **Future Internet Research and Experimentation Initiative (FIRE)**
- Europe's **Future Internet Public Private Partnership Programme (FI-PPP)**



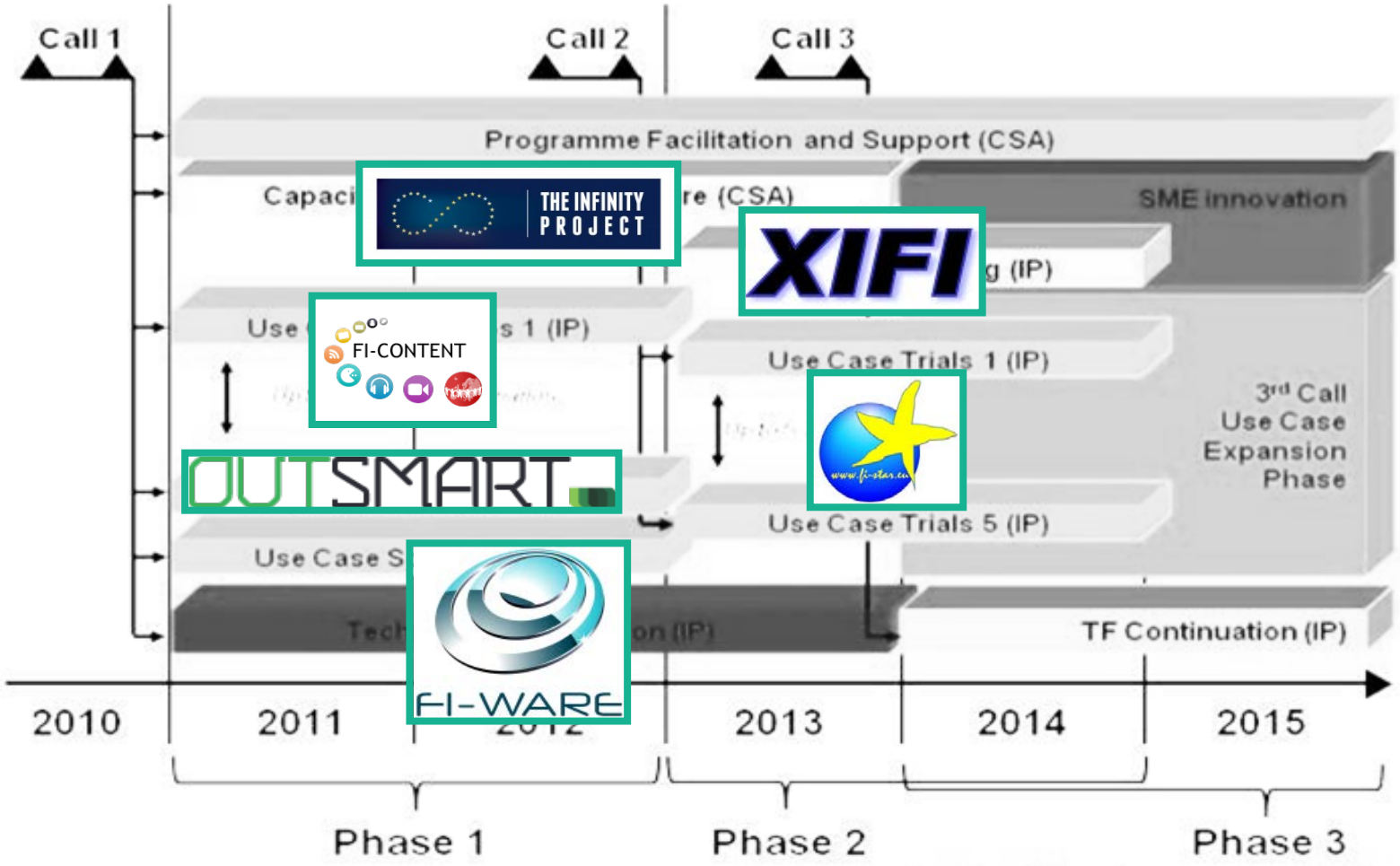
FIRE



Future Internet Core Platform

FI-PPP

Fraunhofer FOKUS' involvement in the FI-PPP



FI-WARE – a collaboration effort between operators and IT providers with good participation from Academia

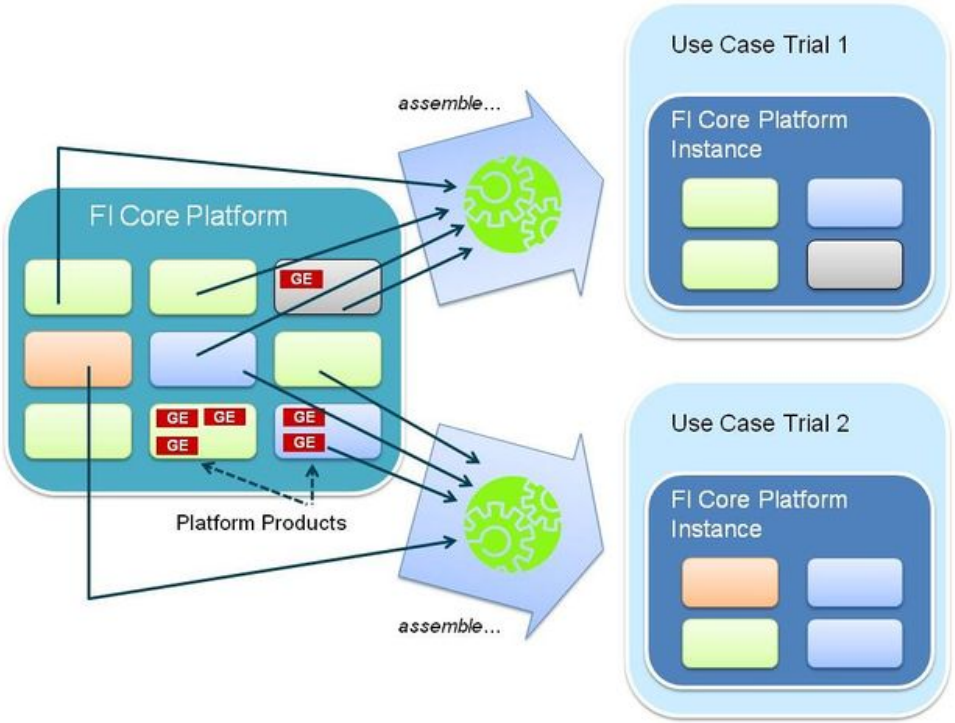
- *The FI-WARE project will introduce a generic and extendible ICT platform for Future Internet services.*
- *The platform – also referred to as the "Future Internet Core Platform" or "FI-WARE" – aims to meet the demands of key market stakeholders across many different sectors, strengthen the innovation-enabling capabilities in Europe and overall ensure the long-term success of European companies in a highly dynamic market environment.*

fi-ware

http://www.fi-ware.eu
http://forge.fi-ware.eu/plugins/mediawiki/wiki/fiware/index.php/Welcome_to_the_FI-WARE_Wiki

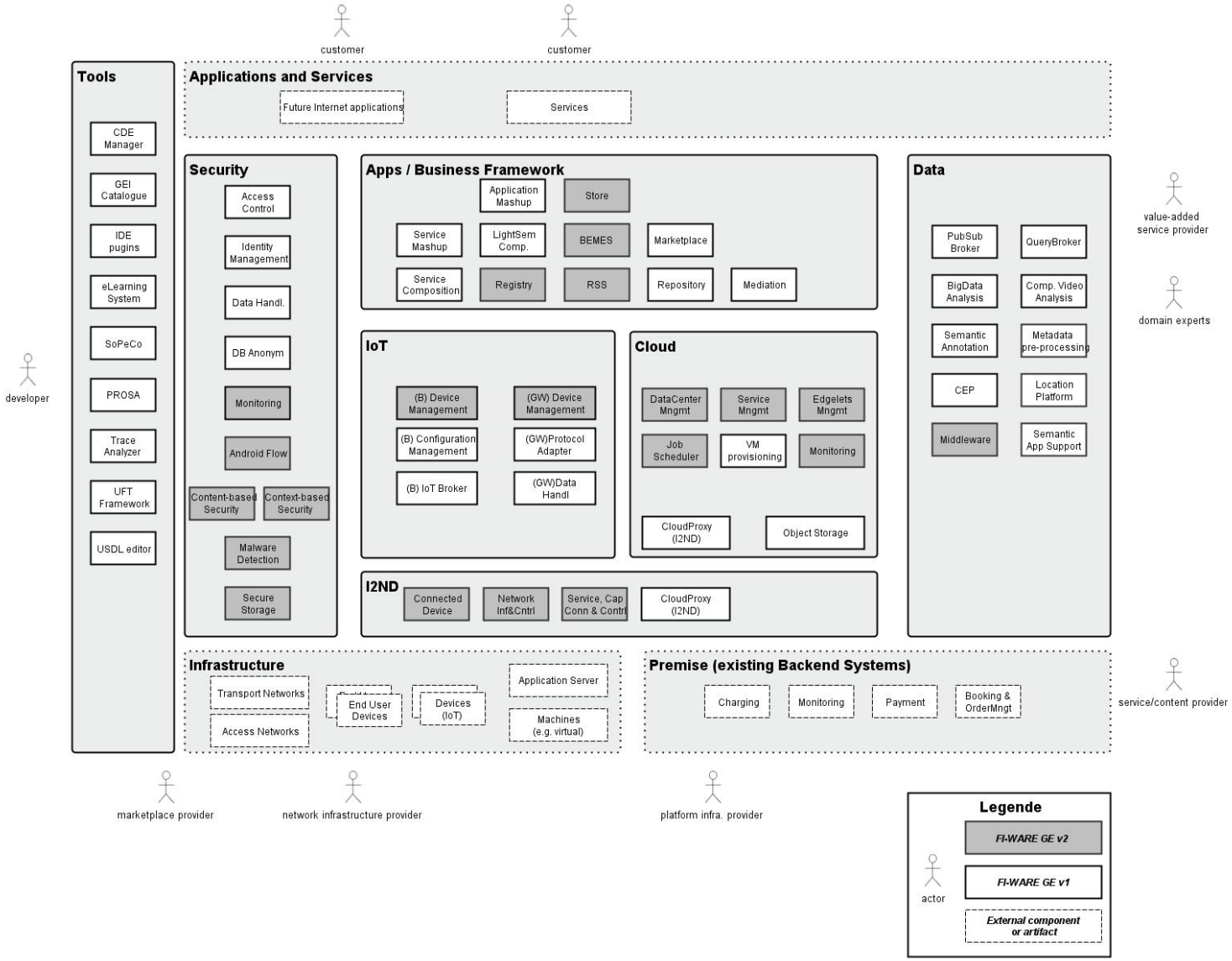
FI-WARE Generic Enablers Overview

- **FI-WARE Generic Enabler (GE)**: A functional building block of FI-WARE. Any implementation of a Generic Enabler (GE) is made up of a set of components which together supports a concrete set of Functions and provides a concrete set of APIs and interoperable interfaces that are in compliance with open specifications published for that GE.



FI-WARE Generic Enablers Overview

FI-WARE Architecture



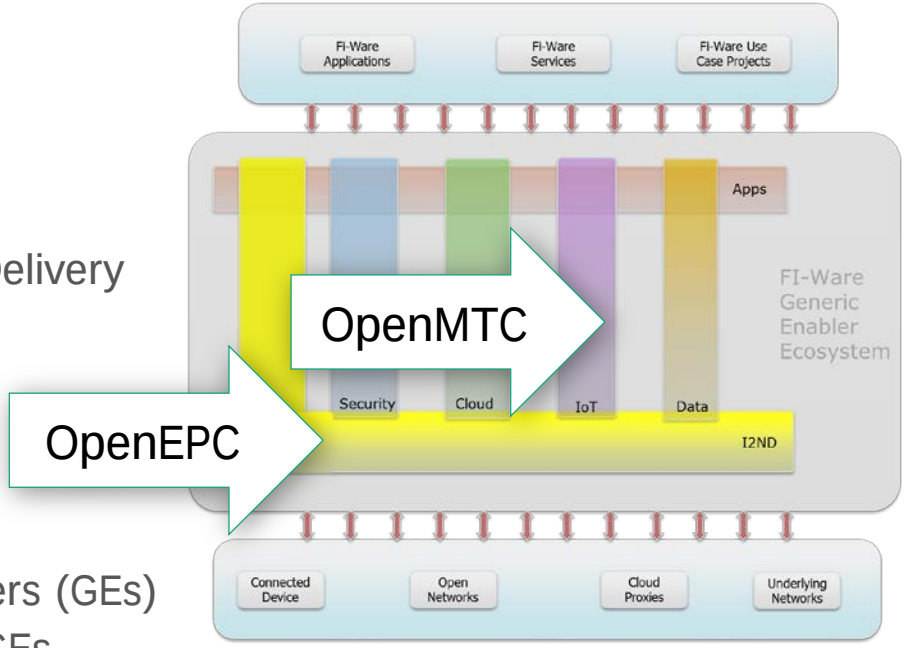
FI-WARE Generic Enablers Overview
(Separated per Work Package)

- Data/Context Management
- Cloud Hosting
- Security
- Applications
- Internet of Things
- Interface to Networks and Devices

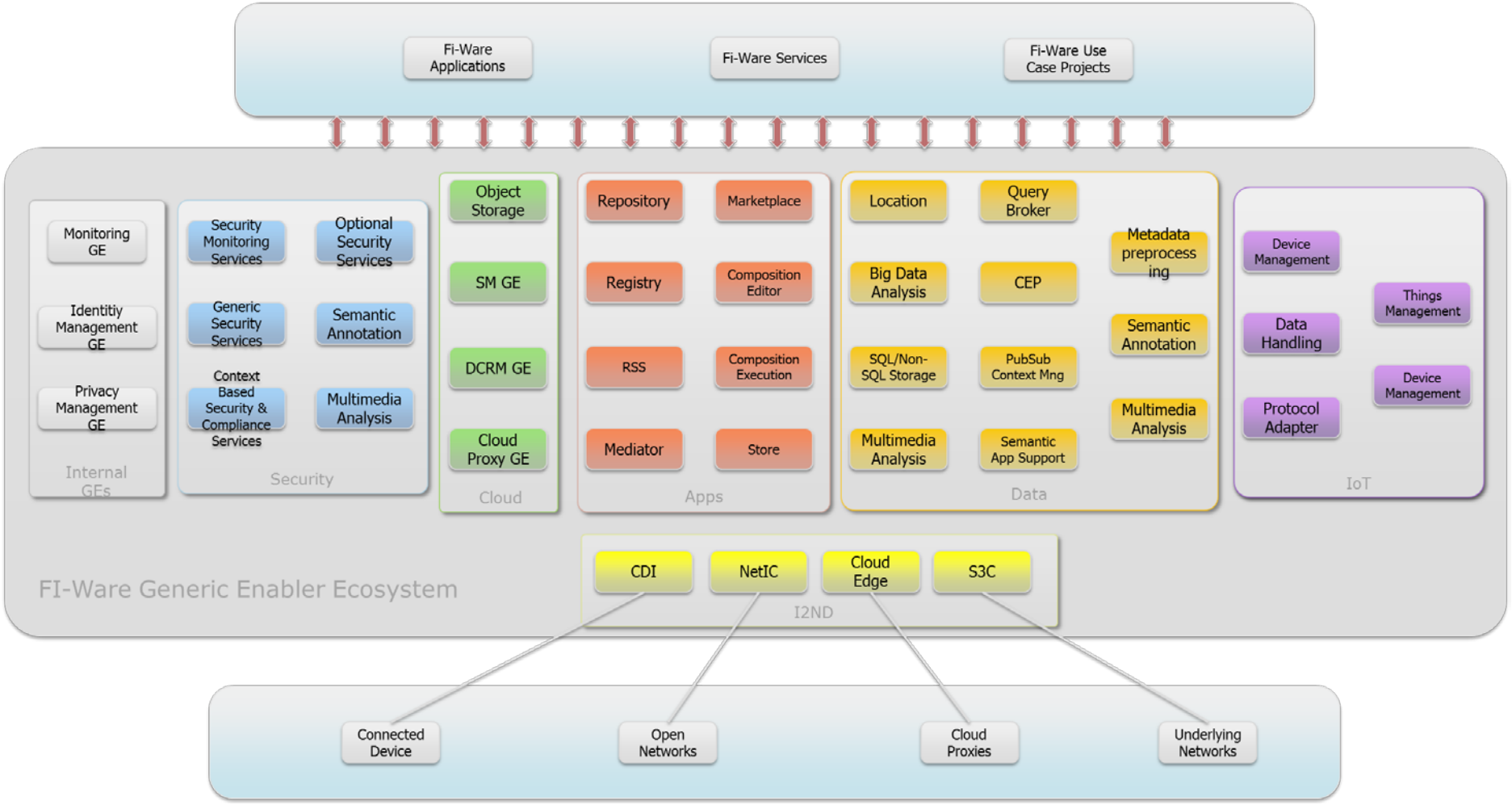
FI-PPP FI-WARE

FI PPP Key Platform Project makes use of OpenXXX Tools

- FI-WARE project is providing the design and the first prototypes of the European Future Internet
- Generic platform covers the following areas / topics (referred to “chapters”)
  - Data/Context Management
  - Internet of Things Service Enablement
  - Cloud Hosting
  - Security
  - Applications/Services Ecosystem and Delivery Framework
  - Interface to Networks and Devices
- FIWARE aims at
  - Identifying and defining generic enablers (GEs)
  - Providing an API specification for the GEs
  - Showing that GEs can be realized

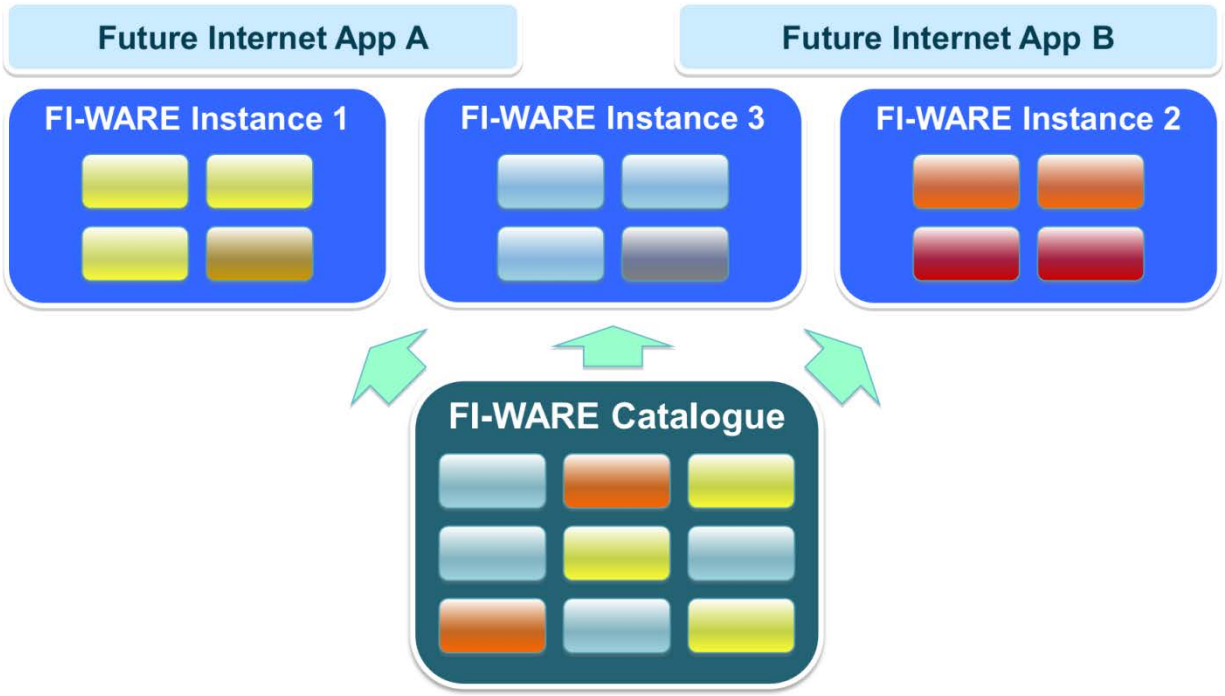


Generic Enabler Ecosystem



FI-Ware Catalogue

- Central repository for implementations of Generic Enablers (GEi's)



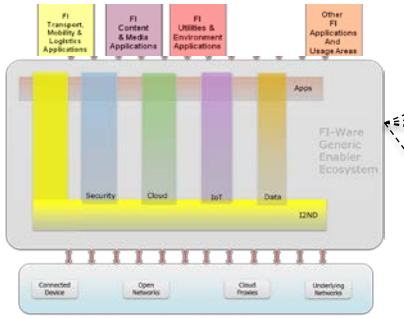
FI-Ware Test Bed
Open Innovation Lab (OIL)

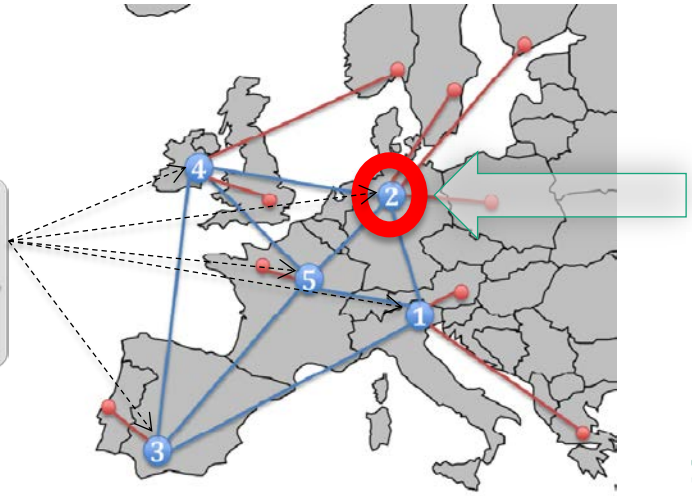
- Why?
  - Targeting business Future Internet Apps developers needs
- What?
  - Laboratory: a place where people meet and find all the technology and access to available data they need to implement their ideas
  - Innovation: making such ideas concrete and profitable by exercising them
  - Open: free access to third parties
- Where?
  - First step: Sevilla (extension of Fi-Ware Testbed)
  - Second step: use XiFi facilities (5 nodes and more in a close future)

FI-Ware Test Bed
Open Innovation Lab (OIL)

- The FI-WARE Open Innovation Lab will be a case example of a FI-WARE Instance:
  - Provides Cloud hosting capabilities so third parties can run experimental Future Internet Applications and test them
  - Incorporates a number of Generic Enablers “as a Service” exporting well-defined APIs
  - Will be operated under central control and be accessible from a dedicated website
- Developer contests during 2nd half of 2013 and beginning of 2014
- 100 M€ of funding for experimentation by developer SMEs in phase 3 of the FI-PPP

Evolution of Telecom Platforms towards the Future internet Deployments of the FI Core Platform across Europe for Large Scale Trials



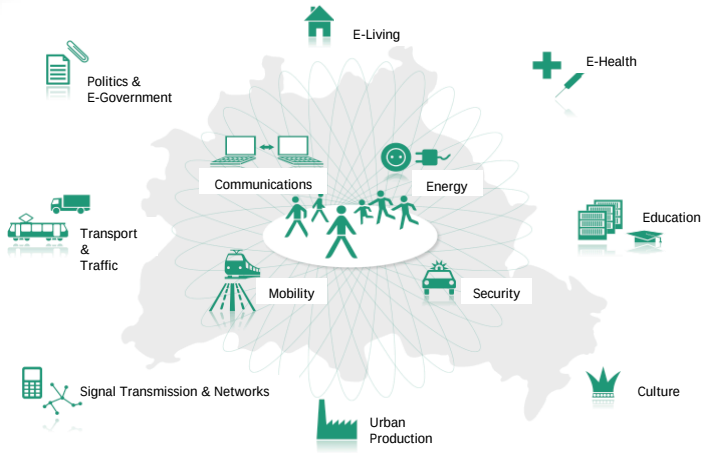


The German FI-PPP Node operated and enabled by

+

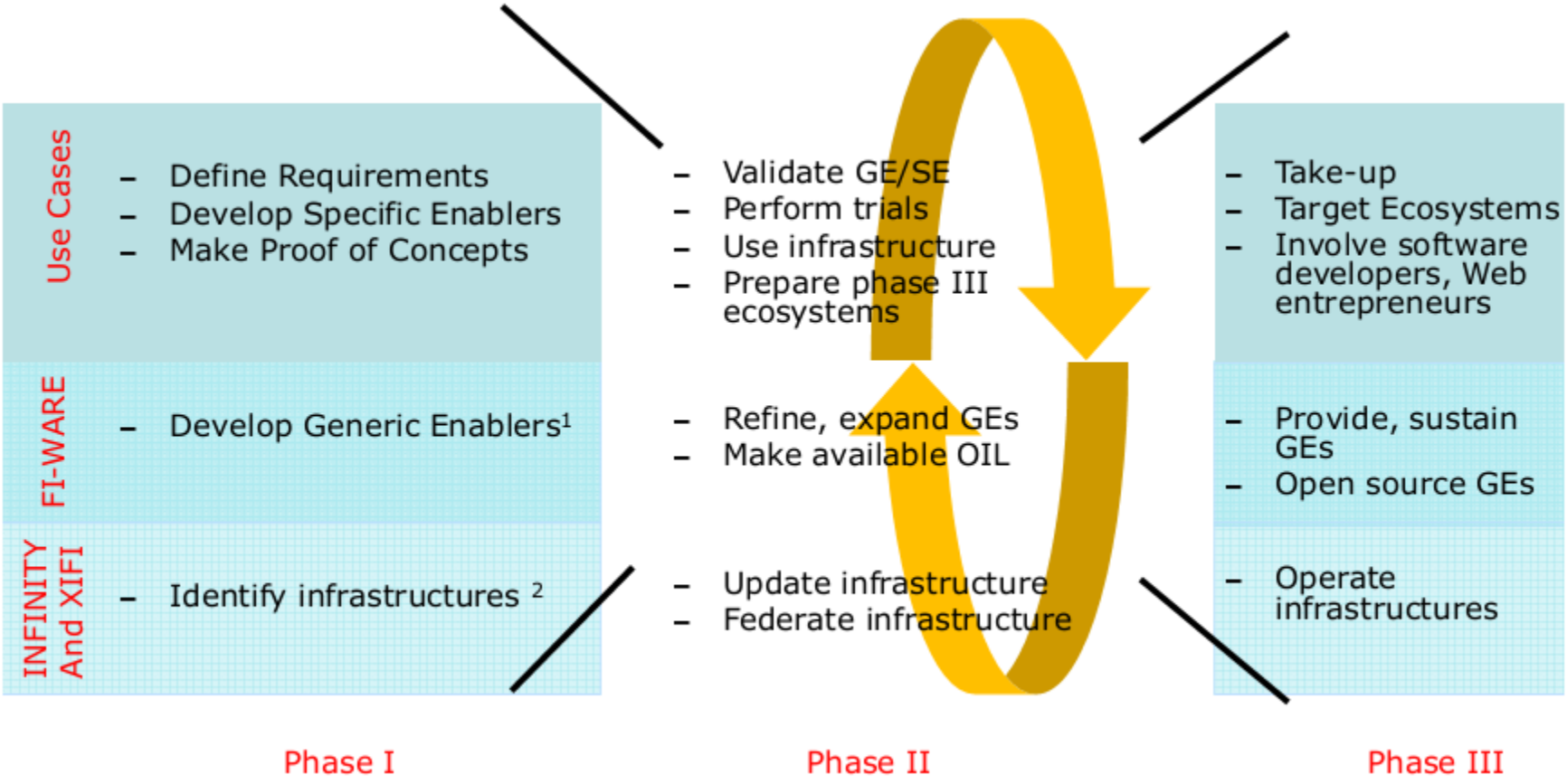
Fraunhofer FOKUS

will soon enable



not only in Berlin, but **across Europe!**

FI-PPP Projects and Phases

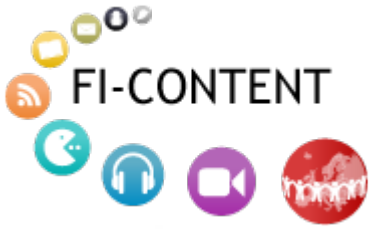


FI-Ware
FI-PPP Use Case Projects

- e-Health
  - FI-STAR (Phase 2)

- Transport, logistics and agri-food
  - FInest (Phase 1)
  - SmartAgriFood (Phase 1)
  - FIspace (Phase 2)

- Social connected TV, mobile city services, and video games
  - FI-CONTENT (Phase 1)
  - FI-CONTENT 2 (Phase 2)



FI-Ware
FI-PPP Use Case Projects

- Smart Cities and public security
  - SafeCity (Phase 1)
  - OUTSMART (Phase 1)
- Smart energy
  - FINSENY (Phase 1)
  - FINESCE (Phase 2)
- Manufacturing
  - FITMAN (Phase 2)
- Personal mobility
  - Instant Mobility (Phase 1)

FI-Ware

FI-PPP Use Case Projects Sites

FUTURE INTERNET
SOCIAL TECHNOLOGICAL ALIGNMENT in HEALTHCARE

www.fi-star.eu
www.fistarblog.com
@fistarproject
www.facebook.com/fistarproject

FI-STAR is a FP7 FI-PPP 2nd Phase user case trial project in the domain of e-Health. The project started in April 2013 and will run for 24 months.

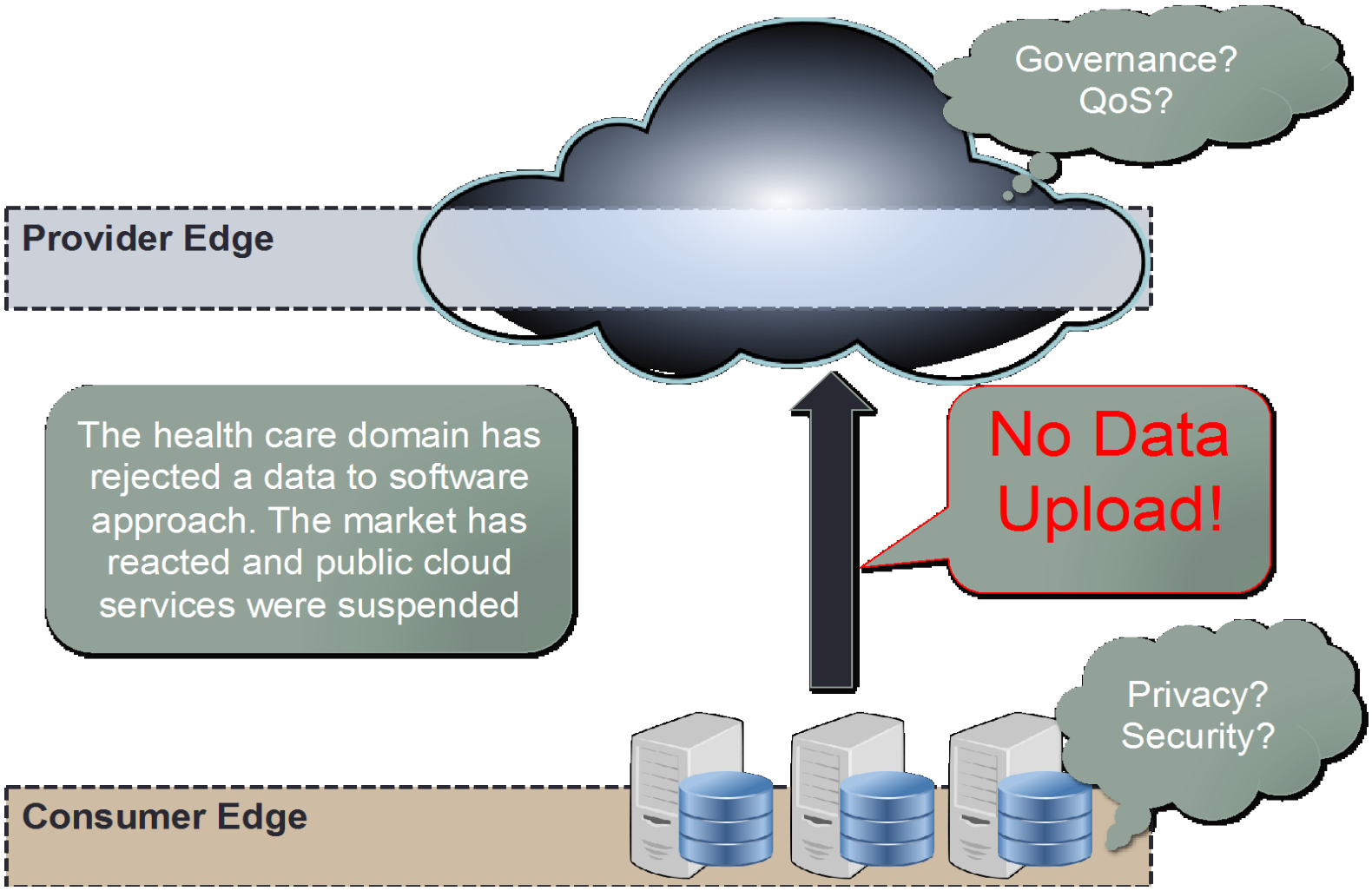
FI-STAR is establishing early trials in the health care domain, building on future internet technology, creating a robust framework based on a “software to data” paradigm.

FI-STAR proactively engages with FI-PPP to propose specifications and standards.

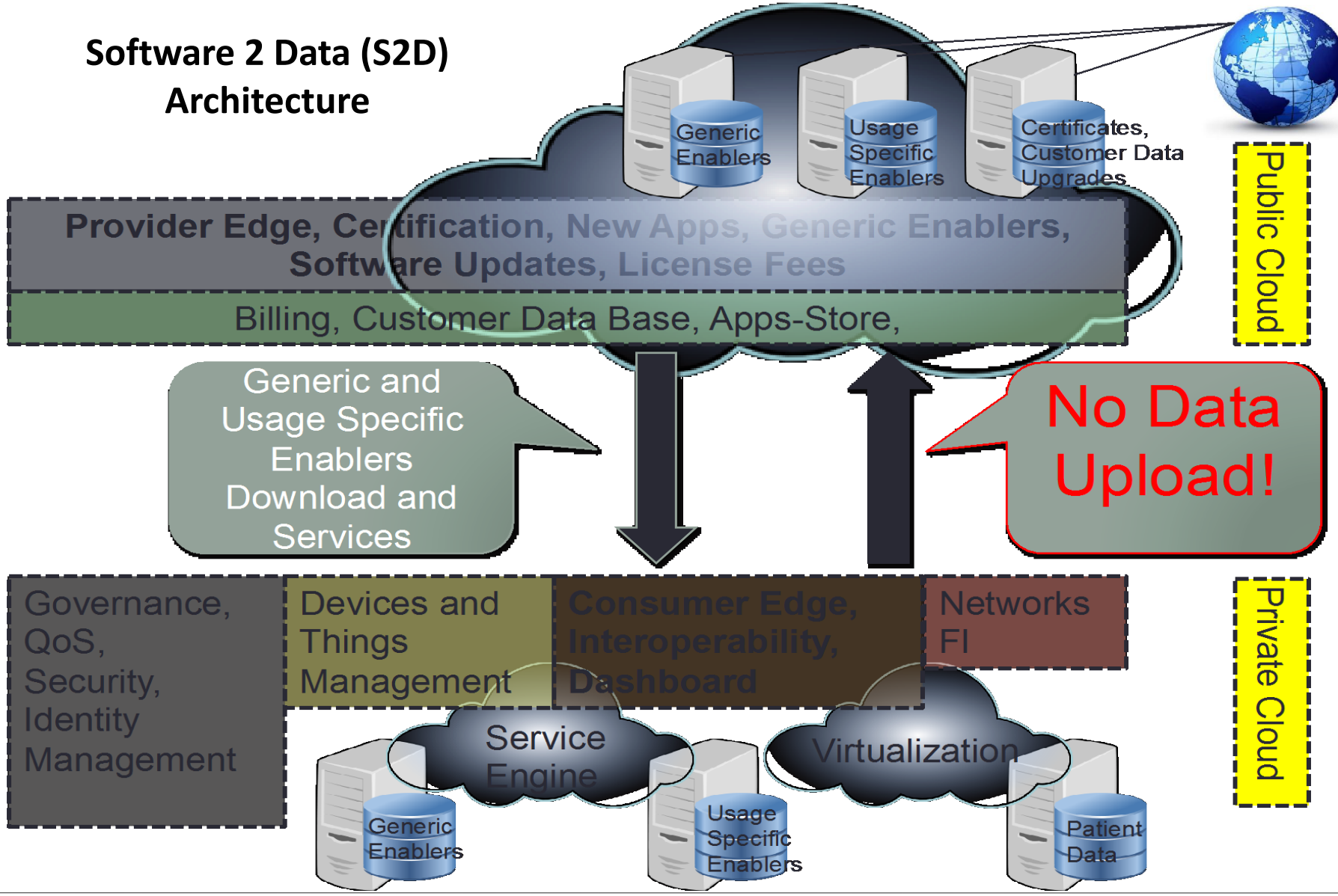
FI-STAR will use the latest digital technologies to build communities made up of developers and users.

FI-STAR will generate new business development and prepare for new partners through open calls.

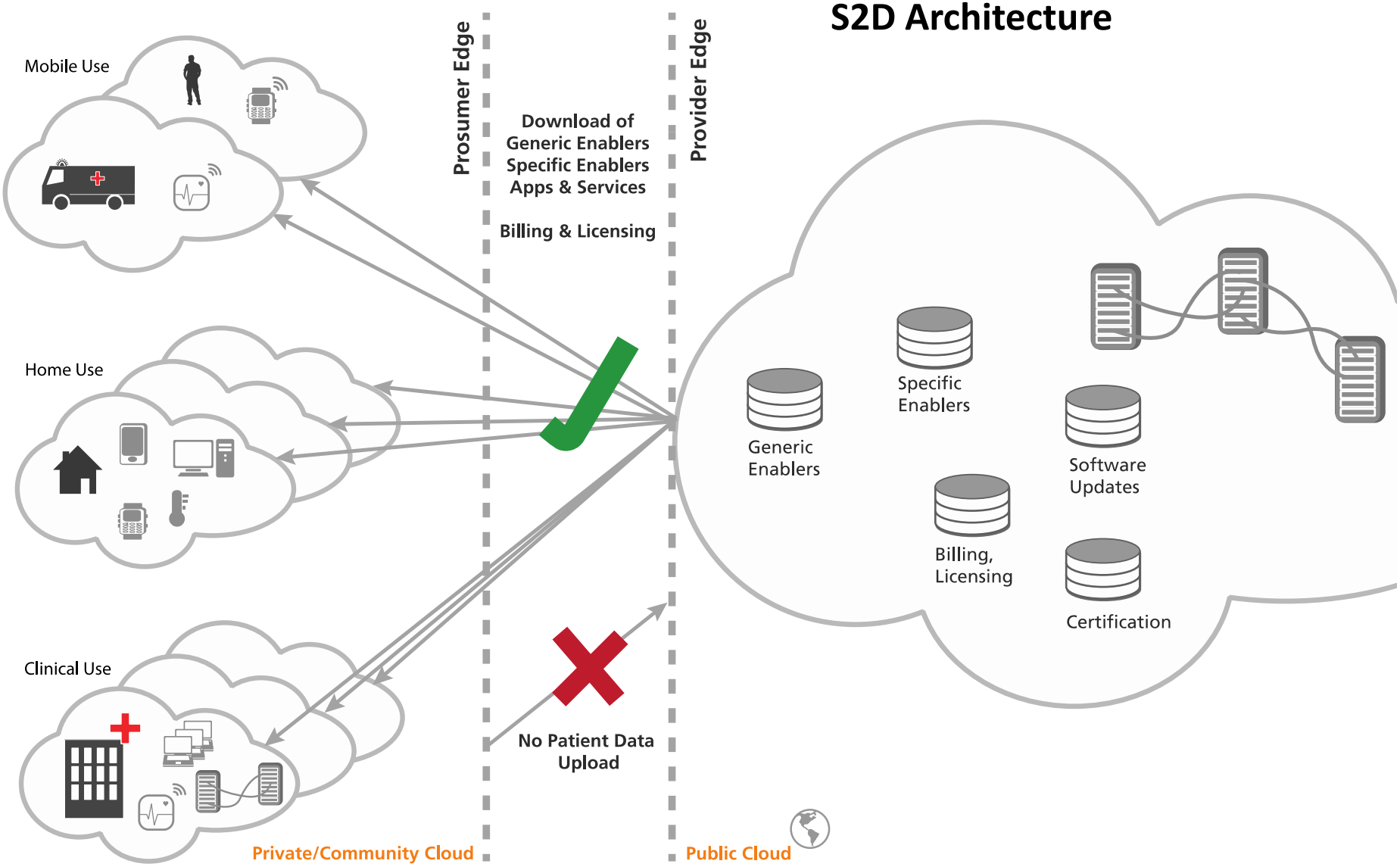
Data to Software



Software 2 Data (S2D) Architecture



S2D Architecture



FUTURE INTERNET
SOCIAL TECHNOLOGICAL ALIGNMENT in HEALTHCARE

www.fi-star.eu
www.fistarblog.com
@fistarproject
www.facebook.com/fistarproject

FI-STAR will execute seven early trials across Europe. Trials will validate the FI-PPP core platform and will introduce ultra-light interactive applications for user functionality.

Osakidetza, in Bilbao, Spain.
Developing Interactive Future Internet based services for people with Mental Health problems. Improve access to care and apply Core Platform to other already existing services successively.

Medichem, in Leeds, UK.
To implement the 2-D Pharmacy bar-coding, offering a real time reverse supply chain model to prevent error and counterfeiting and create interfaces to additional third part services.

CUP 2000, in Bologna, Italy.
Developing healthcare networks to allow healthcare professionals to share data in real-time, allowing citizens to access healthcare data anytime, anywhere.

FUTURE INTERNET
SOCIAL TECHNOLOGICAL ALIGNMENT in HEALTHCARE

www.fi-star.eu
www.fistarblog.com
@fistarproject
www.facebook.com/fistarproject

Norwegian Centre for Integrated Care and Telemedicine in Tromsø, Norway.
To improve the existing telehealth network for Diabetes patients, aiming at the development of smart phone based multi-channeling, allowing for streaming of different data at the same time (sensor data and audio and video)

University of Medicine and Pharmacy Carol Davila in Bucharest, Romania.
Online Cardiology service for people with heart failure by testing software, applications and internet-monitoring. Improvement of physical training and also the improvement in secondary prevention programs.

John Paul II Hospital, in Krakow, Poland.
Designing interactive facilities for cancer patients, using life monitoring sensors, tablets, cameras, web based, treatment diary, mobile and video conferencing client.

Klinikum Rechts der Isar, Technical University, in Munich, Germany.
Implementation of the virtualization of operating theatres to develop methodologies for minimal invasive operating theatre environments with real time data integration for monitoring, to reduce error rates.

FI-Ware
Capacity Building and Infrastructures FI-PPP Projects

FUTURE INTERNET PPP

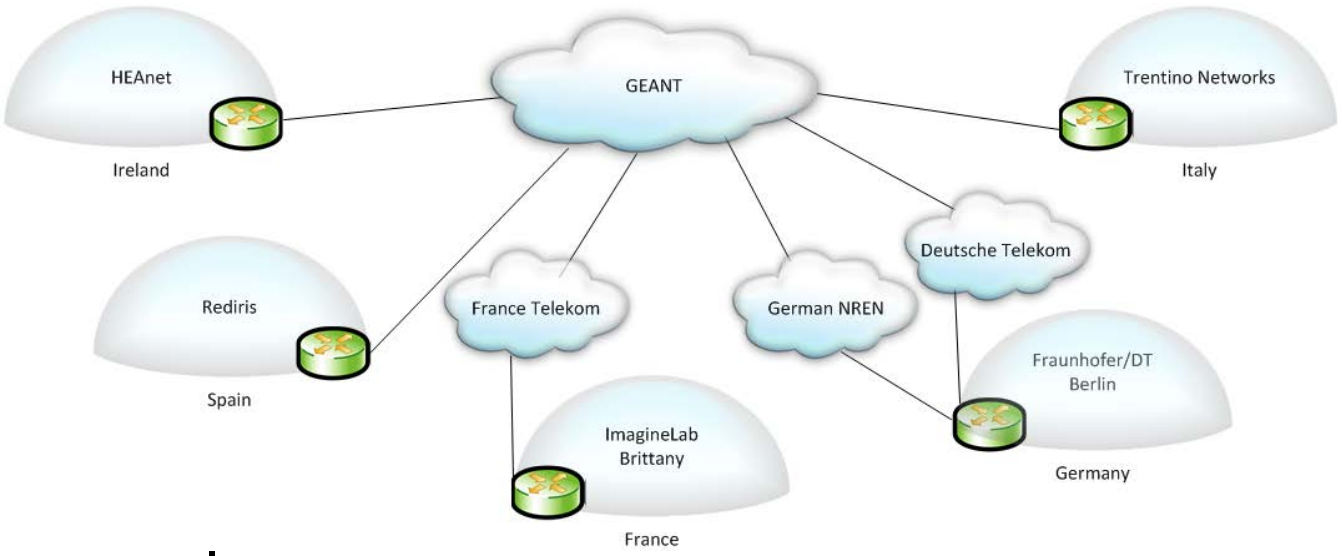
XIFI

- Support advanced experiments on the FI-PPP core platform in order to leverage existing public investments in advanced infrastructures
- Establishes a marketplace for test infrastructures and Future Internet services to cope with large trial deployments involving users
- Core federation of test infrastructures, and by coordinating efforts with ongoing FI infrastructures and pilots (FIRE, EIT ICT Labs, CIP pilots, Living Labs) assisted by investments in pan-European infrastructures such as GÉANT

XIFI Fraunhofer FOKUS TU Berlin

FI-Ware

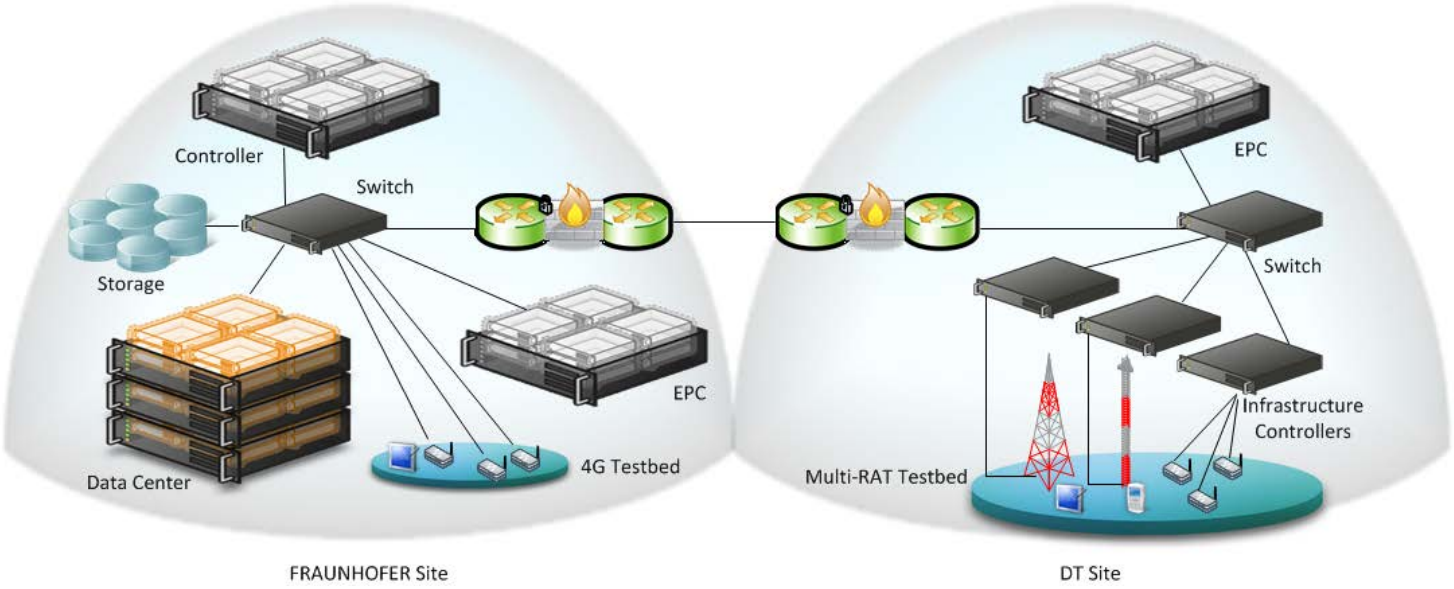
Capacity Building and Infrastructures FI-PPP Projects



XIFI Approach

- Provision of Generic Enablers developed in FI-WARE through high-available and reliable federation of infrastructures.
- Set up of Initial Federation of 5 Nodes in Europe (Berlin, Brittany, Seville, Trento, Waterford)
- Procedures and lifecycle support for FI components on the federated platform
- Processes and Tools for the Deployment of new nodes in the federation
- Open Call to FI-PPP Phase 2 Use Case Projects to use XIFI infrastructure for experimentation

FI-Ware
Capacity Building and Infrastructures FI-PPP Projects



FOKUS Main Contribution to Xifi

- Joint deployment, operation and maintenance of the German Xifi Node in collaboration with Deutsche Telekom
- Offering test platform for experiments in a mobile multi-RAT environment
- Support for Experiment Life Cycle Management and Monitoring

FI-Ware

Capacity Building and Infrastructures FI-PPP Projects

The INFINITY Project

– Objectives:

To facilitate communication and collaboration between future internet infrastructure owners across Europe and organisations developing future internet applications in order to 1) position Europe at the centre of the future of the Internet 2) directly support experimentation for FI-PPP projects and investors 3) accelerate the development and uptake of social and commercial solutions that will provide benefit to the citizens, businesses and governments of Europe

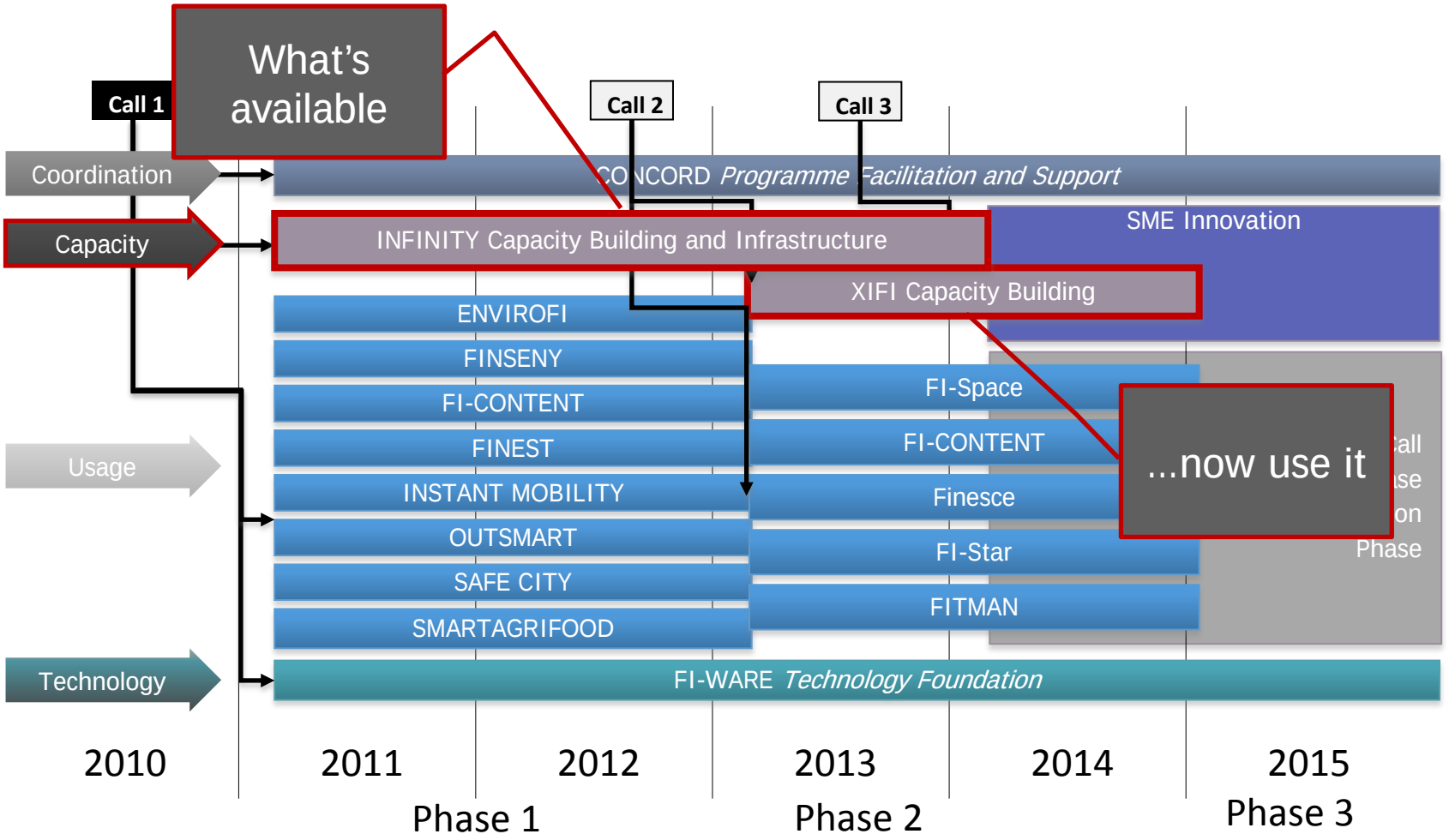
– Main Delivery:

- a new, useful and valuable repository of infrastructure capability and capacity that
  - relates the infrastructure demand to available offerings
  - facilitates the creation of an international community that can collaborate to deliver the Future Internet

Having in-depth knowledge about the FI-PPP Core Platform as well as Usage Areas, NGNI contributes to INFINITY's methodology, infrastructure requirement analysis, infrastructure profiling and detection of interoperability constraints.

FI-Ware

Capacity Building and Infrastructures FI-PPP Projects Infinity & XiFi



FI-Ware On The Web

- Official project website:
  http://www.fi-ware.eu

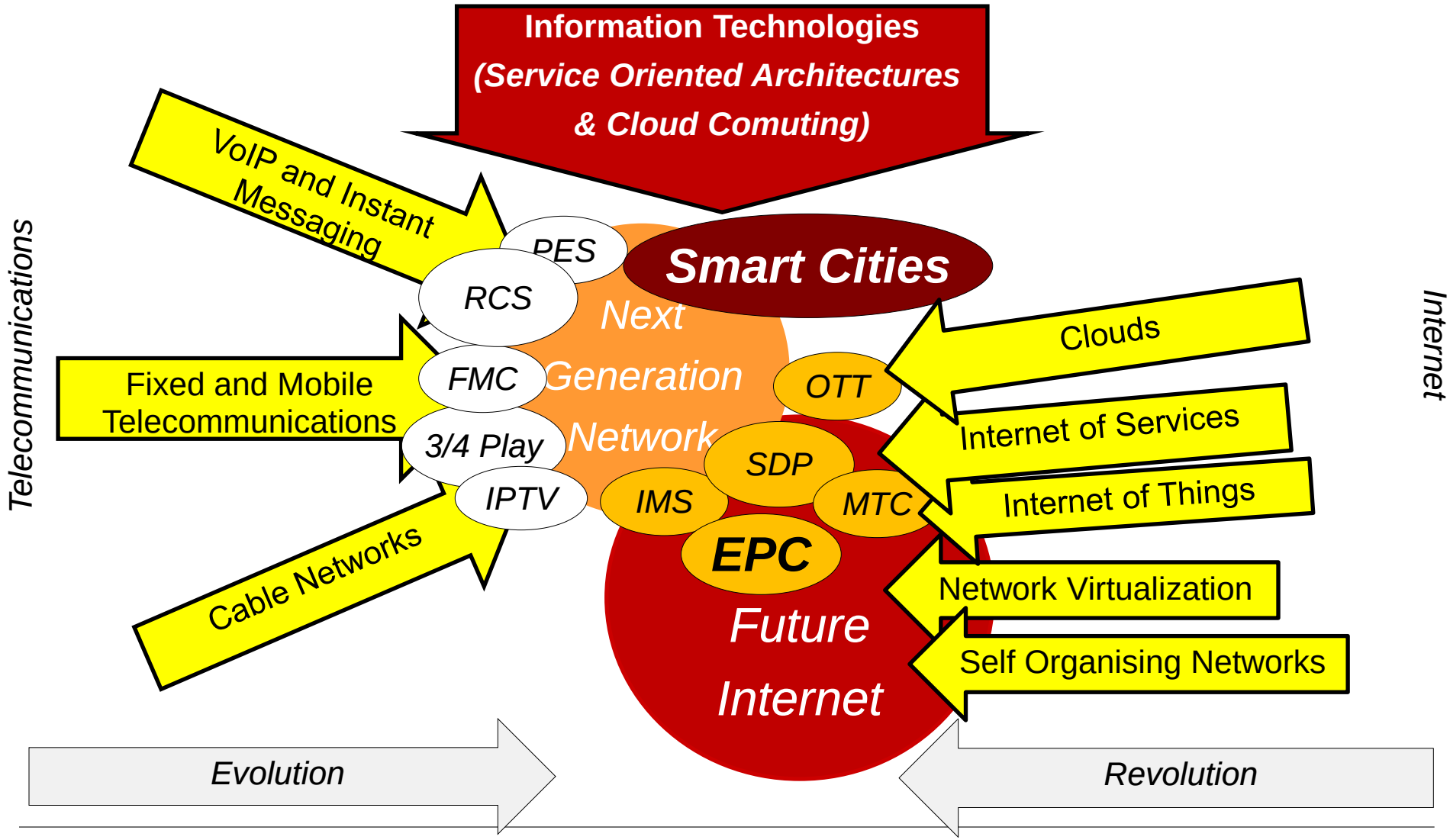
- Project information portal:
  http://forge.fi-ware.eu/plugins/mediawiki/wiki/fiware/index.php

- Architecture descriptions:
  - IoT Chapter:
    http://forge.fi-ware.eu/plugins/mediawiki/wiki/fiware/index.php/Interface_to_Networks_and_Devices_(I2ND)_Architecture
  - Security Chapter
    http://forge.fi-ware.eu/plugins/mediawiki/wiki/fiware/index.php/Security_Architecture
  - App Chapter
    http://forge.fi-ware.eu/plugins/mediawiki/wiki/fiware/index.php/Architecture_of_Applications_and_Services_Ecosystem_and_Delivery_Framework
  - Cloud Chapter
    http://forge.fiware.eu/plugins/mediawiki/wiki/fiware/index.php/Cloud_Hosting_Architecture
  - I2ND Chapter
    http://forge.fi-ware.eu/plugins/mediawiki/wiki/fiware/index.php/Interface_to_Networks_and_Devices_(I2ND)_Architecture
  - Data Chapter:
    http://forge.fi-ware.eu/plugins/mediawiki/wiki/fiware/index.php/Data/Context_Management_Architecture

Agenda

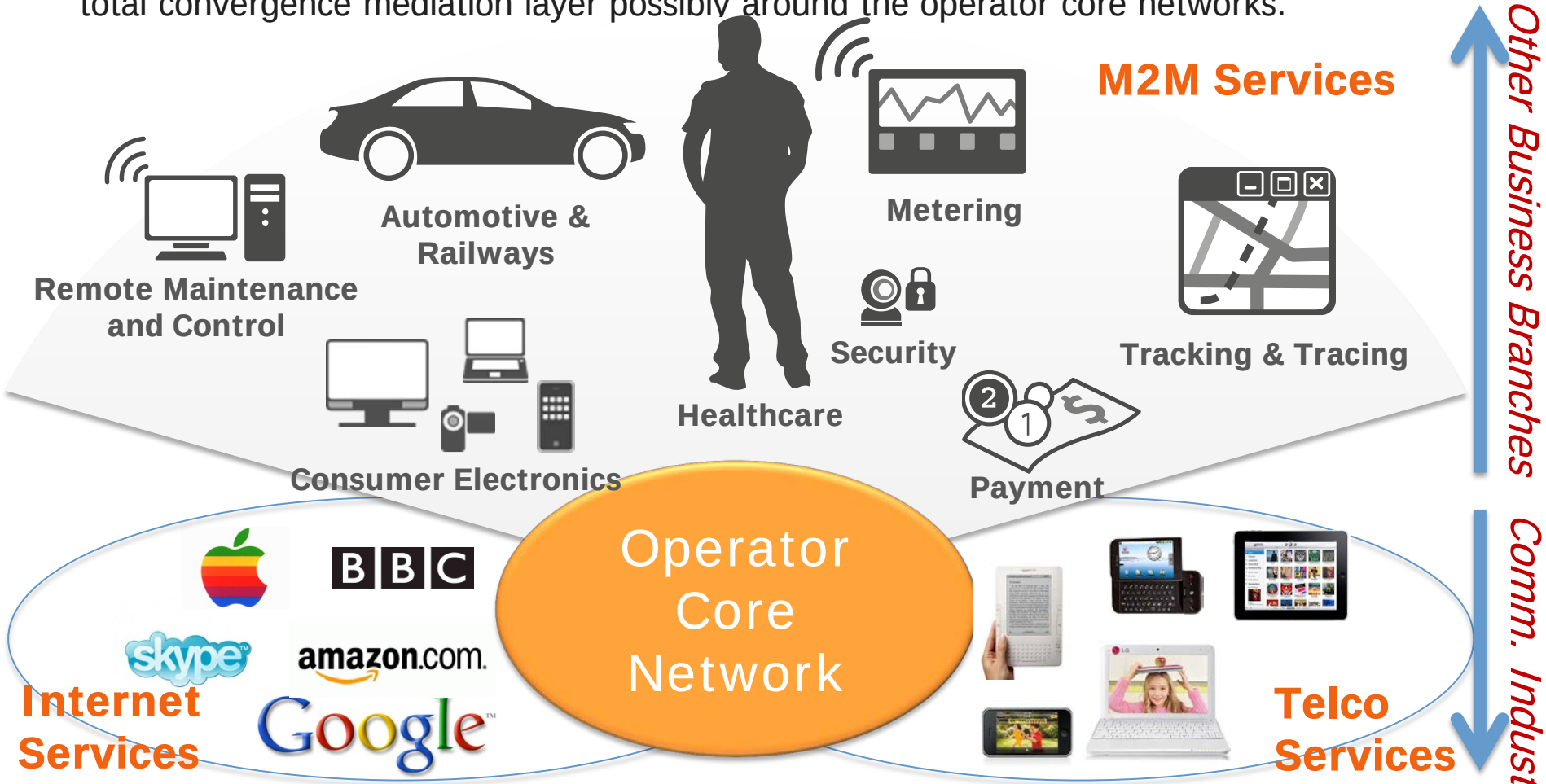
- Smart Cities as Future Internet Show Case
- Smart City communication infrastructures requirements
- The Role of IP Multimedia Subsystem, Machine Type Communication, Evolved Packet Core and related Open APIs within emerging Smart City SDPs
- FOKUS Toolkits and practical examples
- Summary
- *Q&A*

NGN2FI Evolution is a Challenge



Total Convergence of Communication

The telecommunication industry and other business branches are currently merging into a total convergence mediation layer possibly around the operator core networks.



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**

UNIFI Mission

- **UNIFI** – **UNI**versities for **F**uture **I**nternet
- **UNIFI** is an initiative of the Chair of **Next Generation Networks (AV) at the Technische Universität Berlin** aiming at building sustainable teaching and research infrastructures in the areas of Future Internet through global collaboration among academic institutions.
- The initiative intends to reach its goals via enablement and empowerment of all stakeholders of academia:
- the creation and development of high quality curricula, integration and exchange of teaching personnel, students, postgraduates and researchers among the partner universities
- the creation of Competence Centers for a sustainable development and bundling of local expertise
- the creation and development of an open, general purpose, and sustainable large-scale shared Next Generation Networks Infrastructures & Future Internet Technology Experimentation and Research Facility via federation of interoperable local testbeds.
- the creation and operation of an International Multilateral Academic Network as a communication hub and motor for intercultural understanding in the in[illegible]al EI academic comm

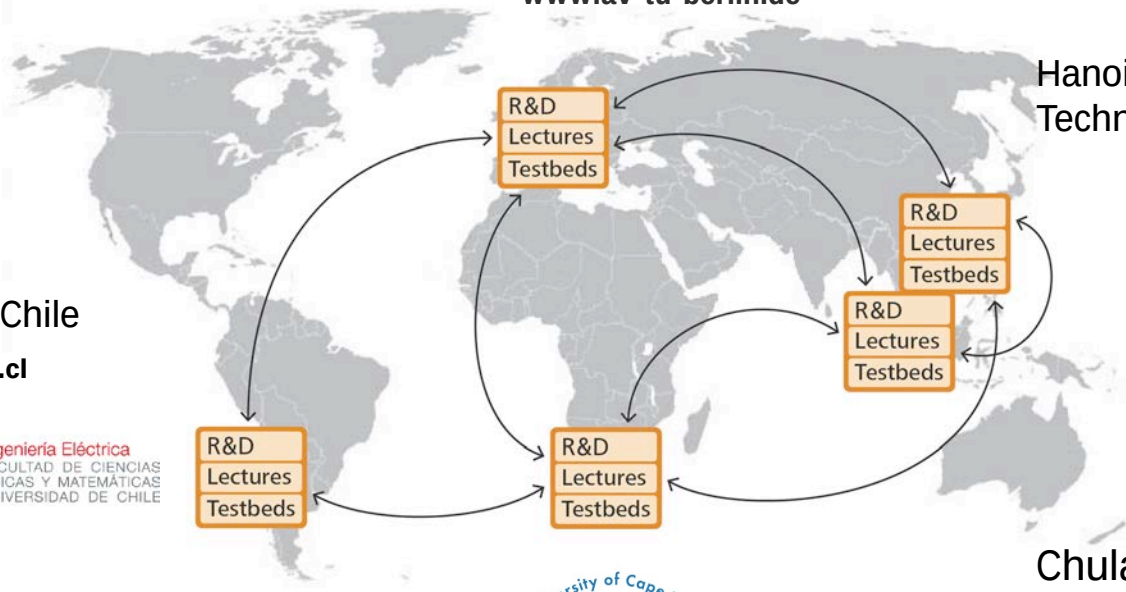
DAAD Project University Future Internet

Unifying Education and Testbeds around the Globe

DAAD unifi University Future Internet

AV Next Generation Networks

www.av-tu-berlin.de



Hanoi University of Science and Technology

en.hustech.edu.vn

Universidad de Chile

www.uchile.cl

fcfm Ingeniería Eléctrica FACULTAD DE CIENCIAS FÍSICAS Y MATEMÁTICAS UNIVERSIDAD DE CHILE

Chulalongkorn University

www.chula.ac.th

University of Cape Town

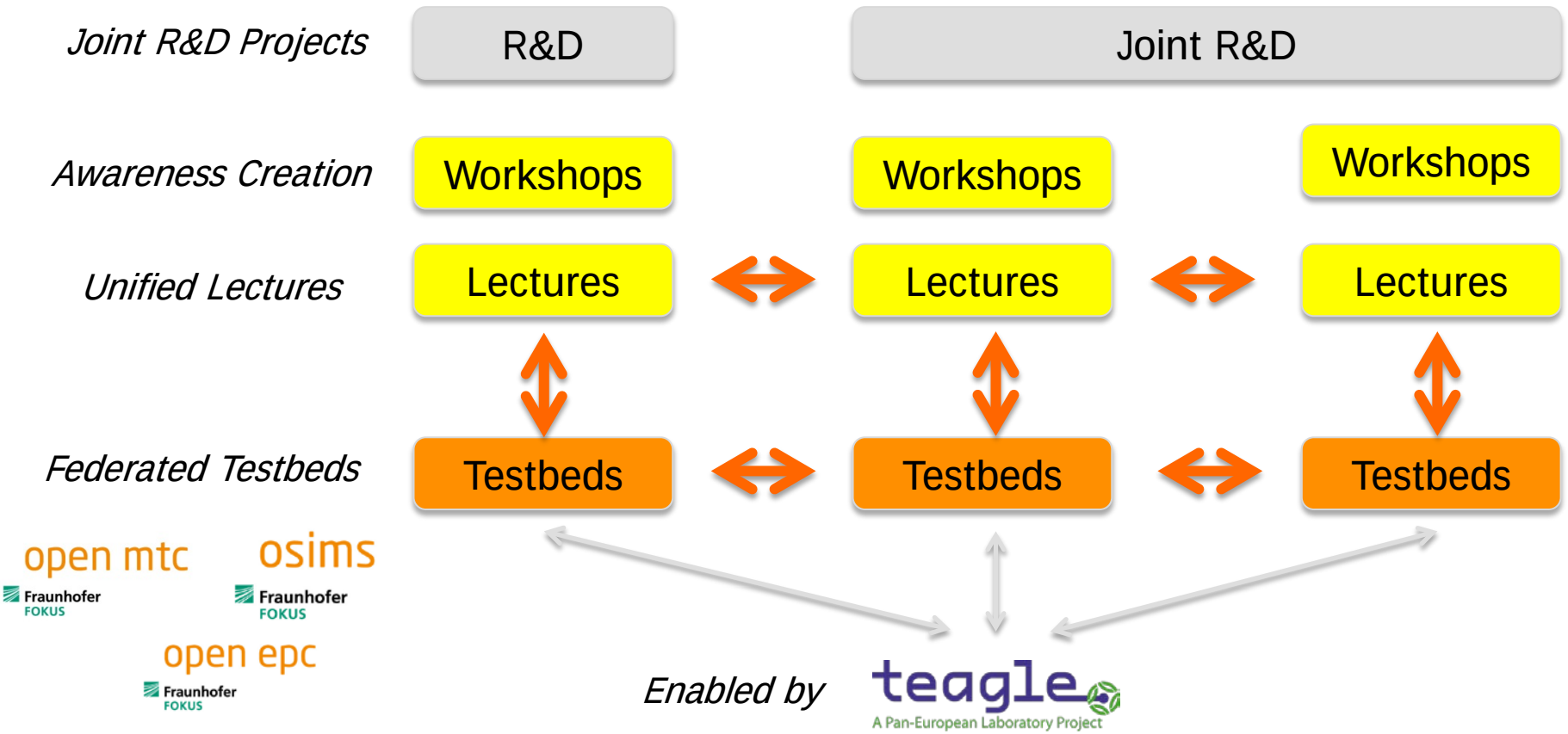
www.uct.ac.za

Enabled by teagle A Pan-European Laboratory Project

DAAD Project University Future Internet

Unifying Education and Testbeds around the Globe

DAAD unifi University Future Internet



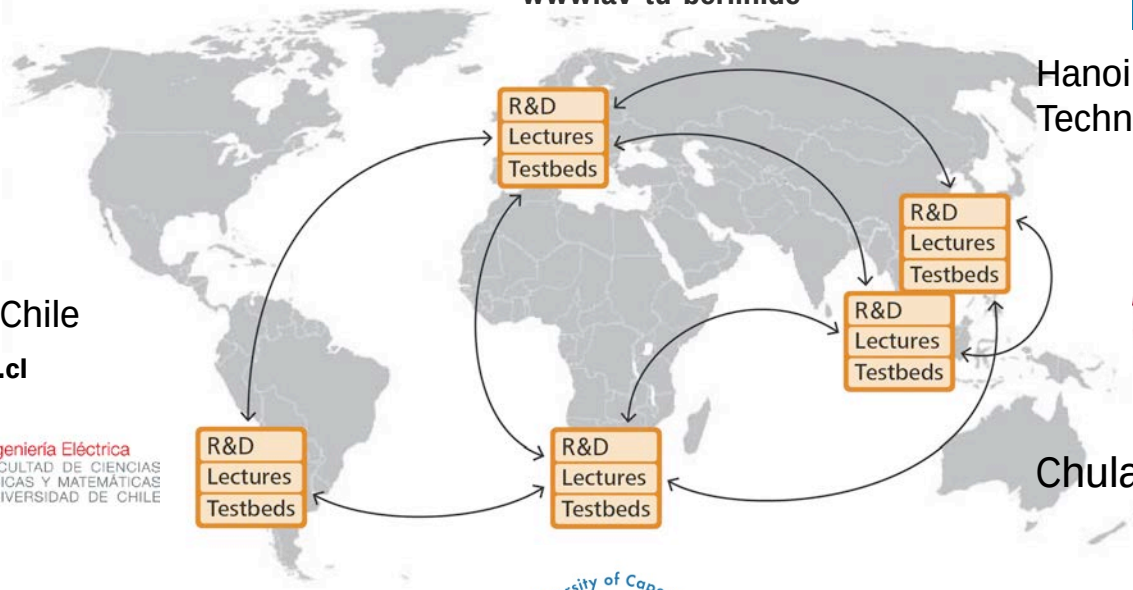
IT Telkom as Partner in DAAD UNIFI

Unifying Education and Testbeds around the Globe

DAAD unifi University Future Internet

AV Next Generation Networks

www.av-tu-berlin.de



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Chulalongkorn University

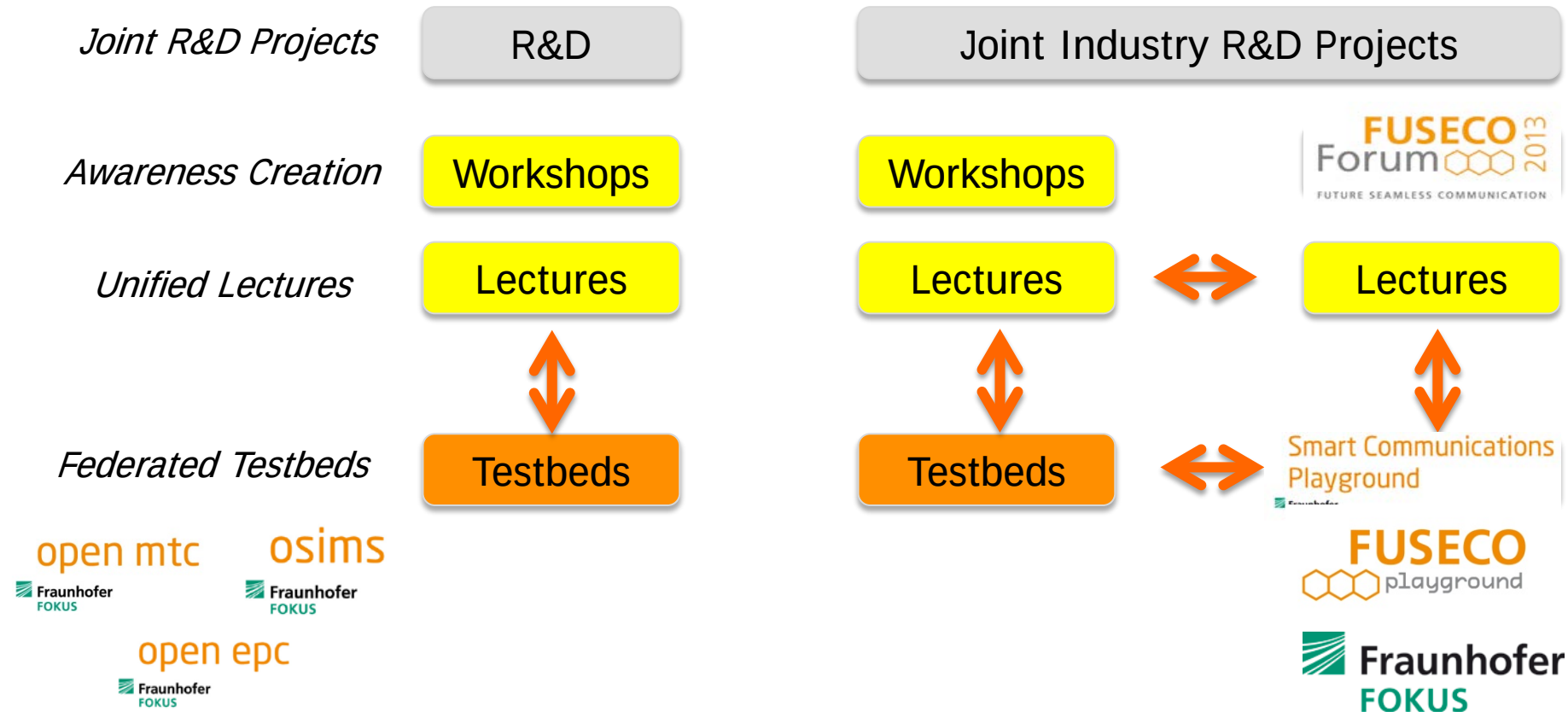
www.chula.ac.th

University of Cape Town

www.uct.ac.za

Beyond DAAD UNIFI

Unifying Testbeds and Education for Local Industry



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

EURESCOM — Project Management.

Technische Universität Berlin — OpenMTC developments. Testbed interconnection.

Fraunhofer FOKUS — OpenMTC developments.

AirBase — Smart device developments. Testbed setup.

i2cat Fundació — Experimentation and evaluation.

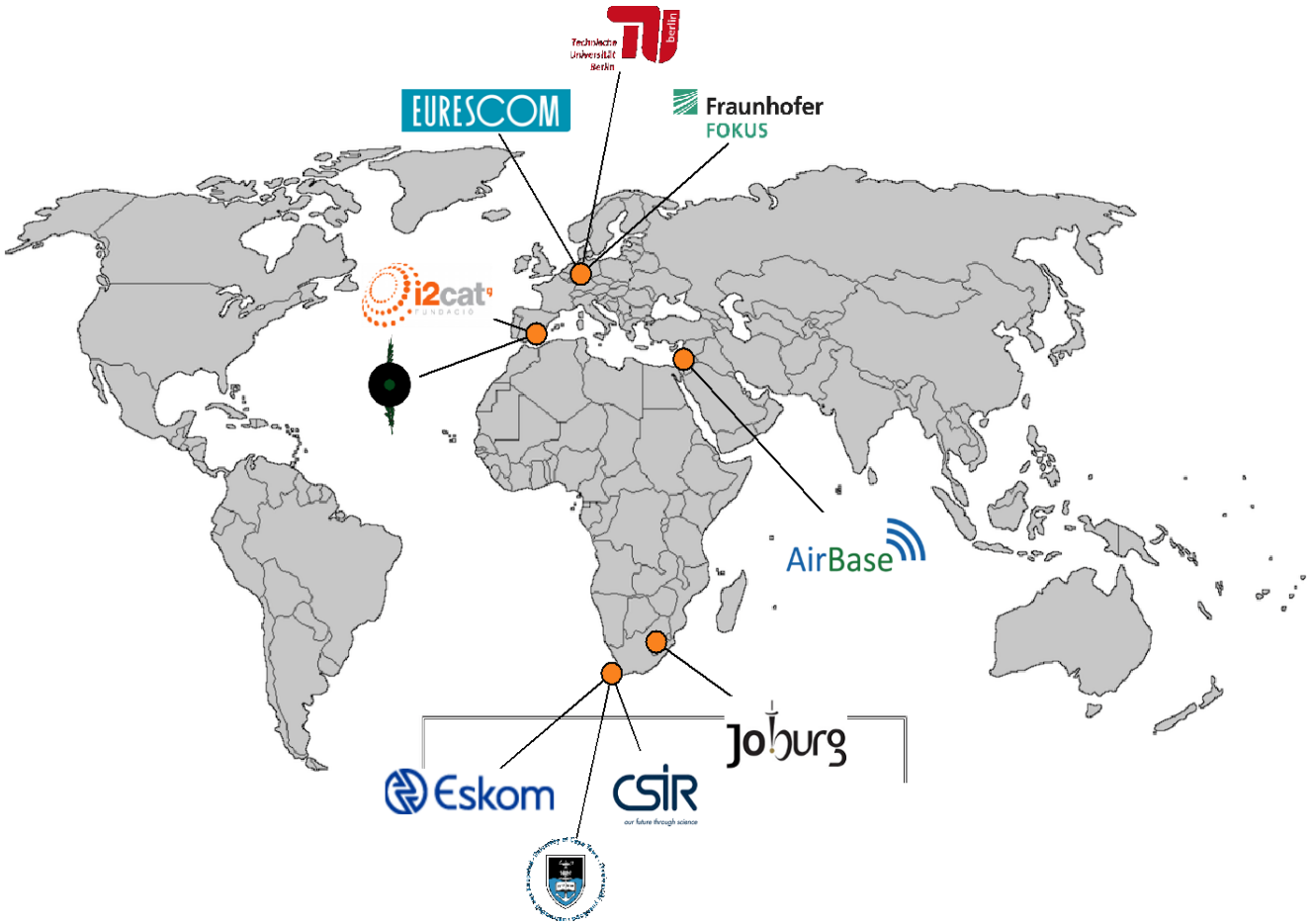
Scenarios and requirements. Smart City platform developments. — CSIR our future through science

Testbed setup. — University of Cape Town · iYunivesithi yaseKapa · Universiteit van Kaapstad

Smart device developments. Testbed setup. — Eskom

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

Approach | Collaboration between Europe and South Africa



Agenda

- Smart Cities as Future Internet Show Case
- Smart City communication infrastructures requirements
- *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
- *Q&A*

Fraunhofer FOKUS

Smart City ICT
Tools & Testbeds

Questions

Fraunhofer SMART CITIES