Half Day Tutorial at National Research Council of Thailand (NRCT) Annual Meeting,
Bangkok, Thailand, August 26, 2013

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

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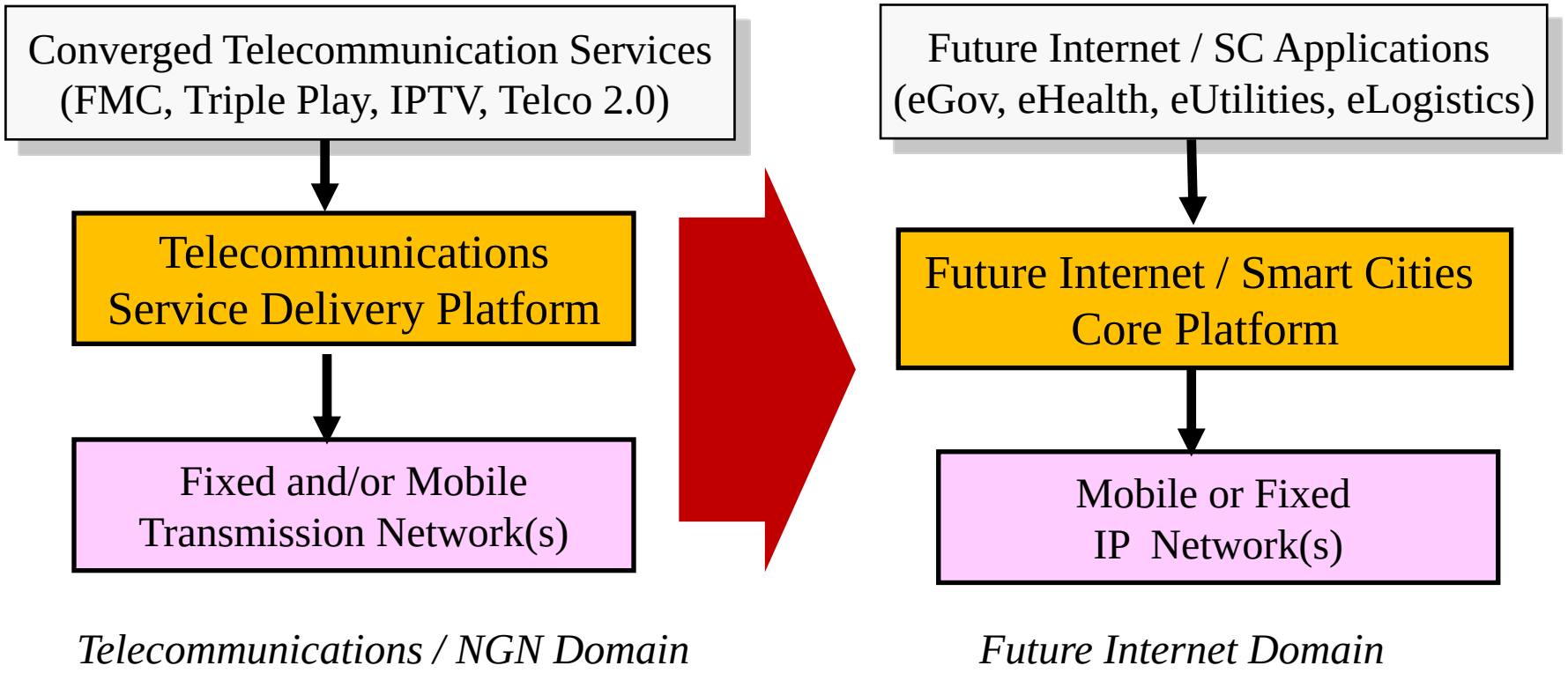
DAAD unifi University Future Internet

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*

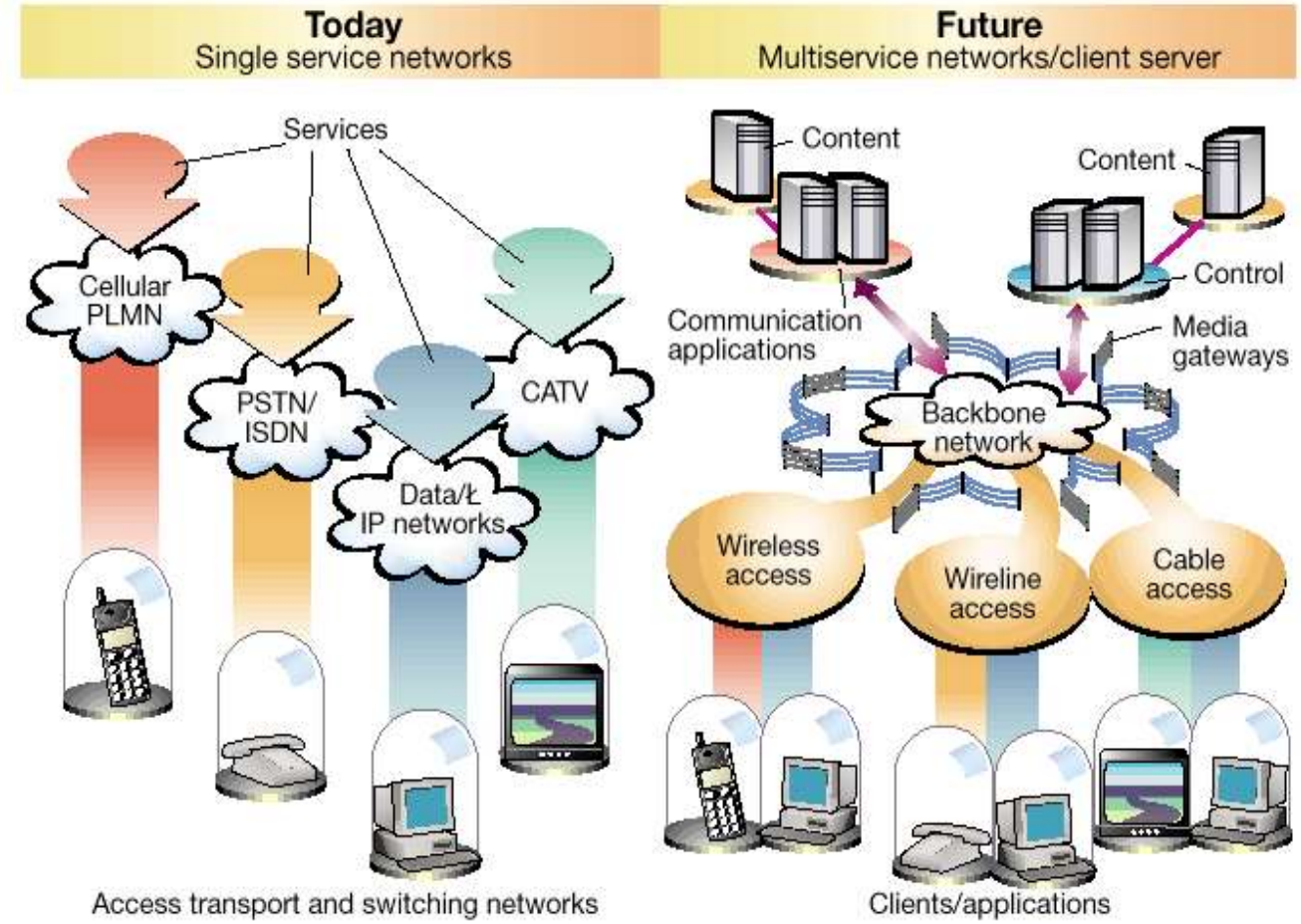
A déjà vu - From NGN towards SDPs for Future Internet / Smart Cities

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



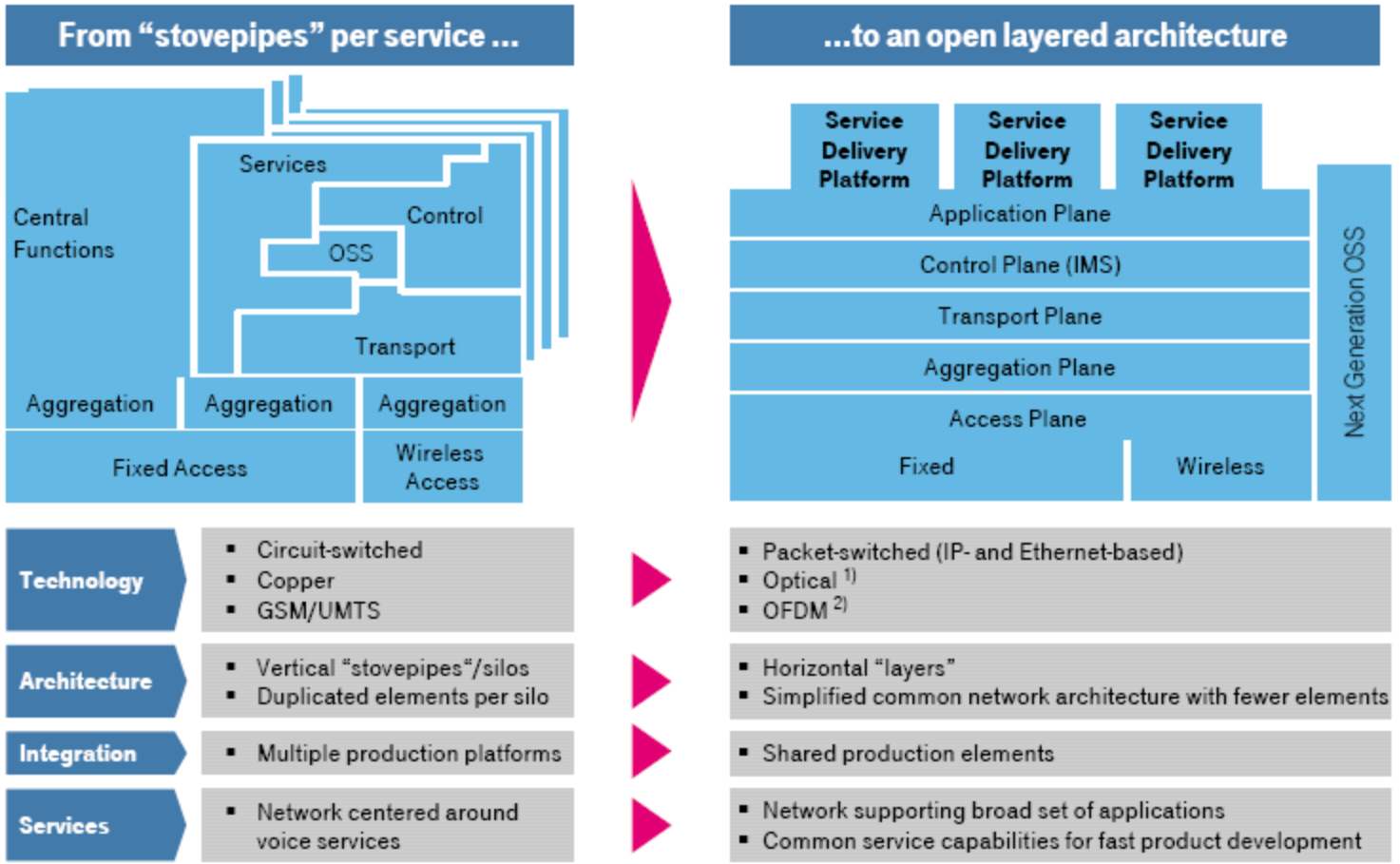
From specific to unified next generation Multi-Service networks

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 ...

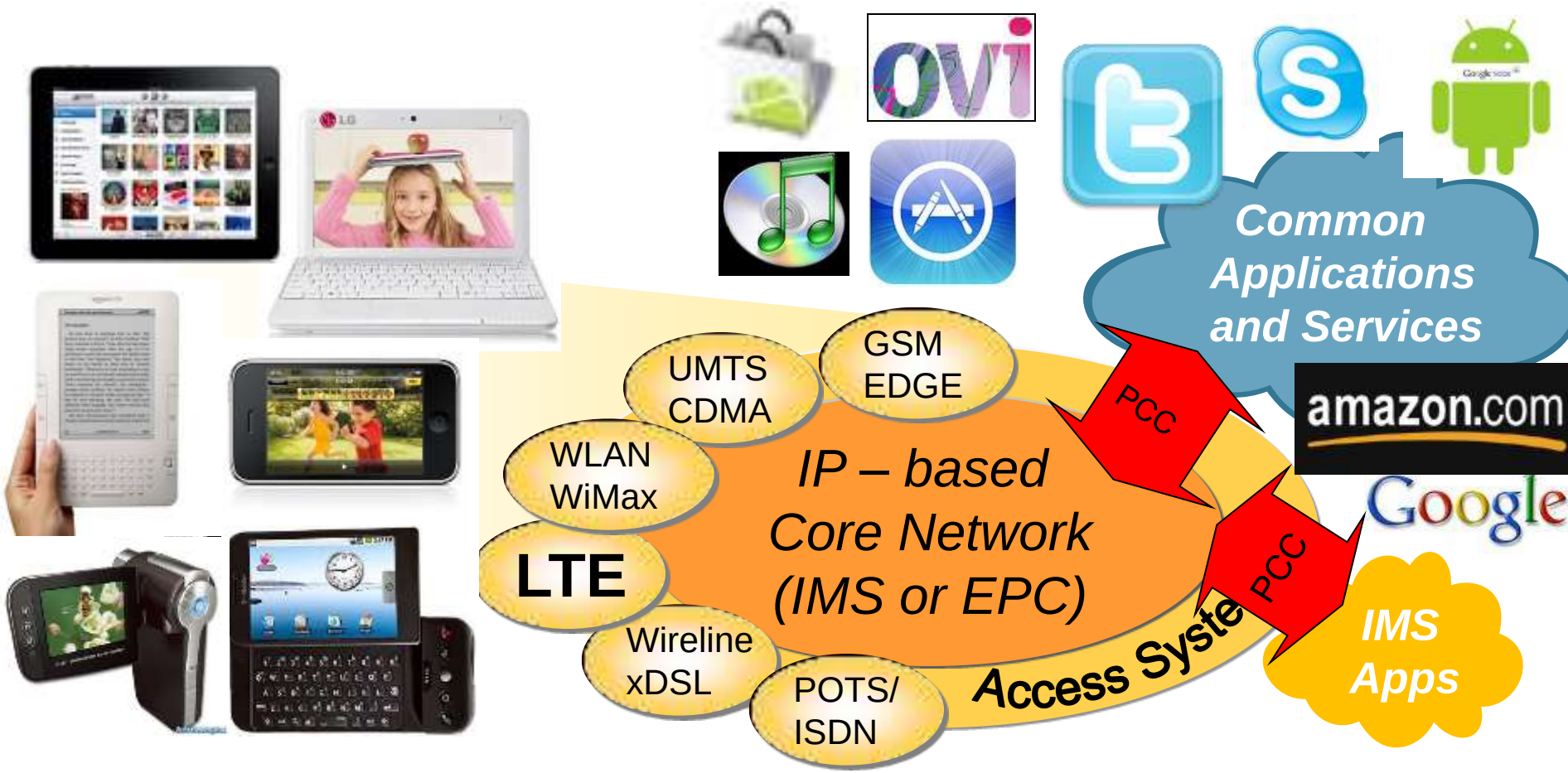


1) Optical and copper in last mile 2) OFDM = Orthogonal Frequency Division Multiplexing

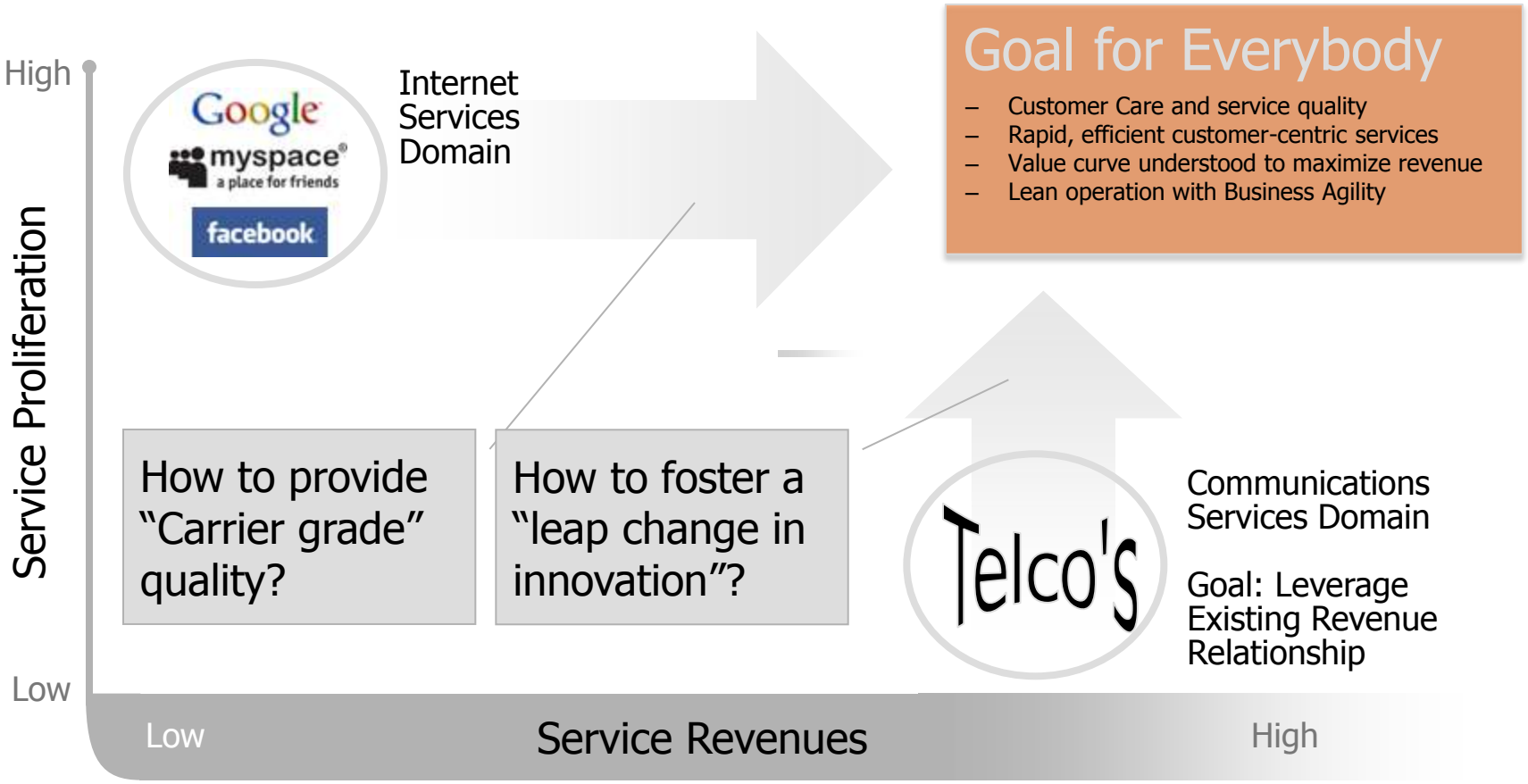
Source DTAG

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

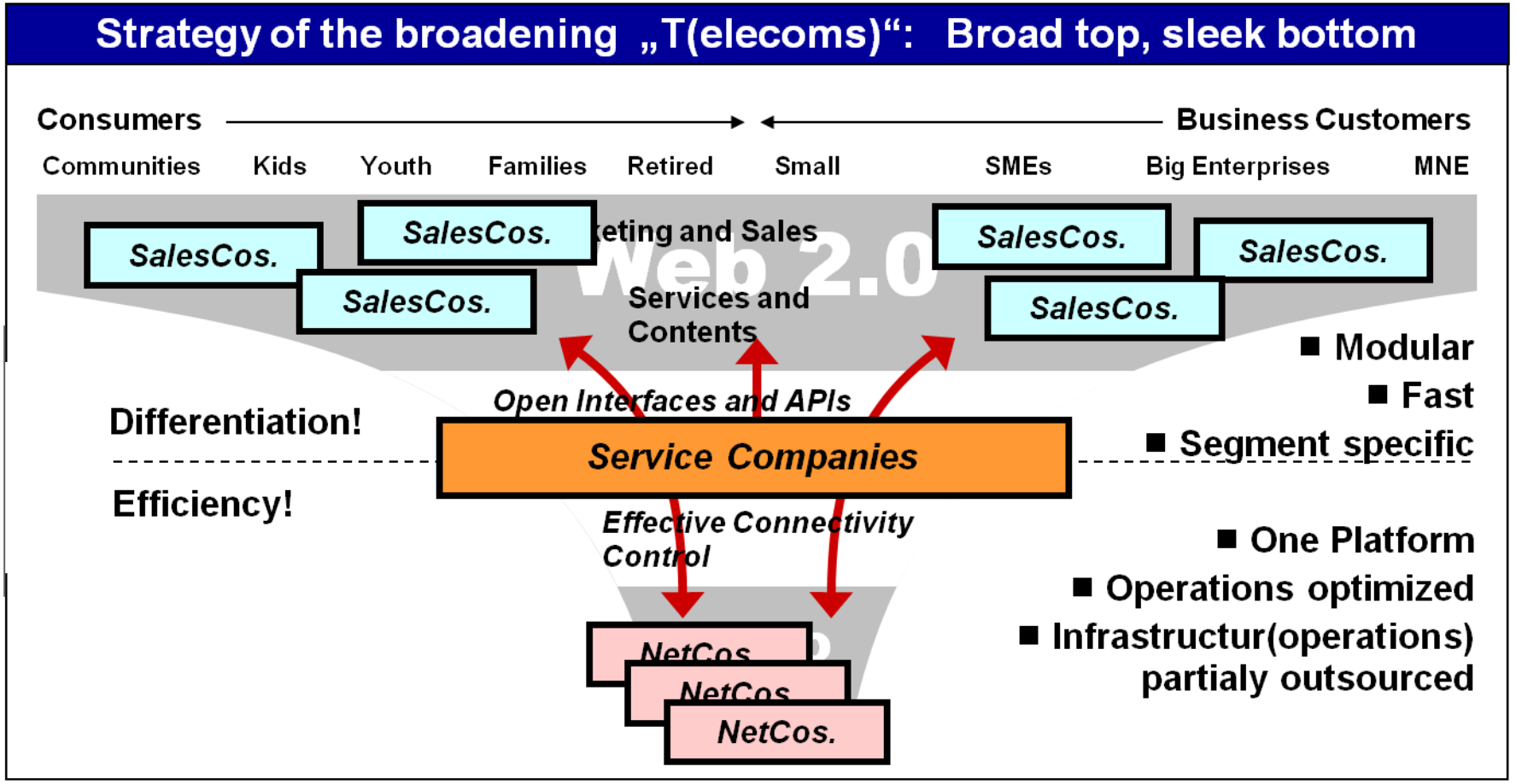
- Communications (Voice/Messaging) vs. Connectivity Services (QoS) versus Multimedia Content (Games, Videos, eBooks, Clouds, etc.)



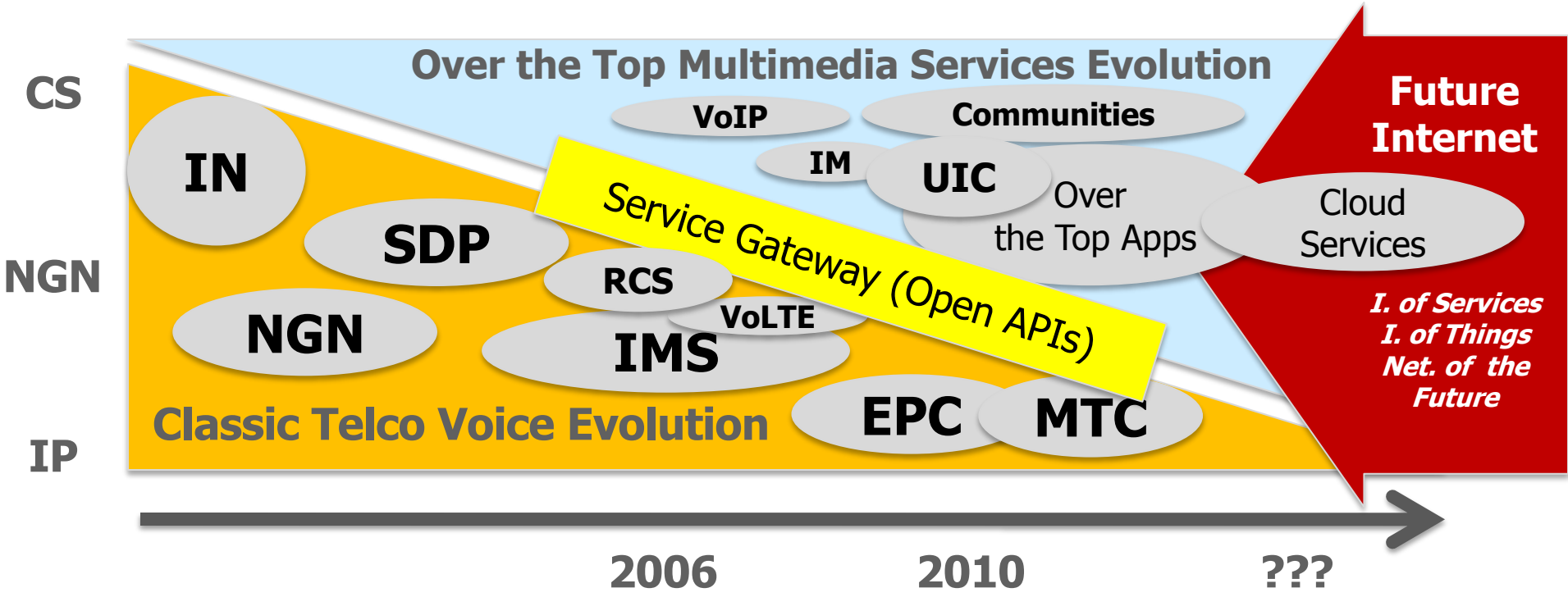
From Simple Voice to Innovative Service Platforms



New Eco System demands Federation and Open APIs

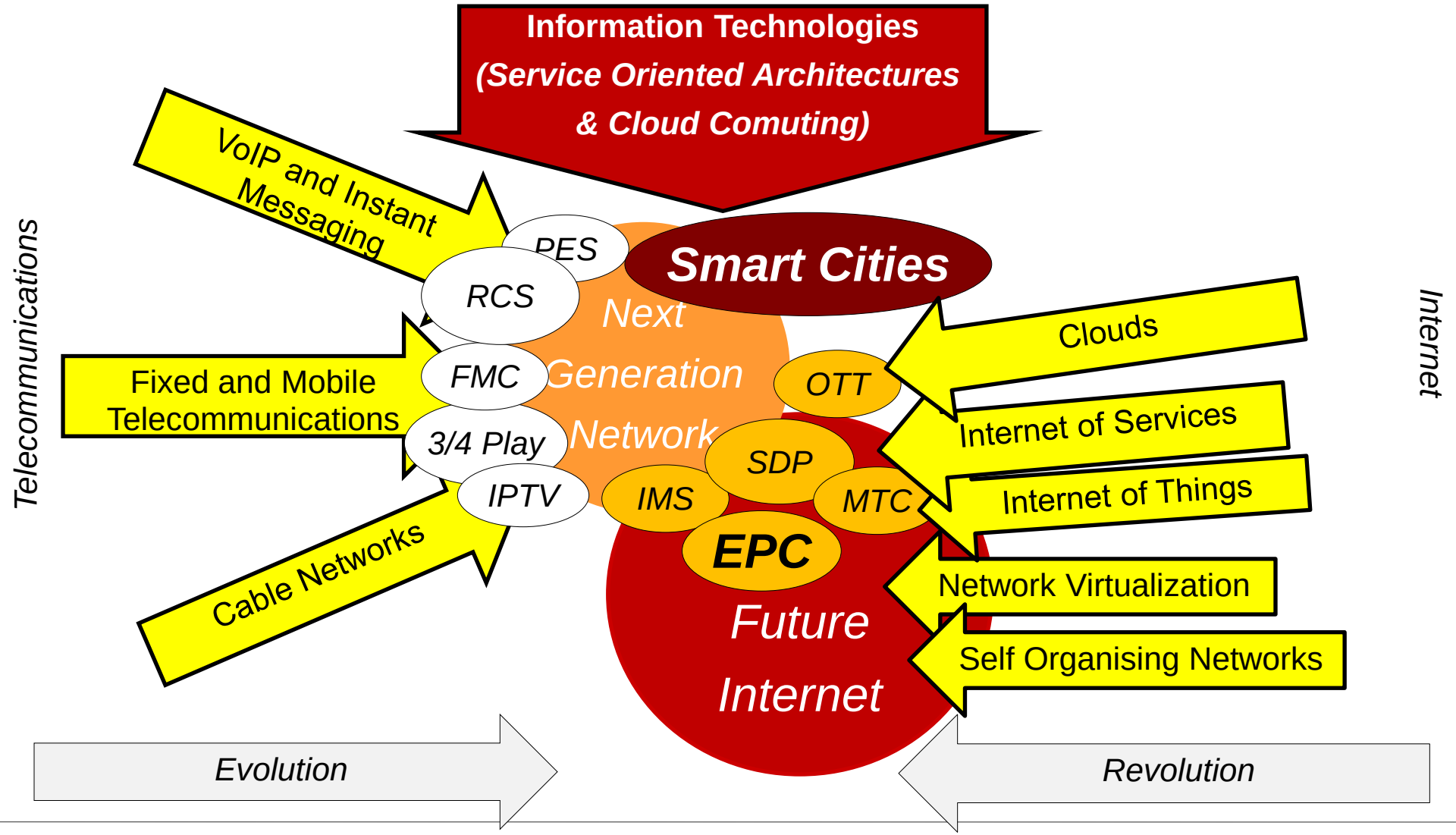


OTT vs. Telco Networks & Platforms – APIs/IMS/EPC/MTC as last resort??

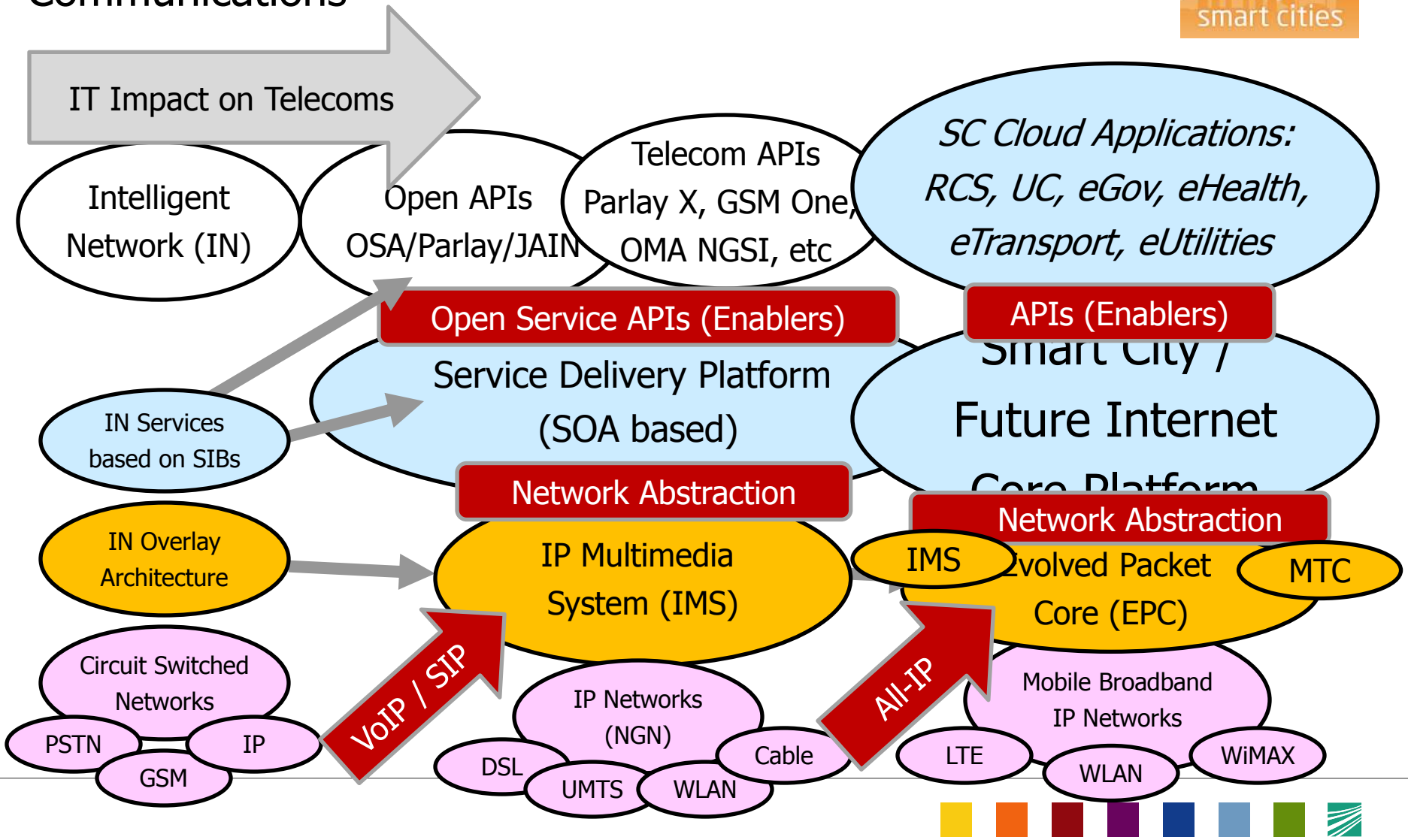


- ✓ All IP Networks will pave the road for Over the Top (OTT) Application
- ✓ Evolved telecom platforms may provide revenue potentials via Service Gateways (APIs) on top VoIP/RCS (IMS), Maschine Type Communication (MTC) and Smart Bit pipe approaches (EPC)
- ✓ *RCS will have to compete with Unified Communications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

NGN2FI Evolution is a Challenge



Evolution of Telecommunication Platforms toward Smart Communications



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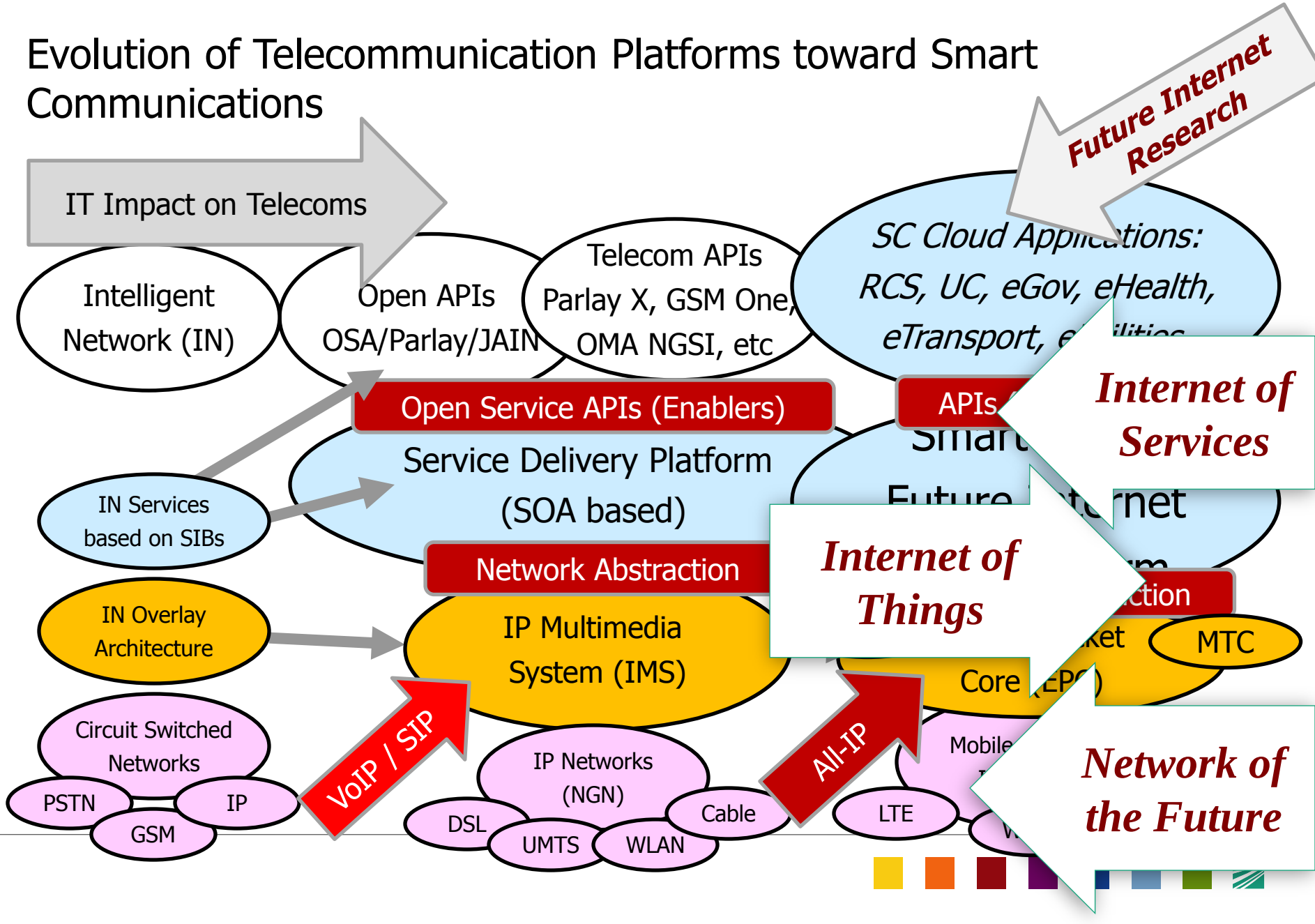
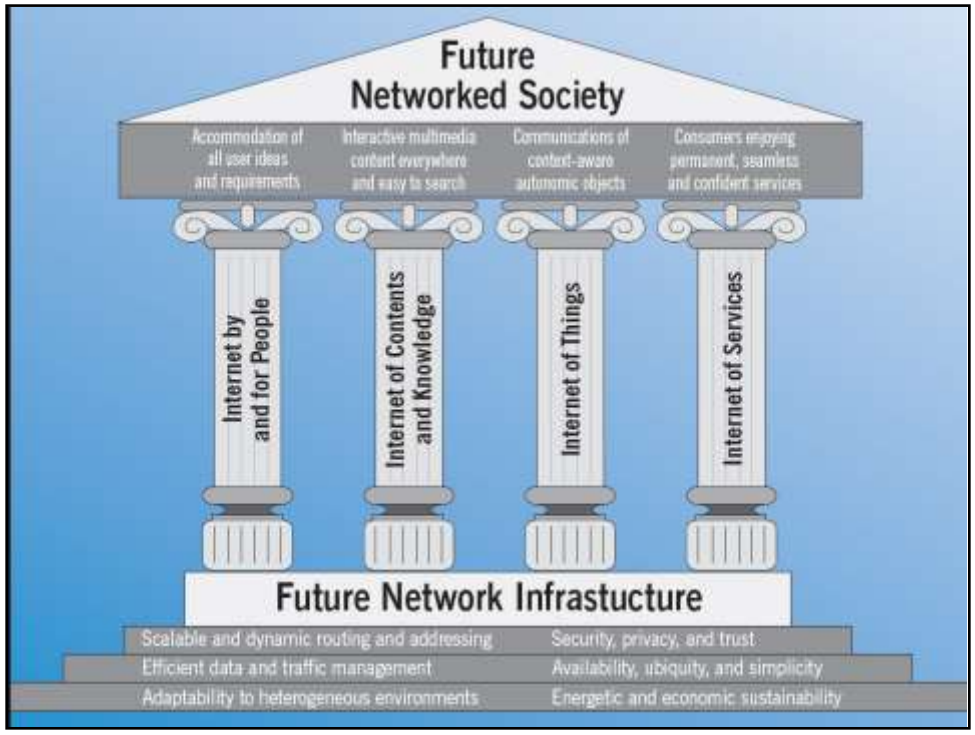


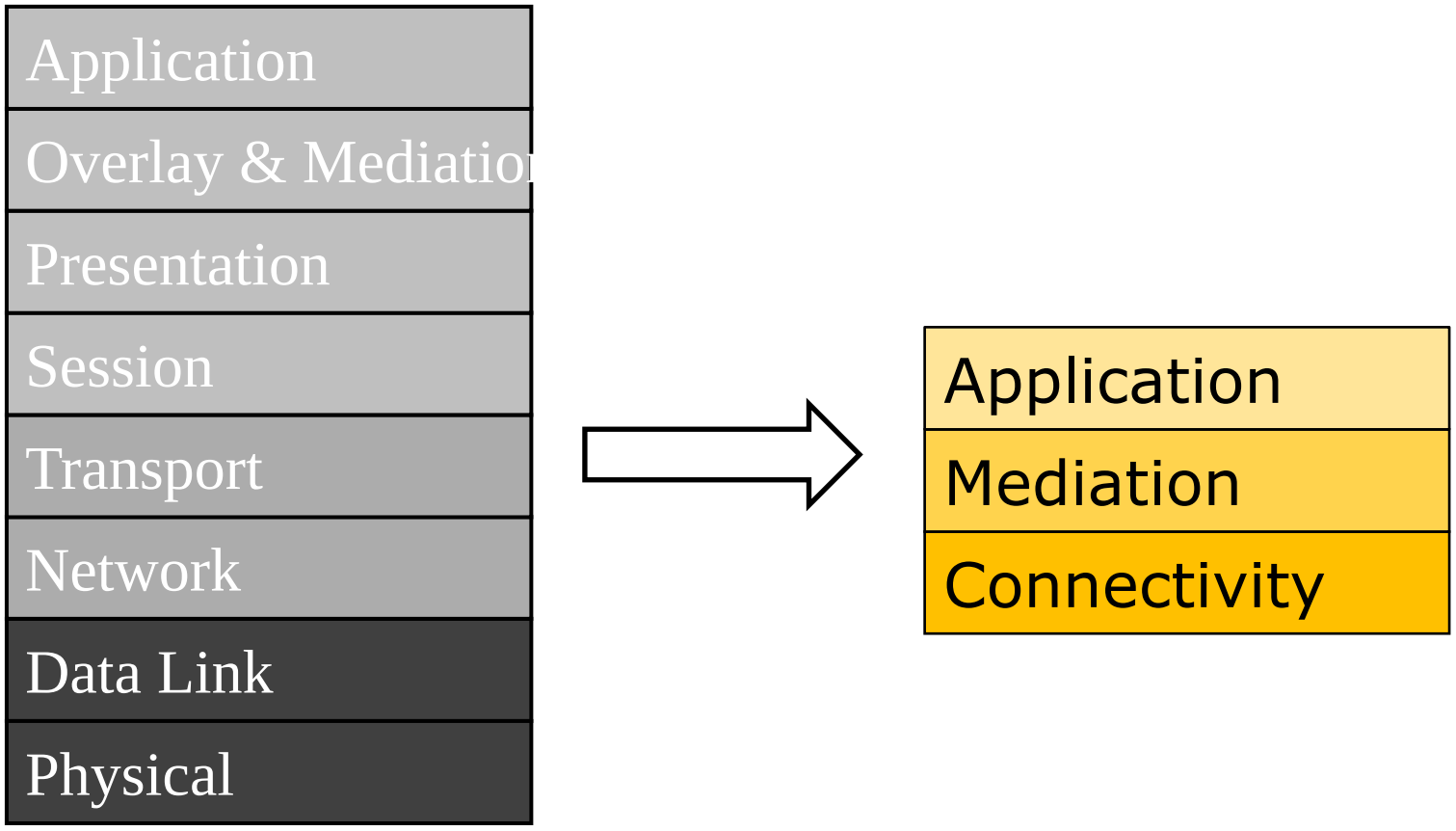
Dimensions of the Future Internet

- 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

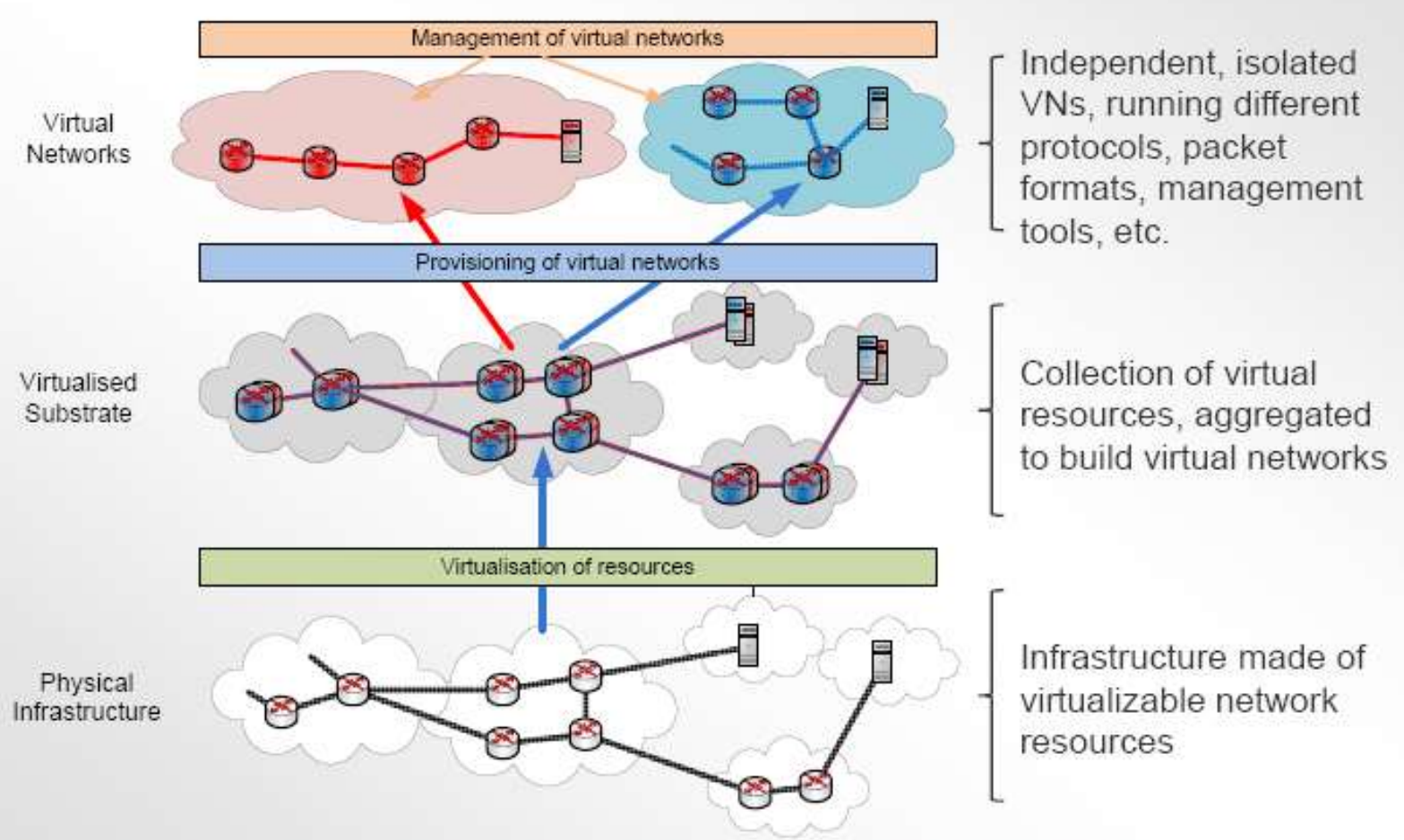


Future Internet, The Cross-ETP Vision Document, Version 1.0, 2009

FI = Towards a Thinner Protocol Stack



Decoupling Networks from Infrastructure



P1956 Network Virtualization – Opportunities and Challenges 5

Source: EURESCOM Project P1956

M2M World of Connected Services

The Internet of Things

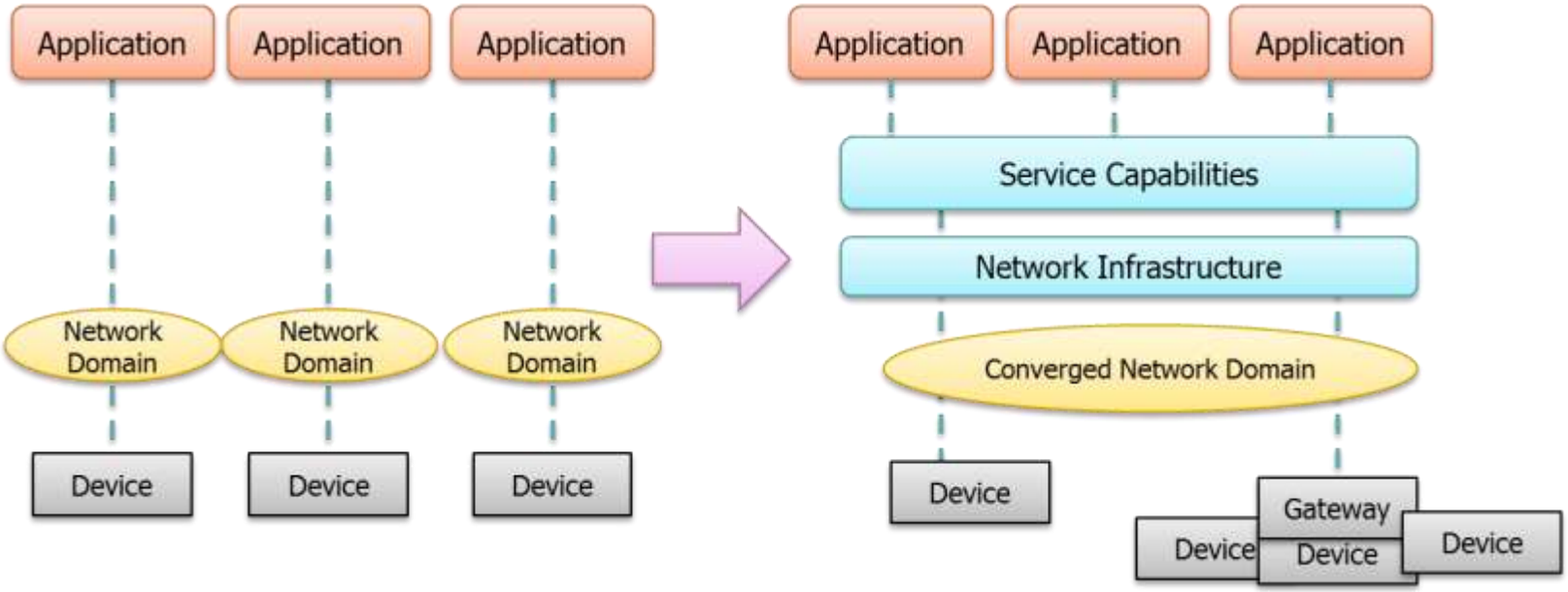
Beecham Research

Boston | London

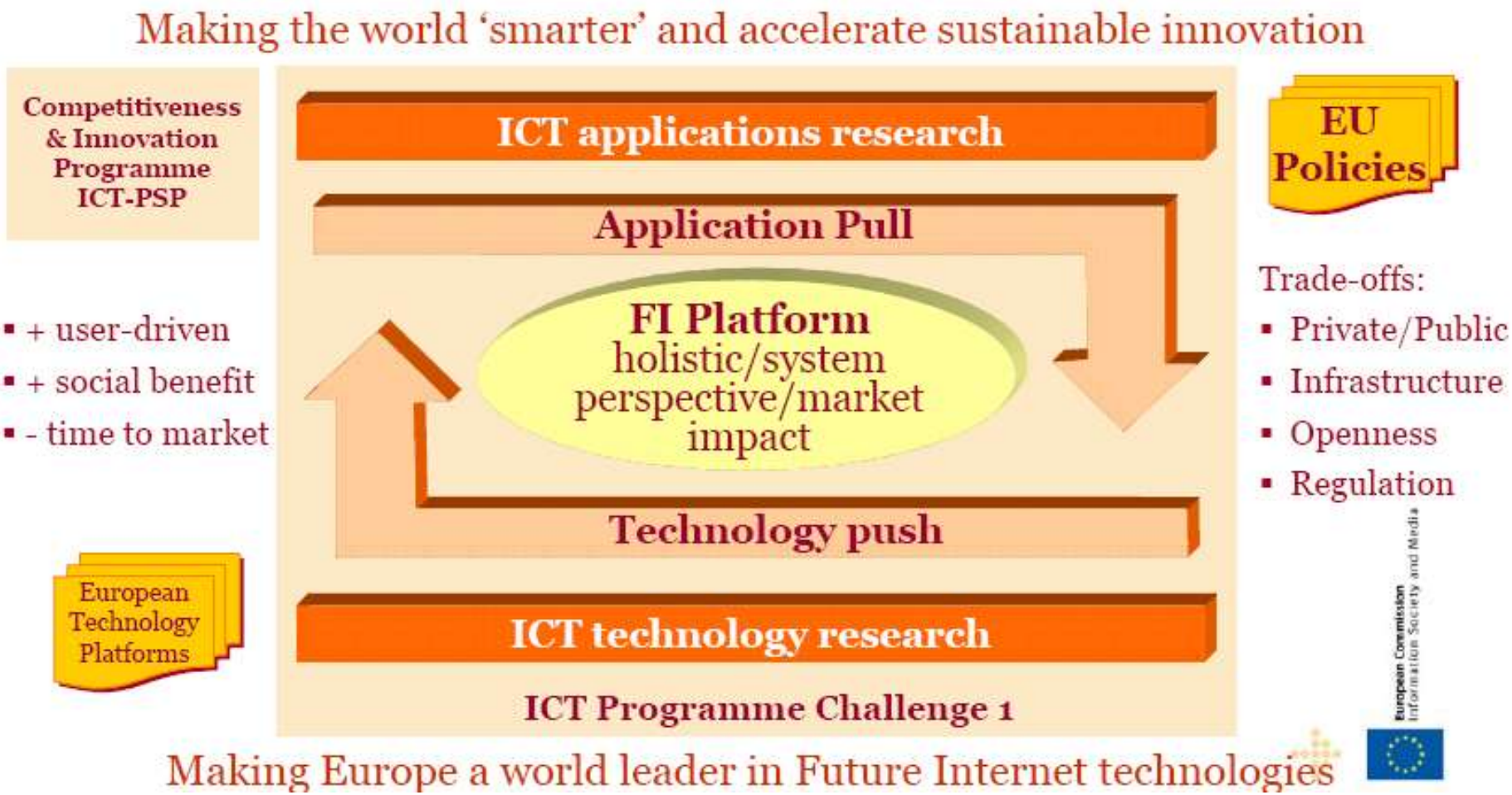
info@beechamresearch.com +44 (0)845 533 1758 www.beechamresearch.com

M2M Services & Applications

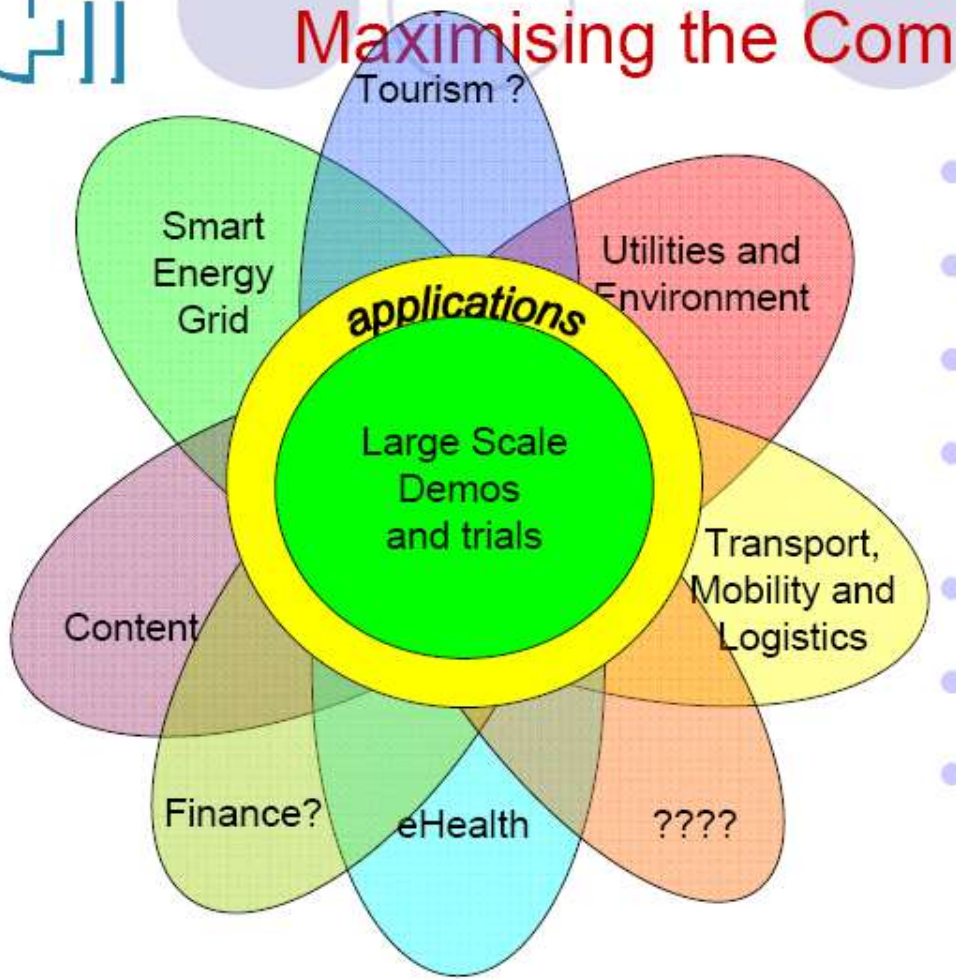
- Today
  - SMS based.
  - Vertical isolated systems.
  - INTRAnet of Things
- Future
  - Global horizontal approach.
  - INTERnet of Things.



Towards a European Future Internet Platform



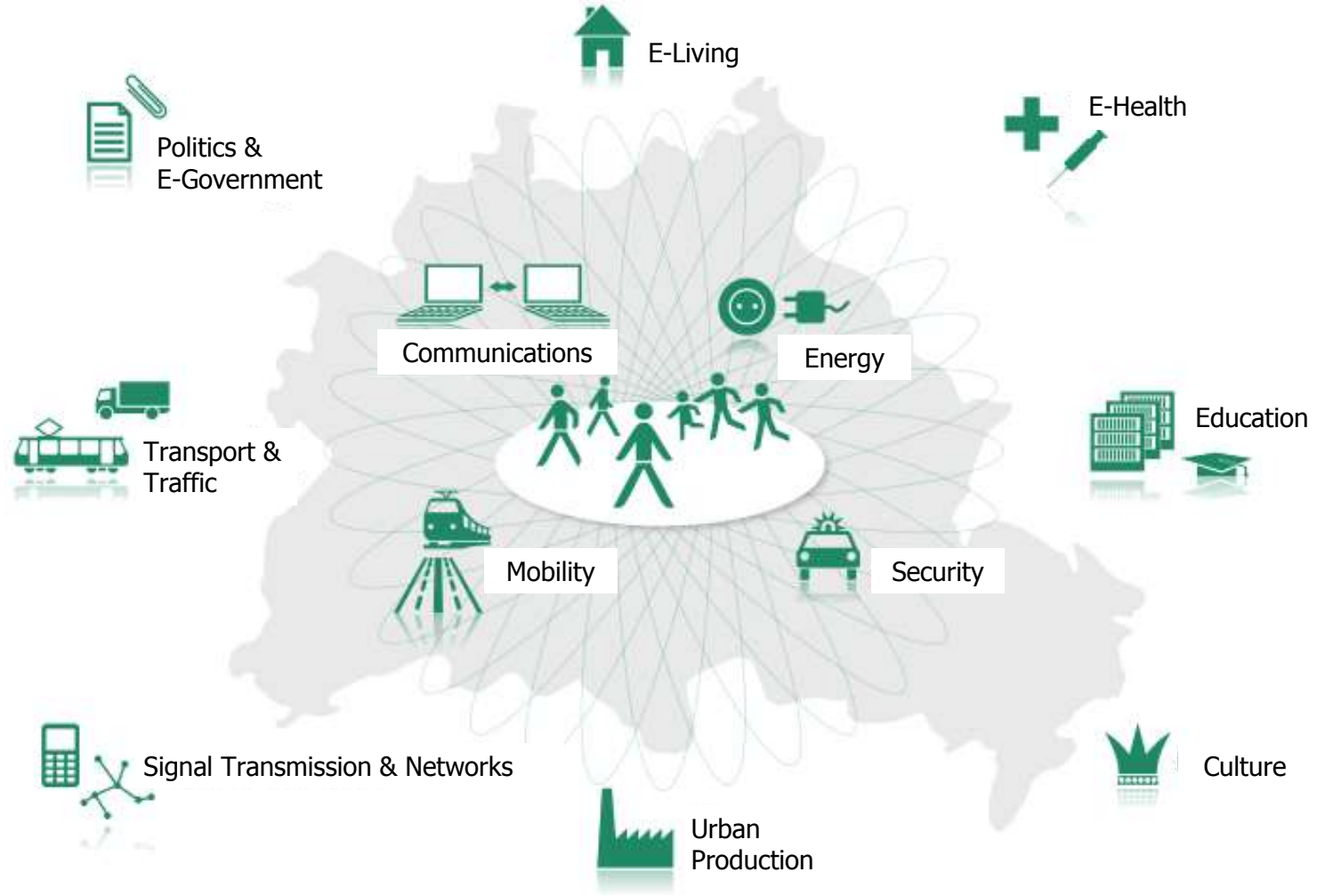
The Notion of Enablers within the European Future Internet Initiative



- 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

Future Internet … to make our cities smart

A Smart City is a huge Future Internet Show Case



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 facilitate 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 exchange information about themselves and their social context and environment.

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

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

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Smart City Vision – Information and Communication is Key

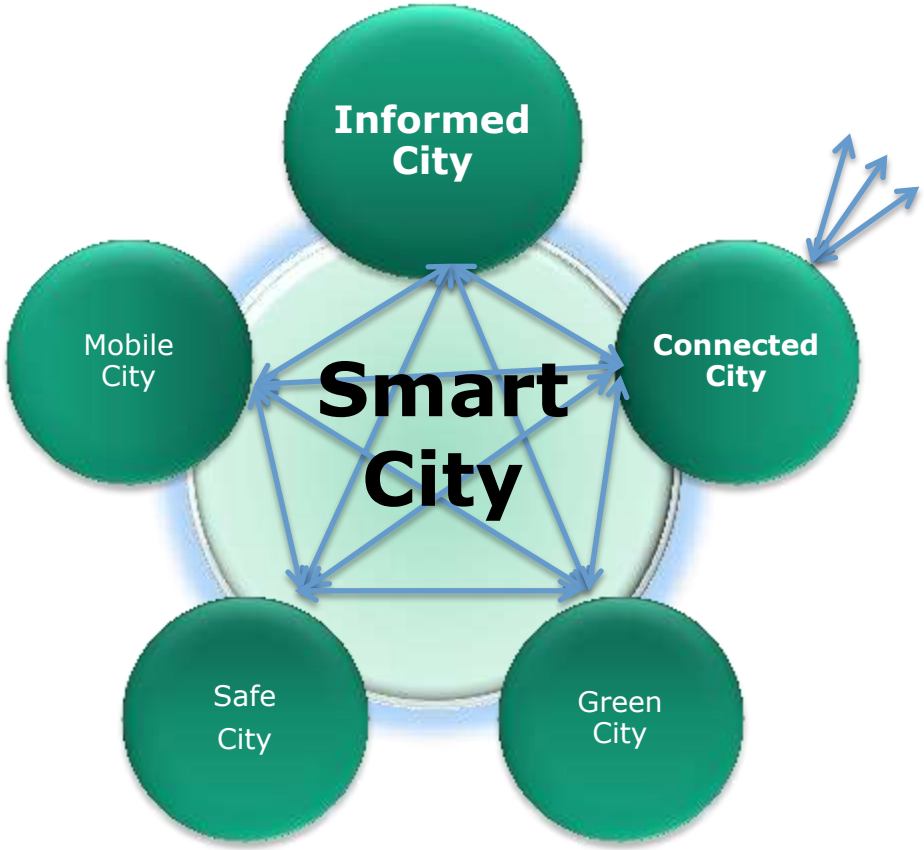
- City as **service provider**

  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

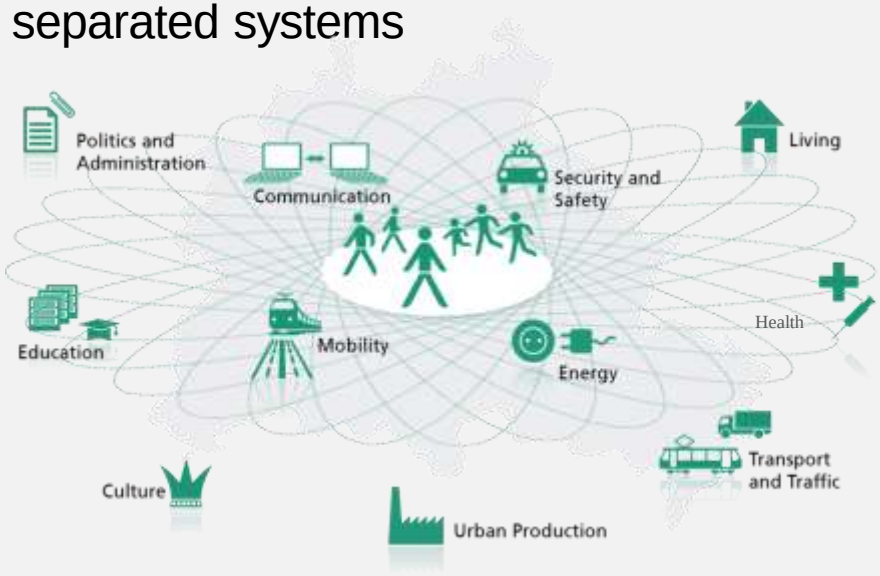


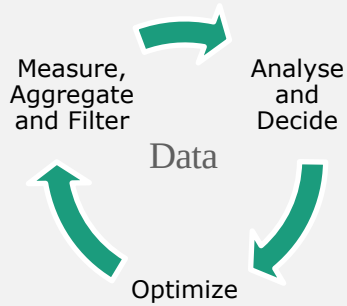
Smart Cities require a common service and network Infrastructure

City is a system of systems

Set of separate technical systems → Integrated systems

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



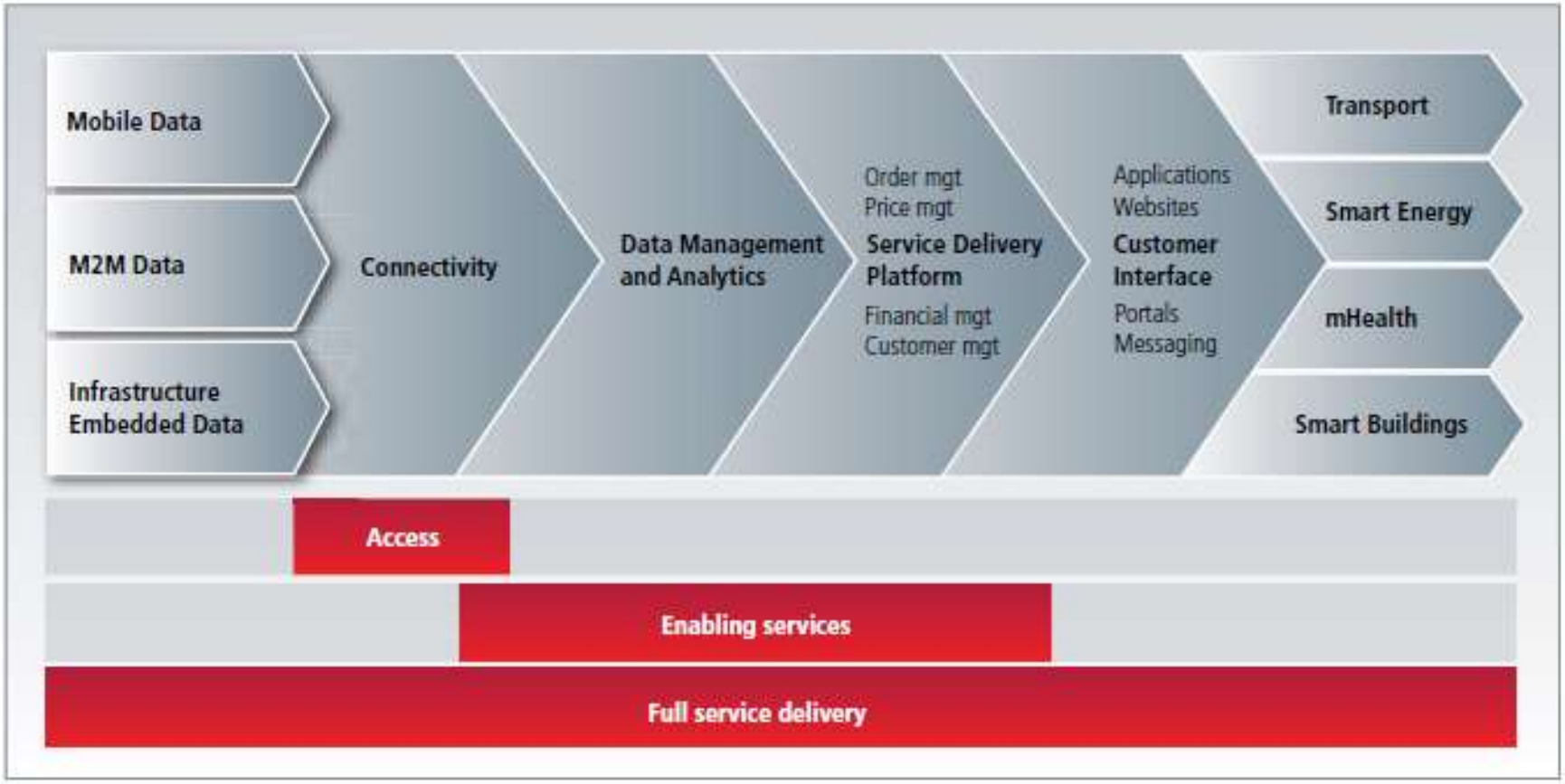


Fraunhofer FOKUS

as Enabler and Integrator for ICT-based Solutions

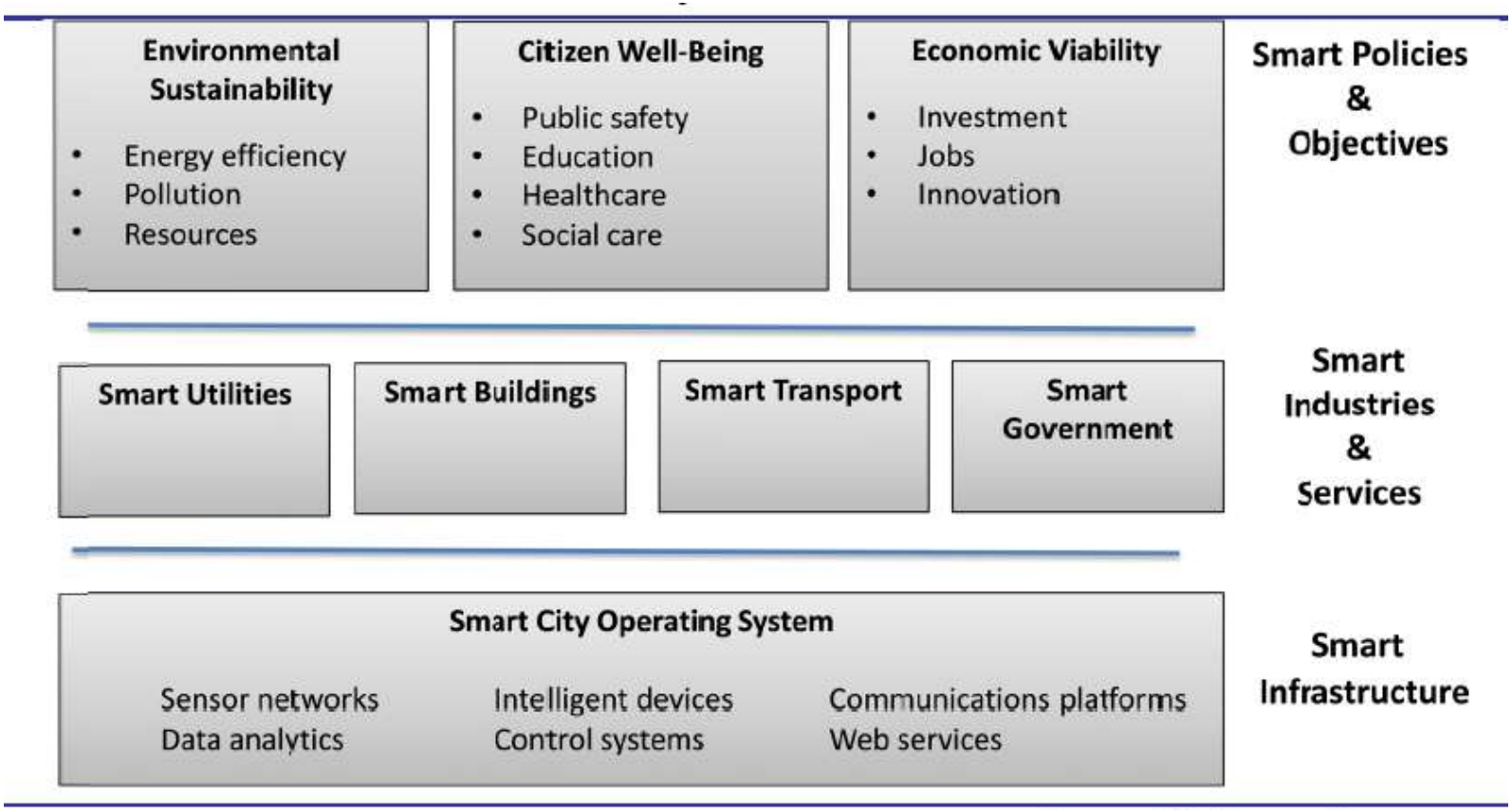
- FOKUS Smart Cities Portal, Sept. 2011
- acatech Position Paper: „Smart Cities“, Jan. 2011.
- Münchener Kreis Smart Cities Conference in Berlin, July 2010

The Smart Cities Value Chain



Source: Accenture

A Multi-Dimensional Smart City Model



(Source: Pike Research)

General Smart City Communication Requirements

- We see different communication patterns
- Generic platform needs to support multiple use cases and application scenarios

➔ Human to human (H2H) communication, typically session based, as we know from NGNs and Telco 2.0 needs to be supported

  ➔ 1-1, multicast, broadcast, group communication (n-m)

  ➔ Typically downlink communication

➔ Machine to Machine (M2M) communication:

  ➔ Communication link between sensors/actuators and data centers, typically uplink data

  ➔ Thousands of devices transporting small information regularly

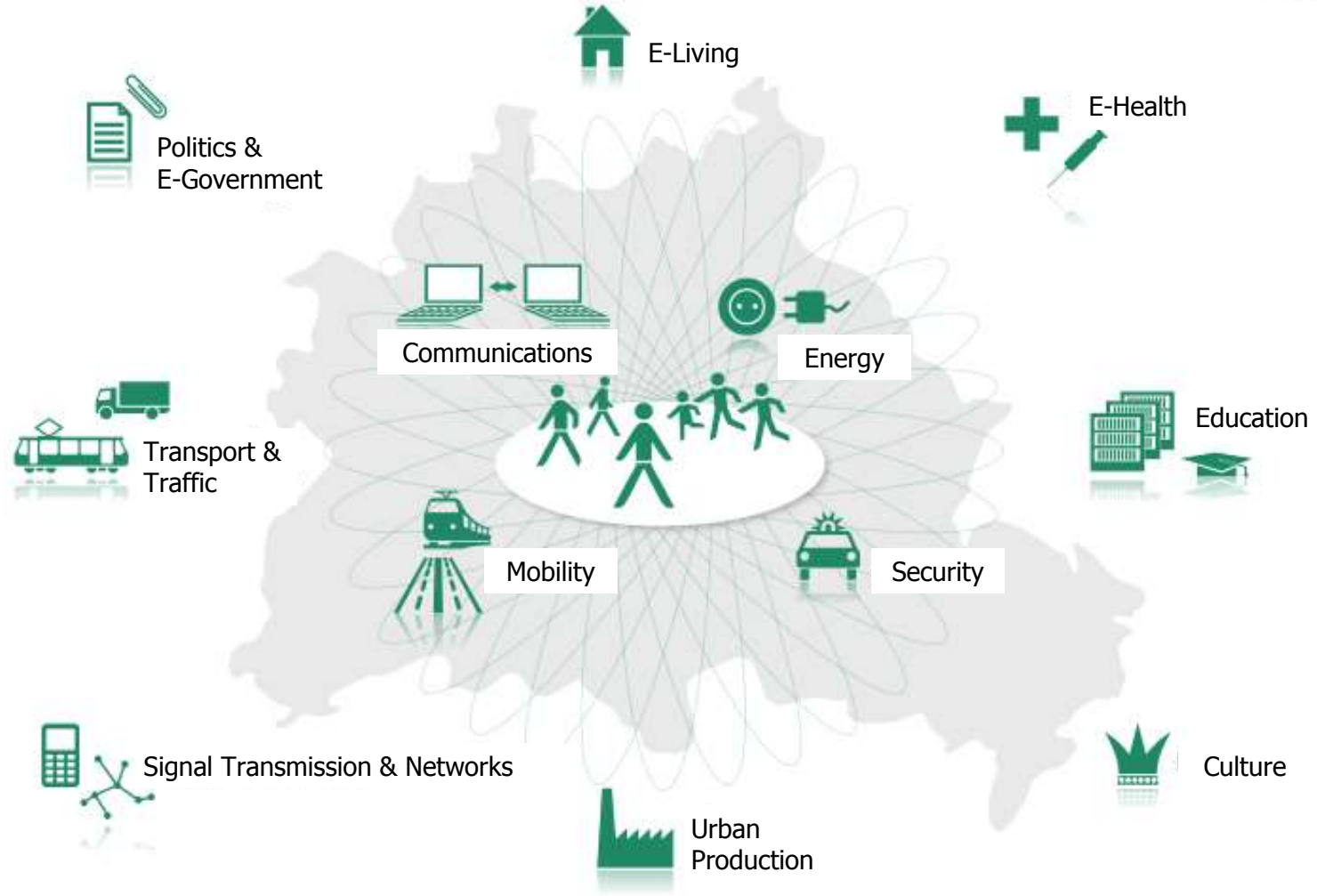
General Smart City Communication Requirements (cont.)

- We see network convergence across multiple networks
  - ➔ Need to support mobile, wireless, fixed, and cable networks
  - ➔ Efficient communication
  - ➔ Mobility support
  - ➔ Network selection and Quality of Service
- Automatic behavior
  - ➔ Combination of information
  - ➔ Handling of large amounts of data
  - ➔ Policy-based behavior of services

Future Internet … to make our cities smart

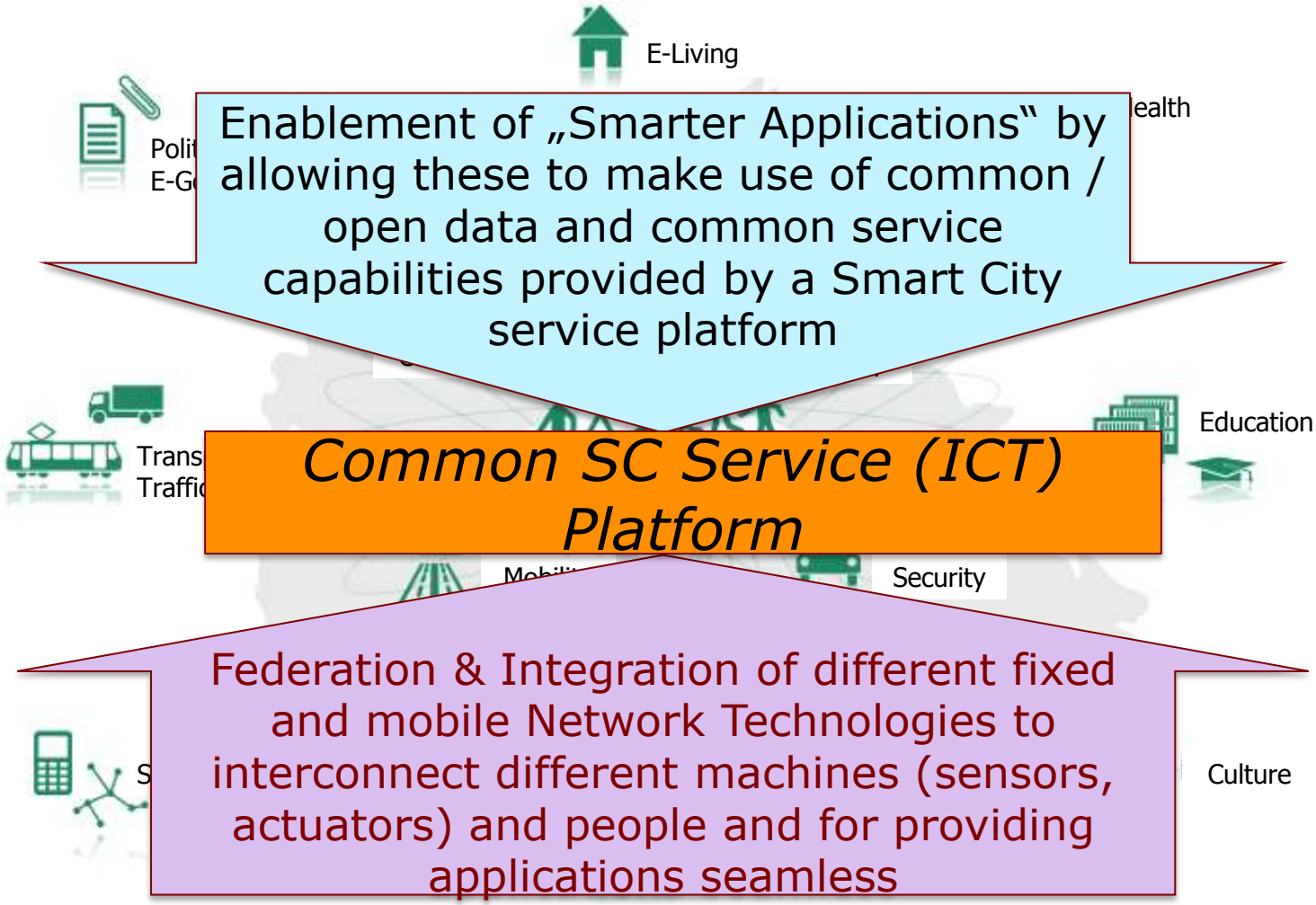
A Smart City is a huge Future Internet Show Case

Fraunhofer SMART CITIES



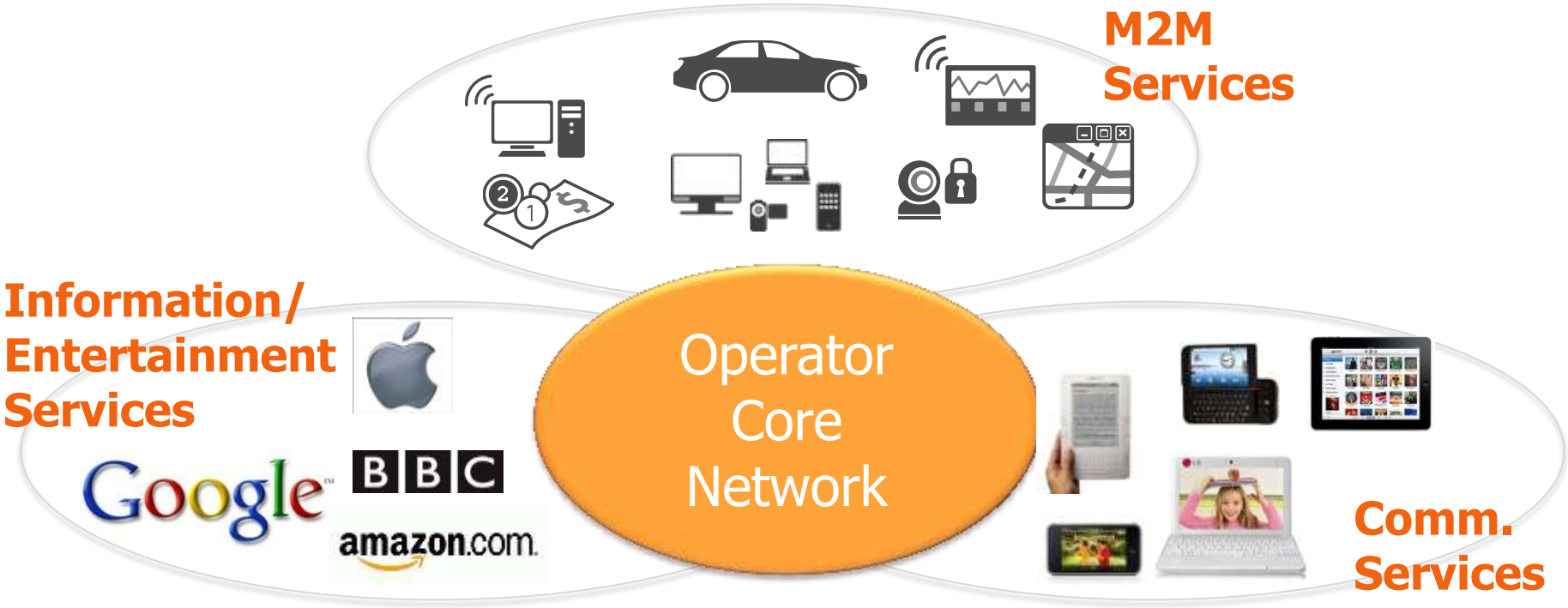
A Smart City relies on Integration & Federation of Systems

Conve



Smart Cities – Total Convergence of Communications

Smart Cities require the convergence of services from the telecommunication industry and other business branches into a common mediation layer possibly around the operator core networks.



General Smart City Communication 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 City communication platform acts as central 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.

Assessment of Platform Requirements

- Separation of communication-centric services and enablers into three categories:

  1. Machine-to-Machine (M2M) Communication
  2. Human-to-Human (H2H) Communication
  3. Overarching Services and Enablers

- Mapping of service and enablers towards different service domains where applicable

- Exemplary refinement for one specific service vertical (facility management)

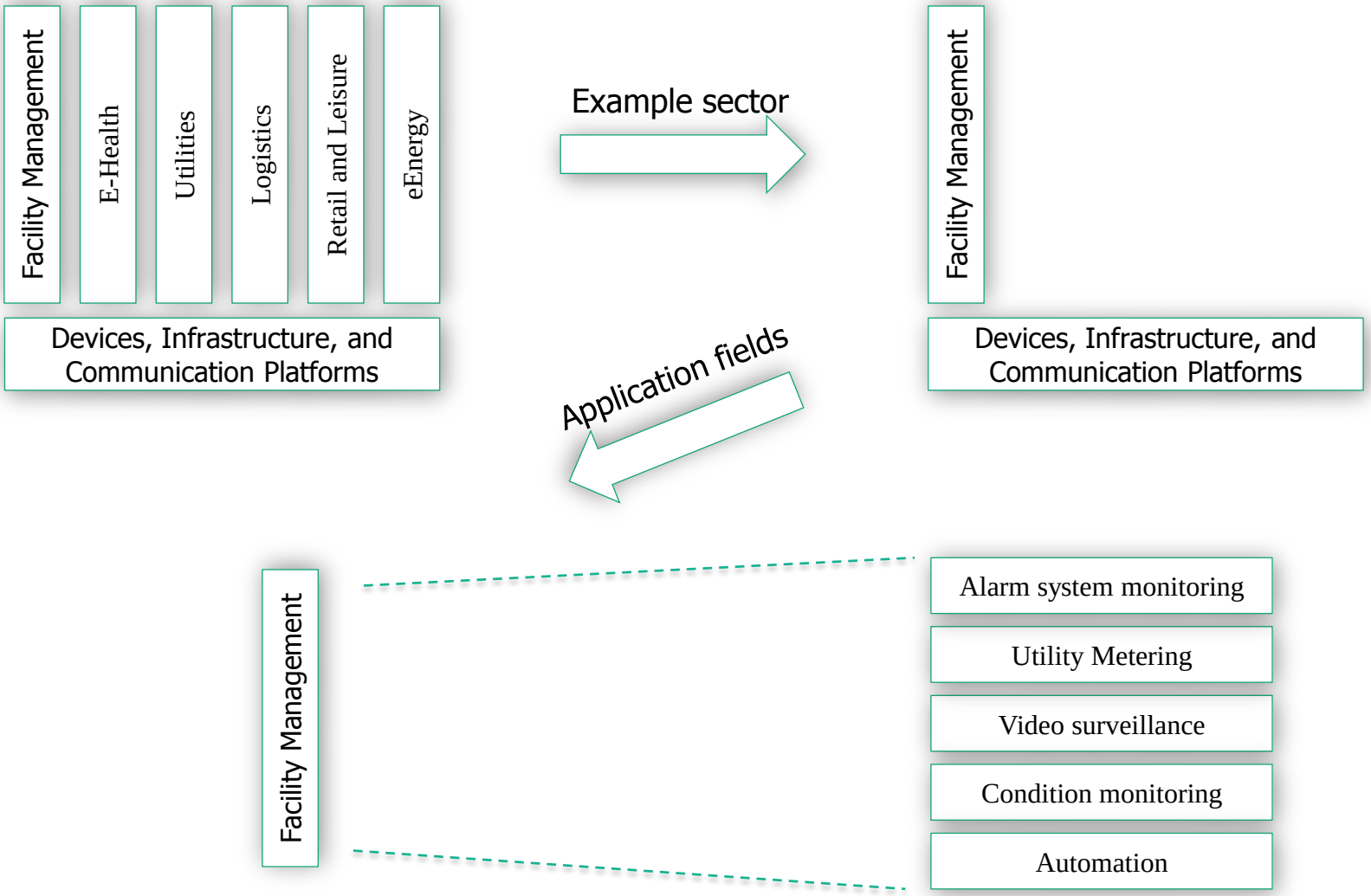
Smart Communication Enablers & Sectors

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 for 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	

Smart Cities … making it tangible



Smart Cities … making it tangible

Facility Management Application fields

- Alarm system monitoring
- Utility Metering
- Video surveillance
- Condition monitoring
- Automation

Demos that we have build @ FOKUS

- Utility Metering
- Condition monitoring
- Automation

Communication requirements

- Retrieve data
- Control devices
- Send data
- A/V Call
- A/V conference
- Messaging / File transfer
- Presence
- Location
- Address Book
- QoS
- Device/entity mgmt
- Security

Demo video

http://www.open-mtc.org/_videos/OpenMTC_Demo_video.mp4

Communication & Control Infrastructures for enabling Smart Cities

- Smart Cities is a heterogeneous field to enable many service verticals by ONE platform:
  - Voice/video/text/binary communication
  - Entertainment
  - Water management,
  - Public safety,
  - Traffic,
  - Buildings,
  - Energy,
  - Security,
  - Utility, etc.

  } Combination of H2H and M2M communication!

- Combination of services is needed and may be achieved on two layers:
  - Service layer (SDP)
  - Control layer (IMS or MTC)

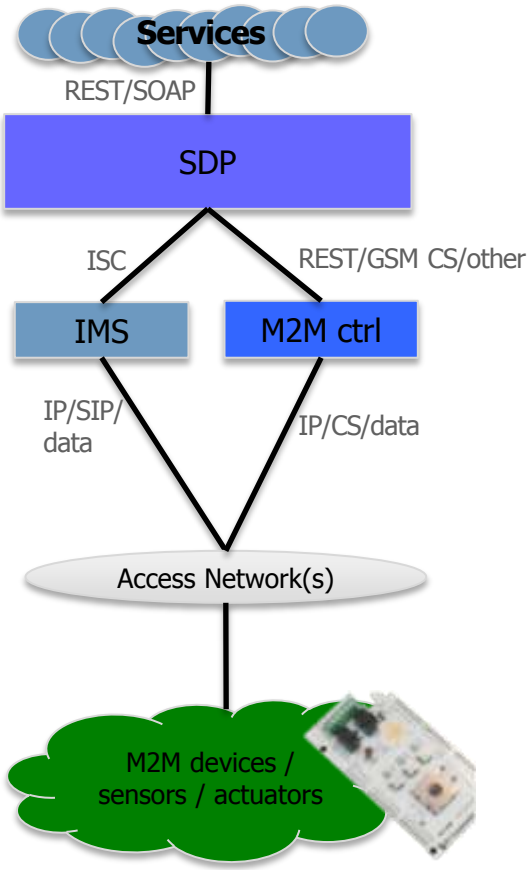
Session-Based vs. Ressource-Based Communication

- Session-based (e.g. IMS)
  - PRO
    - Good for longer sessions such as multimedia streaming
    - E.g. video surveillance
  - CONTRA
    - Has been designed for H2H communication
    - Not so well suited for regular transmission of small amounts of data
    - Signaling overhead
- Resource-based M2M Platform (e.g. ETSI)
  - PRO
    - Good for small amounts of data
    - Good for asynchronous communication
    - Easy replay of stored data (store and forward concept)
    - No signaling
  - CONTRA
    - Model does not find well with continues streams of data
    - Voice services not already integrated

Platforms for Smart Cities – the SDP approach

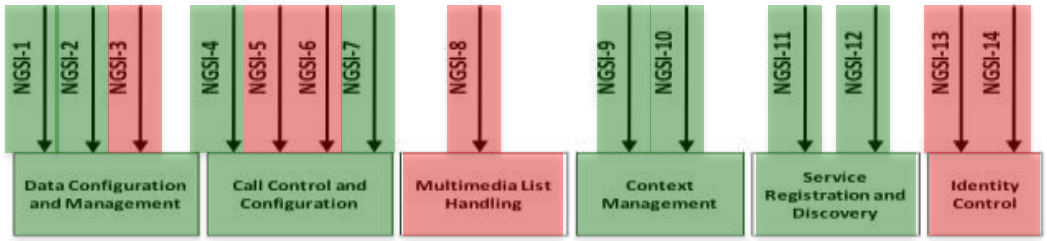
- SDP may provide abstraction over multiple control platforms and expose APIs to developers and services.
- Combination of communication APIs as:
  - OMA NGSI
  - GSMA OneAPI
  - RCS APIs

  for H2H communications
- M2M APIs for
  - data access
  - device control
  - connectivity control



Smart City H2H Communication APIs: OMA NGSI, GSMA OneAPI & RCS-e

- OMA NGSI provides abstract APIs suited for OMA enablers



- GSMA OneAPI profiles NGSI
  - NGSI extension for payment, data connection & device capability
  - Zonal presence for location

- RCS-e Network APIs
  - Defines services for GSMA OneAPI & NGSI
  - New API requirements:
    - Chat & capability discovery
  - Oauth for user/service authentication

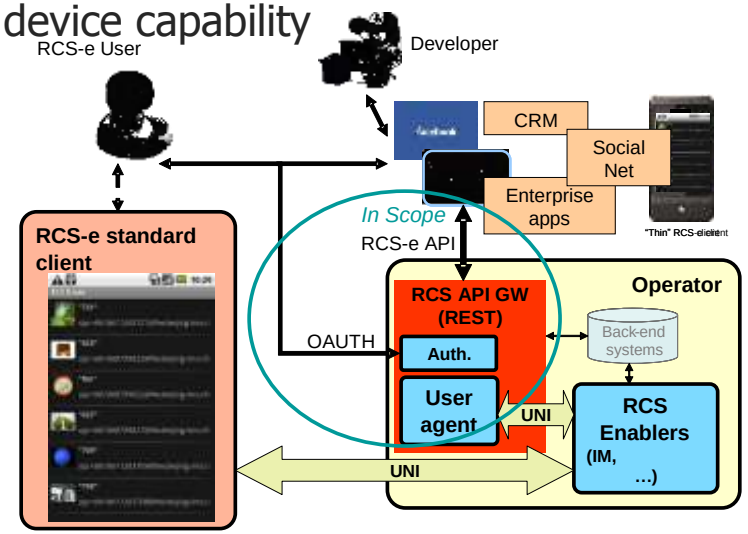
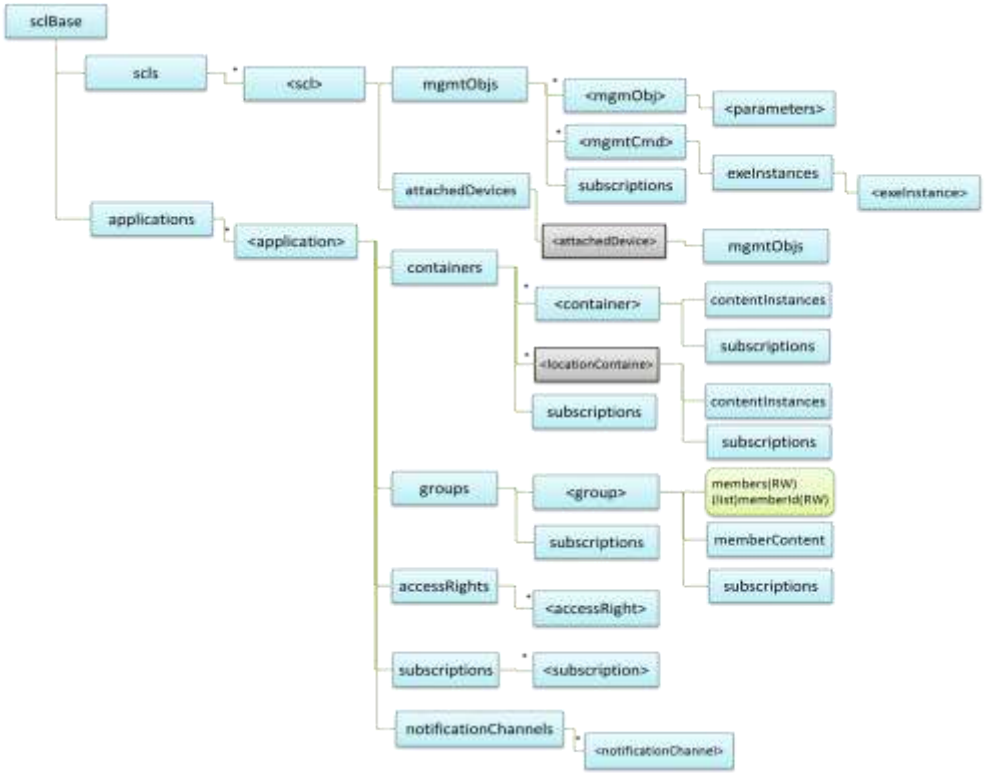


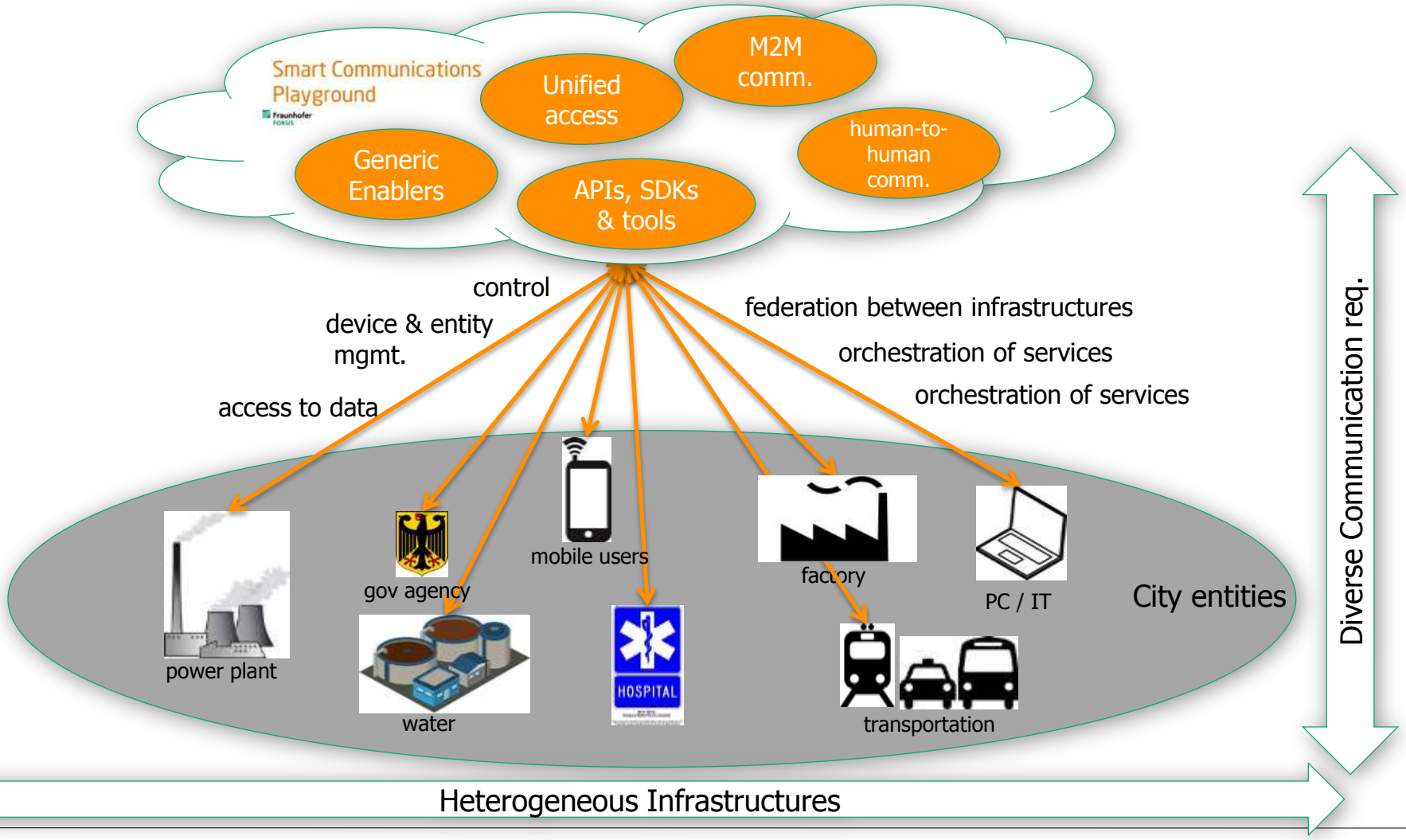
Figure 2 : RCS-e API architecture

Smart City M2M Communication APIs

- API is divided into the following three categories:
  - Network,
  - Device, and
  - Data APIs.
- Network APIs deal with the roles related to the network applications and its session control with the M2M core.
- Device APIs find appropriate devices and gateway resources to fetch information from them.
- Data APIs handle functionalities related to accessing/manipulating data collected from devices/sensors



Smart Communication Infrastructures
Generic Enablers & Service Clouds for Smart Cities



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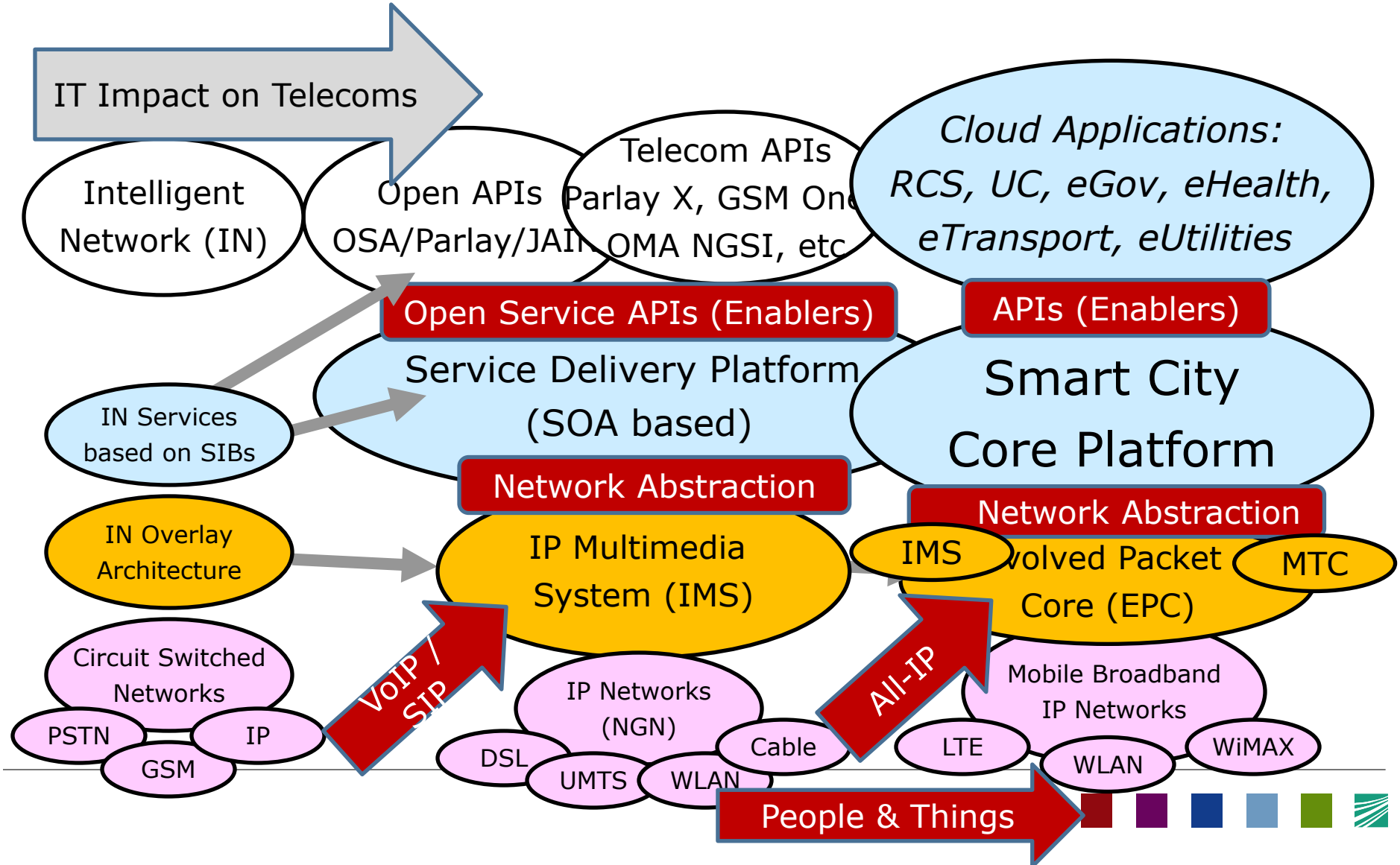
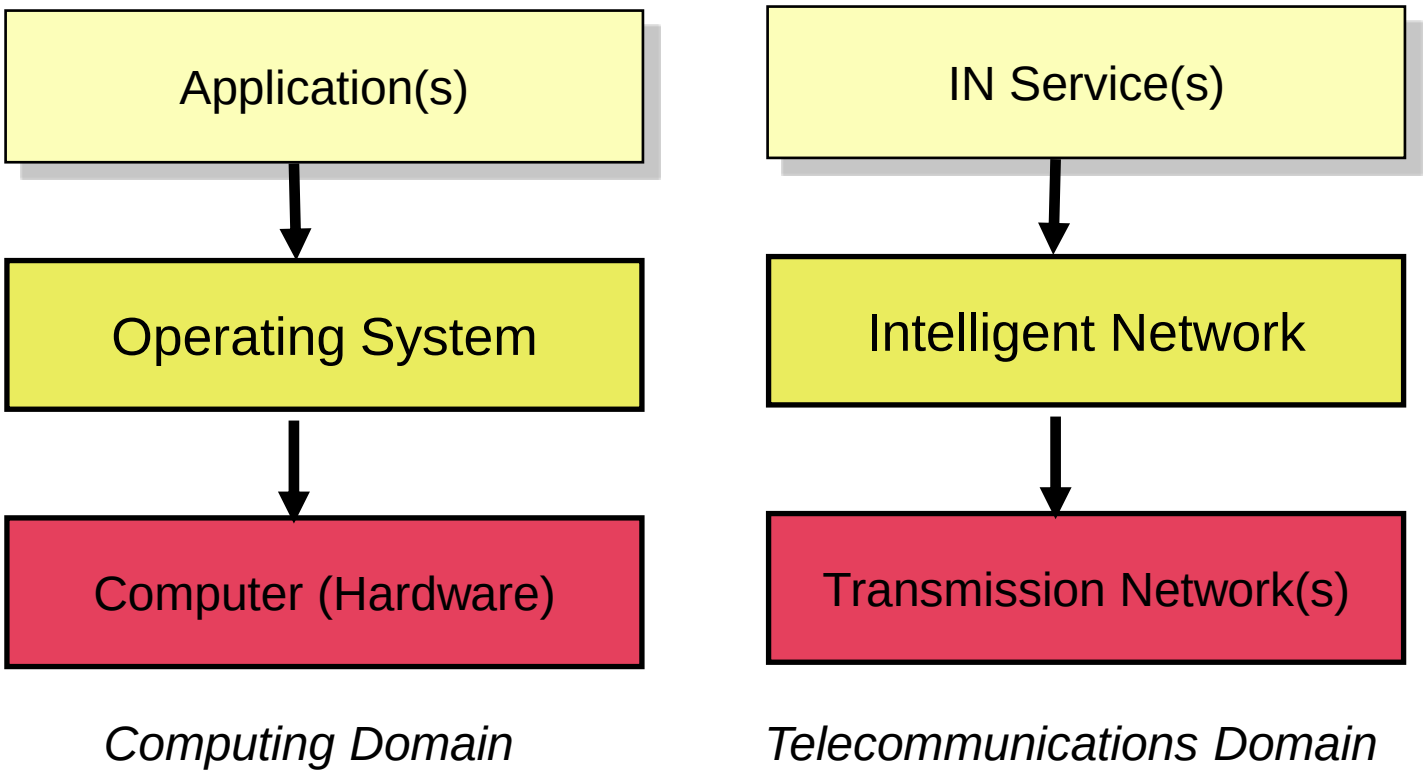
Evolution of Telecommunication Platforms toward Smart Cities



Please compare: The Intelligent Network Analogy!

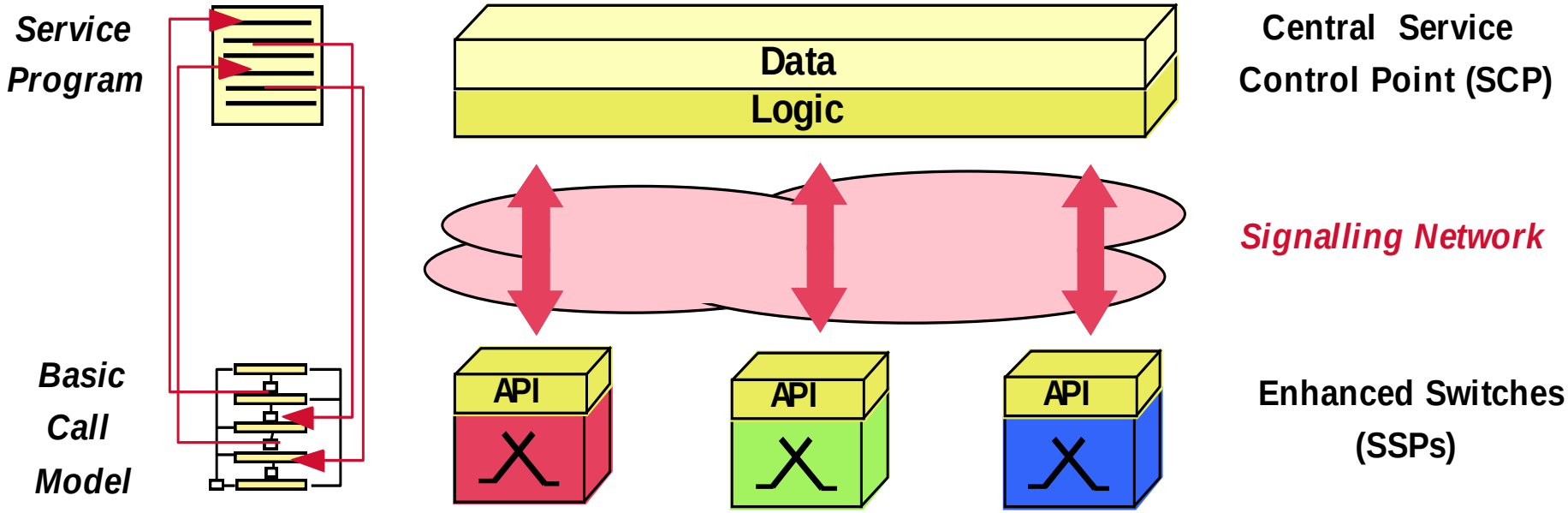
IN provides a uniform platform for providing an open set of telecommunication services, while abstracting from underlying network technologies



Please compare: Intelligent Network Principle

Unified IN service logic and data for all switching nodes provided by:

- Intelligent Node contains service logic and data accessible for switching nodes (Note: Intelligent node is a non-switching node!)
- Hooks are required within the switching nodes to access the remote Intelligent Node
- SS7 network enables real-time signaling interconnection of nodes

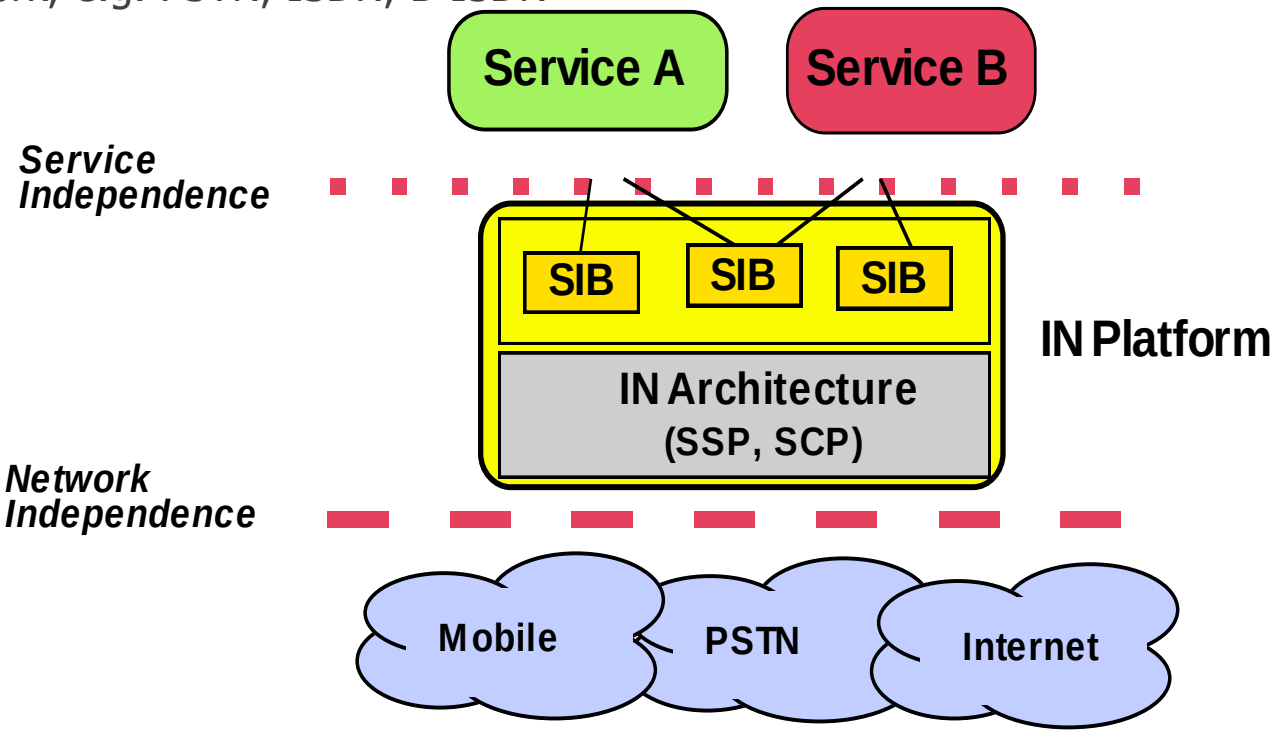


IN - the first Open Telecommunication Service Platform

IN platform provides service and network independence

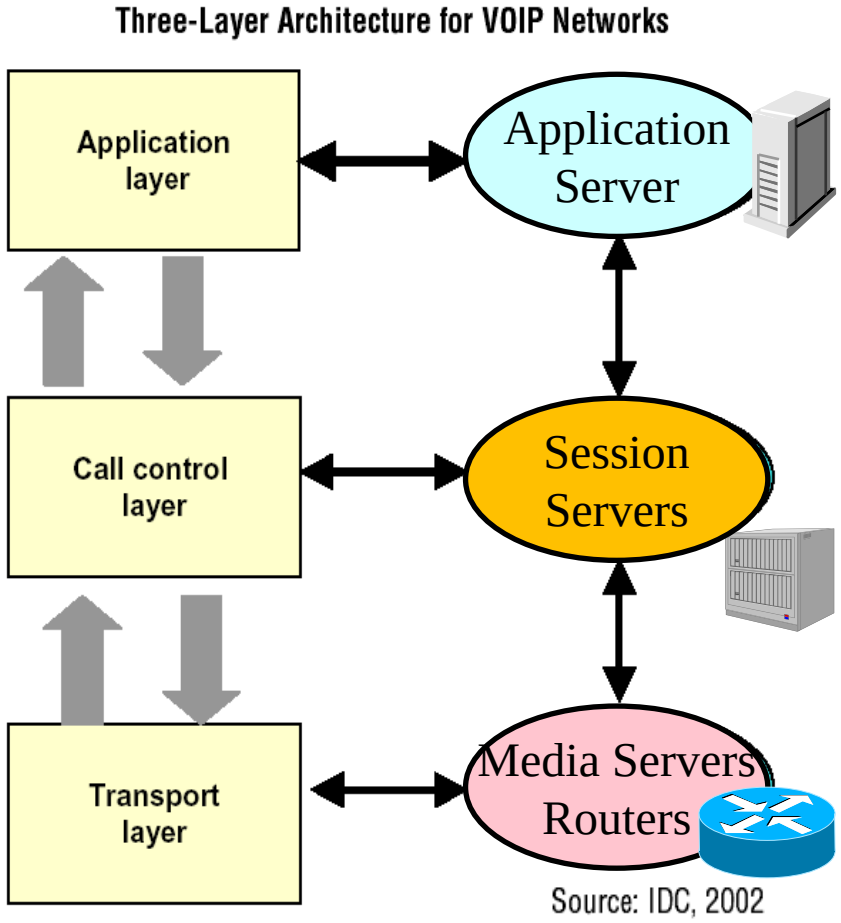
- Service decomposition
- Separation of switching and service control network elements

- IN can be considered as an additional (network) layer on top of any bearer network, e.g. PSTN, ISDN, B-ISDN

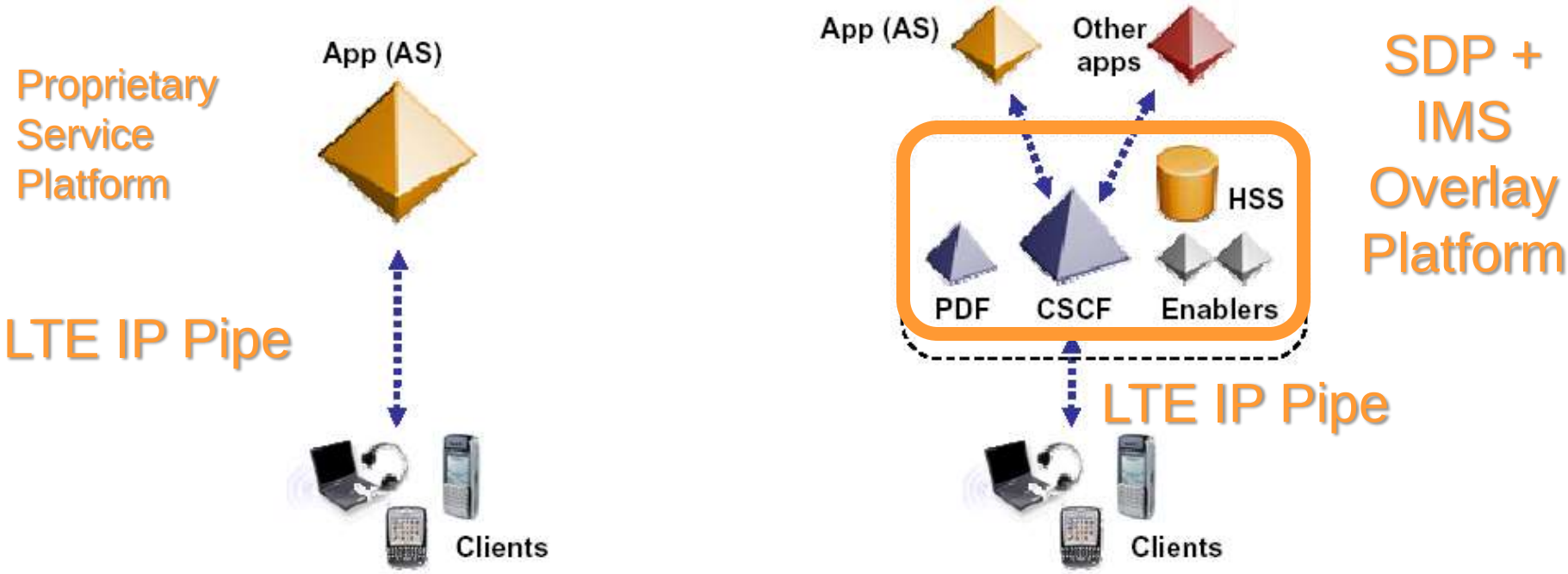


Next Generation Network = 3 Tier Architecture

- Enhanced services for the next generation network will be enabled by a tiered architecture where "Application Servers" will provide an independent service layer for the execution of enhanced services and content
- Session / Call Control based on advanced signaling protocols (i.e. SIP) is performed in Softswitches, or "Session Servers"
- Transport of signaling and content (incl. Voice) data will be done by Routers in the classical IP fashion. Dedicated nodes, i.e. "Media Gateways" and "Media Servers" are in charge for processing content data controlled by the Call Servers.



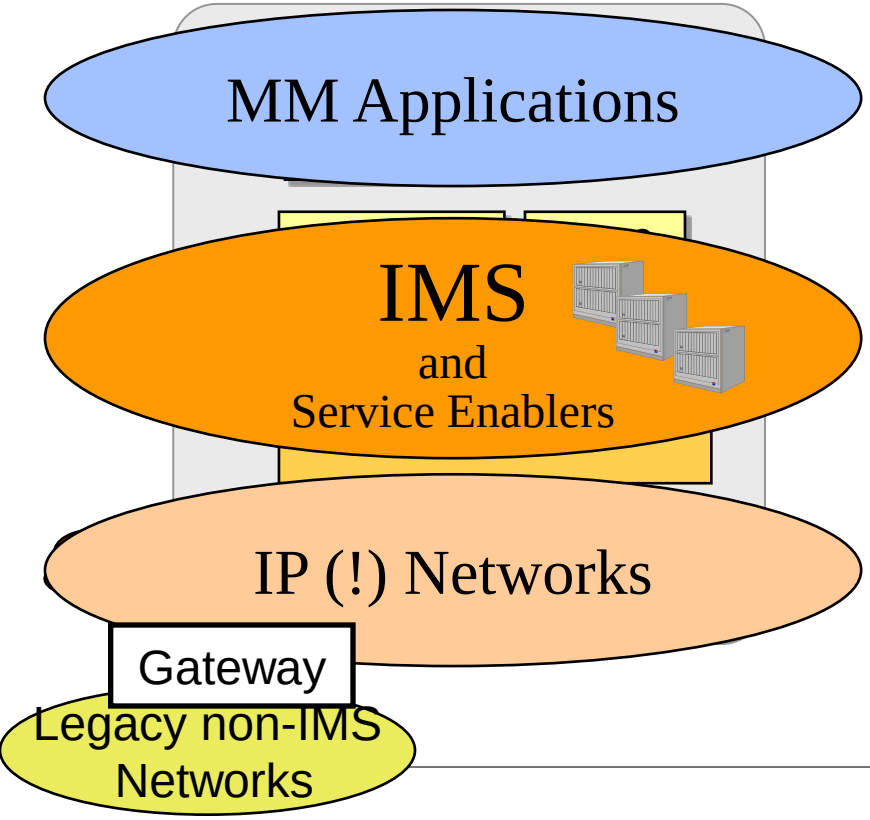
NGMN Over the Top (OTT) vs. Standardised IMS Service Platform



Standalone Solution	IMS based Solution
Fast one-off deployment	Faster integration of subsequent apps
Optimised one-off CAPEX (but repeated)	Re-use deployed infrastructure
OPEX for each standalone solution	OPEX shared across whole solution
Fragmented end-user experience	Integrated end-user experience

IMS Architecture Principles

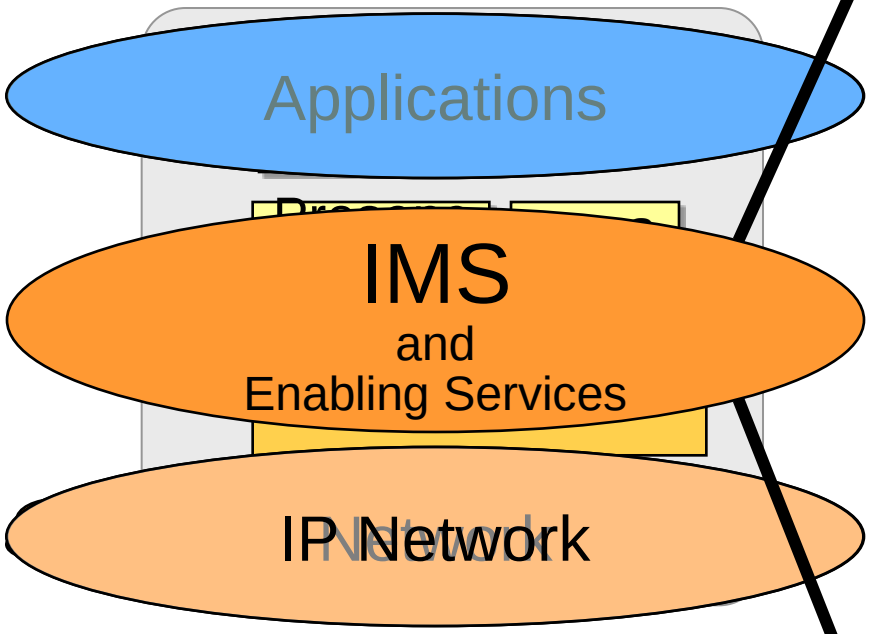
- IMS does NOT standardise specific services, but enablers
- BUT supports inherently multimedia over IP, VoIP, IM, presence (SIP)
- IMS enables the flexibility in providing IP-based applications !!



- 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

IMS Control Capabilities

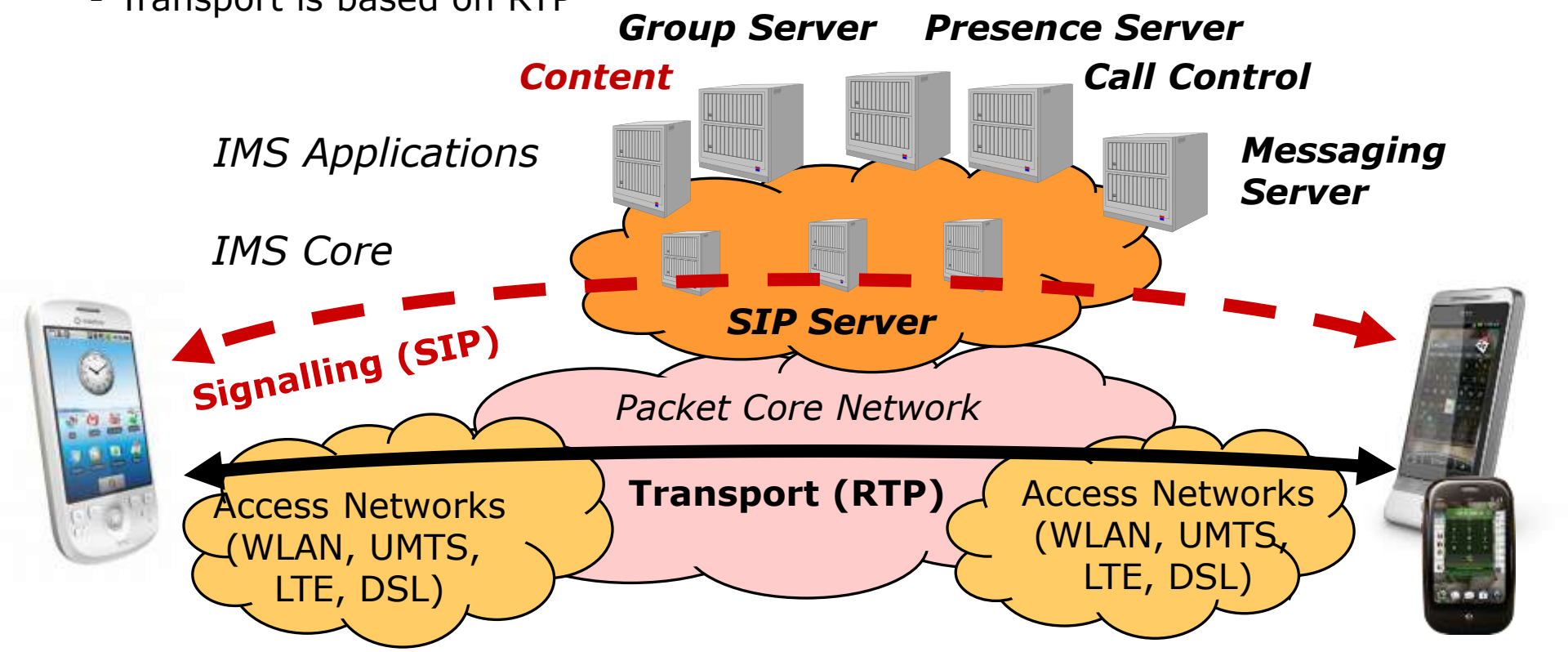
IMS Applications are provided by Application Server



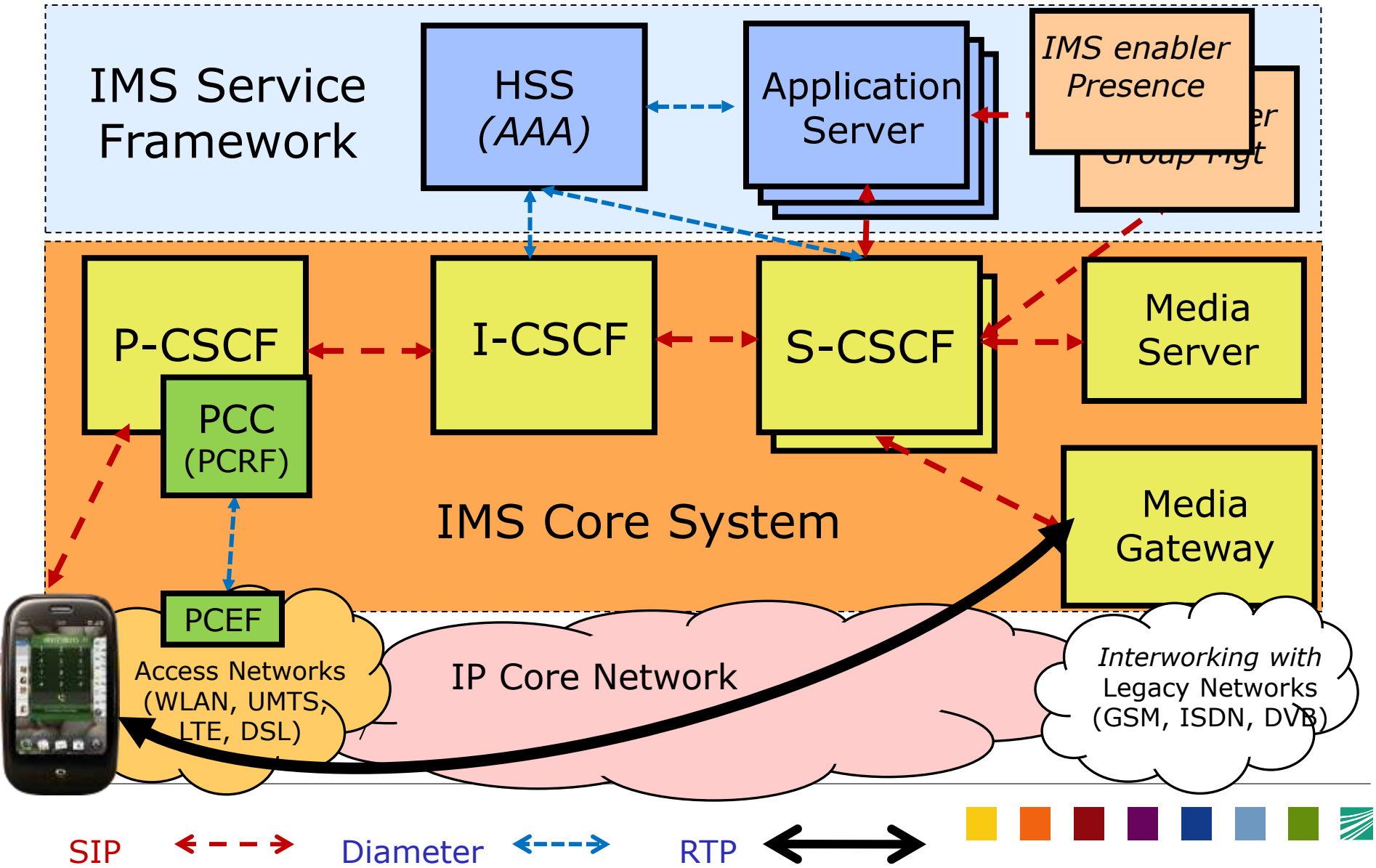
- Multiparty / Multimedia Session handling based on SIP Control
- Multimedia Content Pull & Push
- Messaging Support
- Conferencing and Group Com. Support
- Fixed Mobile Convergence / 3P
- Single-Sign-On User-Authentication
- High Secure Service Access and Provision
- Service based Bearer QoS
- Flexible Charging
- Legacy Network Interworking Support
- *Docking Station for Service Enablers*
- *Docking Station for Applications*

IMS – Flexible & Controlled Service Provision on IP Networks

- IMS Core provides session signalling based on SIP and AAA capabilities based on Diameter
- IMS control and content Application Servers can be dynamically connected to IMS Core for signalling
- Transport is based on RTP

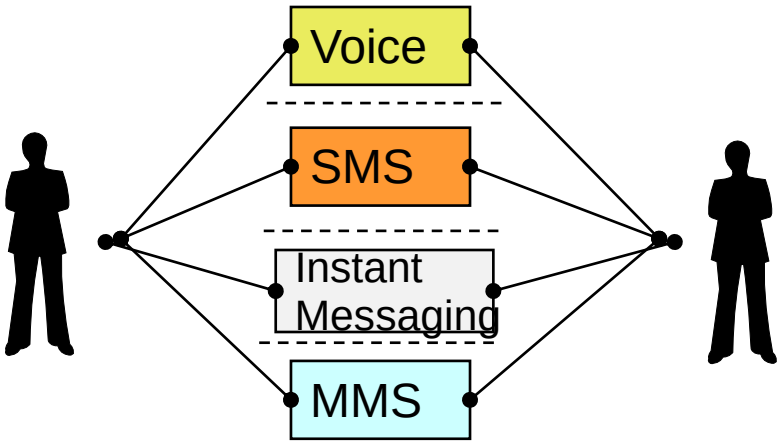


3GPP IMS Architecture: IMS Core and Application Layer



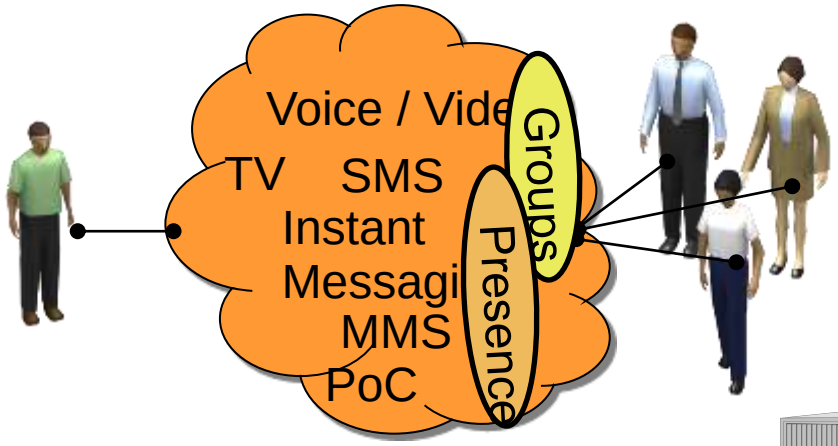
IMS integrates different Communication Services

Pre-IMS Communication
("Service Islands")



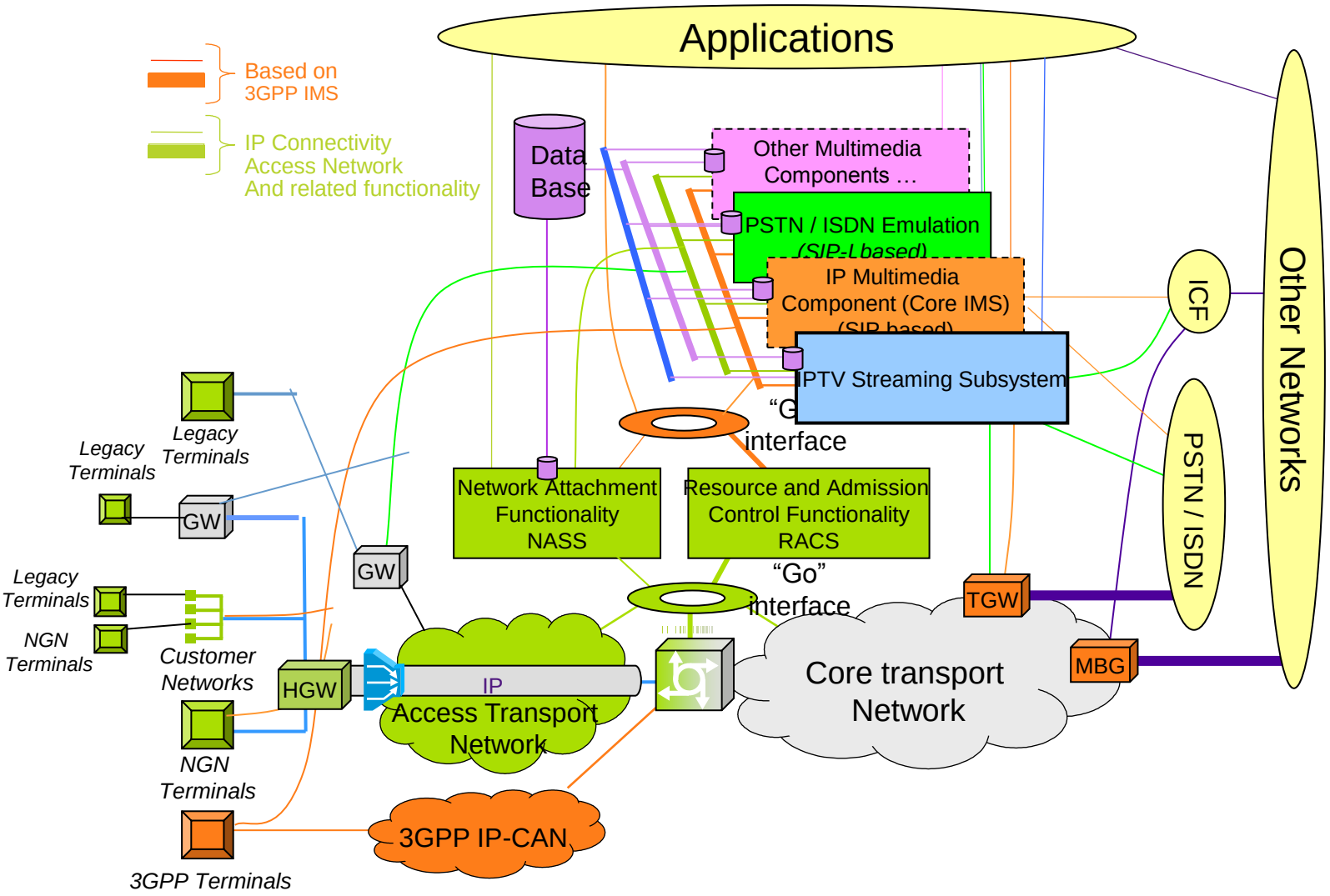
From the usage of specific individual communication services ...

IMS Communication
("Combinational Services")

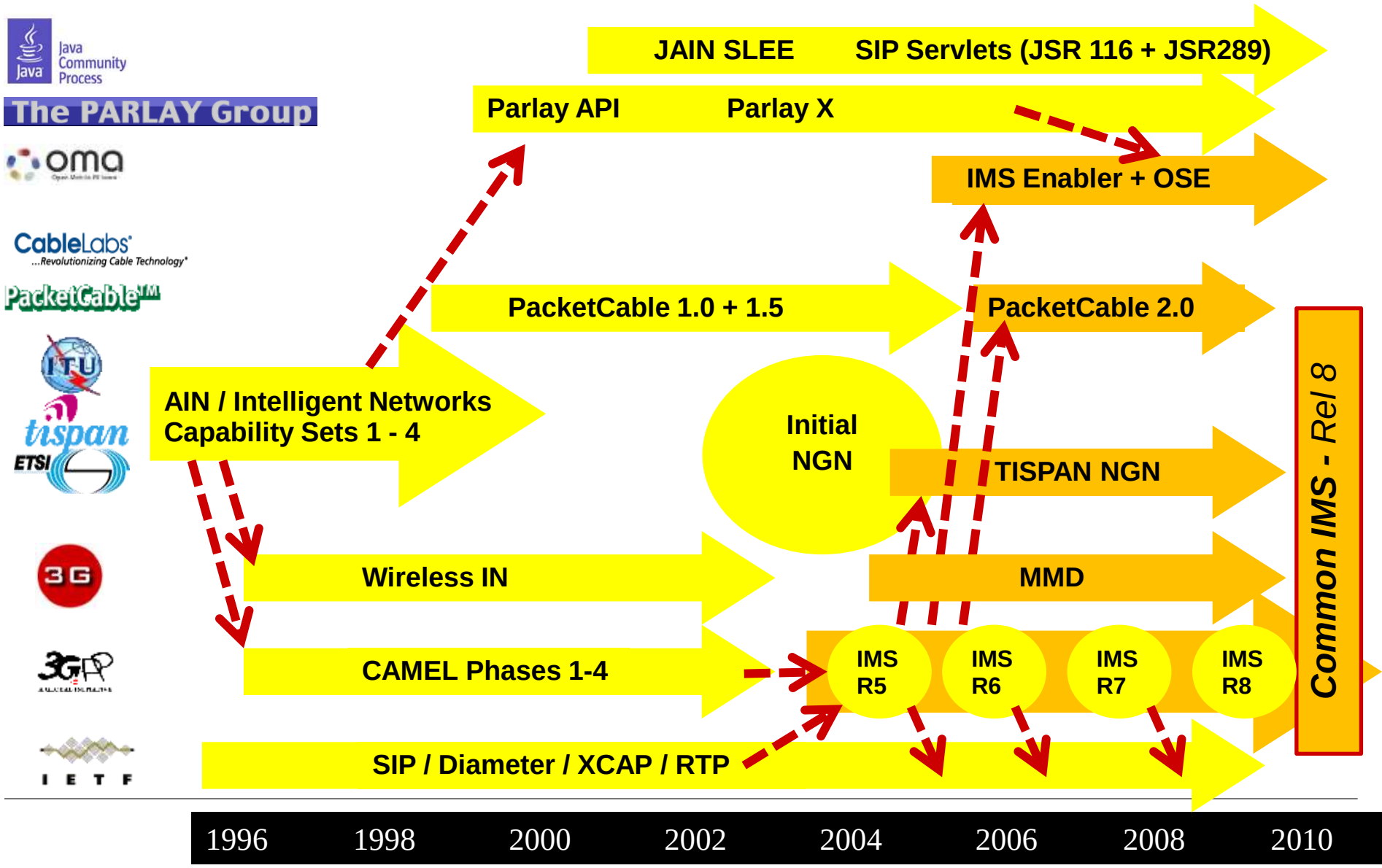


... to the integrated usage of different communication services centered around presence information and within groups (➔ communities)

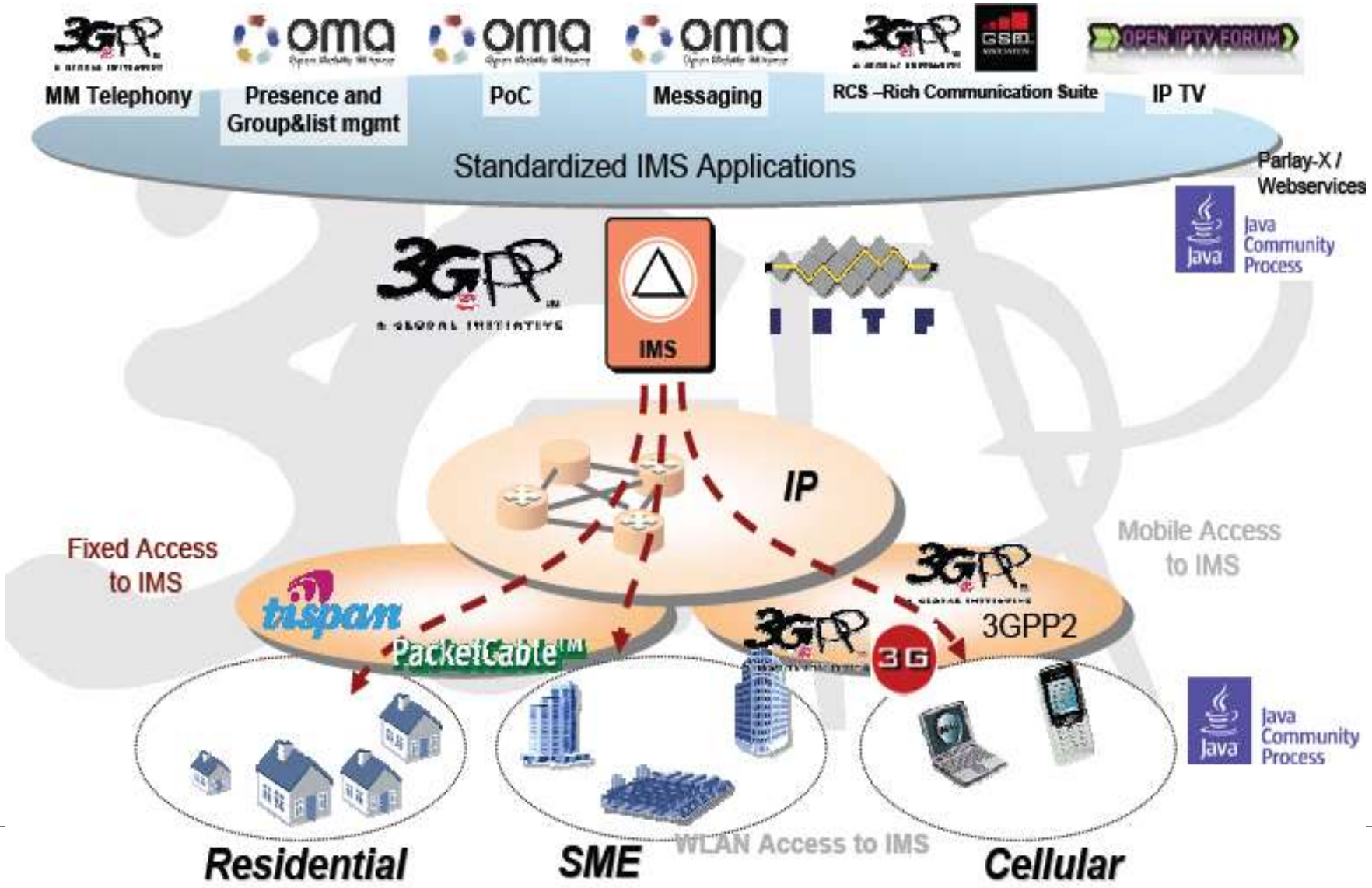
Overall TISPAN NGN Architecture



IMS / SDP Standardisation – Roadmap

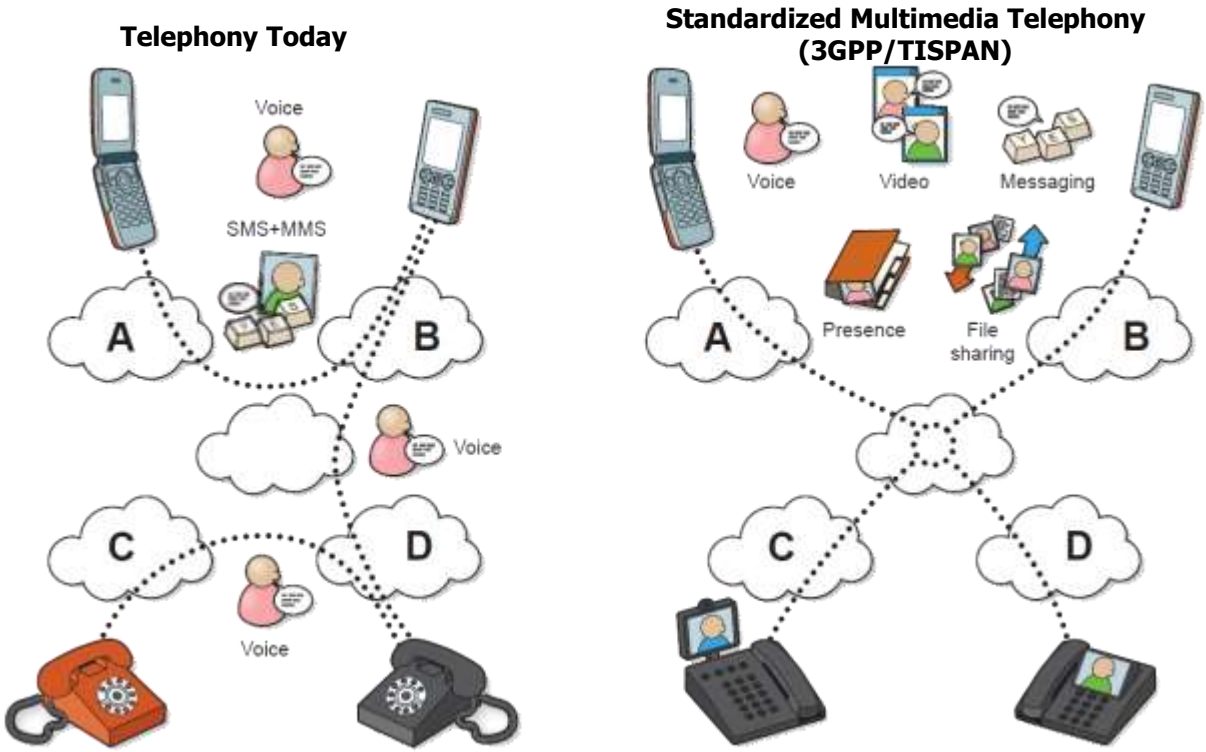


IMS Standardisation Scopes



Multimedia Telephony (MMTel) Overview

- Conventional telephony communicates using the voice medium only, and connecting only two telephones per user over circuits of fixed bit rates. In contrast, modern communication services depart from the conventional telephony service in three essential aspects; multimedia, multi-point, and multi-rate



Rich Communications Services (RCS) - based on IMS

- Enhanced Phonebook
  - with service capabilities and presence enhanced contacts information
- Enhanced Messaging
  - which enables a large variety of messaging options including chat and messaging history
- Enriched Call
  - which enables multimedia content sharing during a circuit switched voice call
- Standardized services:
  - Presence
  - Voice Call
  - IM
  - Video Share
  - Image Share
  - SMS
  - MMS

RCS Evolution

- **Release 1 (December 2008)**
  - Enhanced Address Book
  - Enhanced Messaging
  - Content Sharing
  - File Tranfer
- **Release 2 (June 2009)**
  - Release 1 features plus
  - Broadband Access to RCS features from PC and Laptops
  - Network Address Book
  - Provisioning and configuration of RCS devices/clients
  - MMTel Endorsement
  - OMA IM Endorsement
- **Release 3 (December 2009)**
  - Broadband access enhancement
  - Content sharing enhancement
  - Social presence information enhancment
  - Messaging enhancement
  - Network value added services
- ***RCSe (e=enhanced)***
  - ***Light weight version***
  - ***Branded as „Join"***
- See also *www.**gsma**.com/rcs*

RCS and VoLTE Interoperability Testing

- RCS VoLTE IOT builds on previous IOT Events
  - MSF LTE/EPC IOT in March 2010 & VoLTE IOT in September 2011
  - ETSI IMS Plugtests

- MSF partnered with ETSI & GSMA to jointly organise this event
  - Reflects the common focus of all 3 partners in VoLTE & RCS
  - Endorses a number of GSMA PRDs
  - Joint Task Force, comprising members from the partner organizations, formed to oversee all aspects of the event

  - Event web site at: http://www.msforum.org/interoperability/RCSVoLTE.shtml

IMS Road Map

IMS Deployment Roadmap

2005	2006	2007	2008	2009	2010	2011	2012	2013-2014

IMS Reaches Trial Stage
The bulk of HSS, CSCF, BGCF, PSTN gateways, and application sever (mainly voice app server) equipment move from lab testing to field trials, some moving to services by the end of 2007

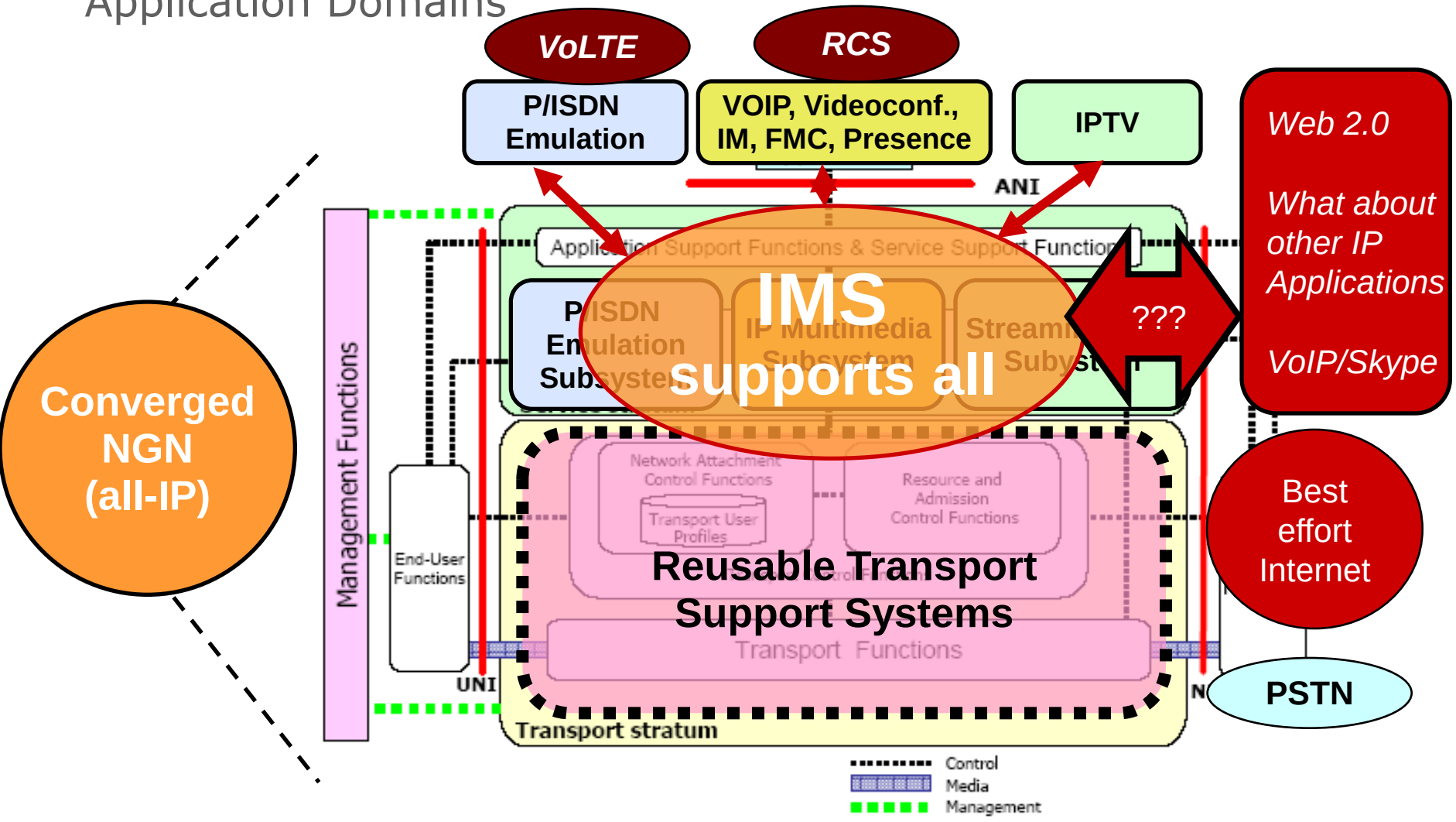
IMS Networks Emerge
IMS deployments consist of an HSS and a CSCF to support fixed-line VoIP services deployed by both large incumbents expanding out of their home turf, and mobile operators jumping into the fixed line business

IMS Deployments Ramp Up
Large fixed-line incumbents continue to migrate their infrastructure from PSTN to TISPAN. Mobile operators begin to deploy IMS with the adoption of RCS in 2010 and the migration of their mobile infrastructure to LTE, with massive IMS deployments expected in 2012.

Source: Infonetics

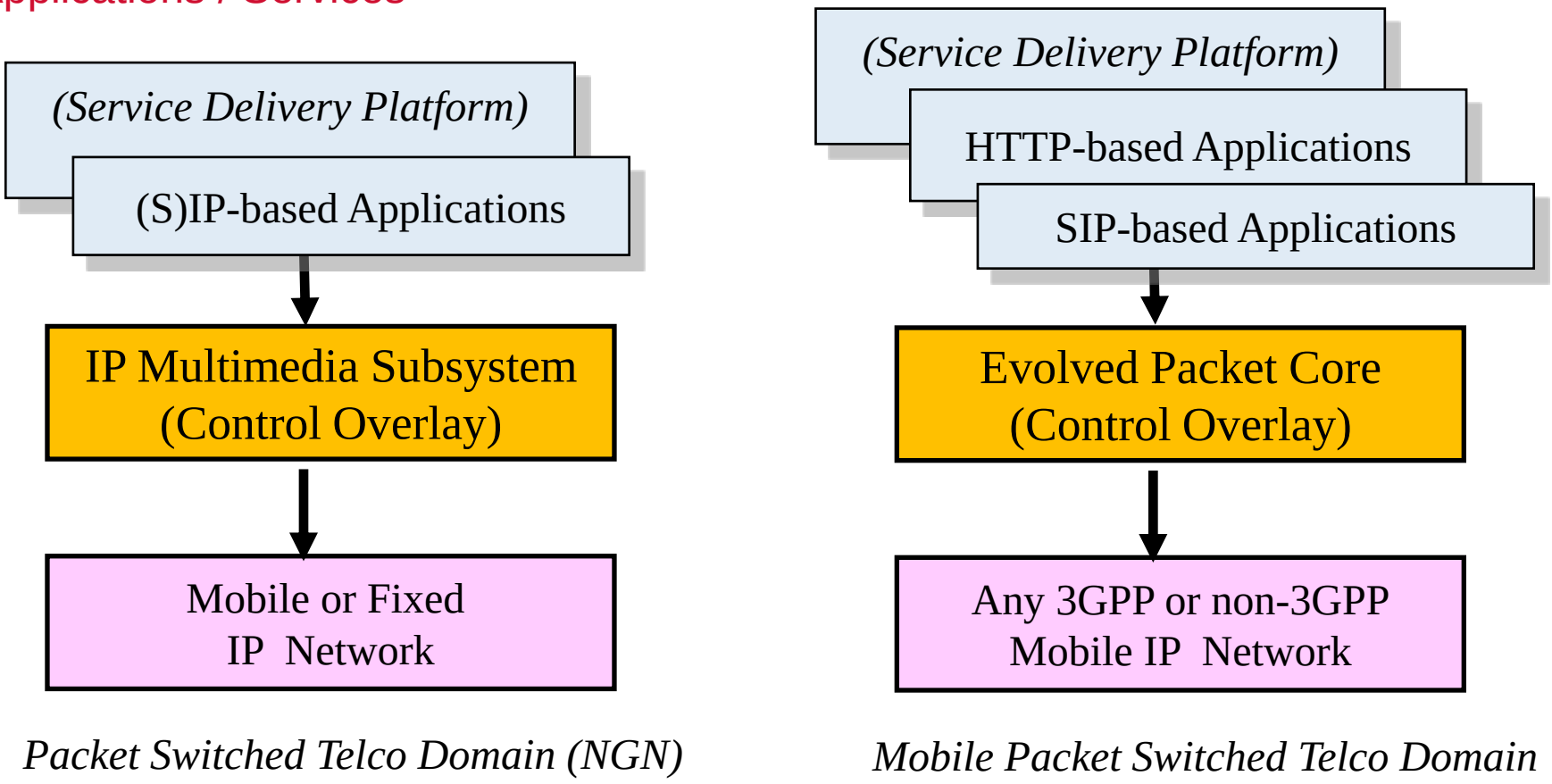
Industry expects IMS deployment to ramp up, driven by PSTN migration from fixed line operators and migration to LTE together with RCS adoption from operators

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

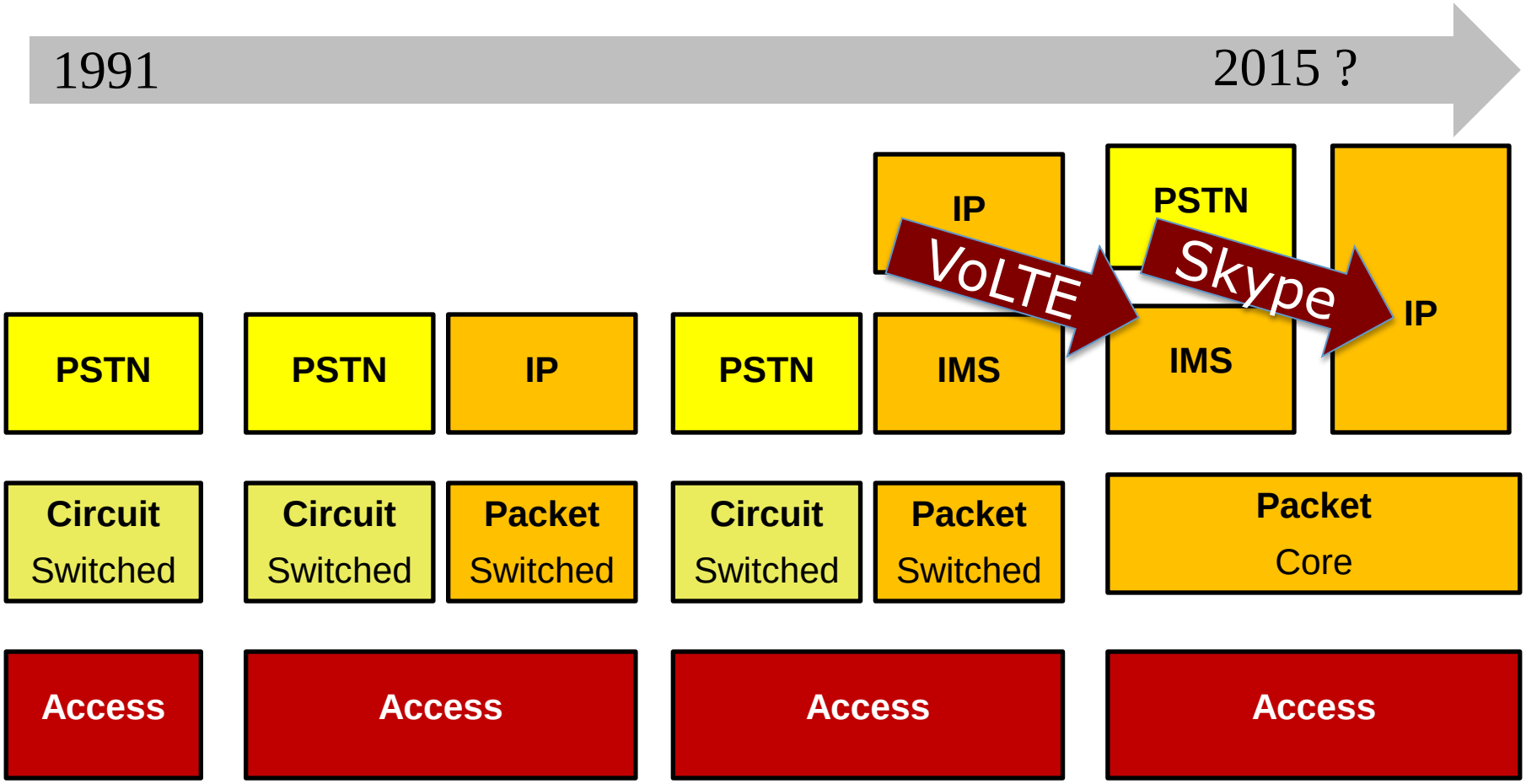


IMS Concept Evolution toward EPC

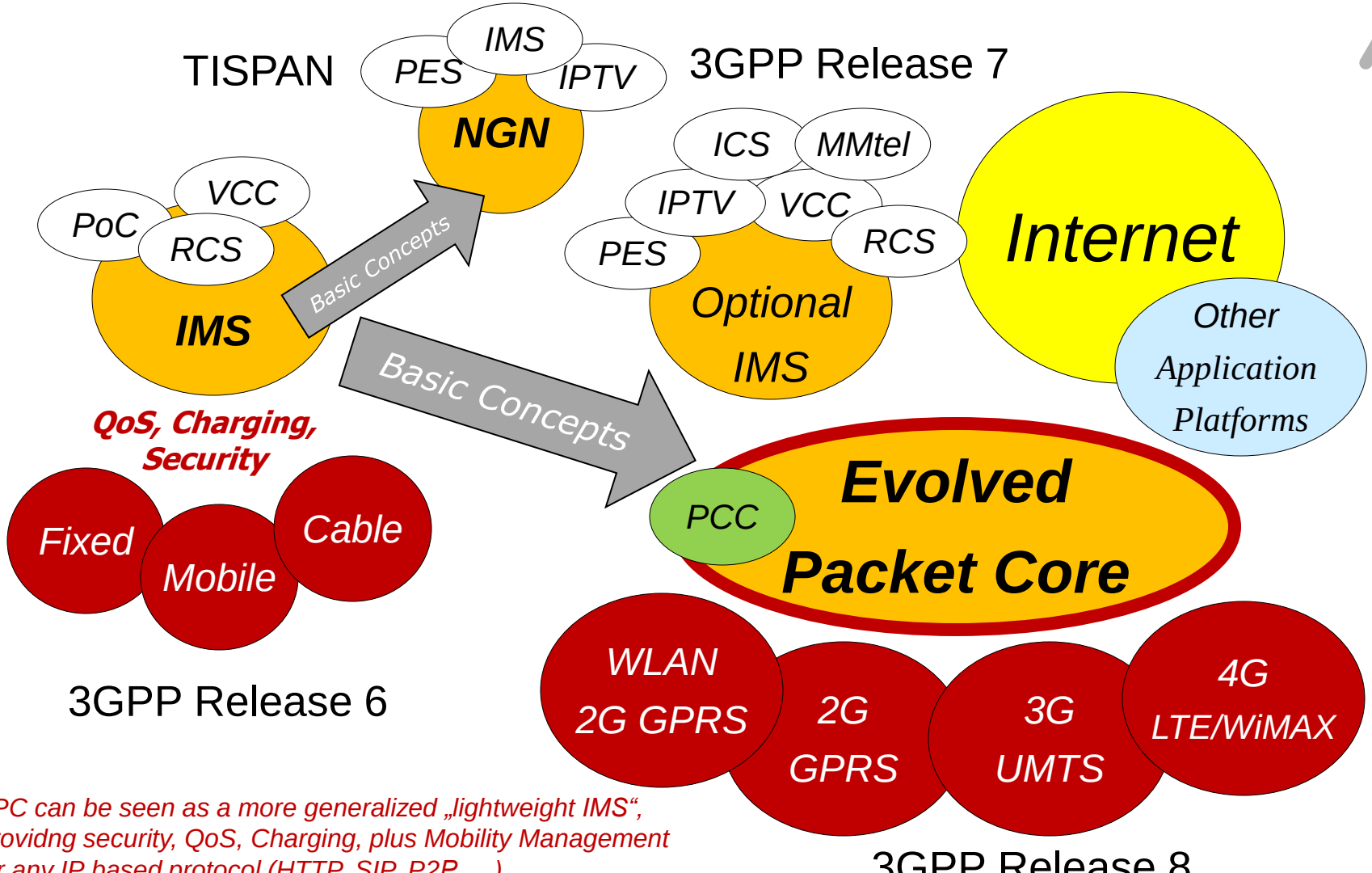
Main Idea: Common Control Overlay Architecture abstracts from underlying IP network technology and provides common platform capabilities for any IP-based Applications / Services



Mobile Network Architecture Evolution



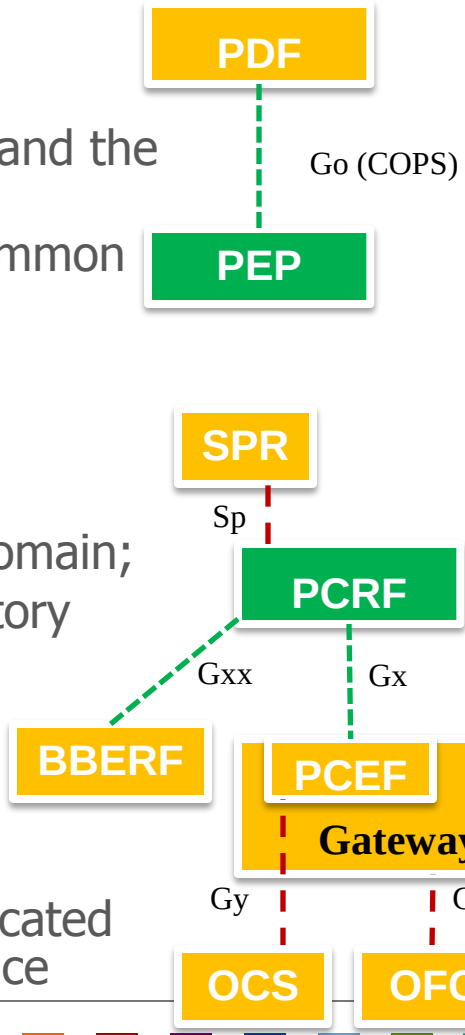
Concept Reuse: From IMS for NGN to EPC for all-IP



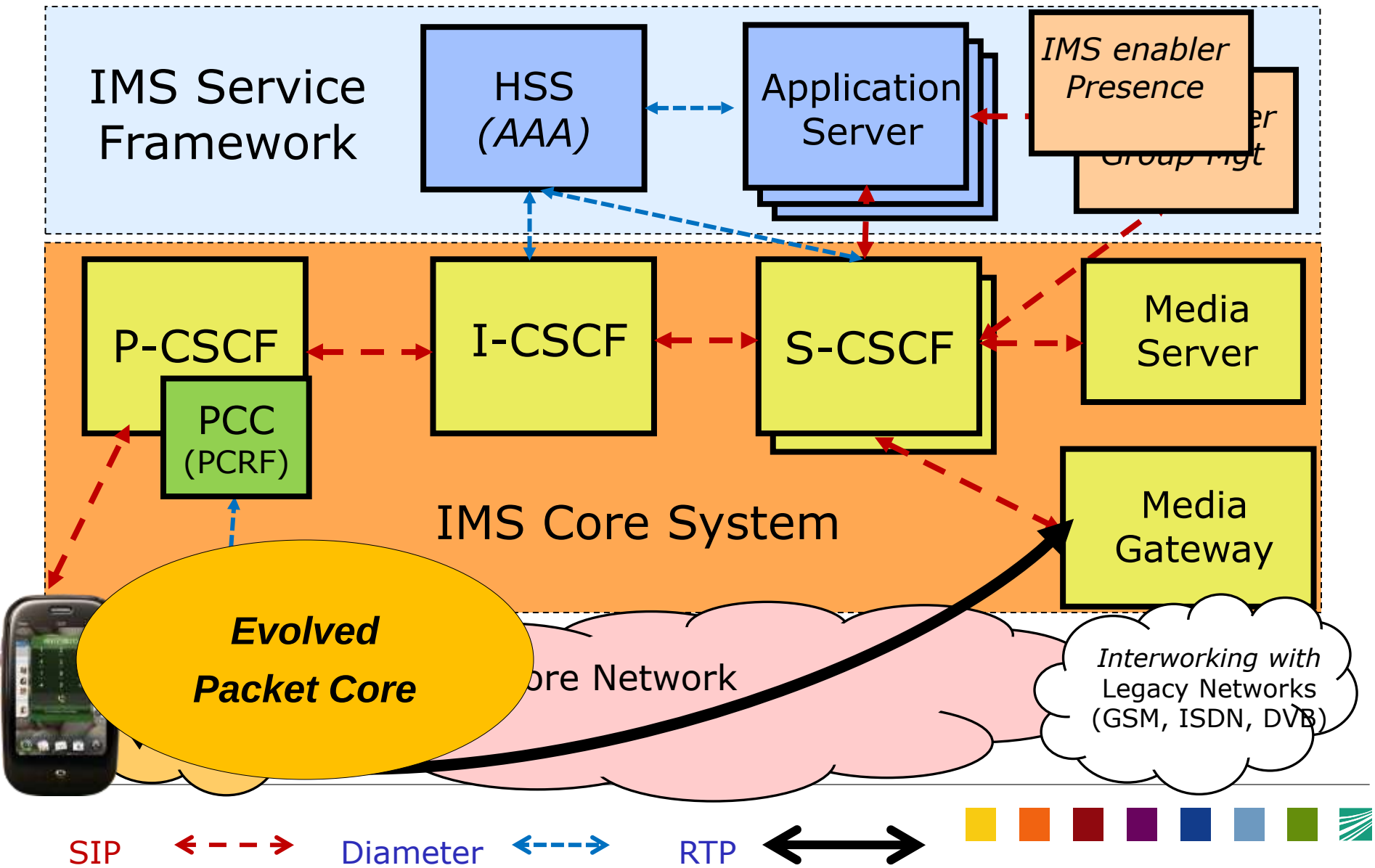
EPC can be seen as a more generalized „lightweight IMS“, Providng security, QoS, Charging, plus Mobility Management for any IP based protocol (HTTP, SIP, P2P, …)

PCC's Architecture Evolution (R6-R7-R8-onwards)

- Release 6 Policy Control (only QoS and gate control)
  - was developed to cope with IMS based services
  - two components: the Policy Decision Function (PDF) and the Policy Enforcement Point (PEP).
  - Policy decisions transferred by Go Interface using Common Open Policy Service (COPS) protocol.
- Release 7 PCC (Policy and Charging Control)
  - More complex architecture; it unifies Qos, policy and charging control;
  - Provides separation from the entities from the IMS domain;
  - A new component is added Subscriber Profile Repository (SPR) for subscription related policy control.
- Release 8 PCC
  - New Bearer Binding and Event Reporting Function (BBERF);
  - The BBERF is specific to each IP-CAN type and is allocated in the corresponding Gateway though the Gxx interface



3GPP IMS Architecture: IMS Core and Application Layer



Who is Who in Next Generation Mobile Network context?

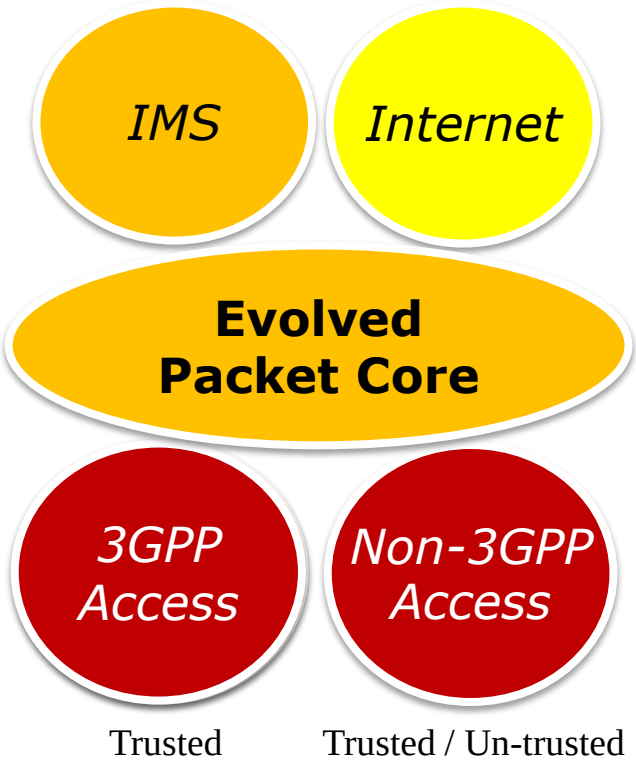
- NGMN Alliance defines LTE/EPC Requirements
  - http://www.ngmn.org

- 3GPP developes LTE/EPC Specifications
  - http://www.3gpp.org/Highlights/LTE/LTE.htm
  - http://www.3gpp.org/Specification-Numbering

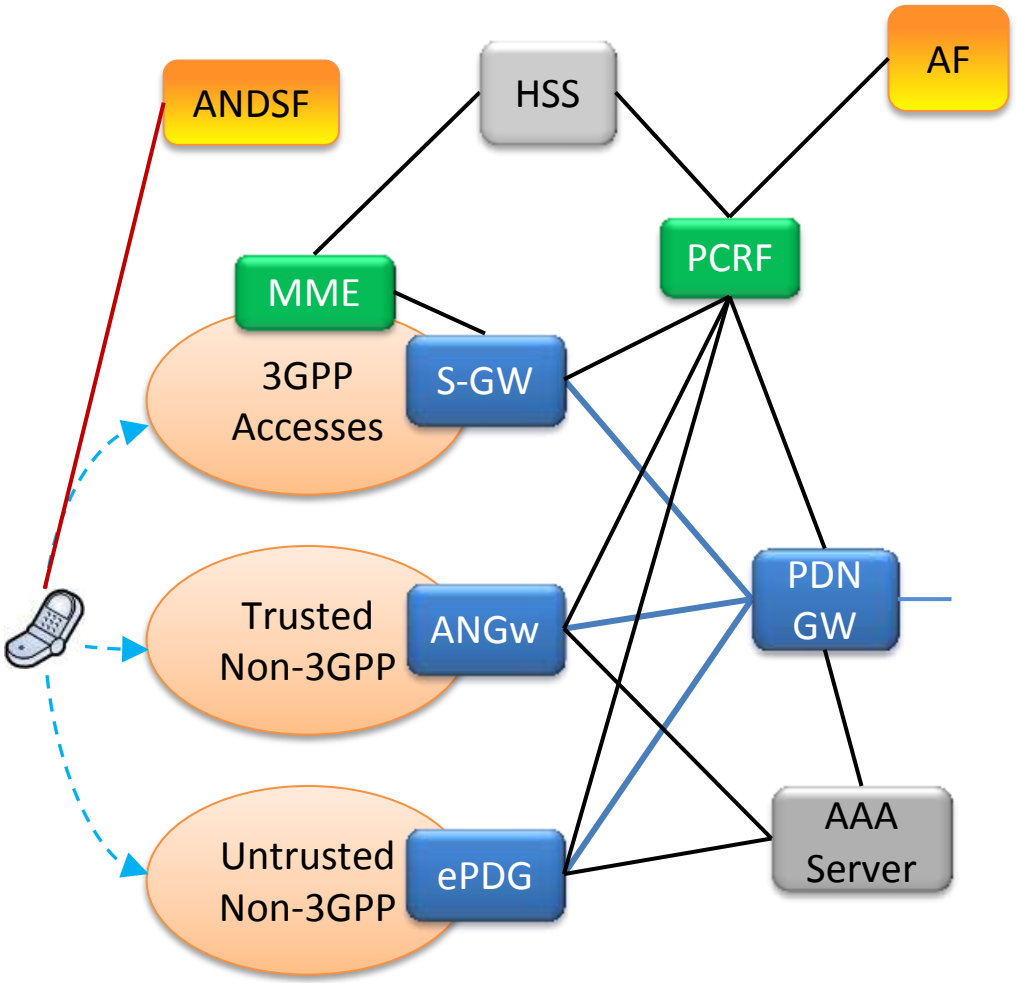
- LTSI performs Proof of Concept / Interoperability Tests
  - http://www.lstiforum.org/file/news/Latest_LSTI_Results_Feb09_v1.pdf

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

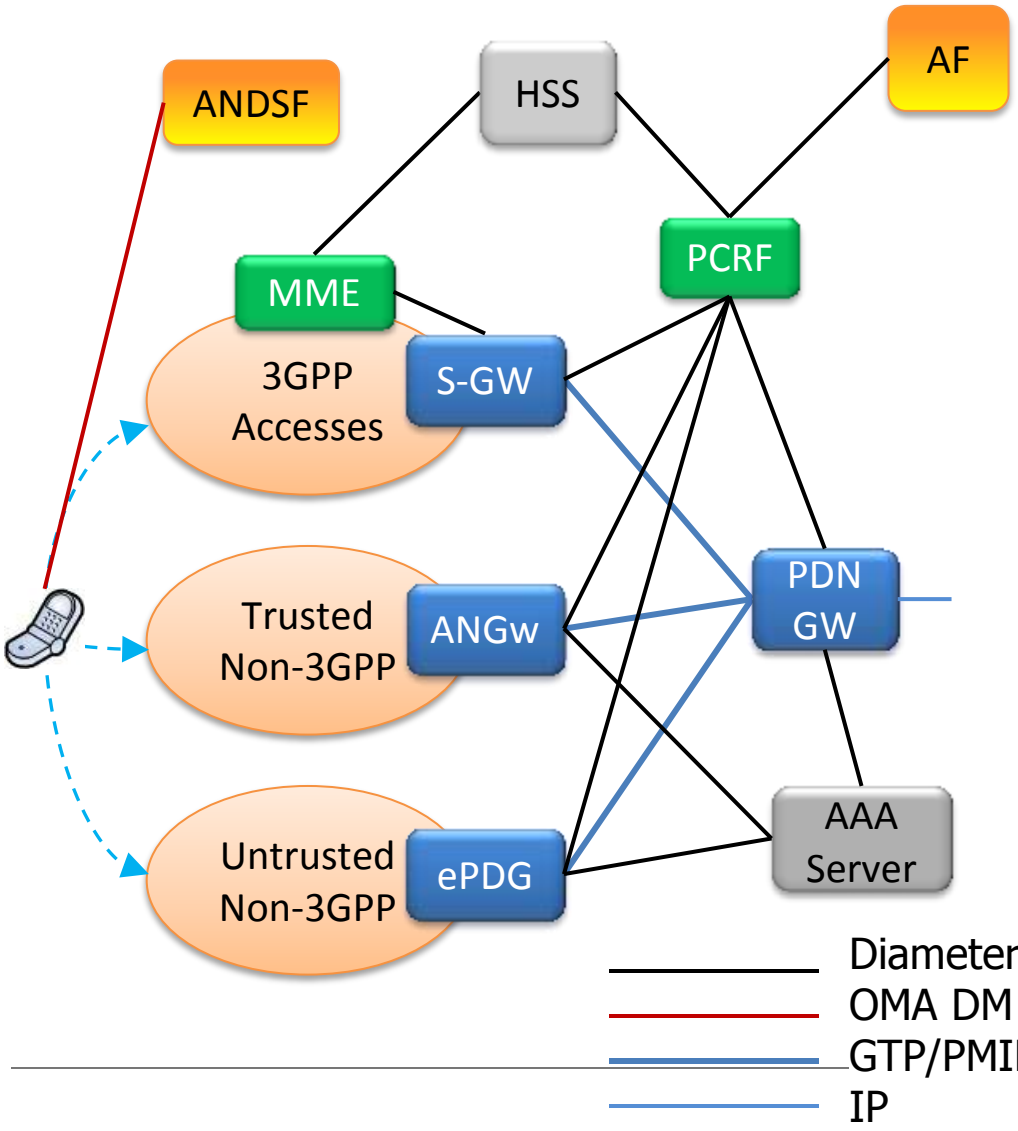


3GPP EPC Architecture



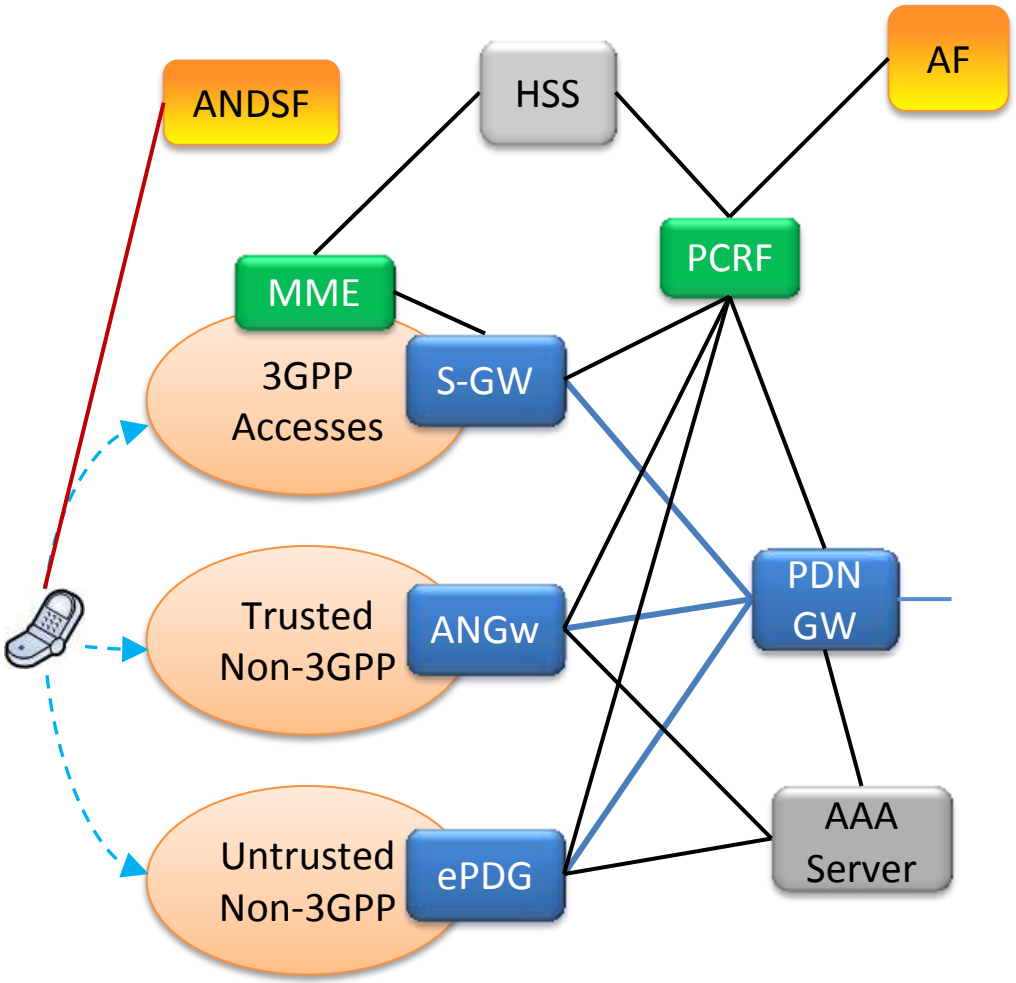
- Gateways – Access Network Specific and Centralized
  - Data forwarding
  - Unified policy based Enforcement
  - Transparent Mobility
- Control Entities – Subscription based:
  - Mobility Management in 3GPP accesses
  - Policy and Charging decisions
    - Based on the App. requirements
  - Access Network Discovery and Selection
- Subscription Entities
  - Home Subscriber Server – Imported from IMS
  - AAA server for communication with non-3GPP Accesses

3GPP EPC Protocols



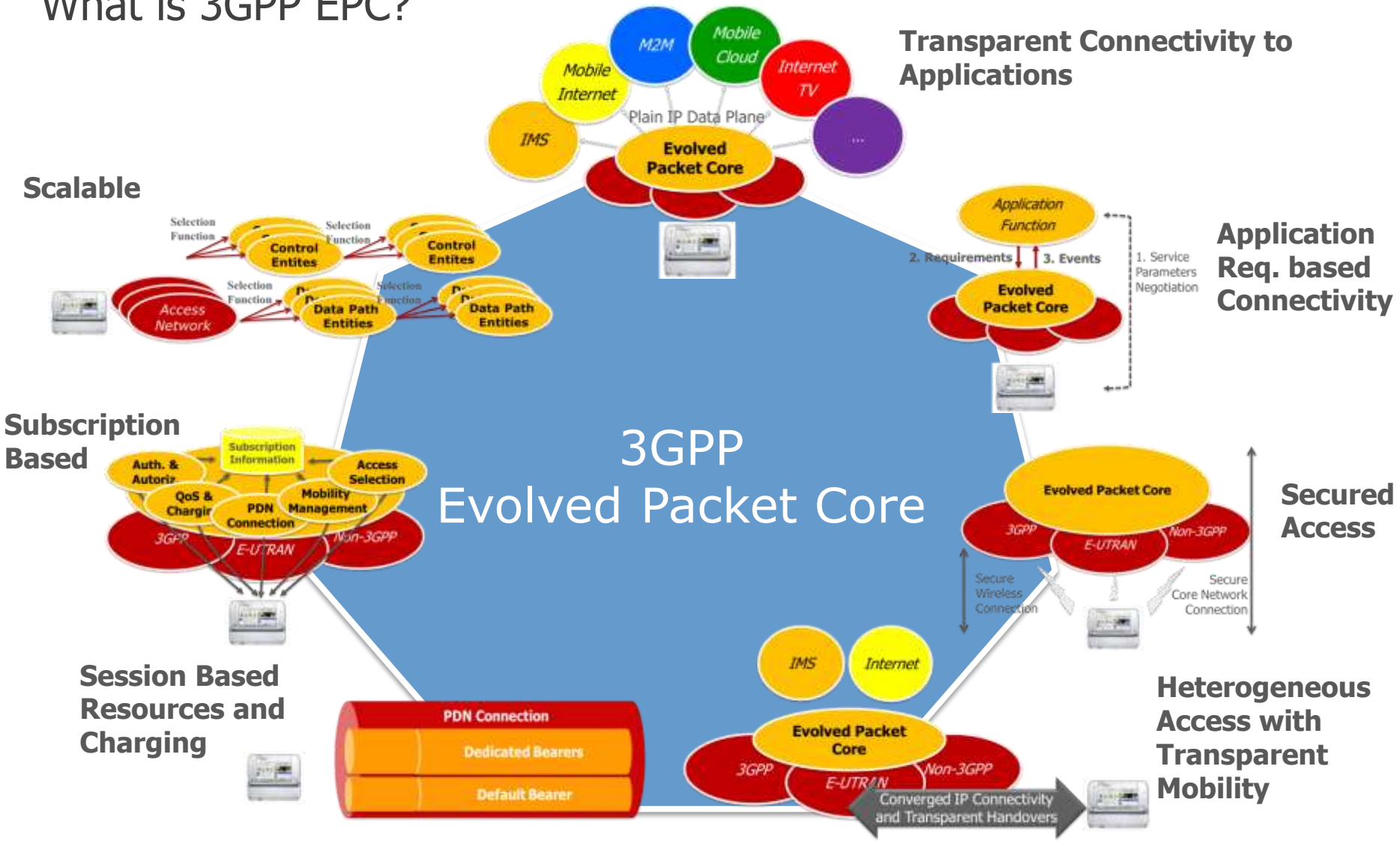
- Mobility and forwarding protocols
  - GPRS Tunneling Protocol (GTP)
  - Proxy Mobile IP (PMIP)
  - Mobile IP (MIP)
- Control protocols
  - Diameter for the communication with:
    - Subscription Repositories
    - Applications
    - Enforcement Points
- Communication with Mobile Devices
  - OMA Device Management (DM)

3GPP EPC Functional Features

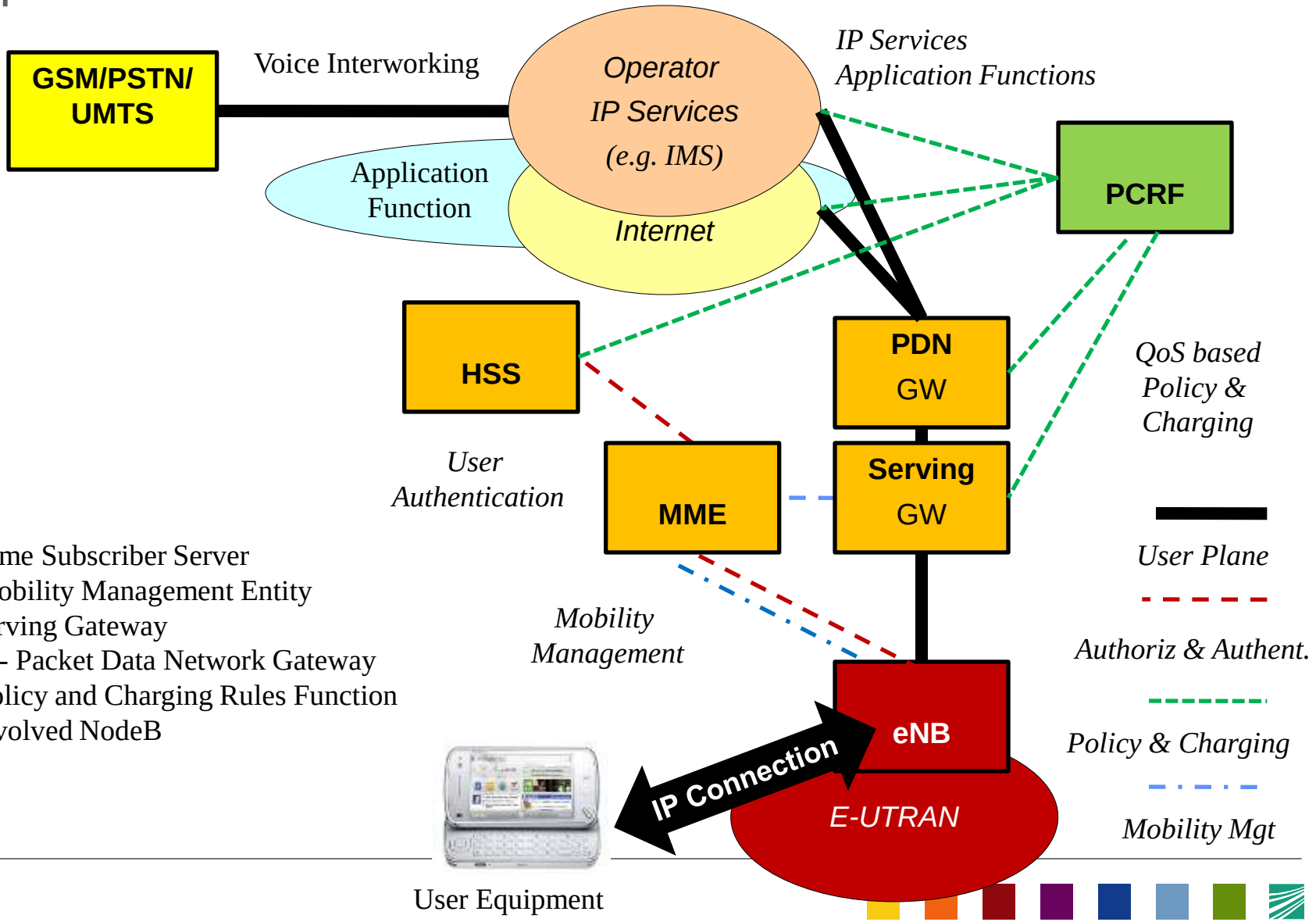


- Network Access Control Functions
  - Authentication and Authorization
  - IP reachability context
  - Indirection tunnel establishment
  - Default bearer is initialized
- Resource Management Functions
  - Application and UE triggered resource reservations
  - Policy based decisions
  - Enforcement of QoS rules on the data path
- Mobility Management Functions
  - Intra-3GPP → MME controlled
    - Soft handovers
  - With non-3GPP → ANDSF assisted
    - Only hard handovers (except CDMA 2000)

What is 3GPP EPC?

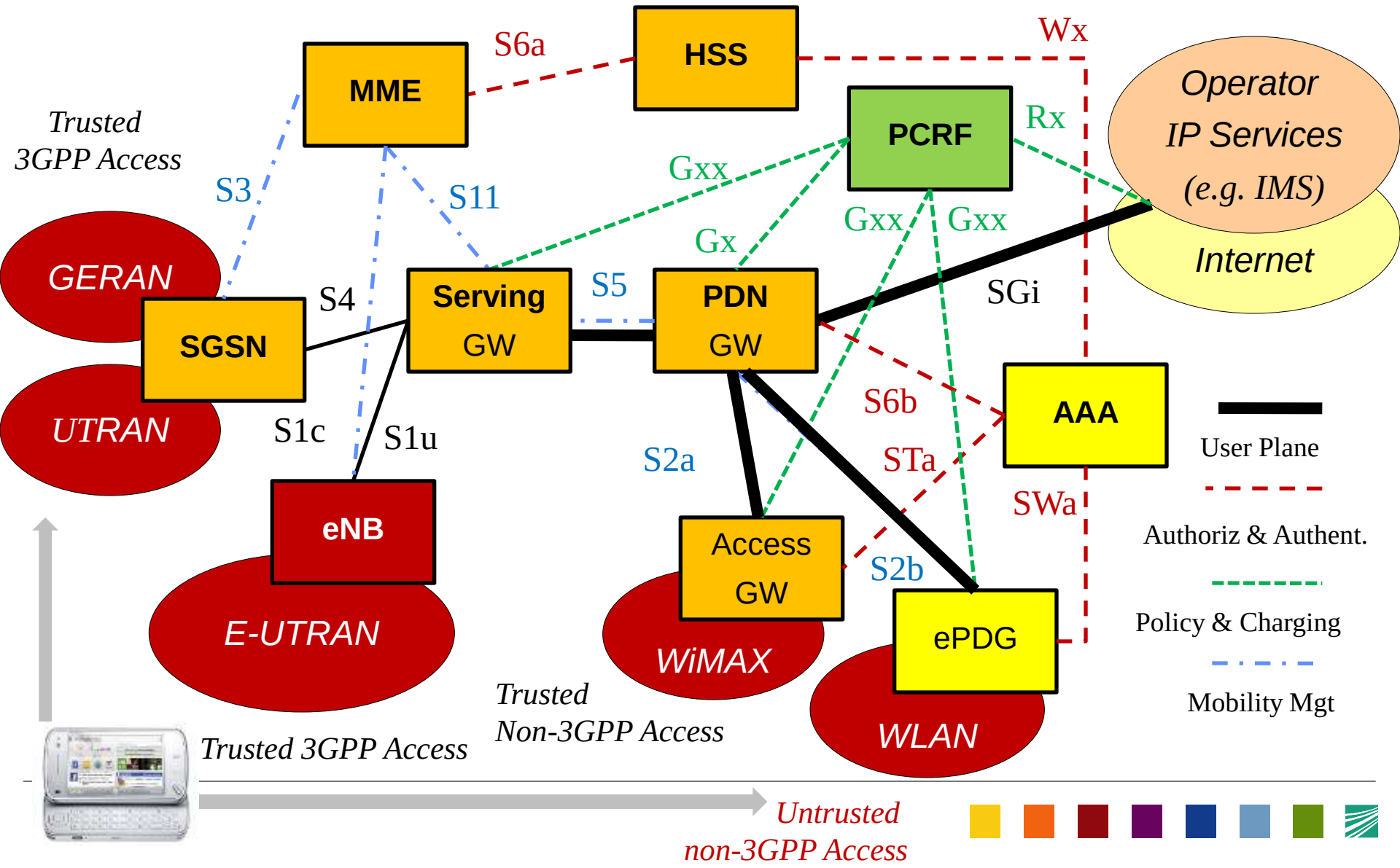


Simplified EPC Architecture



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

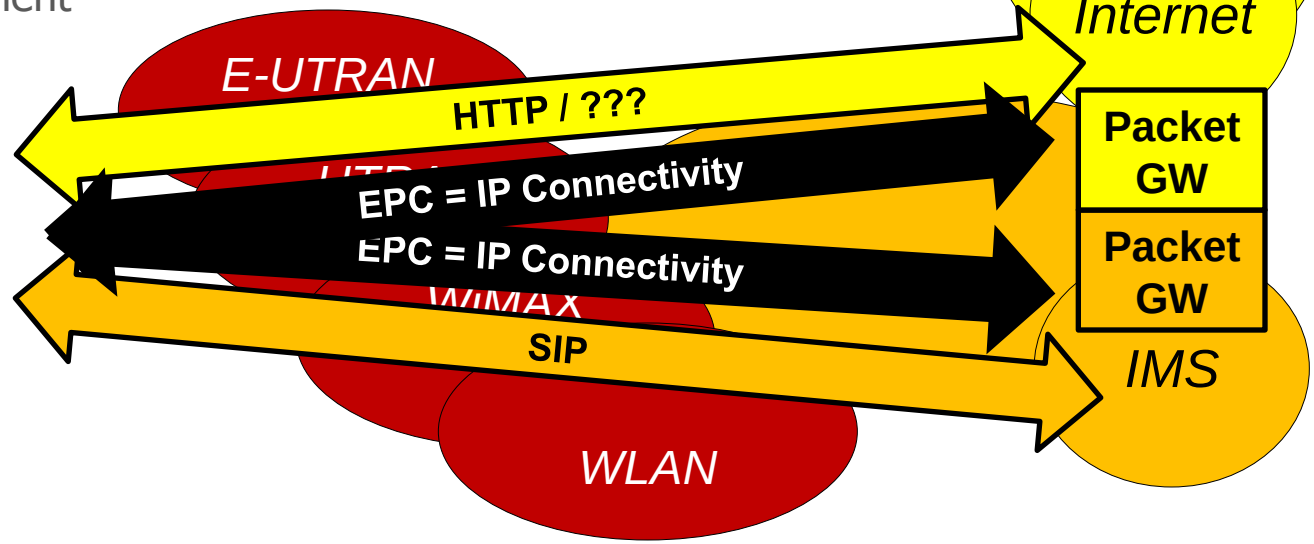
Full EPC Architecture



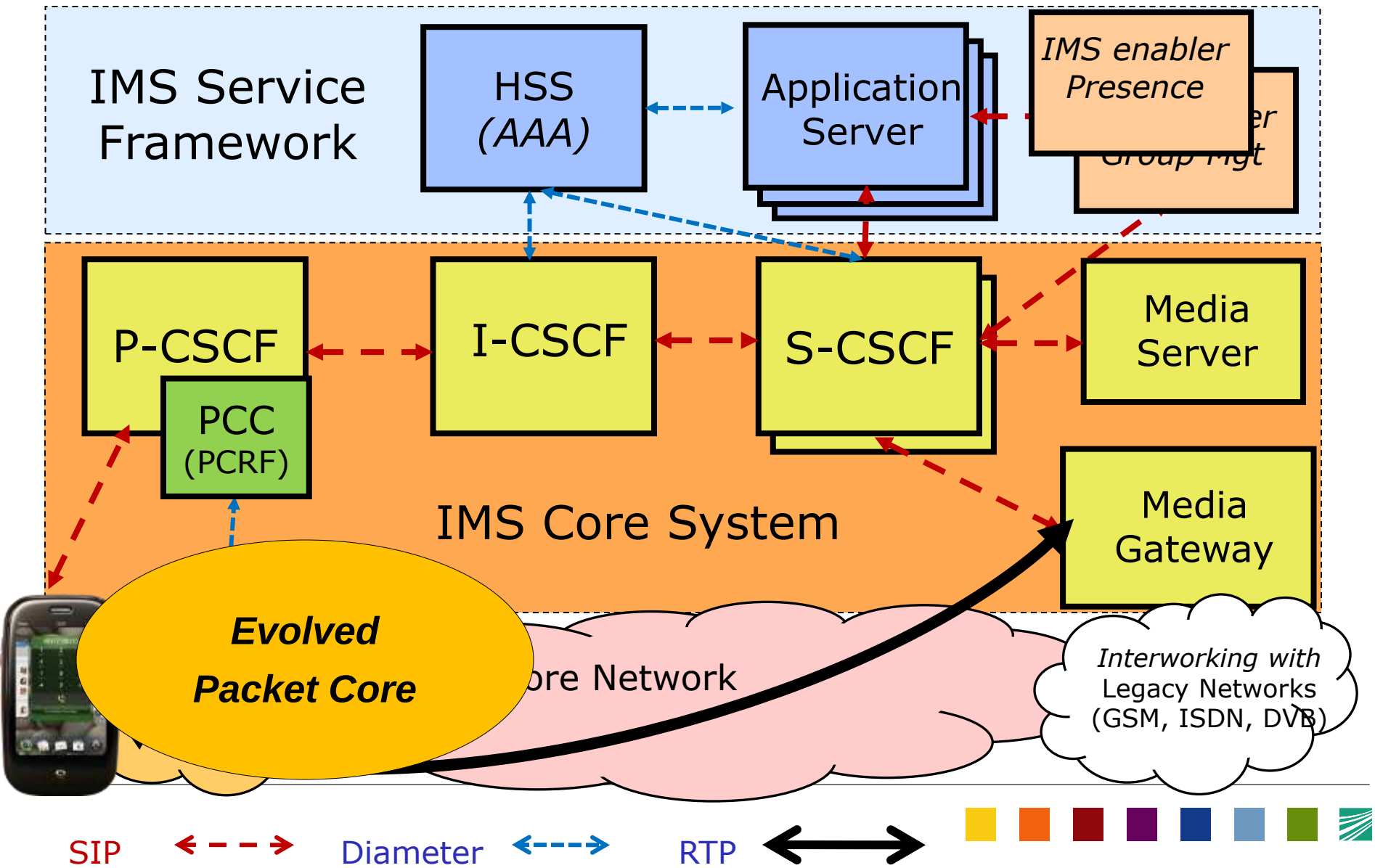
EPC Capabilities = Seamless IP Connectivity (= ABC)

- 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

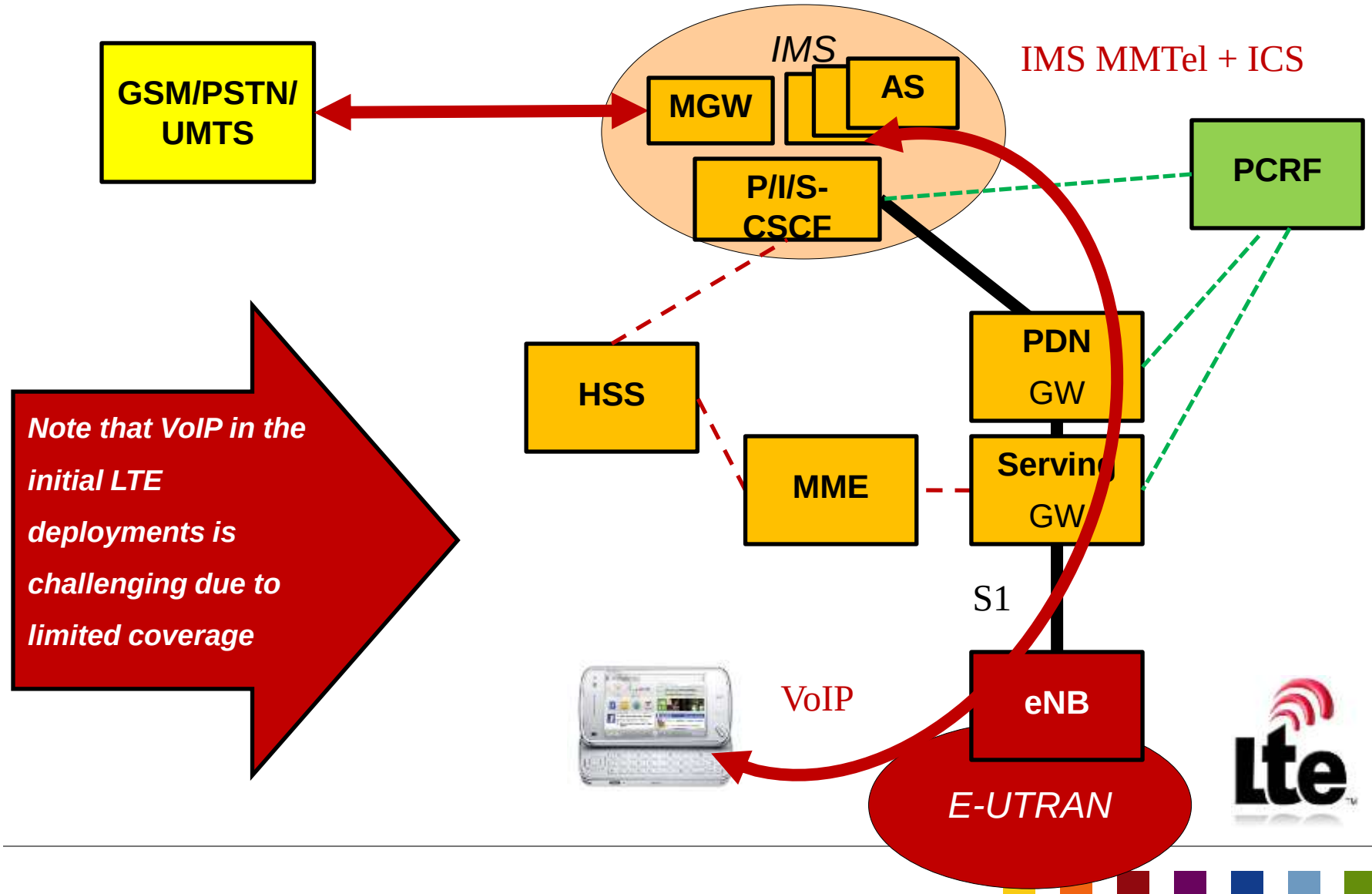
User Equipment
may be connected to several IP service domains in parallel



3GPP IMS Architecture: IMS Core and Application Layer



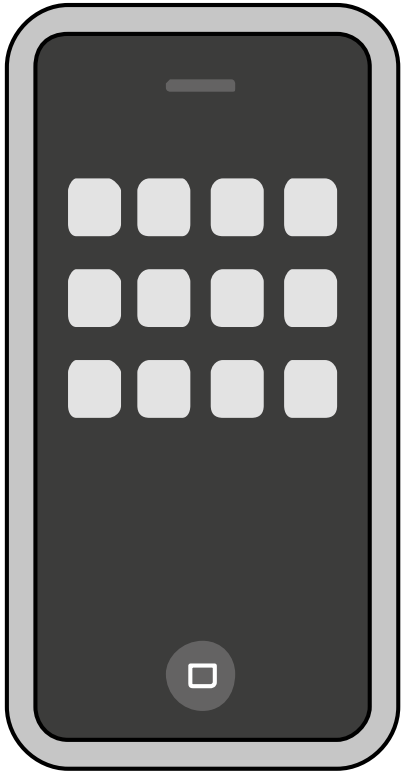
IMS VoIP in EPC Architecture is called VoLTE



Voice over LTE (VoLTE)

- GSMA VoLTE (Voice over LTE) - a standard way of delivering voice and messaging services for Long-Term Evolution (LTE)
  - VoLTE = Voice and SMS for LTE
- VoLTE is based on the One Voice Initiative (from 2009) which was based on the 3GPP IMS
  - VoLTE is not a new standard
  - VoLTE selects pieces of the IMS standard
- VoLTE realization principles:
  - *Single implementation promotes scale*
  - *Single implementation reduces complexity*
  - *Single implementation enables Roaming*

VoLTE Features



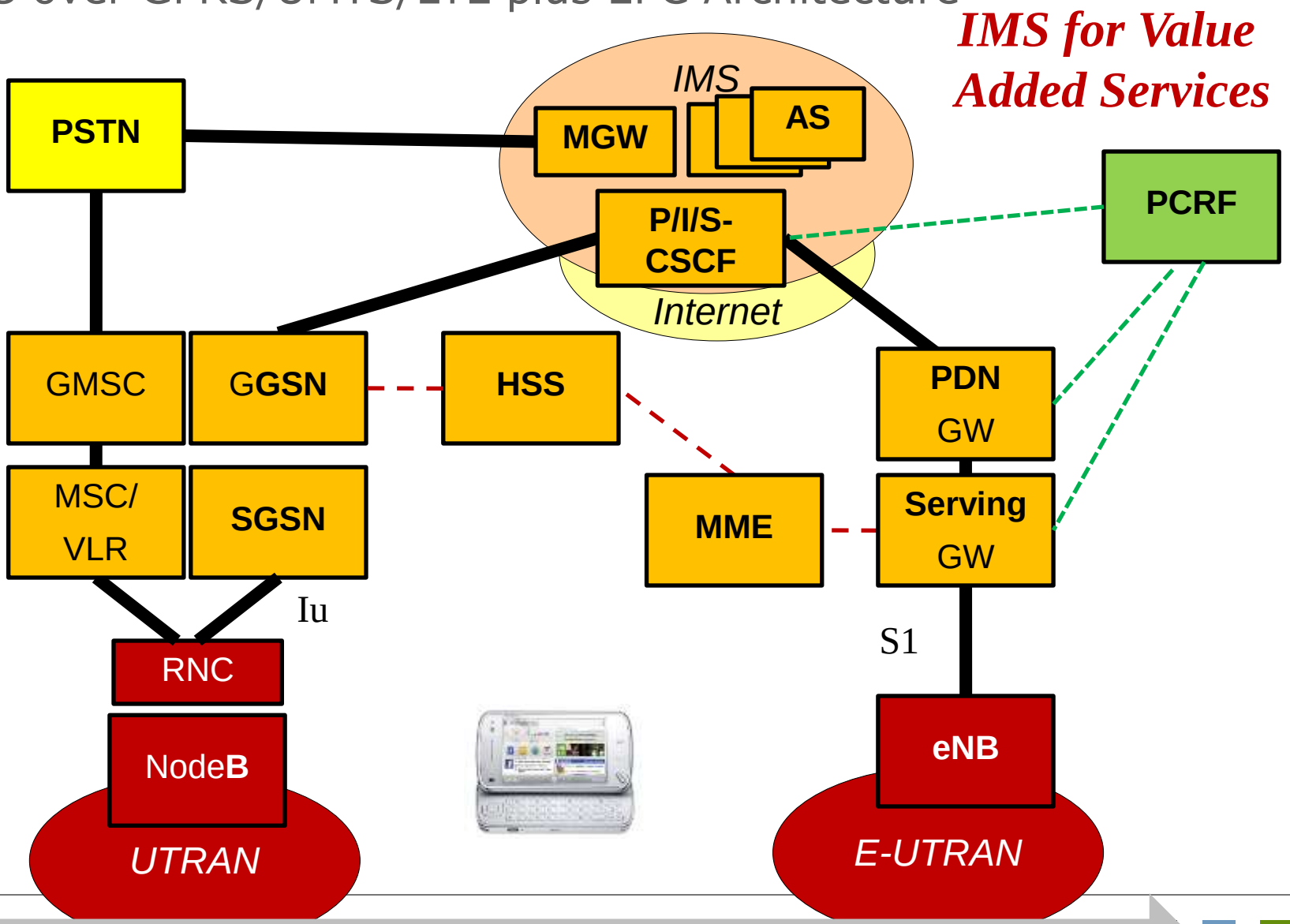
MMTel
Telephony and Supplementary Services
SR-VCC

IMS
Control and Media Features
SMS
Emergency Calls
Roaming

EPC
IP flow and bearer management Features
Roaming

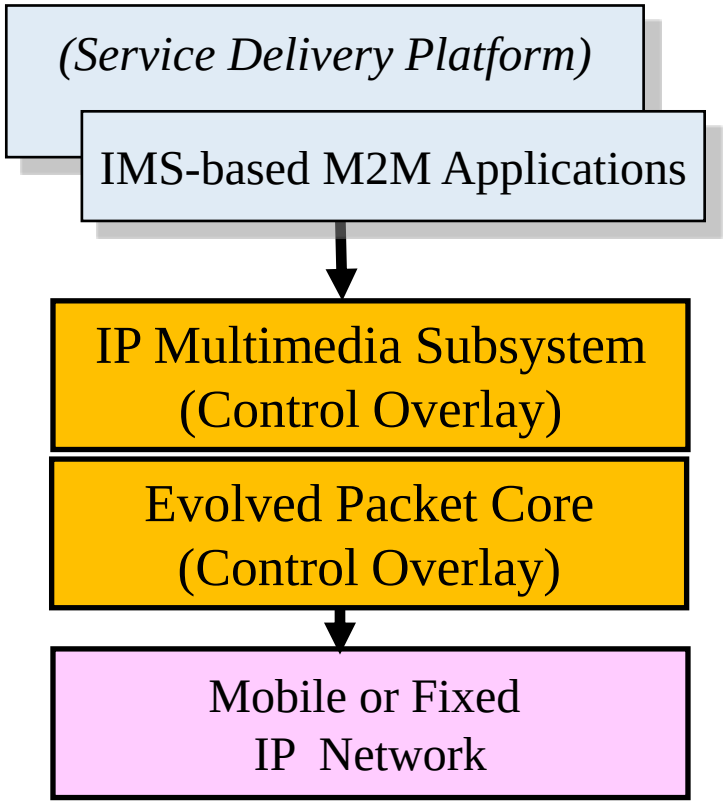
LTE
Radio Capabilities for VoIP

IMS over GPRS/UMTS/LTE plus EPC Architecture

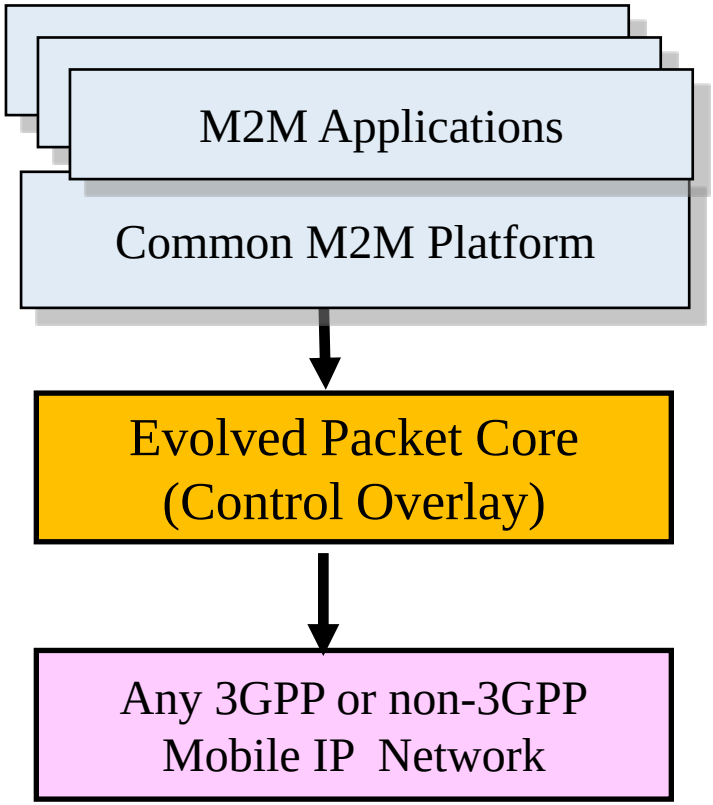


From IMS to M2M Platforms above EPC

Main Idea: Common Control Overlay Architecture dedicated for M2M
Communication needs unifying the existing variety of specialized M2M SDPs



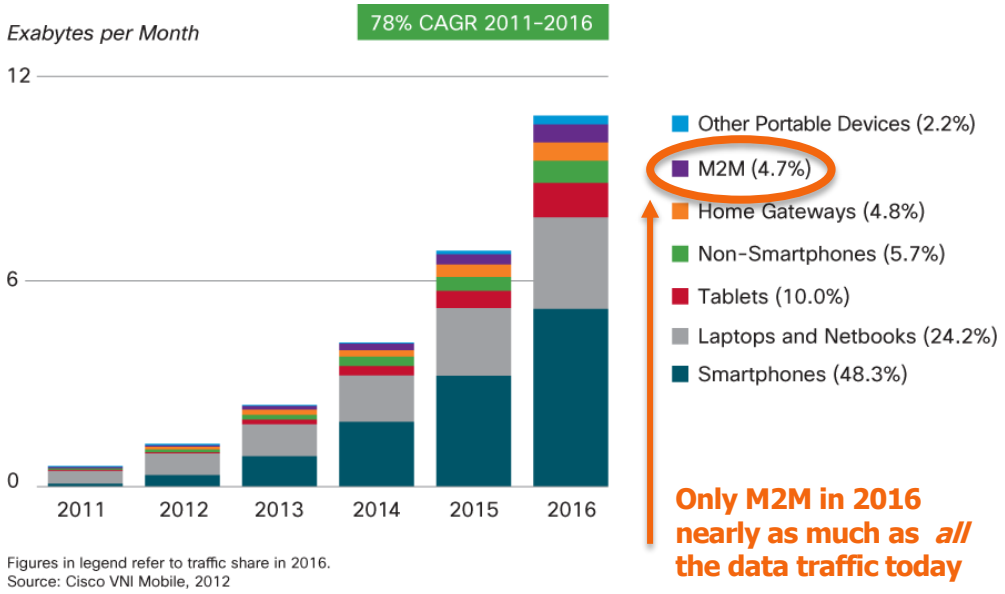
Fixed or Mobile NGN



Mobile Packet Switched Telco Domain

Global Mobile Data Traffic Forecast 2012 - 2016

- Mobile data traffic increase is parallel to the increase in number of devices
- The device capabilities are spanning
  - from: simple sensor nodes
  - to: high definition video cameras
- The comm. requirements are spanning
  - from: a "four byte" fire alarm
  - to: continuous real-time HD video streaming



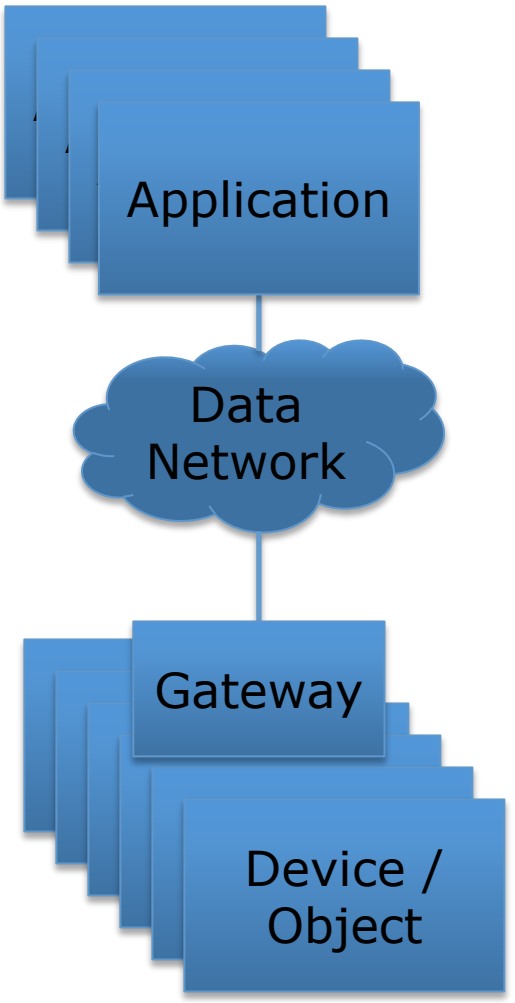
Figures in legend refer to traffic share in 2016.
Source: Cisco VNI Mobile, 2012

Device Type	Growth in Users, 2011-2016 CAGR	Growth in Mobile Data Traffic, 2011-2016 CAGR
Smartphone	24%	119%
Portable gaming console	56%	76%
Tablet	50%	129%
Laptop and netbook	17%	48%
M2M module	42%	86%

Source: Cisco VNI Mobile, 2012

What is M2M? Some characteristics …

- It's all about scale!
- Heavily growing market
  - # of devices
  - # of connections / amount of traffic
  - # of applications
- Highly heterogenous traffic
  - from simple sensor nodes to high definition video cameras
  - from a "four byte" fire alarm to a continuous real-time HD video streaming
- Invisibility & Automatism (e.g. fridge)
- Critically (e.g. eCall)
- Intrusiveness (e.g. fridge posting images of my food to facebook …)



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

Classic M2M Segments

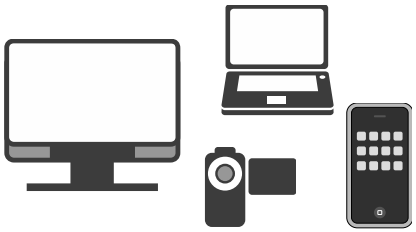
Automotive

Security

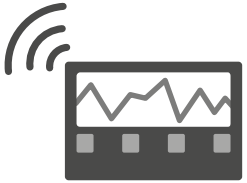
Tracking & Tracing

Payment

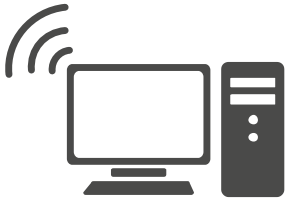
Healthcare



Consumer Electronics

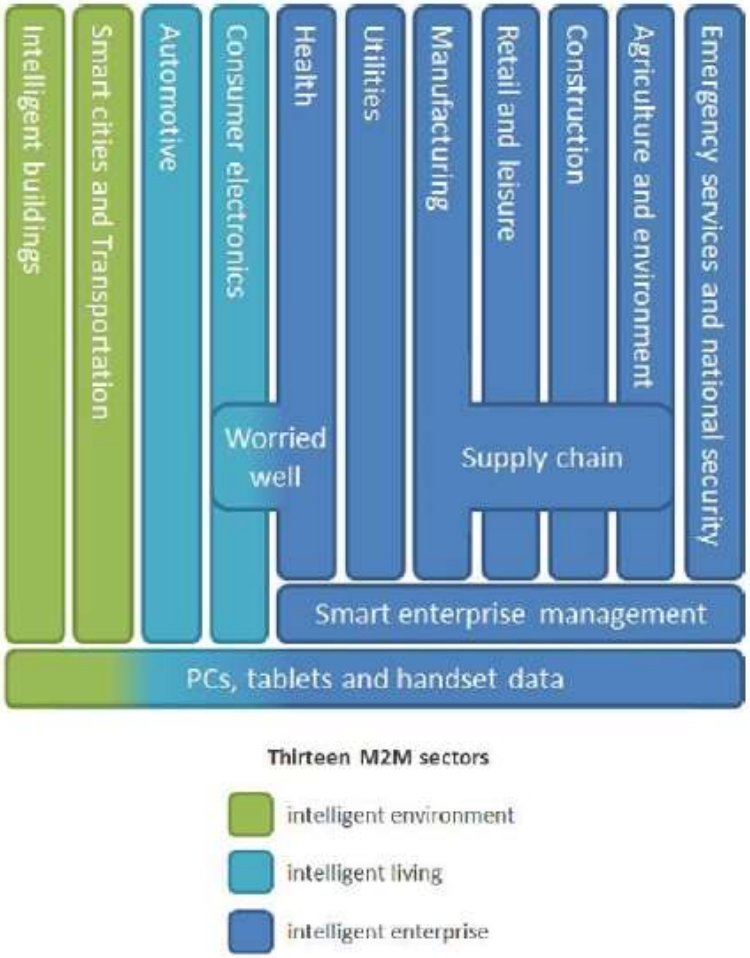


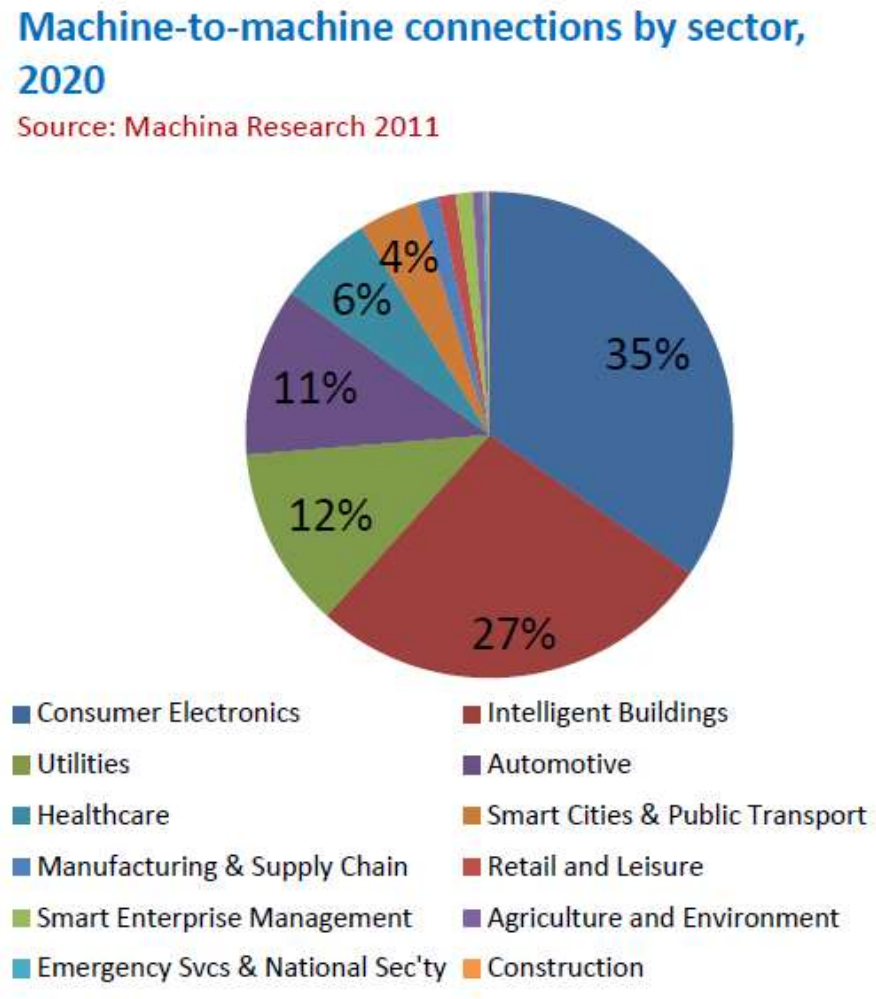
Metering



Remote Maintenance and Control

M2M sectors



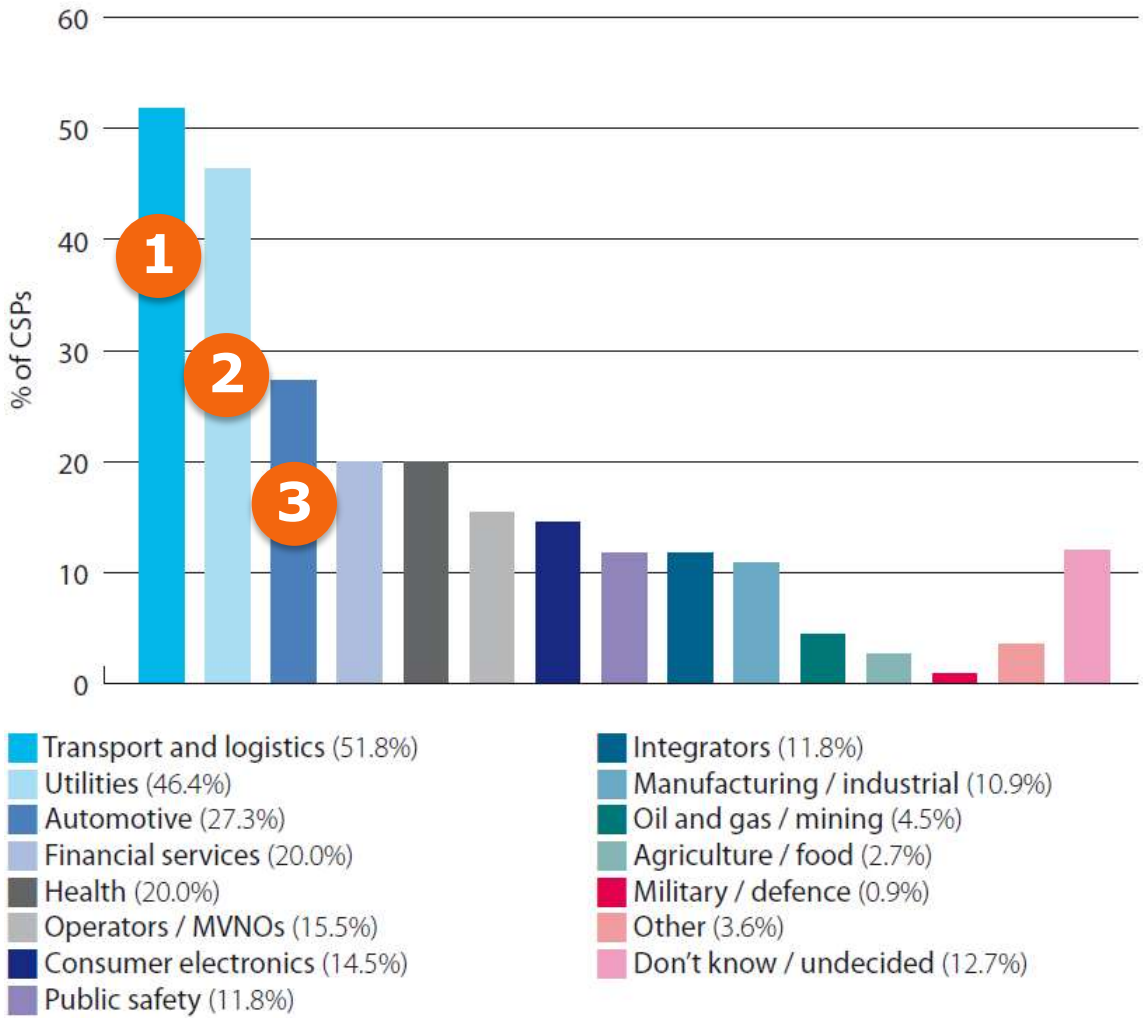


Source: Machina Research: „Connected Intelligence database *2020 connected devices overview*“, *2011*

Target Industries

Main industry drivers today:

1. Transport & Logistics
2. Utilities
3. Automotive

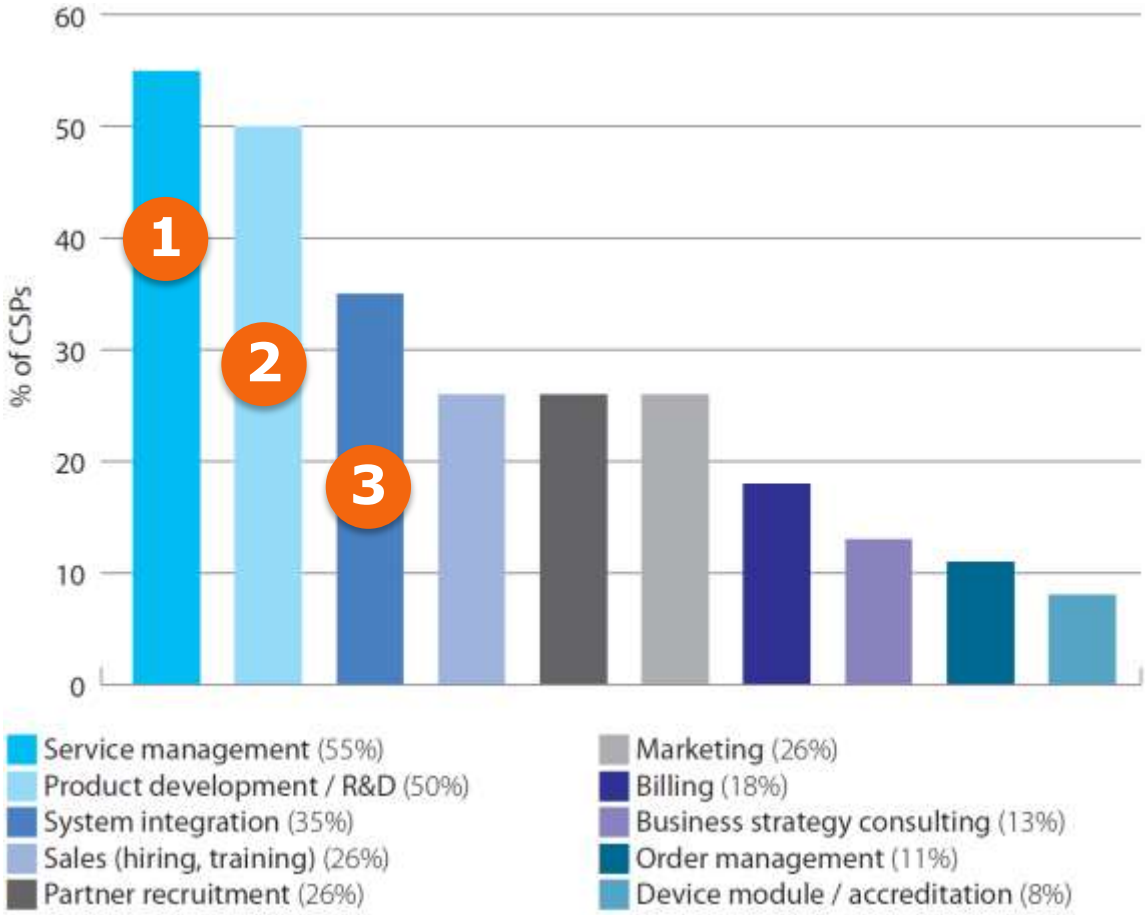


SOURCE: Informa-SAP M2M Communications Survey, 2012

Investment priorities

The machine-to-machine communication investment priorities today:

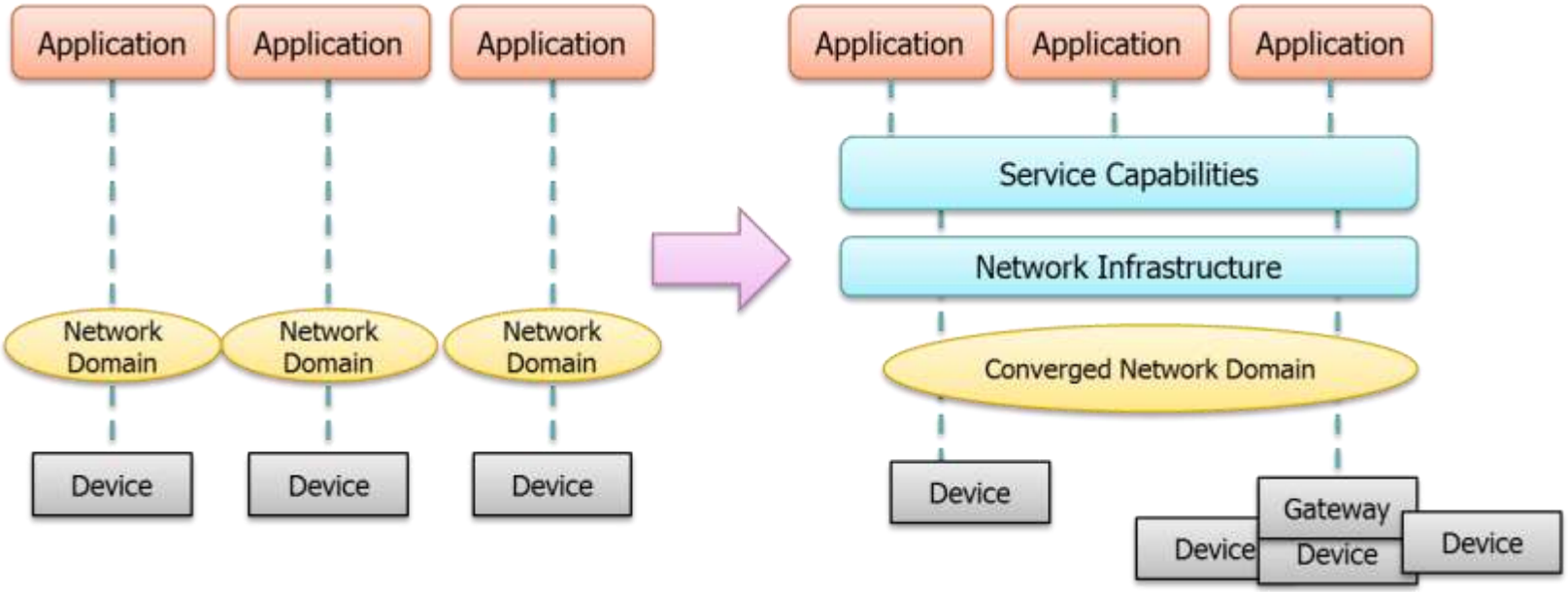
1. Service Management
2. Product dev. / R&D
3. System integration



SOURCE: Informa-SAP M2M Communications Survey, 2012

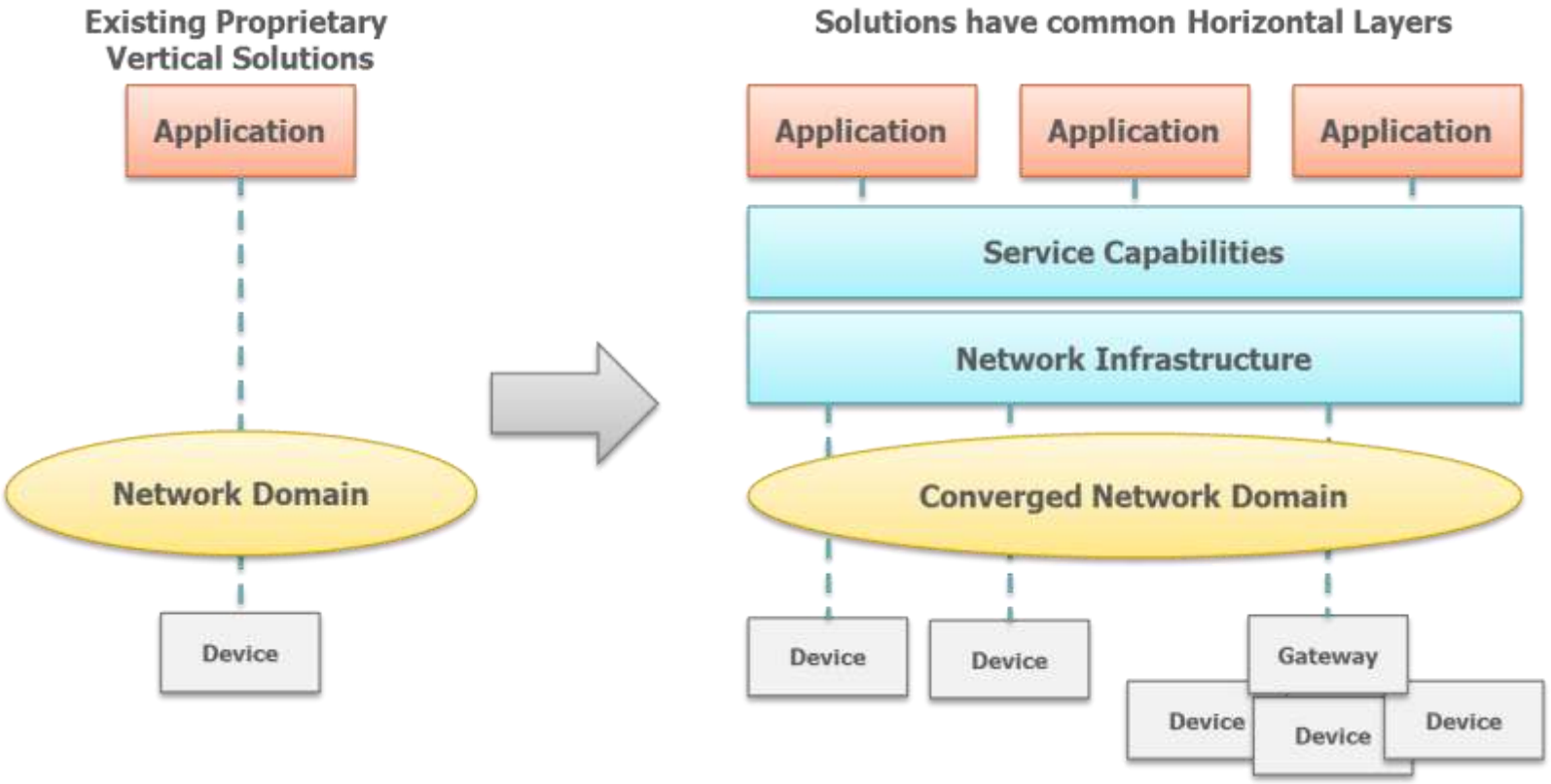
Convergence of M2M Services & Applications

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



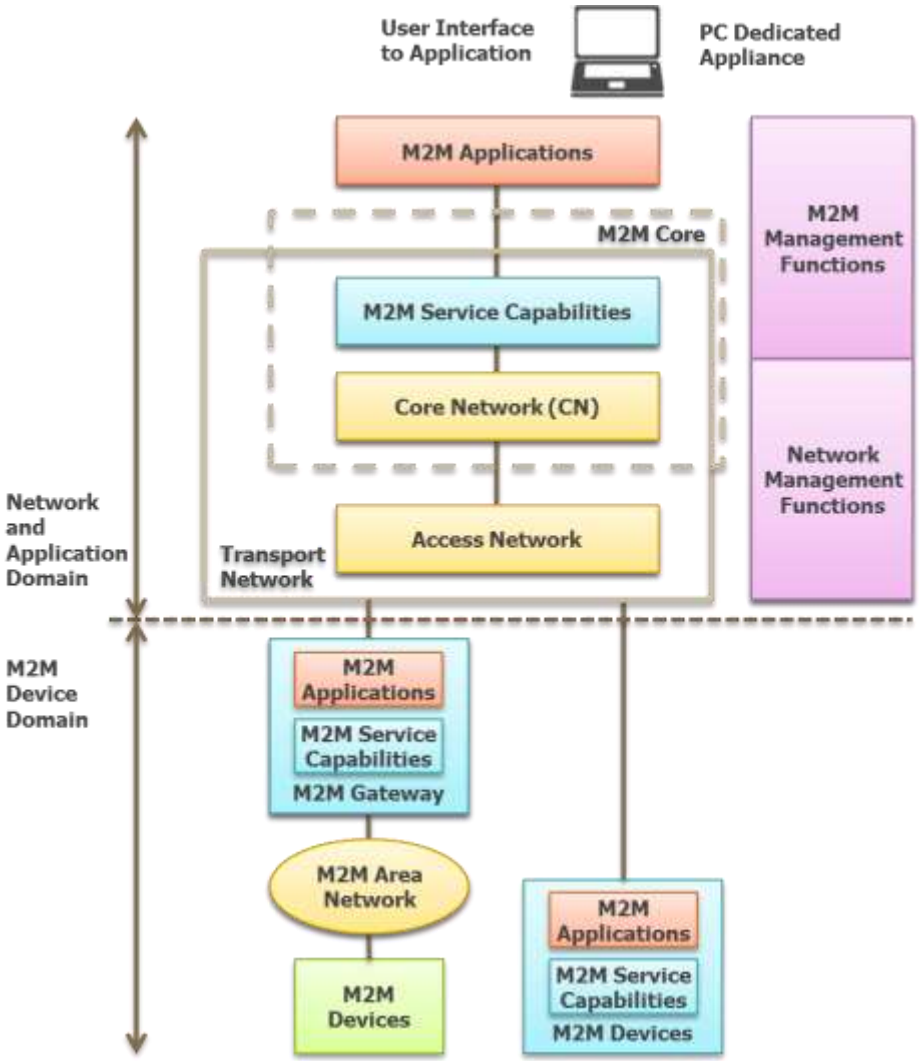
ETSI M2M Horizontal Approach goes into the same direction for M2M

- ETSI TS M2M approach allows for a mutualization of functions in order to transform the vertical approach into a horizontal one



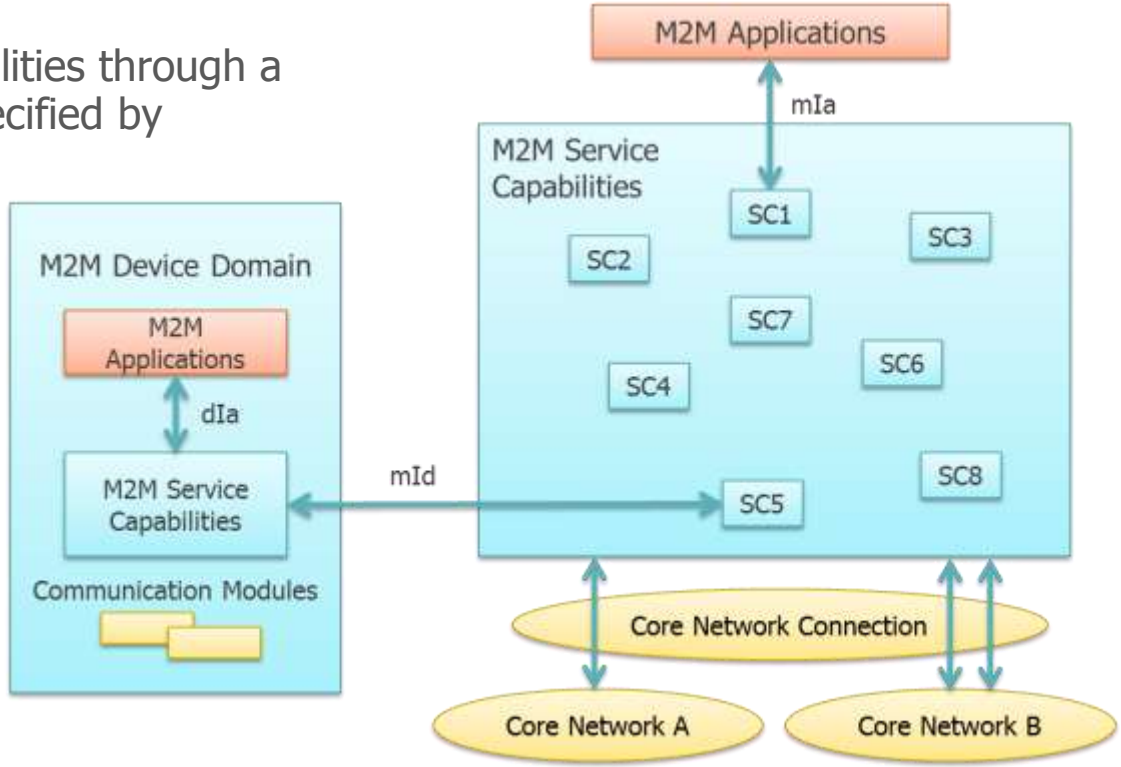
High Level ETSI M2M System Architecture

- Architecture includes:
  - M2M Device Domain
    - Based on existing standards and technologies e.g. DLMS, CEN, CENELEC, Zigbee etc.
  - Network and application domain
    - Based on existing standards e.g. 3GPP, TISPAN, IETF
- M2M is an extension of the current network architecture with:
  - M2M Service Capabilities
  - M2M Applications
- *The User of the system does not control directly the M2M device domain*



ETSI M2M 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

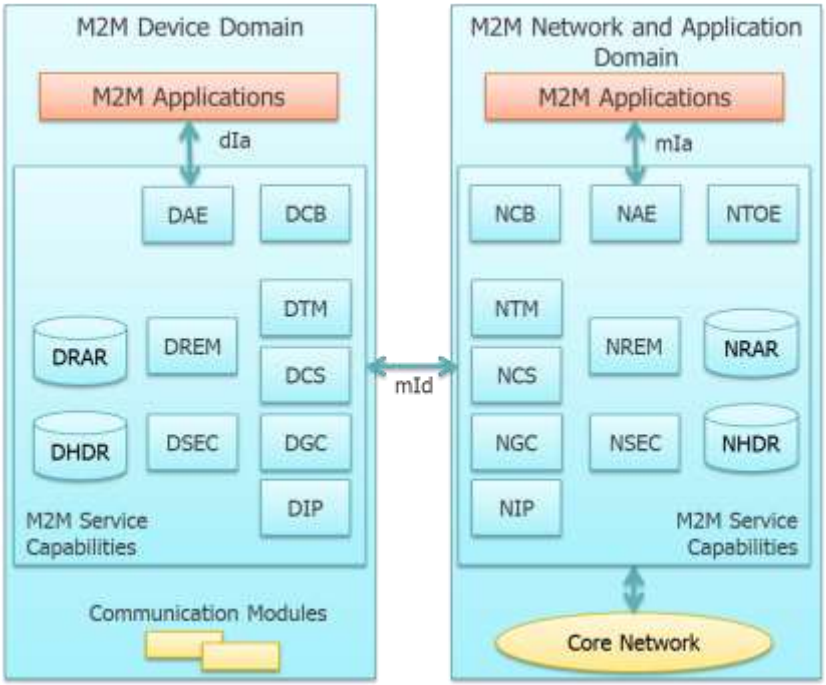
- **M2M SCs provide recommendations of logical grouping of functions**
- **M2M SCs do not mandate an implementation**

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.

ETSI M2M Service Capabilities

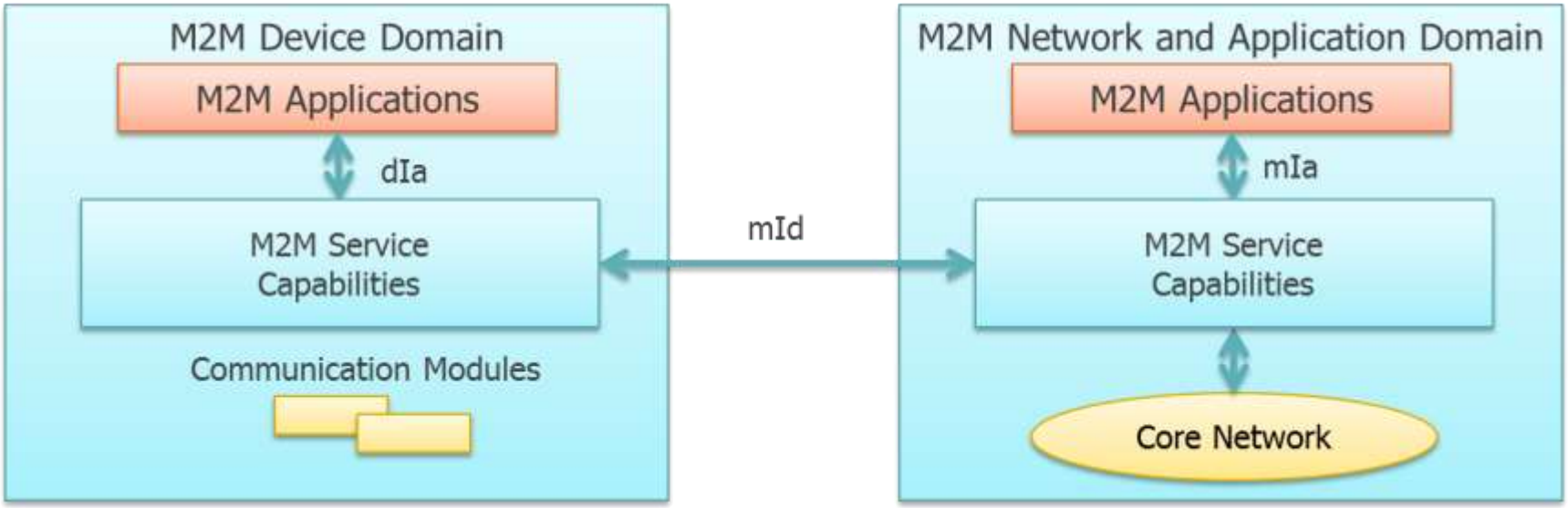
1. Application Enablement (xAE);
2. Generic Communication (xGC);
3. Reachability, Addressing and Repository (xRAR);
4. Communication Selection (xCS);
5. Remote Entity Management (xREM);
6. SECurity (xSEC);
7. History and Data Retention (xHDR);
8. Transaction Management (xTM);
9. Compensation Broker (xCB);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



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

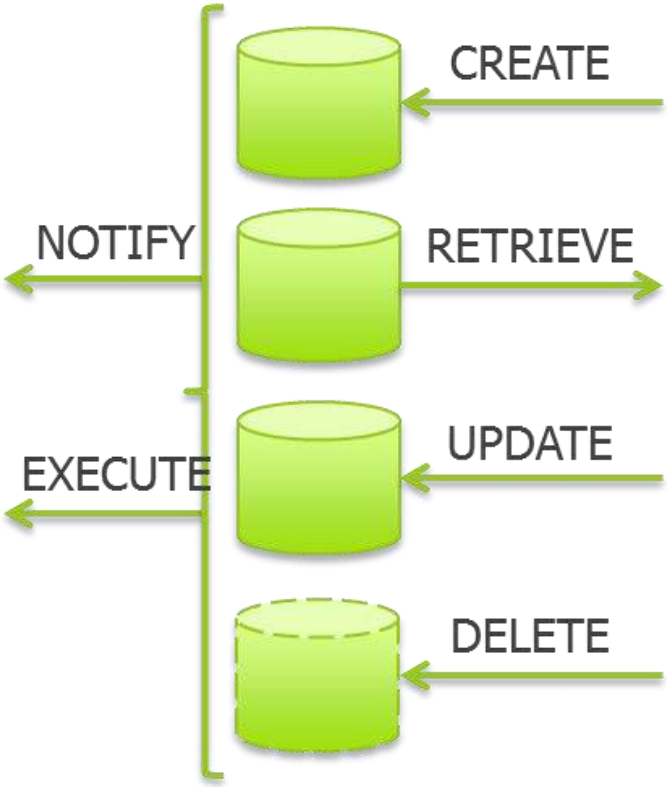
M2M Functional Architecture Reference Points

- **mIa** enables an Application to access the M2M SCs in the Network and Applications Domain
- **mId** enables an M2M Devices to communicate with the M2M SCs in the Network and Applications Domain.
  - Relying on the interfaces between Core Networks and the devices
- **dIa** enables an application residing in an M2M Device or M2M Gateway to access M2M SCs in the same M2M Device or in an M2M Gateway

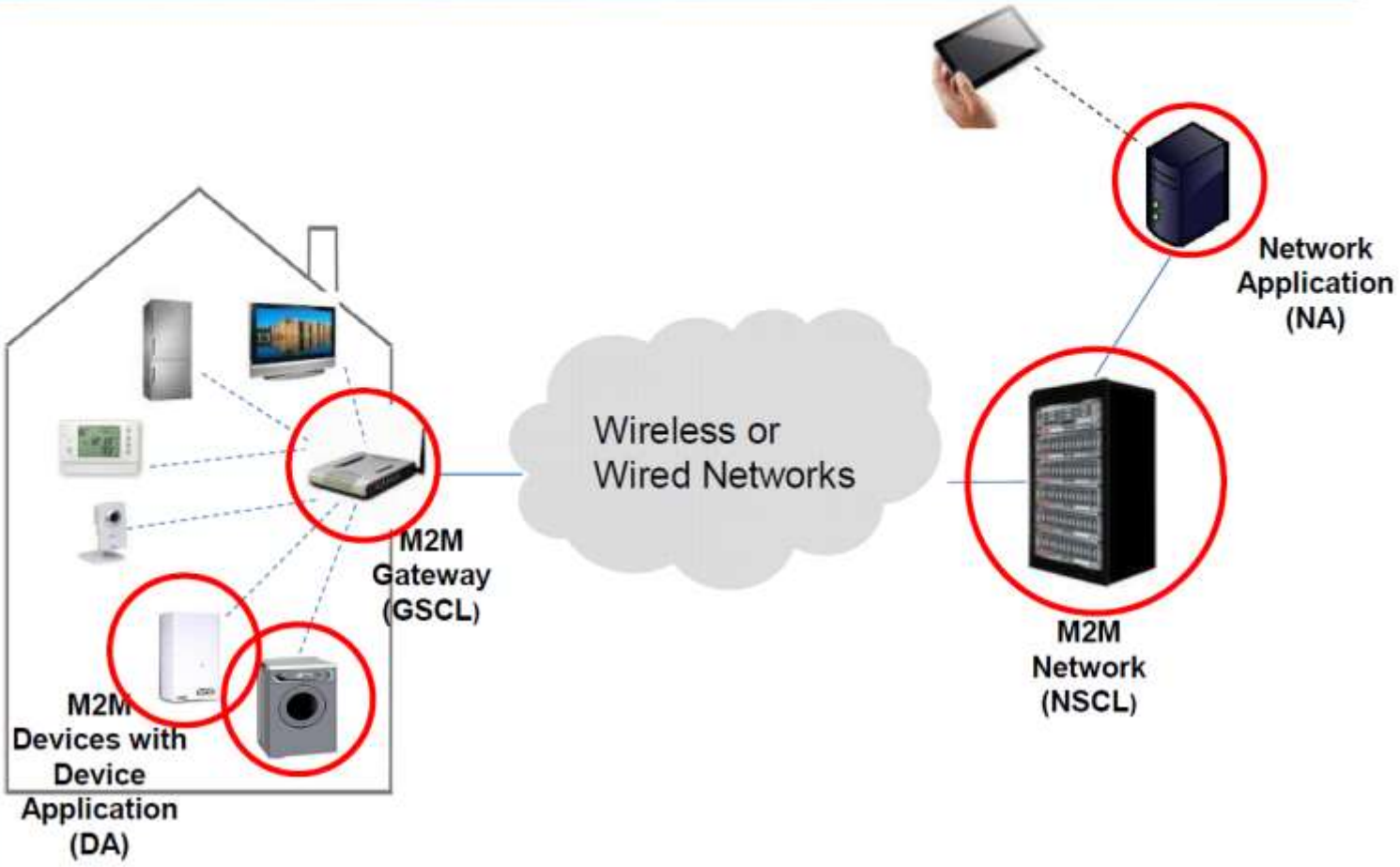


ETSI M2M RESTful Style for Data Exchange

- Adopted for some of the procedures of the M2M ETSI procedures
- Four basic procedures:
  - CREATE: Create child resources
  - RETRIEVE: Read the content of the resource
  - UPDATE: Write the content of the resource
  - DELETE: Delete the resource
- Additional Procedures:
  - NOTIFY: on a change event
    - RETRIEVE for polling
    - UPDATE for pushing
  - EXECUTE: for executing a management command/task
    - Not mapped yet.



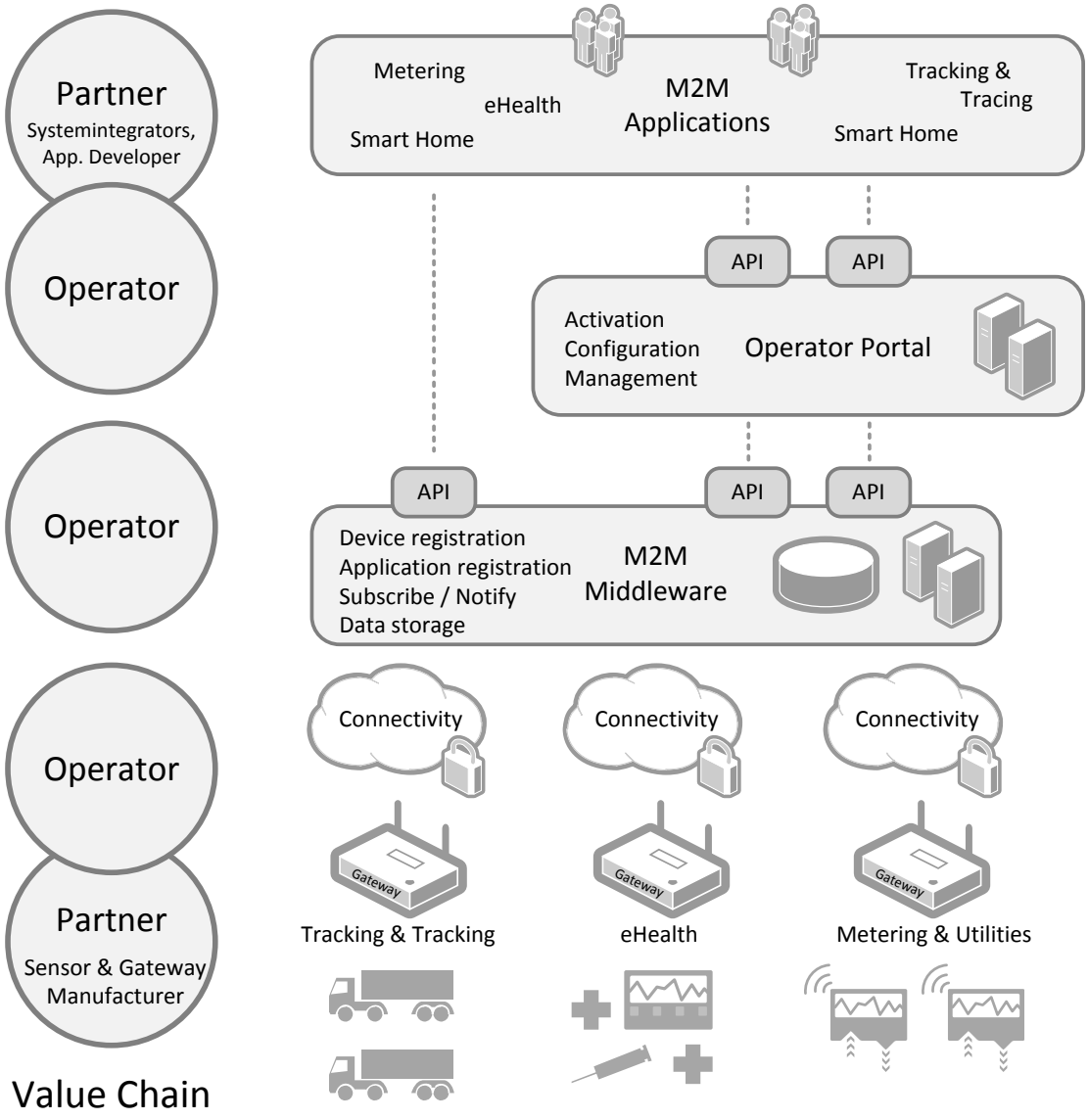
Example: Connected home



Slide provided by ETSI

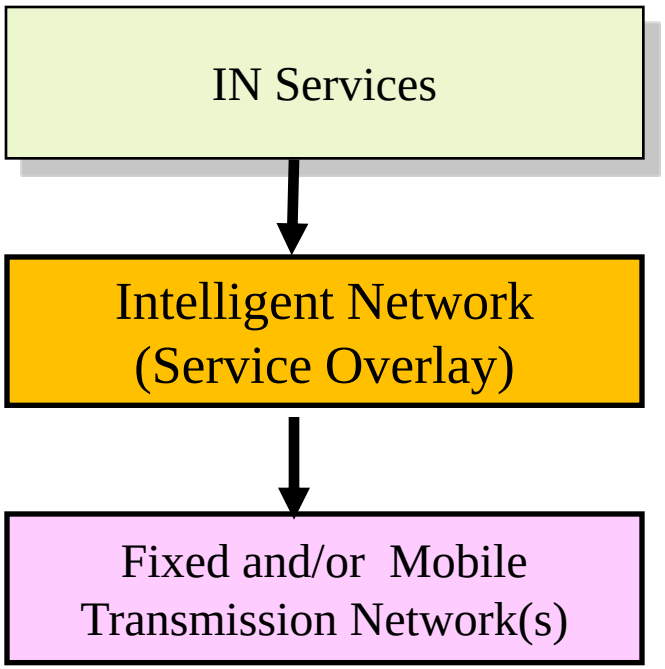
The New Value Chain

- Building on OpenMTC and an associated SDK, operators can cover more parts of the M2M value chain
- Strong strategic partnerships will still be essential for operators
  - to cover system integration & app. development
  - to cover domains with specific hardware requirements

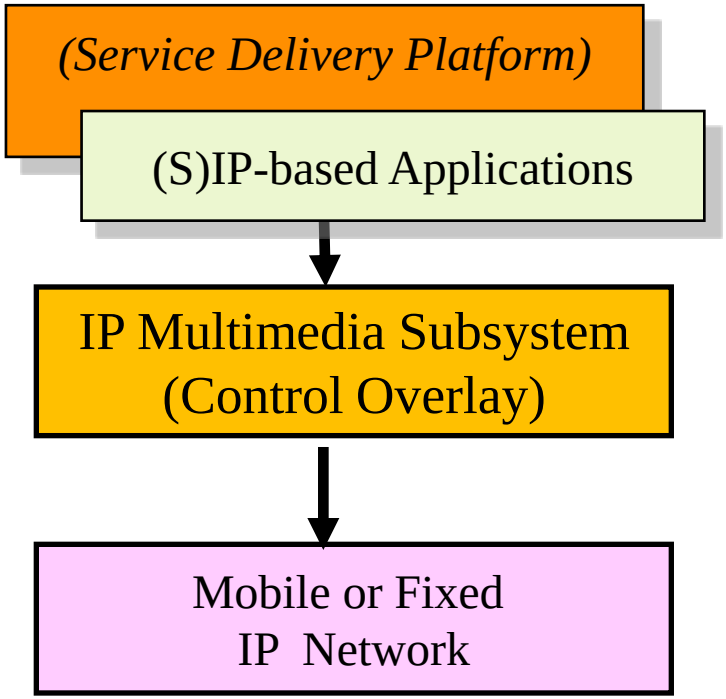


IN Concept Evolution toward SDP

Main Idea: Reusable Service Enablers designed in a Service Oriented Architecture (SOA) way and abstraction from underlying network protocols by means of Application Programming Interfaces (APIs) enable uniforn service realiszation ontop of converging networks

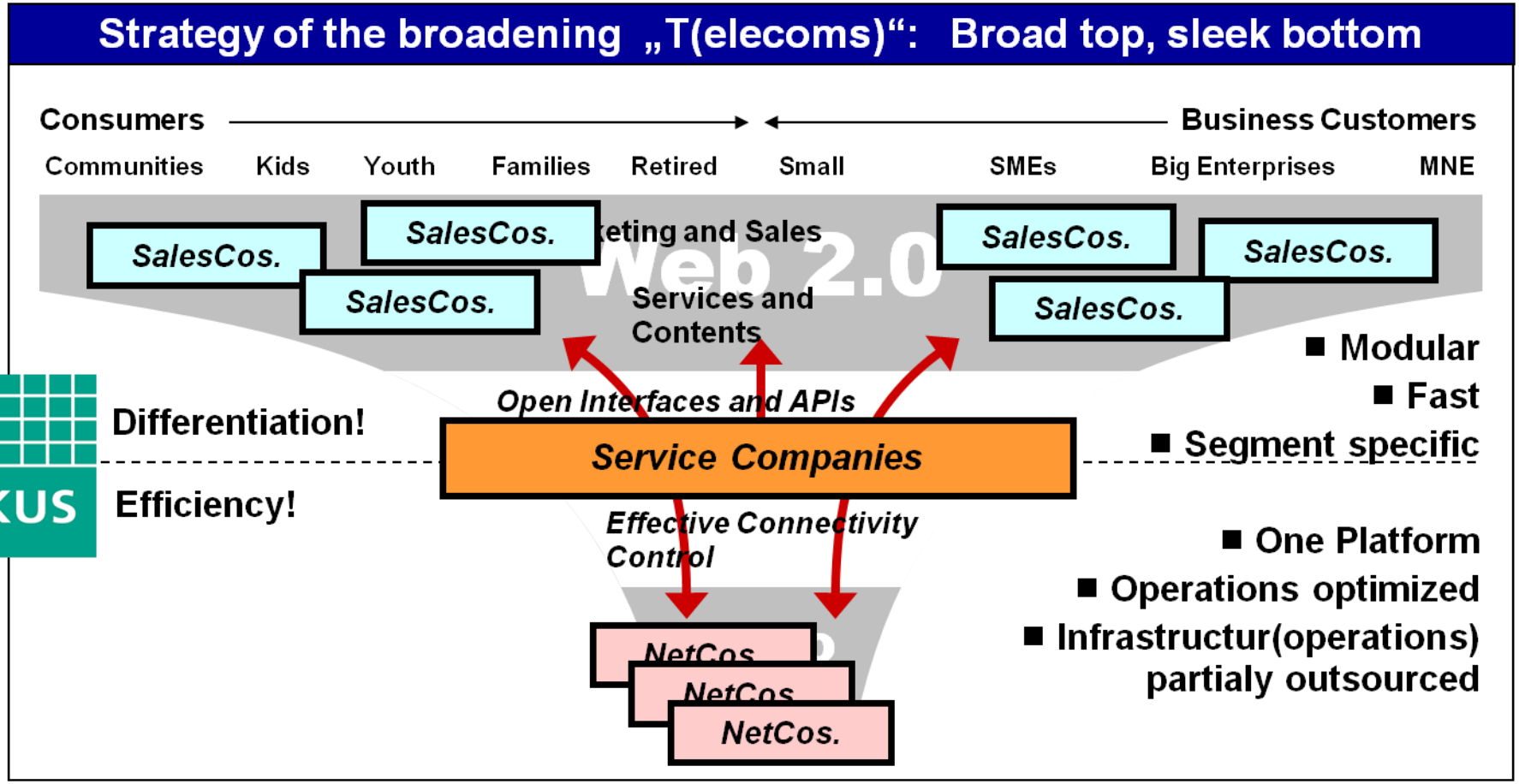


Circuit Switched Telco Domain

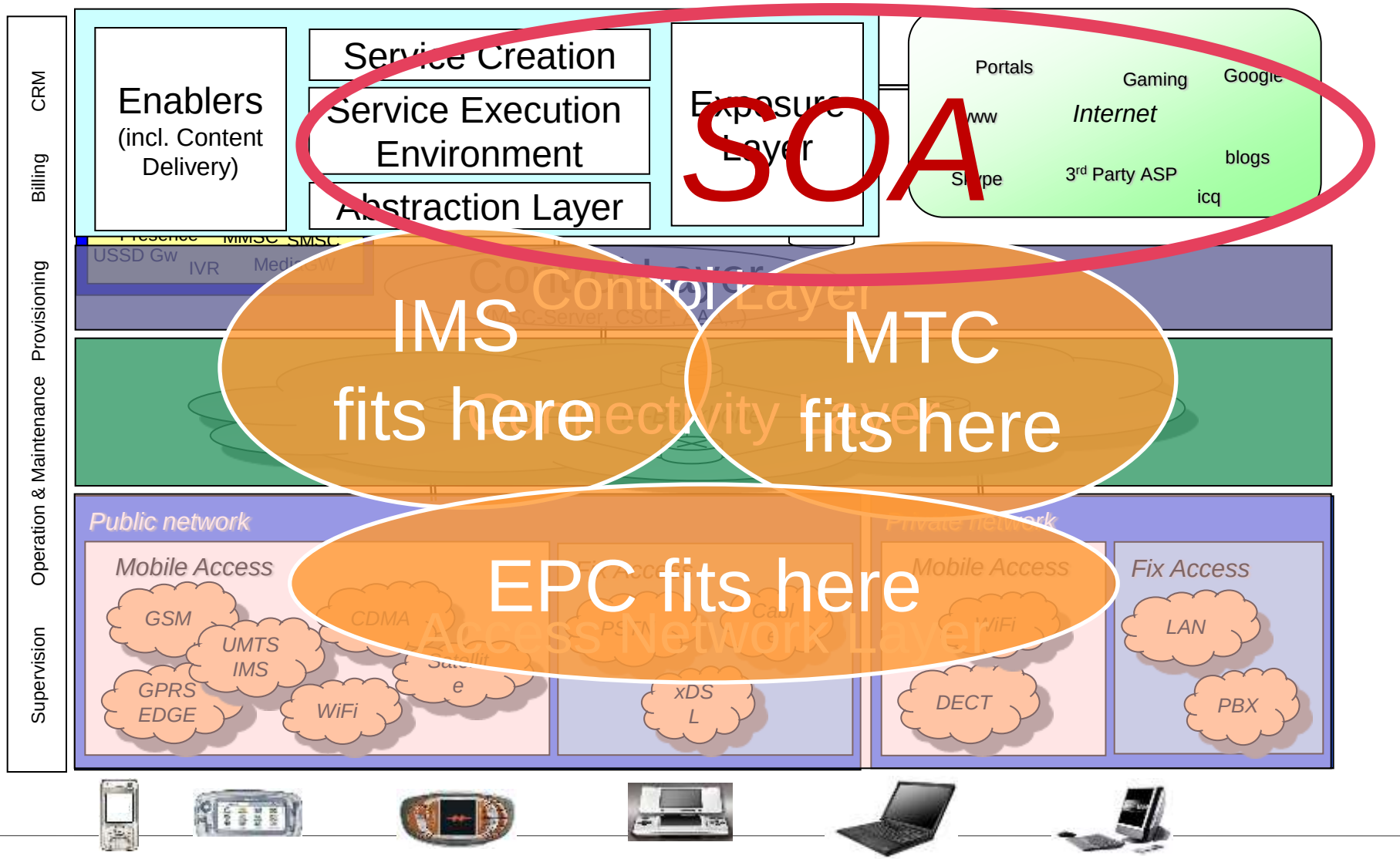


Packet Switched Telco Domain (NGN)

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

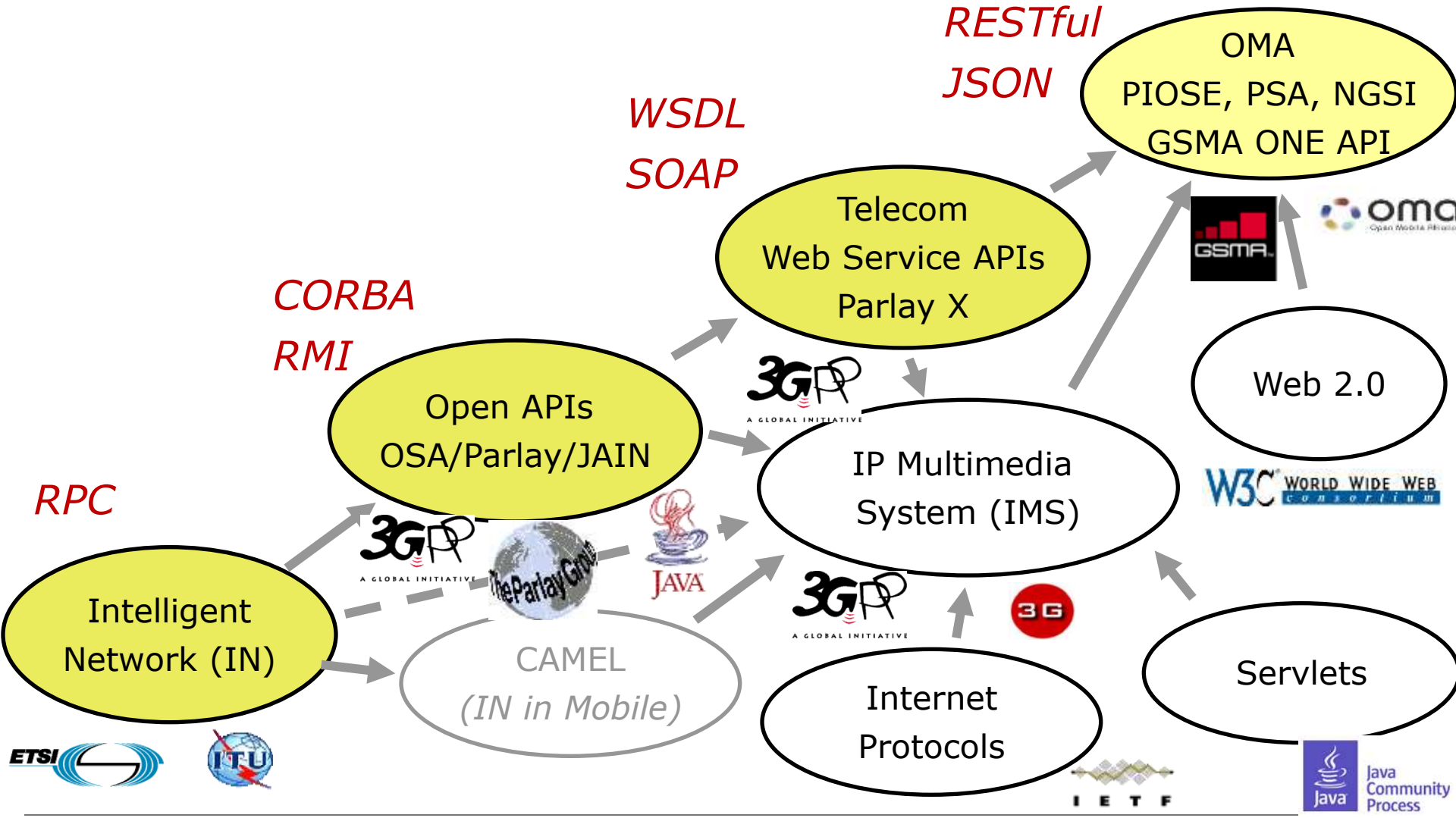
IMS + MTC + Evolved Packet Core

Sensor Networks

Mobile IP Network

Fixed IP Network

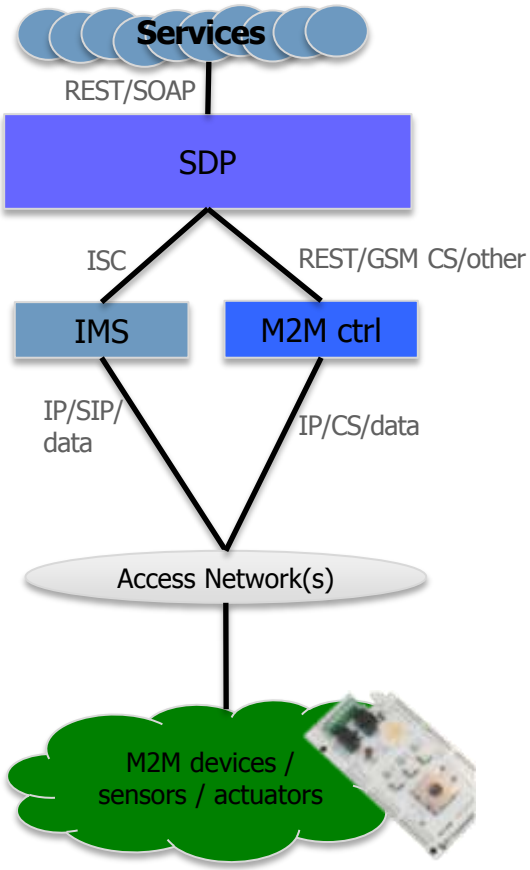
Evolution of Network API Concepts in Telecommunications



Platforms for Smart Cities – the SDP approach

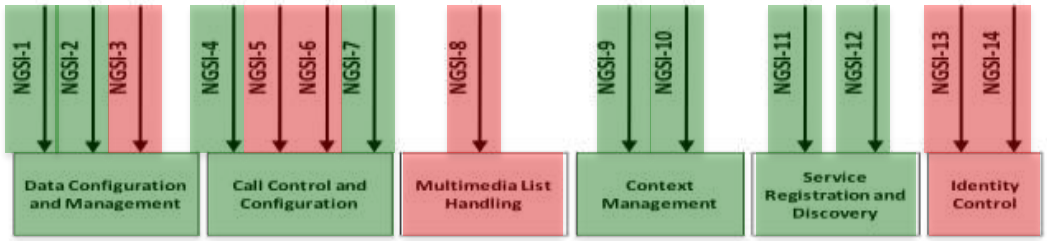
- SDP may provide abstraction over multiple control platforms and expose APIs to developers and services.
- Combination of communication APIs as:
  - OMA NGSI
  - GSMA OneAPI
  - RCS APIs

  for H2H communications
- M2M APIs for
  - data access
  - device control
  - connectivity control



Smart City Communication APIs: OMA NGSI, GSMA OneAPI & RCS-e

- OMA NGSI provides abstract APIs suited for OMA enablers



- GSMA OneAPI profiles NGSI
  - NGSI extension for payment, data connection & device capability
  - Zonal presence for location

- RCS-e Network APIs
  - Defines services for GSMA OneAPI & NGSI
  - New API requirements:
    - Chat & capability discovery
  - Oauth for user/service authentication

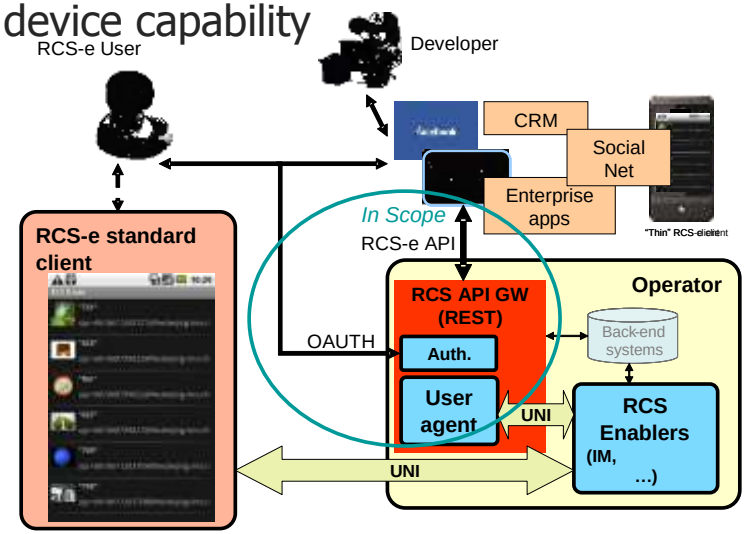
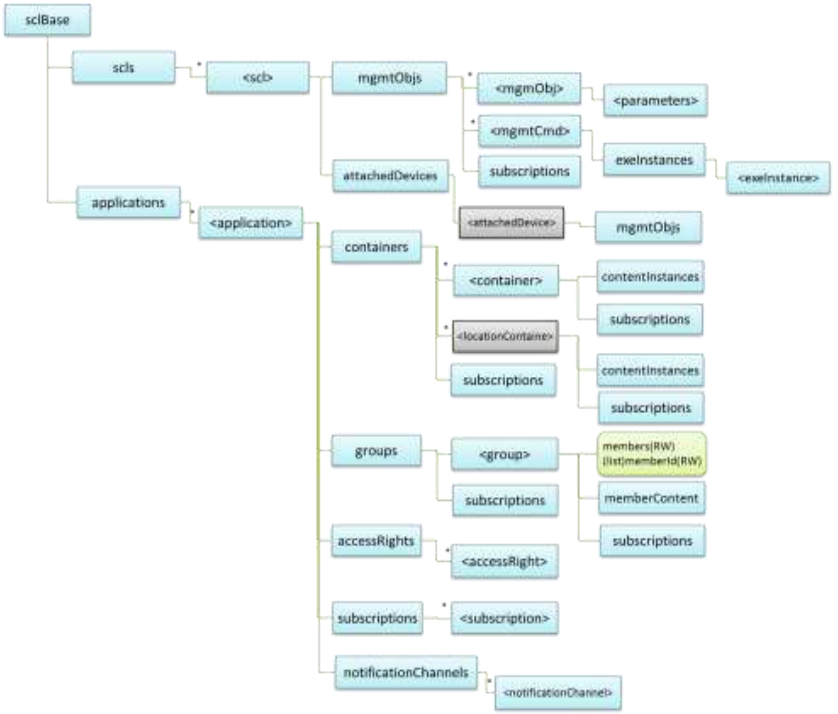


Figure 2 : RCS-e API architecture

Smart City M2M APIs

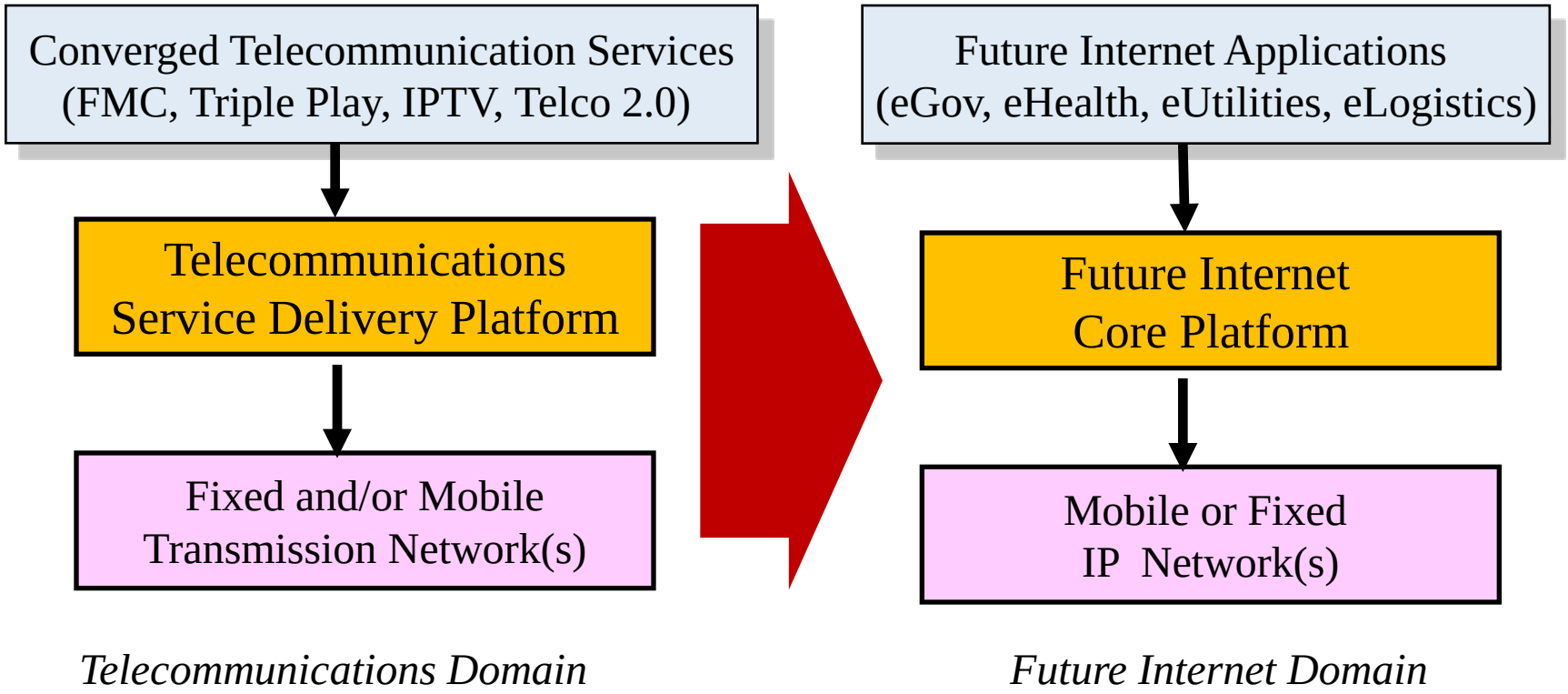
- API is divided into the following three categories:
  - Network,
  - Device, and
  - Data APIs.

- Network APIs deal with the roles related to the network applications and its session control with the M2M core.
- Device APIs find appropriate devices and gateway resources to fetch information from them.
- Data APIs handle functionalities related to accessing/manipulating data collected from devices/sensors



From Telecommunications toward the Future Internet

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

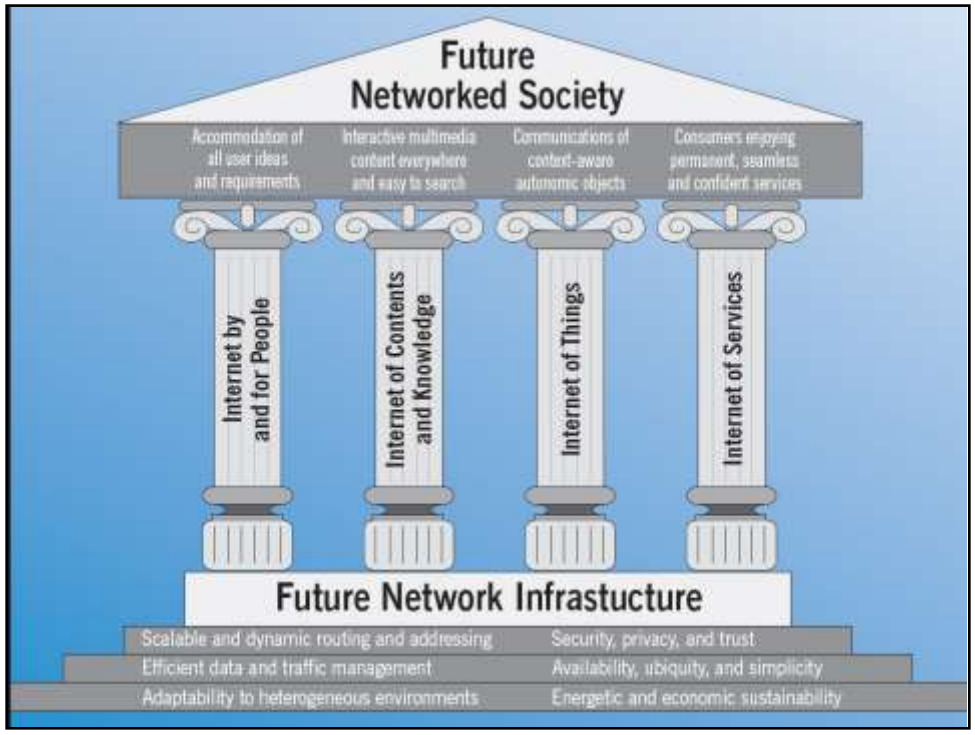


From Internet to Future Internet

- The current Internet technology has been invented in the sixties for the exchange of data between distributed research centers
- File transfer and email have been for many years the key applications
- Society started to recognize the Internet when first web browsers and web pages appeared
- Since then the Internet has been extended step by step to change our daily life: eBooks (Amazon), eCommerce (Amazon), music (P2P, iTunes), photos (Flicker), videos (Youtube), telephony (Skype, VoIP), TV (IPTV), web 2.0, communities (Facebook),
- Today we see the Internet entering serious domains: eGovornment, eHealth, eLearning, eProduction, Utilities, etc.
- Note that the Internet is used today for applications, it has never been designed for!
- But our daily life is dependent on the Internet
- International research is looking since some years for the future of the Internet in order to increase its robustness with revolutionary and evolutionary approaches

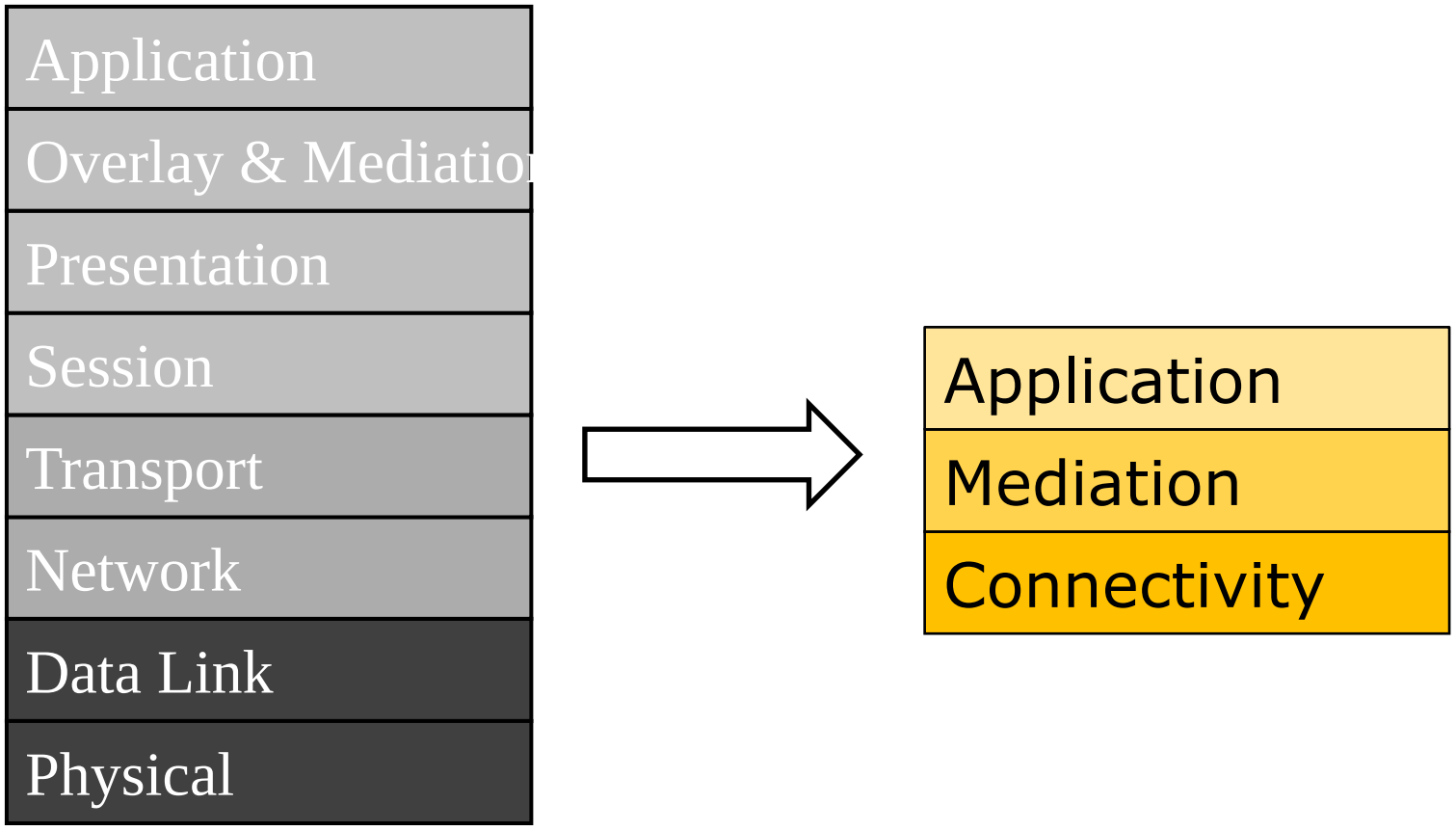
Dimensions of the Future Internet

- 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

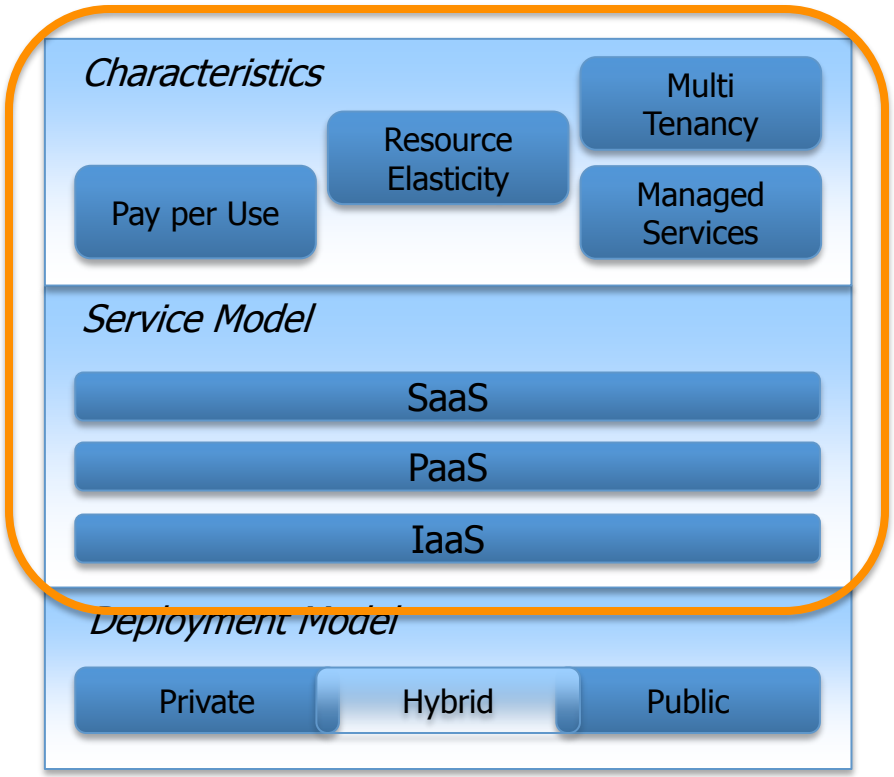


Cloud Services vs. Traditional Telco Services
Advantages of I-/P-/S-aaS Clouds

- Infrastructure as a Service (IaaS)
  - Enabling complete or hybrid IT infrastructure outsourcing and hosting options
- Platform as a Service (PaaS)
  - Scalability through dynamic Cloud elasticity, metering allowing pay-per-use
  - Turning CAPEX into OPEX allowing entrepreneurs a low risk market entry
  - Data aggregation / cloud data pool (Context, Sensor, M2M data)
- Software as a Service (SaaS)
  - Greatly improved manageability through centralized maintenance
  - Frequent updates and upgrades
  - Enhanced device independence, support for multiple devices, device-shift through cooperative devices, hand-overs
  - Access Network independence
  - Collaborative, multi-tenant services
  - Improved time-to-market
  - Enabling complex, multi-tenant value chains

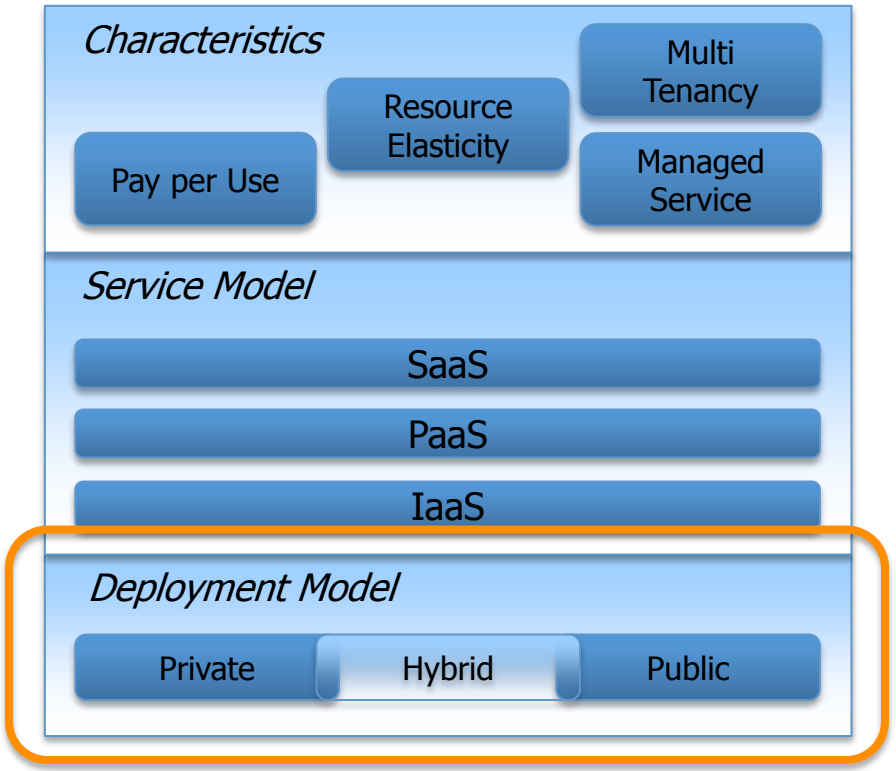
Cloud Computing Service Models

- **Software as a Service (SaaS) Clouds**
  - offering complete cloud-based, *multi-tenancy* applications like
    - communication services
    - collaboration software and tools
    - business processes-oriented applications
    - gaming, etc.
- **Platform as a Service (PaaS) Clouds**
  - providing application developers with
    - application software
    - middleware
    - databases
    - development tools, etc.
- **Infrastructure as a Service (IaaS) Clouds**
  - utilizing a suite of virtual hardware through specific cloud management APIs providing
    - compute, storage & network resources on demand
    - *pay-per-use* charging options
    - *resource elasticity*

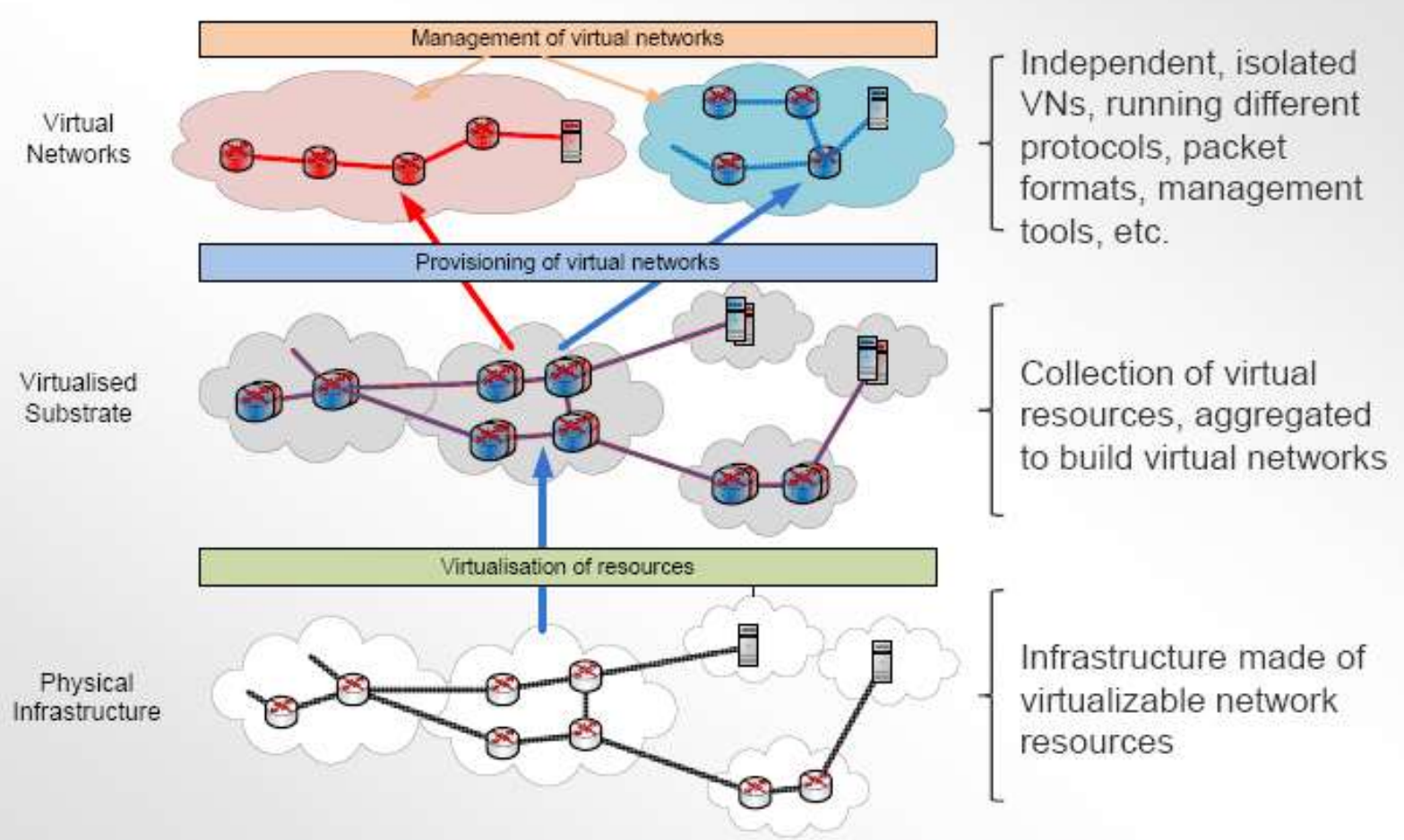


Cloud Computing Deployment Models

- **Public Clouds**
  - services and infrastructure are provided off-site over the Internet
  - potential security and governance / IPR issues
- **Private Clouds**
  - services and infrastructure maintained on a private network
  - greatest level of security and control
  - software and infrastructure must still be purchased
- **Hybrid Clouds**
  - variety of public and private options with multiple providers
  - "on-peak" outsourcing options!
  - potential security and governance / IPR issues



Decoupling Networks from Infrastructure

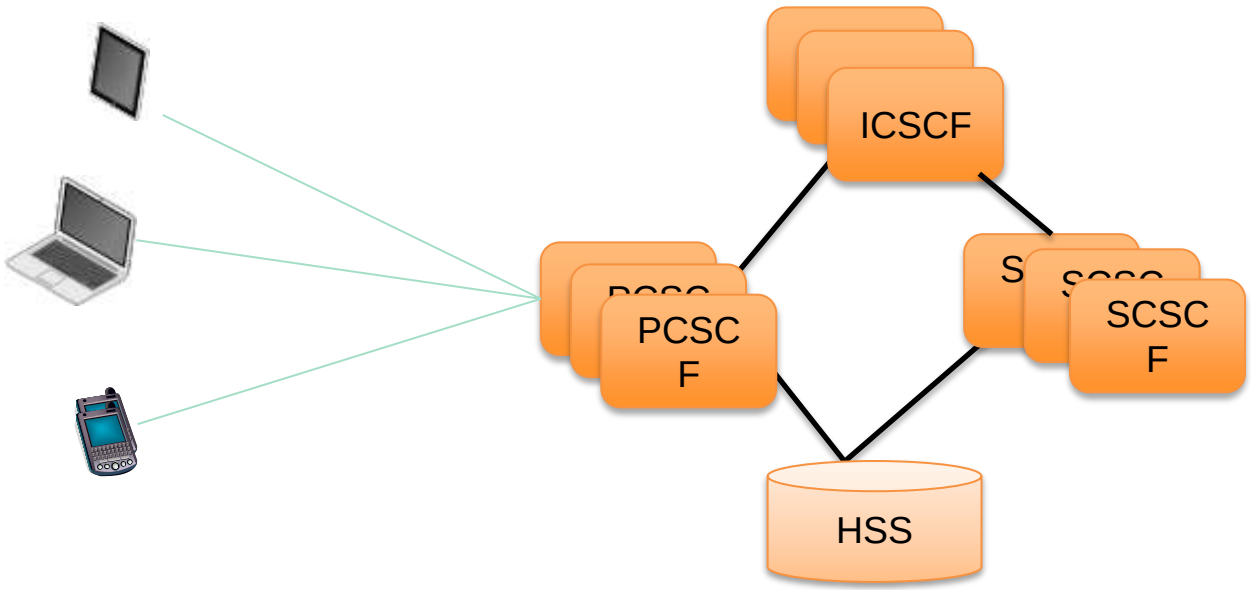


P1956 Network Virtualization – Opportunities and Challenges 5

Source: EURESCOM Project P1956

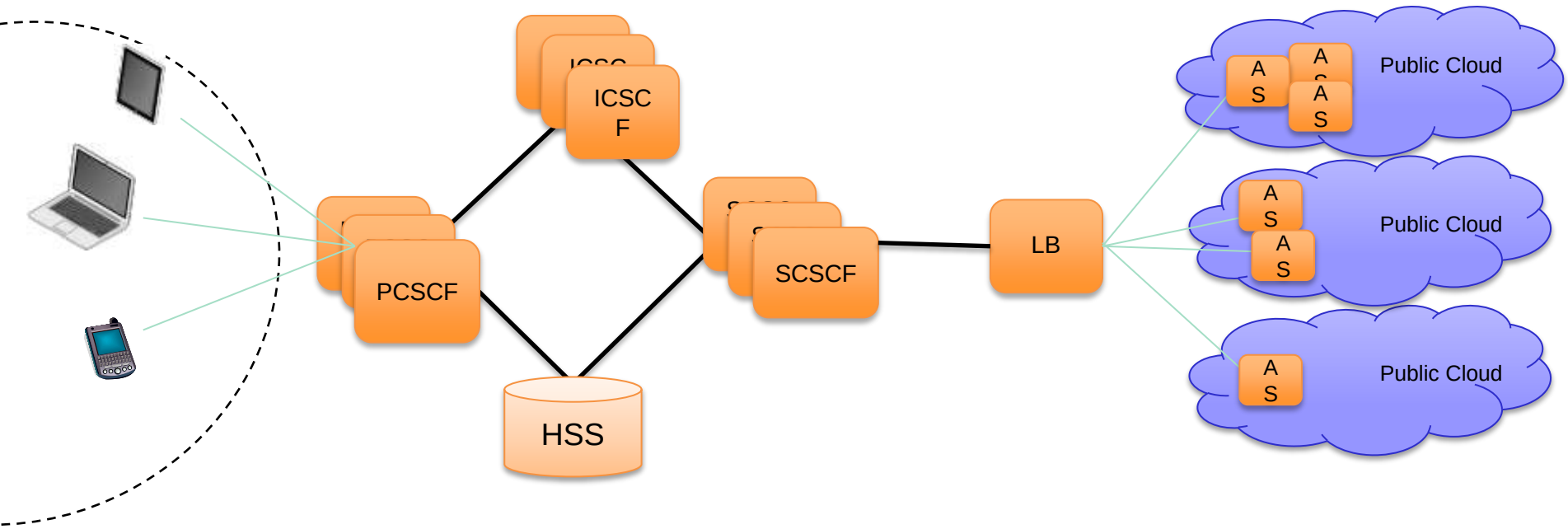
OpenIMS in the Cloud

- First scenario
  - All the IMS infrastructure deployed in the cloud (private or public)
  - HSS highly reliable
  - Elastic Call Session Control Function (CSCF)

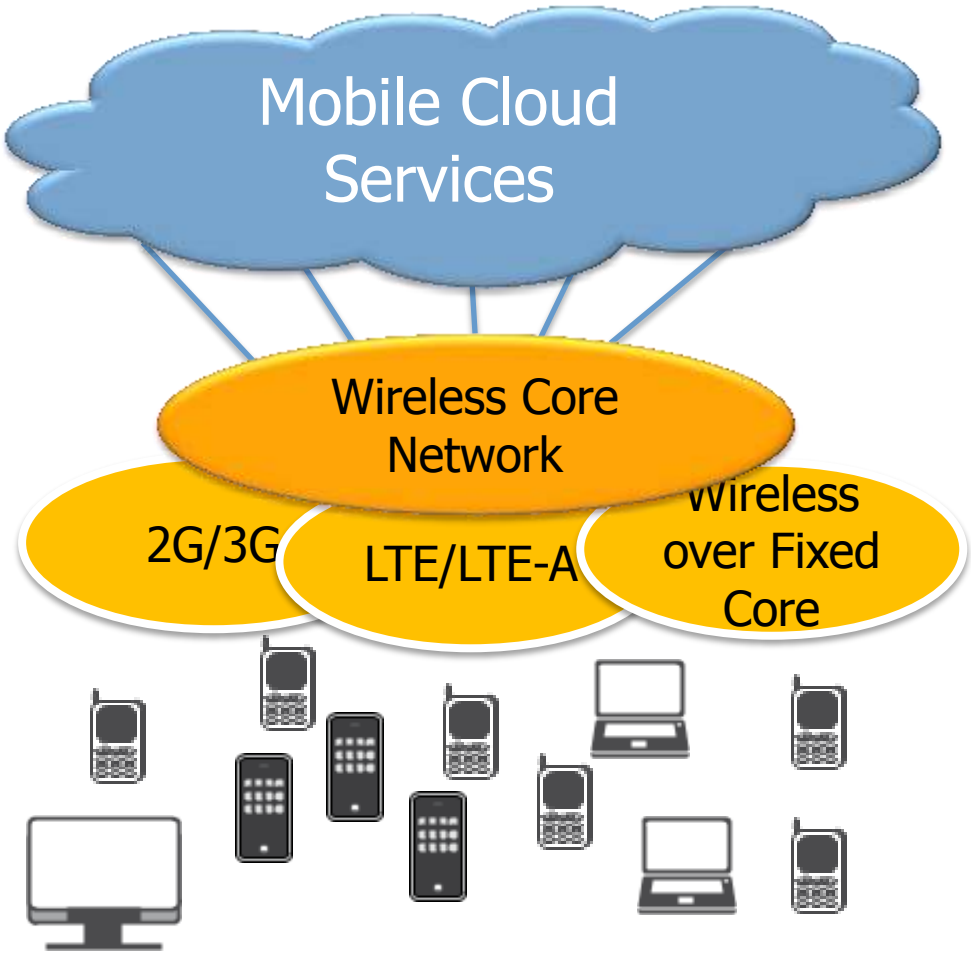


OpenIMS in the cloud

- Second scenario
  - Core components in a private cloud, and third party services moved to the public



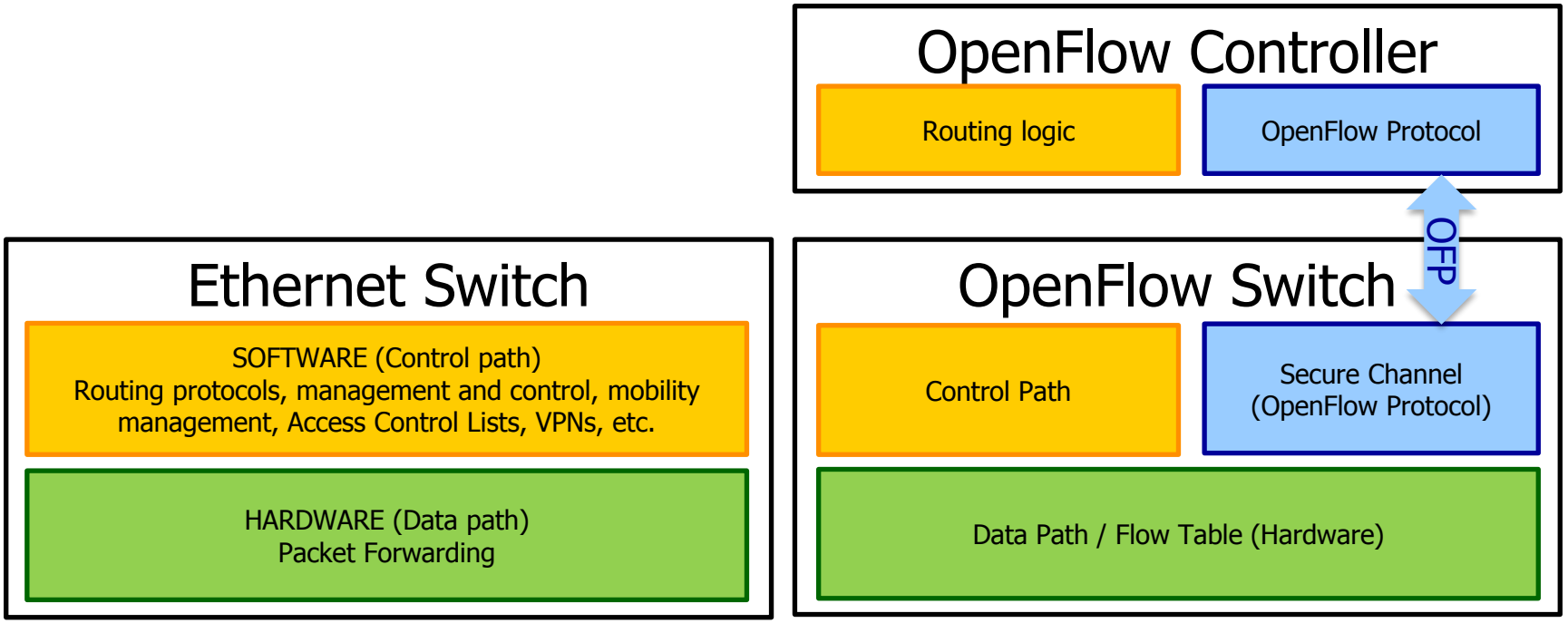
Seamless Mobile Access to Cloud Services as Motivation for Smart Bitpipe



- Cloud services are already available for mass market (e.g. Amazon, Google etc.)
  - Transparent access to the service infrastructure
  - Better resource usage in the service layer
  - Localization of information
- Truly broadband mobile connectivity
  - High increase of the access network throughput
  - Available for a large number of subscribers
  - Enables functionality of the mobile devices to be transferred to the service infrastructure in the network (e.g. Remote OS functionality)

Switch Evolution towards Software-Defined-Networks (SDN)

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

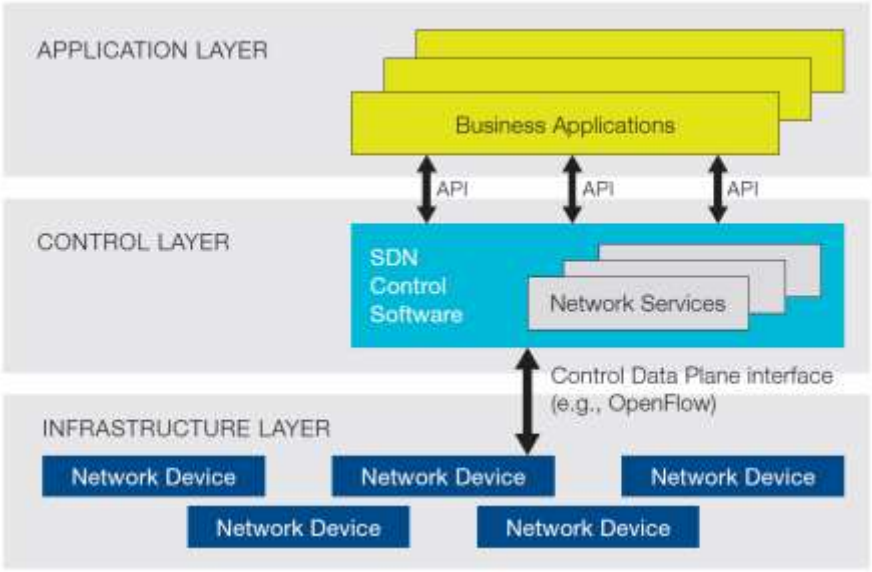


Open Networking Foundation (ONF)

- Accelerates the delivery and use of **Software Defined Networks (SDNs)** by standardizing OpenFlow
- SDN allows networks designers and operators to simplify networks by exploiting fundamental abstractions
- Open flow protocol between network controllers and switches makes it possible to add features, reduce costs and speed innovation.

Software Defined Network Architecture

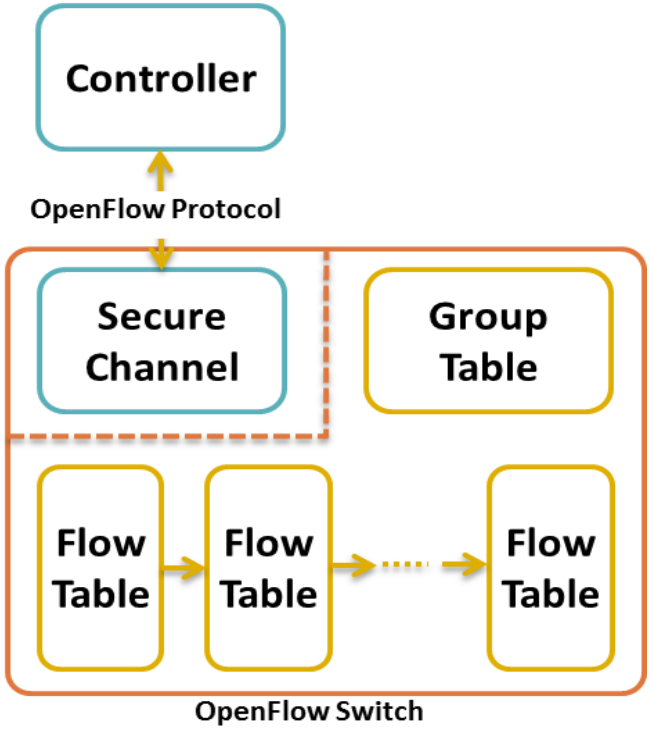
- Features:
  - Decoupling of control and data path – enable the abstraction from the infrastructure layer
  - Network intelligence and state are logically centralized
    - High programmability
    - Automation
    - Easy network control
- SDN architecture aims at:
  - Highly scalable networks (low complexity)
  - Flexible networks
  - Adaptable to specific business needs
  - Increase network reliability and security
  - Higher rate of innovation
  - More granular network control



© Open Networking Foundation (ONF) – "Software-Defined Networking: The New Norm for Networks"
ONF White Paper, April 13, 2012 https://www.opennetworking.org/images/stories/downloads/white-papers/wp-sdn-newnorm.pdf

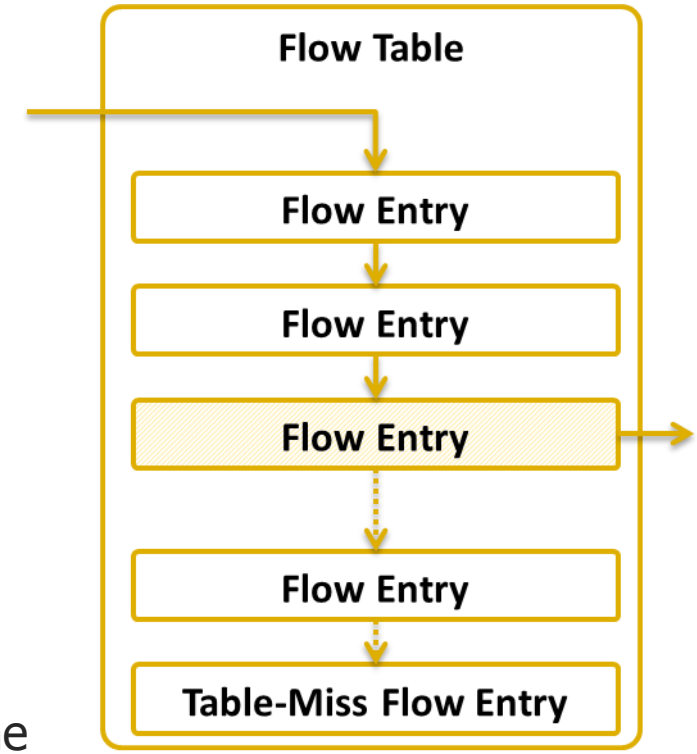
OpenFlow Switch Specification

- OpenFlow Switch Components
  - Flow Tables (one or more)
  - A Group Table
  - An OpenFlow Channel
    - Connects to an external controller
    - Uses the OpenFlow protocol
- OpenFlow Controller
  - Can add, update and delete flow entries in flow tables
  - Proactive and reactive operations



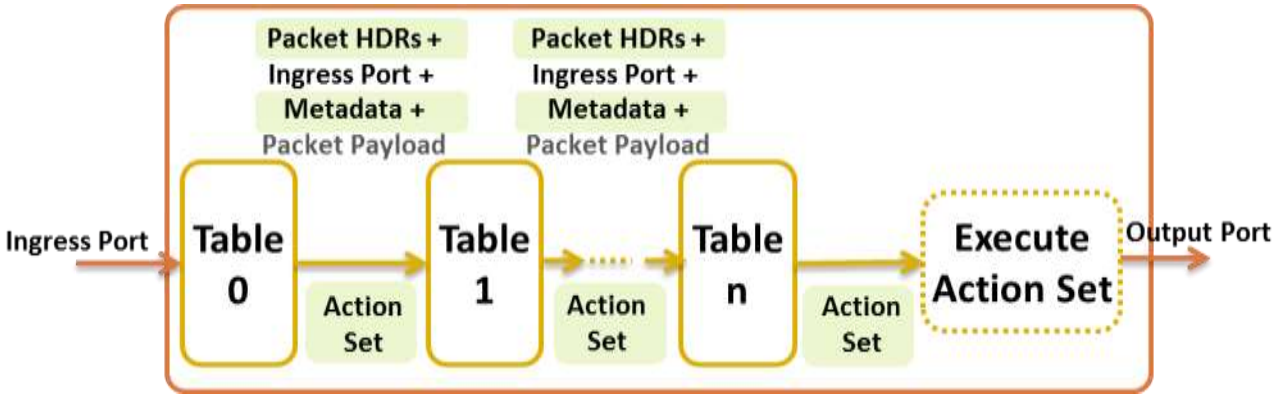
OpenFlow Flow Table

- A Flow Table consists of multiple *Flow Entries*
- A Flow Entry consists of:
  - Match fields
  - Counters
  - Instructions to apply on packets
- A packet is matched in each Flow Table
  - Flow Entries match packets in priority order
  - First matching Flow Entry is used
  - The specific instructions are executed
    - Actions on data packets:
      - Forwarding, group processing …
    - Modification of the processing pipe-line
  - Packet is forwarded to a *Port*



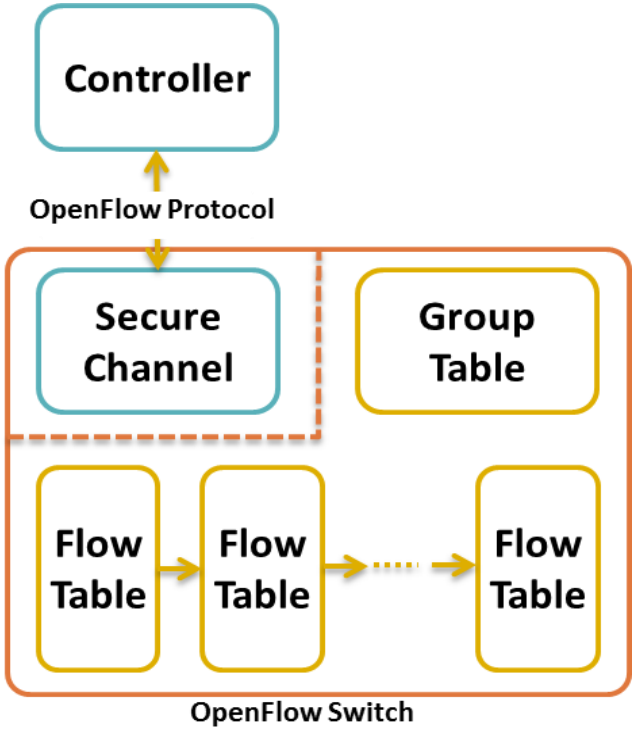
OpenFlow Pipeline Processing

- A Packet is matched against the flow entries in a table
  - If a Flow Entry is found, the instructions associated are executed
    - Modify the packet and update the matching fields
    - Update the action set
    - Update the metadata used by the next table
  - If no Flow Entry is a Table Miss Flow entry may be used
    - A default action is executed e.g. drop, goto next table etc.
- At the end of the pipeline:
  - The action set is executed
  - (Probably) an output port is selected



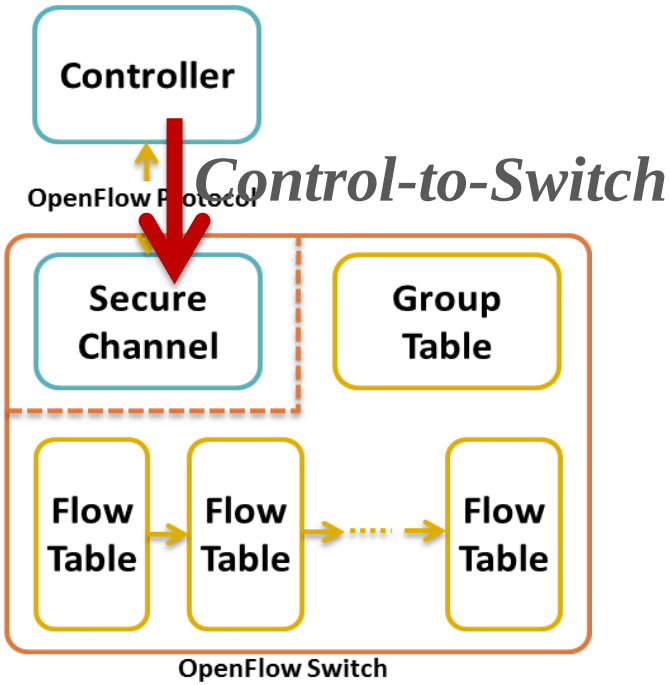
OpenFlow Channel

- The OF Channel connects the OF Switch to a controller
- All OF Channel messages have to be formatted based on the OF Protocol
- OF Protocol
  - Supports 3 types of messages:
    - Controller-to-Switch
    - Asynchronous
    - Symmetric
  - Provides reliable message delivery and processing
  - Does not ensure acknowledgements or order of processing
  - Based on connections with reliable transport



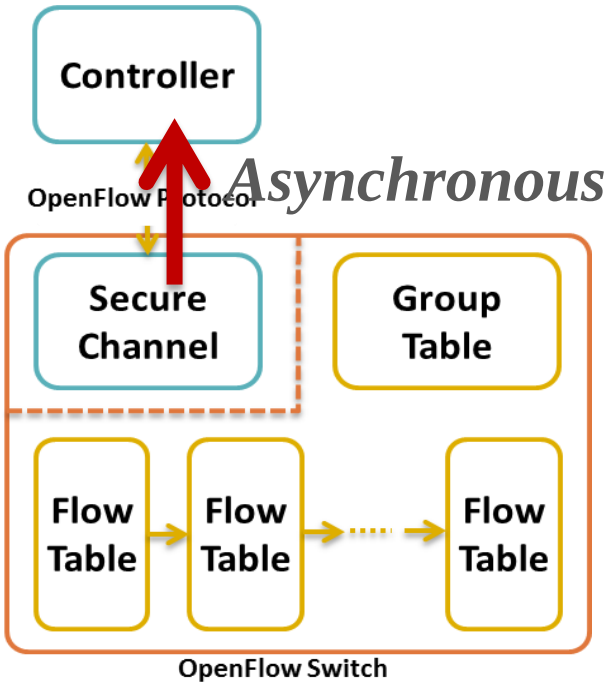
OpenFlow Protocol Messages Controller-to-Switch

- Messages initiated by the controller managing or inspecting the state of the switch
  - May or may not require a response
- Subtypes:
  - Features – the controller requires the capabilities of a switch
  - Configuration – the controller sets and configures the parameters of the switch
  - Modify-State – modify the state on the switch by add, delete or modify of flow/group entries
  - Read-State – querying information from the switch
  - Packet-Out – for packets passing through the controller
  - Barrier – message dependencies request
  - Role-Request – used when multiple controllers connect to the same switch
  - Asynchronous Configuration – controller puts filter on the asynchronous messages of the switch



OpenFlow Protocol Messages Asynchronous

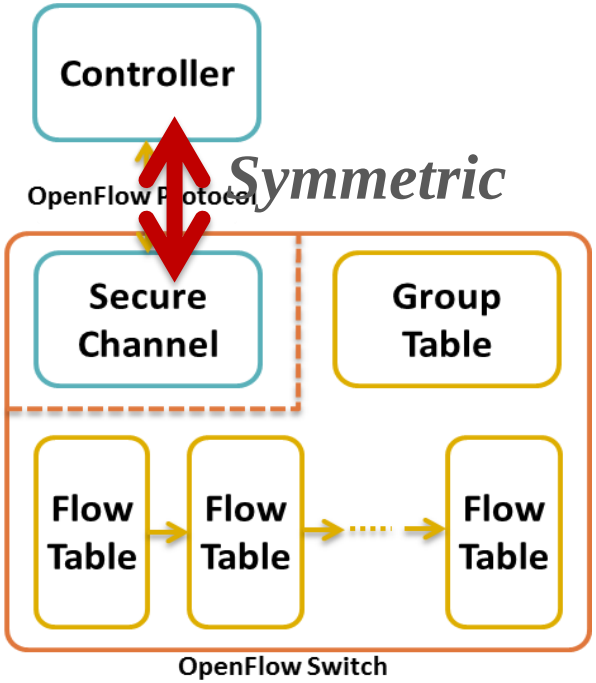
- Messages send by the switch to the controller with updates on:
  - Network events
  - Changes in the switch state
- Subtypes:
  - Packet-in – data packet is forwarded to controller
    - The packet may be buffered at the switch
    - The number of bytes to be received can be configured
  - Flow-Removed – inform the controller that a flow was removed due a timeout
  - Port-Status – inform the controller that a port has changed the status



OpenFlow Protocol Messages Symmetric

- Symmetric messages may be initiated by any of the communicating parties

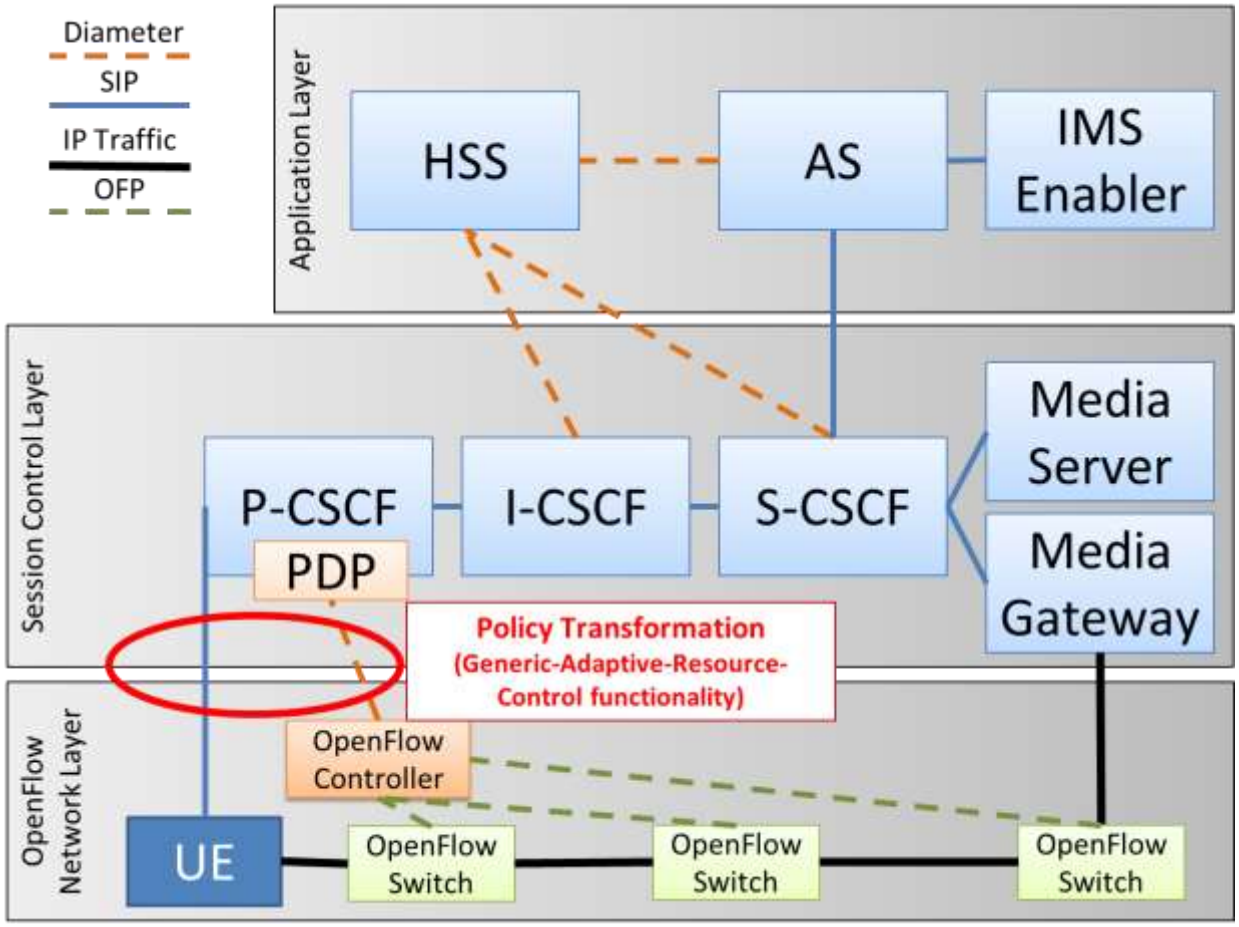
- Subtypes:
  - Hello – used during the connection setup
  - Echo – used to verify the liveliness of a connection
    - it must be responded with an echo reply
  - Experimenter – the means to offer additional functionality from the OF switch
    - Features meant for later releases



Vendor/Operator Open Flow Announcements

- "IBM and NEC Team Up to Enable Industry Innovators Tervela and Selerity to Transform their Networks with OpenFlow", http://www-03.ibm.com/press/us/en/pressrelease/36566.wss, Jan. 24, 2012
- "HP adds to its OpenFlow-enabled switch portfolio", http://www.zdnet.com/blog/virtualization/hp-adds-to-its-openflow-enabled-switch-portfolio/4686, March 5, 2012
- Google runnes all of its backbone traffic over OpenFlow software and hardware, OpenFlow @ Google - Urs Hoelzle, Google on Open Networking Summit 2012, http://opennetsummit.org/, Apil 17, 2012
- "Verizon shows off OpenFlow's benefits for carriers", "Verizon has created a partnership with Intel, HP and networking company Adara to help test and understand the benefits that OpenFlow and software defined networks could have on its business. It's trying to lower the cost of moving data between data center and more.", http://gigaom.com/cloud/verizon-shows-off-openflows-benefits-for-carriers/, Apr 17, 2012
- Cisco Open Network Environment (Cisco ONE), a rich set of platform APIs to allow your apps to directly control Cisco switches and routers, http://www.cisco.com/web/solutions/trends/open_network_environment/index.html, June 2012

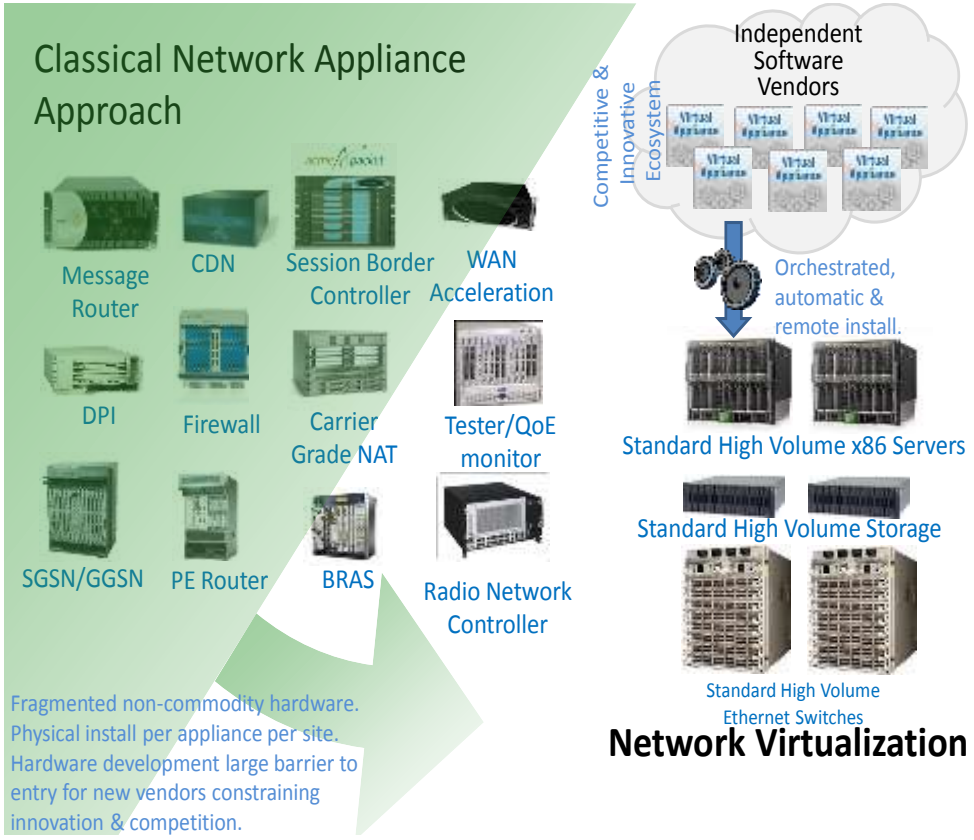
On-going work: IP Multimedia Subsystem and OpenFlow



- Application awareness towards network
- Optimized connectivity control
- Diameter and OpenFlow Protocol translation using Generic-Adaptive-Resource-Control functionality (GARC)
- GARC: 3GPP Policy Charging Control extension for heterogeneous access and core networks

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



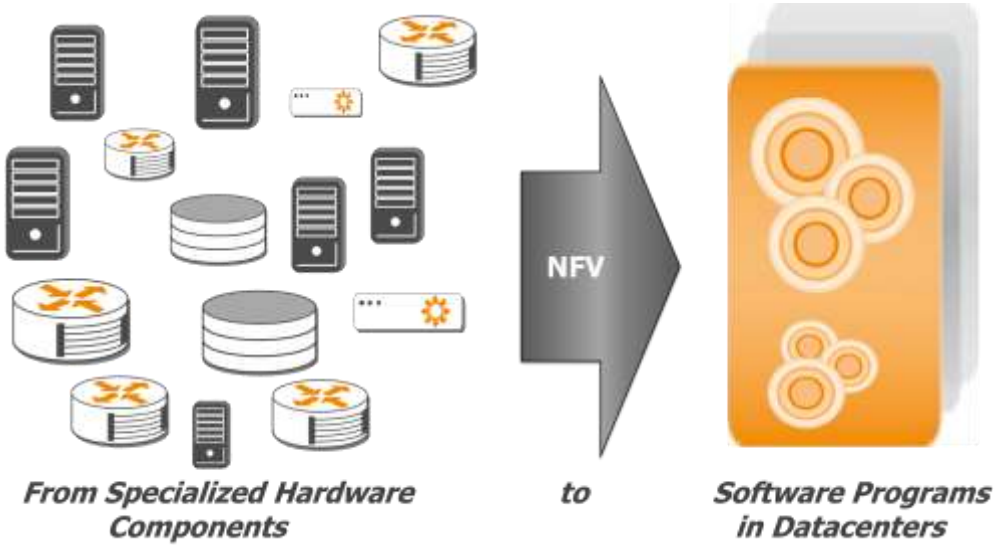
© NFV White Paper presented at "SDN and OpenFlow World Congress", Darmstadt Oct 22-24, 2012

What is Network Functions Virtualization (NFV)

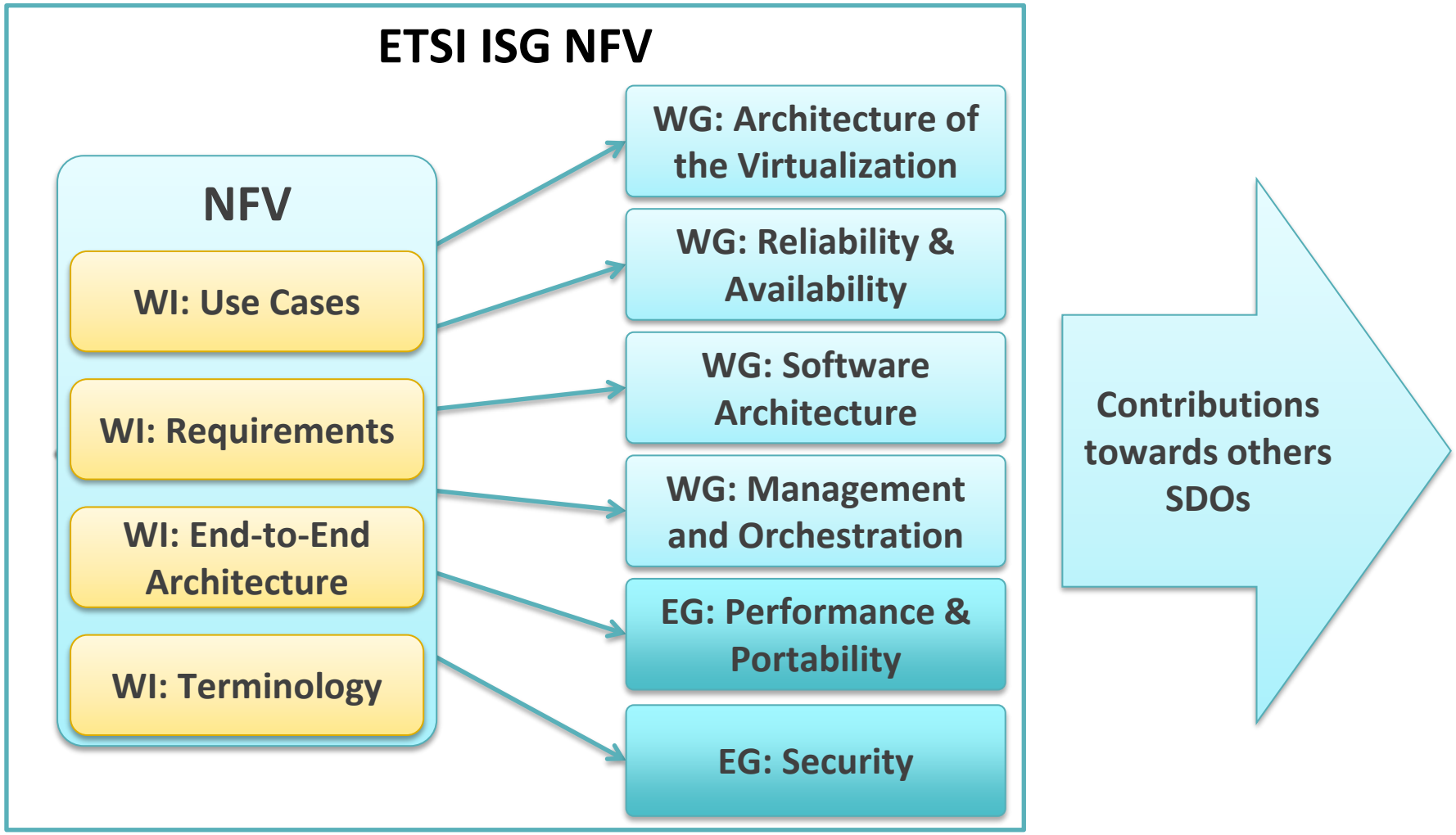
- The objective of NFV is to translate the classic network appliances to software modules
  - Running on high volume servers with high volume storage
  - Interconnected by generic high volume switches
  - Automatly orchestrated and remotely installed

- 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

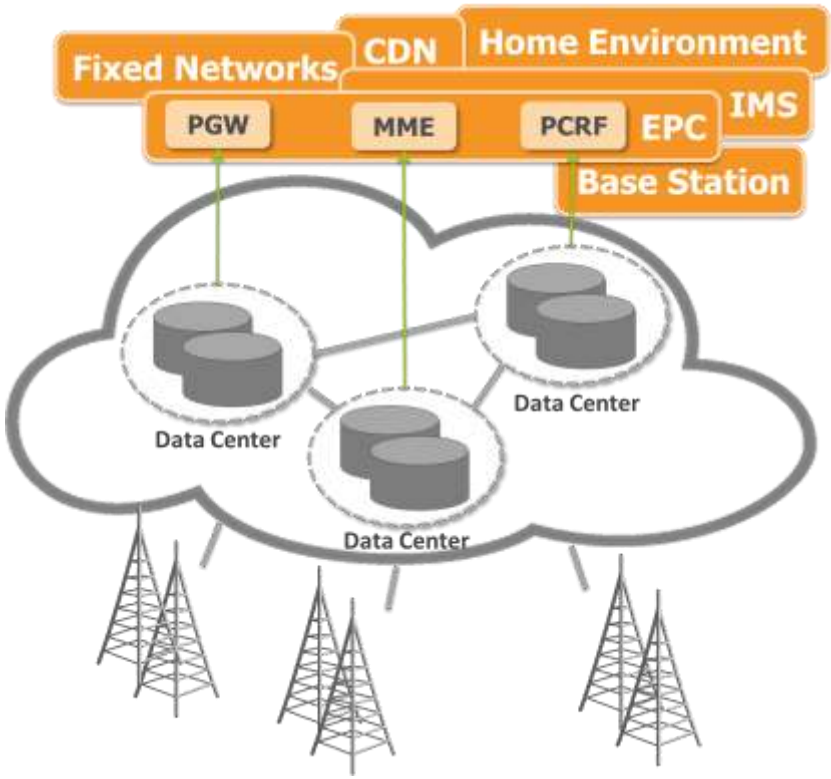


ETSI NFV Internal Organisation



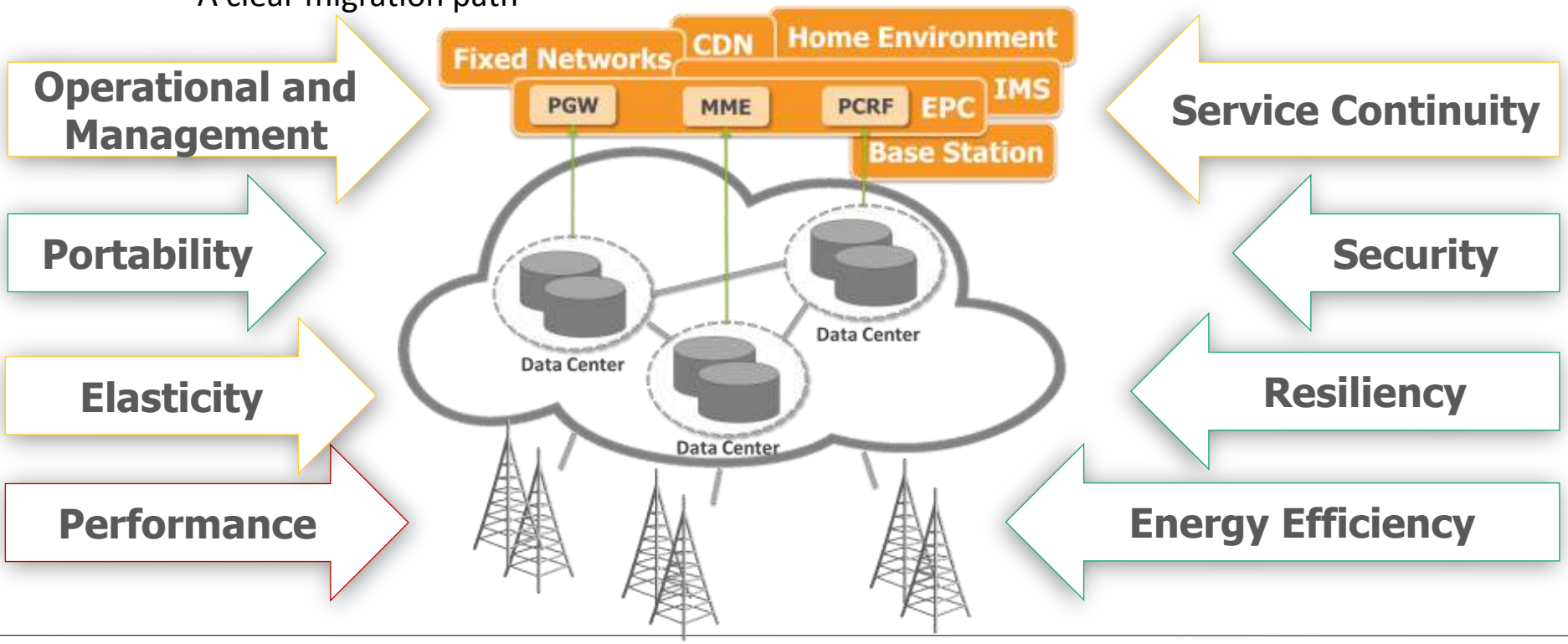
NFV Use Cases

- All network functionality is considered (at least in this initial stage)
  - Mobile core networks
  - Fixed core networks
  - IMS and CDNs
  - Home Environment Functions
  - Radio Virtualization
- Realizing at different openess levels:
  - Infrastructure as a Service
  - Network Function as a Service
  - Platform as a Service
- Needs a very dynamic reconfigurable network
  - Service chaining, routing, and traffic enginering



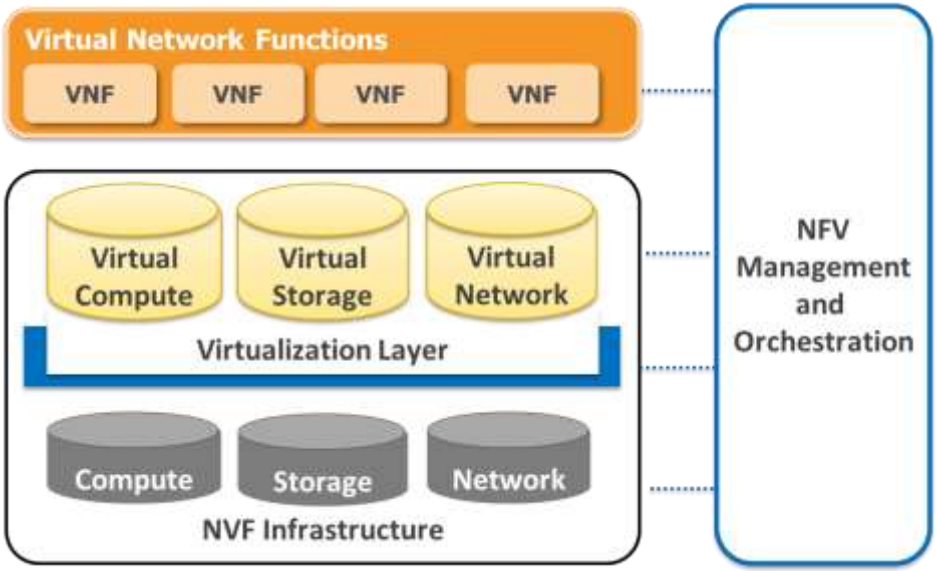
NFV Requirements

- A main requirement/issue for NFV technology to be adopted are:
  - The performance – a penalty comes from the uniform hardware architecture
  - The cost gains vs. the investment costs
  - A clear migration path

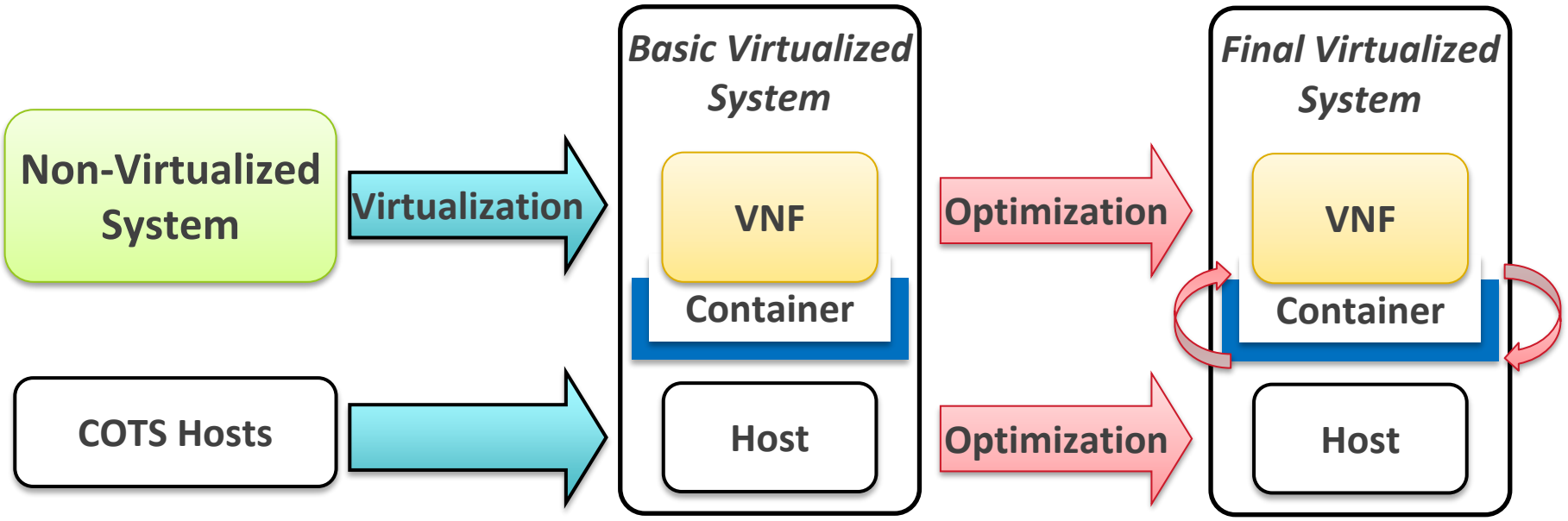


NFV Architecture: A primer

- Virtualised Network Functions (VNF)
  - the software implementation of a network function which is capable to run over NFVI
- NFV Infrastructure (NFVI)
  - includes the diversity of physical resources and how these can be virtualised.
  - NFVI supports the execution of the VNFs
- NFV Management and Orchestration
  - the orchestration of physical/software resources that support the infrastructure virtualisation, and the management of VNFs
  - The service chaining and traffic engineerign

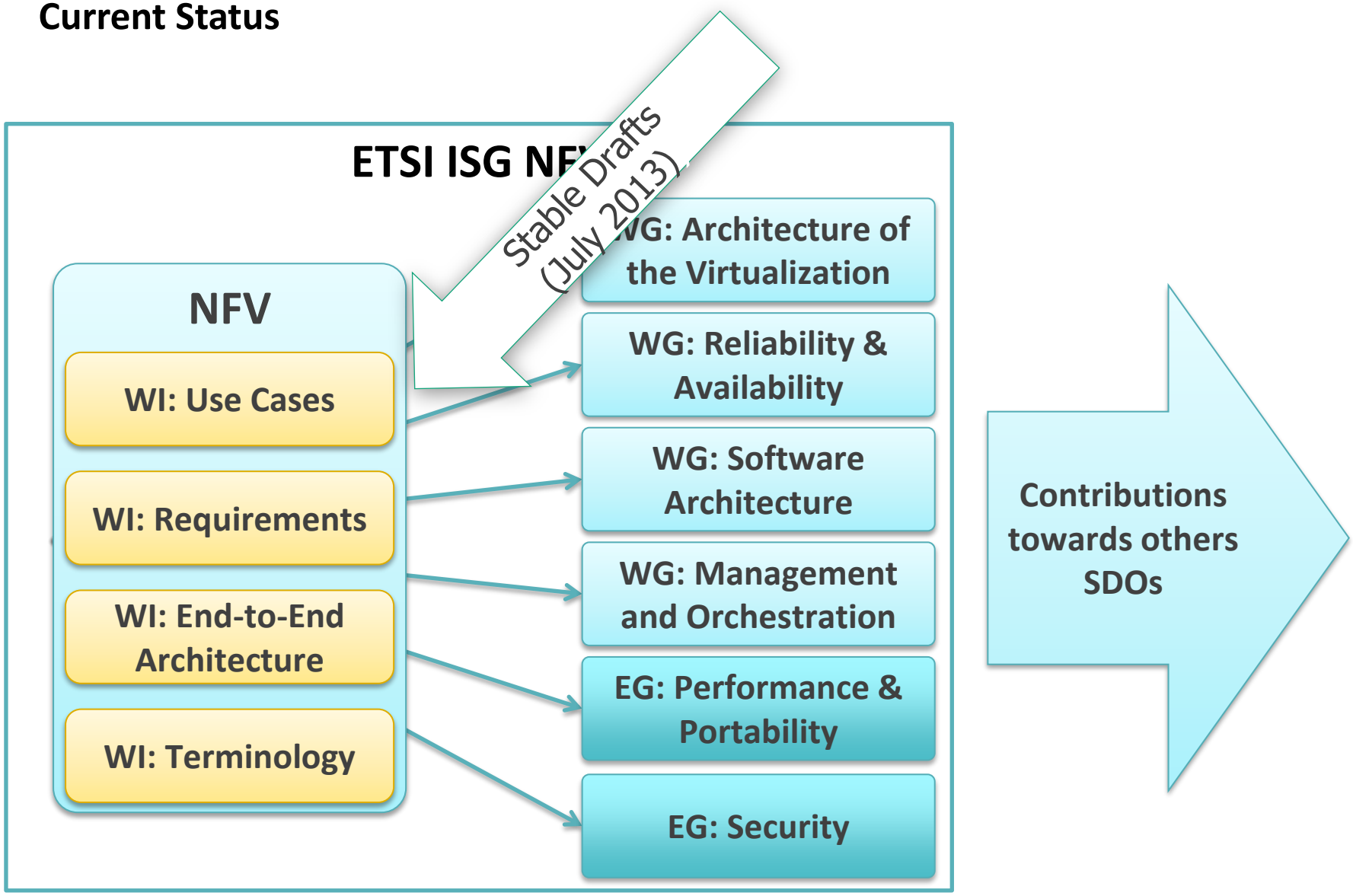


Research and Development of the NFV Framework

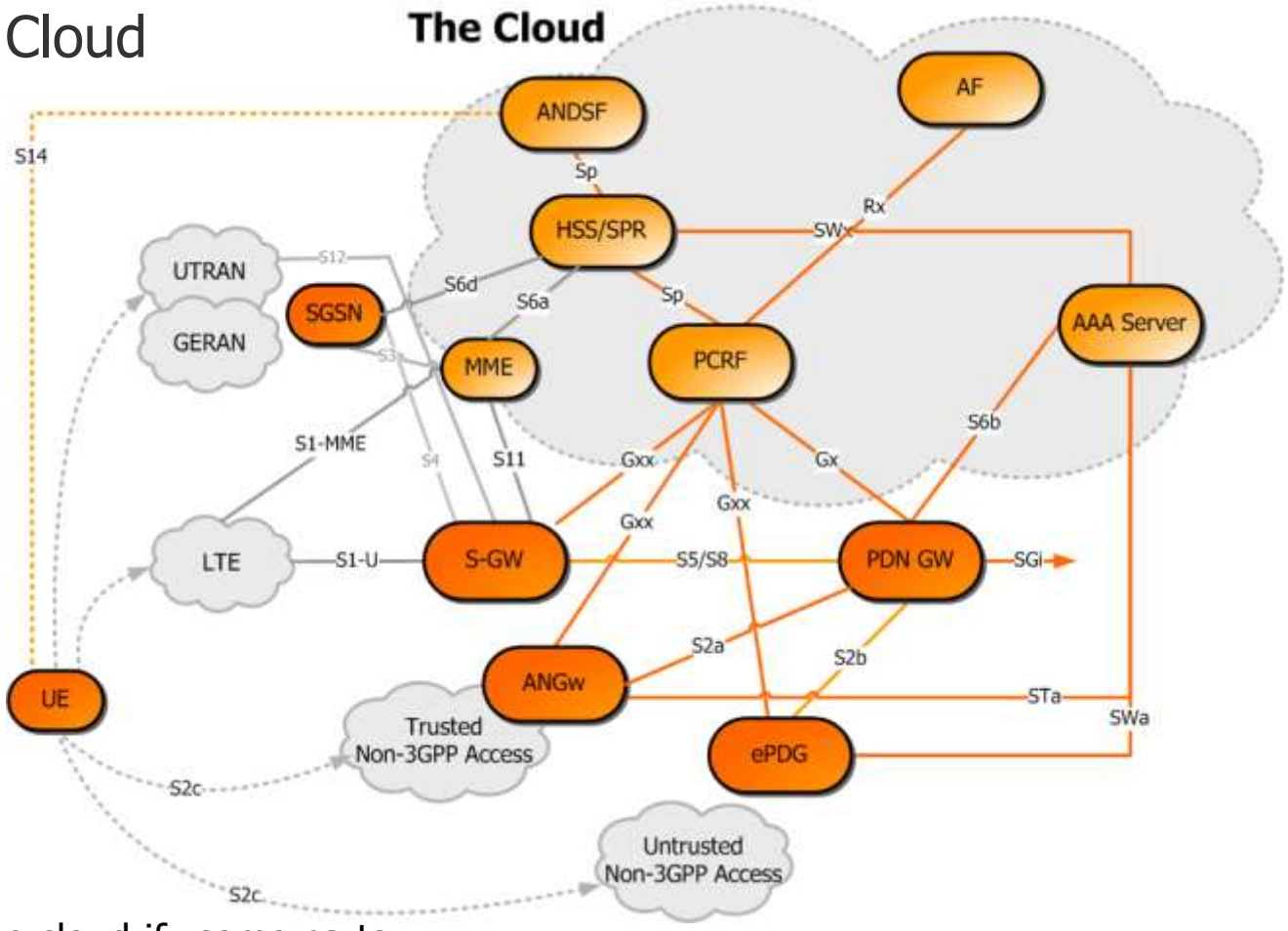


1. Porting the non-virtualized system to COTS hardware → Basic VNF realization
2. Optimizing the VNFs to the new hardware architecture
3. Optimizing the hardware to the network communication characteristics
4. Optimization cycles of VNFs and hardware

Current Status

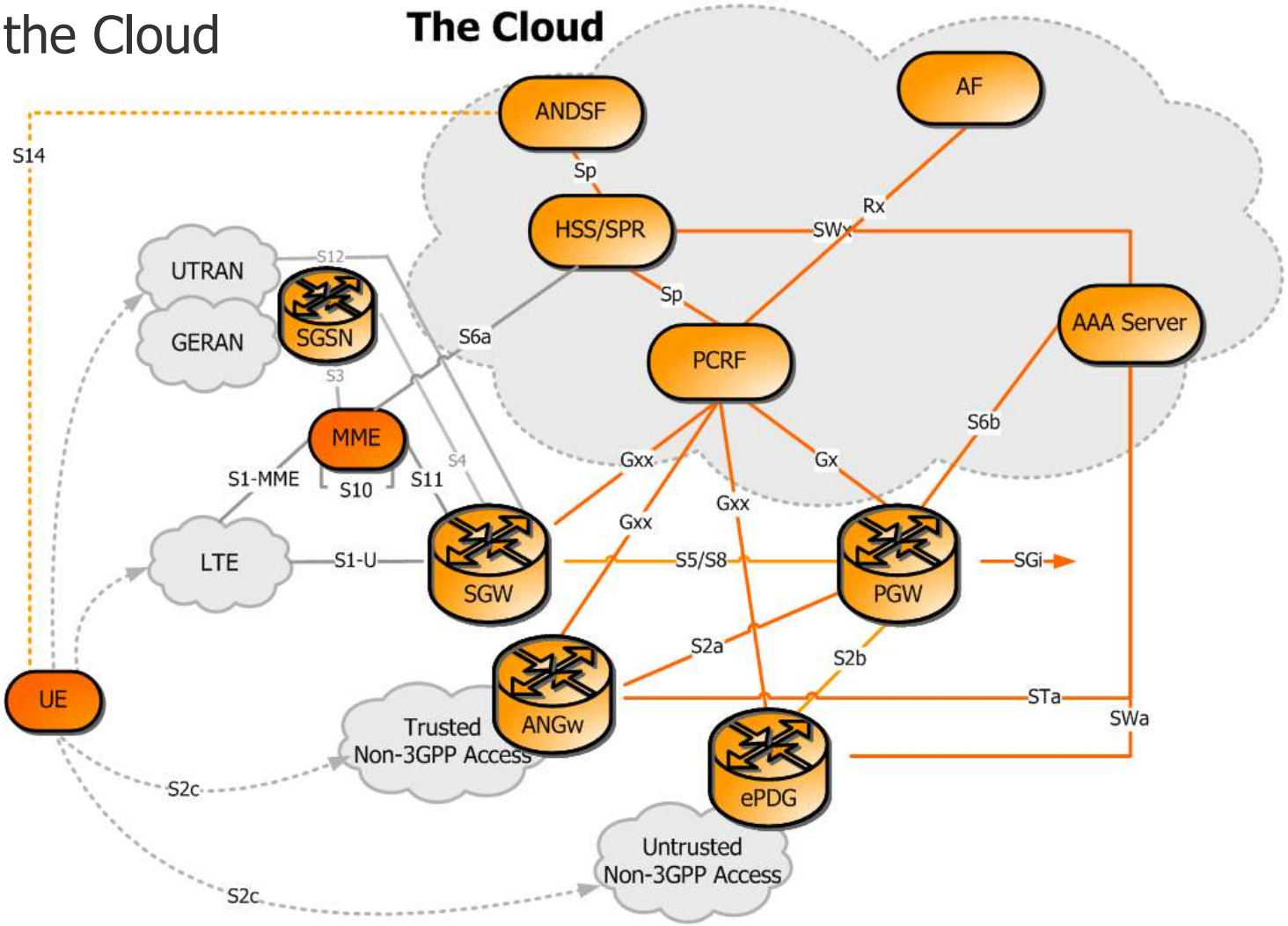


OpenEPC in the Cloud



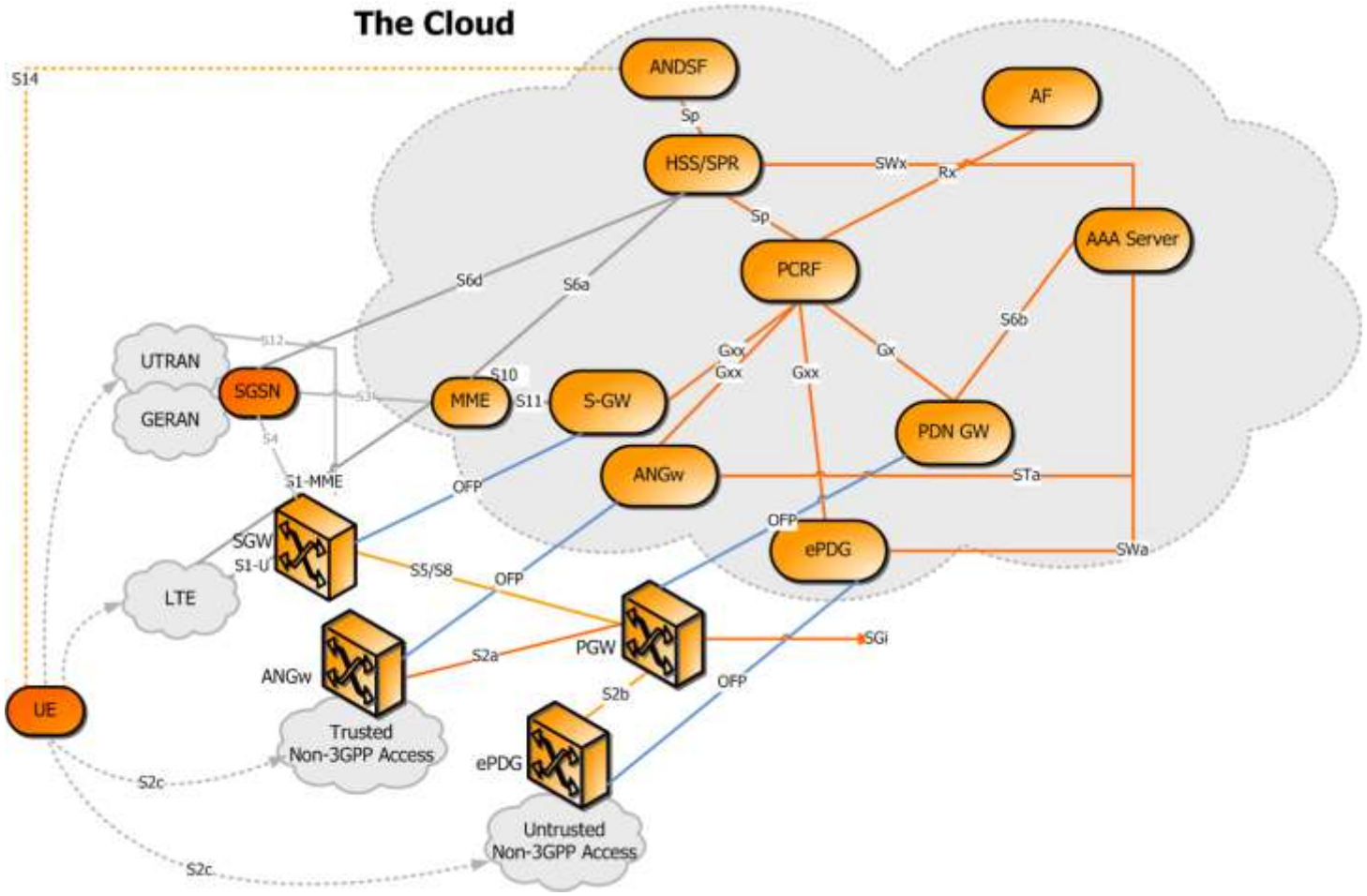
- First phase – easy to cloud-ify some parts
- The rest is infrastructure (Gateways)
  - Yes, more can be done, but are we virtualizing just for the sake of virtualization?
  - highly influenced by latency!!! (e.g. GPRS core must have RTT <2ms)

OpenEPC in the Cloud



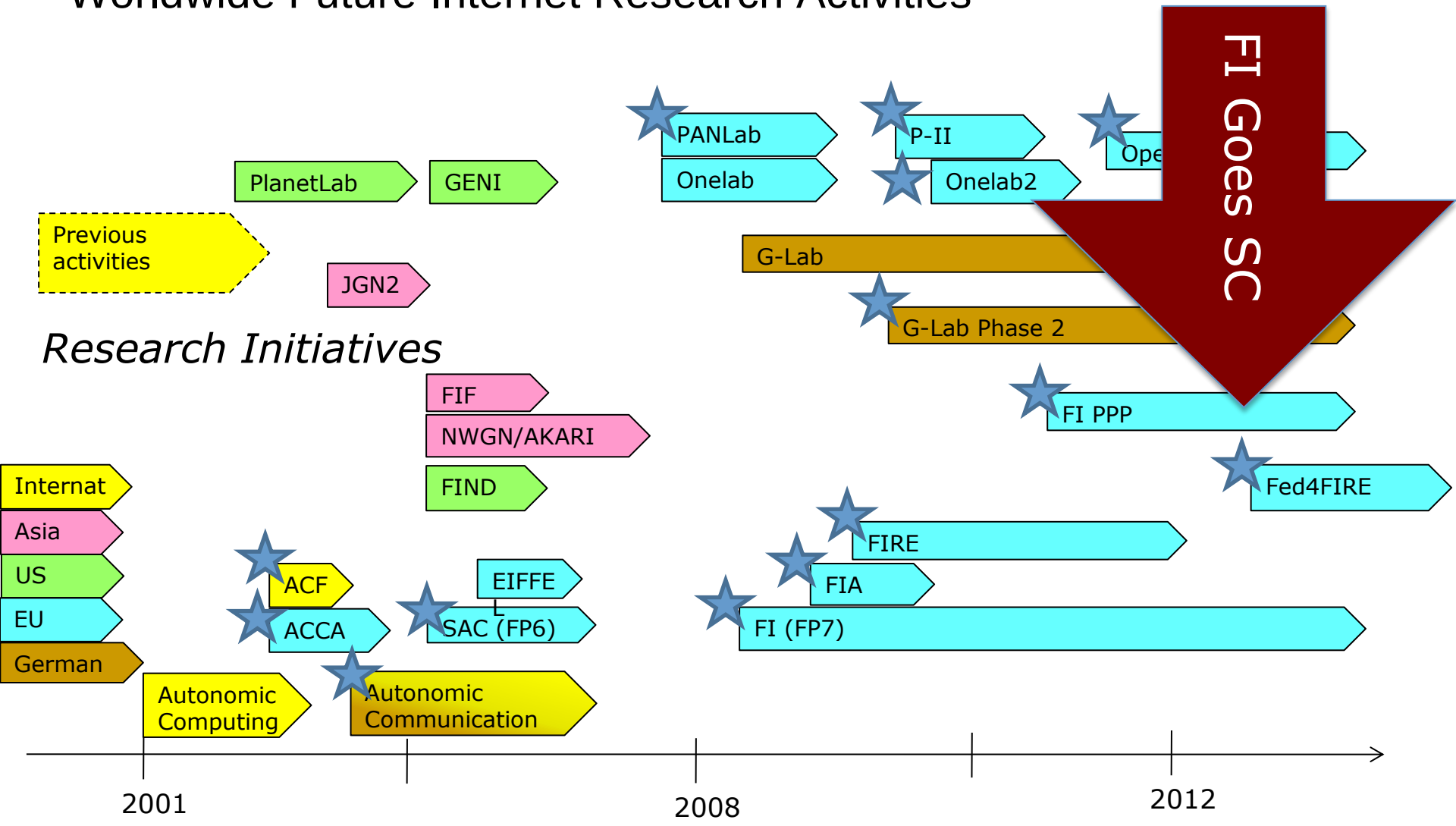
- But what to do with the Gateways?

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

Worldwide Future Internet Research Activities

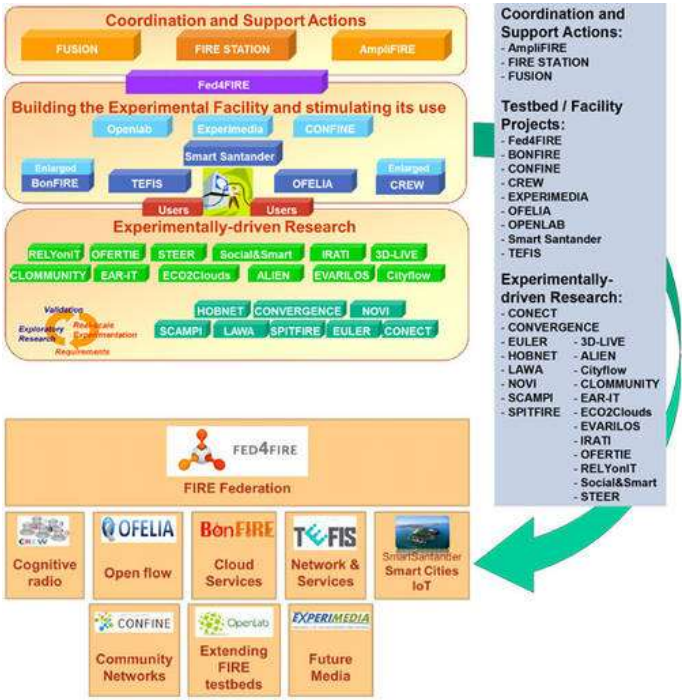


with FOKUS and TUB contribution

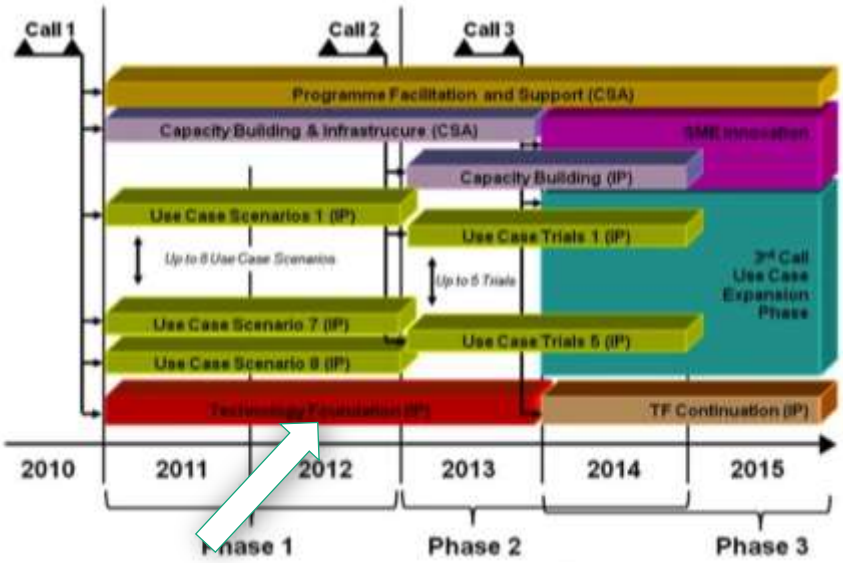
Europe's key Initiatives for Future Internet Research and Development FIRE and the FI-PPP

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

Evolution of Telecom Platforms towards the Future Internet
Future Internet Research and Experimentation - FIRE

In FIRE, we utilize state-of-the-art federation tools to expose our Next Generation Network testbeds to Europe's research community for testing and experimentation.

EU FI PPP Facts

FACTS & FIGURES

2x € 300 million

INVESTMENT BY THE EUROPEAN COMMISSION & PROGRAMME PARTICIPANTS

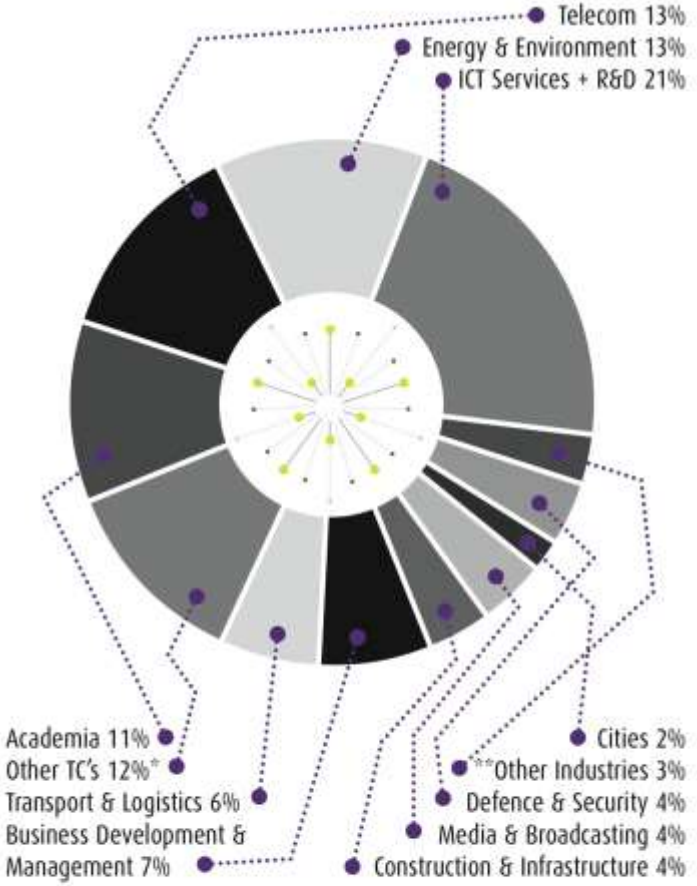
158 PARTNER ORGANIZATIONS AND COMPANIES

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

FI PPP Use Case Projects

ENVIROFI

http://www.envirofi.eu

FI-CONTENT

http://www.fi-content.eu

FINEST

http://www.finest-ppp.eu

FINSENY

http://www.fi-ppp-finseny.eu

INSTANT MOBILITY

http://instant-mobility.com

OUTSMART

http://www.fi-ppp-outsmart.eu

SAFECITY

http://www.safecity-project.eu

SMARTAGRIFOOD

http://www.smartagrifood.eu

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 Mission

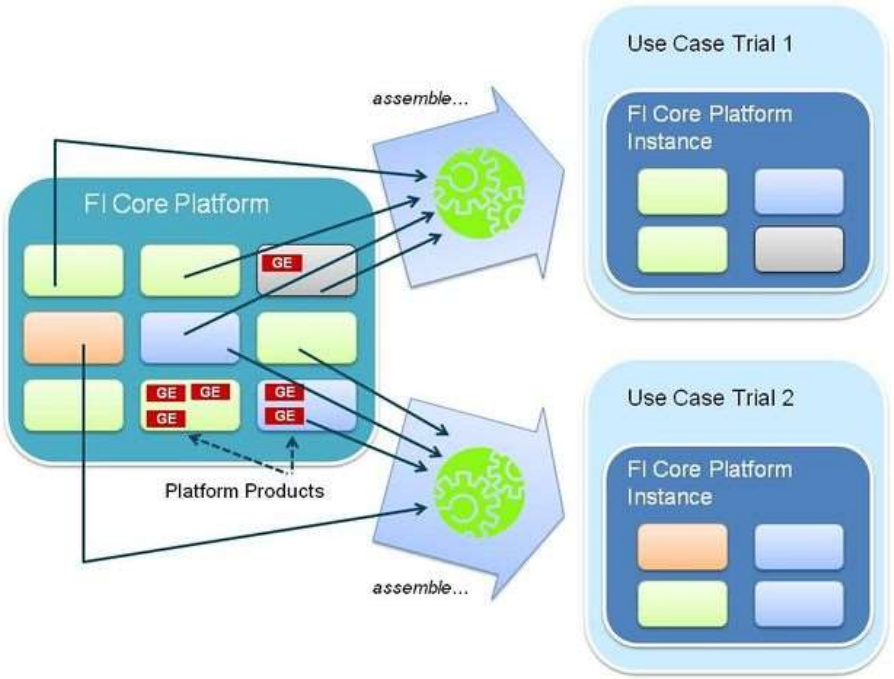
- The FI-WARE project will design, develop and implement the so-called Core Platform within the European Future Internet Public Private Partnership (FI-PPP) Program defined under the ICT FP7 Work Programme.
  - See http://www.fi-ppp.eu

- *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.*

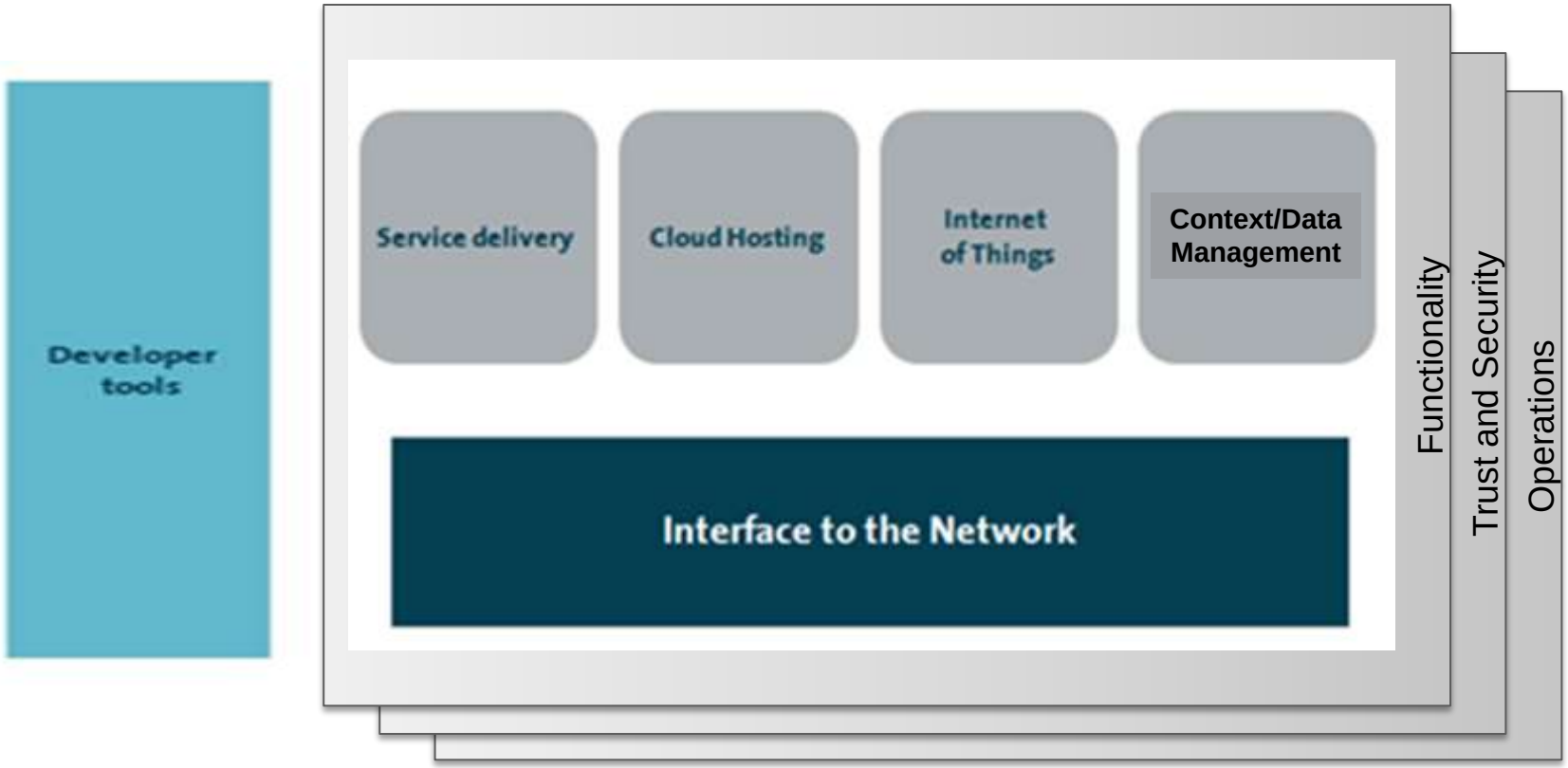
- FI-WARE will be open, based upon elements (hereunder called **Generic Enablers**) which offer reusable and commonly shared functions serving a multiplicity of **Usage Areas** across various sectors**.**

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.

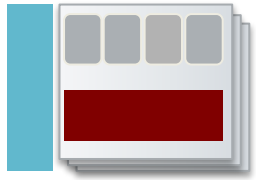


FI Core Platform Architecture: Enablers are grouped in “chapters”



182

Interface to Networks and Devices (I2ND)
Overview



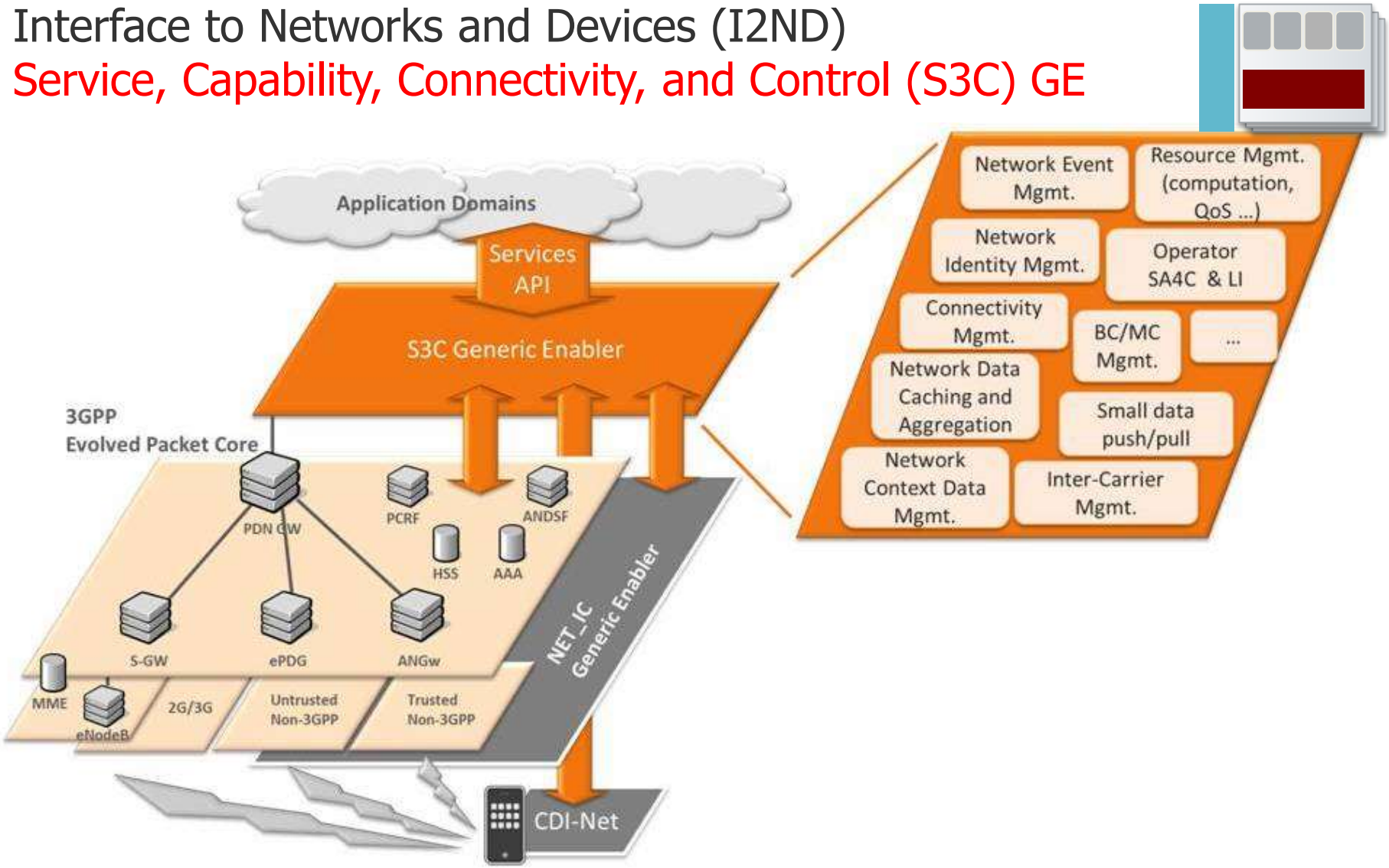
- I2ND provides a common and standard Interface to Devices that allows interoperability among applications running on different devices and the portability of applications across devices

- The Generic Enablers provided to implement a standardized Interface to Networks and Devices (I2ND), can be used by other FI-WARE elements, such as Cloud Hosting, Internet of Things etc., and also directly used by the applications in multiple Usage Areas.

- I2ND chapter addresses four different classes of interfaces:
  - connected device
  - cloud proxy
  - open networking
  - network services

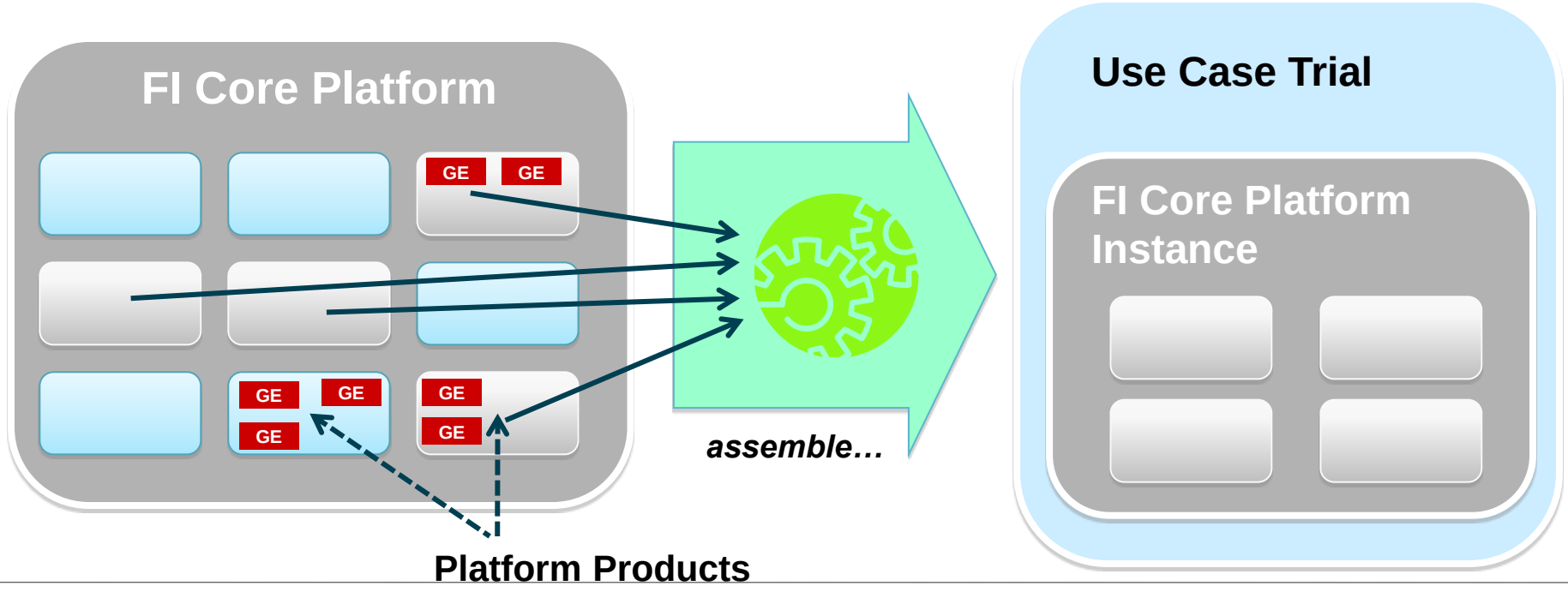
Interface to Networks and Devices (I2ND)

Service, Capability, Connectivity, and Control (S3C) GE



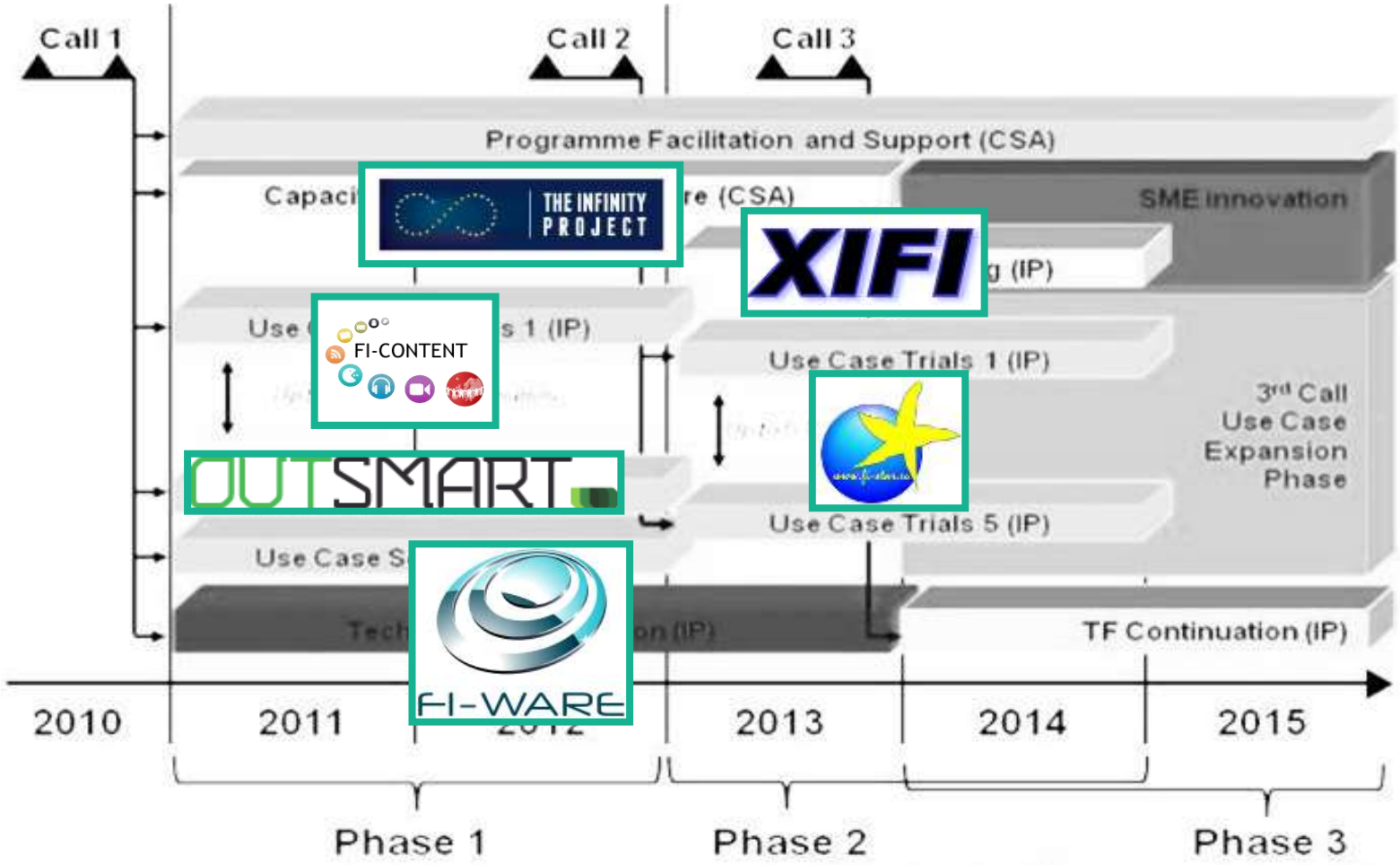
Core Platform Instances and Use Case Trials

- Future Internet Applications run on top of “FI Core Platform Instances” built upon selection and assembly of “Platform Products” implementing “Generic Enablers” of the “FI Core Platform”
- Use Case trials will consist on application scenarios running on top of FI Core Platform Instances, involving real users

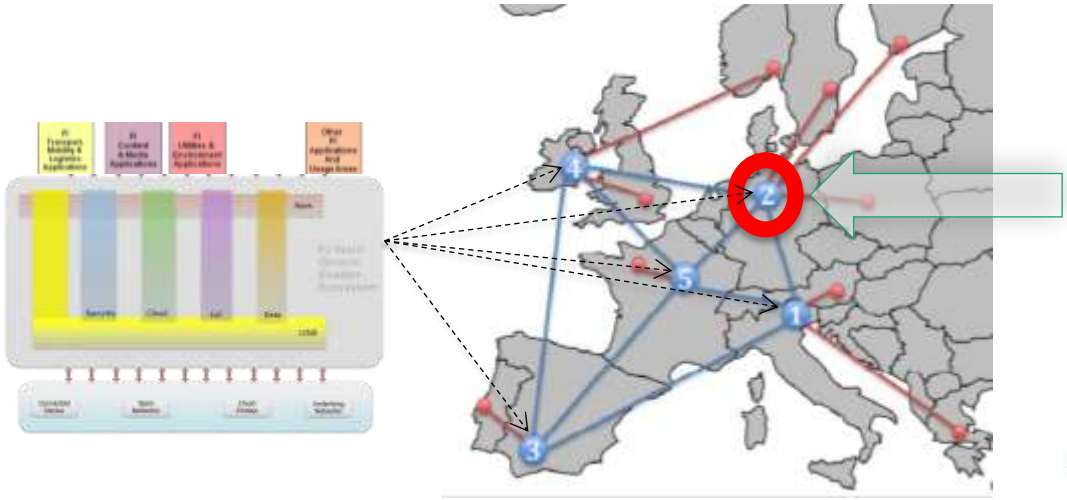


190

Fraunhofer FOKUS' involvement in the FI-PPP



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



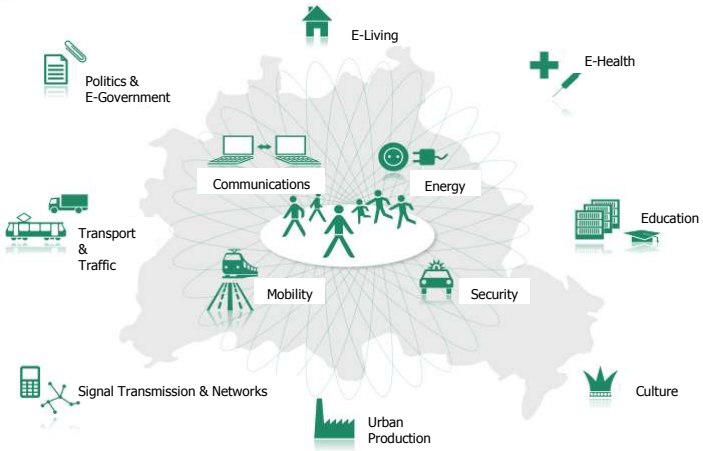
The German FI-PPP Node operated and enabled by

+

Fraunhofer FOKUS

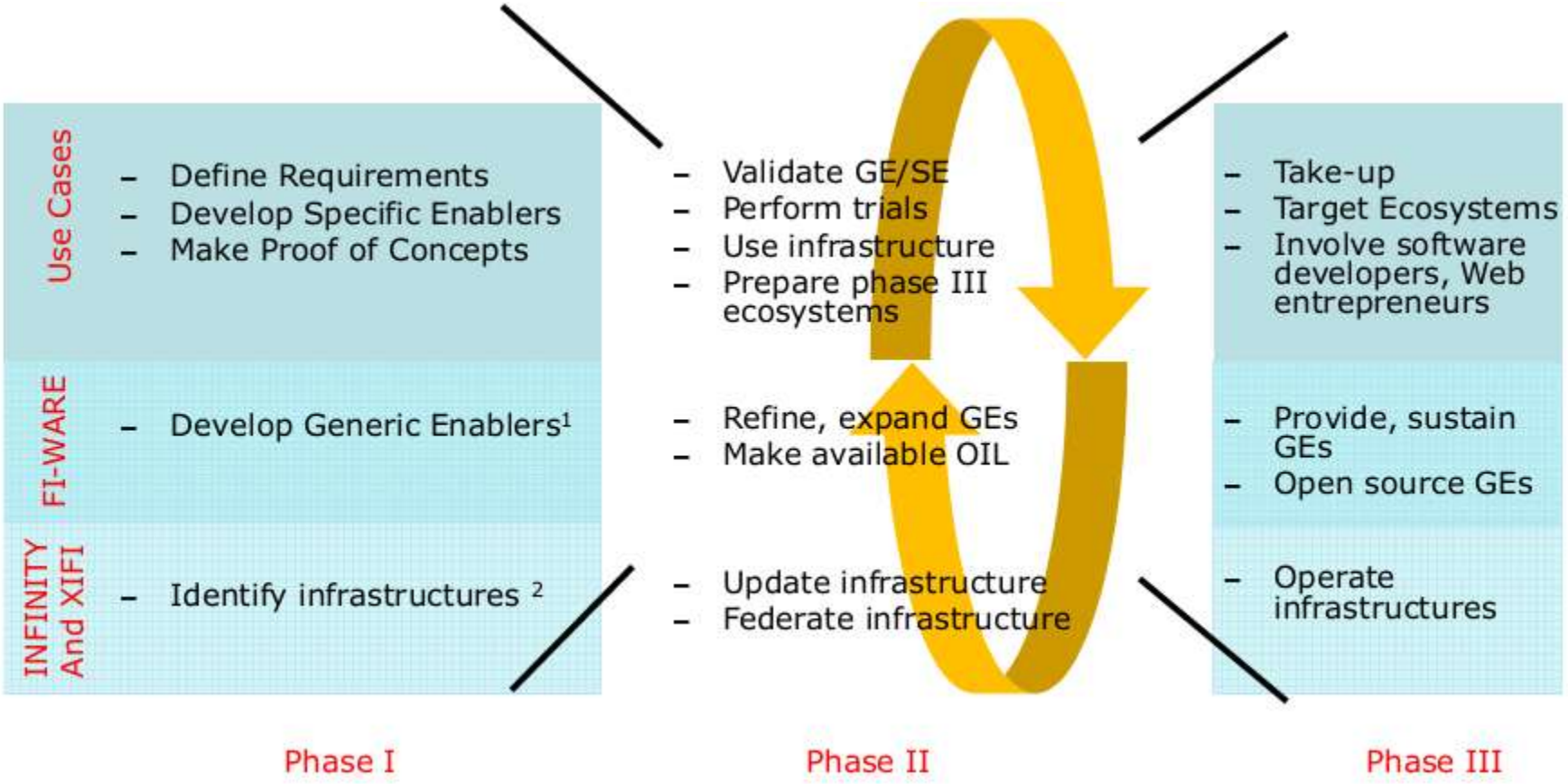
NGN2FI Evolution Lab

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

FI-Ware
Capacity Building and Infrastructures FI-PPP Projects

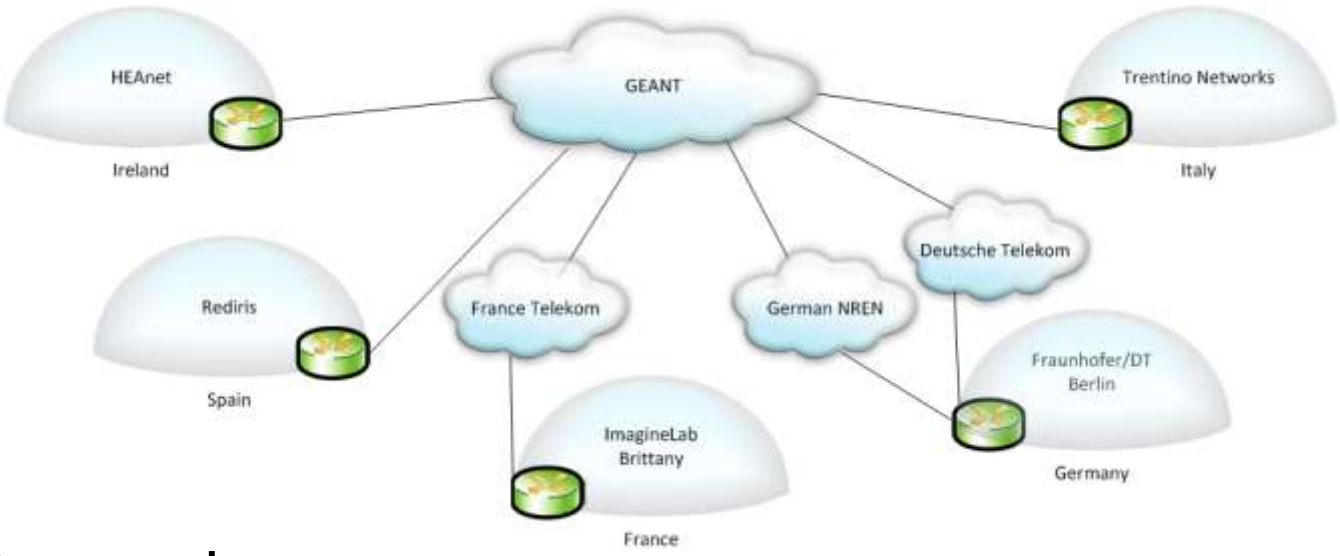
FUTURE INTERNET PPP

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

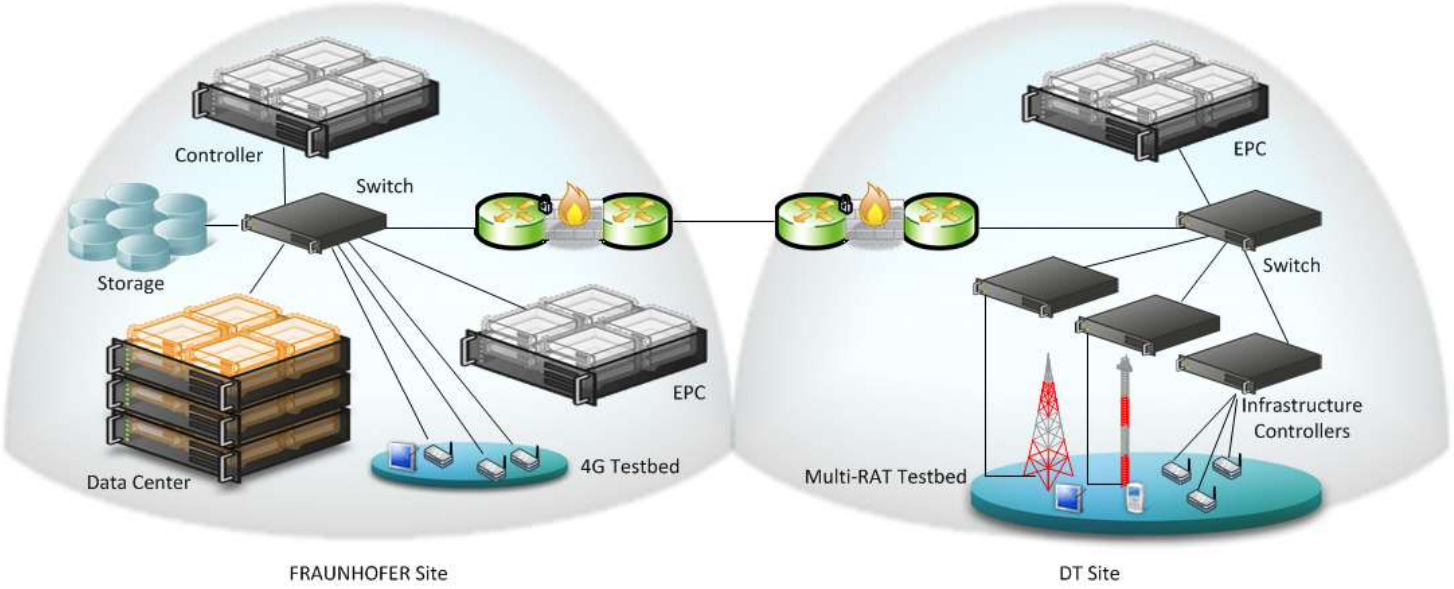
FI-Ware
Capacity Building and Infrastructures FI-PPP Projects



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:

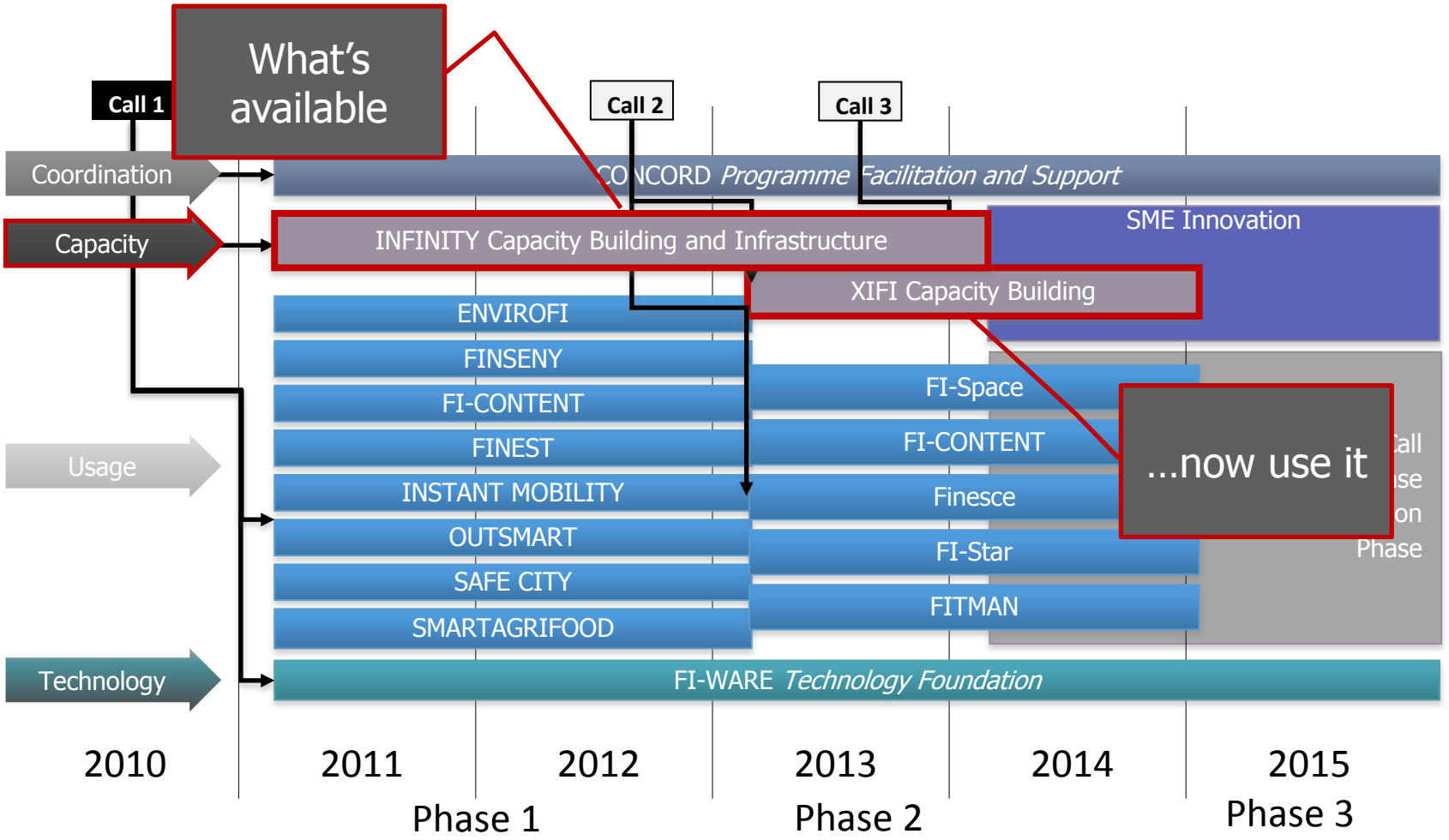
  To facilitate communication and collaboration between future internet infrastructure owners across Europe and organisations developing future internet applications in order to 1) position Europe at the centre of the future of the Internet 2) directly support experimentation for FI-PPP projects and investors 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



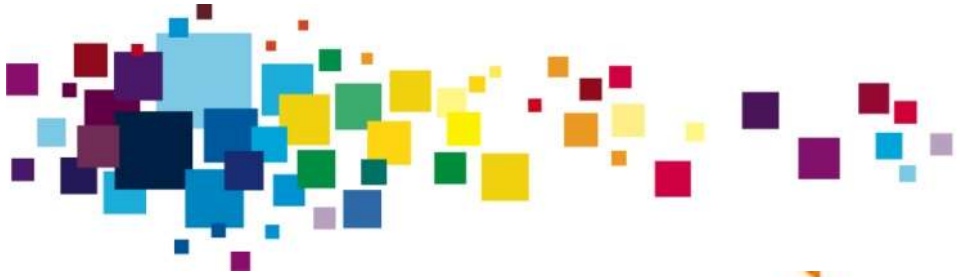
Agenda

- 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



fokus broker
Fraunhofer FOKUS

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**.

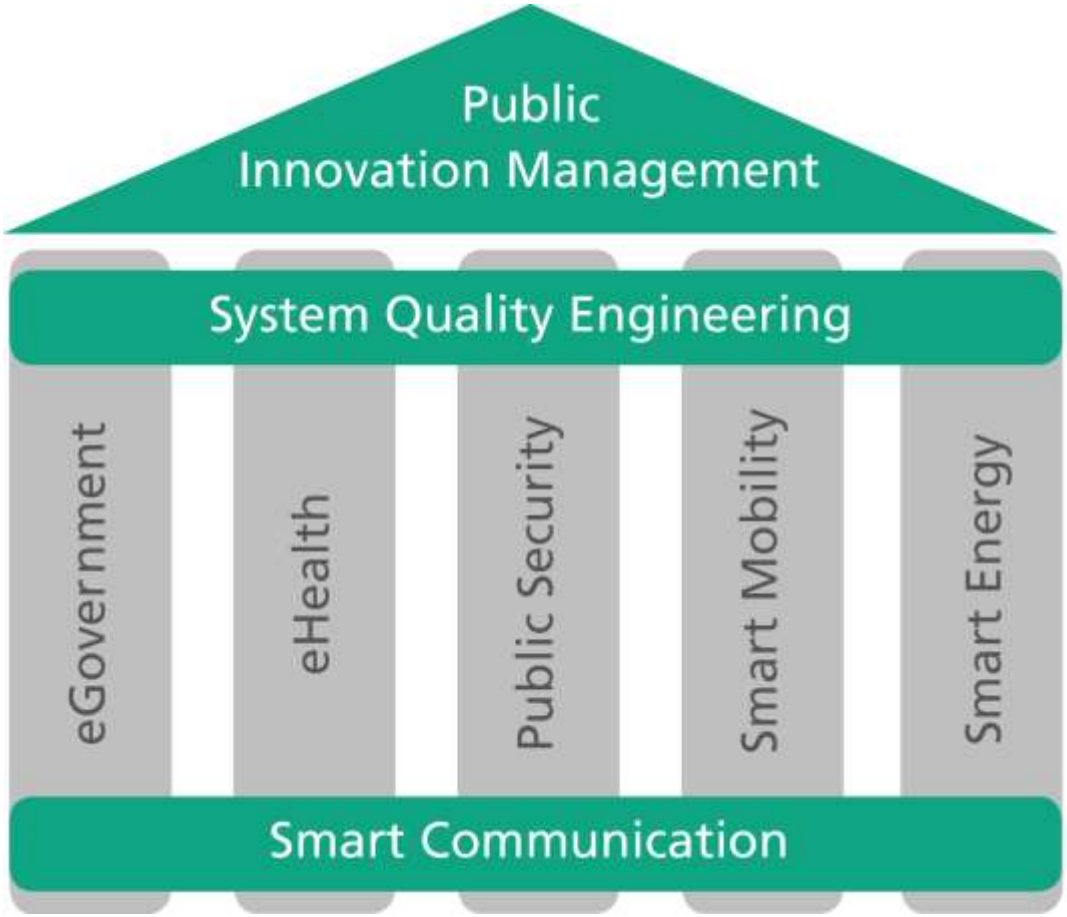
Quelle: www.pg.dk

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

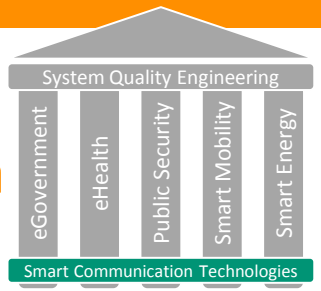
Fraunhofer FOKUS – Activity Domains



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

Next Generation Network Infrastructures NGNI

Next Generation Network to Future Internet Evolution



NGNI works on universal control platforms for Human-to-Human and Machine-to-Machine communications in fixed and wireless networks as well as on integrated communication infrastructures.

Research & Development

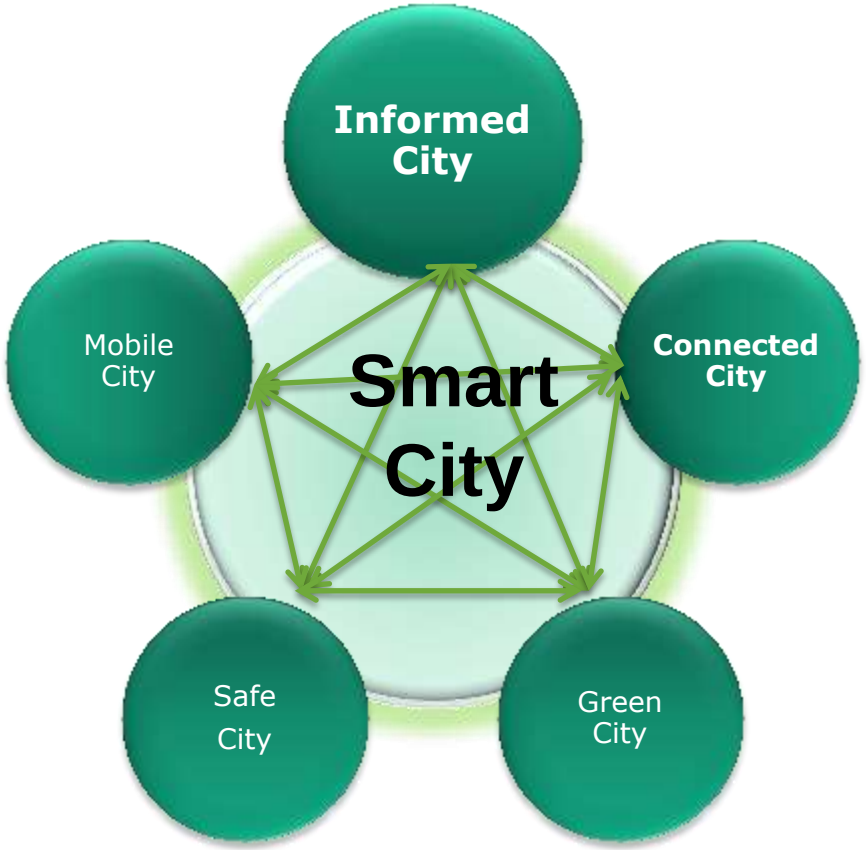
- Integrated Service Architectures for convergence of telecommunication and Internet
- Reliable network infrastructures and end systems for Next Generation Networks
- Rich communication services
- Machine-Type Communication frameworks and M2M toolkits
- Seamless service access across mobile broadband networks
- Mobile Cloud Computing, monitoring and security

FOKUS Smart Cities Vision

Transforming Data into Information

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

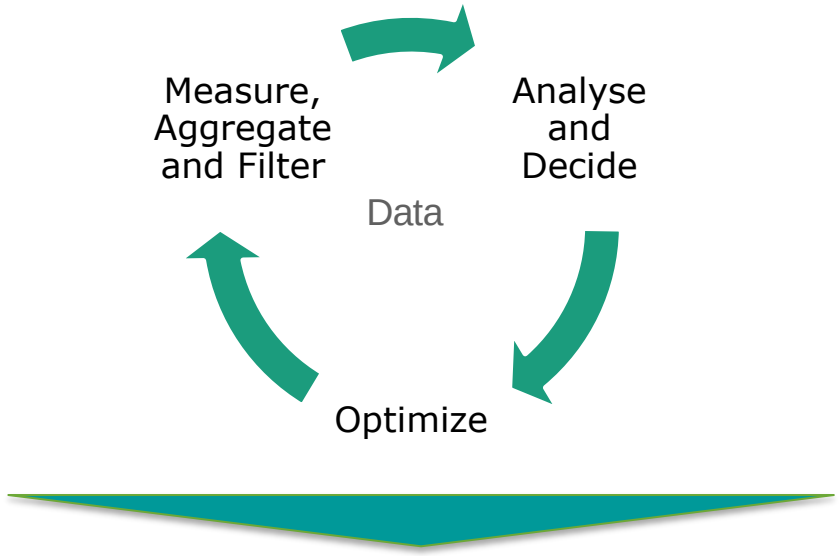
  Always Best Informed and Inter-Connected Urban Actors (Machines, Systems and People)
- Information at any need, at any place, at any device, at any time, at any preference



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



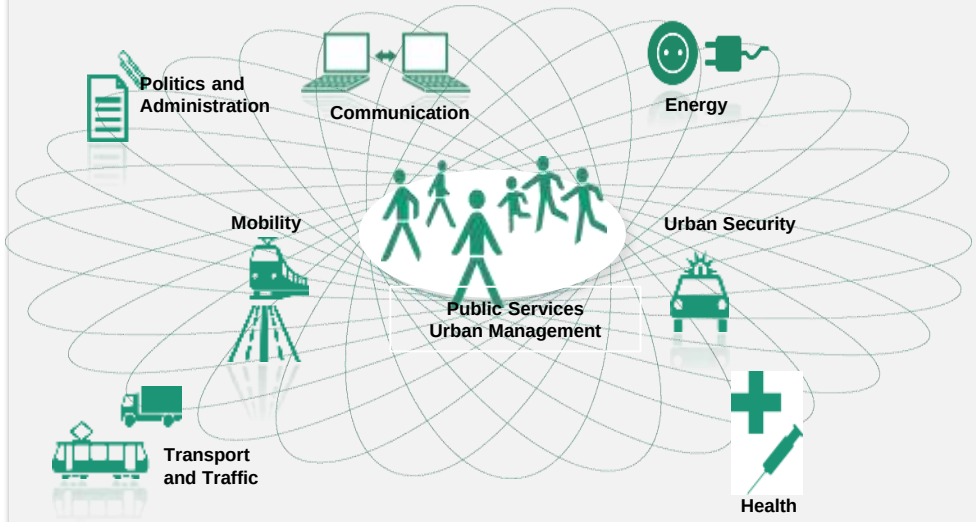
ICT in Smart Cities

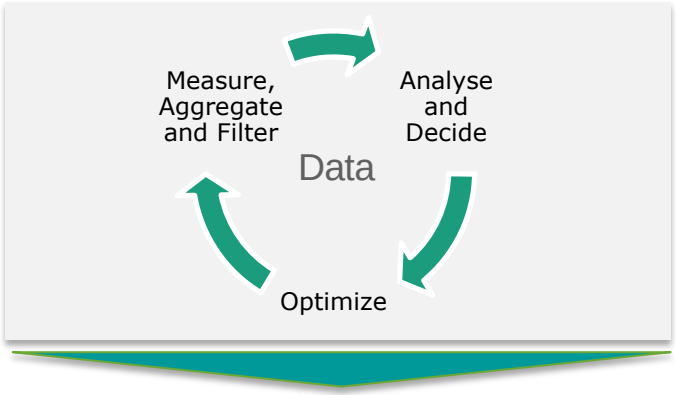
Backbone for Smart Cities

City as a system of systems

Set of separate technical systems → Integrated systems

Affectivity and efficiency results from optimized integration of separated systems



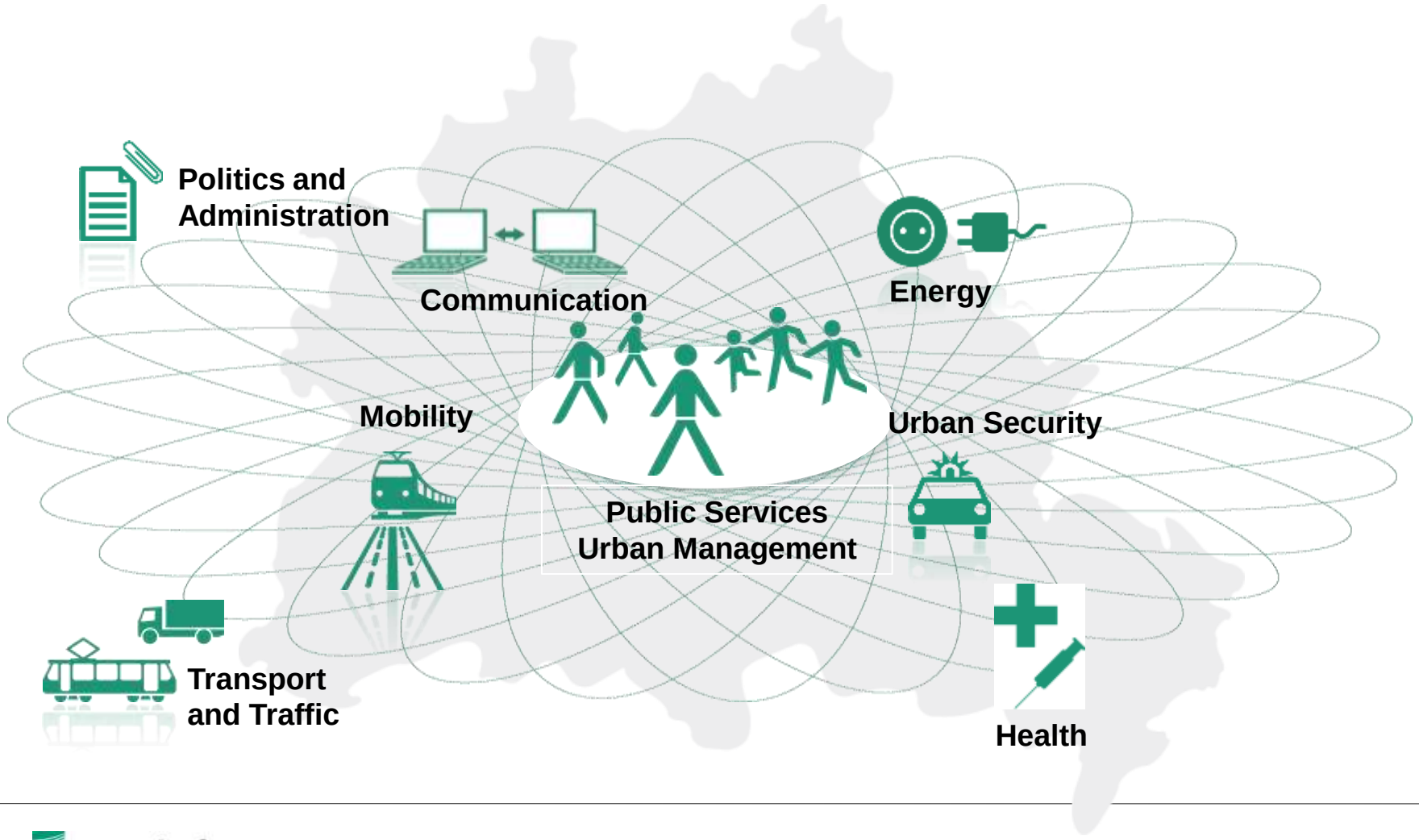


Fraunhofer FOKUS

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

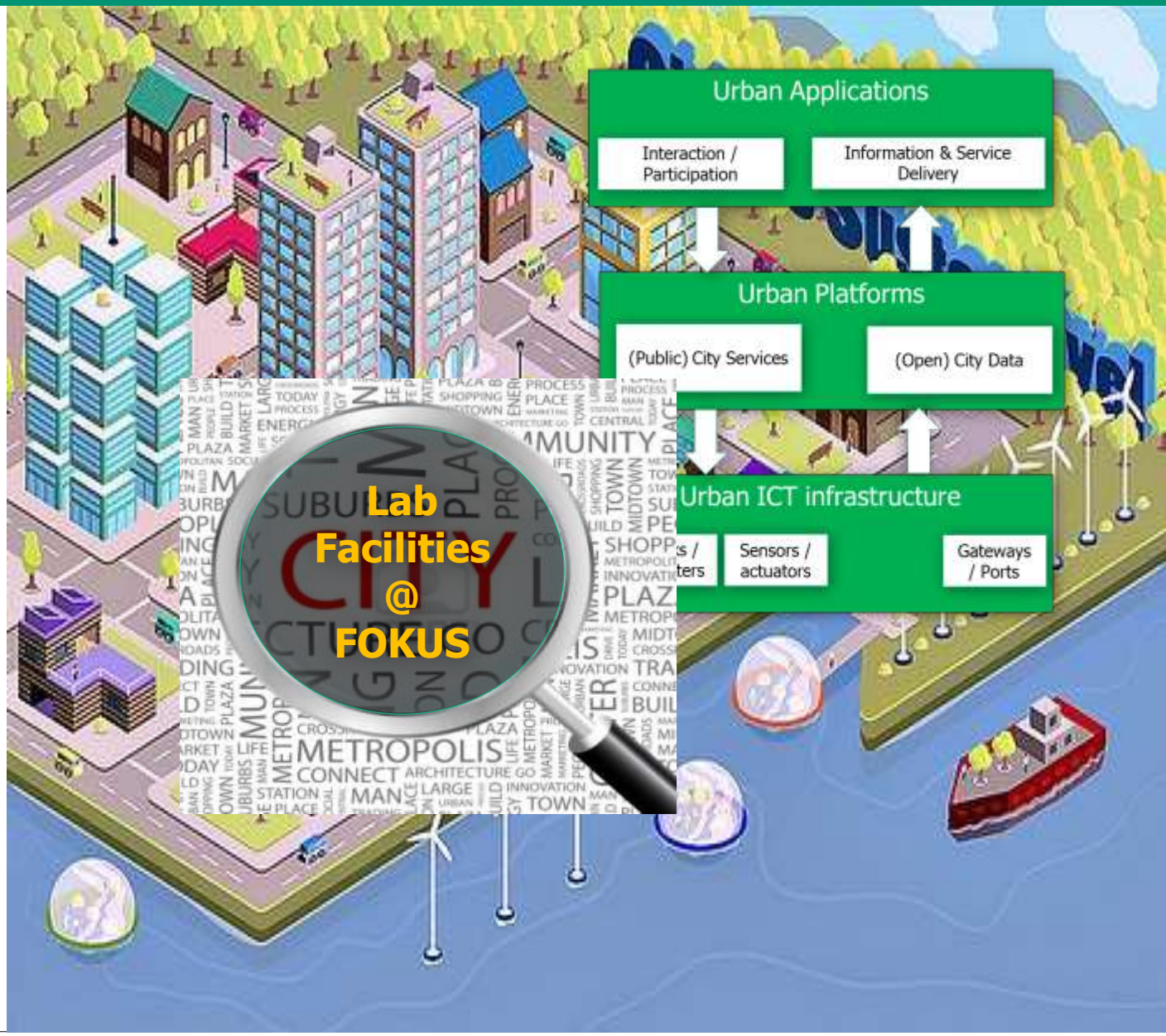
A Smart City

depends on a smart

ICT Infra-structure

that is inspired by

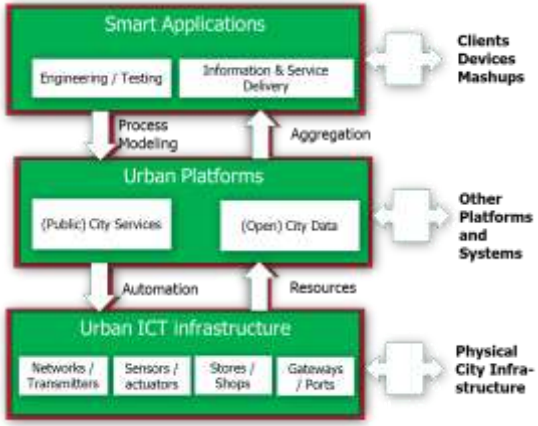
FOKUS Labs



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

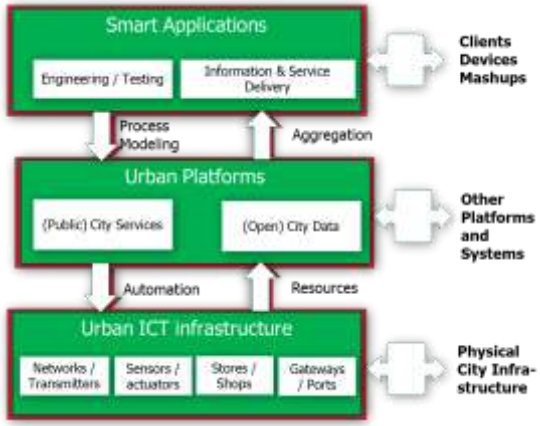


New services, improved processes

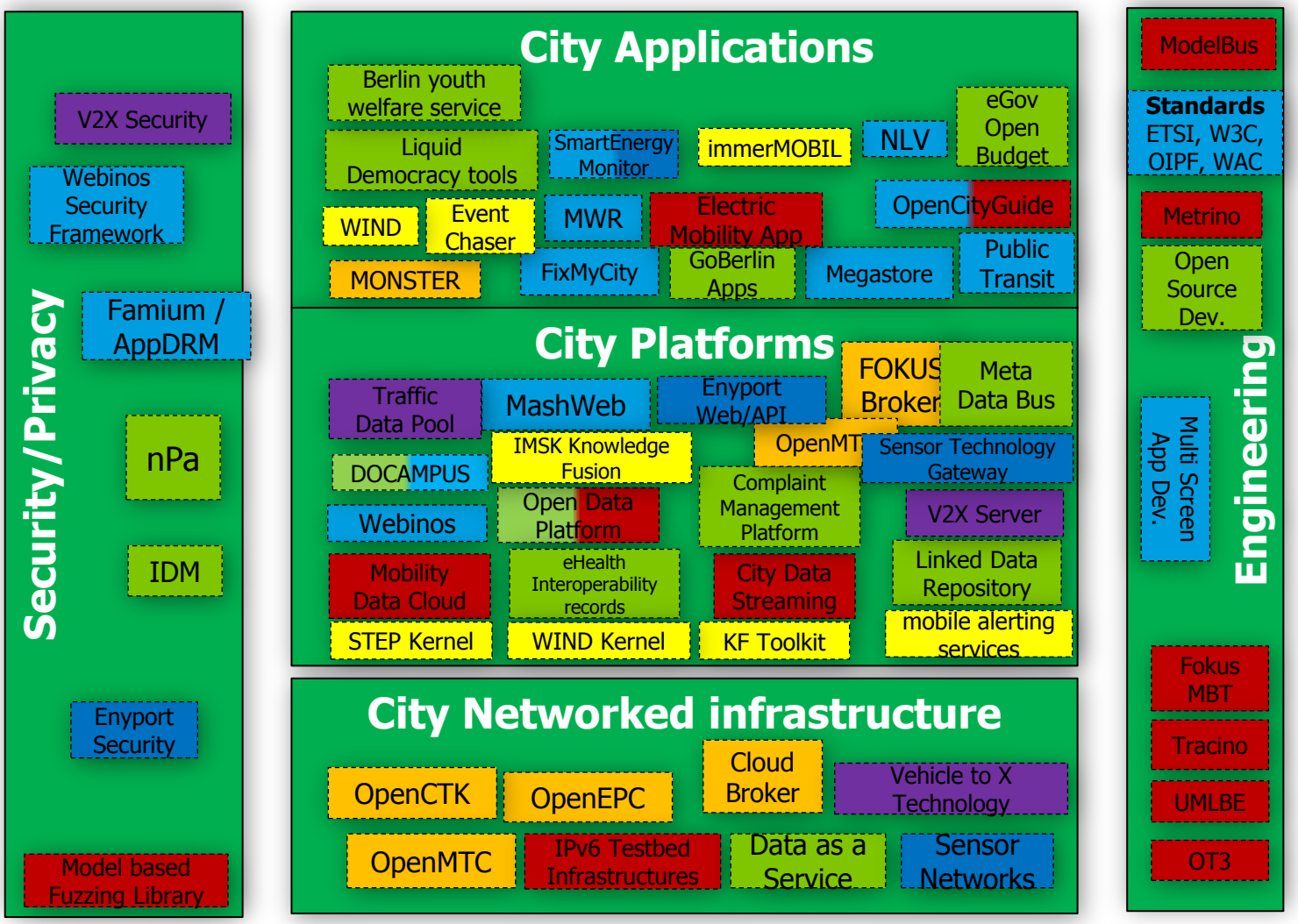
Evolution of a Smart City

Validate your objectives
Get to know Best Practice

Test Systems & Solutions
Use Standards to integrate



Selected Urban Technologies @ FOKUS



Essential Technological Developments

Major Contributions by FOKUS

open mtc

Fraunhofer FOKUS

Internet of Things

e-Identity Management

webinos

Interconnected Media

THESEUS

Internet of Services

P2-3R

MASH WEB

Business Intelligence

Smart Communications Playground

Fraunhofer FOKUS

Smart Communication

FUSECO playground

System Interoperability

Urban Technology Solutions

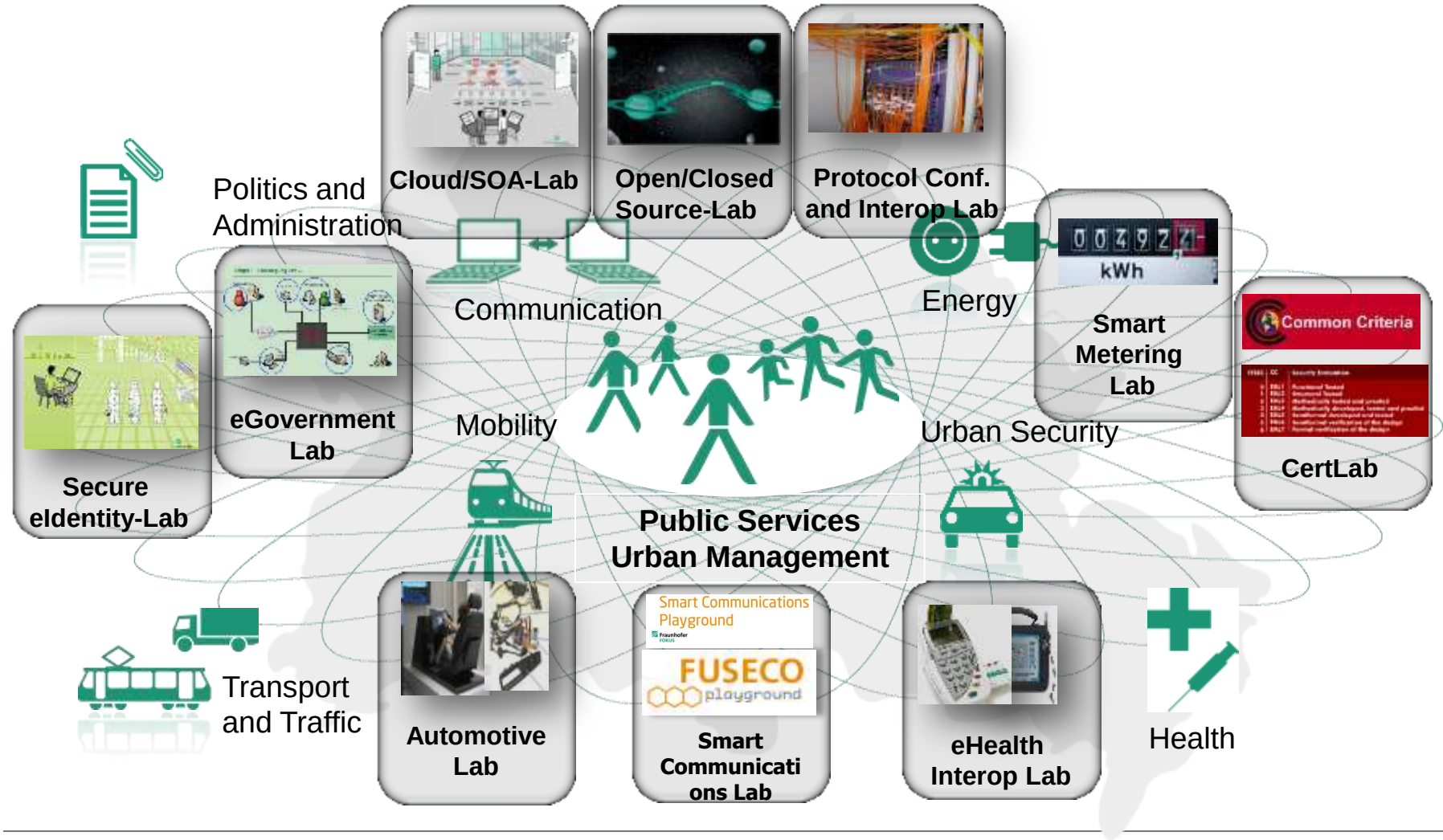
GOVDATA BETA

Das Datenportal für Deutschland

BERLIN OPEN DATA

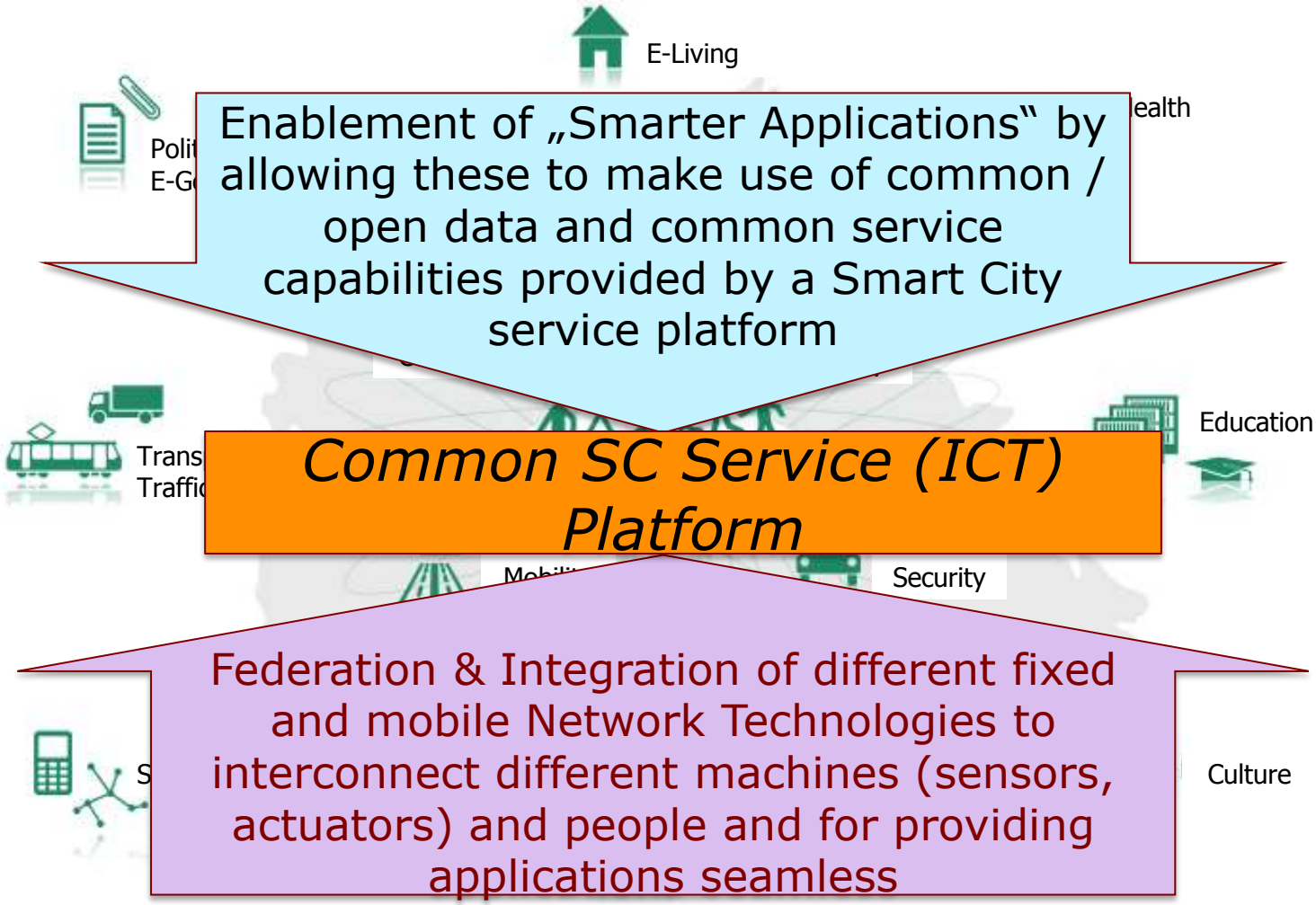
Open Data

Solutions made by FOKUS
FOKUS labs on ICT in Smart Cities

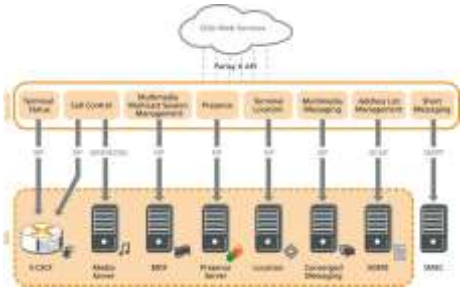


A Smart City relies on Integration & Federation of Systems

Conve

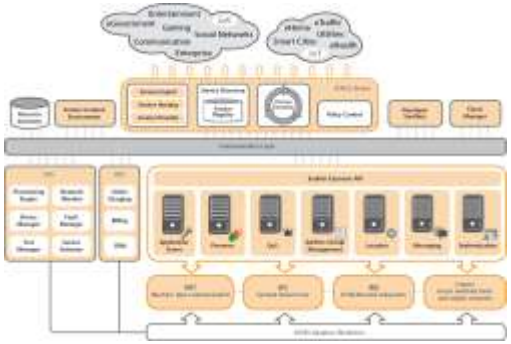


Related FOKUS Testbed Evolution



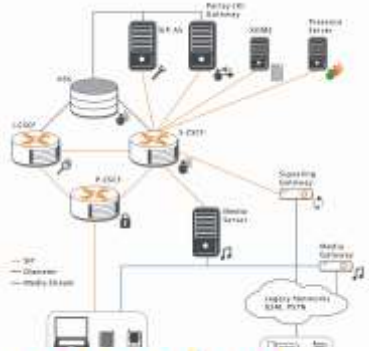
OSA/Parlay Playground

iptel.org



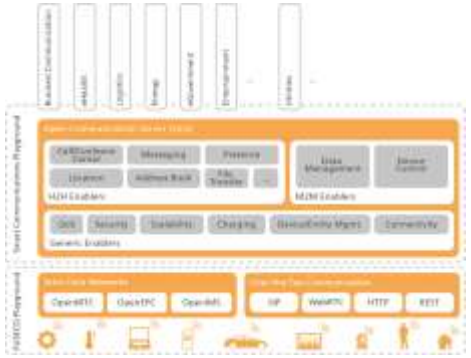
open soa telco playground

Fraunhofer FOKUS



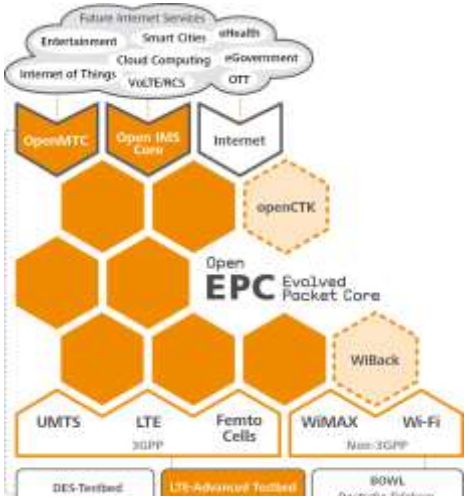
open ims playground

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

FUSECO playground

Circuit Switched Networks

PSTN

IP

GSM

iptel.org

IP Networks (NGN)

DSL

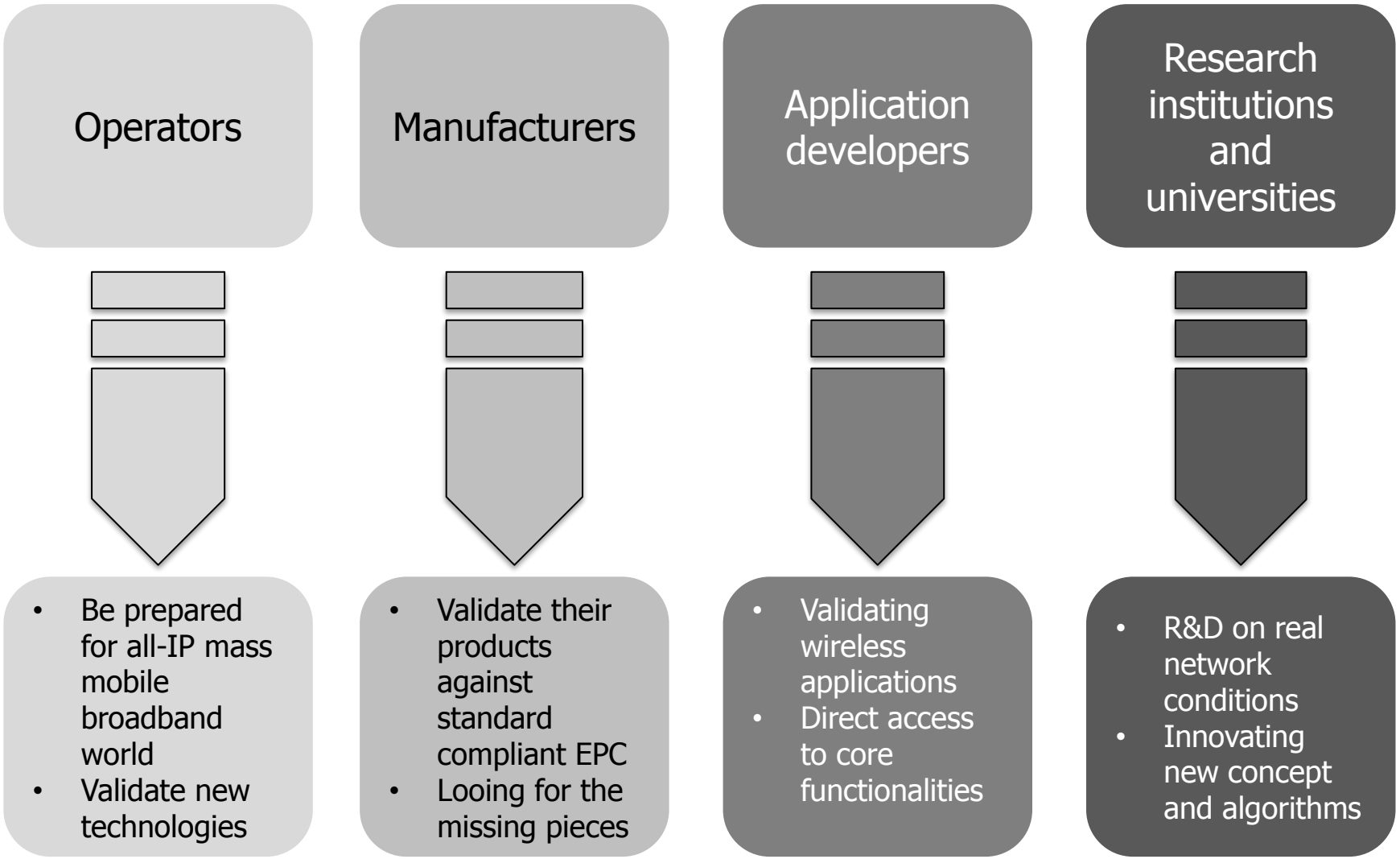
UMTS

WLAN

WiMAX

People & Things

Stakeholders



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

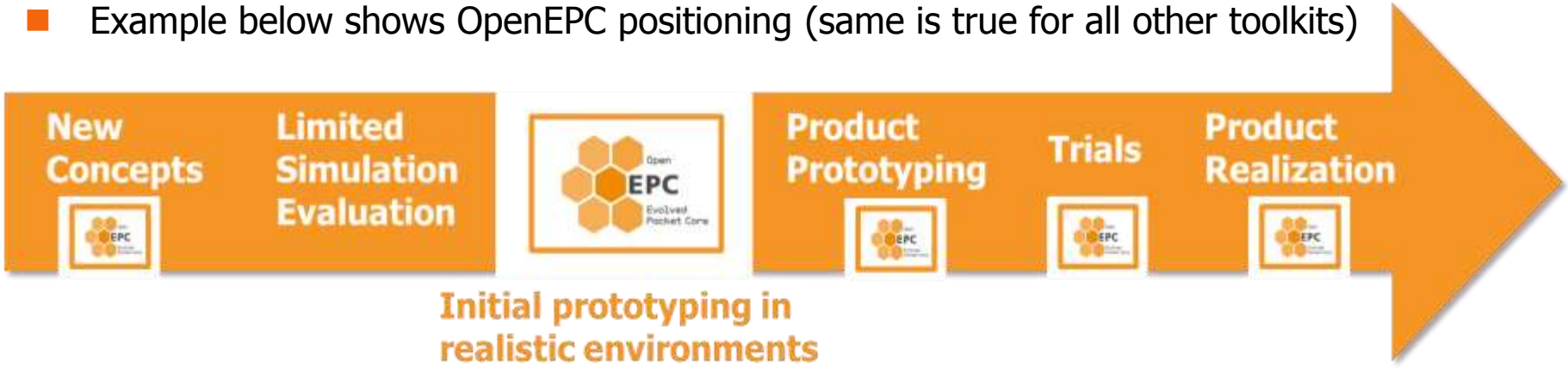
Extendibility

- 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

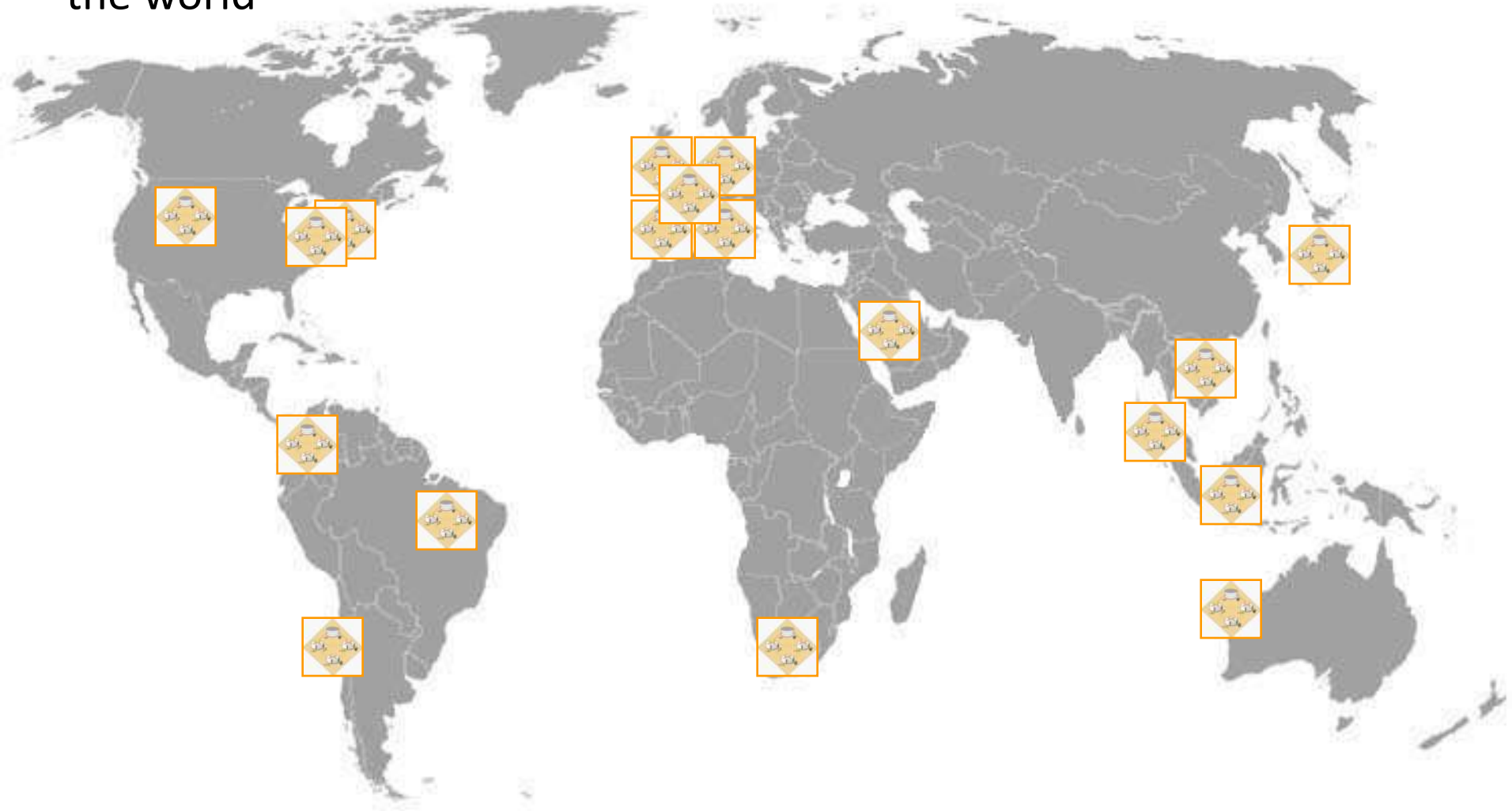
OpenEPC comes to meet the R&D requirements

- FOKUS Testbed Toolkits are spespecially designed for addressing R&D:
  - Enabling the hands-on understanding of technologies, resulting in new concepts
  - **Filling the gap between research and product development** by providing initial realistic environment prototyping
    - Providing trust in research through realistic environments testbeds
    - Mirroring operator core network functionality
  - Providing standard interfaces for product prototyping
  - Providing missing components for large integrated testbeds and trials
  - Providing the counterpart functionality for product realization

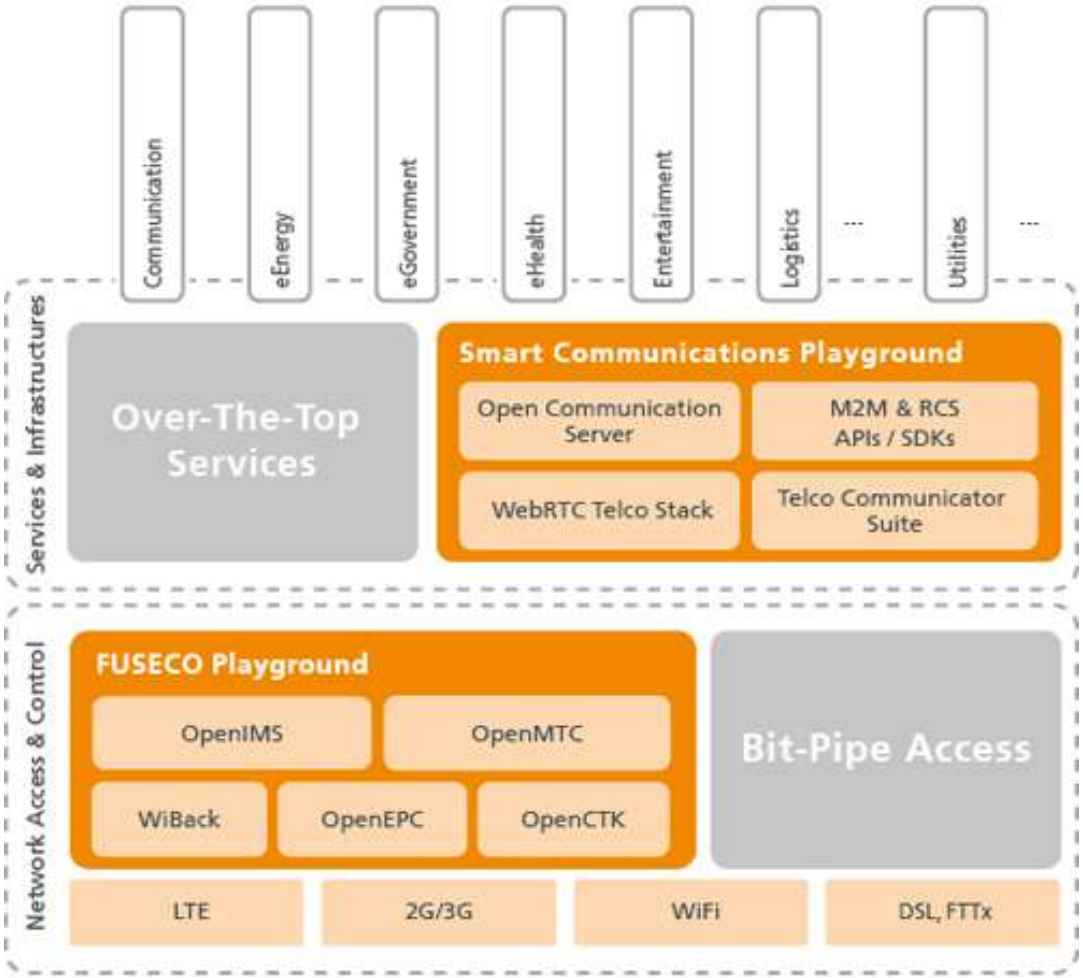
- Example below shows OpenEPC positioning (same is true for all other toolkits)



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



Fraunhofer Testbeds / Playgrounds



Smart Communications Playground

Fraunhofer FOKUS

www.SC-playground.org

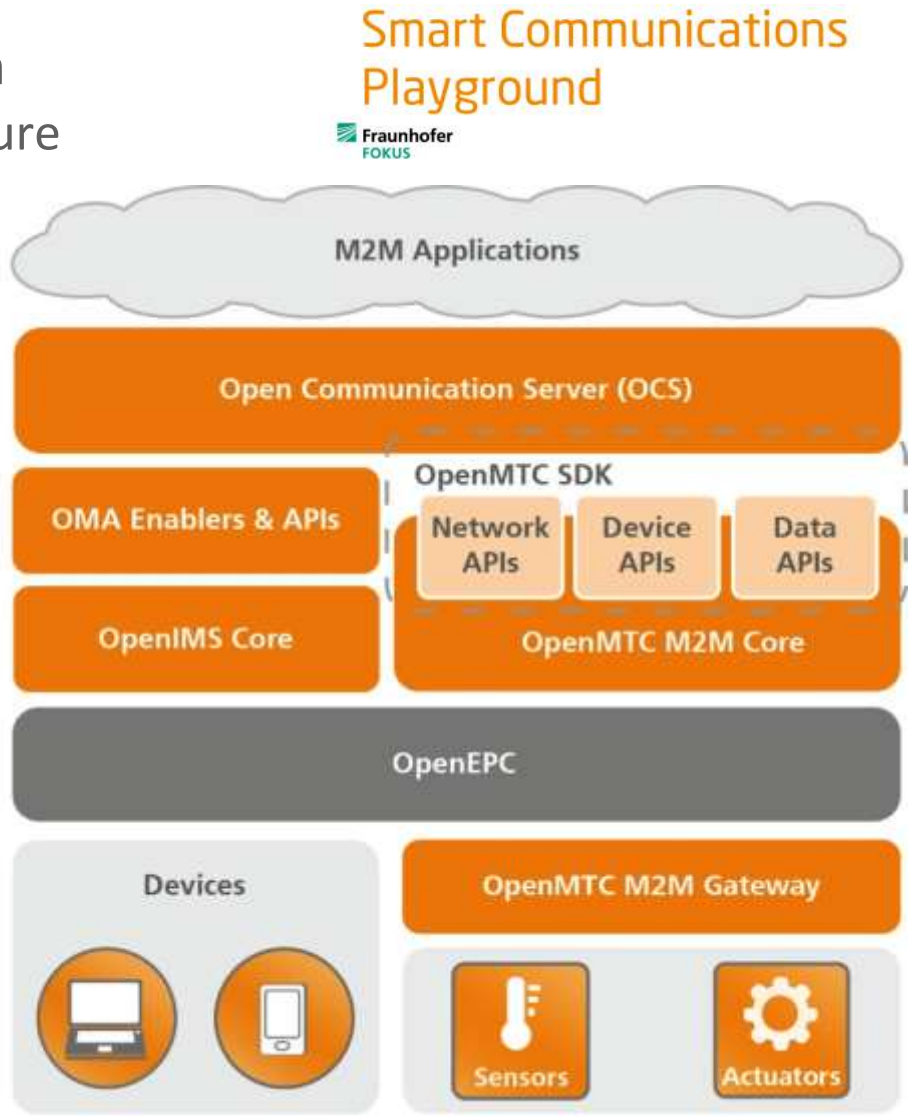
FUSECO playground

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

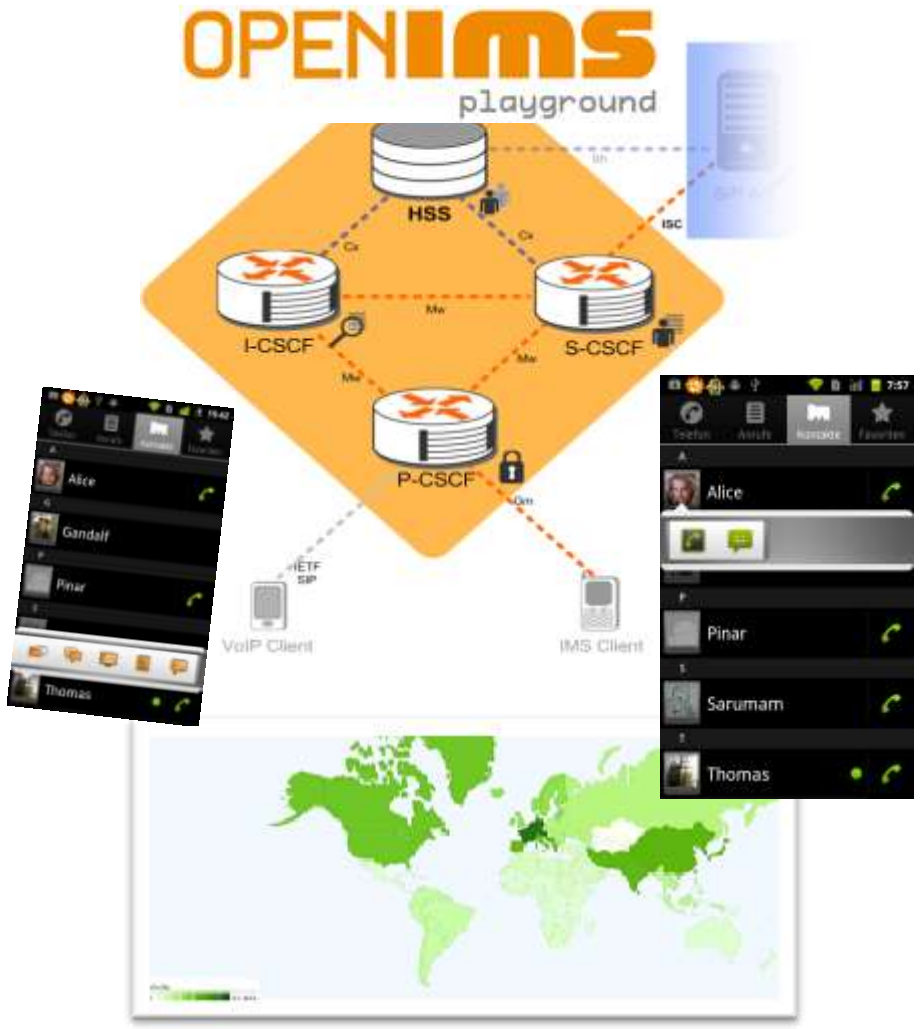


The Start: Open Source IMS Core

- 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
- 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**

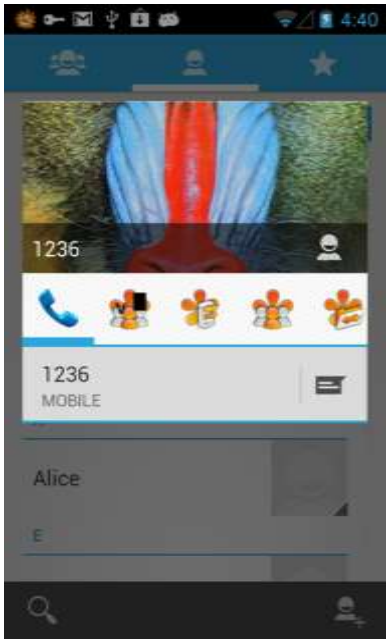


Note: IMS Client shown is MyMonster – see www.opensoaplayground.org/tcs

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



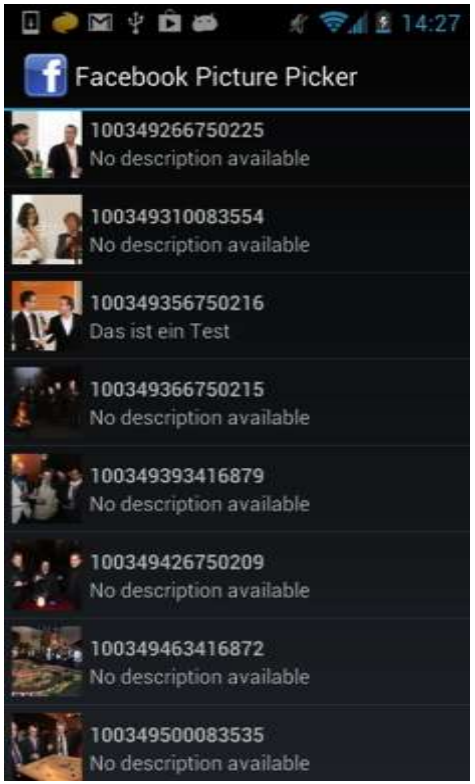
VoLTE

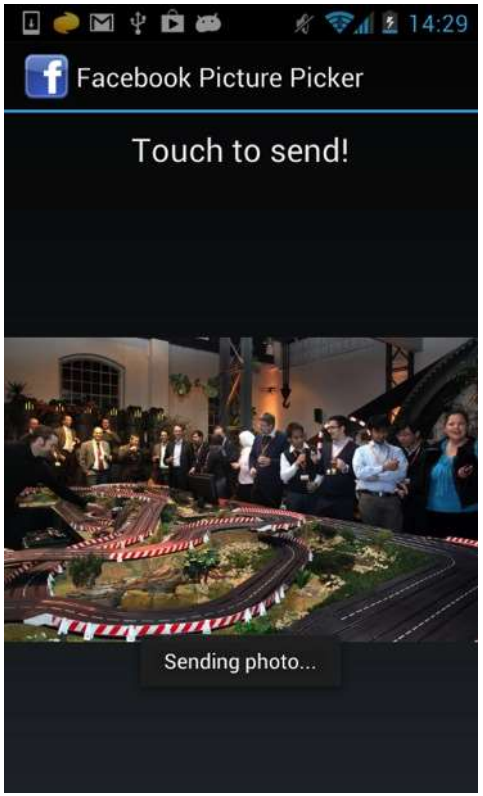
GSMA Rich Communication Suite

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

FOKUS joyn App for Deutsche Telekom
Extending RCS for Facebook Image sharing

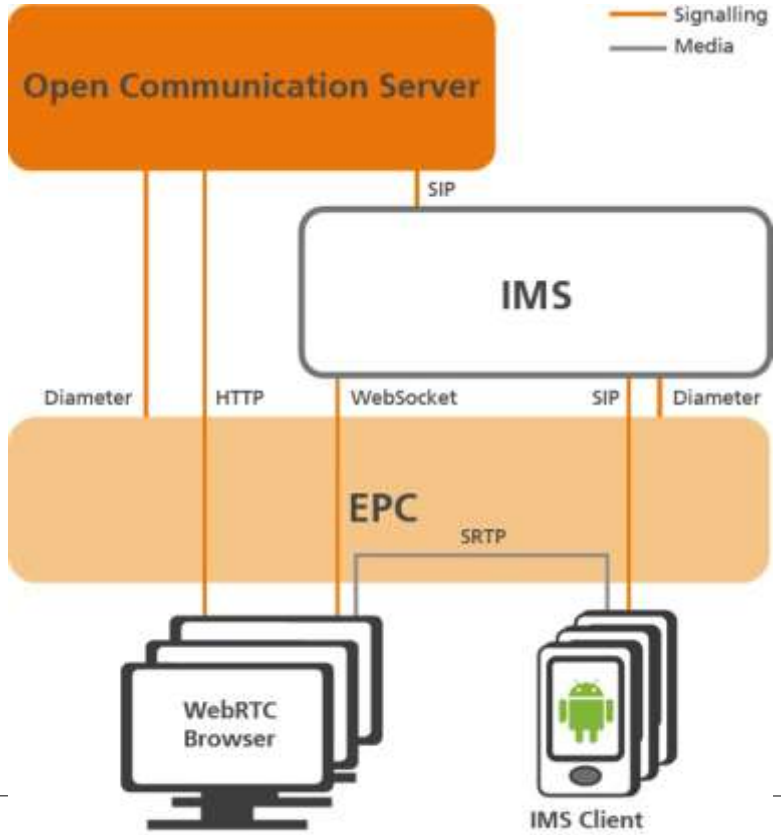
- App uses Deutsche Telekom RCS network gateway to provide mobile image sharing for Facebook images
- Extends Facebook network with mobile operator RCS network





Combining WebRTC, Android RCS, EPC and Application Platform: Smart City Rich Communication Services

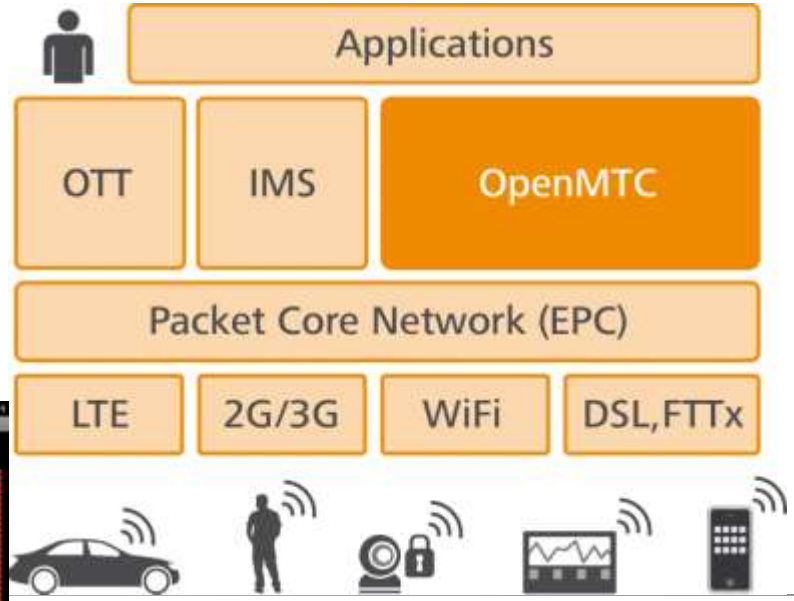
- WebRTC communication is enhanced by session-based QoS control.
- OCS provides WebRTC application and REST-based API towards EPC PCRF
  - setting of application-driven QoS policies for WebRTC session.
- OCS provides additionally REST-based interface to EPC ANDSF for application-driven network selection.
- Mobility manager on Android/PC allows seamless vertical hand-overs.



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 services

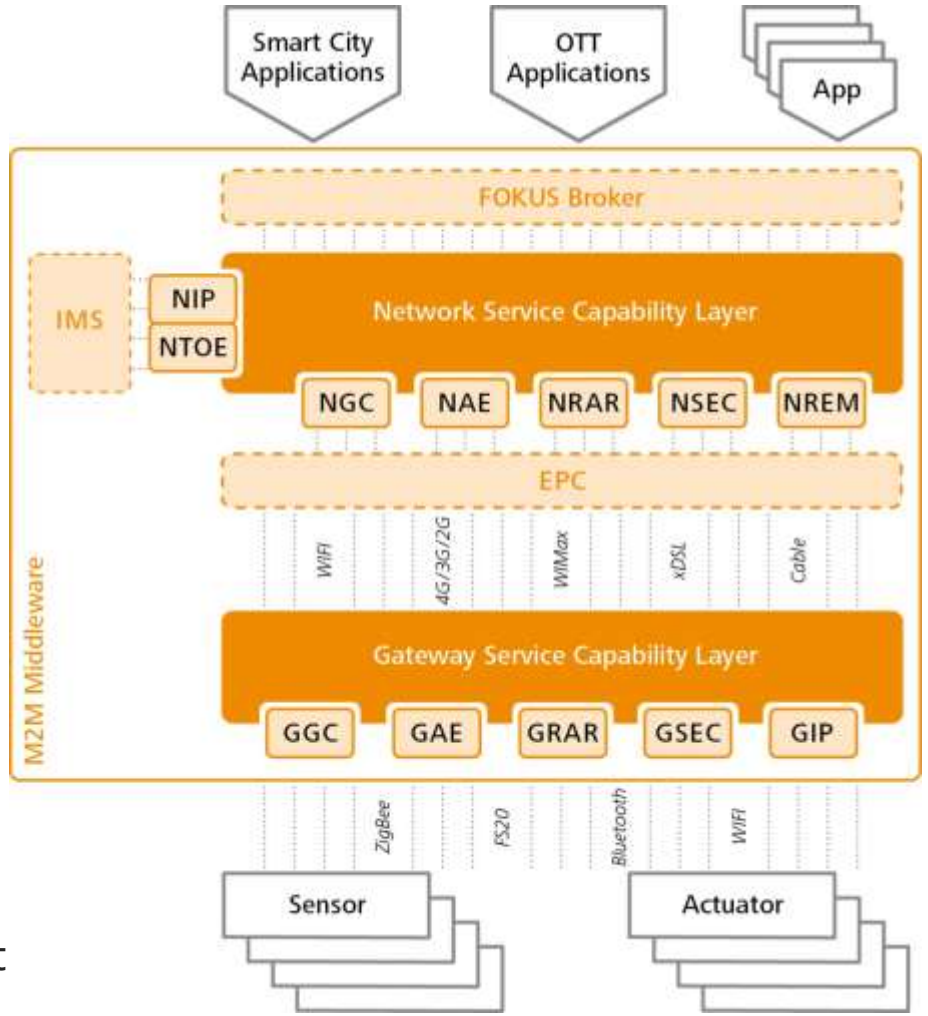
  into a single local testbed, thus lowering own development costs
- OpenMTC is an intermediary layer between multiple service platforms, the operator network, and devices
- This platform can be used to perform R&D the fields of machine type communication
- OpenMTC implemented features are aligned with ETSI M2M specifications:
  - Adaptable to different M2M scenarios (e.g. automotive)
  - Extensible to specific research needs
  - Configurable
  - Performant



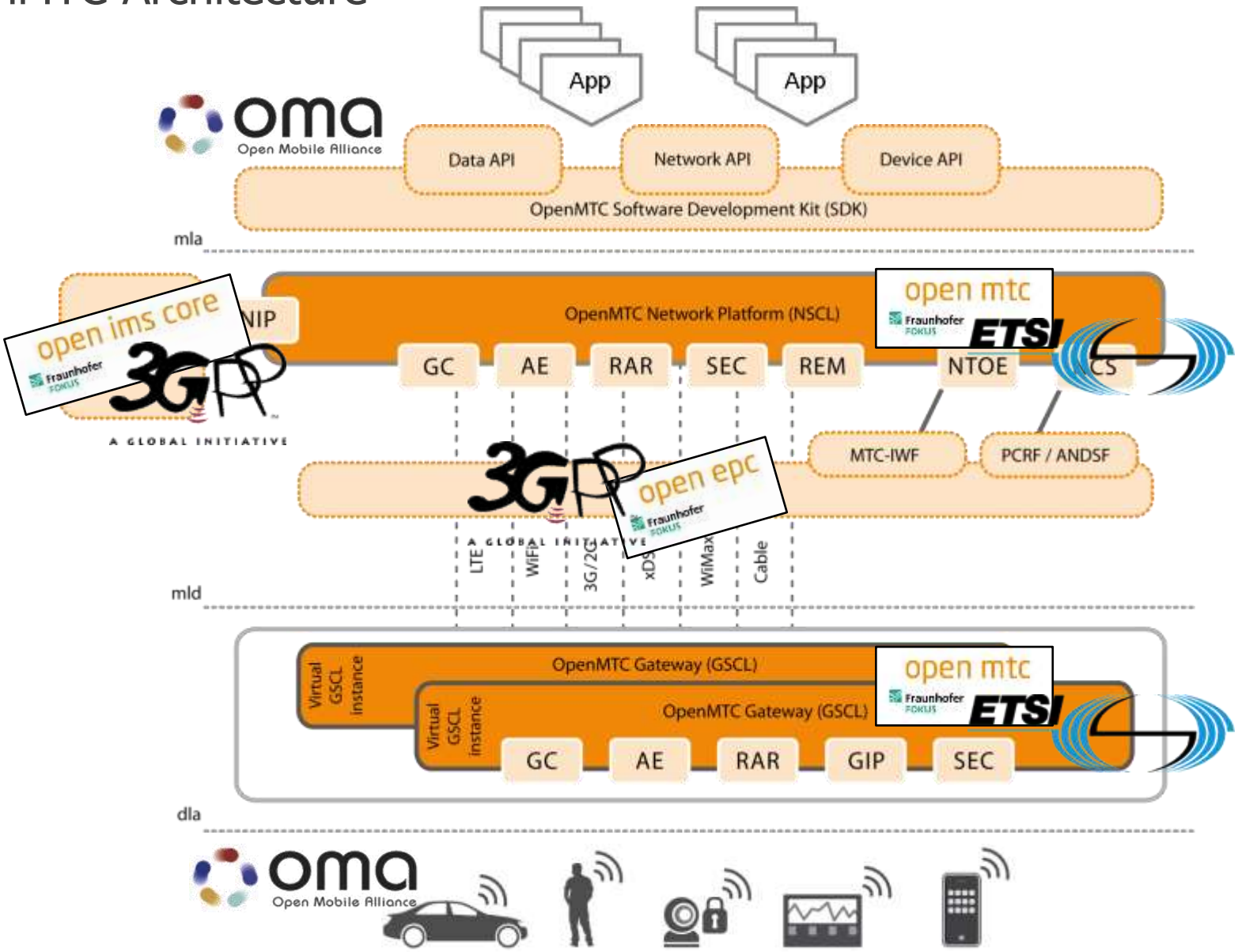
- For more see wwww.open-MTC.org

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.)

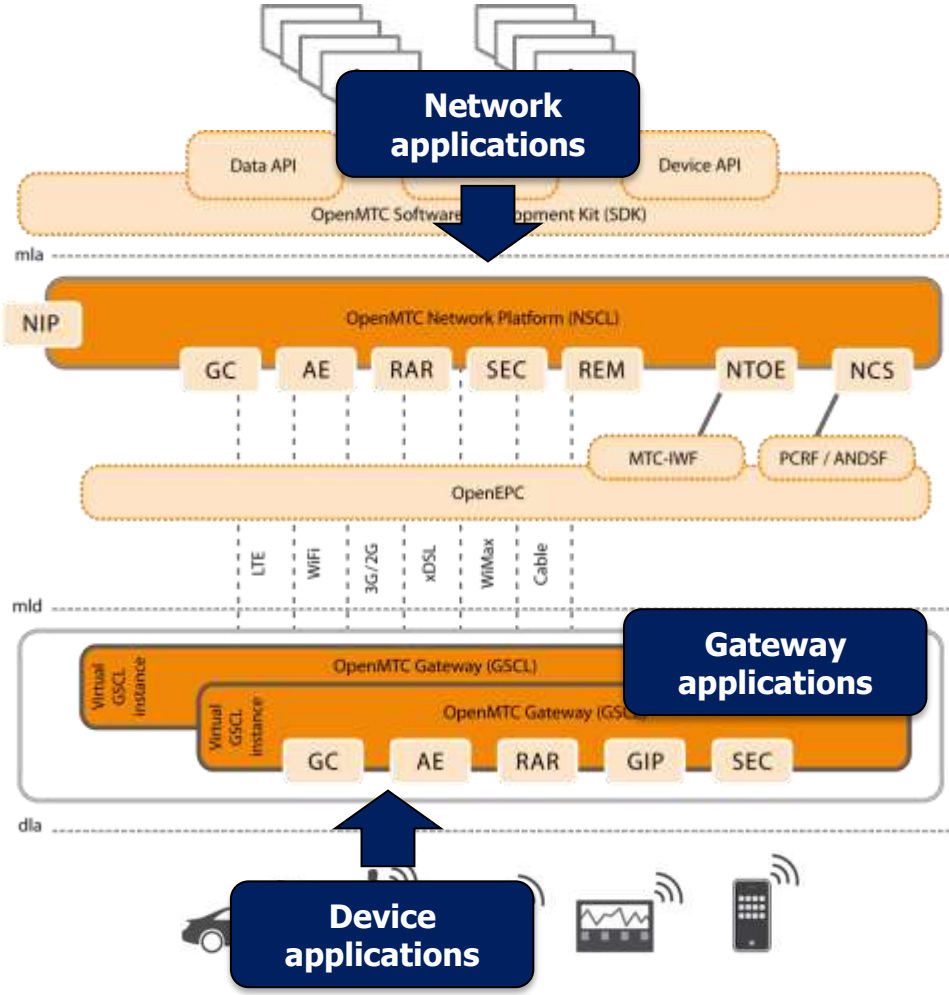


OpenMTC Architecture



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



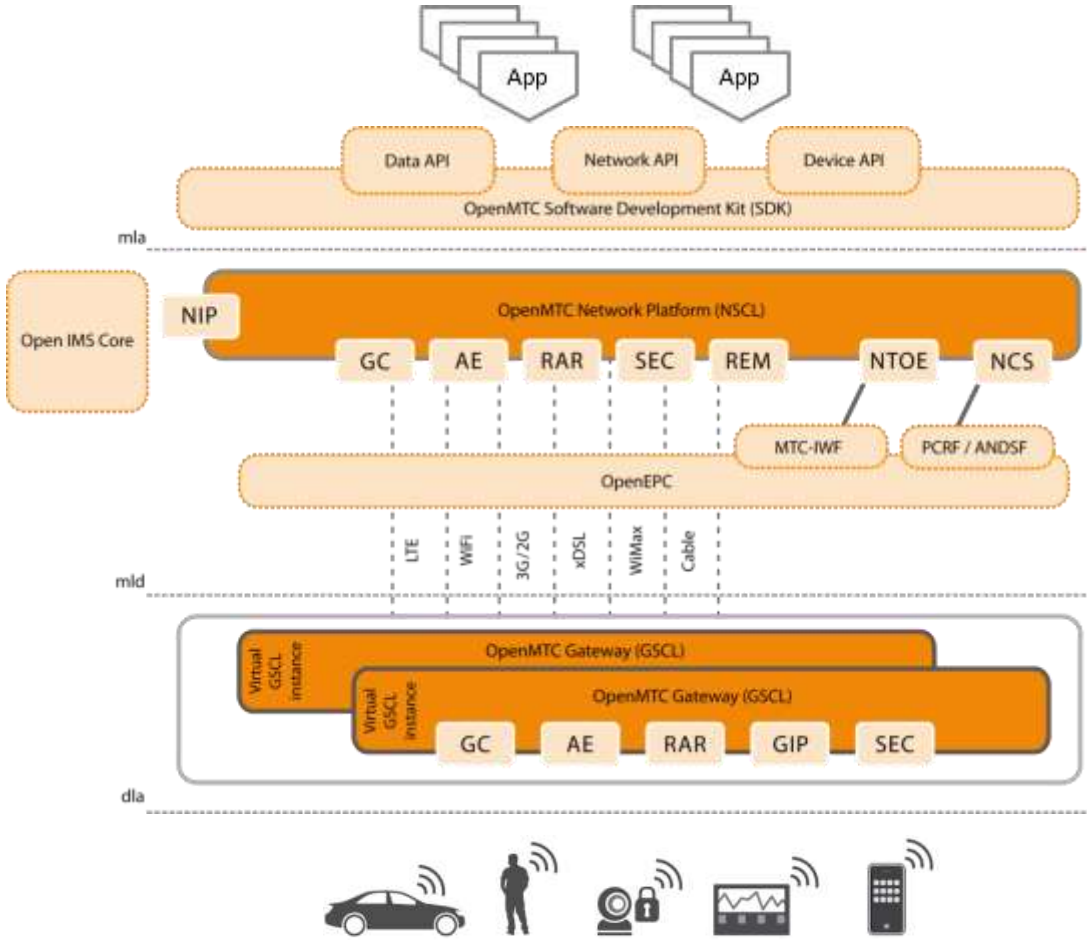
Integration and Interworking on all layers

Supporting Interoperability

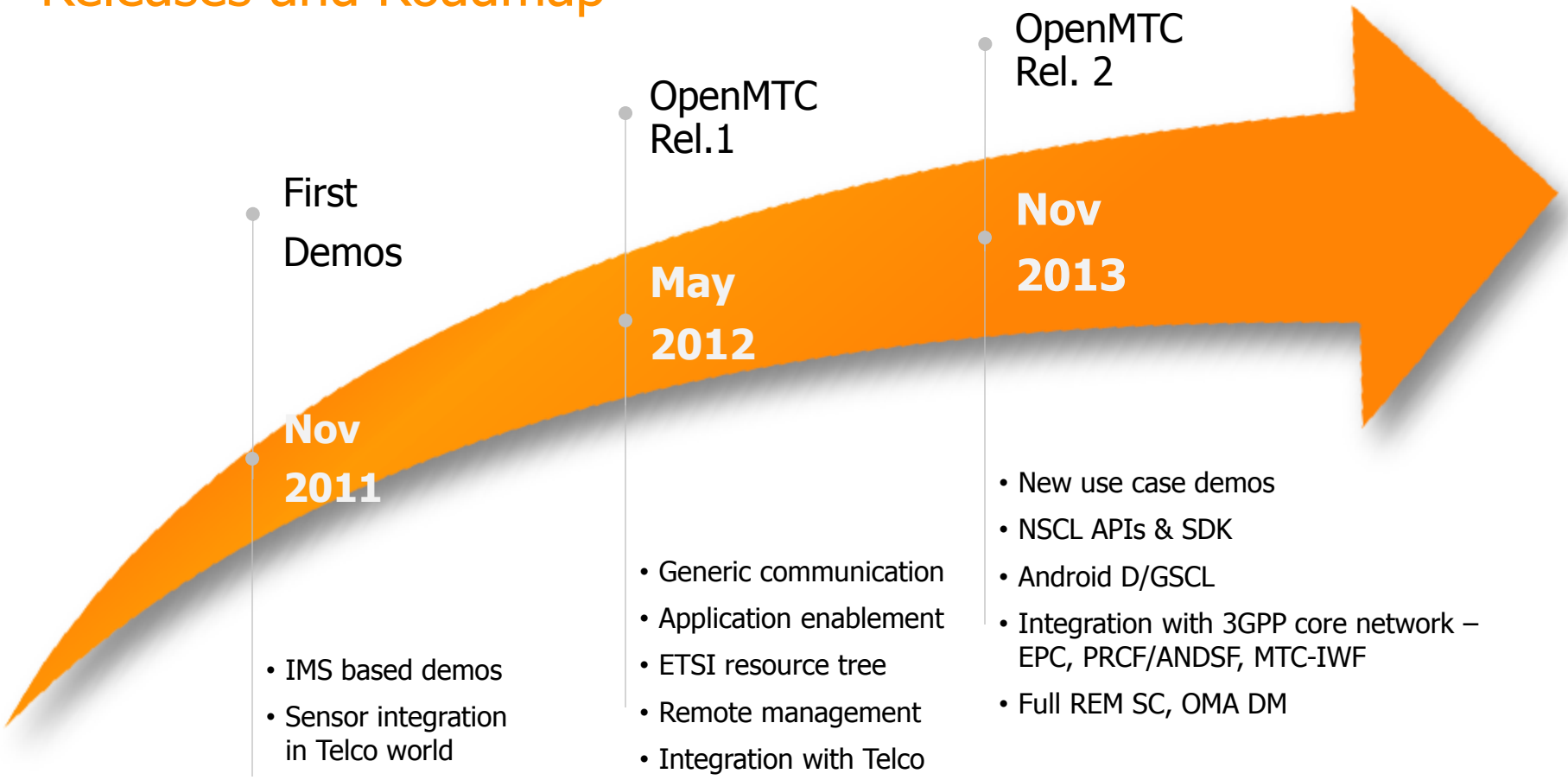
Heterogeneous Application Integration

Heterogeneous System / Platform Integration

Heterogeneous Device Integration

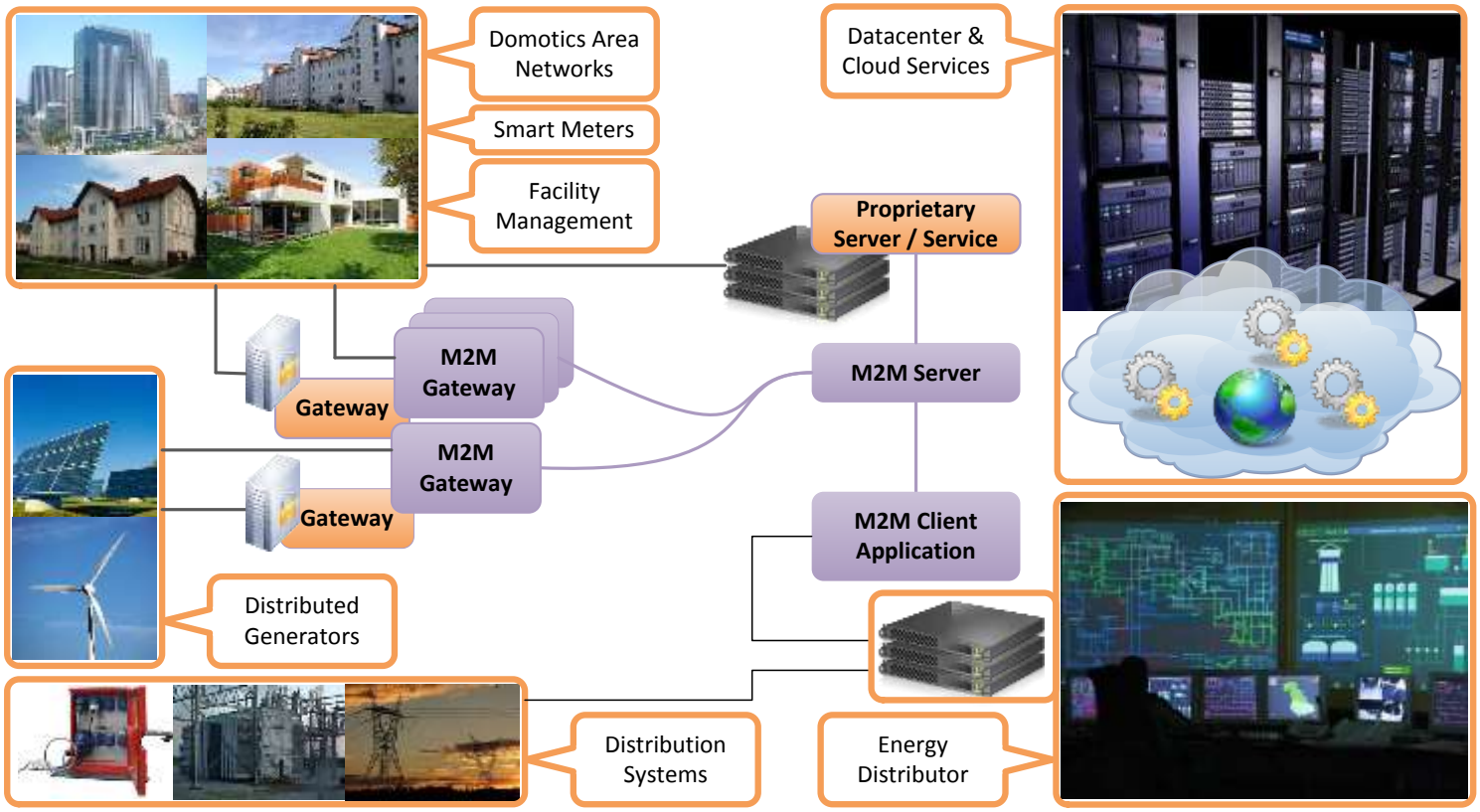


OpenMTC
Releases and Roadmap



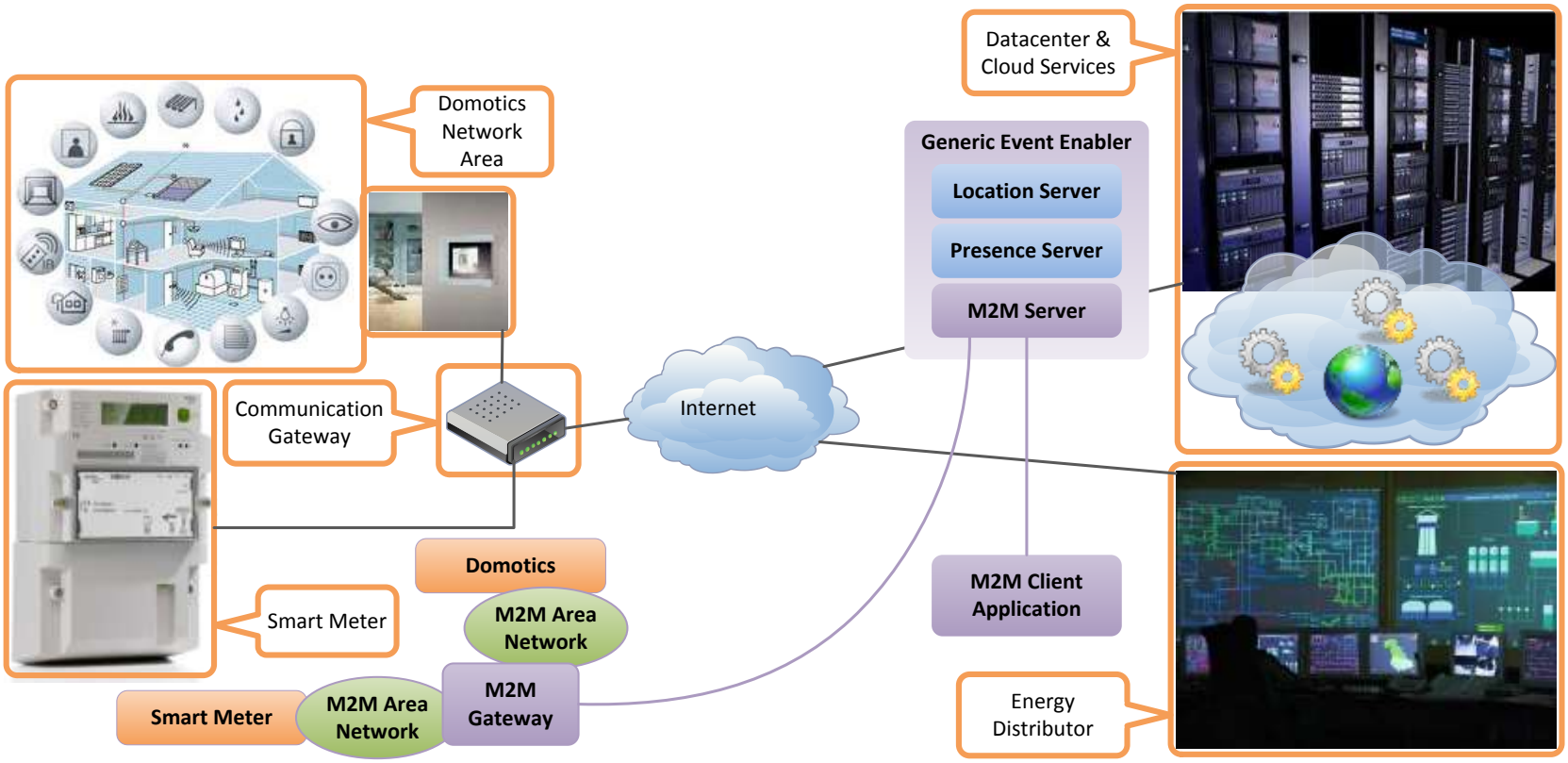
Smart City Services for Facilities and Campuses

- 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 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.

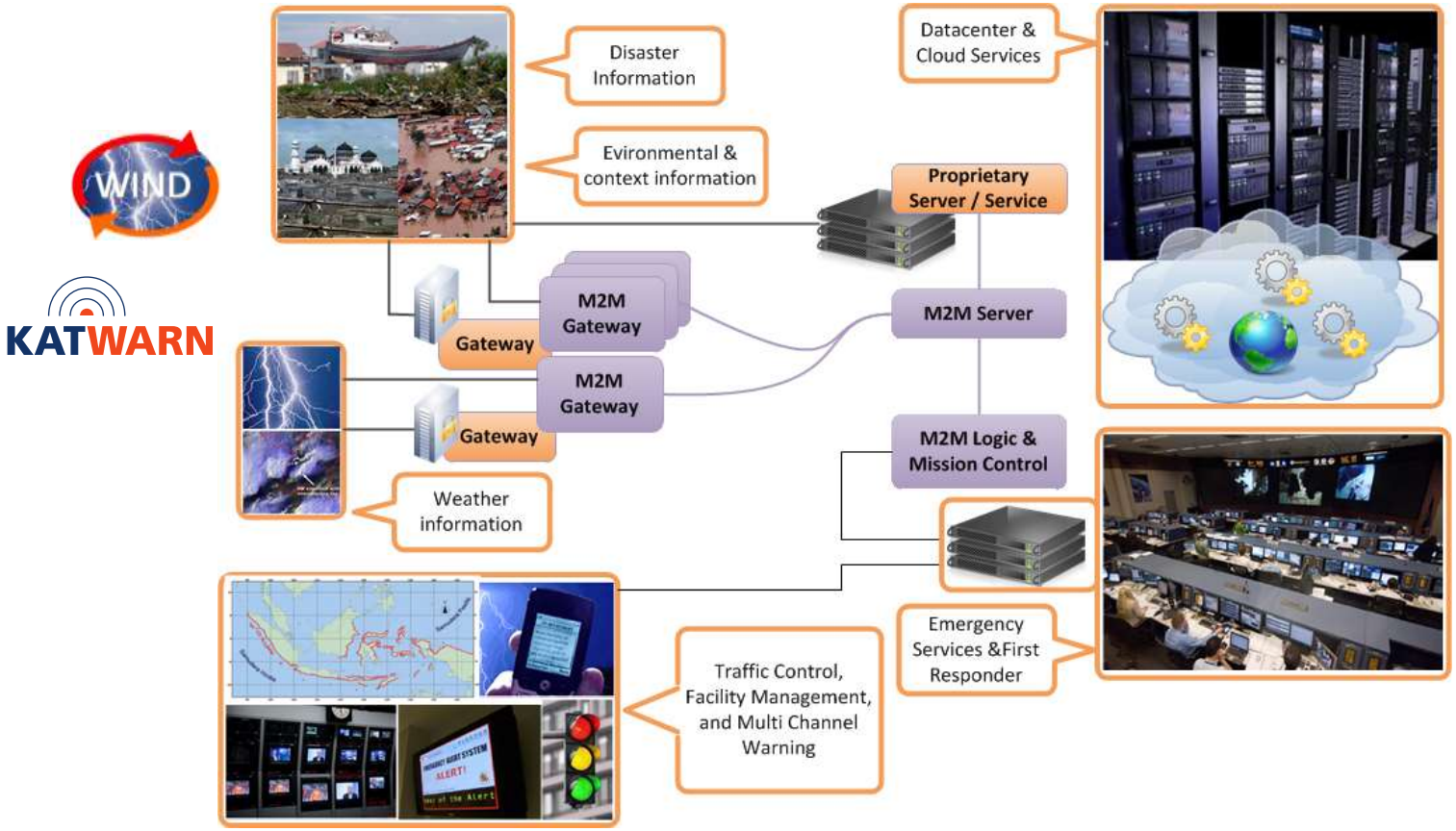


Example R&D Cooperation: TRESCIMO | Testbeds for Reliable Smart City Machine-to-Machine Communication

- **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

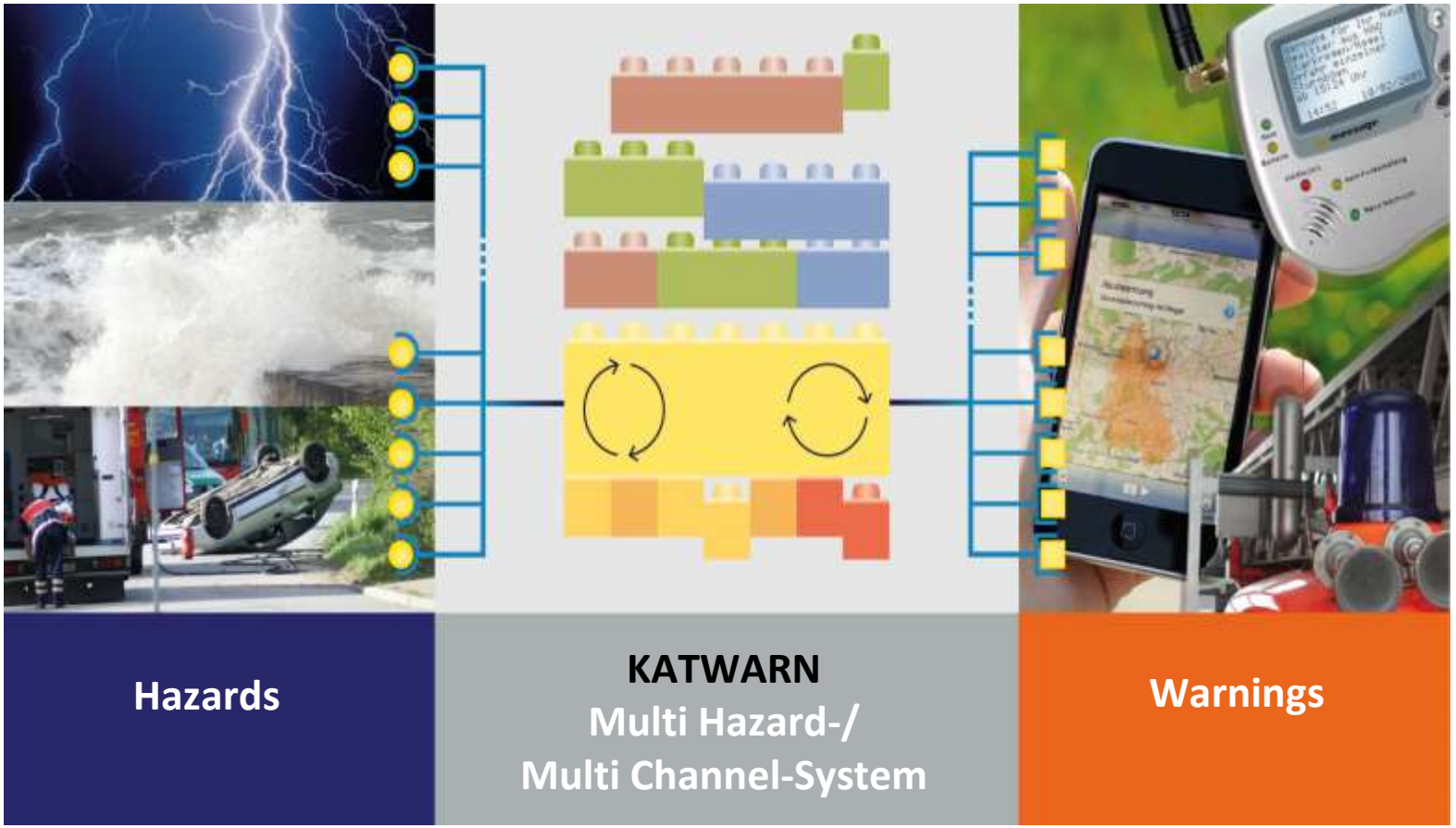
Smart City Services for Early Warning and Emergency Management

- 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



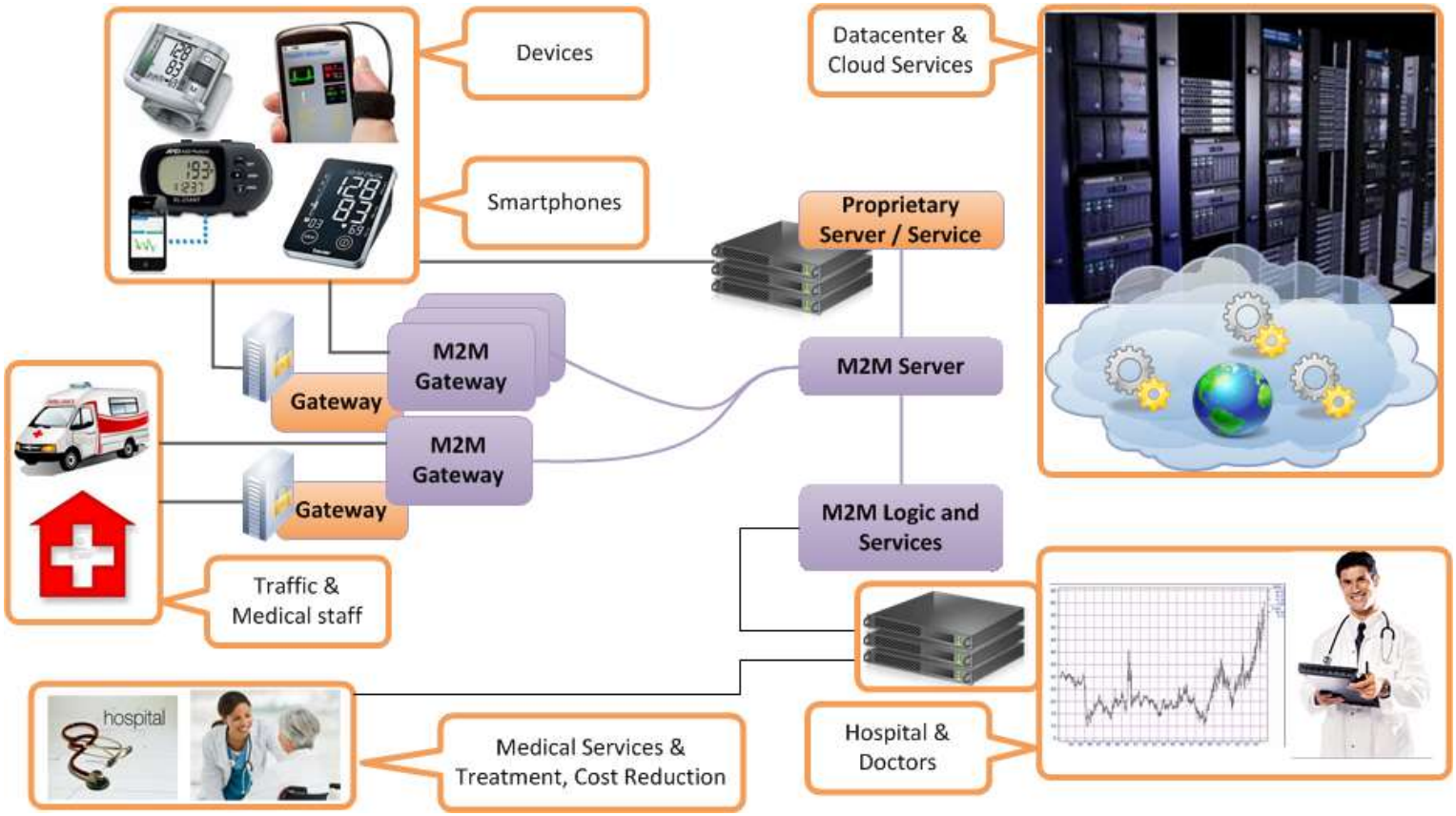

Verband
öffentlicher Versicherer
Fraunhofer
FOKUS
9:48 PM
Lage
Übersicht
Großbrand mit Giftwolke – Warnung für Postleitzahlgebiet 22xxx – öffentliche Plätze verlassen, Fenster schließen, Klima- und Lüftungsanlagen abschalten.

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 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.

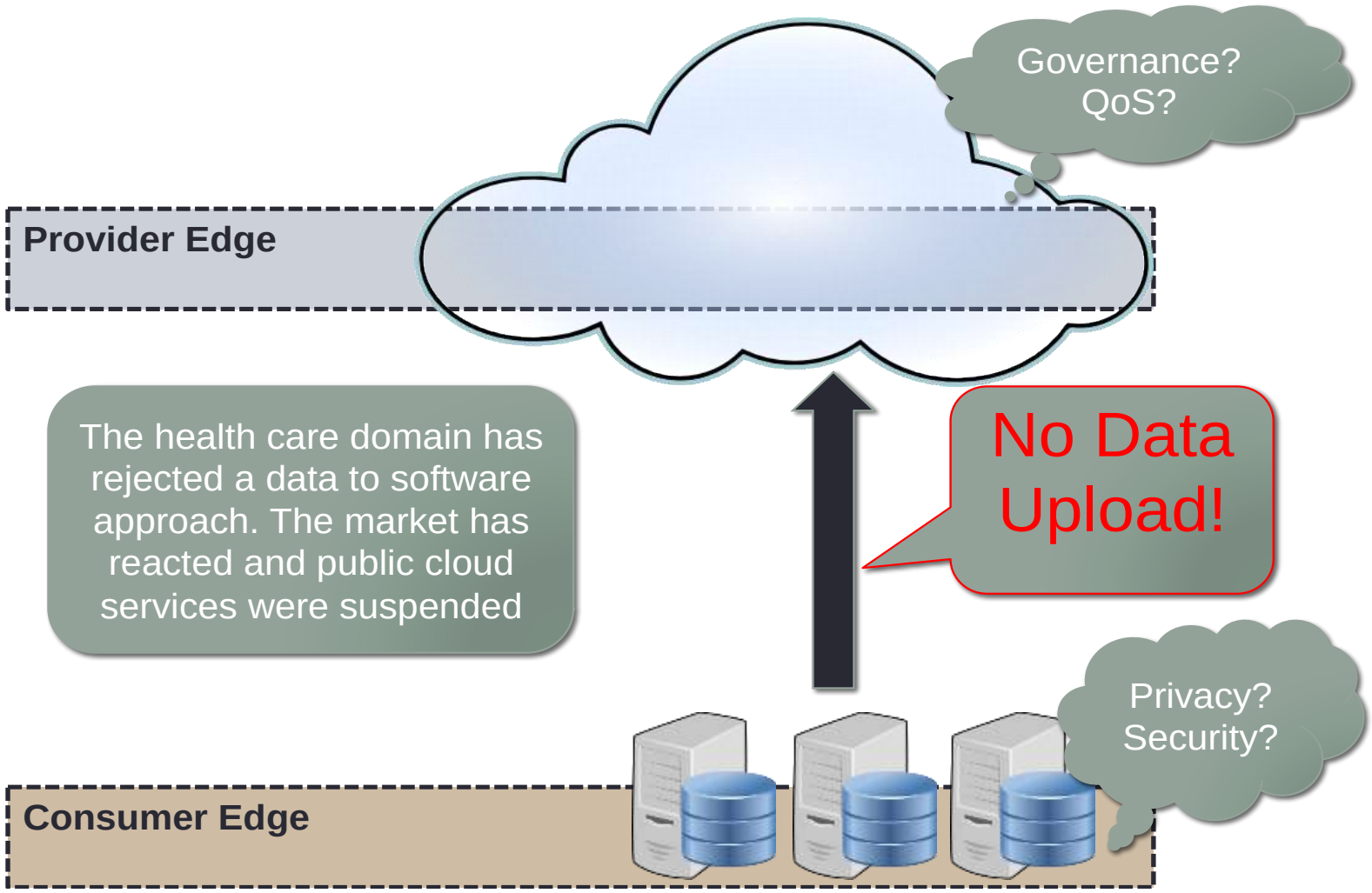
FI-STAR is establishing early trials in the health care domain, building on future internet technology, creating a robust framework based on a “software to data” paradigm.

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

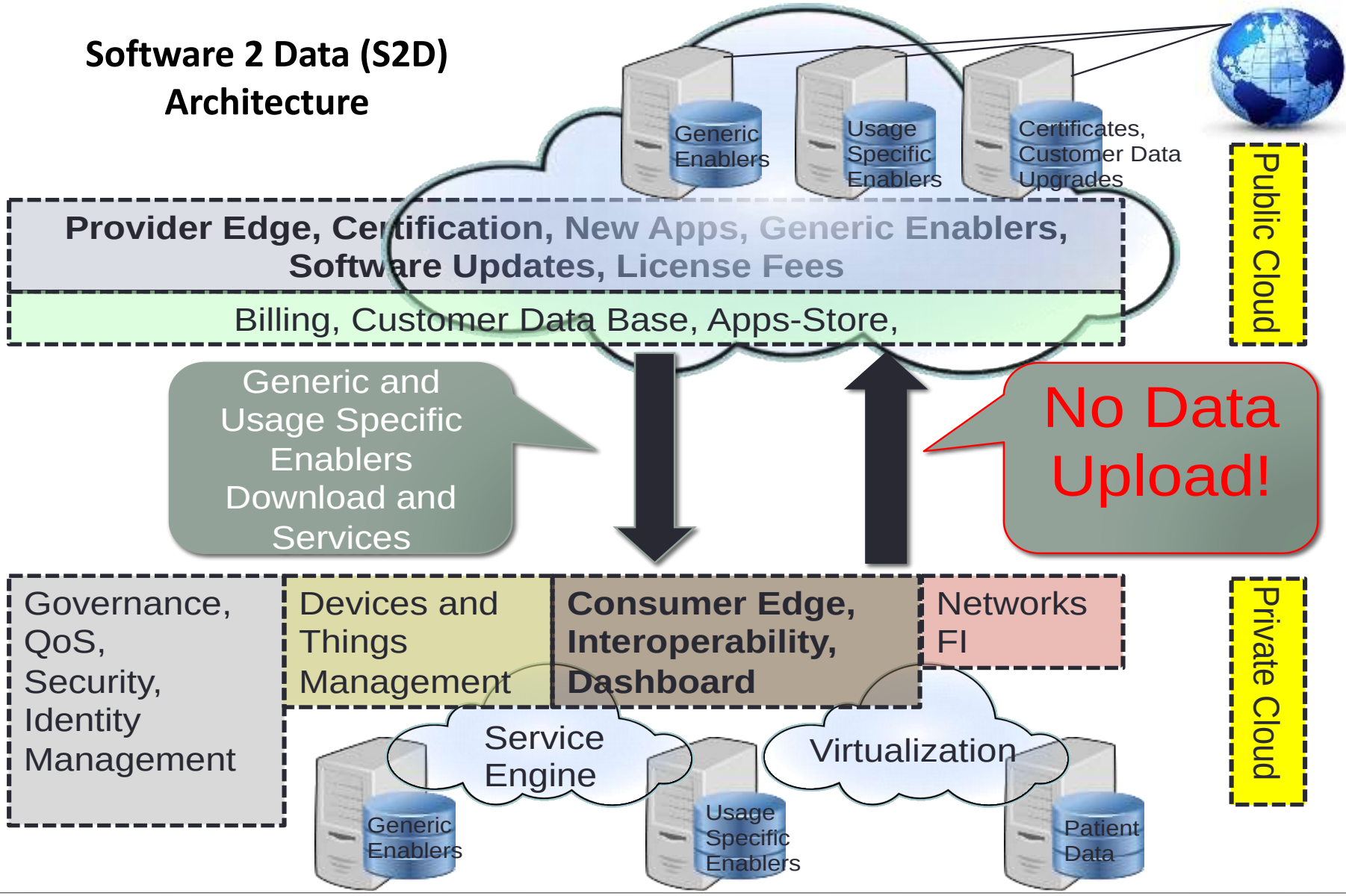
FI-STAR will use the latest digital technologies to build communities made up of developers and users.

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

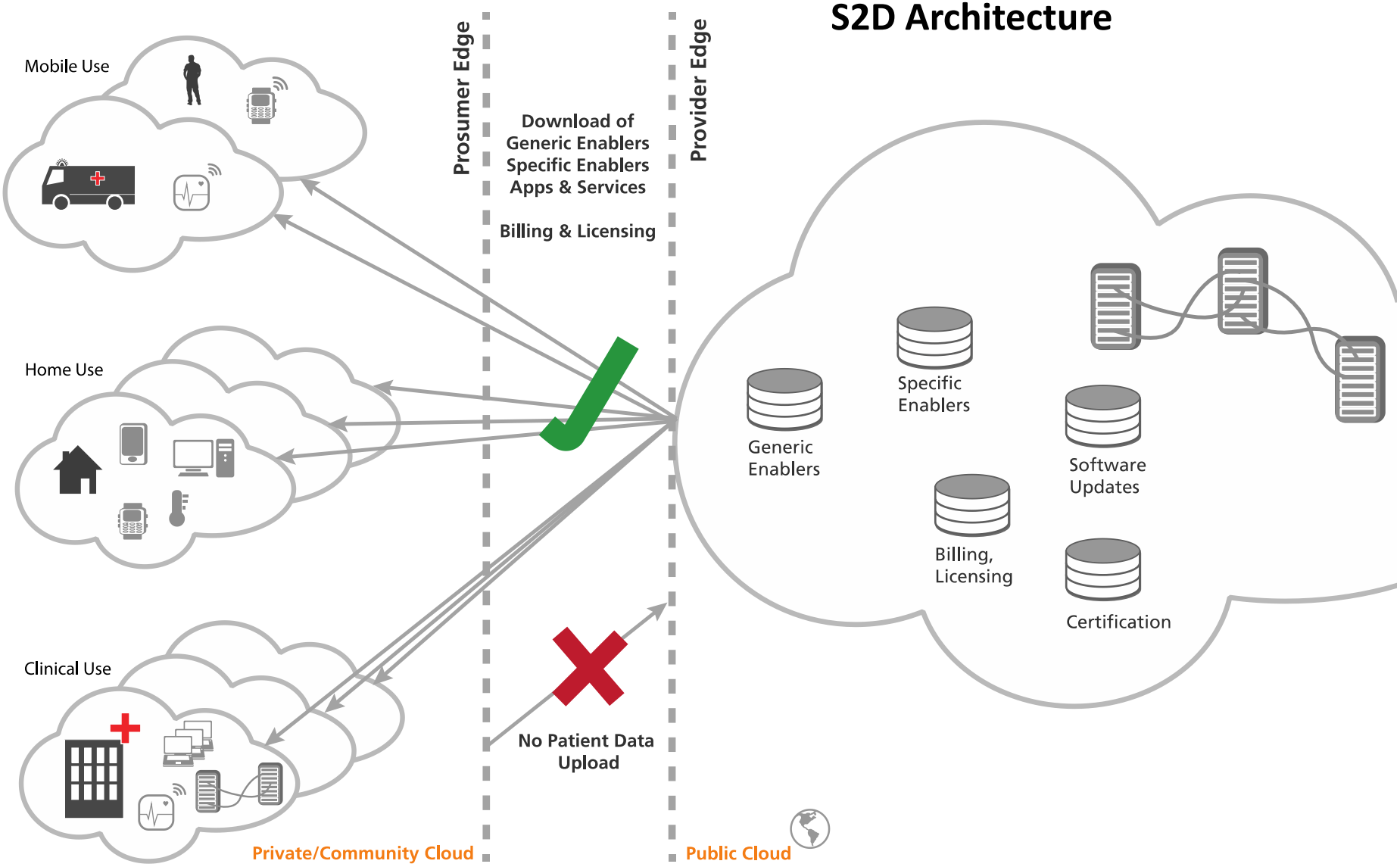
Data to Software



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.

fi-star
FUTURE INTERNET
SOCIAL TECHNOLOGICAL ALIGNMENT in HEALTHCARE

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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.

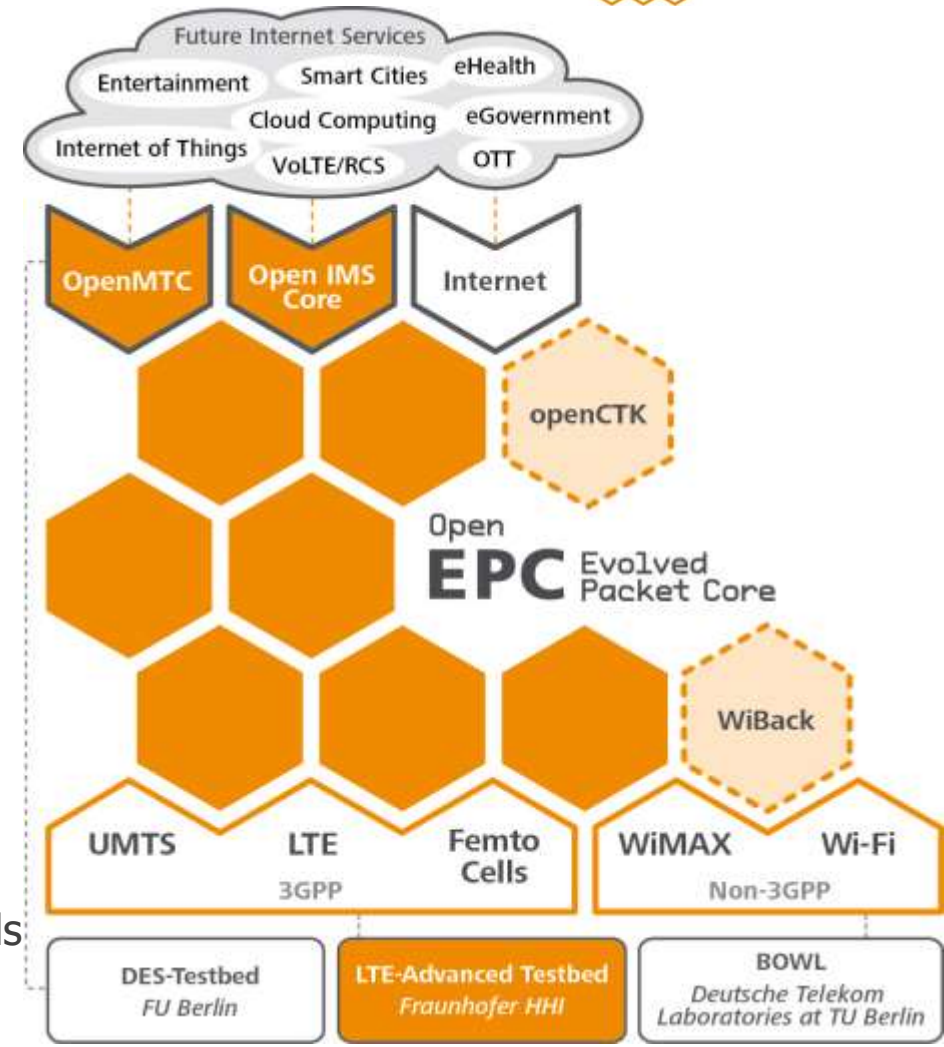





Future Seamless Communication (FUSECO) Playground

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?

- 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 Scales for different deployments

open epc
Fraunhofer FOKUS

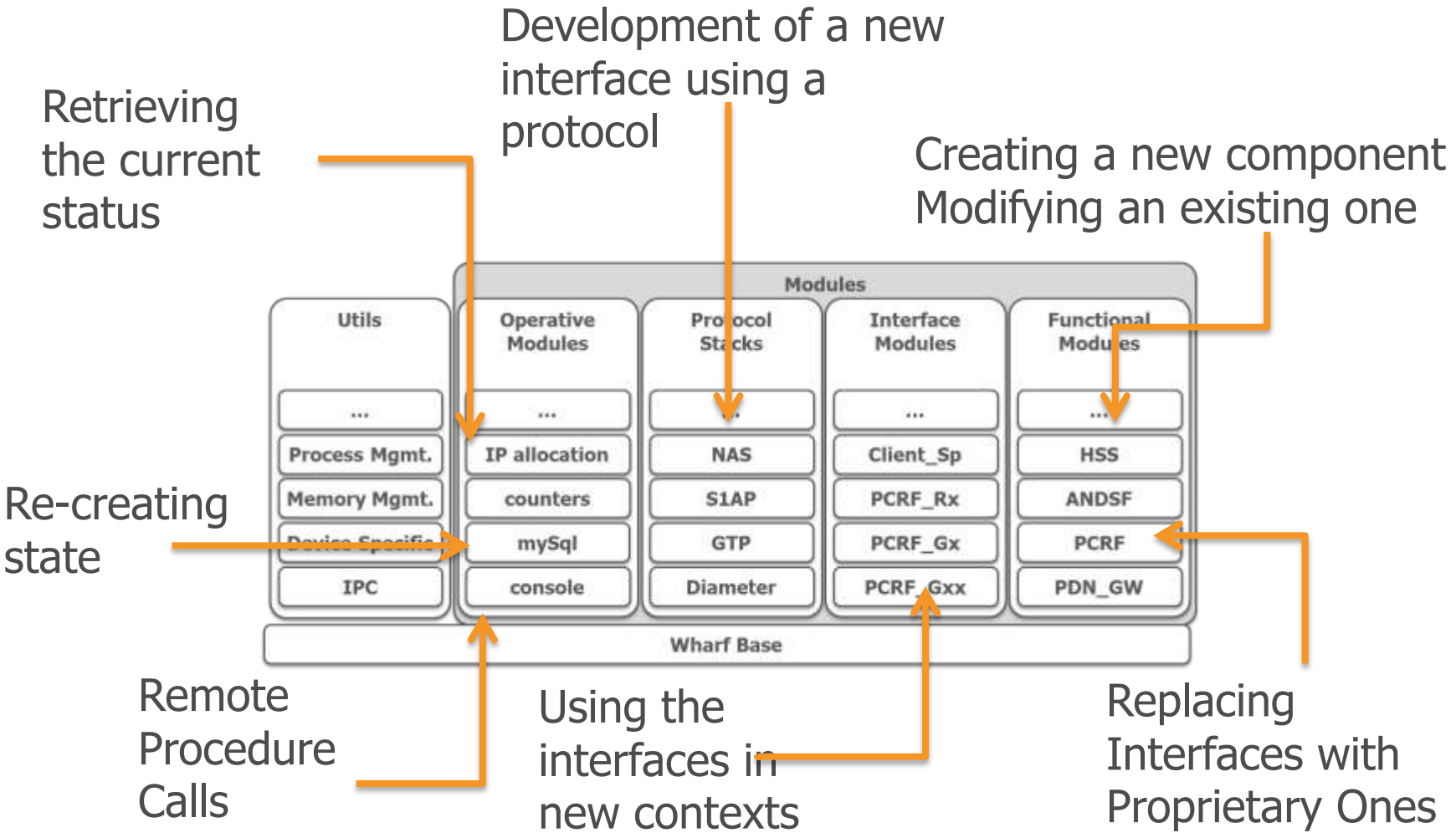
- OpenEPC components can be deployed in almost any configuration possible
  - Large testbeds – each component on a separate machine
  - Smaller testbeds – components are grouped in same servers
  - Single box testbed – components are virtualized on the same machine
  - Minimized testbed – the OpenEPC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

Large Testbed

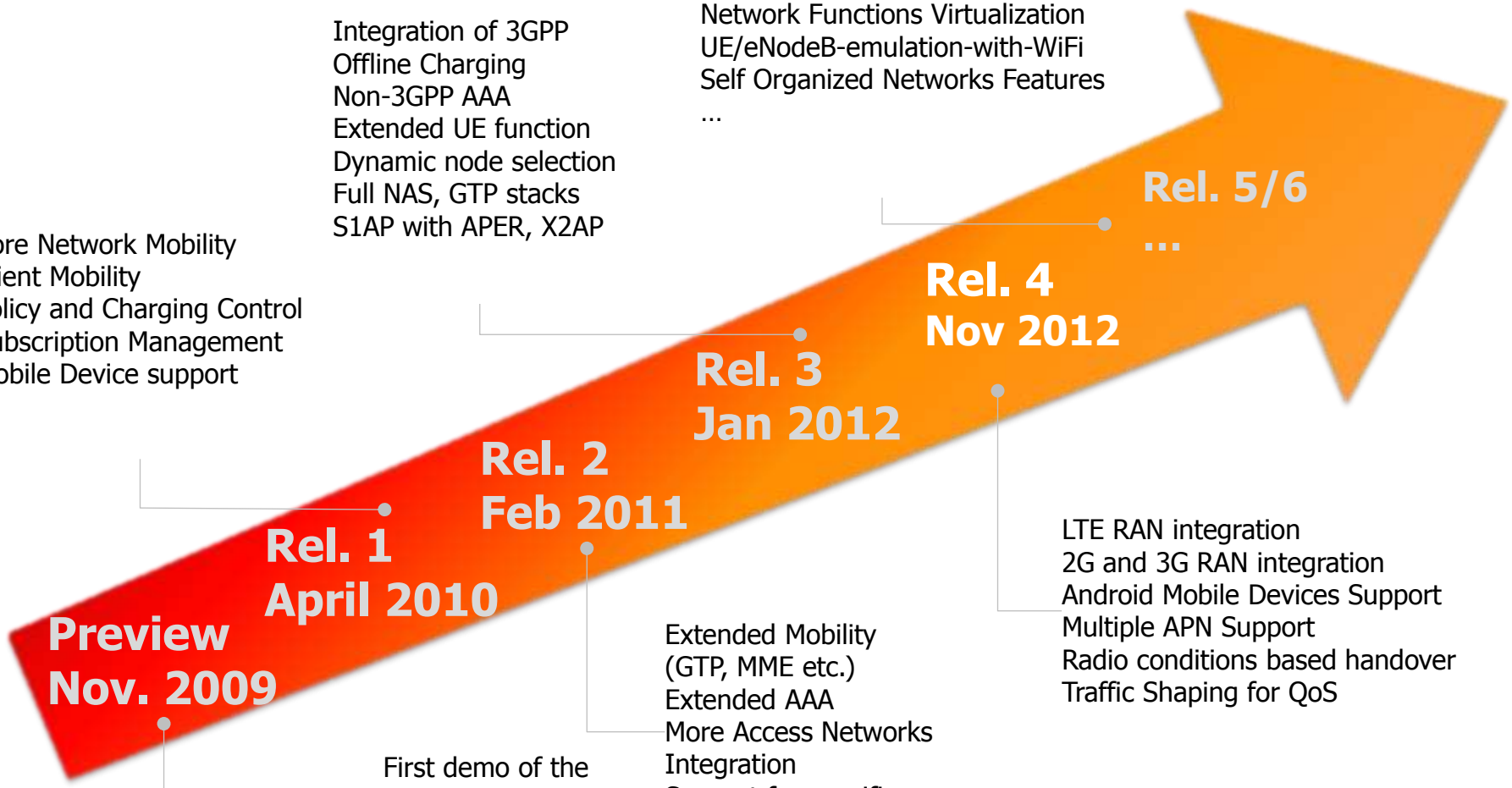
Single Box Testbed

Minimized Connectivity

OpenEPC is highly modular and easy to extend

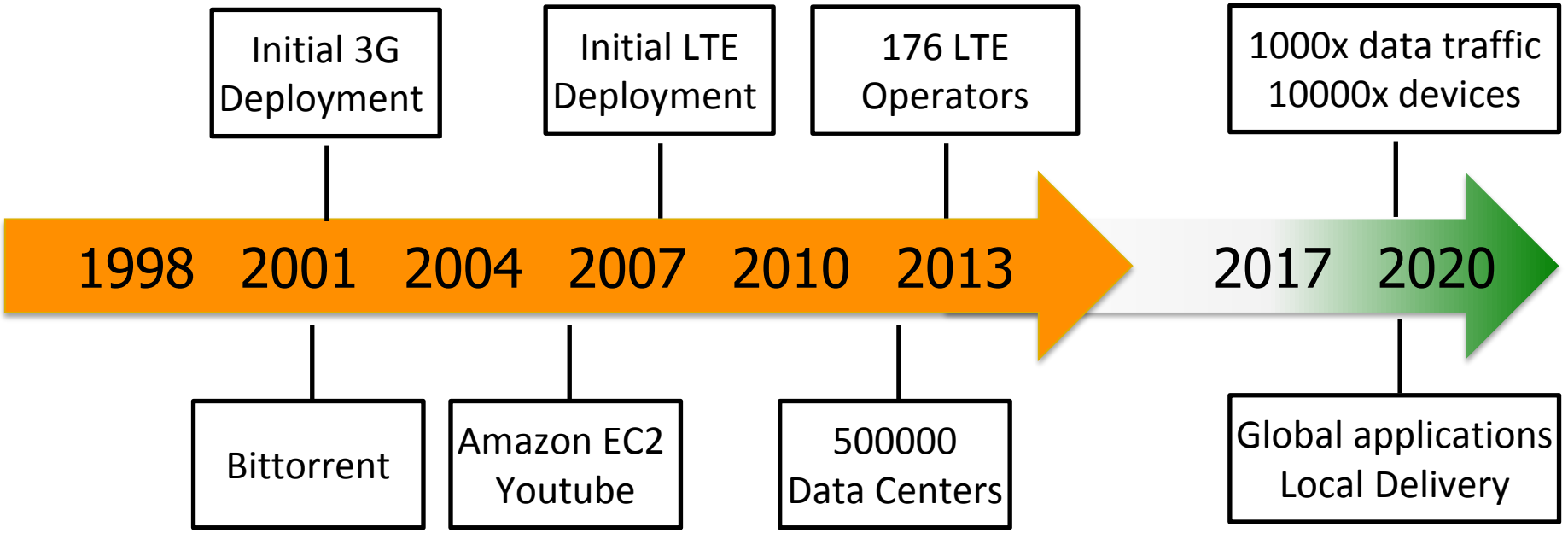


OpenEPC Roadmap



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



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)

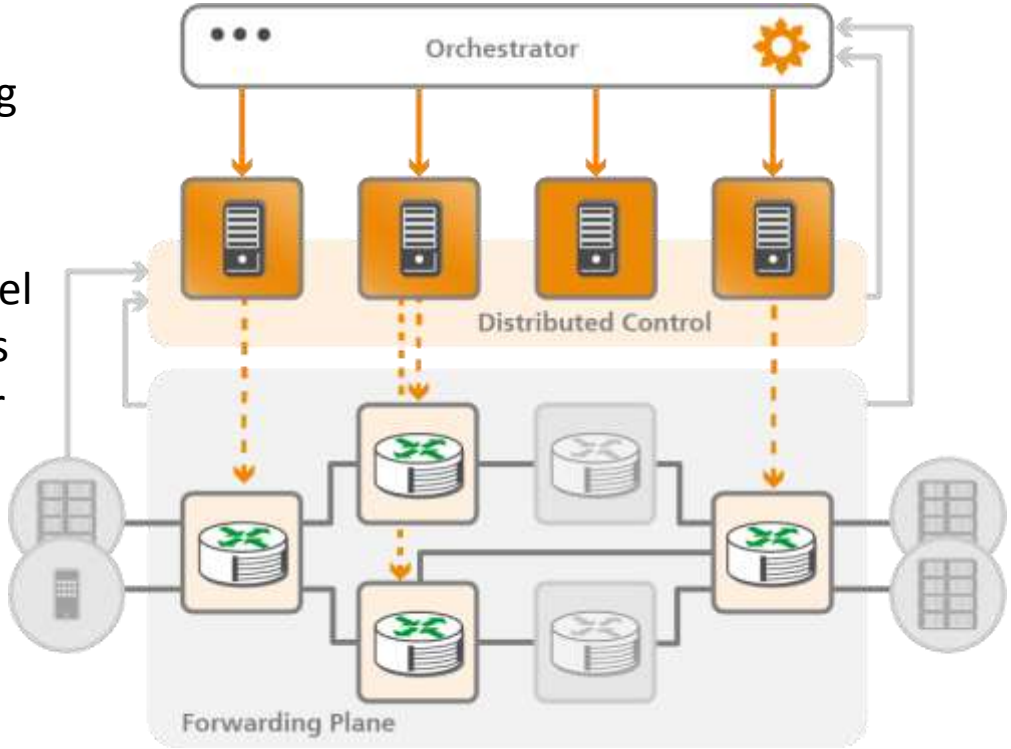
Fraunhofer FOKUS

OpenSDNCore Scope

open SDN core

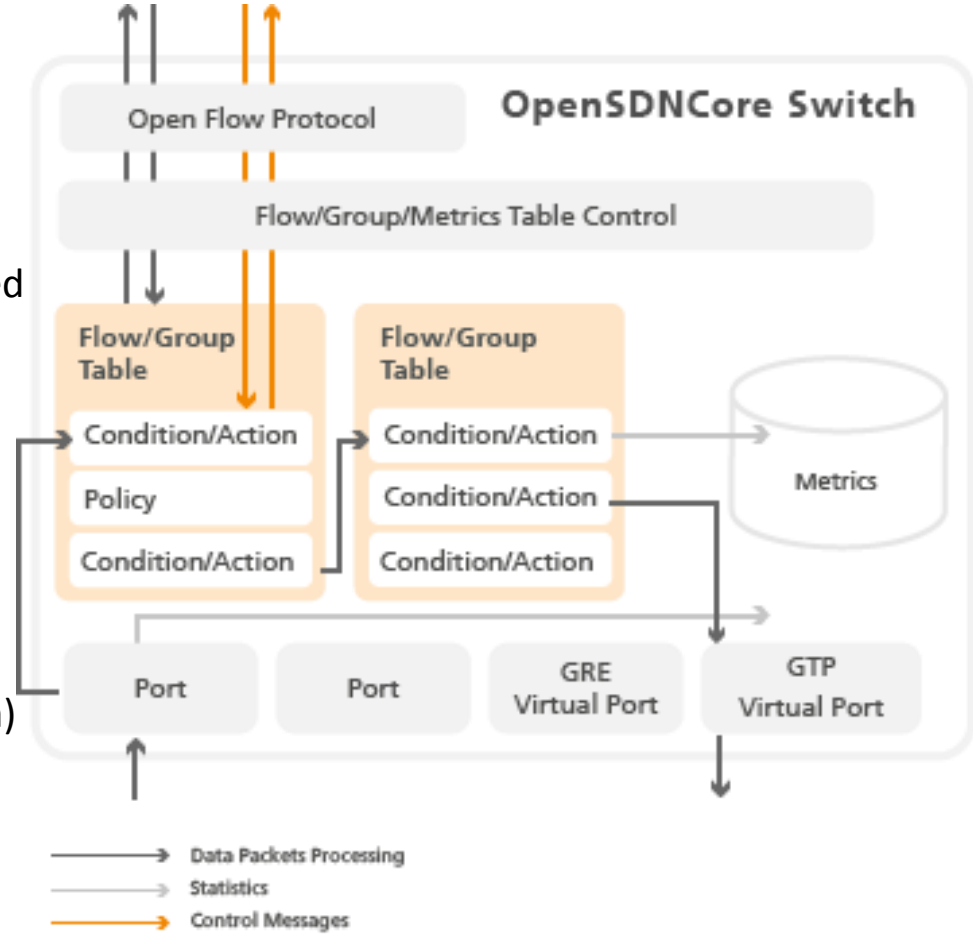
Fraunhofer FOKUS

- 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



OpenSDNCore Switch Features

- OpenFlow 1.3.2 support
  - Other protocols can be considered
- Flow based matching & routing conditions
- GTP and GRE tunneling support
  - Other encapsulations can be considered
- Asynchornous metrics (statistics)
  - At port and at matching rule level



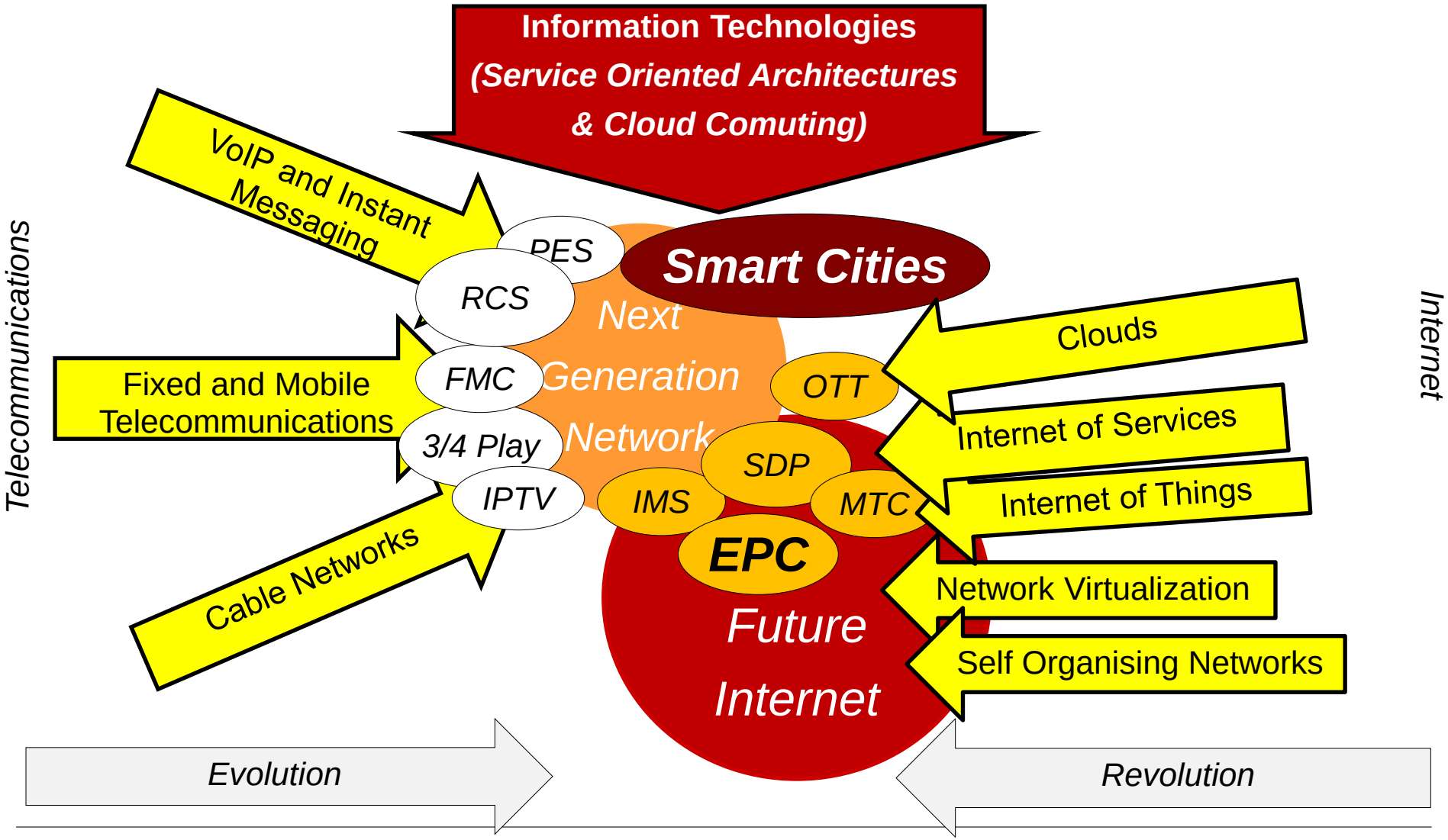
Implementation info:

- Linux based implementation (only for start)
- Implemented on WHARF (OpenEPC platform)
- C based data packets processing
- Highly modular
- Designed for high parallelism

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



UNIFI Workshop @
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

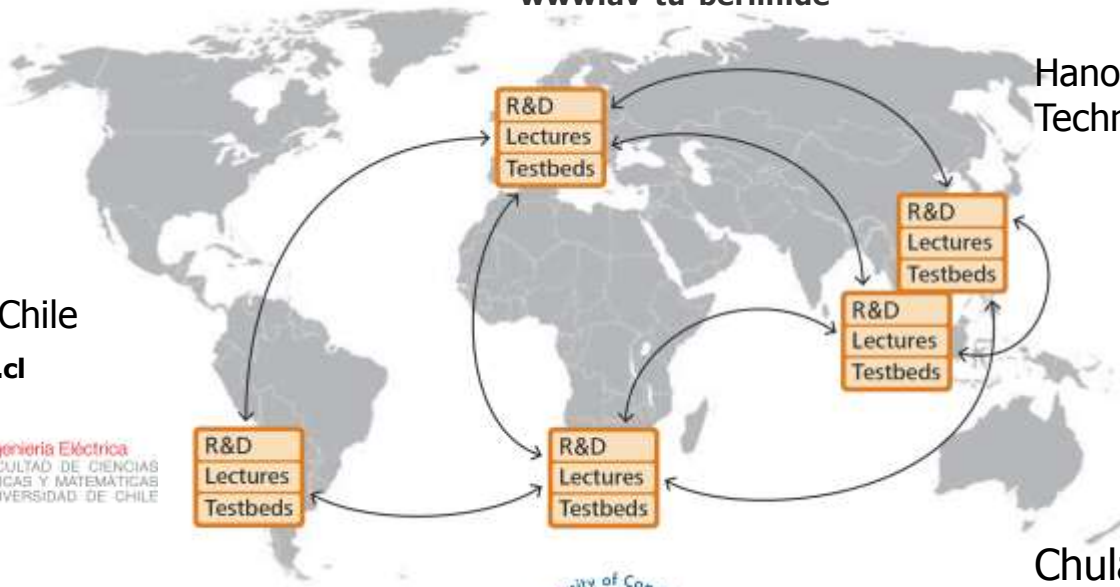
- **UNIFI** – **UNI**versities for **F**uture **I**nternet
- **UNIFI** is an initiative of the Chair of Next Generation Networks (AV) at the Technische Universität Berlin aiming at building sustainable teaching and research infrastructures in the areas of Future Internet through global collaboration 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 international FI academic community

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

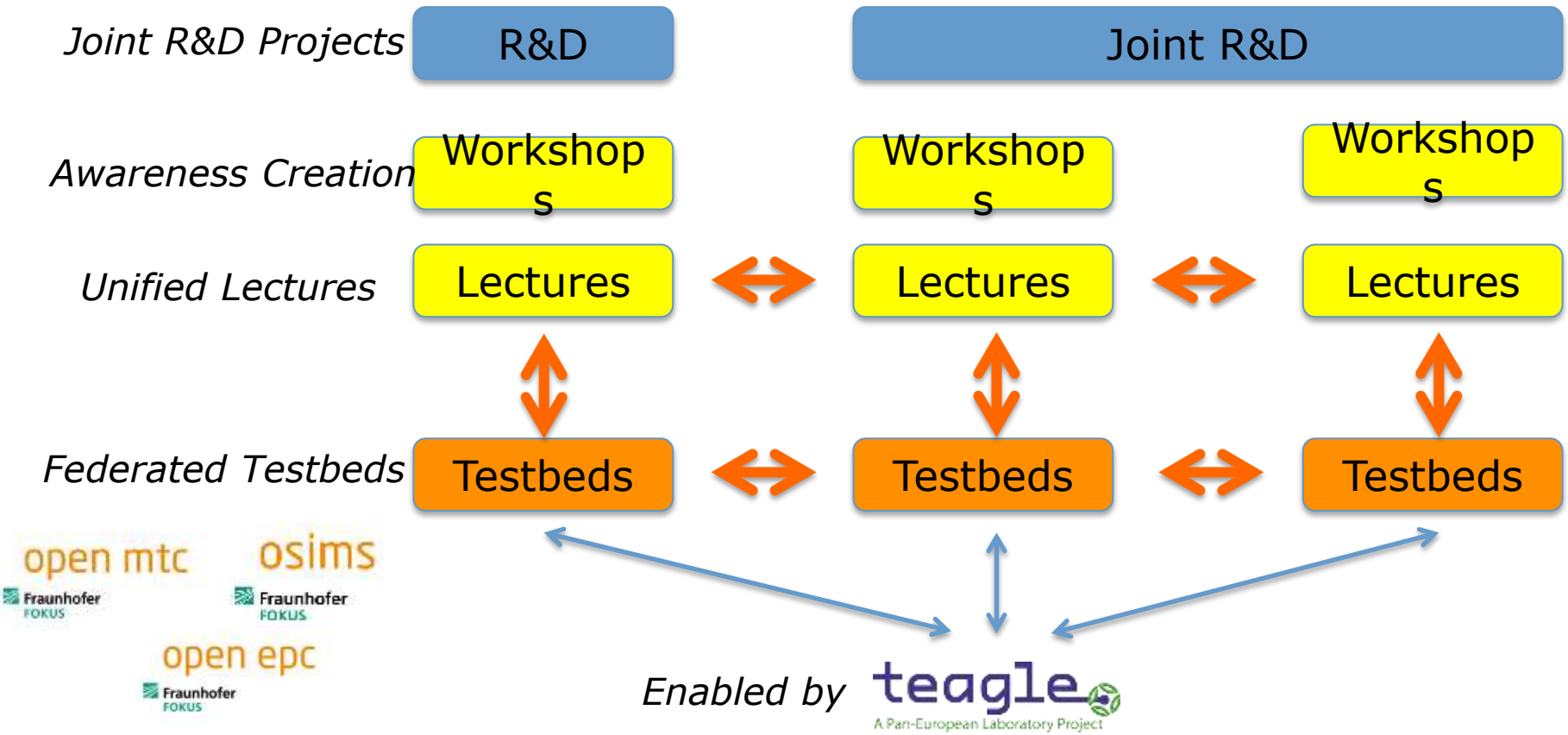
www.chula.ac.th

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



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

S E T

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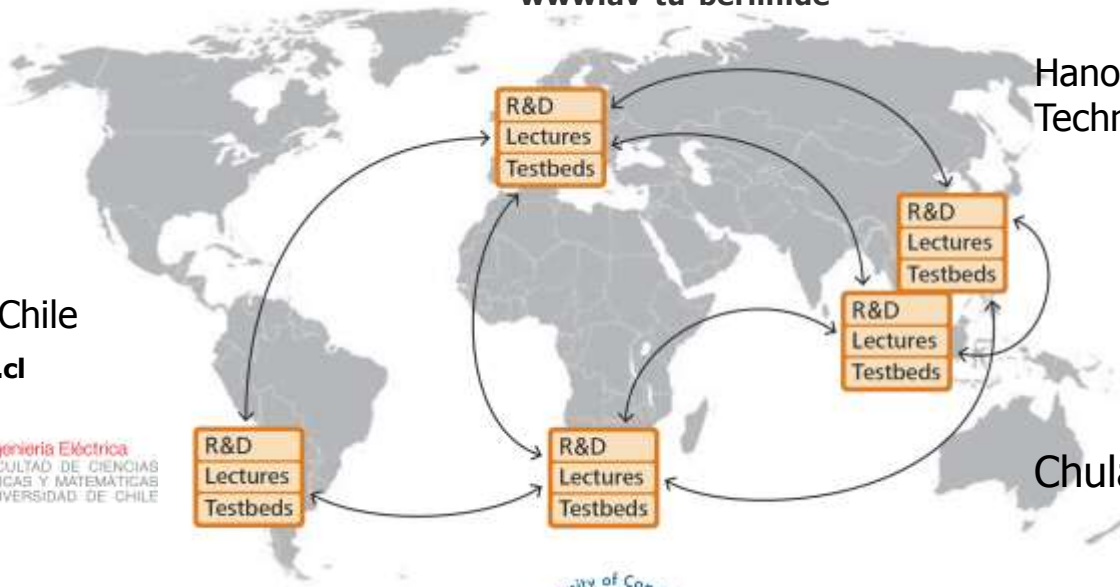

Universidad de Chile

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

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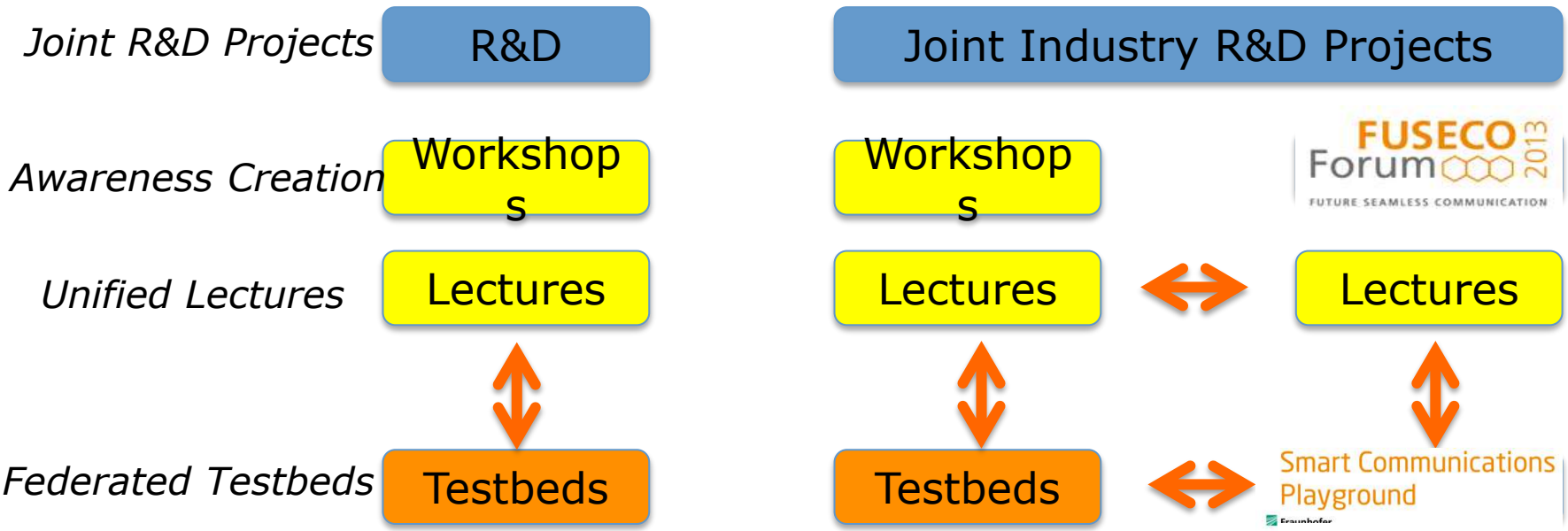
Beyond DAAD UNIFI

Unifying Testbeds and Education for Local Industry



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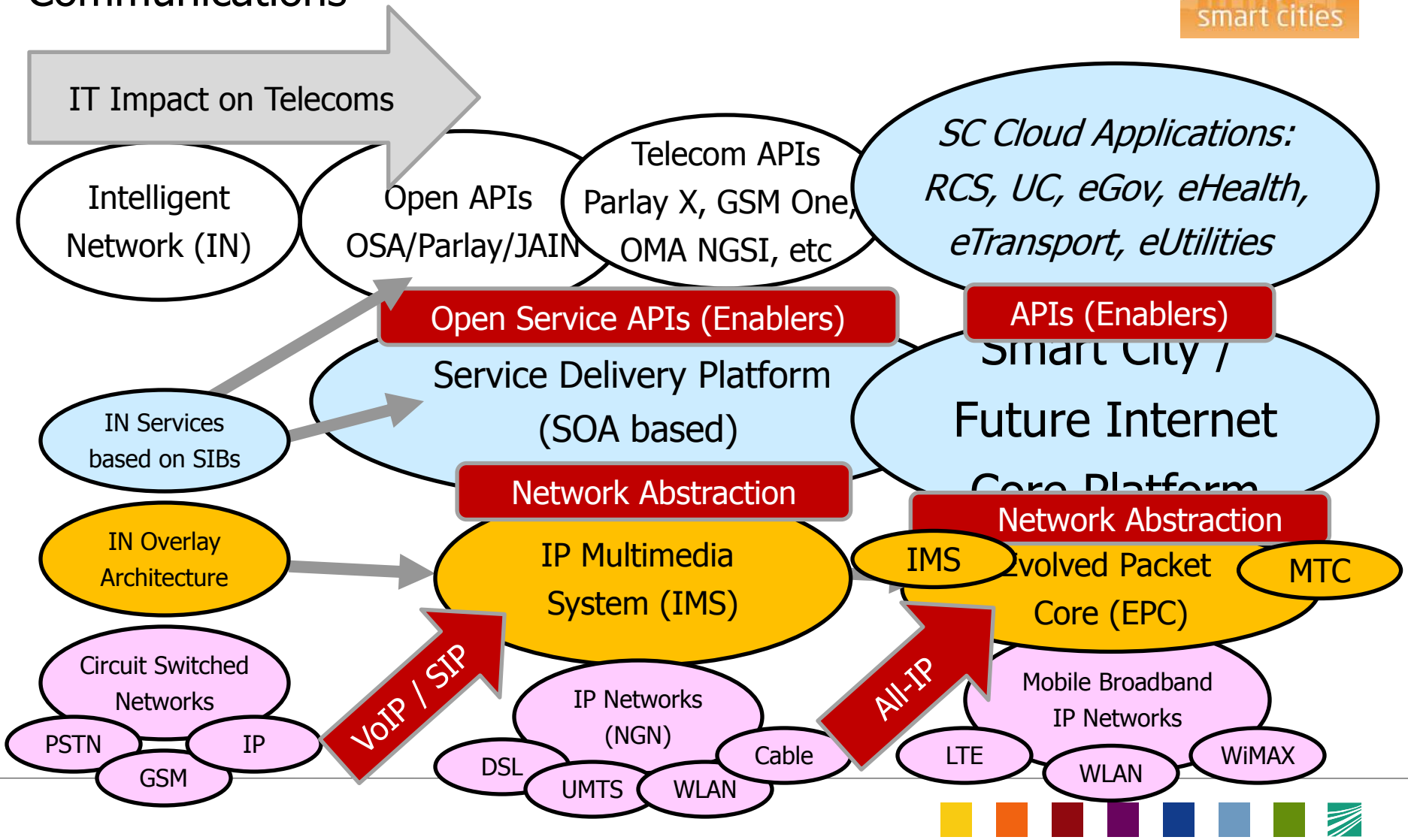
    - Eskom: Utility Load Manager
    - AirBase: Smart City Air Pollution Wireless Sensors
  - Evaluation
    - Pilots: San Vicenç dels Horts and Johannesburg
    - Testbeds: TUB and University of Cape Town
- **Web:** http://trescimo.eu

TRESCIMO

Evolution of Telecommunication Platforms toward Smart Communications



Questions ???