ITU/BDT Regional Economic and Financial Forum of Telecommunications/ICTs for Arab States

Session 1:
Enabling Technologies for ICT development

Nouakchott , 17 May, 2017

Oscar González Soto
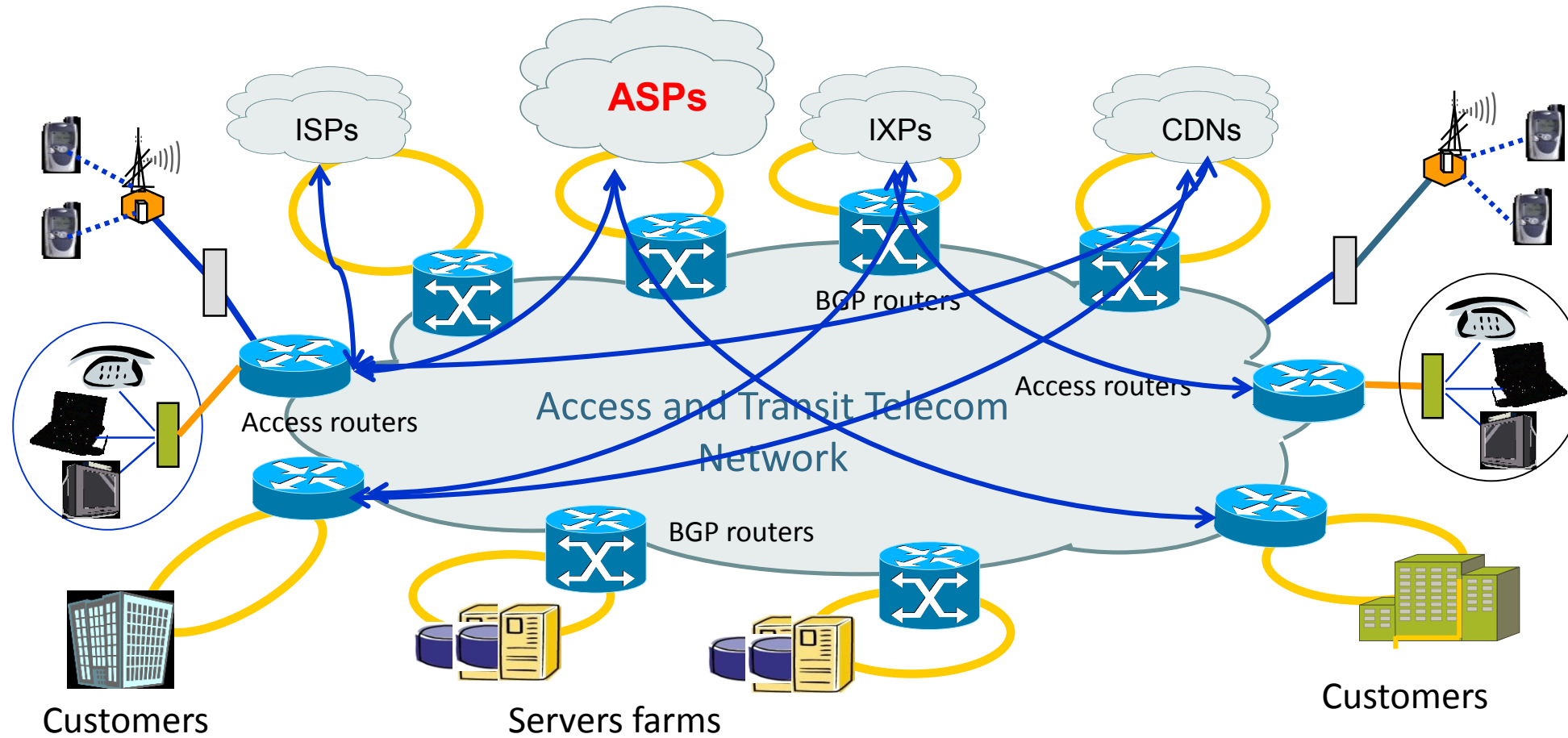**ITU Consultant Expert**
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Enabling Technologies for ICT

- **BB Network Technologies for ICT**

- **Cloud Computing, NFV and SDN**

- **IOT**

- **Big Data and Analytics**

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Enabling technologies for ICT

- **Enabling technologies for ICT are based on an ecosystem with the following elements:**

➤ High capacity BB network infrastructure from end user to end user or network servers

➤ Connectivity to the end customers with BB capacity

➤ Mobile infrastructure and high capacity radio access

➤ High capacity Servers containing required applications located anyware (Cloud Computing)

➤ Flexible network capabilities based on Virtualization and Software Based Networks

➤ Specific treatment for the multiple connected things (IoT)

➤ Gathering, Processing and Analysis of high volume of Data (Big Data)

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Enabling technologies for ICT Network and traffic flows

ISPs

ASPs

IXPs

CDNs

BGP routers

Access and Transit Telecom Network

Access routers

Access routers

Access routers

BGP routers

Customers

Servers farms

Customers

Broadband Network Infrastructure

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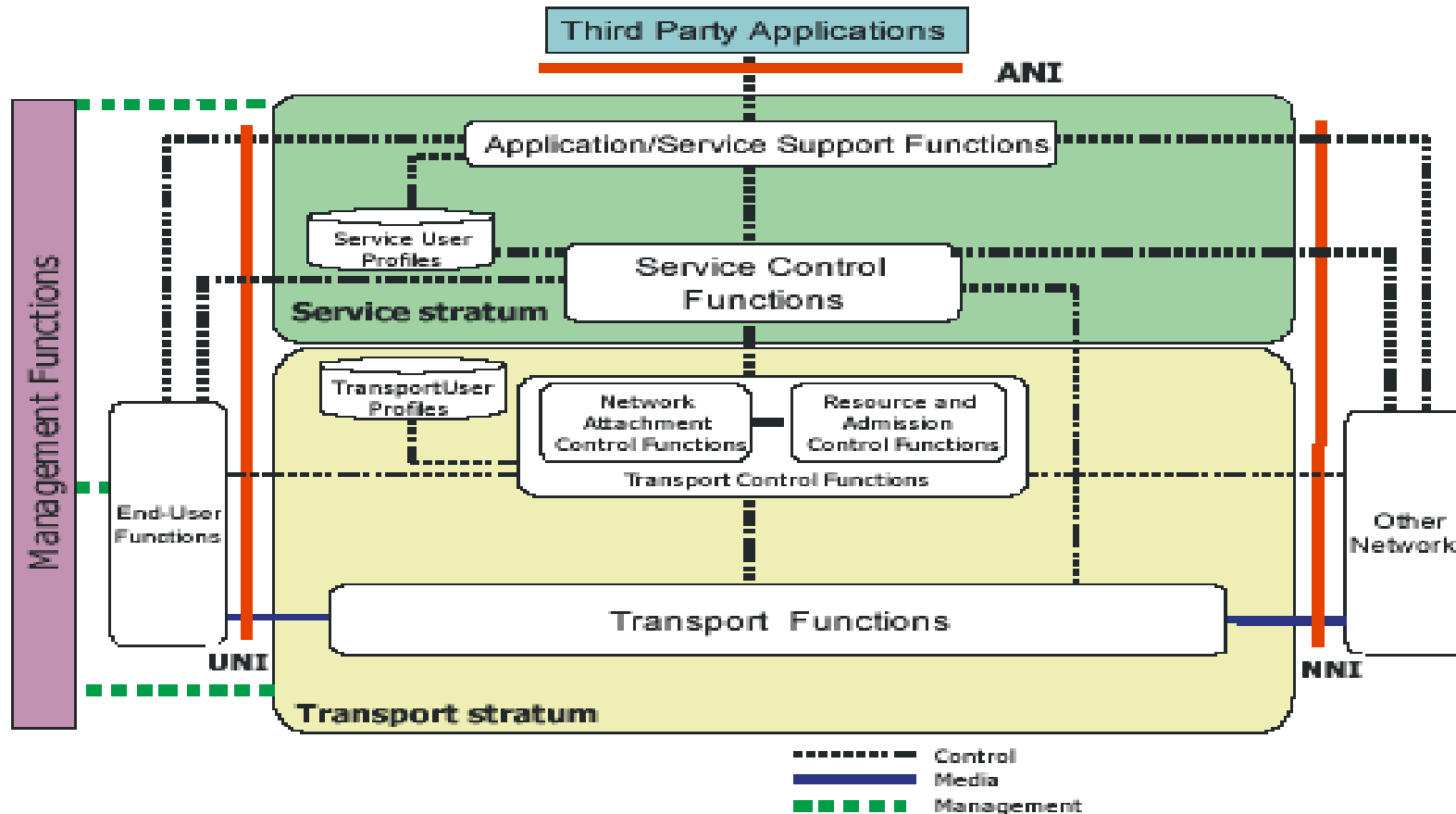
Enabling technologies for ICT: network elements

- **End customers:**
  - Households, Business and Industry users, Things

- Telecom Network **Routers**:
  - Telecom network nodes such as access, edge and core nodes distributed at national level

- **ISPs**:
  - Internet Service Providers: multiple internet centers that gather/send the internet traffic from/to end customers

- **ASPs:**
  - Application Service Providers: Multiple application nodes that receive and send specific services and applications

- **CDNs:**
  - Content Distribution Networks: multiple data centers that send content information from a central point or from distribution points using catching

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Enabling technologies for ICT: ASP functional elements

- An **Application Service Provider** (**ASP**) is a business providing computer-based services to customers over a network; such as access to a particular software application (such as customer relationship management) using a standard protocol (such as HTTP).

- The need for ASPs has evolved from the increasing costs of specialized software that have far exceeded the price range of small to medium-sized businesses. As well, the growing complexities of software have led to huge costs in distributing the software to end-users.

- Through ASPs, the complexities and costs of such software can be cut down. In addition, the issues of upgrading have been eliminated from the end-firm by placing the onus or responsibilty on the ASP to maintain up-to-date services, 24 x 7 technical support, physical and electronic security and in-built support for business continuity and flexible working.

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Enabling technologies for ICT: IMS Architecture in NGN

Separation of Control, Applications and Media in generic strata

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Enabling technologies for ICT: 5G

5G networks imply a major evolution within the mobile systems with the following capabilities:

• Integration of multiple radio access technologies in licensed and unlicensed frequency bands. The radio network will make full use of the entire frequency range from sub-6 GHz up to 100 GHz. The access network will be ultra-dense and provide virtual zero latency.

• Backhaul will be heterogeneous, relying on optical technologies wherever possible, augmented with other secure wireless backhaul options to support flexible deployments.

• Mobile edge computing will bring the cloud i.e. applications, content and context closer to user locations. This will personalize the service experience through faster service delivery and augmented reality enhancements.

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Enabling technologies for ICT: 5G Benefits in Performance and capacity

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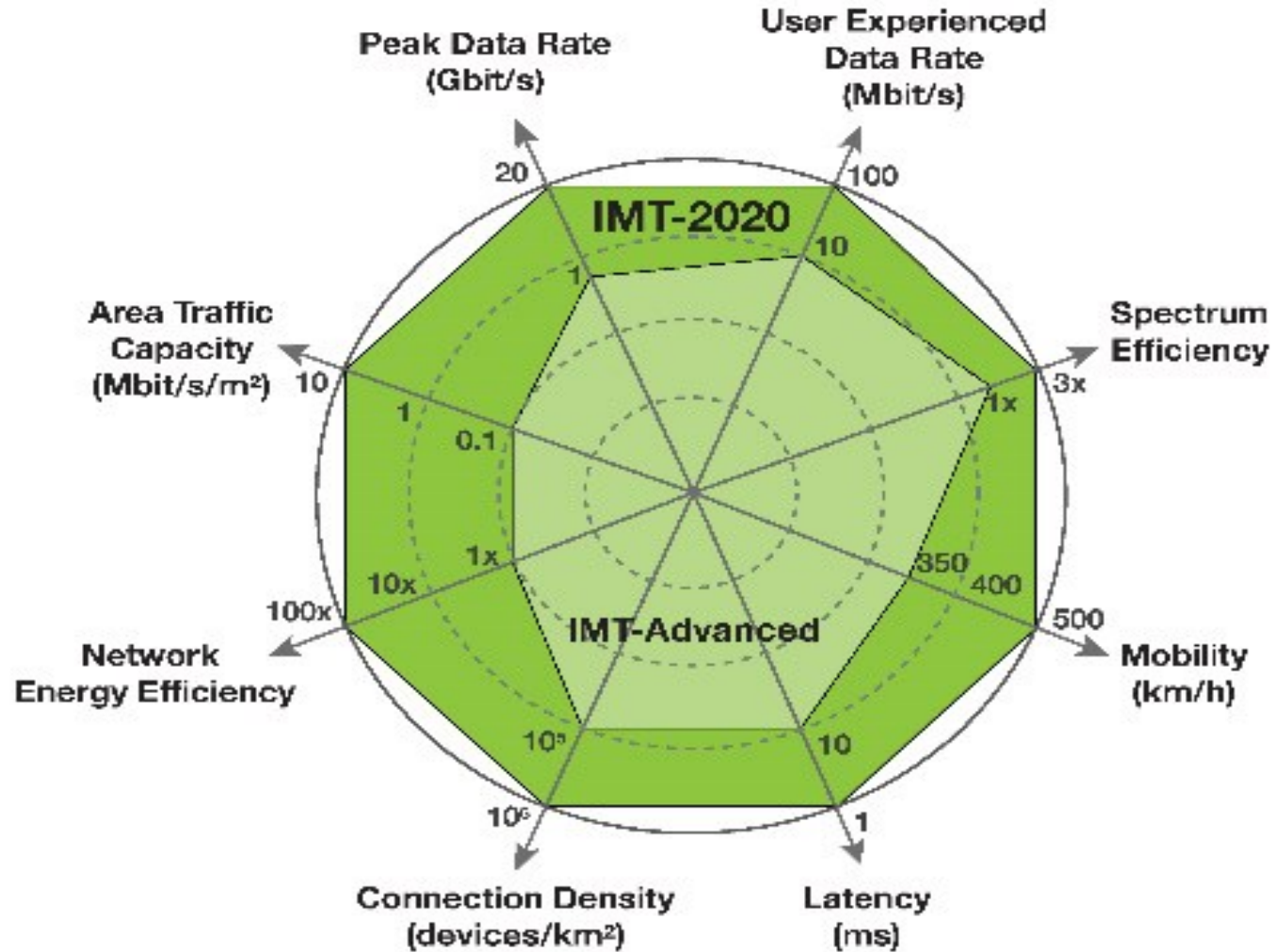
Enabling technologies for ICT: 5G
Economic Benefits

- 5G networks are expected to offer the opportunity to launch, efficiently and cost-effectively, numerous new services thus, creating an ecosystem for technical and business innovation. In addition, the 5G infrastructures will provide tailored network solutions specialized to support vertical markets such as automotive, energy, food and agriculture, healthcare, etc.

- The European Commission supported study " (SMART 2014/0008) forecasts the benefits and impacts of 5G introduction over the four studied industrial sectors (automotive, healthcare, transport and utilities) may reach €113.1 billion per year.

- In year 2025 it is expected that €62.5 billion will arise from first order benefits in the mentioned four verticals. First order benefits focus on the more direct benefits to the producers of goods and services.

- There are also significant second order or indirect benefits on the society, estimated at €50.6 billion in year 2025, arising from the multiplier impacts from the use of goods and services.

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Enabling technologies for ICT: Cloud Computing

As defined by the ITU-T FG, Cloud Computing Services are understood as Products and Solutions that are delivered and consumed on demand (utilizing IT Resources & capabilities of Platform) at any time, through any access network (fixed & mobile) using any connected devices and cloud computing technologies.

- There are 5 main Cloud service categories
- SaaS: Software as a Service
- CaaS: Communications as a service
- PaaS: Platform as a Service
- IaaS: Infrastructure as a Service
- NaaS: Network as a Service:
- And three working modes
- Private or access by a specific company
- Public or access by any user
- Hybrid or mixed access as a function of the content

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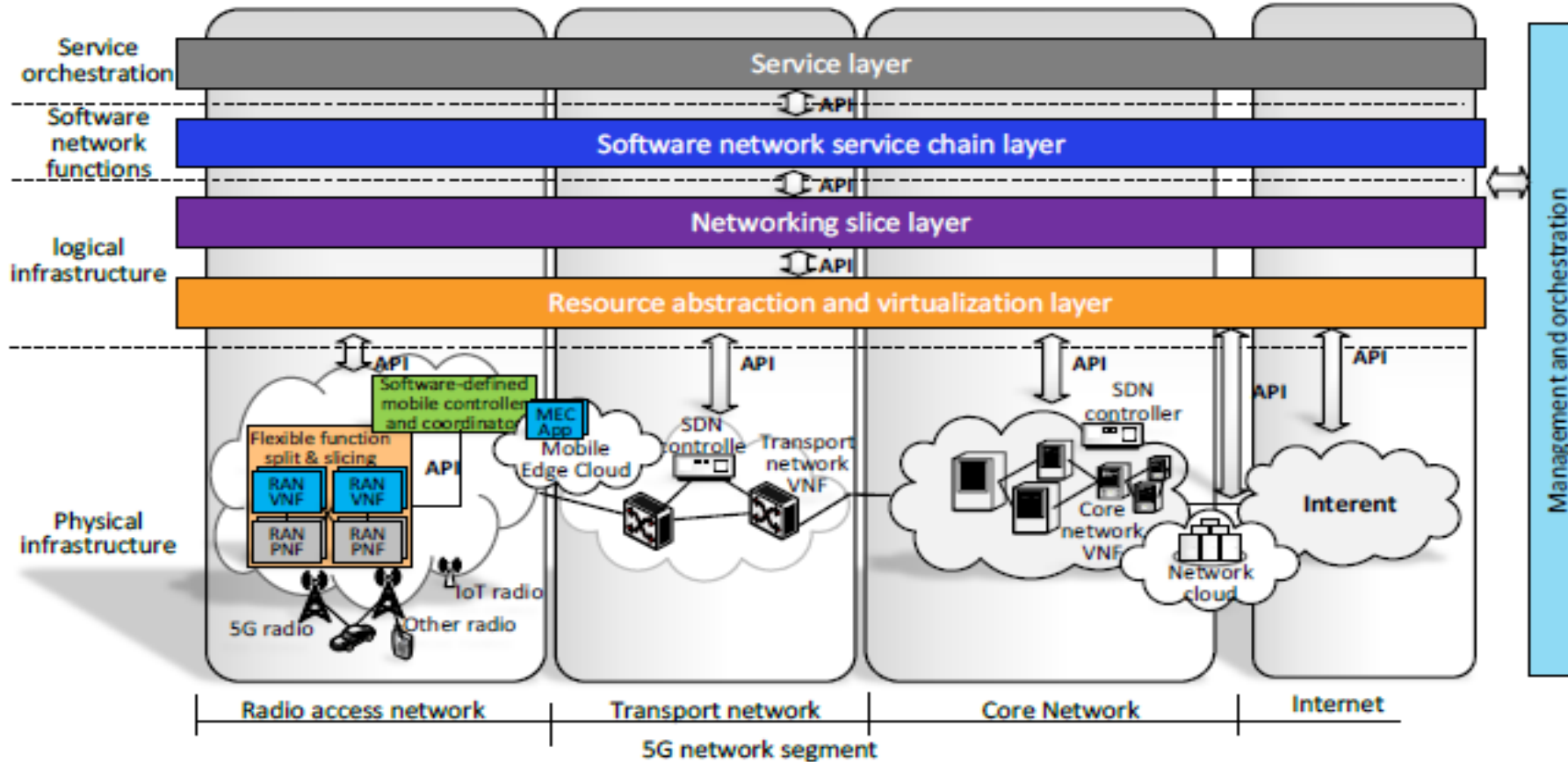
Enabling technologies for ICT: NFV Concept

-**NFV** (Network Function Virtualization) concept of network implementation in which the network functions to provide services are organized by blocs and separated from the media

- The virtual functions are implemented in virtual machines specialized in processes and sub processes where the storage, switching and processing are developed in a high capacity generic HW

- The typical functions of a NGN network as firewall, load balance, intrusion detection, etc. may be located at any point of the network and fragmented for the required optimization

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Enabling technologies for ICT: SDN Concept

- *Software-Defined Networking* (SDN) is a network architecture in which the operation, dynamic assignment, management adaptability and orchestration allow to follow the dynamics of new services, high consumption of BW of modern applications.

- The SDN separate the network control of the forwarding functions with a well defined API between them to allow the programmability of network control and subjacent based infrastructure.

- SDNs are based on the OpenFlow protocol, the formal specification and formal verification to communicate between the control and the subjacent equipments. It is necessary to have an umbrella orchestration function to coordinate different equipments

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Enabling technologies for ICT: NFV and SDN architecture

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Enabling technologies for ICT: SDN operation model
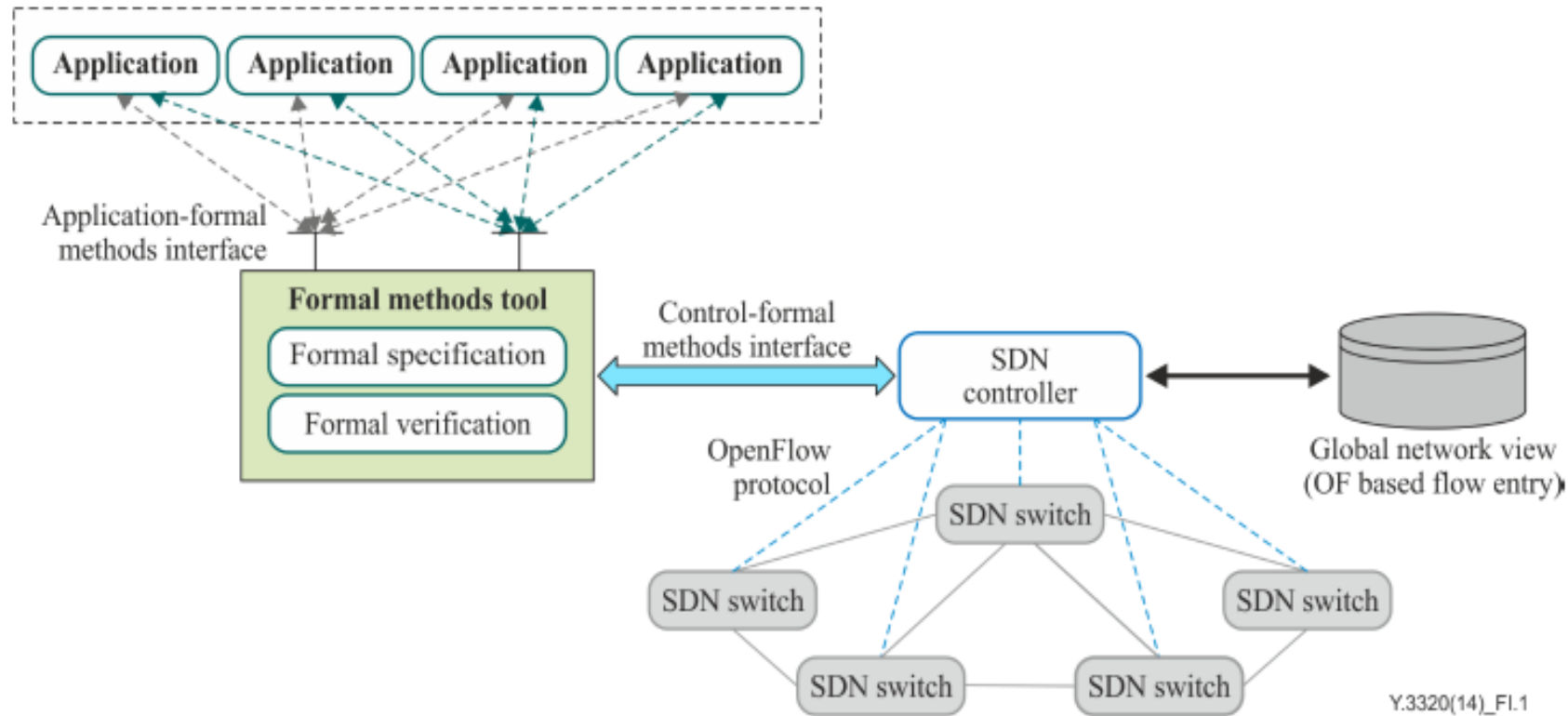
Figure I.1 – High level operational model

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Enabling technologies for ICT: NFV Benefits
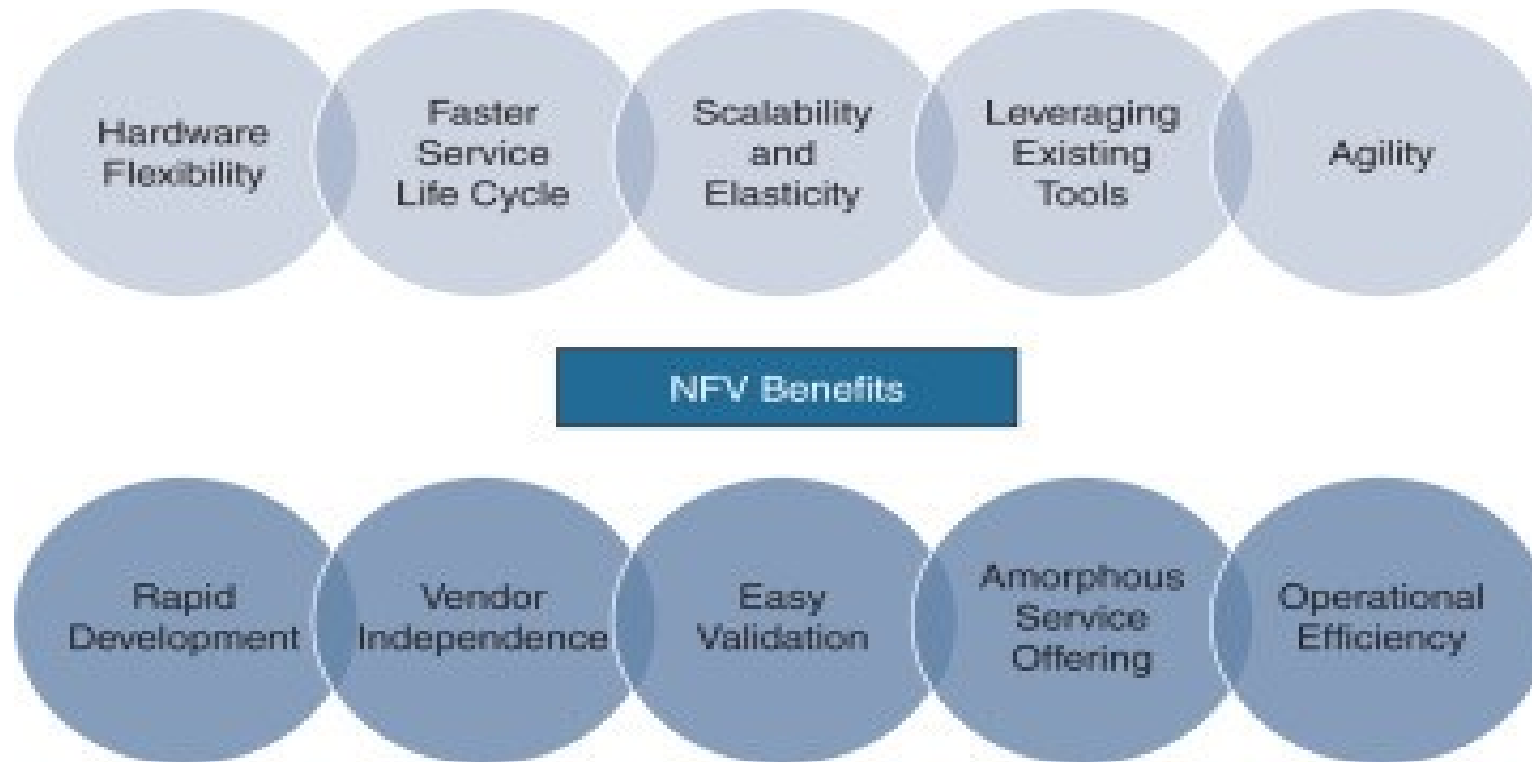
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Enabling Technologies for ICT: IoT

Device:
With regard to the Internet of things, this is a piece of equipment with the mandatory capabilities of communication and the optional capabilities of sensing, actuation, data capture, data storage and data processing.

Internet of things (IoT):
A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

Thing:
With regard to the Internet of things, this is an object of the physical world (physical things) or the information world (virtual things), which is capable of being identified and integrated into communication networks

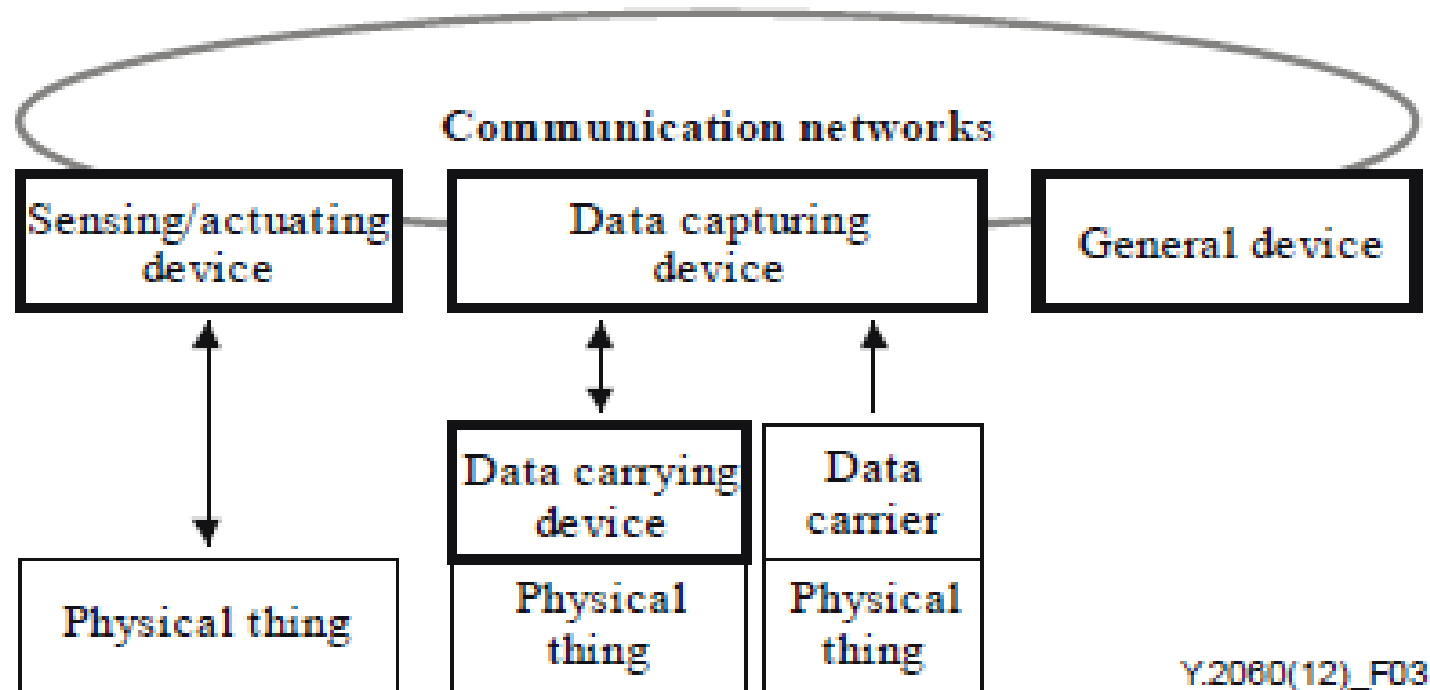Nouakchott, May 2017 , Technologies for ICT, OGS

Devices, physical things and virtual things

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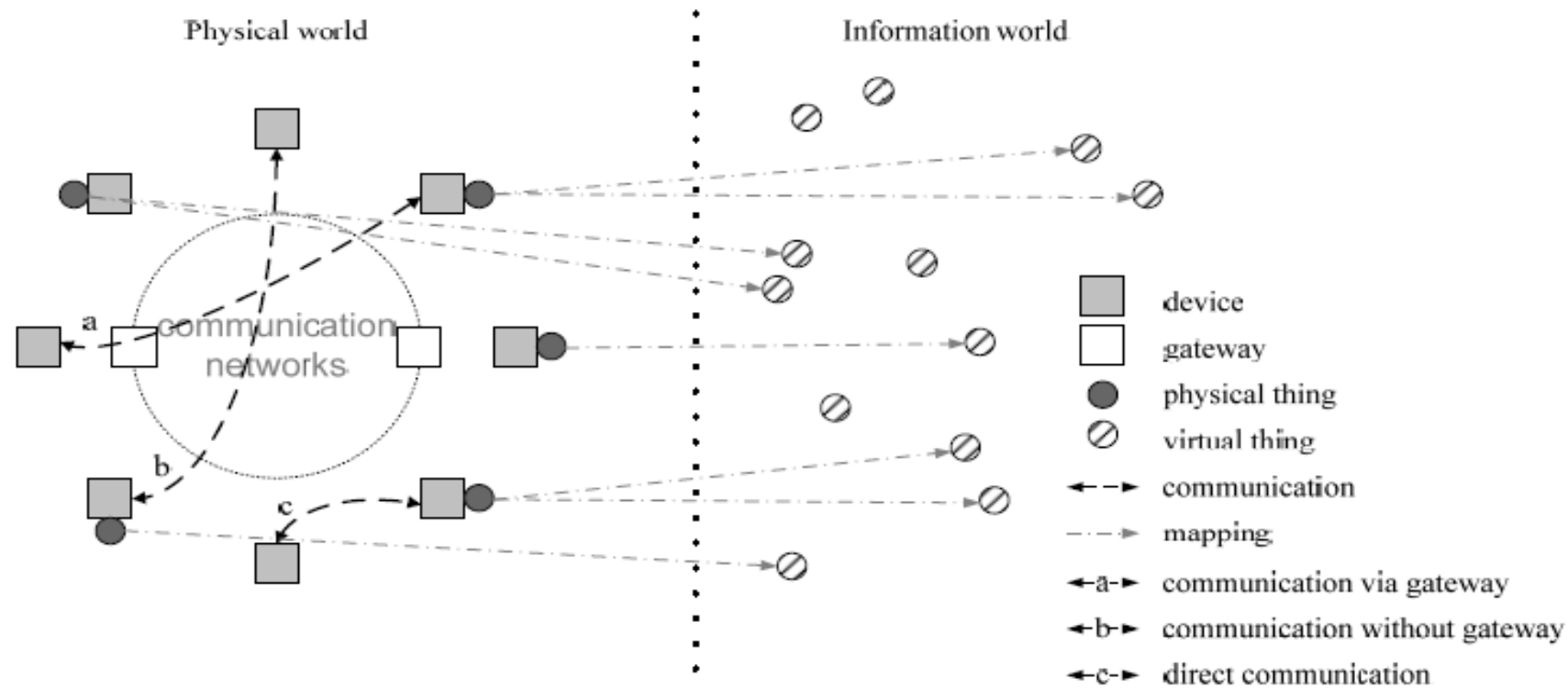
Enabling Technologies for ICT: IoT Associated communications

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Enabling Technologies for ICT: IoT Architecture

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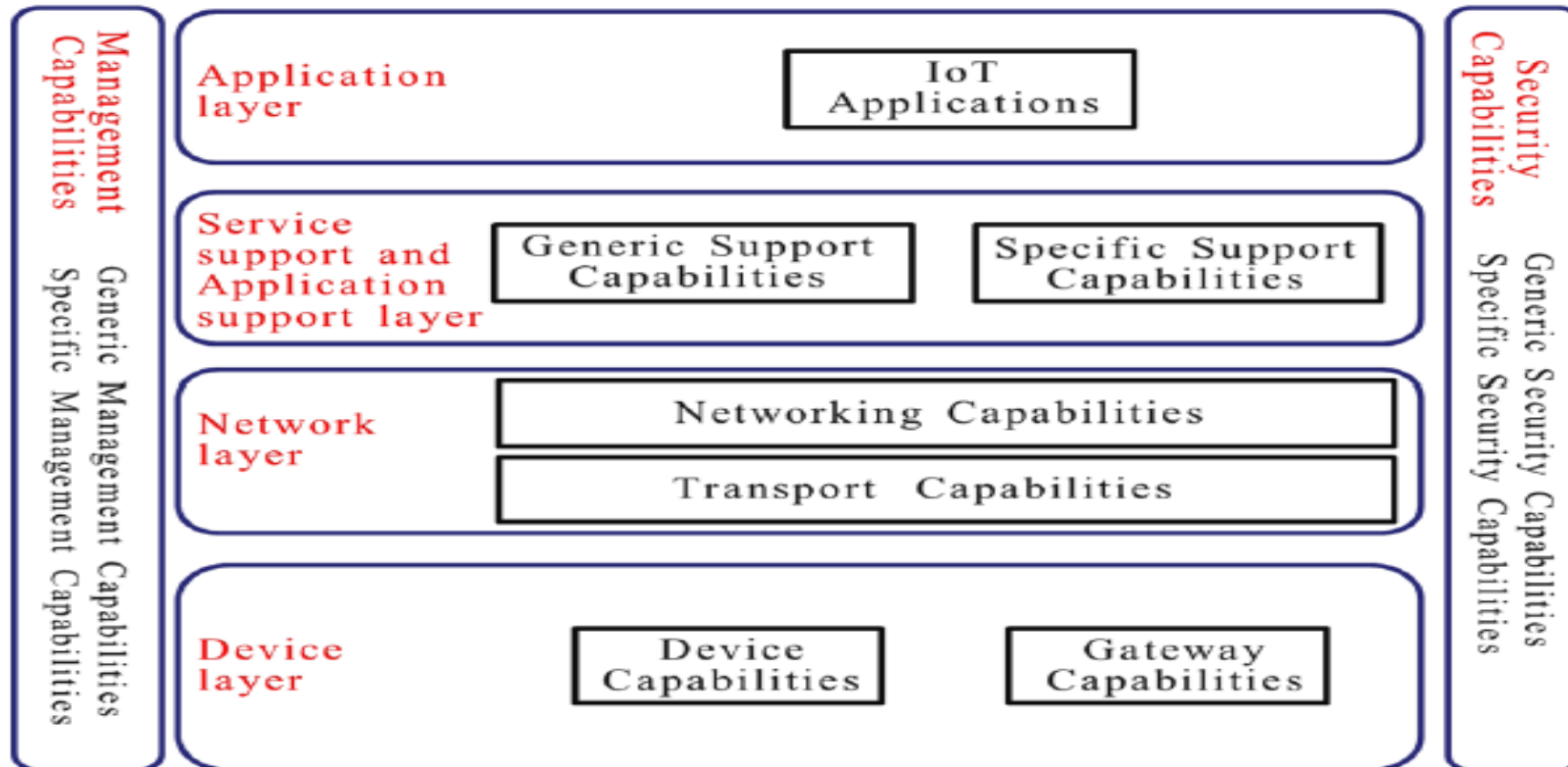
Enabling Technologies for ICT: Main areas

Wearables
- Entertainment
- Fitness
- Smart watch
- Location and tracking

Building & Home Automation
- Access control
- Light & temp control
- Energy optimization
- Predictive maintenance
- Connected appliances

Smart Cities
- Residential E-meters
- Smart street lights
- Pipeline leak detection
- Traffic control
- Surveillance cameras
- Centralized and integrated system control

Smart Manufacturing
- Flow optimization
- Real time inventory
- Asset tracking
- Employee safety
- Predictive maintenance
- Firmware updates

Health Care
- Remote monitoring
- Ambulance telemetry
- Drugs tracking
- Hospital asset tracking
- Access control
- Predictive maintenance

Automotive
- Infotainment
- Wire replacement
- Telemetry
- Predictive maintenance
- C2C and C2I

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Enabling Technologies for ICT: IoT Most popular use in 2014

- Smart home
- Wearables
- Smart city
- Connected health
- Smart grid
- Industrial internet
- Connected car
- Smart retail
- Smart supply chain
- Smart farming

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Enabling technologies for ICT: Big Data and Analytics

With the rapid development of information and communications technology (ICT), Internet technologies and services, huge amounts of data are generated, transmitted and stored at an explosive rate of growth.

Data are generated by many sources and not only by sensors, cameras or network devices, but also by web pages, email systems and social networks as well as by many other sources.

Datasets are becoming so large and so complex or are arriving so fast that traditional data processing methods and tools are inadequate. Efficient analytics of data within tolerable elapsed times becomes very challenging. The paradigm being developed to resolve the above issues is called big data

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Enabling technologies for ICT: Big Data and Analytics
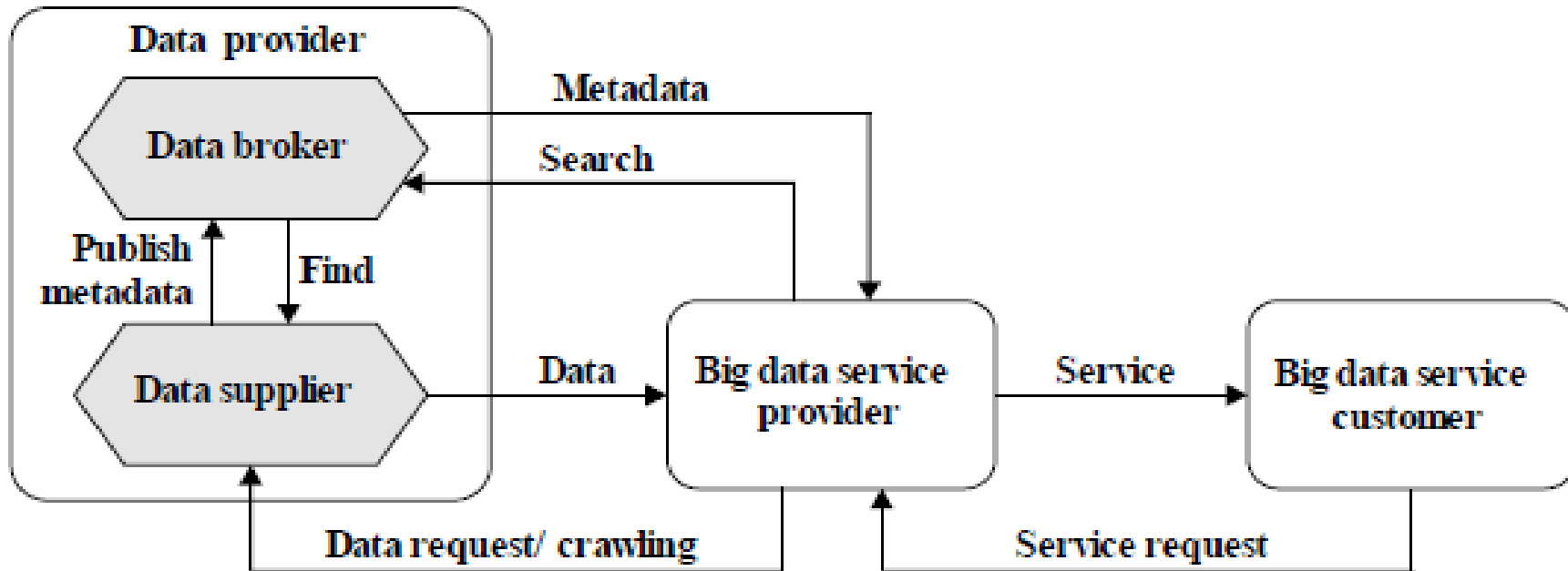
Big Data flow from supplier to customer

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Enabling technologies for ICT: Big Data and Analytics

Data analytics capabilities include:

– Data preparation, which offers the capabilities to transform data into a form that can be analyzed. These capabilities include exploring, changing and shaping of the raw data

– Data analysis, which offers the capabilities of investigation, inspection and modeling of data in order to discover useful information

– Workflow automation, which offers the automation processes, in whole or part, during which data or functions are passed from one step to another for actions, according to a set of procedural rules

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Enabling technologies for ICT: Big Data and Analytics Challenges

– **Timeliness**: The acquisition rate and timeliness, to effectively find elements in limited time that meet a specified criterion in a large dataset, are new challenges faced by data processing. Other new challenges are related to the types of criteria specified and there is a need to devise new index structures and responses to the queries having tight response time limits.

– **Privacy**: Data about human individuals, such as demographic information, Internet activities, commutation patterns, social interactions, energy or water consumption, are being collected and analyzed for different purposes. Big data technologies and services are challenged to protect personal identities and sensitive attributes of data throughout the whole data processing cycle while respecting applicable data retention policy.

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Enabling technologies for ICT: Big Data and Analytics Challenges

– **Heterogeneity and incompleteness**: Data processed using big data can miss some attributes or introduce noise in data transmission. Even after data cleaning and error correction, some incompleteness and some errors in data are likely to remain. These challenges can be managed during data analysis.

– **Scale**: Processing of large and rapidly increasing volumes of data is a challenging task. Using data processing technologies, the data scale challenge was mitigated by the evolution of processing and storage resources. Nowadays however data volumes are scaling faster than resources can evolve. Technologies such as parallel databases, in memory databases, non-SQL databases and analytical algorithms allow this challenge to be resolved.

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Enabling technologies for ICT: Big Data and Analytics

Data analytics capabilities require:

– Analysis algorithm adaptation, which offers the capabilities to apply algorithms of classification, regression, clustering, association rules, ranking, Artificial Intelligence, etc. to process the datasets according to the CSC demands

– Distributed processing, which offers the capabilities to distribute the processing tasks to a cluster of computing nodes

– Data application, which offers the capabilities to support applications or application plug-ins to use the analysis results of datasets.

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Enabling technologies for ICT : Big Data and Analytics LUCA case

- **Objective**: In order to help companies and organizations to extract the maximum value from information ,Telefónica has offered recently for its corporate customers to enable companies, public institutions and all kinds of organizations to advance on the digital transformation, so they may benefit from the opportunity presented by Big Data and the positive effect it has on society as a whole.

- **LUCA** will help its clients by providing BDaaS (Big Data as a Service) to empower clients to get the most out of their own data, using the Telefónica cloud infrastructure. The catalogue of products and services of LUCA will be taken to market by the different business units in different countries

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Enabling technologies for ICT : Big Data and Analytics Benefits

•**Big Data is Timely:** saving 60% of each workday, knowledge workers spend attempting to find and manage data.

•**Big Data is Accessible:** Facilitate senior executives report that accessing the right data.

•**Big Data is Holistic:** Solve the silos organization of data that Information is currently kept in silos within the organization. Marketing data, for example, might be found in web analytics, mobile analytics, social analytics, CRMs, etc. with a global view.

•**Big Data is Relevant:** Solve dissatisfaction of companies with their tools ability to filter out irrelevant data. Something as simple as filtering customers from your web analytics can provide a ton of insight into your acquisition efforts.

•**Big Data is Authoritative:** By combining multiple, vetted sources, more companies can produce highly accurate intelligence sources.

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Enabling technologies for ICT: Outcome

The combination of following technologies in an ecosystem will empower the capabilities of a country to exploit the modern needs of the society:

- High capacity BB network infrastructure
- Mobile infrastructure and high capacity radio access
- High capacity Servers containing required applications located anyware (Cloud Computing)
- Flexible network capabilities based on Virtualization and Software Based Networks
- Specific treatment for the multiple connected things (IoT)
- Gathering, Processing and Analysis of high volume of Data (Big Data)

The way to evolve to this ecosystem has to be carefully planned per country as a function of the initial status

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