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TELCO CLOUD BUSINESS SERVICE OPPORTUNITIES and THE IMPACT ON VENDORS' OFFERINGS

Master's Degree Programme in Business Management and Entrepreneurship (BME)

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Pilviteknologian tarjoamat palvelumahdollisuudet operaattoreille ja niiden vaikutus verkkotoimittajien tarjontaan.

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Tutkimuksen tarkoituksena oli identifioida minkälaisia uusia liiketoiminnan palveluita pilviteknologia mahdollistaa tietoliikenneoperaattoreille, näiden palveluiden ominaispiirteet ja miten tietoliikennetoimittajat voivat mahdollistaa pilvipalveluiden tuottamisen ja täten auttaa operaattoreita.

Tutkimuksen teoreettisen osuus toimi viitekehyksenä empiiriselle tutkimukselle. Tutkimuksen teoreettinen osuuden tarkoituksena oli kuvata pilviteknologian peruspiirteet, ominaisuudet, tunnetuimmat tuottajat ja palvelumallit. Tämän lisäksi kuvattiin operaattoreiden nykyinen rooli pilviteknologian käyttäjänä ja palveluiden tuottajana.

Tutkimuksen empiirinen osuus toteutettiin kahdessa osassa, jotka molemmat perustuivat kvalitatiivisiin tutkimusmetodeihin jakautuen toissijaisen ja ensisijaisen informaation keräämiseen ja analysointiin. Dokumenttianalyysia käytettiin informaation keräämiseen ja analysointiin perustuen analyytikoiden ja eksperttien tuotoksiin. Ensisijainen informaatio saatiin haastattelemalla kahta Nokia Networksin edustajaa sekä suomalaista operaattoria. Tämän lisäksi tutkimuksen tekijä osallistui Telco Cloud forumiin Lontoossa, jossa useat operaattorit, palvelutuottajat ja analyytikot jakoivat näkemyksiään pilviteknologian mahdollisuuksista operaattoreille. Esitysten perusteella neljän operaattorin tuottama informaatio otettiin mukaan tutkimukseen.

Tuloksista voitiin päätellä, että operaattoreiden mahdollisuudet tuottaa pilvipalveluita pohjautuvat traditionaalisten palveluiden tuottamisesta pilviteknologian etuisuuksia hyödyntäen sekä uusien palveluiden tuottamisesta yhteistyössä muiden pilvipalvelutuottajien kanssa. Tutkimustulokset toimivat hyvänä ohjeistuksena operaattoreille, joilla ei ole vahvaa näkemystä strategisesta suuntautumisesta pilviteknologiaa hyväksikäyttäen. Tietoliikennetoimittajille tulokset korostivat virtuaalisten, ohjelmistokeskeisten ja hallittujen verkkojen tärkeyden operaattoreiden kyvyille tuottaa pilvipalveluita, sekä edesauttoivat ymmärtämään operaattoreiden rooleja pilviteknologiaympäristössä.

Telco Cloud Business Service Opportunities and the Impact on Vendors' Offerings.

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The purpose of the study was to identify what kind of new business services cloud computing enables for telecommunication operators, what the main characteristics of services are and how telecommunication vendors could enable service creation and help operators to reach their goals.

Theoretical part of the study concentrated on describing what is meant by cloud computing and the current landscape of cloud computing in the perspective of pure cloud providers and cloud telecommunication operators. The purpose was to provide information on cloud computing to be used as a framework for empirical studies.

The empirical part of the study was conducted in two phases based on qualitative methods. Secondary data were derived applying documentary analysis where information was conducted from analysts and experts. Primary data was conducted by interviewing one Finnish telecommunication operator and two cloud experts from Nokia Networks, and via e-mail communication with one European operator. Addition to interviews author participated to Telco Cloud Forum in London, where several operators shared their views on cloud computing opportunities. Among of these operators four global operators were selected by author and included to the research based on the content of their presentations close to interview themes.

The result indicated many opportunities for operators varying from traditional service offering through cloud to new business services enabled by partnering. The result formed guidelines for operators who are uncertain of their cloud strategic direction by given examples of possible services and roles. The result showed vendors role as enabler of cloud infrastructure for operators, and more importantly gave understanding of operators' possible roles in the cloud ecosystem guiding the way for better customer understanding.

CONTENTS

ABBREVIATIONS

API	Application Programming Interfaces
BYOD	Bring Your Own Device
CAGR	Compound Annual Growth Rate
COTS	Commercial Off-The-Shelf
CRM	Customer Relationship Management
ERP	Enterprise Resource Planning
IaaS	Infrastructure as a Service
IAM	Identity Access Management
ICT	Information and Communication Technology
IoT	Internet of Things
IPTV	Internet Protocol Television
IT	Information Technology
KPI	Key Performance Indicator
M2M	Machine to Machine
MMS	Multimedia Messaging Service
NFV	Network Functions Virtualization
OSS	Operations Support Systems
OTT	Over-The-Top
PaaS	Platform as a Service
QoS	Quality of Service
SaaS	Software as a Service
SDN	Software Defined Networking
SLA	Service Level Agreement
SMS	Short Message Service
SON	Self-Organizing Networks
TCO	Total Cost of Ownership
Telco(s)	Telecommunication Operator
VM	Virtual Machine
VNF	Virtualized Network Functions
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network
WAN	Wide Area Network

1 INTRODUCTION

Technology in the IT (Information Technology) area is constantly evolving introducing new opportunities to enterprises supporting their business requirements and goals. IT was long seen as a must have element to be able to execute business processes creating boundaries what can and cannot be done. During the last 10 years enterprises has realized the importance of IT infrastructure absorption to organisation strategies and business processes to support the goals and not to dictate them.

Large enterprises have heavily invested their own IT infrastructure including hardware (servers, storage, routers, networks etc.) and business software of many kinds (Office Suites, resource and customer management tools etc.). The installation, maintenance and constant replacement cycles require human, operating and capital resources, which are seen a burden rather than a pure opportunity for business development.

Similarly telecommunication operators (hereinafter "Telcos") have a long history investing to their own dedicated telecommunication (hereinafter "Telecom") network equipment (switches, gateways, access modules etc.) and software to run and manage the network. The constant updates of software and hardware are mandatory actions to evolve the network performance and capabilities, and to be able to response business needs of enterprises and consumers and stay in the competition.

Instead of having own or outsourced IT infrastructure enterprises have an opportunity to lower their capital and operating expenditures by renting computing resources based on the current need through cloud computing.

1.1 Cloud Computing

The cloud computing is a model which enables on-demand network access to computing resources (like storage, servers, networks, applications and services) with flexible and scalable provisioning and releasing mechanism. Consumers and enterprises may purchase an access and use service provider software applications and

services located in the cloud over the internet with any internet capable devices (Software as a Service, SaaS), create, deploy and manage new software applications and services by renting a computing platform and environment located in the cloud (Platform as a Service, PaaS), or computing resources and IT infrastructure can be outsourced to fit organisational needs hosted and maintained by the cloud service provider (Infrastructure as a Service, IaaS). (Mell & Grance 2011, 2-3).

There are number of cloud computing providers such as Amazon Web Services (AWS), Google, Saleforce.com and Microsoft. Consumers today are used to have an instant access to applications like Facebook, Google Mail and Instagram. These applications are running in distance servers, consumers data stored into huge databases and accessible from any location at any time with any device. Consumer does not need to worry about the performance and capacity limits on their devices as cloud computing environment take care of application technical requirements. (Mell & Grance 2011, 2-3)

Similarly enterprises have started to use software located in the cloud. There are many business applications available for billing, customer relationship management and project management just a few applications to mention. There is no need to buy life-long software licenses, install application software to enterprise servers and worry about software updates, but instead all they need is to buy an access to software when they need it and leave cloud service provider to take care of any software related support actions.

Cloud computing models give enterprises opportunity to get rid of expensive computing resources and rent resources only when needed and with a level of the need. Cloud service providers provides all required computing resources and infrastructure via Data Centers without enterprises need to install and maintain computing resources. Start-up enterprises may rent servers and storages suitable their current business needs and customer base and increase the power of servers, capacity of storages and add new computing resources as their business grows through web base interface without going out and buying new resources by themselves.

The cloud is no longer only an emerging technology, but seen as essential part to improve organisational productivity, business agility and customer engagement. Based on the Harvard Business Review Analytic Services report (Business agility in the cloud 2014, 1-3), 70% of organisations have adopted cloud, 74% emphasize cloud competitive advantages, 61% have seen productivity increased and 71% expects complexity reductions in business.

There are strong signs for rapid and strong growth of enterprise spending for cloud computing. Even though there are some differences in estimated figures on cloud computing the trend is clear. Cloud market is estimated to reach 24% compound annual growth rate (CAGR) during 2013-2018 globally according to Cisco Global Cloud Index (Cisco Global Cloud Index… 2014,1) following similar estimates of 23% CAGR by IDC research (Press release: Public Cloud Services Spending… 2013). Enterprises are moving towards cloud computing and IDC (Theis 2015) research relieve that there will be around 11% shift from traditional IT spending to cloud spending by 2016. Computer World Forecast study reveals that 43% of enterprises are planning to increase spending on cloud computing in 2015 (Computer Forecast Study 2015 2014). Ovum estimates (The Role of Cloud in IT Modernisation... 2014) that 75% of enterprises in Europe and 80% globally will be using IaaS service model (public or private) by 2016. SaaS based business application services revenues are forecasted to grow from $13.5B in 2011 to $32.8B in 2016, attaining a 19.5% CAGR according Gartner Forecast (Introduction to Centaur Partners SaaS Market Overview 2015, 11).

1.2 Telco and the Cloud

Telcos have traditionally offered telecom services such like mobile and fixed voice, messaging (SMS, MMS), broadband and internet access. These services are not alone sufficient enough to provide sustainable profit and growth opportunities for Telcos (Telco 1.0: Death Slides Starts in Europe 2014). Evolved technology with higher data transfer rates and smart devices have enabled new services like online music and gaming, IPTV, mobile TV, mobile payments to enhance traditional service offering. This evolution from traditional to nontraditional services has been

mandatory to stay in the competition and response the market needs. (Foong & Delcroix 2011).

Emerging cloud computing concept have created many new players which have entered into the market traditionally owned by Telcos providing telecom services; circuit-switched based messaging have seen transformation to instant messaging (like WhatsApp Messenger) and voice carried over the internet protocol (VoIP; like Skype). These have forced Telcos to redefine their business models to fit cloud computing concept and to stay in the competition. (The rise of over-the-top… 2011).

Figure 1 presents the very basic cloud computing service models with known cloud providers and an example of Telco Cloud model.

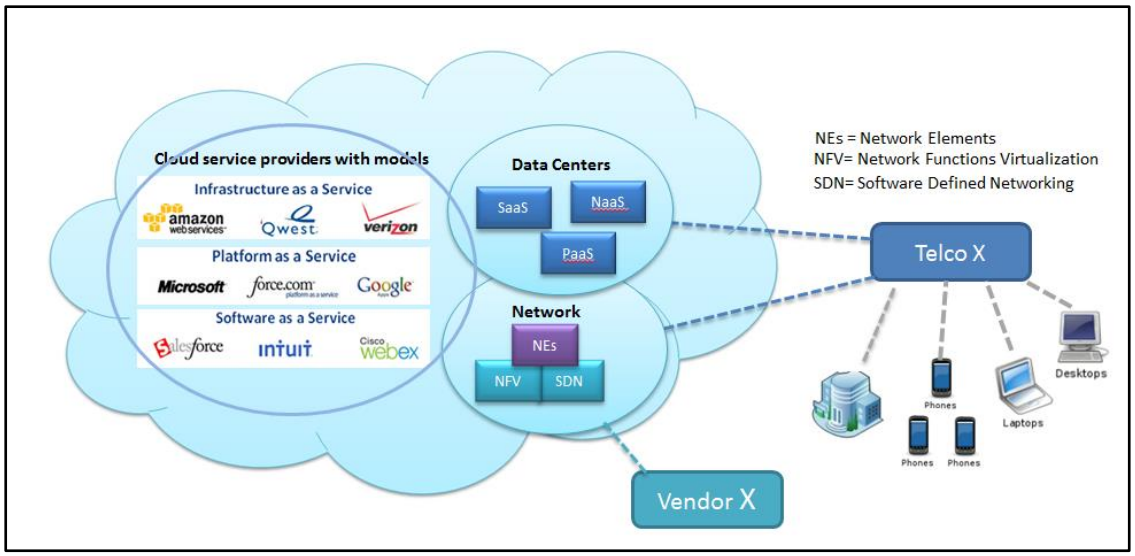


Figure 1. Cloud service models with example of providers and Telco Cloud

Telcos' role in cloud computing (Telco Cloud) is a strategic choice which each organisation is pondering. Telco may provide a network connectivity carrying data between end-users and cloud service providers as a carrier role. Telco may extend the role acting as a broker where Telco bundles multiple cloud service providers' offerings to one complete service with single point of contact for billing and support. Such an offering may include own traditional voice and connectivity services combined with third party software like Microsoft Office 365. The Telco's role as a cloud service provider offers an opportunity to provide cloud service models via own Data Centers without a direct involvement of third party cloud service providers. (Nesse, Svaet, Strasunskas & Gaivoronski 2013, 503-508). Telco has also an opportunity to

adapt cloud service models their own internal operations, as any enterprise, to improve the efficiency and agility (The Telecom Cloud Opportunity 2012, 10). Figure 2 describes the Telcos' possible roles in the cloud model.

Figure 2. Different roles of Telcos in a cloud (Adapted from (Nesse, Svaet, Strasunskas & Gaivoronski 2013, 503-508; The Telecom Cloud Opportunity 2012, 10)

Craig Wilson (2010), Vice President of IBM Telecoms Industry, stated 2010 that networks are critical part of the cloud ecosystem delivering business value and Telcos have potential opportunities to act as a valuable actor in the cloud value chain through their strengths gained in fairly long period of time serving network and communication services to consumers and enterprises. The large and wide enterprise customer base, customer insight and the experience of large scale service deliveries combined with a strong brand and trusted partner recognition are characters which many new players in the cloud landscape are lacking. Telcos core business as network provider with comprehensive network capabilities, service assurance, customer care systems and automated service fulfillment are assets to build upon. Also existing marketing experience, sales channels and billing relationships are worth to leverage.

Still after four years from Mr. Wilson presentation these benefits are not fully capitalized among majority of Telcos.

The author has a Master's degree on Computer Science and a long telecommunications history with Nokia Networks and Nokia Siemens Networks. Author's 17 years international (seven years in England and 10 in Finland) management experience in telecommunication sector, especially in the area of network management solutions, mobile core networks and initial steps in Telco Cloud management solution definitions, have been major inspiration sources for this study.

The broad experience of networks end-to-end operability solutions, telecom and IT business processes, Telcos' business requirements and the cooperation with major global Telcos in the past have all helped to build overall understanding of business landscape and are supporting to achieve research goals.

2 THE PURPOSE AND OBJECTIVES

Telcos have had a slow start to adapt and leverage the benefits of cloud computing. It is mandatory for Telcos to increase their share and take full advantage of cloud computing to be able to increase the revenue and drive down operating expenditures and capital expenditures of legacy hardware and related maintenance. By creating an environment allowing rapid creation, deployment and launching of new services and offering cloud based business services to enterprises is the direction which some Telcos have already started to move.

The purpose of the study is to identify new business service opportunities for Telcos enabled by cloud computing. The study also supports telecommunication equipment and infrastructure vendors (hereinafter "vendor(s)"), especially Nokia Networks, to identify their role enabling the creation of Telcos' cloud business services. The purpose of this thesis is not to create new strategies, but instead identify development guidelines to support strategic decisions.

The study is beneficial for both global Telcos providing, and deploying, (or planning to provide) cloud services and vendors providing Telco Cloud capabilities and services for Telcos. Telcos will gain better understanding on cloud business service opportunities, and vendors will gain the information to address their offering accordingly.

This thesis has three main objectives:

- What kind of new business services cloud computing offers to telecommunications operator end customers?
- What are the main characteristics of these business services?
- How do new business services impact on vendor's offerings?

3 THE FRAMEWORK: CLOUD COMPUTING

This chapter describes the framework: cloud computing model in general and the telecom perspective of cloud computing (Telco Cloud). The chapter describes also the most common services offered by cloud providers and Telcos today, the benefits and concerns of the cloud, why cloud is seen important and network evolution with virtualization.

3.1 Benefits of the Cloud Computing

Large corporations have traditionally been able to utilize computing resources to support the business goals by building and maintaining comprehensive in-house IT infrastructure. Smaller enterprises have struggled to invest and maintain computing resources in a same level, especially in situations where high computing power and storage space are needed in a temporarily basis. Cloud computing brings benefits for enterprises by providing the opportunity to "rent" computing resources based on the current need and not invest on expensive on premise hardware and software. The capital investment of IT can be sifted to IT operating expensive in the cloud model where no up-front investment of capital is required. Similarly, enterprises in the third-world countries, where the investment and building comprehensive IT infrastructure is more challenging, are benefiting the flexible cloud computing models. (Marston, Li, Bandyopadhyay, Zhang & Ghalsasi 2010, 177-178).

Cloud computing enhances enterprise capabilities to take into use computing resources via cloud without a delay; setup, maintain, configure and scale computing power and storage without a need to build in-house infrastructure, but letting cloud service providers to provide and manage the infrastructure. This leads capabilities to response consumer demands much faster than in traditional approach. Because computing resources are available to enterprises, consumers and developers much faster than deploying on-premise hardware and software it will result dramatic increase in agility, lower the cost of deployment and maintenance and the time to start experiment the cloud environment and introduce services to markets is decreased. (Marston, Li, Bandyopadhyay, Zhang & Ghalsasi 2010, 177).

Flexibility and scalability promotes innovations to be realized as IT is not seen as a barrier to create, deploy, manage and deliver business targets. Good examples of such innovations are services like Facebook, LinkedIn and Instagram. Cloud enables application deliveries to anywhere to any device with location and environment awareness and provides real-time responses. Services which process a huge number of data -like business analytics aimed to understand customer buying habits collected by various purchasing schemes, or locations maps rendered with details- are supported and enabled by cloud computing i.e. the actual processing of data is not done in the end device, but in the Data Centers in the cloud infrastructure, and made available to enterprises and consumers anywhere (Marston, Li, Bandyopadhyay, Zhang & Ghalsasi 2010, 178).

3.2 Cloud Computing

The National Institute of Standards and Technology, NIST, (Mell & Grance 2011, 2) defines cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

Expanding the NIST cloud definition to include device and location independency, scalability, virtualization, Quality of Service (QoS), and the reduction of capital expenditure (Marston, Li, Bandyopadhyay, Zhang & Ghalsasi 2010, 177) gives more comprehensive approach for cloud computing: "an information technology service model where computing services (both hardware and software) are delivered on-demand to customers over a network in a self-service fashion, independent of device and location. The resources required to provide the requisite quality-of service levels are shared, dynamically scalable, rapidly provisioned, virtualized and released with minimal service provider interaction. Users pay for the service as an operating expense without incurring any significant initial capital expenditure, with the cloud services employing a metering system that divides the computing resource in appropriate blocks."

Both definition highlights the “on-demand” aspect referring consumers capabilities to access computing resources when they need them, decide how long they need them, and will only pay for actual usage.

There are various needs to exploit the cloud computing models as described by European commission report (Schubert & Jeffery 2012, 18-22). Not all cloud users have a same aspect on how the cloud is explored. An end-user (a consumer or enterprise) who’s primary target is to use cloud services is interested on the reduced cost of using the service, its availability and easy to use experience. Such an end-user is not interested in technical aspects of the cloud. On the other hand, the cloud service provider providing computing resources (hardware and software) is interested on the scalability of resources in the cost effective manner and yet to meet the Quality of Service (QoS) levels through high security, availability, reliability etc. Developers exploiting the cloud capabilities to serve their requirements respect the adaptability and elasticity of resources to be able to serve multiple devices, locations and users.

3.2.1 Characteristics of Cloud Computing

The cloud computing model has five essential characteristics (Mell & Grance 2011, 2) to serve consumers conveniently. The provisioning of computing resources and services are provided automatically without human interactions with each service provider (on-demand self-service). The provisioning and releasing of resources and services is elastic and scalable in any time at any quantity (rapid elasticity). Network should also be accessible via range of devices like laptops, PCs and mobile phones (network access) via standardized APIs (Application Programming Interface). The infrastructure is shared enabling shared physical and logical resources among number of consumers (pooled resources). The locations of resources are not usually known by consumers. The performance of resources, service levels and QoS are monitored, controlled and reported (measured services). The information gained by monitoring can be used for example to optimize the computing capabilities or consumer billing based on resource/service usage.

Another important characteristic is multi-tenancy referring the usage of same resources by multiple users. Consumers and enterprises may use the same public or private cloud service offerings, but with individually applied Service Level Agreements (SLA), security settings or billing policies. From cloud service provider point of view it means "an architectural and design approach to enable economies of scale, availability, management, segmentation, isolation, and operational efficiency". (Security Guidance for Critical… 2011, 14-15).

3.2.2 Cloud Computing Service Models

Cloud computing has 3 general service models (Mell & Grance 2011, 2-3): Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

International Telecommunication Union (ITU) defines cloud service as "A service that is delivered and consumed on-demand at any time, through any access network, using any connected devices using cloud computing technologies." (Part 1: Introduction to… 2012, 1).

SaaS model provides capabilities to access and use service provider applications hosted in the cloud. The consumer does not have a control of underlying infrastructure, but are only able to use application and programs purchased. It is a distribution model where applications are running on SaaS service providers servers and available to consumers over the network, and generally charged on a per-usage basis**.**

Consumers are able to create, deploy and manage their own application and software in a cloud by purchasing cloud based platform with PaaS model without having a control on the operating system, storage or network access, i.e. consumers do not need to manage the underlying hardware and software leading to reduced programming needs and faster time to market capabilities.

IaaS provides infrastructure with capabilities to manage and control computing resources such as storage, processing, operating systems and networks for enterprises

to deploy software and applications to fit in their own needs, but do not have a control of underlying cloud infrastructure. IaaS is basic compute and storage services without software development tools, modules or applications.

On top of these basic cloud service models there are number of modified models derived from basic models. Most of them are not explicitly defined and may have multiple purposes depending on the content and the author defining. In a short anything can be offered as a service via cloud, referred as a XaaS (*Website of Techopedia 2015)*. Below is a short a non-comprehensive list of commonly used terms of offered cloud services as an example (Figure 3).

ACRONYM	SERVICE	DESCRIPTION
CAaaS or BDaaS	Continues Analytics as a Service	Service for analyzing large amount of data
CaaS or UCaaS	(Unified) Communication as a Service	IP telephony, video conferencing, presence, unified messaging and collaboration delivered on any device with service level agreements. Also referred as Computing as a Service.
DaaS	Desktop as a Service	Solution where virtual desktop infrastructure (VDI) is hosted by cloud provider. Also used as Data as a Service for Big Data
DRaaS	Disaster Recovery as a Service	offers replication and hosting of servers in case of primary resource failure caused by human or natural incident
IAMaaS	Identity Access Management as a Service	Security service covering the management of identity, entitlement, authorization and access management in the cloud service. Also IDaaS
ITaaS	IT as a Service	Combination of all service models IaaS PaaS and SaaS Provides an enterprise with the needed hardware, software, and support for an agreed-on monthly fee
MaaS	Monitoring as a Service	Service to monitor infrastructure and applications offered in a cloud
NaaS	Network as a Service	Telcos' provided network capabilities with IT capabilities including location, messaging, call control etc. and integrates cloud services with network services
SDPaaS	Service Delivery Platform as a Service	SDP functionalities and services provided by a cloud service provider, and the capability provided to a cloud service provider to deploy, control and manage SDP functionalities.
SecaaS	Security as a Service	Secures enterprise data and systems in the cloud
StaaS	Storage as a Service	Offers online digital storage on vendors' own infrastructure for individuals or enterprises

Figure 3. Examples of cloud services derived from basic cloud service models. (Adapted from Website of OpenCrowd 2010, Website of Techtarget 2015, Website of Techopedia 2015, Website of HP 2015, Website of ZDNet 2015, Website of ITU 2015 and Website of Wikipedia 2015)

3.2.3 Cloud Computing Deployment Models

There are 4 deployment models for cloud computing (Mell & Grance 2011, 3). Private cloud is considered as "internal cloud" provisioned for a use of a specific organisation with multiple end users. The cloud may locate on-premises or off-premises and is managed and operated by the organisation itself or a third-party. Through to restricted network access and optimized control of data, processes and services private cloud provides improved security and flexibility to enterprises (Mervat & Sarfraz 2011, 77). Community cloud follows the principle of private cloud and is provisioned for the use of community of consumers shared between organisations.

Public (also referred as "external") cloud is available for general public and is offered and operated by service provider. The cloud is located on-premises of service provider. Public cloud offers cost-effective and elastic approach to deploy computing resources and services.

The cloud infrastructure in hybrid cloud model may consist of any type of cloud , but the data and applications are transferrable between clouds. This enables retaining some specific data inside the organisation (private) and release general data or services for the public. The need for a hybrid cloud is justified by having critical application and data in private cloud and having less sensitive applications in the public cloud (Mervat & Sarfraz 2011, 78).

Figure 4 combines above deployment and service models and characteristics as described by Nokia Networks (Cloud computing security for… 2012, 3).

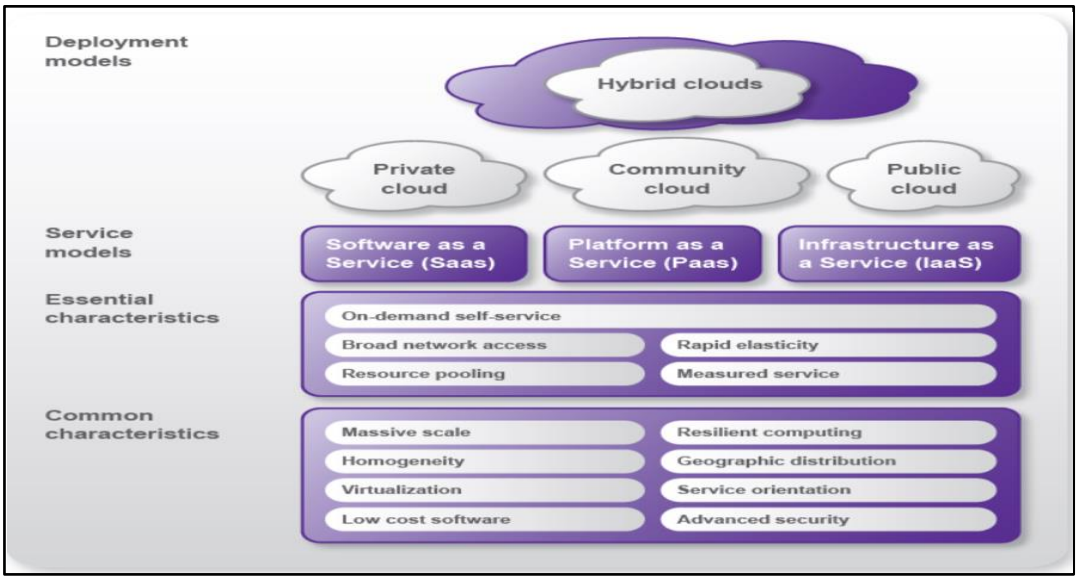


Figure 4. The cloud definition framework as described by Nokia Networks (Cloud computing security…2012, 3)

3.2.4 Key Cloud Providers and Services

Marston, Li, Bandyopadhyay, Zhang & Ghalsasi (2010, 177-180) categorized key cloud providers based on their role adapting cloud computing service and deployment models in 2010. Service providers are categorized as of established players (IBM Cloud, Google Cloud Platform, Microsoft Cloud etc.), key technology providers (Apache with Hadoop, EMC Federation, Cisco, etc.), innovators (Amazon AWS, SalesForce.com) and enablers (CapGemini, RightScale). Their list of companies is still valid although many services have been modified and extended, and there are much more players providing cloud services today. Figure 5a and 5b provides OpenGrowd defined taxonomy (*About Cloud Taxonomy 2010*) of service models with functional coupling and providers demonstrating the diversity of offerings. The list is by no means comprehensive, there are far more cloud services and providers globally. The purpose is only to give an overview about the type of services offered and providers. The list could be expanded with major PaaS players like IBM Smart Cloud and CloudBees with Java-based PaaS, SaaS vendors like Oracle on-demand for CRM (Customer Relationship Management) and SAP Business ByDesign for ERP (Enterprise Resource management) and CRM.

Most cloud providers do not only offer one type of service, but combined set of cloud services as demonstrated in Figure 6 in a case of Google Cloud Platform with hosting and computing engines, storages, Big Data and services with Application Programming Interfaces (API).

SOFTWARE SERVICES				
Billing Consumer billing management based on the usage and subscriptions	**CRM** Application that range from call center applications to sales force automation	**Project Management** Application to manage projects	**Sales** Applications for sales purposes like pricing	**Desktop Productivity** Analysis of large and complex data sets that requires high scalability
Aria System OpSource Redi2 Zoura	NetSuite Rightnow Saleforce.com Responsys	Asonex Smartsheet Huddle Assembla	Xatly StreetSmarts Saleforce.com	Soho Google Apps ClusterSeven Parallels
Financials Application for financial processes like invoicing and taxation	**Human Resources** Application for HR management tasks	**Content Management** Services to manage deployment and access to applications in a cloud	**Document Mgmt** Management for documents like creation, finding and access	**Security** Services for cloud security like virus scanning and single sign-on
Concur Zero Intuit Beam4d	Taleo Work Day iCIMS Successfactors	CrownPoint NetDocuments Clickability Spring CM	NetDocuments Questys Xythos DocLanding	OpenID AlertLogic Ping Identity Symplified

Figure 5a. Taxonomy of service models with type of services and providers (About Cloud Taxonomy 2010)

PLATFORM SERVICES			
General Purpose	**Business Intelligence** Platform for Business Intelligence (BI) applications creation	**Integration** Service for cloud-to-cloud and custom applications integrations	**Big Data as a Service** Analysis of large and complex data sets that requires high scalability
Force.com Google App. Engine OpenShift Caspio Rollbase Agiel Apps Live Jelastic	Micro Strategy Cloud9 Analytics Panorama PivotLink K2 Analytics Indicee Good Data	Amazon SQS OpenSource Connect Microsoft Biz Talk Services MuleSource Mule OnDemand Boomi gnip Appian Anywhere	BigML Datameer Actian Cloud Edition Altscale Mortar Data RMS (one) Qubole

INFRASTRUCTURE SERVICES		
Storage Scalable storage capacity for applications, backups, archiving, file storage etc.	**Compute** Server resources with dynamic provisioning and configuration capabilities	**Service Management** Management of cloud infrastructure platforms on top of cloud provider features.
Amazon S3 Amazon SimpleDB Microsoft SSDS Rackspace Mosso CloudFS Google BigTable HP Cloud Object Store Zetta	Amazon EC2 IBM SmartCloud Savvis Cloud Compute Rackspace Mosso Cloud GoGrid Serve Path HP Helion Flexiscale	Rightscale Bitnami Scalr CloudStatus Ylastic New Relic Kaavo

CLOUD SOFTWARE		
Data Database systems to meet scalability requirements of large web based systems	**Map Reduce** An algorithm for scalable processing of big data sets by utilizing a large number of servers	**Cloud Management** Simplify automation and cloud management on top of infrastructure services.
Apache Accumulo Redis CouchDB AsterData	Hadoop Cloudera GridGain MapR	3Terra App Logic VMWare Ops OpenStack CloudStack

Figure 5b. Taxonomy of service models with type of services and providers (About Cloud Taxonomy 2010)

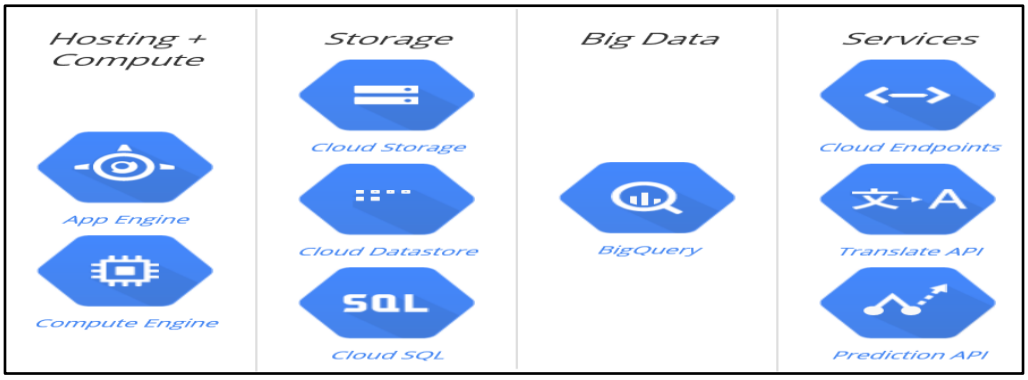


Figure 6. Google Cloud Platform with services (Website of Google Cloud 2015)

According to Talkin' Cloud survey (Top 100 cloud service providers 2014, 7) 81% of cloud service providers are offering SaaS, 71% offering IaaS and 54% offering PaaS in 1H 2014. Top three offered SaaS services were Backup and Disaster recovery, Email (and email security) and Storage (Figure 7).

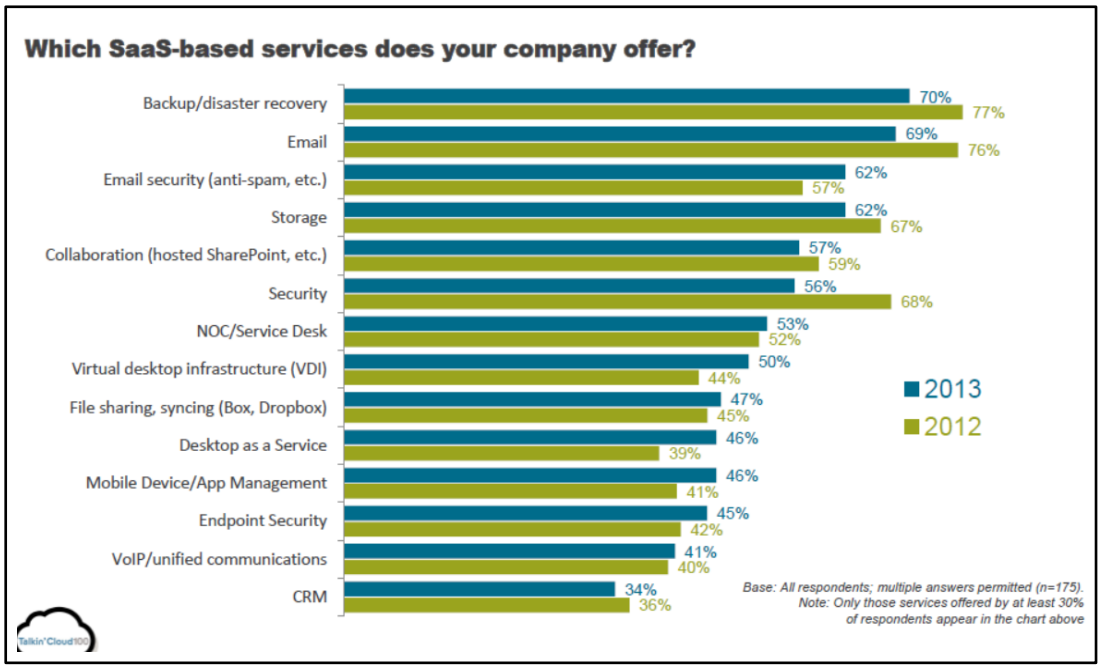


Figure 7. The most common SaaS based offerings in 2012 and 2013 (Top 100 cloud service providers 2014, 6)

Hosting cloud services (IaaS, PaaS, and SaaS) requires massive computing resources and suitable environment to run and maintain these resources 24/7. Cooling, space, power, fire suppression and broadband access must be well planned and implemented. Such physical facilities are provided by colocation centers (Figure 8) where the site and infrastructure is provided, but enterprise is required to purchase own computing hardware equipment and software applications (Website of Techopedia 2015).

Data Center (Figure 8) concept goes one step further and extends the facilities to include computing resources like servers, routers, switches and firewalls (Website of Techopedia 2015). Data center may be owned by service provider or enterprise may have their own data centers. The benefit of colocation and Data Centers concept is that enterprises do not need to have a space and environment for computing resources and they do not have a burden for maintain resources by themselves, but service is outsourced or rented from the provider. Talkin' Cloud survey (Top 100 cloud service providers 2014, 8) states that 68% of cloud services are hosted by colocation centers, 58% by public clouds, 34% by provider data center and 27% within customer data centers. As an example, Netflix, the popular movie stream and video-on-demand site, is hosted by Amazon AWS Data Center relying on Amazon's cloud infrastructure capabilities for rapid scaling and deployment of servers and storages.

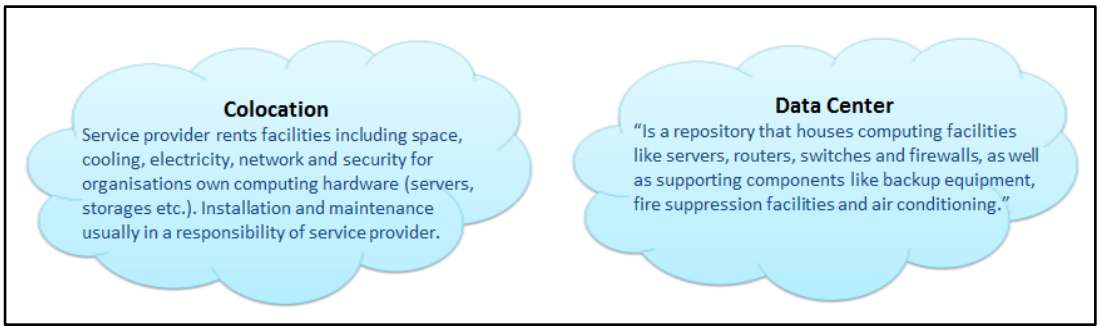


Figure 8. Definition of Colocation and Data Center (adapted from Website of Techopedia 2015)

There are numbers of low cost, massive economics of scale global cloud based deployments available called Over-The-Top (OTT) service providers. OTT concept (Figure 9) offers free basic access to services for consumers; the revenue model is based on the usage of extended and paid features and/or advertisement. OTT players are offering voice, audio and other media to consumers through Telcos owned networks. Well known services are Skype, Facebook, WhatsApp and Netflix. As an example, Skype offers free VoIP (Voice over IP) calls to consumers through Telco owned network. Only what is needed by consumer is to have an internet capable device and data contract with Telco. Telco's role is to offer only the data access, carry the data over the network from consumer to Skype. (The rise of over-the-top… 2011, 2).

Figure 9. Definition of Over-The-Top (OTT) application (adapted from Website of Techopedia 2015)

3.2.5 Concerns around Security and Latency

Although there are clear benefits offered by cloud computing, there are also some concerns around. Storing information to the hard disks in unknown locations, running business sensitive application in remote servers and transferring critical data through networks(s) raises the importance of security actions in a cloud computing. Data of any kind must be securely accessible, identity and access management (IAM) securely ensured and data encrypted (Vitti, Santos, Westphall, Westphall & Vieira 2014, 37). In the cloud environment where one single physical hardware resource is shared between virtualized units (virtual machines), vulnerable service in one virtual machine may cause failures in other services in that physical machine if not properly secured (Vitti, Santos, Westphall, Westphall & Vieira 2014, 37). Furthermore the security is challenged through data breaches by cybercriminals, distributed denial-of-service (DDoS) attacks to take down the cloud services and data losses caused by service provider hardware failures or network transfer failures or even bankrupt of provider (Kobialka 2015). To ensure the success of widely adapted cloud services, it is mandatory to ensure the security of services and it is expected that a cloud infrastructure provides strict control to access to different resources.

Another drawback in cloud computing is latency (Minnear 2011). Even the enterprises have a flexibility to store their workloads to data center hard drives the latency accessing the data depends on the bandwidth allocated between enterprise and the cloud. Business critical data requires fast access. Enterprises must consider are their data suitable for public clouds or private; mostly leading to the outcome that non crit-

ical data is stored to public clouds and critical workloads in own private clouds. Viable option is also to use hybrid cloud option where data is stored to both local disk for a quick access and cloud for the backups.

3.3 Telco Cloud

Telcos have faced and are facing challenges to maintain revenues with traditional service offerings and European based Telcos have reported decline on revenues in first quarter of 2014 as big as 12%. This is a continuum to first half 2013 declined figures of revenues by 5% in Western Europe (Hare 2014). The trend is expected to continue in developing countries and STL Partners estimates (Figure 10) traditional voice, messaging and broadband access revenues to drop dramatically in coming years (Telco 1.0: Death Slides Starts in Europe 2014, 5).

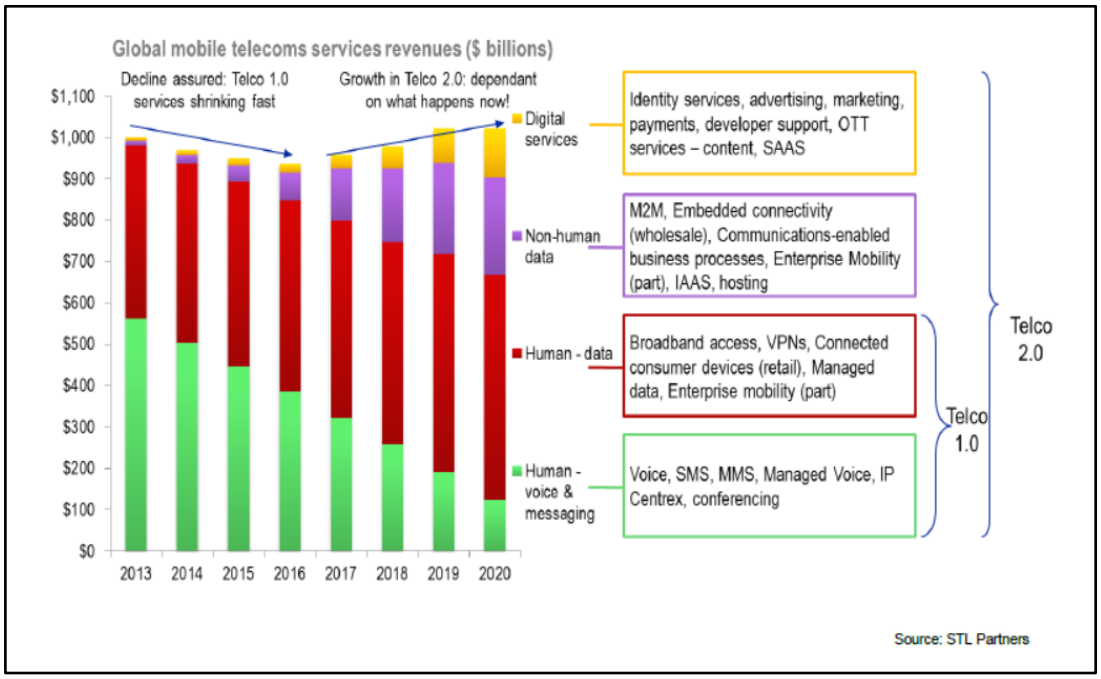


Figure 10. Estimates of global Telcos' service revenues (Telco 1.0: Death Slides Starts in Europe 2014, 5)

Telcos are losing revenues to OTT players. The business model of OTT players does not generate extra revenues for Telcos (apart from having the data plan contract with consumer) as OTT players are offering their own services and using Telcos' network only for carrying the data. Analytics Ovum predicts $386 billion revenue losses for

Telecom industry during years 2012 and 2018, and OTT VoIP increases at the level of 20% CAGR until 2018 (Olson 2015).

Telecom networks carry a large number of data through traditional data services and the amount of data is estimated to grow tenfold during next five to six years partly caused by new cloud computing services generated data (Cisco Visual Networking Index 2015). There are applications which are very data and performance sensitives like video based services, and applications which are transmitting small amount of data, but for millions and millions of user devices. The increase of data traffic highlights the importance of high performance and availability of underlying networks. Traditional Telcos have a long history of carrying voice and data through networks, and have established global network of consumers and enterprises, which offers an option to leverage capabilities also in the cloud service model.

3.3.1 Telcos' Role in the Cloud

The role of Telcos' in the cloud ecosystem is yet to be stabilized. Most global Telcos have started to define their own role, but it is expected to evolve further in coming years.

Telcos' role in the cloud can be simplified to include a) carrying only the data between cloud service providers and end users, b) deploy and provide own and partner cloud services, or c) both as described in the research carried out by Nesse, Svaet, Strasunskas & Gaivoronski (2013, 503-508) specifying the roles as cloud "carrier" and "broker".

As a carrier Telcos' role are to provide connectivity and delivery of cloud services between the end-user and cloud provider. The primary task is to connect cloud services between Data Centers and end users, and offers cloud specific connectivity services. The carrier role is supported by Telco's core business, the service they have a best know-how and experience, and which can be seen as a natural choice for most Telcos offering single point of contact for consumers and cloud providers.

The role as a broker is more challenging as it requires comprehensive management of cloud services. Acting as an intermediate between cloud providers and end-users integrating and enhancing existing cloud services provided by multiple providers into new services or value added services like analytics and reporting, predictive capacity planning and managed services requires effective and quality management of performance, delivery and usage of services. Telcos are using current assets of network and related capabilities to act as a retailer for enterprises and consumers, wholesaler for developers and cloud service providers, and transforms own business models to be part of the cloud supply chain. The role also builds a relationship between consumer and provider with single interface reducing the administrative tasks from both parties.

3.3.2 Telcos' Benefits Adopting Cloud

Providing cloud services to enterprises and consumer enable Telcos to roll-out services faster decreasing time to market. The lead time of launching new services traditionally takes several months by Telcos compared to pure cloud players like Amazon where cloud service lead time can be counted in days or even less (Reinvent Telcos for the cloud 2014, 5**).** Traditional way of creating, launching and delivering services without the cloud is not sufficient method in today's cloud enabled world to response the needs of consumers and enterprises, and to increase revenues and reduce costs. Through cloud service models (SaaS, PaaS, IaaS) consumers and enterprises are not purchasing licenses to have rights to create, deploy and manage computing resources, but instead they deploy and access web based resources through internet and are charged on pay-as-you-go or subscription basis enabling Telcos to shift from one to one selling mode to one to many impacting on the relationship between Telcos, consumers and developers (Gonçalves & Ballon 2010, 14).

Adopting cloud base service models for internal operations purposes Telcos can concentrate on operating profitable services and businesses instead of deploying and running large scale hardware and software installation and their maintenance. Transferring internal business services to cloud they will realize same flexibility, agility, lower capital and operating expenditures and fast time to market as any large enter-

prises would. The cloud provides the possibility to commercialize internal business services and become as a user and provider for the service simultaneously. (The Telecom Cloud Opportunity 2012, 10).

The third aspect of benefits is related to telecom network itself. Traditional method composes of single physical computing instance providing single network functionality. Cloud computing transforms how the network elements are deployed, maintained and managed through virtualization and software defined networking enabling the use of general purpose hardware instead of proprietary (dedicated) hardware. Hardware resources can be deployed to operate network functions as seen feasible offering scalable, agile and flexible environment. Through the cloud model Telcos have capability to provide a great network experience and implement new services quickly. This directly, or indirectly, leads to customer satisfaction easing to acquire new customers and reduce the churn. (Reinvent Telcos for the cloud 2014, 3)

3.3.3 Provided Services

It has been a slow start for Telcos in the cloud market comparing OTT players and pure cloud service providers. Especially the public cloud arena is already crowed by other players and Telcos are concentrating more to hybrid cloud service sector (Mendler 2014). Telcos' cloud based service offering are still in a fairly early stage and narrow; main offering consist of colocation and hosting services, and reselling other cloud providers services or solutions instead of integrating cloud capability and skills with legacy network, and take the full advantage of cloud market.

There were 330 communication service providers, Telcos, globally offering cloud services in 2013. The revenue cloud services bring to Telcos are fairly low compared to Telcos' total business revenue; estimates in 2013 shows NTT Communication Group with 9% cloud revenue, T-Systems 7.5% and Orange Business Services 2% of total revenue. But the direction is up fort like T-Systems 40% increase figures in 1H 2014 indicates. On the other hand, increased revenues in cloud services may reduce legacy service revenues leading close to 0% profit in overall. (Mendler 2014).

The major part of customer wins during the last four years has been based on IaaS for providing compute, storage, network resources and services via cloud, and Unified Communication (UCaaS) service models (Mendler 2014) as shown in Figure 11. Verizon is marketing its global IP network and switching network for controlling its IaaS offering with high availability and performance (Website of Verizon Cloud 2015). Tata Communications Ltd. promotes its worldwide IP network as a differentiator for its Infrastructure as a Service (IaaS) and SaaS for cloud-based unified communications (UCaaS), compute and storage (Website of Tata Communication 2015). The large Telcos with in-house IaaS offering (less acquisitions, more in-house VMWare strategy) consist of Telcos like Orange, AT&T, China Telecom and BT among others. In Australia Next Telecom offers virtual conference room services delivering high-definition videoconferencing to users through the cloud, allowing them to access the virtual meeting room using a Web browser (Website of Next Telecom 2015).

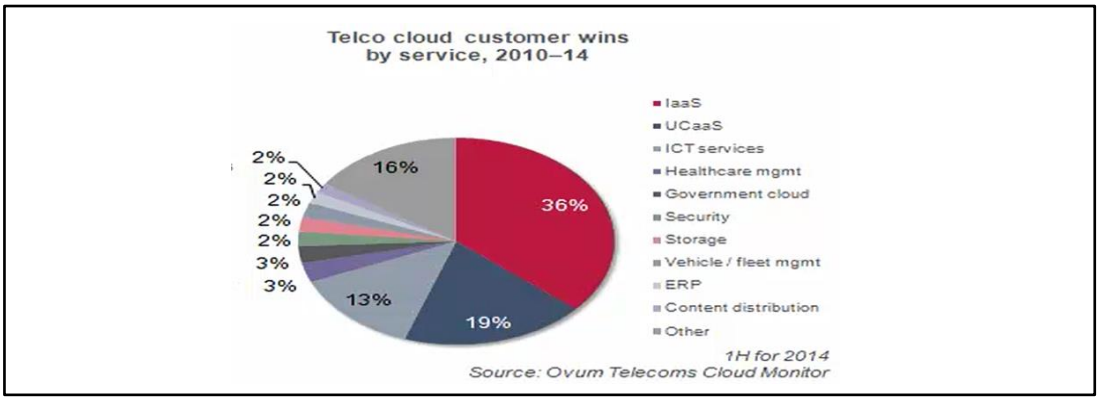


Figure 11. Telco Cloud customer wins in 1H 2014 (Mendler 2014)

One of the most common cloud service Telcos' are offering is based on Telcos' own or acquired Data Centers through which they can provide server, storage, operating system and network access for enterprises to host enterprise business applications and IT resources. The service is elastic and scalable where users will provision the capacity they need with pay per usage model. (Sholay 2010).

Enterprises may have tens and hundreds of software development and testing environments requiring multiple platforms. Some Telcos are offering centralized cloud development and testing environment to merge activities under one or few platform. Similarly Telcos offer platforms to support development, deployment and manage-

ment of application to speed up the process; rapid development, faster time to market with one centralized environment. Such services are provided by offering database, middleware, user interface and access management on top of next generation data center structure as a Private PaaS. This will decrease enterprise operating expenditures pressures having one centralized environment instead of many. (Sholay 2010).

Private PaaS offering is also expanded in some cases to include Business Support Systems (BSS) applications like CRM (Customer Relationship Management), ERP (Enterprise Resource Planning) and operator own build applications. The purpose is to provide one environment with shared application capabilities; big organisations or governments may have several CRM applications in use and consolidating these applications to one will have a cost benefits. (Sholay 2010).

3.3.4 Acquisition and Partnering

In order to enter, and stay, in the competition and fulfil Telcos' cloud strategies, many large Telcos have been actively acquiring Data Centers and cloud service providers with software and development expertise, Figure 12 (Mendler 2014). Such examples of acquisitions are AT&T acquisition of USinternetworking almost ten years ago to move towards traditional Data Center business, Vodafone acquisition of Cable & Wireless Worldwide, Verizon acquisition of Terremark, CenturyLink's acquisition of Savvis and China Mobile for China Tietong are some well noticed examples. NTT Group overall acquisitions have been impressive during the 2012-2013 spending around $3bn on data centers and security management systems (Mendler 2014). Although investments have been massive Google, Microsoft and AWS are investing and building even bigger data centers to outpace Telcos, and they are not realistically to be caught and competed as such.

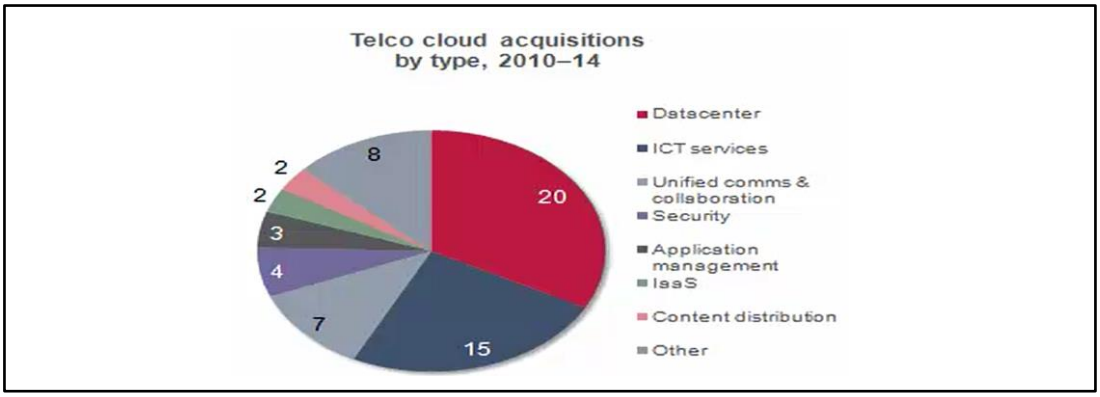


Figure 12. Telco cloud acquisitions by type, 2010-14 (Mendler 2014)

Some Telcos have also partnered with global brands to increase the cloud service portfolio. Some Telcos are reselling well-known global applications which attract wide audience, like Microsoft Office 360, and bundled these applications to include Telcos' own strengths, voice and connectivity, to increase the interest and visibility of offerings. The less known partners are used to differentiate the offering. Partnering works vice versa also; Enterprises do not always trust on pure cloud service providers security capabilities through networks and thus cloud service providers are partnering with major Telcos to ensure secure networking and services (Mendler 2014).

3.4 Network Functions Virtualization and Software Defined Networking

Traditionally, and still today, mobile broadband networks consist of hardware appliances, which are dedicated to serve one specific function only like routers, firewalls, Session Border Controllers, load balancers, etc. Dedicated hardware itself is not the only capital investment, but also appropriate space must be provided including availability of power, cooling and other elements to run computing appliances. Hardware must also be maintained and tend to become obsolete in fairly quickly due to rapid technology evolution causing rapid replacement cycle. This is where Network Functions Virtualization (NFV) enables reduction in capital expenditures due to the efficient use of hardware by offering a migration path for telecom applications from legacy hardware onto virtualized and cloud platforms. Cloud computing enables significant cost reduction through automation of solution deployments and economy of scale. Traditionally introducing new services with new technology will take months

to build up, but that time is reduced hugely with cloud technology. (Network Functions Virtualization… 2012).

Offering cloud services is getting more and more complex where various numbers of parties (telecom infrastructure vendors, service providers, network providers etc.) are involved. If any part of the chain fails is has an impact on end user service experience. Telcos' offering telecom services have strong requirements on end-to-end performance, latency, security, availability and reliability, and these are all important factors also when providing quality services under cloud. (Caruso, Curescu, Olrog, Sölvhammar & Vajda 2012, 30-31).

Similarly as Telcos are partnering and acquisition with Data Center and cloud services providers, vendors are partnering with SDN (Software Defined Networking) and NFV (Network Functions Virtualization) service providers to provide solutions for Telcos helping them in a creation and management of cloud infrastructure. Such a partnering example is formed between Nokia and Juniper Networks (Press Release: Nokia and Juniper 2014).

Traditional method of building a network and data centers required variety of expensive and proprietary network devices whereas with virtualization computing and storage resources are based on virtual devices. The cloud model approach with Virtual Machines (VM) is to reduce the burden on running and maintaining the hardware dedicated to certain functionality only. VMs run on industry standard servers, switches and storages providing capabilities to run network functions on virtualized computing environment, move virtualized application to locations they are needed, increase elastically the computing power or storage space without installing new dedicated equipment under the Network Functions Virtualization (Network Functions Virtualization.. 2012, 5). The ETSIs vision of NFV is shown in Figure 13.

NFV can be used together or separately with Software Defined Networking (SDN). SDN virtualized the control of the network managing the configuration and deployment of NFV functions in virtual network, separating the network control from user data. The control is based on the software enabling automated configurations and rapid adaptation of the cloud. NFV optimize the network functions like firewalls and

routers, and SDN optimize the underlying networks. (OpenFlow-enabled SDN… 2014, 3-5).

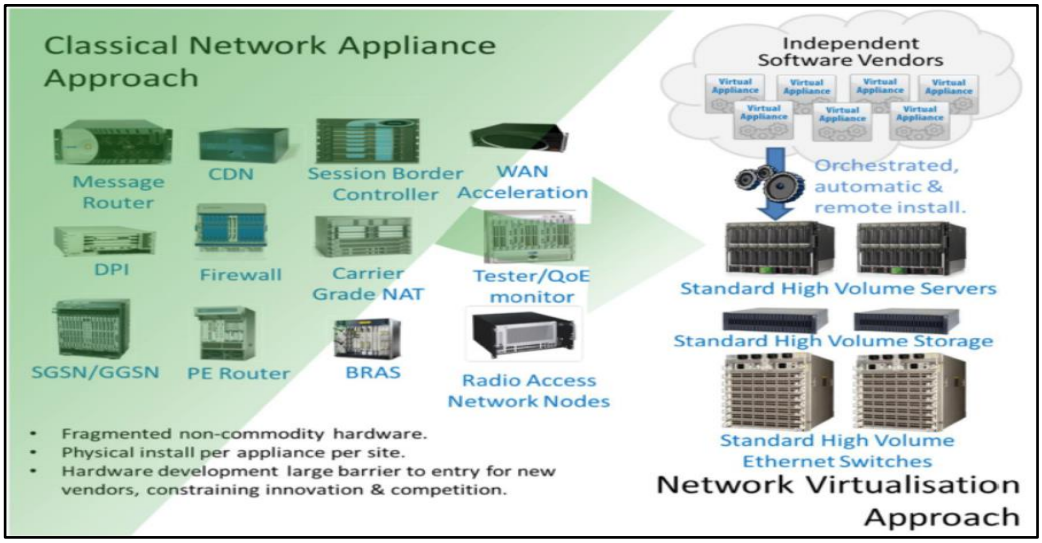


Figure 13. ETSI's vision for NFV (Network Functions Virtualization... 2012, 5)

3.5 Summary

Cloud computing transforms traditional landscape of creating, deploying, maintaining and offering business services (and business supporting services). Enterprises are able to concentrate on their core business by not investing their owned IT infrastructure with heavy burden on maintenance and constant hardware and software updates. The capability to deploy and scale computing resources on-demand with pay as per usage model lowers the capital and operating expenditures and flexibility and agility to the IT operations leading to rapid service creations and offerings fulfilling consumer's and enterprise's needs.

The main characteristics of cloud computing consist of capabilities to provide on-demand and automated provisioning of computer resources as self-service with scalable mechanism to provide rapid elasticity, provide network access with any device at any time at any place, provide pooled physical and logical resources with monitored quality and service levels, and offering same resources for multiple users simultaneously.

There are various target groups for cloud computing providing opportunities to focus on. There are consumers interested on certain mobile application usage only or enterprises requiring office applications for employees where SaaS service model is the most suitable for service providers and is the most offered service model globally. Individual software developers and enterprise R&D units requires software platform which can be easily scaled and modified for current purposes (PaaS), or the enterprise IT infrastructure can be delivered and managed with IaaS service model.

There are different cloud service providers competing with each other. Pure cloud providers like Amazon and Google are offering massive scale services for each service model sector. Their businesses are based on massive Data Center structure where each service model can be delivered in massive scale to anywhere. The over-the-top players are offering services which are mainly based on SaaS model. They offer comprehensive services especially in the communication sector like voice, video and messaging, and compete against Telcos' traditional businesses. This is one of the causes for declined telecom revenues in recent years and has an impact on Telcos' strategies to adapt cloud computing in their business models.

Telcos have had fairly slow start to leverage current experience and competence to provide network services to gain advantage in cloud offerings. As great as cloud computing service models are, no services are provided without network access and connections. The connection between end-users, devices and applications must be secure, fast and reliable with low latency, and this is what Telcos have offered for years to consumers and enterprises. They have also monitored the service and quality levels, are experienced with billing and service level agreements and regulations. Thus is somehow natural that Telcos have adapted the carrier role in the cloud ecosystem providing end-to-end connectivity between computing resources and end user appliances.

There are also some Telcos who have expanded the role to act as a broker, where the connectivity is not the only offered service, but is extended to include 3rd party cloud based services and bundle offerings to meet individual consumer needs. This comprehensive service offering is not widely spread and concentrating mainly on main stream application offerings related to communication. In overall the most offered

service model by Telcos is the IaaS providing compute, storage and network resources, where Telcos like Verizon, China Telecom, Tata Communications and Orange are strong players among others.

4 METHODOLOGY AND RESEARCH PROCESS

The research topic was initiated by Nokia Networks with a set of initial objectives for the researcher consideration. This research is based on development methodology (Ojasalo, Moilanen & Ritalahti 2014, 18-20), which sets a focus on producing valuable new information for vendors and for Telcos planning to deploy cloud computing models. It requires critical evaluation of theoretical and practical information from Telcos, cloud experts and analysts.

Ojasalo, Moilanen & Ritalahti (2014, 26) defines two bases for the study; problem based and reformed based. Problem based approach set the targets to find solutions for existing identified problems. This research has a reformed approach where new opportunities are identified and valuable information provided based on the cloud computing landscape.

Ojasalo, Moilanen & Ritalahti (2014, 28-30) emphasize the importance of acquiring adequate background material to understand the research topic in its depth to be able to redefine the research goals and objectives. Similarly Saunders, Lewis & Thornhill (2007, 54-63) emphasis the importance of critical literature reviews to provide the foundation for the research by making reasoned judgments and acting critically towards writings and materials.

The research requires material collection, reviews and analyses to describe the current cloud computing landscape (the framework) and to study the cloud computing opportunities for Telcos (empirical).

4.1 Defining the Framework

To meet the objectives and reach the goals of this study it is mandatory to understand the basic cloud computing landscape. The framework describes the fundamental parts of cloud computing; what is the cloud computing, what services and delivery models it offers, what are the benefits and main concerns of cloud computing and who are main cloud computing providers and their service models.

It is equally important to describe the role of Telcos in the cloud computing value chain in today and what service and delivery models they currently capitalize, and how cloud computing impact on their operations. Also network evolution is described to understand the cloud and virtualization impacts.

Ojasalo, Moilanen & Ritalahti (2014, 34) describes the framework as "knowledge base ("tietoperusta"), which collects the existing information to be used as a base for the research. Knowledge base forms the foundation for research through terms and abstracts and their relations. The knowledge base in this research is to model the existing cloud computing landscape. This research uses the term "framework" instead of "knowledge base" in the sake of clarity.

The material for framework is collected using scientific journals, articles, vendors and Telcos' freely available material, and market research materials.

Figure 14 simplifies the approach of reaching the target –future service opportunities by defining the framework first and use of empirical studies.

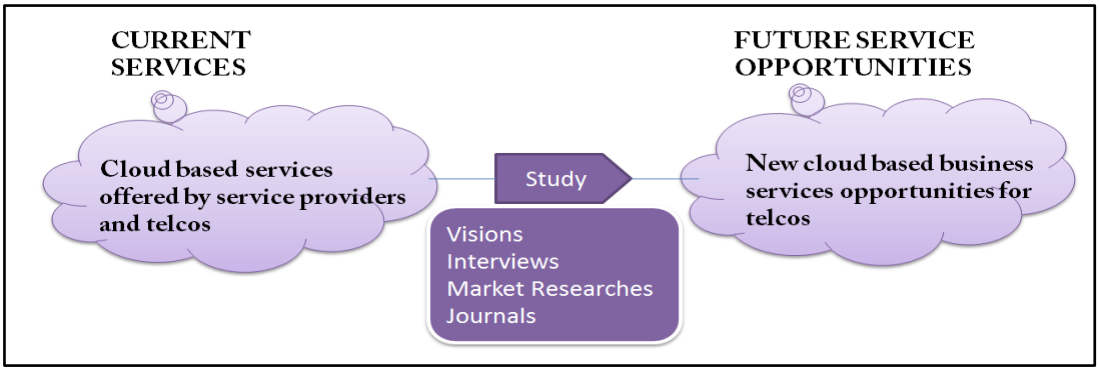


Figure 14. Reaching the target by defining the framework and empirical studies

4.2 Research Process, Strategy and Approach

The research process combines Saunders description of research process (Saunders, Lewis & Thornhill 2007, 10) and Ojasalo description of development process (Ojasalo, Moilanen & Ritalahti 2014, 24). Both processes have some similarities to run through the research process, but this applied research compiles appropriate ap-

proaches from both to have a meaningful purpose for this research. The process is presented in Figure 15.

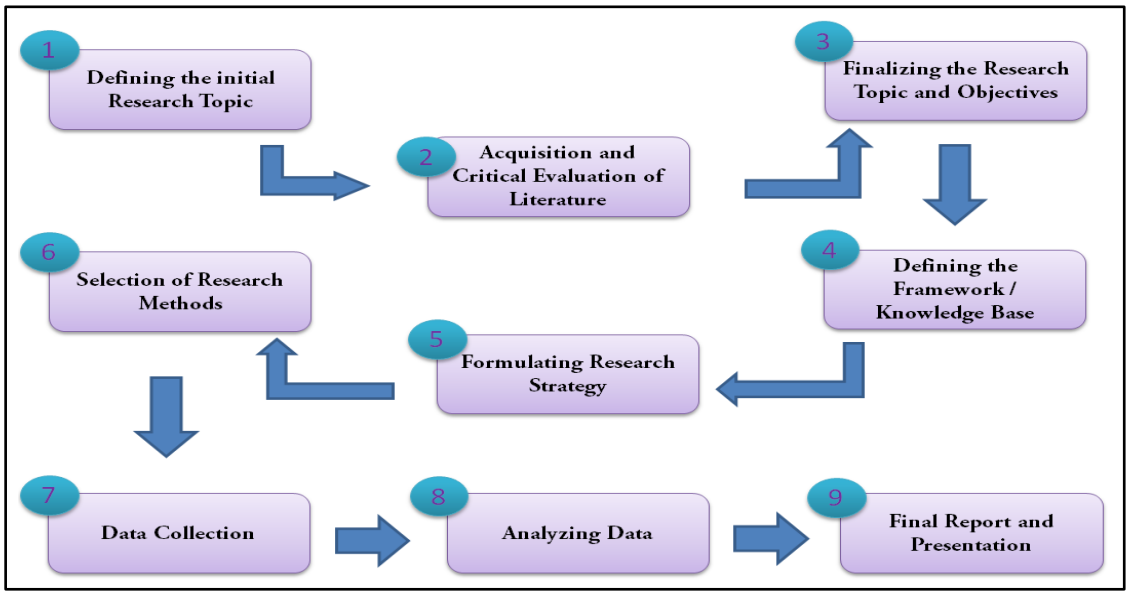


Figure 15. The applied research process (Adapted from Saunders, Lewis & Thornhill 2007, 10; Ojasalo, Moilanen & Ritalahti 2014, 24).

There are seven different strategic approaches described by Ojasalo, Moilanen & Ritalahti (2014, 37-39) to be used with development methodology: case study, action research, constructive research, service design, examining and producing innovations, foresight and network research.

Case study is the preferred strategy in this research as there is none or little control over the events, i.e. there is no possibility to manipulate of those involved in the study and the interest is on contextual conditions in which something unique has occurred; the perspective of Telcos experiencing cloud computing opportunities in their offerings. The case study focus is on investigating a contemporary phenomenon, generating a holistic understanding of the research being conducted within the real-life context. (Yin 2014, 12-17).

Furthermore Ojasalo, Moilanen & Ritalahti (2014, 53-54) highlight the case study an approach where the research target is explored and understood, and where new development proposals are derived The case study have four process steps starting with defining the research target, studying the phenomenon in practice and theory, contin-

uing with empirical studies and analysis with selected methods, and concluding to present findings with a development or strategic proposal.

The research follows the descriptive type of case study where the case study describes the phenomenon (cloud computing) in its real-life context (Telco Cloud) (Yin 2014, 138-139, 238). The use of descriptive case study with multiple case studies among Telcos from Eastern Europe, Central Europe, Western Europe and Northern America with previous experience of some cloud computing services provides possibility to compare opportunities cloud computing may create around multiple regions.

4.3 Selection of Research Methods and Data Collection

The research will use both qualitative primary and secondary data collection methods. Semi-structured interviews are used to collect primary data, and documentary analysis for a secondary data collection.

The secondary data collection method is analysis of documentary evidences. The purpose of secondary data collection via documentary analysis is to collect, study, interpret and analyse written documents (Ojasalo, Moilanen & Ritalahti 2014, 135-136) to provide valuable empirical data to support primary data collection, interviews. The documentary analysis forms a foundation for the interviews; it defines the direction for interviews and gives the insight of future cloud computing opportunities for Telcos based on the analysts view.

Documents as secondary sources of data are collected from scientific journals, written interviews of cloud experts, Telcos' whitepapers, telecommunication infrastructure vendor's whitepapers, marketing researches (free) and material provided by actors in cloud seminars. Nokia Networks provide cloud based material and marketing research material.

In semi-structured interviews a list of themes is prepared in advanced based on the result of documentary analysis. Interviewees may speak freely and the interviewer may add or remove questions (or themes) according the interview flow (Saunders,

Lewis & Thornhill 2007, 312). Themes are distributed to interviews in advanced due to nature of complexity and the extent of themes. Themes are targeted on Telcos' cloud visions and strategies, virtualizations, service developments, cloud service characteristics etc. The complete list of themes as delivered to the interviewees is attached to Appendix 1.

The initial plan was to interview five global Telcos and two Nokia Networks cloud experts. There were one Telco from United States, one from UK and one from Finland who did not participate as was planned. Also one Telco from Europe did not want to disclose information publicly, but participated here as anonymous.

There are one Telco and two Nokia Networks experts interviewed:

- Nokia Networks, Head of Telco Cloud Management, Norbert Mersch
- Nokia Networks, Business Development Manager, Kevin Rowland
- TeliaSonera Finland Oy, Director of Global Products, Pekka Isomäki

To replace three missed Telcos, the author participated in the Telco Cloud Forum in London 27-29.05.2015 where several Telcos presented their view on Telco Cloud opportunities and characteristics of services. The author selected four Telcos for the research purpose based on their content of the message. This method proved to be sufficient. Telcos are:

- Telefonica Spain: Global Cloud Director, Juan Manuel Moreno
- Telecom Italia: Executive Director, Cloud & Over The Top Services Riccardo Jelmini
- CenturyLink USA: Director Business Operations, David Treybig
- Verizon Terremark USA, Vice President, Cloud Sales & Business Development, Andy Ward

Interviews were carried out face-to-face for TeliaSonera and via phone for Nokia Networks. All interviews and presentations were audio recorded. The Telco from Europe participated via e-mail discussion following provided themes.

4.4 Analyzing Data

Analysis of interviews and forum presentations started by transcribing recordings one by one. Transcribes were read several times, themes categorized and linked to between respondents (Ojasalo, Moilanen & Ritalahti 2014, 110). Analyze of the documentary evidences and transcribed interviews together is based on "analysis procedures", where data is organized forming meaningful categories, data is unitized to be able to fit to the categories, and the data is reorganized based on key themes and relationships which occurs during the analyse (Saunders, Lewis & Thornhill 2007, 479-482).

The analysis of the data in this research is relaying on categorization based on themes derived from secondary data and from interviews. Themes form clear categorization of which data can be analyzed, although it is expected that themes may have sub groups, or units, which needs further analyze and possible categorization. Drawing a link between units and furthermore categories to find similarities between answers is mandatory as data provided by interviewees may have various perspectives on future business service opportunities; similar characteristics of services may be presented in different formats or context.

The data derived from interviews and forum presentations are compared between each other and reflected on the findings of secondary data (documentary analysis). As the objective is to find opportunities for Telcos and the impact on vendor's offerings the conclusions are concluded from both set of objectives, forming a holistic approach of findings.

4.5 Final Report and Presentation

The report is not compiled at the end of the project, but is seen as a continuous process throughout the project. The initial intention was to discuss and present research findings with Nokia Networks during the project, but this was not seen necessary, only after completion if required. Additional material is created containing meaningful presentations styles for final presentation purposes supporting the research report.

4.6 Research Plan

The research plan was initiated in early January 2015 including the target customers for interviews. The plan and target Telcos were modified in the middle of the research and the outcome is shown below in Figure 16.

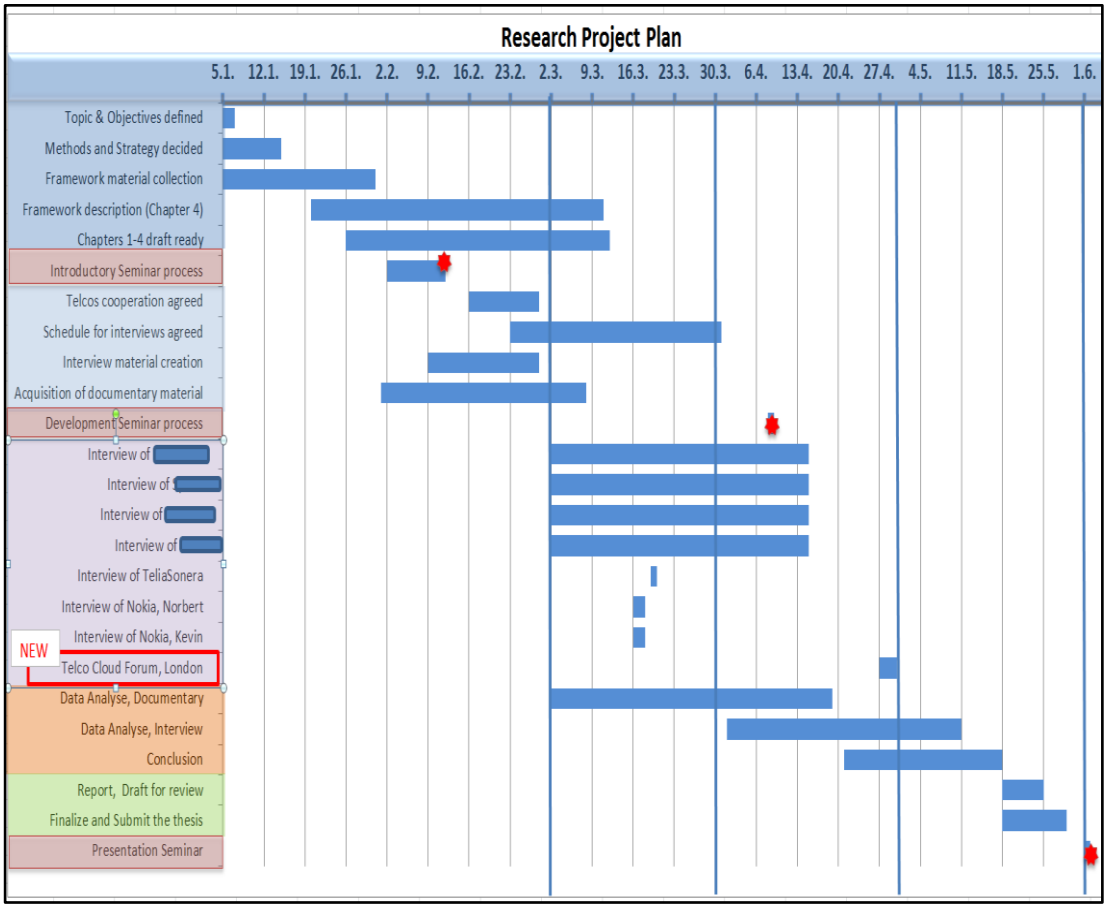


Figure 16. The Research Project Plan

5 ANALYSTS AND MARKET VIEW FOR OPPORTUNITIES

Sue Rudd, Director Service Provider Analysis, from Strategy Analytics (2015) praised Telco Cloud advantages compared to IT Cloud. Telco Cloud capabilities optimizing connectivity bandwidth, data center resources, and guaranteed end-to-end **Service Level Agreements** (SLA) with service and network awareness are all areas to utilize in competition. The opportunities are leveraging horizontal mass services like voice and video to **vertical markets** enabled by **Software Defined Networking** (SDN). Rudd listed cloud services to consider including **Virtual Private Network** (VPN), **bandwidth on-demand**, **cloud Wi-Fi hotspots**, **connected cars**, **edge computing** for **Internet of Things** (IoT) and **Machine to Machine** (M2M**)**, **eHealth** with **variable bandwidth on-demand**, and all network functions as a service model.

Jim Scott (2015), Vice President, Service Provider Architectures, Cisco said Telcos' should differentiate themselves from competition through brand, scale and security by providing platform for developers enabling "sexy" innovation around services. The service orchestration is essential to provide flexible environment where NFV and SDN are managed and seen as one platform to the users. Scott mentioned service to include **managed Virtual Private Network** (VPN) **through cloud** and **Wi-Fi through cloud**, Service **Orchestration Automation**, and provisioning and **interworking** of physical and virtual resources.

5.1 Valued Cloud Services and Challenges by Enterprises

Cloud market is estimated to reach 24% compound annual growth rate (CAGR) globally during 2013-2018 according to Cisco Global Cloud Index (Cisco Global Cloud Index… 2014) following similar estimates of 23 % CAGR by IDC research (Press release: Public Cloud Services… 2013).

Enterprises are moving towards cloud computing and IDC (Theis 2015) research relieve that there will be around 11% shift of spending from traditional IT to cloud by 2016. Ovum report (The Role of Cloud in IT Modernization 2014) estimates that

75% of enterprises in Europe and 80% globally will be using IaaS service model by 2016.

Ovum carried out a telecom cloud global insights survey (Mendler 2014), where enterprises evaluated the main values having an influence when selecting cloud infrastructure provider among Telcos (Figure 17). Basic **network services** scored highly following closely by **professional services** like in the area of **security**. Enterprises are seeing **end-to-end service levels** for both network and cloud important. IT cloud infrastructure management is the basic requirement for many enterprises.

Highlighting the relevance of professional services, or **Managed Services**, some cloud providers who offered IaaS only have moved towards Managed Services (like Rackspace) because Amazon, Google and Microsoft have superior advantage of offering IaaS through massive investment for Data Centers and cloud ecosystem. As an example Rackspace managed cloud offering consists of features like **backups**, **maintenance**, **monitoring**, **configuration**, **on-demand scaling** just a few to mentioned (Website of Rackspace 2015).

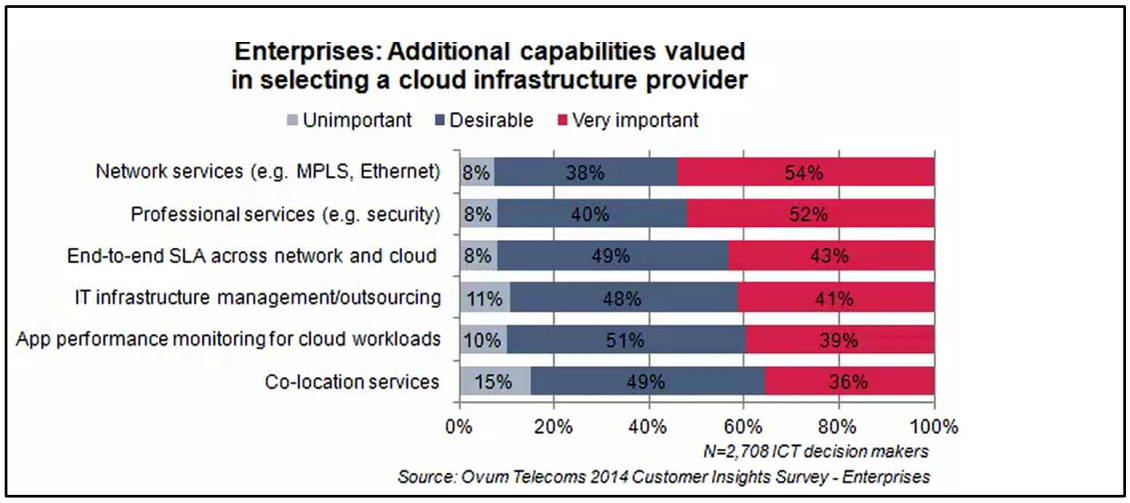


Figure 17. Telcos' capabilities valued among enterprises (Mendler 2014)

451 Research (Cote 2015, 18) asked enterprises which deployment method they will favorite for their workloads in the near future. The research showed that the most preferable delivery model would be **on-premises private workloads** for most workload types (Figure 18). **Hosted private** cloud model is seen more favorable option than hybrid model and public clouds. The results highlighted that private cloud is seen more lucrative option than public.

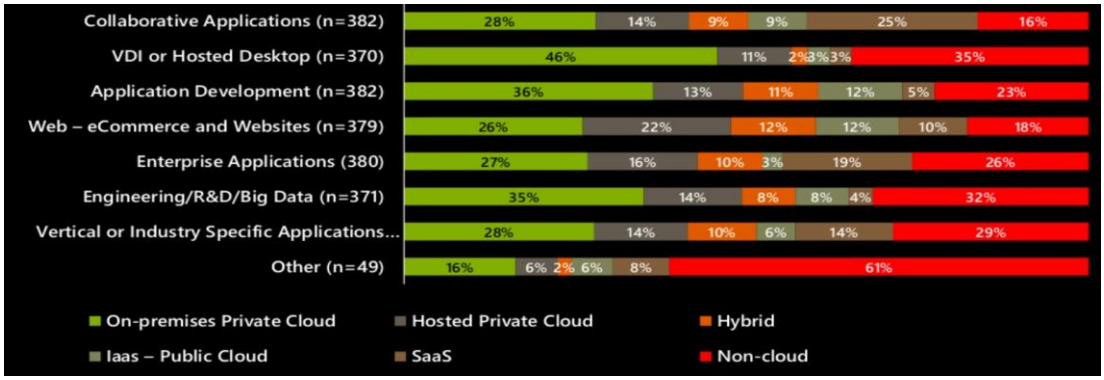


Figure 18. Favorable delivery models among enterprises (Cote 2015, 18)

When asked (Cote 2015, 19) what would be the main reason for enterprises not to adapt cloud computing, the **security**, **compliance** and the **control of data** were seen having the significant impact (Figure 19).

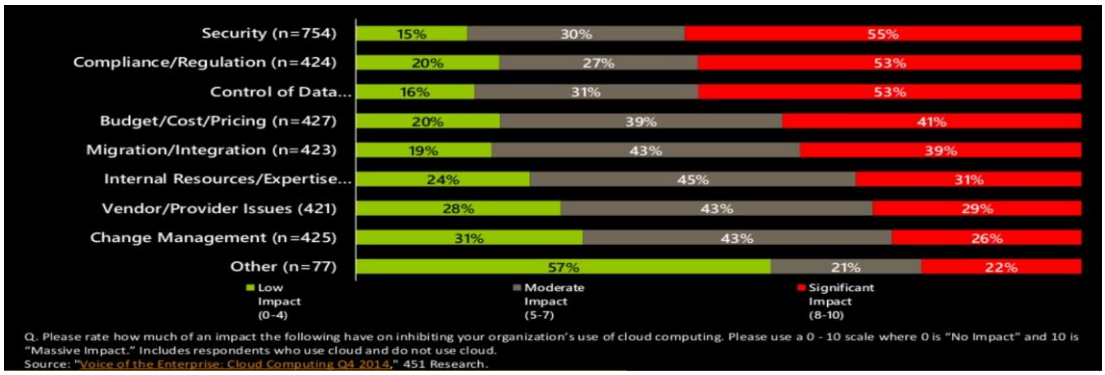


Figure 19. Main concerns of cloud among enterprises (Cote 2015, 19)

Rightscale research (State of the Cloud Report 2015, 20) concluded the main challenges for enterprises and the trend from 2014 to 2015. The **security** and **compliance** remained as one of the top concerns, and **lack of resources and expertises** have increased during one year from 17% to 27% landing between those two (Figure 20). The **performance** of the environment was seen as **less** concerned among enterprises. The increased number of commonly available cloud services have raised concerns of **managing multiple cloud services** (increased from 16% to 25%).

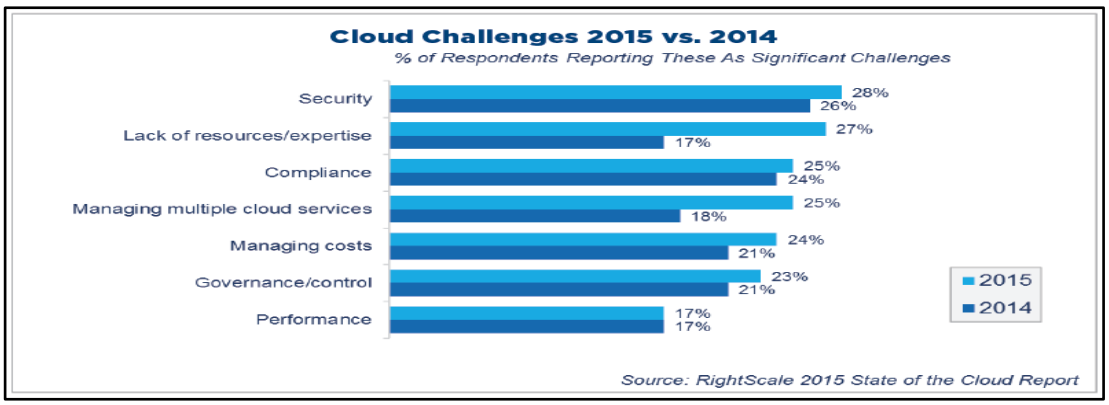


Figure 20. Main cloud challenges among enterprises (State of the Cloud Report 2015, 20)

If challenges are divided between type of users (beginners, explores and focused users), the response is somewhat different as stated in the below Figure 21 (State of the Cloud Report 2015, 21). In an early phase the lack of resources and expertises is the main challenge and in the mid phase the complexity of building the cloud. More mature users are more worried about the compliance and managing cost, and for security, which is rated highly in all maturity levels.

Top 5 Challenges Change with Cloud Maturity

Place	Cloud Beginners	Cloud Explorers	Cloud Focused
#1	Lack of resources/expertise (35%)	**Complexity of building a private cloud (32%)**	Security (19%)
#2	Security (32%)	Security (30%)	Compliance (18%)
#3	Compliance (28%)	**Managing multiple cloud services (30%)**	Managing costs (18%)
#4	Governance/control (28%)	Lack of resources/expertise (26%)	Managing multiple cloud services (17%)
#5	Managing costs (27%)	Compliance/governance/control (24%)	Governance/control (17%)

Source: RightScale 2015 State of the Cloud Report

Figure 21. Main cloud challenges among enterprises based on maturity (State of the Cloud Report 2015, 21)

Ovum researched (Mendler 2014) Telcos' biggest strengths evaluated separately by ICT (Information and Communication Technology) vendors and Telcos themselves (Figure 22). Surprisingly Telcos did not value their existing customer base as high as ICT vendors ranked; 56% of ICT vendors believed that the biggest strenght of Telcos are their current customer base and only 28% of Telcos thought so. Telcos valued their strenght to include network, end-to-end service management and local presense before customer base. Neither sector ranked security experties very highly as Telcos'

strenghts, which may trouble enterprises valuing security as one of the key characterisric.

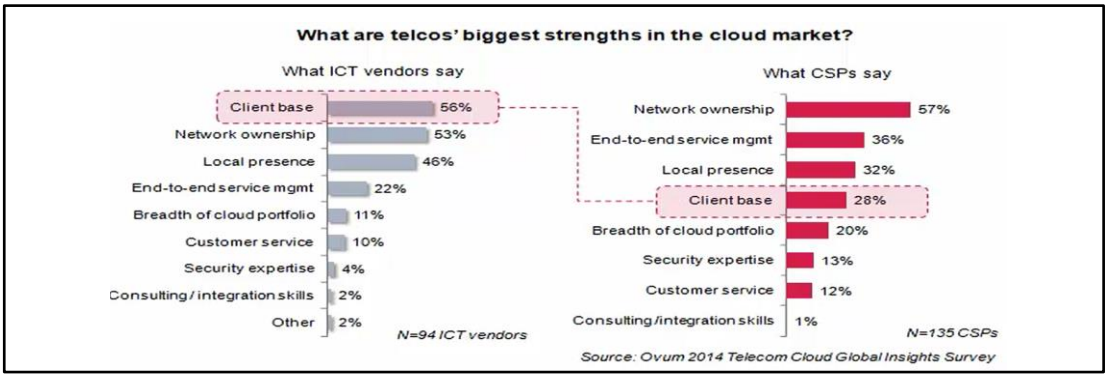


Figure 22. Telcos' biggest strenghts evaluated by ICT vendors and Telcos itself (Mendler 2014)

5.2 Role in the Cloud

The cloud computing has been with us almost a decade and Telcos' role in the cloud ecosystem has not yet been seen as value creator. The question is not should Telcos enter to cloud ecosystem, but rather what their role is in the cloud ecosystem. This is the strategic choice to be made.

5.2.1 The role

Analyst (2020 Vision: The Heavy Reading perspective 2014, 13) emphasis that future revenues depend on Telcos' capabilities to act as a valuable member in cloud value chain by

a) Providing **network capabilities** to connect and deliver and execute (compute and storage) 3rd parties' (or partners') cloud services,
b) Creating **own cloud services attracting partners** to include services to their offerings, and
c) Offering a **marketplace** where many various offerings can be **bundled** through APIs to serve consumers and enterprises own dedicated needs i.e. combine services to one customer tailored solution.

Especially the above points b) and c) require interworking **Application Programming Interfaces** (API) to be successful (2020 Vision: The Heavy Reading perspective 2014, 13). APIs are seen the main contributor to establish cloud ecosystem which serves customers as individuals allowing them to personalized services by collecting various cloud services from multiple providers to one service or solution with one price and payment channel to deal with. Most Telcos have started to explore opportunities to exploit APIs, which will enable them to start offering **network-as-a-service**, **voice-as-a-service**, **device management, billing integration** and other services.

Telcos have a chance to build comprehensive **cloud infrastructure** service offerings, but also concentrate offering differentiation services by cooperating and **partnering** with major cloud service providers and channel partners, and service **bundling** enabled by API capabilities. Telcos' **traditional** offerings are moving **to cloud** also leading to the revenue model where traditional and cloud services revenues are difficult to distinguish. (2020 Vision: The Heavy Reading perspective 2014, 14).

5.2.2 Industry Sectors to Enter

Telcos' cloud offering raises interest among industrial sector and OVUM reports (Mendler 2014) shows that there were more **government** sector wins than any other in 2013 (Figure 23). Also **financial** and **health** sectors are seen potential industries to enter especially when the cloud computing healthcare market is estimated to grow at CAGR of 20.5% from 2012 to 2017 (Healthcare Cloud Computing… 2012), and the forecast for cloud financial services predicted to reach 24.85 percent CAGR over the period 2013-2018 (Global Private and Public Cloud Market… 2014).

Hospitals are investing in electronic health care records which enable accessibility and mobility of patients' health information creating opportunities for Telcos. Cloud computing offers major benefits to the healthcare sector where the information of patient can be stored, accessed and shared across various entities and geographies **without** a **delay** and loss of time in urgent cases, with **decrease cost** and **scalable** solutions (Healthcare Cloud Computing… 2012).

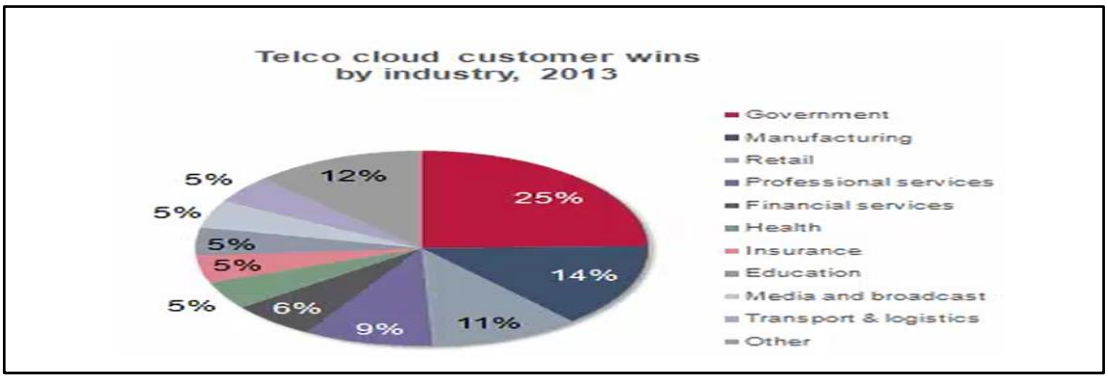


Figure 23. Telco Cloud customer wins by industry 2013 (Mendler 2014)

The cloud benefits for financial sector are similar to any other sector, but allocating services to manage capital and to reach dedicated financial customers brings the benefit which ready-made solutions or mass production services are not able to compete (Global Private and Public Cloud Market… 2014). This opportunity to serve dedicated industry sectors is valid to any digitally aware industry sector utilizing cloud capabilities.

5.2.3 Mode of Data Centers

Today's Telco Cloud concept is highly based on services offered via Data Centers. Some Telcos have partnered with Data Center providers rather than invested their own infrastructure, and the direction is somewhat clear: Telcos cannot compete against big cloud players like Amazon, Microsoft and Google, who are investing massively for Data Centers and overall cloud infrastructure and at the same time they have decrease the price levels. (Kavis 2014).

The debate between **distributed** or **centralized** data center concept has increased lately and both have some good and bad points; centralized are more cost effective and distributed will reduce the latency. Analysts (2020 Vision: The Heavy Reading perspective 2014, 19-20) indicate that distributed concepts are favored by enterprises as they want to keep data close to them, **reduce latency and increase security**, impacting Telcos' strategies for data centers.

The current hardware defined Data Center model is not the most feasible approach with today's on-demand requirements requiring tight integration between application and hardware. The Next Generation Data Center is software defined where the infrastructure is virtualized, delivered as a service and managed by software with automation (Website of Techopedia 2015). It offers more agile, secure and scalable model than "traditional" hardware based Data Centers truly fitting the cloud service and delivery models.

Traditional data centers have started to lose ground for cloud data centers. In 2013 53% of workloads were carried by cloud data centers and the amount is estimated to increase to 78% with 24% CAGR (Cisco Global Cloud Index… 2014, 10). At the same time traditional data centers are decreasing with -2 CAGR (Figure 24). The cloud based data centers are more efficient and flexible with **virtualization** capabilities where workloads can be shared virtually between Data Centers and geographical locations instead of having assign physically to one server in a dedicated location.

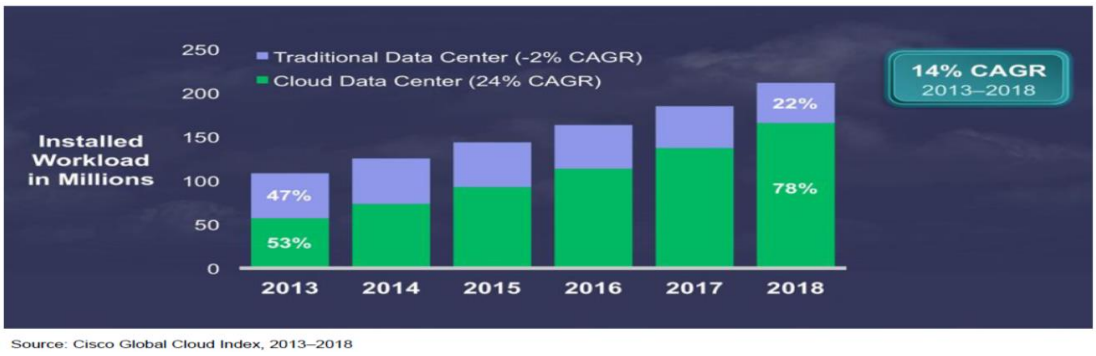


Figure 24. Traditional and cloud data centers predictions for enterprise workload assignments (Cisco Global Cloud Index… 2014, 10)

5.2.4 Cloud Marketplace

The marketplace is seen important concept to **improve cloud service creation, deployment, promotion** and **delivery**. The cloud marketplace is the forum where applications coming from different providers can be modified to different user needs, **integrated** and **traded** together. Marketplace supports the **complete service lifecycle** (including planning, development, testing, provisioning, deployment, discovery, executing and monitoring) and acts as a unified location for all stakeholders. Market-

places support pricing, automated revenue sharing, promotion and billing capabilities for smooth transactions and rapid response to current business conditions. (Menychtasa & al. 2014, 105).

Telcos have advantage compared to OTT players with their existing customer base to provide **localized services** and **end-to-end solutions** with **performance** and **quality**, but they lack behind on online (internet) product offering. Many industries are offering services via internet by giving a control to end-user (creation of profile, customization of content, online purchases and configuration of services etc.), but Telcos are still controlling largely the environment of online markets. Furthermore Telcos offering does not commonly include **anchor** functionality; a service which draws attention and brings customer back for further purchases. The anchor concept in overall consists of offerings like free functionality for useful content, regular product offering with easy to use online versions to support free functionality and advanced offering tailored based on customer profiling. The anchor concept includes profiling and log-in functionality, and has a self-service and customization capabilities providing personalized customer experience. (Taga, Levy, Best & Racz 2013, 7-8).

There are emerging number of **marketplace providers** offering business applications and looking for Telcos to partner. The fundamental characteristic of these providers is to have extensive catalogue of cloud services from leading application providers and developers, offering services to consumers and enterprises through partnering with Telcos according to marketplace providers BSCG, AppDirect and OpenXchange presentations in Telco Cloud Forum on 27th of May 2015 in London (Platt; Dufty; Hoberg 2015).

5.3 Service and Delivery Models

5.3.1 Service Model Predictions

SaaS will reach 59% global market share with 33% CAGR by 2018 according Cisco Global Cloud Index (GCI) research (Cisco Global Cloud Index… 2014, 14). **IaaS**

will have 28% market share with 13% CAGR and the smallest share is and will be for **PaaS** with 13% share and 21% CAGR (Figure 25).

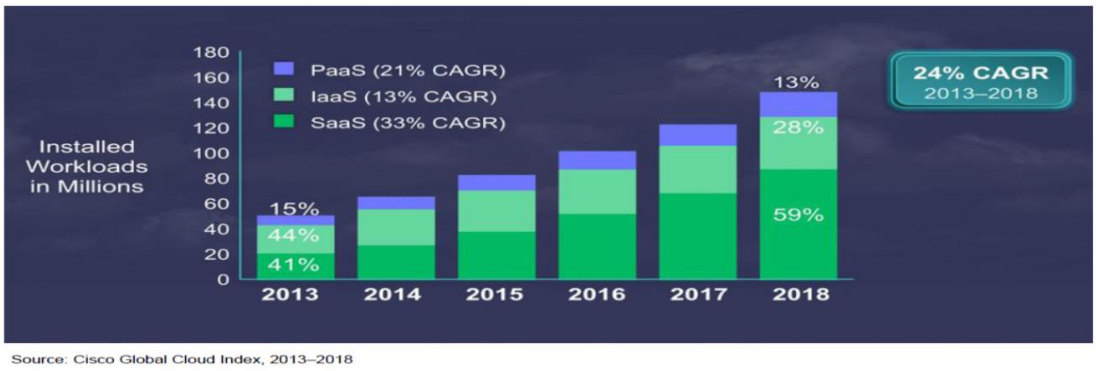


Figure 25. Predictions for service models, combined private and public (Cisco Global Cloud Index… 2014, 14)

To understand figures better, GCI separates also the usage of private and public clouds for service models. For the public cloud, the SaaS deployment has been the most favorite with 65% share, but in private cloud only 35% in 2013. The public cloud SaaS market share will be declining as more IaaS and PaaS services are shifting from private to public once there are more secure and cost effective options available for enterprises. Figures 26 and 27 below present the market shares based on the delivery model (private and public).

Figure 26. Predictions for service models in private cloud (Cisco Global Cloud Index… 2014, 15)

Figure 27. Predictions for service models in public cloud (Cisco Global Cloud Index… 2014, 16)

SaaS based business application services revenues are forecasted to grow from $13.5B in 2011 to $32.8B in 2016, attaining a 19.5% CAGR according Gartner Forecast Analysis as presented in Figure 28 (Introduction to Centaur Partners SaaS… 2015, 11).

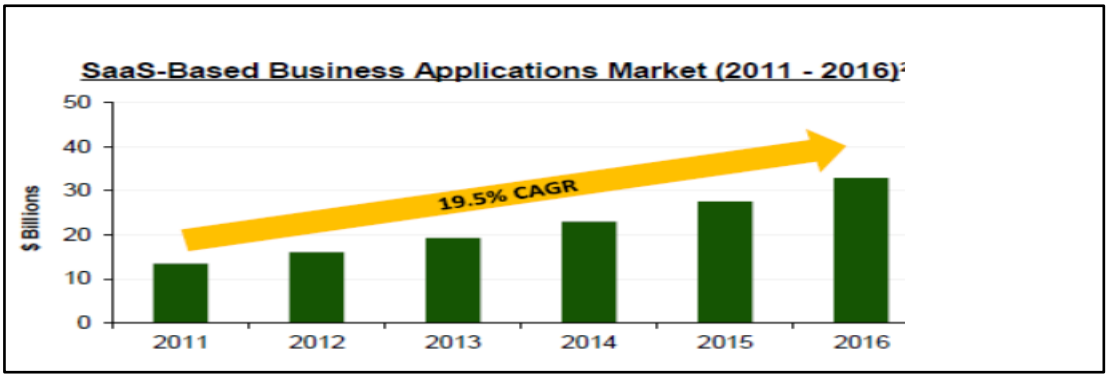


Figure 28. Predictions for SaaS-Based business application market growth (Introduction to Centaur Partners SaaS… 2015, 11)

Furthermore, SaaS applications of **CRM** and **ERP** (enterprise process applications) are leading the SaaS subscription revenues and will continue to do so according the Forrester forecast (Gagliordi 2015). Also data integration and storage management are estimated to increase heavily.

Telco 2 Research (Cloud: What is the role of telcos… 2014) relieves that Telcos' opportunity in SaaS market is utilized on their capabilities to act as a **single billing** and **support** point to the enterprises for all services. According their research, bundling leading SaaS products is proven to **decrease churn** up to 50% level and over 100% **increase in ARPU** (Average Revenue Per User) from business users.

Senior Director of Data Center and Cloud Solutions Kevin Jonhson (2015) from Intel presented interesting predictions, based on Gartner Cloud Adaption Survey 2014, of SaaS market changes where SaaS security has raised the priority from bottom to second among enterprise spending behaviors as presented in Figure 29 below. Other highly rated SaaS opportunities for Telcos are Customer Relationship Management, **IT Operations Management**, **Business Intelligence**, **Office Suites** and **Web Conferencing** including social interactions.

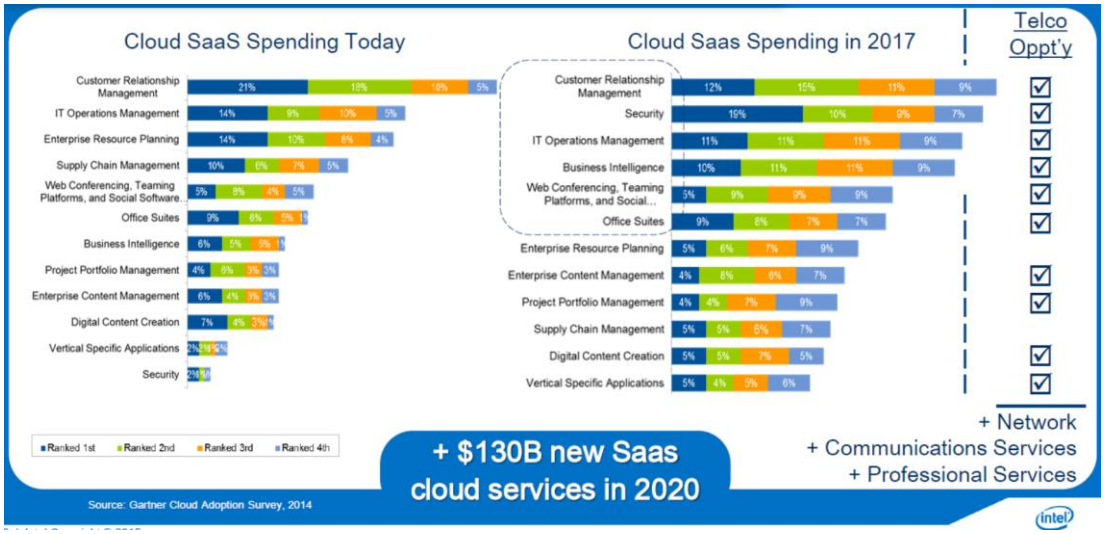


Figure 29. Enterprise Cloud SaaS spending predictions from today to 2017 (Johnson 2015)

Telcos' traditional role as network controller enables high Quality of Service (QoS) attributes in the cloud value chain; Telcos have gained QoS experience providing traditional voice, message and data services for many years. The integrated services, platforms and networks require end-to-end Service Level Agreements (SLA), the areas where Telcos have previous experience and capabilities to manage. Offering multiple services to multiple consumers and enterprises requires efficient and optimal network resource allocations, the area where Telcos have major role. (Part 7: Cloud computing... 2012, 6).

Network as a Service (NaaS) is a service where network capabilities are combined with IT capabilities including location, messaging, call control etc. Telcos have an advantage providing NaaS based on their existing knowledge on security, connectivity, QoS and SLA management of legacy network and services (voice, data etc.). The overall benefit of NaaS is based on its **flexibility on capacity** and **scalable control**

and **network efficiency** without a need for device configuration (access to network with any network access based device). (Magalheas R & M 2014).

5.3.2 Delivery Model Predictions

Private clouds have been and are more favorable for enterprises as they are considered more secured with good level of data integrity. Enterprises do not trust their critical workloads to public clouds. This is changing in coming years according to GCI report (Cisco Global Cloud Index… 2014, 12). Workloads in private clouds increase in a level of 21% CAGR during 2013-2018, but loosing shares to public clouds from 78% to 69%; and similarly private clouds will have 33% CAGR from 22% share to 31% share by 2018, Figure 30.

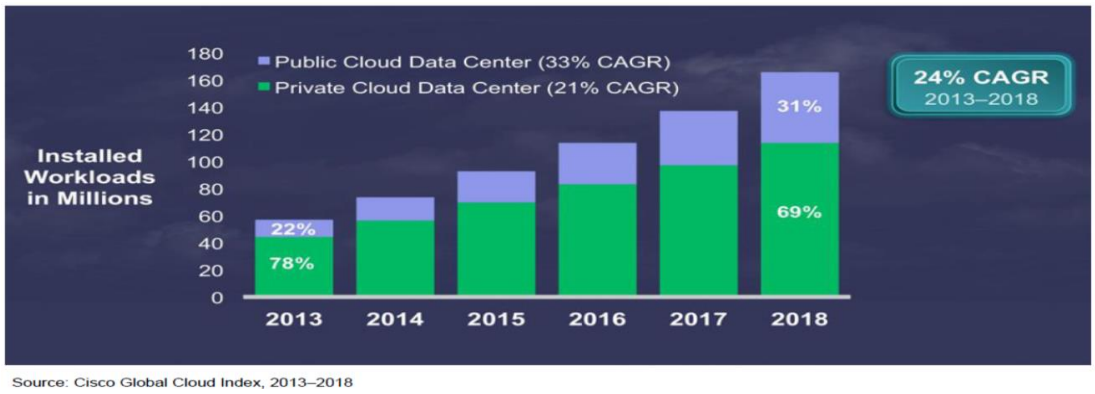


Figure 30. Public vs. Private cloud usage predictions (Cisco Global Cloud Index… 2014, 12)

Competing pure cloud providers like Amazon Web Services (AWS) in the area of public IaaS offering to enterprises is seen extremely challenging where Telcos' possibilities to leverage their existing competences are not exploited in a full scale. Instead Telcos could leverage their core competences by **offering end-to-end network** with WAN (Wide Area Network) and IaaS through private cloud **combined with service management** to gain competitor advantage, according to Analysys Mason principal Andrew Kloeden (2014).

Instead of deploying pure private or public cloud it is estimated that more than 65% of enterprises are considering **hybrid** clouds before 2016 (Theis 2015). Cliff Gross-

ner from Infonetics Research (2015) said that "Cloud service providers are catching the hybrid cloud CaaS (**Cloud as a Service**) wave, an emerging market where we can expect lots of innovation as the introduction of new IaaS and SaaS off-premises cloud services begin to wane", and highlighted that the challenges are not in technical implementation, but rather raising the confidence among enterprises on the **security** and low risk cloud deployment.

5.4 Data Amount and Analytics

The increased deployment of cloud computing will generate huge data traffic to networks. Global mobile data traffic grew 69 percent in 2014. Global mobile data traffic reached 2.5 Exabyte per month at the end of 2014. Global mobile data traffic will grow at a CAGR of 57 percent from 2014 to 2019, reaching 24.3 Exabyte per month by 2019 (Figure 31), almost ten times more than today. (Cisco Global Cloud Index 2014, 5).

Such an enormous growth of data traffic has an impact on Telcos' businesses and highlights the importance of ensuring the availability, performance and scalability of resources.

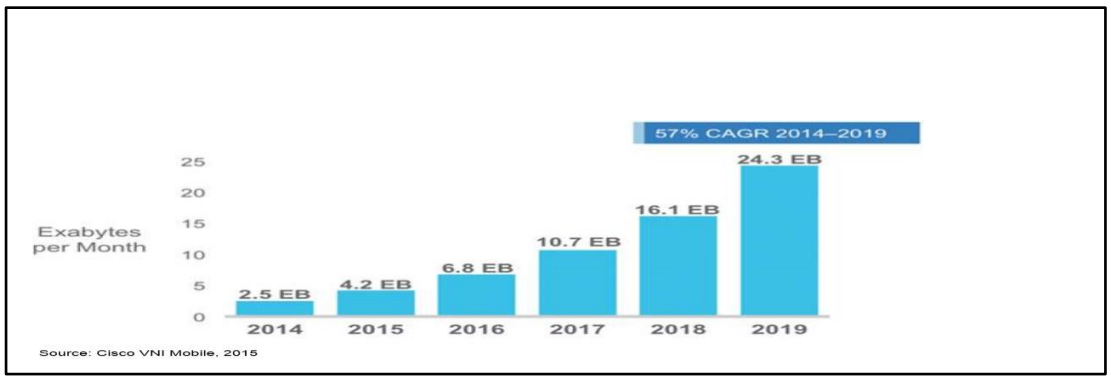


Figure 31. Prediction of data growth between 2014 and 2019 (Cisco Global Cloud Index 2014, 5)

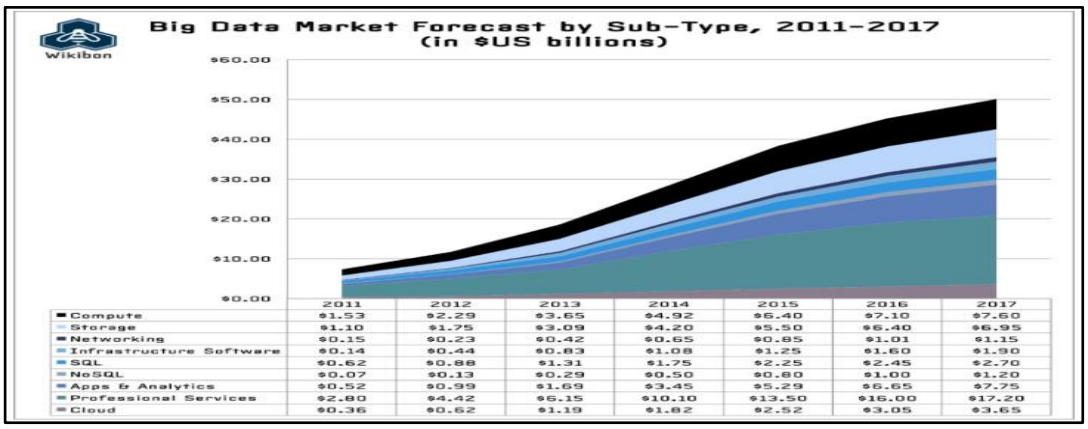
5.4.1 Big Data

Telcos have a huge amount of customer and network related data (Big Data) in their hands. Adapting **advanced analytics** methods (data mining, location intelligence and predictive analytics etc.) to the existing data Telcos have a focus **on predicting fu-**

ture behaviors of events and consumer behaviors, and helping to **personalize** consumer's network and service experience (Four trends that will change our industry 2015).

Tom Kershaw (2015), Director of PM from Google, demanded Telcos to take action of Big Data. He highlighted that Telcos have better user data than any other industry with demographic, usage, friend and locations data; the data is the most important asset of Telcos.

The Big Data market estimates are on 17% CAGR level over the next 6 years, including related hardware, software and **professional** services (The Big Data Market 2014–2020… 2014). Figure 32 divides Big Data to sub-types with forecast figures.



	2011	2012	2013	2014	2015	2016	2017
Compute	$1.53	$2.29	$3.65	$4.92	$6.40	$7.10	$7.60
Storage	$1.10	$1.75	$3.09	$4.20	$5.50	$6.40	$6.95
Networking	$0.15	$0.23	$0.42	$0.65	$0.85	$1.01	$1.15
Infrastructure Software	$0.14	$0.44	$0.83	$1.08	$1.25	$1.60	$1.90
SQL	$0.62	$0.88	$1.31	$1.75	$2.25	$2.45	$2.70
NoSQL	$0.07	$0.13	$0.29	$0.50	$0.80	$1.00	$1.20
Apps & Analytics	$0.52	$0.99	$1.69	$3.45	$5.29	$6.65	$7.75
Professional Services	$2.80	$4.42	$6.15	$10.10	$13.50	$16.00	$17.20
Cloud	$0.36	$0.62	$1.19	$1.82	$2.52	$3.05	$3.65

Figure 32: Big Data market forecast by market components 2011-2017 (Kelly 2014)

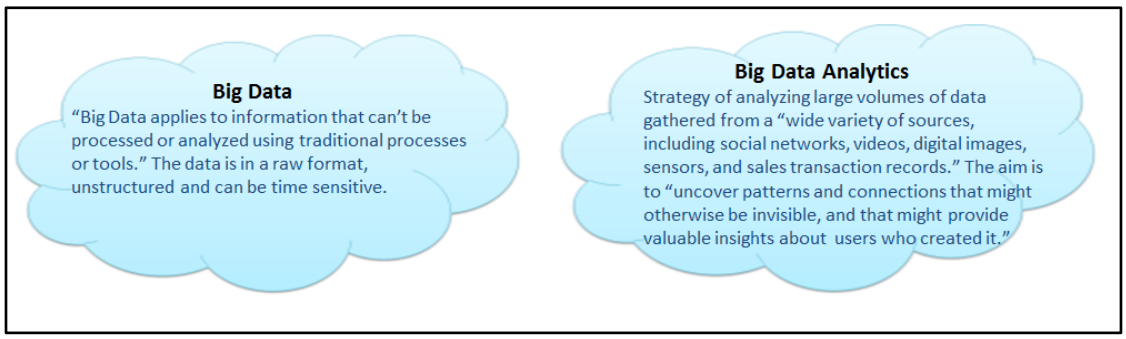


Figure 33. Definition of Big Data (Eaton, Deroos, Deutch, Lapis & Zikopoulo 2012, 3) and Big Data Analytics (Website of Technopedia 2015)

The data analytics market is estimated to reach 26% CAGR level from 2014-2019 according to Global Cloud Analytics Market 2015-2019 report (2015). Big Data ana-

lytics offer a possibility to gain competitive advantage by understanding consumers and their anticipations, and offering **tailored** solution for individual needs (Assunçãoa, Calheirosb, Bianchic, Nettoc & Buyyab 2013, 2).

Telcos must find a way to collect the data from various sources, analyse the data of many forms and build an overall picture of behaviors and trends among their network, services and users to support and improve decision making for better customer experience (2020 Vision: The Heavy Reading perspective 2014, 16).

Analytics can be categorized as descriptive, predictive and prescriptive (Assunçãoa, Calheirosb, Bianchic, Nettoc & Buyyab 2013, 2). Descriptive is based on the historical data for patterns, predictive uses both historical and current data to predict the future, and prescriptive defines the actions related to business objectives. Cloud computing can be used to address above categories where **services are hosted** in the cloud and offered as **pay-as-you-go** model.

Assunçãoa, Calheirosb, Bianchic, Nettoc & Buyyab (2013, 9) referred to Sun, Gao & Fan work on potential analytics service business models based on the resources, expertise and needs in enterprises. Enterprises with multiple analytics departments may be offered a service with shared analytics infrastructure to save operating and maintenance. Enterprises with no analytics expertise may be offered end-to-end solution where provider is providing and managing the software and resources associated to the analytics, and enterprise itself is responsible of uploading the data and configures templates to receive models and perform scoring. The third option by Sun, Gao & Fan is for enterprises that do not have necessary data to perform analysis. In these cases analytics services are hosted by the cloud service provider using enterprise defined models, but data provided by customers in the cloud. The service offerings are determined under **Analytics as a Service** (AaaS) or **Big Data as a Service** (BDaaS) names (Assunçãoa, Calheirosb, Bianchic, Nettoc & Buyyab 2013, 10).

IBM listed their own use cases for Big Data opportunities by highlighting the importance of low latency, data velocity and real time analytics to bring more value compared to traditional models and tools. They claim that only 5-20% of all produced data is used for analytics and the rest is too expensive and complex to analyse

with traditional methods. Their examples of Big Data Analytics usage included IT Log Analytics brining value by analyzing more computing logs and traces in real-time to understand system behaviors and enabling faster response; Frauds in financial sector can be tackled by Fraud Detection Pattern where Big Data Analytics is used in individual level with decreased latency for quick detection; Big Data Analytics from social media can be applied to individual level to understand and predict end-user behavior aiming to improve marketing mix; Analytics-in-motion and Analytics–in-rest are real-time support models where models are built and analyzed during a customer call. (Eaton, Deroos, Deutch, Lapis & Zikopoulo 2012, 17-29).

5.4.2 Internet of Things and Machine to Machine

IoT (Internet of Things) and M2M (Machine to Machine) market is forecasted to grow significantly during next five years and Telcos have an opportunity to enter the game. The global IoT and M2M communications market is estimated to grow CAGR of 29.9%, from $255.87 billion in 2014 to $947.29 billion in 2019 (Internet of Things Market & M2M… 2014).

The GSMA Intelligence research (Kechiche 2015) predicts even higher growth rates for M2M if certain market conditions are fulfilled by industry players and via government actions researching over 40% annual growth (CAGR) as presented in the Figure 34 below.

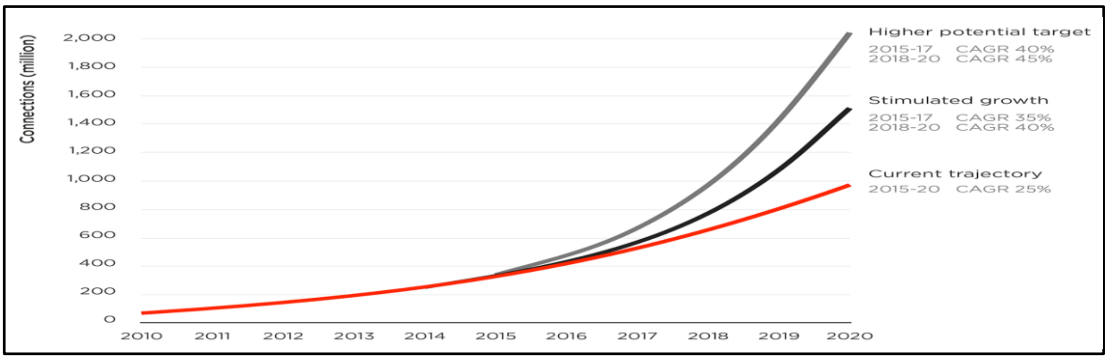


Figure 34. Global cellular M2M connections with variable predictions (Kechiche 2015)

M2M connects devices and acts more as closed system, whereas IoT connects these closed systems through a cloud; devices, sensor and users (Figure 35). Analytics emphasis that IoT will create market where Telcos have an opportunity to take a slide as industries are looking for **connectivity**, **integration** and service providers to support **industry service** and **supply** effectiveness. (2020 Vision: The Heavy Reading perspective 2014, 24-25).

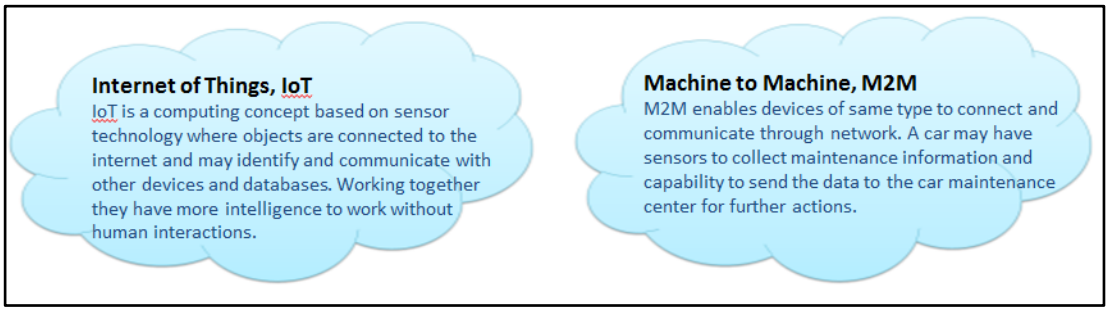


Figure 35. Definition of IoT (Gubbia, Buyyab, Marusica & Palaniswamia 2013, 1647) and M2M (Website of Techopedia 2015)

IoT fundamentals include capabilities to interconnect objects to create "smart environment" (Gubbia, Buyyab, Marusica & Palaniswamia 2013, 1646). It is estimated to have 24 billion devices in 2020 compared to 9 billion in 2013. IoT main components are sensors (hardware) with embedded communication capabilities, storage and tools for data analytics, and presentation capabilities to be able to understand the information and share to different platforms and audiences (Gubbia, Buyyab, Marusica & Palaniswamia 2013, 1647). With such components involved, IoT must unify with cloud computing, not just to reach **scalable** resources and **security**, but also to form complete service chain: sensing service providers **offer data** and uses the cloud storage systems, analytic tool developers and artificial intelligence experts convert the **data to knowledge**, graphic experts turns **knowledge to visual** format with using cloud service models SaaS, PaaS and IaaS (Gubbia, Buyyab, Marusica & Palaniswamia 2013, 1651).

Potential IoT applications for smart environment are described by Gubbia, Buyyab, Marusica & Palaniswamia 2013 (1651). Such an application includes **healthcare** and **emergency** services with location**,** patient and **health monitoring, resource monitoring, predictive information sharing**; **traffic management** with real-time traffic

information and path optimization; **building management** with temperature, humidity, activity and energy **monitoring** and **controlling**; **environment management** with pollution, noise, industry **monitoring** and **controlling**.

Creation of smart environment requires cooperation with IoT and cloud applications and capabilities to combine multiple and diverse services, and support large customer base with reliable and secure manner. The cloud platform must be able to provide **fast** application creation, deployment and delivery with Quality of Service requirements. Cloud resources must be able to prioritize **dynamically** and critical task deliver in **real-time**, meet **Quality of Service** parameters (response time, maximum number of resources etc.) and provide alternative routes to deliver critical workloads in case of failure in the initial delivery. (Gubbia, Buyyab, Marusica & Palaniswamia 2013, 1657-1658).

Camilla Mendler (2015), Principle Analyst from OVUM said that nine out of ten enterprises today want service provider who can **orchestrate** and manage end-to-end between and across Data Centers and networks. Telcos should not silo cloud from M2M and IoT as they all come together and are linked.

5.5 Security and Regulations

Security is one of the main interests among enterprises as the data is not controlled by their own IT resources anymore as described in the earlier Chapter 5.1. Cybercrime is growing with a number of attackers and the frequency of attacks. Networks are undergoing transformation from legacy hardware to virtualized infrastructure and Software Defined Networking (SDN) which in transformation phase will be more vulnerable for attacks than legacy hardware. (2020 Vision: The Heavy Reading perspective 2014, 7).

Security has and will have an impact on Telcos' revenues in a negative manner: if the security is breached it will have a direct consequences for revenue losses through billing and possible penalties defined in contracts, and indirect effect caused by the loss of reputation and churn (2020 Vision: The Heavy Reading perspective 2014, 7).

Analysts (2020 Vision: The Heavy Reading perspective 2014, 8) predict that the service model will evolve from current Telco owned end-to-end security model to more customer data centric model. In a new model Telcos are keen to make use of customer data, which may require 3rd party involvements, and customers may want to make use of another customer data directly without Telcos' contribution. Telcos no more deliver and own end-to-end security, but rather delivers **security modules** in the service chain. The importance to know where Telcos' resources are, who are using them and in what terms is a mandatory to ensure security and defined responsibilities in a cloud environment.

The new EU General Data Protection Regulation (Proposal for a Regulation of European… 2012) for data protection is expected to take into effect on 2016. New regulations require cloud service providers and data center hosting providers to share liability of data protection. There are requirements for example data residency, data encryption, data deletion policies (handing over all data after termination) and for data breach detection and notification (reporting responsibility to supervisory authority during 72 hours of detection). (Johnson J. 2015).

There is no commonly agreed definition for Net Neutrality, but the purpose is to treat digital data and traffic carried through networks equally. This issue has been highlighted as data carrier provider may protect their own interests by discriminating the data offered by competitors or parties they are threated. (Trends in Telecommunication Reform 2013 2013, 6-7).

5.6 Network Evolution to Cloud and Management

To response to these Telcos' pains, vendors' role are to offer management systems to **virtualized network elements** with deployments of VMs (Virtual Machine), network and storage configurations and automated software installations. (Caruso, Curescu, Olrog, Sölvhammar & Vajda 2012, 30-31). Furthermore vendor's role is to provide solution for the pains Telcos are facing with unpredictable data growth, high total cost of ownership (TCO) of hardware, low level of automation capabilities, long

development and launching cycles and high amount of churn by enabling the smooth evolution into cloud, virtualized, model (Reinvent Telcos for the cloud 2014, 3-7).

Vendor's cloud management strategy may further include activities under workflow **automation**, fulfillment of **SLAs** and efficient **resource reallocation** to ensure Telcos' capabilities for individualized product offerings to satisfy consumer and enterprise demands and requirements, and ensure **short time to market**. (Caruso, Curescu, Olrog, Sölvhammar & Vajda 2012, 30).

5.6.1 Network Function Virtualization

Today's NFV (Network Function Virtualization) is still on trial phase for many Telcos, although there are some live implementations in a low scale. Analytics predict that **mastering NFV** will provide Telcos' opportunities to expand network **capacity**, reduce operational **costs**, create new **revenues** and remain **competitive** (2020 Vision: The Heavy Reading perspective 2014, 10-11). Adding the VNF (Virtualized Network Functions) capabilities to virtualize legacy components of the network will further increase benefits. (2020 Vision: The Heavy Reading perspective 2014, 10-11).

Telco2 research lists the **NFV benefits** (NFV: Great Promises, but How to Deliver? 2015) running network functions on a COTS (Commercial Off-The-Shelf) based systems to include: "

- Lower operating costs (some claim up to 80% less)
- Faster time to market
- Better integration between network functions
- The ability to rapidly develop, test, deploy and iterate a new product
- Lower risk associated with new product development
- The ability to rapidly respond to market changes leading to greater agility
- Less complex operations and better customer relations "

The ecosystem around NFV has a chance to reach mass market and VNF developers in the future if there is a necessary standardization in place. NFV ecosystem market-

places would enable possibilities for both vendors and Telcos selling related services as a service; new operational models will be derived from NFV enabling Telcos to provide **NFVI as a Service** (Network Function Virtualization Infrastructure) and **VNF as a Service** (Virtualized Network Functions). (2020 Vision: The Heavy Reading perspective 2014, 11-12).

Software defined networking (SDN) have a big impact how networks are built and managed, and how it will impact on service creation, delivery and monitoring. SDN will try to solve burden caused by increased data traffic and also create new service opportunities and differentiate existing service offering. SDN **enables automation of tasks saving operating expenditures**, coordination of layers increasing **effective service delivery** and **creation** of new SDN based services **increasing revenues**. Such services may include **bandwidth on-demand**, **performance on-demand** and **virtual private cloud with end-user control**. (2020 Vision: The Heavy Reading perspective 2014, 28).

Analyst (2020 Vision: The Heavy Reading perspective 2014, 29) prediction is that SDN will not have a major impact on revenues in next three years, but on 2018 onwards. The reason behind is the legacy hardware, systems and personnel; migration of legacy network elements to SDN based will take time and not all elements will fit to the concept, personnel must be trained for SDN and management systems like OSS (Operations Support Systems) must migrated too.

Principal analyst from OVUM (Mavrakis 2014) highlights the importance of NFV and SDN to run and manage network more **effectively** and **save on costs**, but the lack of other business cases may delay some Telcos adapting NFV and SDN capabilities especially when legacy hardware have not reach its end of life to justify the replacement.

5.6.2 Cloud Orchestration

Orchestration of cloud infrastructure is one of the key points for **effective** and **rapid** service delivery. Janine Sneed (2013), Director of Strategy and Product Management

from IBM Cloud and Smarter Infrastructure, describes orchestration to include resource, workload and service orchestrations where business requirements are fulfilled through automated workflows including storage, network and computing provisioning and configuration.

Tom Nolle (2015) from CIM Corporation differentiates orchestration from provisioning by compering walking to dancing. Provisioning is a fix process to get required resources for applications and components, following certain steps and routes to reach the target. Orchestration in the other hand defines the goal and considers all possible attributes to reach the goal, and is not fixed on predefined steps.

OpenStack, CloudStack and other Cloud Orchestration frameworks ensure **dynamic** and **rapid** service delivery by **controlling** computing resources (storage, network, servers etc.) and providing end to end service **provisioning** across the virtual and physical infrastructure (Cloud Ethernet Technical White Paper… 2013, 18).

Cloud Orchestration frameworks provide the following capabilities as defined by Cloud Ethernet Forum (Cloud Ethernet Technical White Paper… 2013, 18): “

- Enabling rapid provisioning of end-to-end services across server VMs, NFV VMs, overlay and underlay layers
- Allowing enterprises to mirror their own network and security policies by provisioning a chain of virtual firewalls, load balancers, IDS/IPS, etc. of their choice
- Enabling self-service, thereby reducing the need for intervention by and coordination between administrators from multiple domains (i.e. servers, network, etc.)
- Tracking and optimizing physical and virtual resource usage
- Resource metering for usage-based billing of compute and network resources

“

The IDC report (Orchestration Simplifies and Streamlines… 2013, 3) highlights the importance of unified automation and orchestration tools for virtual and legacy infrastructure and to avoid cloud specific silos, and instead concentrates on **integrated** provisioning, configuration, capacity and resource utilization across combined re-

sources. Orchestration solution needs to be expandable as IDC predict (Orchestration Simplifies and Streamlines… 2013, 4) future orchestration needs to cover evolved standards, analytics, new service models and patterns. The homogeneous orchestration of virtual and legacy resources will enable **fast** deployments and migrations, and **efficient** service creation and deployment.

5.6.3 Self-Organizing Networks for Cloud

SON (Self-Organizing Networks) is a concept to improve network performance, capacity, quality and overall network experience by automating the management of base stations. SON includes automated functionalities of self-configuration, self-optimization and self-healing aimed for radio network resources. As network complexity grows SON concept could be expanded to cover end-to-end network where cloud generated data (through IoT sensors and M2M) could be analyzed and used to improve network capabilities. (Technology Vision: Networks that… 2014, 12-13).

Analysts (2020 Vision: The Heavy Reading perspective 2014, 16) highlight the importance of self-healing and self-management concept for virtualized networks where service fulfilment, assurance and measurement must have information provided by advanced analytics to be able to provide **quality services** derived from various virtualized functions.

Nokia believes that expanding the SON concept to include advanced analytics with big data analytics and machine learning enables to manage “complex end-to-end optimization tasks autonomously and real time” as a “Self-Aware Network” (Technology Vision: Networks that… 2014, 13). Furthermore the optimized experience of each end user can be provided by combining traffic differentiation, customer differentiation and offering differentiation information with Self-Aware Network enabled by **advanced analytics** (Technology Vision: Networks that… 2014, 15). As an example, by knowing consumers location, application usage and frequency of usage, it would enable steering the traffic based on latency and network load conditions, and adjust the energy consumption among other possibilities (Teaching networks to be self-aware… 2014, 5).

5.7 Result

The chapter shows the result from all previous chapters in Chapter 5 containing business service opportunities for Telcos, main characteristics of services and enablers for successful service creation (Table 1). Result combines analysts, service providers, vendors and enterprise views on the matter. Items in Table 1 are not in any specific order.

The cloud business services are interrelated to the strategic choice of Telco's role in the cloud ecosystem. **Network connectivity** and traditional **communication** services with **secure** and **scalable** methods are seen as a base for offerings including **on-demand performance** and **bandwidth** offerings. More advanced role would consist of **IT infrastructure** offerings with **Managed Services** providing **end-to-end** solutions to enterprises decreasing enterprise investment and **cost** structure.

Enterprises are cautious for security and the control of the data in the cloud creating opportunities for Telcos to leverage their experience delivering **secure networking** and **services**, and can be used as an asset for offerings. Private cloud has mastered the enterprise cloud delivery models, but public cloud delivery is estimated to increase its share leading to more **hybrid** delivery model.

Telcos can master the cloud **ecosystem** by acting as a **single point of contact** for service offerings and customer relationships. **Marketplace** is seen a valuable method to **bundle** offerings derived from multiple cloud service providers offerings, especially in **SaaS** model. Providing single **billing**, **Service Level Agreements** with Quality of Service parameters are strong areas in Telcos' business and are services to master in the cloud. The importance to provide an **anchor** service to guide enterprises for cloud adaption is seen important where future offerings can be based on, creating upselling opportunities.

The **Big Data Analytics** offers opportunities to understand and predict customer **behaviors**. Successful analysis will lead effective network optimization, enables tailored solutions offerings resulting unique customer experience. **IoT** and **M2M** enable

new business opportunities where connected cars, smart building, environment and traffic management are mentioned as an example.

Customer base can be expanded to various **industries** like healthcare, financial and government for business specific tailored solution combined with mass service offerings.

Telcos' capabilities to offer cloud end-to-end services and solutions building comprehensive cloud environment are insufficient without **partnering**. Partnering is seen essential part to increase revenues. **Data Centers** are the heart of delivering cloud service models and essential part of enabling services. Distributed models are seen more favorable through the localization and low latency requirements.

Similarly Telcos need vendors to deliver **virtualized network infrastructure** to be able to execute cloud services with speed and low cost, and scalability and agility applied. The **standardize interfaces** play an important role to avoid silo effect between and within service developers, vendors and services providers; Interoperability of services is a mandatory requirement where vendors have a role to take part.

Table 1. Summary of result

Service Area	Identified Services	Characteristics
Network Services	Connectivity as a Service; Network as a Service; Bandwidth on-demand; Performance on-demand	Flexible on capacity, scalable control, network efficiency, secure
Infrastructure Services	IaaS	
Digital Transformation	Traditional service to cloud: Voice as a Service, Communication as a Service, Virtual Private Network as a Service; Cloud Wi-Fi hotspots	Pay as you go
Managed Services	Back-up as a Service; Monitoring as a Service; Configuration as a Service; On-demand Scaling as a Service; Hosted IaaS as a Service	
Security	Security Modules as a Service	Secure
SaaS	Customer Relationship Management; Enterprise Resource Planning; Business Intelligence, Office Suites, Operations	
Industry sectors	Tailored services for government, health, financial sector; Bandwidth on demand; scalable resource offerings	Low latency, scalable
Marketplace	Anchor service; Mastering ecosystem	Integrated and Bundled offering providing decreased churn, increased ARPU; Service creation, deployment, promotion, delivery; service lifecycle
Single Point of Contact	Billing integration; Support services; Service Level Agreement; Integrated service offerings	
Big Data Analytics	Shared analytics platforms; Hosted analytics services; Analytics as a Service; Big Data as a Service; Real-time Analytics; IT Log Analytics; Fraud Detection Pattern; Big Data for social media; Analytics-in-motion; Analytics-in-rest	Predicting future behaviours, personalization, low latency, data velocity, tailored solutions
Internet of Things and Machine to Machine	Connectivity; Integration; Security; Scalable resources on-demand; Optimal bath service	Rapid deployment, Quality of Service, real-time
Smart Grid	Healthcare and emergency services with location, patient and health monitoring; Resource monitoring, predictive information sharing; Traffic management with real-time traffic information and path optimization; Building management with temperature, humidity, activity and energy monitoring and controlling; Environment management with pollution, noise, industry monitoring and controlling; Connected cars	
Network Functions Virtualization (NFV) and Virtualized Network Functionality (VNF)	Mastering NFV, Network Function Virtualization Infrastructure as a Service; Virtualized Network Functions as a Service	NW capacity expansion, reduced Opex, competitive advantage, effectiveness, fast time to market, effective integration capabilities
Software Defined Networking (SDN)	Enables bandwidth on demand, performance on demand; Virtual private cloud with end-user control	Solves burden caused by increased data traffic and also create new service opportunities and differentiate existing service offerings
Orchestration	Resource, workload and service orchestrations; Integrated e2e service provisioning	Effective and rapid service delivery, controlling computing resources,
Self-Organizing Networks (SON)	Self-configuration, Self-optimization and Self-healing, quality combined with Analytics	Traffic differentiation, customer differentiation and offering differentiation information
Hybrid Cloud		On-premises (or hosted) + public cloud for less critical workloads
Data Centers		Distributed: low latency, more secure, with virtualization and SDN capabilities
Application Programming Interface (API)		Standardized
End-to-End service delivery		Performance and Quality; Ecosystem creation
Partnering		Ecosystem enabler

6 EMPIRICAL RESULTS

This chapter shows results for Telco Cloud business service opportunities, the characteristic of services and vendors' role to enable Telcos' ambitions based on the method described in Chapter 4.4. Telcos and vendor, Nokia Networks, results are combined and analysed together. Telcos are named as Telco A, Telco B etc. including Nokia Networks.

Telcos included to the research are already offering cloud services and can be considered to be advanced Telcos compared to many other Telcos. All respondents are likely to follow the role where their own cloud services attract partners to include services to their offerings, to be on driving seat. The cloud delivery model is more based on private cloud rather than public.

Table 2 combines services, characteristics and enablers which created interest among respondents. Services are not categorized to any specific order as the importance of the service depends on the nature of enterprise and their specific needs. If the Telco is not mentioned in a specific service area in the table, it does not mean that the service would not be interesting or valuable for that Telco, but it is not just mentioned during sessions.

6.1 Infrastructure, Platform, Managed Services and Data Centers

Telcos are providing **IaaS** based services to enterprises. Telcos will help enterprises to transform enterprise traditional services to **digital** to be more **productive** and more **cost effective** with cloud IT infrastructure. The cloud based infrastructure provides reduced time and resources allocated to deployment and maintenance of IT infrastructure. The main characteristics of cloud like the **agility** and rapid deployment are valid to each service provided.

Table 2. Summary of empirical result

Telcos / Vendor	Service Area	Identified Services	Characteristics
A, B, C, D, E, F	**IT infrastructure**	IaaS	Low cost, secure, availability, reliability, productivity, fast deployment, agility
A,B, C, D, F	**Managed Services**	Traditional IT and connectivity to Data Center; Customer Life Cycle Management; B2B cloud automation; Managed backup, storage, disaster recovery; Automation, orchestration Management; Iaas Management; Consultation, managed hosting; Traditional Managed Service offering through cloud; Virtualized customer equipment services, Virtual content delivery networking services	IT strategy analysis; Partnering; e2e offering opportunity
C	**PaaS**	Platform services	Low cost, secure, availability, reliability, productivity, fast deployment
A,B, C, D, E, F	**Data Center**		Distributed, virtualized, orchestrated; Enabler for service creation and delivery
A,B, C, D, E	**End-to-End solutions**	Ecosystem offering	May requires partnering; IT strategy analysis
A,B, C, E	**Segmentation**	Tailored services for larger enterprises; Mass services for SMEs; Healthcare, government, insurance with connectivity and tailored services	Geographical growth opportunity; Customer understanding; High availability and reliability; Low cost and fast deployment
A, D, E	**Partnering**	Ecosystem offering	Enabler for ecosystem creation
A,B, E, F	**SaaS**	OTT Services, Unified Communication as a Service, Business Process as a Service, Desktop as a Service	Bundled for SME, Build, provisioned, managed by platform, relevant apps only
A, F	**Digital Transformation**	IT Infrastructure; Virtual Private Network as a Service; Communication as a Service; Traditional Services	Effectiveness, Productivity, Agility
A,B, D, F	**Security**	Cyber Security; Digital Identity management; Secure login, Secure net; Device management	
C, E,	**Network**	Connectivity; Network as a Service	Quality, flexibility, secure, availability, reliability
A, B,D, E, F	**Internet of Things, Machine to Machine**	Connected cars; Building, logistic, transport, energy, financial monitoring and control; Smart Grid concept	High availability and reliability; Low cost and fast deployment
B, E, G	**Big Data Analytics**	Real-time Analytics; Analytics for Self-Organizing Networks	Improved customer satisfaction; Real-time; Understanding of customer behaviour
B, C, D, E, F	**Marketplace**	Anchor service: Infrastructure offering extended with services; managed service layer with OSS, QoS, security	Sales automation portal and information sharing; Engage the customer; Self-Service
C, E,	**Single Point of Contact**	Billing integration; Support; Service Level Agreement	One contract, one bill, one support
B, E, F	**Application Programming Interface (API)**		Standardized; Enabler for integrated service offerings
E, F, G	**Network Functions Virtualization (NFV), Virtualized Network Functionality (VNF), Software Defined Networking (SDN), Orchestration**		Enablers for Telcos service offerings; Automation; Low cost; Dynamic allocation of resources

The service offering ranges from colocation, the pure renting of space in the data center, to private cloud through **Data Centers**. Enterprise extensive IT capabilities are unleashed to save costs; there is no need to have enterprise owned servers and space required leading to **lower operating** and **capital** expenditures.

The future direction is not only to provide basic computing resources via IaaS and PaaS, but to include comprehensive solution on top with **Managed Services** (also as professional services). **Managed services** are offered to transform traditional IT and connectivity to Telcos' own Data Centers and networks. Possible Managed Services are **managed backup, storage and disaster recovery**, **managed hosting**, **consultancy**.

Telco B raised **customer lifecycle management** and customer care that differs from traditional due to new service and delivery models of the cloud and must be tuned to follow customer journey from the start to optimize customer experience offering opportunities to Managed Services offerings

There has been some interest among Telcos to run some part of the telecom application on vendors provided cloud rather than Telcos' own private cloud in the future. This would create opportunities to vendors and their Managed Services to offer deployment and integration services to Telcos. The possible future Managed Services could include **virtualized customer equipment services** and **virtual content delivery networking services**.

All Telcos in the study have Data Centers (or colocation centers) where the computing resources are located with appropriate environment. Future Data Centers are to be powered with **virtualization** capabilities. The **orchestration** of virtualized computing resources within and between **Data Centers** is a future model where geographically located Data Centers can interact between each other forming one "internal" Cloud. The **distributed** Data Center concept is favored due to latency restrictions and regulations of data security and the usage.

6.2 Segmentation, Partnering and End-to-end solutions

Segmentation of customers and defining target groups are seen important factors to offer cloud based services. The offering is based on the nature of the enterprise and mainly categories as small and medium size enterprises (SME) and large and multi-national enterprises. The offering of services for SME sector is more based on ready-made solution and mass services, whereas tailored and customized services are offered to large enterprises. There is also possibility to expand offerings beyond national borders to support **geographical** growth through cloud.

Most respondents are already involved with industry sectors, like **health care** and **government** by offering traditional **network services**. The expansion to offer cloud services is seen an option as the purpose in overall is to offer targeted solution to enterprises and industries where Telco Cloud could help to create services cheaper and faster in the future. The business logic is to offer whole scale services (mass services) on top of the dedicated industry offerings. Other possible sectors were mentioned to be **insurance**, **logistic, transport and financial.**

The cloud **ecosystem** concept is seen valuable where Telcos offer **end-to-end** services and solutions to enterprises. As an example, Telco C approach is very customer centric where enterprise entire IT strategy are analysed to form end-to-end solutions. Cloud services are created by walking with customers to understand their requirements and teach them to understand the benefits and possibilities of cloud compared to traditional IT.

ITC ecosystem cannot be built alone, but partnering is seen essential element to provide comprehensive services and solutions. All respondents highlighted the importance of partnering with other service providers to be able to offer **end-to-end** solutions.

6.3 Digital Transformation, Network, Software and Security

Telcos' intention is not to create extensive **own** software application repository, but rather include other service providers software and **bundle** application to fulfill customer needs. Only Telco C did **not see SaaS** services as a mandatory as enterprises are buying applications directly from application providers. Another approach was mentioned where only dedicated set of **applications are selected** to their clients by Telco, instead of having waste application repository where the customer must select services from the scratch.

Telco F described the difference between traditional and cloud based offerings by saying that in the past different services were created and launched and eventually used only by marginal amount of consumers without creating revenues, but required maintenance and thus increasing operating expenditures. But moving services to cloud will be easier to run also legacy services and reduce the costs.

Unified communication as a service is one of the most favored service to be offered by Telcos due the traditional nature of their services; traditional communication services can be transformed to cloud and combined with IT infrastructure offering through Data Centers.

Connecting corporate networks with **Virtual Private Network** (VPN) is a traditional service which creates flexibility, speed and cost savings when deployed to the cloud and run through Data Centers.

Telco E predicts that offering only computing resource and storage services in not valuable business alone for Telcos. The horizontal business approach is the key with **communication, connectivity and customer interaction services** extended with **Business Process as a service (BPaaS), Desktop as a service** (DaaS) and **Virtual Desktop Infrastructure as a Service** (VDIaaS) with **Bring Your Own Device** (BYOD).

Network is to be offered as a service (NaaS) with quality providing reliability availability and secure connections. In some cases part of the network infrastructure is

separated exclusively for dedicated customers and management of network activities are offered, which enables fulfillment of specific customer use cases. The characteristic of such services are very high availability and reliability.

Offering **security** as a service creates two fold perspective among respondents. All respondents share the view that security must be provided and is something Telcos are in a good position to offer based on their traditional business. The security is embedded to all connectivity, networking, access and infrastructure related services, but can be seen both as a service and as a characteristic of the service. Telco E emphasis that they have dealt with network security issues for many years and even though cloud model will bring new challenges requiring more effort, it is not seen as a burden. They do not see **security** bringing new business opportunities as a sellable item because enterprises demand the security as presumption to all provided services.

Similarly Telco G pointed out that security has always been important part of deliveries and is a must requirement and cloud model does not dramatically change that. It is more about careful planning and deployment of cloud network and infrastructure with sufficient competence; the demand of relevant competences is increasing.

Security can also been seen as a service opportunity. Possible service opportunities around security were highlighted to include **secure login to the company network**, **virus protection**, **administration of the mobile devices, cyber security** and **digital identity.**

6.4 Marketplace and Single Point of Contact

Marketplace is the efficient model to share information on available service portfolio and acts as a sales automation portal. Marketplace supports **self-service** concept where various cloud offerings from various numbers of cloud service providers can be bundled to one service to serve consumers' and enterprises' individual and dedicated needs; i.e. to combine cloud services to one customer tailored solution.

Enterprises require online and **single point of contact** with capabilities to offer resolution for their problem. Single point of contact brings a huge value for the customer say Telco C. Similarly it is believed to bring more revenue opportunities, if the personal service can be offered with **one contract, one bill and one support channel**. That includes comprehensive **SLA management**, where customer communicates with Telco's representative only, and Telco negotiates with other parties involved; or where Telco monitors 3rd party services and consults customers in 3rd party SLA negotiations.

It is important to offer an **anchor service** to the enterprises rather than massive set of services to start with. Enterprises are generally not well aware of cloud offerings and benefits, thus offering one service first, guiding of the use and benefits of the service, will generate opportunities to upsell other cloud services. Such an anchor service cannot be explicitly defined for all enterprises, but selected based on the current enterprise need. Telco C and D predicted that the anchor service could be in line with **infrastructure offering extended with services; manage service offering;** It is not just pure infrastructure, but everything around it including, **security, management**, **QoS** etc. Basically managed service follows the bath from traditional managed service concept, but in the cloud environment.

6.5 Internet of Things, Machine to Machine, Big Data Analytics

Iot, **M2M** and **Big Data Analytics are** rated highly as future service opportunities, and where Telcos should be involved (there are some cases already today).

Analytics are and will be important part to understand customer and service behavior and will be used to improve network performance and scalability among others. A**nalytics of Big Data** is an important factor to improve services and customer satisfaction, and it is an area to concentrate.

There is a need for **real time analysis for IT infrastructure and services**. Enterprises require simulation how certain services will perform in certain situations. Telco E gave an example: how streaming service will affect on another service applica-

tion performance. Combining analytics with network self-optimizing concept would create a benefit to manage and understand the end to end cloud behavior.

Analytics are also important for **Self-Organizing Networks** and **orchestration** mentioned by Telco G; predicting network behavior through Key Performance Indicators (KPI). Analyzing behaviors is seen as a must to understand how customers are using the network and how to optimize resources and network behavior.

Telco D gave an example of IoT/M2M capabilities presented in the Mobile World Congress in 2015 with **connected cars**. In the Connected Cars concept the car provides automatic status of the car with location and conditions etc. information, and receives automatic notifications of alerts, information of driving behavior and access to media.

One of the interesting future opportunities was mentioned by Telco A where M2M approach can be applied; **Smart Grid**. Smart metering is part of the Smart Utilities or Smart Grid for intelligence management of water, gas and energy services for buildings. In the smart metering Telcos have a chance to leverage their communication infrastructure, connectivity, network management, Data Centers and cloud for the better control of consumption, payments and services. Smart Building provides end-to-end solutions for building security, lighting and air conditions (and heating) as an example.

6.6 Application Programming Interfaces, Virtualization, Software Defined Networking, Orchestration

When discussing on Telco Cloud services, characteristics of services and vendors role in the concept, it is vital to understand how to enable creation of such services. It cannot be avoided to consider what is required to deploy and deliver cloud based services.

Telcos are aiming to bundled cloud services from multiple service providers. To be successful combining services without extra complexity and workload requires **integrated APIs**. Currently APIs are not standardized and four respondents emphasis the

importance of standardization of interfaces to be major requirement for Telcos and standardization bodies. This is an area where vendors are able contribute and help Telcos to reach their goals. Nokia understands the importance of APIs and the standardization, and there are many initiatives where Nokia is visible present.

The virtualization, orchestration, automation and SDN do not apply for Data Centers only, but are equally important to apply network elements too. **SDN** was mentioned to enable services like connectivity on-demand with **automation** providing reduced operating and capital expenditures. SDN can also be seen as an enabler for telecom cloud service model where the application itself can require resources and services from the network leading to the scenario where the application acts as an end user and not the consumer.

In the **IoT** world there will be billions of sensor connections to each other wirelessly and requiring network resources and such a scenario is not able to be managed manually, but dynamically and automatically through standardized interfaces. The scenario will evolve the network capabilities and services. **Dynamic allocation of resources with orchestration** requires understanding of users and application and relationship between them. Orchestration is already possible for smaller components, but for more complex solutions with multivendor application evolving the orchestration is a must.

7 CONCLUSION AND RECOMMENDATIONS

Without the network there is no cloud. Telcos' position in the cloud ecosystem is vital; no data is transferred without an access to the network and end-to-end connectivity of resources. The amount of data is increasing rapidly in the network due to cloud services requiring constant monitoring and control of network performance and bandwidth. The traditional network infrastructure is inflexible and rigid for rapid changes, costly to maintain and introduction of new features is a slow process. Moving towards virtualized cloud based world where characteristics of on-demand, fast time to market, scalability and any time accessibility are to be fulfilled require Telcos to transfer their network infrastructure to the virtualized cloud model where resources can be allocated, released and scaled much faster than today, and new services deployed and introduced in a short time.

Vendors' delivering virtualized and software defined network resources are out most important for Telcos. The transformation does not happen overnight; there will be a network infrastructure with both legacy and virtualized equipment for many years to come. Managing the two fold landscape end-to-end is one challenge where the importance of orchestration of both resources is mandatory. Orchestration of cloud infrastructure has its own challenges with missing standardized interfaces. In each layer of communication of resources the standardization of interfaces are mandatory to avoid multiple management systems working in silos leading increased cost and loss of agility in operations. Vendors have a big role to work with standardization bodies to reach solution until unstandardized interfaces are too widely spread. In a wider perspective IoT will bring billions of sensors communicating with each other requiring a common language to understand. The fear is that there are soon IoT cloud based environment with massive amount of data without homogeneous controlling capabilities leading to chaos.

Telcos' role providing connectivity and network in the cloud enabled world is the mandatory requirement for all Telcos in the future. Expanding the role in the cloud ecosystem providing wider spectrum of cloud services is a strategic choice to make. The ecosystem consisting IT infrastructure, platform, software, communication, con-

nectivity and network services requires close co-operation with other service providers, partnering. Telcos are not in the best position to create attractive own software based services (SaaS), but there are many service providers out there with far more advantage capabilities and great innovations looking for network providers to connect. Telcos' capabilities to create an alluring marketplace where end-user may select suitable services based on their needs are attracting service providers to partner. Selecting widely known and productive applications like Microsoft Office 365 to be part of the offering creates visibility and engaged the customers leading to upselling opportunities. Similarly there are many 3rd party applications bundling providers who have necessary contacts for application developers and software service providers offering a software marketplace to be embedded to Telcos' own marketplaces; such a partnering reduces the need to create direct interfaces to developers, but let providers to take care of the individual contracts.

Telcos can master the cloud offering and end-users by providing single point of contact for service agreements including single billing and support. Telcos act as a central point for customers of any service related issues and engage the customer creating a value for all parties involved. Telcos have delivered and managed Service Level Agreements with Quality of Service requirements in their traditional business and are well capable to manage them in the cloud environment as well. It is very important for enterprises to understand what they can expect from the service and what the limits of the service are. Pure cloud and OTT players are not able to guarantee service levels for networks in a same level than Telcos. There are more 3rd parties involved in cloud ecosystem which makes SLAs more challenging to manage, but Telcos have an opportunity to master end-to-end service level chain.

Telcos should move their traditional services (voice, communication etc.) to cloud for cost savings and performance purposes and for faster deployment. Embedding traditional service offerings with emerged technology trend of cloud computing is an option to response OTT offerings and gain back revenues.

Telcos have massive competitive advantage due to existing experience and knowledge of networks and their massive customer base. They have delivered secure and quality connections for years better than anyone else. These attributes do not

fade out with cloud, but rather increase the demand; more sensitive and critical data is transferred over the network and stored away from enterprise's own premises. Secure networking is characteristic what every enterprise values and demands. There is no room for errors in security, otherwise the brand is damaged and trust is gone. Not providing sufficient security will dissatisfy enterprises and eventually will lead to churn and loss of trust harming the Telco's brand image.

Even though security is a characteristic it also can be seen as a service to deliver. This has created some debates if security can be sold separately, but there is room for independent security module selling. Security cannot be separated completely from cloud offerings, but the power of security should be used as a competitive advantage.

The specific data legislations in some countries, and pending EU level regulations, demand high security for data and Telcos are requested to report their data security capabilities, like where the data is located. To ensure the trust towards consumers, the regulations are to be followed. It does not mean that Telcos need to alter their current security actions dramatically as security has always been a part of service.

With virtualized cloud infrastructure service creation, deployment and delivery are much faster and effective than in traditional system encouraging Telcos and other cloud service providers to try and withdraw multiple services without a fear of heavy burden of costs and loss of time.

As there are no killer cloud applications (like SMS was in the early phase of mobile era) defined, Telcos should concentrate customer understanding and segmentation. Enterprises today are not well aware of availability of services and benefits of the cloud thus Telcos must educate enterprises and walk the first mile with them. Offering one anchor service instead of offering a huge set of services to choose from relieves the cloud service adoption. The anchor service may also be a predefined set of services carefully selected by Telco forming an entity. The upselling time comes after first successful experience of cloud service.

Bundling service offering is a feasible method to offer cloud services to SME sector; offering certain set of office applications, communication and network services

through cloud. The concept is somewhat different with large and specific industry sectors. They require more tailored solution suitable for their business parameters, and the mass service offering comes on top of tailored solutions. Some Telcos are already offering traditional services industries like healthcare and government, and these services are to be moved to cloud environment to bring extra benefits offered by cloud. There are more industries interested on cloud benefits and that offers the opportunity to enter, not just for connectivity but also for IT infrastructure.

Enterprises are transforming their traditional IT infrastructure, data and applications to the cloud as part of digital transformation. The cloud benefits of agility, increased productivity, flexibility, scalability and cost savings are the main reasons for transformation. Offering infrastructure services (IaaS) with virtual computing resources like storage and computing power are the basic offerings. Offering cloud based IT infrastructure with networking and communication services is great opportunity to Telcos to leverage. Enterprises are still and will be cautious of their critical workloads and the private cloud will continue to master the delivery, but the use of public cloud is increasing causing the hybrid cloud to be the most advantage options to many.

Telcos' experience to offer Managed Services (professional services, consultant, hosting etc.) is the direction for the cloud based IaaS offering. The competition with pure cloud players offering basic IaaS and PaaS is not a battle to win, but offering complete IT infrastructure with connectivity, networking and Managed Services will differentiate Telcos from others.

Vendors have provided Managed Services to Telcos for many years and will continue to do so in the cloud. The virtualized cloud based world will offer opportunities to run part of the Telcos' network functionality in vendor's Data Centers as a part of the Managed Service offering, especially in non-workload critical areas. Offering network management and cloud orchestration solutions through cloud is an opportunity, where monitoring and controlling of the resources are relieved from Telcos.

Data Center is the main physical entity which is required to offer IT infrastructure. Large Telcos have own Data Centers and some have acquired and partnered with other Data Center providers. Investments on Data Centers continue to grow as the customer base grows. Centralizing Data Center concept would offer overall cost savings, but are not the most feasible method to offer services as the distance to an end-user might cause latency unsuitable for critical workloads. There is also a need for local, country specific, offerings where distributed model is more effective method to use. In the distributed model Data Centers are to be linked together (not to work purely independently) where virtualization, software defined networking and orchestration are to be applied to provide effective, flexible and scalable computing resource management and distribution across and within Data Centers.

Telcos have a huge amount of end-user and network data, which needs to be composed and analysed; and the amount of data is increasing daily. In most cases the data is laying in the hard drive and only minor part of the data is used for analysis. The challenge is how to process huge amount of data, derived from multiple directions, to give a value. To be successful forming on meaningful information, Big Data Analytics give a value for data. Produced information can be used to improve network efficiency, service quality and user experience leading to customer engagement, tailored solutions capabilities and thus new business opportunities. Telcos cannot ignore the data and they cannot manage the analysis without dedicated resources allocated to the Big Data Analytics process. The organisation who is ready to admit the importance of analytics, establish organisation around and figure out reasonable methods to exploit the data will gain huge competitive advantage.

Selling individual data to 3rd party purposes (like marketing) could bring new revenues, but can also harm the brand thus not seen commonly attractive among Telcos. Still today, selling the individual information to third parties is challenging as enterprises and consumers appreciate the trust around personal data; the individual should have the final say of which information can be shared and to whom; managing of own data. Telcos may gain end-user acceptance if data usage is promoted to improve the end-user service experience leading to customer engagement and upselling, and even new service, tailored, opportunities.

Internets of Things and Machine to Machine are all areas which should not be separated from the cloud. Each of them offers new business opportunities; there are good examples of IoT, M2M and Smart Grid use cases including monitoring and controlling of connected cars, logistics with transportation and buildings with electricity, water, gas, heating etc. Telcos' role in the value chain providing connectivity, network, communication, monitoring and controlling services are worth to leverage.

To conclude in short, Telcos' first challenge is to decide their role in cloud environment; carrier or broker, or both. It has already shown that their network must be adapted to response requirements of cloud. Acting as a broker can be started with small steps by partnering cloud service providers for application and software deliveries. Enterprises are transforming their IT infrastructure to cloud and Telcos' offering solution though own or partner virtualized and software defined Data Centers are responding enterprises pains and gains. Combining enterprise IT offering (IaaS) with Managed Services and partnering with 3rd party cloud service provider for SaaS will lift Telcos to higher position in the cloud ecosystem value chain. To master the cloud ecosystem requires controlled anchor driven marketplace and capabilities to act as a single point of contact with end-to-end Service Level Agreements.

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APPENDIX 1

INTERVIEW GUIDE, THEMES.

The PURPOSE of THEMES

The aim of themes is to direct the interview to find answers for following questions:

- What kind of new business services cloud computing ("Telco Cloud") offers to telecommunications operator end customers?
- What are the main characteristics of these business services?
- How could telecommunication vendors help you to reach your targets?

The emphasis on Your long term visions and strategies for cloud computing business services

THEME 1 VISION

ROLE in the CLOUD

Analysts emphasis that future revenues depend on Telco's capabilities to act as a valuable member in the cloud value chain by

a) Providing **network capabilities** to connect, deliver and execute (compute and storage) 3rd parties (or partners) cloud services,
b) Creating **own cloud services** attracting partners to include services to their offerings, and
c) Offering a **marketplace** where various cloud offerings from various numbers of cloud service providers can be bundled **to one service** through APIs to serve consumers and enterprises individual and dedicated needs; i.e. to combine cloud services to one customer tailored solution.

Especially the above points b) and c) require wide interworking APIs to be successful. APIs are seen the main contributor to establish cloud ecosystem which serves customers as individuals allowing them to personalized services by collecting various cloud services from multiple providers to one service or solution with one price and payment channel to deal with.

- **What is Your role in the future cloud ecosystem?**
- **Does the role follow above principles or would you share different approach?**
- **Your view on the importance of APIs, and any contribution to API standardization ?**

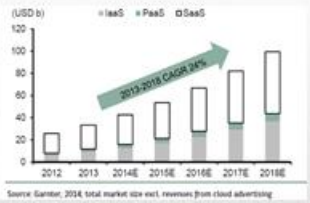
THEME 2 VISION

SERVICE & DELIVERY MODELS

Public cloud market is estimated to reach 23-24% compound annual growth rate (CAGR) during 2014-2018 globally according to Gartner and IDC researches.

SaaS presents 65% of global public cloud market with 21%CAGR.
IaaS have 27%market share with 32%CAGR.
The smallest service model is **PaaS** with 7%market share and 23%CAGR.

Public cloud space is crowded by big cloud players like Amazon and Google. Enterprises have an interest to have own **private** (internal) cloud for critical workloads.



- **Which service model is the most attractive for You in the future?**
- **Explain reasoning behind the service model strategy?**
- **Are You planning to deliver services via Public, Private or Hybrid Cloud?**
- **What is the business thinking behind the decision?**

THEME 3 VISION

INDUSTRY SECTORS to ENTER

Telco's cloud offering have raised interest among many industrial sectors and OVUM report shows that there were more government sector wins that any other in 2013. Also financial and health sector are potential industries to enter especially when the cloud computing healthcare market is estimated to grow at CAGR of 20.5% from 2012 to 2017, and the forecast for cloud financial services predicts a CAGR of 24.85 percent over the period of 2013-2018.

As an example, cloud computing offers major benefits to the healthcare sector where the information of patient can be stored, access and shared across various entities and geographies without a delay and loss of time in urgent cases.

- Are You planning to enter new industry sectors (health care, financials, government, insurance etc.) ?
- What are the main characteristics of these services?
- How could vendors help You to provide these services?

THEME 4 VISION

MANAGED SERVICES

Some cloud providers have previously offered IaaS, but moved towards Managed Services (like Rackspace) because Amazon, Google and Microsoft have superior advantage of offering IaaS through massive investment for Data Centers and Cloud infrastructure.

- Are You considering to offer Cloud Managed Services?
- What type of Managed Services?
- To which industry sector?
- Is Cloud Managed Services seen as mandatory service to create revenues?
- How could vendors help You to offer Cloud Managed Services?

THEME 5 VISION

MORE DATA CENTERS ?

Today's Telco Cloud concept is concentrating to offer **basic services via Data Centers**. Some Telcos have partnered with Data Center providers rather than invested their own infrastructure, and the direction is somewhat clear: Telcos cannot compete against big cloud players like Amazon, Microsoft and Google, who are investing massively for Data Centers and overall cloud infrastructure and at the same time they have decrease the price levels.

The debate between **distributed** or **centralized** data center concept is ongoing, and both have some good and bad points; centralized are more cost effective and distributed will reduce the latency. Analyst indicates that distributed concept are favored by enterprises as they want to keep data close to them, reduce latency and increase security, impacting telcos strategies for data centers.

- Are You investing on Data Centers? Own, acquired or partnered?
- Does distributed or centralized model serve Your future purposes?
- What new business service opportunities will Your Data Center strategy bring?
- How could vendors support Your new services and Data Center strategy?

THEME 6 VISION

SECURITY

Security is one of the main interests among enterprises in all sectors as the **critical data** is not controlled by their own home based IT resources in the future. Cybercrime is growing with a number of attackers and the frequency of attacks. Networks are undergoing transformation from legacy hardware to virtualized infrastructure and Software Defined Networks (SDN) which in transformation phase will be more vulnerable for attacks than legacy hardware.

The new **EU regulations** (EU General Data Protection Regulation) for data protection is expected to take into effect on 2016. New regulations require cloud service providers and data center hosting providers to share liability of data protection. There are requirements for example data residency, data encryption, data deletion policies and for data breach detection and notification.

- Are You planning to provide security services to enterprises in the future?
- What type of security services?
- What are the main characteristics of these services?
- How could vendors help You to provide security services?
- What kind of impact new regulations have on Your business?
- How are You planning to response and meet new regulations?
- How could vendors help You to meet new regulations?

THEME 7 VISION

VIRTUALIZATION and SDN

Today's **NFV implementations** are still on early phase for many Telcos. Analysts predict that mastering NFV will provide opportunities for Telco's to expand network capacity, reduce operational costs, create new revenues and remain competitive. Adding the VNF (**Virtualized Network Functions**) capabilities to virtualize legacy components of the network will further increase benefits; not only new components are virtualized, but also legacy forming the overall virtualized system to support cloud ecosystem.

Furthermore the **New IP** (virtualized IP) network concept will change the way Telcos creates revenue by selling content driven services and reduce operational and capital expenditures.

Software defined networks have a big impact how networks are built and managed, and how it will impact on service creation, delivery and monitoring. SDN will try to solve burden caused by increased traffic and also create new service opportunities and differentiate existing service offering.

- How NFV, VNF, New IP and SDN will impact on Your future service offerings?
- What are the main characteristics of these potential new services?
- The importance of vendor's capabilities to support virtualization is obvious, but in which way? Give Your high level thoughts?

THEME 8 VISION

CLOUD ORCHESTIRATION

OpenStack, CloudStack and other **Cloud Orchestration frameworks** ensure dynamic and rapid service delivery by controlling computing resources (storage, network, servers etc.) and providing end to end service provisioning across the virtual and physical infrastructure of Data Centers.

Cloud Orchestration frameworks provide the following capabilities as defined by Cloud Ethernet Forum:

- Enabling rapid provisioning of end-to-end services across server VMs, NFV VMs, overlay and underlay layers
- Allowing enterprises to mirror their own network and security policies by provisioning a chain of virtual firewalls, load balancers, IDS/IPS, etc. of their choice
- Enabling self-service, thereby reducing the need for intervention by and coordination between administrators from multiple domains (i.e. servers, network, etc.)
- Tracking and optimizing physical and virtual resource usage
- Resource metering for usage-based billing of compute and network resources

- How should Cloud Orchestration be enhanced in the future?
- What kind of new business services may it create?
- What is the vendors role in Cloud Orchestration?

THEME 9 VISION

SON for CLOUD

SON (**Self-Organizing Networks**) is a concept to improve network performance and capacity with functionalities of **self-configuration, self-optimization** and **self-healing** aimed for radio network resources. Expanding the concept to include advanced analytics (Theme 10) enables tiding service fulfilment, measurement and assurance together to ensure self-healing and self-optimization capabilities with virtualized networks. As an example, by knowing consumers location, application usage and frequency of usage, would enable steering the traffic based on latency and network load conditions, and adjust the energy consumption among other possibilities.

Advanced Analytics
Advanced Analytics is a grouping of analytic techniques used to predict future outcomes. Such techniques may include data mining, location intelligence, predictive analytics etc.

- How could advanced analytics be used to improve network experience?
- Would it create new business service opportunities?
- What kind of features could SON for Cloud include?

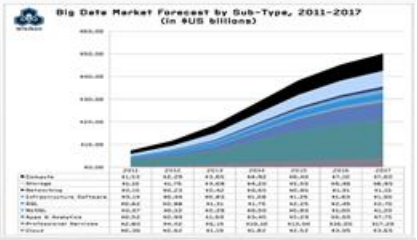
THEME 10 VISION

BIG DATA + ANALYTICS

The Big Data market estimates are on 17% CAGR level over the next 6 years, including related hardware, software and professional services.

Telco's have a huge amount of customer and network related data (Big Data) in their hands. Adapting **advanced analytics** methods (data mining, location intelligence, predictive analytics etc.) Telco's have a focus on predicting future trends of events and consumer behaviors, and helping to personalize consumer's network and service experiences.

Telco's capabilities to find a way to collect the data from various sources, analyse the data of many forms and build an overall picture of behaviors are seen critical factors by analysts to stay ahead of competitors.



- Are You planning to provide advanced analytics services to enterprises?
- What type of characteristics these services holds?
- Are You planning to use advanced analytics to improve Your customer experience?
- In which way?
- How could vendors help You to reach Your ambitions?

THEME 11 VISION

IoT & M2M

IoT and M2M market is forecasted to grow significantly during next five years and Telco's have an opportunity to enter the game. The global IoT and M2M communications market is estimated to grow a CAGR of 29.9% from $255.87 billion in 2014 to $947.29 billion in 2019.

As M2M connects devices and acts more as closed system, whereas IoT connects these closed systems through a cloud; devices, sensor and users. Analytics emphasis that IoT will create market where Telcos have an opportunity to take a slide as industries are looking for connectivity, integration and service providers to support industry service and supply effectiveness.

Internet of Things, IoT
IoT is a computing concept based on sensor technology where objects are connected to the internet and may identify and communicate with other devices and databases. Working together they have more intelligence to work without human interactions.

Machine to Machine, M2M
M2M enables devices of same type to connect and communicate through network. Like a car may have sensors to collect maintenance information and capability to send the data to the car maintenance center for further actions.

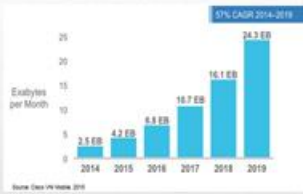
- What are the most relevant areas of IoT or M2M to You in the future?
- What new business services it will bring to You?
- How could vendors help You?

THEME 12 VISION

DATA GROWTH and NET NEUTRALITY

The increased deployment of cloud computing will generate huge data traffic to networks. Global mobile data traffic grew 69 percent in 2014. Global mobile data traffic reached 2.5 exabytes per month at the end of 2014. Global mobile data traffic is estimated to grow at a CAGR of 57 % from 2014 to 2019, reaching 24.3 exabytes per month by 2019, almost ten times more than today.

Such an enormous growth of data traffic has an impact on Telco's business and highlights the importance of ensuring the availability, performance and scalability of resources.



The purpose of **Net Neutrality** is to treat digital data and traffic carried through networks equally. This is issue has been highlighted as data carrier provider may protect their own interests in the network by discriminating the data or service offered by competitors or 3rd party service providers.

- How do You plan to address the data growth?
- What kind of business opportunities will data growth generate?
- What are characteristics of these services?
- What kind of business benefits and opportunities will Net Neutrality create?
- How could vendors help You to address these issues?

THEME 14 VISION

CLOUD MARKETPLACE

The cloud marketplace is the forum where applications coming from different providers can be modified to different user needs, integrated and traded together. Marketplace **supports the complete service lifecycle** (including planning, development, testing, provisioning, deployment, discovery, executing and monitoring) and acts as an unified location for all stakeholders. Marketplaces **support pricing, revenue sharing, promotion and billing** capabilities for smooth transactions and rapid response to current business conditions.

The cloud marketplace is not a common scenario yet today, but seen important concept to improve cloud service creation, deployment, promotion and delivery.

- Are You currently offering services via own, partner or any cloud marketplace ?
- How should cloud marketplace evolve from here?
- What should be the main characteristics of future marketplace?
- Do vendors have any role in a cloud marketplace scenario?

THEME 15 VISION

OTHER SERVICE MODELS

There are currently many services offered, or planned to be offered, based on IaaS, PaaS and SaaS service models: Identity Access Management as a Service (IAMaaS), Service Delivery Platform as a Service (SDPaaS), Desktop as a Service (DaaS), Unified Communication as a Service (UCaaS), Network as a Service (NaaS), Everything as a Service (XaaS) just a few to mentioned.

Previous themes in the slide set have identified some new service opportunities. Please share Your thoughts of other business service opportunities which may occur in the future.

- What kind of other service opportunities You anticipate to emerge in the future?
- What could be the main characteristics for these new services?
- How could vendors help You to rationalize these services?