Understanding the Relationship Between SDP and the Cloud

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Abstract — **Notions of SDP (Service Delivery Platform) has been widely used in Telcos albeit without a common industry understanding. SDP projects have spearheaded next generations of Telco service provider (SP) services and their forays into new business models. Recently, Telco players tried very actively to understand how to take advantage of Cloud Computing to improve efficiencies or open new opportunities for them. Today most initial activities have often started disconnected from Consumer, VAS and Enterprise activities where SDPs are used. The main contributions of this paper are in explaining how to understand SDPs in the context of Cloud Computing and in positioning Cloud Computing and SDPs from an architecture for Telcos that want to reduce cost and complexity and increase efficiencies, scalability and availability of existing SDP and communication services as well as explore new business models with differentiators that could favor Telco SPs over other more conventional cloud providers. Such recommednatiosn and blueprints have never been discussed before as far as we know.**

Keywords-component: Service Delivery Platforms, SDP, Cloud Computing, IaaS, PaaS, SaaS, Telecommunications, Telcos, SDF, OSS, BSS, Services

I. INTRODUCTION

Telcos (i.e., Telecommunications operators or Telco SPs in this paper) have deployed many variations of SDPs over the last decade, sometimes multiple SDPs within a same domain, to efficiently offer services including core communications, collaboration and multimedia services, content sales and delivery, exposure to third parties and reselling, etc. Initially some operators have deployed SDPs as one platform per service, network (technology) or target market. Today, one can see many SDP consolidations around one platform across all networks and for all services, including examples of multinational SDPs that allow multi-property operators to reduce cost and time to market across their multiple local subsidiaries as well as increase the application addressable market and therefore attractiveness to third party developers.

Still, the absence of similar and sustained SDPs across enough Telcos has hurt the attractiveness of SDPs for developers when compared to the opportunities opened to them by the internet or the recent applications stores for smartphones. The omnipresence of the Internet / web and its fundamentals impacts on the business of Telcos, is today forcing Telcos to better compete or cooperate with Internet Service Providers. In fact, one can expect that that many Telco SPs today will eventually morph their service business into similar "SoftCos" (i.e., not really distinguishable from many of the Internet service providers like Google, Yahoo, Facebook and many others).

In the context, the successes or promises of Cloud Computing initiatives driven by companies like Amazon, Google, Yahoo, Salesforce.com and Microsoft as well as the offerings of companies like IBM, Oracle, VMWare and many open source projects have caught the attention of Telcos. Could it really be an ideal opportunity for Telcos to develop new business models with significant credibility, differentiators and hence chances of success? Certainly many Telcos realize that the market is moving fast but they still lack validation of the opportunities…

Today many Telcos have some Cloud Computing initiatives, proof of concepts, pilots, initial offerings or even production services [7]. The industry seems to have learned from the mistakes of wall garden Telco-only vertical solutions that failed repeatedly in the past (e.g. IMS (IP Multimedia Subsystem) [3,4]): most initiatives are built or extend on what we may call as IT or Internet clouds … as examplified by Amazon AWS [6] (Most projects reuse AWS EC2 or S3 services and possibly a few others).

For Cloud Computing Audience, we believe that it is important to summarize what an SDP really is before discussing the relationship to the cloud and recommending how "IT or internet compatible clouds" can be used or offered by Telcos with differentiated features that exploit Telcos strengths.

II. UNDERSTANDING CLOUD COMPUTING AND TELCOS
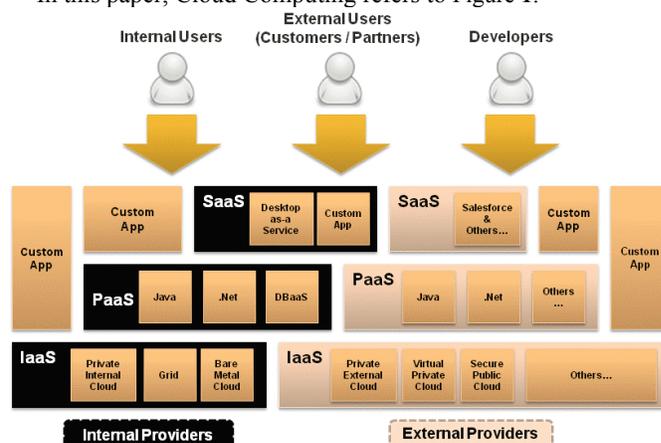
In this paper, Cloud Computing refers to Figure **1**.

Figure 1 – Anatomy of Cloud Computing. Figure inspired from [1]

Cloud Computing enabless "capabilities available on demand" or "on demand offerings" that can respectively support internal need or what a customer uses and therefore pays for. These include: 1) IaaS (Infrastructure as a Service) that can provide computing infrastructure (e.g. virtualized OS with underlying computing HW (CPU) and storage). 2) PaaS (Platform as a Service) which include a control plane and an application plane with development and execution environments. The associated development tools can also be hosted in the cloud (and for example accessed through a browser). With PaaS, developers can build (web) applications on its SEE/SCE (Service Execution Environment / Service Creation Environment) without installing any tools on their computer and then deploy those applications without any specialized systems administration skills. The control plane can provide a combination of features like application scalability, application plane and infrastructure usage management shared across many applications (GAE (Google App Engine), Force.com) or customizable per application (~ like with OSGI bundles an application can be bundle with the SEE bundles that it requires). For service providers of complex or critical applications (like Telcos), the latter is recommended as it ensures easier management and performance assurance while the former is more for "consumer" or simpler less critical applications. 3)

Software as a Service: software that is deployed over the internet or intranet. With SaaS, a provider rents an application to customers on demand, through a subscription or a "pay-as-you-go" model.

As described in Figure 1, a Cloud Computing solution can be built on multiple "clouds" configurations: private cloud (i.e., in house on demand infrastructure), public cloud (provided by other cloud service providers) or combinations of the above. The latter illustrates especially well how Cloud Computing can allows a service provider to handle peak requirements without having to allocate or invest in infrastructure that would otherwise remain idle, hence reducing CAPEX requirements. With a PaaS, OPEX costs are also further reduced by consolidating the development environment and the life cycle management of the applications developed on it.

Offering IaaS, PaaS and SaaS open new business models to any service providers. PaaS today are only closely closely-held and only available as a Public Cloud service. No full fledge PaaS exist as a middleware product offering yet. None offer yet the customization mentioned above.

III. CLARIFYING THE NOTION OF SDP

In the absence of an industry accepted definition of SDP, we proposed to define a SDP as IT SOA middleware with Telco / communications features, capabilities and performances (see Figure **2**) [5]. A good blueprint of how it should be implemented is provided by the OSE (OMA Service Environment) and related OMA and ITU work and specifications [2].
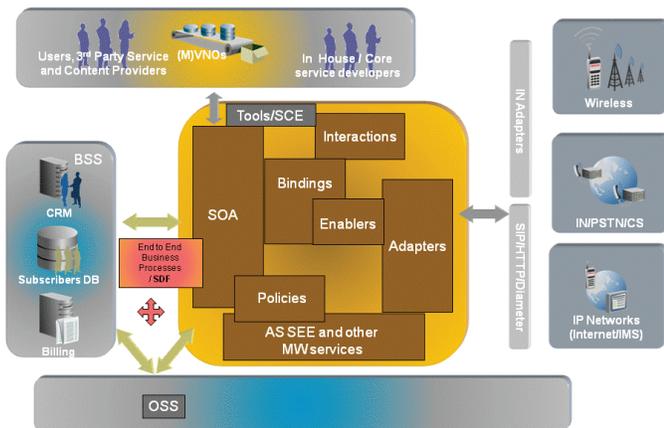

Figure 2 – Blueprint and positioning in a Telco Environment (or generic Service provider environment) of a SDP as Middleware + Telco (in fact communications as this works also on internet for ISPs) functions, capabilities and performances [5].

Accordingly, the SDP IT middleware provides communication functions (e.g. enablers and SEE/SCE like SIP AS (e.g. JSR 289), etc) in a SOA IT middleware (e.g. JEE). The underlying network capabilities are exposed as enablers and controlled by these enablers through adapters that abstract them from the underlying network technologies. Applications, in house or developed by third parties are implemented by composition of enablers and / or within the SEE/SCE. This way, applications can be network technology and equipment vendor independent, future proof and convergence, continuity and FMC services are trivial to implement [4]. Enablers can be used to expose (Telco) backend applications like BSS (Business Support Systems) e.g. CRM, Billing Systems and BI and like OSS (Operating Support Systems) like network and system management, activation, provisioning. In this paper, in the context of a SDP and according tour SDP recommendation and blueprint [2, 4, 5], resources denote the system exposed and controlled via enablers or

SEE/SCE (e.g. network elements like location server, SMSC, SIP router, IN call control, HSS, HLR, media servers, IVR/Voice servers etc, or OSS, BSS functions). SDPs can also be integrated with OSS and BSS via end to end SOA business processes as described in [5].

With a SDP, Telcos can:

- Repurpose, increase, improve or rapidly and efficiently develop, with IT software practices, current and next generation core services as well as new communications services across Telco and Internet Networks.
- Develop many content (and application or service) delivery services that allows operators to play new roles in the Internet value chain by becoming reseller, content aggregators, content distributors or even content providers towards their users.
- Asset exposure (to third party)
  o Following the OSE blueprint [2], SDP can be used to expose through interfaces of enablers the operator's assets and capabilities, like features from the operator's network, OSS or BSS to applications, especially to third party applications. The interfaces typically accommodate web services (e.g. SOAP) and web 2.0 bindings (e.g. REST) and the SDP ensures that the exposure is "controlled" by enforcing policies and SLAs on all requests and responses to and from the enablers and containers.
  o This enables operators to create "two sided businesses". Conventionally this was for consumer services, but recently two sided businesses have proven also very successful to increase the role, and revenues, of operators with enterprises. Indeed, it allows service providers to resell third party services to enterprises bundled with their own communications services, therefore increasing revenue opportunities for operators and facilitating the distribution for third parties.
  o Both for consumer or enterprise markets, policy controlled exposure and two sided business models can enable new sources of revenue for operator where they can for example:
    ▪ Monetize their assets
    ▪ Share revenue with third party application / service providers
    ▪ Create businesses for other third party to sell "enablers".
    ▪ The model can be revenue sharing or reselling agreement etc.
  o With enterprises, the approach allows also operators to insert themselves in the enterprise value chain
- Enablers expose relevant function ranging from communications functions like call control, media control, multimedia messaging, contextual functions like location, presence, OSS functions like device management or system provisioning or BSS functions like user or subscriber profile management, subscription management or account management, payment etc. They may also denote reusable functions (SOA) or MW exposed services.
  o Some enablers open the possibility of new businesses for operators like for example:
    ▪ Payment and account management can enable operators to allow third party to bill services against the bill (pre or post-paid) and therefore provides alternatives to services like pay pal.
    ▪ Profile information or derived recommendations or business intelligence can be communicated (possibly filtered to respect privacy, preferences or regulation)
- Policy enforcement. A SDP provides advanced policy decision capabilities. The can be used to provide ease of control of many other assets like:
  o Policy based differentiated traffic QoS
  o Converged charging as policy enforcement
  o Traffic control based on policy enforcement
  o Etc.

- Anything else: as an open platform, operators can use the service creation and execution of the SDP middleware for any other need that they have, thereby enabling them to develop new services on par with the IT and internet players.
  o For example, developing recommendations, "ad insertion" and "ad warehousing" solutions that can be used to:
    ▪ Subsidize services to better compete against the Internet "free" services that are similarly subsidized but differentiated with the addressable channels, applications that can support ad insertions and accurate ad targeting.
    ▪ Maintain or create relationships with advertiser instead of giving them up to Internet advertisement warehouse like Google, Yahoo etc.

With the above, operators are able to offer more efficiently services and better compete or partner with other IT/ Internet service providers. Tellcos can also create new businesses. For example:

- Providers of financial services like mobile banking, payments
- Providers of hosted platforms for third party services
- Aggregators or federation of web 2.0 and social network services.

These new services and some of the other services described above might be considered to be offered to "Internet users" instead of just the current Telco subscribers... This might truly perfect the transition of the Telco SP to SoftCos (i.e., Telco service providers looking better like Internet service providers).

It is worth nothing also that SDP as IT/SOA middleware with Communications capabilities are also suitable platforms for other Service providers or Enterprises aiming at developing or offering communications related services…

IV. SDP, SDF AND OSS/BSS

SDF (Service Delivery Framework) denotes SOA integration of OSS, BSS and SDP and the services running over it. It encompasses patterns like EIA (Enterprise Integration Architecture), AIA (Application Integration Architecture) and TMF SDF [1].

The integration enables the automation of end-to-end business processes across the OSS, BSS and SDP, like "concept to cash", "trouble to resolve", etc. Modern SDPs [5] provide such integration framework and business processes so that it further reduces the time to market of new services and automates all business processes surrounding businesses built around the services.

V. TELCO SERVICE PROVIDERS AND CLOUD COMPUTING

Telcos like many other players in other industries have observed the trends of Cloud Computing and the emergence of new players as providers of infrastructure, platform or software on demand [7]. It is has been argued that the business models around Cloud Computing play well along some of the core expertises of Telco like:

- Offering (often to other businesses) reliable infrastructure (and services) integrated with reliable supporting OSS and BSS.
- Bundling capabilities from their own assets like network QoS, Prepackaged OSS, BSS and end to end business processes.
- Offering communications services that can be considered as precursors of SaaS business models (especially towards enterprise customers) albeit often today without the "on demand" / elastic scalability characterizing Cloud Computing.

Therefore, many Telcos envisage creating successful Cloud Computing based businesses (See [7] for details). In fact many

Telcos have already started to explore or provide such services. However, these initiatives have been so far mostly separated from their core services businesses and often driven by other departments than conventional Telco departments like IT, OSS, BSS and Network. With notable exceptions where Cloud Computing is provided as internal IT services provided by theTelco's IT department.
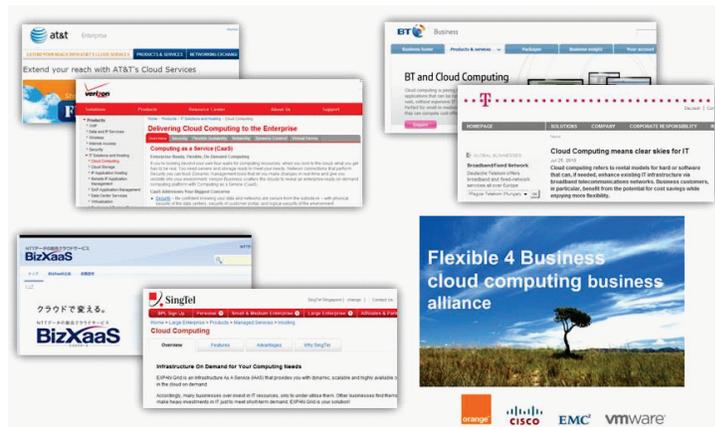

Figure 3 – Example of Recent Cloud Announcements

In general Telco services are very basic so far with Telco Cloud offerings usually added to their existing Hosting Businesses. Most are just entering the market, not wanting to compete on low margin services: 1) Most Telco Offerings are IAAS versions of their hosting businesses as a Phase I. 2) Some Telcos have trials of SMB/Enterprise Offerings, including Telstra, SingTel, NTT Data, Orange and Telefonica. Orange [8] announced recently its value proposition of best in class, simple, secure and easy to pay per use managed services on private cloud with storage, security and unified communications. 3) Some Telcos have new offerings of Storage Clouds like Vodaphone and Orange. 4) Most Telcos are still studying what to do including in terms of PaaS and SaaS, talking to vendors or sending out RFI's. They know they need more sophisticated business models.

In general the value proposition for Telco is therefore: 1) To allows efficiencies & cost savings (e.g. Reduce CAPEX (Elastic architecture fit to needs); Reduce OPEX (Consolidated management); Green (Reduce power consumption)). 2) Opens new business models (e.g. computing / storage services: PaaS, IaaS; SaaS reselling; own SaaS (SDP – like Communications Services, OSS, BSS, BaaS)).

VI. SDP PATTERNS FOR CLOUD COMPUTING

Today, SDP and Cloud Computing are typically different and unrelated stacks, operated by different departments for different projects or business models. Can Cloud Computing further help evolve the core SDP services business of Telcos?

To combine SDP and Cloud Computing, a few different options exist. The most interesting ones as discussed below.

- SDP as resources (or SDP by the Cloud) where SDP exposes its capability in the cloud for applications in the cloud but it is not implemented on the cloud.
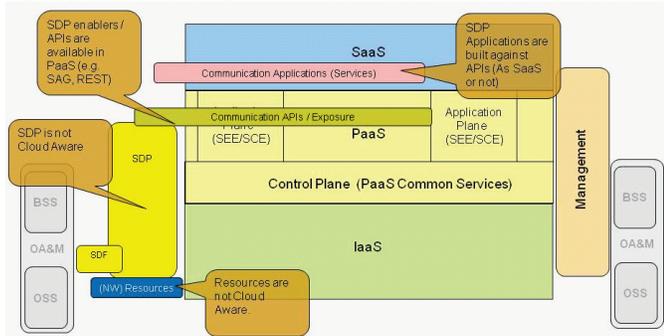
Figure 4 – "SDP by the Cloud".

o With this option, the SDP and its components including enablers as well as underlying resources abstracted via adapters are treated as infrastructure (not cloud based) exposed in IaaS or PaaS via its northbound interfaces with appropriate resource affinity.

o The SDP and underlying resources would be expected to provide (some) scalability support to efficiently support scalable IaaS, PaaS or SaaS here the enablers are used.

o This option enables Telco operators to add SDP (e.g. communications, policies or OSS/BSS) capabilities to a "more conventional computing offering", therefore allowing them to provide a computing on demand offering while differentiating (using their network, SDP, OSS and BSS assets) with respect to other "non Telco" providers.

o This option presents the additional advantage to consist into a relatively straightforward integration of an IaaS or PaaS with possibly an unmodified existing SDP.

o However we do not recommend "porting" the SDP to IaaS differently from the next option (SDP as a PaaS). The present option is rather just a quick way to add communications features to Cloud Computing. In particular this approach does not allow taking advantage of the SDP integration and management via OSS/BSS.

o CMCC OMP (Open Mobile Platform) follows this pattern.

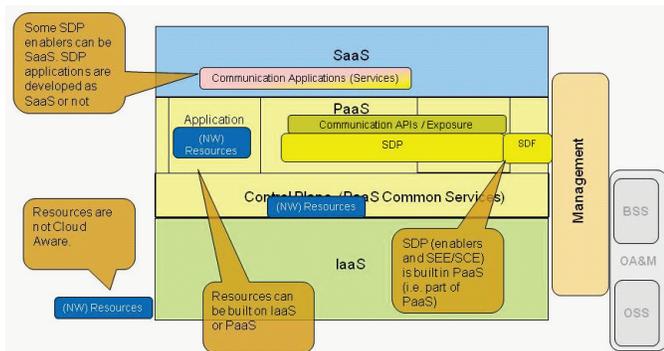• SDP as a PaaS (or SDP on the Cloud)

Figure 5 – "SDP on the Cloud".

o A SDP, understood as middleware as previously discussed ([5]), shares its SEE / SCE container(s) with the PaaS (e.g. as a same container or as part of a multiple container PaaS). Resources as defined in SDP (see [1,5]) are preferably implemented in elastic ways (part of IaaS). Resources may of course just be non cloud infrastructure, in which case scalability may be constrained.

o Enablers are part of the PaaS functions (and can therefore be SaaS)

o SDP adapters are built on PaaS to provide resource affinity and support for elastically scalable resources

o Applications can be built on SDP as a PaaS as SaaS or as third party applications (as today) that may be hosted on PaaS or IaaS.

o This option includes the particular cases where the PaaS is just the virtualization of the SDP SEE/SCE running on IaaS.

o This option enables Telco operators to
  ▪ as previously add SDP differentiating capabilities to computing offerings
  ▪ Use Cloud Computing as ways to more efficiently implement its SDP and services e.g. By allowing dynamic allocation of resources based on load demand
  ▪ Provides a path to integrate the Cloud Computing stack with the OSS and BSS, reusing the SDF patterns and capabilities provided by the SDP.

o With such an option, all the services (and enablers) already built on SDP (SEE/SCE) can be easily adapted to the new SDP as a PaaS platform.

o Such an option usually requires support for customizable control plane as mentioned above.

• SDP or Enablers as SaaS (SDP in the Cloud): Enablers are built one way or another as SaaS than can be used by other services.

o The SDP can be any hosted scalable platform implementation, implemented in many ways including the ways described in the previous options or the SDP may not exist and the SDP capabilities and functions are re-implemented on IaaS or PaaS.
  ▪ SDF is not immediately available and it needs to be re-implemented.

o This option may be suitable for new capabilities that can be consisted as enablers or reusable capabilities but are not directly "Telco related" e.g. Search, user profile ... However for existing enablers, it may not be that advantageous considering the previous and following options.
  ▪ This option is especially useful for Telcos to "resell" enablers provided by third parties…
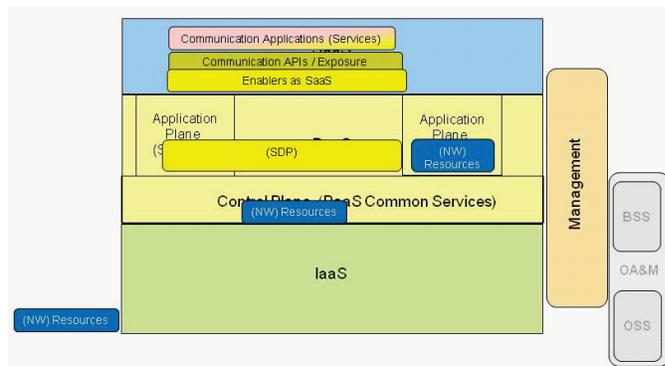

Figure 6 – Example of "Enablers as SaaS".

Again all these patterns can be adopted by generic (i.e., non Telcos) Service Providers or Enterprises building "Communications" offerings.

VII.   SDF PATTERNS FOR CLOUD COMPUTING

OSS and BSS integration with SDP provides ways to support:
• OA&M for life cycle management of the SDP and resources as well as applications using or running on it.
• SDF provides support for end to end business process automation across OSS, BS and SDP

With the SDP as a PaaS pattern, the implementation of the PaaS can include appropriate interfaces life cycle management / OA&M of the services, SaaS, PaaS and IaaS (just as for traditional middleware with traditional hardware, OS and applications). Therefore, reusing the SDF and OSS/BSS/SDP integration and adapting the end to end business processes (e.g. to encompass IaaS provisioning on demand and multi-tenancy).

VIII.   BLUEPRINT FOR SDP BASED CLOUD COMPUTING SDP

Telcos should target such a combination or roadmap of the above options as appropriate for their objectives and time frame. The end target should be a SDP as a PaaS with enablers as part of

the PaaS or in the Cloud (SaaS) and new related business models: SDP in the Cloud.

With such a SDP as a PaaS (and with our without enablesr as SaaS), Telcos can: 1) More efficiently provide SDP and services (scalable on demand without requiring acquisition or locking of infrastructure to support it). We expect in fact that many target will target PaaS solutions that can target multiple underlying infrastructures like: i) Private Cloud / Next Generation data center, i.e., Private IaaS under the control of the telco, ii) Legacy servers and data centers used as private cloud iii) Public cloud (preferrably as Private Public Cloud) to support Cloud Burst or allow cheap and agile testing environment (while the private assets would be sued for production). Some operators in Europe have started exploring such models. 2) Provide computing services with communications capabilities available to the developers using the service.
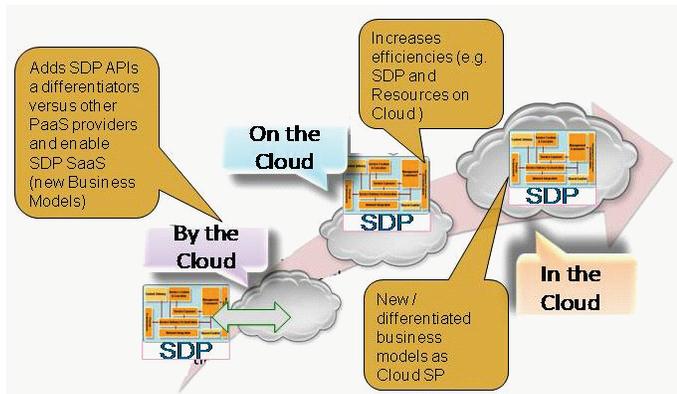

Figure 7 – Evolution of the SDP and the cloud

A. Examples of Evolution between Options

As an example of tactical solution, consider for example SaaS SDP communications applications like PBX or Unified communications. They can be built on a JSR 289 (SIP Servlets) / JEE converged container that is virtualized and managed/distributed on an IaaS, while the media servers, conference servers and IVRs are treated first as resources then as scalable resources that can then be built on IaaS. Other "enablers" can be provided first by the cloud. Billing, provisioning and subscription management are driven from the OSS/BSS (via an end to end SOA business processes).

B. BaaS

BaaS (Business as a Service) illustrates how Telcos can further differentiate a Cloud Computing offering based on SDP as a PaaS by bundling:
- An on-demand hosted platform to build and execute applications i.e., computing for rent
- On demand backend business applications to build and run a business around the applications:
  - BSS (e.g. CRM, Billing), OSS on demand (as SaaS): i.e., applications for rent
- On demand Customizable pre-build end to end business processes across Platform, OSS, BSS: i.e., business processes for rent.
  - i.e., Pre-built business infrastructure for Rent.

With a BaaS, third parties can rent, develop and run applications and they can also rent a complete backend business infrastructure to run the resulting business as well as all the business processes to automate their business. In other words, besides renting computing and renting say CRM on demand they can rent OSS/BSS on demand and their integration to support selling their applications,

campaigning, billing for usage, analyzing the usage, taking new subscriptions, etc.

BaaS is differentiated from conventional IaaS, PaaS and SaaS models. Indeed,
- It is not easy to provide an integrated OSS/BSS/Platform on demand.
- Telco SPs have OSS/BSS assets and end to end Business processes.

IX.   FUTURE WORKS

Huawei has numerous SDP deployments with many Telcos currently engaging in Cloud Computing initiatives. Many have reached the point where the Telcos experiments with the patterns and combinations of these patterns described in this paper.

Analysis of lessons learned from such Telco deployments as well as implications on IaaS, PaaS and SaaS and SDP technologies will be provided in upcoming works. Explicit examples today still depend on confidentiality agreements with customers.

X.   CONCLUSIONS

This paper provides clarification and recommendations on how to relate SDP and SDF to Cloud Computing. Different patterns that have been discussed are suitable for evolutionary extensions of SDP business model to encompass Cloud Computing.

In particular, we emphasized key value propositions that Cloud Computing can bring to Telcos in the context of SDP and services, including:
- Efficient implementation of SDP and services with always just the resources needed at a given moment.
- New business model to add computing services to the Telco portfolio while being able to successfully differentiate from other computing providers
- BaaS as another differentiated offering that builds on Telco expertise and further facilitate third parties to build business using the services and assets provided by their Cloud Computing service providers.

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