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Service Delivery Platforms: Servicing Real-World Mobile Ubiquitous Computing Applications

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This paper provides the reader with some insight into an emerging technology in mobile, distributed systems environments. This technology is - at least - a facilitator, and possibly a catalyst for wireless, ubiquitous and pervasive computing environments. A *Service Delivery Platform* is an integrated suite of applications which provides mobile network carriers and their content partners the ability to develop, deploy, deliver, and manage mobile voice and data services quickly and cost effectively. The elements and roles it has to play on a mobile carrier's network are described. A service delivery platform can bring new content services to the market in a matter of hours or days as opposed to weeks or months. The paper finishes with a business analysis regarding the implementation of service delivery platforms, a brief overview of emerging technical architectures and concluding remarks on what opportunities the service delivery platform concept may offer for academic research.

1. Introduction

The purpose of this paper is to provide the academic reader with some insight into an emerging technology concept in mobile-carrier, distributed systems environments. This technology is a potential facilitator at least, and possibly a catalyst for wireless, ubiquitous and pervasive computing environments. It is of interest to examine these mobile, Service Delivery Platforms (SDP) also from the perspective of what mobile and other services are facilitated, in particular user-orientated services that have heretofore not been available. It is likely that SDP is a necessary but not sufficient requirement for an explosion in both complexity and number of mobile based service offerings. As normal the market must 'speak' before the outcome can become known.
This paper studies the service delivery platform concept. The elements and roles it has to play on a mobile carrier's network are described. Diagrammatically the paper compares a mobile carrier's network with and without a service delivery platform. It was found that a service delivery platform can bring new content services to the

market in a matter of hours or days as opposed to weeks or months. The need for mobile carriers to take control of the services they offer and the complexities involved are examined. The paper describes emerging technical architectures and provides a business analysis of obstacles involved in getting senior management approval for the implementation of a service delivery platform. The paper concludes with some tentative conclusions about the reality of SDP as a real-world ubiquitous system, upon which experimental work on autonomic systems may be developed.

The progression of mobile telecommunications has seen the technological advancements from first generation networks (1G) to today's third generation networks (3G). The market for mobile data services appears to be expanding, as many people need to make use of mobile data services for business and personal lifestyles.

The need for mobility in terms of Internet access and various data services has mobile carriers concentrating on new ways of generating data revenues in the future. This in turn increases the need for the mobile carrier's network being capable of providing and managing the many data services for the future.

2. The Service Delivery Platform

A Service Delivery Platform is an integrated suite of software applications which provides mobile network carriers and their content partners the ability to develop, deploy, deliver, and manage mobile voice and data services quickly and cost effectively [1].

A SDP deployed in a mobile carrier's network will create a structured environment suitable for rapid service creation and deployment. Instead of seeking the high revenue killer application, mobile carriers are now turning their attention to the killer environment; a service delivery environment.

SDP is more of a concept than a technology. The single aim of the platform is to provide more diverse applications, which can meet the needs and demands of consumers in a time- and cost-effective way [2]. The platform creates an open architecture using open protocols and standards such as the Session Initiation Protocol (SIP) and OSA/Parlay [3].

2.1 The SDP Ecosystem

There are three main parties involved in deploying a service delivery platform; service integrators, Value-Added Service Providers (VASPs), and the mobile carrier. Service integrators are experts in implementing service delivery platforms and can be contracted into a company should the carrier choose to outsource the project. VASPs play the role of adding value to the mobile carrier's network by providing new services that would be of interest to their customers, e.g. Java games. And of course the mobile carrier is the telecommunication company that provides the public with access to these services via the use of their infrastructure.

Using the OSA/Parlay approach, the service offering process would operate as follows; the VASP would submit their service to a framework gateway. This

framework gateway controls access to many services that belong to many VASPs. The mobile carrier subscribes to a service via the gateway and authorises their customers' access to use the service. Once this authorisation is in place, access to the service is widely available to each customer on that mobile network (Figure 1) [3].

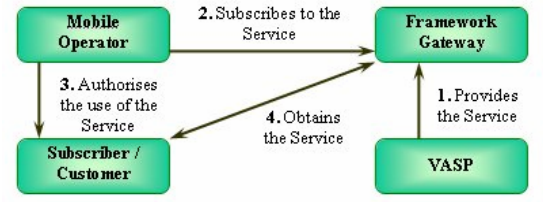

Figure 1. This diagram illustrates the 4-step OSA/Parlay Business Model

The elements or building blocks of a service delivery platform are service creation and acquisition, service integration, service management, and service delivery. Figure 2 illustrates the process of delivering a new service to the market via a service delivery platform. The first stage is to acquire or create the service. The second stage involves integrating the service into your network. Management of the service is required before the service can be delivered to the customer via their mobile device, such as their mobile phone. The service completes the cycle by its ability to incorporate re-use, which allows features of the service being used in future service creations.

3. The Evolution of Mobile Telecommunication Infrastructures

Mobile telecommunication infrastructures have shown a desire to evolve instead of being replaced. The advancements in telecommunication technologies from 2G to 2.5G and now 3G have seen new technologies being layered onto what already exists. None of these technologies replaced its predecessor.

A SDP is an open architecture and prolongs this approach by layering technologies onto the current infrastructure. The aim is getting more from past investment by creating a more sustainable architecture around the expensive infrastructure that already exists [2].

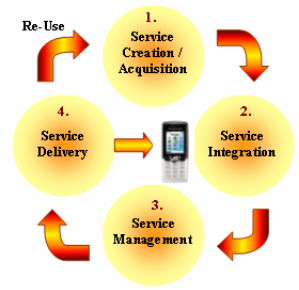

Figure 2. SDP Elements

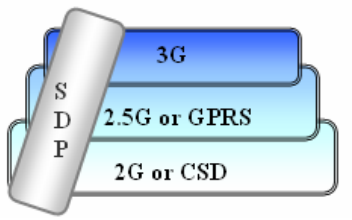

Figure 3. SDP: An Orthogonal Approach?

Figure 3 illustrates 2.5G being layered onto the 2G technology and 3G being layered onto 2.5G technology. Above these is the layering of a SDP, which incorporates the use of all the systems and technologies in these three generations of mobile telecommunications

3.1 Why a Service Delivery Platform?

Imagine if software application developers could utilise the capabilities of the mobile telecommunication network? Gaining access to location based information, billing, authentication and messaging. What if mobile users could access the Web's content via a handheld device like a mobile phone, as easily as that done on a PC? Service delivery platform may be the answer to many of these types of questions [4].

There are many reasons why a mobile telecommunication company would want to implement a service delivery platform. There are numerous imperatives both strategically and technologically that make a SDP beneficial.

Strategically, a SDP can rapidly introduce new services, saving time and money. It increases the ability to encourage customers actively to use these services by promoting and making the services readily and easily available. As mentioned before, it can utilise convergence services opportunities by re-using services created beforehand. Flexible processes allow supply to change with demand in order to meet the market needs. Utilisation of human resources can be high as new innovative service ideas can be implemented with little overhead. Very importantly for market research, a SDP can enable a carrier to learn more about customer needs and tailor future services to meet those needs, offering services that match user interests, language, and device capabilities [5].

From a technology perspective a SDP reduces complexity by introducing standardised interfaces and protocols. Standardised service creation processes speed up time to market and reduce error rates. It eases the process of managing user profiles, products and promotions. Very importantly it provides the ability to make mobile applications exchangeable with non-mobile applications and environments; one application for many devices [5].

However, having listed all these great technology and strategic benefits, one outstanding need from mobile telecommunications is that of financial efficiency. Many IT investments have simply failed to deliver the expected or hyped returns. WAP is a prime example of getting it wrong. Openwave Systems, Inc., one of the principal inventors and architects of WAP announced a stock price of $204 in March 2000, and in September 2001 its trading was at $15[1] [6].

Mobile carriers might buy into the SDP concept on the simple basis that it will reduce future service delivery costs.

Cutting costs is viewed as having a vital element of securing continued future profit growth as the mobile industry matures. The competitive environment of the mobile telecommunication industry has also mounted pressure on careful and realistic IT/IS budgeting [2].

Service integrators claim that a service delivery platform can bring new content services to the market in a matter of hours or days as opposed to weeks or months. It's not surprising to see the SDP concept grabbing the attention of many mobile carriers worldwide [7]. In the UK, BT and 3 (mobile) have invested in the service delivery platform concept.

4. Complexities Increase the Need for Management and Control

Just like the evolution of telecommunication IT systems, telecom service offerings have also displayed an evolution. In the first generation (analogue) of mobile communications, service offerings consisted of voice calls. The 2nd generation (digital) saw a technology leap from analogue to digital, but not much of a service leap. The service offerings now included voice and data communications in terms of the short messaging service (SMS); dare I even mention WAP. Complexity was not an issue and the mobile carriers' infrastructure sufficiently supported these service offerings.

More recently, the introduction of GPRS (or 2.5G) offered a technology with mobile speeds ranging from 20Kb/sec to 45Kb/sec. The technology leap may not be as great as that from 1G to 2G (analog to digital), but the service leap was immense. We now have smart phones capable of rendering services offered by a mobile carrier such as voice, SMS, and Multimedia Messaging Service (MMS), which in turn brought picture messaging and ringtones to life. Other offerings included Java games, and at the time of writing this paper, Vodafone's mobile connect card and the "Vodafone live!" experience.

[1] OPWV was $8.36 as of September 29, 2004

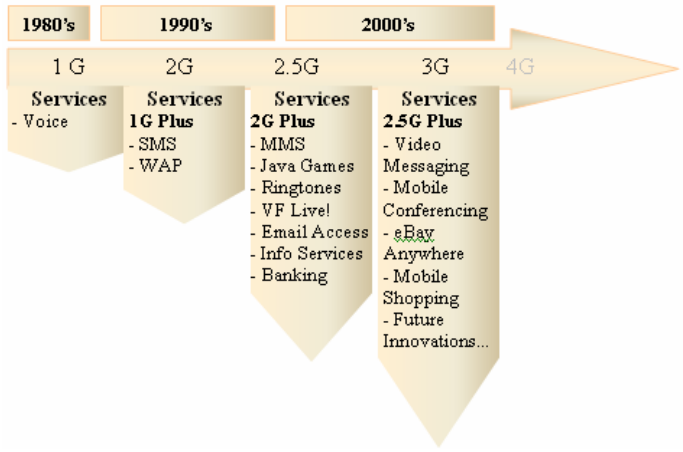

Figure 4. Mobile Services Evolution

Figure 4 illustrates the service evolution as the mobile generation's mature from 1G to 3G. With 2.5G and more so 3G, service offerings can be expected to increase at a rapid rate, with particular emphasis on data services

4.1 Infrastructure Complexities

Reliably supplying customers with existing services and potential future services will involve having a sound infrastructure that can support the complexities of managing and supplying many data services. A mobile telecommunications carrier has two choices; support these services with the current infrastructure or modify the infrastructure in a way that would reduce this complexity.

If a decision is made to supply and manage these services on the current infrastructure, this will involve providing many services that are standalone and need separate connections to billing systems, support systems, fault management systems, and use many proprietary protocols and software to run them successfully. The alternative is to offer these services on a service delivery platform.

The rollout of 3G will see the offering of services that are more advanced and bandwidth consuming than previous offerings. 3G speeds of up to 2Mbps easily support services like video messaging. The restriction is now limited to the imagination and creation of the human mind. Innovation will increase complexity and the need for management and control will rise. Other complexities include network supporting voice over data networks, voice over voice networks, data over voice networks, and data over data networks. Many standards, more protocols, and future change add to this complicated environment.

A service delivery platform is the enabling technology that can reduce complexity to a minimum. With a SDP, as service offerings increase, complexity needn't.

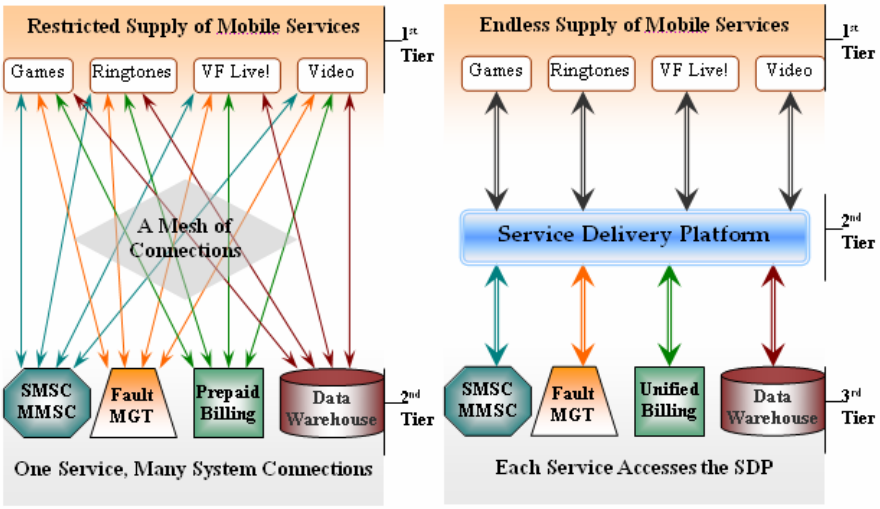

Figure 5. The Role for SDP

Figure 5 (a) illustrates a scaled-down but visual representation of the complexities of a mobile telecommunication's infrastructure without a SDP. It consists of two tiers that separate the services from the systems they run on. Telecommunications have many more services and system connections when compared to this diagram. Complexity is colossal with management and maintenance efforts increasing as services need many system connections.

Figure 5 (b) illustrates a SDP infrastructure for a telecommunication company in control of its assets/services. Instead of having to connect each service to the various telecommunication systems, each service must simply access the service delivery platform as shown between the first and second tiers. All services access the systems in a standardised way via the SDP. New services can be quickly added as many complex connections don't need to be setup. Unification of billing systems is enabled as one connection from the SDP to the billing systems can be used by all services via the SDP. The second tier is the service delivery platform, which acts like an abstract layer between the first and third tiers. The third tier consists of the legacy systems. Each system in this tier can be changed without affecting the services that use them. It is important to note that no direct communications or connections are made between tier one and tier three.

5. Potential Scenarios for Use

To make a service delivery platform a success it must be feasible to sell the applications and not the technology. After all it's the applications that generate new customers and revenue, not the technology. The simplicity of adding new services enables a trial and error approach. Implement it, offer and sell it, and then assess its usage and make a strategic decision to continue or discontinue the service. Such a trial and error approach would be too costly without a SDP.

Two possible scenarios for use of a SDP are mobile shopping and eBay-anywhere. Both these solutions show the advancements from window shopping to home shopping and now the proposal of mobile shopping (M-Commerce). They are outlined briefly in the following section

The proposed mobile shopping example operates using GPRS/3G (whichever is available) technologies and the multimedia messaging service. The process would involve the following steps:

- Registering your personal and financial details with your mobile carrier.
- Taking a picture of a barcode i.e. the product you'd like to buy in store.
- Sending it to your carrier via a premium short code.
- Using web services, the carrier finds many companies on the web that sell the product (like the Froogle service offered by Google)
- It then takes into consideration the pricing and delivery arrangements.
- Returns the top 5 offers including the seller's details and you choose based on pricing and shipping.
- Return "Buy Option 3"
- Transaction takes place and a receipt/order number is returned to your phone and email address.

This solution isn't offered at the moment and is just one potential solution that could be implemented with little overhead on a SDP. However the next example of eBay-anywhere is available and the service provider of this solution is Volantis.

eBay-anywhere is a service offered by Volantis that makes it possible for eBay.co.uk to go mobile, enabling eBay.co.uk users to manage their transactions from their mobile phone. eBay users will be given remote access to their bidding and selling processes from their mobile phone as well as their PC's. The technologies used are GPRS and SMS. Buyers will be alerted by SMS if a have been outbid on an item, if you win the auction, and when the auction ends. Sellers will be alerted by SMS, if a buyer has filled out purchase information during checkout or if any buyer has left feedback for the seller [8][9].

This service offering uses simple technologies and can be implemented easily on a network that doesn't have a service delivery platform. However, the service could be greatly enhanced to serve service providers that operate on a service delivery platform. In terms of functionality and technologies, buyers and sellers would be capable of fully managing the buying and selling processes from their mobile phone using GPRS and 3G technologies. A simple interface that resembles that of eBay's website could be rendered on a mobile phones interface, allowing the user to search for items, using the eBay search engine. The buying process can be made identical to the user experience from a PC.

6. Business Analysis

Before any new technology gets introduced into a business, IT/IS professionals need to obtain senior management approval. Business people are not concerned about the

technology or how it can improve what is extant. To sell a new project like a SDP, business people need to be convinced by a listing of the potential service offerings and all the benefits associated with the project. Senior management are mostly interested in what can be done to help the carrier become superior to the competition and generate new revenue in the short-term principally.

Having explained the meaning and purpose of a service delivery platform, it may appear that business people would find it difficult to reject this project opportunity. However, what if they ask some of the following questions; can we implement these new service opportunities on our current infrastructure without change? Is this just a fix or an alternative to what already exits? Can success and increased revenues be guaranteed? Can mobile carriers survive without a SDP?

Success cannot be guaranteed. If you consider that 3 mobile in the UK have delivered video messaging to UK subscribers over the past 2 years and have built all their technologies on a SDP, why do they still only have 1.2 million customers [10]? Why are customers remaining on other networks that only offer voice and restricted data communications, when 3 offers similar services and more?

Is it a fix or an alternative? A SDP can be viewed as both a fix and an alternative to what has already been implemented. Business people may feel that it's just another route leading to the same destination, and that the investment may not be worth the costs involved.

Can these services be offered on the current infrastructure? Yes, and this could be the determining factor that could see a SDP project being rejected. The services that can be put into place on a SDP can also be implemented on the mobile carrier's current infrastructure. However the time, effort, and costs involved could hugely offset the return on investment if a SDP isn't in place. Also, a mobile carrier cannot realistically continue to add new services over and over, eventually unification of various systems such as billing and messaging will be required.

Is survival possible without a SDP? Declining voice revenues and increased data revenues have exposed a pattern that should increase the attention of mobile carriers to provide more data services to their customers [11]. Voice revenues continue to drop due to the competition substantially lowering voice tariffs as a means of competitive advantage. Materialisation of voice over IP (VoIP or VoP) could lead to a viable alternative for voice communications, and a huge threat to those telecommunications carriers that have a substantial reliance on voice revenues. If future revenues lie within data services, then market leadership would appear to be difficult without the ability to quickly turn innovative service ideas into solutions for customers. A service delivery environment is ideal for service creation, which at present is a SDP environment.

7. Emerging Technical Architectures

There is little consensus in the business and ICT community as to the core elements of a SDP. However, in 2004, an industry report, supported by many vendors sought to define the core technical architecture [12]. This report is the best available view of what constitutes a technical architecture of a SDP, and this section draws heavily on

it. Figure 6 (below) outlines a generalised SDP architecture, as presented in the 2004 Moriana Group Report on SDPs.

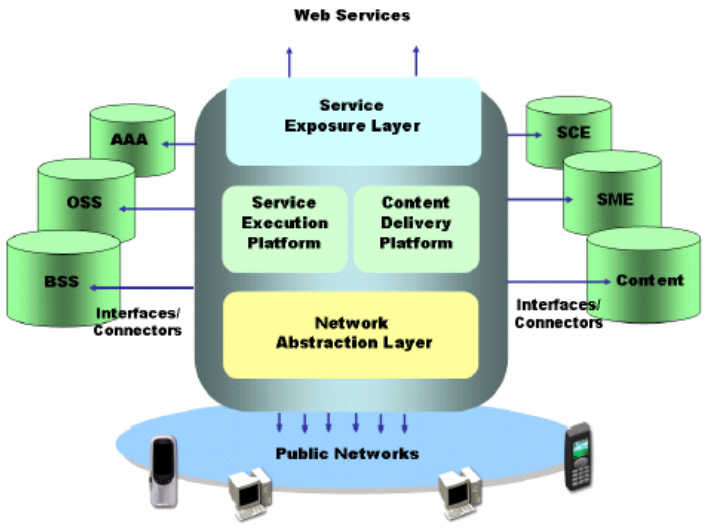

Figure 6. Generalised SDP Architecture (Source: [12])

The Moriana Group report states that in general, a SDP should be seen as a commercial bundle of different products, possibly offered by different vendors. They define four elements that may constitute a service delivery platform. These are:

- Service Execution Platform (e.g. Telecom Application Server), a core element of a SDP providing the deployment and execution environment for broad range of voice and data applications.
- Network Abstraction Layer (e.g. Parlay GW or SIP GW), a core element of a SDP providing standardized interfaces to core network elements and services.
- Service Exposure Layer (e.g. Parlay X GW), an optional element exposing service capabilities (usually via Web Services) to 3rd party service providers and enterprises.
- Content Delivery Platform, an optional element usually present in mobile SDPs for the provisioning of multimedia content to mobile devices.

The Service Execution Platform (SEP) provides an environment in which the service applications are deployed and executed. The SEP can be build around a standard J2EE or .NET Application Server or highly specialized Telecom Application Server. Due to variety of capabilities used in state-of-the-art mobile and convergent services, the service logic is rarely implemented as one monolithic application, but rather as a set of interacting applications implemented by using different technologies such as J2SE, J2EE, Java Servlets, XML, etc

The Network Abstraction Layer (NAL) provides standardized interfaces to network service capabilities such as call management, multimedia and multiparty services, charging and account management, messaging (SMS, MMS, Instant Messaging, and e-mail), user location and status information, presence and availability, information, session control, and others.

The Service Exposure Layer (SEL) is a new, important element of a SDP as it literally changes the meaning of "delivery". This layer delivers voice and date service capabilities to external 3rd party service providers and enterprises. Using the SEL an operator can "open" its network through a set of standardized and secure interfaces. In the same way that the Network Adaptation Layer exposes the basic, core network capabilities to the applications hosted on a SDP, the Service Exposure Layer exposes the services capabilities to the applications located in enterprises and service provider networks.

Network operators can use the Service Exposure Layer in various ways. The first is to provide simple standardized interfaces like Parlay X to the basic service capabilities like SMS, MMS, user location or two-party call creation. Another use of the SEL is to provide external access to more complex value added services implemented by an operator on a SDP. Examples of such services could be MMS/SMS multicast, click-to-conference, multimedia virtual call centre, etc.

It is clear that SDPs represent highly technical architectural challenges as well as opportunities for the entire telecommunication ecosystem to develop new services and products. There is some publicly-available material on SDP technical architectures [13] [14], but it is clear that this is not an entirely mature technology platform, with clear consensus on the foundations of a technical solution.

8. Concluding Remarks

The future of a SDP is intimately interlinked to the (market) need for mobile data communications and services. Should there be a market for innovative services that maximise the use of technology in the near future, then a service delivery platform will prevail. The key is offering services that people will eventually need as opposed to want. Just like the voice call service on a mobile phone, most people need it in their daily lives and don't necessarily see mobile phones as a luxury. If these types of services are offered then mobile data services have the potential to be a new growth area for the ecosystem of mobile companies and service delivery platforms will become a necessity to every mobile telecommunication company across the globe.

As mentioned in the introduction, the purpose of this paper is to shine the spotlight on an emerging technology area in the mobile ecosystem. The majority of the paper is indeed focused on doing just that. However, the authors would like to conclude by highlighting some opportunities that SDP may offer for researchers. SDPs can facilitate networked and distributed computer-mediated environments that provide new opportunities to test services and technologies. For example, many of the concepts relating to autonomic communications [15] and the concept of the knowledge plane [16] can be researched using SDPs. At a high conceptual level, the authors believe that emerging areas such as policy-based management [17], dynamic context-awareness [18] and other next-generation network areas can benefit from utilisation of the SDP for as a research test environment.

We know that the research roadmap for the development of ubiquitous communications will present some major conceptual hurdles as we strive to cater for the increasing complexity and heterogeneity of the ubiquitous and pervasive

computing vision. This paper outlines how a sector of industry is attempting to realise this vision with its own pragmatic roadmap for service delivery realisation. There are significant opportunities for collaborative and mutually beneficial work if academic research laboratories and industry begin to believe in a shared vision.

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