Service delivery platform:
Critical enabler to service provider's new revenue stream

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Service creation and delivery platforms as key network components support objectives for next-generation services, such as the ability to tailor services quickly and flexible for individual customers and to provide an open platform for third-party service development. The Service Integration Environment (SIE) described in this paper aims at providing an enabling technology for developing advanced applications for fixed and mobile networks. The main focus of this realization is the integration of advanced value added services over the 3GPP IP Multimedia Subsystem. This paper will give an overview about the Service Integration Environment as a potential part of a future SDP solution. An in-depth view of the respective market and its relation to the ongoing standardization activities will be outlined. A detailed description of the functional structure of the architecture layers, the advantages of the involved integration techniques (including the dynamic policy management) are provided. The provided sample application will motivate the easiness for service creation by exploring the SIE-offered IMS and non-IMS service enablers.

1. Introduction

Today's mobile telecommunications service providers face strong competition to deliver new revenue-generating services to the market while decreasing related operational costs. Mobile users are getting more demanding in their requirements for useful, personalized application offered at a reasonable price. Future service creation and delivery platforms as key network components are targeting to deliver more creative services and more quickly to a service provider's target market. They support objectives for next-generation services, such as the ability to tailor services quickly and flexibly for individual customers and to provide an open platform for third-party service development. Systems integrators are bringing together multiple SDP products of different vendors, combining the strengths of these different products, and ensuring to be in a standards-based and open service-oriented environment.

Within 3rd Generation Mobile Networks, Internet-related concepts are being introduced more and more in the telecommunication environment. At the same time the industry is standardizing services and service enablers within the Open Mobile Alliance (OMA). OMA has defined a reference architecture called OSE that defines how basic services can be re-used and combined to integrate into new and advanced services. OMA's role is to create application level specifications for various services, agnostic to the underlying network technology. The missing part on the way to even more attractive new services is the glue that ties network and service enablers together and makes service creation easy and efficient.

The Service Integration Environment (SIE) described in this paper aims to provide an enabling technology for developing advanced applications for fixed and mobile networks.

This paper will give an overview of the Service Integration Environment as a potential part of a future SDP solution. An in-depth view of the respective market and its relation to the ongoing standardization activities will be outlined. A detailed description of the functional structure of the architectural layers, the advantages of the involved integration techniques (including the dynamic policy and resource management) are provided. The provided sample application will motivate the easiness of service life cycle exploring the SIE-offered IMS and non-IMS service enablers.

2. Market Review

The migration towards "All-IP" is transforming the telecommunication landscape and, together with voice price erosion, it is putting additional pressure on telecommunications operators to launch innovative services and create differentiation. In the past few years fixed line and wireless operators primarily focused on OPEX and CAPEX reduction. The business focus is now shifting towards developing new services and bringing them to market quickly and efficiently.

Service bundling has been and still is one of the approaches followed by telecommunications operators to gain or retain market shares. However, service bundling is only a short term solution since it offers little differentiation. Moreover, telecommunications operators which will make service bundling their key strategy for fighting competition, in the long term, will become simply flat-rate pipe providers and be constantly involved in price wars.

Despite the fact that wireline and wireless operators are rather different, a common set of requirements can be identified:

– Creating service differentiation
– Faster time-to-market
– Achieving cost efficiency
– Ensuring compelling user experience

The current approach to service creation has been characterized by a "stovepipe" approach which has lead to the proliferation of separate platforms, one for each specific service. This approach presents several limitations and it is suitable only in the case of a limited service portfolio with no integration and orchestration between services. Moreover, it is not optimal and unsustainable in the next-generation service environment which requires the support of convergence of data communications (IT) and voice communications (telco).

For this reason, OMA is now focusing on a new service enabling approach, which will enable operators to quickly implement service orchestration and therefore will enable them to create greater service differentiation.

Wireless operators have been traditionally more innovative and agile than wireline operators. Service Delivery Platforms (SDP) and IP Multimedia Subsystem (IMS) were both initiatives originating from the wireless industry. The fixed line industry is now catching up and there is a growing interest amongst fixed line operators in introducing SDP and IMS as key elements of their next-generation service layer.

Despite many initiatives around the world led mainly by the largest telecommunications operators (e.g. AT&T, BT, Bell Canada, Sprint), SDPs are not yet deployed ubiquitous across the industry. Costs, complexity, uncertain Return on Investment (ROI) and legacy companies' organizations are seen often as the major obstacles to the wide adoption of these platforms. Moreover, it is important to stress the fact that there is no comprehensive definition for SDP, because SDP functionalities do not reside on a single platform, but are rather comprised of an integrated set of software modules.

The introduction of SDP solutions in the operators' environments is also linked to the migration to IP-based platforms and services. SIP application servers and IMS are key enablers of this migration at the service level. Operators will adopt different strategies for the introduction of SIP Application Servers, IMS and SDP. Their strategies will be dictated by the local environment, e.g. competition, regulatory, etc., and it will result in a slower or faster deployment of IMS, SDP and SIP Application Servers. As illustrated in *Fig. 1.* [1], the initial IMS and SDP deployments will start in the next 12 to 24 months, whilst full deployment is expected to follow at later dates.

A study conducted by the Moriana Group [2] shows that SDP spending is expected to reach about $19 billion over the period 2003-2007 *(see Fig. 2)*.

NW Operators	Large	Medium	Small
Mobile	500	2,200	1,900
Fixed/Mobile	1,000	1,600	500
Fixed/IP	1,000	800	200
Total			9,700 M€

Service Providers	Large	Medium	Small
MVNO	420	630	336
VNO	630	525	336
ASP	1,050	630	252
ISP	2,100	2,250	880
Total			10,039 M€

Figure 2. SDP Forecast Spending (2003-2007)

The importance of SDP is also confirmed by the increasing number of companies growing from smaller solution vendors to large IT system providers, which populate the SDP marketplace. Interestingly, most of the SDP providers are not traditional telecom suppliers. This is a key sign that highlights how SDP is mainly an IT solution. In the future, the role of the Telco networks will be of pure (IP) transport bearers whilst the delivery of services recognizable by consumers and enterprises will be through an IT rather than a network infrastructure. The shift towards IT and the growing importance that SDP and IT technologies will play in the future for the telecommunications industry is also recognized by the corporate management.

According to a study conducted by the Yankee Group [5], the majority of corporate managers interviewed be-

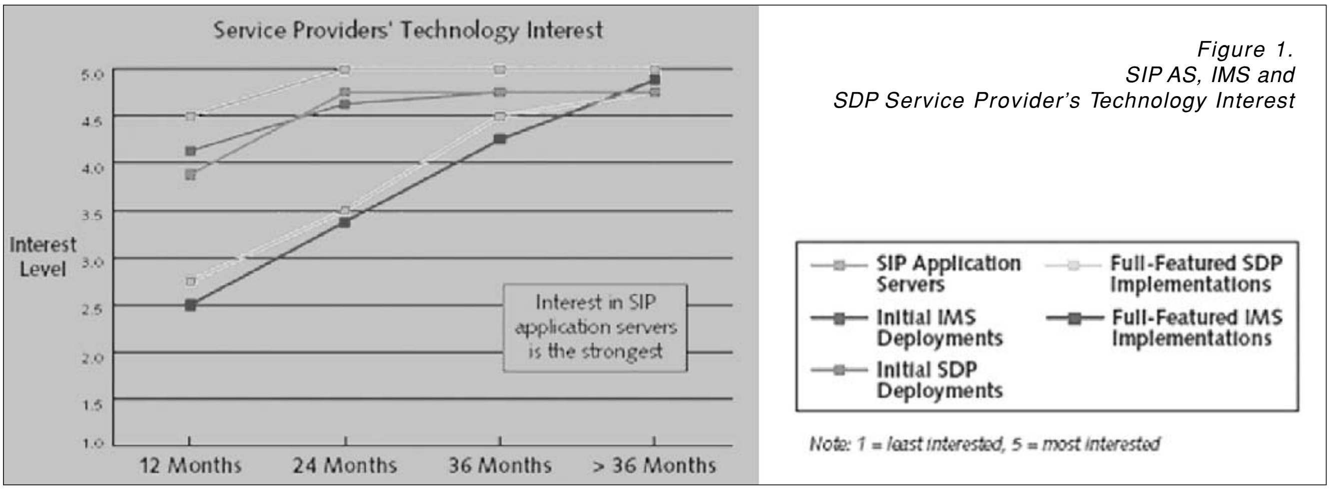


Figure 1. SIP AS, IMS and SDP Service Provider's Technology Interest

lieve that new products and service technologies will remain one of the key factors to success for the next 5 years. Therefore, investment in new products and service technologies represents a "strategic" investment for telecommunications companies.

3. Standardization

The Open Mobile Alliance (OMA) [4] is the leading standardization organization for mobile service related technologies. Founded in 2002, it has incorporated several existing fora like WAP Forum, Location Interoperability Forum (LIF), Wireless Village Initiative, Mobile Games Interoperability Forum (MGIF), Mobile Wireless Internet Forum (MWIF) and many others.

The OMA Service Environment (OSE) is a logical architecture that provides a conceptual environment for service enablers, interfaces to applications that make use of these enablers, interfaces to a Service Providers' Execution Environment (e.g. software life cycle management) and the interfaces to invoke and use underlying capabilities and resources for enabler implementations. The IP Multimedia Subsystem (IMS) (as defined by 3GPP) is a Session Initiation Protocol (SIP) based IP multimedia infrastructure that provides a complete platform for globally interoperable IP multimedia services – especially for the mobile environment. The ISC (IMS Service Control) interface allows applications, i.e. commercial services, to access IMS capabilities. IMS provides service-enabling functions and IP transport, which are relevant for the OSE as defined by OMA. Applications and service enabler implementations may make use of IMS capabilities, e.g. charging, authentication, service management, etc.

The main requirements defined for an OSE can be summarized as

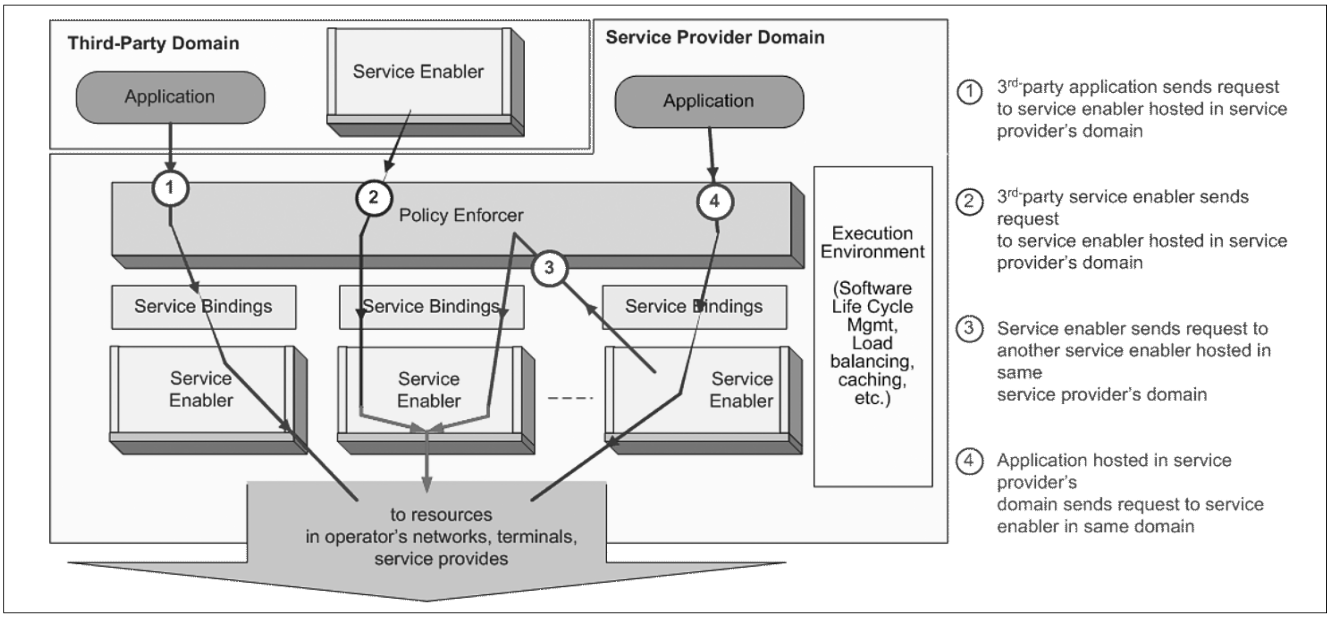
- Mechanisms for authentication, authorization, federated identity, subscription management,
- Single sign-on/log-out,
- Accounting and Charging Handling,
- Provisioning of services, service enablers, and user parameters,
- Service Registration, Discovery Mechanisms, Policy Management,
- O&M support (including service monitoring).

The conceptual architecture of the OSE is shown in *Fig.3* [4]. It also presents a simplified view of the OSE request flow from various entities towards the network. In OMA, a service performs useful work for users or service providers while applications are defined as a software or hardware implementation of a related set of functions. Therefore, applications are the way to access one or more services using service enablers. Applications may be deployed within or outside a service provider's domain or in a terminal. Service enablers provide standard access to network and terminal resources, and to other service enablers using service bindings.

The OSE deals with service requests from applications (located inside or outside the service provider's domain) as well as requests from other service enablers. Enablers shall be re-usable in the same or in different service provider domains. Enablers can be exposed by various binding mechanisms (e.g. Web Services, standardized APIs, CORBA, etc.).

To secure existing networks and their operations, the OSE may protect network resources by a policy management allowing fine grain control of access and system behaviour. The policy management is also used when application access service enablers or when service enablers interact with each other. Policy mechanisms are used to enforce access control by dynamic policy evaluation, to manage the use of network resources e.g. through appropriate charging, logging and enforcement of user privacy or preferences, and to allow extensibility by offering service-platform-controlled delegation between enablers.

Figure 3. Description of OSE and request flow



4. Service Integration Environment

At NEC's European Network Laboratories we develop a solution for a service architecture tailored for the creation of advanced services, specially tailored for IMS services [3]. The Service Integration Environment is the realization of our concept for the core engine of a framework for service creation and delivery. The main benefits in the approach of this unique Service Integration Environment are to develop advanced integrated applications by composing new service logic with re-usable service functions as basic building blocks. Its target for OMA-compliance is expressed in the architecture with emphasis on the centralized intelligent policy management and the flexibility for future extensibility in service creation. As service creation function the SIE provides service API bindings for a flexible service enabler portfolio offered for the application development.

4.1. Service Creation Concept

The Service Creation Process can be described as a 2-phase-process divided into knowledge domains – the *Business and Service Knowledge* and the *Network Capability and Operation Knowledge*. This separation is illustrated in *Fig. 4.*

The Network Capability and Operation Knowledge covers the network and operation control, network service management and control as well as the reliability for the entire service handling from invocation of a service up to the charging and revenue control. The Business and Service Knowledge builds upon this trusted knowledge from the operator's side. It allows for well-defined service interface access, service provider's policy setup under operator's management control, permission-controlled service invocation and revenue control.

A service created on the service provider's domain contains the business logic parts which are specific and unique to the new service. For its operation, this new service is re-using the well-operated services of the operator's domain without installing and managing its own lifecycle for those network-provided service building blocks.

This view supports the arguments for the strongly horizontal approach of the SIE. The separation of service creation from the service enabler's execution calls for a reliable concept for "test once, use forever" with an open graduation for easy and fast new service creation.

4.2. Architecture and Functional Description

The Service Integration Environment (SIE) architecture provides the technical re-

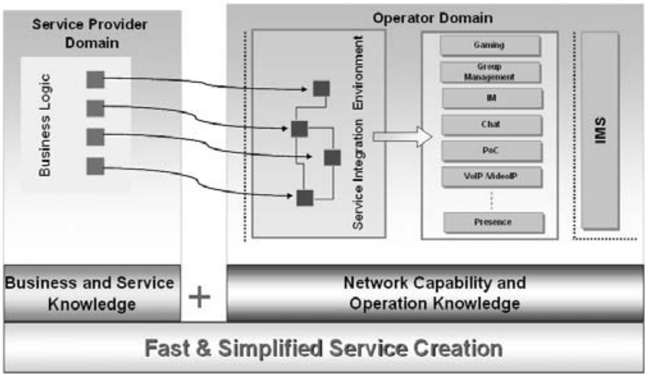


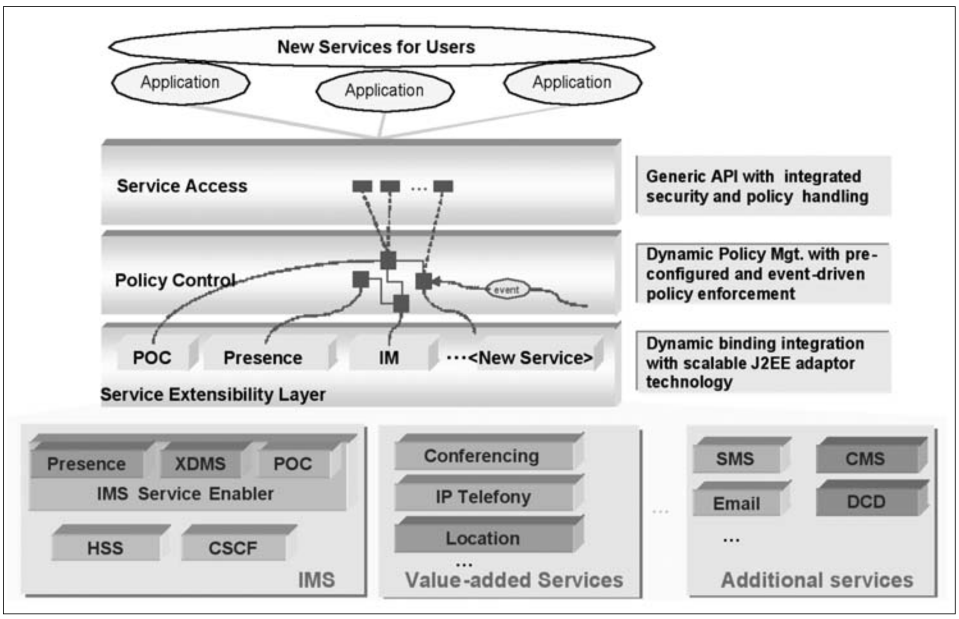
Figure 4. Visualization of the Service Creation

alization for the exposure of network capabilities towards application developers and 3rd party service providers in a secure and manageable way. The SIE provides a combination of various service integration technologies in the different layers *(see Fig.5).*

The top layer, called *Service Access*, allows the discovery of and the access to existing service enablers using e.g. Web Services, enabler discovery, dynamic proxies, and AAA. Service Access technology offers a generic API integration with intrinsic security and policy handling. This framework's gate opens services the access and control to the service enablers via Java (J2EE) APIs and Web Services. *Fig. 6.* (on next page) shows a simplified flow example.

Functionalities included in this layer are
- User administration for SIE platform (e.g. access control),
- permission handling towards the SIE platform and its managed underlying service platforms (e.g. Mutual authentication where user/application has mutual login to different underlying platforms),
- convergence and combination control setup with dynamic PEEM proxy delegation mechanism.

Figure 5. Architecture of the Service Integration Environment (SIE)



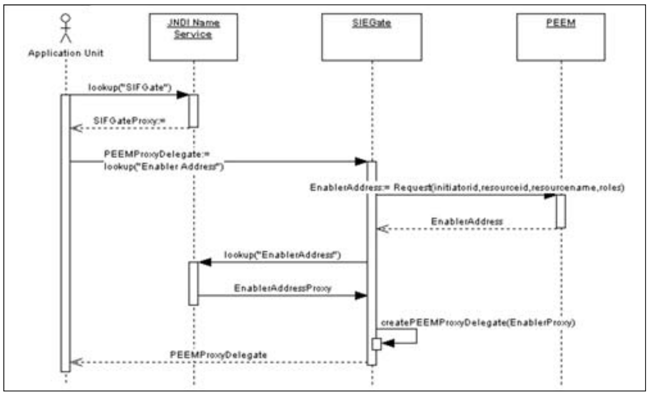


Figure 6.
Example Flow for service access via SIE Access gate

This service environment contains – as crucial point of this service integration platform – an embedded intelligent *Policy Control* layer that allows the creation and enforcement of rules to ensure safe and controllable access to any kind of resource.

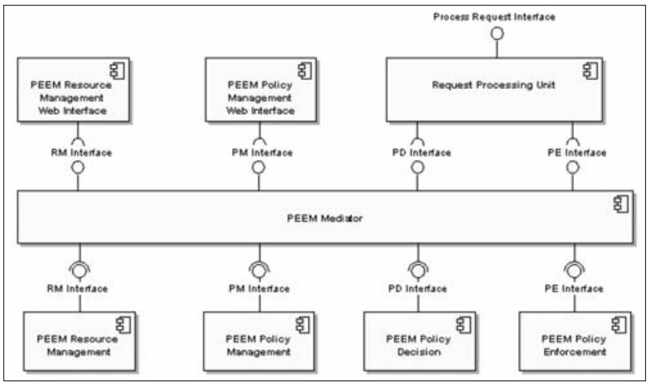
The middle SIE layer – containing this intelligent policy control – permits network operator to control requests between advanced application and service enablers. Within this concept, the design of a dynamically enabled service composition over policy control is a major part of SIE platform. Policy Control technology is designed for static pre-configured as well as dynamic event-based policy enforcement. This permits e.g. for dynamically enabled service invocation respecting current network conditions. The Policy Control's component overview is shown in *Fig.7.*

The access layer towards the underlying network capabilities and services – the *Service Environment Extensibility* allows dynamically expanding the set of service enablers using adaptor technologies for the dynamic installation of new APIs. The service adaptors shown in this layer in Fig. 5 and 8. are represented as Java or Web Service interface, depending on the underlying service platform.

4.3. Performance

Estimating the performance of the SIE prototype implementation, the performance of the centralized policy control layer for a request applied in the direct policy enforcement mode is measured. The time consumed by the policy decision and enforcement process has been measured by issuing 10000 local requests from within a single thread to the application server. By issuing the requests locally we avoid noise effects from network access. For our performance tests one policy had to be found, analyzed and enforced. Since policy decision and enforcement times depend on the number of applicable policies, processing times should increase in more complex cases.

Figure 7. Policy Control Component overview



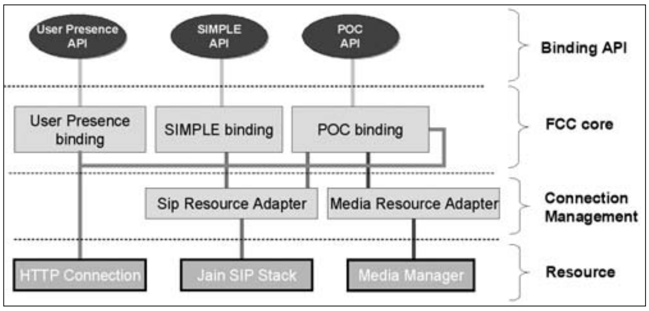


Figure 8. SIE's Extensibility Layer Component overview

In *Fig. 9,* the processing times for requests are varying between 16 to 30 ms normally, and 25 ms in average. The peaks are due to the application server's EJB pooling and allocation behavior that should reduce in a constantly running system.

Running conditions:

10000 requests issued locally from within a thread.

Measurement conditions:

JBoss 4.0.0 application server, single processor 2.0 GHz Intel Pentium 4, machine with 512 MB of memory.

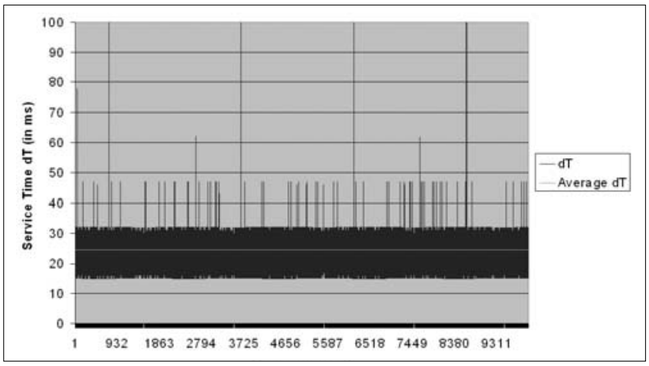


Figure 9. Performance measurement for the policy layer

In this system no code optimization was performed on the policy framework, so that further performance gains in the future can be expected. The response times show that policy enforcement can be done in an acceptable timeframe. Since we are using clustering and load balancing capabilities of the application servers, extending the cluster can insure availability if the need arises.

5. Advanced Application: Mobile Auction

This section will provide an example description of an advanced application using the service creation potential of the SIE platform.

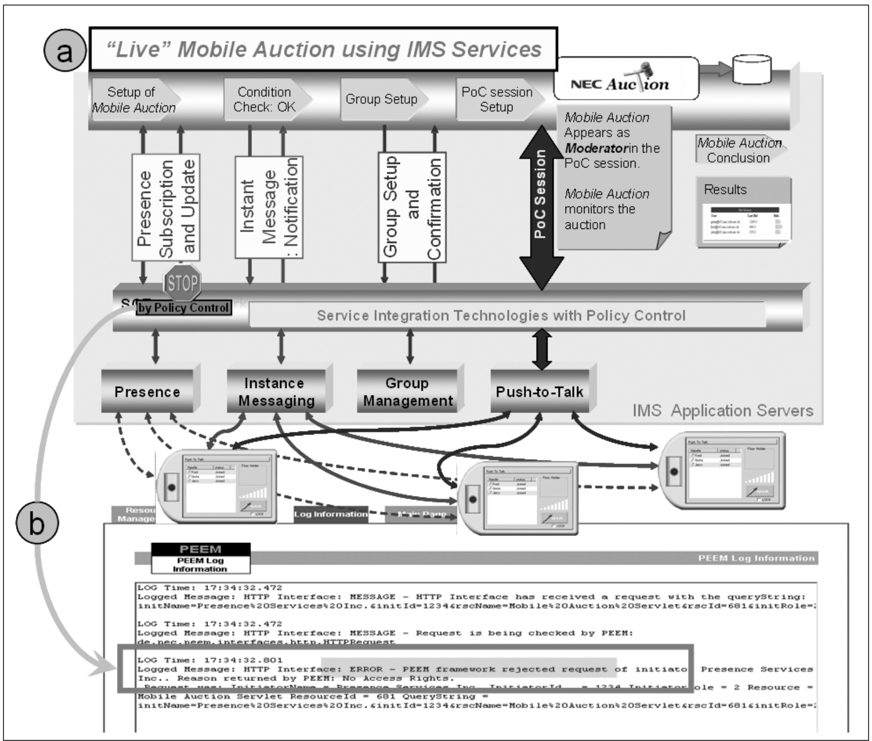
The example is outlining an application for a *Mobile Auction*. This example application is based on the consumer market. The basic idea of auctions is a well known application which is deployed in various scenarios (e.g. internet (eBay), live auctions). Those existing scenarios are normally fixed scenarios in place and/or time and/or procedure. Internet auctions are providing the convenience of attending the final phase of bidding from any private or most suitable location with access to the internet, however it actually is lacking the real life-feeling to be connected to a group of people in order to share information/dispute about an item. The proposed Mobile Auction scenario is bridging this experience gap by expanding the fixed internet-based scenario into the mobile communication world. The focus is not just basically to provide mobile internet access, but rather to use context parameters to integrate an interactive, mobile communication phase adaptable by preferences given by the auction participants (seller and purchasers). The specific idea is the integration of IMS-based communication services with respect to context information (e.g. presence, location). Fig. 8 illustrates the basic request flow for the Mobile Auction application.

The Mobile Auction starts with “online” bidding for an auction item on the internet. The internet-based auction switches to the “Live” auction on “context condition”, e.g. if enough bidders are online (can be distinguished by using their presence status) and when there are enough biddings issued to the portal.

The “Live” auction phase can utilize different IMS communication services for “live” bidding and price update e.g. Push-to-Talk ad hoc group call or a dedicated text chat room based on Instant Messages. The portal also has a functionality, so that the text chat service connects between mobile and fixed (internet) users.

Fig. 10. is illustrating this scenario. There might be certain conditions which prohibit the setup of the mobile phase by policy control to receive e.g. Presence Update information (due to charging restrictions), as shown in Fig 9. The SIE platform will record those activities as visualized above in the policy execution logging capability.

Figure 10.
Illustration of Mobile Auction service request flows



6. Conclusion

The world of Mobile Network operators and service providers in Europe is different from the situation in Japan in several aspects. Many large and small providers are competing with each other. Their main challenge is to be ahead of the competition regarding the roll-out of new and attractive services. In order to improve service development speed and to contain development costs, mobile operators want to build as much as possible on standardized architectures and solutions. OMA is the leading mobile services standards body.

This paper gave an overview of the Service Integration Environment (SIE) as a potential part of a future SDP solution accompanied with a respective market and OMA standards discussion. A detailed description of the functional structure of the SIE architecture layers, the involved integration techniques are provided. The centralized dynamic policy control has been explained as a major part of our platform. The provided sample application illustrates the easiness of creating advanced applications utilizing e.g. IMS service enablers.

The SIE developed at NEC’s Network Laboratories in Heidelberg aims at complying with the OMA service model paradigms. The resulting SIE architectural model opens a big market opportunity for future service revenue for network operators.

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