Service management evolution

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Abstract— **This paper presents an outline for the evolution of service management. The outline includes the motivations for moving to more advanced schemes, as well as descriptions of the actual schemes in different evolution phases. The outline is also linked to ongoing research projects within the Wireless World Research Forum (WWRF) and the Wireless World Initiative (WWI) programme.**

Index Terms— services, management, service quality, lifecycle, personalisation, adaptation, context information.

I. INTRODUCTION

The increase in complexity and number of packet-based services pose a challenge to service management systems. A parallel trend to growing complexity is observed with increasing competition with respect to both network access providers and service providers. This competitive situation calls for the ability to provision services quickly and accurately. Furthermore, the value nets and business models are growing in complexity. A simple example of this is emergence of stakeholders such as so-called third party content providers and service providers, in addition to network providers.

In addition to the aforementioned factors and in some sense also as a consequence of it, the emergence of new, open application and service platforms, as well as new business models will dramatically change the traditional service management principles. The possibility to rely on common network and service platform architectures for both fixed and mobile networks offers the players in Information Communication Technology (ICT) and other sectors the possibility to plan and deploy cost effective, future-proof and multi-purpose infrastructures and service offerings for several customer segments. In this open and heterogeneous communication environment, the role of the service management will be more pronounced. Understanding the new requirements for Operations Support Systems/Business Support Systems (OSS/BSS) functions and their relation to the service environment and overall service management process is very important for developing a new basis for service management.

This situation has led to a number of consequences [4]. There has been growing interest towards cooperative activities both in standardization (e.g., TeleManagement Forum, TMF) and in research and development (e.g., the IST MobiLife project [1] of the Wireless World Initiative (WWI) funded within the IST 6th framework programme of the European Union and the Wireless World Research Forum, WWRF [9]). We shall say a few words about these to set a frame of reference for the following discussion.

From the viewpoint of TeleManagement Forum standardization, one of the focus areas has recently been coordinated modelling the different activities relating to service management. Some aspects of this include development of process maps (enhanced Telecom Operations Map, eTOM) [3] and information model called Shared Information/Data (SID) model [8]. The Service Framework Team (SFT) has made analysis of the models provided by TMF within the context of the requirements of stakeholders to service provisioning [4]. We refer to some of the outcomes of this work later on in this article.

From a research point of view, an ideal next generation service management system has to support multi-access systems, distributed service platforms, and peer-to-peer services, to mention a few areas. The WWRF has formulated a vision of "I-centric communications", and is in the process of analysing the requirements for a future service provisioning architecture [9,10]. The IST MobiLife project [1,6] applies User-Centred Design (UCD) principles for addressing mobile services supporting personalization and context usage. Both research activities also pay attention to evolving business models.

The service support architecture in development cannot be a technological discontinuity, but needs to interface to existing infrastructure. This is a requirement that has been formulated clearly within WWRF.

The evolution of service management can be categorized by the following main architectural paradigms:

- Traditional operator-based management

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- Component-based service management
- Distributed service management

This framework will be used within this article. Due to limited space, service examples are not provided in this example. All of the paradigms should support legacy services, in addition to enabling new ones.

The high-level goal for service management should be the management of the end-to-end experience of the parties involved within a business process management framework. In particular, relating end user experience and the service management processes to the value customers should be emphasized. The paradigm of service oriented architecture as the basis for future service developments is studied within this article.

II. Evolution of Traditional Operator-Based Management

Traditionally, telecommunication management solutions have been "silo-based", i.e. in principle every network and service element has had its own and often vendor specific solutions for network and service management even if services run on the same connectivity infrastructure. For example, different network elements may have disparate data models for representing the same information. Telecommunication systems are evolving from these vertical, service-specific infrastructures towards horizontal end-to-end infrastructures through the adoption of the Internet Protocol (IP) as a basis for core networks.

From a technical standpoint, using IP-based platforms for core networks in both mobile and fixed domains affects multiple areas ranging from the creation of the common transport network and network management system to the common multi-purpose service management system.

For new service management schemes, there is still a natural requirement to be interoperable with the telecommunications based service management schemes. New service innovations are quite often composed of both new and existing service components. Even new applications may require access to legacy systems. Another motivation for interoperability comes from an emerging operator business environment where end user services can be composed of the service offerings of several providers.

III. Component-Based Management

New paradigms have been devised to address the limitations posed by element-based management. The following goals have been identified for the next generation of service management products:

- End user centricity
- Operation at a higher abstraction layer
- Support for entire service lifecycle
- Faster and more accurate service configuration
- Support for flexible value nets

End user centricity means that state-of-the art service management system must allow for using of end user requirements in creating and updating services. At the same time, the system should minimize the need for the end user to make any service related configurations.

Operation at a higher abstraction layer than element specific configurations is a necessity for being able to address the real needs of end users.

Support for entire service lifecycle relates to the ability to support the entire process from business requirements to element specific configurations.

In view of today's business environment, the system must allow for quick and accurate service configuration.

Service management system must be flexible in view of partitioning service management tasks across stakeholders of service management process. This is necessitated by the increasing need for strategic cohesion for each business actor.

In the following, we outline the use of the component-based management paradigm for addressing these requirements.

The basic idea is to construct end user services out of service components. The components represent well-defined functionalities or information, and can be used as a basis for devising new components. The following figure from the Service Framework Team (SFT) deliverable [4] illustrates the basic concept.

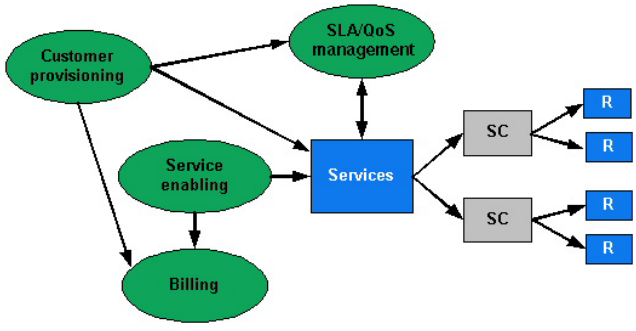

Figure 1: Component-based service management framework. From [4].

The components may contain service specific configurations, and contain information related to particular resources. Referring to an example used by the SFT, the resource could be a Multi-media Messaging Service Centre (MMSC) and a service component would describe a building block for Multimedia Messaging Service (MMS)-based service. Each component may be managed separately, and be considered to have a lifecycle of its own.

The actual end user service (called a "product" in SID) contains information, which allows it to be provisioned to end users. In SID, a distinction is made between customer-facing and resource-facing aspects of services. The end user service has a lifecycle of its own, and can be used as a building block in devising other end user services.

Referring to the requirements listed above, the following observations may be made:

- Use of components allows for raising of abstraction level.
- When properly used, components allow for shorter development cycles and fewer configuration errors.
- Use of components also allows for better focus on end user requirements.
- Service lifecycle support is provided in form of separation of composition of end user service from creation of components.

Mere use of components is not sufficient, however. The service component management needs to be related to a framework describing how services are created and operated using components. The SFT found the concept of service management roles useful in describing such a framework. The service management framework described in [4] – illustrated in the Figure below – describes how different roles participate to the lifecycle of a service.

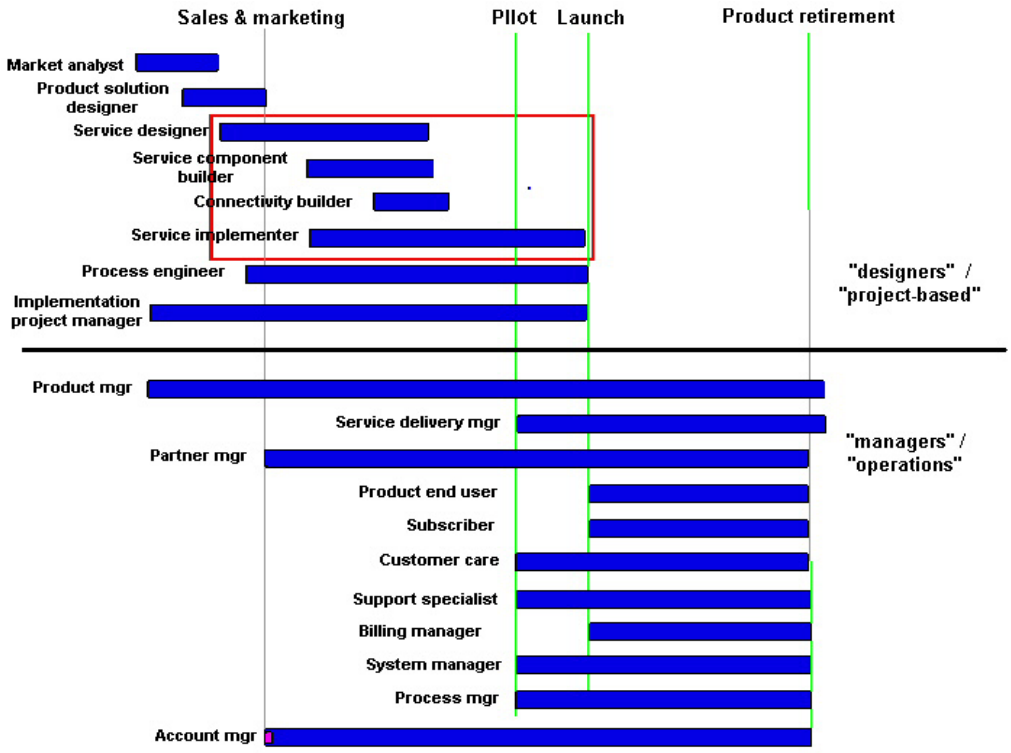

Figure 2: service management roles in TeleManagement Forum's service framework. From [4].

The service framework describes the participation of roles in service management in a time context. As can be seen in the Figure above, the roles cover formulation of business requirements, design of the end user service (product), as well as design and implementation of components and connectivity between them. The framework also includes roles related to operational management of the service.

In addition to components and roles, the ultimate service management framework also needs to address information modelling and relation to service assurance.

A common information model is useful for achieving the goal of managing services instead of individual systems. The SID model of TMF is a candidate for this, but as of the time of writing this, has not yet included detailed support for mobile domain.

Adequate support for service assurance is important for being able to obtain information relevant to service performance, and using it for “traffic engineering” type optimisation of network parameters as well as composition of services.

IV. Distributed Service Management

As a further evolution step of component-based management, distributed service management is analysed next. In what follows, we study this topic from network viewpoint, and also how distribution could be reflected in service lifecycle.

A. Network viewpoint

In future networks, support for different kinds of services needs to be regarded in a broader scope than just on application layer. Projects like IST Ambient Networks [2] study the means to build networks out of multiple access networks, which adapt to different needs and are able to provide contextual information as well. The change in network architecture is expected to lead to redefinition of service, as well as compensation models.

One vision of Ambient Networks project is to provide overlay network capabilities. This kind of network composition can appear in such a way that they, in essence, become one single entity and are governed by single policy and behaviour, so the outside world doesn't see the composed structure. This also relates to the adaptability as the different kind of users may have different kind of quality requirements or different kind of equipment

From a management perspective, much of the centralised management can be distributed by giving more responsibility to individual elements and services. In such a self-management paradigm, the local scope configuration is used as much as possible for invoking the desired functionality. Of course, this approach cannot be always applied, and more global view is needed in order to keep the level of service within agreed limits in the whole network.

B. Service lifecycle

From another viewpoint, service management addresses the whole service lifecycle. Typically service management includes a loop in which deployed services are optimised based on feedback from the operational environment where they are deployed.

The service lifecycle encompasses a variety of functions to support a service in all its phases from the service development to the service retirement.

The service lifecycle management provides capabilities to guide the whole service product process considering the different service management roles as shown in Figure 2. It takes care of the development of a service including all activities for a successful service creation such as requirements analysis, specification, design, and coding. After a successful development, the service lifecycle management leads to the next phases of the service life cycle, summarized under service provisioning, continuing the service management process. The actual service offering to the customer on a particular system platform and the usage of the service by the customer are part of service provisioning. In addition to service deployment, service usage, and service retirement, service provisioning also includes the operational management. Here, customers can subscribe to services and manage their profiles and preferences regarding service usage, security levels and billing settings.

In addition to the phases of the service lifecycle discussed above, commercial phases such as advertising have to be included in service management. Corresponding functions are needed that allow dynamic advertising on terminals to increase the user‘s knowledge about newly available services and consequently its willingness to use and pay. As we show below an advanced service usage support includes functions to support advertising.

Figure 3, taken from [7], illustrates the phases related to service management and the relations between them. The figure is organized into three levels, which are explained in the following.

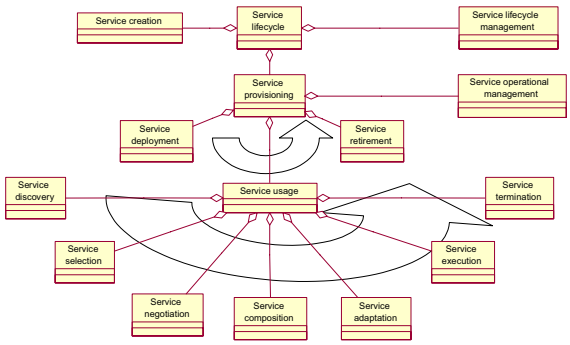

Figure 3: Generalized service lifecycle. From [7].

The highest level relates to service lifecycle, consisting of service creation and service provisioning phases as well as service lifecycle management. Service creation includes all phases of service development as mentioned above.

The second level relates to service provisioning, and consists of service deployment, service usage, and service retirement phases, as well as operational service management.

The third level relates to service usage.

Taking into account the capabilities to be provided by a next generation network the service usage functions expand beyond a simple usage chain consisting of service invocation, service execution and service terminations that we know from mass market services such as plain old telephony services.

Arbanowski et al. [9] describe new capabilities such as personalization, context awareness and adaptation that play a

major role in service provisioning already now and that have to be supported by advanced systems in the future. Personalization describes the acquisition of user specific data and the process of tailoring of services to the identified needs. Context awareness means the ability to utilize context information. Adaptation describes the necessary process of customising and optimising services to actual conditions.

Taking these future directions into account, service usage can be described encompassing the following phases: service discovery, service selection, service negotiation, service composition, service adaptation, service execution, and service termination. Of course, not all of these phases have to be present in any service usage process. However the arrow indicates the sequence of the service usage phases.

Service discovery supports the customer or her or his devices to find a new service that has been previously deployed, based on a user request or proactively suggested to a user based on contextual triggers.

The selection of services that can actually fulfil the user request among the discovered service portfolio is described by service selection, either proactively or on demand through an analysis of the current context of users. In this way, a certain location can trigger services, e.g. a bus stop triggers a service to buy tickets.

The service negotiation phase supports the matching and adaptation of service capabilities among the selected services in order to find the best agreement between service provider and end user.

If the requested service is not available by itself but can be composed from different more basic available parts, an automatic service composition may take place in order to provide the requested service.

In the service adaptation phase the service is tailored to user information (e.g., terminal capabilities, user preferences) or context information. The service adaptation also includes the configuration of the service and the related environment (e.g., terminal settings, download of user configuration).

The actual consumption of a service is described by the service execution phase. Service adaptation can also be performed during the service execution (e.g., runtime adaptation of a media stream).

Finally, the service is terminated either by the end user or by the system.

V. Summary

A view of evolution of service management paradigms has been presented, consisting of vendor-specific systems, component-based management, and distributed service management.

Due to limited space, many interesting and relevant issues have not been discussed here. For example, using distributed service management gives rise to novel requirements for security and service quality. These may be considered to be topics for further work.

VI. Acknowledgments

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VII. References

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