SOA: New Era of Telco Services

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Abstract:
Traditional signaling based telecom service control architecture, intelligent network service control architecture, and even Next Generation Network (NGN) and IP Multimedia Subsystem (IMS) that are pictured as the fundamental of future services have become an obstacle for telecom service development because they are closed in service creation and service control and implemented on a centralized computing platform. As newest technologies in Internet, distributed computing and enterprise information services, Service-Oriented Architecture (SOA), Web services and Web 2.0 have been widely recognized in information and service industry in past years. According to the SOA definition of OASIS, SOA will bring tremendous changes in capability, service and service interface, compared with traditional telecom service architecture. Moreover, it adds a capability-service transform mechanism and greatly simplifies application development.

1 Evolution from NGN to Telco 2.0

By definition, the Service-Oriented Architecture (SOA)-based next generation telecom service network is to apply SOA concept and mechanism, which was proposed recently for enterprise information services, into the next generation telecom service network. It is a breakthrough of traditional telecom services and Next Generation Network (NGN) and IP Multimedia Subsystem (IMS), which are based on traditional telecom service network architecture, the result of technical development and innovation of telecom services.

Based on IP technology, NGN[1] has always been discussed along with such concepts and technologies as soft switching, Session Initiation Protocol (SIP), IMS, and Intelligent Network (IN). It is a new kind of signaling network constructed on IP infrastructure with service control capability. As a result, it supports fixed, mobile or nomadic terminals, delivers telephone services, multimedia session services (which are derived from telephone service and signaling network capability) and intelligent services, and provides interfaces for third-party to develop intelligent applications via an open service platform.

The concept SOA[2] was recently proposed by the IT industry to promote the development of enterprise information service software. Currently, it has been integrated with Web Services[3] and Web 2.0[4] technologies, which were also introduced on Internet in recent years, into a new enterprise business solution called Enterprise Web 2.0[5]. The new solution applies enterprise business process in Internet rather than Local Area Network (LAN) only, and expands enterprise information services in terms of field, geographical region, department, and personnel. Besides, it can flexibly allocate and combine the business components that are managed or maintained by different entities. Consequently, it greatly decreases the complexity of application development and speeds up the response of information service, thus improving enterprise productivity, resource utilization, response to market change, as well as the enterprise competitiveness.

Meanwhile, SOA's application is begun in telecom industry. One of such applications is Telco Web 2.0[6] or Telco 2.0. Integrated with SOA, Web Services and Web 2.0 technologies, as well as research achievements of Enterprise Web 2.0, Telco 2.0 enables telecom services to be developed in a larger resource bank. It can achieve high resource utilization by large-scale deployment of distributed computing in the network, allow applications to quickly respond to differentiated market demands, and promote innovation of telecom technologies and services. Now, Telco 2.0 has become a hot topic globally in the research of next generation telecom service network architecture.

Many researchers claim that the architectures of telecom service networks are always service-oriented, and the evidence can be found in Broadband Integrated Services Digital Network (B-ISDN) architecture, IN[7] architecture and Telecommunications Information Networking Architecture (TINA)[8], all of which had been applied many years ago. However, analyses show either traditional telecom service network architectures or existing next generation telecom network architectures (e.g. IMS[9]/NGN) bear no direct relation to SOA-based Telco Web 2.0 discussed herein.

In the context of Telco Web 2.0, telecom services have been extended dramatically in either quantity or quality. To supports new telecom services, the

next generation telecom service network should make considerable changes in terms of principle, architecture, and key technologies. Hence, the telecom industry pays attention to and studies SOA.

2 Definition and Design Principle of SOA

SOA can be regarded as a result of two reasons or two demands: one is the thirst of software and information service development enterprises for efficiency and adaptability to change; the other is the information service operators need for enlarging their information service scopes, expanding their business scales and capabilities and reducing operation costs.

Many documents or references give their own definitions of SOA. These definitions reveal that people try to, from different perspectives, use service–oriented approach to handle business process and implement the process via software in distributed environment. Precisely speaking, the definition of SOA Reference Model (SOA–RM) by the Organization for the Advancement of Structured Information Standards (OASIS)[10] explains the significance of SOA in telecom service networks more accurately than other definitions.

According to the SOA–RM specification, SOA is a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains. It provides a uniform means to offer, discover, interact with and use capabilities to produce desired effects consistent with measurable preconditions and expectations. Functionally, SOA provides a manageable mechanism for matching needs of service consumers with capabilities provided by service providers.

The central concept of SOA is service. Service is a mechanism to enable access to one or more "capabilities", where the access is provided using a prescribed interface and is exercised consistently with constraints and policies as specified by the service description.

At the same time, in order to improve software development efficiency and reusability, the research and discussion on the architecture has never stopped these years. As a matter of fact, the focus of the discussion is not those common problems such as function breakdown or modularity, but some specific ones. For instance, what is the granularity of the module, how does the network interconnect traditional systems, whether service's flexibility or module reusability is aimed for.

Therefore, SOA is also regarded as a software methodology. According to the SOA definition by Yvonne Balzer and Thomas Erl, the following guiding principles define the ground rules for development, maintenance, and usage of the SOA[11]:

- Reuse, granularity, modularity, composability, componentization, and interoperability
- Standards compliance (both common and industry–specific)
- Services identification and categorization, provisioning and delivery, and monitoring and tracking

Meanwhile, SOA's software architecture design must follow the specific architectural principles below:

- Service encapsulation
- Service relationship: Services maintain a relationship that minimizes dependencies and only requires that they retain an awareness of each other
- Service contract: Services adhere to a communications agreement, as defined by one or more service description documents
- Service abstraction: Beyond what is described in the service contract, services hide logic from the outside world
- Service reusability: Logic is divided into services with the intention of promoting reuse
- Service composability: Collections of services can be coordinated and assembled to form composite services
- Service autonomy: Services have control over the logic they encapsulate
- Service non–state: Services minimize retaining information specific to an activity
- Service discoverability: Services are designed to be outwardly descriptive so that they can be found and assessed via available discovery mechanisms

The above guiding and design principles reflect the basic ideas of SOA. They are important bases for us to analyze the differences between SOA–based next generation telecom service network and traditional telecom service network as well as to find new approaches for developing services.

3 SOA vs. Traditional Telecom Service Network Architecture

The SOA definition and software architecture design principles of OASIS show that SOA–based telecom service network is basically different from any traditional telecom service network in many aspects. Only when we identify these differences, we can develop a SOA–based next generation telecom service network that excels existing NGN/IMS, achieving innovation and breakthrough of telecom services.

(1) Capability

The capabilities supported by SOA are far beyond the scope of NGN's "open service capability" defined by Parlay working group. In SOA, new capabilities can come from different owners and can be controlled by the owners themselves. Particularly, these capabilities include not only communication capability and information processing capability of traditional telecom services, but also information service capability, media distribution capability, social network capability, the capability of managing consumers, resources and services, as well as the capability of processing information and business of the following:

- Enterprise Network
- Inter–department of an Enterprise
- Inter–enterprise
- Internet
- Special Network
- Home Network, and
- Individuals

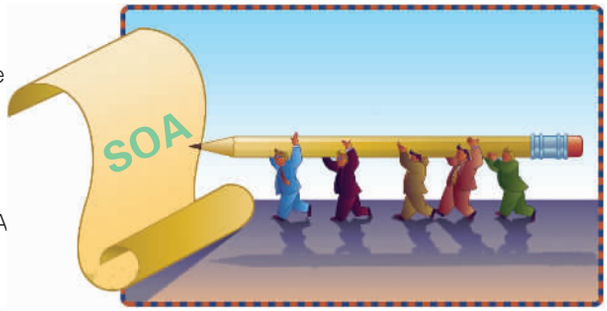
All telecom services that are open and developed on the basis of these external, autonomous capabilities can be implemented in the SOA–based next generation telecom service network. In contrast, the traditional telecom network architecture takes no account of these capabilities, let alone implements them.

(2) Service

The services in SOA are not just call processing services in traditional telecom service network and IN and session services in NGN. First, the entity of traditional telecom services is the telecom network itself, while the service concept in SOA is an abstraction of customer needs. Second, the core concept of call processing and session services is to maintain, in a centralized execution context, a group of conversation states that exist in call or session path according to predefined service logics, while the service in SOA is a mechanism to enable access to one or more capabilities, where the access is exercised consistent with constraints and policies as specified by the service description. In early days, telecom services were closed, without any open service interface to provide access. Since the introduction of open service capability, access interfaces are provided for call processing and various telecom networks. However, the service access interface defined by Parlay can only directly access the capability, which is quite different from the service mechanism in SOA.

(3) Service Interface

The definition of service interface in SOA completely differs from User–Network Interface (UNI) and Network–Network Interface (NNI) in traditional telecom service network. In traditional telecom service network, each interface is used to access a service node of the network, and the node is often a physical switch or server. Hence, all traditional accesses imply such limitations as access location, access bandwidth and processing capability of access server. Meantime, reliability, security, and error–tolerance of the access have to be taken into account. With all these considered in the design, the interface becomes extremely complicated. In SOA, the physical device–related capabilities are separated from the access to services, so service interfaces are independent of physical devices. As a result, the abovementioned limitations of physical interfaces as well as the requirements for reliability, security, and error–tolerance are all isolated from service interfaces. This means not only the complexity of service interface decreases considerably, but also the functions of service interface can be greatly improved.



(4) Transformation from Capability to Service

From the above, we can see the main function of SOA mechanism is to achieve spatial transform between capabilities and needs. Therefore, SOA mechanism can be regarded as a transform layer between two spaces, which is established in physical capabilities of different natures and in different locations and supports diverse needs. This is a feature of SOA distinct from traditional telecom service network[12]. In traditional telecom service network, the service layer is a layer between transmission network and application. As a result, either above or under the layer, it corresponds to specific physical service nodes. On the contrary, the service interface provided by SOA is independent of physical networks and nodes, so service integration or access can be done at any location, and it is not necessary to consider any factor related to network, location and server's processing capability.

(5) Execution of Service Logic

In traditional telecom service network, the logics for service control is specified in advance, maintained at multiple points but executed at a fixed point. This execution method is called Remote Procedure Call (RPC). Even in IMS architecture, the states of session control have to be maintained by several Call State Control Functions (CSCFs) and the service logics are executed in application servers. In contrast, the Web access system of Internet works differently. In such a system, the web page containing service logics acts as a service control module, which can run in the browser of any terminal to access the server. For the server, the access of massive web pages is stateless, but the server has to perform end–to–end maintenance of the execution state of each service request. In Web Services architecture, service logics and states are carried in the work stream to realize interaction between loosely–coupled service function servers, and the execution state of each service request does not require maintaining a special server. Further, in Web 2.0 system, a service control web page is broken down into some small, messaging–associated independent modules, and with SOA mechanism, asynchronization operation of service resources rather than physical server access is performed. As a result, except the terminals, no server is required to maintain users' service logics and execution states. This approach simplifies the interactive structure of the system, lowers the requirements for processing capability and storage capability involved in state maintenance, and effectively reduces the complexity in application development and relocation of service logic running node. As the SOA mechanism places service control execution points on the terminals and sets service logics in work streams, service resources are separated from capabilities; hence, the capabilities maintained by different departments or different enterprises are not required to support interactive state management, allowing a dynamic service development system to be established in heterogeneous environment.

(6) Application

Web 2.0 technology reveals this fact: The complexity of application development has been dramatically decreased with increasing open service resources being introduced on the Internet and application development tools being continuously improved. With Web 2.0 technology, application development is no longer complex function design, process design and web page design, but has become simple web page programming. The programmed web application is called Mashup[13], which is delivered to and runs on the terminal or server. Doubtless, this is a new form of application, where the new cooperative application

development business model has been introduced. In Enterprise Web 2.0 environment, the business process development department of an enterprise can, without any special software knowledge, directly design, test and maintain the applications. Similarly, in Telco Web 2.0, Mashup–based applications will emerge. Because its applications can get services and capabilities in a larger network environment, Telco Web 2.0 can greatly improve the innovative capability for application development, and, at the same time, decrease the complexity, thus promoting information services.

4 Conclusions

Architecture is a very important issue in system development because it defines potential capabilities and development of a system. Affected by traditional telecom service network architecture, the architectures used in IP multimedia telecom service network, including NGN/IMS, are still closed and focus on session services and call processing.

The application of SOA, Web Services, Web 2.0 and Enterprise Web 2.0 has no doubt opened a new "window" for next generation telecom service development.

In terms of technology, the SOA–based telecom network service network, i.e. Telco Web 2.0, is an enhancement of Enterprise Web 2.0 with communications and computing capabilities being added. But this enhancement means much more in the market. It breaks through the obstacles in the development of both telecom services and enterprise information services, allowing telecom services to be developed in a national or even global open cooperative context. With a mechanism transforming capabilities into services, Telco Web 2.0 expands its capabilities to a great extent and completely changes its service structure, even the form of application. These changes not only enhance the efficiency of telecom service development and utilization, but also improve the capability of quick response to user needs. Moreover, Telco Web 2.0 provides means for service innovation, which can promote healthy development of telecom market and enterprise information service market, thus speeding up the industrialization process of information services.

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Biography

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Jing Yang is the chief scientist and chief structure engineer of UTStarcom (China) Co., Ltd., a professor and doctoral advisor in the Institute of Computing Technology of Chinese Academy of Sciences, and a member of Experts Commission of China Next Generation Internet (CNGI) project. His research interests cover a wide range, including communications, electronics, computing, telecom networks, Internet, information services and information system modeling and analysis. He presided over the development of telecom integrated service management system and the preparation of engineering specifications (version 97) for the Directorate General of Telecommunications of the former Ministry of Posts and Telecommunications (MPT) of China, and was granted several science and technology advancement awards by the former MPT. In recent years, he is mainly engaged in the research of interactive multimedia telecom service system with distributed computing architecture.

Roundup

ZTE Receives WiMAX Forum Certification

ZTE Corporation announced in September 2008 that its WiMAX 16e system passed Mobile WiMAX certification testing by the WiMAX Forum. This is another milestone following the earlier certification for its WiMAX 16e terminals in August 2008.

"ZTE's WiMAX system and terminals both passed certification from WiMAX Forum, not only signifying that ZTE has the capability of mature commercial application, but also driving the development of the Mobile WiMAX industry chain. ZTE has been actively promoting the development of WiMAX 16m standards, and has put forward a number of effective proposals. The growth of WiMAX industry requires the joint efforts of all terminal providers, chips provider and service providers," said Zhao Songpu, General Manager of ZTE's WiMAX Product Line.

Certification of WiMAX products is the authority of the WiMAX Forum, aiming to standardize the consistency of WiMAX equipment and terminal manufacturers. Professional and strict specifications have been established for test contents from protocol consistency to function implementation and product performance. The text contents covering thousands of test items are reviewed by the experts of WiMAX Forum. The WiMAX Forum Approval Certificate is awarded only when all the test items have been passed.