Handbook of Service Description

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Editors

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USDL and Its Methods

Springer

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To my wife Kylie, and our beautiful babies, Marion, Thomas, Emily and Veronica — with love from Alistair

Preface

The Positioning of Services

We are at the dawn of the long anticipated services revolution. To be sure, the notion of a service is hardly new, for services have been an ostensible feature of the way labor is organized to deliver consumer value since at least the shift to the post-industrial age. Indeed, services, together with goods, characterize the outputs of human organized systems, as understood by macroeconomics, no less. They have increased in prominence, under globalization and deregulation, as units of functionality that influence organizational restructures and outsourcing on a global scale. Look into most company operational plans, and services are among the key reference points for how work is coordinated both internally and externally, and against that which productivity is measured. Technologically, it is now some 10 years since Web services were proposed as the mechanism for unlocking valuable, often stove-piped logic, from software applications, and interoperating these across heterogeneous stacks, applications, business units and company boundaries. In the intervening years, the maturity towards the Service-oriented Architecture (SOA) has followed, through considerable investments and efforts by business, technology and research sectors.

So, why the excitement about services now? The reason is simple: the Internet and mobile communications, coupled with new and disruptive business models, are lifting up the conventional barriers to service access in an unprecedented way. Beyond familiar Web consumer services such as Facebook, Twitter, eBay, Amazon, iTunes, Google Maps, PayPal, FlickR, technological breakthroughs, especially around smart devices and cloud computing, are ushering in a dramatic growth of services. Mobile "Apps" and software-as-a-service are growing by the day. Business process outsourcing on-demand, multi-enterprise business process in the cloud, service marketplaces, service-centric business networks, and platform and infrastructure-as-a-service, are also on the rise and remonetizing services beyond their original settings. Moreover, mainstream segments such as transportation and logistics, banking and finances, public sector and manufacturing, and enterprise software providers, are slowly but surely following suit, when one considers the following Web-based services entering the “long tail:” carrier bookings and track-and-trace of shipments, world-wide tariff look-ups, news events, loan originations and servicing, healthcare (the American Health Level 7 standard), business formation, enterprise software services, water/energy utility monitoring, platform services such as business process management and enterprise services bus, and virtualized IT infrastructure services.

With the growth in number and sophistication of services widely available, the question turns to how effectively consumers can discover, understand and access services — with relative independence and without full reliance on providers. Experience has so far shown that any attempt to describe services faces a common stumbling block: *what is a service*? Despite the widespread phenomenon of “service” in economic, political, business, communal and individual walks of life — and, undoubtedly, because of that diversity — there are still many uncertainties and tensions in arriving at a general conception of services.

Some services concern human endeavor or largely human interactions, such as project management, sales, consultancy, therapy of different sorts, church worship, and bus, train and other transportation services. These clearly don’t fit the motif of services understood as Web services. At the other extreme are technical services providing platform and infrastructure functionality whose complexities and resource dependencies challenge the consumer “Apps” motif of services. In between are business applications delivered through business units, actors and designated work centers and channels. A mix of human and automated tasks are involved, where service knowledge is dispersed across operational procedures, transactions and the data inside databases. Even in this regular form encountered in businesses, the notion of service strikes ambiguities. In the example of a travel agency offering flight bookings, what is the service? Is it flight bookings as a business function, the flight booking application, or the flight services involving different airplanes that are sought?

The Need for Explicit Service Descriptions

In the IT community, SOA languages such as the Web Services Definition Language (WSDL) [4], the Web Application Description Language (WADL) [10], or the Web Services Business Process Execution Language (WS-BPEL) [1], have focused on describing services and their interactions in a uniform way, for leveraging heterogeneous technologies. By consequence, other Web services specifications such as WS-Policy [2] and Web Service Level Agreements [17], even if they concern operational issues, are fixed to the particular view of a service as software. The Universal Description and Directory Service (UDDI) [5] specification was defined for a standard naming and directory service, as part of a Web services architecture, so that consumers can discover and interact with services. UDDI, too, has a software focus while allowing arbitrary non-technical and non-functional attributes (e.g., pricing) to be supported through a service description scheme which has to be defined by the user, though.

Approaches for service description in the realm of Semantic Web Services, e.g., OWL-S [13], Web Services Modeling Ontology (WSMO) [16], Semantic Annotations for WSDL (SAWSDL) [8] or Semantic Annotations for REST (SA-REST) [9], have anchored programmatic descriptions of services with conceptual meaning through ontologies in order to automate *Web* services discovery, composition, access and interoperability. The prospect of improving automatic discovery, interaction and composition of services has additionally spurred efforts to conceptualize the wider context in which services are accessed, seen through the SOA Reference Model (SOA-RM) [7] and its semantic form [14]. Through these efforts, concepts such as *capability*, to define the exposed functionality of a service, *policy*, to constrain how a service can operate, and *service provider*, to capture the agent responsible for delivering a service, *interaction protocol* etc. — have gained consensus in the community. As with the work on Semantic Web Services, the target of these languages is on service interoperability through architectural frameworks. Thus, the form of service under consideration remains with software.

With the emergence of on-demand applications, the notion of software-as-a-service has arisen, covering software applications (e.g., customer relationship management on-demand) and business process outsourcing (e.g., gross-to-payroll processing, insurance claims processing) to cloud and platform services. The emphasis of service here implies that the consumer gets the designated functionality he/she requested together with hosting through a consumption-based model (such as pay-per-use). Thus, software-as-a-service is not synonymous with Web services and the service providers need to carefully disclose non-functional aspects such as pricing and availability and to factor these into the overall service they deliver. Services, in other words, are more than core functions that are accessed by consumers. They are delivered by a provider to a consumer possibly over a specified period of time, in a particular geographic context, with a pricing model and payment structure, monitored with a service level agreement, and related legal obligations of the consumer and the provider [6]. The functionality together with constraints, rights, obligations and penalties understood between providers and consumers for delivery, moves toward an understanding of service encountered in commercial practice.

A further dichotomy in the understanding of services is the distinction between business and software (or technical) services. Ironically enough, software practitioners appeal to the notion of business or enterprise services to emphasize the business relatedness of software solutions, while business practitioners take it for granted that their software applications are used in commercial operations. More specifically, different parts of commercial organizations catalogue their services assets to different ends. The focus of governance portfolios tends to focus on business services (and business processes) as integral to business operations — meaning their cost centers, organizational objectives, customer segments and volumes, operating margins, profits, revenue targets etc. An explicit alignment of business and IT services through formal mechanisms such as governance and enterprise architectures is rare in practice. Instead, IT services are separately managed through software registries, which describe software services, their technical dependencies and supportive platforms. The separation of concerns across business and technical portfolios largely explains the conceptual impediment for a holistic cognizance of services; indeed, one that is still prevalent today.

One of the first attempts at comprehensively describing services was the work of O'Sullivan [15]. This work drew from practical insights into how everyday services such as hotel accommodation, hair-dressing, house building and insurance, are advertised and offered, to a scheme for describing services and a variety of delivery aspects including locative, temporal, pricing, payment, security, trust and rewards. As O'Sullivan presciently observed: "The everyday services that surround us, and the ways in which we engage with them, are the result of social and economic interaction that has taken place over a long period of time. Any attempt to provide automated electronic services that ignores this history will deny consumers the opportunity to negotiate and refine over a large range of issues, the specific details of the actual service to be provided."

About USDL

The need for a new stage of maturity for service conceptualization across all key aspects, and shaping the standardization of a next generation service description language, has paralleled a wider development.

As the different research and development efforts in SOA, software-as-a-service, cloud computing, service management methodologies and governance, a dedicated intellectual foundation for the services — as a field in its own right — has been sought. In 2006, Henry Chesbrough and Jim Spohrer published *A Research Manifesto for Services Science* [3] that argues for a new multi-disciplinary academic to integrate across academic silos and advance service innovation more rapidly. Accordingly, several strategic research initiatives and flagships were established, notably the following:

- The EU Framework Programme 7 has had as a key strategic theme, viz., the *Internet of Services*, leading to several millions of Euros in research investments across at least 20 projects. These concerned different aspects of business and IT service management, beyond single organizations, out to service-based hubs, communities and business networks, and ultimately out to the Internet;
- *Future Internet Public Private Partnership (FI-PPP)* [11] with a budget of 90 million Euros aiming to advance Europe's competitiveness in future internet technologies and systems and to support the emergence of future internet-enhanced applications of public and social relevance. It addresses the need to make public service infrastructures and business services/processes significantly smarter (i.e., more intelligent, more efficient, more sustainable) through tighter integration with Internet networking and computing capabilities. The frameworks of the Internet of Services and Internet of Things underpin the Future Internet vision;

- THESEUS/TEXO [18], one of Germany's largest publicly funded IT research projects in recent years, addressing the fact that it has become commonplace to sell content such as music and videos on the Internet, yet Web-based services are not as widely used. The goal of the project is develop an infrastructure that will make it easier to combine and utilize the electronic services in wide service-based hubs, communities and networks, as an important step towards fostering an Internet of Services;
- In the US, an industry consortium led by IBM sponsors the *Service Research and Innovation Institute (SRII)*,[1] a non-profit organization aimed at improving the productivity and transformation for the technology industry, organizations and society at large — around services. It brings together industry, technology, solutions, research and academic organizations to share their work and experiences on all the key areas of services. It strives for shaping the science and engineering for service delivery in healthcare, financial, telecom, retail, education, government, and energy, to name just a few verticals.
- In the APJ region, a similar endeavor has been initiated called the *Smart Services CRC*.[2] The CRC is a commercially focused collaborative research initiative, developing innovation and productivity improvements for the services sector, especially for small-to-medium businesses. It has drawn representations from the enterprise service and solution specialists (Infosys), media (Fairfax Digital), government (the state governments of Queensland and New South Wales), health (Austin Hospital) to collaborate with a number of Australian universities in yearly projects over a seven year horizon. It aims at innovative (smart) services, agile tools for aggregation and next-generation service delivery platforms.

Out of a number of these mega-investments, the *Unified Service Description Language (USDL)* was born. It has been developed across several research institutes and publicly funded projects across Europe and Australia, and this now extends to the Americas as part of a standardization push through W3C.[3] The overarching philosophy of development has been inspired from the design science approach [12]. In addition, USDL required a highly collaborative and interdisciplinary approach. Previously developed service description concepts, languages and experiences were harnessed, and USDL, at the outset, was situated at the conceptual level so that a variety of aspects could be analyzed without constraint of any one implementation language or technology.

Clearly, the key challenge for USDL is scope: what sorts of services can be uniformly described? That is to say, is a uniform conception of services across political, economic, business, entertainment, technological, individual and other spheres, in the first place, possible or desirable? In the case of USDL, the scope of service has been on services as understood for business and supportive IT provisioning, i.e., the socio-technical sense of services. In this respect, purely human, purely automated and mixed human/automated services were considered, that have a boundary

[1] http://www.thesrii.org/

[2] http://www.smartservicescrc.com.au/

[3] http://www.w3.org/2005/Incubator/usdl/

of cognizance that is available through the tasks of service provisioning, discovery, access and delivery. Services from various domains including cloud computing, service marketplaces and business networks, were investigated. Noteworthy were use cases involving service marketplaces procuring services as complex as those from SAP's portfolio and ecosystem, advancing previous insights into aspects such as service bundling and business contexts in which services are requested and consumed. Further use cases from the corporate world shed insights into commercial management of services, such as cost center ownership, releasing, and service granularity validated against enterprise-grade software portfolios.

Taken together, key dichotomies, encountered in the current state-of-the art service languages and techniques, that were addressed in USDL included: technical and business; structure and behavior; intra- and inter-organizational; single- to third-party provisioned; single-flavored composition (process-based) to multi-flavored composition (process, data dependency, functional inheritance/import and bundling); singular to plural pricing models; functional to non-functional service delivery (service level agreements).

About the Book

This book provides a state-of-the-art insight into previous developments, the design and specific proposals of USDL, and different methods that use USDL for service design, engineering and management.

Part I of the book provides an in-depth overview of existing state-of-the-art service description approaches. The plethora of approaches is grouped into different strands each devoted a separate chapter. Experts were invited to survey *Product-Service System Approaches*, *Service Network Approaches*, *Service System Approaches*, *Service-oriented Architecture (SOA) Approaches*, as well as *Semantic Web Services*, respectively.

The remaining parts of the book deal exclusively with USDL and can be read independently from the state of the art. Part II is concerned with the actual meta-model of USDL providing both an overview chapter on the design rationale as well as several chapters that highlight specific aspects of the language. Contributions to this part came from researchers in the different projects that developed the different parts of USDL.

In light of the efforts and insights of multiple institutes and disciplines — comprising business management, information systems, IT and computer science (incl. SOA, security and cloud), and law — the design rationale set the ground for a consensual design of USDL across diverse and distributed teams that contributed. The design proceeded through a constructivist synthesis, whereby a services discourse and requirements illuminating on key challenges for USDL concept formation ("signposts" model development), were established. The result is that USDL contains:

- concepts (either well-established or new and agreed upon) that are essential to service descriptions, and self-contained in USDL;
- concepts that are part of USDL but serve to align service descriptions with other artifacts, e.g., USDL should relate to, not overlap with, languages dedicated to other organizational phenomena (e.g., business processes, organizational resources, WSDL and other SOA aspects);
- concepts that can support domain-specific (e.g., industry specific) specializations, since a "silver bullet" language for all service domains and industries is infeasible.

Given the complexity of the service domain, USDL has been designed to be conceptual and modular. Specifically, USDL's structure can be seen from the following, broad logical arc:

- The essential descriptors of a service that are central to understanding it and that tie together other parts (*Service*);
- The structural aspect of functionality (*Functional*);
- The behavioral aspect of functionality (*Interaction*);
- How a service is interfaced with for delivery (*Technical*);
- The participants involved in the provisioning, delivery an consumption of a service (*Participants*);
- The non-functional aspects of pricing (*Pricing*), legal constraints (*Legal*), and service level agreements (*Service Level*).

Knowledge about the USDL meta-model is the prerequisite for Part III whose chapters deal with methodological aspects of USDL, e.g., basic tooling or variant management. Finally, Part IV documents different evaluation endeavors of USDL such as case studies.

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The people who were instrumental in development of USDL and this book are too numerous to mention. Nevertheless, we would like to draw attention to the following for special mention.

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Last but by no means least, the development of USDL involved many more people from research and industry than is indicated through the authorship of the book's USDL chapters and in the publicly released specification of USDL (available at www.internet-of-services.com). USDL, as it stands today, and its intellectual baseline available through this book for on-going refinement and maturity, rests of the shoulders of many "giants."

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