

# Service-Oriented Architecture (SOA)

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*A White Paper by:*

The Open Group SOA Working Group

July 2007

## ***Service-Oriented Architecture***

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### **Service-Oriented Architecture**

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## **Executive Summary**

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Service-Oriented Architecture (SOA) is an architectural style that has recently come to prominence. The Open Group has a long history of providing support for enterprise architects, notably through development and maintenance of The Open Group Architecture Framework (TOGAF™).

The Open Group is naturally concerned to understand the relation of SOA to other styles of enterprise architecture, and to support enterprise architects using SOA. It has established its SOA Working Group as a vehicle for its work on SOA.

This White Paper sets out the understanding that has been reached by the SOA Working Group of SOA and its relation to enterprise architecture, and in particular to TOGAF, in order to:

1. Communicate that understanding to the rest of The Open Group and to the IT industry at large
2. Provide a basis for the further development of the work program of the SOA Working Group

# **Introduction**

## **Overview**

This White Paper does not provide a detailed analysis. Rather, it seeks to create a high-level understanding of SOA and its relation to enterprise architecture, and in particular to TOGAF.

The chapter following this Introduction discusses the nature of SOA, how it is applied to a typical enterprise, and how it relates to other styles of enterprise architecture.

The next chapter gives a brief overview of TOGAF, concentrating on its Architecture Development Method (ADM).

The final chapter analyzes the impact of SOA on the ADM, taking each ADM phase in turn.

The first appendix describes the work that The Open Group is currently doing on SOA.

The second appendix contains the recommendations of the project that was set up to investigate where The Open Group can add value to the evolution of SOA.

## **Future Directions**

This White Paper is intended to form a basis for the future development of the Work Program of the SOA Working Group. That program already includes a number of substantial projects. The evolution of those projects, and the addition of new ones, will be decided by the project teams and the Working Group as a whole. This White Paper provides input to those decisions, but does not make any recommendations for what they should be.

The deliverables of the current projects, and any new ones that are formed, will provide a detailed analysis of the relation of SOA to enterprise architecture, and give practical support to enterprise architects using SOA.

There are no current plans to produce future versions of this White Paper.

# **Service-Oriented Architecture**

## **Definition of SOA**

Service-Oriented Architecture (SOA) is an architectural style that supports service orientation. It is a way of thinking in terms of services, service-based development, and the outcomes of services.<sup>1</sup>

A service is a logical representation of a repeatable business activity that has a specified outcome, such as “check customer credit”, “provide weather data”, or “consolidate drilling reports”. It is self-contained, may be composed of other services, and is a “black box” to its consumers.

The SOA architectural style has the following distinctive features.

- It is based on the design of the services – which mirror real-world business activities – comprising the enterprise (or inter-enterprise) business processes.
- Service representation utilizes business descriptions to provide context (i.e., business process, goal, rule, policy, service interface, and service component) and implements services using service orchestration.
- It places unique requirements on the infrastructure – it is recommended that implementations use open standards to realize interoperability and location transparency.
- Implementations are environment-specific – they are constrained or enabled by context and must be described within that context.
- It requires strong governance of service representation and implementation.
- It requires a “Litmus Test”, which determines a “good service”.

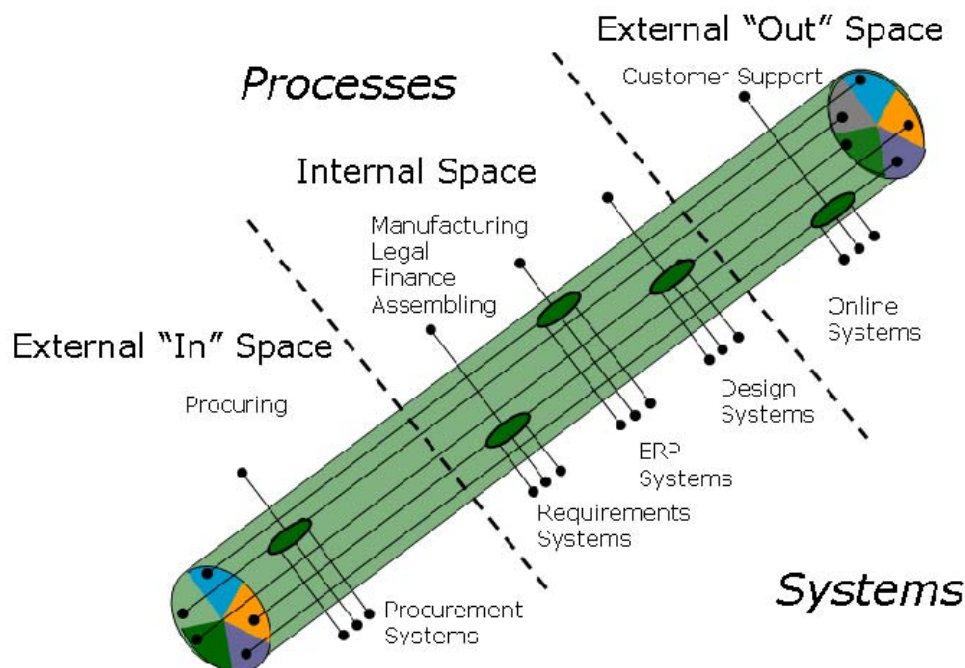
## **SOA and Boundaryless Information Flow**

Why is SOA important to The Open Group?

The Open Group vision is Boundaryless Information Flow. It has long been a principle of enterprise organization that permeable boundaries between departments, organizational levels, enterprises, and nations deliver productivity and enterprise agility. This was established in the 1980s by pioneers such as Jack Welch of GE (see *The Boundaryless Organization: Breaking the Chains of Organizational Structure* [1]). But traditional IT architectures hinder this! The need for Boundaryless Information Flow – provided by IT architectures that enable information to flow freely across the permeable organizational boundaries – was identified by The Open Group and described in its *Interoperable Enterprise Business Scenario* [2]. The Open Group took on the mission of driving the creation of Boundaryless Information Flow.

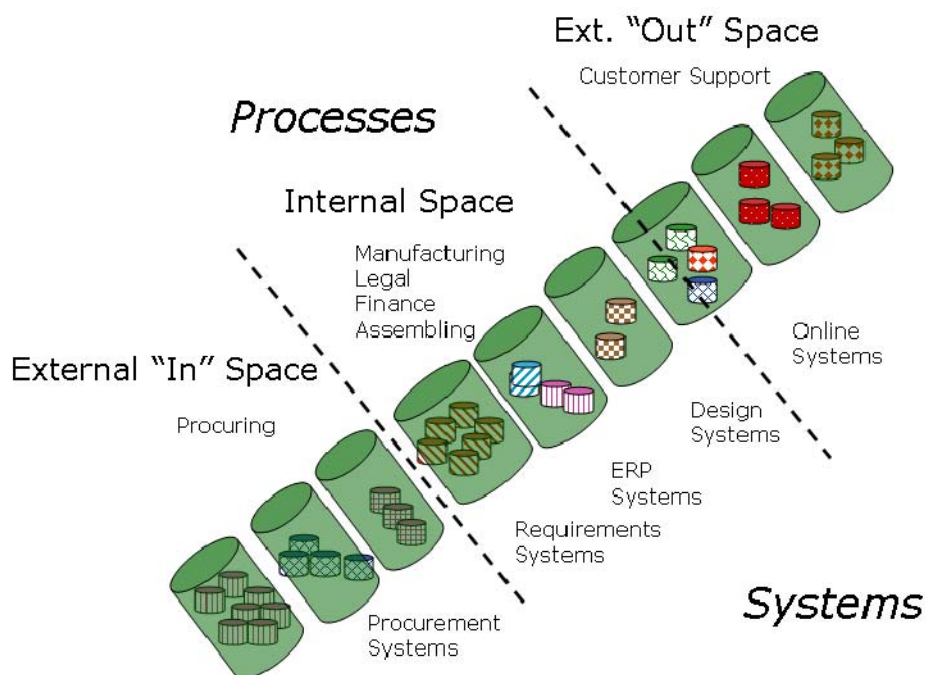
Enterprise architecture is the key to achieving Boundaryless Information Flow. The problem, as described in the *Interoperable Enterprise Business Scenario*, is that enterprises need the kind of architecture illustrated in Figure 1, in which the business processes are supported by systems that can exchange information freely.

<sup>1</sup> The definition in this section was produced by the SOA Definition project of the SOA Working Group.



**Figure 1: Enterprise Architecture for Boundaryless Information Flow**

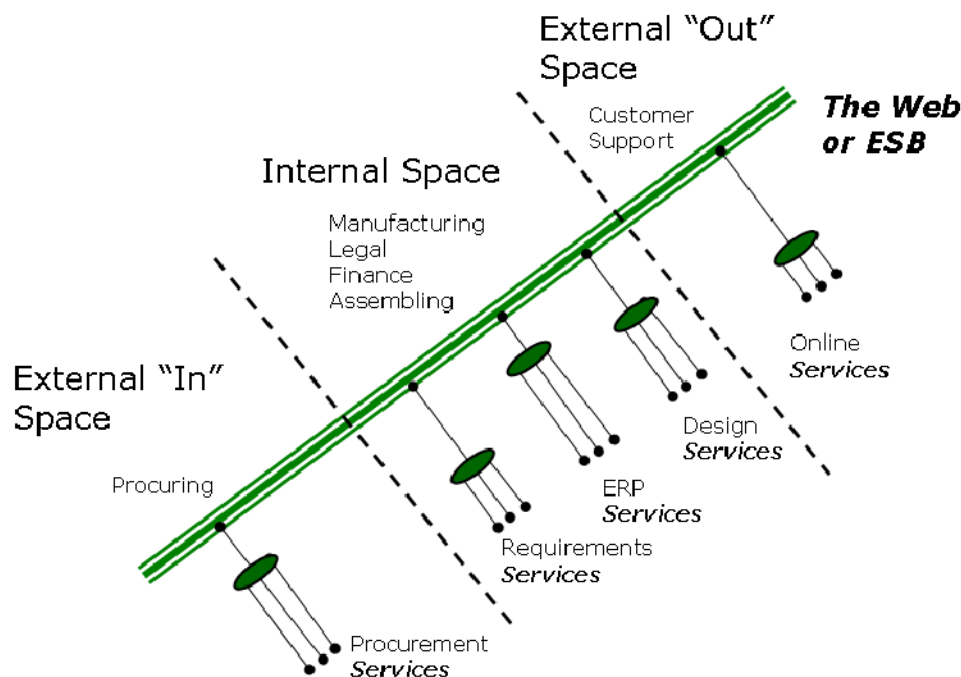
Too often, however, they are faced with a situation where each business process has its own system which has its own particular interfaces and information formats, and is a so-called “information silo”, as illustrated in Figure 2.



**Figure 2: Information Silos**

## Service-Oriented Architecture

With SOA, the applications are replaced by services that interact with each other. Typically, interactions take place by exchange of messages via an Enterprise Services Bus (ESB) within the enterprise, or across the web in the case of external services, although other forms of interaction, even direct invocation of one service by another (so-called “hard wiring”) may be used. This style of architecture can be the basis of Boundaryless Information Flow, as illustrated in Figure 3.



**Figure 3: SOA for Boundaryless Information Flow**

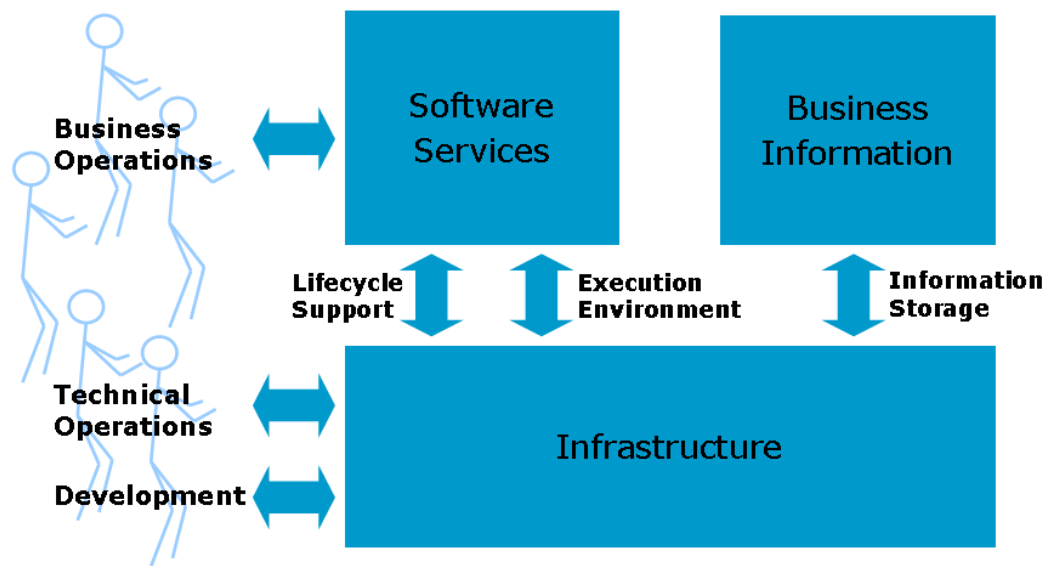
It is because of the potential for SOA to deliver Boundaryless Information Flow that SOA is critically important to The Open Group.

### SOA in the Enterprise

The principle of service orientation can apply throughout the enterprise architecture, but is most commonly applied to the organization of the software that supports the enterprise's business operations. With SOA, this software is organized as a set of software services. The services are supported by an infrastructure that, together with the services, provides information flow within the enterprise and between the enterprise and external enterprises. This is illustrated in Figure 4.



## Service-Oriented Architecture



**Figure 4: Overview of a Service-Oriented Architecture**

The software services are used by the enterprise's business operations. This frequently involves a human-computer interface, often implemented as a web interface using portals, etc., but it may also involve other interfaces, such as machine interfaces for process control.

Note that the business operations themselves may be organized on the service-oriented principle. Indeed, there are many people who believe that the greatest benefits of SOA are obtained when it is applied to the business architecture.

The infrastructure provides the execution environment for the software services. This includes the basic operating system and networking, and also includes specific support for software services, such as message passing and service discovery. The infrastructure is managed via human-computer interfaces by technical staff who are responsible for all aspects of operating the enterprise's information technology, including its availability, performance, and security.

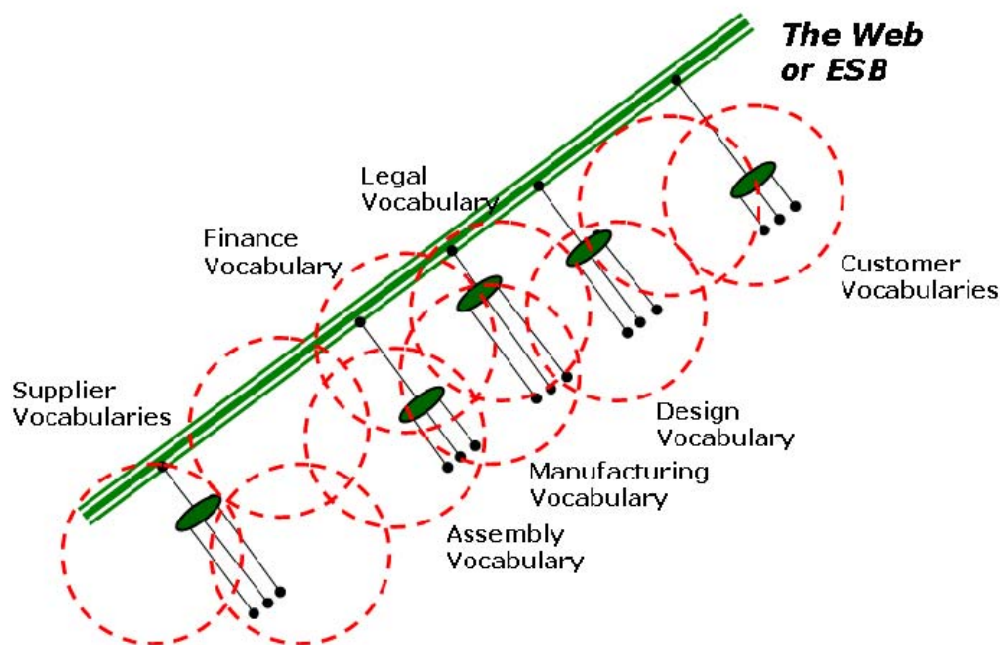
A major benefit of SOA is that it delivers enterprise agility, by enabling rapid development and modification of the software that supports the business processes – and hence makes it easier to change the business processes themselves. The infrastructure can provide for this by including facilities such as business-oriented scripting languages like BPEL [28] that make it easy to re-use existing services to do new things, and model-driven implementation tools. These facilities support not only the creation of new software services, but also the modification and replacement of existing ones: the whole service lifecycle. They are used via human-computer interfaces by development staff.

Again, service-orientation may extend to the design of the infrastructure, and many people advocate this, but it is not essential to service-oriented software architecture.

The infrastructure also provides for storage of enterprise information. SOA can enable easier flow of information within and between enterprises. The information is not locked up in specific services, as it often is in the so-called "silo" applications of earlier architecture styles, but is available to all the software services that need it. This, however, brings to the forefront the need for semantic interoperability; that is, for different services to be able to interpret the same information in the same way.

### The Problem of Semantic Interoperability

As illustrated in Figure 5, each business process has its own vocabulary. To make things worse, these vocabularies often contain terms that are specific to a particular enterprise or department; two different manufacturing companies, for example, may describe the same manufacturing operations in different ways. And the messages that a particular service generates or accepts are often defined in terms of a particular vocabulary.



**Figure 5: The Problem of Semantic Interoperability**

At present, this problem is typically addressed within the services, and by use as far as possible of enterprise-standard and industry-standard vocabularies. In the future, it may be addressed by semantic technology that is incorporated in the infrastructure, which will be a more scalable way to deliver the ideal of Boundaryless Information Flow.

### SOA as an Architecture Style

The key difference that SOA makes to software architecture is that the software building blocks are loosely-coupled services that can be combined dynamically, as opposed to subroutines, scripts, or other forms of program that invoke each other directly.

A further difference is the increased emphasis on infrastructure support for service development and evolution. The enterprise architect has always been concerned with principles and guidelines governing the evolution of the architecture components over time. With SOA, this extends to the specification of particular development tools and methods, and their incorporation in the infrastructure to provide software service lifecycle support.

The ability to develop and modify services rapidly, and the need to ensure that this supports the business operations as effectively as possible, impacts on governance: the process by which the translation of the

## ***Service-Oriented Architecture***

architect's specifications into implemented systems, and the continuing evolution of those systems, is controlled.

Finally, the ability of SOA to support Boundaryless Information Flow represents a major improvement over earlier architectural styles.

SOA is an evolution of traditional enterprise architecture styles, not something different. It has new features, which deliver major benefits. Enterprise architects must be able to take advantage of these new features, and they must therefore be supported by the architecture frameworks that those architects use.

## The Open Group Architecture Framework (TOGAF)

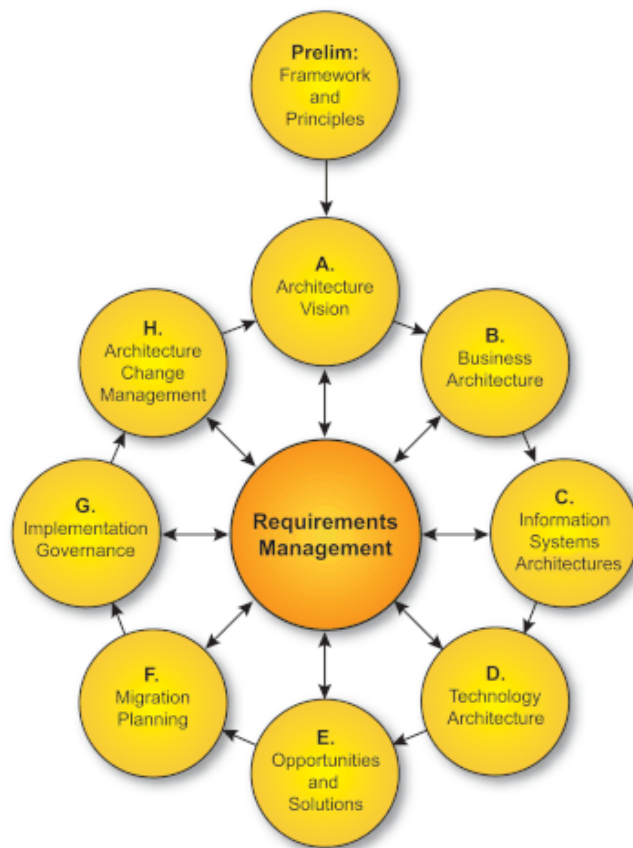
This chapter contains a simplified description of The Open Group Architecture Framework (TOGAF) Version 8.1.1. The reader is encouraged to consult the full description that is freely available from The Open Group website [3].

TOGAF has three major sections:

- The Enterprise Continuum, which helps the architect manage different levels of abstraction and provides context for the use of relevant architecture assets
- The Resource Base, which is a set of supporting resources, such as guidelines, templates, and checklists
- The Architecture Development Method (ADM), which many regard as the core of TOGAF

### The TOGAF ADM

The TOGAF ADM breaks down the process of developing an enterprise architecture into a number of phases. First, there is a preliminary phase concerned with establishing principles and configuring the framework itself. This is followed by eight phases that are shown in order of logical dependency, but that are typically executed iteratively: over the whole process, between phases, and within phases. Central to these phases is the process of requirements management. This is illustrated in Figure 6.



**Figure 6: The TOGAF Architecture Development Method (ADM)**

## ***Service-Oriented Architecture***

The eight iterative phases are as follows.

- **Architecture Vision:** creating a summary of the architecture and what it should achieve, for communication throughout the enterprise (and to obtain approval and funding).
- **Business Architecture:** describing the product and/or service strategy, and the organizational, functional, process, information, and geographic aspects of the business environment, based on business principles, business goals, and strategic drivers.
- **Information Systems Architectures, comprising:**
  - **Data Architecture:** defining the major types and sources of data necessary to support the business.
  - **Applications Architecture:** defining the major kinds of application system necessary to process the data and support the business.
- **Technology Architecture:** delivering a specification of the technical solution at the level necessary to support implementation.
- **Opportunities and Solutions:** generating an overall implementation and migration strategy by evaluating implementation options, identifying parameters for change, and assessing dependencies, costs, and benefits.
- **Migration Planning:** sorting the various implementation projects into priority order and creating a detailed Implementation Plan and Migration Plan.
- **Implementation Governance:** developing and operating a process to ensure conformance with the defined architecture by implementation projects.
- **Architecture Change Management:** establishing a process for the evolution of the new enterprise architecture in the light of developments in technology and changes in the business environment.

# SOA and TOGAF

This chapter describes the application of TOGAF to SOA, focusing on the eight iterative phases of the TOGAF ADM.

TOGAF as a whole provides a valid framework for SOA.<sup>2</sup> Some parts of it – the Enterprise Continuum and the Preliminary, Opportunities and Solutions, and Migration Planning phases of the ADM – are unaffected. The ways in which the other phases of the ADM are carried out are changed, in some cases quite radically. New, SOA-specific resources are needed for the Resource Base.

The rest of this section considers the iterative phases of the ADM, and evaluates the impact on them of SOA.

## Phase A: Architecture Vision

The general approach to the Architecture Vision phase is not changed. The vision, naturally, will be a service-oriented one, achieving benefits such as improved enterprise agility and information flow. But a full-blown SOA may not be appropriate for the enterprise in question and, if the enterprise does not yet have extensive experience of SOA, it may wish to apply it in one particular area, perhaps as a pilot project, rather than enterprise-wide. The Architecture Vision phase will set out the scope of the SOA project within the enterprise, and the level of SOA to be achieved.

## Phase B: Business Architecture

The Business Architecture phase is concerned not only with the operations performed by humans, but also with the software services and business information that support them, as shown in Figure 7.

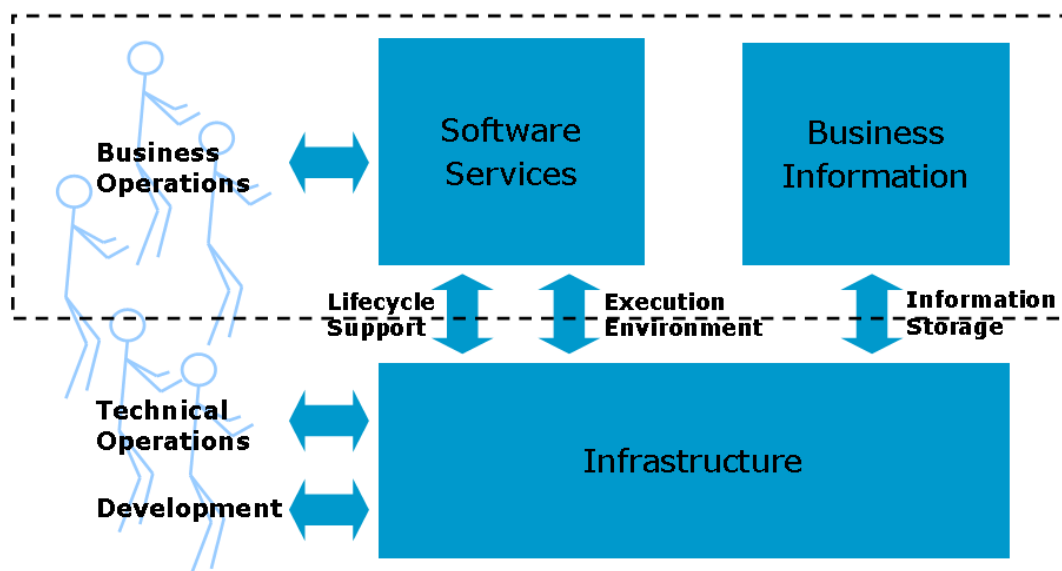


Figure 7: Scope of the Business Architecture Phase

<sup>2</sup> This is an interim conclusion of the SOA/TOGAF Practical Guide project of the SOA Working Group.

## Service-Oriented Architecture

In this phase, what should be done by people and what should be done by technology may not be clear – and should not have to be clear. The business operations should be described without regard to how they will be implemented.

One major difference for an SOA project is that it will be natural and desirable to describe the business operations as services.

The second major difference is that, while the existing business operations can be described precisely, the target operations that the architecture will support in the future may not all be known; business agility is a key benefit of SOA. Because of this, the Business Architecture phase of an SOA project may, as well as describing specific business operations, describe methods for developing new ones.

### Phase C: Information Systems Architectures

The Information Systems Architectures phase consists of two parts: Data Architecture and Applications Architecture.

An important consideration for both parts of this phase is that they must consider how the new services will interwork with existing applications that will not be converted to services. “Legacy”, as ever, must not be forgotten.

#### Data Architecture

The Data Architecture part of the Information Systems Architectures phase is concerned with the Business Information component of Figure 4, as shown in Figure 8.

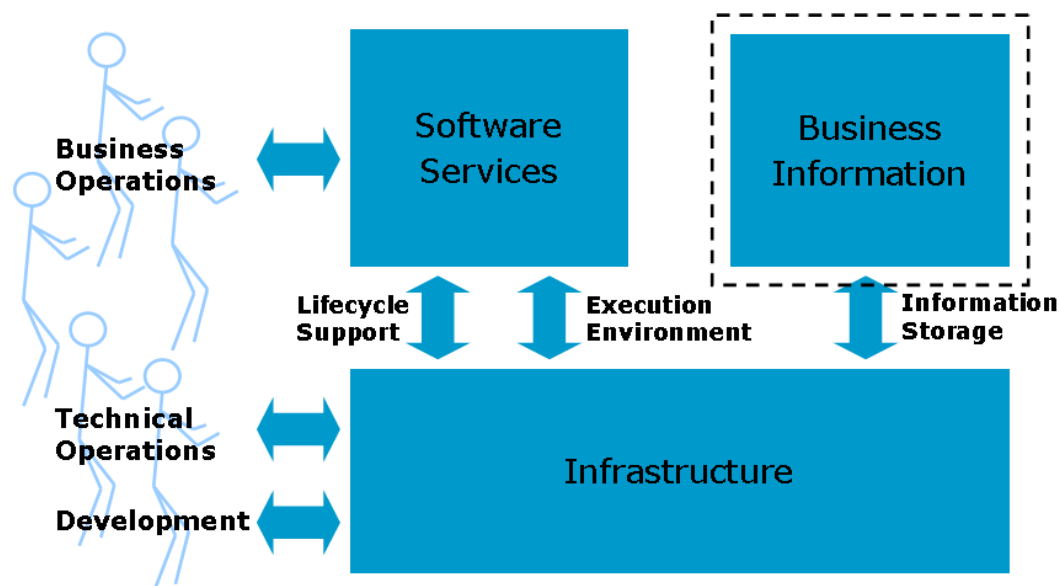


Figure 8: Scope of the Data Architecture Sub-Phase

This is crucial to an SOA project. There is as yet no best practice for it that is specific to SOA, although there is much interesting work in progress; for example, on the Semantic Web.

## Service-Oriented Architecture

### Applications Architecture

The Applications Architecture part of the Information Systems Architectures phase is concerned with the Software Services component of Figure 4, as shown in Figure 9.

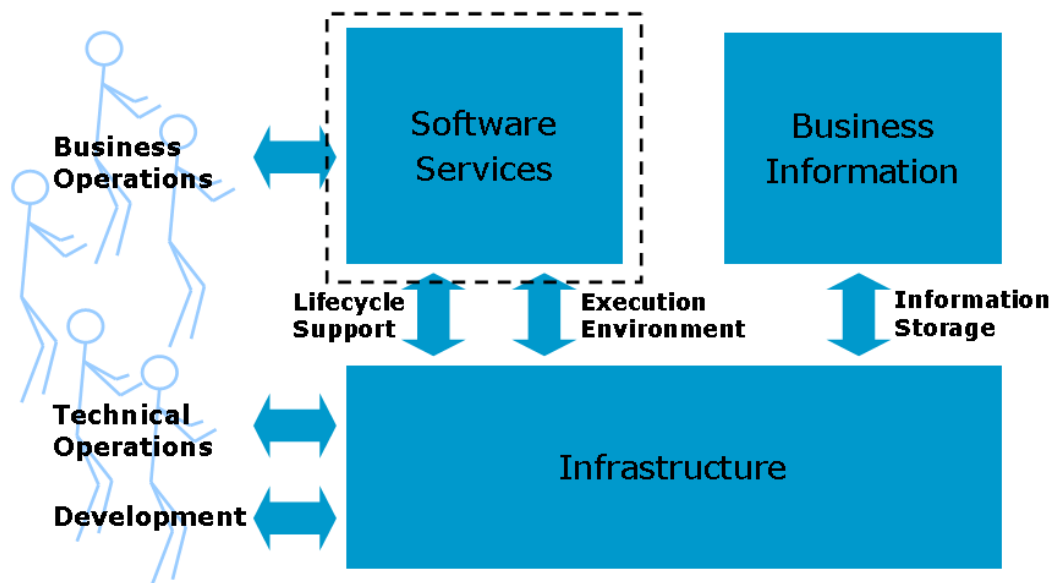


Figure 9: Scope of the Applications Architecture Sub-Phase

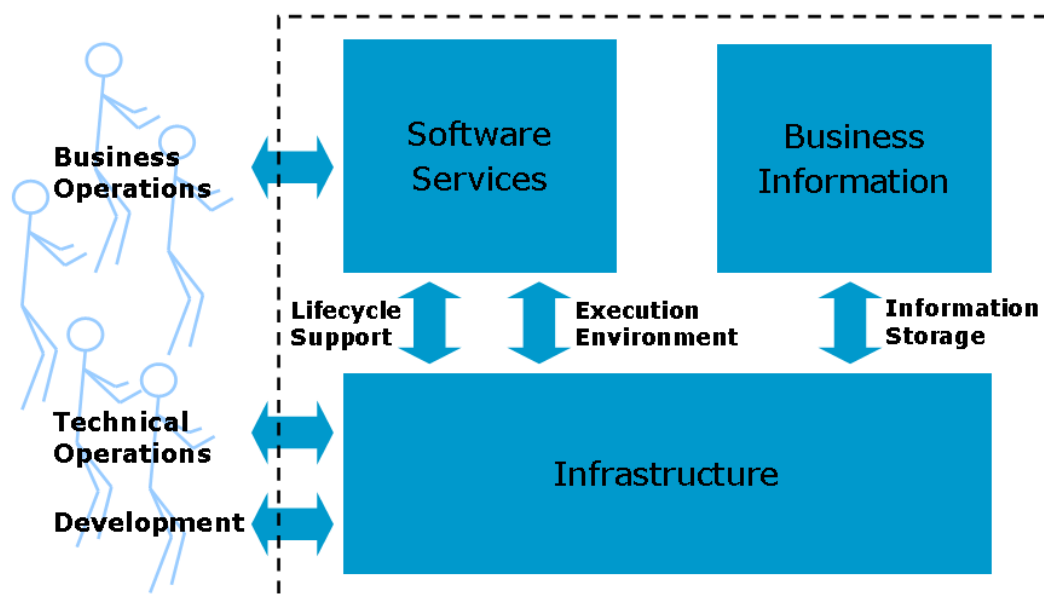
When TOGAF is used to develop a solution architecture, this phase may identify specific application components; but when it is used to develop a high-level enterprise architecture it will often just describe general application areas.

The key distinguishing feature of an SOA is that the software applications are defined as loosely-coupled services. Again, for an agile enterprise, it will in general not be possible to describe all the target services precisely, and this phase may describe methods for defining and evolving services as well as identifying application service areas or describing particular services.

### Phase D: Technology Architecture

Just as the Business Architecture phase is not only concerned with operations performed by humans, the Technology Architecture phase is not only concerned with the infrastructure. As shown in Figure 10, it is concerned with the technical specification of the infrastructure and also of the software services and business information.





**Figure 10: Scope of the Technology Architecture Phase**

Having said which, a particular kind of infrastructure is needed to support the service paradigm, and the specification of this kind of infrastructure (service bus, registry, etc.) is an important feature of the Technology Architecture phase for SOA.

The second difference for this phase is the focus on tools. Methods are important for the Business Architecture and Information Systems Architectures phases of SOA development. The Technology Architecture phase must specify the tools to support these methods.

A third difference is that, although the infrastructure does not have to be service-oriented to support SOA, many SOA projects will wish to apply the principle of service-orientation at all levels, and specify a service-oriented infrastructure. The SOA Working Group is investigating this topic; see “Service-Oriented Infrastructure” in Appendix A, Current SOA Working Group Projects on page 20.

Like the Information Systems Architectures phase, the Technology Architecture phase must also consider how the new services will interwork with existing applications that will not be converted to services.

### Phase E: Opportunities and Solutions

SOA has little impact on the Opportunities and Solutions phase of TOGAF.

### Phase F: Migration Planning

SOA has little impact on the Migration Planning phase of TOGAF.

## ***Service-Oriented Architecture***

### **Phase G: Governance**

SOA Governance is the application of Enterprise Architecture, IT, and Corporate Governance to Service Oriented Architecture.<sup>3</sup> The SOA Governance processes focus on governing the service lifecycle, supporting service infrastructure, and compliance with the service oriented architecture of the organization.

Corporate Governance affects the implementation of the Business Architecture; and IT Governance affects the implementation of the Information Systems Architectures and the Technology Architecture. Architecture Governance ensures that the integrity of the architecture as a whole is maintained.

With SOA, it is generally the case that each part of the enterprise depends on services provided by other parts. This helps to improve the overall efficiency of the enterprise, and allows for greater service re-use, and should therefore be encouraged. But it means that good governance is essential, so that the service users are assured that service provision will be maintained in the manner that they expect.

Also, the increased emphasis that SOA has on methods and supporting tools, and the nature of the service lifecycle, impact on Corporate and IT Governance, and this impact must be addressed in the Implementation Governance phase.

### **Phase H: Architecture Change Management**

Modification of the architecture itself is addressed in the Architecture Change Management phase. SOA delivers agility. Changes to services and development of new services should no longer be regarded as changes to an architecture, when they are carried out using methods that are part of that architecture. Projects that in a traditional architectural approach would be subject to Architecture Change Management may therefore be covered by Implementation Governance in SOA. The dividing line between projects that implement the architecture and projects that change it remains; but SOA can move projects across that line by including methods for change within the architecture.

<sup>3</sup> This is an interim conclusion of the SOA Governance project of the SOA Working Group.

## **Appendix A: Work on SOA within The Open Group**

The Open Group formed its SOA Working Group [4] in October 2005 in response to the rapidly growing interest in SOA and the importance of SOA to its vision of Boundaryless Information Flow.

The SOA Working Group was constituted as a working group of The Open Group joint Customer Council and Supplier Council, to facilitate participation by all members.

The mission of the SOA Working Group is to develop and foster common understanding of SOA in order to facilitate alignment between the business and information technology communities.

It does this by conducting a work program to produce definitions, analyses, recommendations, reference models, and standards to assist business and information technology professionals within and outside of The Open Group to understand and adopt SOA.

In addition to setting up the SOA Working Group, The Open Group also established, in October 2006, a special working group of its Governing Board to develop a maturity model for SOA, based on input from IBM.

This appendix describes the SOA-related activities of The Open Group, including the work program of the SOA Working Group and the Governing Board SOA Maturity Model working group.

### **Initial Activities**

Following its formation, the SOA Working Group set up three projects to establish its role and eventual scope of work:

- Definition of SOA
- SOA Case Studies
- Evaluation of the Value that The Open Group can add to the Evolution of SOA

These projects are now all completed. Their results form the basis for the current program of work.

### ***Definition of SOA***

In order to promote better understanding and to give the IT industry an opportunity to make progress, it is important to come to a single, generally agreed definition of SOA. This project was responsible for developing that definition and promoting it through the SOA Working Group to the rest of The Open Group and the industry in general, to help both business and technical people to gain a better understanding of SOA concepts.

Under the leadership of Dave Hornford of Hornford Associates, the project team reviewed a number of [existing definitions for SOA and services](#) and the emerging [OASIS SOA Reference Model](#), and delivered a [basic definition of SOA](#). This definition is reproduced in Definition of SOA on page 6.

### ***SOA Case Studies***

Much has been made of the business benefits offered by adopting a Service-Oriented Architecture. Companies must be able to understand how to obtain those benefits in order to realize the promise of SOA. Conversely, it is also important to identify situations where SOA does not add value.

## ***Service-Oriented Architecture***

The aim of the SOA Case Studies project was to produce a set of documented SOA case studies, to help both business and technical people to gain a better understanding of SOA.

Led by Sylvia Vargas of Hornford and Associates, the project created a web page with a set of references to SOA Case Studies [5]. The project team is no longer actively working on further case studies, but submissions of new case studies to be added to the set may be accepted.

### ***Evaluation of the Value that The Open Group can add to the Evolution of SOA***

The purpose of this project was to help the SOA Working Group to understand how it could best fulfill its mission, and to form the basis for the formation of projects in areas where The Open Group can add value.

Led by Jorge Diaz of IBM, the project delivered a set of **recommendations on areas where The Open Group can add value to the evolution of SOA**. These recommendations are summarized in Appendix B: Recommendations of the Unique Value Project.

## **Project Establishment**

Following the delivery of the recommendations on the value that The Open Group can add to the evolution of SOA, the Working Group has established a number of new projects. This was, however, not done in “top down” fashion by setting up a project in each of the recommended areas. Rather, it was done “bottom up”, by working group members deciding, in the light of the recommendations, which areas they wished to work on.

The procedure for establishing a project of the SOA Working Group is simple. Any Working Group member can propose a project. A proposed project must be within the Working Group’s scope, and be achievable with Working Group resources. Project proposals are approved by vote of the Working Group.

The projects that have been established under this procedure, and that are currently being conducted by the SOA Working Group, are described below.

## **Current SOA Working Group Projects**

### ***Ontologies for SOA***

The SOA Working Group contributes to The Open Group mission of Boundaryless Information Flow by developing and fostering common understanding of SOA in order to facilitate alignment between the business and information technology communities. The Ontologies for SOA project will provide part of that contribution in the following specific ways. It will:

- More precisely define the concepts, terminology, and semantics of SOA in both business and technical terms, in order to:
  - Create a foundation for further work in domain-specific areas
  - Enable communications between business and technical people
  - Enhance the understanding of SOA concepts in the business and technical communities
  - Provide a means to state problems and opportunities clearly and unambiguously to promote mutual understanding
- Potentially contribute to model-driven SOA implementation, which will facilitate SOA adoption

## ***Service-Oriented Architecture***

The project is led by Chris Harding of The Open Group. It will deliver formal ontologies containing definitions of SOA concepts and the relationships between them. These ontologies will incorporate, where possible, existing standard ontologies for SOA, and will relate them to concepts of particular importance to The Open Group, including the concepts identified by the SOA Working Group definition and modeling projects, and the concepts of The Open Group Architecture Framework (TOGAF).

The ontologies will be designed for use by:

- Business people, to give them a deeper understanding of SOA, and its use in the enterprise
- Architects, as metadata for architectural artefacts
- Architecture methodologists, as a component of SOA metamodels

Relevant work by other bodies, which the project is taking into account, includes:

- Initiatives for ontology modeling on SOA, including specific work on web services such as SWSO [6], WSMO [7], and OWL-S [8]
- The Federal Enterprise Architecture Reference Model Ontology (FEA-RMO) [9]
- The OSERA project [10]
- The OASIS SOA Reference Model [11]
- The OMG Ontology Definition Metamodel (ODM) [12]
- The Architecture Forum [13] terminology work
- The **TOGAF [3] 8.1, 8.1.1, and 9 metamodels**

The project uses RDF [14] and OWL [15] as ontology representation languages, and Protégé [16] as a tool.

A bibliography of relevant work will be kept up-to-date throughout the life of the project.

### **SOA Governance**

The SOA Working Group contributes to The Open Group mission of Boundaryless Information Flow by developing and fostering common understanding of SOA in order to facilitate alignment between the business and information technology communities. The SOA Governance project will provide part of that contribution in the following specific ways. It will:

- Develop a common definition of SOA Governance, including distinguishing between overall IT Governance and SOA Governance
- Define re-usable processes and structures for SOA Governance
- Describe the relationship between IT to business governance and technical IT governance
- Define an SOA Governance Reference Model

Better understanding of governance around SOA will facilitate SOA adoption.

The project is led by Tony Carrato of IBM and Mats Gejnevall of Capgemini. It will deliver typical TOGAF architecture artifacts such as:

- Business scenarios: illustrating the overall processes that we expect to include in SOA Governance, and

## ***Service-Oriented Architecture***

more detailed scenarios including business services, actors, and possible organizational views; for example:

- Service-Oriented Architecture Management (the architecture itself)
  - Business Process Management
  - Information Management
  - Solution (composite application) Management
  - Service Portfolio Management
  - Service Value Management
  - Service Management
  - Service Delivery Management
  - Service Design, Implementation, Deployment, De-commission Management
  - Service Assets Management
- A conceptual model of concepts used within SOA governance
  - An information model for SOA Governance
  - A description of a business-IT governance in an SOA environment (View)
  - A description of technical IT governance in an SOA environment (View)
  - An SOA Governance reference model, including:
    - IS functions needed and their interaction
    - Application system – IS function mappings
    - Application system interactions
  - Standards for SOA Governance tool interoperability

Relevant work that the project is taking into account includes:

- TOGAF [3]
- The SOA Working Group SOA Definition
- Available SOA Governance inputs from members of The Open Group and other relevant, publicly available material such as the OASIS SOA Reference Model [11]
- ITIL [17] and COBIT [18] materials, as appropriate for them to be used
- SOA Reference Architectures

The project primarily works using conference calls, documents posted to the SOA Working Group [4] Plato website, and meetings at appropriate times and venues. The work of the project follows the principles of the TOGAF standard and SOA principles such as agility and re-use.

## ***Service-Oriented Architecture***

The project collaborates and aligns with other relevant work both within and outside the SOA Working Group when appropriate:

- Relation of SOA to EA (TOGAF) for work stream process
- SOA Ontology for Information Concepts
- SOA Reference Architecture for concepts and IS Architecture
- SOA Maturity Model for governance processes
- SOA Definition for SOA principles
- OASIS [19], OMG [20], and other organizations

### ***SOA/TOGAF Practical Guide***

SOA is an emerging architectural style that needs to be explicitly supported by TOGAF [3]. As an architectural style, explicit support is best provided through style-specific adjustments of TOGAF. Style-specific adjustments should enable a TOGAF-trained practitioner to use TOGAF 8 and the SOA adjustment “out of the box” to develop a service-oriented architecture.

A practical guide to performing SOA with TOGAF will provide a common practical method of delivering SOA using an industry leading enterprise architecture method. The process of refining best practices into a practical guide will require a common understanding of SOA, SOA preparation, and SOA implementation for architecture practitioners, business people, and information technology.

The SOA/TOGAF Practical Guide project was established as a joint project of the SOA Working Group [4] and The Open Group Architecture Forum [13]. It will make a very specific contribution to the common understanding of SOA and the utilization of TOGAF, thus fulfilling part of the missions of the SOA Working Group and the Architecture Forum.

The project is led by Awel Dico of the Bank of Montreal and Dave Hornford of Hornford Associates. They are both members of the SOA Working Group and of The Open Group Architecture Forum. They report progress to and accept direction from both Open Group bodies.

The project will deliver a Practical Guide to using TOGAF to “do SOA”, including:

- Necessary adjustments to the TOGAF ADM:
  - Rationale for adjustment
- Recommended Views and Attributes
- Recommended Artefacts:
  - Example SOA Building Blocks
  - Other examples
- Recommended Reference materials:
  - Reference Architecture (other SOA Working Group project)
  - SOA Ontology (other SOA Working Group Project)
  - TOGAF Process model (may be Architecture Forum Eclipse Project)

## ***Service-Oriented Architecture***

- SOA Definition (previous SOA Working Group Project)

The scope of the project is bounded by the current version of TOGAF 8. The intent is to provide “preliminary phase adjustments” to TOGAF. The focus is on the Architecture Development Method (ADM) Phases A-D, providing required views, attributes, artefacts, and process change. The work effort and scope will be adjusted to capture other SOA Working Group and Open Group Architecture Forum projects that overlap. The guiding principles will be “good enough” and “practical” to an architecture practitioner.

The project will use open tools and mainstream office productivity tools by preference to avoid participant barriers to entry. Specialized commercial tools will be utilized if a participant has the tools, licenses can be provided to other participants for the purpose of the project, and the output is in a transportable format.

### ***Service-Oriented Infrastructure***

The Service Oriented Infrastructure (SOI) project is investigating the application of the principles of service-orientation to IT infrastructure, regardless of whether they are also applied at the application layer.

SOI is one of the three pillars of information technology. Together with the other pillars – Service-Oriented Enterprise (SOE) and Service-Oriented Application Architecture – it provides guidelines for the development of IT capabilities. As SOI is a domain in itself and the mechanisms and structures of SOI are to some extent different from SOA and SOE, The Open Group wishes to develop a common understanding of this domain.

IT infrastructure is of common interest to the members of The Open Group and the development and articulation of the relevant structures for SOI are well-aligned with the interests of Open Group members.

While the term “Service-Oriented Architecture” is most commonly used to refer to the application of the principles of service orientation to software application programs, Service-Oriented Infrastructure results from applying those principles to IT infrastructure.

Note that SOA at the application program level requires an infrastructure to support it, but the concept of this infrastructure is distinct from the concept of SOI. An SOI reference model would be different from a technical reference model for SOA.

The SOI project is led by Mark England of HP and Hemesh Yadav of Unisys.

The project will support the development of Service-Oriented Infrastructure solutions. The intended audience for its deliverables is:

- IT staff tasked with the development or maintenance of SOI solutions
- Product management of organizations developing solutions within the SOI domain
- IT staff developing solutions in the SOA domain that need to interface with an SOI solution set

The deliverables will be:

1. A reference framework for Service-Oriented Infrastructure, including:
  - A definition of the SOI domain, explaining what SOI is, and defining SOI terms and concepts
  - An SOI model, structuring the domain and documenting generic mechanisms applicable; the model should identify infrastructure components, including those required for development, at run-time, and to support governance



## ***Service-Oriented Architecture***

- An overview of service characteristics relevant to the SOI services
  - An overview of the interfaces between SOI and the SOA/SOE domains
  - An overview of the relevant standards within the SOI domain
2. A Technical Guide describing how to design and implement SOI
  3. A White Paper describing how SOI might evolve, perhaps to include dynamic provisioning

The project will use the following externally-developed material as input:

- The SOA Reference Architecture section of the SOA Practitioners Guide input to The Open Group by BEA Systems for the SOA Alliance
- Material developed by Capgemini [21]
- There is a CBDI [22] paper that distinguishes SOA applied to business from SOA applied to infrastructure

### ***SOA Reference Architecture***

An SOA Reference Architecture will assist information technology professionals to understand and adopt SOA.

This project, led by Ali Arsanjani of IBM and Nikhil Kumar of Applied Technology Solutions, will deliver one or more non-vendor-specific reference architectures that describe the various characteristics of a reference SOA environment from an architectural perspective. These architectures will be appropriate for use with The Open Group Architecture Framework (TOGAF).

The base document for the work is an SOA Reference Architecture input by IBM. The project works by developing deltas to it, including deltas derived by comparing the base with other SOA reference architectures. Inputs to be compared with the base document include:

- Infosys Reference Architecture input
- Input from Applied Technology Solutions
- Input from Wipro
- The SOA Alliance Reference Architecture

The following is useful background material.

- TOGAF [3] 8.1.1
- The OASIS SOA Reference Model [11]

### ***SOA and Security***

This project is a joint initiative of The Open Group SOA Working Group [4] and Security Forum [23], with input from the Jericho Forum<sup>™</sup> [24].

The mission of The Open Group SOA Working Group is to develop and foster common understanding of SOA in order to facilitate alignment between the business and information technology communities.

## ***Service-Oriented Architecture***

The Security Forum works to raise industry confidence levels by defining standards and guidelines to counter the whole range of security risks and vulnerabilities; it looks at both the business and technical perspectives, drawing upon the expertise of security professionals on both the customer and supply sides of industry, government, and academia, to assess, evaluate, and address security issues, so as to deliver secure computing solutions that will interoperate with other systems.

The Jericho Forum is an international IT security thought-leadership group dedicated to defining ways to deliver effective IT security solutions that will match the increasing business demands for secure IT operations in our open, Internet-driven, globally networked world. Its key concern is de-perimeterization. Its interest in contributing to the SOA and Security project arises from its perception of significant parallels between security requirements in SOA and de-perimeterized environments.

The Security Forum embraces the Jericho Forum approach that, whilst traditional security solutions like network boundary technology will continue to have their roles, we must respond to their limitations. In a fully de-perimeterized network, every component will be independently secure, requiring systems and data protection on multiple levels, using a mixture of encryption, inherently-secure computer protocols, inherently-secure computer systems, and data-level authentication. The Security Forum already has membership overlap with the Jericho Forum so will involve the Jericho Forum membership in review and feedback contributions with the SOA and Security project, as appropriate.

There is a common requirement to align the streams of activity in the SOA Working Group and the Security Forum. The SOA and Security project will address that requirement by identifying and analyzing security issues for SOA. This will contribute to the understanding of a vital area of SOA, and assist business people and IT professionals in their adoption of SOA in an appropriately secure fashion.

Particular issues that should be addressed include the following.

- In common with other approaches to architecture, the delivery of SOA requires that consideration is given to maintaining the Confidentiality, Integrity, and Availability of data and services delivered to support business functionality in addition to considering the wider requirements for Identity Management, Access Control, Authentication, Authorization, Accounting, and Trust Management.
- This can be a complex undertaking – requiring as it does consideration of business drivers and the impact of the threats and vulnerabilities to the C, I, & A of the data and systems to be protected.
- In a distributed SOA environment there are significantly more complex relationships to manage regarding the controller of a service authenticating the requesters at the correct levels (identity management), authorizing the appropriate level of use of that service (provision management), and the effective federation/delegation controls that this requires when one service cascades to call on another service. All of these must be managed at the required level of security commensurate with managing the overall accepted risk for the transaction involved.
- Open systems architectures are by their nature technology-neutral. Interoperability of implementations of SOA will depend on use of industry-standard protocols for passing authentication attributes and provisioning information between the service provider controllers.
- Added to the above considerations are the various compliance frameworks that may apply through commercial good practice or increasingly stringent regulatory constraints.

The project will:

- Produce as appropriate white papers analyzing security issues for SOA and identifying work to be undertaken by The Open Group. These white papers, which project members may decide to keep

## ***Service-Oriented Architecture***

internal to the project or publish as external deliverables, will address steps leading to comprehensive understanding of the components which will be included in the Guide. Such steps will be identified as the project proceeds, but at the start are anticipated to include:

- A white paper that describes the characteristics which define SOA security services, and identifies and elaborates the core Security and Information Assurance services required to deliver a non-industry-specific SOA
- A white paper that makes recommendations for the definition of new service types (where none exist), identifies gaps in the existing standards needed to support security for SOA, proposes extensions to those services which may be required to deliver appropriate levels of assurance, considers the technologies which may exist to deliver these services, and from this identifies the extent to which a service may currently be realized conceptually, logically, or physically
- A white paper that gives a set of use-case descriptions and an SOA threat profile that is based on them
- Deliver a guide for enterprise architects on how to address security in SOAs, including material from the white papers as appropriate

It is expected that, in the course of the project, input may be required from, or the project may wish to direct or influence, the output of other project streams. These are expected to include liaison with:

- The SafeSOA Task Force [25], which has identified four main categories of issue: federated identity; roles and authorization; threat prevention; and policy enforcement
- SAFE [26], which is an organization doing work in the pharmaceuticals area, but which is probably generally applicable
- OASIS [19], which is developing standards for federated identity and web services security
- Project Liberty [27], which is developing web-based interactions scenarios
- Governance and Service-Oriented Infrastructure projects and the Reference Architecture project
- The Jericho Forum [24]

The project is a joint project of The Open Group Security Forum and SOA Working Group. It uses normal Open Group procedures for development and review of documents. Decisions are taken by majority vote of Open Group member companies that are represented on the soa-sec email list (except for approval of changes in formal reviews, where the normal 75% rule described in The Open Group technical procedures applies).

### **The SOA Maturity Model Project**

As more organizations continue to embrace the use of services as the foundation for their next-generation IT infrastructures, it is increasingly important for them to assess their maturity within a complete SOA migration path and identify how to maximize business benefits from their adoptions. Many SOA maturity models exist today, but an industry-recognized adoption model and terminology based on open standards are both required for companies to realize the full potential of SOA.

In its meeting in October 2006, the main Board of The Open Group unanimously resolved that:

- A paper from IBM be adopted as the initial input for a Board-level Maturity Model Work Group

## ***Service-Oriented Architecture***

- The group should actively welcome input from other members of The Open Group and other industry groups
- The group should be chaired by Andras Szakal of IBM, with representation from Ron Tolido of Capgemini, Sam Ceccola of BEA Systems, and Mateen Greenway of EDS.

The work of this group is supported by the SOA Working Group, which has held sessions at its meetings in October 2006 and January 2007 to discuss the OSIMM and provide comments and input.

The work will result in The Open Group Service Integration Maturity Model (OSIMM). It will leverage proven best practices within the industry, helping IT practitioners create a roadmap for their incremental adoption and evolution of SOA. Additionally, the model is being developed to help organizations achieve advanced levels of service integration that are specifically in line with their unique SOA migration path and business goals.

## Appendix B: Recommendations of the Unique Value Project

### Introduction

The “Unique Value” project was one of the three projects that were set up initially by the SOA Working Group. Its remit was to develop an evaluation of the value that The Open Group can add to the evolution of SOA.

Topics were volunteered by members of the SOA Working Group. These inputs were collected into a spreadsheet, containing descriptions. Members provided comments on the items, reviewed the spreadsheet, and voted on their preferred topics. Items with more than four positive votes were selected. This resulted in ten recommendations. A further vote was then conducted to prioritize the recommendations.

### Recommended Areas

Two of the recommendations, Definition of SOA and SOA Case Studies, were already the subjects of ongoing projects. The other eight are listed in Table 1 and Table 2.

Topic	Description	Value	Possible Deliverables
SOA Maturity Model	There is a need for a non-vendor-specific model that helps identify characteristics of an SOA environment, from a maturity perspective.	This model can be used by companies wanting to obtain non-vendor-specific SOA maturity direction.	SOA Maturity Model document
SOA Reference Model	There is a need for a non-vendor-specific model that describes the characteristics of a reference SOA environment, from an architectural perspective.	This model can be used by companies wanting to refer to non-vendor-specific reference.	SOA Architecture Model document
SOA Relation to EA (TOGAF)	This effort will position SOA and EA (TOGAF), describing where they align and where they differ.	Ease up confusion regarding the relationship of two concepts, helping leverage the TOGAF brand more effectively in current SOA-driven marketplace.	Guide for implementing an SOA using TOGAF

**Table 1: Recommended Work Areas (Part 1)**

Topic	Description	Value	Possible Deliverables
Business-driven SOA	There is a lot of emphasis on the technical characteristics of SOA. This effort will focus on the managed evolution of business needs/potential and IT needs/potential.	Help capture common, cross-vendor understanding of business driver behind SOA.	Guide explaining business concepts underlying SOA Scenarios for business-driven SOA
Legacy Evolution to SOA	Legacy systems drive the vast majority of IT solutions worldwide. There is too much out there that is not going to be replaced in the near future. There is a need to show how Legacy can play in an SOA.	Deliver pragmatic advice on legacy integration with and/or transformation to an SOA environment.	Positioning guide on legacy and SOA
SOA Governance	Describe governance across the lifecycle of an SOA solution. Document relationship with various governance efforts in the industry.	Clarify position of SOA governance with respect to EA (TOGAF) governance, promote SOA governance best practices.	SOA Governance from a TOGAF perspective document List of SOA Governance Control areas
Ontologies for SOA	An Ontological approach helps establish a more in-depth understanding of the relationships existing in an SOA solution, leading to more accurate representation of concepts.	Ontologies allow for the more accurate definition of models.	Ontology for SOA document
SOA Key Performance Indicators	This effort will define concrete indicators that define the advantages of an SOA, and approaches for measuring them.	This indicators can be used as inputs to SOA architectures, governance policies and management solutions, helping deliver more accurate control mechanisms.	SOA Key Performance Indicator descriptions Method for measuring them

**Table 2: Recommended Work Areas (Part 2)**

### Prioritization

Members of the SOA Working Group were asked to select the items, from this list, that they would like to get involved with, to help establish the degree of interest and resources available.

The following areas received the most votes:

- SOA Relationship to EA (TOGAF)
- SOA Reference Model
- Ontologies for SOA

### Referenced Documents

The following documents are referenced in this White Paper:

- [1] The Boundaryless Organization: Breaking the Chains of Organizational Structure Ron Ashkenas, Dave Ulrich, Todd Jick, and Steve Kerr, Jossey-Bass, ISBN 0-7879-5943-X.
- [2] Business Scenario, October 2002, Interoperable Enterprise (K022), available at [www.opengroup.org/bookstore/catalog/k022.htm](http://www.opengroup.org/bookstore/catalog/k022.htm).
- [3] The Open Group Architecture Framework (TOGAF); refer to [www.opengroup.org/togaf](http://www.opengroup.org/togaf).
- [4] The Open Group SOA Working Group; refer to [www.opengroup.org/projects/soa](http://www.opengroup.org/projects/soa).
- [5] The Open Group SOA Case Studies; refer to [www.opengroup.org/projects/soa-case-studies](http://www.opengroup.org/projects/soa-case-studies).
- [6] Semantic Web Services Ontology (SWSO); refer to [www.w3.org/Submission/SWSF-SWSO](http://www.w3.org/Submission/SWSF-SWSO).
- [7] Web Service Modeling Ontology (WSMO); refer to [www.wsmo.org](http://www.wsmo.org).
- [8] The Web Ontology Language-based Web Service Ontology (OWL-S); refer to [www.daml.org/services/owl-s/1.0](http://www.daml.org/services/owl-s/1.0).
- [9] The Federal Enterprise Architecture Reference Model Ontology (FEA-RMO); refer to <https://osera.gov/web/guest/projects/fea-rmo>.
- [10] The Open Source E-Government Reference Architecture (OSERA) project; refer to <https://osera.gov/web/guest/home>.
- [11] OASIS Reference Model for Service-Oriented Architecture; refer to <http://docs.oasis-open.org/soa-rm/v1.0/soa-rm.html>.
- [12] The Object Management Group Ontology Definition Metamodel (ODM); refer to [www.omg.org/docs/ptc/06-10-11.pdf](http://www.omg.org/docs/ptc/06-10-11.pdf).
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- [14] Resource Description Framework (RDF); refer to [www.w3.org/RDF](http://www.w3.org/RDF).
- [15] Web Ontology Language (OWL); refer to [www.w3.org/2004/OWL](http://www.w3.org/2004/OWL).
- [16] The Protégé Open Source Ontology Editor and Knowledge-Base Framework; refer to <http://protege.stanford.edu>.
- [17] Information Technology Infrastructure Library (ITIL); refer to [www.tsoshop.co.uk/bookstore.asp?FO=1162745](http://www.tsoshop.co.uk/bookstore.asp?FO=1162745).
- [18] Control Objectives for Information and related Technology (COBIT); refer to [www.isaca.org](http://www.isaca.org).
- [19] The Organization for the Advancement of Structured Information Standards (OASIS); refer to [www.oasis-open.org](http://www.oasis-open.org).
- [20] The Object Management Group; refer to [www.omg.org](http://www.omg.org).
- [21] Capgemini: Service-Oriented Infrastructure; refer to [www.capgemini.com/services/soa/soi](http://www.capgemini.com/services/soa/soi).

## ***Service-Oriented Architecture***

- [22] Everware-CBDI; refer to [www.cbdforum.com](http://www.cbdforum.com).
- [23] The Open Group Security Forum; refer to [www.opengroup.org/security](http://www.opengroup.org/security).
- [24] The Jericho Forum; refer to [www.opengroup.org/jericho](http://www.opengroup.org/jericho).
- [25] The SafeSOA Task Force; refer to [www.safesoa.org](http://www.safesoa.org).
- [26] The SAFE-BioPharma Association; refer to [www.safe-biopharma.org](http://www.safe-biopharma.org).
- [27] The Liberty Alliance; refer to [www.project-liberty.org](http://www.project-liberty.org).
- [28] The Web Services Business Process Execution Language (BPEL); refer to <http://docs.oasis-open.org/wsbpel/2.0/wsbpel-v2.0.pdf>.



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### **About The Open Group**

The Open Group is a vendor-neutral and technology-neutral consortium, whose vision of Boundaryless Information Flow™ will enable access to integrated information within and between enterprises based on open standards and global interoperability. The Open Group works with customers, suppliers, consortia, and other standards bodies. Its role is to capture, understand, and address current and emerging requirements, establish policies, and share best practices; to facilitate interoperability, develop consensus, and evolve and integrate specifications and Open Source technologies; to offer a comprehensive set of services to enhance the operational efficiency of consortia; and to operate the industry's premier certification service, including UNIX® system certification. Further information on The Open Group can be found at [www.opengroup.org](http://www.opengroup.org).