GEOG 482 / 582 : GIS Data Management

Lesson 13: Web-Enablement Using ArcGIS Server – Implementation Considerations

Overview

Learning Objective Questions:

1. What are some design issues associated with a Service-oriented Architecture (SOA) approach?
2. What are the key aspects of SOA?
3. What are SOA logical components?
4. What is a web services protocol stack?
5. What is the service support function within the SOA Infrastructure?
6. What are some Esri Components for a SOA?
7. What are some ArcGIS Web Services?
8. What are ArcGIS server system architecture components?
9. What is involved in Esri SOA component deployment?

Lesson Preview

Learning objective questions act as the lesson outline.

Questions beg answers.

1. What are some design issues associated with a Service-oriented Architecture (SOA) approach?

- IT departments long-held application-centric view of the world. Most of budgets allocated to the purchase, deployment, and maintenance of individual applications.

- More recently, a growing percentage of budget allocated to integration projects in an attempt to deliver broader and more seamless support for business processes.

- Projects have often fallen short of their promise due to the inherent rigidity of hardwired integration.

- Any change to a single application must be propagated across the entire integration, creating an expensive and change-averse infrastructure.

Lesson material developed from
http://www.esri.com/library/whitepapers/pdfs/integrated-geoenabled-soa.pdf

Transition to web services needs SOA

- SOA is not the same as web services, but web services can be organized in terms of SOA. SOA is a 'bigger picture' about organizing and distributing services.

- SOA enables IT departments to make the transition from an application-centric view of the world to a business process-centric one; that is, moving from a technology centric-based approach a more function-process-centric (user information need) based approach.

- Business function-process-centric view enables freedom to combine business services from multiple applications to deliver true end-to-end support for business processes.

- Upgrade or change applications without impacting other applications in the SOA by utilizing integration mechanisms such as Web services...this is the key to interoperability.

Key terms
SOA
Web services

2. What are the key aspects of SOA?

SOA is a method of building applications that utilize common services to support organization functions. Organization for the Advancement of Structured Information Standards (OASIS) provides key aspects.

- **Contract and Policy**—A contract represents an agreement by two or more parties. A policy represents some constraint or condition on the use, deployment, or description of an owned entity as defined by any participant as related to the contract.

- **Execution Context**—The set of technical and business elements that form a path between those with needs and those with capabilities and that permit service providers and consumers to interact.

- **Interaction**—The activity involved in making use of a capability offered, usually across an ownership boundary, to achieve a particular desired real-world effect.

3. What are SOA logical components?

SOA is an architectural concept that must be mapped to a logical construct followed by an implementation using a specific set of technologies/products/platforms. As with any other solution, a SOA is characterized by a set of both mandatory and optional components. A SOA solution consists of the following three main logical components.
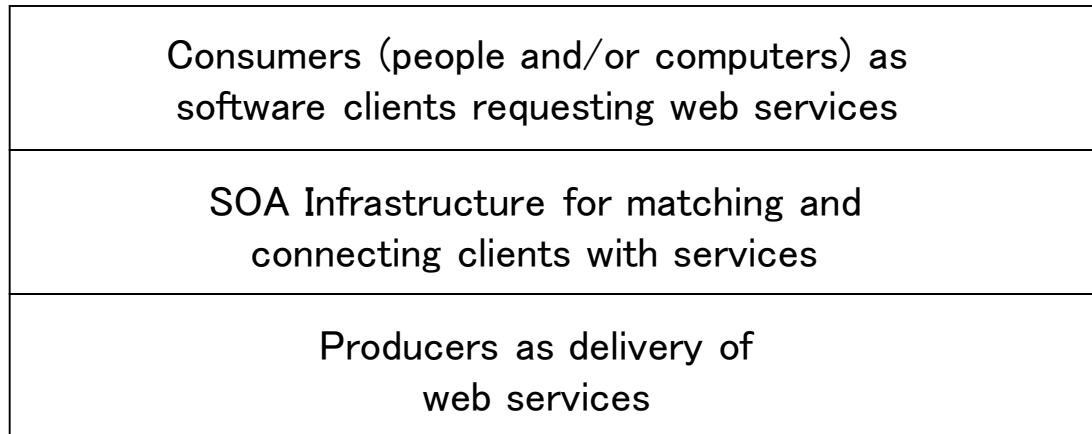
Consumers — An entity makes use of a service offered by producer

SOA Infrastructure – Provides an exchange of services

Producers — An entity that offers a specific service or functionality

Key terms
OSA Infrastructure

Consumers (people and/or computers) as software clients requesting web services
SOA Infrastructure for matching and connecting clients with services
Producers as delivery of web services

Expanded view of SOA Infrastructure layer

• **Applications**—Provide a graphic interface and varying degree of tightly coupled business logic for consumers to perform tasks (a crossover area of enterprise solutions versus the SOA loosely coupled)

• **Services**—component that performs a specific task when invoked

• **Service Support**—component that provides the background support functions for SOA

Key terms
Consumers
Service support
Services
Producers
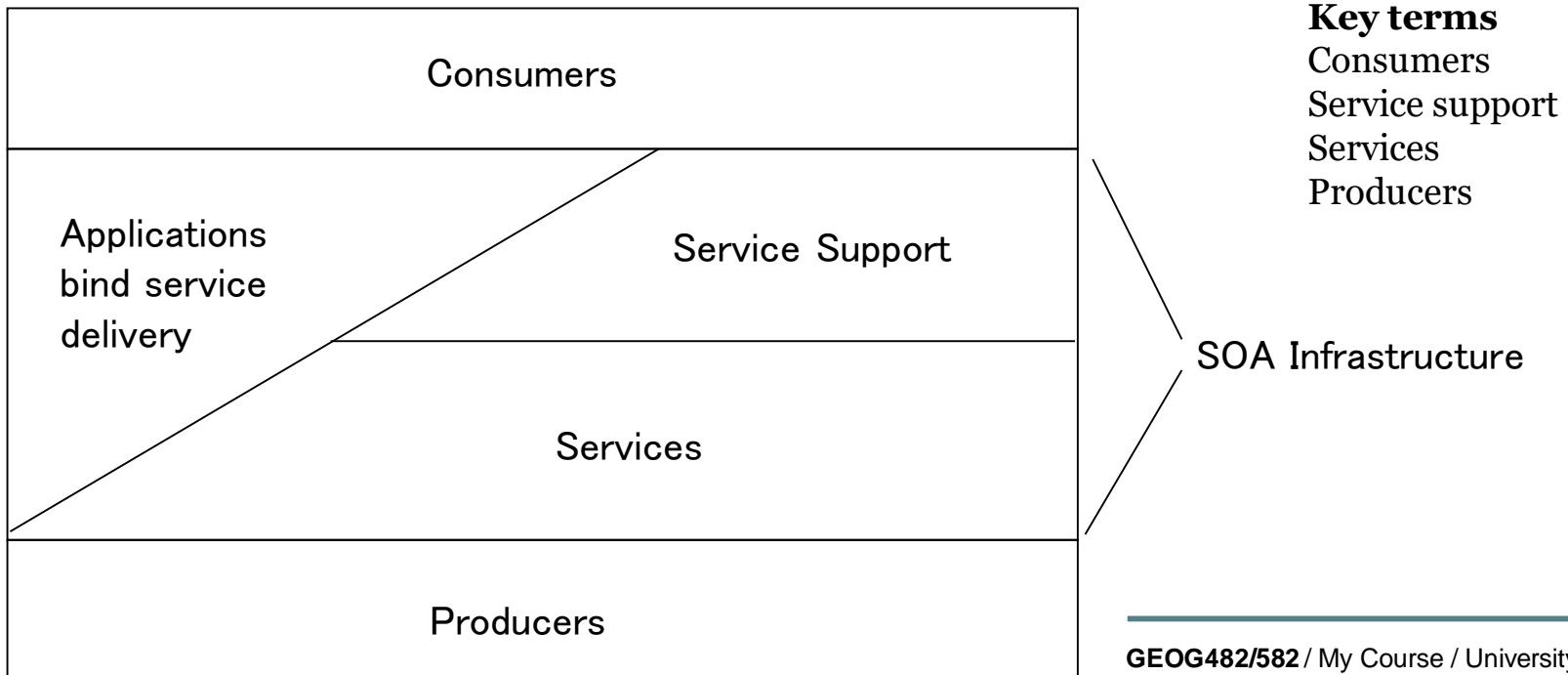
Consumers – Top Level of SOA Diagram

Desktop

- Thick client: Complete application functionality, limited to specific platforms
- Thin client: Small, focused applets/applications

Web Browser

- Thin client: as platform- and Operating System-neutral user interface

Mobile Device

- A simplified user interface for phones, pagers, PDAs, and Tablet PCs

Service Calling a Service

- A single service calls multiple other services for consolidating information

Portlets

- A portal Web site component providing access to a specific information source or application

Consumers can be designed to operate completely independently of common SOA infrastructure components (service support and services) or utilize them to varying degrees.

Applications – SOA Infrastructure

Applications component is depicted as wedge shape (in diagram),
since thick client solutions on the left side are less dependent on
the services and service support components to perform their work,
whereas Web (thin client) applications (Web apps, mobile apps)
are reliant on additional services and service support functionality.

Thick Client Solutions

- Typically related to the desktop (thick clients) applications,
allowing for robust, highly interactive analysis and visualization
beyond technological thin client capabilities of Web or mobile
application solutions

- Can perform SOA infrastructure layer-type functions (in addition
to the presentation layer functions) so that users may have full
application functionality without requiring additional SOA
infrastructure middleware

- Can operate in disconnected environments

Applications - continued

Thin Client Web Application Solutions

- Developed independently of both the common service support and services components, or be completely dependent on them.

- Single Interface—Application interface designed as a stand-alone solution, not requiring portal infrastructure.

- Portals and Portlets—Portlets are applications designed as a component that can be integrated into a portal interface. The application programming interface (API) standards for portal subcomponents are different for Java (Oracle promoted) and .NET (Microsoft) solutions.

Mobile Application Solutions

- Custom user interfaces are typically utilized for mobile devices to provide a specific user experience via mobile development platforms.

Service - SOA Infrastructure

Services are the architecture components that process business logic for the organization. A ***service*** is an abstract notion that must be implemented by a concrete ***agent*** where...

- The agent is an instance of software/hardware that sends and receives messages.
- The service is the resource characterized by the set of functionality that is provided.
- Services are abstract in the sense that you might provide the same service using one particular agent one day, then use a different agent the next. The idea of service makes the agent-instances interchangeable. As such, flexibility, along with performance. is built into a SOA services solution.
- Supporting both performance and flexibility is the ultimate goal of all software development, as this issue has been a age-old trade-off for decades.

Service - continued

Two primary perspectives on services:

Business Perspective

- IT assets that correspond to real-world business activities and recognizable business functions

Technical Perspective

- Coarse-grained, reusable IT assets that have well-defined interfaces (service descriptions), which can be broken down further into two categories:
  - Data-centric—Tightly coupled with specific datasets and may offer access to customized portions of that data, i.e., performance focused
  - Business-centric—Services designed based on business process needs rather than data access needs, i.e., flexibility-focused

Business (workflow and governance) focus is primary driver for the creation of services in a SOA, but this is the age of BIG DATA.

Service Support - SOA Infrastructure

- Service support bridges communication between consumers and producers, and has a variety of names depending on the author:
  - SOA infrastructure
  - Integration platform
  - Enterprise service bus
  - Enterprise services

- The purpose of service support is to facilitate a robust SOA infrastructure to later deploy technical services (data-centric or business-centric) in software or hardware solution.

- Standards are the foundation of the service support.

4. What is a web services protocol stack?

a stack of computer networking protocols that is used to define, locate, implement, and make Web services interact with each other.

A web service protocol stack typically involves four protocols:
1) Transport Protocol (Service)
2) Messaging Protocol (XML)
3) Description Protocol (Service)
4) Discovery Protocol (Service)

From Wikipedia, the free encyclopedia

Layers 1 and 2

(Service) Transport Protocol: responsible for transporting messages between network applications and includes protocols such as HTTP, SMTP, FTP, as well as the more recent Blocks Extensible Exchange Protocol (BEEP) for creating network application protocols.

(XML) Messaging Protocol: responsible for encoding messages in a common XML format so that they can be understood at either end of a network connection. Currently, this area includes such protocols as XML-RPC, WS-Addressing, and SOAP

Layers 3 and 4

- **(Service) Description Protocol**: used for describing the public interface to a specific web service. The WSDL interface format is typically used for this purpose.

- **(Service) Discovery Protocol** : centralizes services into a common registry such that network web services can publish their location and description, and makes it easy to discover what services are available on the network. Universal Description Discovery and Integration (UDDI) was intended for this purpose, but it has not been widely adopted, and thus has languished. The convenience of a world-wide standard for WS discovery has not yet been realized.

5. What is the service support function within the SOA Infrastructure?

Service Support functions can be divided into five key areas:

- Directory
- Security
- Management
- Orchestration
- Semantics

Directory

- **Registry**—System-wide metadata
  - Universal Description, Discovery, and Integration (UDDI) — registry solution for linking consumers and suppliers
  - ebXML/ebRIM—Most flexible and extendable registry and repository solution - provides business processes and related metadata along with collaboration protocol profiles.
- **Catalog**—Domain specific such as geospatial metadata only
  - Catalog Services for Web (CSW)—An OGC standard for geospatial metadata

Security

- XML-based security mechanisms address authentication, role-based access control, distributed security policy enforcement, and message layer security that accommodates the presence of intermediaries.
- WS-Security framework establishes a security model supported by a family of specifications that permeate service-oriented application and enterprise architectures on many levels.
- SOA abstracts application functionality to a business services layer, regardless of the location or awareness of the underlying applications. Therefore, identification and access policies for different systems may not be the same or easily coordinated.
- Security Assertion Markup Language (SAML) is intended to enable federated authentication. Extensible Access Control Markup Language (XACML) may then be utilized to support an authorization policy framework.

Management

- Web service management capabilities typically include
  - Monitoring
  - Transaction management
  - Routing
  - Transformation
  - Controlling and reporting of service qualities
  - Service usage
- Service qualities include:
  - health qualities such as availability (presence and number of service instances),
  - performance (e.g., access latency and failure rates), and
  - accessibility (of end points).
- Facets of service usage information that may be managed include frequency, duration, scope, functional extent, and access authorization.

Orchestration

- Orchestration
  - expresses a process logic that is typically owned by a single organization, and is a capability that controls the execution of software-based units (e.g., applications, components, services) so as to achieve a pre-specified effect.
  - standardizes process representation (workflow) across the organization while addressing the goal of enterprise federation and promoting service orientation.
  - exist as services, called composite services.
- Choreography attempts to organize information exchange between organizations.
- An initial standard called business process execution language (BPEL) does not incorporate humans into a workflow but is being addressed through two avenues:
  - BPEL4People—A proposed extension for WS-BPEL
  - Treating people as services in the workflow

Key terms
Orchestration

Semantics

Service providers and consumers must have a shared
understanding of the meaning of the messages they exchange,
e.g. as in a controlled vocabulary wherein terms have shared
meaning. Semantic integration is critical to dynamic,
automated interactions between companies.

The semantic Web addresses two main issues:
- Common formats for interchange of data. The initial Web
  focused on the interchange of documents.
- Language for recording how the data relates to real-world
  objects

These capabilities allow a person (or a machine) to start off in one
database and move through an unending number of databases
that are connected not by wires but by common
formats/languages.

Producers – Bottom Level of SOA Diagram

Web service producers define a service request format and publish it to service directories for discovery and reuse.

- Internal Data—Data available for processing via high-speed LAN.
- Enterprise Application Servers—Examples include extending functionality of enterprise resource planning and customer relationship management products.
- Hosting Providers—Data is available via WAN, allowing usage of data not necessarily owned by consumers.
- Search Engines—Allow for discovery of detailed metadata about services.

6. What are some Esri Components for a SOA?
GIS SOA Conceptual View – Integration Focus
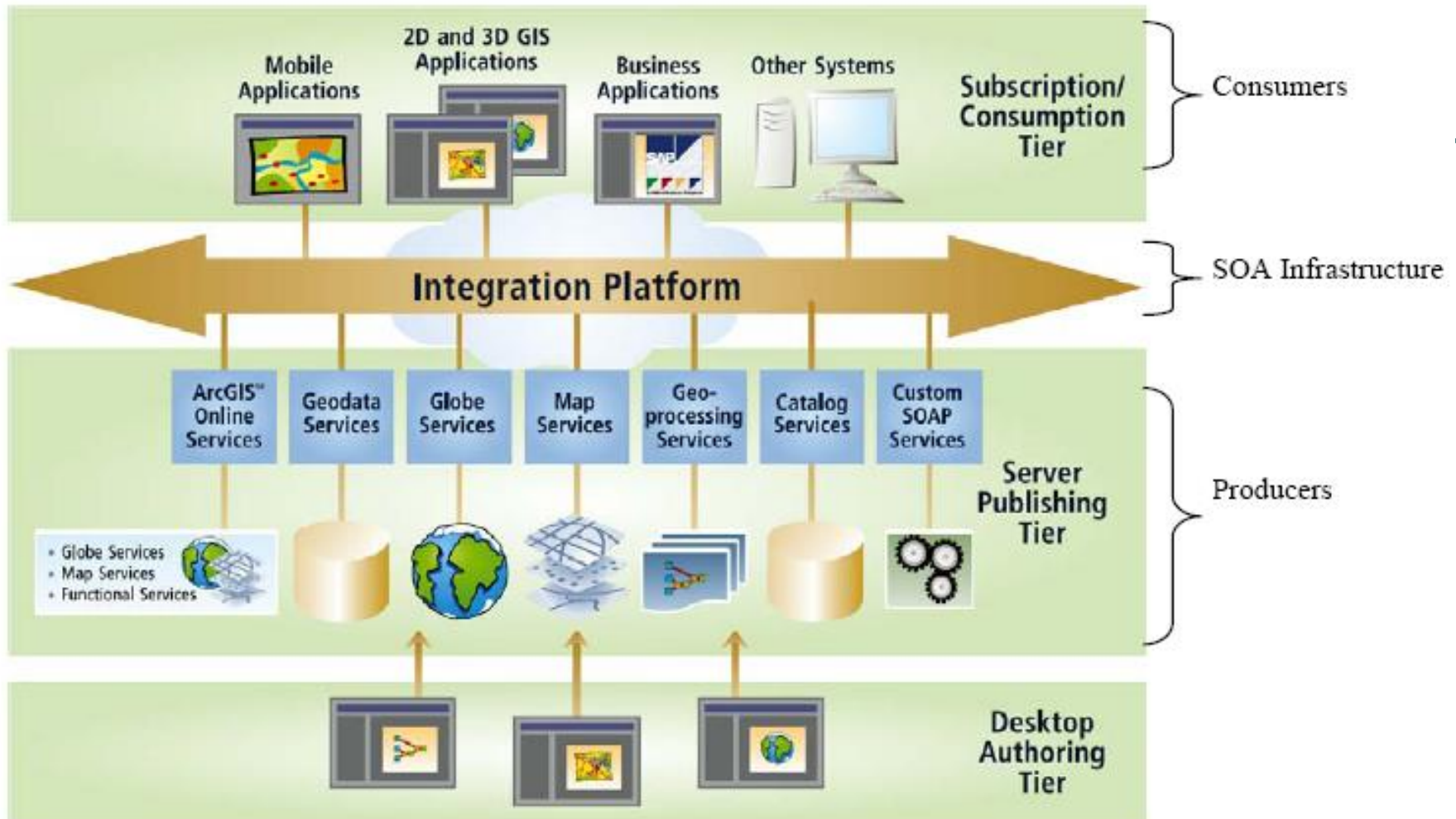
Remembering the SOA logical components below, let's look at some examples of Esri WS implementations, i.e., SOA physical components...

Key terms
Consumers
Service support
Services
Producers
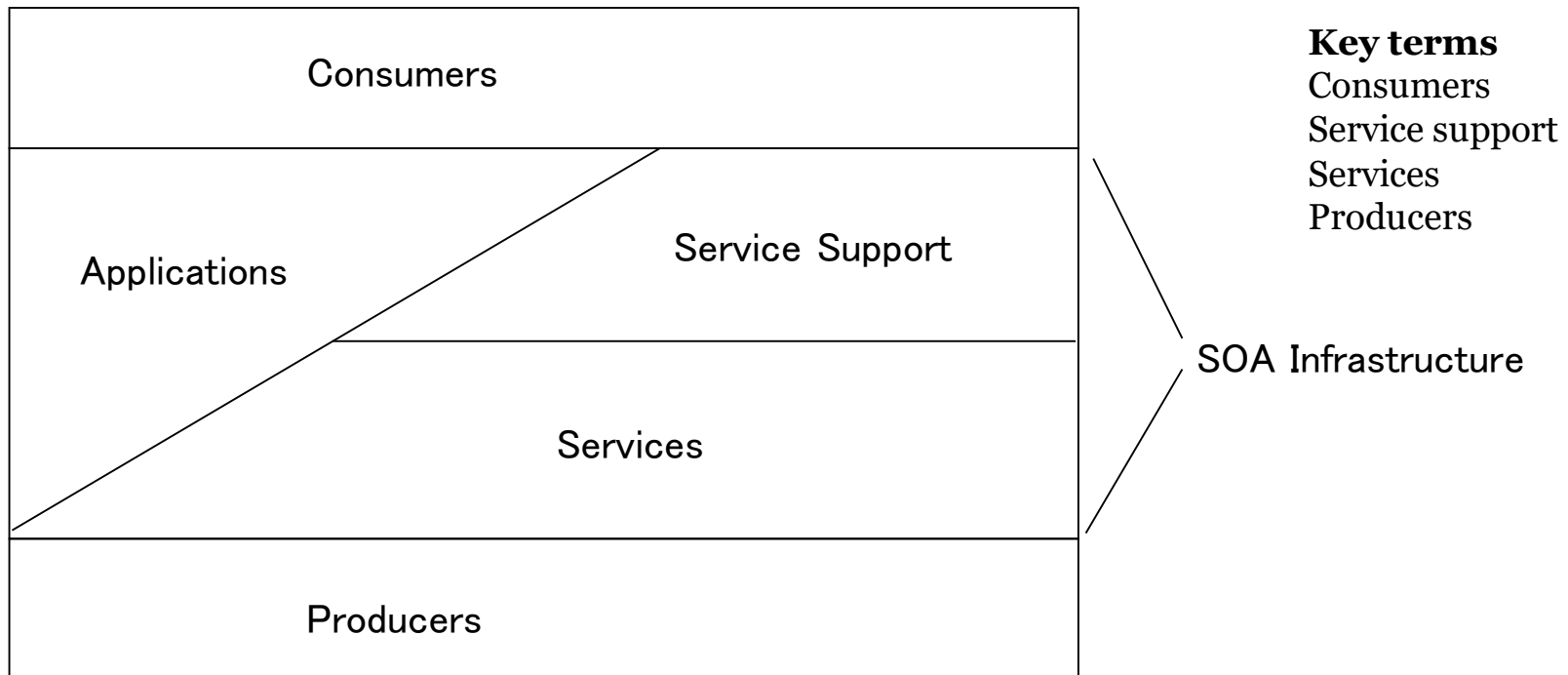
Consumers

Consumers

Desktop (Heavy)	Desktop (Light)	Web Browser	Mobile Device	Service Calling a Service	Portlets

• ArcMap
  .NET, VB. C++
	• ArcGIS Explorer
	  .NET
	• ArcReader
	• ArcGIS Engine
	  Java, .NET, VB, C++
		• ArcGIS Server/IMS ADF
		  Java & .NET, AJAX
		• IMS JITK
		  JavaScript, HTML
		• ArcWeb Services
		  SVG, Flash
			• Mobile ADF
			  .NET
			• ArcPad
			• ArcWeb Services
			  J2ME
				• Image Fusion
				  JITK
				  GPT
				  ADF
					• GPT
					  JSR 168
					• .NET ADF
					  Webparts
					• Java ADF
					  EJBs

http://www.esri.com/library/whitepapers/pdfs/integrated-geoenabled-soa.pdf

SOA Infrastructure

Applications

Rich Clients
- ArcGIS Explorer
- ArcView
- ArcInfo
- ArcEditor
- ArcGIS Engine

Web Apps.
- .NET Web
- Java Web
- Java EJB
- JITK
- GPT

Mobile Apps.
- ArcGIS Mobile
- ArcPad

Service Support

Directory
- UDDI
- ebXML
- CS-W

Security
- LDAP / Certs.
- WS-Security
- GeoDRM

Management
- QoS
- ESB
- Transformers
- JMX

Orchestration
- BPEL

Semantics
- NIEM
- OWL/RDF

Services

Data Centric

Data Links
- ODBC
- JDBC
- RPC

OGC
- WMS
- WFS
- WCS

ESRI
- Replication
- Data Interop.
- Tracking
- Events

Business Centric

GIS Based
- Routing
- Analysis
- 3D Globe
- Gazetteer
- Geocoding
- Placefinder
- Weather

Geoprocessing
- Line of Sight
- Plume Modeling
- Map on Demand

Non-GIS Based
- Work Order
- Financial Info
- Customer Service
- Notify Field Personnel

http://www.esri.com/library/whitepapers/pdfs/integrated-geoenabled-soa.pdf

Producers

Producers

Internal Data
- RDBMS Interfaces
  Direct Connect (SQL)
  Application Connect (SDE)
- Flat Files
  Image Server Raster
  2D, 3D Cache
  File-Based GeoDB

Search Engines
- Google Search
- Metadata
- SQL

Hosting Providers
- Geospatial One-Stop
- The *National Map*
- ArcWeb Services

Enterprise Application Servers
- ArcIMS
- ArcGIS
- Image
- Tracking
- ERP
- CRM
- DMIS
- RMS
- EOC

http://www.esri.com/library/whitepapers/pdfs/integrated-geoenabled-soa.pdf

Esri datacentric services

Datacentric Services						
Service Name	OGC	SOAP	XML over HTTP	Direct Link	ArcIMS	ArcGIS Server
Web Map Service	X	**	X		X	X
Styled Layer Descriptor (SLD)	X		X		X	*
Web Feature Service	X	**	X		X	*
Transactional Web Feature Service (WFS-T)	X	**	X			*
Web Coverage Service	X	**	X			*
Web Catalog Service	X	X	X		X	
Google (KML)	**		X			X
ODBC				X	X	X
JDBC				X	X	X
RPC				X	X	X
Replication			X			X
Data Interoperability		X	X	X	X	X
Tracking			X	X	X	
Events			X	X	X	**

Esri businesscentric services

Businesscentric Services						
Service Name	OGC	SOAP	XML over HTTP	Direct Link	ArcIMS	ArcGIS Server
Routing		X	X		X	X
Network Analysis		X	X			X
3D Globe		X	X			X
Gazetteer		X	X		X	
Geocoding		X	X		X	X
Place Finder		X	X			
Weather		X	X			
Line of Sight		X	X			X
Plume Modeling		X	X			X
Workflow Management		X	X		X	X

* In 9.3 Development
** Future Development

7. What are some ArcGIS Web Services?

Capability	What It Does	Required Resource
Mapping (2D)	Provides access to the contents of a map document. This capability is always enabled when you publish a map service.	Map document (.mxd) or published map document (.pmf)
WMS	Uses a map document to create a service compliant with the Open Geospatial Consortium's Web Map Service specification.	Map document
Mobile Data Access	Allows extraction of data from a map document to a mobile device.	Map document
KML	Uses a map document to create Keyhole Markup Language features.	Map document
Geoprocessing	Provides access to geoprocessing models from either a toolbox or a tool layer. A tool layer represents a model that has been dragged from ArcToolbox™ and dropped into a map document's table of contents. Enabling this capability while publishing a map document creates an associated geoprocessing service. This capability is always enabled when you publish a geoprocessing service.	Toolbox (.tbx) or a map document with a tool layer
Network Analysis	Solves transportation network analysis problems using the ArcGIS Network Analyst extension.	Map document with a network analysis layer

ArcGIS Web Services - continued

Globe (3D)	Provides access to the contents of a globe document. This capability is always enabled when you publish a globe service.	Globe document (.3dd)
Geodata	Provides access to the contents of a geodatabase for data query, extraction, and replication. This capability is always enabled when you publish a geodata service.	ArcSDE connection file (.sde), personal geodatabase (GDB), file GDB, or a map document with a layer from a GDB
Geocoding	Provides access to an address locator. This capability is always enabled when you publish a geocode service.	Address locator file (.loc), ArcView 3 locator (.mxs), ArcSDE locator, personal GDB locator, file GDB locator
Workflow Management	Provides an integration framework for ArcGIS multiuser geodatabase environments. It simplifies and automates many aspects of job management and tracking and streamlines workflow.	ArcGIS Server
Data Interoperability	Enables Web applications to directly access hundreds of data formats. The extension also provides access to data translation tools and brings spatial extraction, transformation, and loading (ETL) capabilities to custom server applications via a geoprocessing framework.	ArcGIS Server

8. What are ArcGIS server system architecture components?

GIS server hosts your GIS resources, such as maps, globes, and address locators, and exposes them as services to client applications

Composed of two distinct parts: the server object manager (SOM) and the server object container (SOC).

Key terms
SOM
SOC

SOM manages the services on a server. When a client application requests the use of a particular service, the SOM assigns the request to an available server object. There is only one SOM per GIS server. The SOM connects to one or more SOCs.
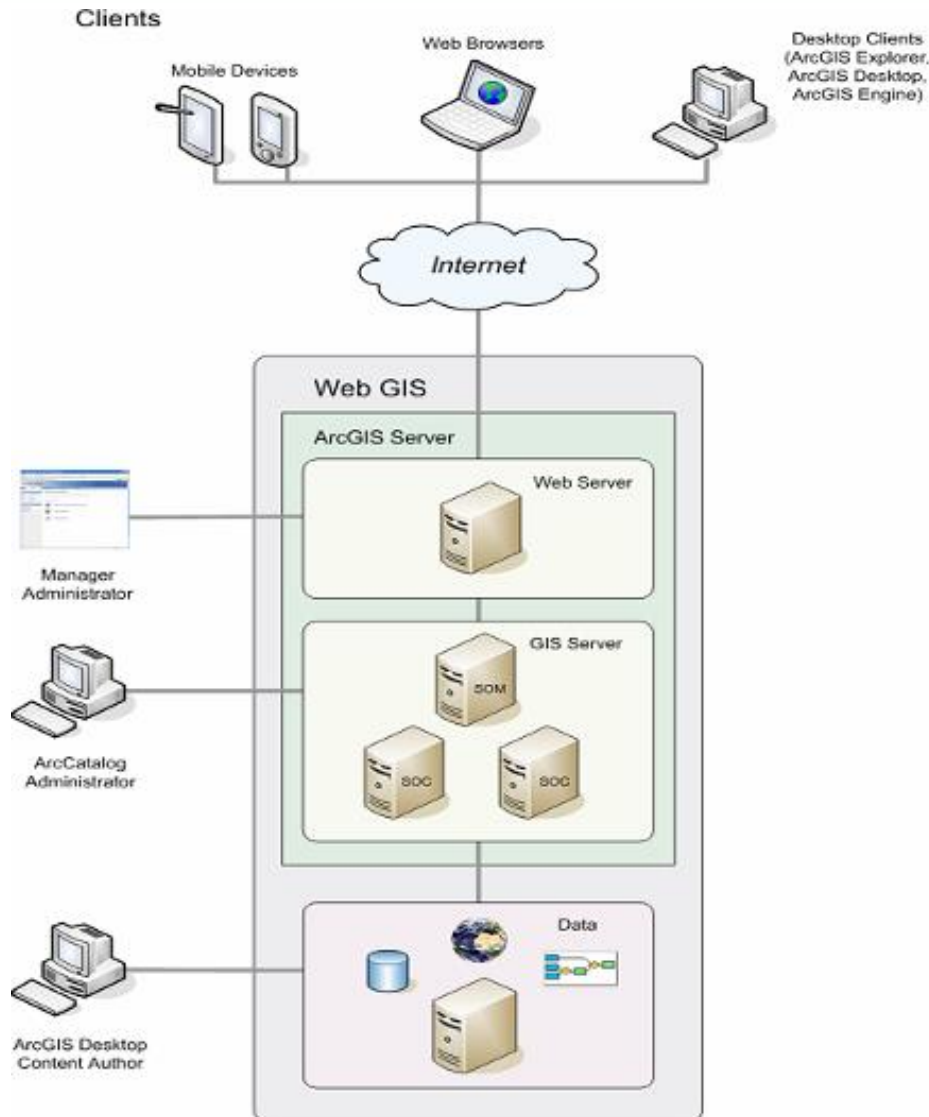
SOC machines, also referred to as containers or hosts, provides the services that the SOM manages. Depending on a configuration, one may run the SOM and SOC on different machines, or have multiple SOC machines per SOM.

# ArcGIS Server System Architecture - Overview

Key terms

Four tiers:
Clients
Web server
GIS Server
Data Server

9. What is involved in Esri SOA component deployment?

- The scalable architecture of ArcGIS Server lends itself to numerous deployment options.

- Larger deployments may require multiple Web servers or reverse proxies, Web application servers, Web service support boxes (core of the SOA infrastructure), Web service boxes (focus processing business logic), and data sources,

- Smaller deployments might want to consolidate these resources onto one or two machines.

- Each of the main component groups is broken down into separate components in figure following.

Esri Component Deployment Locations

http://www.esri.com/library/whitepapers/pdfs/integrated-geoenabled-soa.pdf, p.51
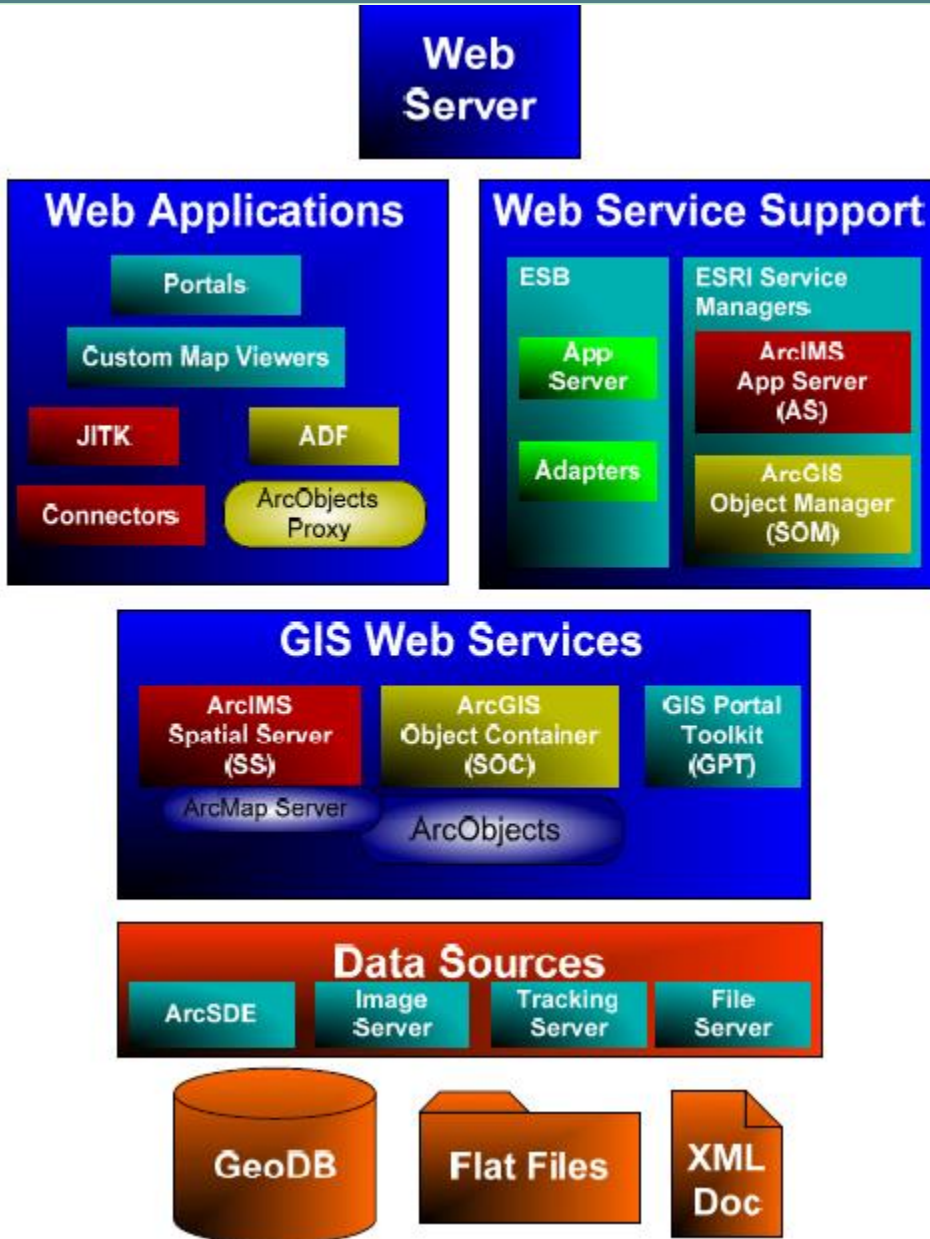
Summary

In this lesson, you learned about...

1. Design issues associated with a Service-oriented Architecture (SOA) approach
2. Key aspects of SOA
3. SOA logical components
4. Web services protocol stack
5. Service support function within the SOA Infrastructure
6. Esri Components for a SOA
7. ArcGIS Web Services
8. ArcGIS server system architecture components
9. Esri SOA component deployment

Contact me at
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have questions or
comments about this
lesson.

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END Lesson 13: Web-Enablement Using ArcGIS Server