Course: Software Technologies and Enterprise Architecture

WEEK 3: Service-Oriented Architecture (SOA) and Visualization

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Week-3: Service-Oriented Architecture (SOA) and Visualization

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Week-3: Service-Oriented Architecture (SOA) and Visualization

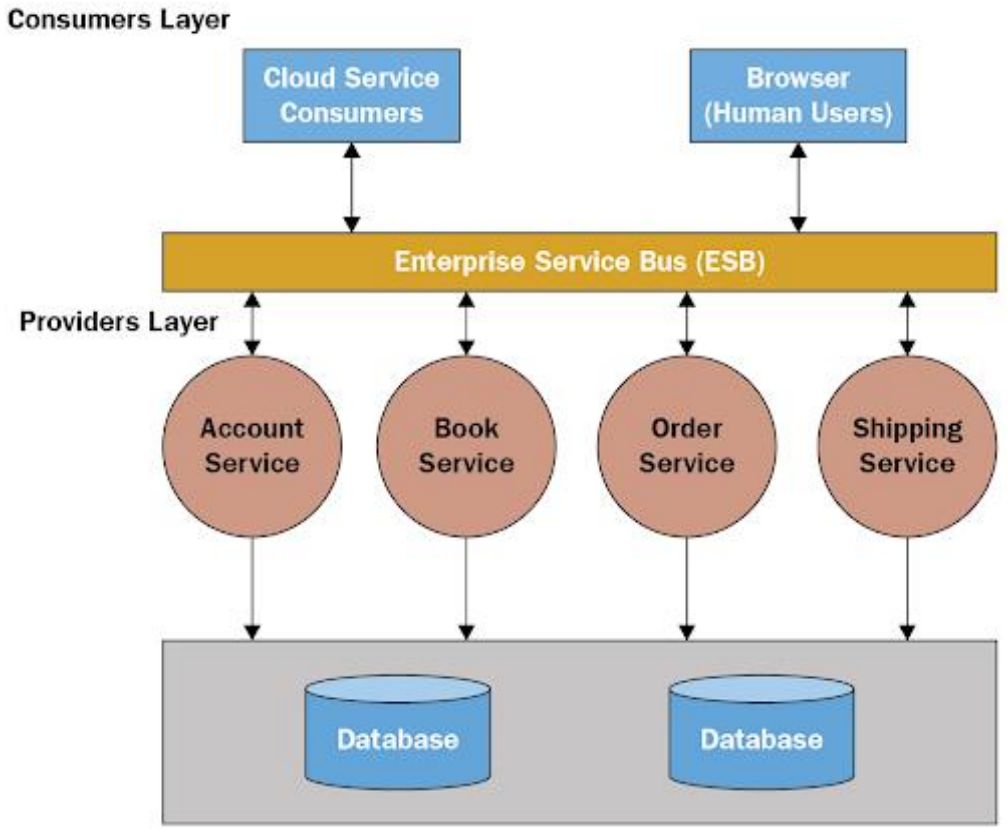
By the end of this unit, the student will be able to

- Define Service-Oriented Architecture (SOA) and explain its purpose in enterprise systems
- Describe the structure of SOA, including services, providers, consumers, and ESB
- Identify key SOA protocols such as SOAP and REST.
- Explain the core principles of SOA, like loose coupling, interoperability, and abstraction
- Analyze the advantages and disadvantages of SOA
- Identify real-world applications of SOA in different industries
- Compare SOA with Microservices architecture

Service-oriented architecture

What is service-oriented architecture?

- It focuses on the services we use and provide.
- The figure highlights the decoupling of consumers from providers using an intermediary layer.
- An approach for building a software environment and software that encompasses all aspects of enterprise-level development.
- It allows for the development of a series of modular web services across the organization that can easily communicate with each other and thus support all applications.

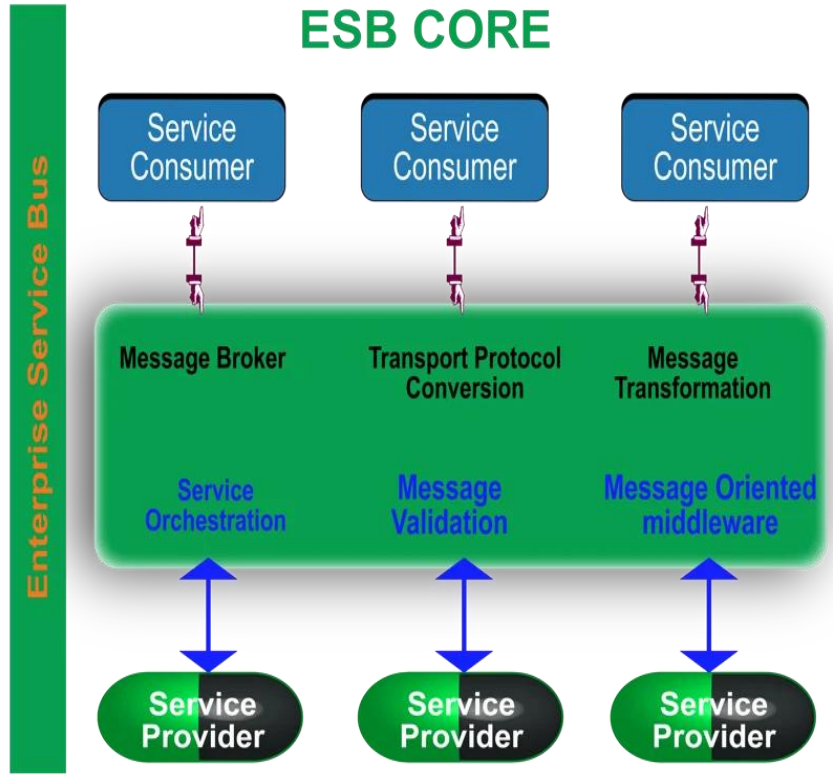


How SOA Is Structured

[1]. Service-Oriented Architecture vs. Microservices, N/A, OpenLegacy, 2023, n.p. https://www.openlegacy.com/blog/service-oriented-architecture-vs-microservices

Cont. ...Service-oriented architecture

- **Enterprise Service Bus (ESB)** is a feature-rich, drag-and-drop message-oriented middle-tier network layer that combines service-oriented architecture with the message-oriented layer to address the limitations of SOA.
- ESB also lets us change our infrastructure by configuring and reusing ESB parameters instead of writing new code.
- Offered by several vendors such as IBM WebSphere, Dell Boomi, and Oracle.
- ESB is the primary tool for an enterprise integration platform.



[2]. How to Choose the Best Enterprise Integration Platform, CET Digital. https://www.cetdigit.com/blog/how-to-choose-the-best-enterprise-integration-platform

Cont. …Service-oriented architecture

- One standout feature of SOA allows for an easy communication protocol between any different platforms we use (such as Microsoft Azure or Amazon Web Services [AWS]), as well as different programming languages.
- SOA's structure is based on the idea of decreasing the coupling between the applications we use (also known as *decoupling or loose coupling*).
  - Decoupling allows two applications to communicate with each other even if they're completely different.
  - Improved business functionality and makes the development of new software and software architecture easier.

[1]. Service-Oriented Architecture vs. Microservices, N/A, OpenLegacy, 2023.
https://www.openlegacy.com/blog/service-oriented-architecture-vs-microservices

Cont. …Service-oriented architecture

Service-Oriented Terminologies

- The most vital elements that play a very important role in the architecture that bind service consumers to services and make it an efficient and useful architecture.

1. Services

- Reusable components that represent business or operational tasks, such as *customer lookup, credit card validation, weather lookup, or line-of-sight calculation*.
- They are well-defined, independent units of functionality that can offer a specific service to other services or systems.
- It is platform-independent but accessible over a network using standard protocols like *HTTP, SOAP, or REST*.

[3]. Service-Oriented Architecture Guide, Sumit Malviya, Talent500, Feb.2025.
https://talent500.com/blog/service-oriented-architecture-guide/

Cont. …Service-oriented architecture

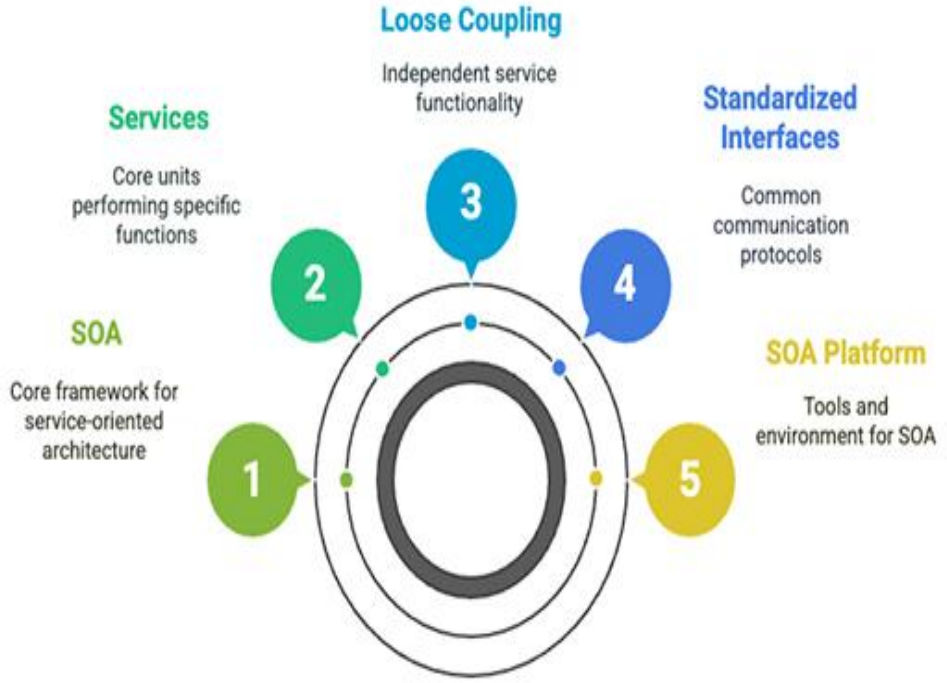
…Service-Oriented Terminologies

2. Service Provider

- It is an entity that implements and makes a service available to other consumers.
- The service is hosted, which can be provided by different applications or components within an enterprise.

3. Service Consumer

- Any application or system that consumes or utilizes the services a service provider supplies.
- This could typically be software that interacts with services to deliver some specific goal.



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Cont. …Service-oriented architecture

…Service-Oriented Terminologies

4. Service Locator

- A service locator design pattern is used to locate and access services.
- It offers an abstraction layer so that the consumer can discover and use services without knowing the implementation details.

5. Service Broker

- An intermediary between the service provider and the service consumer.
- It ensures discovery, routes the process, and initiates communication between both parties so that services are provided effectively.

[3]. Service-Oriented Architecture Guide, Sumit Malviya, Talent500, Feb.2025.
https://talent500.com/blog/service-oriented-architecture-guide/

Cont. ...Service-oriented architecture

- Components of the SOA architecture always include the following key elements

Service Registry	Central directory of all services listed, which can be discovered by the service consumers.
Service Provider	The system or application that provides the service.
Service Consumer	The application or client that requests and consumes services.
Service Broker	An intermediary that helps in service discovery and communication between service consumers and providers.
Enterprise Service Bus (ESB)	A middleware that enables communication and data exchange between different services and systems.
Service Contract	It lays down the expectation of input and output along with protocols used in the service; hence, clearly communicating between a service consumer and provider.

[3]. Service-Oriented Architecture Guide, Sumit Malviya, Talent500, Feb.2025. https://talent500.com/blog/service-oriented-architecture-guide/

Cont. …Service-oriented architecture

SOA offers four different types of services:

- **Functional**: This is the general SOA service relating to all business-oriented apps.
- **Enterprise:** This service is used when we want to implement specific functional services.
- **Application:** used by our DevOps team for developing and deploying new apps.
- **Infrastructure:** This aspect of SOA services is used for non-functional features, most often used for authentication and other security aspects.

[1]. Service-Oriented Architecture vs. Microservices, N/A, OpenLegacy, 2023. https://www.openlegacy.com/blog/service-oriented-architecture-vs-microservices

SOA Protocols

The main SOA communication protocols

- An **enterprise service bus (ESB)** is the main middleware component for enabling service-to-service communications.
- In short, an ESB acts as a “lobby” where different people (services) can come to exchange information.
- In contrast to microservices, SOA services talk to the bus rather than connect with one another directly.
- For enterprises, ESB is an effective way to expose internal applications to their counterparts without building a point-to-point integration.

[4]. Service-Oriented Architecture (SOA): The Modern Merits, Andre Nedelcoux, Intellias, 2025. https://intellias.com/service-oriented-architecture-soa/

Cont. …SOA Protocols

Extra benefits of ESB include:

- **Protocol transformation and standardization.** If your services use different protocols (REST, SOAP, FTP, etc.), an ESB can act as a “converter.”
- **Simplified transactional message flows.** An ESB can be used to securely process messages between two or more heterogeneous transactional data sources.
- **Service orchestration.** An ESB helps you create the optimal service hierarchy and ensure smooth routing.

[4]. Service-Oriented Architecture (SOA): The Modern Merits, Andre Nedelcoux, Intellias, 2025. https://intellias.com/service-oriented-architecture-soa/

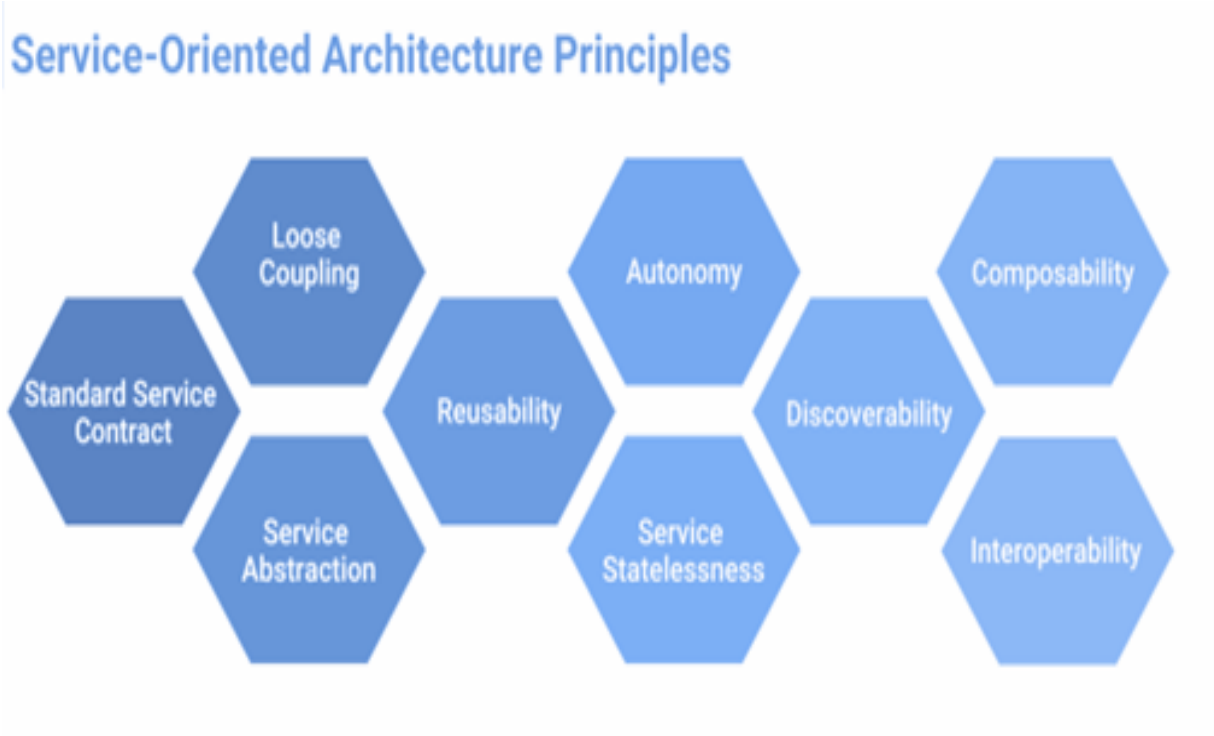
Cont. ….SOA Protocols

- **SOAP (Simple Object Access Protocol):** is one of two standard network protocols for inter-service communication.
  - It primarily relies on XML to provide messaging services a somewhat heavy way to structure messages.
  - This makes SOAP rigid in terms of the messaging structure and not as common and effective as JSON these days.
- **SOA architecture and REST**. REST (Representational State Transfer) is a low-bandwidth protocol that works with an array of data formats (plain text, XML, HTML, and JSON).
  - Primarily used by microservices, REST-based architectures provide speed and agility in communications.

[4]. Service-Oriented Architecture (SOA): The Modern Merits, Andre Nedelcoux, Intellias, 2025. https://intellias.com/service-oriented-architecture-soa/

Characteristics and Principles of SOA

- Many characteristics and principles define SOA and have made it so beneficial for developing *scalable, flexible, and interoperable* systems.
- Successful implementation of SOA depends upon the following guiding principles, such as:

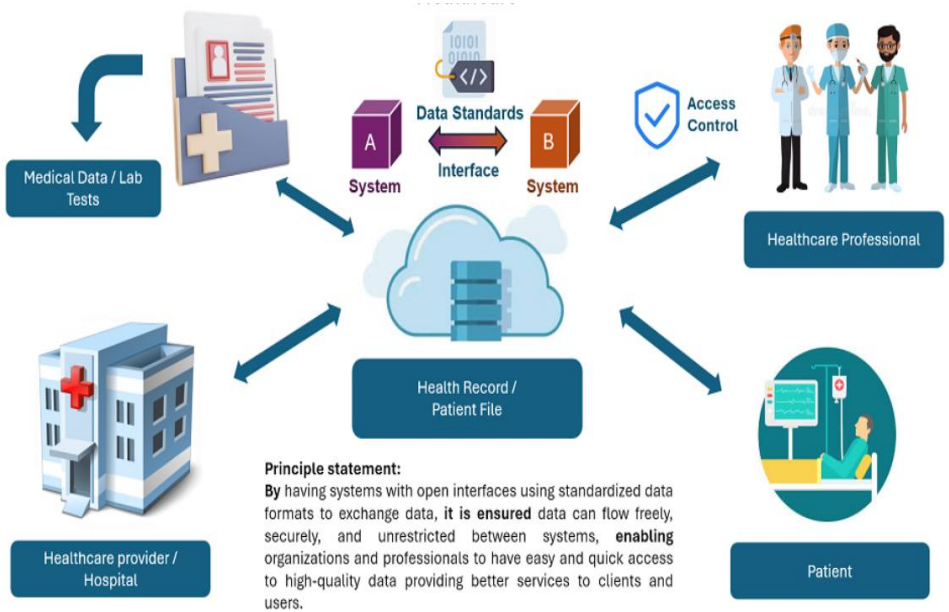


[3]. Service-Oriented Architecture Guide, Sumit Malviya, Talent500, Feb.2025. https://talent500.com/blog/service-oriented-architecture-guide/.

Cont. ...Characteristics and Principles of SOA

a) Interoperability

- Each service in SOA includes description documents that specify the functionality of the service and the related terms and conditions.
- Any client system can run a service, regardless of the underlying platform or programming language.
- For instance, business processes can use services written in both C# and Python.
- Since there are no direct interactions, changes in one service do not affect other components using the service.



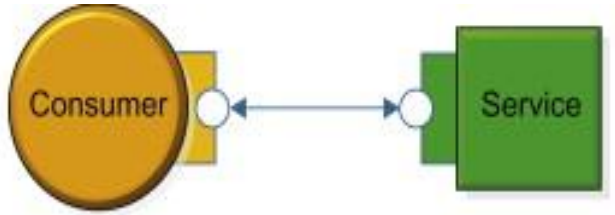
https://share.google/Q0hSN2rWZCsUXm3to

[5]. What Is SOA? – Service-Oriented Architecture Explained – AWS, Amazon Web Services. https://aws.amazon.com/what-is/service-oriented-architecture/

Cont. ...Characteristics and Principles of SOA

b)Loose coupling

- Services in SOA should be loosely coupled, having as little dependency as possible on external resources such as data models or information systems.
- They should also be stateless without retaining any information from past sessions or transactions.
- This way, if we modify a service, it won't significantly impact the client applications and other services using the service.



Tightly Coupled
(consumer interacts directly with the service)

Loosely Coupled
(consumer and service interact via messaging and the ESB)

https://share.google/BnCYogl6N1LReVqSu

[5]. What Is SOA? – Service-Oriented Architecture Explained – AWS, Amazon Web Services. https://aws.amazon.com/what-is/service-oriented-architecture/

Cont. .....Characteristics and Principles of SOA

c) Abstraction

- Clients or service users in SOA need not know the service's code logic or implementation details. To them, services should appear like a black box.
- Clients get the required information about what the service does and how to use it through service contracts and other service description documents.

d) Granularity

- Services in SOA should have an appropriate size and scope, ideally packing one discrete business function per service.
- Developers can then use multiple services to create a composite service for performing complex operations.

Advantages of SOA

- Service-oriented architecture (SOA) offers several advantages that have made it very popular in modern enterprise systems:

a) Flexibility

- SOA allows organizations to change and modify services independently without affecting the overall system.

b) Increased Scalability

- Since services are independent and may be scaled differently, SOA can support scaling business requirements quickly.

c) Cost Effectiveness

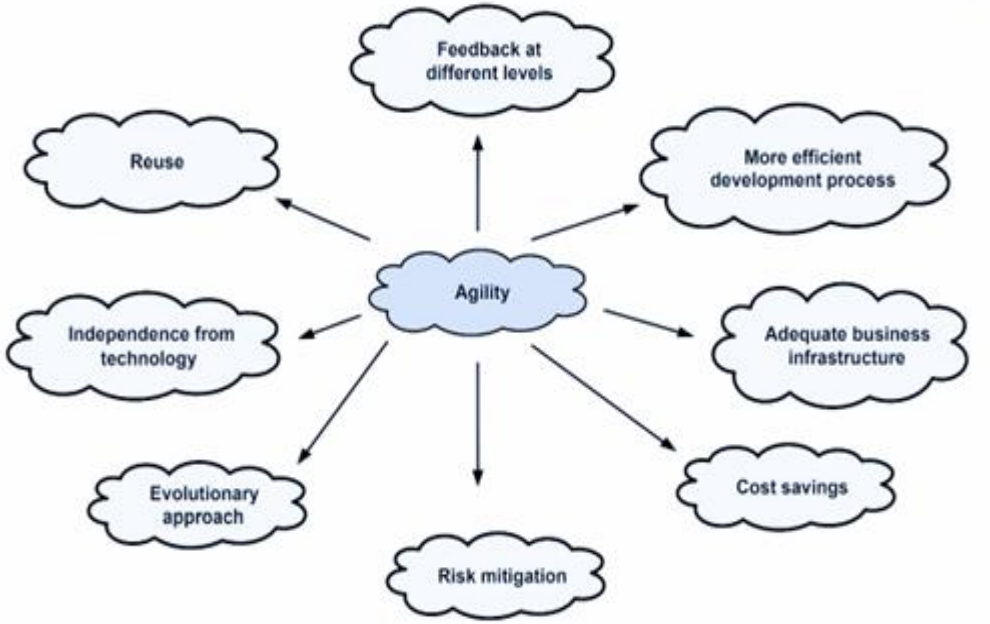
- By reusing available services within applications, the likelihood of redundancy and development costs is reduced.

[3]. Service-Oriented Architecture Guide, Sumit Malviya, Talent500, Feb.2025. https://talent500.com/blog/service-oriented-architecture-guide/.

Cont. …..Advantages of SOA

d) Agility and Velocity

- SOA proposes two distinct ideas: First, reuse makes it easy.
- With loosely coupled services, the introduction of new functionalities or service updates is done faster and more simply.



e) Better Integration

- SOA new or expanded business or opportunities by enabling the integration of various disparate systems and platforms, with minimal friction to the data flow between organizations.

[3]. Service-Oriented Architecture Guide, Sumit Malviya, Talent500, Feb.2025. https://talent500.com/blog/service-oriented-architecture-guide/.

Disadvantages of SOA

a) Complexity

- The implementation and management of an SOA are complex due to the number of services and their interactions.

b) Performance Overhead

- Communication between distributed services introduces latency and performance problems, especially in high-traffic systems.

c) Security Concerns

- With multiple services interacting over a network, security becomes a big concern, and robust measures need to be implemented to ensure data integrity and privacy.

[3]. Service-Oriented Architecture Guide, Sumit Malviya, Talent500, Feb.2025. https://talent500.com/blog/service-oriented-architecture-guide/.

Cont. ….Disadvantages of SOA

e. More Effort for Maintenance

- Because SOA is a composition of so many independent services, the task of maintaining such services and their compatibility with one another can be tough.

f. Single point of failure

- For SOA implementations with an Enterprise service Bus (ESB), the ESB creates a single point of failure.
- ESB is a centralized service, which goes against the idea of decentralization that SOA advocates.
- Clients and services cannot communicate with each other at all if the ESB goes down.

[3]. Service-Oriented Architecture Guide, Sumit Malviya, Talent500, Feb.2025. https://talent500.com/blog/service-oriented-architecture-guide/.

Real-world Applications of SOA

SOA is applied to a variety of domains for several purposes, and the best part is these services can be implemented using different technologies and support diverse protocols of communication, data models, etc. Its uses include:

Enterprise Applications

- Enterprises apply SOA to integrate numerous legacy systems with modern applications that have enhanced data flow and reduce redundancy.

Cloud Computing

- SOA forms the base in cloud environments because services are provisioned, consumed, and scaled dynamically across a distributed network and air forces to deploy situational awareness systems.

[3]. Service-Oriented Architecture Guide, Sumit Malviya, Talent500, Feb.2025. https://talent500.com/blog/service-oriented-architecture-guide/.

Cont. …Real-world Applications of SOA

E-commerce Platforms

- SOA enables seamless communication between various e-commerce modules such as inventory management, payment processing, and customer management.

Healthcare Systems

- SOA is used to interconnect heterogeneous health information systems to make patient data instantly available across healthcare institutions.

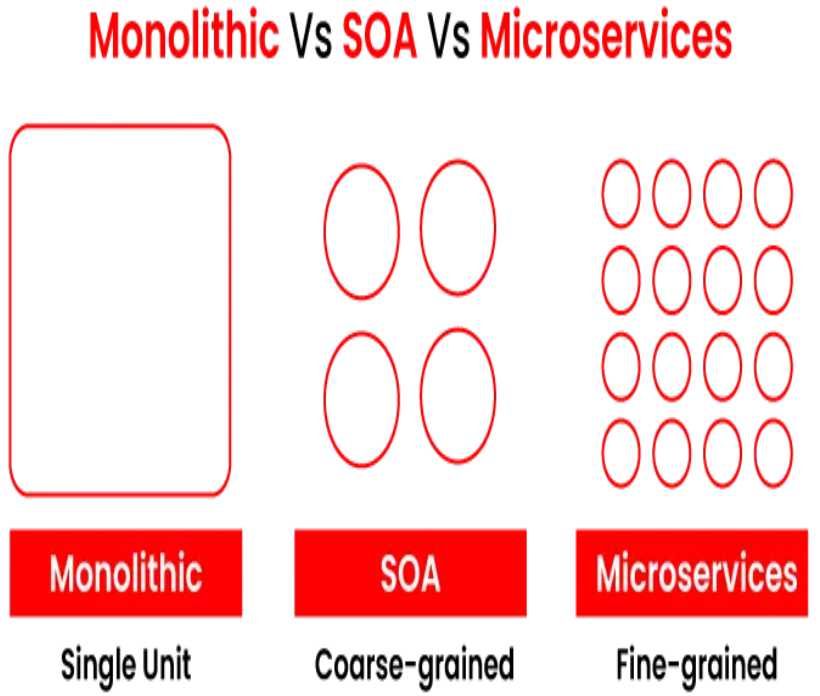
Defense Mechanism

- SOA infrastructure is used by many armies and air forces to deploy situational awareness systems.

[3]. Service-Oriented Architecture Guide, Sumit Malviya, Talent500, Feb.2025. https://talent500.com/blog/service-oriented-architecture-guide/.

SOA Vs Microservices

- Microservices architecture is an evolution of the SOA architectural style.
- Microservices address the shortcomings of SOA to make the software more compatible with modern cloud-based enterprise environments.
- They are fine grained and favor data duplication as opposed to data sharing. This makes them completely independent with their own communication protocols that are exposed through lightweight APIs.
- It's essentially the consumers' job to use the microservice through its API, thus removing the need for a centralized ESB.



https://share.google/RYuCQgthxuNVXvZ2m

[5]. What Is SOA? – Service-Oriented Architecture Explained – AWS, Amazon Web Services. https://aws.amazon.com/what-is/service-oriented-architecture/.

Cont. …..SOA Vs Microservices

- Both promote service-based design.
- Microservices emphasize bounded contexts, independent deployment, and decentralized data, often ***without*** a centralized ESB.
- Using APIs (Application Programming Interfaces), the different components of our microservices architecture pattern communicate with one another.
- Every microservice we use is focused on a single business domain/function and organizes a dedicated network for that function.

[5]. What Is SOA? – Service-Oriented Architecture Explained – AWS, Amazon Web Services. https://aws.amazon.com/what-is/service-oriented-architecture/.

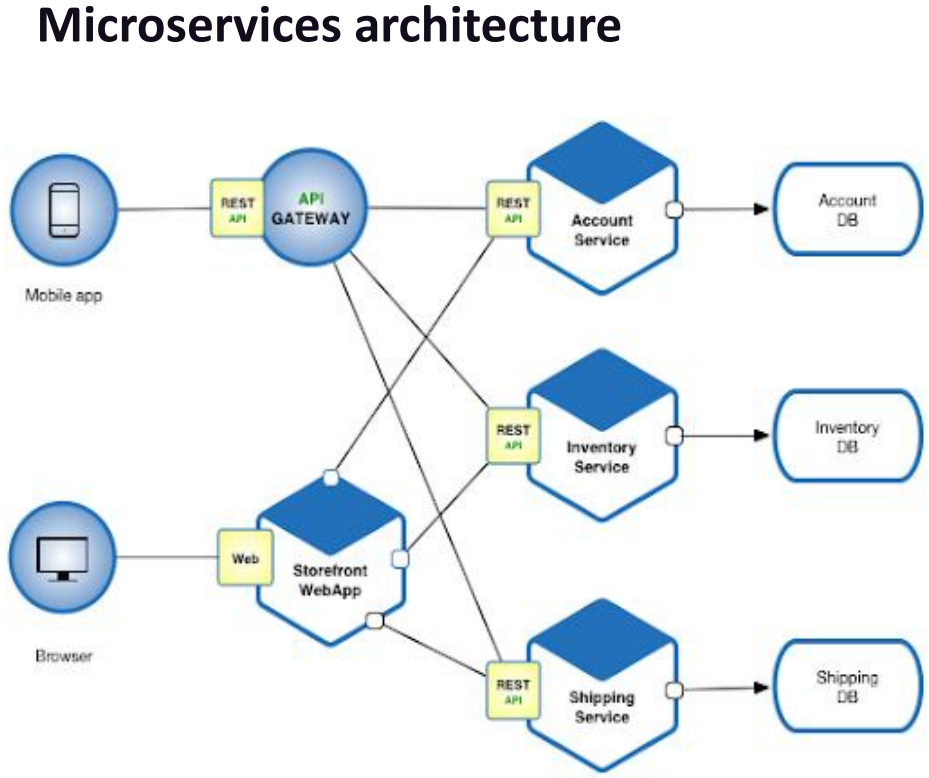
Cont. ….SOA Vs Microservices

- With microservices, we can combine components to create more complex apps and also higher-level services.
- Modernizing our legacy system with microservices architecture and middleware lets us create application systems as single-purpose units that are mostly unique from each other.
- The structure of microservices is fairly simple and straightforward.
- Any applications we use are broken down into specific functions and objectives.

[1]. Service-Oriented Architecture vs. Microservices, Ori Bar, OpenLegacy, 2025. https://www.openlegacy.com/blog/service-oriented-architecture-vs-microservices.

Cont. …SOA Vs Microservices

- As shown in the figure, an e-commerce app has been built using microservices and that there are three essential features to that app:
  - ✓Accounts/finances
  - ✓Inventory and inventory management
  - ✓Logistics and shipping
- The architecture dictates that each of those features has its own independent components. Those components have their own independent data storage.
- This is a basic principle :- every resource must be a standalone feature that can communicate with others when needed via a messaging system.



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Cont. …SOA Vs Microservices

- Difference between SOA and Microservices: At-a-glance
- They function in cloud settings and thus each can scale to fulfill the requirements of big data size and speed.

Aspect	SOA	Microservices
Service implementation	Different, course-grained services with shared resources	Independent, specialized services connected by APIs
Ease of deployment	Challenging, due to interdependence of the system	Easy, as each service can be deployed are altered independently
Scalability	Only horizontal scaling. Shared resources make scaling individual services complex	Horizontal and vertical scaling. Independent services can scale separately with ease.
Speed	Better than monolithic systems but can slow down as more services are added.	Consistent speed of performance.

[1]. Service-Oriented Architecture vs. Microservices, Ori Bar, OpenLegacy, 2025. https://www.openlegacy.com/blog/service-oriented-architecture-vs-microservices.

Cont. …SOA Vs Microservices

Which architecture to choose? SOA or Microservices ?

- SOA is better suited for large and complex business application environments that require integration with many heterogeneous applications.
- However, workflow-based applications that have a well-defined processing flow are a bit difficult to implement using SOA patterns.
- Small applications are also not a good fit for SOA as they don’t need a messaging middleware component.

[6]. Service-Oriented Architecture vs Microservices Architecture: Comparing SOA to MSA, Sudip Senguta, BMC, 2021. https://www.bmc.com/blogs/microservices-vs-soa-whats-difference/

Cont. …SOA Vs Microservices

….Which architecture to choose? SOA or Microservices ?

- The MSA pattern is well-suited for smaller and well-partitioned web-based systems.
- The lack of messaging middleware is one of the key factors that make MSA unfit for complex environments.
- **Control vs orchestration.** When developing an application from scratch, using MSA is considered a pragmatic choice as it offers greater control as a developer.
- On the other hand, if the goal is to orchestrate business processes, SOA is considered idle as it provides the right framework.

[6]. Service-Oriented Architecture vs Microservices Architecture: Comparing SOA to MSA, Sudip Senguta, BMC, 2021. https://www.bmc.com/blogs/microservices-vs-soa-whats-difference/

Cont. …SOA Vs Microservices

Which architecture to choose? SOA or Microservices?

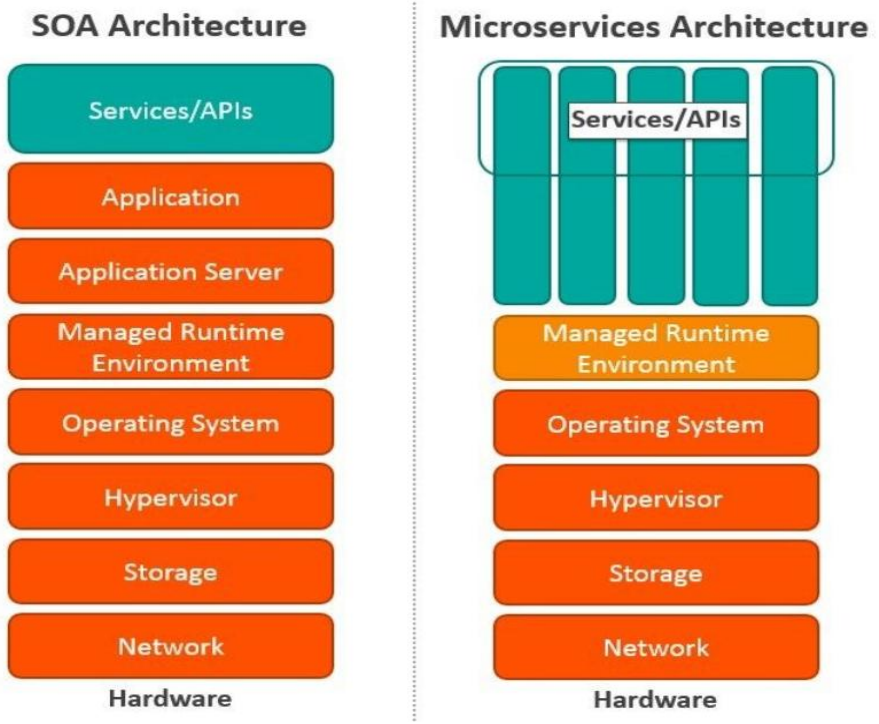
- Early-stage vs more mature organizations. Businesses that are in their early stages might find MSA as an ideal choice.
- As the business grows, organizations may require capabilities such as complex request transformation and heterogeneous systems integration. In such situations, organizations often turn to the SOA pattern to replace MSA.

[6]. Service-Oriented Architecture vs Microservices Architecture: Comparing SOA to MSA, Sudip Senguta, BMC, 2021. https://www.bmc.com/blogs/microservices-vs-soa-whats-difference/

Cont. …SOA Vs Microservices

Which architecture to choose? SOA or Microservices?

- In General, both SOA and MSA follow an identical pattern of services at different layers of an enterprise.
- The existence of MSA comes down to the success of the SOA pattern and is therefore often referred as a subset of SOA.
- While both Microservices and a Service-Oriented Architecture function entirely on breaking an application into multiple services, an MSA disaggregates services on an application level, while an SOA does so on an enterprise-level service-reusability.



[6]. Service-Oriented Architecture vs Microservices Architecture: Comparing SOA to MSA, Sudip Senguta, BMC, 2021. https://www.bmc.com/blogs/microservices-vs-soa-whats-difference/

Summary

- SOA is an architectural approach that uses reusable and loosely coupled services to build systems
- It enables communication between different platforms using standard protocols
- ESB acts as a middleware to integrate and manage communication between services
- SOA follows principles like interoperability, abstraction, and loose coupling
- It offers benefits such as flexibility, scalability, and better system integration. However, SOA has challenges like complexity, performance overhead, and security issues
- SOA differs from microservices in scale, structure, and communication style
- As organizations continue to evolve their software stacks, SOA software and SOA integration remain essential tools for connecting legacy systems, enhancing agility, and enabling digital transformation.

References

1. Service-Oriented Architecture vs. Microservices, Ori Bar, OpenLegacy, 2025. https://www.openlegacy.com/blog/service-oriented-architecture-vs-microservices.
2. How to Choose the Best Enterprise Integration Platform, Paul Nilsen, CET Digital, April 2018. https://www.cetdigit.com/blog/how-to-choose-the-best-enterprise-integration-platform.
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6. Service-Oriented Architecture vs Microservices Architecture: Comparing SOA to MSA, Sudip Senguta, BMC, 2021, https://www.bmc.com/blogs/microservices-vs-soa-whats-difference/.


Thank you!