Application integration with SOA and ROA

PV207 – Business Process Management

Spring 2021

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Last lecture recap

- Processes
  - **What is business process?**

Last lecture recap

- Processes
  - What is business process?
  - **What is BPM?**

Business Process Management

Is a **Management discipline**, focused on systematic **definition** and **execution measurement of processes** in organizations

- **An effort to describe processes** in organisation measure results and **manage process changes** towards higher efficiency

- **"Evolution not Revolution"**

Last lecture recap

- Processes
  - What is business process?
  - What is BPM?
  - **What is BPM adoption?**

Last lecture recap

- Processes
  - What is business process?
  - What is BPM?
  - What is BPM adoption?
  - Why BPM ?
  - Roles in BPM
  - Process life-cycle
  - Phases of process based development
- BPMS
  - BPMS components
  - Architecture
  - Human Tasks
  - Business Rules
  - BAM
  - Existing BPMS

Lecture summary

- Generations of EAI
- Motivation for SOA
- Role BPM in IT management
- Core BPM architecture
- BPM – SOA relationship
- Microservices
- Web Services
  - What are WS?
  - Artifacts WS
    - WSDL
    - SOAP
  - WS - standards
- WS in Java
- REST

3 meanings of the word "service"

- ....

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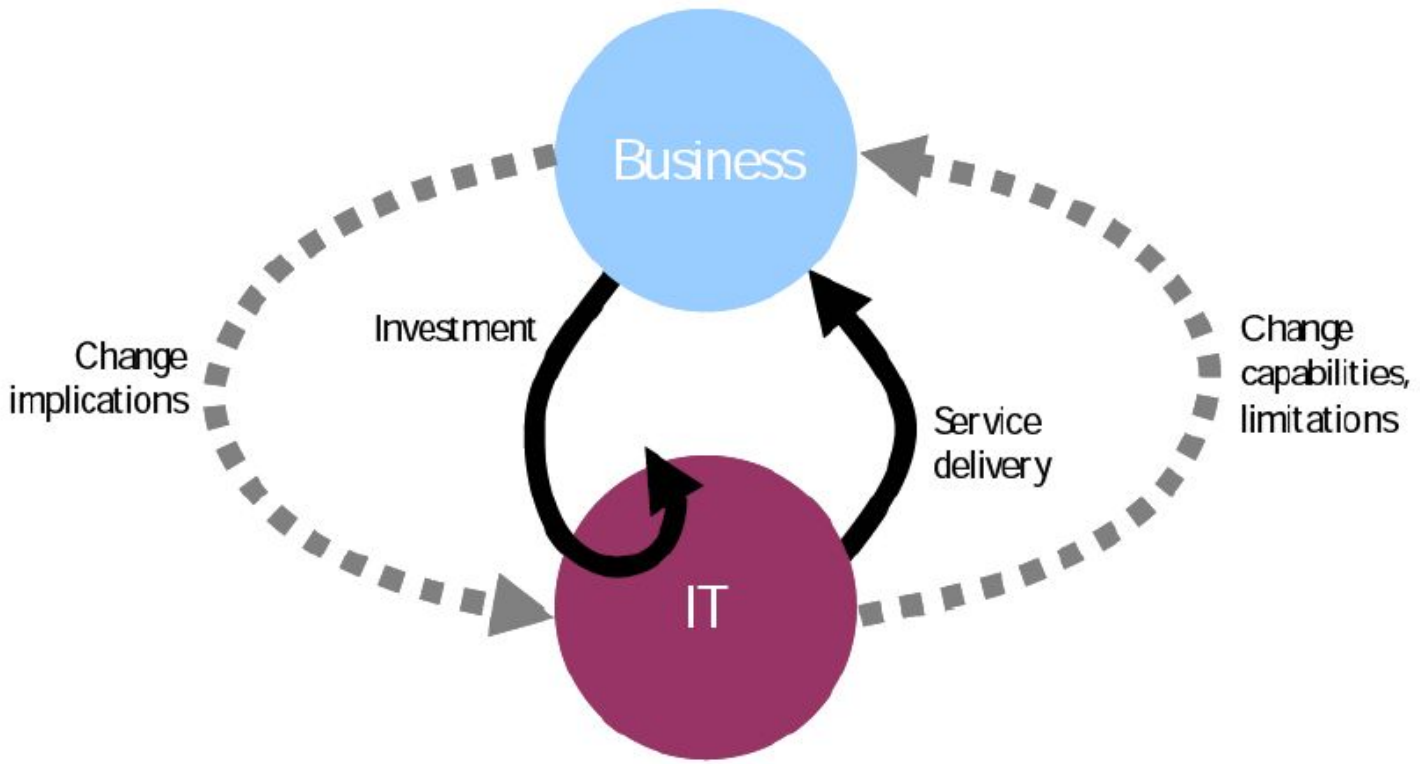
- "Technical" service
  - Google provides a search for addresses of restaurants in neighbourhood
  - Defined by a User Interface / Programming interface
- Web Service
  - Google provides Web Service API for retrieving GPS coordinates of particular address
  - Defined by a WSDL/REST methods definition
  - Request - response model

Business & IT alignment

Figure 1: The elements of IT-business alignment



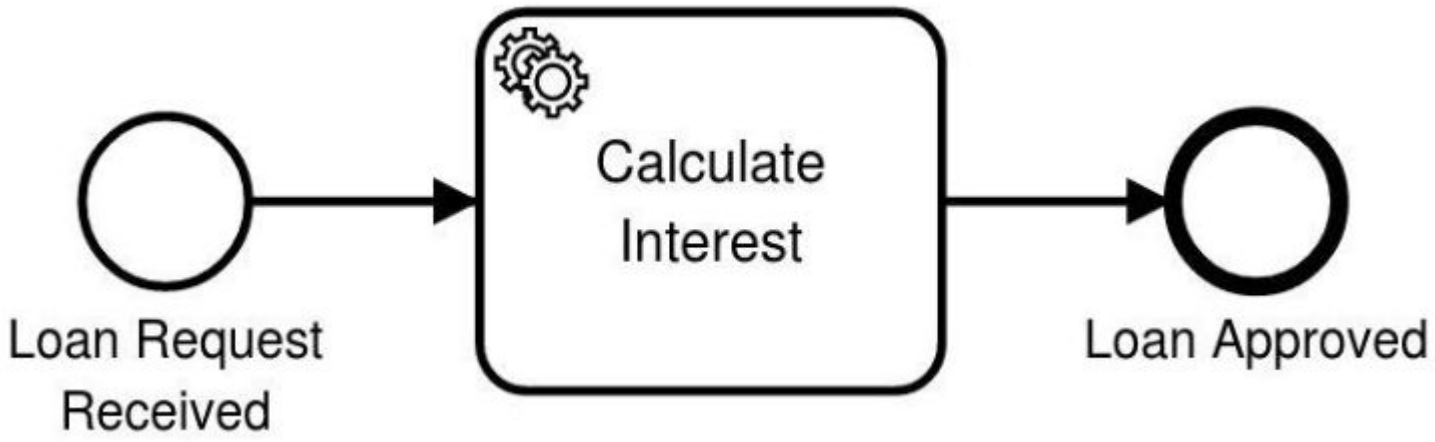
There are three important elements in IT-business alignment: investment, service delivery, and collaboration in change management.

Macehiter Ward-Dutton

Enterprise Application Integration

Why application integration?

- Allow different applications to share data and processes states.
- In BPMS systems we use the Service Task to directly invoke some functionality.



Services Examples (IT/Web)

- ....

Services Examples (IT/Web)

- createUserProfile
- setUserStatus
- searchFlights
- returnAccountBallance
- ….

EAI Generations – spaghetti

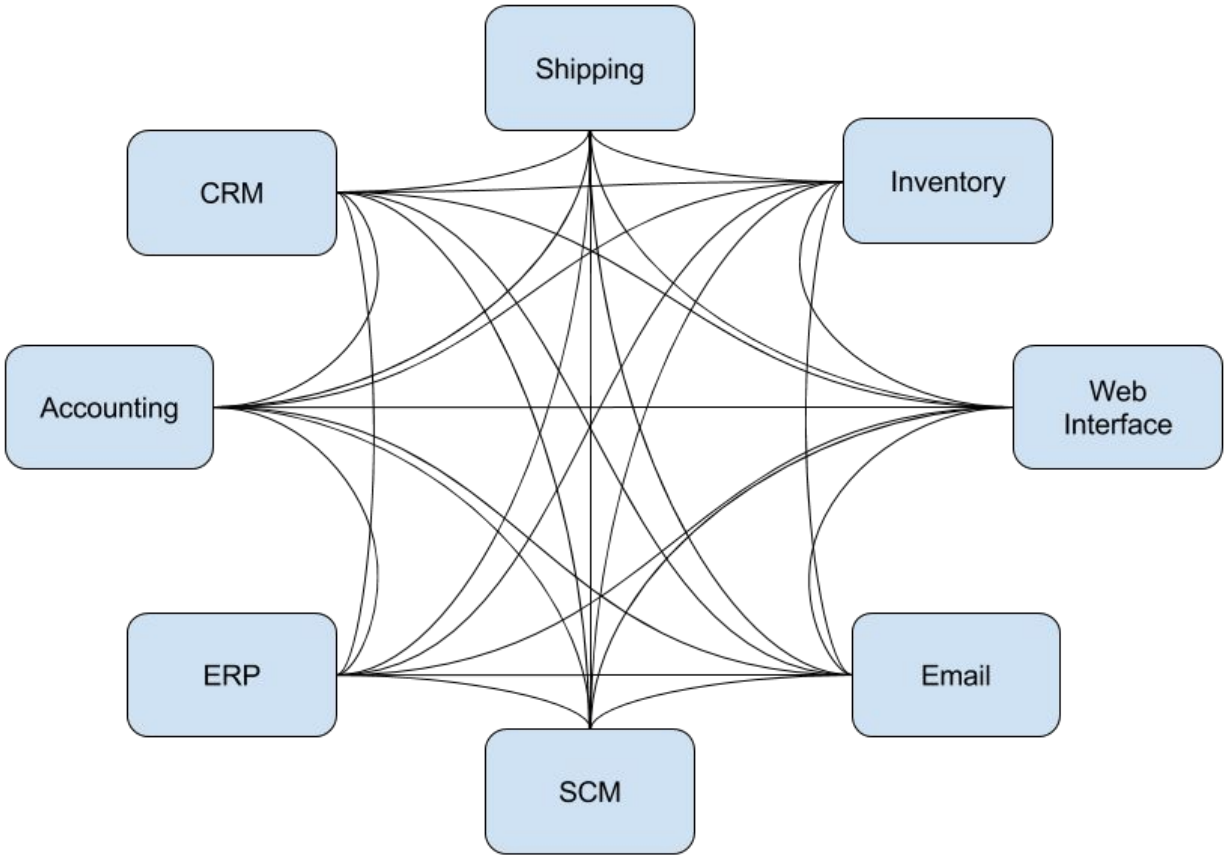


Figure 2: Spaghetti Integration

Different communication protocols and principles:

- File exchange
- DB access
- MQ messaging
- CORBA
- Web Services
- Proprietary connectors

https://dzone.com/articles/building-integration-solutions-a-rethink

EAI Generations – SOA

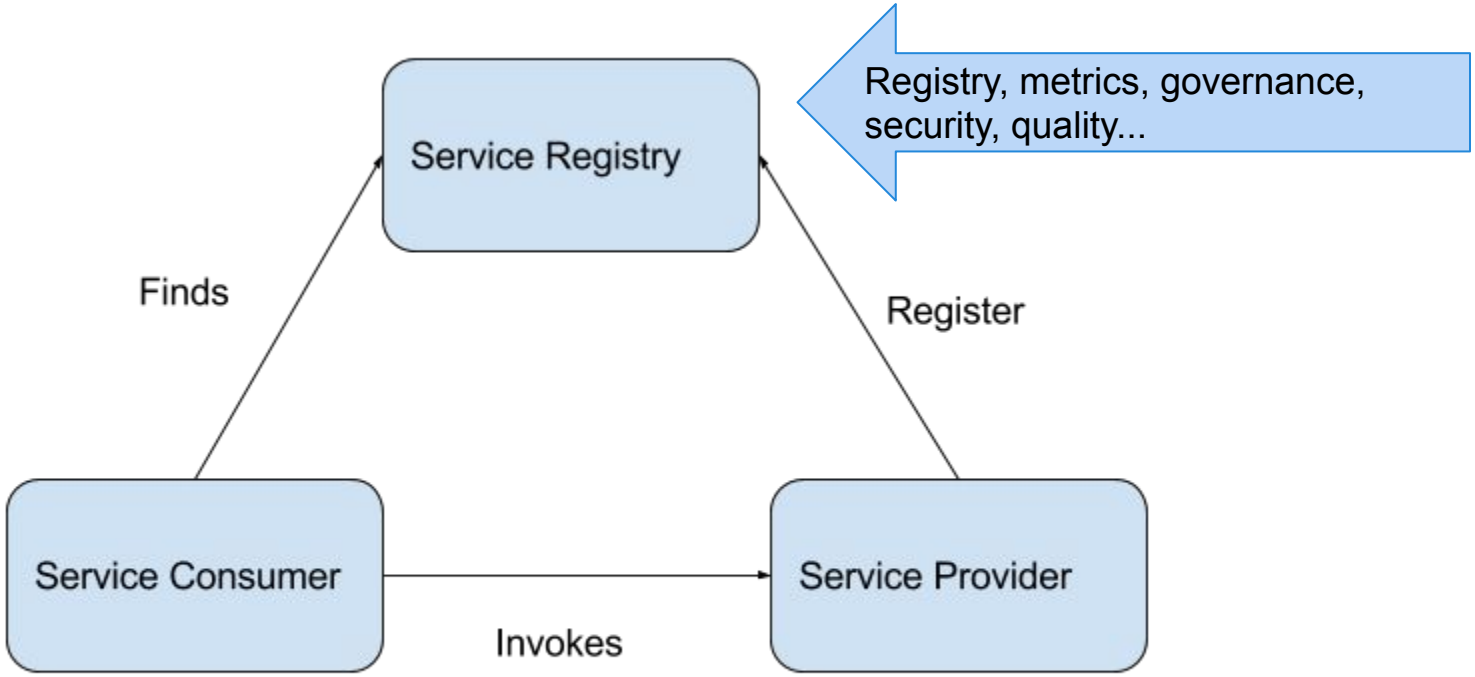


Figure 1: Service Oriented Architecture

https://dzone.com/articles/building-integration-solutions-a-rethink

EAI Generations – SOA and ESB

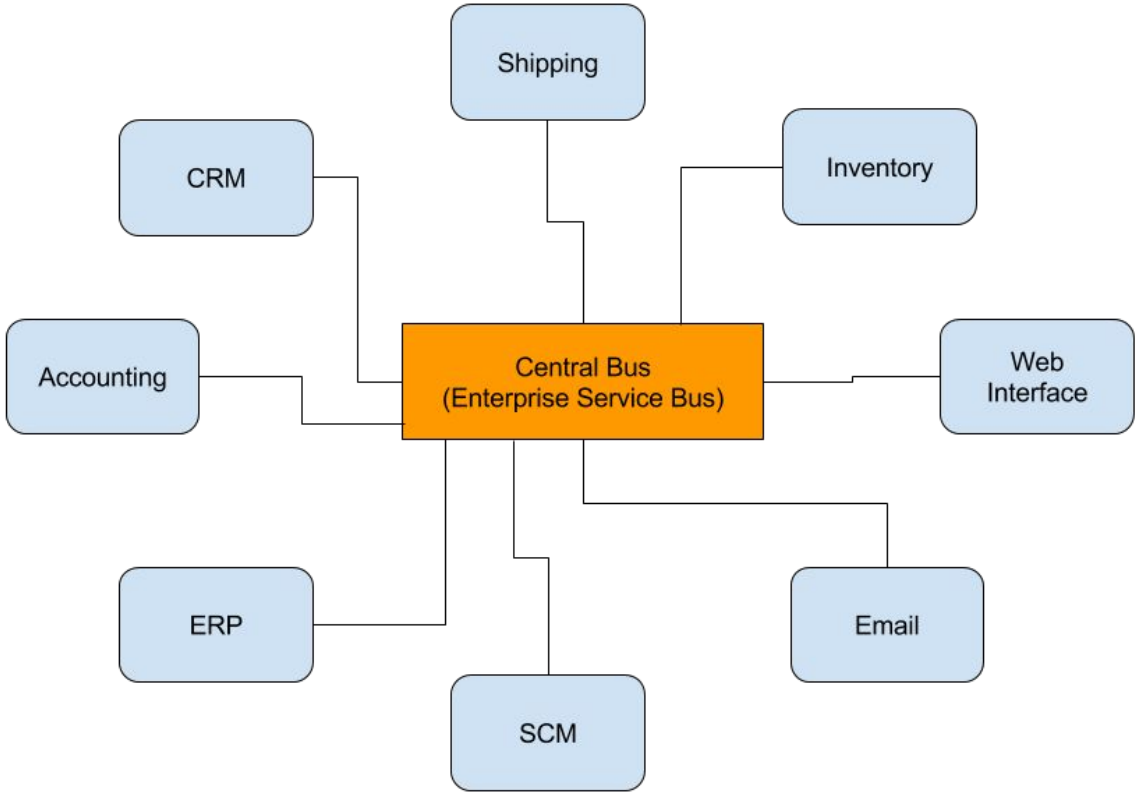


Figure 3: Bus Integration

https://dzone.com/articles/building-integration-solutions-a-rethink

Business & IT alignment

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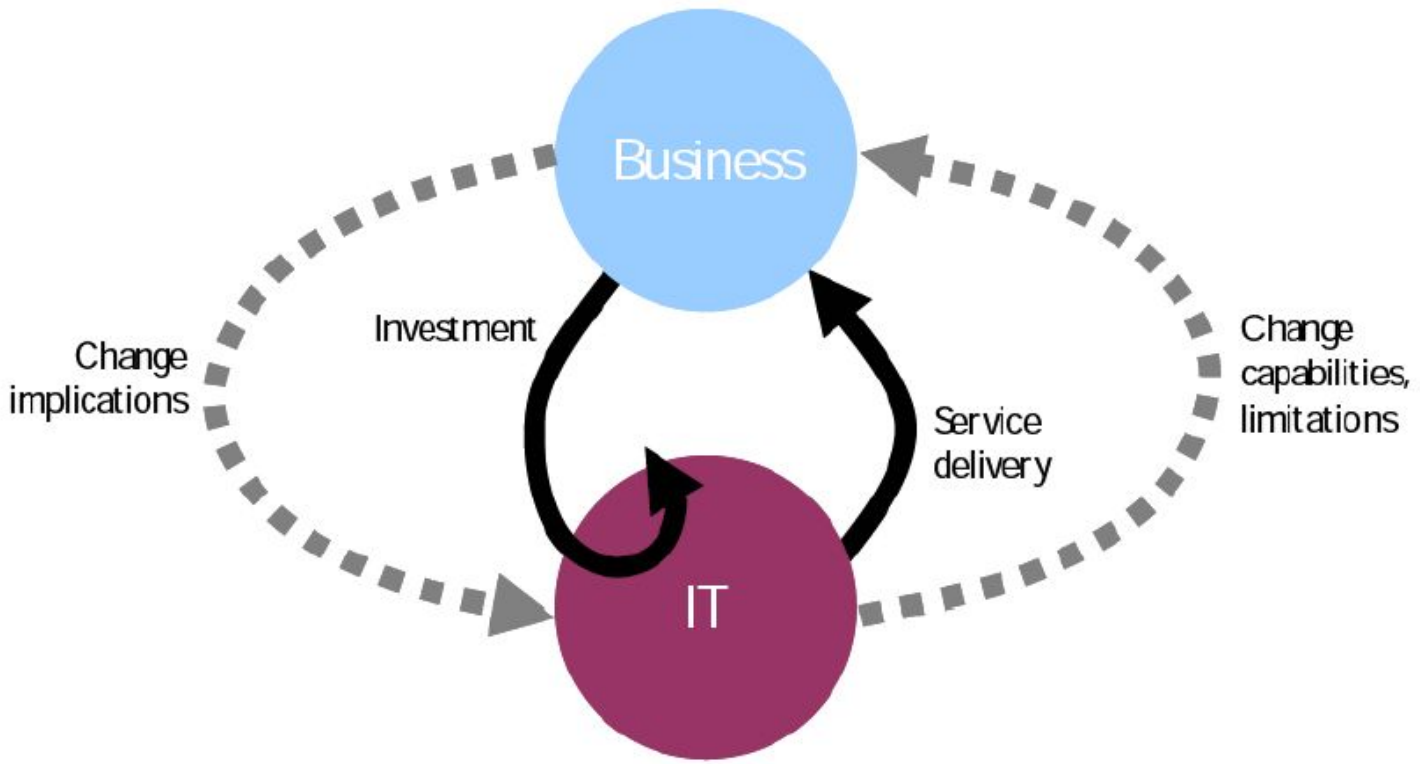


There are three important elements in IT-business alignment: investment, service delivery, and collaboration in change management.

Macehiter Ward-Dutton

SOA motivation

- **Reduction of costs** on development and integration
- Efficient **maintenance and integration** across various systems
- Component/service **reusability**
- Integration of **Legacy applications**
- Efficient **management and monitoring**
- **Just-in-time management** (real time business)

SOA definition

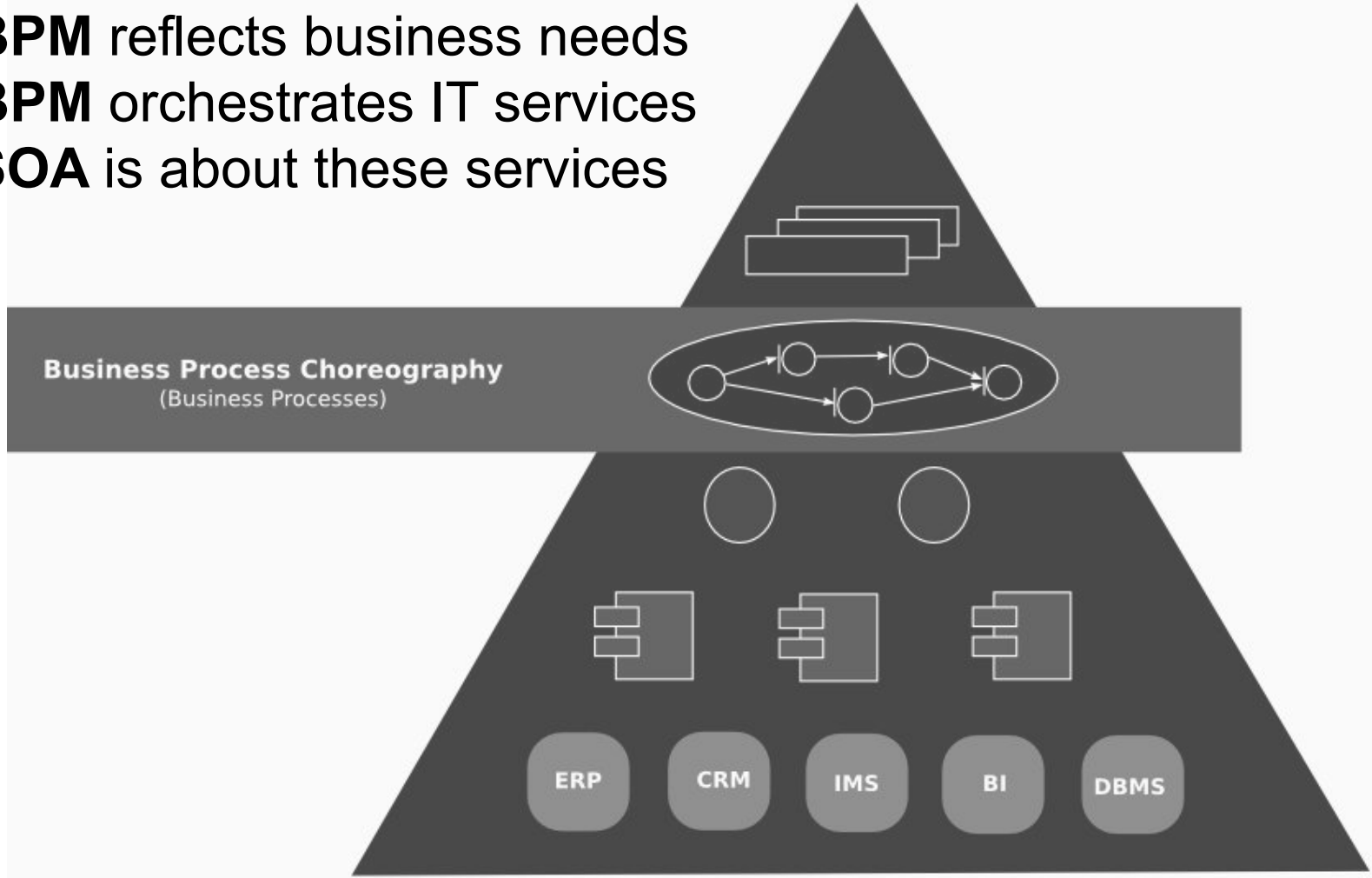
Service-Oriented Architecture *(SOA)* is an *architectural style* that supports *service-orientation*.

Service-orientation is a way of thinking in terms of services and service-based development and the outcomes of services.

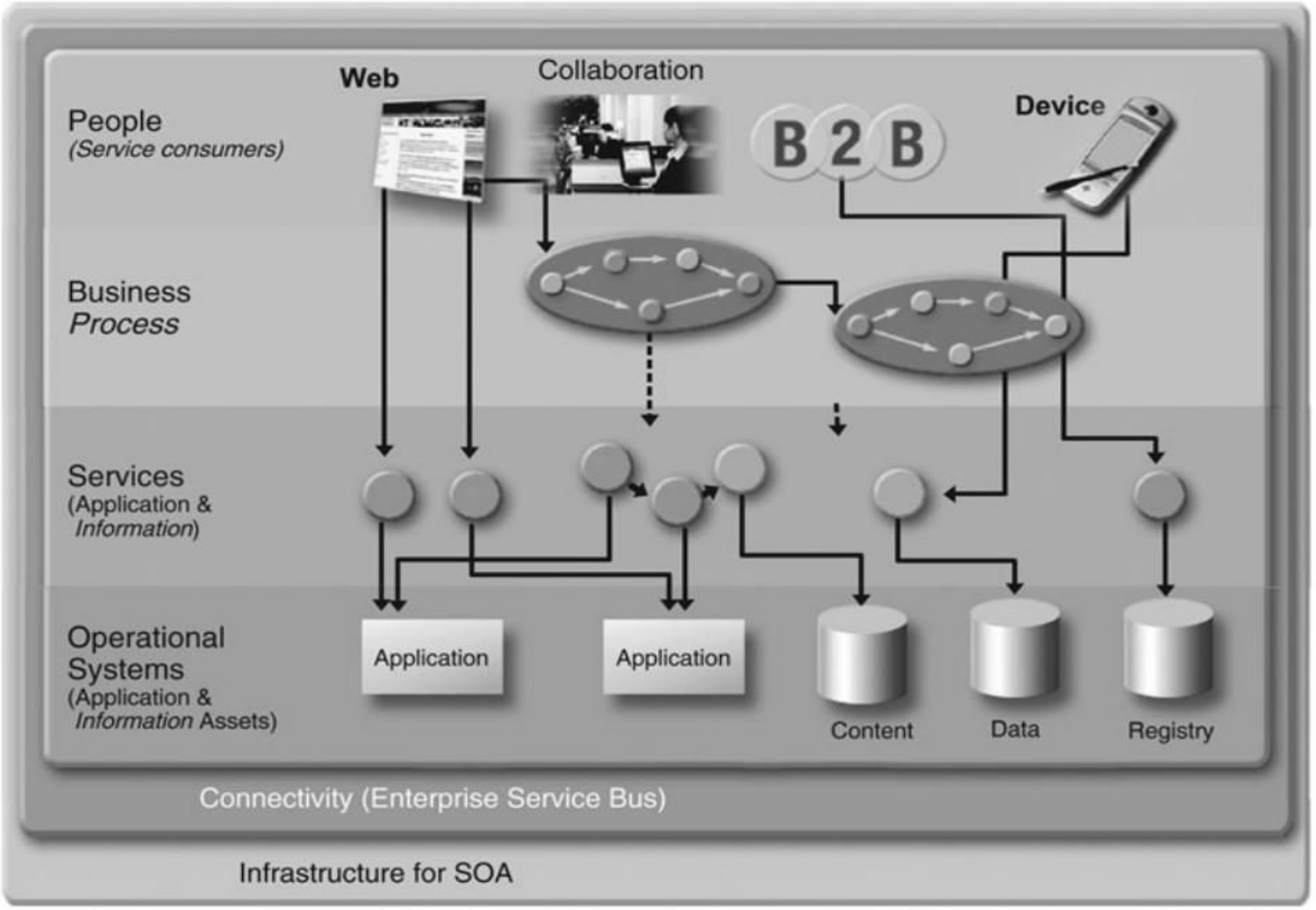
-- The Open Group

How is BPM and SOA related?

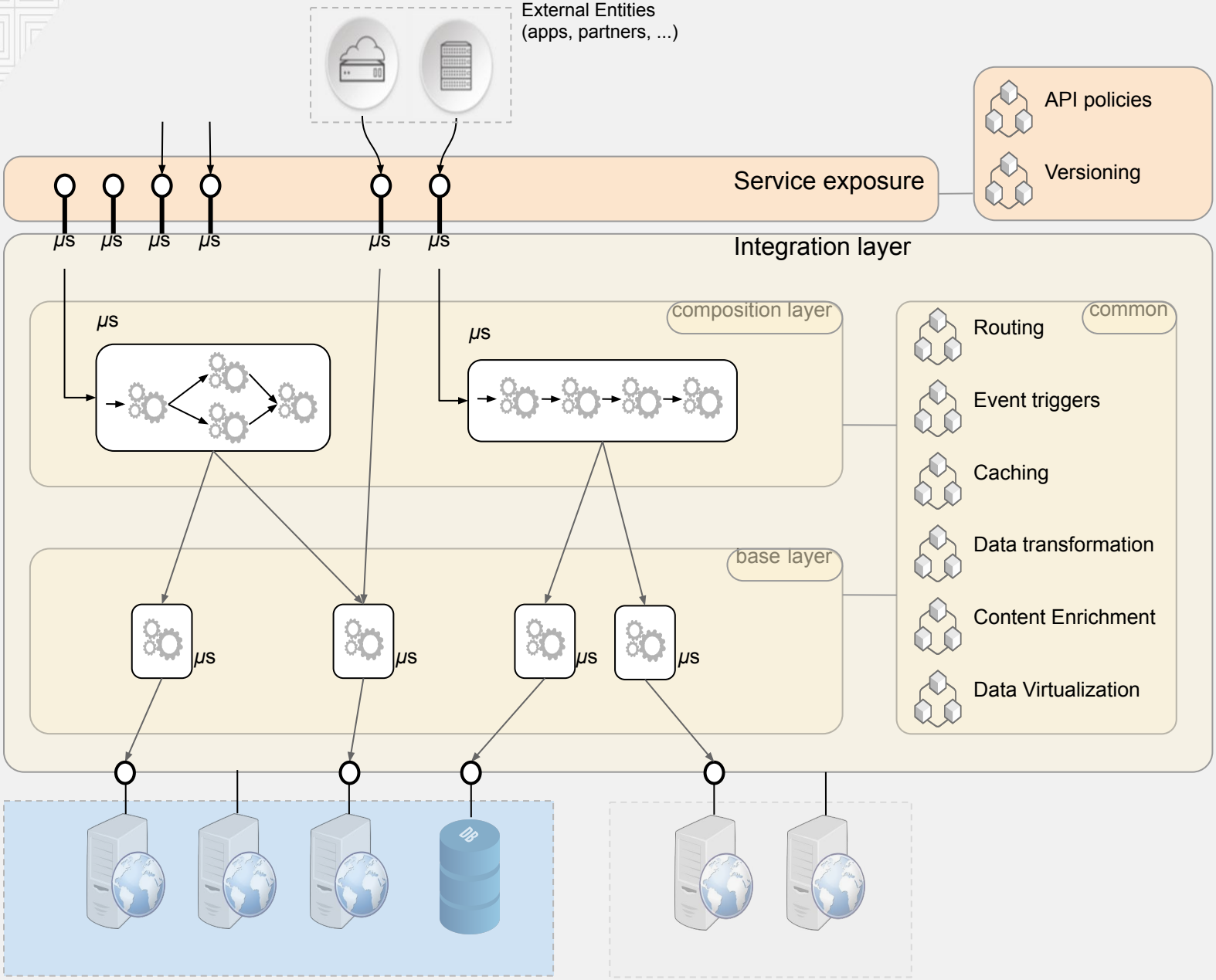
- BPM stands between IT and business
  - **BPM** reflects business needs
  - **BPM** orchestrates IT services
  - **SOA** is about these services



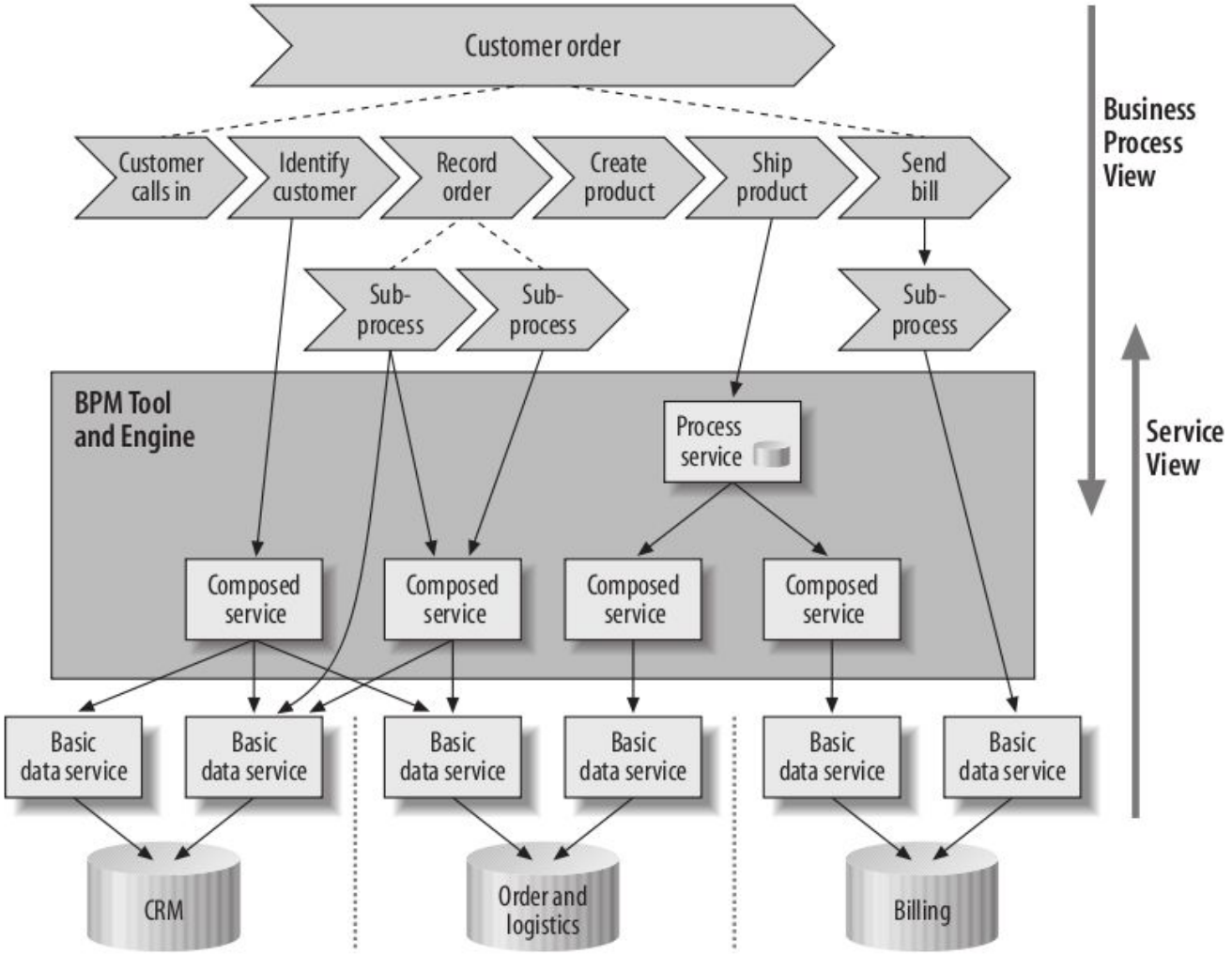
SOA Architecture



Source: SOA Community of Practice, SOA Solution Stack Project

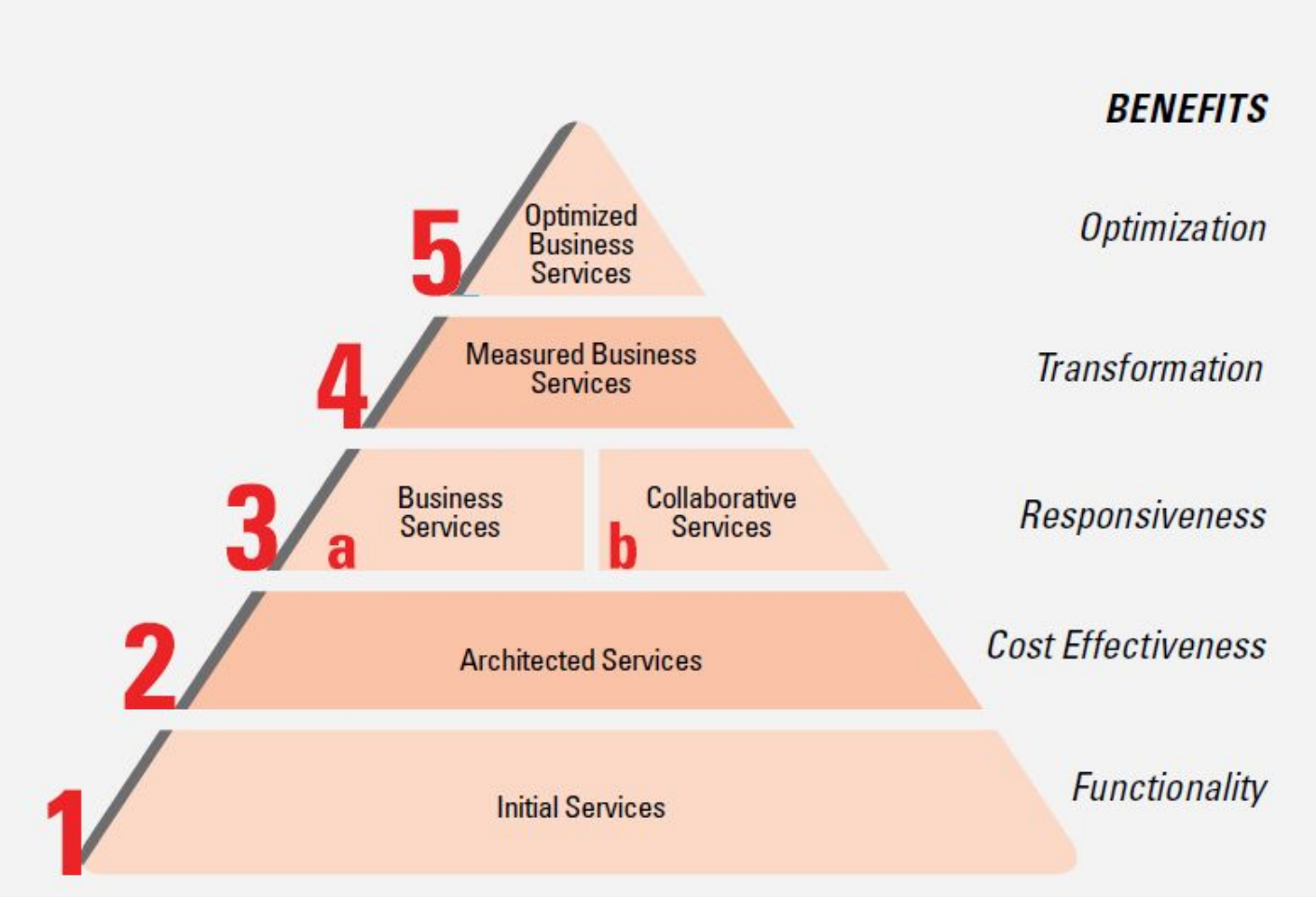

External Entities
(apps, partners, ...)
API policies
Versioning
Service exposure
μs
Integration layer
composition layer
common
Routing
Event triggers
Caching
Data transformation
Content Enrichment
Data Virtualization
base layer
DB
Internal Services/Data-Sources
External Services (e.g Partners)

BPM and SOA Relationship



SOA in Practice, , Nicolai M. Josuttis

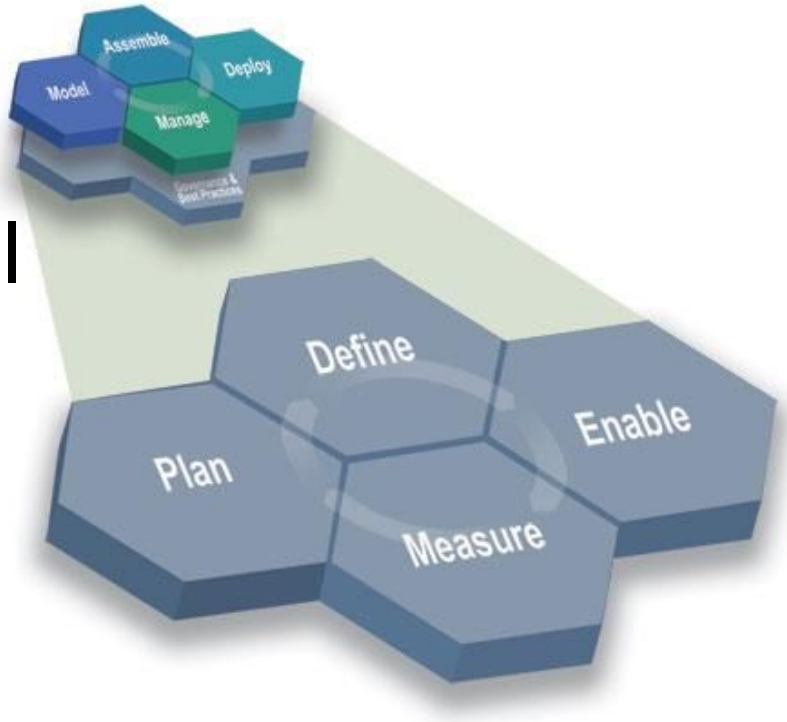
SOA – Maturity Model



Sonic Software Corporation, AmberPoint Inc., 2005

SOA Governance

- Service definition
- Service deployment life cycle
- Service versioning
- Service migration
- Service registries
- Service message model
- Service monitoring
- Service ownership
- Service testing
- Service security



SOA – Methodologies

- SOA methodologies
  - IBM SOAD (Proprietary)
  - IBM SOMA (Proprietary)
  - SOA RQ (Proprietary)
  - CBDI-SAE
  - SOAF
- SOMA
  - Service-oriented modeling and architecture

--Ali Arsanjani, Chief Architect,
SOA and Web services Center of Excellence,
IBM, Software Group

EAI Generations – MSA / ROA

MSA – Microservices Architecture

Breaking *monolithic* application structure into set of *discrete* services (IT/web).

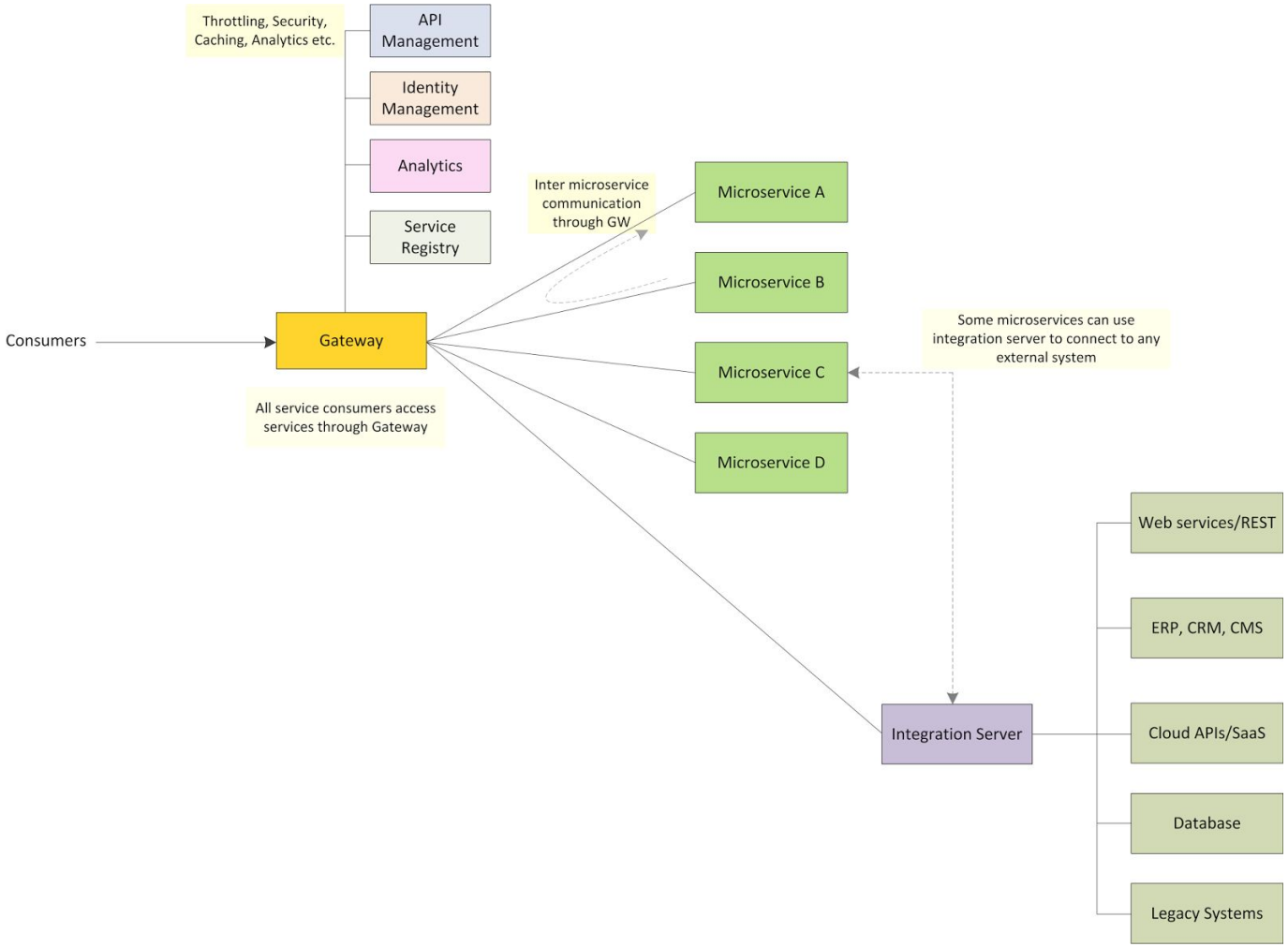
- https://martinfowler.com/articles/microservices.html

ROA – Resource oriented Architecture

(Inter-)networking application resources accessible through *RESTful* webservices.

- https://www.oreilly.com/library/view/restful-web-services/9780596529260/ch04.html

EAI Generations – MSA / ROA + SOA



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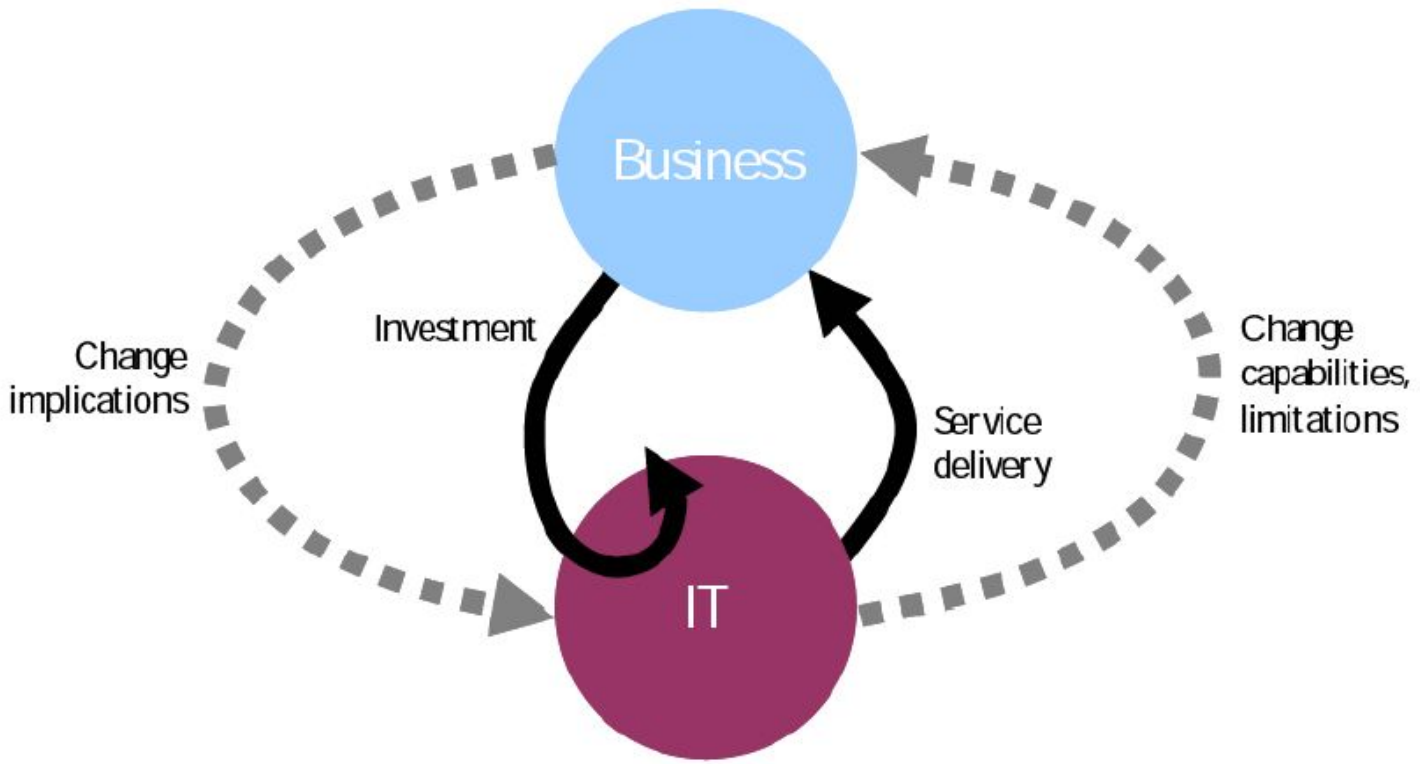

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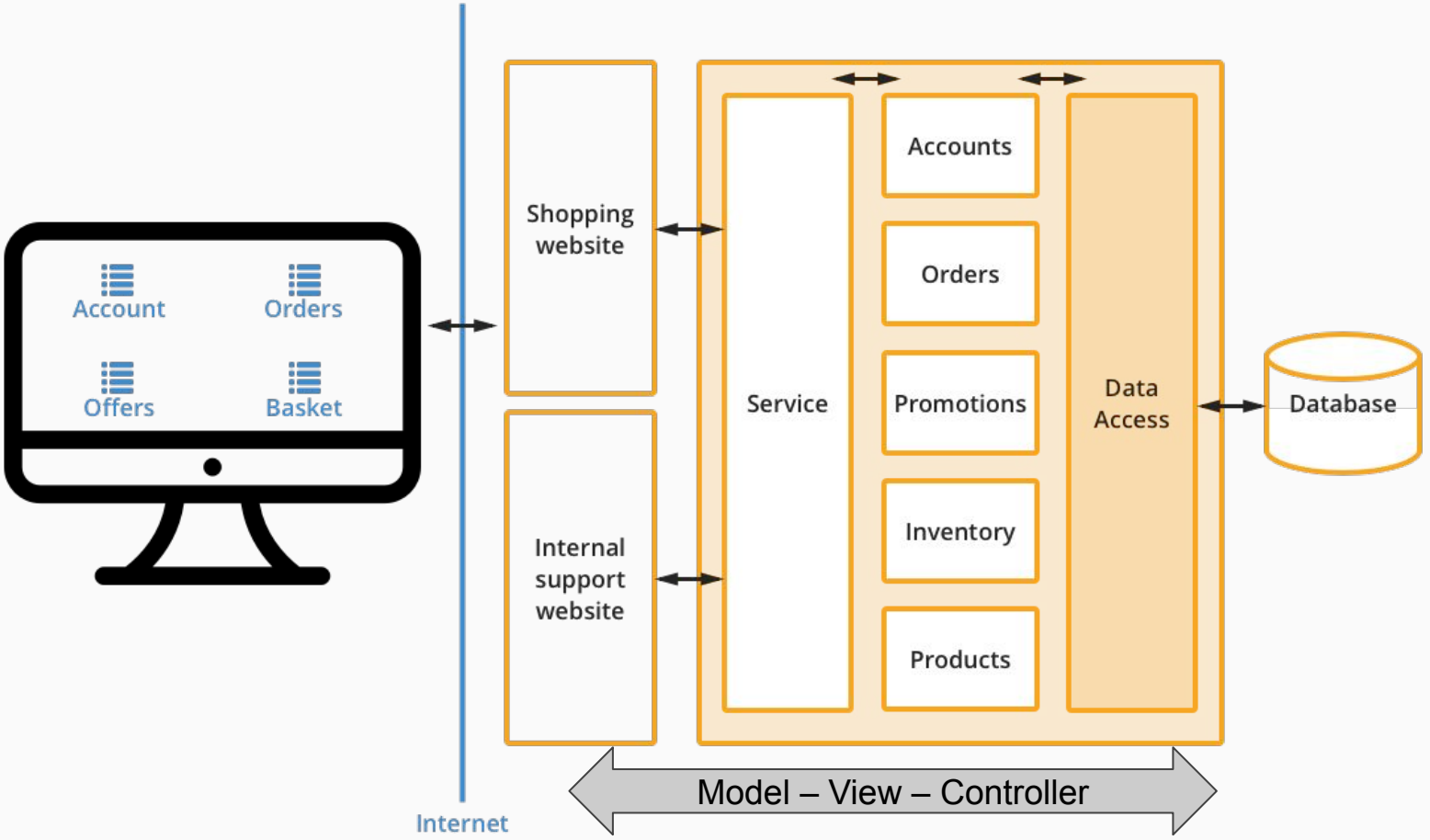
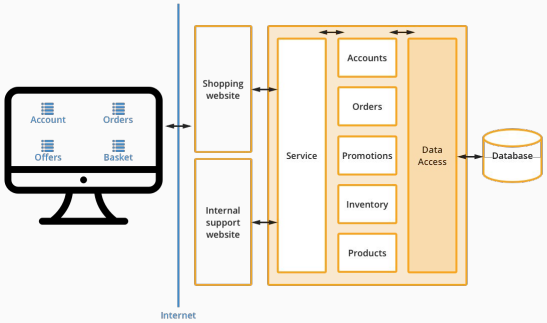
Monolith


Account
Orders
Offers
Basket
Internet
Shopping website
Internal support website
Service
Accounts
Orders
Promotions
Inventory
Products
Data Access
Database
Model – View – Controller

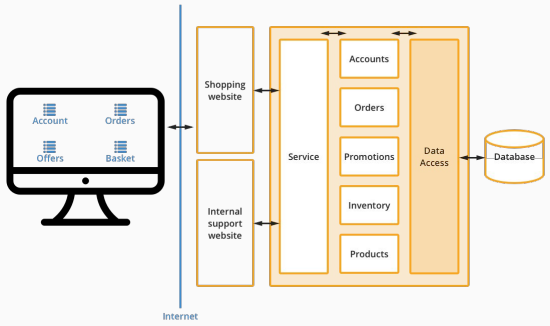
Pros of monolithic architecture



Pros

- natural evolution of system without restriction
- everything is accessible from one place
- does not push to automate infrastructure, deployment and testing

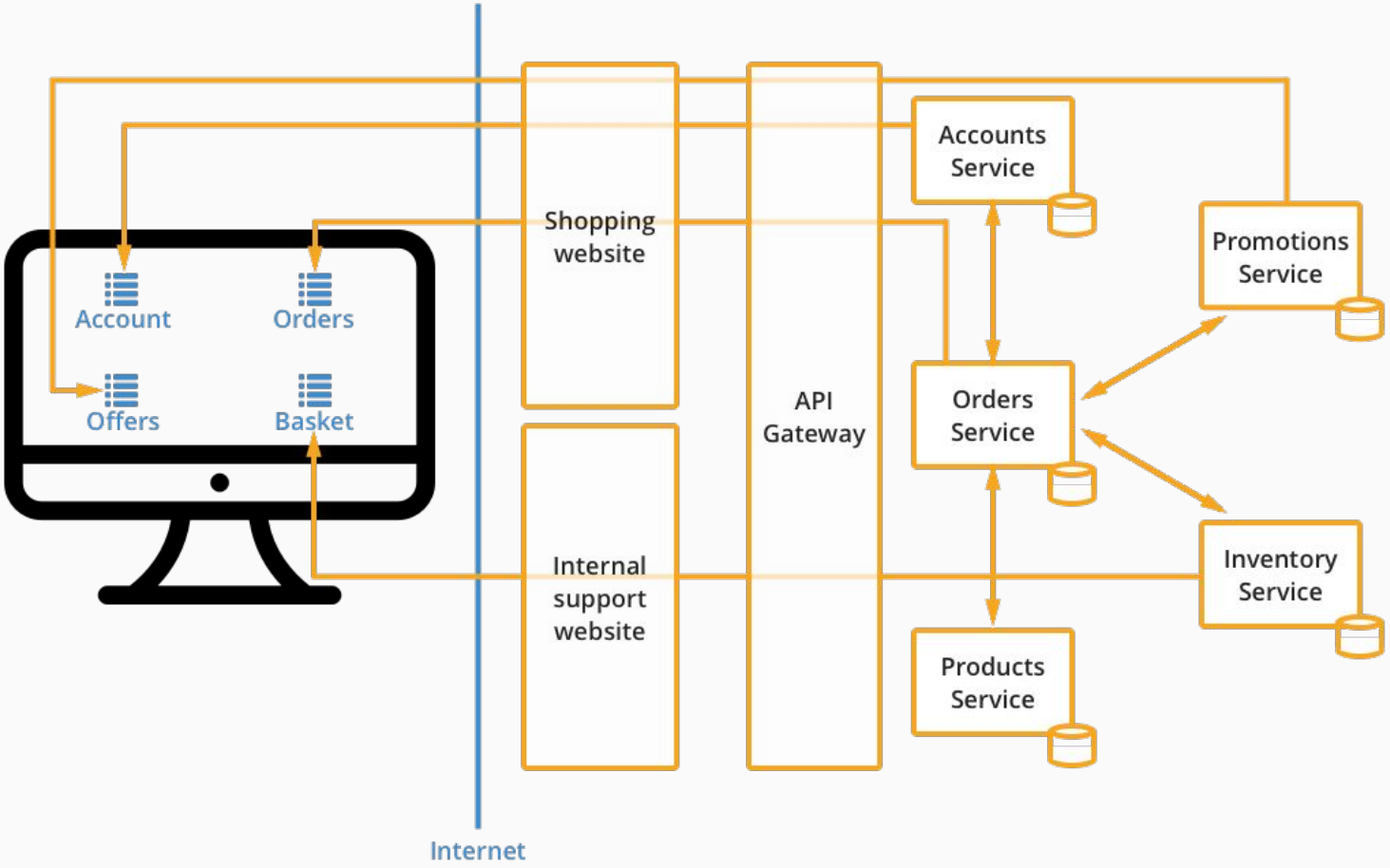
Cons of monolithic architecture



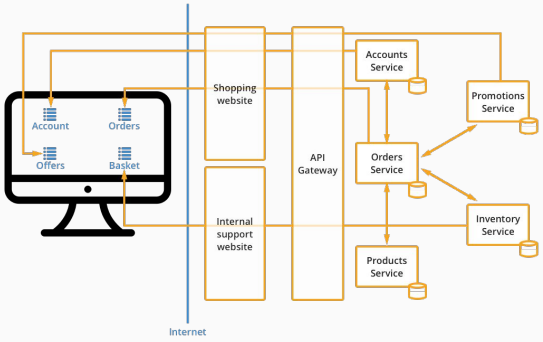
Cons

- large codebase
- deploy takes too long
- one fix means deploy the whole system and test everything
- hard to scale just single part of the system
- one failure usually equals downtime of the whole system
- team has to understand everything

Microservices



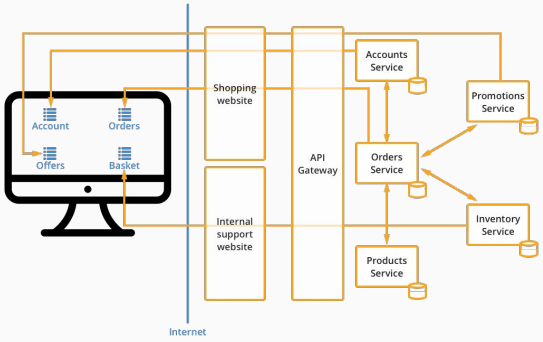
Pros of microservice architecture



Pros

- deploy of single service is easy
- scaling a service is possible
- one team is responsible for single service
- service can be created or changed in short amount of time
- slowdown or downtime of a service does not block the whole system
- services can be aligned to support new business needs in short amount of time
- APIs have to be defined

Cons of microservice architecture



Cons

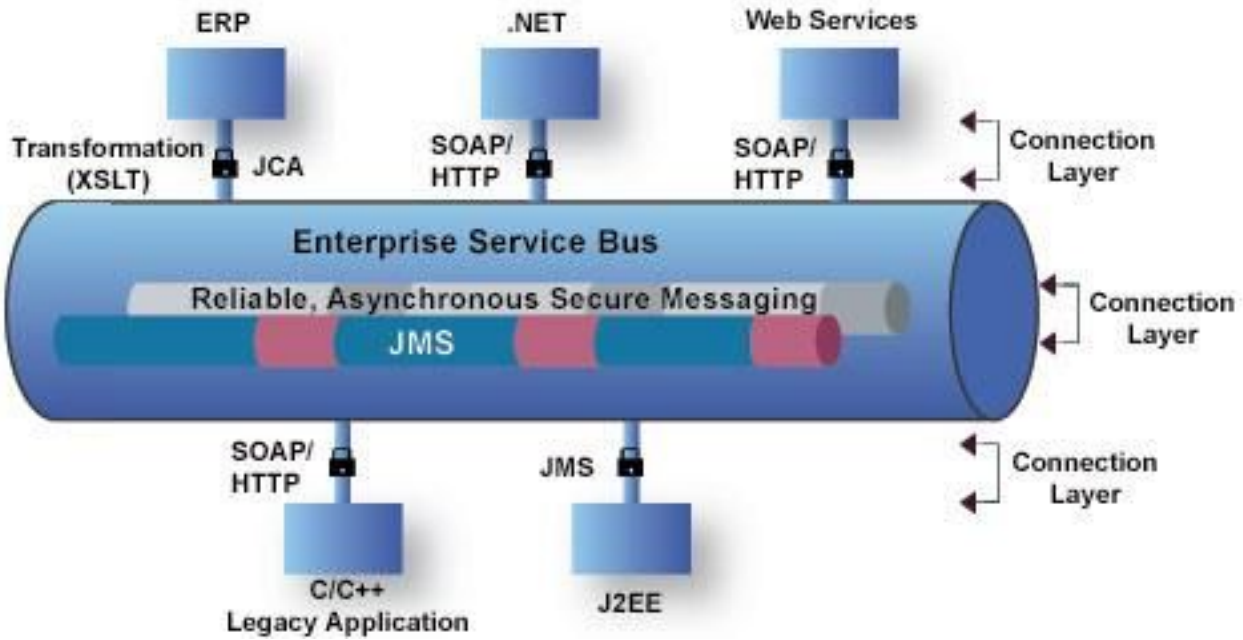
- deployment and versioning is complex
- more automation and DevOps knowledge is needed
- Architecture, technology and performance overhead
- team does not have to know other parts of the whole system, only their services and related APIs
- no one know how the whole system works if business processes are not documented/automated
- tooling for API design and management are often necessary

Questions?

Break 10mins

SOA in practice: ESB – Enterprise Service Bus

- Message routing
- Protocol conversion
- Security, reliability



http://wso2.com/products/enterprise-service-bus/

3 meanings of word "service"

- "Business" service
  - Restaurant owner can register his restaurant to Google database and be shown in Google Maps
  - Defined by contract / service offering
- "Technical" service
  - Users can search for their favourite restaurant in Google Maps
  - User interface for "Human task"
- **Web Service**
  - Google provide Web Service API for retrieving location of certain address
  - WSDL interface definition
  - Request - response model

Web Service

- Service for message transport and remote procedure calls
- Messages are transported in XML format
- Transport protocol is HTTP/HTTPS (mostly)
- Web service define:
  - Operations (method) a and their parameters
  - Return types

WSDL

WSDL (Web Service Description Language)

- Describes basic interface of the service
- Methods
- Parameters and their types
- Return values
- Specify **where** is WS available
  - Protocol (HTTP/HTTPS/SMTP)
  - Port (:1666)
  - machine (kore.muni.cz)
  - URL (http://kore.muni.cz:1666/My Service)

WSDL example

```
<?xml version="1.0" encoding="UTF-8"?>
<definitions name="PrvniSluzba"
 targetNamespace="urn:mojeURI"
 xmlns:tns="urn:mojeURI"

xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/
"

xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/
"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xmlns:xsd="http://www.w3.org/2001/XMLSchema"
 xmlns:ns1="urn:mojeURI"
 xmlns:SOAP="http://schemas.xmlsoap.org/wsdl/soap/"
 xmlns:WSDL="http://schemas.xmlsoap.org/wsdl/"
 xmlns="http://schemas.xmlsoap.org/wsdl/">

<!-- definice typů -->
<types>
 <schema targetNamespace="urn:mojeURI"
     xmlns:xsd="http://www.w3.org/2001/XMLSchema"
     xmlns="http://www.w3.org/2001/XMLSchema"
     elementFormDefault="unqualified"
     attributeFormDefault="unqualified">
  <element name="cislo" type="xsd:long"/>
  <element name="vysledek" type="xsd:boolean"/>
 </schema>
</types>

<!-- komunikační zprávy -->
<message name="jePrvocisloRequest">
 <part name="cislo" element="ns1:cislo"/>
</message>
<message name="jePrvocisloResponse">
 <part name="vysledek" element="ns1:vysledek"/>
</message>

<!-- dostupné operace -->
<portType name="Cisilka">
 <operation name="jePrvocislo">
   <documentation>Operace jePrvocislo()</documentation>
   <input message="tns:jePrvocisloRequest"/>
   <output message="tns:jePrvocisloResponse"/>
 </operation>
</portType>

<!-- volatelné přes HTTP -->
<binding name="PrvniSluzba" type="tns:Cisilka">
 <SOAP:binding style="rpc"
transport="http://schemas.xmlsoap.org/soap/http"/>
 <operation name="jePrvocislo">
  <SOAP:operation style="rpc" soapAction=""/>
  <input>
   <SOAP:body use="literal" namespace="urn:mojeURI"/>
  </input>
  <output>
   <SOAP:body use="literal" namespace="urn:mojeURI"/>
  </output>
 </operation>
</binding>

<!-- adresy komunikačních bodů -->
<service name="PrvniSluzba">
 <documentation>Sluzba pocitajici
prvocisla</documentation>
   <port name="PrvniSluzba" binding="tns:PrvniSluzba">
    <SOAP:address location="http://localhost:10000"/>
   </port>
</service>
</definitions>
```

SOAP

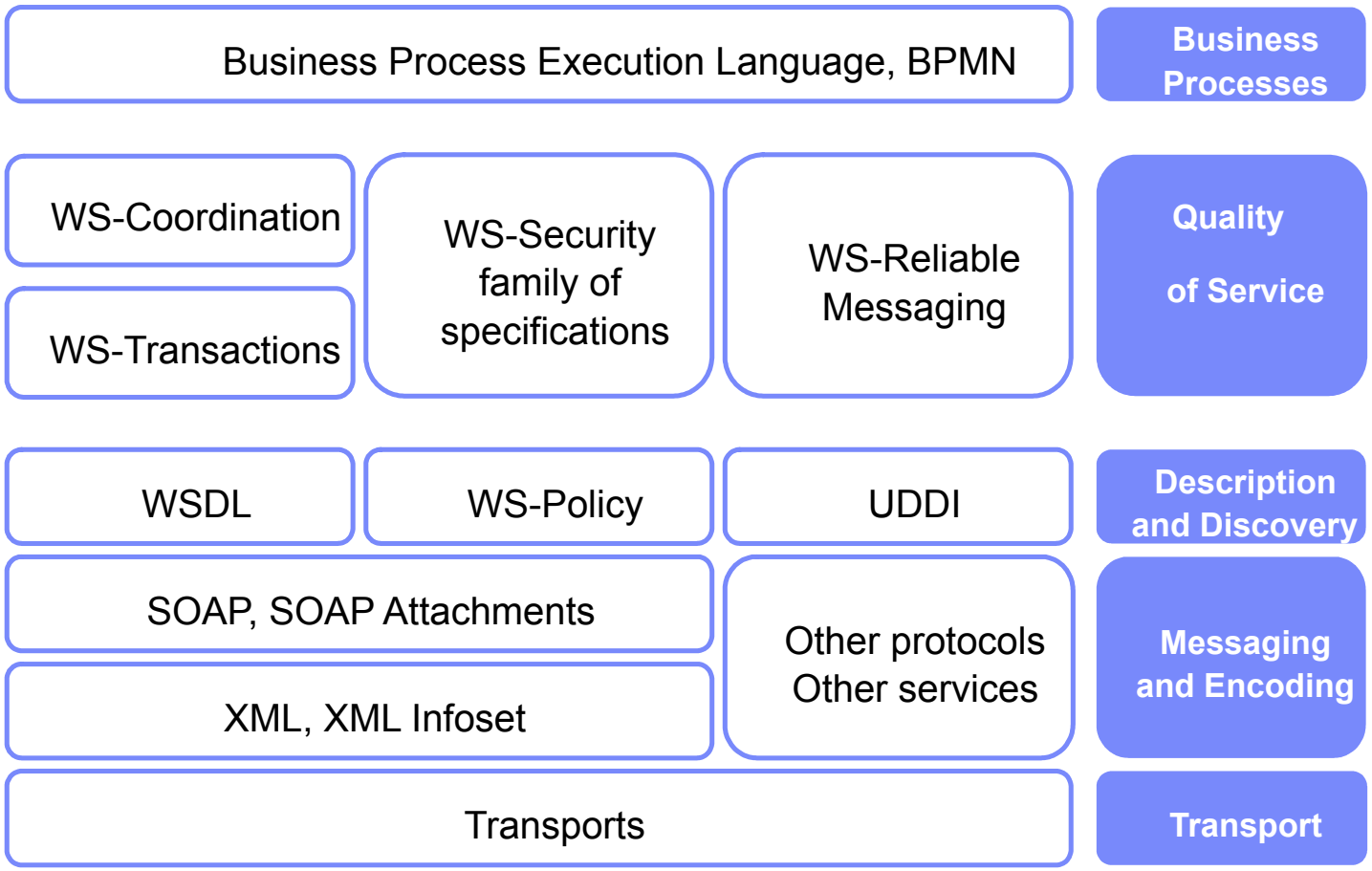
- Protocol for **transfer of XML messages**
- Used for **communication between service and its consumer** (client)
- Common use of HTTP/HTTPS as a transport protocol
- Request – Response communication model

SOAP example

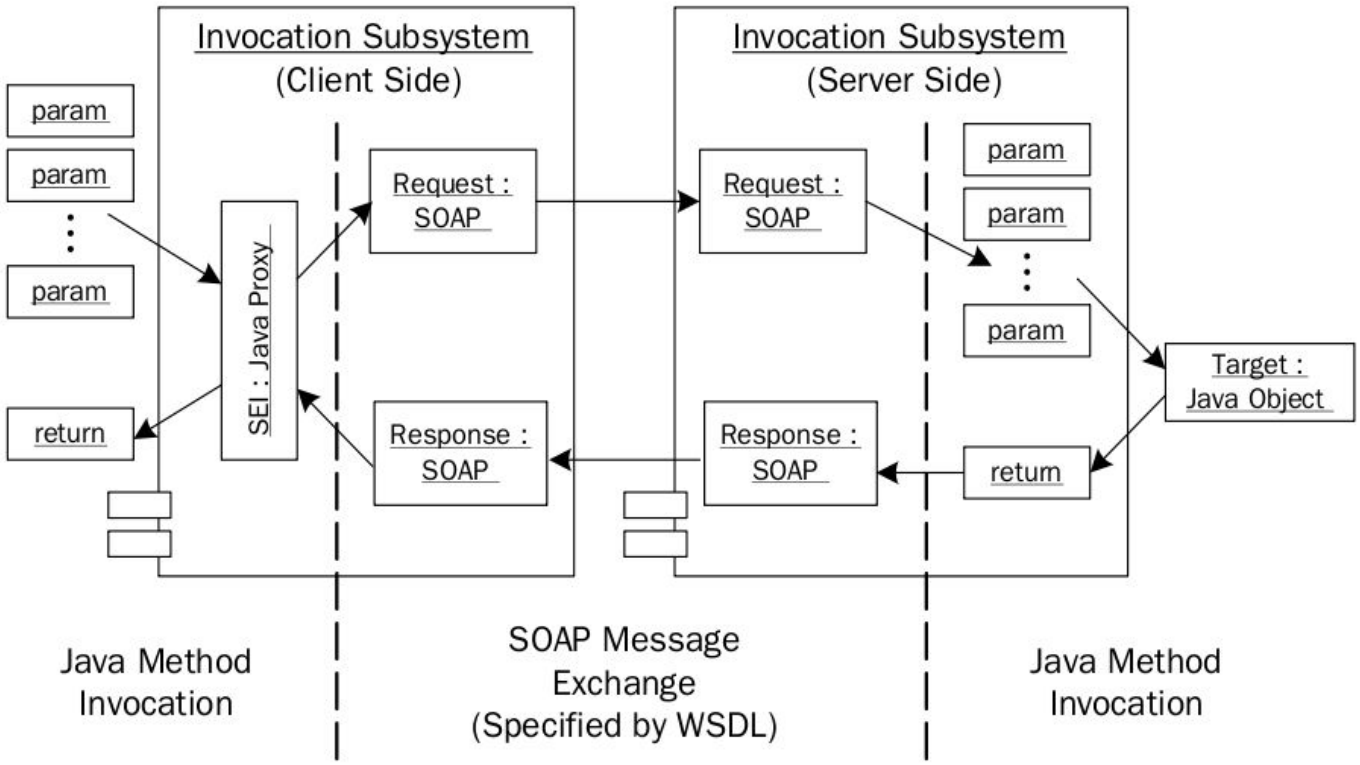
```
POST / HTTP/1.1
Content-Type: text/xml; charset=utf-8
Content-Length: 423
Connection: close
SOAPAction: ""

<?xml version="1.0" encoding="UTF-8"?>
<env:Envelope

xmlns:env="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi=""

 <env:Header/>
 <env:Body>
  <jePrvocislo xmlns="urn:mojeURI">
    <cislo xsi:type="xsd:long">1987</cislo>
  </jePrvocislo>
 </env:Body>
</env:Envelope>
```

```
HTTP/1.1 200 OK
Content-Type: text/xml; charset=utf-8
Content-Length: 468
Connection: close

<?xml version="1.0" encoding="UTF-8"?>
<env:Envelope

xmlns:env="http://schemas.xmlsoap.org/soap/envelope/"  xmlns:xsi=""
xmlns:xsd="http://www.w3.org/2001/XMLSchema">

 <env:Body>
  <jePrvocisloResponse xmlns="urn:mojeURI">
   <vysledek
xsi:type="xsd:boolean">true</vysledek>
  </jePrvocisloResponse>
 </env:Body>
</env:Envelope>
```

WS - Standards

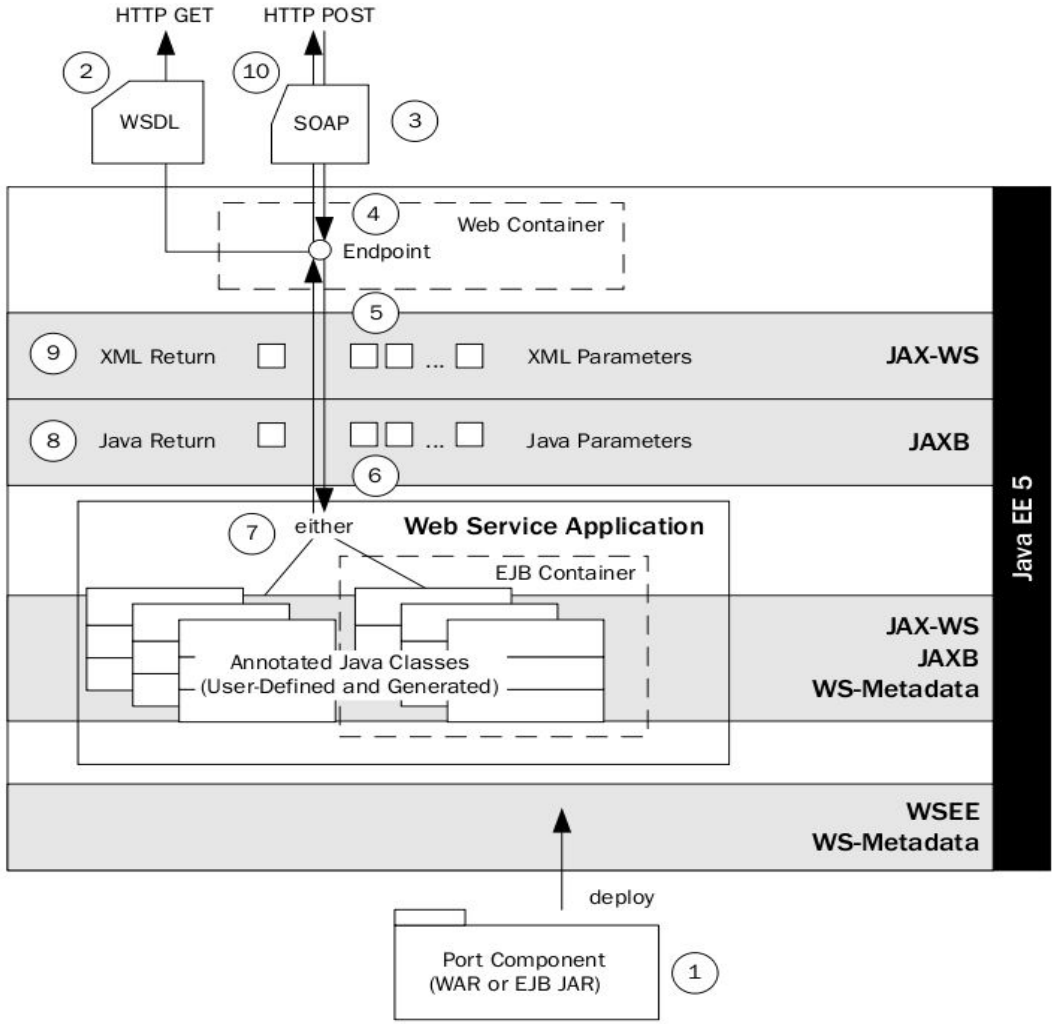


Web Services in Java



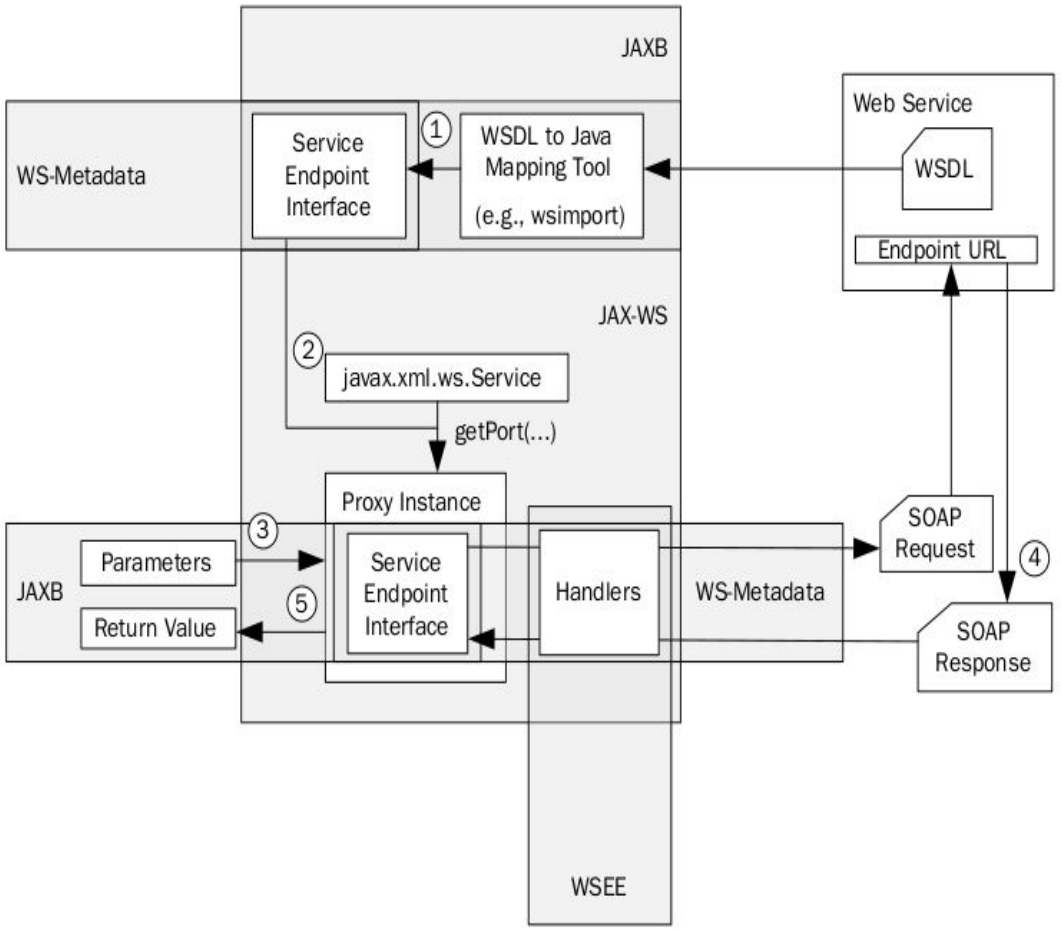
WS in Java - Server

- JAX-WS
- JAXB
- WS-Metadata
- REST



WS in Java - Client

- JAX-WS
- JAXB
- WS-Metadata
- REST



RESTful Web Service

Representational State Transfer

- Uniform resource interface (a set of constraints)
- Client-server separation
- Stateless
- Cacheable resources
- Layered system
- Code on demand (optional – JavaScript)

https://raygun.com/blog/soap-vs-rest-vs-json/

RESTful Web Service

RESTful Web Services characteristics:

- HTTP/HTTPS protocols:
  - Using URI for resource identification
  - Only POST, GET, PUT & DELETE (CRUD)verbs (or only others from HTTP specification)
  - HTTP Status Codes as flow control
  - XML, JSON, YAML text formats as resources representations
- OpenAPI (swagger), RAML, API Blueprint, WADL, HAL specification formats and tools

REST example

```
curl -i -X POST
"http://localhost:3000/api/personal/users/4c617f2b-2bad-498b-a9c6-4e9a8c303798/bookmarks"
-H "accept: */*" -H "Authorization: Bearer eyJhbGciOiJ...."
-H "Content-Type: application/json" -d
"{\"name\":......,\"public\":true,\"lastAccessedAt\":\"2020-03-06T20:14:28.101Z\",\"likeCount\":0}"


HTTP/1.1 201 Created
X-Powered-By: Express
Access-Control-Allow-Origin: *
Access-Control-Allow-Methods: POST, GET, PUT, PATCH, DELETE, OPTIONS
Access-Control-Allow-Headers: Content-Type, Authorization, Location
Access-Control-Expose-Headers: Content-Type, Authorization, Location
Location:
http://localhost:3000/api/personal/users/4c617f2b-2bad-498b-a9c6-4e9a8c303798/bookmarks/5e62b18b59770b5
487a4c741
Content-Type: application/json; charset=utf-8
Content-Length: 79
ETag: W/"4f-26GcBfsvgN8d+T+zqql3Y5R+Rl8"
Date: Fri, 06 Mar 2020 20:24:44 GMT
Connection: keep-alive

{"response":"Bookmark created for userId 4c617f2b-2bad-498b-a9c6-4e9a8c303798"}
```

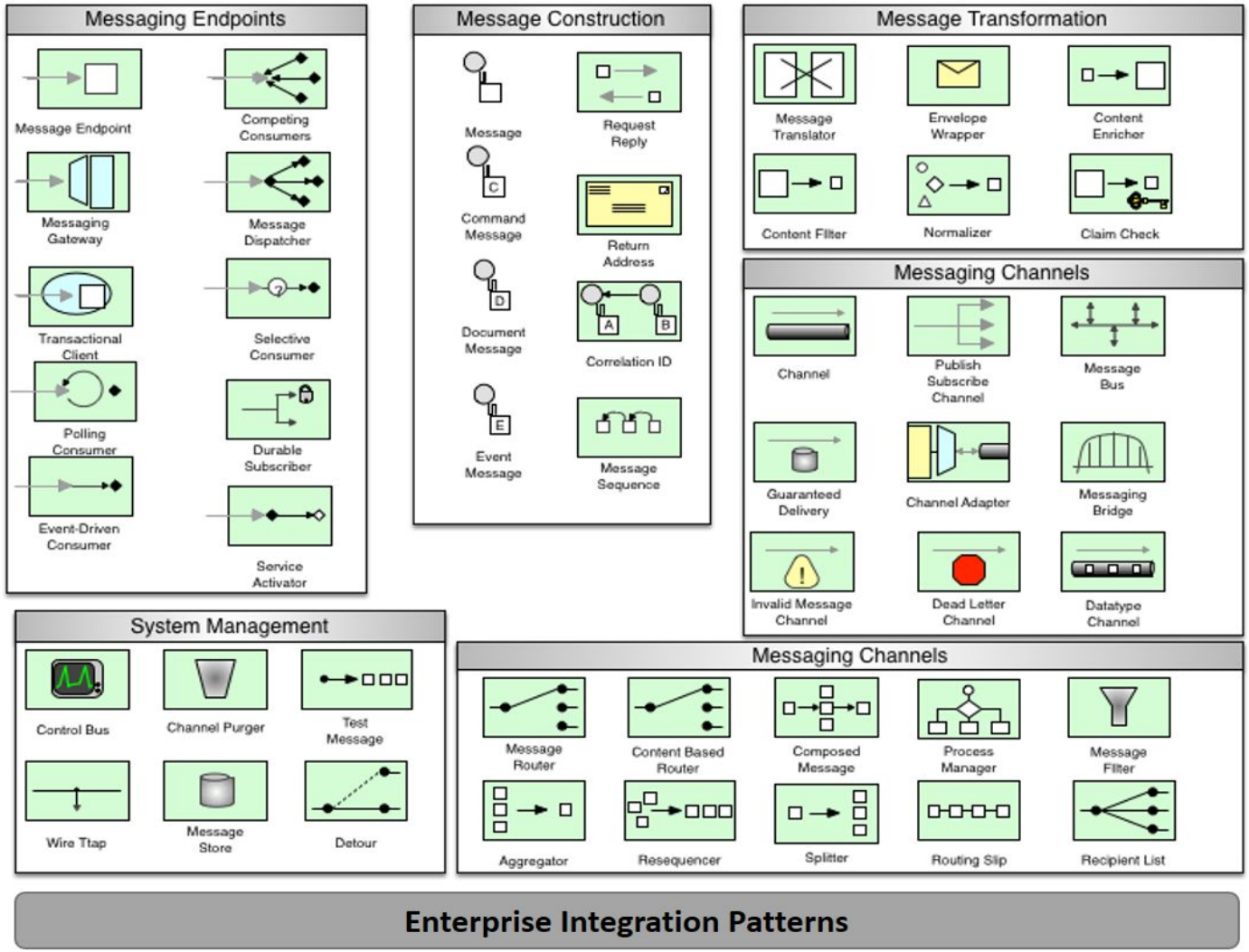
WS Standards

- JAX-WS (JSR-224)
- JAX-RS (JSR-311)

- Apache Axis, Axis2
- Apache CXF
- Jersey

- Spring Boot MSA framework

Other options
EIP as microservices



Project service implementation tips

Mock your webservice

- Use existing public APIs:
  - SOAP https://documenter.getpostman.com/view/8854915/Szf26WHn?version=latest
  - REST https://documenter.getpostman.com/view/8854915/Szf7znEe

- Use mocking framework
  - I.e. Mockito for Java https://site.mockito.org
  - Online service i.e. https://www.mockable.io

Implement your web service

Spring Boot REST Example

```
@RestController
public class HelloBootController {


   @GetMapping("/whereami")
   public String whereami(@Value("${message.prefix}") String prefix) {
       String resp = String.format("%s from %s", prefix,
         System.getenv().getOrDefault("HOSTNAME", "localhost"));
       return resp;
   }


}
```

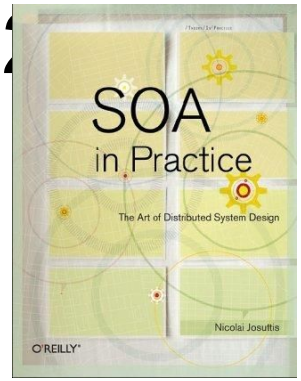
- There are many frameworks available for popular modern development platforms….
- If you implement your own microservices (not-trivial with some db backend), you can receive some bonus help for final evaluation :-)

Web Service tutorials

- Web Services
  - http://netbeans.org/kb/docs/websvc/jax-ws.html
- REST
  - http://netbeans.org/kb/docs/websvc/rest.html
- NetBeans Trail
  - http://netbeans.org/kb/trails/web.html

SOA - Information Resources

- SOA in Practice, Nicolai M. Josuttis, 2
  ISBN-13: 978-0596529550



- IBM Systems Journal, Volume 47, Number 3, 2008

FIN
Questions?

PV207 – Business Process Management

Spring 2019