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Tutorial III:

Process Integration and Service Oriented Architectures

Session 10
ESB

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European Commission

TEMPUS

About

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- Birzeit University, Palestine (**Coordinator**)
- Palestine Polytechnic University, Palestine
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- Ministry of Telecom and IT, Palestine
- Ministry of Interior, Palestine
- Ministry of Local Government, Palestine
- University of Trento, Italy
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Tutorial Map

Intended Learning Objectives
A: Knowledge and Understanding
3a1: Demonstrate knowledge of the fundamentals of middleware.
3a2: Describe the concept behind web service protocols.
3a3: Explain the concept of service oriented architecture.
3a4: Explain the concept of enterprise service bus.
3a5: Understanding WSDL service interfaces in UDDI.
B: Intellectual Skills
3b1: Design, develop, and deploy applications based on Service Oriented Architecture (SOA).
3b2: use Business Process Execution Language (BPEL).
3b3: using WSDL to describe web services.
C: Professional and Practical Skills
3c1: setup, Invoke, and deploy web services using integrated development environment.
3c2: construct and use REST and SOAP messages for web services communication.
D: General and Transferable Skills
d1: Working with team.
d2: Presenting and defending ideas.
d3: Use of creativity and innovation in problem solving.
d4: Develop communication skills and logical reasoning abilities.

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Session 3: Xpath & Xquery	4	Romi
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Session13: BPEL	3	Aldasht
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Session 10: ESB

Session ILOs

After completing this session students will be able to:

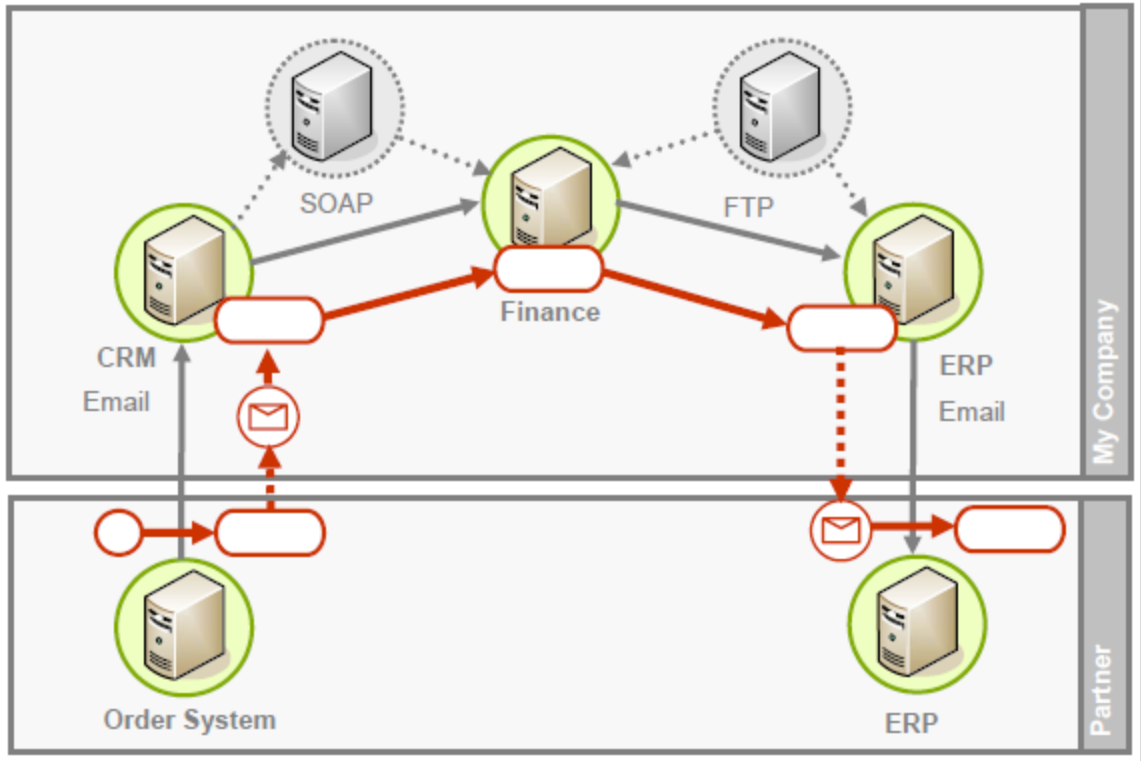
1. Explain the concept of enterprise service bus
2. Setup, invoke and deploy web services.

Session Outlines

- **Introduction**
  - ESB functions
- ESB role
- ESB Components
- Service invocation
- ESB Routing Facilities
- ESB example (Biztalk)

Introduction

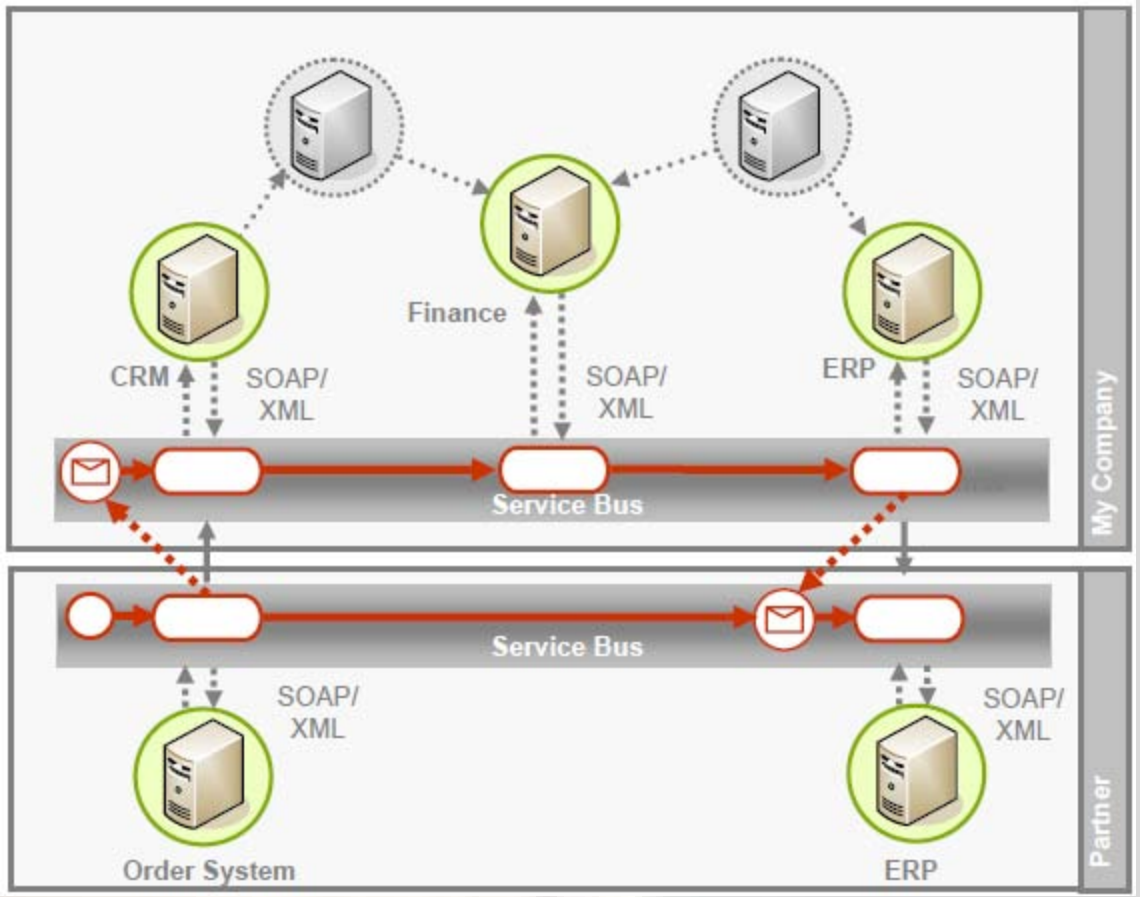
- Using point-to-point integration approach leads to unreliable, insecure, non-monitorable and in general non-manageable communication channels between applications.
- Process logic and data transformation logic is encoded into the applications.



Tightly-coupled applications, Source [6]

Introduction

- In an ESB architecture all kinds of applications are provided as business services and connected via reliable, secure and manageable virtual channels.
- Process orchestration and data transformation logic can be moved to the bus
- Process interactions can be performed in a controlled manner
- The ESB is an innovative approach to enterprise application integration (EAI)



Integrate all kinds of applications using a centralized EAI broker, Source [6]

Introduction: definitions

- The ESB is a new approach to integration that supports a loosely coupled, highly distributed integration network [1].
  - Shortly, a standards-based integration platform
- Also, we can say that an ESB is a flexible connectivity infrastructure for integrating applications and services [4].

ESB 4 functions [4]

- An ESB performs the following between requestor and service:
  - **Routing** messages between services.
  - **Converting** transport protocols between requestor and service.
  - **Transforming** message format between requestor and service.
  - **Handling** business events between different sources.

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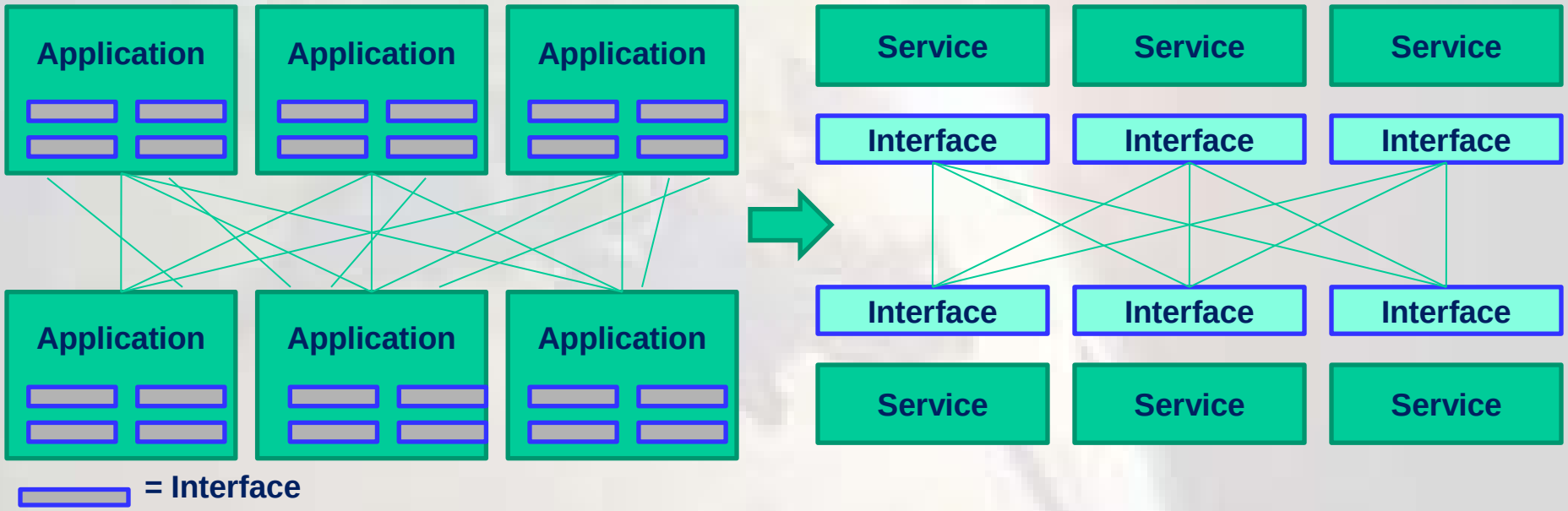
SOA Role

- SOA decouples interfaces from applications.
- The number and complexity of interfaces is reduced.
- Business applications and their interfaces become reusable.
- Interfaces tightly coupled with *point-to-point* connections

SOA Role

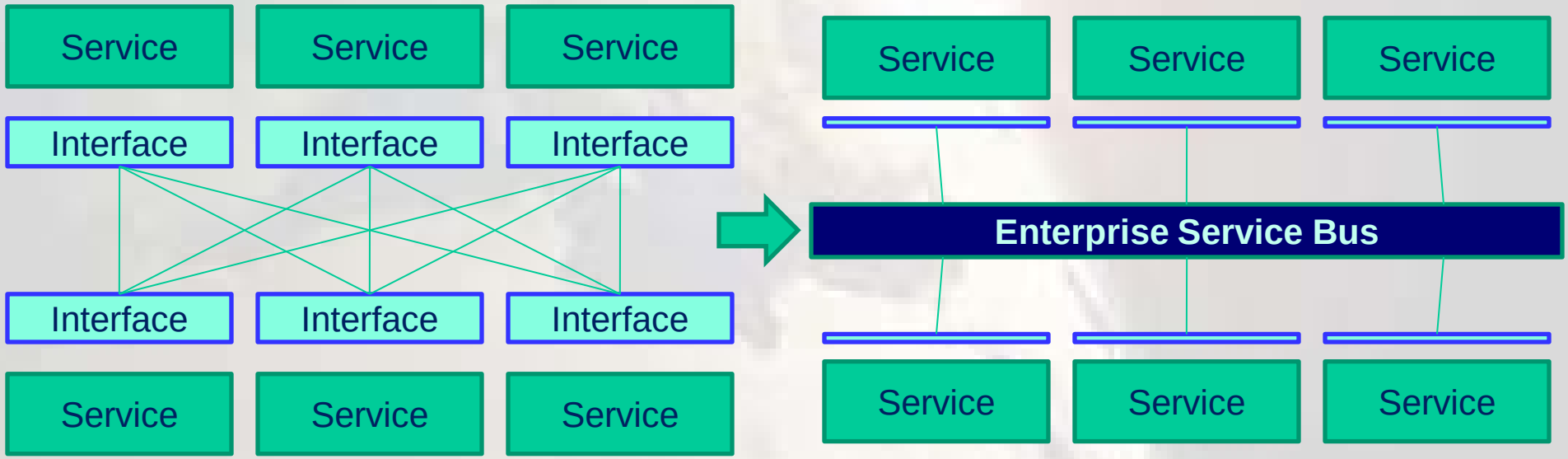


Source, IBM education assistant:
http://publib.boulder.ibm.com/infocenter/ieduasst

ESB Role

- ESB decouples the point to point connections from the interfaces.
- More flexible coupling and decoupling of applications
- Enables for finding applications and interfaces for reuse.
- Add or modify services faster and with less impact on existing services.

ESB Role



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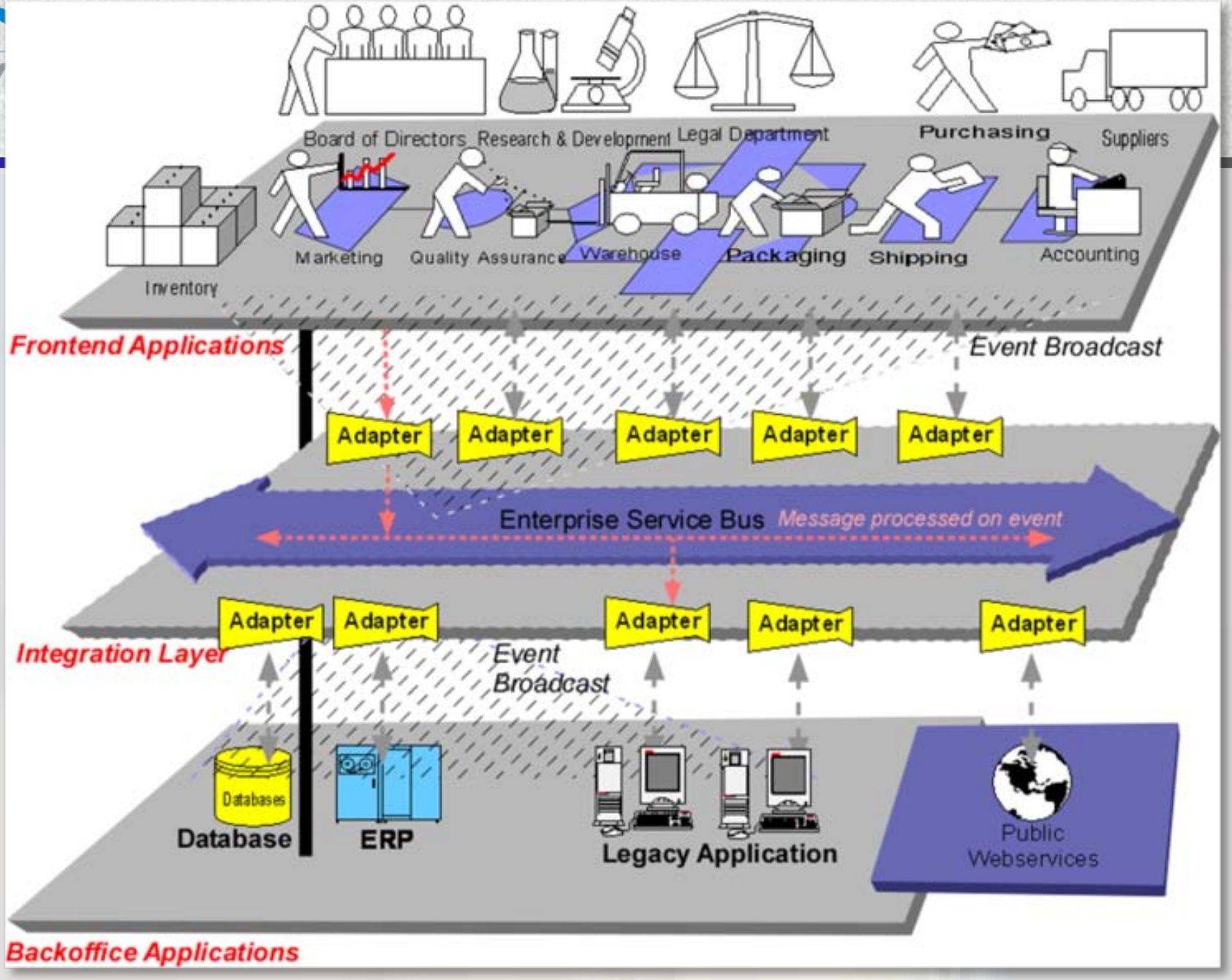
ESB role

- In an ESB, applications and event-driven services are tied together in an SOA in a loosely coupled fashion.
- An ESB provides the implementation backbone for an SOA.
- An ESB provides a loosely coupled, event-driven SOA with a highly distributed universe of named routing destinations across a multiprotocol message bus.
- Applications (and integration components) in the ESB are abstractly decoupled from each other, and connect together through the bus as logical endpoints that are exposed as event-driven services.



ESB forms a pervasive grid that can span a global enterprise network, Source [5]

Some ESB Characteristics

- Standards-Based Integration [1].
  - ESB can utilize J2EE components for connectivity.
  - ESB also integrates with applications built with .NET, COM, C#, and C/C++.
  - Can easily integrate with anything that supports SOAP and web-services APIs.
- Distributed Data Transformation.
  - Transformation services can be located anywhere and accessible from anywhere on the bus
- Remote Configuration and Management.
  - Local IT staff can't always be at each remote location

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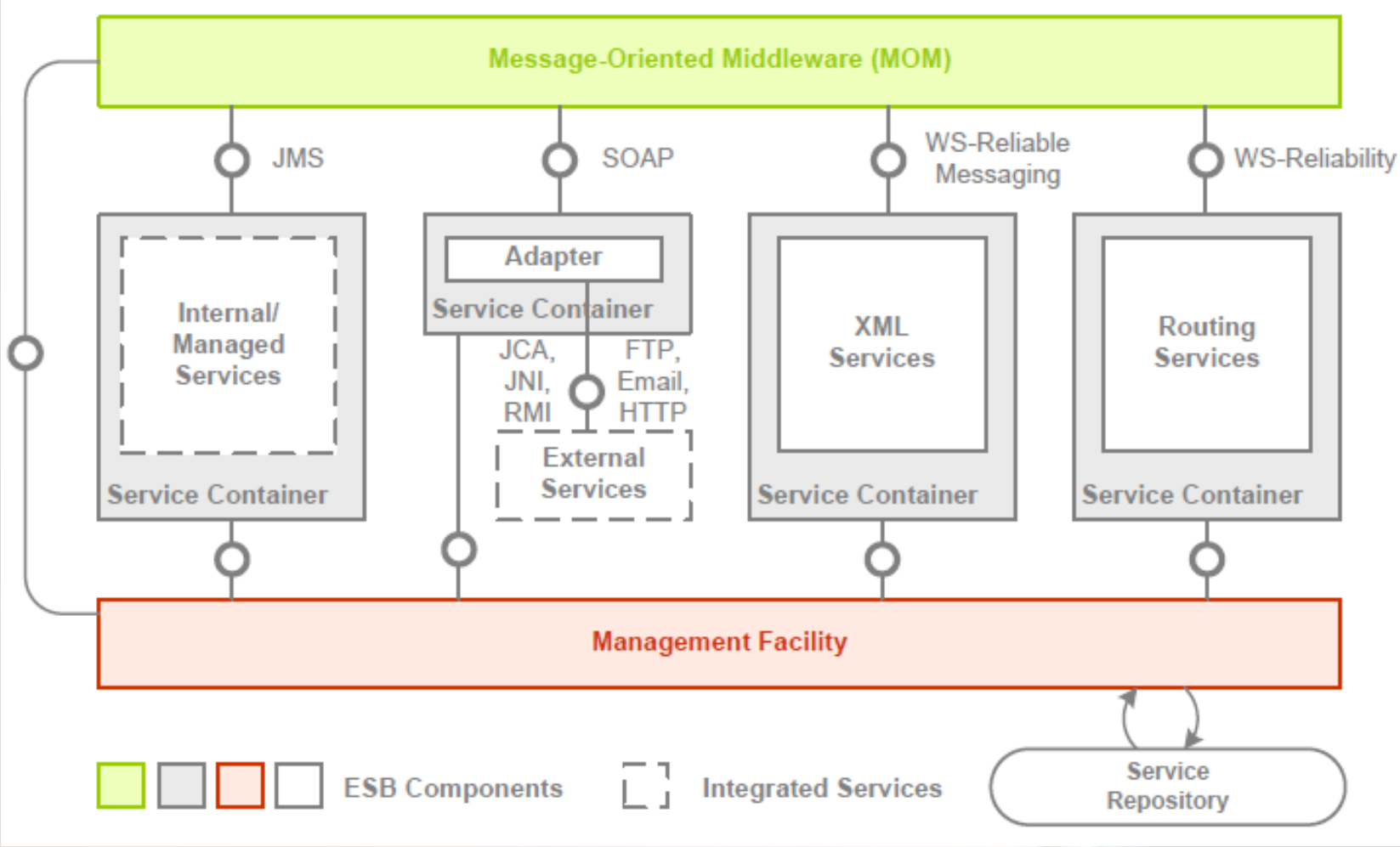
ESB Components

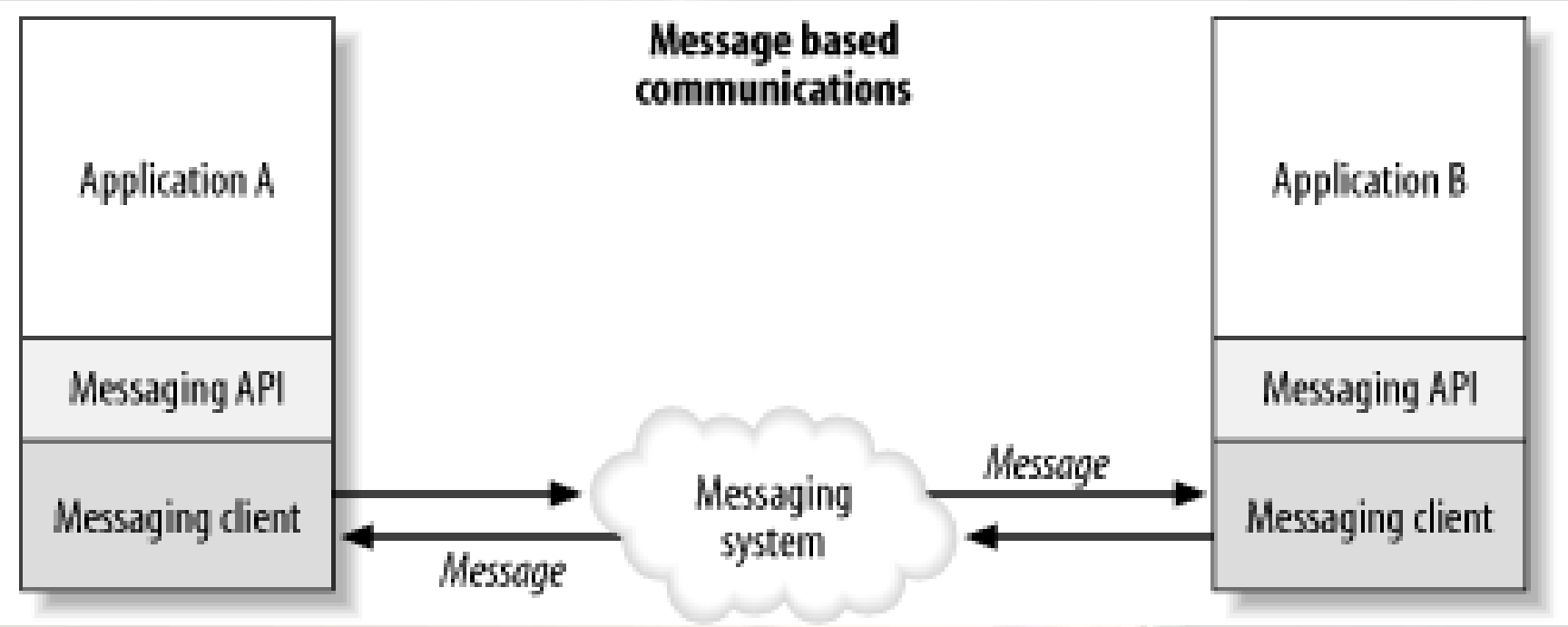


3 key components of an ESB architecture: MOM, Service container, and Management facility, Source [5]

Message Oriented Middleware (MOM)

- A MOM is a key part of the ESB architecture [1].
  - It provides a network of virtual channels that an ESB uses to route messages throughout an enterprise and beyond.
- In a MOM-based communication environment, messages are usually sent and received asynchronously
- MOM in combination with message queues are fundamental components of the ESB

Message Oriented Middleware

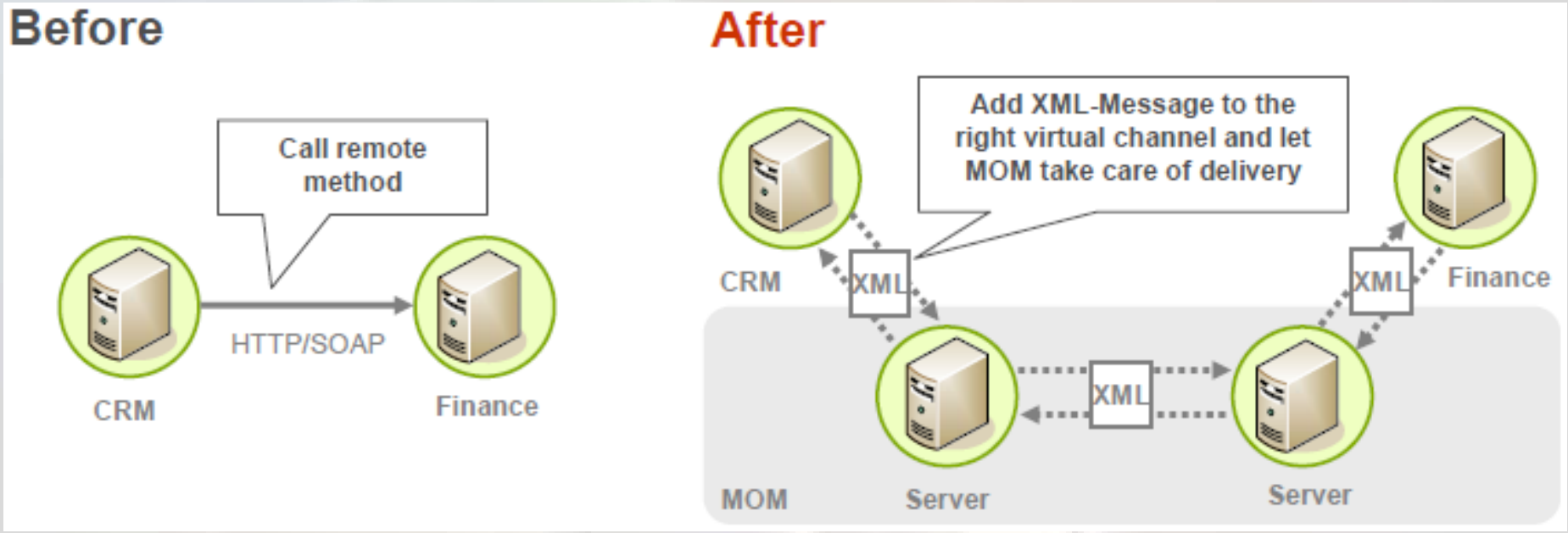


Source, [1]

Tightly Coupled Versus Loosely Coupled Interfaces

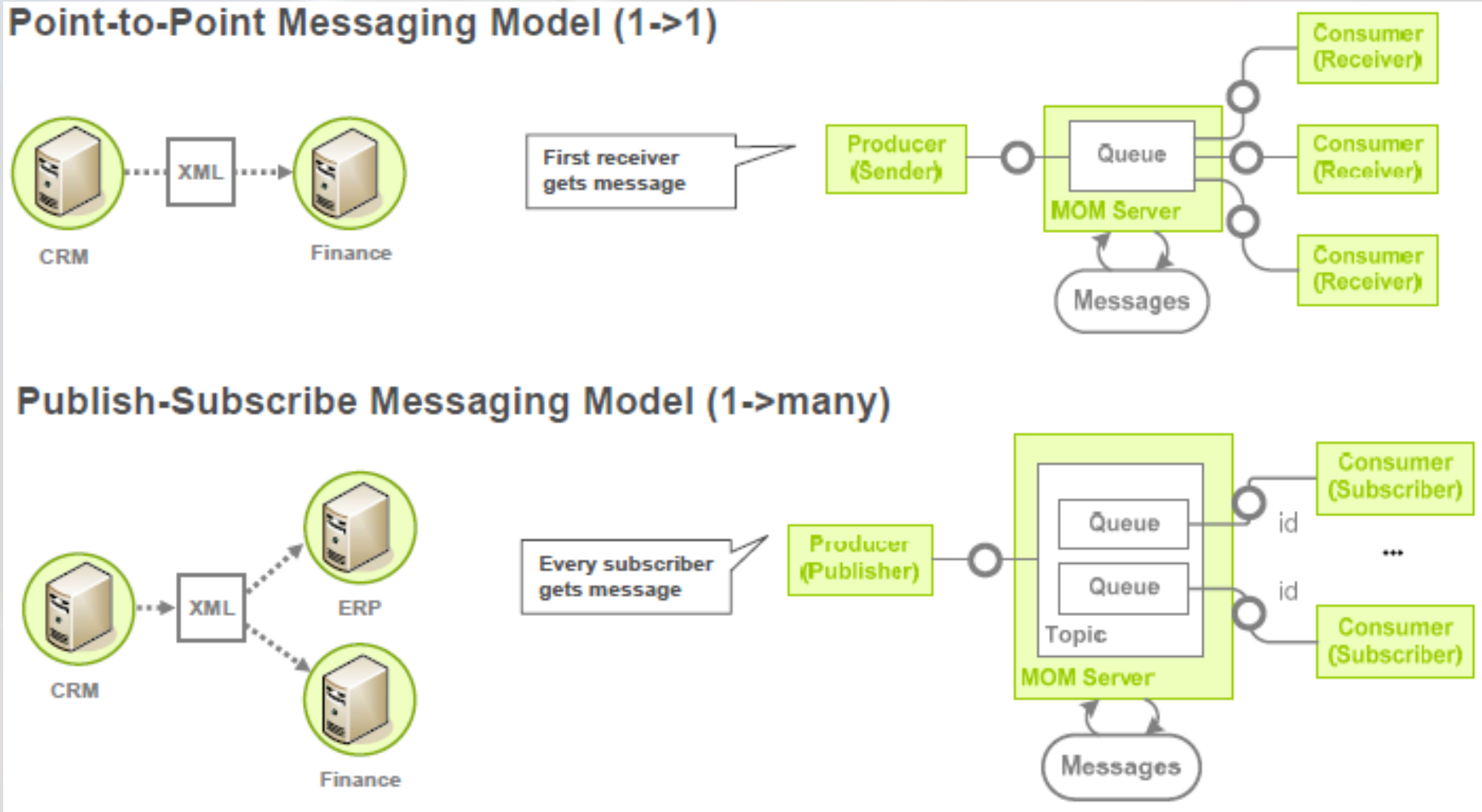
- Synchronous RPC-Style Programming [1]:
  - Technologies that predominantly use RPC-style communication include: CORBA, RMI, DCOM, Sun-RPC, Java API for XML-RPC (JAX-RPC)
  - Synchronous RPC-based interactions consist of multiple point-to-point integrations that depend on each other.
  - Minimum number of application interfaces is n(n-1)/2
- Asynchronous message-based interfaces are much more loosely coupled and manageable

Where MOM fits?



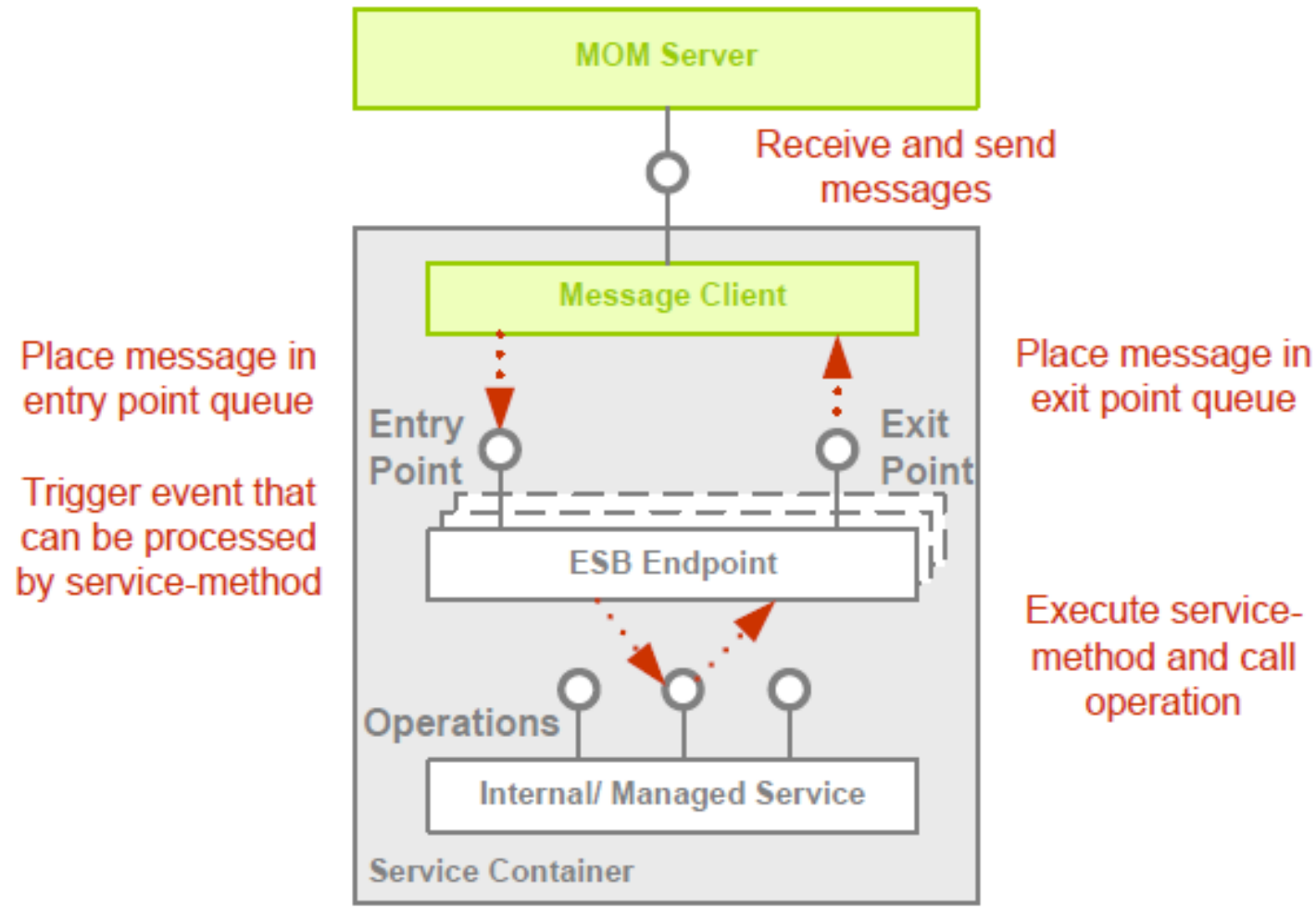
The shift from synchronous remote calls to asynchronous message exchange, Source [5]

Asynchronous Messaging Models



Point-to-point and publish-subscribe messaging models, Source [5].

Service Container



Connecting services to the ESB using ESB endpoints that are managed by a service container, Source [5]

Management Facility

- ESB centrally manages its decentralized infrastructure
- Each ESB, therefore, has a powerful and versatile management facility, which consists of:
  - A central repository
  - A network of management servers
  - Management interfaces at message servers and service containers
  - Different configuration, management and monitoring tools.

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Service invocation model

- A typical SOA uses the find/bind/invoke model
- This model assumes that there is a registry or a directory that stores the location and metadata about a service implementation
  - In the "*find*" operation, the service client does a **lookup** in the registry for the service, using certain criteria, like names.
  - The "*bind*" operation, for a web services request could simply mean doing an HTTP **connect**.
  - The "*invoke*" operation, means **sending a message** or **invoking a remote procedure**.

ESB Service Invocation

- ESB has the concept of a **registry or directory** service in which information about service **endpoints** is stored
- An inherent find/bind/invoke operation occurs as part of the ESB mechanics, but it is separated out from the business logic.
- In an asynchronous ESB environment, the set of find/bind/invoke operations may actually map to sending an XML message to a queue and processing the reply.
- The means by which the find/bind/invoke operations are defined, is through **configuration and deployment tools**.

Steps of service invocation

1. XML messages are received by the service from an **entry endpoint** that is managed by the **service container**.
2. Upon conclusion of its task, the service implementation places its **output message** in the **exit endpoint**.
3. The output of the service is the reply, which the **ESB routes** to the next step or back to the request.

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- **ESB Routing Facilities**
- ESB example (Biztalk)

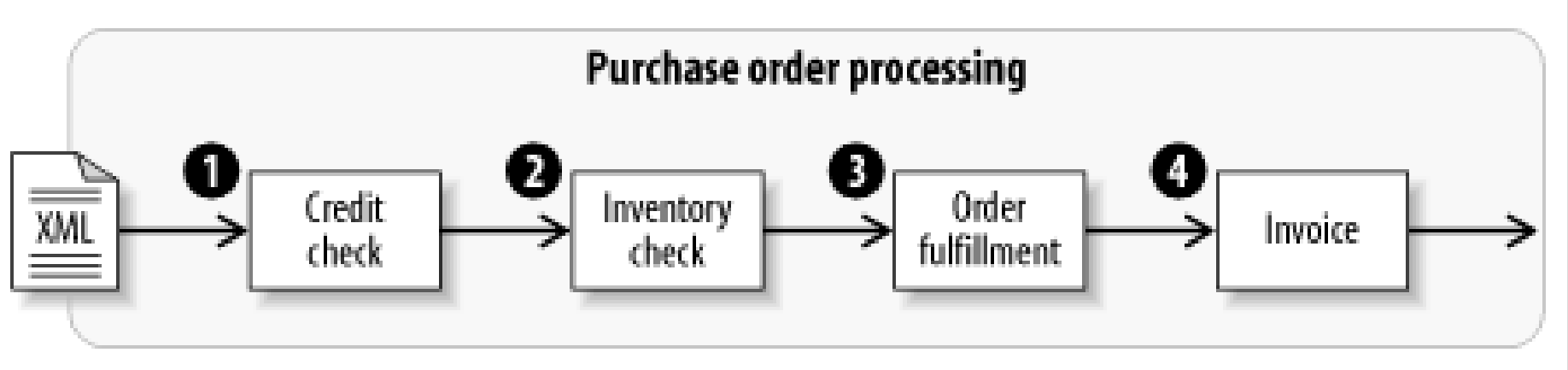
ESB Routing mechanisms

- ESB basically provides 3 routing mechanisms thereby invoking multiple business services:
  - Itinerary-based routing.
  - Service orchestration using BPEL.
  - Content-based routing.

Itinerary-Based Routing

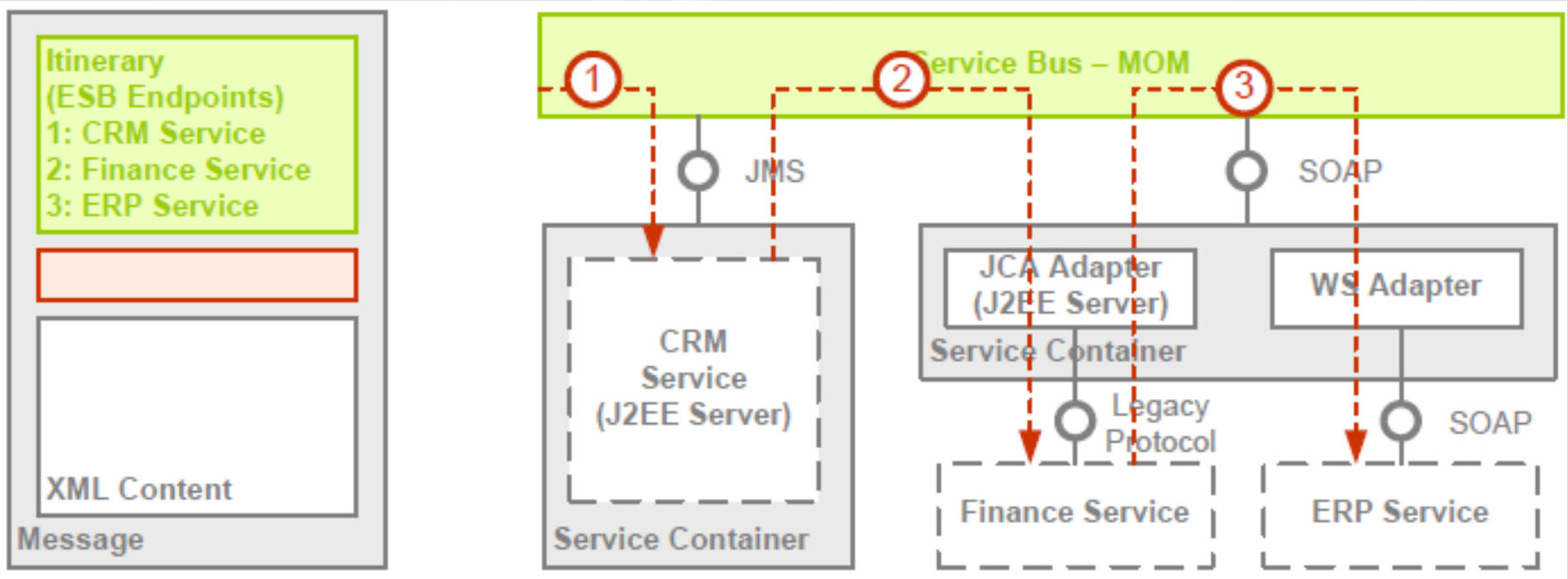
- Message itineraries (*routes*) are key to enabling a highly distributed SOA across an ESB.
- In order to route a message through the bus, each message contains an itinerary.
- The **itinerary** consists of a **list of ESB endpoints** that have to be visited and the information about **already visited ESB endpoints**.
- The **message payload** contains the **current processing state.**

An ESB itinerary represents a distributed business process



Source, [1]

Itinerary-based routing in an ESB

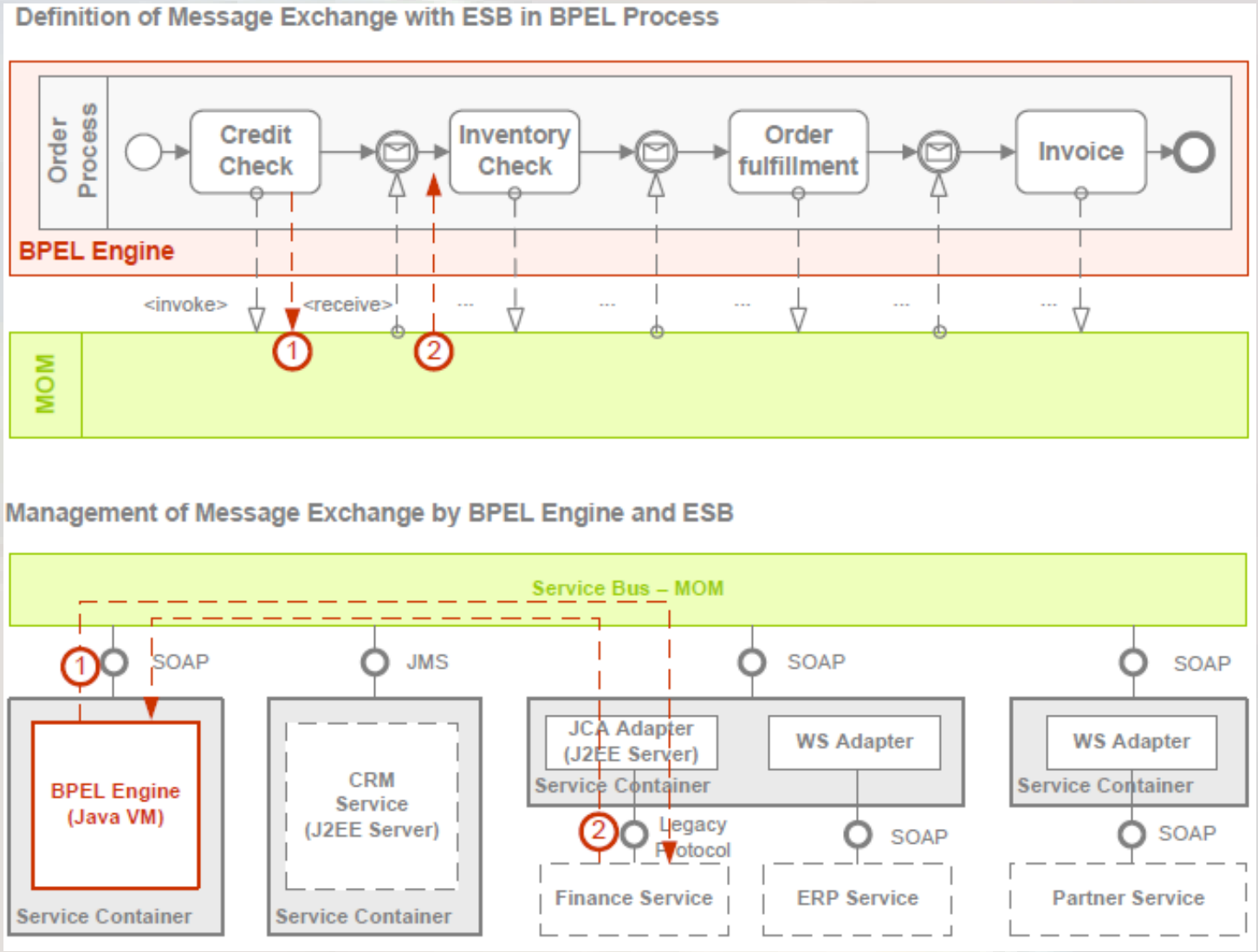


Source, [5]

Service Orchestration using BPEL

- Used to manage **long-running business processes** that might run for **months or years**.
- A BPEL process definition consists of a number of logical steps that are connected to each other by conditional or unconditional links and can be executed in sequence or in parallel.
- A BPEL process definition also allows to define time-based, condition-based and event-based triggers.
- As in the itinerary based routing, each logical step refers to an ESB endpoint

Service orchestration using BPEL

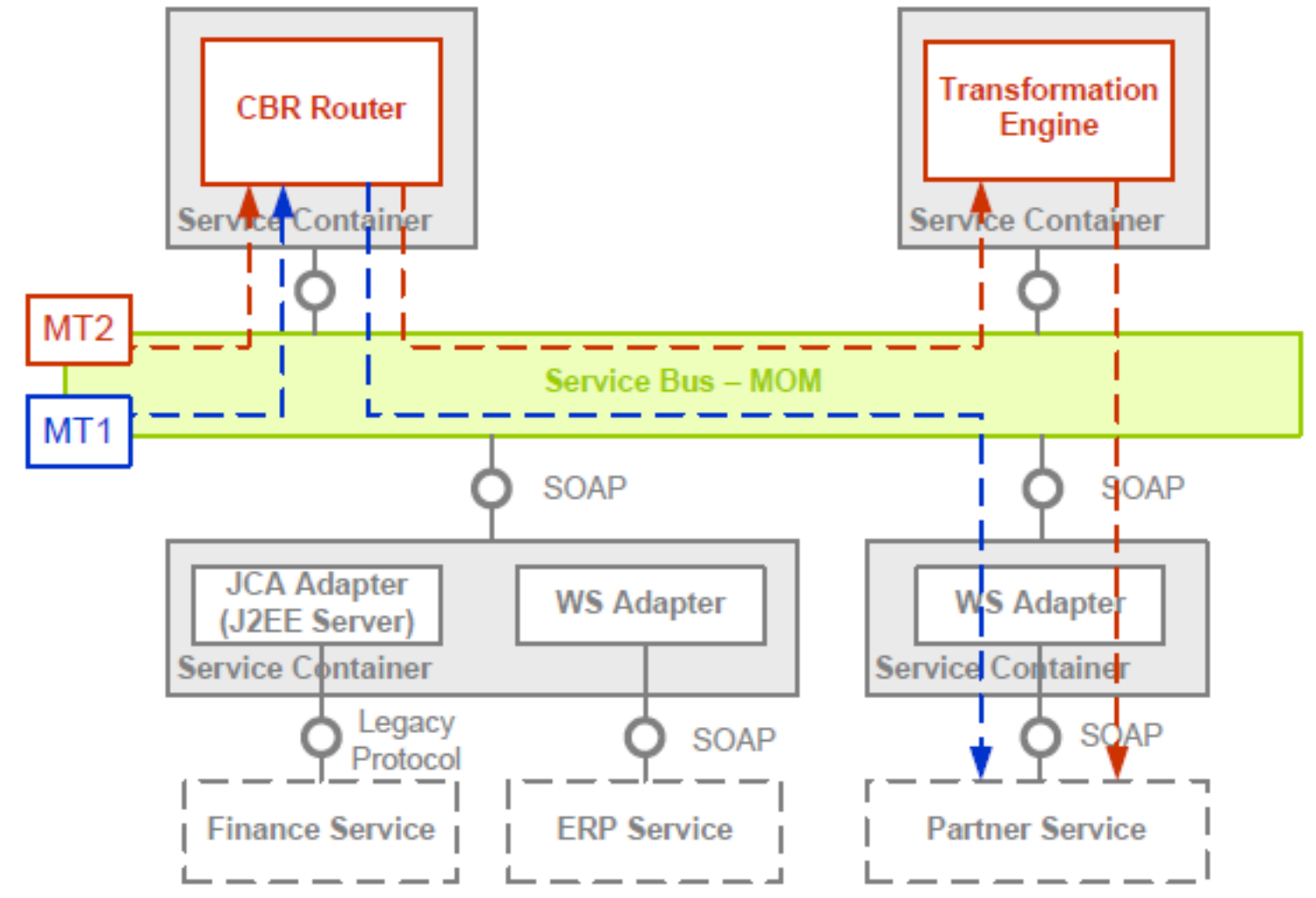


Source, [5]

Content-Based Routing (CBR)

- Based on the fact that XML processing services with different capabilities are plugged into the bus.
- They basically allow to validate, enrich, transform, route and operate XML messages.
- Combinations of these services allow to form lightweight processes with the purpose to process messages.
- Such a lightweight process is plugged as CBR service into the message flow between a message producer and a message consumer

Content-based routing in an ESB



Source, [5]

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- **ESB example (Biztalk)**

Microsoft BizTalk Server

- Referred to as "BizTalk“
- An Enterprise Service Bus (ESB) created by Microsoft.
- It enables companies to automate business processes
  - Through the use of "*adapters*" which are tailored to communicate with different software systems used in an enterprise.
- Provides the following functions:
  - Enterprise application integration.
  - Business process automation.
  - Business-To-Business communication.
  - Message broker.
  - Business activity monitoring.

Biztalk main competitors

- Commercial:
  - WebSphere by IBM
  - webMethods by Software AG
  - Oracle Enterprise Service Bus (BEA Logic)
- Open source:
  - Apache ServiceMix
  - Apache Synapse
  - JBoss ESB
  - NetKernel

Architecture

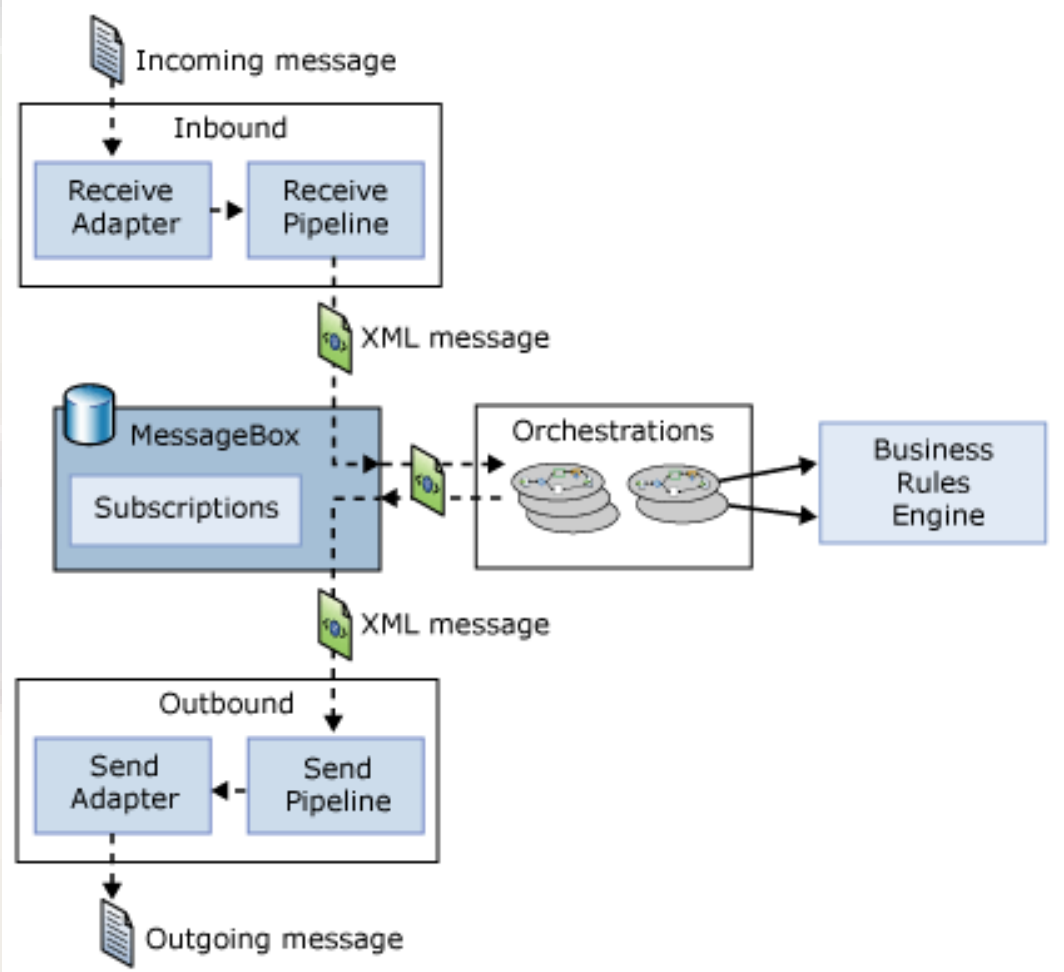
- The BizTalk Server runtime is built on a *publish/subscribe* architecture, sometimes called "content-based publish/subscribe".
  - Messages are published into BizTalk, transformed to the desired format, and then routed to one or more subscribers.
- BizTalk makes processing safe by serialization (called dehydration in Biztalk's terminology)
  - Placing messages into a database while waiting for external events, thus preventing data loss.
- This architecture binds BizTalk with Microsoft SQL Server.
- Processing flow can be tracked by administrators using an Administration Console

BizTalk Server Messaging engine

- Enables users to create business processes that spans multiple applications by providing two primary things:
  - A way to specify and implement the logic driving that business process
  - A mechanism for communicating across the applications that the business process uses

BizTalk Server engine

- **Send** and **receive adapters**, use the appropriate mechanism to communicate with receiver and sender applications respectively.
- **Receive** and **send pipelines**, convert between XML format used by BizTalk Server and the format required the external application, validate/add a digital signature, etc…
- Business process logic is implemented as one or more **orchestrations**, each of which consists of executable code.
- **MessageBox**, a database where the message is delivered into and is implemented using Microsoft SQL Server.



Different people perform different functions using the BizTalk Server engine

- A BizTalk application wraps orchestrations, pipelines, message schemas, etc. into a single logical unit
  - Which is an abstraction for management and deployment
- Three roles are necessary to create and maintain BizTalk Server solutions, this done by:
  - A **business analyst:** to define the rules and behaviors that make up a business process.
  - A **developer** can create a BizTalk application that implements the business process.
  - An **administrator:** setting up communication among the parts, deploying the BizTalk application.

Biztalk Application Example (Practical Session)

- Before start:
  - Install BizTalk server on a single-computer environment
  - Do the basic configuration
- We will create and build the first project in the enterprise application integration (EAI) solution.
  - The project contains message schemas, and a map.
- Then, we will create the business process that routes the messages and evaluates the contents of the request message.
- Then, we will learn administering BizTalk Server artifacts by using the BizTalk Server Administration Console, as follows:
  - Deploy the project
  - Configure and start the application
  - Test the solution

Summary

During this module we have introduced the concept of enterprise service bus; we have covered the following:

1. ESB role
2. ESB components
3. Service invocation
4. ESB Routing Facilities
5. BizTalk

Next module will cover the SOA design and Integration Patterns

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Thanks

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