# Enterprise Application Integration

Faculty of Computer Science
Workflow Systems and Technologies

## Interoperability SS 2023

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## Interoperability and (Application) Integration

**Interoperability** is *"… the ability of two or more systems or components to exchange information and to use the information that has been exchanged."* (IEEE Standard Computer Dictionary)

*"… interoperability means that two (or more) systems work together unchanged even though they weren't necessarily designed to work together … **Integration** means that you've written some custom code to connect two (or more) systems together."* (B. Woolf, IBM Blog)

## Introduction

- Enterprise application integration (EAI) aims to provide a *unified set of services* by *integrating data and functionality* of *multiple separate applications* with the support of integration approaches
- Enables unification and standardisation of processes in enterprises
- Examples:
    - Share data between organisations
    - Expose unified APIs that accomplish complex tasks involving the functionality of multiple dispersed systems
    - Orchestrate processes across different organisations

# Application Integration Styles

- **File Transfer** Applications export and import files of shared data
- **Shared Database** Multiple applications store their data in a single shared database
- **Remote Procedure Invocation** Applications expose their services which enable to invoke behaviour remotely
- **Messaging** Applications interact with a common messaging system to exchange data and invoke behaviour

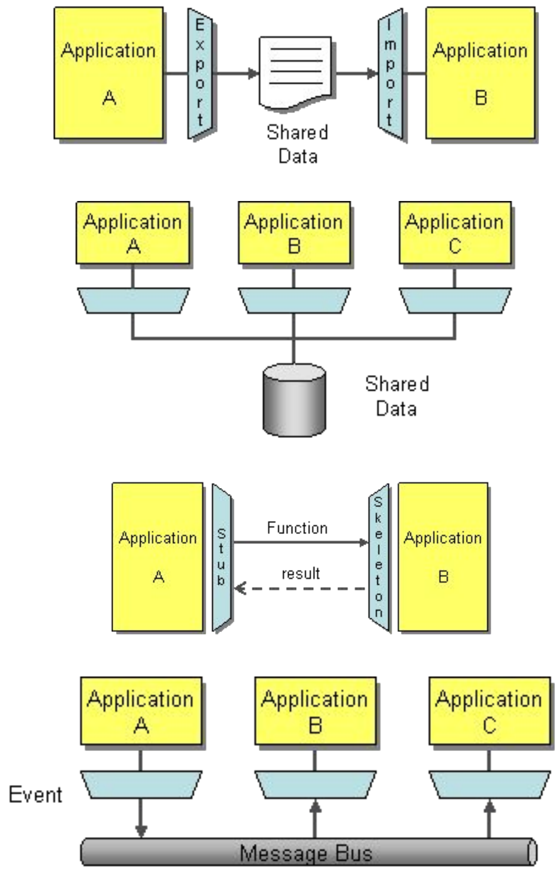


Illustration of the four Integration Styles [1]

## Application Integration Criteria

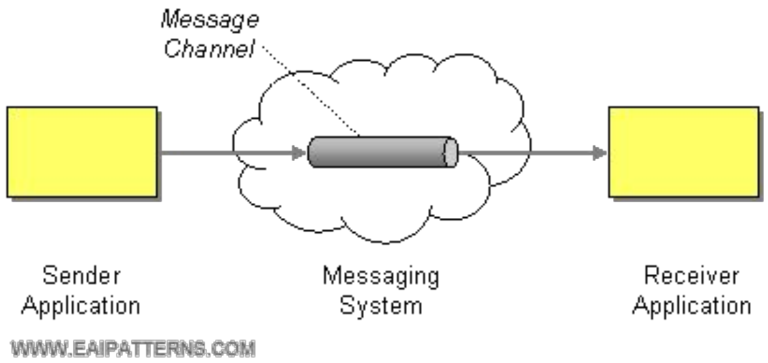
- **Integration** Does an application require collaboration with other systems to accomplish tasks?
- **Application Coupling** Integrated applications should avoid tight coupling and provide room for future changes.
- **Integration Simplicity** Advocate solutions which require minimal changes to the application and minimal amount of integration code.
- **Asynchronicity** Integration solutions must not assume constant availability of remote applications and block computational resources
- **Data or Functionality** Ability to handle exchange of data but also invoke (e.g. computationally heavy) behaviour

## Application Integration Criteria cont'd

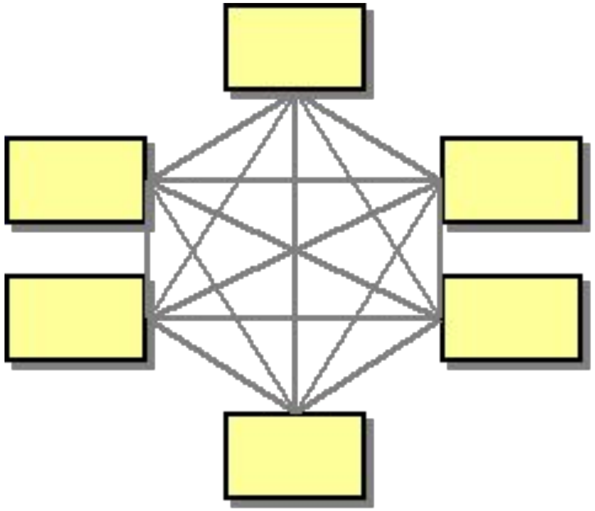
- **Data Format** Ability to unify different data formats and handle the evolution of those formats over time
- **Data Timeliness** Data to be shared produced by an application should be delivered to its designated consumers in a timely manner
- **Integration Technology** Certain integration approaches may require a highly specialised solution which may introduce further complexity and potentially result in vendor lock-in and high costs

## Messaging

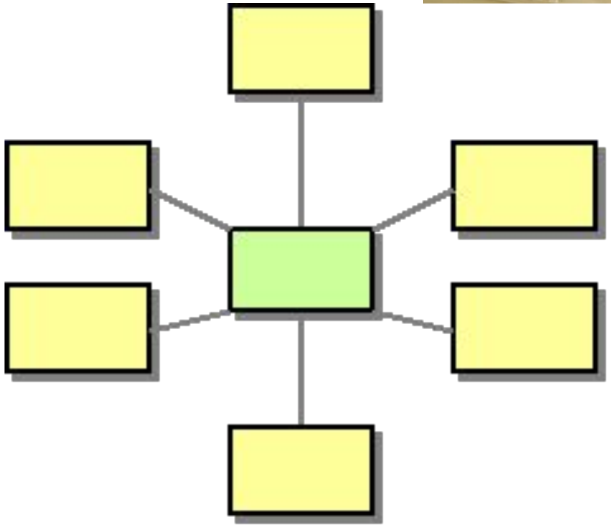
- Communication between applications via a *Message Channels*
- *Sender* writes information *to* the channel while the *Receiver* reads information *from* channel
- Sender *does not* necessarily know the particular recipients of the information provided
- *Choice* of Message Channel determines the recipients of a Sender's information



## The $n^2$ Integration Problem

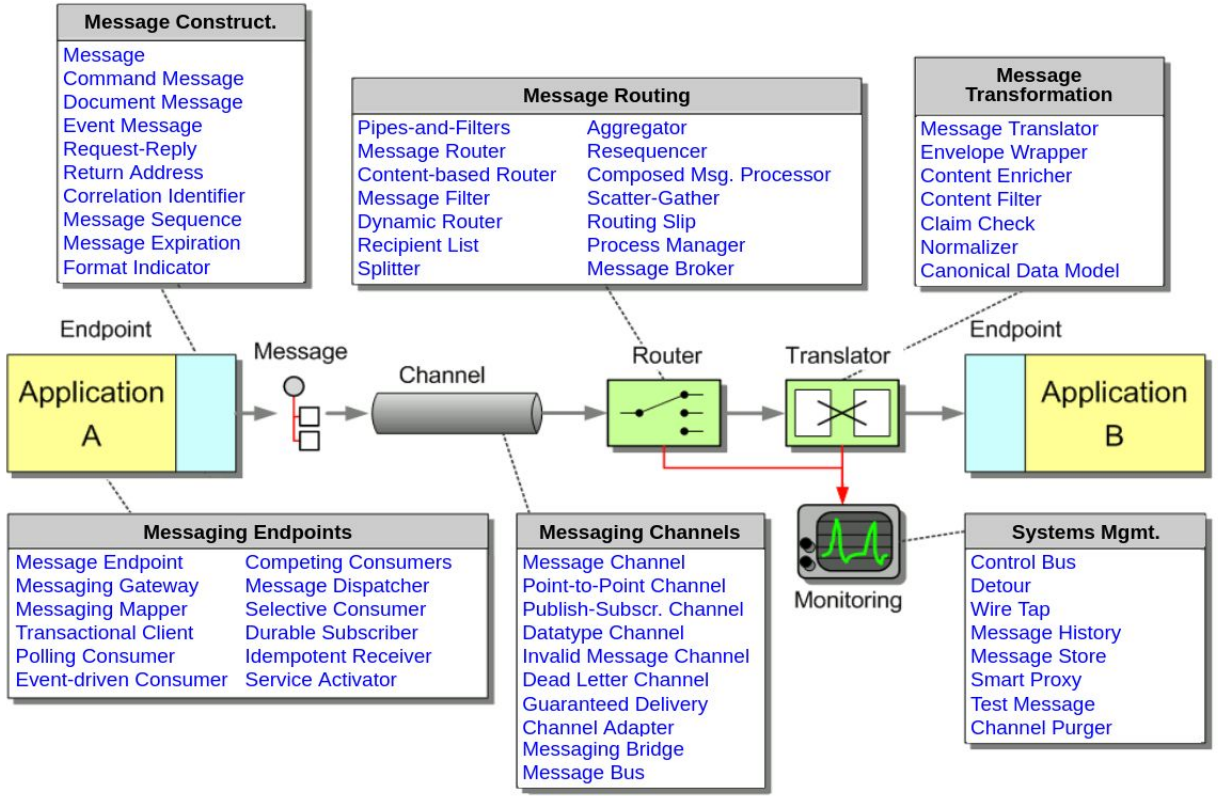


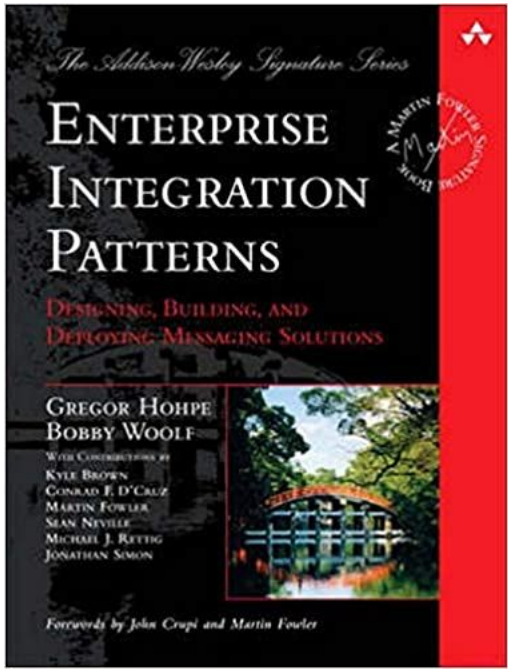
Spaghetti Integration [1]:
*up* to *n* * (*n* - 1) connections



Solution: Hub and Spoke [2]
a.k.a. “**Message Broker**”

# Messaging Patterns




The Addison-Wesley Signature Series
ENTERPRISE INTEGRATION PATTERNS
DESIGNING, BUILDING, AND DEPLOYING MESSAGING SOLUTIONS
GREGOR HOHPE
BOBBY WOOLF
With Contributions by
Kyle Brown
Conrad F. D'Cruz
Martin Fowler
Sean Neville
Michael J. Rettig
Jonathan Simon
Forewords by John Crupi and Martin Fowler
A Martin Fowler Signature Book

https://www.enterpriseintegrationpatterns.com/patterns/messaging/

# Messaging Patterns

Messaging patterns provide *technology independent design suggestions* for integration problems.

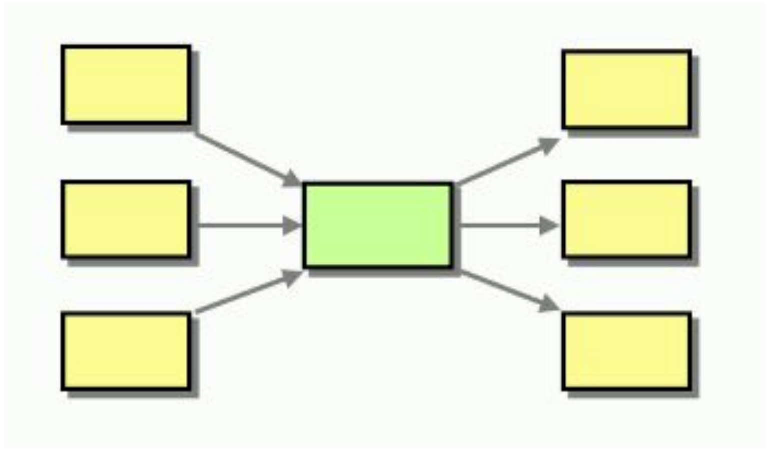
- **Channel Patterns** describe how messages are transported across a unidirectional message channel and how the sender and receiver can be decoupled
- **Message Construction Patterns** describe the intent, form and content of messages passed over a messaging system
- **Routing Patterns** describe how messages are routed from a sender to the desired receiver based on a set rules and conditions

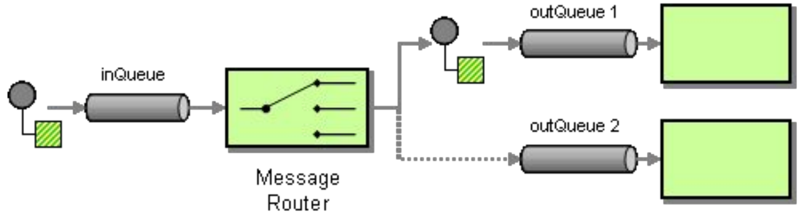
## Messaging Patterns cont'd

- **Transformation Patterns** deal with the transformation of the content of messages into the appropriate format required by the receiver
- **Endpoint Patterns** deal with how messages are produced and consumed by the clients of messaging systems
- **System Management Patterns** describe how to maintain and monitor messaging systems

## Message Broker

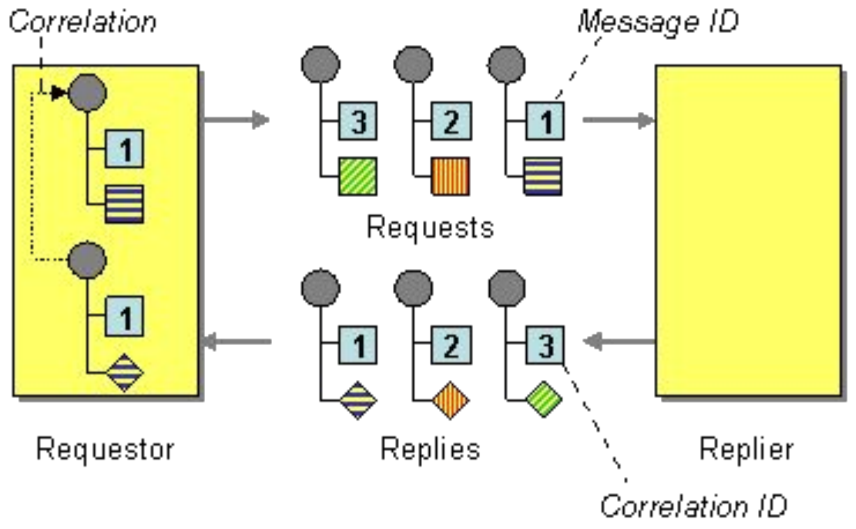
- Architectural pattern to facilitate the correct delivery of incoming messages to their intended target
- Can have multiple sources of incoming messages and receivers
- May implement several routing patterns to determine the appropriate channel for the incoming messages
- Potentially single point of failure





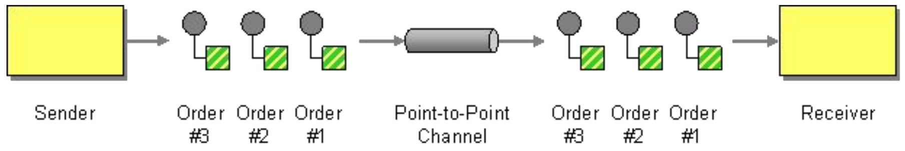
## Correlation Identifier

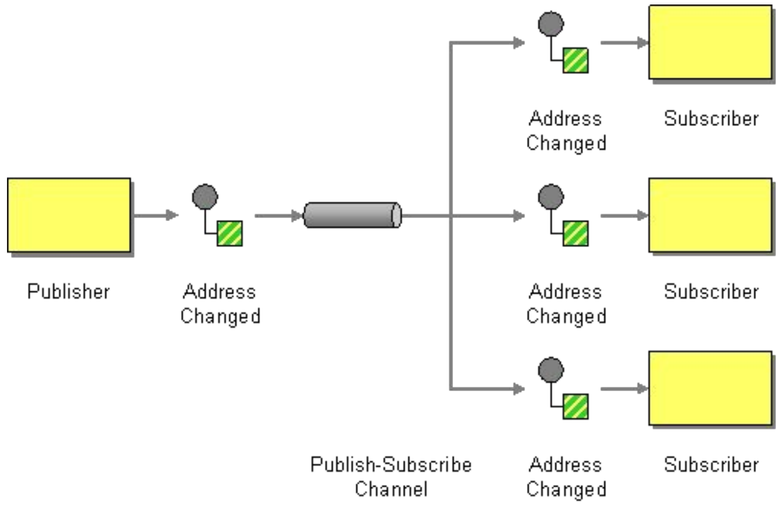
- Requestor includes a message identifier (ID) - a token that uniquely identifies the message
- Replier extracts the token - now referred as correlation identifier - from the received message and includes it in the response



## Point-to-Point and Publish-Subscribe Channels

- Point-to-Point Channel only has one receiver
- In case multiple receiver exists only one of them gets to consume the message
- In contrast a Publish-Subscribe pattern delivers a message to all interested receivers (subscribers)
- Requirements may include reliability of message delivery





## Service Composition

## Service Composition

- **Composite Service** "... a service implemented by combining the functionality provided by other web services" [3]
- **Service composition** is the act of creating new services by composing existing services [3]
- Focus on the design of reusable web services
  - This is facilitated by the use of web standards
  - E.g. by the classic web service technology stack consisting of SOAP, WSDL and UDDI
- **WS-BPEL** (OASIS) [4] and **WS-CDL** (W3C) [5] standards to facilitate service composition for complex interactions

## WS-BPEL

- Web Service - Business Process Execution Language
- XML-based process description language with structural programming elements
- Enables to model the behaviour of executable and abstract business processes interfacing with web services
- Uses an **Orchestration** model:
  - Service composition through the coordination of interactions and flow of messages between systems
  - Interactions are coordinated by a *central entity* (orchestrator)
  - Participants (web-services) are unaware of each other

## WS-CDL

- Web Services Choreography Description Language
- **Choreography** uses a peer-to-peer collaboration style
- Declarative XML-based language
- Aims to define from a *global view* the *information exchange between two (or more)* independent *participants* or *processes* and *how* those *cooperate (rules of engagement)*
- WS-CDL is *not* an executable description language

## Resources

[1] G. Hohpeand B. Woolf. Enterprise Integration Patterns: Designing, Building, and Deploying Messaging Solutions. Addison-Wesley Longman Publishing Co., Inc., 2003

[2] G. Hohpeand. Hub and Spoke [or] Zen and the Art of Message Broker Maintenance. https://www.enterpriseintegrationpatterns.com/ramblings/03_hubandspoke.html, Last Accessed 31.05.2023

[3] Alonso, G., Casati, F., Kuno, H. and Machiraju, V. (2004) Web Services. Concepts, Architectures and Applications, Springer-Verlag Berlin Heidelberg.

[4] https://docs.oasis-open.org/wsbpel/2.0/varprop

[5] https://www.w3.org/TR/ws-cdl-10/#Choreography