Introduction

Software integration refers to the process of combining multiple software systems, applications, or components to create a seamless and cohesive whole. This process involves a variety of tasks, including:

- data exchange,
- interface design,
- system testing (integration testing).

Software integration is important, because it allows organizations to take advantage of the strengths and capabilities of different software systems and bring them together in a way that maximizes efficiency and productivity.

For example, a company might use one software system for its customer relationship management (CRM) and another for its financial management (FM). By integrating these systems, the company can streamline processes such as sales and billing, and have a more complete view of its customer relationships and financial data.

Another benefit of software integration is the ability to reduce complexity and increase the reliability of an organization's systems. By integrating multiple software systems, organizations can reduce the number of different applications and systems they need to maintain and support, which can reduce costs and improve efficiency. Additionally, integration can help ensure that different systems are working together smoothly, reducing the risk of errors and downtime.

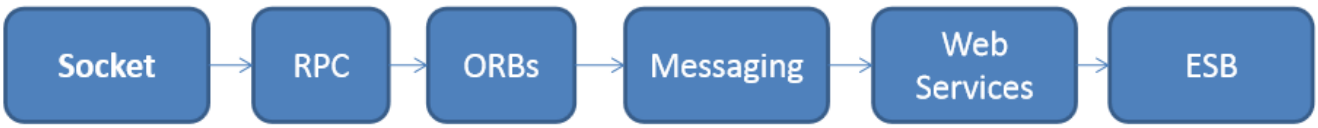
There are several approaches to software integration, including custom integration, point-to-point integration, and using integration platforms. Custom integration involves creating custom code to connect different systems, which can be time-consuming and costly.

e.g. *point-to-point integration* involves connecting two systems directly, which can be more efficient but can also become complex and difficult to maintain as more systems are added. Integration platforms, on the other hand, provide a centralized hub for connecting and managing different software systems, making it easier to add and remove systems as needed.

Regardless of the approach taken, successful software integration requires careful planning and coordination. It is important to carefully define the goals and objectives of the integration, as well as the data and processes that will be involved. It is also essential to test the integration thoroughly to ensure that it is working as intended and to identify and resolve any issues that may arise.

Evolution of software integration

Following figure shows the six classical Software Integration methods.



Integration based on TCP/IP Sockets

The client sends requests to the server over a TCP socket connection, and the server responds to these requests with appropriate data.

Here are the basic steps involved in integrating software systems or components using TCP socket communication:

1. Choose a protocol: TCP/IP is a common protocol for socket communication, but other protocols like UDP can also be used depending on the requirements.
2. Determine the message format: Decide on the format of the messages that will be exchanged between the client and server. This could be a simple text-based format or a more complex binary format.
3. Define the communication interface: Define the functions or APIs that will be used for communication between the client and server.
4. Set up the server: Write the code for the server that listens for incoming client connections and handles incoming requests.
5. Set up the client: Write the code for the client that connects to the server and sends requests.
6. Handle errors: Implement error handling mechanisms to ensure that communication errors are handled gracefully and do not cause the system to crash or become unstable.
7. Test and iterate: Test the system thoroughly and make any necessary changes or improvements to ensure that it is functioning correctly.

Summary:

- Socket ::= IP address + (TCP/UPD) port number
- TCP Sockets provides 'real-time' data transfer
    - binary data transfer but can be normal text or XML as well
    - no direct method sharing (can be done by hand)
    - TCP and UDP connections are possible. UDP is 3 times quicker but one-way communication
- Persistent or On-Demand communication channel
    - because of connection time-loss usually persistent channels are better, but periodically 'ping' messages should be sent. (in order to avoid connection closing). In case of any problems reconnection is possible
    - in case of UDP channels an extra TCP channel is available for synchronizing - in online games
- Results in the fastest possible transmission.
    - Where the number of transactions per second up to ~ 20 transactions, there should have been applied. (50ms / sec transfer)

RPC Remote Process Call

- Classical client-server programming. The underlying socket solution remains hidden from developers.
- The channel is not only suitable for simple data transfer, remote execution of procedures also natively supported (on API level).
- Interface description
    - It is necessary to describe the remote procedures with some form of XDR (External Data

Representation Standard) can help.
- Platform independence
    - Can be solved by the help of cross-platform interface descriptors

Object Request Broker

- First introduced to object-oriented programming paradigm in software integration. It extends the concept of objects in the “distant objects”.
- Distant objects communicate with each other
    - they can share both data and methods
- Known implementations: Corba and Java-RMI
- Marshalling/Unmarshalling concepts appear. Platform independent serialization of the transferred parameters (or data)
- Language independent interface description methods with Corba IDL (interface definition language)
- Initial concept of Service Registry.
    - services are browse-able in an uniform manner.
- Despite its antiquity is still supported in the modern application servers (like JBoss, IBM Websphere)

Messaging systems

- Messaging systems are asynchronous parallel systems
- In the background there is socket communication as well
- The system is asynchronous because we should not wait for the answer, execution flow is continuous, non-blocking.
- Each function call creates a message on the “Message Queue”. Message processing is alway parallel in a different process.
- This indirect method facilitated the loose coupling of different systems.
- Guaranteed message delivery is feasible, because of the intermediate message queue.
- Synchronous function calls can be simulated with a second message queue.

Web services

- XML (eXtendible Markup Language) based communication, which combine the advantages of RMI, CORBA, Messaging.
- Messages and responses are text messages in XML format.
- Advantage: communication can be followed easily, because data streams are not binary.
- Disadvantage: XML processing is more resource intensive than binary data processing.
- Interface description is in XML format as well. WSDL (Web Service Definition Language), is programming language, platform independent.
- UDDI (Universal Description, Discovery and Intergration) It is a registry for discovery, describe services.
- SOAP (Simple Object Access Protocol) is applied for data transmission.
    - Simpler solution is the XML-RPC. (XML-Remote Process Call)

Enterprise Service Bus (ESB)

- The Web services are not effectively solve the interconnection of heterogeneous systems.
- Not resolve the communication protocol deviations, i.e. during communication, the protocol offered by the service is different than the protocol used by the client.
- Protocol and message transformation is also possible
    - message routing – based on context and content
    - QoS (Quality of Service) – performance, security, reliability
    - data enrichment – information extension with automatic extra data

EAI Requirements

EAI (Enterprise Application Integration) covers every part of an enterprise system including business processes, architecture, hardware, software.

- **Business Process Integration (BPI)**. It is very important for a corporation to specify the processes involved in the interchange of enterprise information. “This allows organizations to streamline operations, reduce costs and improve responsiveness to customer demands.” This can include process management, process modeling and workflow. Here, we involve the combination of tasks, procedures, organizations,required input and output information, and tools needed for each step in a business process.
- **Application Integration**: Here, the goal is to “bring data or a function from one application together with that of another application that together provide near real-time integration.” This can include, business-to-business integration, customer relationship management (CRM) systems which can be integrated with a company's backend applications, web integration, and building web sites that interact with multiple business systems.
- **Data Integration**: If we want the above two integrations to succeed, we must also integrate the data involved. Its location must be identified, recorded, and a metadata model must be built (a master guide for various data stores). Now, data can be shared or distributed across database systems, providing it is in a standard format such as COM+/DCOM, CORBA, EDI, JavaRMI, and XML.
- **Platform Integration**: Finally, the separate needs of the heterogeneous network must be integrated. Platform Integration deals with the processes and tools that are required to allow these systems to communicate, both optimally and securely, so data can be passed through different applications without difficulty.