Middleware and Web Services

Lecture 2: Introduction to Architectures

doc. Ing. Tomáš Vitvar, Ph.D.

tomas@vitvar.com • @TomasVitvar • http://vitvar.com



Czech Technical University in Prague
Faculty of Information Technologies • Software and Web Engineering • http://vitvar.com/courses/mdw





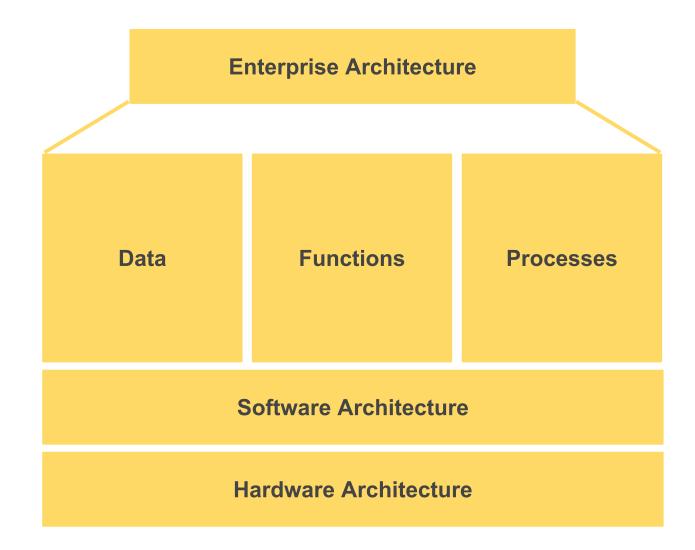
Overview

- Architecture Overview
- Data, Functions and Processes
- Software Architecture

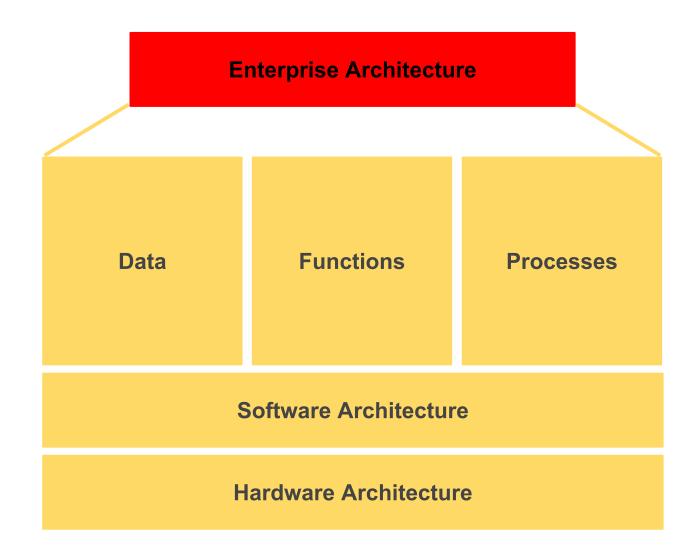
Global Architecture

- A structure and a behavior of system's parts
- Complexity views on the global architecture
 - basic architectural views (also called dimensions): enterprise, data, functional, process, software, hardware.
- Development
 - basic **methodology** and **actors**:
 - ~ analysis, design, implementation, testing, maintenance
 - ~ end-user, architect, developer, administrator
 - basic architectural development levels:
 - ~ conceptual, logical, physical.
- Global architecture and cloud computing
 - data, functions, processes are application (domain) specific
 - software architecture defines a software platform
 - hardware architecture defines an **infrastructure**

Views



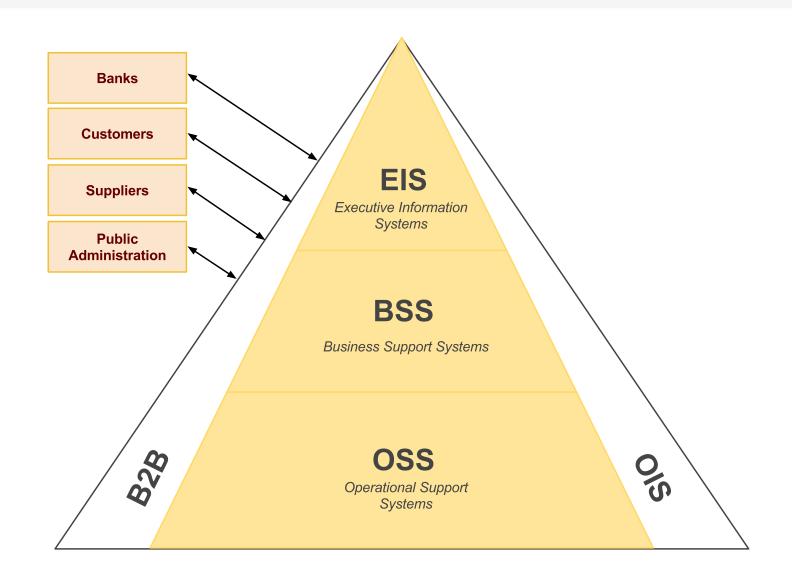
Enterprise Architecture



Enterprise Architecture Levels

- Defines a structure of an enterprise system
 - Abstracts from data, functions, processes, software, hardware
 - divides enterprise system into functional blocks applications
 - → Order Management System (OMS)
 - → Customer Relationship System (CRM)
 - → Billing and Revenue Management (BRM)
 - applications correspond to **domains** such as sales, finance, procurement, production, etc.
- Enterprise architecture levels
 - Operational Support Systems (OSS)
 - Business Support System (BSS)
 - Executive Information Systems (EIS)
 - Office Information Systems (OIS)
 - Integration
 - \rightarrow Business-to-Business (B2B)
 - → Enterprise Application Integration (EAI)

Enterprise Architecture Representation



Organization Types

Customer

- user needs: support for business processes
- defines business requirements
- roles: enterprise architect, developers, admins, users
- Supplier (enterprise system/application provider)
 - solutions and customization according to requirements
 - roles: technical and solution architects, developers, admins
- Vendor (technology provider)
 - product development according to market needs
 - roles: product managers, developers, reference users

Architect Roles

• Technical Architect

- Technical architecture design
- technology configurations, performance

Solution Architect

- Requirements gathering, analysis
- Solution design (data, functions, process)

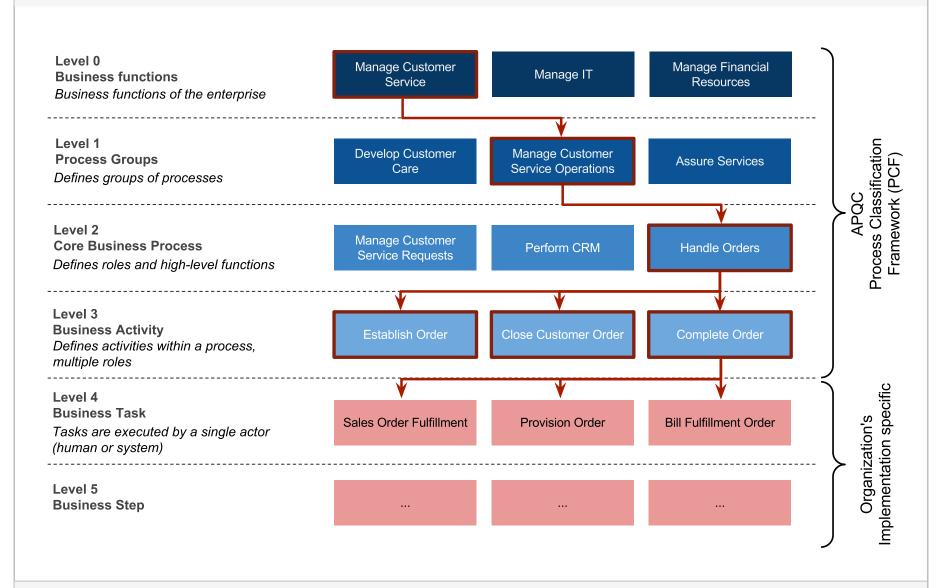
• Enterprise Architect

- High-level enterprise architecture design
 - → Applications, processes, data models
- Should be aligned with industry standards
 - → APQC American Productivity & Quality Center (Process Classification Framework)
 - → TM Forum eTOM Enhanced Telekom Operations Map (Business Process Framework)

Overview

- Architecture Overview
- Data, Functions and Processes
 - Integration
- Software Architecture

Process Classification Framework

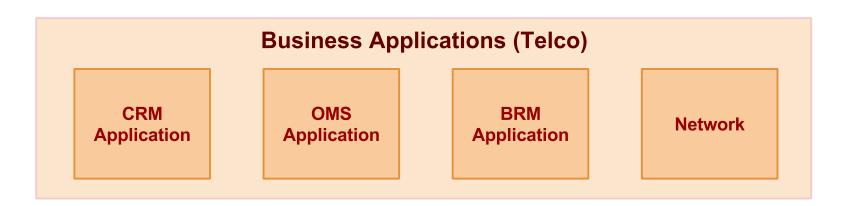


Order Process Example in Telco

- Order to Cash Process (O2C)
 - end-to-end (E2E) order process



- Involved applications
 - integrated applications



Syntax and Domain Semantics

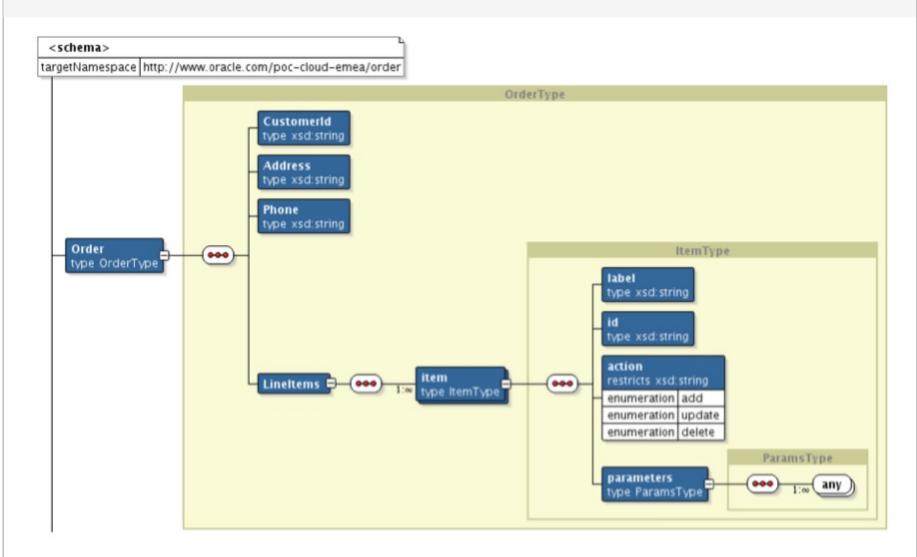
Syntax

- Data format, representation, serialization
- Various languages at various architectural levels: XML, JSON, Class/object models in a specific programming language, SQL, DB native structures, ...
- They have formal grammars, can be checked for the correct syntax

• Domain semantics

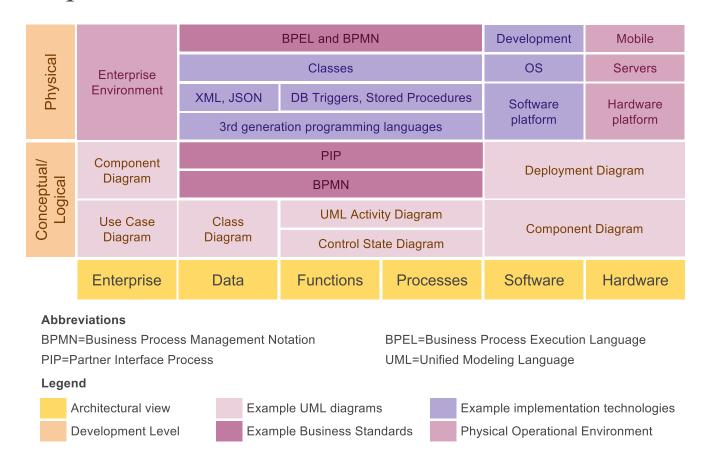
- Meaning of terms in a domain they are being used
- We understand meaning of terms:
 - → Through syntax by using the natural language
 - → Through some **agreement** among users of the terms
- Every applications can use different semantics
 - → Need to mediate data from one application to another

Simplified Order Type Example



Overview of Representations

- Languages to realize architectures
 - development levels × architectural views



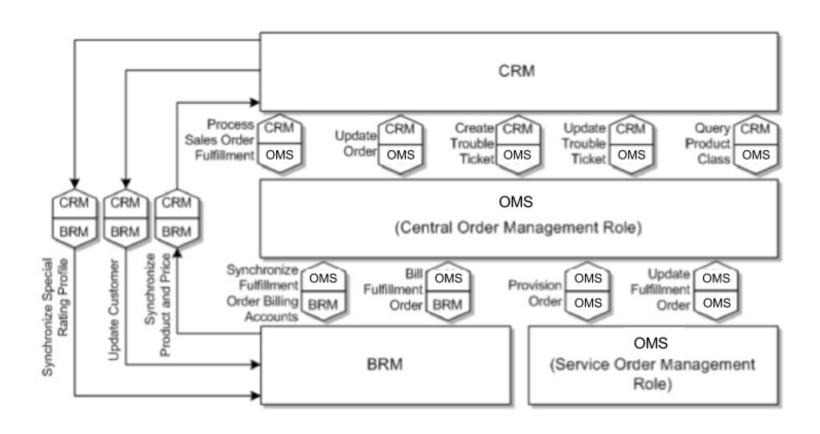
Overview

- Architecture Overview
- Data, Functions and Processes
 - Integration
- Software Architecture

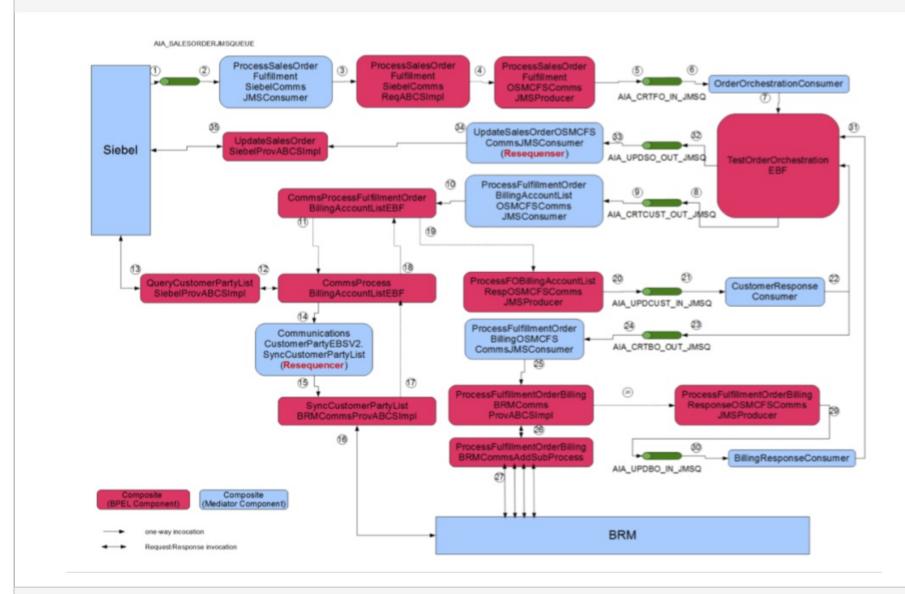
Integrating Applications

- Enterprise Application Integration (EAI)
 - applications operate in a domain
 - functions and data often overlap across domains
 - need to integrate them
 - → applications can share data
 - → applications can share functionalities
 - → applications can communicate a result of one process may trigger another one
- Business-to-Business Integration (B2B)
 - automation support for communication and collaboration among enterprises
 - for example, B2B automates customers' orders processing, tracking orders, etc.

Integration Example – O2C



Example Oracle O2C Technical Flows



Integration Issues

- Key to integration = **interface**
 - standards data, functions, processes, technical aspects
 - → enterprise standards, committee standards
 - → unified environment from a single vendor
 - mediators
 - → where standard do not work out
- Data
 - Message exchange formats, data representation
 - \rightarrow often standardized
 - Semantics of data
 - → also standardized, more difficult
- Functions and processes
 - how apps' functionalities should be consumed and orchestrated, protocols, naming issues
 - A service concept

Overview

- Architecture Overview
- Data, Functions and Processes
- Software Architecture
 - Types, Separation of Concerns, Interface
 - Client/Server Architectures

Software Architecture Types

- Centralized Client/Server (C/S)
 - Central server, a bunch of clients
 - monolithic, two-, three-, multi-tier architectures
 - Single point of failure!
 - \rightarrow when a server fails the whole system fails
 - → need for a scalable and **highly reliable** server-side solutions
 - Enterprise systems (mostly) use centralized solutions
 - → But, enhanced with peer-to-peer principles
- Decentralized Peer-to-Peer (P2P)
 - Reliability
 - \rightarrow when a node fails, other nodes take up its function
 - Scalability
 - → multiple nodes can share the load
 - → such as messaging systems in enterprise systems

Separation of Concerns

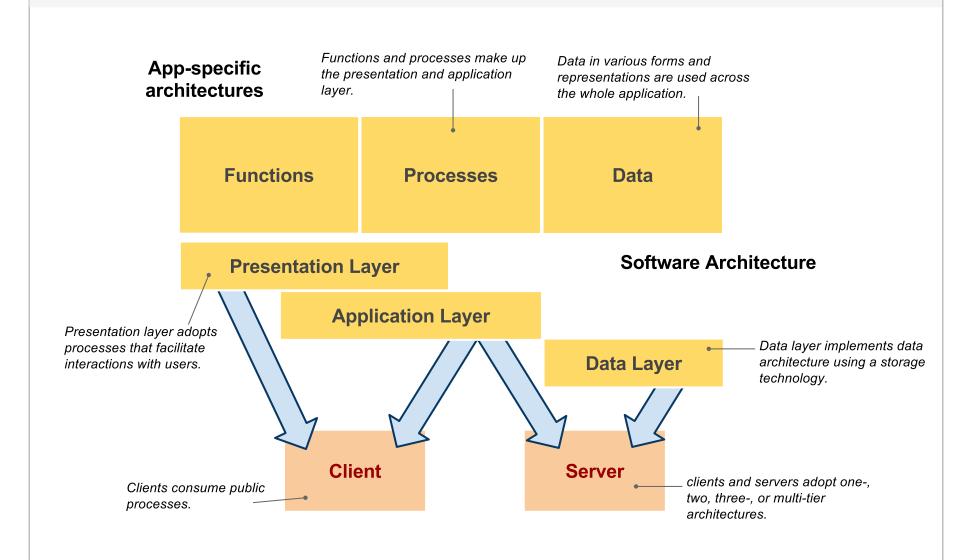
Separation of Concerns

- also called Separation of Layers
- Concern any piece of interest (part) in the application
 - → concerns should overlap in functionality as little as possible
- Basic application concerns: data manipulation, data integrity, application logic, user-interactions
- Software architecture separates concerns into layers
 - → presentation, application, data

• Interface

- ~ agreement on "how layers should communicate"
- most important artifact in Separation of Concerns
- If an interface is in place, application development and innovation can happen **independently** at each layer

Software Architecture Layers

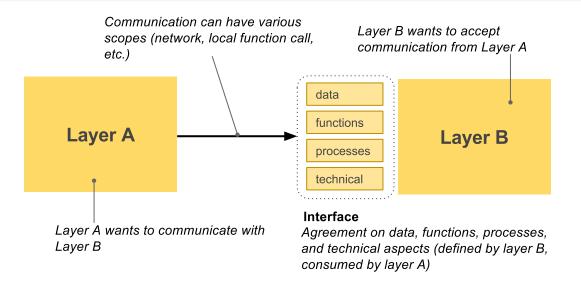


Interface

Definition

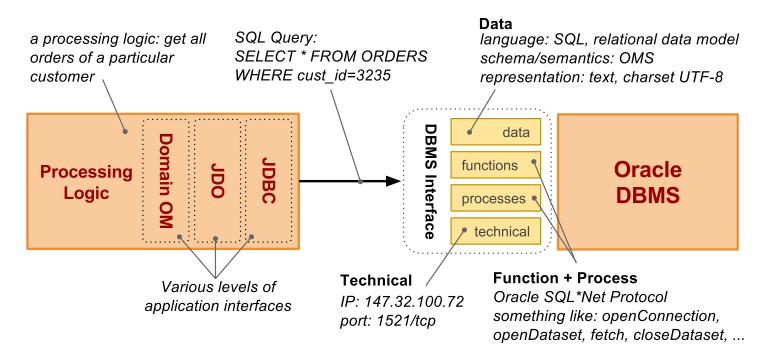
- Agreement (contract) between two or more layers during communication
- May be achieved by
 - Through standards (accepted or enforced),
 - Through a social agreement during design
 - A dominant position of a technology on the market
- Interface includes subsets of domain architectures
 - Subsets that are subject to communication between layers
 - data defines communication language (syntax, semantics),
 - functions defines entry points (operations),
 - processes defines valid states and transitions between them
 - technical details protocols, ports, IP addresses, etc.

Interface Scope



- Scope
 - local: layer A and B on one machine
 - network: layer A and B on separated machines (client/server)
- Application Programming Interface (API) ~ local scope
 - OS/complex apps' interface for extension development
- Web Services and Web API (network scope)
 - − Web API is a new term − API of Web Applications

Complex Interfaces



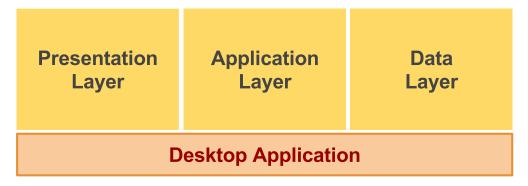
More levels of interfaces

- 1. DBMS native interface
- 2. JDBC universal connectors for various DBMS systems
- 3. JDO mapping of Java classes to data objects
- 4. Domain Object Model (OM) app-specific (~API, SDK)
 - try to be as universal as possible; cover many technologies

Overview

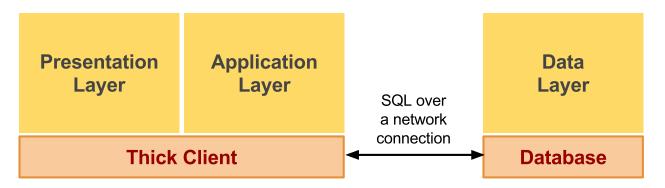
- Architecture Overview
- Data, Functions and Processes
- Software Architecture
 - Types, Separation of Concerns, Interface
 - Client/Server Architectures

Monolithic Architecture



- All layers on a single machine
 - usually non-portable apps; specific OS
 - first types of computer systems, typical for 90-ties
 - single-user only; standalone apps, minimal integration
 - technologies: third-gen programming languages, local storage systems
- Drawbacks
 - hard to maintain (updates, distribution of new versions)
 - data security issues
 - performance and scalability issues

Two-tier Client/Server Architecture

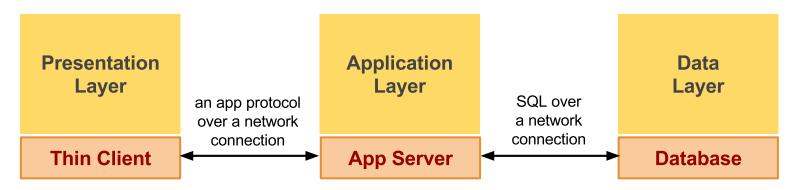


- Presentation and app layers separated with data
 - Thick client desktop application, OS-dependent
 - Data on a separate server (DBMS)
 - Multi-user system, all sharing a database
 - Storage system of high performance, transactions support
 - SQL technology; native OS desktop application

Drawbacks

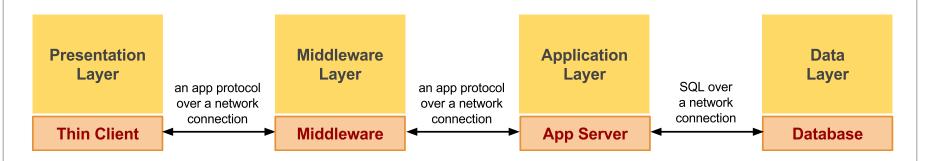
- Thick client hard to maintain (reinstallation with every update)
- No app logic sharing (only through copies)
- Data-oriented integration (integrity in the app logic!)

Three-tier Client/Server Architecture



- All layers on separated machines
 - Thin client desktop application or interpreted code
 - Multi-user system, all sharing app logic and a database
 - App server of high performance, scalability
- Drawbacks
 - Spaghetti integration (see Lecture 1)
 - Limited, single app server scalability

Multi-tier Client/Server Architecture



- Additional middleware layer
 - loose coupling, shift towards peer-to-peer architectures
 - provides value-added services for communications
 - individual servers or a compact solution (e.g., Enterprise Service Bus)

Types of Middleware

Scalability

- They help to achieve high performance through better scalability
- Messaging Servers (message queues, publish/subscribe)
- Load Balancers
- Proxy servers, reverse proxy

Functional

- They help to achieve more flexible integration
- Process servers
- Repositories, registries of services/components
- Mediators data interoperability, process interoperability, technical interoperability (SOAP server)
- Monitors for analytics of apps usages

• Security

- Firewalls, Gateways, ...