Software Design and Architecture

Software Connectors

Software Connectors …

- **During the refinement of the software architecture**

  - If the two elements are mapped to a single process, the connector could be mapped to a local method invocation
  - If the two elements are mapped to two different processes on the same computer, then the connector could be mapped to a local message queue or a pipe
  - If the two elements are mapped to two different computers, then remote method invocation or Web service invocation could be used for the architectural refinement for the corresponding connector between them

Software Connector Classification

- **Based on connector's synchronization mode**
  - **blocking**
    - allows one of its incident elements to send a request (method call or message) to another and wait for a response (method return value or message), and the element will be blocked from further execution until it receives a response
  - **non-blocking**
    - allows one of its incident elements to send a request (method call or message) to another and then continue its execution without waiting for a response

Software Connector Classification …

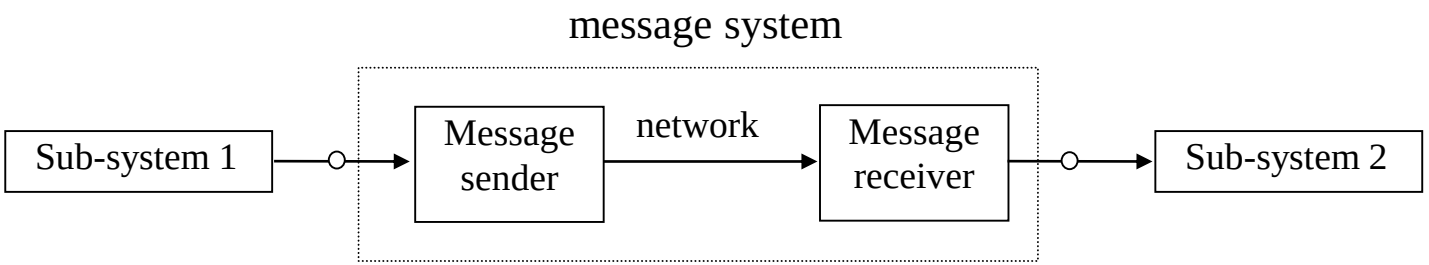
- **Based on the connector's initiator**
  - An initiator is an incident element of a connector that can make a request to its partner
  - ***one-initiator connectors***
    - allows one of its two incident elements to make a request to the other element, but not the another way around
  - ***two-initiator connectors***
    - allows either of its two incident elements to make a request to the other element
      - For a system to support callback between its two sub-systems, the two sub-systems must be connected by a two-initiator connector

Software Connector Classification …

- **Based on connector's information carrier**
  - Variable
    - for elements in the same process
  - Environment resource
    - for elements in different processes of the same system
  - Method
    - Local invocation
    - Remote invocation

Software Connector Classification …

- **Based on connector's information carrier …**
  - Message
    - An example message system, consisting of a message sender module and a message receiver module connected by a network, is used to implement a one-initiator connector for sub-system 1 to send messages/requests to sub-system 2
    - A message format must be defined so both the message sender and the message receiver can understand the messages
    - a protocol must be adopted to decide the proper handshaking and synchronization between the two parties



Software Connector Classification …

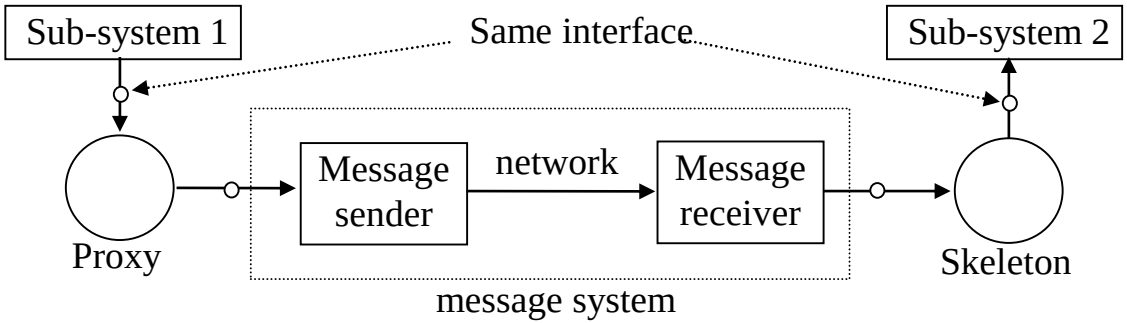
- **Based on connector's implementation type**
  - Signature-based
    - The method's name indicates an operation, and the parameters carry argument values for the execution of the operation
    - If we assign one or more parameters of a method also to indicate operation types, then the connector can be used to implement protocols
  - Protocol-based
    - A protocol-based connector can implement multiple operation types with a single binding signature

Software Connector Classification …

- **Based on connector's active time**
  - Programmed
    - A method call will be made at a time specified at programming time
  - Event-driven
    - One element will function as an event source
    - All elements that need be notified of the event will register as listeners of the event source
    - When the event happens, all the registered listener elements will be notified for potential reaction
      - Method callback can be considered as a special case of this event-driven mechanism

Software Connector Classification …

- **Based on connector span**
  - Local
    - The incident elements are located in the same processor
  - Networked
    - Normally implemented with the proxy design pattern to support object-oriented programming paradigm in a distributed environment



Software Connector Classification …

- **Based on connector fan-out**
  - "1-1"
    - for connecting two elements only
  - "1-*"
    - for connecting one element with variable elements of the same type
      - A web server and the web browsers are connected with a 1-* connector
      - So are the server and clients in a client-server architecture

Software Connector Classification …

- **Based on connector environment**
  - Homogeneous
    - The incident elements of a homogeneous connector are implemented with the same programming language and software framework and run on the same operating system
  - Heterogeneous
    - The incident elements of a heterogeneous connector may be implemented with different programming languages or software frameworks and may run on different operating systems

Software Connector Classification …

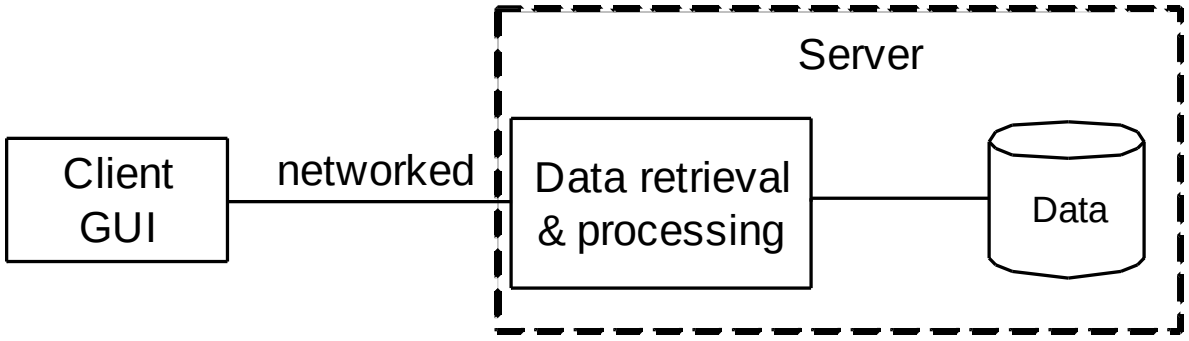
- **Based on connector environment …**
  - Heterogeneous …
    - CORBA, Web services and messaging are typical implementation technologies for heterogeneous connectors
    - Heterogeneous connectors are usually implemented with the broker design pattern
    - A message system could be implemented with the message sender and receiver modules implemented in different programming languages or on different platforms

An Agile Example to Software Architecture Design

- **A standalone data presenter**

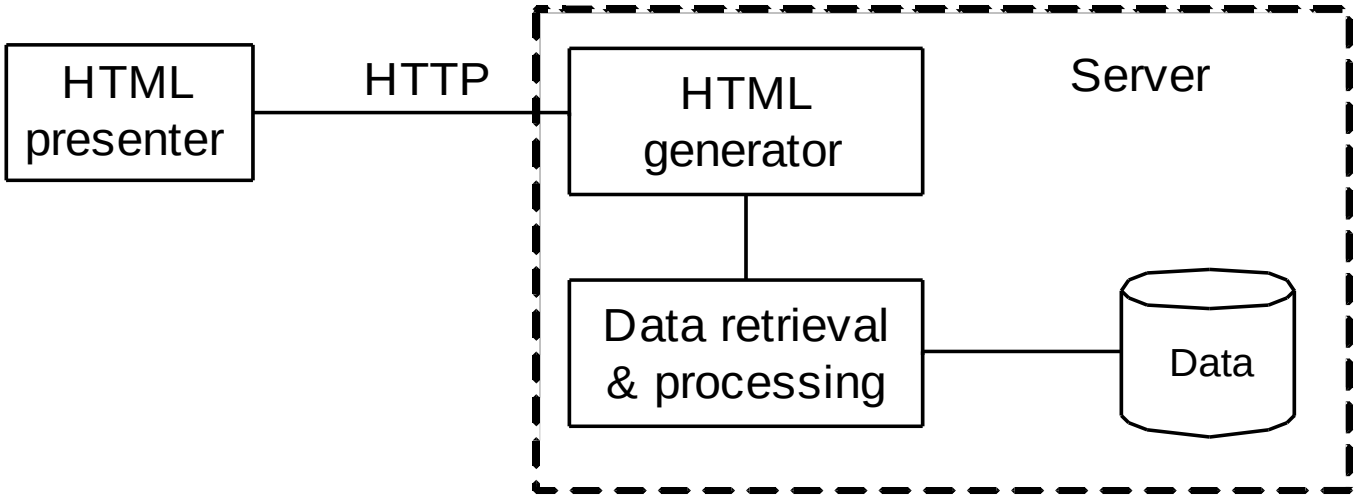
An Agile Example to Software Architecture Design

- **Networked data presenter**



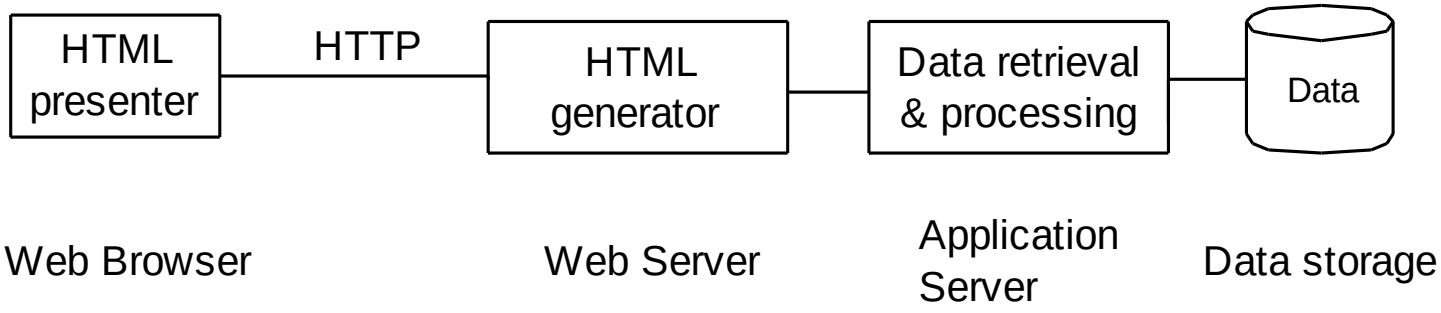
An Agile Example to Software Architecture Design

- **HTML and HTTP based data presenter**



An Agile Example to Software Architecture Design

- **The web architecture**



Summary

- Introduce software connectors

- Classification of software connectors