Limitations of Object-Based Middleware

Object-Oriented programming is a standardised technique, but…

- Lack of defined interfaces between objects
- It is hard to specify dependencies between objects
- Internal configuration of objects
- Long time to install new applications

Components

- Components are functional entities – they must define what they offer and what they need
- Application construction: composition of objects with defined interfaces
- Semi-automatic deployment of the application: Run-time environment configuration
Components in CORBA

**CORBA Component Model (CCM)**

- Distributed, component-oriented model
- *Components* are binary code fragments for functional entities, maybe implemented in different languages
- Application deployment by definition of functional entities and interactions between entities
- Standardised environment for
  - Component management: creation, activation, deactivation, …
  - CORBA services for components (Security, Persistence, Event, Transactions)
- Interoperability with Enterprise Java Beans (EJB)

„CORBA Component Model is a specification for creating server-side scalable, language-neutral, transactional, multi-user and secure enterprise-level applications“
The CORBA Component Model

- Extends the CORBA Object Model
- Provides standard run-time environment for components
  - application servers
  - containers
- Component: reusable physical entity
- Container: standardised execution environment for components
- Application server: generic server process
- Adoption of POA
- Uses CORBA services: Transactions, Security, Event, …
CORBA Component

- Component is a new CORBA meta-type.
  - Extension of type Object (with constraints)
  - Has an interface, and an object reference
  - Also, a stylized use of CORBA interfaces/objects
- Provides component features (also named Ports)
- Could support multiple interfaces
- Each component instance is created and managed by a unique component home

A component describes:
- What functionality a component offers to other components
- What functionality a component needs from other components
- What kind of interaction are used between components: synchronous or asynchronous
- Which component properties can be configured
- Which manager is responsible for managing component instances
A CORBA Component

Concepts:
- Component interface
- Facets
- Event sources
- Event sinks
- Attributes
- Offered operation interfaces
- Required operation interfaces
- Offered operation interfaces
- Required operation interfaces
- Consumer events
- Produced events
- Configurable properties
Building CCM Applications is Assembling Component Instances
Facets

- Multiple named interfaces that provide the component’s application functionality to clients - one of these must be the same as the supported interface
- Each facet embodies a view of the component, corresponds to a role in which a client may act relatively to the component
- A facet represents the component itself, not a separate thing contained by the component
- Facets have independent object references
Receptacles

- Connection points between components, where one uses an interface of another
- No inherent life cycle dependencies or ownership relationship implied - no operations are inherently transitive across receptacle connection
- “Plug in” to the receptacle one or more references to instances of the required component type
  - Explicit client relationship
  - Ability to specialize by delegation, compose functions
  - IDL compiler generates operations to connect to and disconnect from the receptacle
Events

- Decoupled communication between components
  - Receptacle supports direct communication between components
  - In contrast, events are indirect: Event channel contacts set of consumers for each event
- Simple event model based on channels
- Subset of CORBA Notification Service (“push” model)
- Components can declare that they
  - Produce a kind of event (event source)
    - Emit (1:1)
    - Publish (1:N)
  - Accept a kind of event (event sinks)
Attributes

- Named configurable properties
- Allow component configuration on an instance basis
- Determine behavior (within range of possible behaviors) for particular component instance

- “Configurator” objects can configure components by establishing attribute values
  - Attributes exposed through accessors and mutators
  - Signal when completed and then validity checked
- Can be configured
  - By visual property sheet mechanisms in assembly or deployment environments
  - By homes or during implementation initialization
  - Potentially readonly thereafter
Homes

- A home manages a specified component type
  - Home definition is distinct from component definition
  - More than one home type can manage the same component type (but any given component instance has only one home)
  - Allows life cycle characteristics or key type to vary/evolve without changing component definition
- Instantiated at deployment time
A CORBA Component Home

Home interface

MyComponentHome

C₁

... 

Cₙ
HomeFinder

- A HomeFinder is used to find out the reference for the home interface belonging to a component type
- All homes can be registered here (is not done automatically)
- A brokerage of homes to clients
  - Home implementations register with home finder
  - Clients request homes from home finder
- Home finder makes determination of what is the “best” home to service a client, based on the client’s request and any available environmental or configuration data
- `resolve_initial_reference("ComponentHomeFinder")` gives back reference to HomeFinder
Dining Philosophers Example

Thinking
Hungry
Starving
Eating
Dead

Kant

Fork

Descartes

Fork

Aristotle

Thinking
Hungry
Starving
Eating
Dead

Kant

Fork

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Kant

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Thinking
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Dead
component Philosopher
{
    attribute string name;
    // The left fork receptacle.
    uses Fork left;
    // The right fork receptacle.
    uses Fork right;
    // The status info event source.
    publishes StatusInfo info;
};

home PhilosopherHome manages
    Philosopher {
    factory new(in string name);
};
Chapter 8: Middleware

Dining Philosophers as CORBA Components

Philosopher name = Kant

Philosopher name = Descartes

Philosopher name = Aristotle

Fork

Fork

Fork

Observer

Component
Base ref.
Facet
Receptacle
Event Sink
Event Source
Philosopher State Types

```c
enum PhilosopherState {
    EATING, THINKING, HUNGRY,
    STARVING, DEAD
};

eventtype StatusInfo {
    public string name;
    public PhilosopherState state;
    public unsigned long ticks_since_last_meal;
    public boolean has_left_fork;
    public boolean has_right_fork;
};
```
component Philosopher
{
    attribute string name;
    // The left fork receptacle.
    uses Fork left;
    // The right fork receptacle.
    uses Fork right;
    // The status info event source.
    publishes StatusInfo info;
};

home PhilosopherHome manages Philosopher {
    factory new(in string name);
};
exception InUse {}; interface Fork {
    void get() raises (InUse);
    void release();
};
// The fork component. component ForkManager {
    // The fork facet used by philosophers. provides Fork the_fork;
};
// Home for instantiating ForkManager components. home ForkHome manages ForkManager {};
component Observer
{
    // The status info sink port.
    consumes StatusInfo info;
};

// Home for instantiating observers.
home ObserverHome manages Observer {};
Client Programming Model

- Component-aware and -unaware clients
- Clients see two design patterns
  - Factory – Client finds a home and uses it to create a new component instance
  - Finder - Client searches an existing component instance through Name Service, Trader Service, or home finder operations
- Invokes operations on component instances