Creating CORBA Applications Using UML and SDL

Morgan Björkander

mbj@telelogic.com

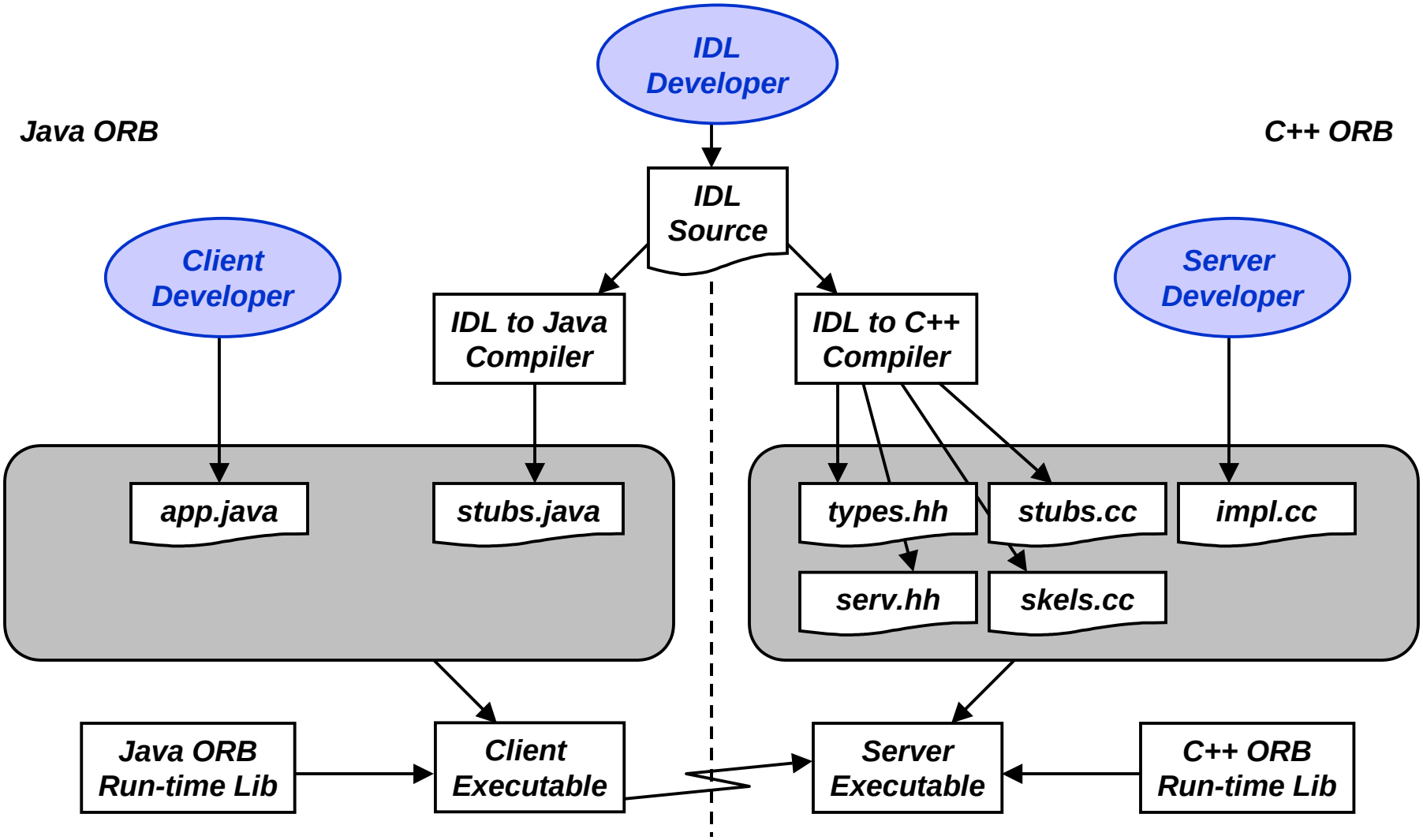
Two Observations

- Many profiles are being defined to tailor the UML towards specific domains
- There is an increased focus on specifying behavior in UML
  - Making it executable
  - Allowing early verification

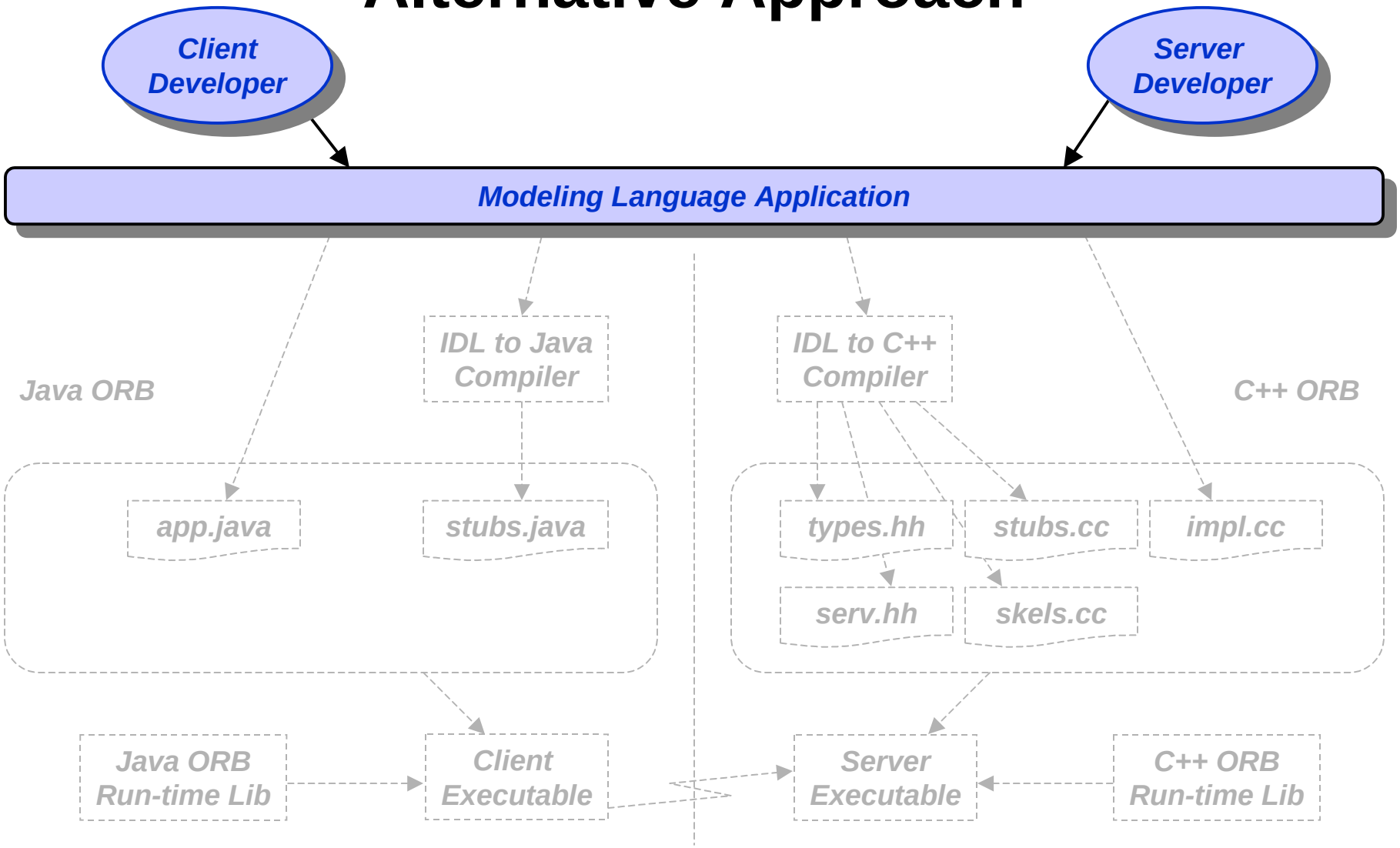
CORBA IDL—an Abstract Language

- IDL is used as an abstract language in the sense that it is target language independent
  - What if it were possible to specify behavior in a manner that is also target language independent?
- UML contains a profile mechanism that can be used to tailor it towards specific domains, but also to create language mappings

Creating a CORBA Application

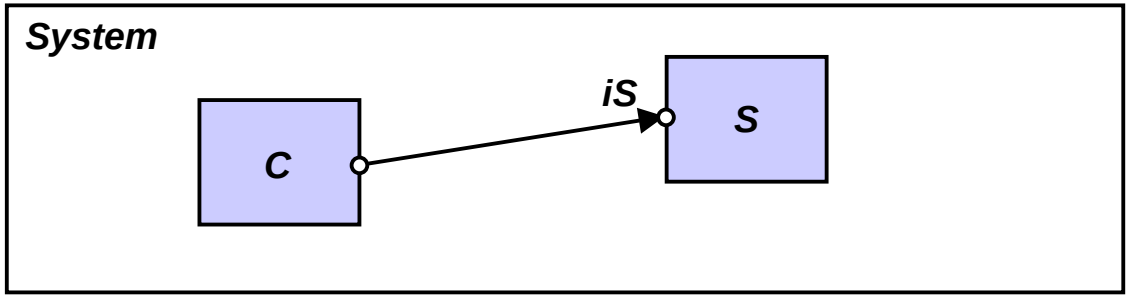


Alternative Approach

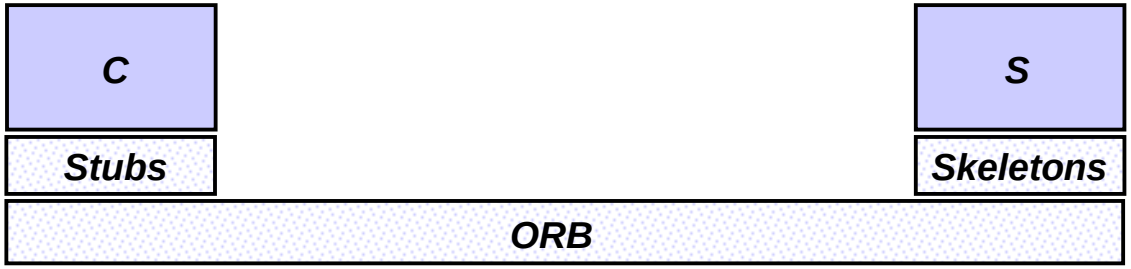


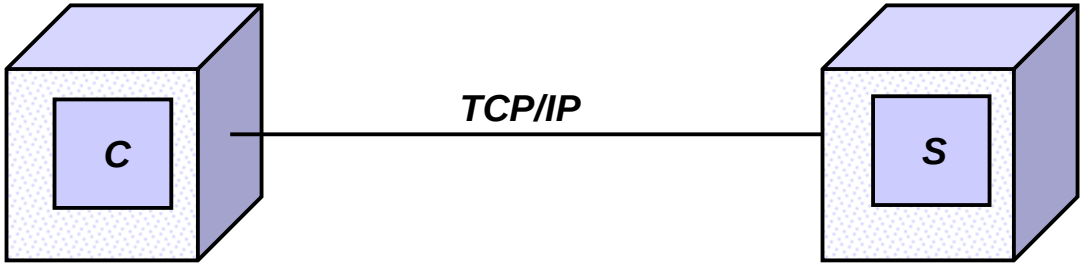
Raising the Abstraction Level

Target language independence

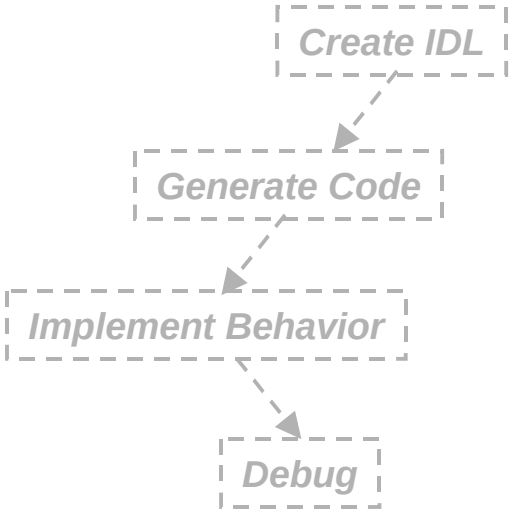


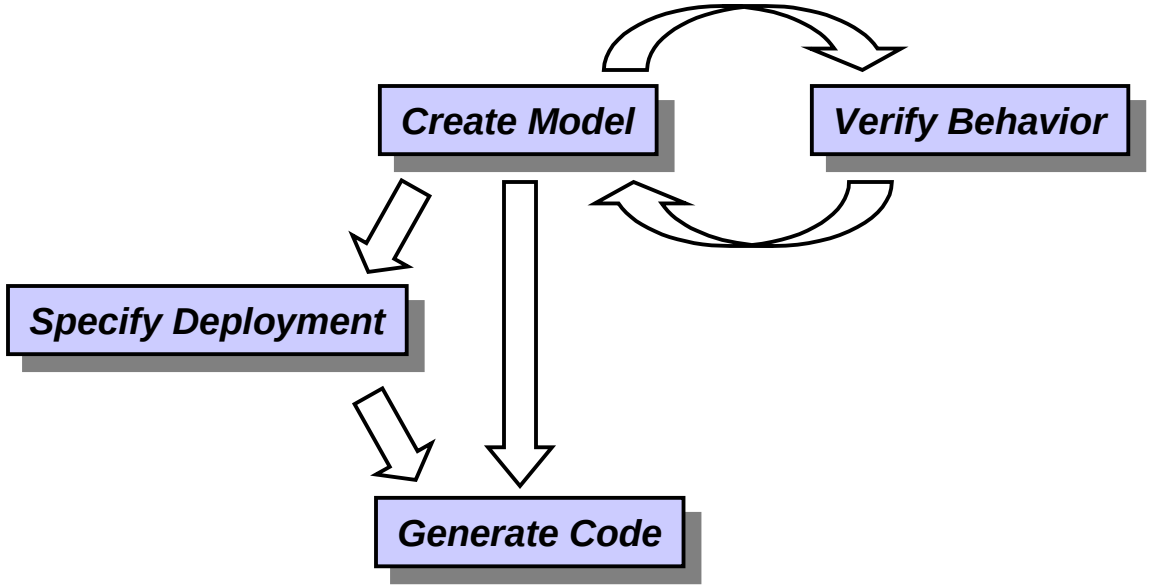
Platform independence





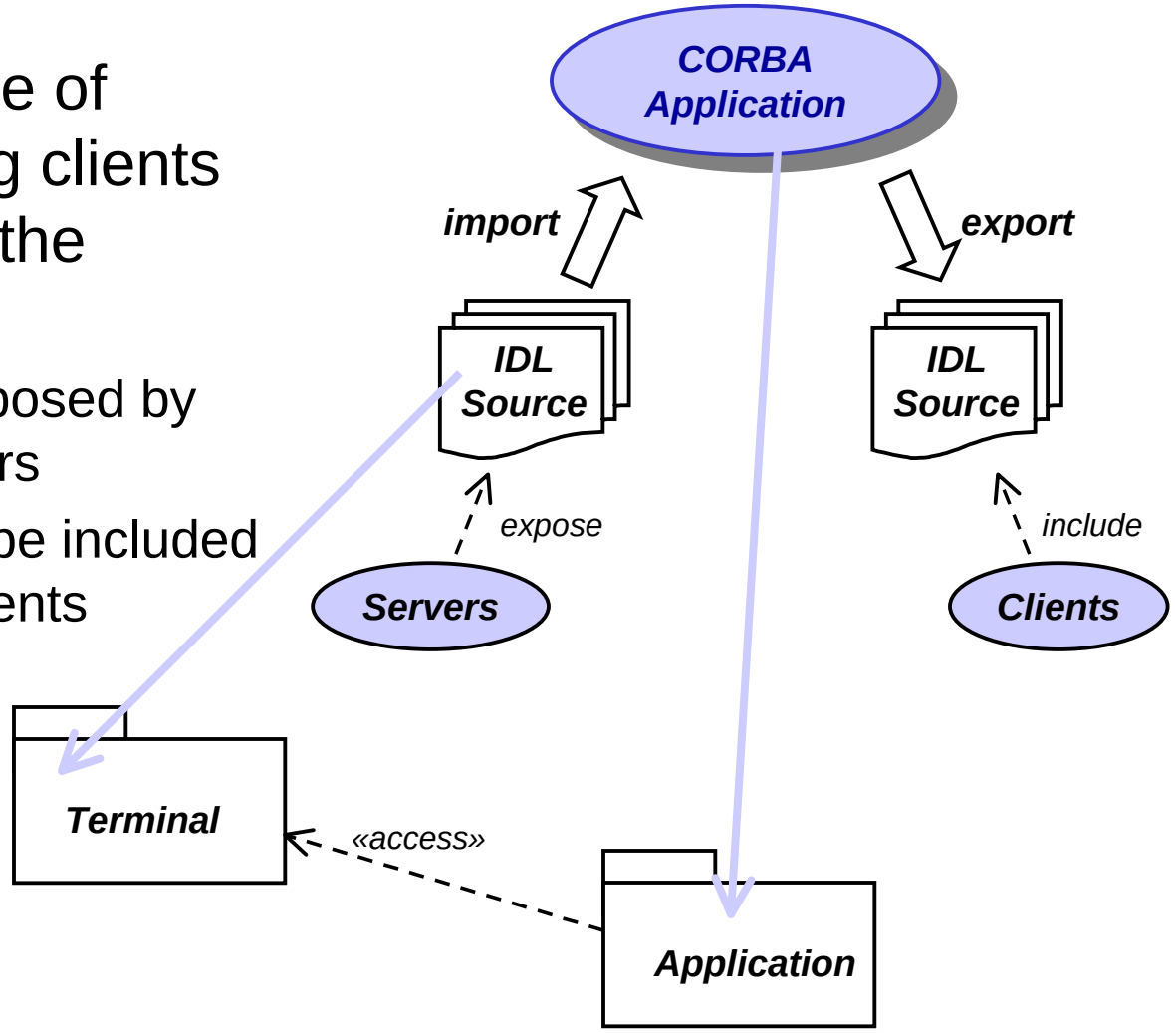
Process Considerations





Importing and Exporting IDL

- Take advantage of already existing clients and servers in the network
  - Import IDL exposed by external servers
  - Export IDL to be included by external clients



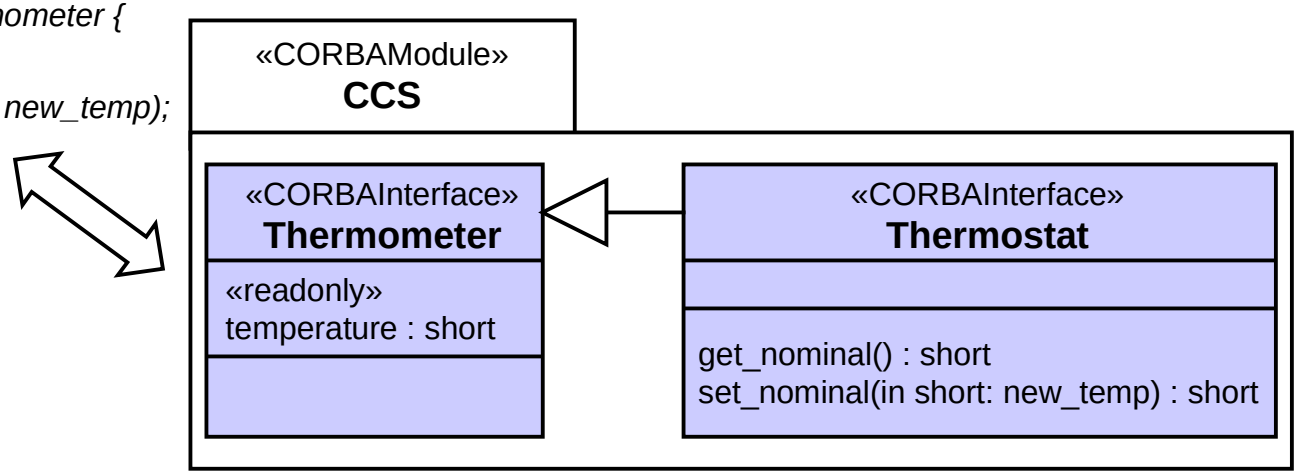
UML Profiles

- Stereotypes
  - Model elements that can be used as if they are a part of UML
  - Specialize existing model elements
- Tagged Values
  - Define additional stereotype properties
- Constraints
  - Restrict the use of stereotypes

The UML Profile for CORBA

- Specifies how to use interface descriptions (IDL) in UML
- Does not (and was not intended to) cover the logical next step: *behavior*

```
// IDL sample code
module CCS {
    interface Thermometer {
        readonly attribute short temperature;
    };
    interface Thermostat : Thermometer {
        short get_nominal();
        short set_nominal(in short new_temp);
    };
};
```



Action Semantics for the UML

- Turn the UML into an executable language
  - Provides the semantics of actions
    - Lacks a notation
    - Does not include a data model
- Necessary to map a language on top of the action semantics (such as C++, Java, or SDL)
  - Target language independence?
  - At some point in the future, UML may provide sufficient detail by itself

SDL-2000

The Specification and Description Language

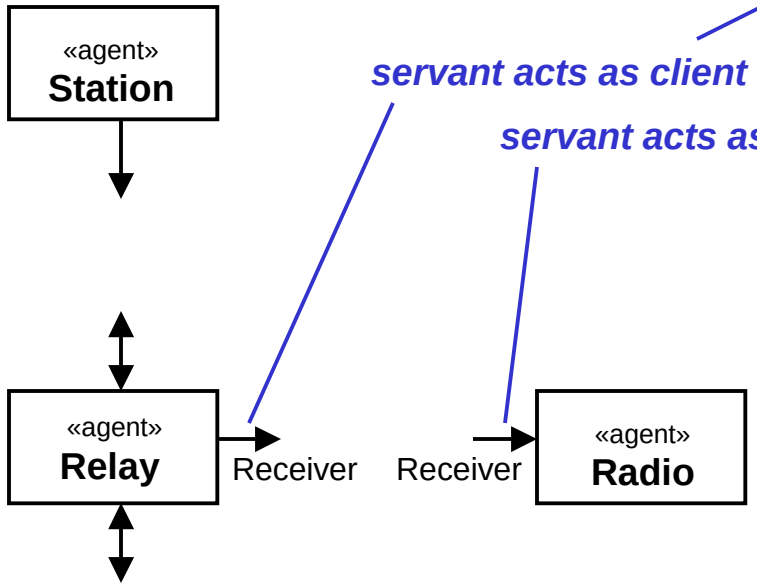
- SDL is an executable modeling language that is standardized by the ITU
  - Similar to UML in many ways, but specifically geared towards modeling of event-driven, distributed applications
- It is often used as a full-fledged programming language
  - There are many indications that UML is heading in the same direction

Using IDL

- Incorporate IDL data types in the action language
  - Basic data types
  - User-defined types
  - Extend types with operators defining “+”, “-”, type casting rules, etc.
- Attributes and parameters can be declared using these IDL data types
  - IDL interfaces may be shown textually or graphically (using the UML profile for CORBA)

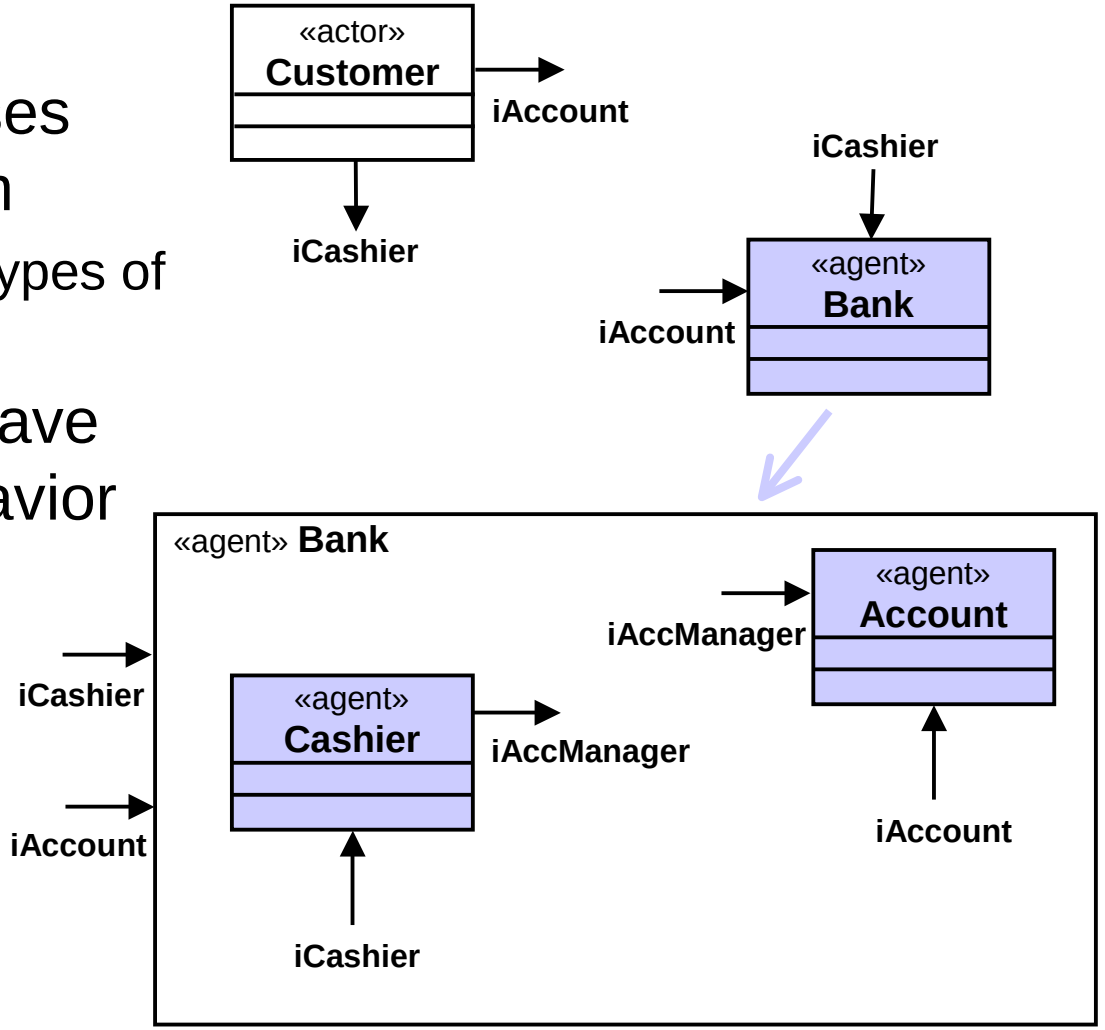
Designing the Application

- *Agents* define logical components
  - define the system's functionality
- Bi-directional interfaces specify contracts between agents
  - required interfaces
  - implemented interfaces
    - an agent may implement multiple interfaces



An Example: Static Structure

- Describe the classes used in the system
  - agents are stereotypes of classes
- Each agent may have structure and behavior



An Example: IDL Interfaces

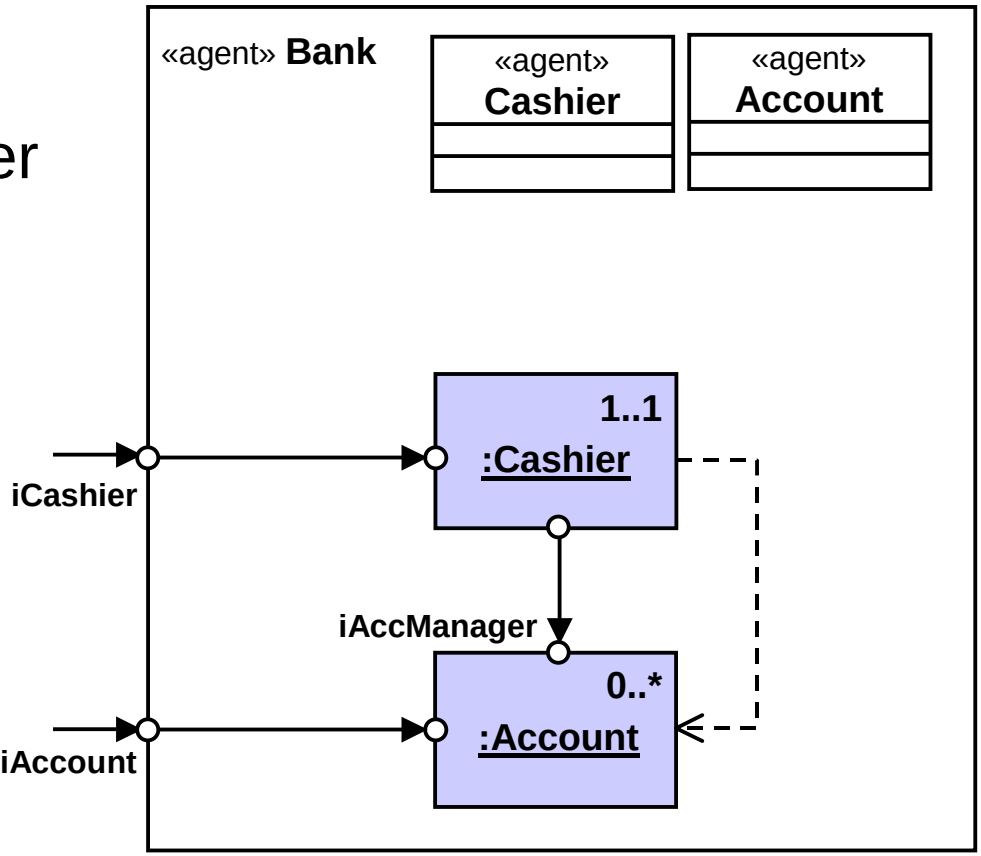
```
// Customer's view of accounts
interface iAccount {
   typedef double MoneyT;
   readonly attribute MoneyT balance;
   void insert(in MoneyT amount);
   void withdraw(in MoneyT amount)
      raises (InsufficientBalance);
};

// Customer's view of cashiers
interface iCashier {
   iAccount createAccount(in string code, out number);
   void terminateAccount(in iAccount account)
      raises (NoAccount, AccountLocked);
   iAccount loginAccount(in string code, in long number)
      raises (WrongCode, WrongNumber);
};
```

```
// Manager's view of accounts
interface iAccManager : iAccount {
   iAccount addInterest(in float rate);
};
```

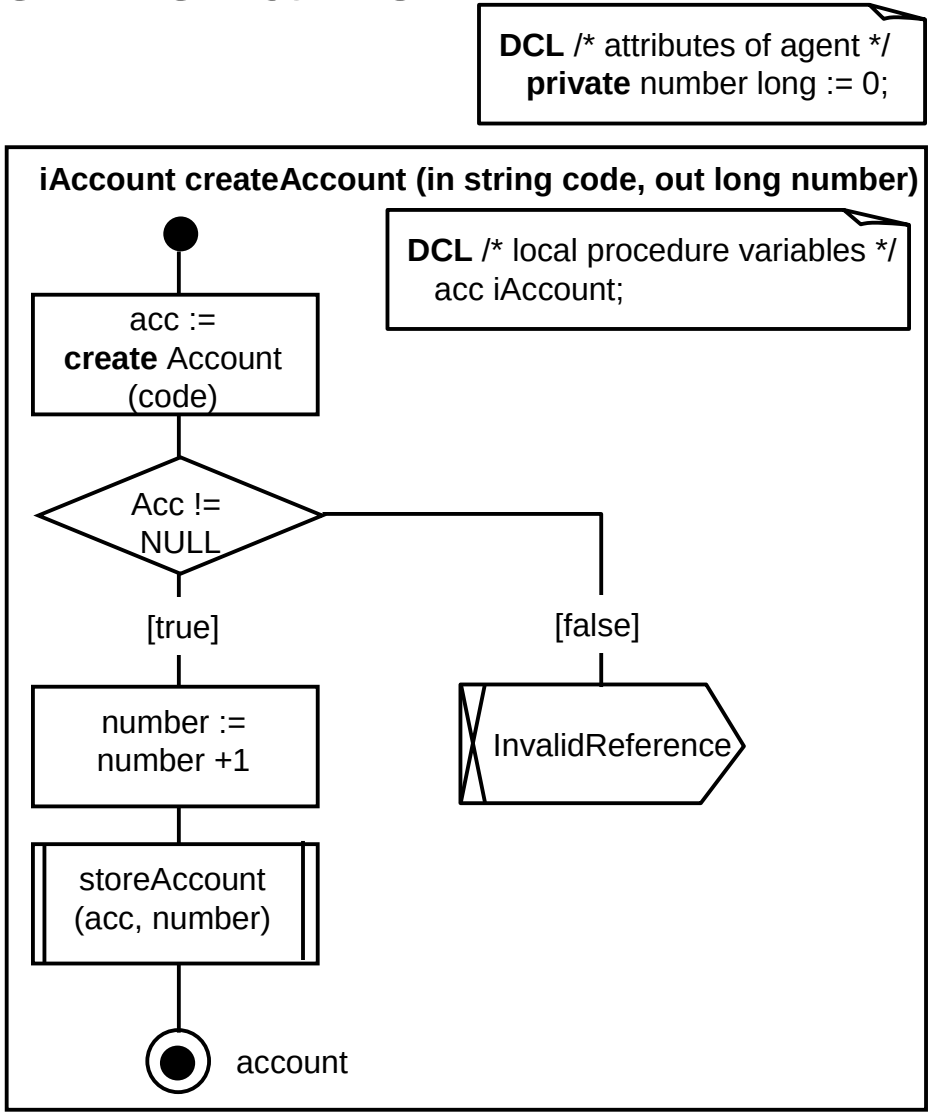
An Example: Dynamic Structure

- Describe how agents interact with each other
  - connections
  - dynamic creation
- Provide initialization information
  - number of instances to be created at start-up
    - multiplicity
  - compare with main function

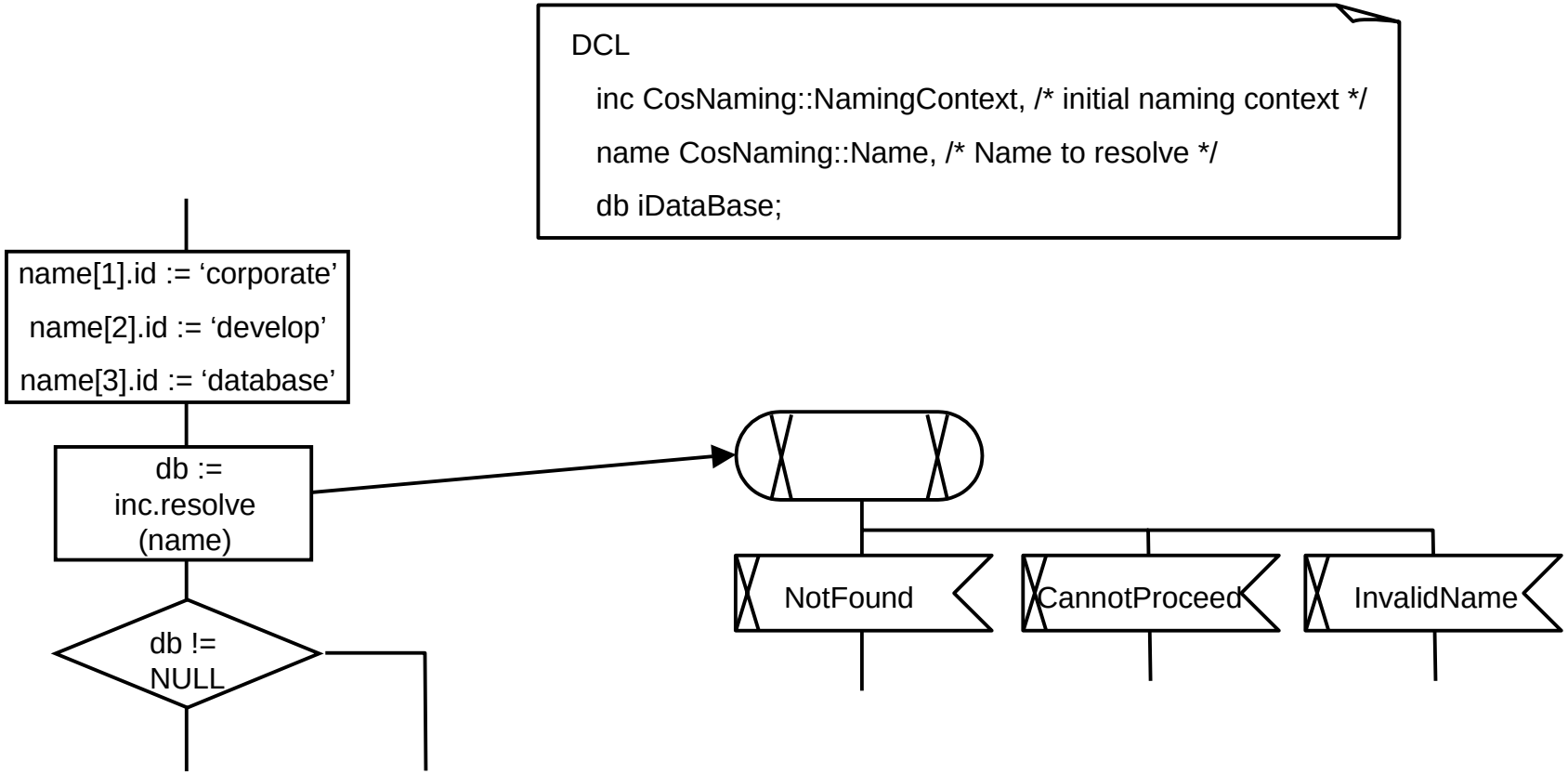


An Example: Behavior

- Action semantics defines the behavior of
  - operation bodies
  - transitions
  - entry/exit actions
- Each such computational unit is represented by a *procedure*
  - a sequence of actions



An Example: Using CORBA Services



Deployment

- Determine if and how to partition the system
- Determine code generation policies for each partition
  - orb
  - target language
- Manage the setting of POA policies
- Tagged values may be used to control desired behavior, such as:
  - persistent objects
  - transient objects

Application Code Generation

- The final step is to generate the application code for the different parts of the system
  - according to deployment information
- Apply the IDL mapping rules for the target language
- Generate implementation specific details according to model

References

- Henning, M., Vinoski, S.: Advanced CORBA® Programming with C++, Addison-Wesley, 1999
- OMG: The Unified Modeling Language Specification, version 1.4 draft, 2000
- OMG: The UML Profile for CORBA, 2000
- OMG: Action Semantics for the UML, RFP, 1998
- OMG: Action Semantics for the UML, Joint Initial Submission, 2000
- ITU-T: ITU Recommendation Z.100: Specification and Description Language (SDL), Geneva 2000
- ITU-T: ITU Recommendation Z.109: SDL Combined with UML, Geneva 2000