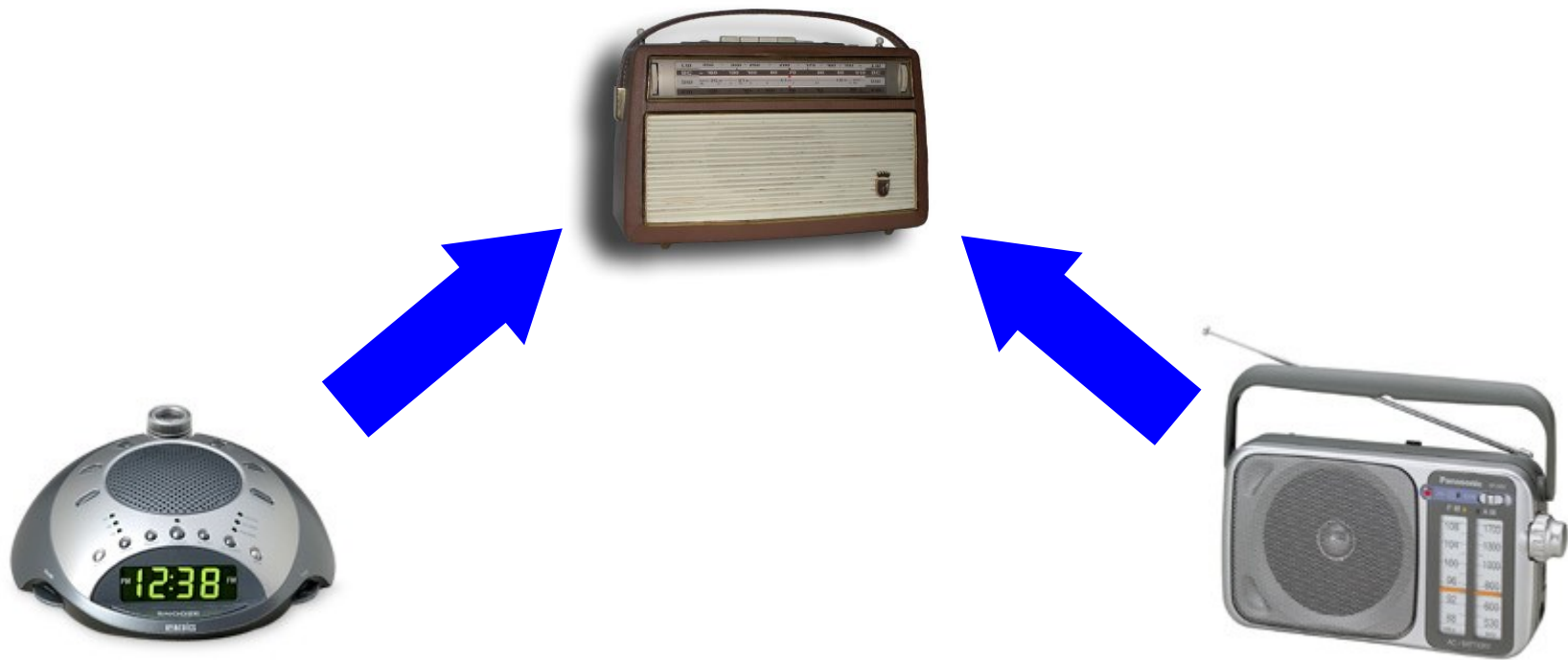


Using Resemblance to Support Component Reuse and Evolution



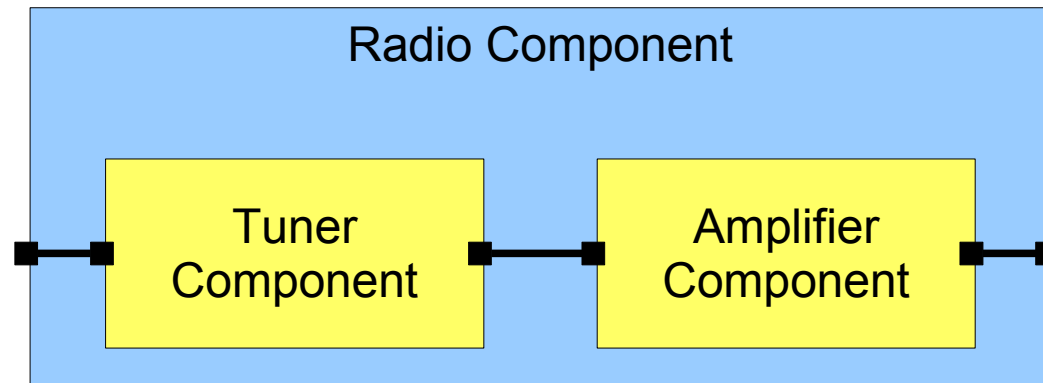
Andrew McVeigh, Jeff Kramer and Jeff Magee
Department of Computing
Imperial College, London

SAVCBS 2006

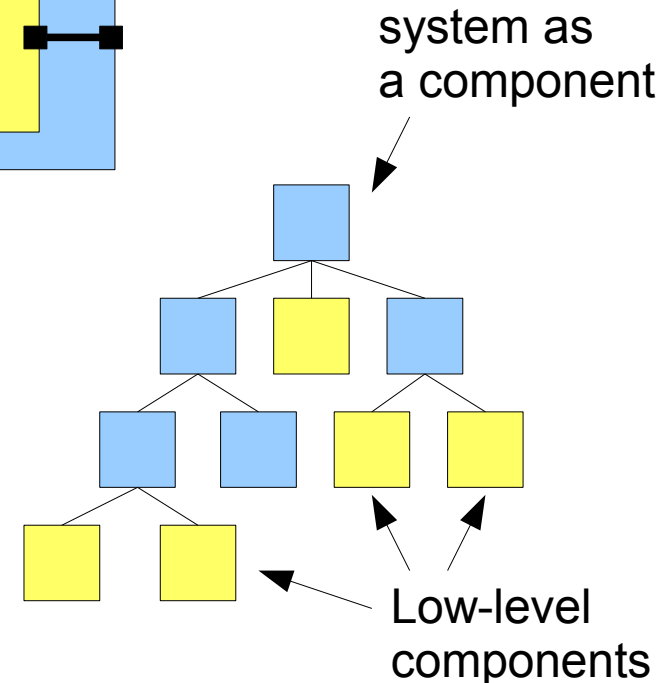
Introduction

The Vision of Software Components

- Composite components are constructed by composing existing components and connecting them together
E.g. A radio...

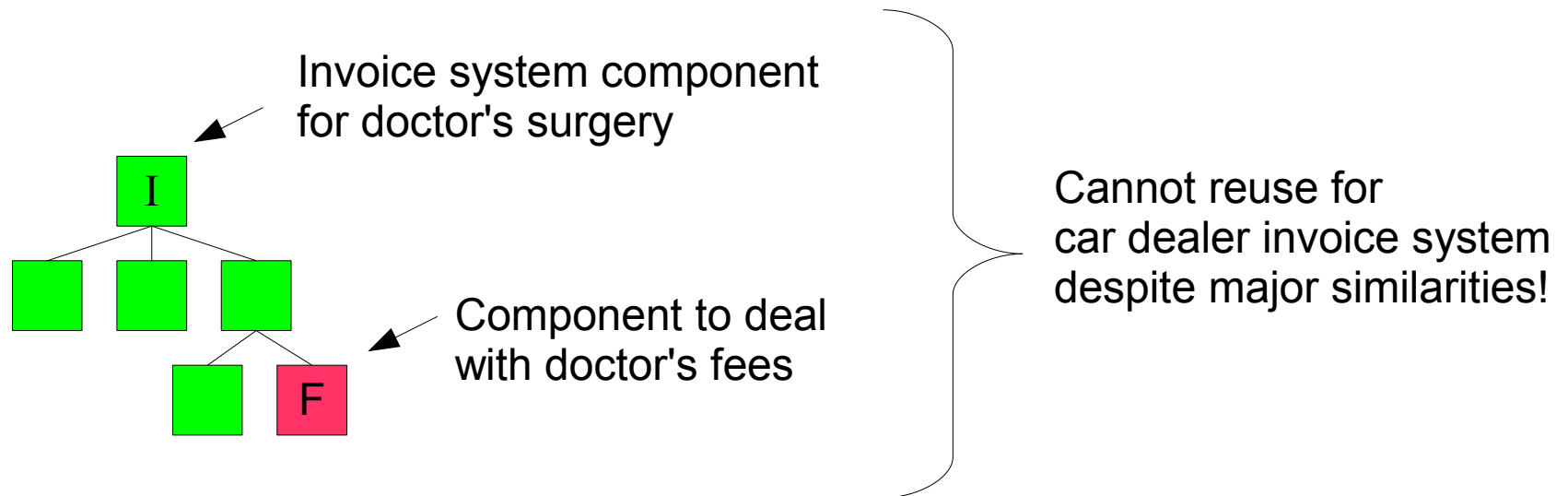


- This is a scalable concept...
 - Entire systems can be represented hierarchically in this way



But, Higher Abstraction = Less Reuse

- System construction should ideally be a case of connecting together increasingly higher-level components...
- BUT the higher the level of abstraction of a component
 - the more specific it generally is (buried abstractions)
 - the less reusable it becomes...



4 Requirements for a Reuse Solution

- Reuse implies (extensive) alterations *1. Alter*
- Can we just change existing component?
 - No! We can't break it for existing users *2. NoImpact*
- **Can we copy and modify the source?**
 - No! Must be able to accept upgrades *3. Upgrades*
 - Copying leads to maintenance problems
 - We may not have the full source code *4. NoSource*

Keep components the
same for existing users



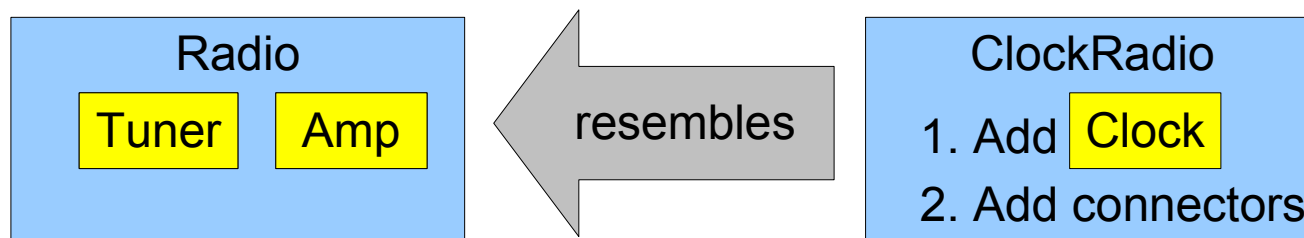
Change components
for reuse

To address these we introduce two constructs:

Resemblance and Redefinition

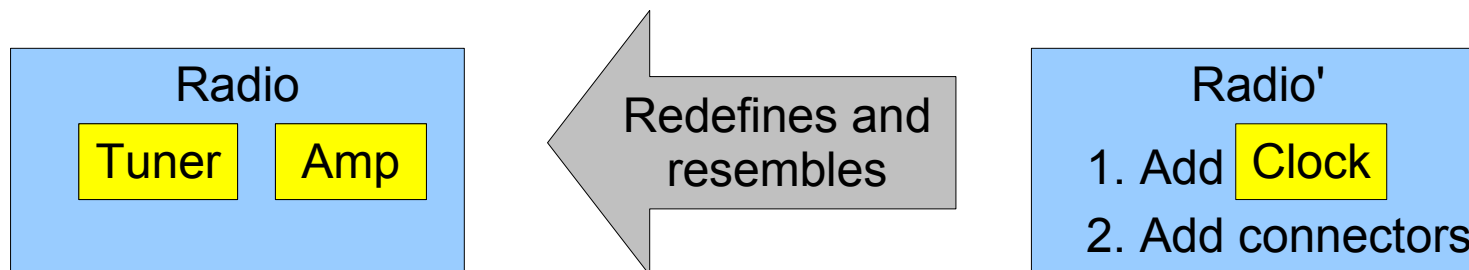
Resemblance: Enabling Reuse

- Defines a component in terms of similarity to another
 - An inheritance-like construct for components
 - The new component is specified as add / delete / replace changes to the architecture of a base component
- **We keep the changes as elements in the new component**
 - Lets us reason about combining changes, upgrades etc.
- Intuitively: ClockRadio resembles Radio, but adds a Clock



Redefinition: Modelling Evolution

- Used to model evolution of a component
- Replaces the existing definition of a component
 - The existing definition and the redefinition are kept separate
 - Changes will only be applied if redefinition is “loaded”
 - Can be combined with resemblance to evolve a component in terms of changes to the old definition
- Intuitively: Evolving a Radio to add a Clock



Using the Constructs

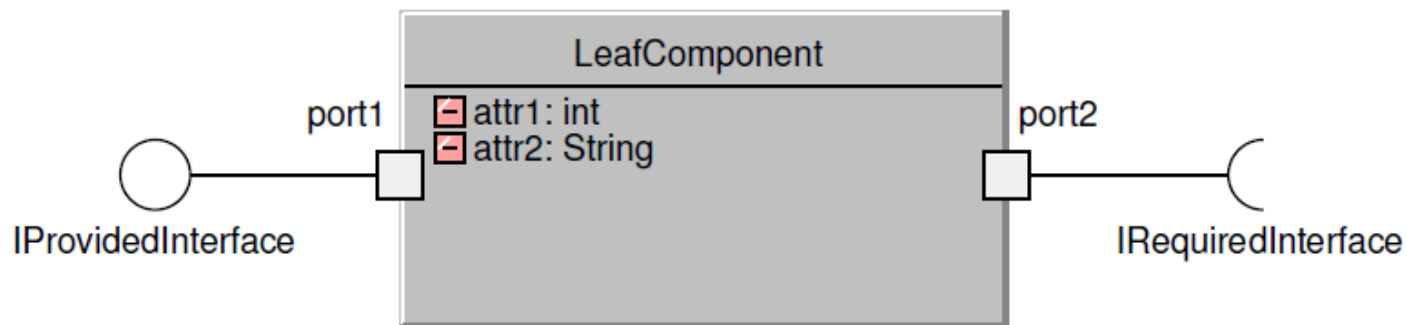
These can be used independently, or together:

- Resemblance
 - defines one component in terms of changes to another
- Redefinition
 - changes the definition of an existing component
- Resemblance + redefinition
 - allows evolution of an existing component in terms of changes to the previous definition

The Notation

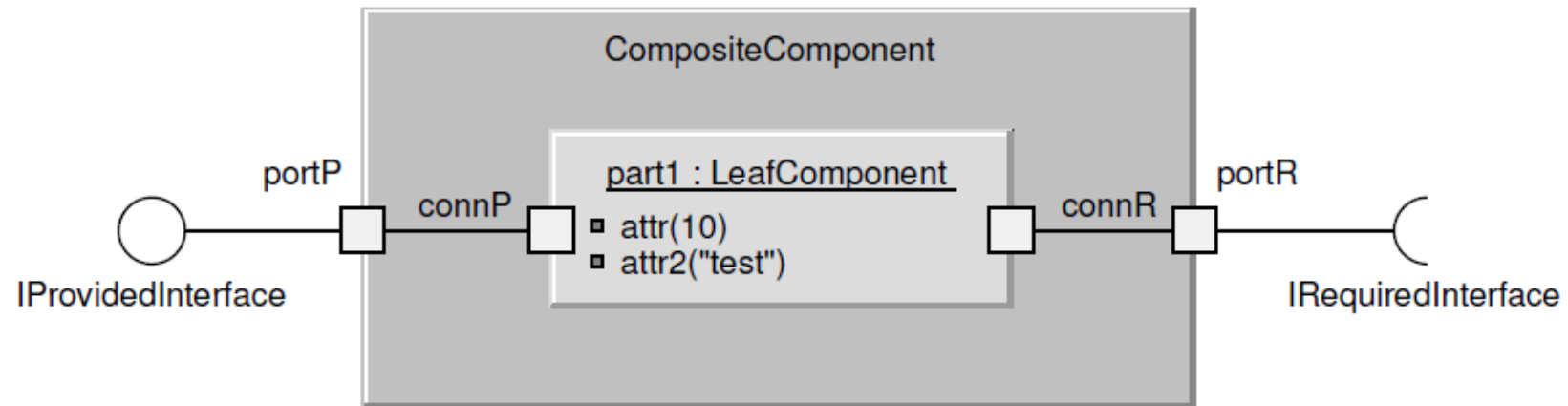
Notation for Leaf Components

- The graphical form is UML2 composite structure diagrams.
- The textual form is remarkably similar to Darwin.



```
component LeafComponent
  describes com.example.JavaLeafComponent
{
  attributes:
    int attr1; String attr2;
  ports:
    port1 provides IProvidedInterface;
    port2 requires IRequiredInterface;
}
```

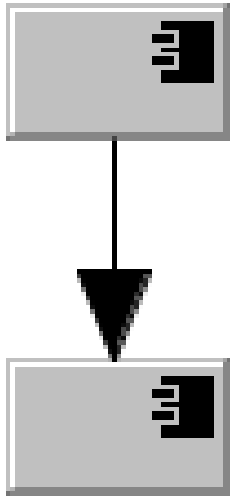
Notation for Composite Components



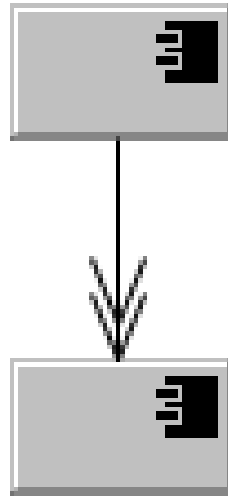
```
component CompositeComponent
{
  ports:
    portP provides IProvidedInterface;
    portR requires IRequiredInterface;
  parts:
    LeafComponent part1
      set attr1(10), attr2("test");
  connectors:
    connP joins portP to port1@part1;
    connR joins portR to port2@part1;
}
```

Notation for the Constructs

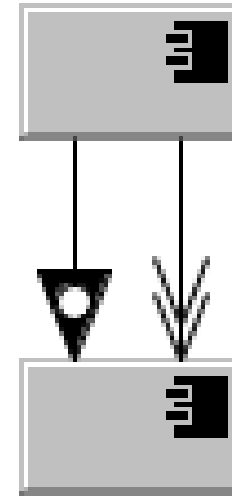
Resemblance



Redefinition



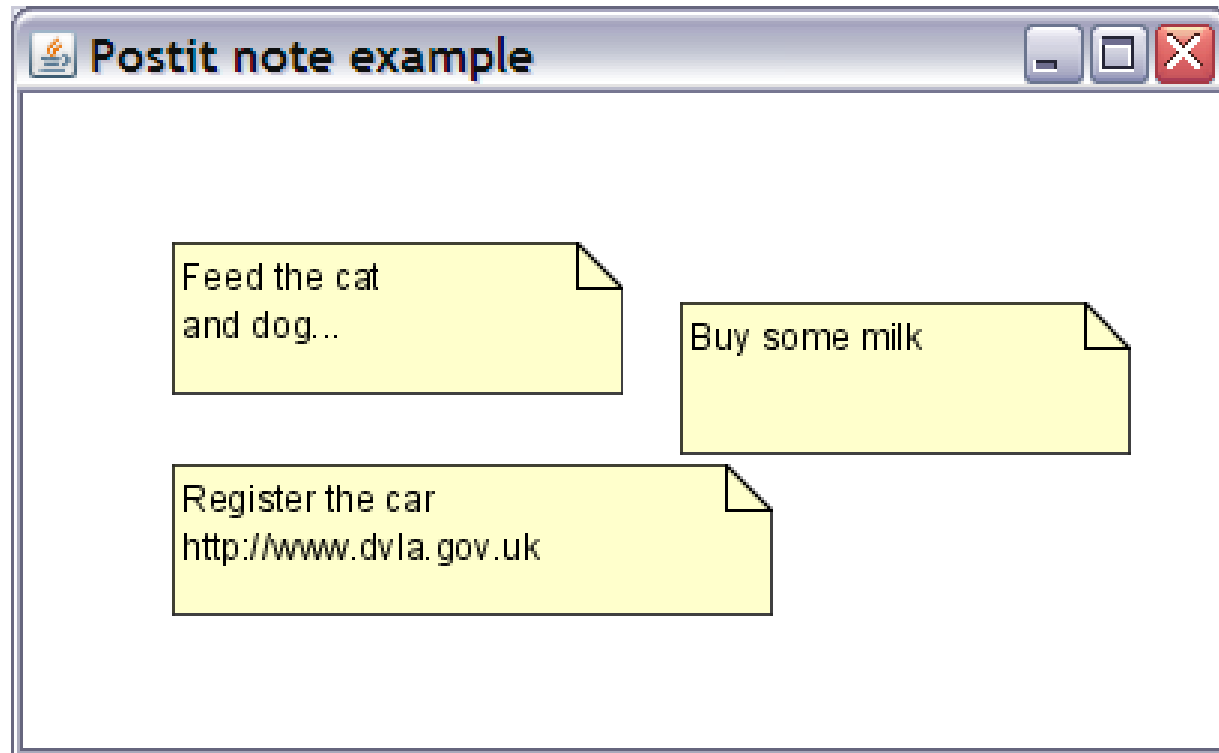
Combination



Applies to both composite and leaf components

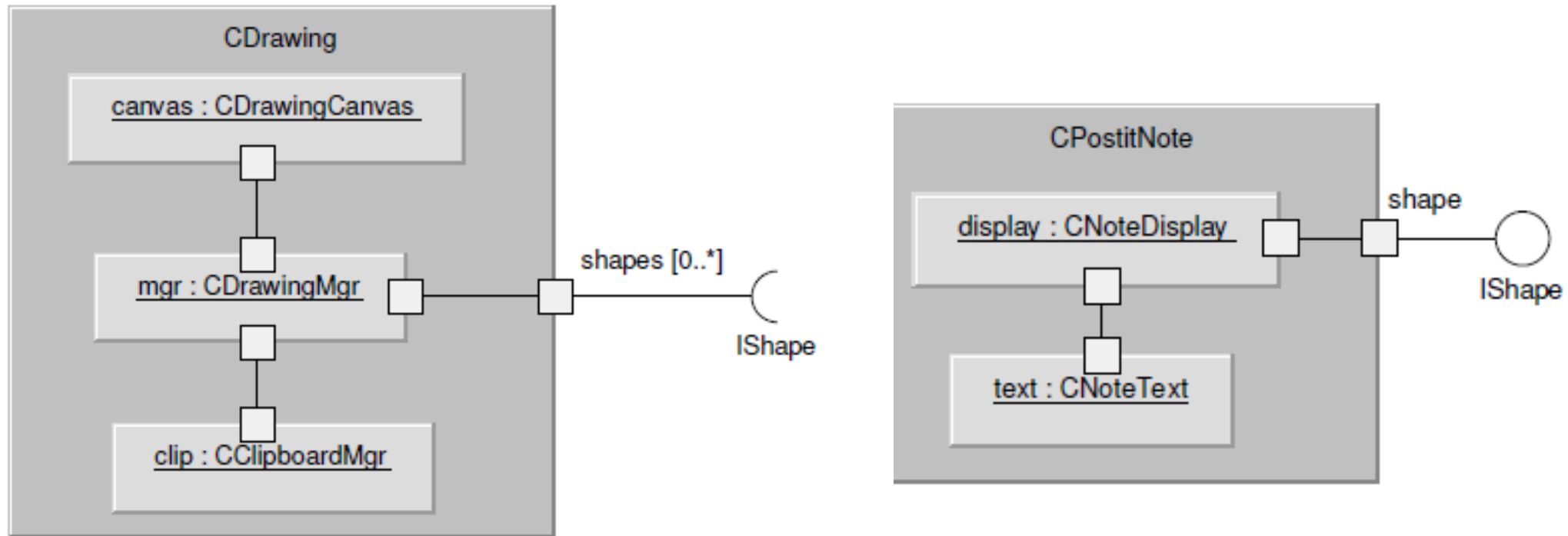
Example

A note taking application



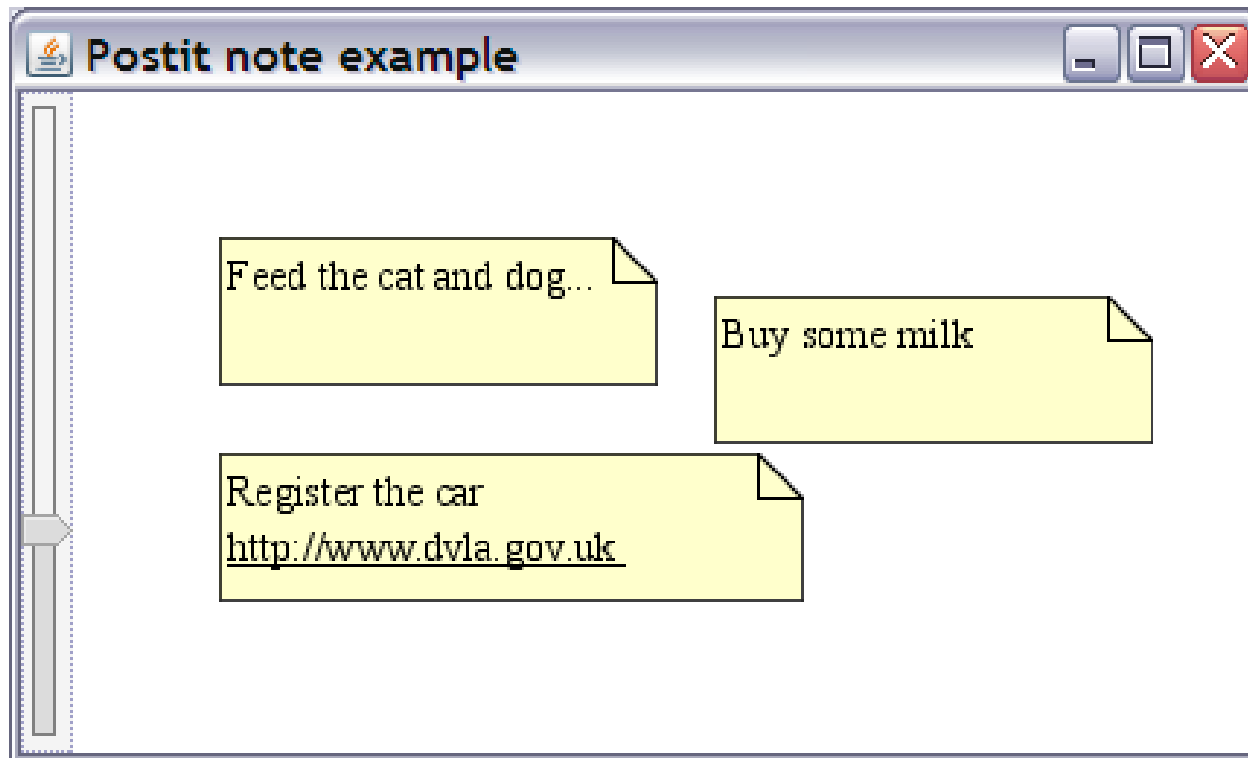
The Base Application

- Company X makes a drawing application, which has a postit-note component

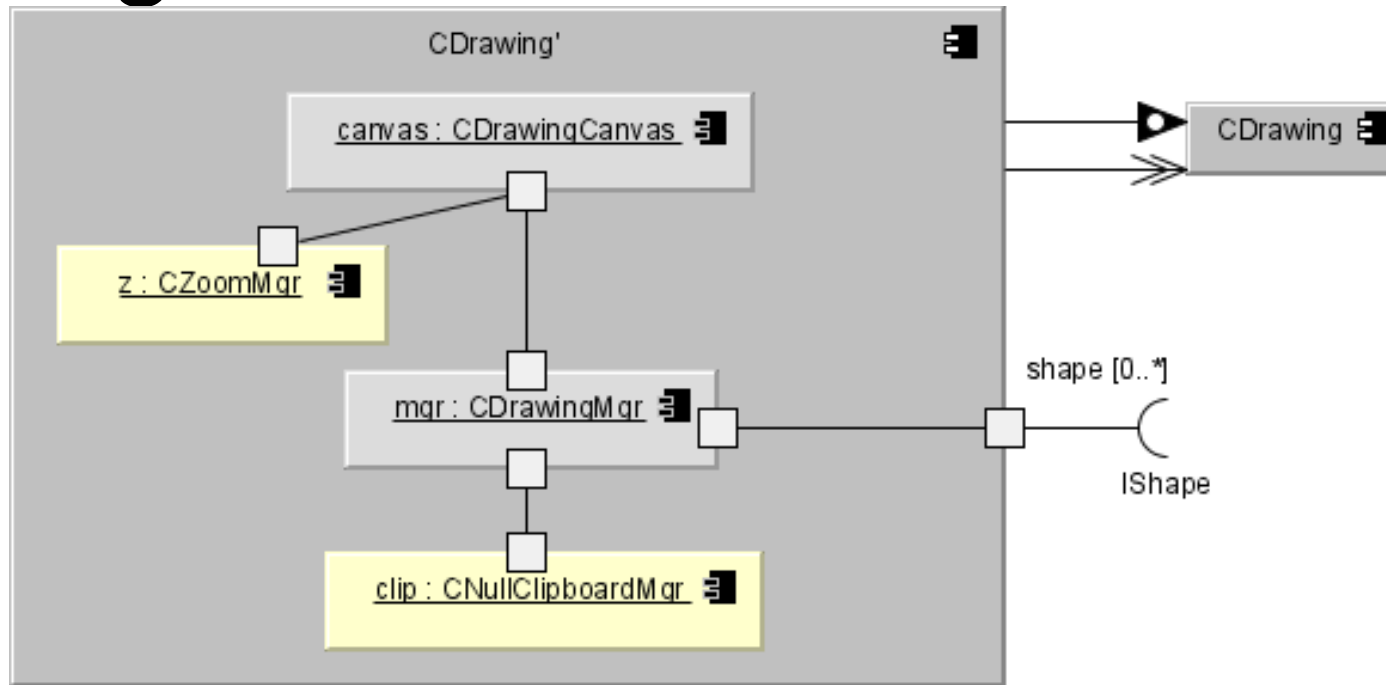


Reusing and Altering

- Company Y wishes to reuse and customise
 - Add a zoom facility
 - Remove the clipboard
 - Add hyperlinked text

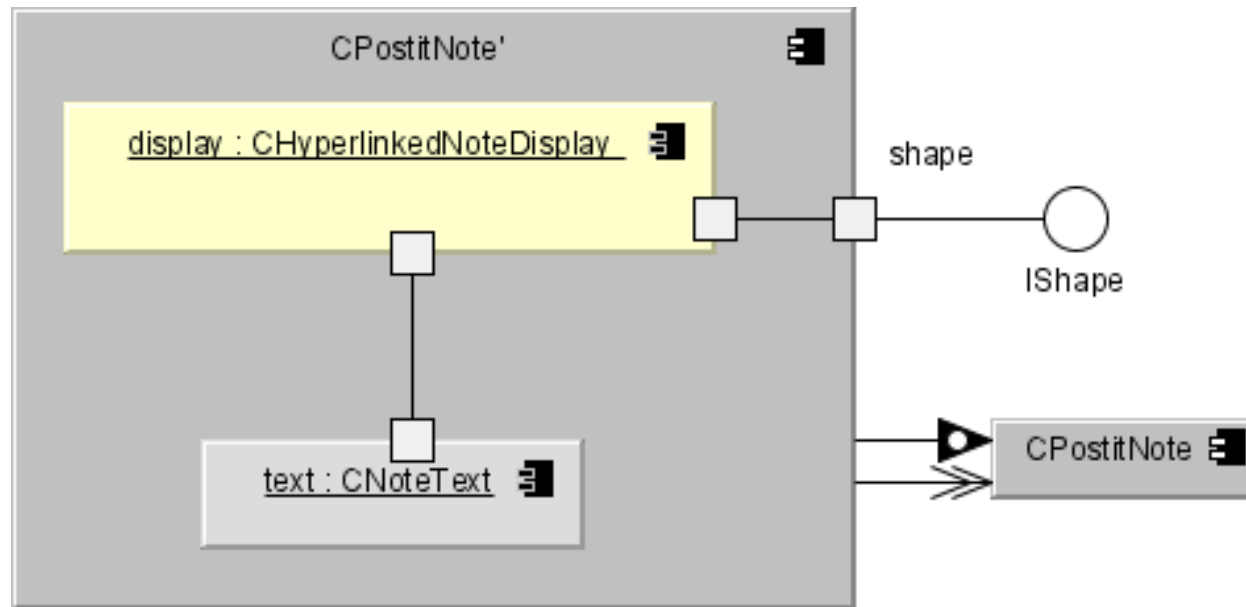


Using Resemblance to Alter (1)



```
redéfinition CDrawing
resembles [previous] CDrawing
{
  replace-parts:
    CNullClipboardMgr clip;
  parts:
    CZoomMgr z;
  connectors:
    zoom joins zoom@z to surface@canvas; }
```

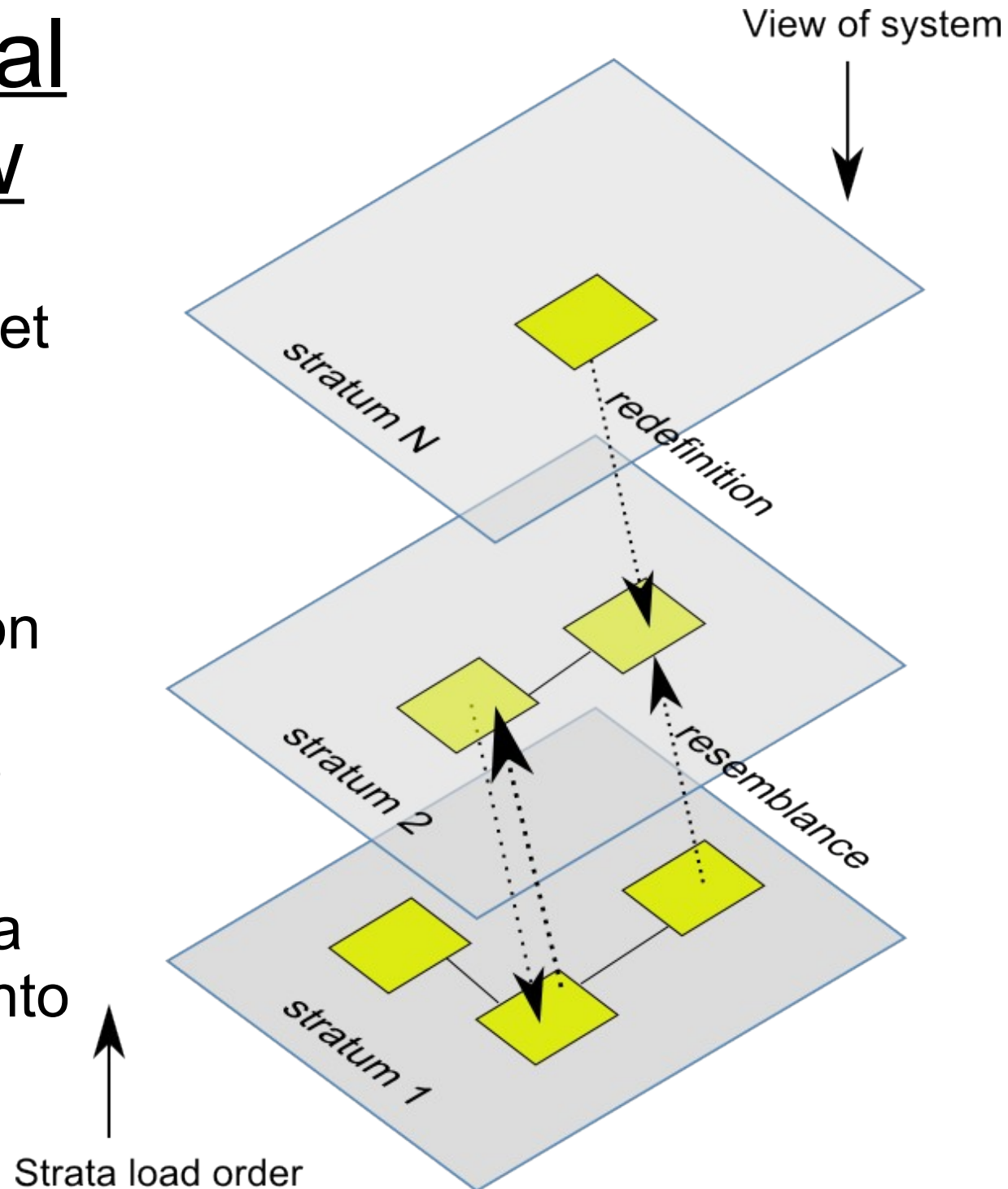
Using Resemblance to Alter (2)



```
redefine-component CPostitNote
  resembles [previous] CPostitNote
{
  replace-parts:
    CHyperlinkNoteDisplay display;
}
```

Conceptual Overview

- A *stratum* groups a set of related definitions
- *Resemblance* copies an existing component's definition into the current definition, and allows changes
- Redefinition pushes a new definition back into an existing name



Issues

- Most issues occur when combining multiple redefinitions of the same component
 - This occurs when combining independently developed changes. This related to a merge conflict in a CM system.
- How do we reason about the soundness of combined redefinitions?
 - What is the resultant system behaviour?
 - Does the combination accomplish the goals of each redefinition, or do they conflict?
- Currently only for non-distributed architectures...

Related Work

Related Work

- MAE
 - Architectural configuration management system
- ADLS
 - Darwin, ROOM, C2SADEL etc.
- Koala & product line architectural approaches
 - Parametrization for reuse
 - Variation points
- COM and other component standards
 - mechanisms versus design approach

Conclusions and Further Work

Summary

- The constructs satisfy many of the requirements:
 - **Alter**: Parts, attributes, connections can be added, deleted, replaced. Extensive changes possible.
 - **NoImpact**: Only see the changes if redefinition is applied
 - **Upgrades**: Can be phrased as another redefinition
 - **NoSource**: Most changes can be performed with just the architectural description.
i.e. No implementation code
- Major issue is how to reason about combined redefinitions that are independently developed
 - What properties are we trying to preserve?
 - How do these relate to engineering specifications?

Further Work

- Graphical support for modelling with changes
- Expressing the properties we want preserved
 - Protocol compliance of component compositions
 - Reachability of a specified goal
- Resolving conflict between redefinitions
 - Structural
 - Behavioural
- Further work on formal models
 - Alloy model for showing structural conflict exists
 - FSP translation for protocols
 - Semantic model