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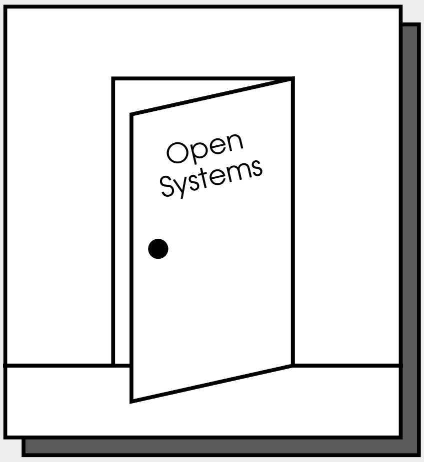
ZYPHER

Tailorability as a Link from Object-Oriented Software Engineering to Open Hypermedia

Serge Demeyer
June, 13th 1996

Open Systems

OLE
OpenDoc
CORBA
Exodus
Unix
OS/2

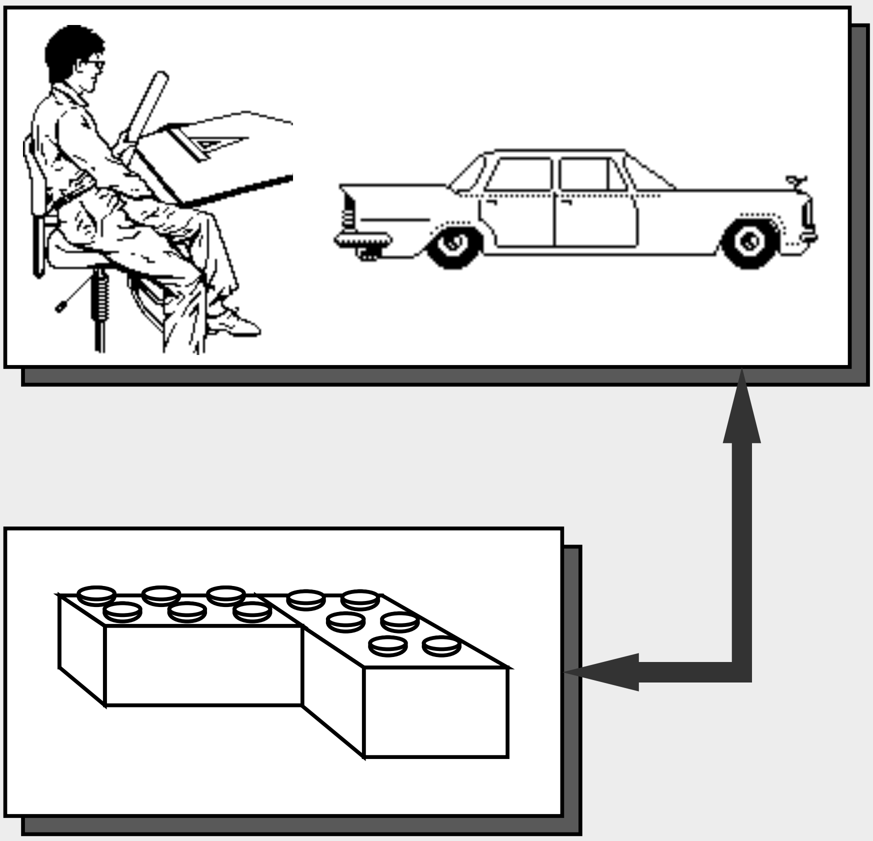


Emacs
AutoCAD
CLOS
Smalltalk
Open Hypermedia
World-Wide Web

Why ?
Simple ideas
⇒ difficult problems

Interoperability
Extensibility
Distribution

Software Engineering



Software Systems ?
- complex
- conform
- change
- invisible

("No Silver Bullet" - Brooks'87)

⇒ *Incremental Development*

Techniques ?
- Object-Oriented Frameworks
- Meta-Object Protocols

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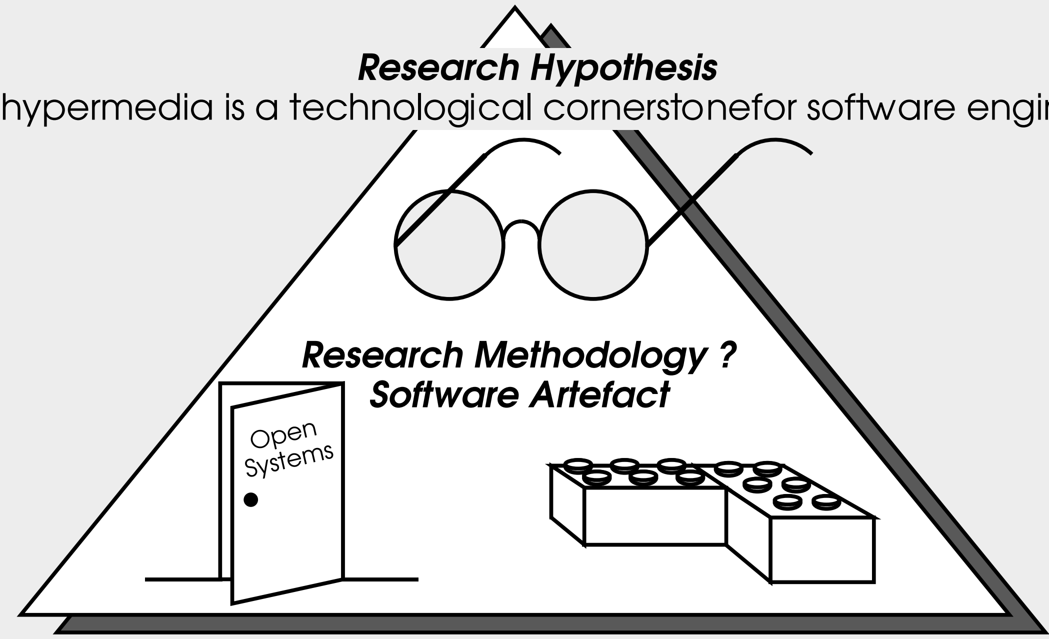
Research Hypothesis
Open hypermedia is a technological cornerstonefor software engineering.



Research Hypothesis
Open hypermedia systems are representative for the larger set of open systems.

Research Hypothesis
Object-oriented frameworks and meta-object protocols are two complementary techniques in the design of open systems.

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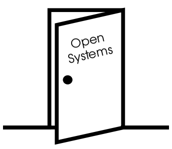
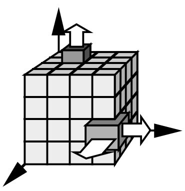
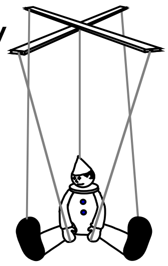
Open Hypermedia Systems

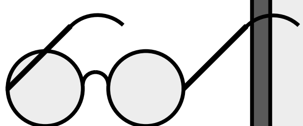


- open design space
- tailorability



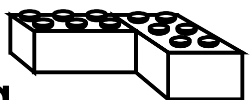


Open Hypermedia & Object-Oriented Software Engineering



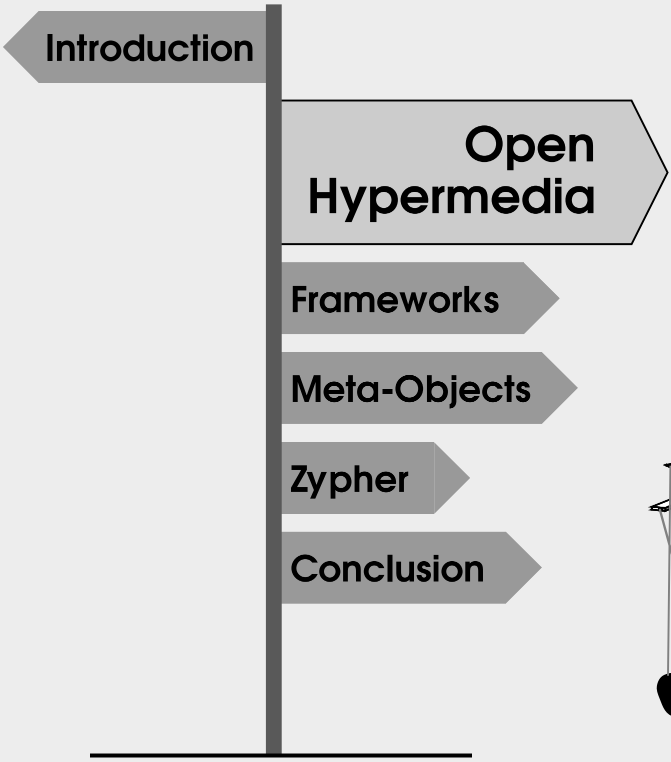
- framework browser

Object-Oriented Software Engineering



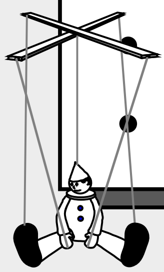
- tailorability
  $\Leftrightarrow$ framework
  $\Leftrightarrow$ meta-level
- base level $\Rightarrow$ meta-level

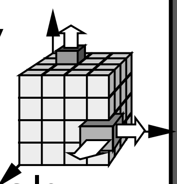
Road Map (1)



Open Hypermedia

- Definition
- Requirements
- Flag Taxonomy
- Design Space
- Tailorability Levels





Hypermedia Definition

"Hypermedia is a **style** of building systems for the creation, manipulation, presentation and representation of information in which:

- the information is stored in a collection of multi-media nodes
- the nodes are explicitly or implicitly organised into one or more structures (commonly, a network of nodes connected by links)
- users can access information by navigating over or through the available information structures."

(Halasz'91)

"(…) true hypertext should also make users feel that they can move freely through the information according to their own needs."

(Nielsen'90)

"(…) It is this personalisation and customisability of the information presentation that characterises hypermedia."

(Ashman'94)

Open Hypermedia Requirements

"An open hypermedia system is a hypermedia system, where the term open implies the possibility of importing new objects into a system. A truly open hypermedia system should be **open** with regard to: ..."
(Davis,Lewis,Rizk'96)

Size
- object size
- number of objects

Data Models
- node/link variations
- esoteric models

Data Formats
- legacy formats
- virtual data

Platforms
- multiple
- distributed

Applications
- system specific
- unaware viewers

Users
- private views
- concurrency

Flag Taxonomy

Design Principle
Separate storage from presentation

⇐

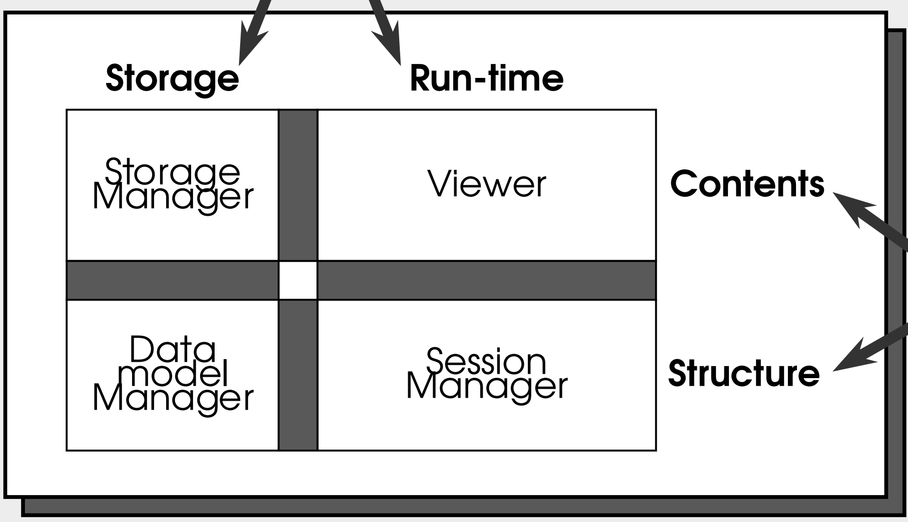
Requirements
- Size
- Data Formats
- Applications

Requirements ???
- *Data Models*
- *Platforms*
- *(Users)*

Requirements
- Size
- Data Formats
- Applications
- (Users)

⇓

Design Principle
Get the links out of the data



Design Space

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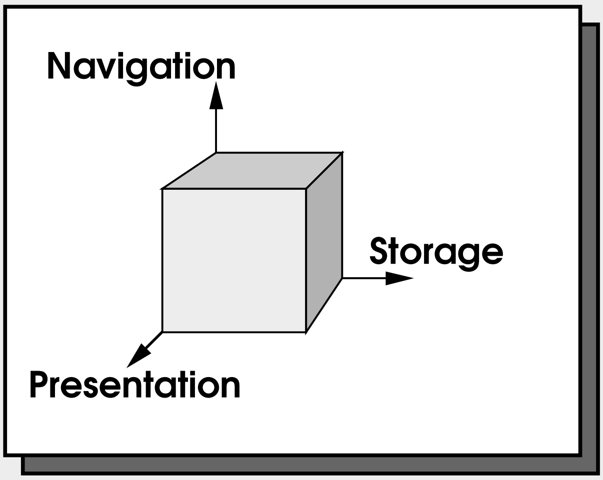
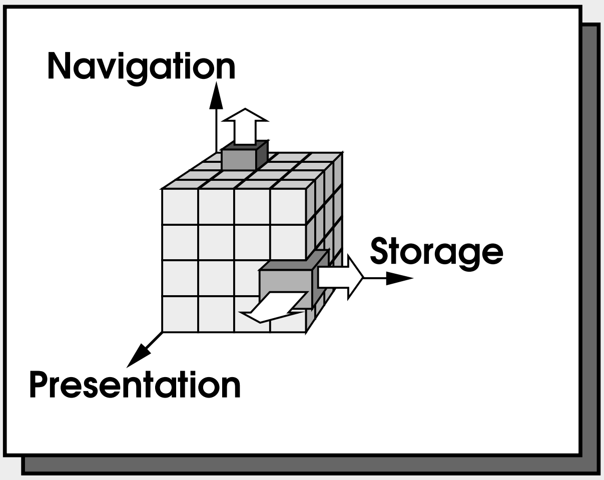
Hypermedia System
"Hypermedia is a style of building systems for the creation, manipulation, presentation and representation of information ..."
(Halasz'91)

Open Hypermedia System
"... the term open implies the possibility of importing new objects into a system ..."
(Davis,Lewis,Rizk'96)



Monolithic Volume



Tailorable Volume

Puppet Master

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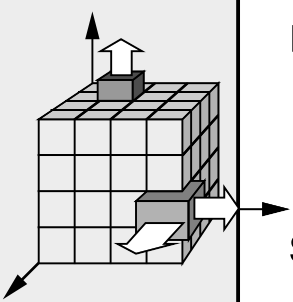


3 TAILORABILITY LEVELS

DOMAIN (FEATURES)
- more storage & presentation
- extensible link engine

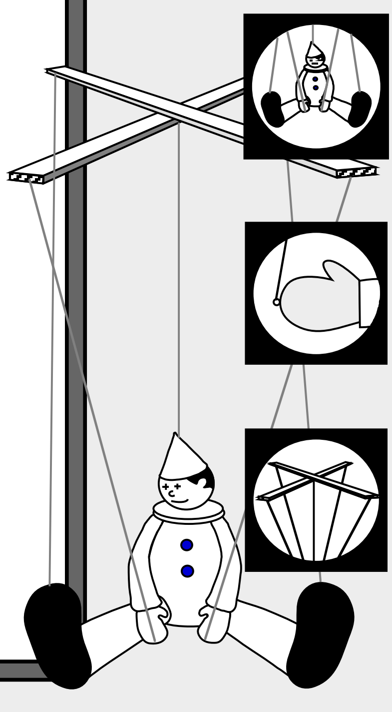
= *extend design space axes*

SYSTEM (SERVICES)
- logging, locking, caching, versioning
- authority & integrity control

= *modify design space axis*

CONFIGURATION (PLUG & PLAY)
- run-time extensions (Java)
- protocol negotiation

= *change relationship between points on design space axes*



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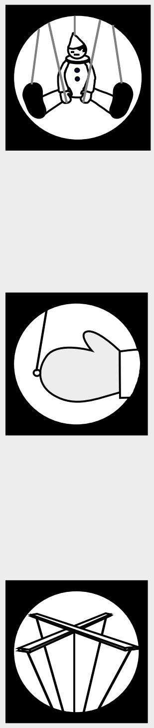
Requirements

Size	extend storage & presentation and integrity control
Data Formats	extend storage & presentation and integrity control
Applications	extend storage & presentation and integrity control
Data Models	extend navigation axis and integrity control
Users	locking, caching, versioning and authority control
Platforms	run-time extensions and protocol negotiation



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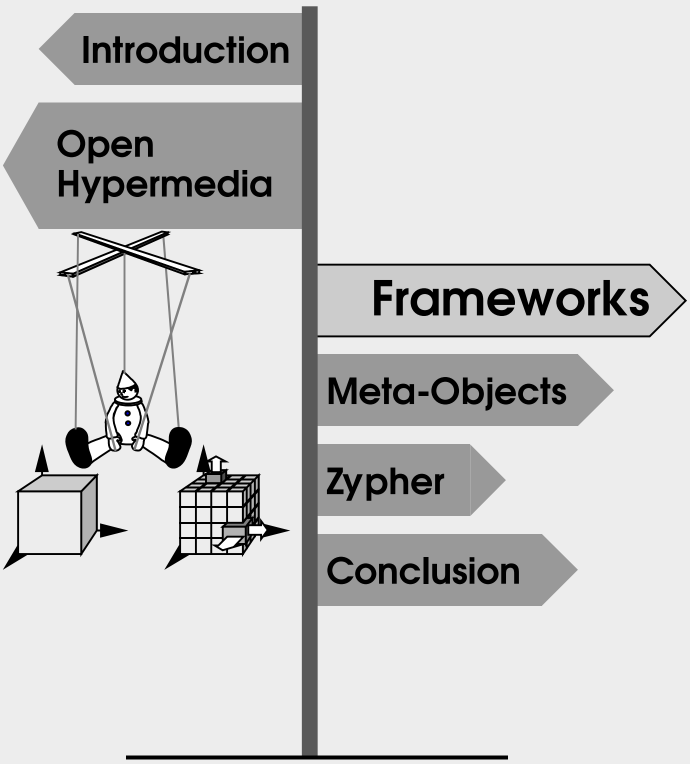
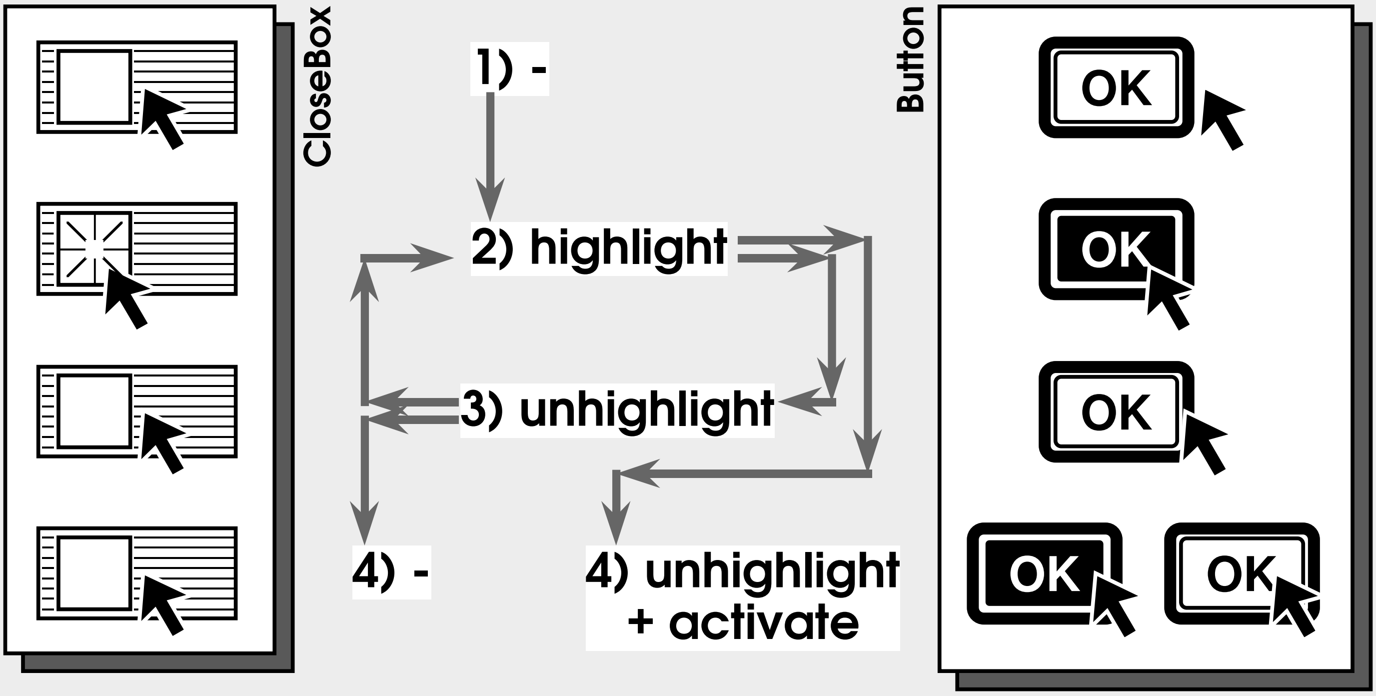


Frameworks

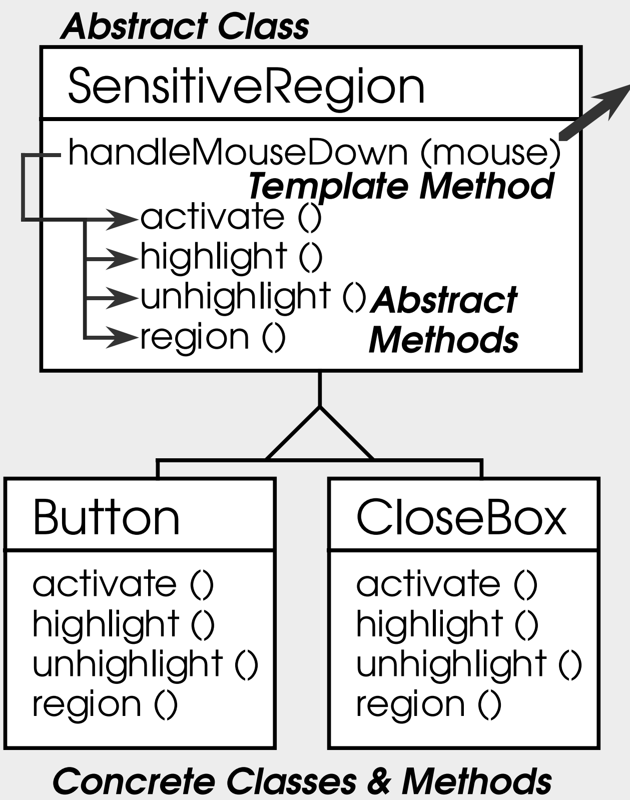
- Design Reuse
- Terminology & Example
- White-Box & Black-Box
- Contracts

Framework - Problem Domain

"An object-oriented framework consists of a set of co-operating classes and objects that make up a reusable design for a specific problem domain."
(GammaEtAl'95)



Framework - Design Reuse




```
method handleMouseDown (mouse)
[if contains(region(self),
            position(mouse))
  highlight(self)
  while buttonPressed(mouse)
    if contains(region(self),
                position(mouse))
      highlight (self)
    else
      unhighlight (self)
    endif
  endwhile
  unhighlight (self)
  if contains(region(self),
              position(mouse))
      activate (self)
  endif
endif]
```

White-Box & Black-Box Reuse

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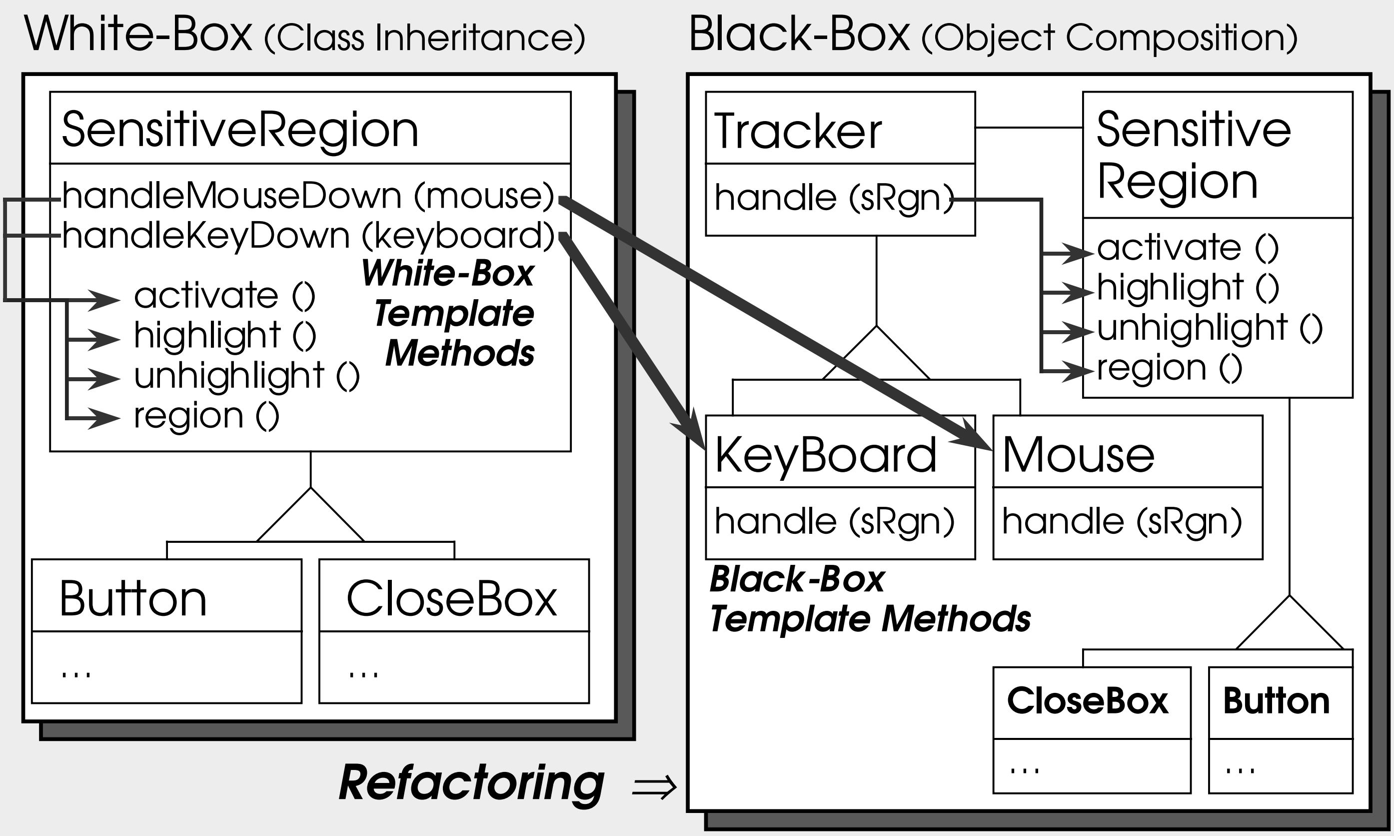

White-Box versus Black-Box

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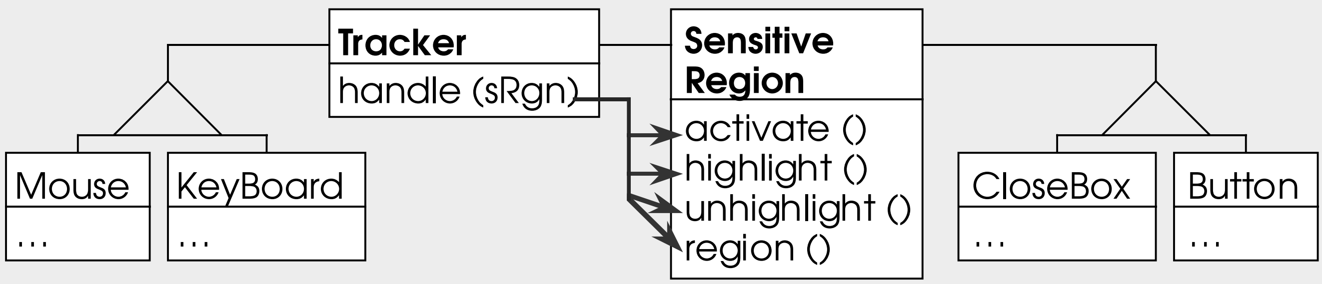
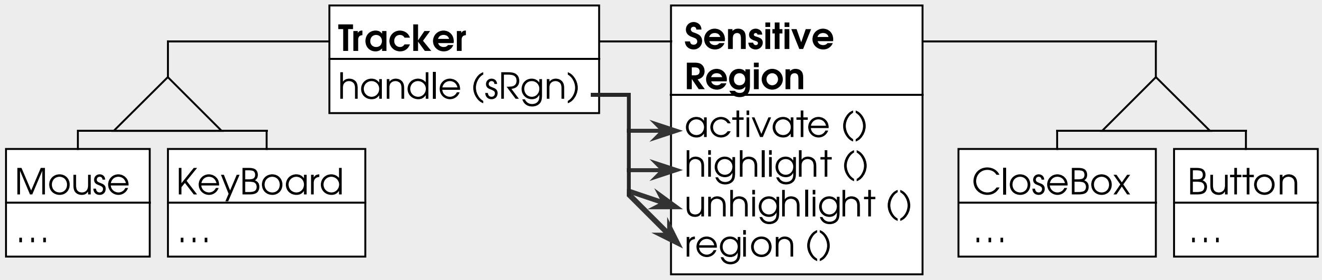


	White-Box		Black-Box	
Complexity	+	Straightforward	-	Difficult
Capability	+	More	-	Less
Encapsulation	-	Breaks	+	Respects
Extensibility	-	Less	+	More
Configurability	-	Definition-time	+	Run-time

Contract

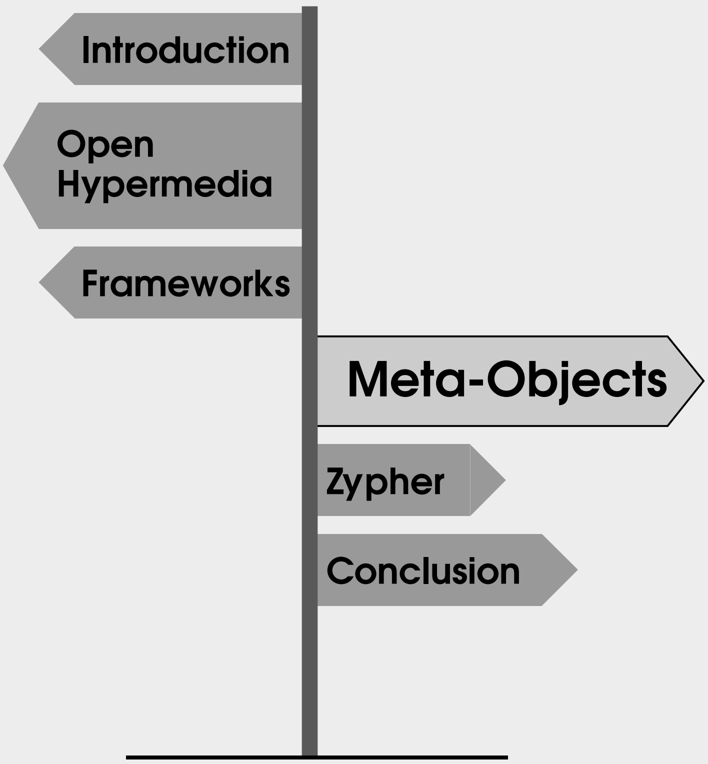
A contract is a mechanism for the explicit specification of dynamic object relationships and interactions. (Helm,Holland,Gangopadhyay'90)



Tracker Contract
- implement track method
- track method must
  - send highlight message
  - balance highlight/unhighlight
  - always end with unhighlight
- track method may
  - send activate message
  - send region message

Sensitive Region Contract
- implement the methods
  - activate,
  - highlight,
  - unhighlight,
  - region
- all calls to highlight must be balanced with an unhighlight

Road Map (3)



Meta-Objects
- Mapping Dilemma
- Meta-level Interface
- Criterion

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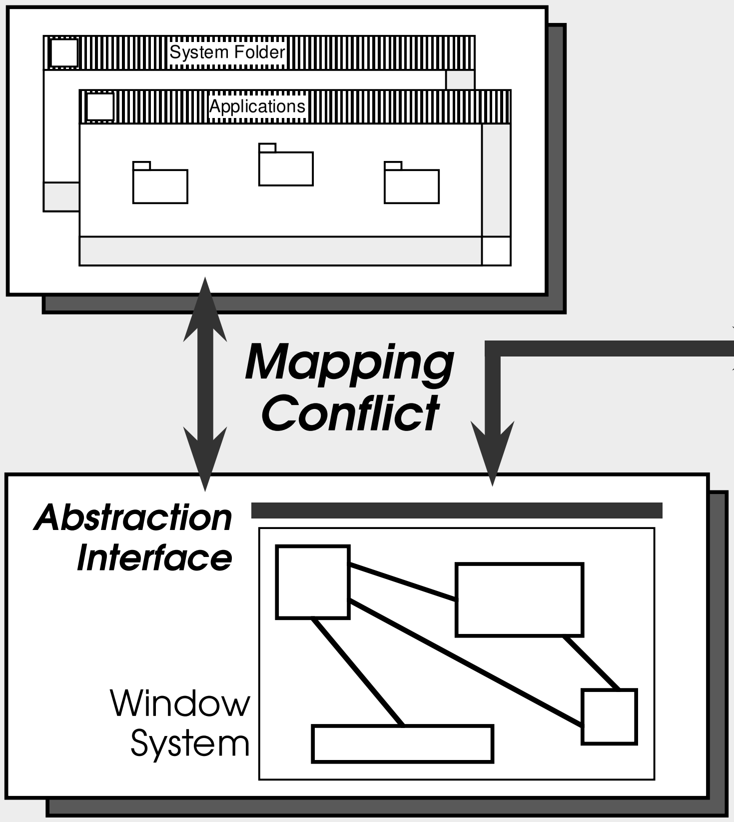

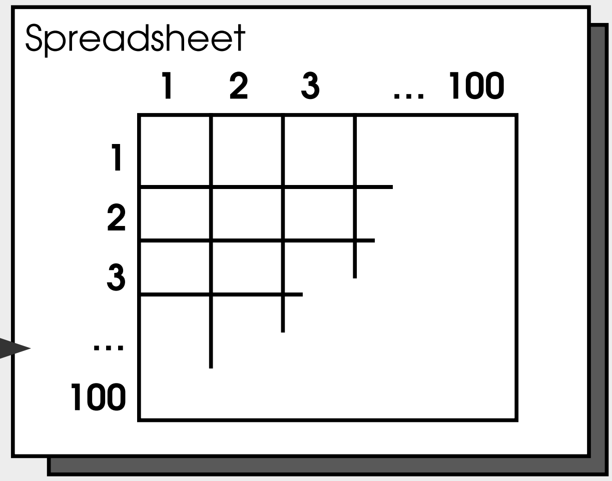


```
FUNCTION makeSpreadSheet
FOR i = 1 TO 100
  FOR j = 1 to 100
    makeWindow (100, 100,
      i * 100, j * 100)
  END
END
```


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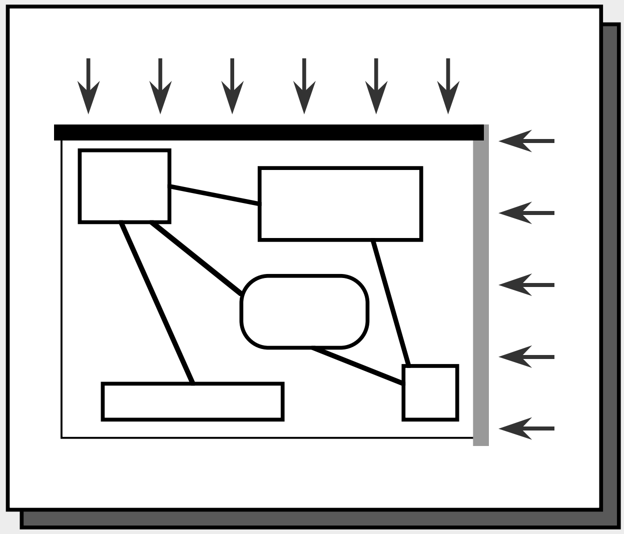


Base-Level Interface
Abstract Implementation Issues

+ Meta-Level Interface
Control Mapping Dilemma

= System Interface

Research Issue: How to design a Meta-Level Interface ?

Criterion

"A reflective system is a computational system which is <u>about</u> itself in a <u>causally connected</u> way."
(Maes'87)

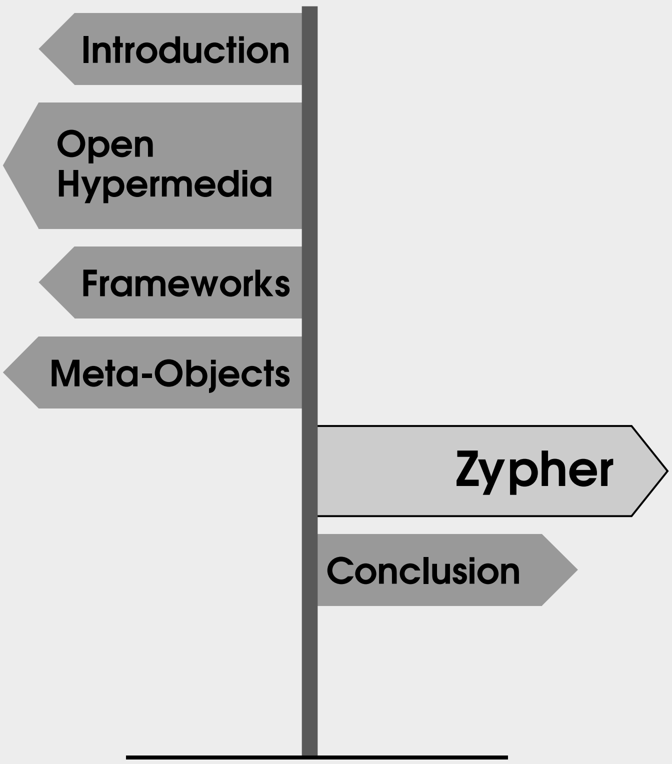
- <u>about</u>: Incorporates internal structures that represent the system's domain.
- <u>causally connected</u>: Internal structures and domain are linked in such a way that if one of them changes the other one adjusts automatically.

$\Rightarrow$ An object O is a meta-object if

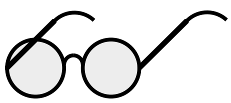
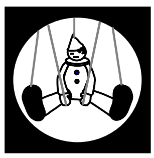
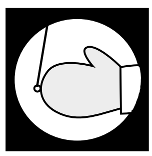
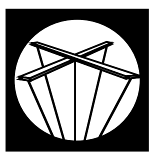
a) O is about the system
(not about the system's domain)

b) O is causally connected to the system

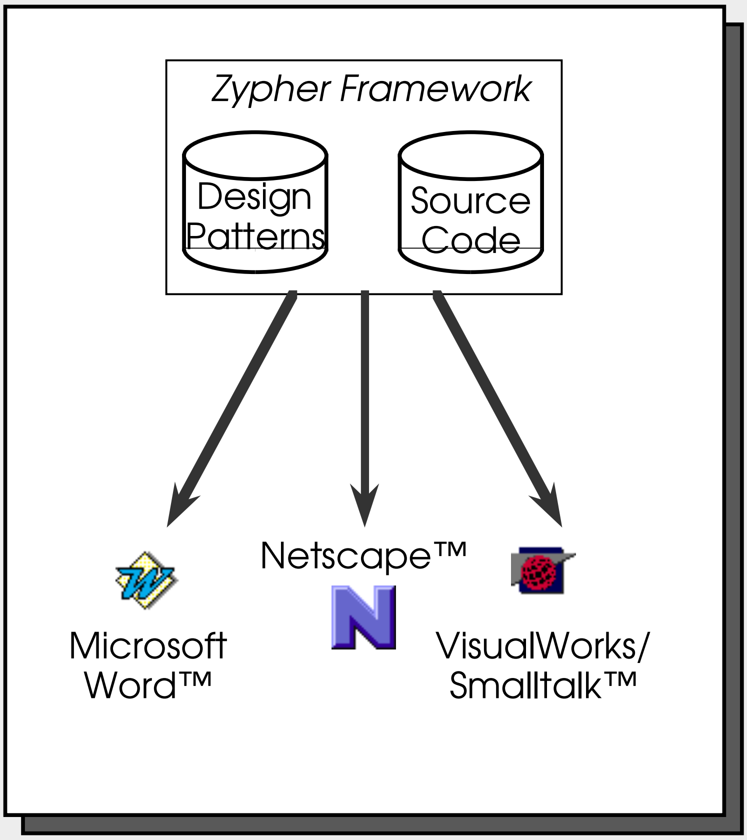
Road Map (4)



Zypher

- Framework Browser 
- Dexter Model
- Domain level $\Leftrightarrow$ framework 
- System level $\Leftrightarrow$ meta-level 
- Configuration $\Leftrightarrow$ meta-level 

Framework Browser



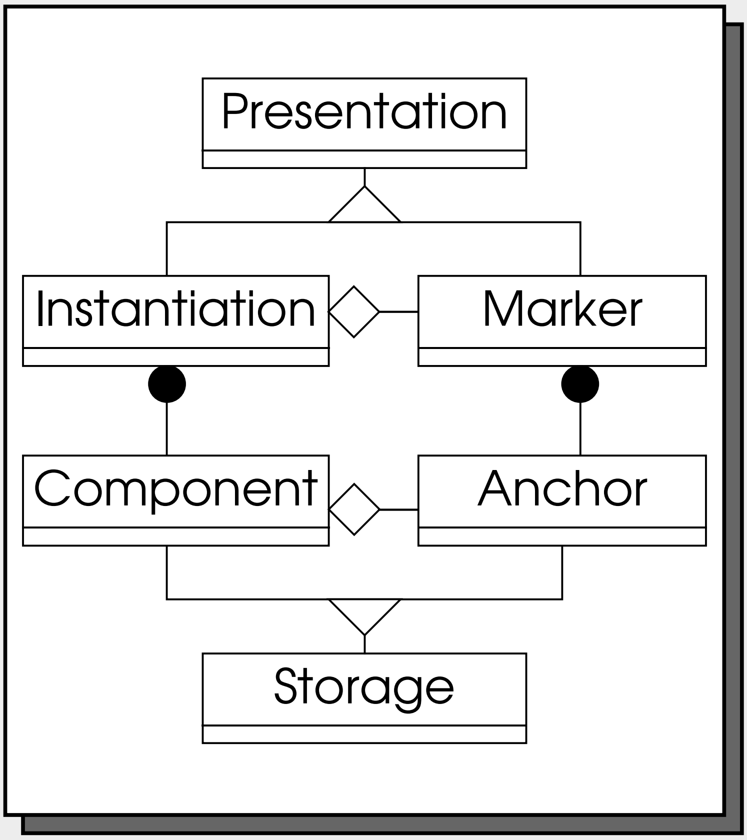
Results

- Scenario for Open Hypermedia
- Third-party applications for documentation
- Mix of different code-browsers (configuration !!)
- Exchange with WWW
- Extensible link engine

Future Work

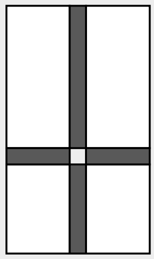
- Integration with ApplFLab
- Tele-presence (event notification)

Zypher — Base Level

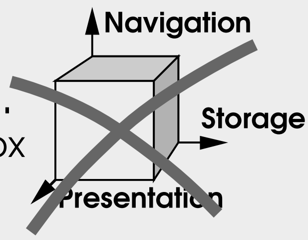


THE DEXTER MODEL

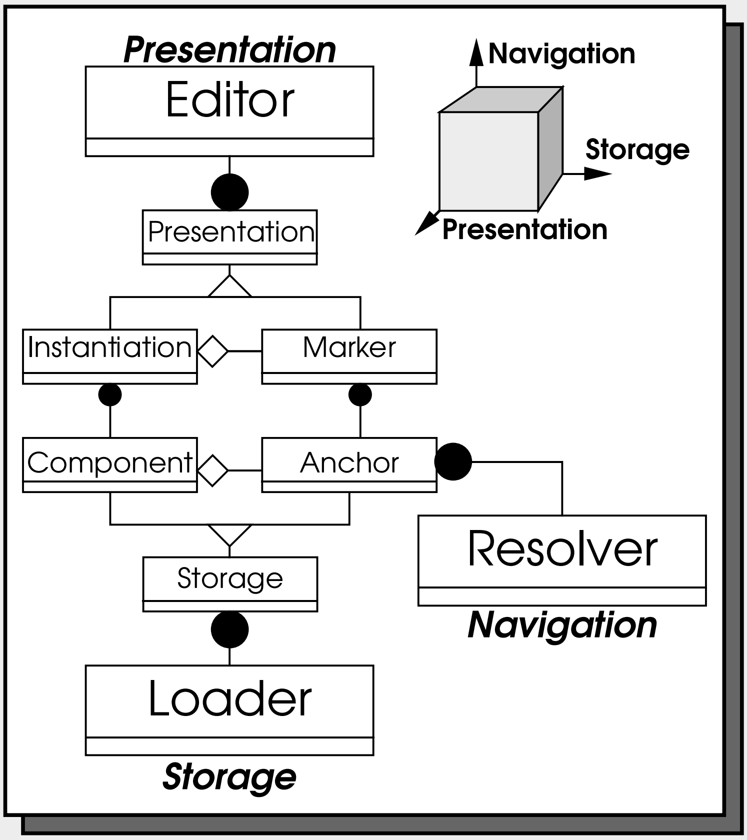
Good factorisation
(cfr. Flag Taxonomy)



However ...
White Box

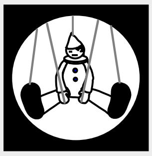


Domain Level Tailorability

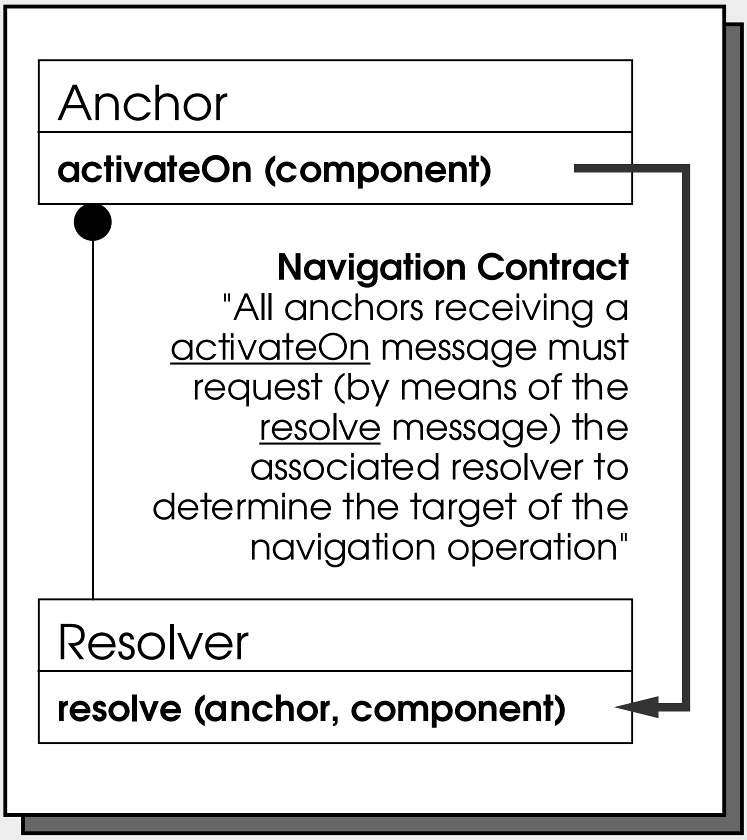


Design Guideline
Each design space axis should correspond to a black-box template method.

⇒ **Domain Level Tailorability**



Navigation Contract

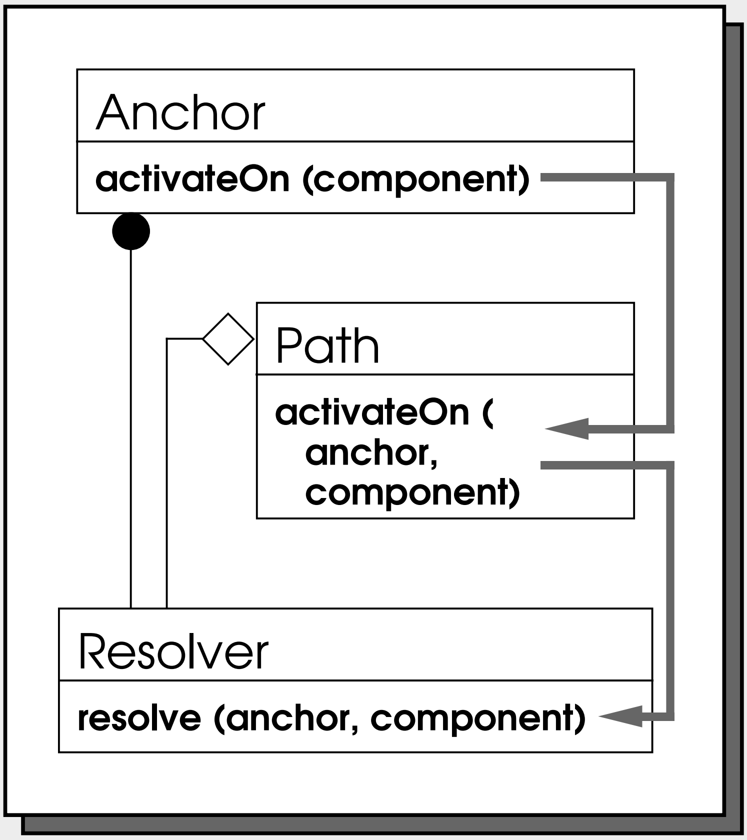


How to maintain a trail of visited locations ?

⇒ Log all occurrences of "navigation contract"

~~Inheritance~~ ?
White Box

Path Object



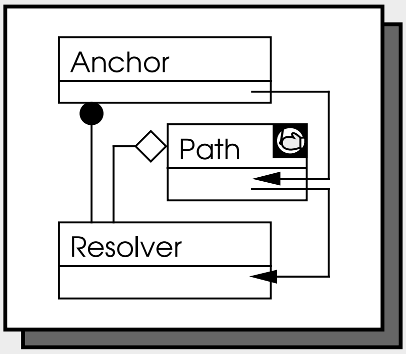
PATH OBJECT =
Explicit representation of navigation contract

Funnels all occurrences of "navigation contract"

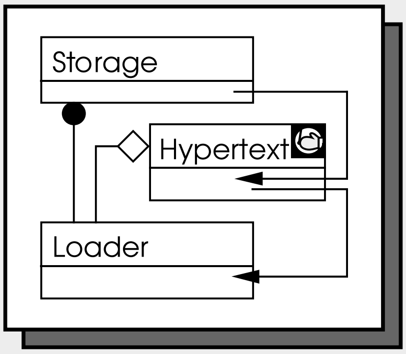
⇒ Easy to trap

⇒ Black-box to wrap additional behaviour

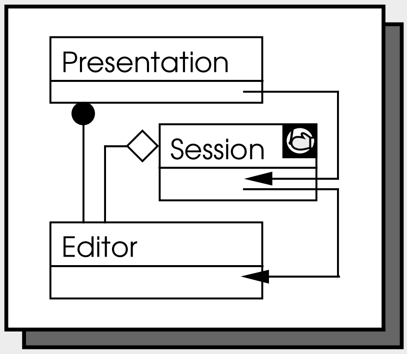
System Level Tailorability



Navigation
- **Logging**
- **Caching**
- **Integrity Control**



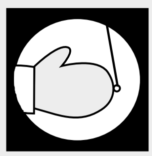
Storage
- **Caching**
- **Locking**
- **Versioning**
- **Integrity Control**



Presentation
- **Authority Control**
- **Caching**
- **Integrity Control**

Design Guideline
Each design space axis should correspond to a framework contract.

⇒ **System Level Tailorability**



Meta-Object Criterion

An object O is a meta-object if

a) O is about the system
(not about the system's domain)

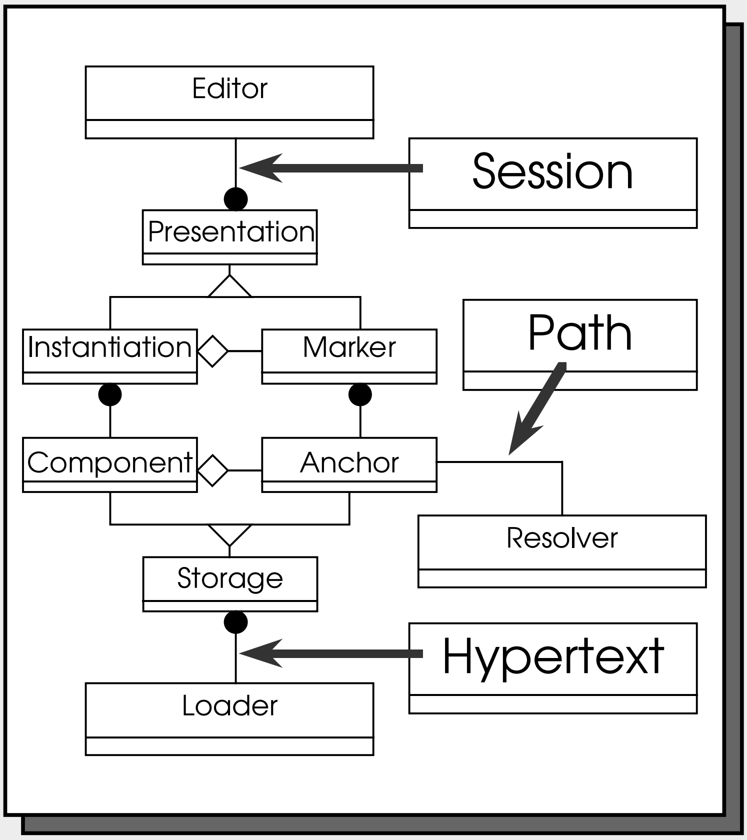
b) O is causally connected

O is an explicit representation of a framework contract

⇒ a) a framework contract is by definition about the system

⇒ b) - changing O changes system's behaviour
- changing O is only legal way to change global systems' behaviour

Design base-level interface ⇒ Clues for meta-level



PATH CONTRACT

- Decide which Resolver handles an Anchor-Component Pair

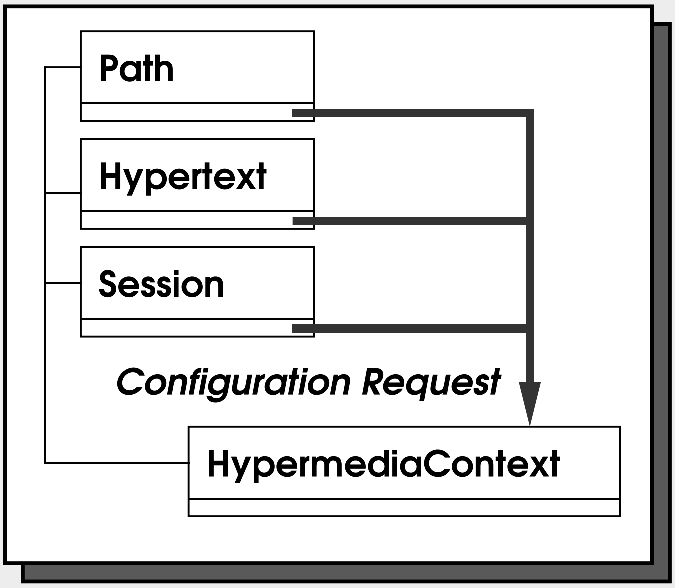
HYPERTEXT CONTRACT

- Creates the Storage Layer Object that represents target location
- Decide which Loader handles a Storage Layer Object

SESSION CONTRACT

- Creates the Presentation Layer Object that represents target location
- Decide which Editor handles a Presentation Layer Object

Configuration Level Tailorability



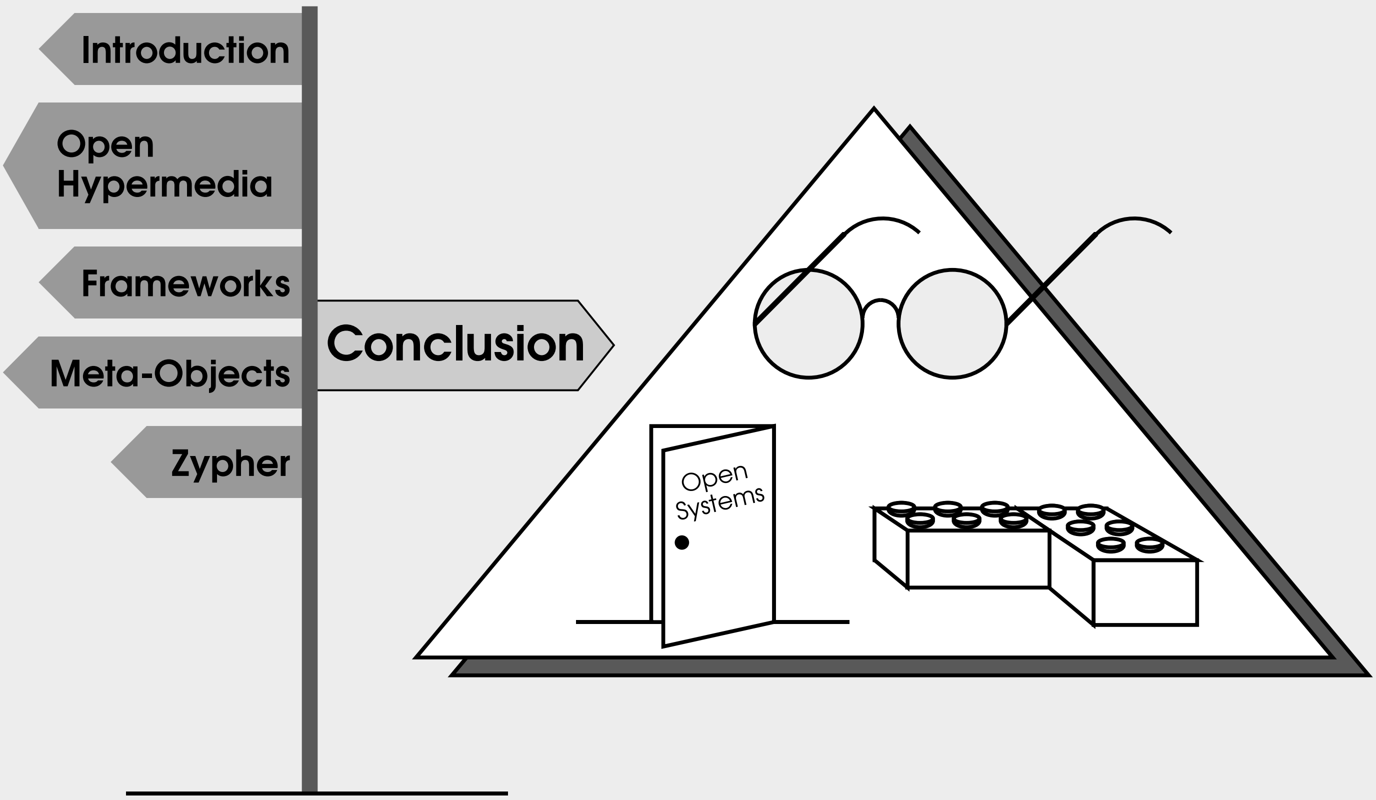
Design Guideline
The configuration of the design space axes should correspond to a framework contract.

⇒ **Configuration Level Tailorability**

HypermediaContext
=
Explicit representation
of configuration contract

⇒ **Meta-Object**

Conclusion



Design Guidelines

Devise a design space for the problem domain.

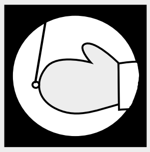
Each design space axis should correspond to a black-box template method.

Apply framework refactoring.

Framework base-level

Each design space axis should correspond to a framework contract.

Have explicit objects that represent these contracts.

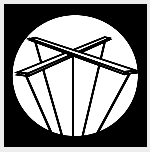


Framework meta-level

Base-Level ⇒ Meta-Level !!!

The configuration of the design space axes should correspond to a framework contract.

Have an explicit object to represent that contract.

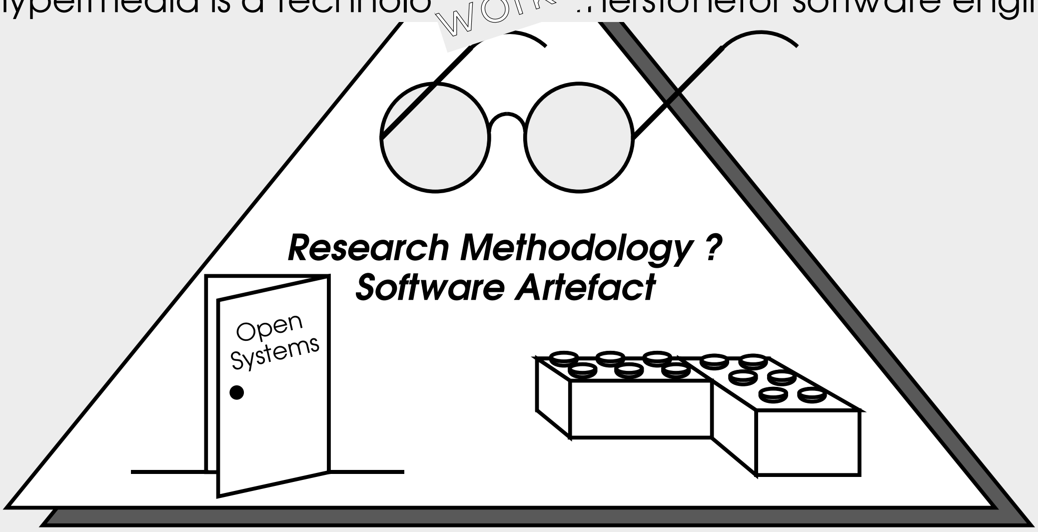


Framework meta-level

Research Hypotheses

Rese Future work ***othesis***

Open hypermedia is a technolo ...nerstonefor software engineering.



Research Hy...othesis

Open hyperm YES ystems are representative ...e larger set of open systems.

Research Hy...othesis

Object-oriente YES neworks and meta-object ...ocols are two complementary techniques in the design of open systems.