A Framework for "Mobile Systems"

BCTCS'05 – Nottingham
March 23, 2005

Cristóvão Oliveira – PhD Student
University of Leicester and
New University of Lisbon

Supervisors:
José Fiadeiro – University of Leicester
Michel Wermelinger – Open University

Joint work with:
Antónia Lopes – University of Lisbon

University of Leicester

Introduction

- **Topics:**
  - Software Architecture
    - Separation of concerns
    - Distribution
    - Mobility
  - Coordination
    - Interactions
    - Synchronizations
  - Category Theory
    - Mathematical Foundation
    - Synchronization Sets

University of Leicester

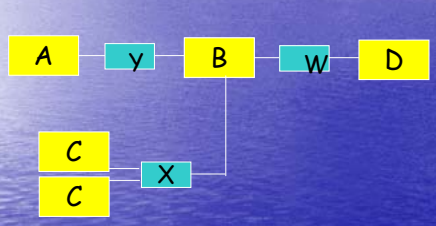
Motivation

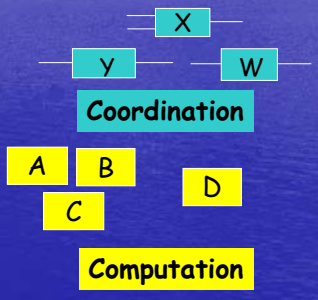
- **Distribution / Mobility**
  - A new factor of complexity in the development of software systems
- **Software Architectures**
  - Have contributed to the taming of the complexity of developing software systems by separating **Coordination** from **Computation** and promoting **Connectors** as first-class citizens

University of Leicester

Motivation

Separation of Concerns





SYSTEM

University of Leicester

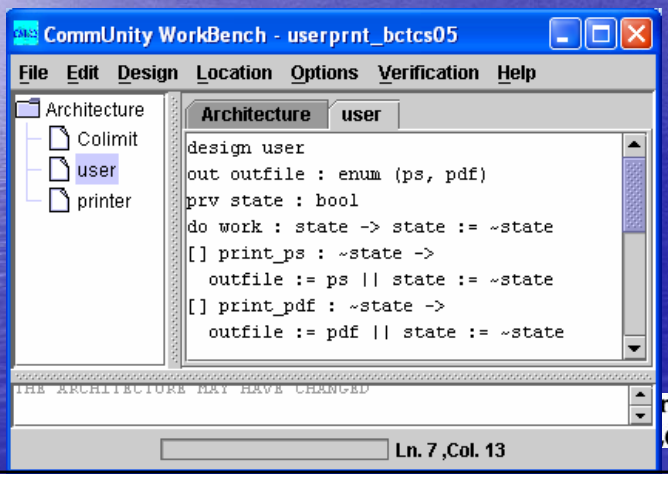
Approach

- CommUnity was born as a language for parallel program design in the style of Unity, but based on action sharing; Its semantics are based on Category Theory;
- CommUnity supports the complete separation of "coordination" and "computation" concerns; Providing a paradigmatic architectural description language in which connectors are first-class entities;
- Moreover, the CommUnity Workbench is a tool support for the approach, providing a graphical integrated development environment in which CommUnity designs can be written in the core language, run, and debugged;

University of Leicester

Example

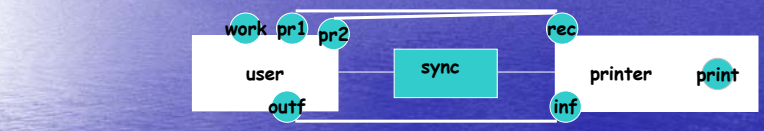
Designs in CommUnity

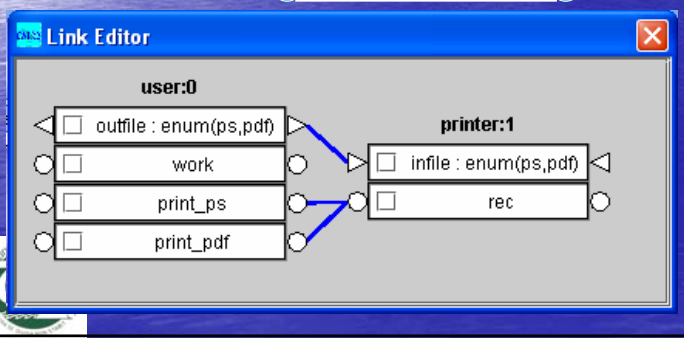


niversity of eicester

Architectural Descriptions in MMOCNITY

Example: A simple user-printer system





University of Leicester

Categorical semantics in MMOCNITY

Example: A simple user-printer system

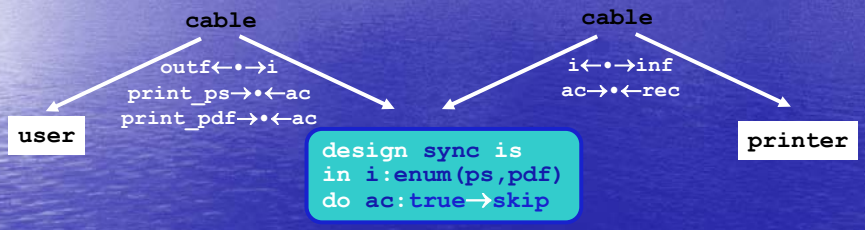


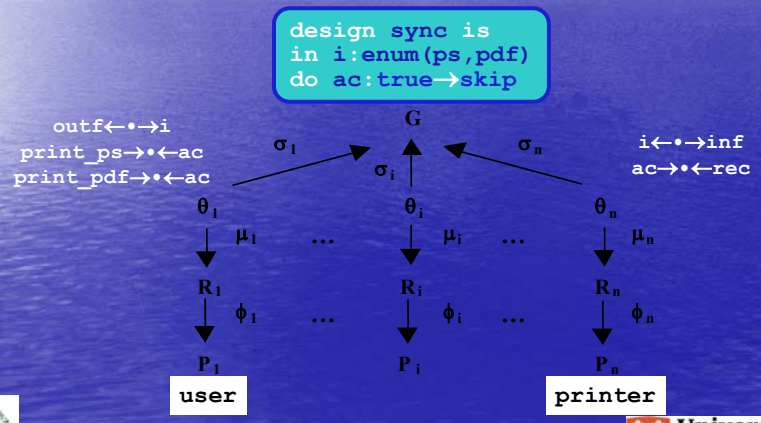
Diagram in a category of designs

Semantics given by the colimit

University of Leicester

Categorical semantics in MMOCNITY

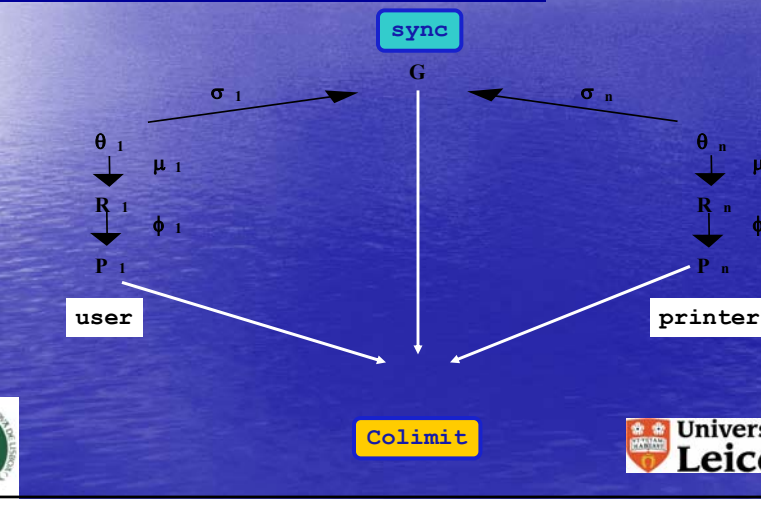
Semantics given by the colimit (1)



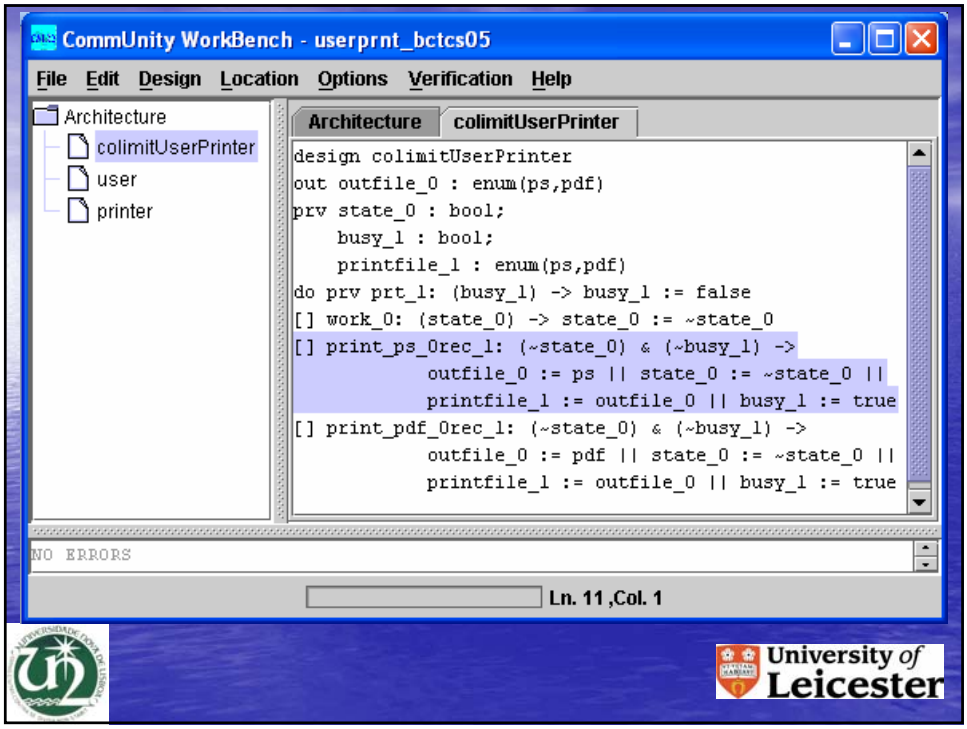
University of Leicester

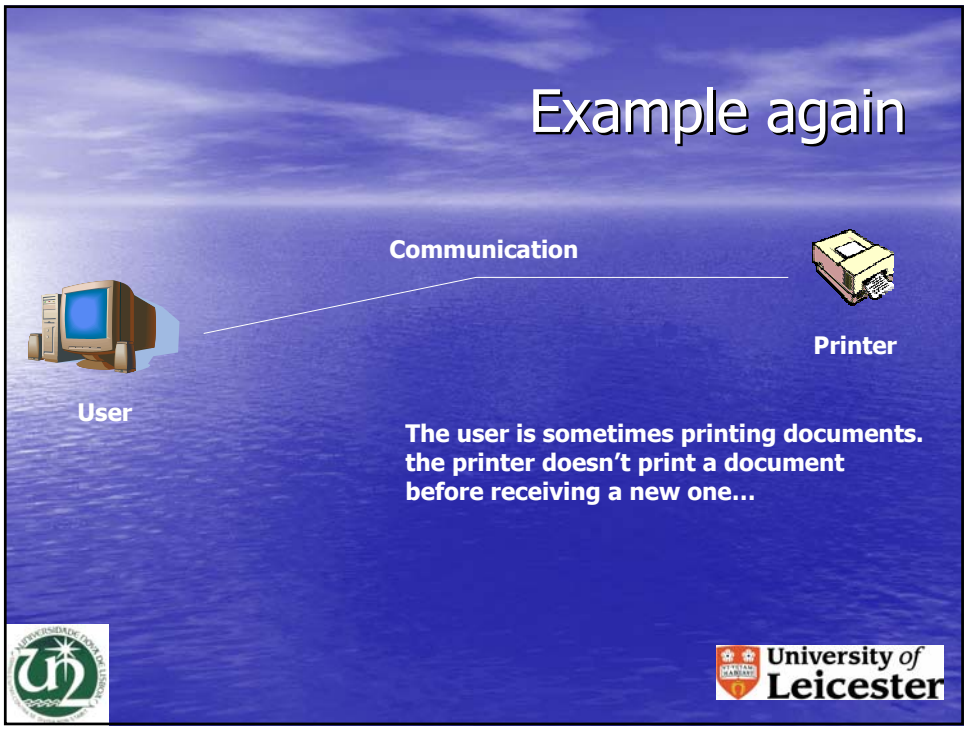
Categorical semantics in MMOCNITY

Semantics given by the colimit (2)



University of Leicester


CommUnity WorkBench - userprnt_bctcs05
File Edit Design Location Options Verification Help
Architecture
colimitUserPrinter
user
printer
Architecture
colimitUserPrinter
design colimitUserPrinter
out outfile_0 : enum(ps,pdf)
prv state_0 : bool;
busy_1 : bool;
printfile_1 : enum(ps,pdf)
do prv prt_1: (busy_1) -> busy_1 := false
[] work_0: (state_0) -> state_0 := ~state_0
[] print_ps_0rec_1: (~state_0) & (~busy_1) ->
outfile_0 := ps || state_0 := ~state_0 ||
printfile_1 := outfile_0 || busy_1 := true
[] print_pdf_0rec_1: (~state_0) & (~busy_1) ->
outfile_0 := pdf || state_0 := ~state_0 ||
printfile_1 := outfile_0 || busy_1 := true
NO ERRORS
Ln. 11 ,Col. 1
University of Leicester


Example again
Communication
Printer
User
The user is sometimes printing documents. the printer doesn't print a document before receiving a new one...
University of Leicester

New Example

User

Communication

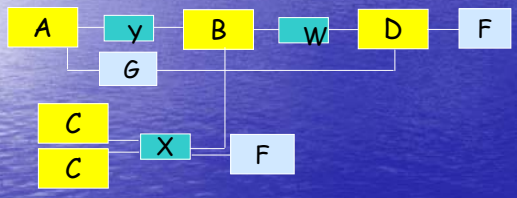
Printer

The User is sometimes moving, and wants to print documents. When the printer is not accessible for a while the user wait until the communication is available again…

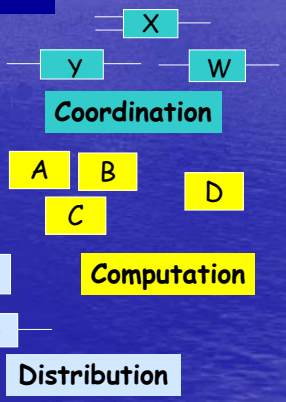
University of Leicester

Separation of Concerns: Distribution

Architectural Approach to Mobility



SYSTEM



University of Leicester

Distribution / Mobility

- The designs are distributed over different Locations through the mapping of their constituents to location variables
- The mobility is achieved while changing the value of a location variable.

```
design mobile_user
outloc locuser
out outfile@locuser : enum (ps, pdf)
prv state@locuser : bool
do work@locuser : state -> state := ~state
[] print_ps@locuser : ~state ->
    outfile := ps || state := ~state
[] print_pdf@locuser : ~state ->
    outfile := pdf || state := ~state
[] prv move@locuser : locuser := newLoc()
```

University of Leicester

Future Work

- Answer the problem of scalability of modelling systems;
- Difference between Static analyses and Dynamic analyses;
- Definition of a Methodology to use the CommUnity approach in order to model mobile systems (Meta-modelling, Architectural Views (SA), following MDA approach, Coordination mechanisms, …)

University of Leicester