Organizing Ad Hoc Agents in Smart Environments

Colloquium Computer Graphics & CAD CAM

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Overview

Problem description
Existing solutions
Service matching solution
Organizing agents:
    efficiency, context awareness
Example of service matching
Agent negotiation in detail

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Problem Description

Large Smart Ad Hoc Environments:

- Environment is full of agents (autonomous pieces of software) trying to offer services
- Ad-Hoc: Agents can appear, move or disappear at any time
- Agents al speak different languages (ontologies)

How does the user find the agent he needs?

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Existing approaches

- Menu or list
  - does not scale to large environments
  - cumbersome if available
    services not fixed

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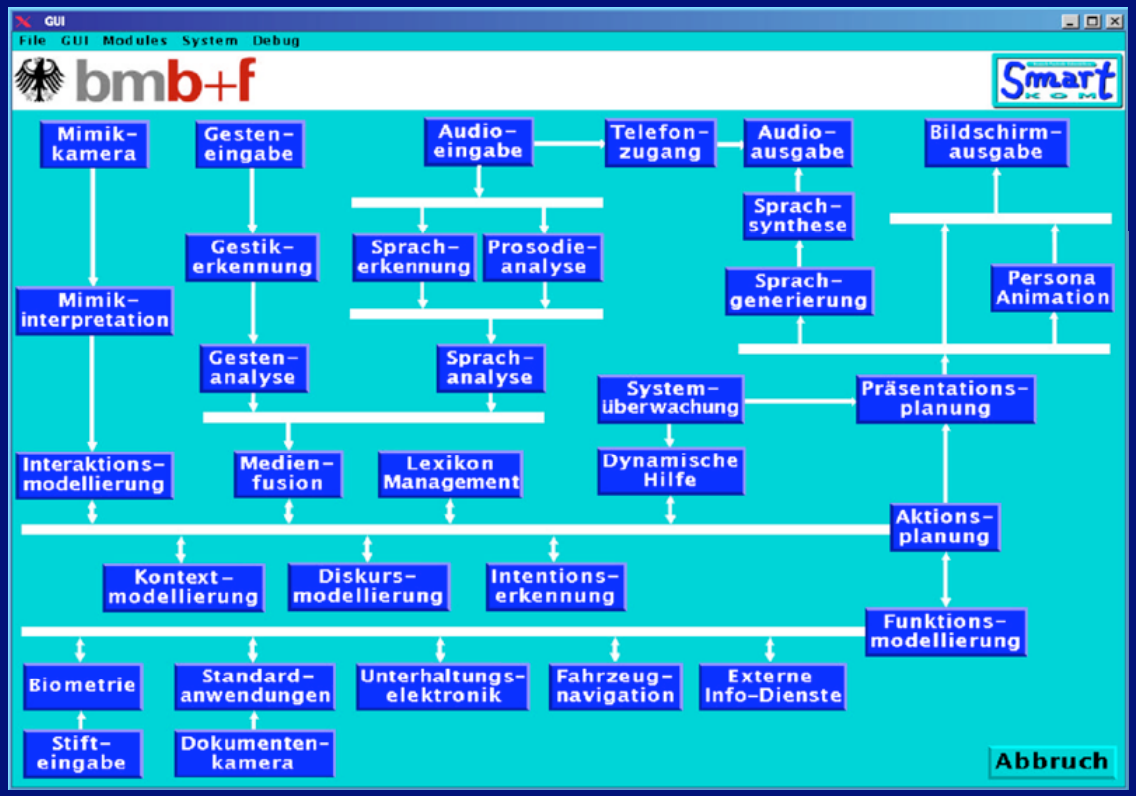
- Simple script-like natural language interface
  - user has to remember keywords for services, eg "turn on - master bedroom light"

- Centralized natural language interpreter
  - highly complex, inflexible central conversion
  - conversion to semantics is highly task-dependent and does not fit with central approach



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Our approach: Service Matching

- Free Natural Language
  + no keywords to remember
- Interpretation at individual Agent level (distributed),
  + clear task frame
  + proven robust technology for free natural language
- two-step understanding
  + first ask agents if they UNDERSTAND and CAN HANDLE a request. Activate only one if multiple understand the request.

Context Awareness

Broadcast request to ALL agents is not a good idea:

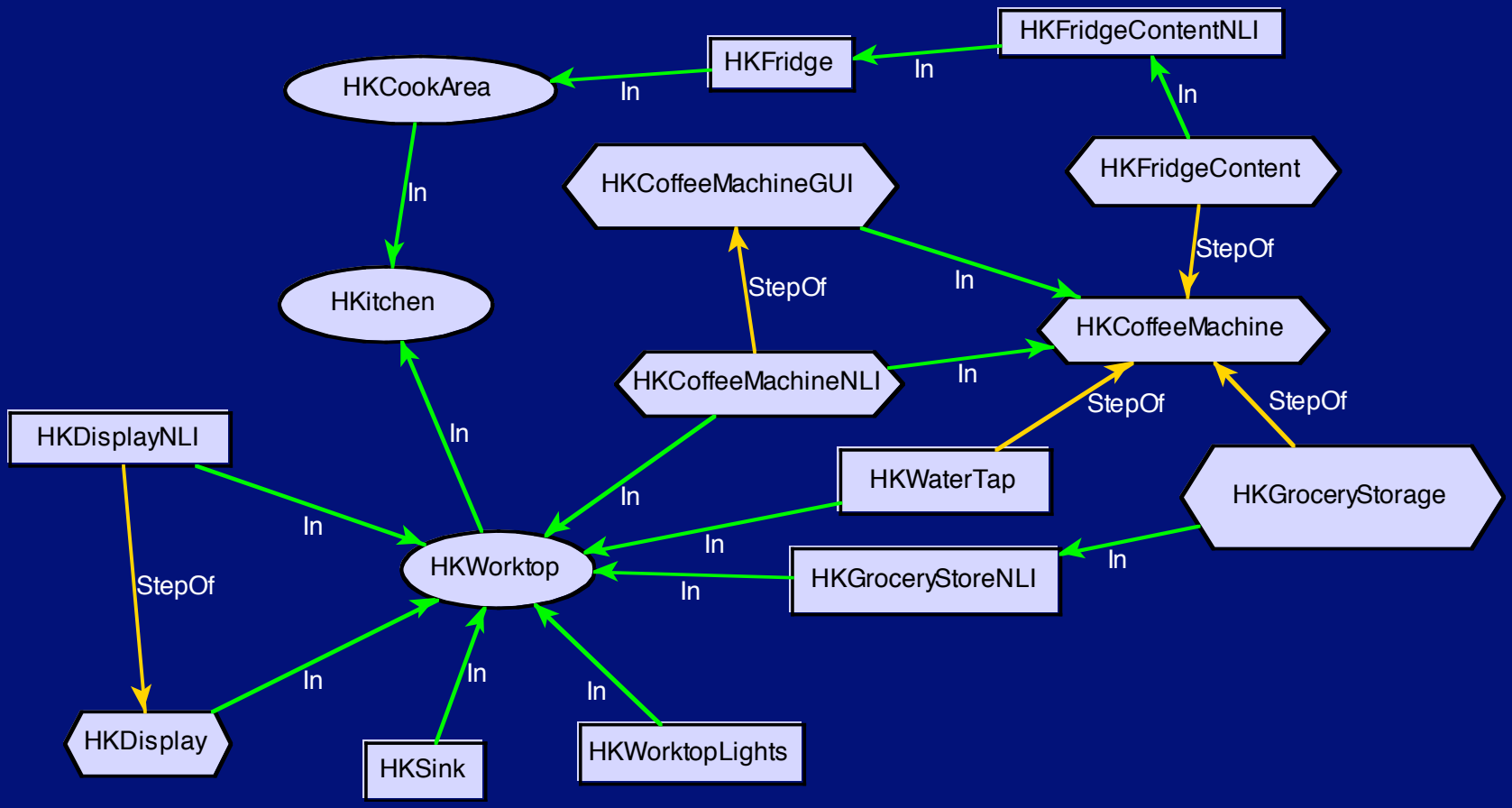
- completely overload the system (millions of services?)
- "your coffee is served in Sydney"?

Solution: Context Awareness to every agent

- All agents know and can communicate about about task- and location related agents

Related Agents Graph

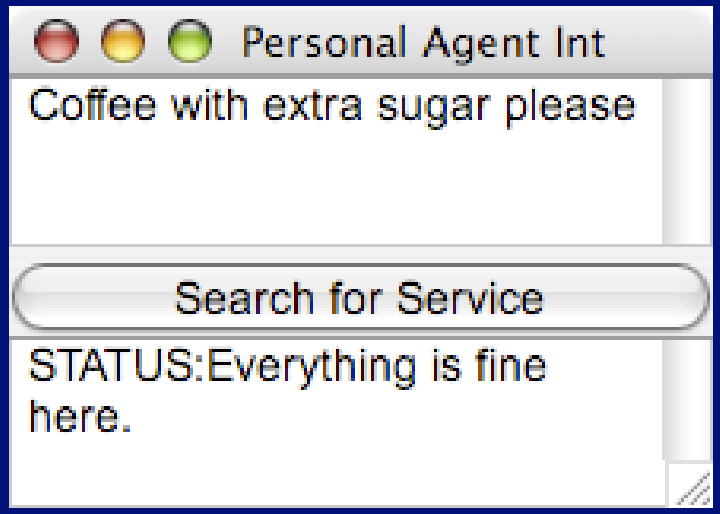
knowledge distributed over agents



Using Relations for Service Matching

Example Use:

- user in kitchen,
- Just turned on the light
- now asks the Service Matcher



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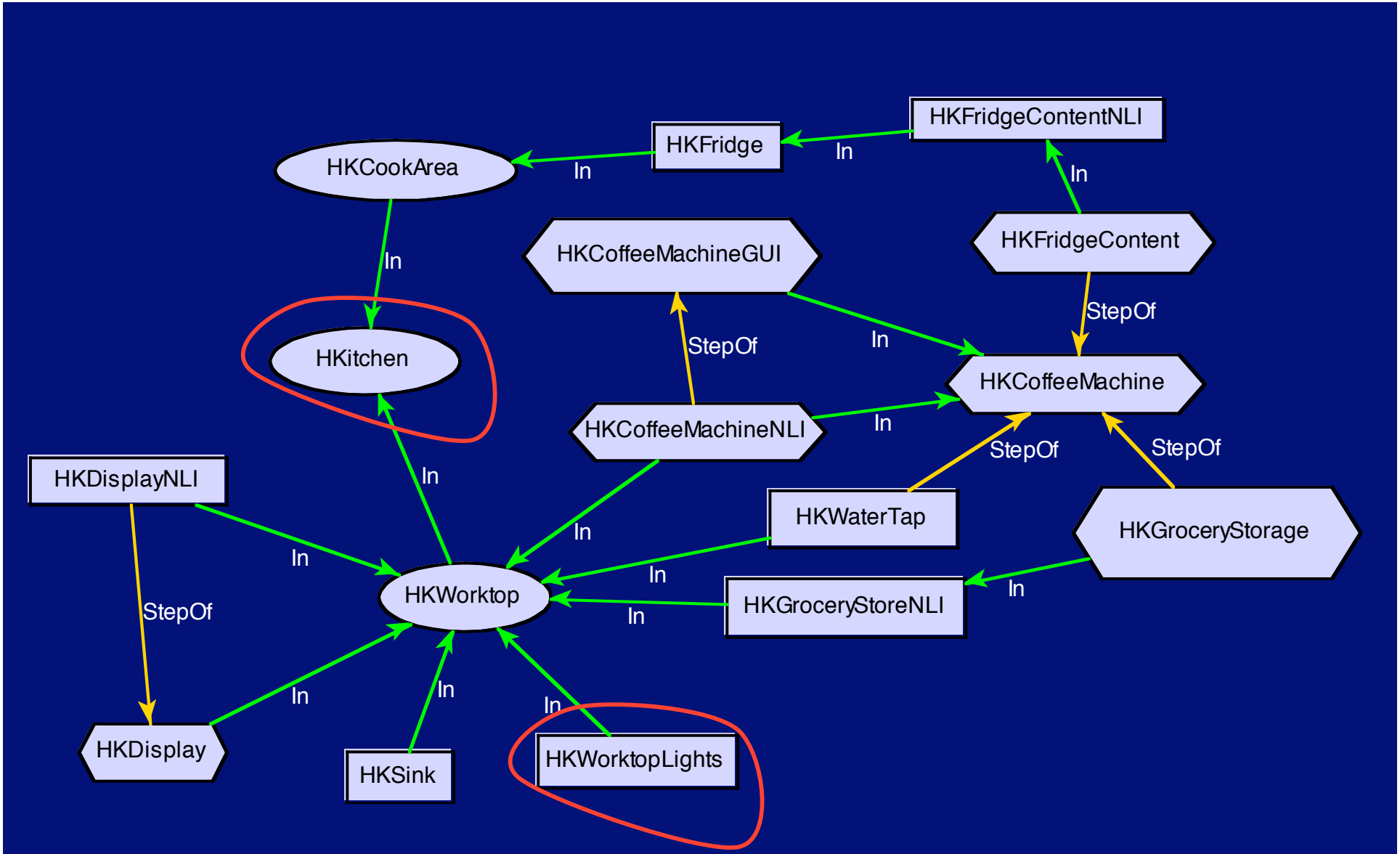
HKFridgeContentNLI
HKFridge
HKCookArea
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In
HKCoffeeMachineGUI
StepOf
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HKKitchen
HKCoffeeMachine
HKCoffeeMachineNLI
In
StepOf
StepOf
HKDisplayNLI
In
In
HKWaterTap
HKGroceryStorage
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StepOf
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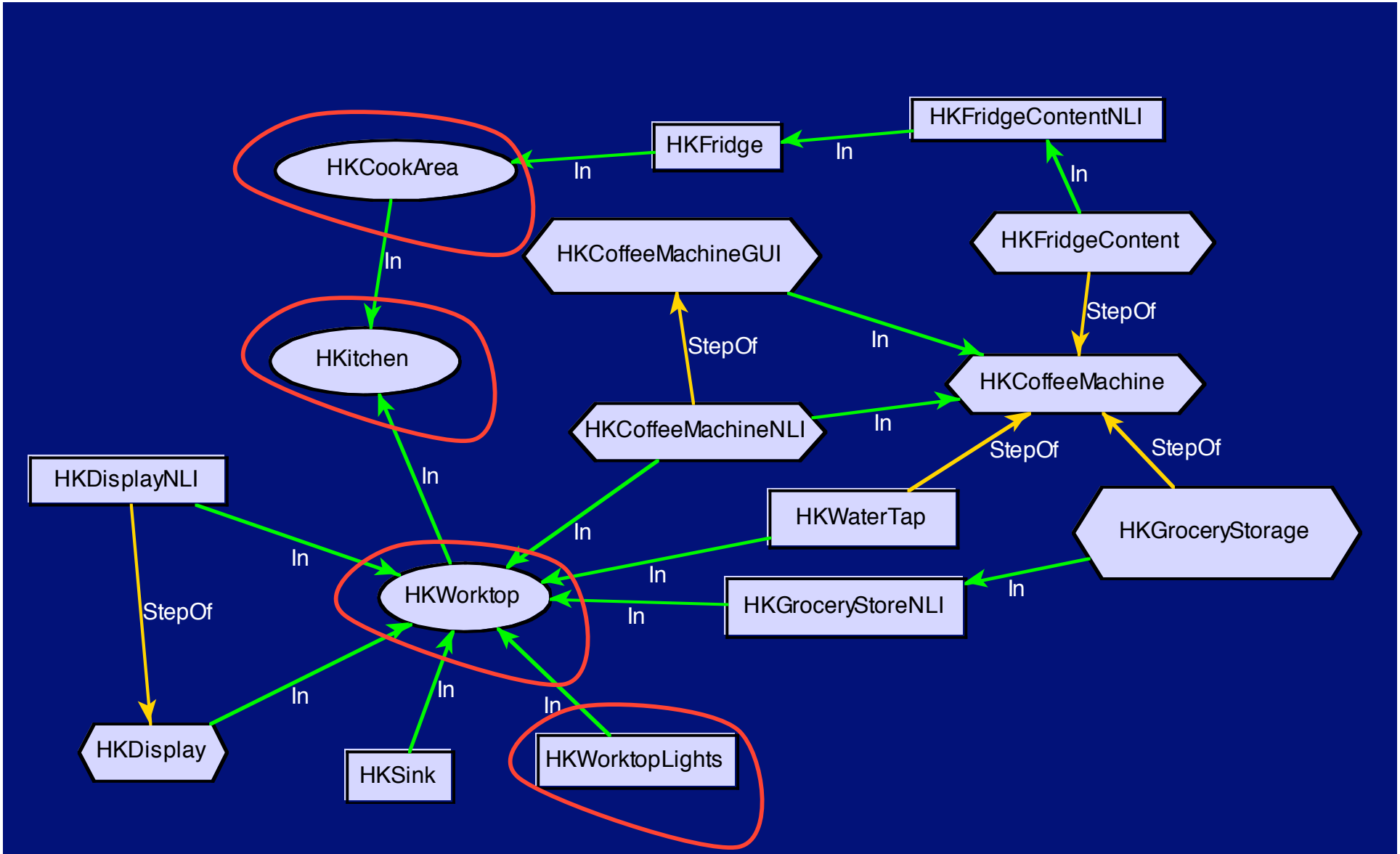
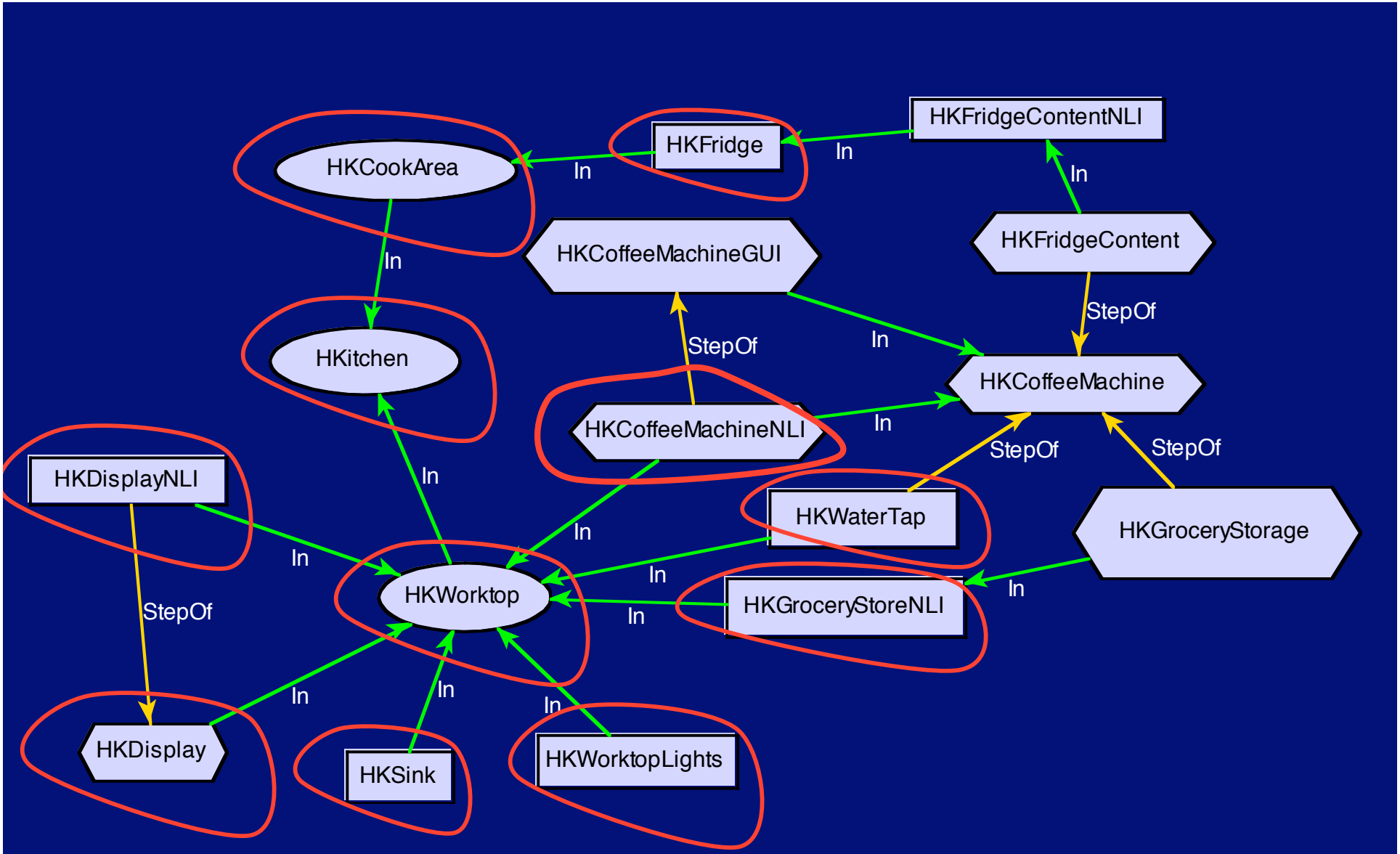
HKDisplay
HKSink
HKWorktopLights


HKCookArea
HKFridge
HKFridgeContentNLI
HKFridgeContent
HKCoffeeMachineGUI
HKitchen
HKCoffeeMachine
HKCoffeeMachineNLI
HKDisplayNLI
HKWaterTap
HKGroceryStorage
HKWorktop
HKGroceryStoreNLI
HKDisplay
HKSink
HKWorktopLights
In
StepOf


HKCookArea
HKFridge
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HKCoffeeMachineGUI
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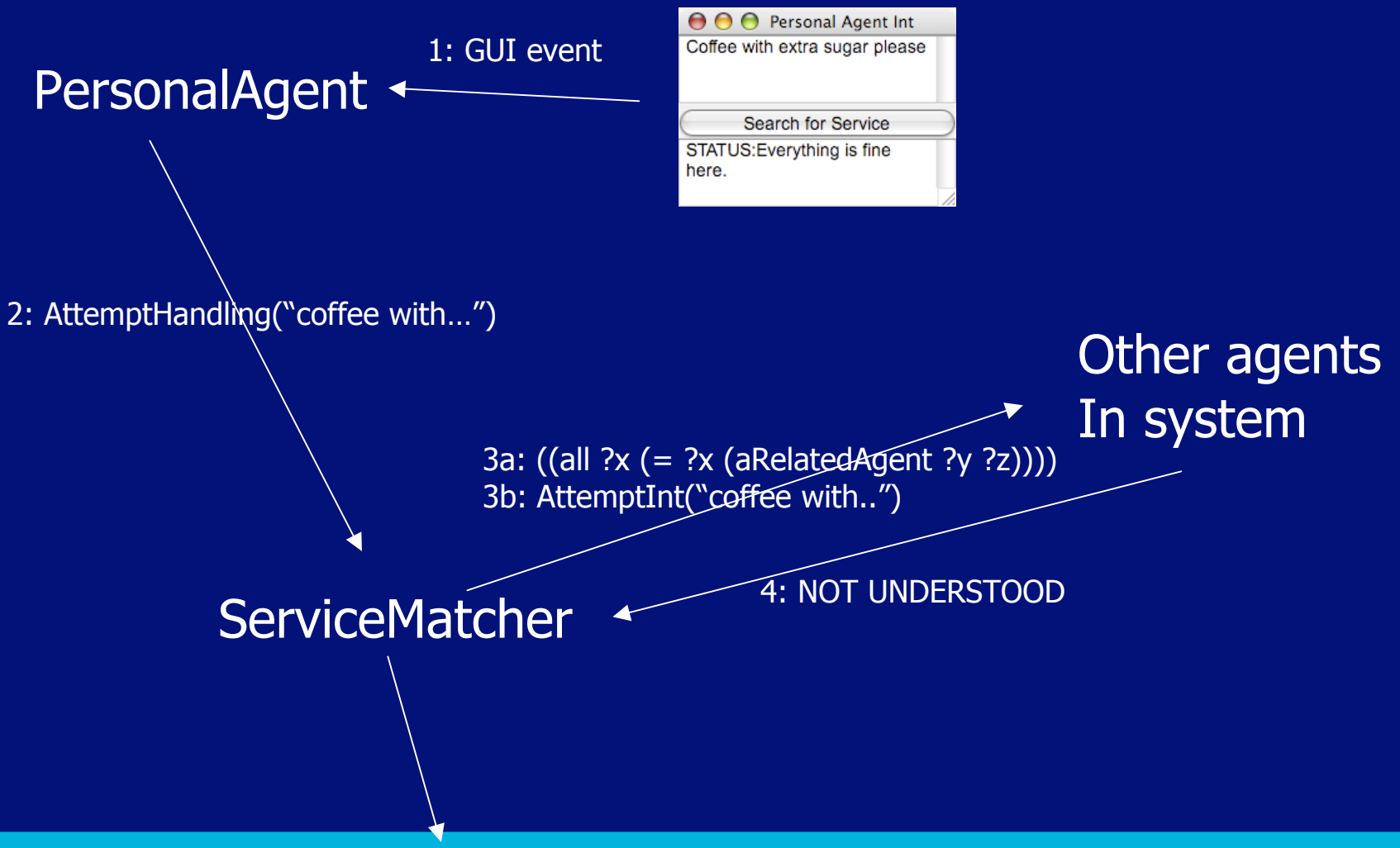
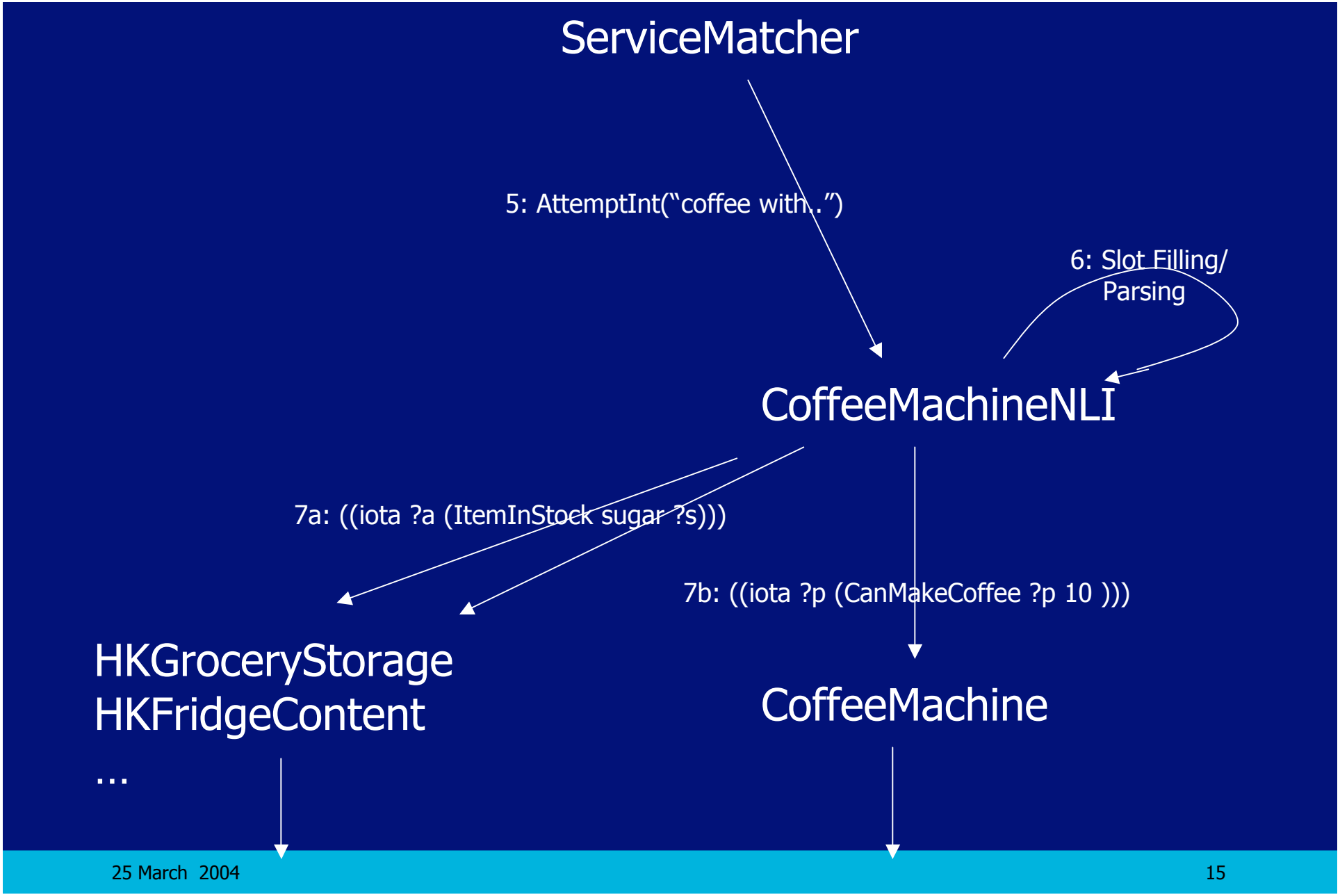
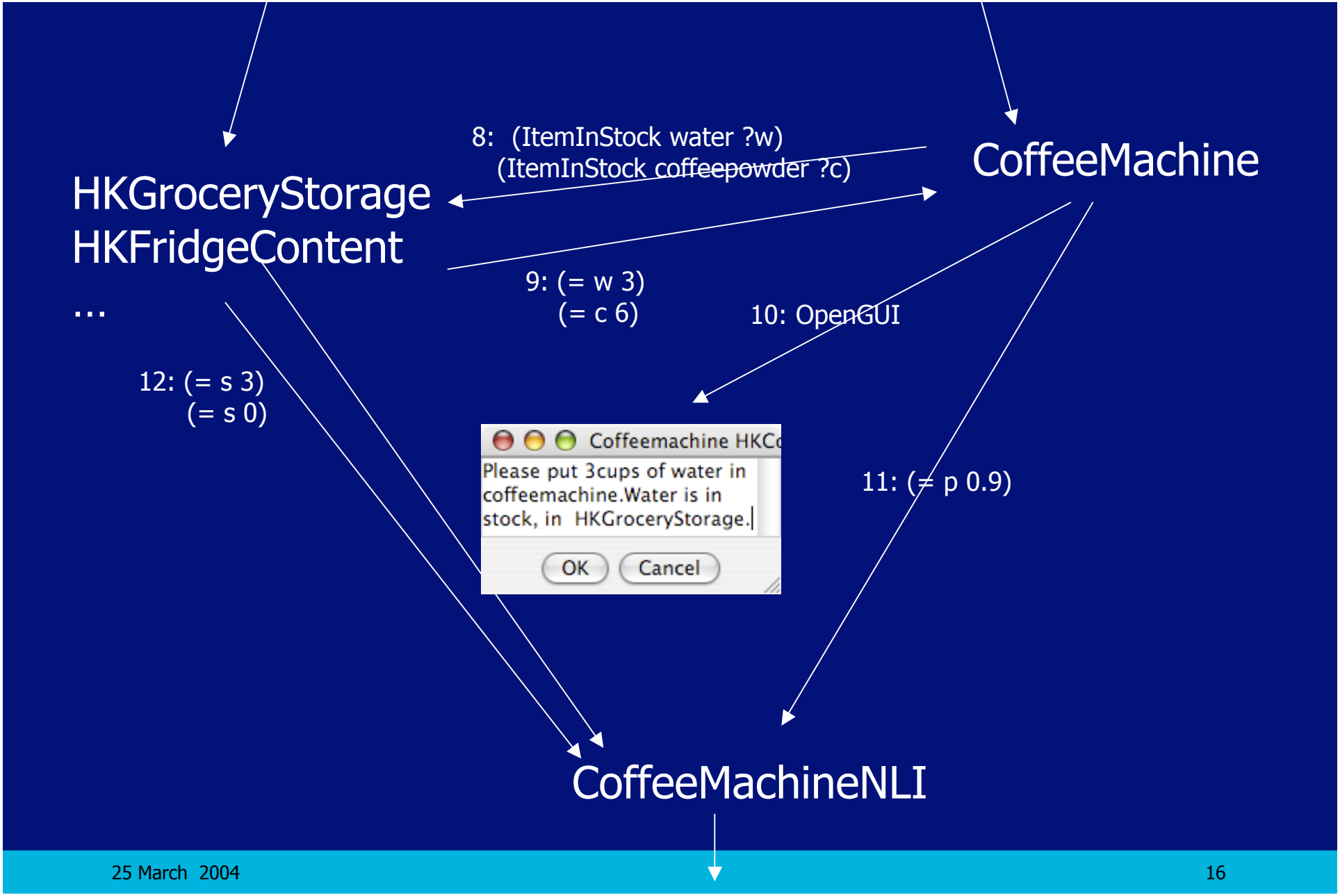
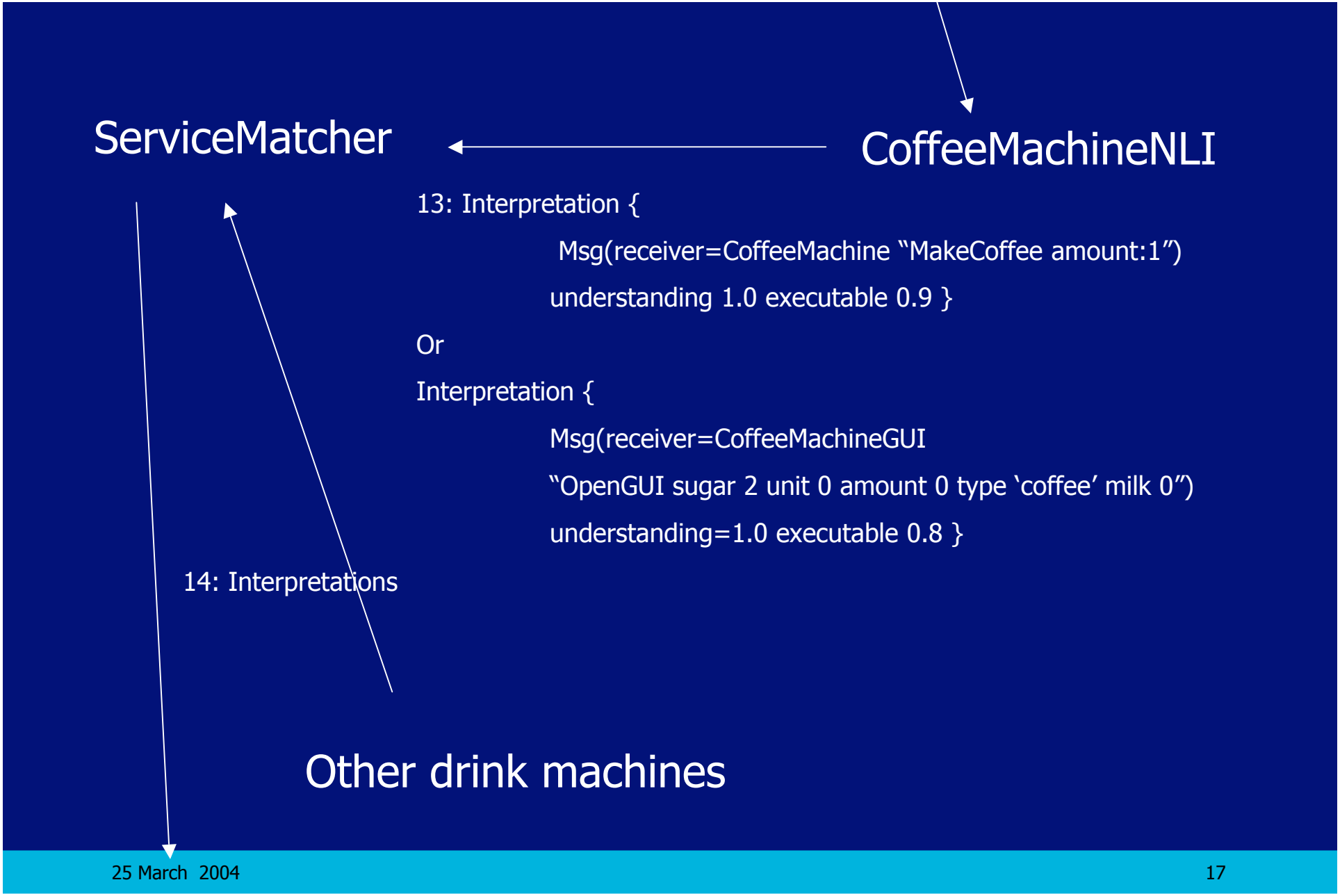
HKitchen
HKCoffeeMachine
HKCoffeeMachineNLI
HKDisplayNLI
HKWaterTap
HKGroceryStorage
HKWorktop
HKGroceryStoreNLI
HKDisplay
HKSink
HKWorktopLights
In
StepOf

Agent Negotiation in (some) Detail

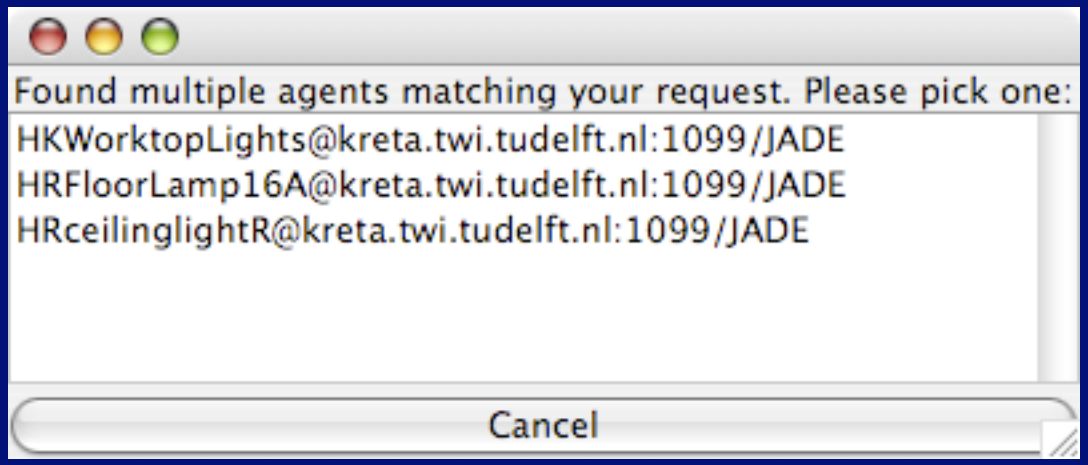



ServiceMatcher
5: AttemptInt("coffee with..")
6: Slot Filling/
Parsing
CoffeeMachineNLI
7a: ((iota ?a (ItemInStock sugar ?s)))
7b: ((iota ?p (CanMakeCoffee ?p 10)))
HKGroceryStorage
HKFridgeContent
...
CoffeeMachine


HKGroceryStorage
HKFridgeContent
...
8: (ItemInStock water ?w)
(ItemInStock coffeepowder ?c)
CoffeeMachine
9: (= w 3)
(= c 6)
10: OpenGUI
12: (= s 3)
(= s 0)
Coffeemachine HKC
Please put 3cups of water in coffeemachine.Water is in stock, in HKGroceryStorage.
OK
Cancel
11: (= p 0.9)
CoffeeMachineNLI


ServiceMatcher
CoffeeMachineNLI
13: Interpretation {
Msg(receiver=CoffeeMachine "MakeCoffee amount:1")
understanding 1.0 executable 0.9 }
Or
Interpretation {
Msg(receiver=CoffeeMachineGUI
"OpenGUI sugar 2 unit 0 amount 0 type 'coffee' milk 0")
understanding=1.0 executable 0.8 }
14: Interpretations
Other drink machines

15:



ServiceMatcher

16: Execute(Interpretation ….)

CoffeeMachineNLI

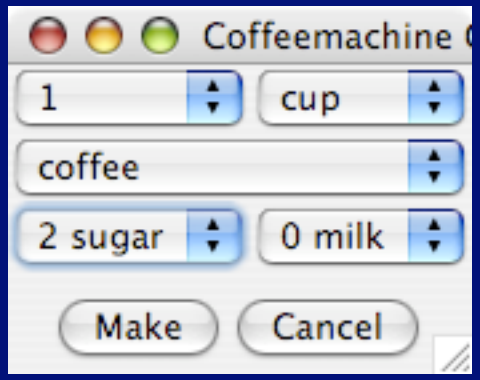
CoffeeMachineNLI

17a: OpenGUI sugar 2 unit 0 amount 0 type 'coffee' milk 0

17b: MakeCoffee amount 1

CoffeeMachineGUI

18: MakeCoffee amount 1



CoffeeMachine

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(if time left…)

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