A Reflective Approach to Dynamic Software Evolution

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Overview

- *Problem Statement*
- *Towards Separated Concerns*
- *Towards Dynamic Software Evolution*
- *Conclusion*
- *Issues*

Problem Statement

- *Software Evolution is Unavoidable*
- *Critical Systems*
    - *Systems that "cannot" be shut down*
    - *Web services, Telecommunication switches, Banking Systems, Airport Traffic control systems, GPS satellite update...*

What if a small part of those systems has to evolve?

Towards Separated Concerns

- *Every concern implemented as a separate entity.*
  - *Function, ADT, class, component, aspect, ...*
- *Advantages*
  - *No scattered code*
  - *Every entity can evolve separately*
  - *Easier to maintain*

return TomTourwé.doResearch(loadsOfMoney);

Towards Dynamic SW Evolution

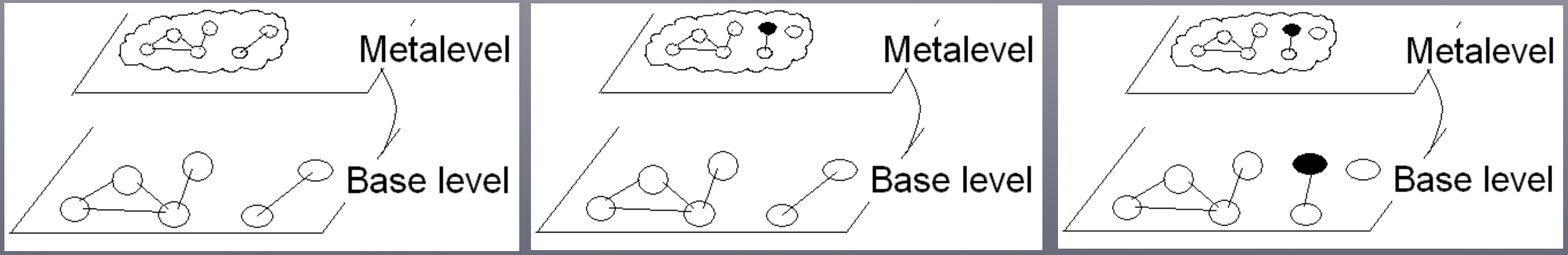
Goal

- *Divide and conquer!*
- *Allowing every entity to evolve separately*
- *System evolution -> Entity evolution*
  - *Entity addition*
  - *Entity removal*
  - *Entity modification*
- *Dynamic comes in when this is done at runtime*

Towards Dynamic SW Evolution

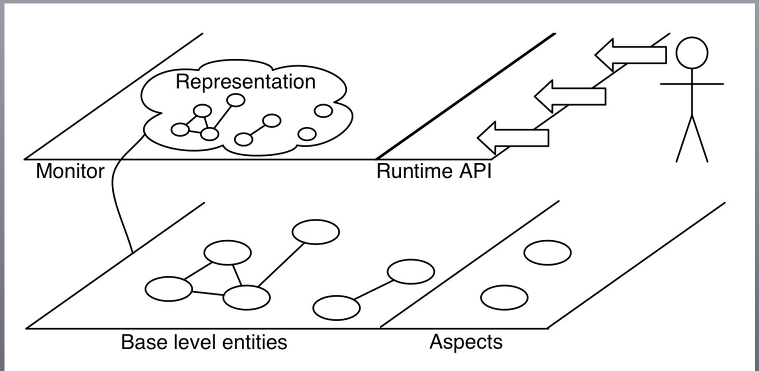
Reflective Systems

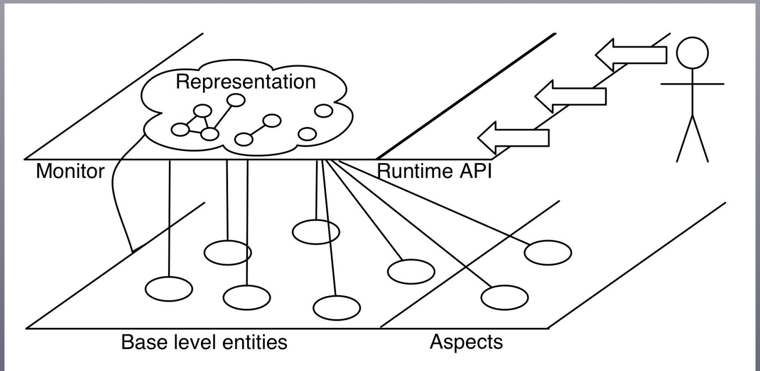
- *Able to reason about itself*
  - *2 levels of calculation: base level, metalevel*
  - *Causal connection between the 2 levels*
    - *Base level application has access to its metalevel representation on the base level*
    - *A change of the metalevel representation impacts the base level application.*



Towards Dynamic SW Evolution
The Framework

- *Two layered architecture*
  - *Base level: instrumented application*
  - *Metalevel: monitor*
    - *Gets control on every inter-entity communication*
    - *Propagates control to the adequate base-level entity*





Towards Dynamic SW Evolution

The Runtime API

- *Allows runtime interaction with the system*
  - *Modification of the base-level applications representation*
- *API functions on the Monitor*
  - *Adding an entity*
  - *Removing an entity*
  - *Modifying an entity*
    - *Deactivate the entity -> Queue all messages to it*
    - *Transfer the state -> Programmers decision*
    - *Activate the entity -> Execute all queued messages*

Conclusion

- *Two-step solution for dynamic evolution*

  1. *Make the system well modularized*
  2. *Control the instrumented base application by a metalevel monitor*

     -> Use reflective programming capabilities

- *Works for a lot of programming styles*

  Object-oriented, aspect-oriented or any other, as long as it is well modularized.

Issues

- *Issues*

  Do we really want D.E.?
  Are there good alternatives?
  Does DAOP allow D.E.?
  Does Reflection allow D.E.?

  Existing Instances
  State Mapping
  Running Threads with D.E.
  Aspect Composition

- *References*

- *Peter Ebraert and Tom Tourwé*
  A Reflective Approach to Dynamic Software Evolution
  In the proceedings of the Workshop on Reflection, AOP and Meta-Data for Software Evolution (RAM-SE'04) in conjunction with the European Conference on Object Oriented Programming (ECOOP 2004), 15th of June 2004, Oslo Norwa

- *Peter Ebraert and Eric Tanter*
  A Concern-based Approach to Dynamic Software Evolution
  In the Dynamic Aspects Workshop (DAW) proceedings in conjunction with the conference on Aspect Oriented Software Design (AOSD 2004), March 22-26 2004, Lancaster UK