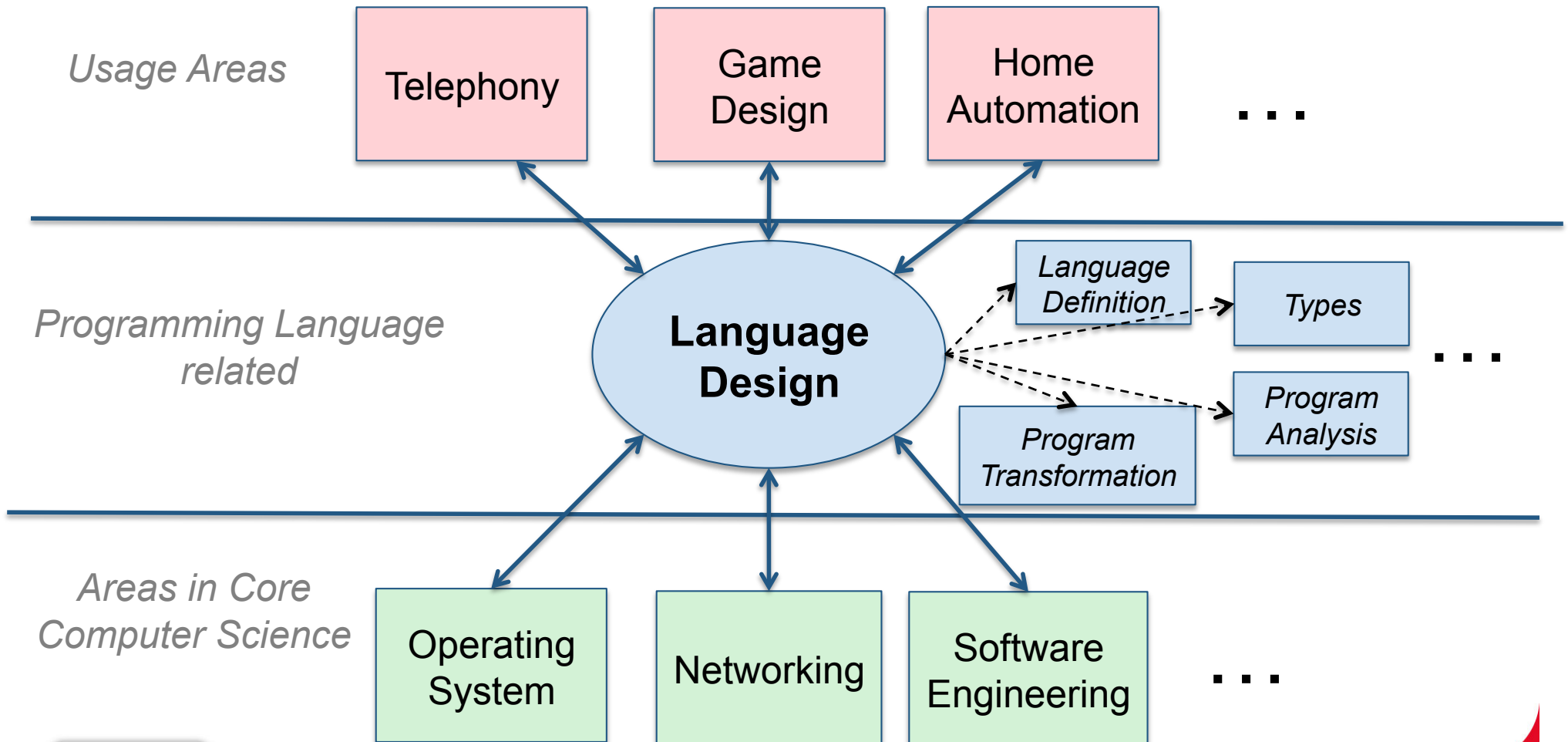




Language Design Cross-fertilizing with other areas

Charles Consel
Phoenix Research Group
Inria / University of Bordeaux
`phoenix.inria.fr`

Language Design: Central Activity



Collaborating with Areas in Core Computer Science

- Domain-Specific Languages
 - Domain analysis
 - DS properties
 - DS abstractions
 - Program analysis
 - Compilation
 - Examples: Networking, Operating systems, Multimedia, *etc.*

Collaborating with Areas in Core Computer Science

- Benefits
 - Interacting with researchers from other CS communities
 - Building a complementary expertise (more job opportunities)
 - Strengthening research hypotheses
 - Validating research results
 - Widening impact of research results
 - Opening new research avenues
 - Finding new research problems
 - Creating more funding opportunities (government, industry)
 - Attracting students

Collaborating with Usage Areas

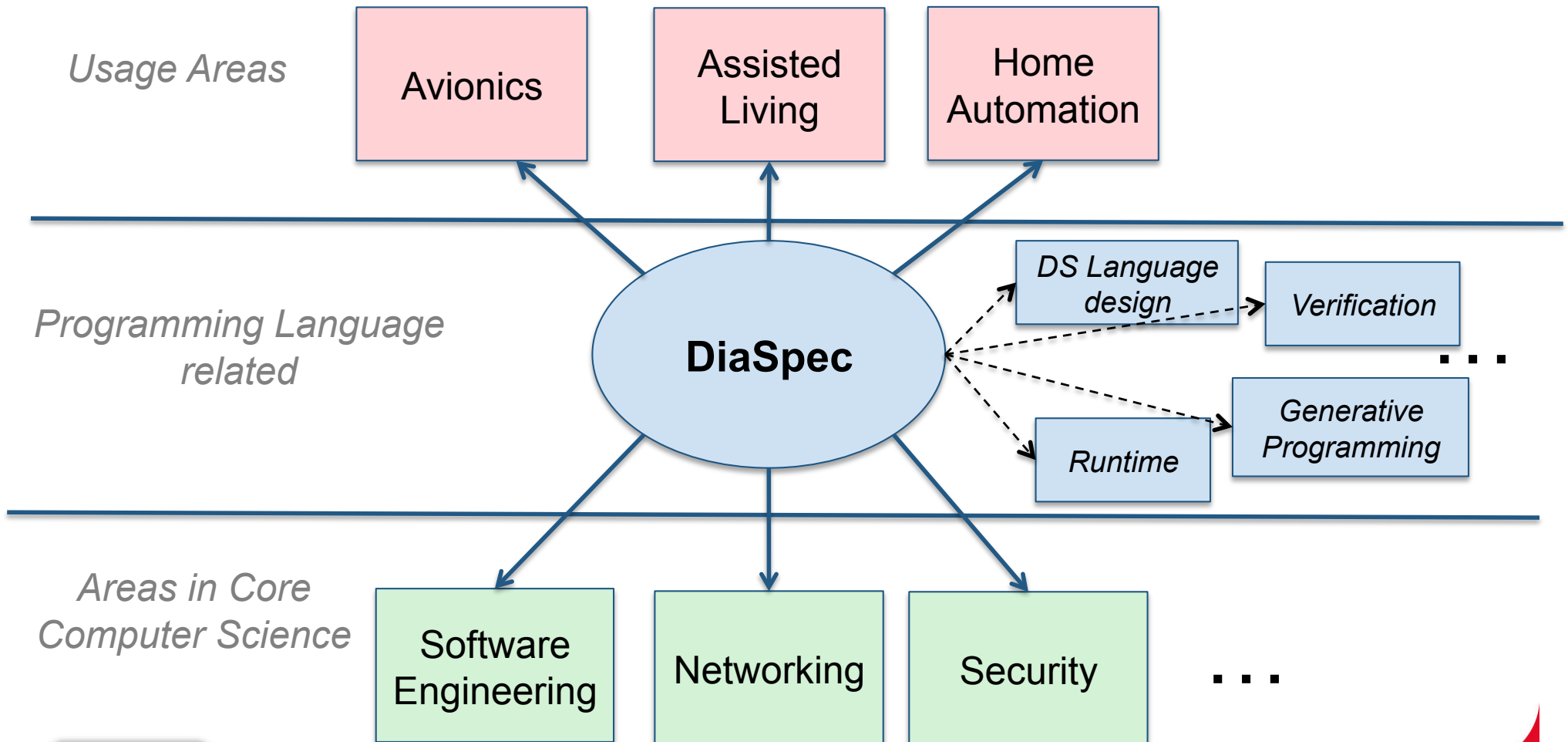
- User programming
 - Domain analysis
 - Domain process
 - Language engineering
 - Evaluation: usability, productivity, verifiability, *etc.*
 - Tools
 - Examples: Telephony, Assisted living, *etc.*

Collaborating with Usage Areas

- Benefits
 - Interacting with non-computer scientists (multidisciplinary)
 - Widening research hypotheses
 - Widening research avenues
 - Finding new research problems
 - Creating more funding opportunities (government, industry)
 - Attracting students

The DiaSuite Project *(ongoing)*

diasuite.inria.fr



The DiaSuite Project

A design language to specify a software system

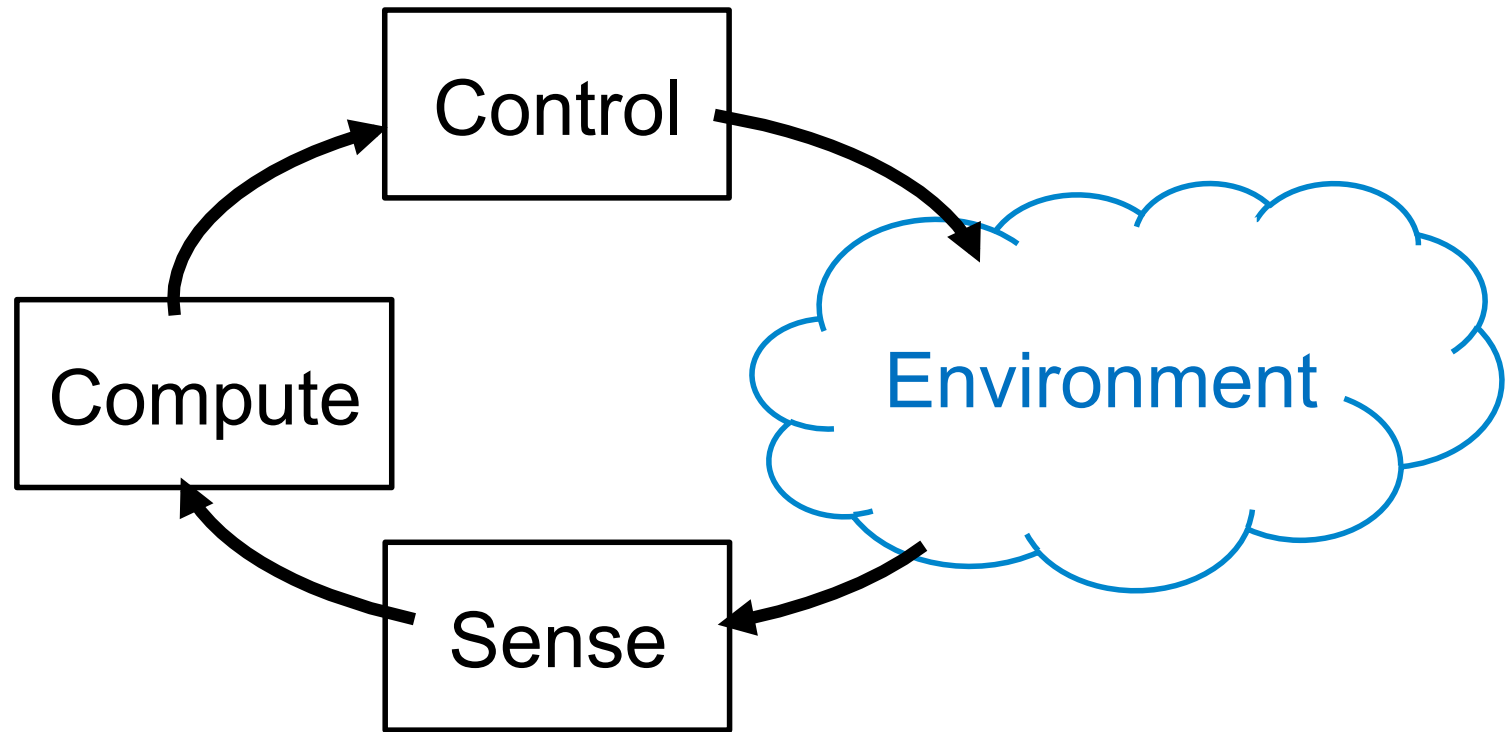
A paradigm-specific language

A compiler to process a specification to

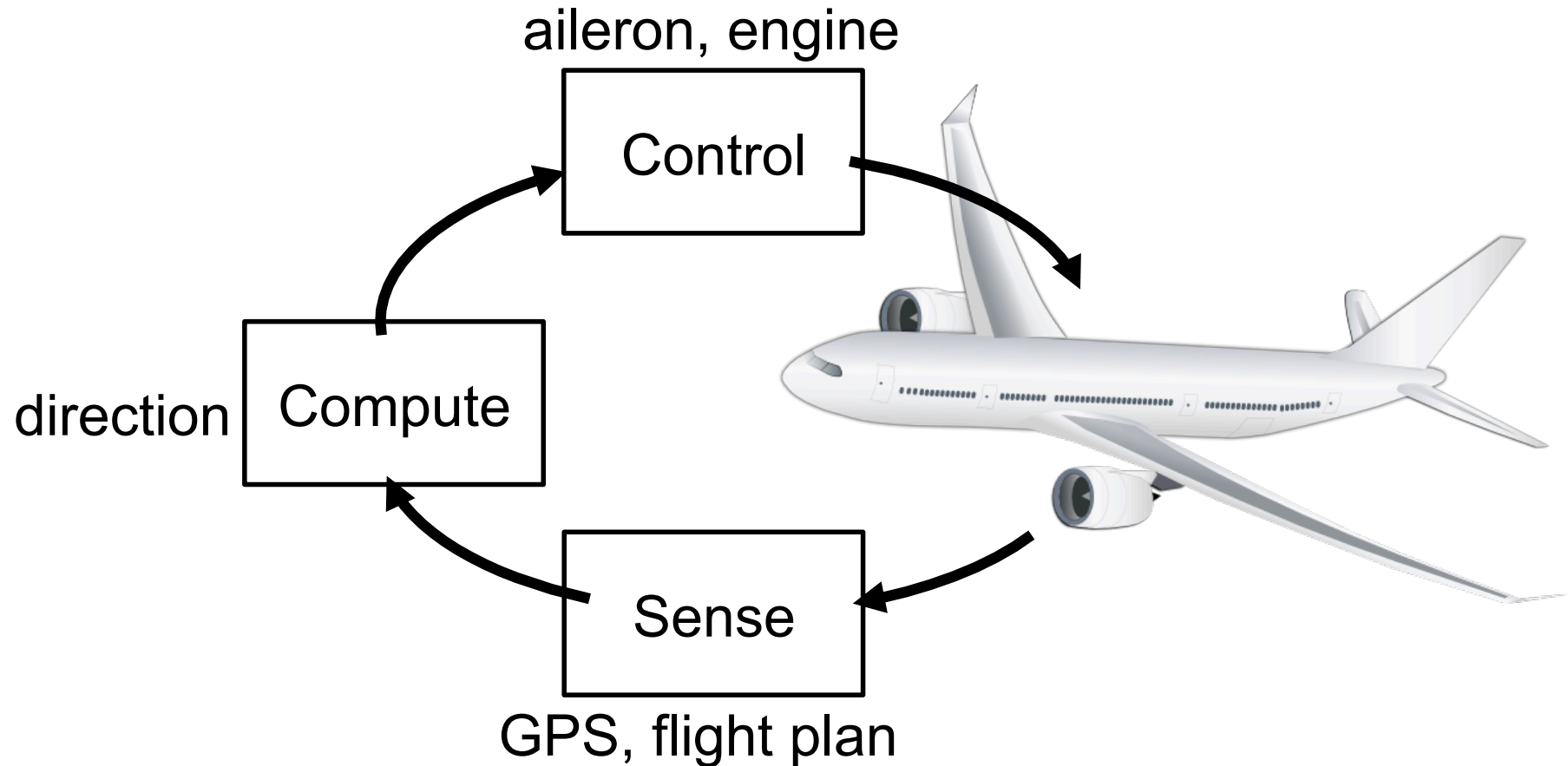
- guide the implementation
- verify safety properties
- ensure conformance

**Paradigm:
Sense/Compute/Control
software systems**

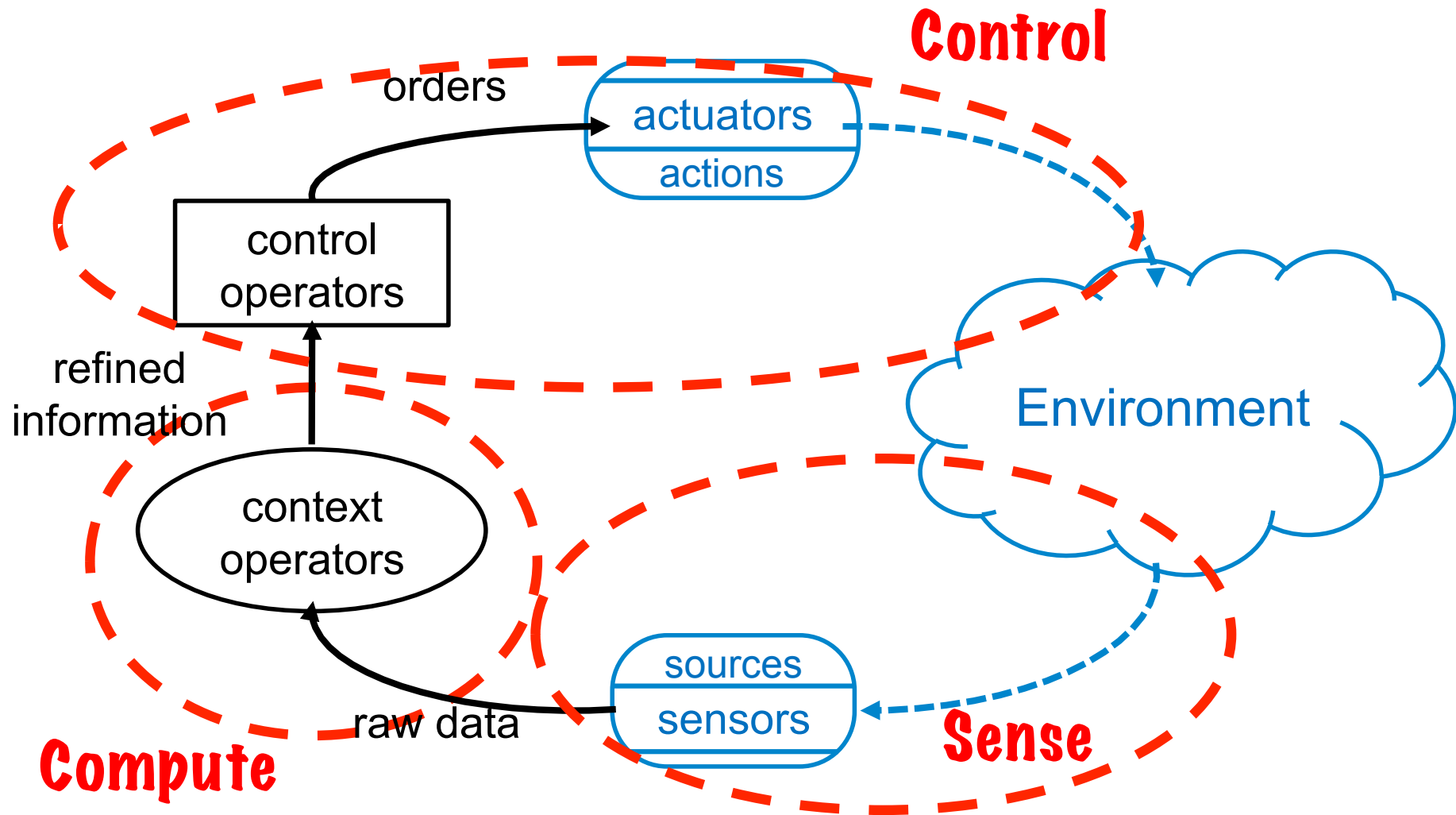
Sense/Compute/Control (SCC) Software System



Sense/Compute/Control (SCC) Software System

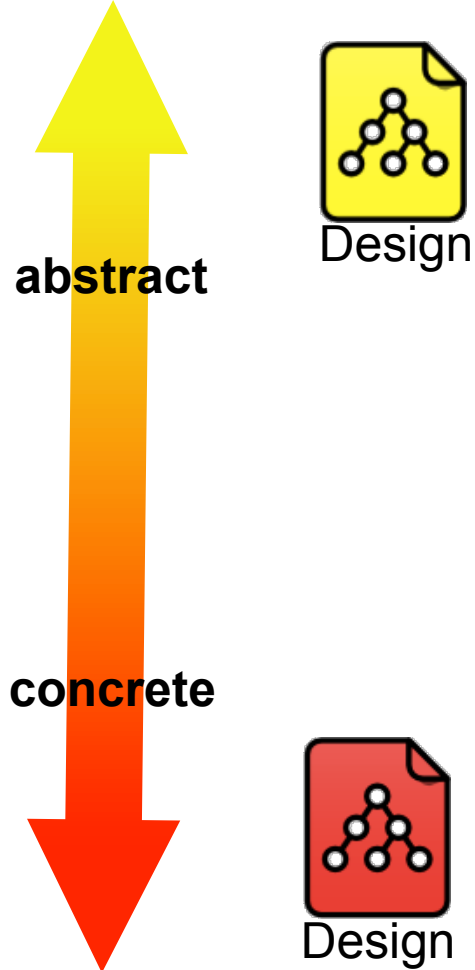


The SCC Architectural Style



Compiling a Design

Design
Language

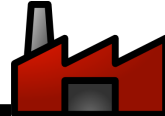


Compiling a Design

Design Language



Design



Compiler



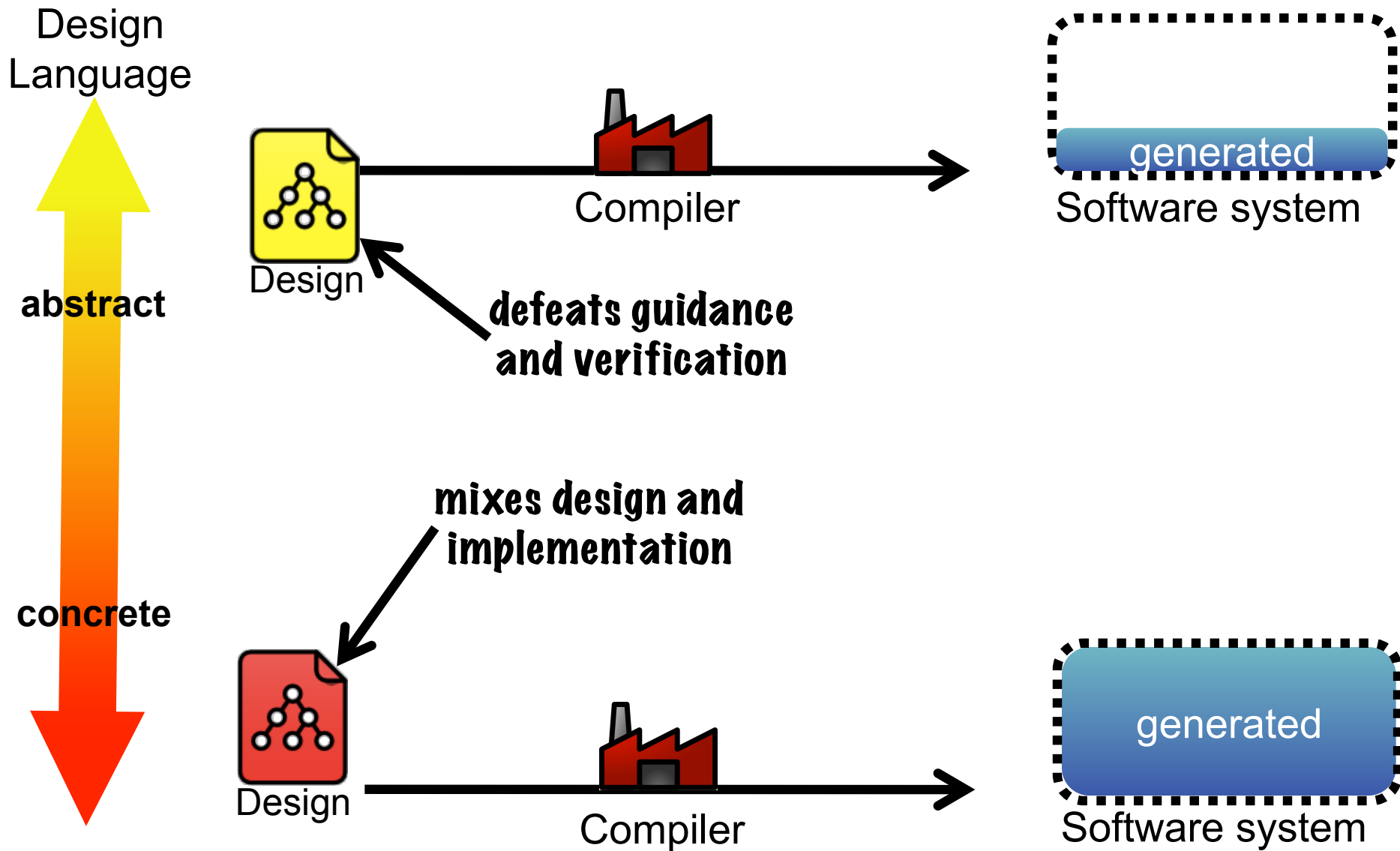
Software system

**defeats guidance
and verification**



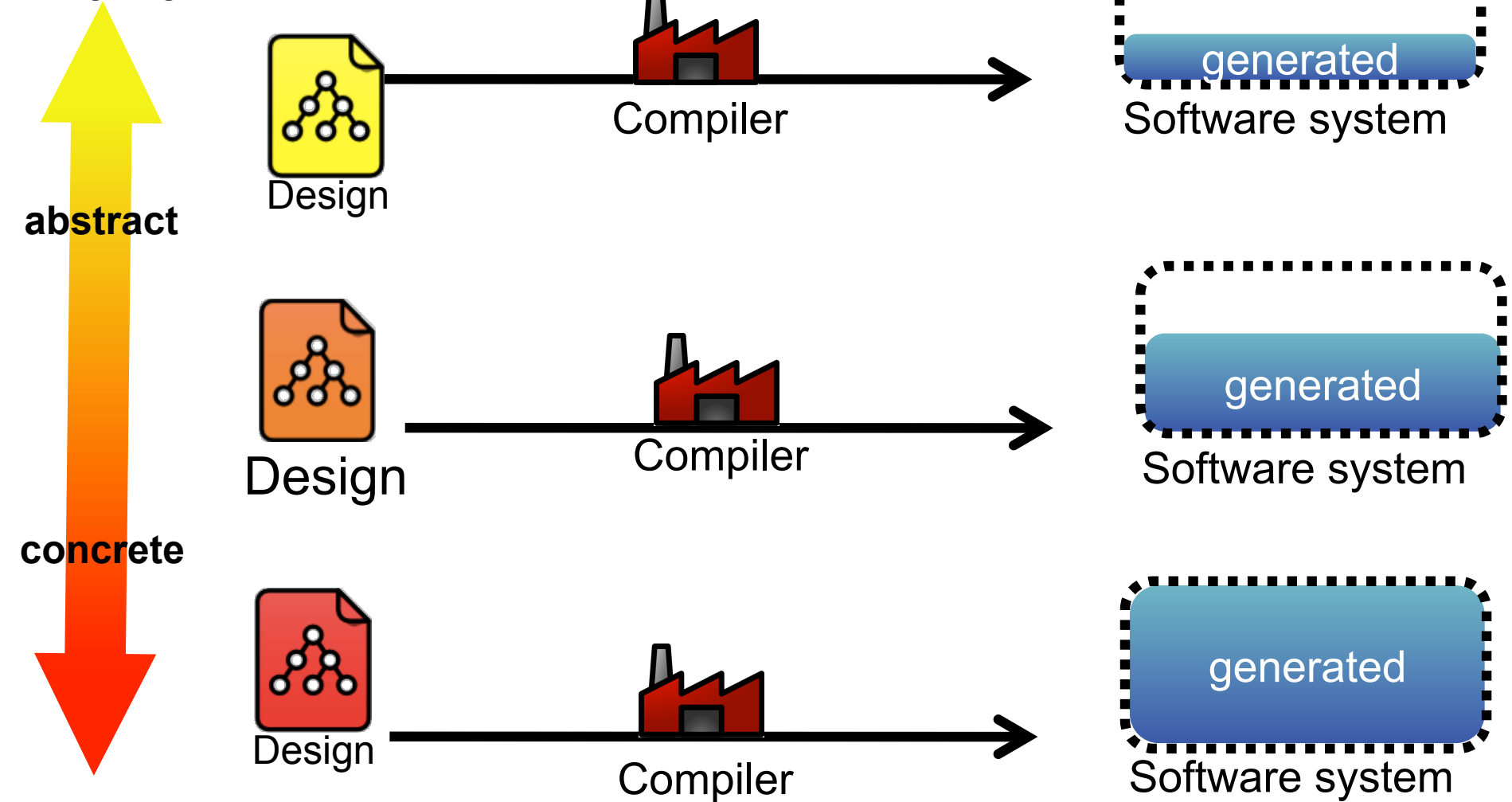
Design

Compiling a Design

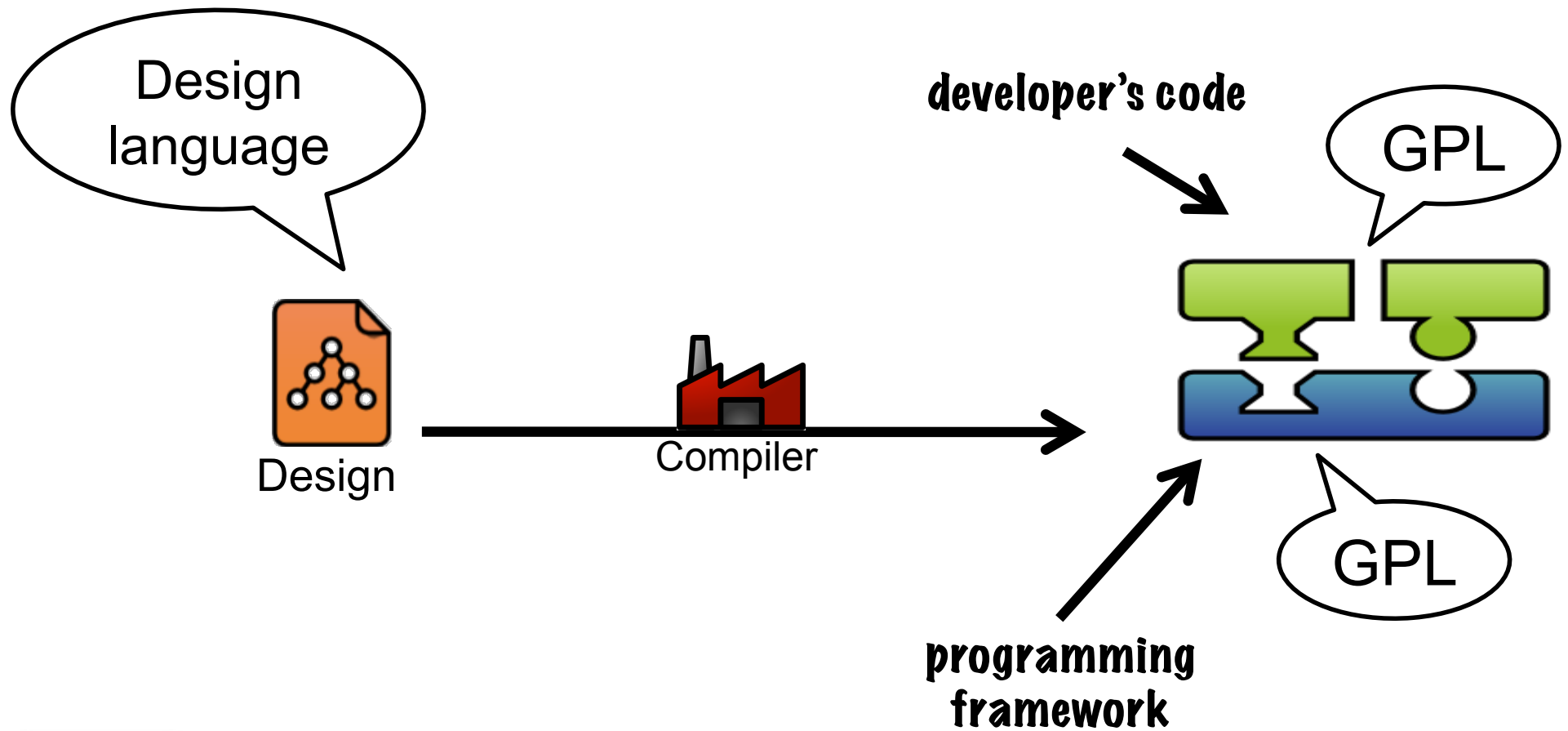


Compiling a Design

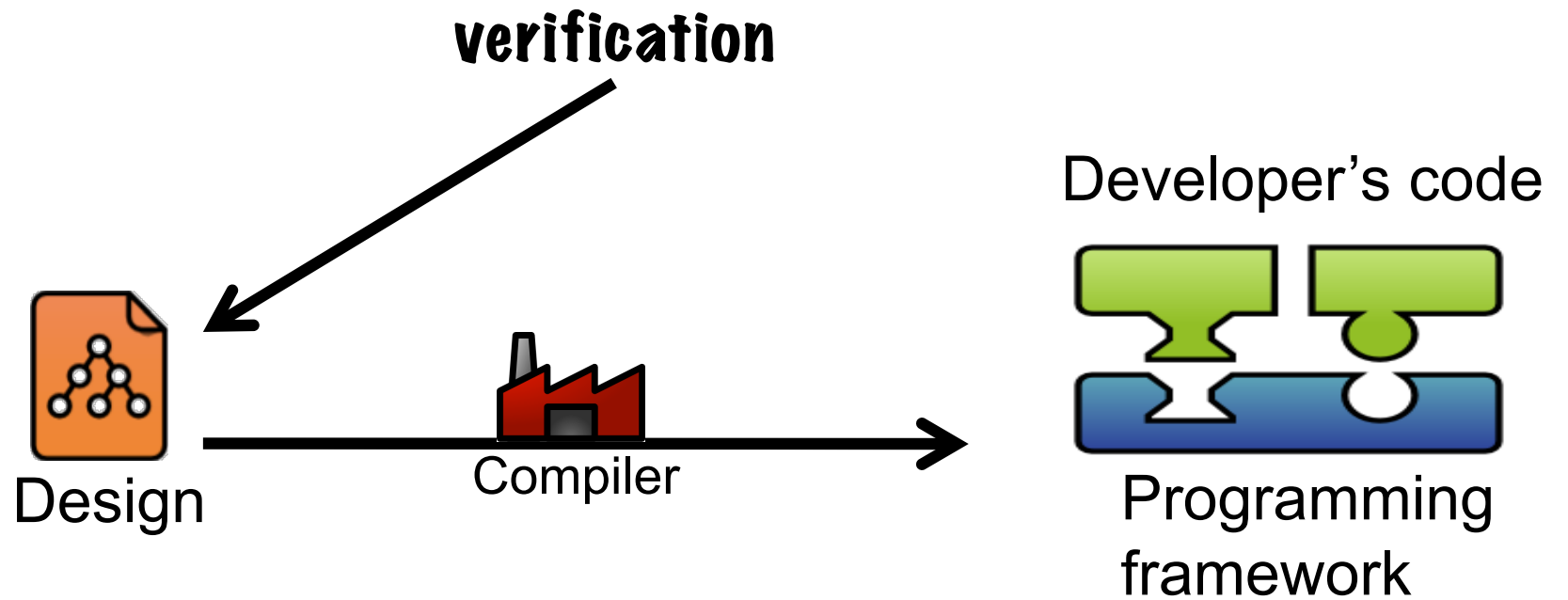
Design Language



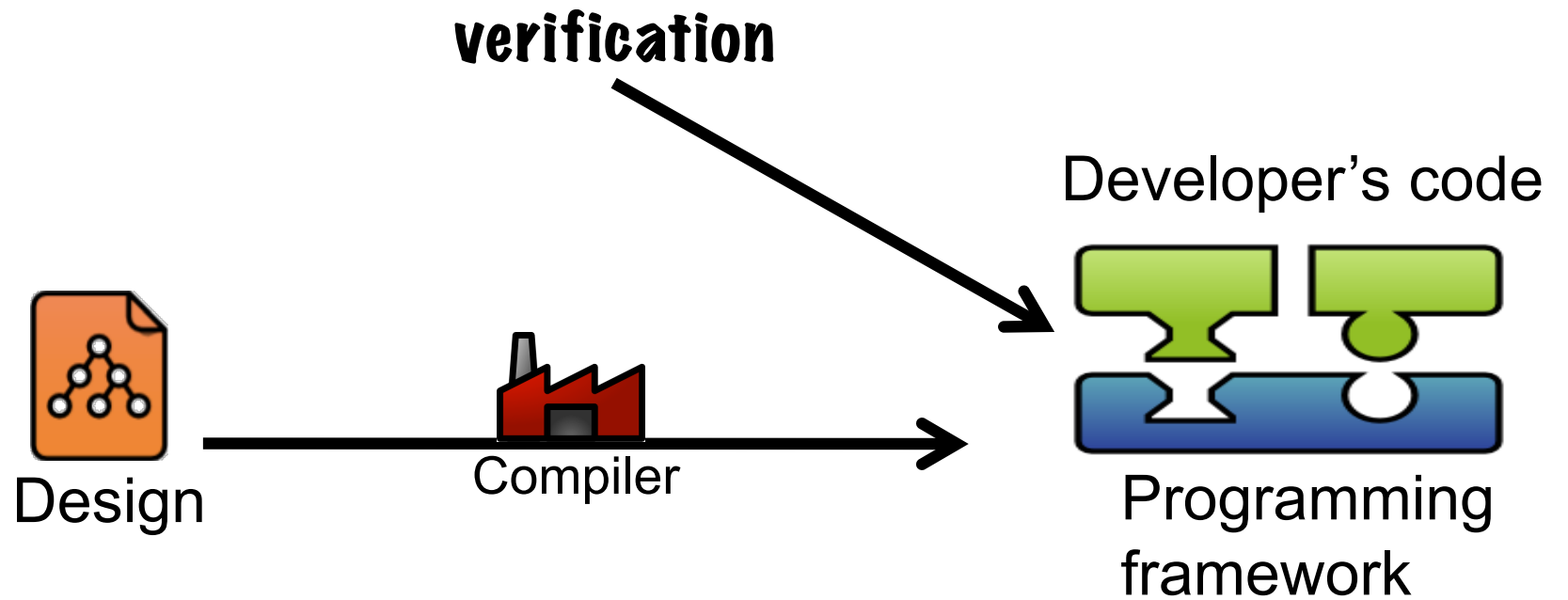
Our Approach



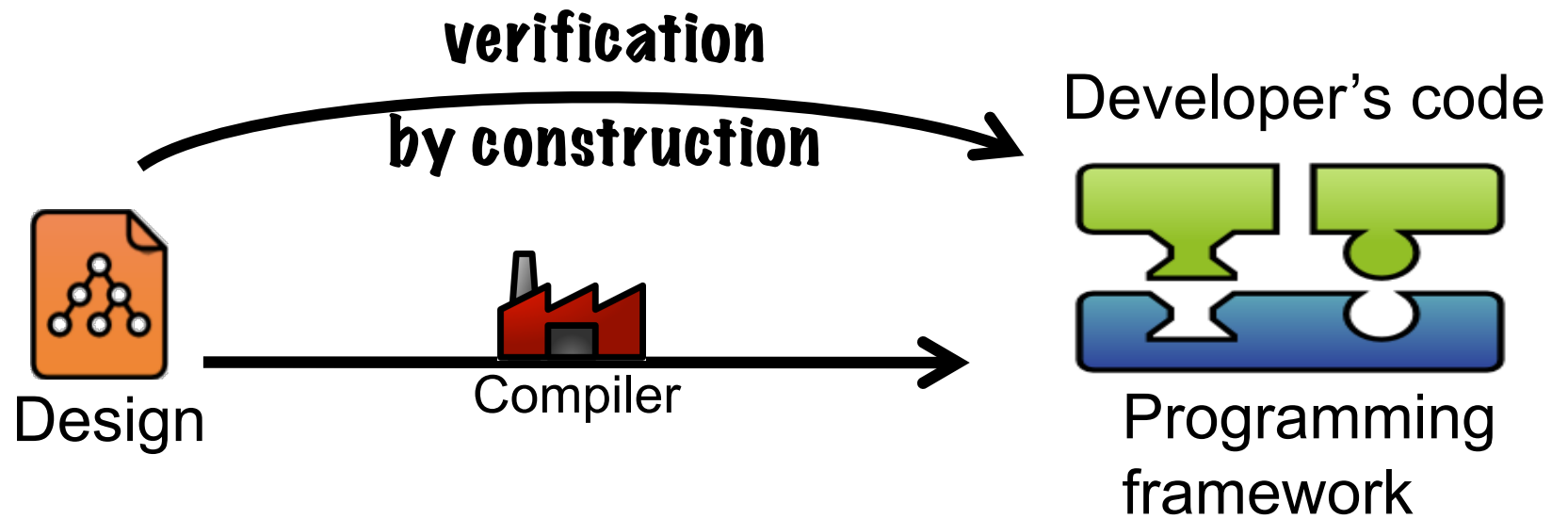
Our Approach



Our Approach

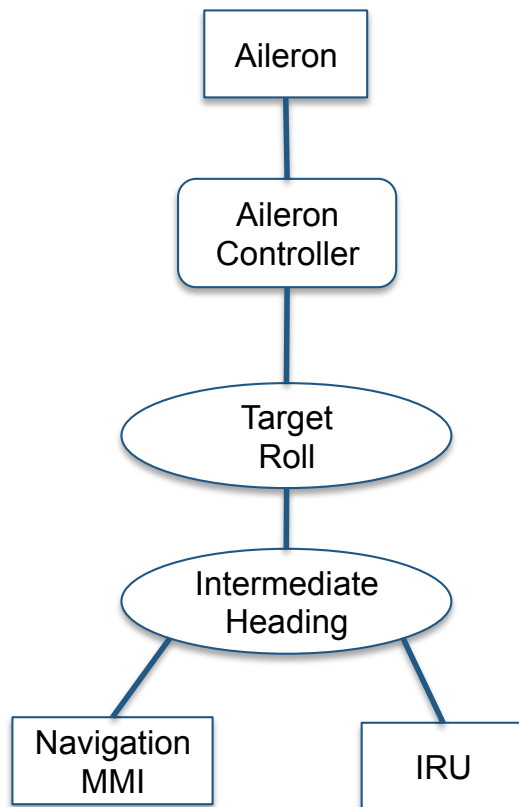


Our Approach



Flight Guidance System

DiaSpec – Taxonomy



```
action Control {
    incline(targetRoll as Float);
}

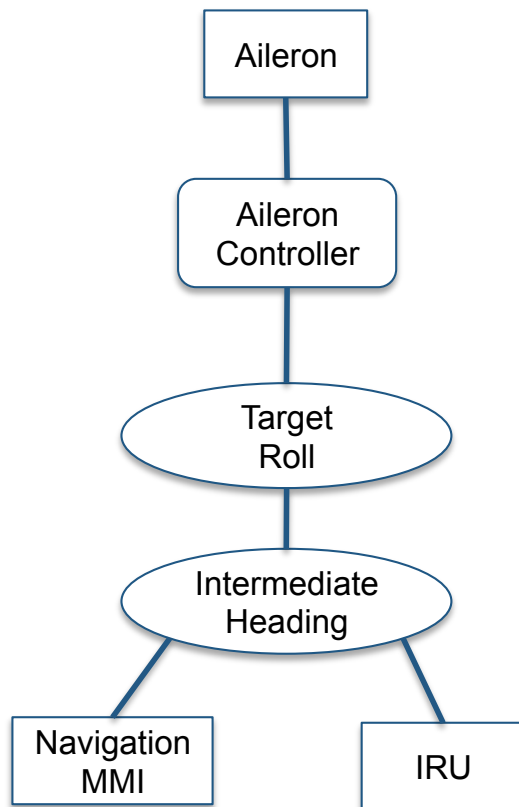
device Aileron {
    action Control;
}

device NavigationMMI {
    source targetHeading as Float;
    action DisableMode;
}

device IRU {
    source heading as Float;
    source position as Coordinates;
    action Deactivate;
}
```

Flight Guidance System

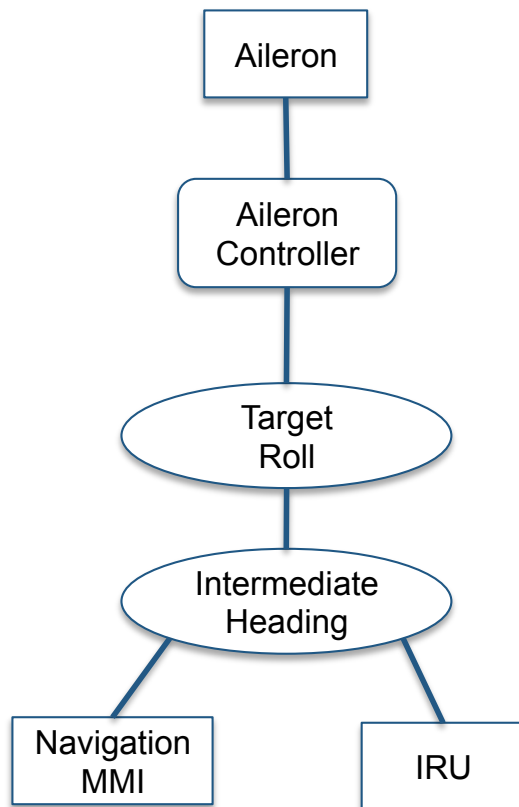
DiaSpec – Data Flow



```
controller AileronController {  
    context TargetRoll;  
    action Control on Aileron;  
}  
  
context TargetRoll as Float {  
    source roll from IRU;  
    context IntermediateHeading;  
}  
  
context IntermediateHeading as Float {  
    source heading from IRU;  
    source targetHeading from NavigationMMI;  
}
```

Flight Guidance System

DiaSpec – Control Flow [ICSE'11]



```
controller AileronController {
    context TargetRoll;
    action Control on Aileron;
    interaction {
        when provided TargetRoll;
        do Control on Aileron;
    }
}

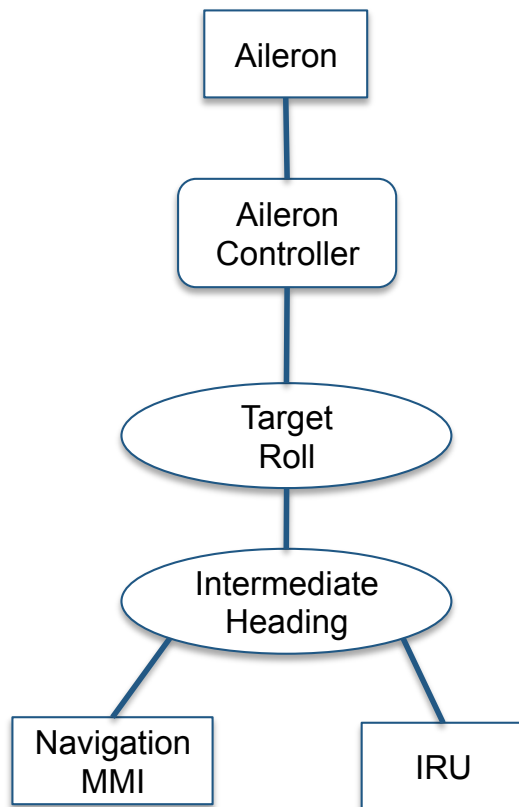
context TargetRoll as Float {
    source roll from IRU;
    context IntermediateHeading;
    interaction {
        when provided IntermediateHeading;
        get roll from IRU;
        always publish;
    }
}

context IntermediateHeading as Float {
    source heading from IRU;
    source targetHeading from NavigationMMI;
    interaction {
        when provided heading from IRU;
        get targetHeading from NavigationMMI;
        always publish;
    }
}
```

Flight Guidance System

DiaSpec – Non-Functional Specification

[OOPSLA'11, FASE'11]



```
action Control {
    incline(targetRoll as Float);
}

device Aileron {
    action Control;
}

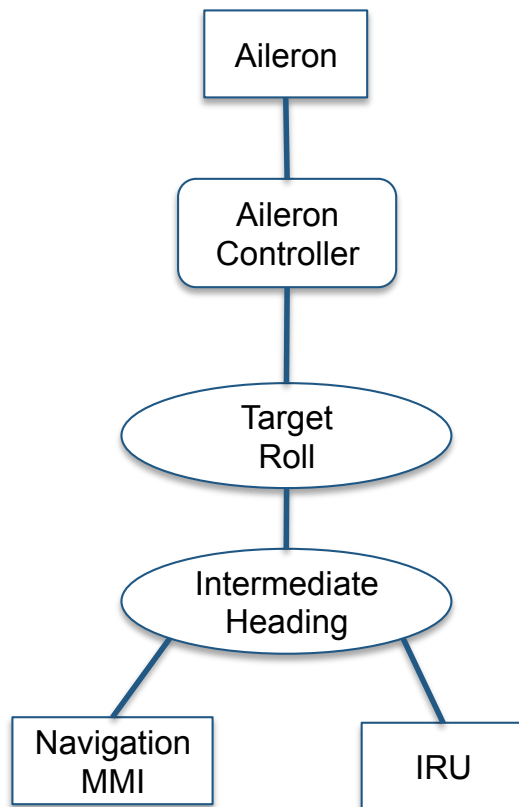
device NavigationMMI {
    source targetHeading as Float;
    action DisableMode;
}

device IRU {
    source heading as Float [frequency 200ms];
    source position as Coordinates;
    action Deactivate;
    raises FailureException ;
}
```

Flight Guidance System

DiaSpec – Non-Functional Specification

[OOPSLA'11, FASE'11]

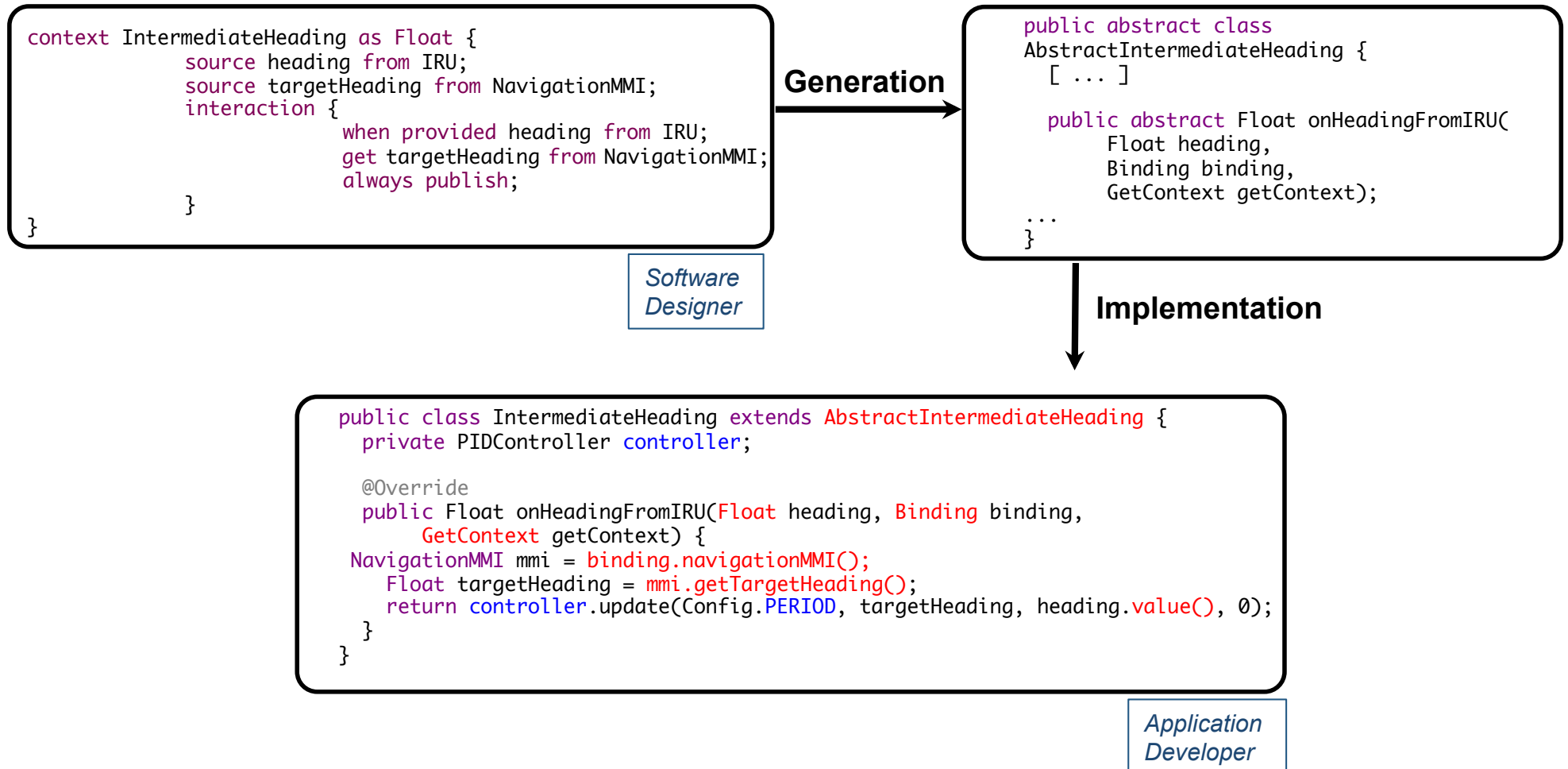


```
context TargetRoll as Float {
  source roll from IRU;
  context IntermediateHeading;
  interaction {
    when provided IntermediateHeading;
    get roll from IRU in 100ms
      [skipped catch];
    always publish;
  }
}

context IntermediateHeading as Float {
  source heading from IRU;
  source targetHeading
  from NavigationMMI;
  interaction {
    when provided heading from IRU;
    get targetHeading from NavigationMMI
      in 100ms [mandatory catch];
    always publish;
  }
}
```


Flight Guidance System

DiaSpec – Generative Programming [GPCE'09]



The DiaSuite Project

- Funding

- Avionics
- Home automation
- Assisted living

- Collaborations

- Avionics engineers
- Researchers in Cognitive Sc.
- Caregivers

- Research problems

- Software design
- Software reliability
- Quality of service, ...

- New directions

- Security
- User interaction
- Certification, ...