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Europe
Stood 5
www.tni-world.com

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« the HOOD company »

2000

Created near Manchester (UK)

2001

Acquisition of CP-HOOD from Critical Path

(40 sites, 500 licenses)

2004

Acquisition of Stood from TNI-Valiosys

(20 sites, 150 licenses)

Office in Brest (F)

Release of Stood 5.0

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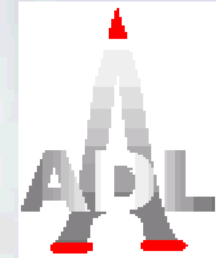
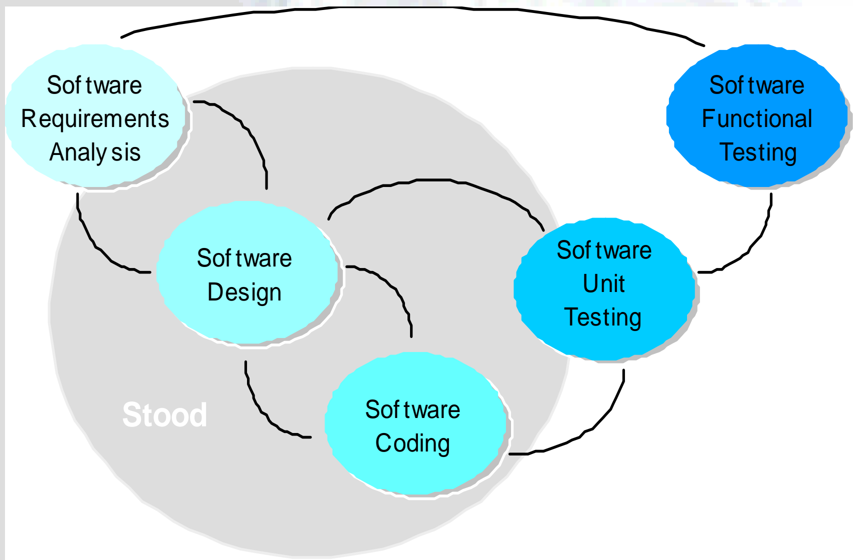
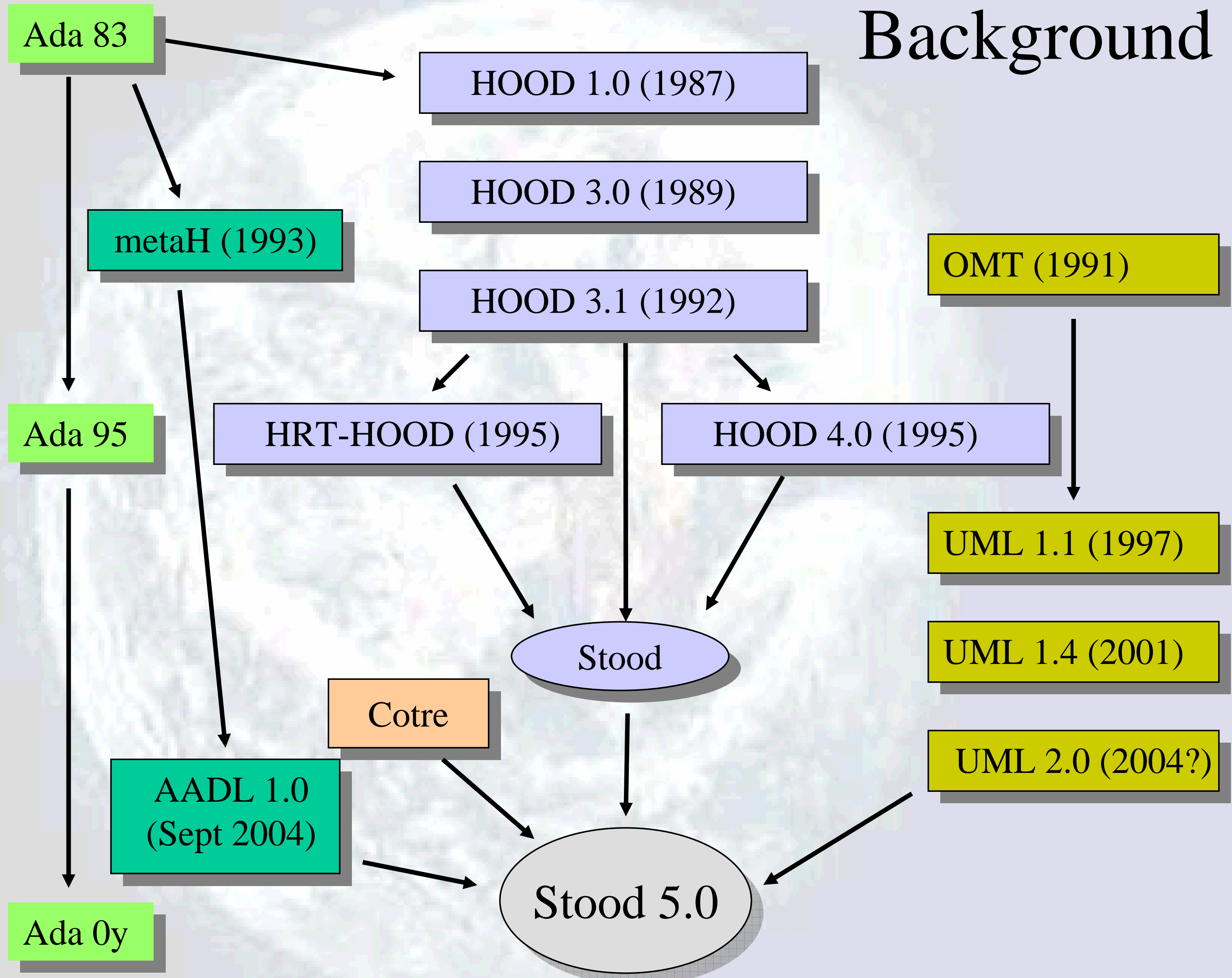
Stood

- An industrial software design tool
- Already deployed & supported on many critical projects (DO-178B, ECSS-E40, MIL-STD-498)
- UML 2.0 front end & AADL plug-in





Background



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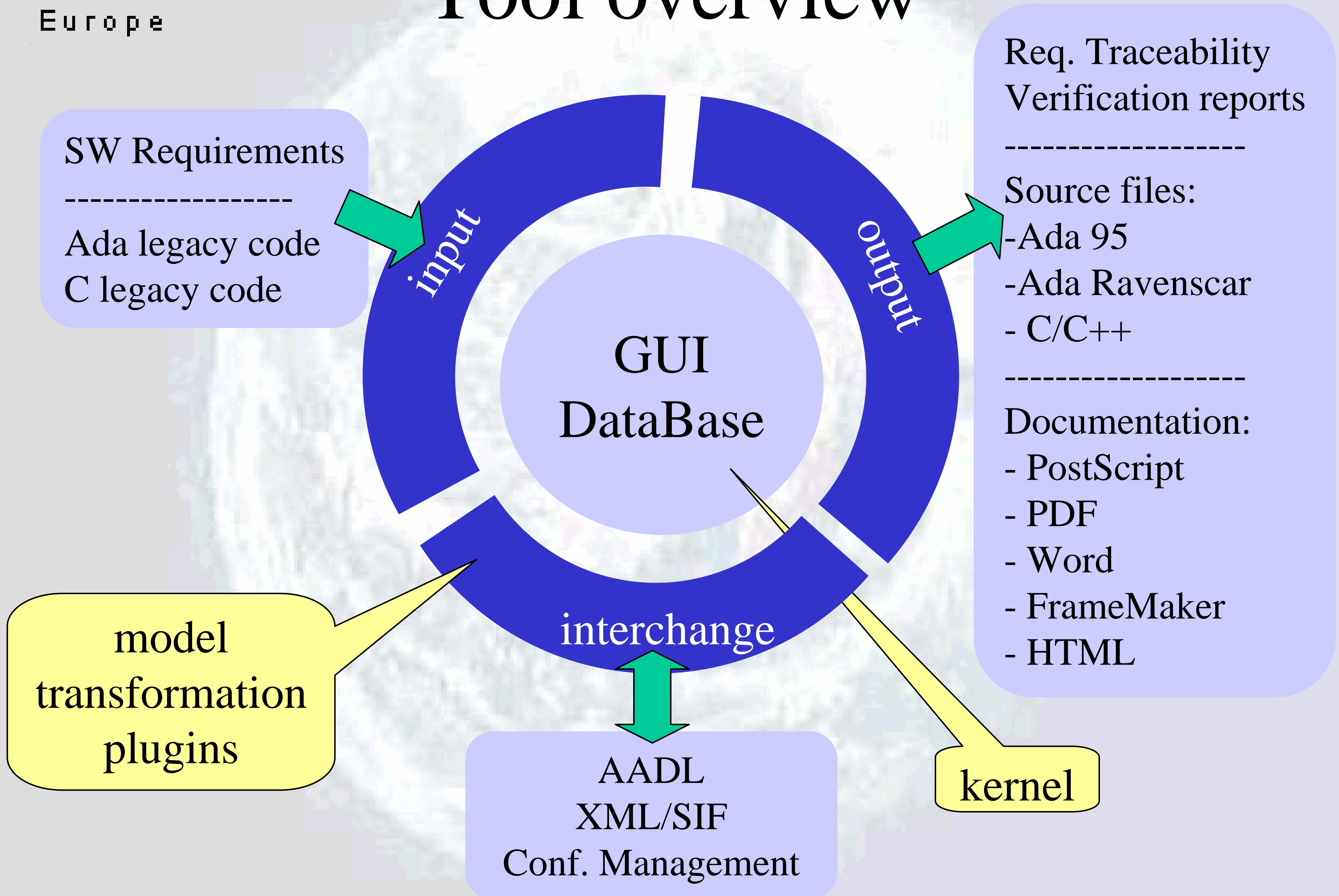
In line with current trends

- promotes Model Driven Engineering: « designing before coding »
  - advanced modeling solution
  - model transformations

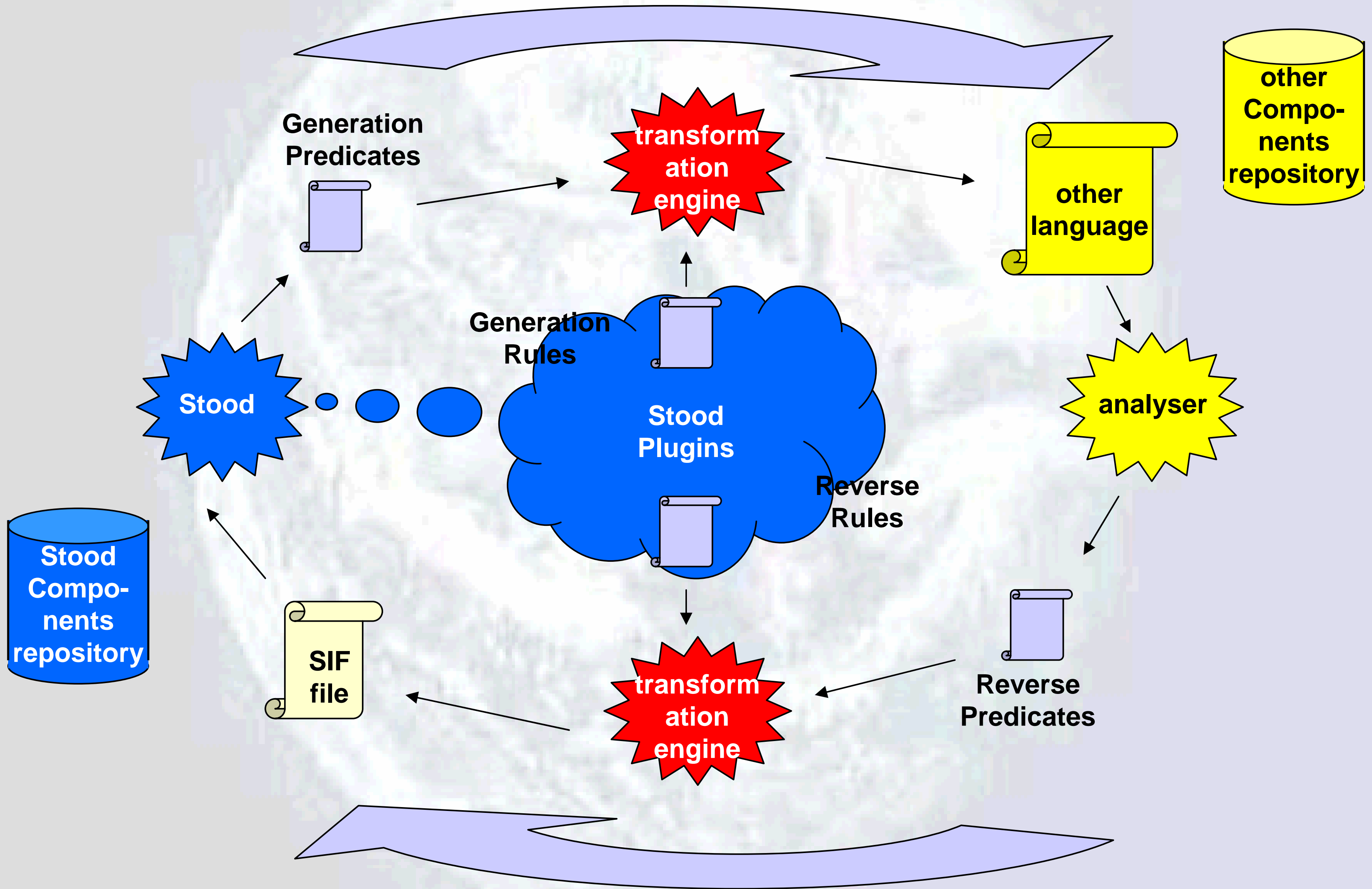
- promotes Component Based Architectures to ease:
  - team development
  - reuse
  - testing
  - maintenance

- promotes flexible Software Design practices:
  - incremental documentation
  - incremental coding and round-trip engineering
  - incremental requirements traceability
  - extensive tool customization capabilities

Tool overview



Model transformations



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Formal transformation rules

example: AADL generator

- AADL definition:

```
component_type_extension ::=
component_category defining_component_type_identifier
extends unique_component_type_identifier
[ features ( { feature | feature_refinement }+ | none_statement ) ]
[ flows ( { flow_spec | flow_spec_refinement }+ | none_statement ) ]
[ properties ( { component_type_property_association }+ | none_statement ) ]
{ annex_subclause }*
end defining_component_type_identifier ;
```

- Corresponding code generation rule in prolog:

```
genComponentType(X,C,I,P) :-
  indent(I), write(C), sp, write(X),
  opt_EXTENSION(X,C), nl,
  opt_FEATURES(X,I,P),
  opt_FLOWSPEC(X,I),
  opt_TYPPROPERTIES(X,I),
  opt_ANNEXES(X,I),
  indent(I), write('END '), write(X), sc, nl, nl.
```

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What is a Component ?

- UML 2.0 *(final adopted specification)*

  « A component can always be considered an autonomous unit within a system or subsystem. It has one or more **provided** and **required** interfaces (...), and its **internals** are hidden and inaccessible other than as provided by its interfaces. Although it may be dependent on other elements in terms of interfaces that are required, a component is **encapsulated** and its **dependencies** are designed such that it can be treated as independently as possible. »

- AADL 1.0 *(AS5506)*

  « A *component* represents some hardware or software entity that is part of a system being modeled in AADL. A component has a *component type*, which defines a **functional interface**. The component type acts as the specification of a component that other components can operate against. (...) A component has zero or more *component implementations.* A component implementation specifies an **internal structure** for a component as an assembly of subcomponents. »

- HOOD *(HRM 4)*

  « A HOOD object is thus a software module specification, being primarily an encapsulation of services provided to other client software. (...) An object has a visible part (the **interface**) , and a hidden part (the **internals**) which cannot be accessed directly by external objects. (...) The interface part defines the services (...) **provided** by the object, as well as the services **required** from other objects. »

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Mapping 1/2

AADL	UML 2.0	HOOD
component	component	(parent) module
subcomponent	part	(child) module
features	provided interface	provided interface
	required interface	required interface
containment connection	delegate (provided)	implemented_by
	delegate (required)	use (uncle)
components connection	assembly	use (sibling)

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Mapping 2/2

predefined Components

AADL	UML 2.0	HOOD
System instance		System configuration
System		Non terminal object
Process		Active root object
Thread group		Active non terminal object
Thread (aperiodic)		Active terminal object
Thread (periodic)		Cyclic object
Thread (sporadic)		Sporadic object
Data		Protected object Passive terminal objects
Package		Class

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why the AADL ?

- The AADL is System oriented and can be used in the early phases of a project.
  - It complements and easily interacts with the UML 2.0 / HOOD Software modeling approach
  - It may become an efficient communication media all along the project lifecycle.
- It brings a default predefined behavioural semantics to real-time components.
  - It can be used at System level for simulation
  - It can be used at Software level for advanced real-time code generation
- It offers wide extension mecanisms
  - Property_sets and Annexes
  - Already used by the COTRE (ending) and ASSERT (starting) projects
- It is already supported by the industry of critical systems in the USA and in Europe.

Graphical notations

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Provided Interface

UML 2.0

Required Interface

HOOD

Note:
an annex of the AADL standard also defines a specific graphical notation

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Summary

UML gives the general background:
What is a component ?

+

AADL brings precise semantics for real-time components:
What is the behaviour of a periodic thread ?

+

HOOD offers a well structured process to build the system:
How do I define and assemble my components ?

=

Stood provides the appropriate framework to support all that in the context of real industrial projects:

- **productivity**: distributed development, reuse of legacy data, code generation
- **quality**: verifications, documentation, certification issues

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Use case 1

AADL Modeller

- UML 2.0 structure diagrams front end
- HOOD design rules:
  - visibility rules
  - information hiding (i.e. for ports)
  - immediate C, Ada, ... and doc generation
- AADL 1.0 generator
- AADL 1.0 semantics checker (under dev.)
- AADL 1.0 code generation rules (under dev.)
- future possible improvements:
  - AADL graphical notation,
  - XML output, ...

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Use case 2
"bridging the gap"

- using AADL as a System to Software bridger
- importing AADL 1.0 specifications
  - to be developed with other AADL compliant tools
  - preserving the System architecture
- standard Software development process
  - SW architectural design refinement
  - SW detailed design and documentation
  - SW coding and round-trip engineering
- using the AADL output again for V&V
  - checking System to Software compliancy
  - connecting to external Verification tools (i.e. Cheddar)
  - implementing the COTRE annex

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Use case 3
reusing legacy systems

- a three steps process:
  - Ada or C legacy code reverse engineering
  - architecture adjustments at SW design level
  - AADL generator
- benefits:
  - let existing source code components be made visible for new systems at high level
  - building non proprietary format component libraries
  - facilitating reuse of specialized building blocks

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Features summary 1/2

Support of the Software Design activities

Architectural Design

- components based approach
with black-box and white-box views
- UML 2.0 graphical notation
- AADL import/export
- support of HOOD and HRT-HOOD methodology
- built-in real-time model

Verifications

- cross references table
- automatic calculation of the required interfaces
- automatic generation of call trees and dataflow graphs
- real-time schedulability analysis
- requirements traceability matrix
- design rules checker
- design metrics

Detailed Design & Coding

- customizable structured detailed design framework
- incremental documentation
- incremental coding and round-trip engineering
- incremental requirements coverage
- legacy Ada and C code reverse engineering

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Features summary 2/2

Workflow Integration

Project management

- full Windows-Unix interoperability
- network distributed project bases
- integrated interface to remote Configuration Management Systems
- multi user management at system and subsystem level
- SIF and XML design model interchange

Compliancy to Standards

- DO-178B for embedded avionics
- ECSS-E40 for space systems
- EN-50128 for railways
- MIL-STD-498 for military

Requirements traceability

- import of high level requirements
- incremental requirements coverage
- management of the derived requirements
- bidirectional interface with Reqtify[tm]

Code & Doc generators

- Ada95
- C/C++
- HTML
- PostScript/PDF
- RTF (Word[tm])
- MIF (FrameMaker[tm])

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Try it…

Stood 5.0 - demo

File Edit Design Component Feature Tools Help

(design) calculator

(design) calculator
calculator
keyboard
screen
ALU
complex
integer
real
number
controller
stdio
(design) EHD
(design) std
(design) stdio
(design) stdlib

ods | ada | c | cpp | aadl | test | checks

type description (text)
type properties (hood)
class inheritance (hood)
type attributes (hood)
type enumeration (hood)
type pre-declaration (ada)
type definition (ada)
type definition (c)
type definition (cpp)
CONSTANTS
OPERATION_SETS
OPERATIONS
add
operation spec. description (text)
operation declaration (hood)

Requirements | Graphic Design | Detailed Design | Checkers | Code | Documentation | Deployment

Hood
Uml

Save text operation declaration (hood)

```
add (
        me : in number;
        op : in number
)       return number;
```

(ty) number
<pa> me
<pa> op

stood@tni-world.com

www.tni-world.com