

# The Compiler Field and its Competitor, the Semantic Web

Uwe Aßmann

PELAB

Linköpings Universitet

Sweden

Talk given at

IFIP WG 2.4 San Mineato Meeting,

2002, somewhat changed

# *The Compiler Field - A Lady with Age*

---

- Compilers are about
  - Checking programs for static semantics
    - contextsensitive syntax
  - Optimizing programs
  - Translating to other languages
- A honorable lady, about 55 years old.

# The Agressive, but Harmless Teens - HTML/XML

---

- The Web took documents by storm
- Only deal with contextfree syntax
  - Document Type Definitions (DTD) are a restricted contextfree grammar
  - Xschemas comprise type checking
- They need something for static semantics
  - context conditions
  - name analysis
  - typing
  - scoping
  - definition-use graphs

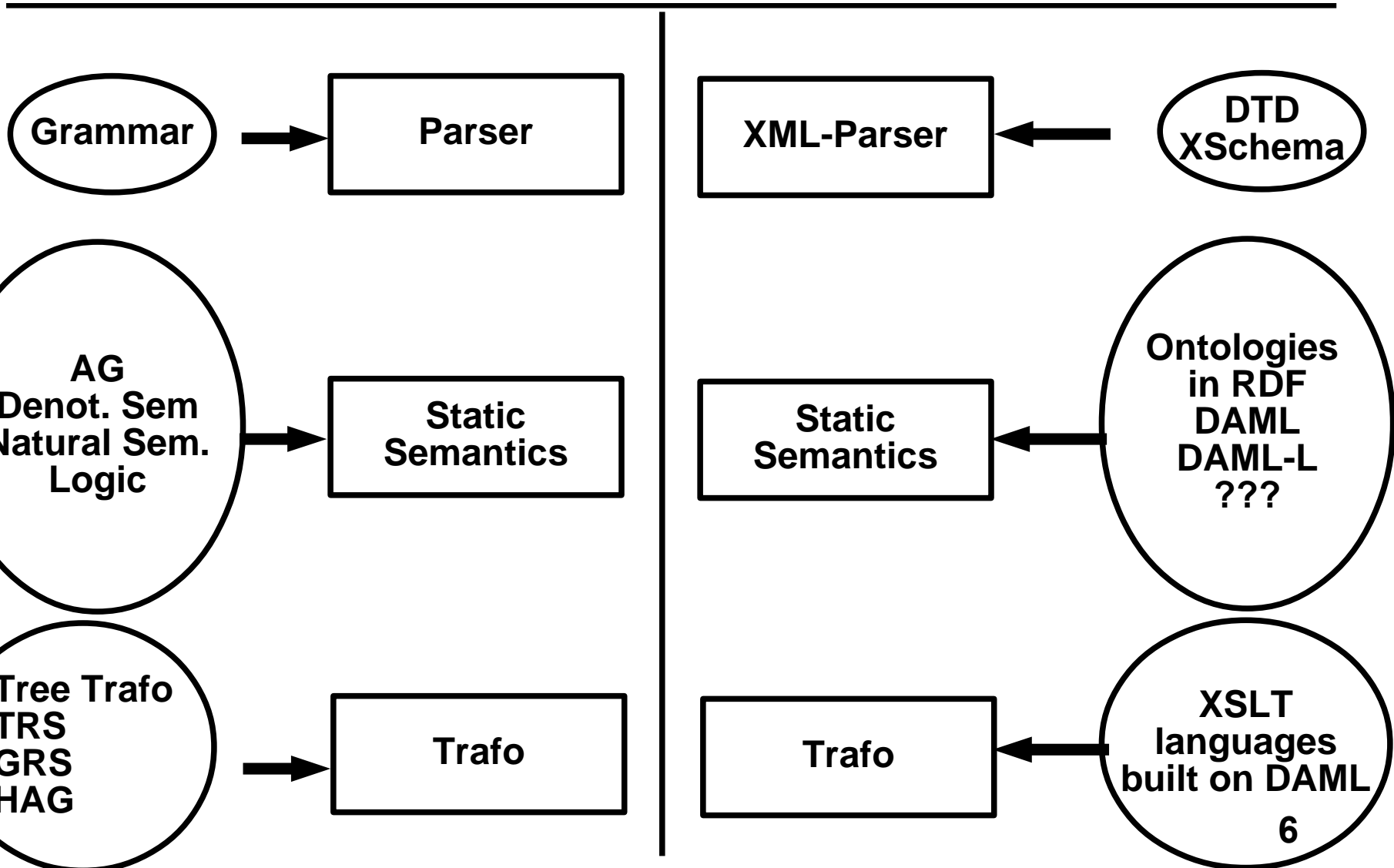
# The New Born Killer: The Semantic Web

---

- 199?-2000: James Hendler (Michigan U.) develops SHOE
  - ontologies for HTML
  - An ontology is a glossary with constraints
- August 2000:
  - DARPA creates the DAML program
    - \$80 Mio are put to one language (Darpa Agent Markup Language) for ontologies
  - J. Hendler becomes boss of the initiative
- February 2001:
  - T. Berners-Lee announces the Semantic Web initiative of the Web consortium

- 
- Winter 2001: OIL, the European competitor, is merged with DAML
    - OIL was the leading European technology for ontologies (AI people)
    - several European projects
  - May 2001: Berners-Lee, et. al. announce the Semantic Web in Scientific American
  - June 2001: The CEC opens a call for the Semantic Web
  - ....

# What is the Idea?



# Ontologies...

---

- T. Gruber: A specification of a representational vocabulary for a shared domain of discourse
  - definitions of classes, relations, functions, and other objects
- A body of formally represented knowledge is based on a *conceptualization*
  - An *ontology* is an explicit specification of a conceptualization.
- A description of static semantics
  - In logic

# DAML and DAML-L

---

- `<class> Person </class>`
- `<relation> r subsetof="s" </relation>`
- cardinality constraints
- `<rule> <if> ... <then> </rule>`
- Terms?
- `person(X).`
- `s(X,Y) :- r(X,Y).`
- `s(X,Y) :- r(X,Z), t(Z,Y).`
- arithmetic
- `conclusion :- premise.`



---

Has the first web been an industrial  
revolution?

# The Semantic Web is The Next Industrial Revolution

---

- All industrial sectors with administrative tasks will be automatized
- Checking, Comparing, Measuring
- Tax documents, Billing, Production Data, Workflow data, .....
- All checking will be done by DAML checkers
- Who does the ontologies?

# The New Born Is Threatening The Old Lady

---

- Several people have shown that logic first-order logic can be used to describe static semantics
  - Uhl, Odersky, Poetzsch-Heffter, ...
- DAML-L will be a logic language
  - Similar to the power of Prolog, with recursion
  - Core DAML is restricted: no recursion, but classes, inheritance of relations
  - superset of UML structure diagrams
- DAML will be THE standard for all kinds of documents, also programs
  - Java, C, Fortran, Ontology in DAML
- Interpreters will check the static semantics

# A Little Hierarchy

---

**Disjunctive logic**

---

**Horn clause logic**

**DAML-L**

**Natural Semantics**  
**Monotone DFA**

---

**Datalog**  
**(relational Algebra with recursion)**

**EARS**  
**Distributive DFA**

---

**AG**

---

**Relational Algebra**

---

**Description logics**

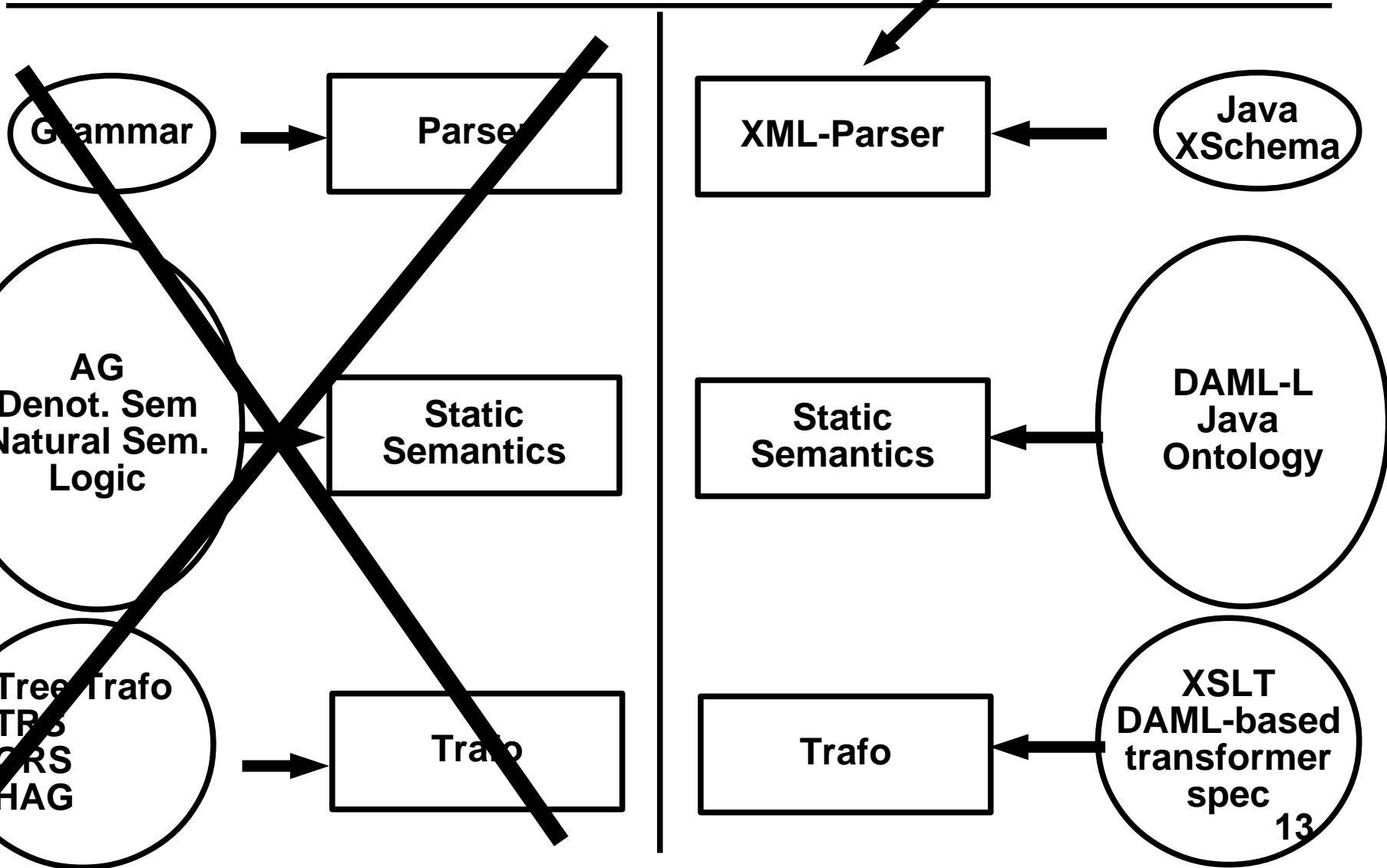
**DAML**

---

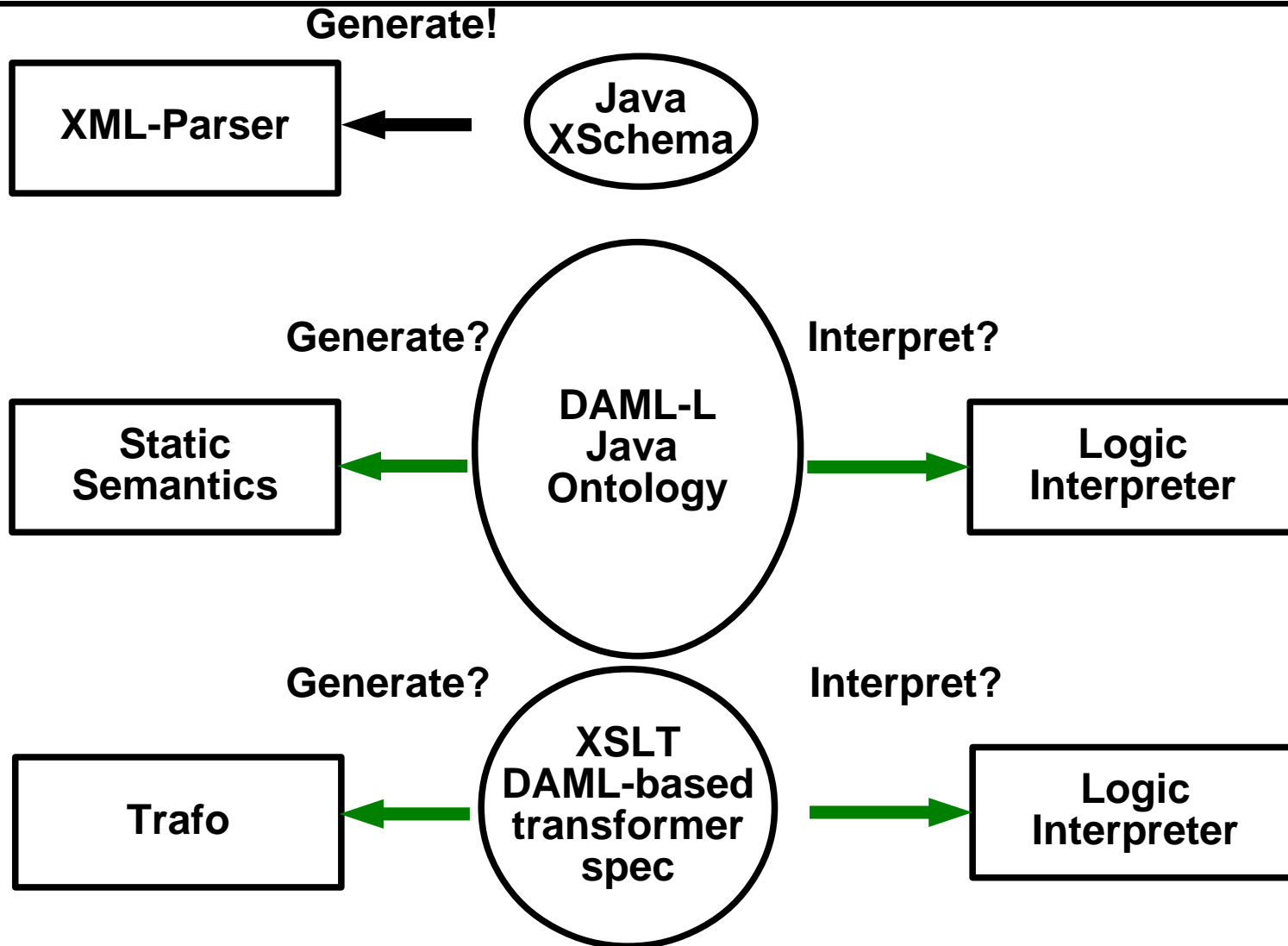
**UML Structure**  
**diagrams**

# What is the Future?

Editor  
working on view



# What is the Future II



# Why Compilers Might be Killed (Well, Frontends)

---

- All documents represented uniformly in XML
  - stored in OS XML files
  - edited with visual metaphor editors
- All analysis and checking will work uniformly on XML documents
- DAML and ontologies will be the semantic description standard
  - In 2010, nobody will care about other semantic description formats anymore
  - no AG, no Natural Semantics
  - no ....

# Is the Battle Decided?

---

- Has AI won?
  - since it managed to get it into the Web movement as uniform semantic description mechanism!
- Compilers have lost...
  - No more money for compilers
  - All money for DAML interpreters and generators
  - All money for AI?



# Why Compilers will Rise Again Under a Different Name

---

- No software engineering!!
- What about speed? there are gigabytes out there
  - we need linear semantic analysis
- We need compilers tools for XML, Java and C#
  - since they will integrate with JavaML, C#ML, and MSIL-ML
- We need tools for the embedded script languages out there
  - PerlML PythonML phpML

# What People Say

---

- H. Ait-Kaci (Life, Feature Logic)
  - Databases (Datalog)
  - AI (frame logic, problem-based reasoning)
  - Programming languages ??
  - Logics (resolution, bottom-up)
  - Constraint systems
  - all will unite!
- Berners-Lee, Hendler, Lassilo
  - The Semantic Web is.. an extension of the current one, in which information is given well-defined meaning, better enabling computers and people to work in cooperation.

# Proposal: The IFIP 2.4 Rallye

---

- Map DAML (descriptive logic) to your language
  - Eli- AG
  - Linköping - RML (natural semantics)
  - Karlsruhe - natural semantics, GRS, AG
  - ?? - relational algebra
  - ?? - datalog
- We select a benchmark set
- We challenge the Webbers with our tools
- We have a Rallye web site

- 
- Traditional knowledge-representation systems typically have been centralized, requiring everyone to share exactly the same definition of common concepts such as "parent" or "vehicle." But central control is stifling, and increasing the size and scope of such a system rapidly becomes unmanageable.
  - The challenge of the Semantic Web, therefore, is to provide a language that expresses both data and rules for reasoning about the data and that allows rules from any existing knowledge-representation system to be exported onto the Web.

- 
- Meaning is expressed by RDF, which encodes it in sets of triples, each triple being rather like the subject, verb and object of an elementary sentence. These triples can be written using XML tags.
  - An important facet of agents' functioning will be the exchange of "proofs" written in the Semantic Web's unifying language

OK,  
Why they Won't Win and  
Where is the Chance of Compiler  
Field

Uwe Aßmann  
PELAB  
Linköping University, Sweden

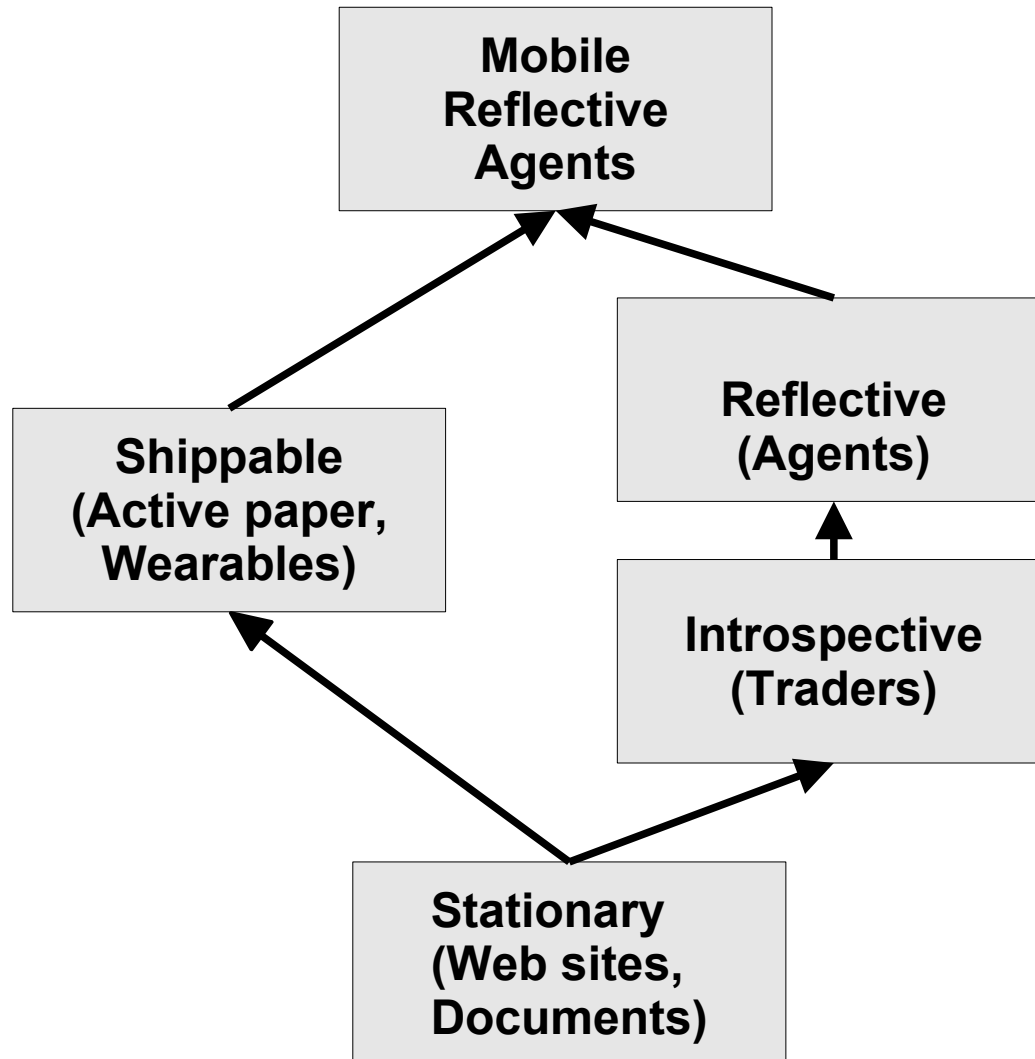
# Everything Will Be An Active Document

---

- Vision stems from [Orfali/Harkey: Instant CORBA]
- Documents
  - Web sites, server objects
  - Simulated objects
  - ...
- Traders
- Wearables/Active Paper
- Agents
- Mobile Reflective Agents

# Overview of Active Documents

---





# Active Documents are Software

---

But use poor software engineering!

Apply Modern Software Engineering Techniques!

But how does Software Engineering look like today?

# Powerful Composition: Composition Languages

---

- Generalized Architecture Languages
- How to analyze composition:
  - When is a composition sound?
  - When can we extend components soundly?
  - Merge components?
  - Invasively edit components?
- How to optimize composition:
  - When is it efficient?
  - What, if it is executed at run-time?

# Composition is Your Chance

---

- because it will be the 3<sup>rd</sup> generation web
- and they don't know about it
- and it will be done with compiler techniques!

# THE END

---

- [www.easycomp.org](http://www.easycomp.org)
- [www.ida.liu.se/~uweas](http://www.ida.liu.se/~uweas)
- [i44w3.ipd.info.uni-karlsruhe.de/~compost](http://i44w3.ipd.info.uni-karlsruhe.de/~compost)
- [www.daml.org](http://www.daml.org)
- [www.semanticweb.org](http://www.semanticweb.org)