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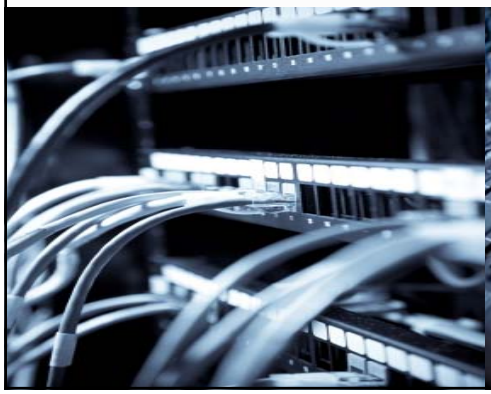
# Textual DSLs and Code Generation with Eclipse and oAW

# Context: Architecture DSLs

As you
**understand**
and
**develop**
your architecture…

…develop a
language
to express it

The language resembles
architectural
concepts…



and we describe
the application(s)
with the language

# Architecture
# DSL

# 2

# Architecture DSL Example

# Components

```
component DelayCalculator {
  provides IDelayCalculator
  requires IInfoScreen
}
component InfoScreen {
  provides IInfoScreen
}
component AircraftModule {
  provides IAircraftModule
  requires IDelayCalculator
}

interface IDelayCalculator {}
interface IInfoScreen {}
interface IAircraftModule {}
```

```
namespace com.mycompany.test {
  system testSystem {
    instance dc: DelayCalculator
    instance screen1: InfoScreen
    instance screen2: InfoScreen
    connect dc.screens
         to (screen1.default, screen2.default)
  }
}
```

# Data Replication

```
struct FlightInfo {
  from: Airport
  to: Airport
  scheduled: Time
  expected: Time
  …
}

replicated singleton flights {
  flights: FlightInfo[]
}

component DelayCalculator {
  publishes flights
}

component InfoScreen {
  consumes flights
}
```

# Pre- and Post-Conditions

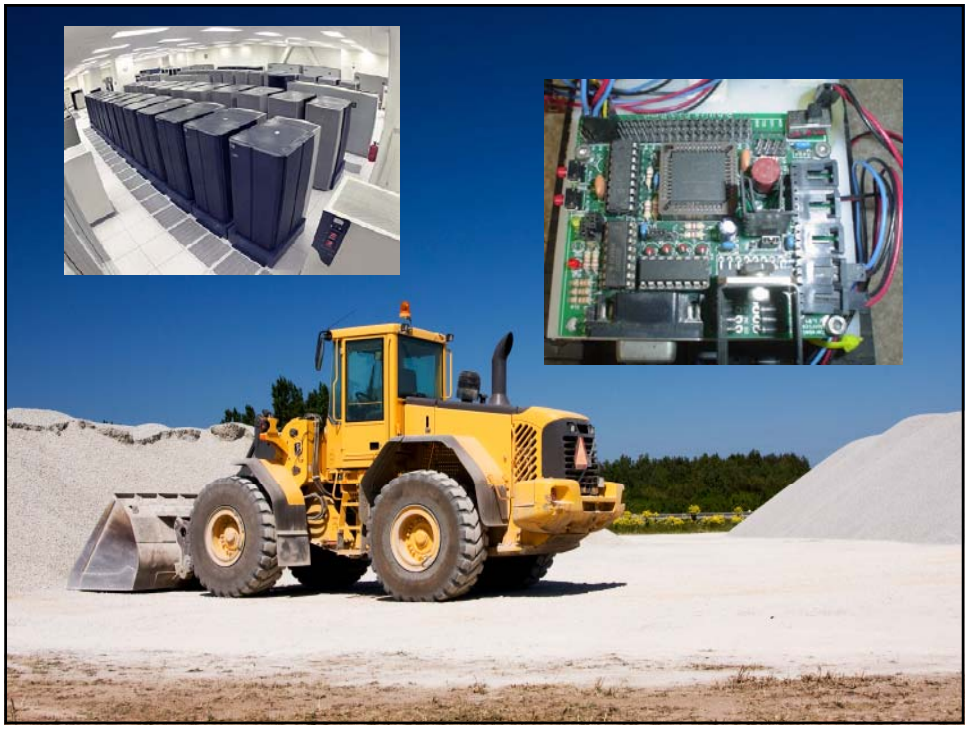
```
interface IAircraftStatus {

  oneway message reportPosition(aircraft: ID,
                                pos: Position ) {
    pre aircraft != null: “aircraft not specified”
    pre pos != null: “position not specified”
  }

  request-reply message reportProblem {
    request (aircraft: ID, problem: Problem,
                           comment: String)
    reply (repairProcedure: ID)
    pre aircraft != null: “aircraft not specified”
    pre problem != null: “problem not specified”
    post repairProcedure != null
  }

}
```

# Message Sequences: Protocol State Machines

```
interface IAircraftStatus {
  oneway message registerAircraft(aircraft: ID! )
  oneway message unregisterAircraft(aircraft: ID! )
  oneway message reportPosition(aircraft: ID!,
                pos: Position! )
  request-reply message reportProblem {
    request (aircraft: ID!, problem: Problem!,
             comment: String!)
    reply (repairProcedure: !ID)
  }
  protocol initial = new {
    state new {
      registerAircraft => registered
    }
    state registered {
      unregisterAircraft => new
      reportPosition
      reportProblem
    }
  }
}
```

## Based on actual practical experience

## Currently in use with four of my customers



# Why Textual?

# … or: why not graphical?

# Languages and Editors are easier to build

# Languages and Editors are easier to build

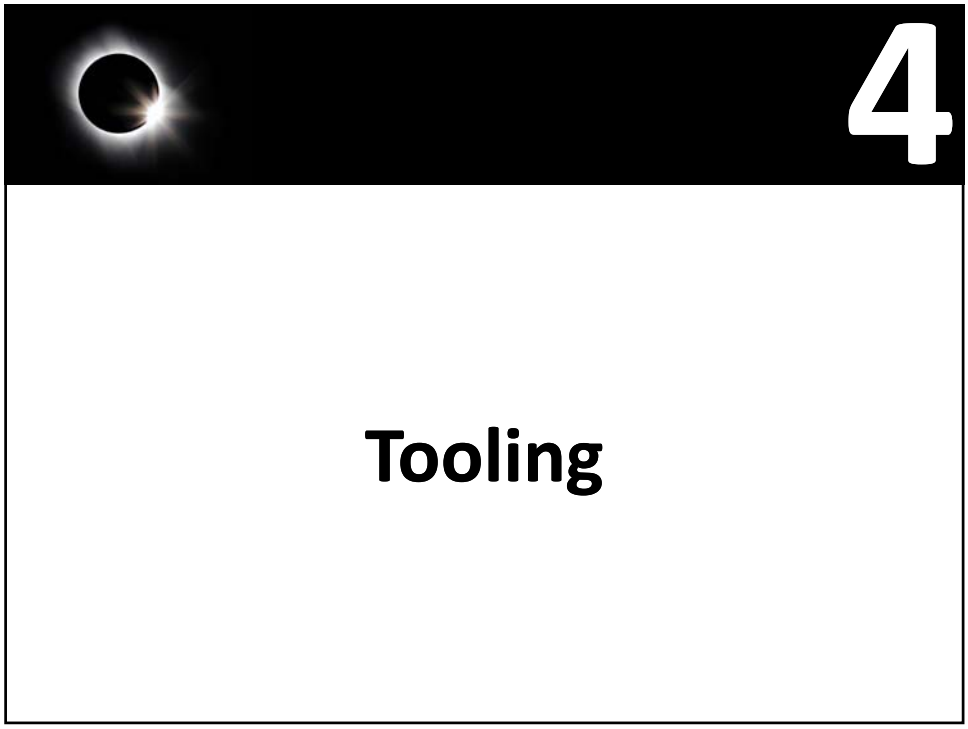
**Evolve Language and simple editor as you understand and discuss the architecture, in real time!**

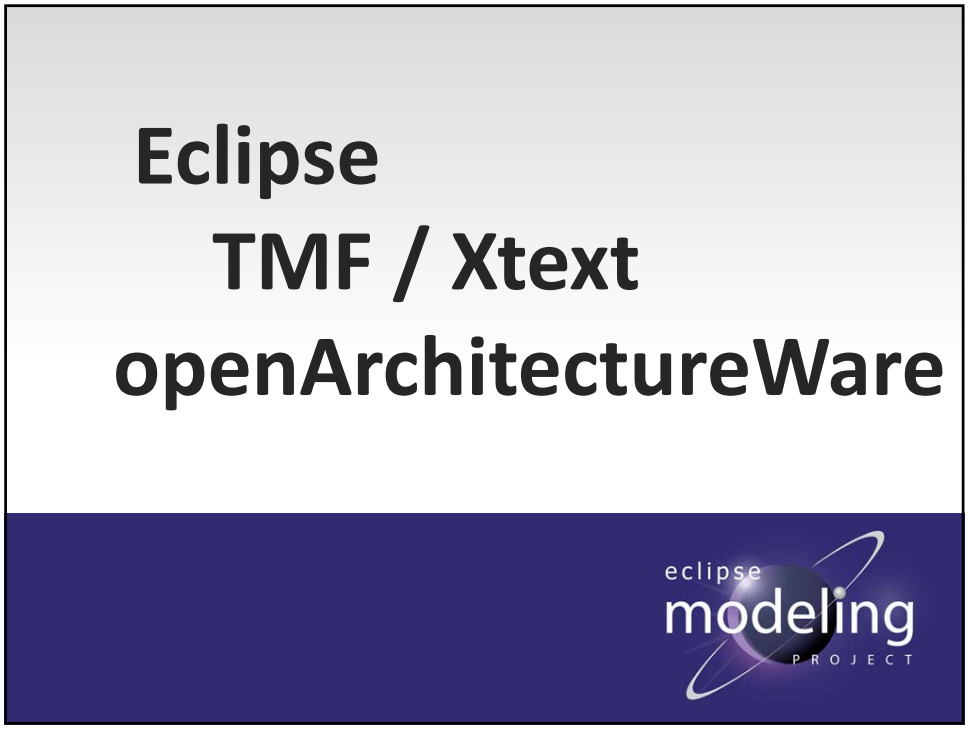
Integrates easily with current infrastructure: CVS/SVN diff/merge

adapting existing models as the DSL evolves

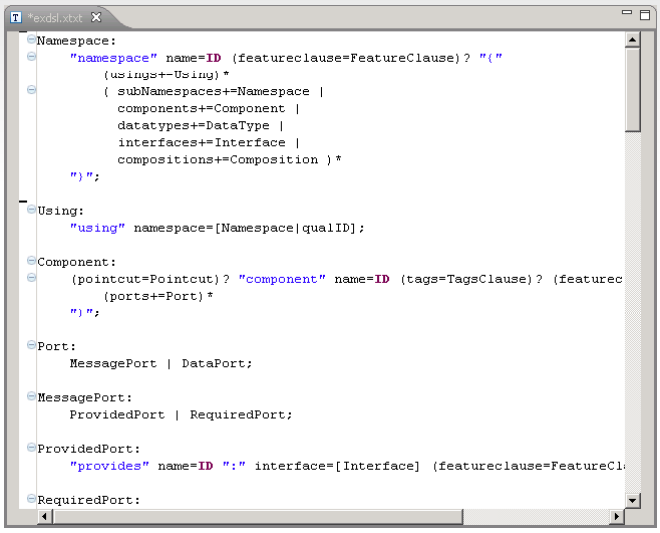
Model evolution is trivial, you can always use *grep*.

Many developers prefer textual notations


4
Tooling

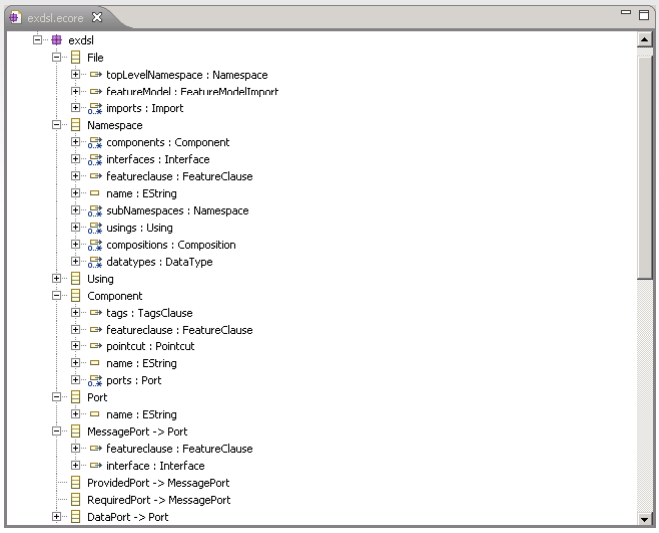

Eclipse
TMF / Xtext
openArchitectureWare
eclipse
modeling
PROJECT

# Specify Grammar

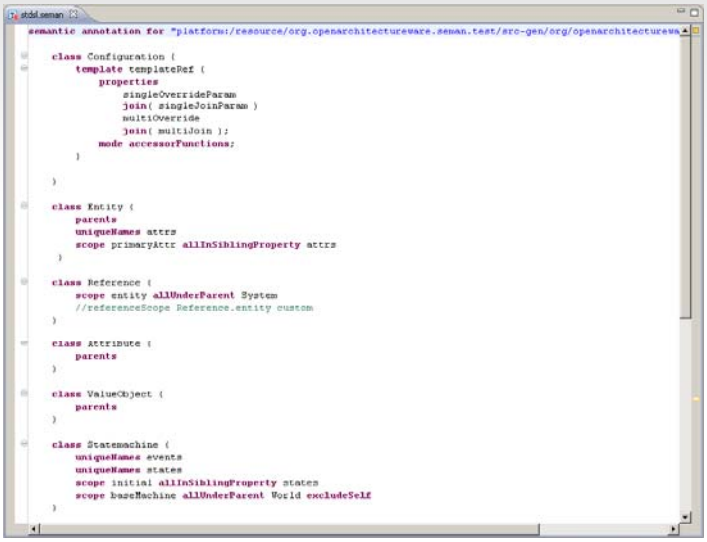



# Antlr Grammar and Parser is generated from this specification

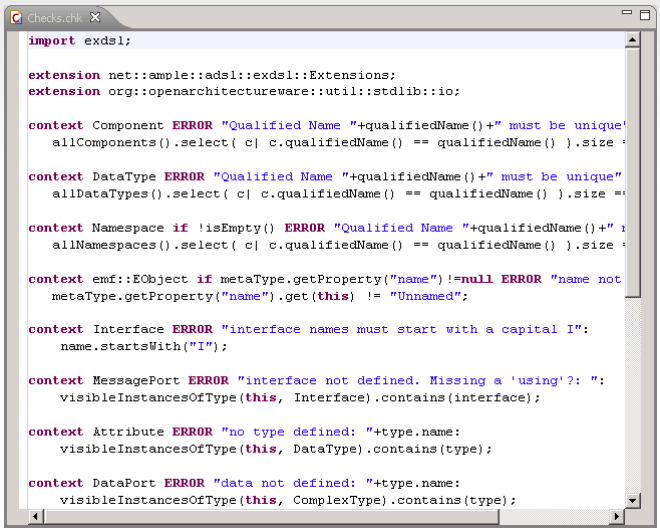
# Generated Metamodel



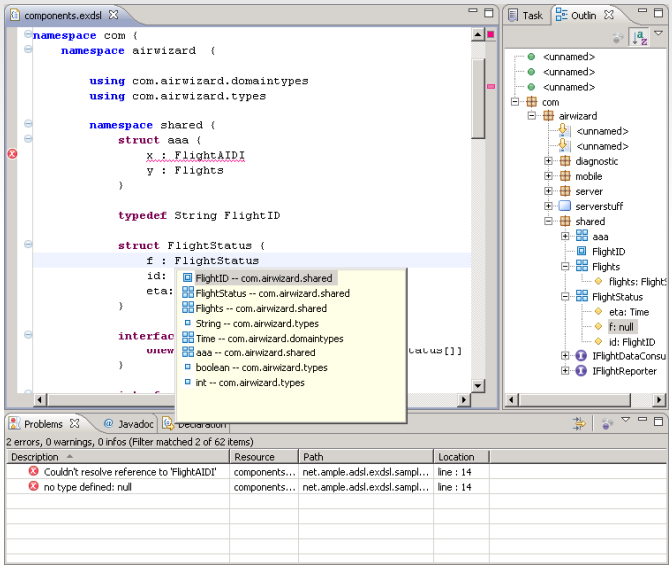

# Specify Semantics



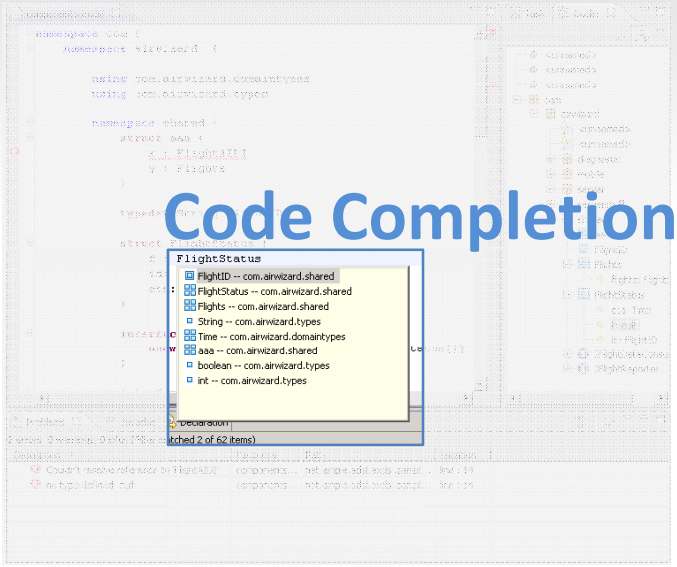
# Specify Constraints




# Generated Editor

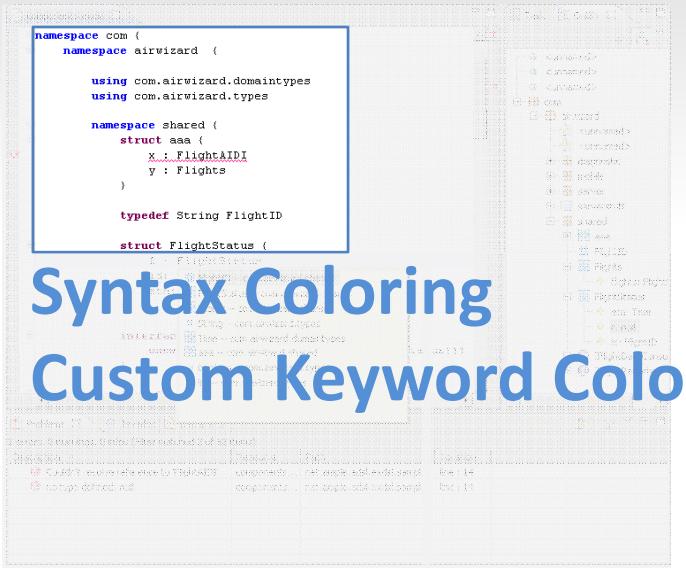


# Generated Editor




Code Completion

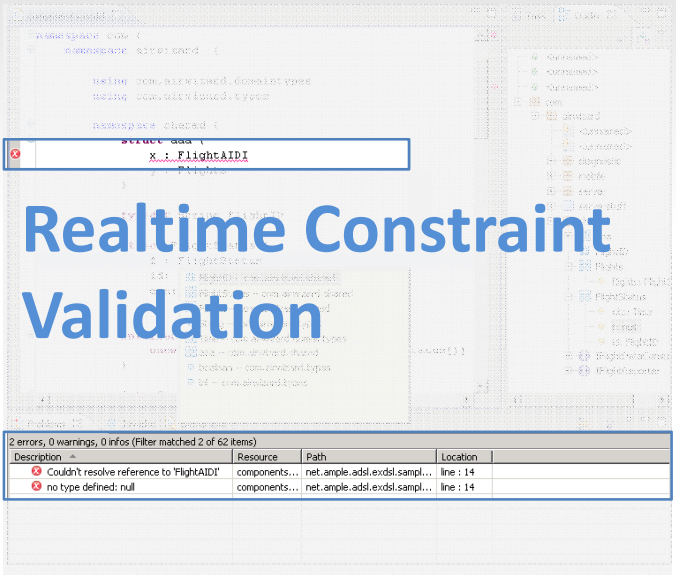
# Generated Editor




Syntax Coloring

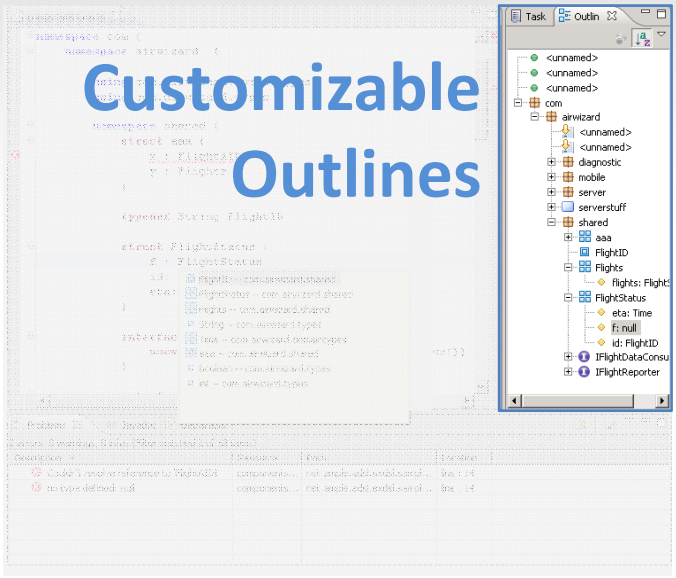
Custom Keyword Coloring

# Generated Editor



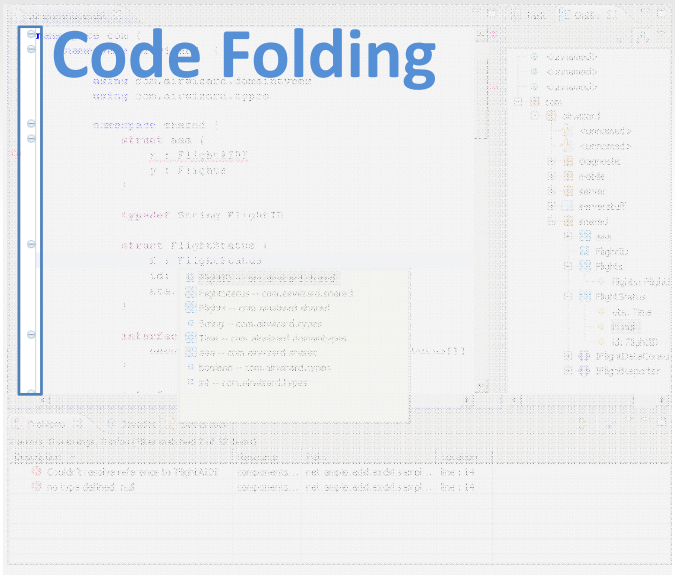

Realtime Constraint Validation

# Generated Editor



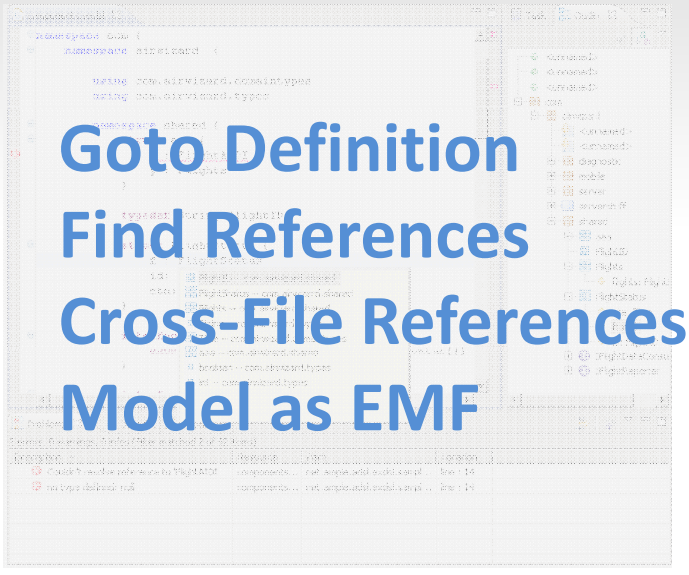

Customizable Outlines

# Generated Editor



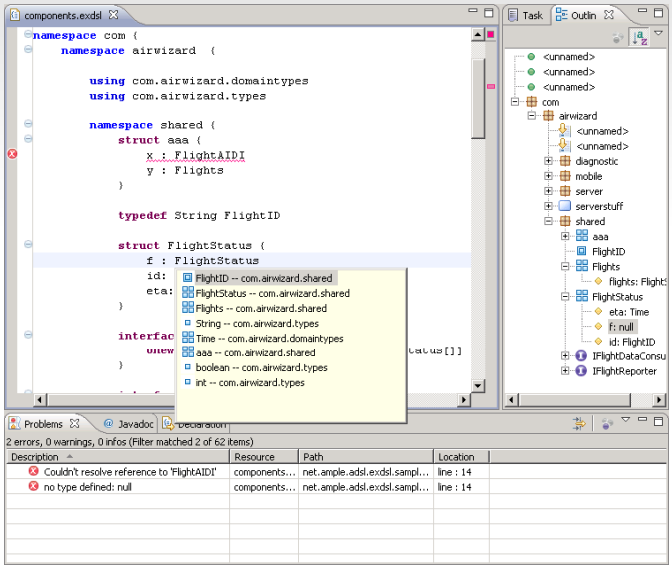
Code Folding

# Generated Editor

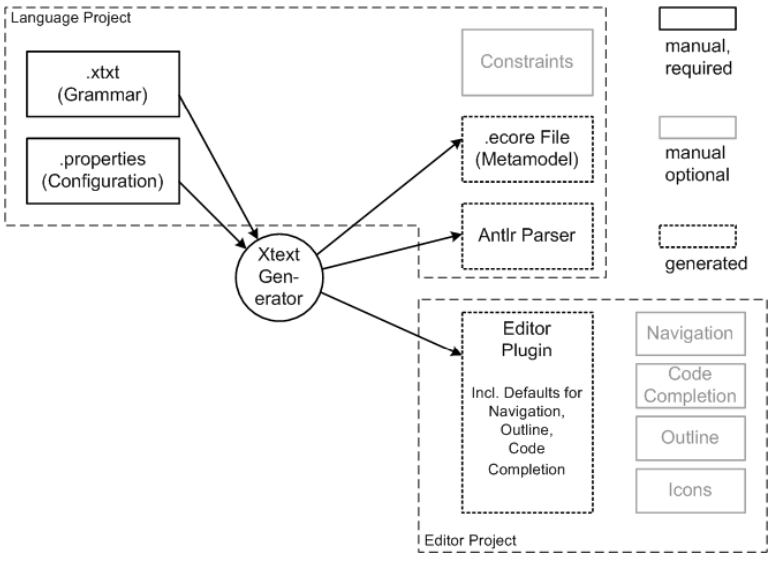


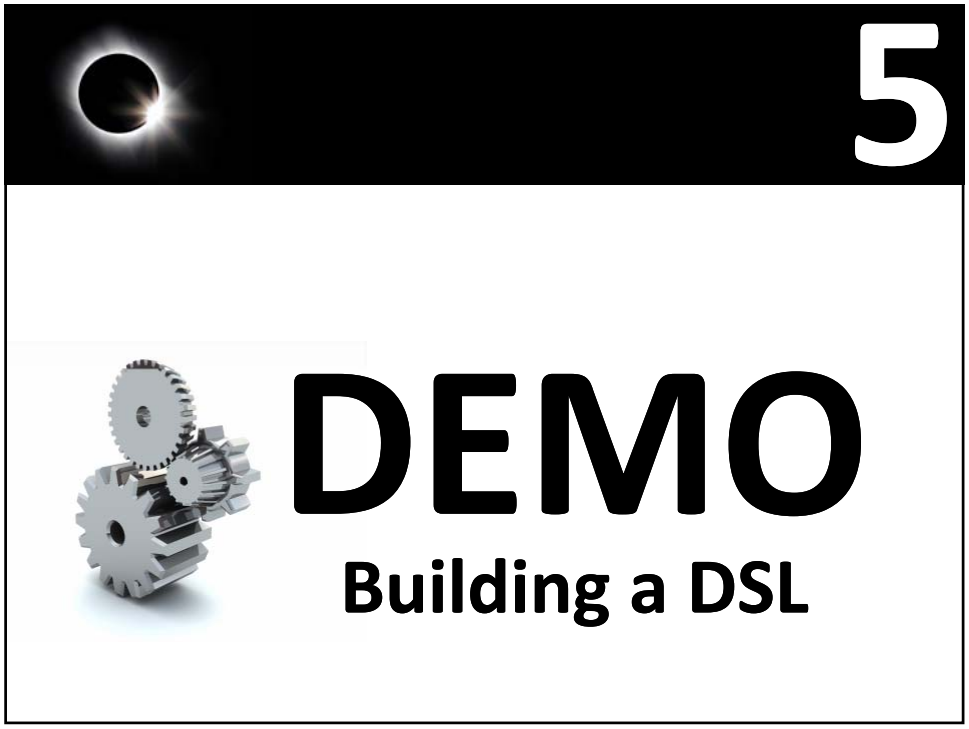
Goto Definition
Find References
Cross-File References
Model as EMF

# Generated Editor



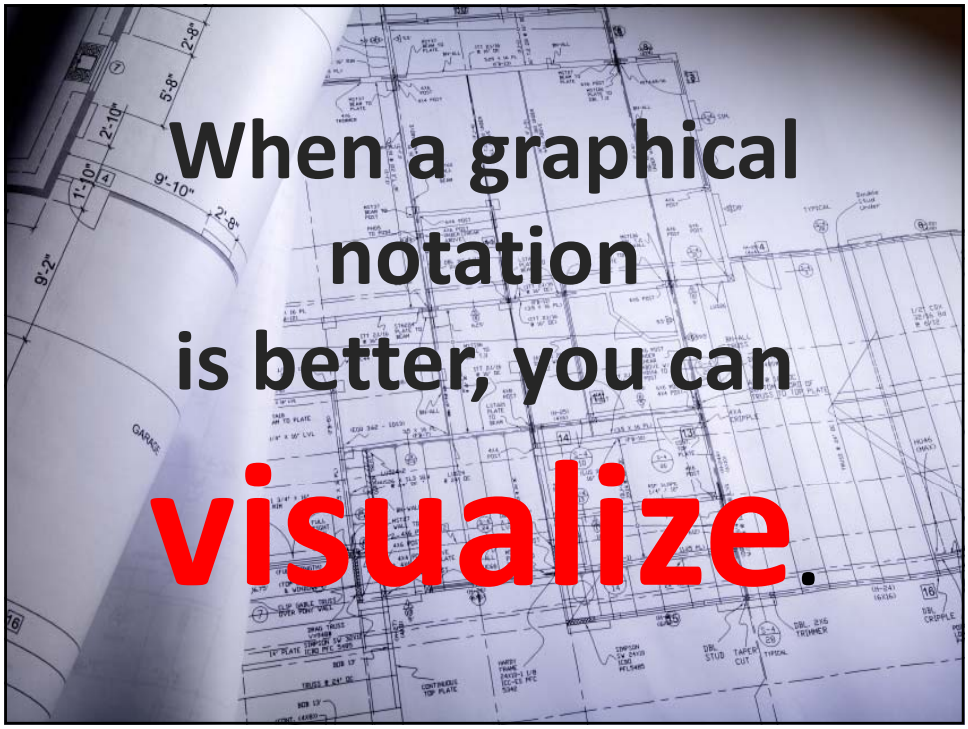

# Xtext Overview




5
DEMO
Building a DSL

# 6

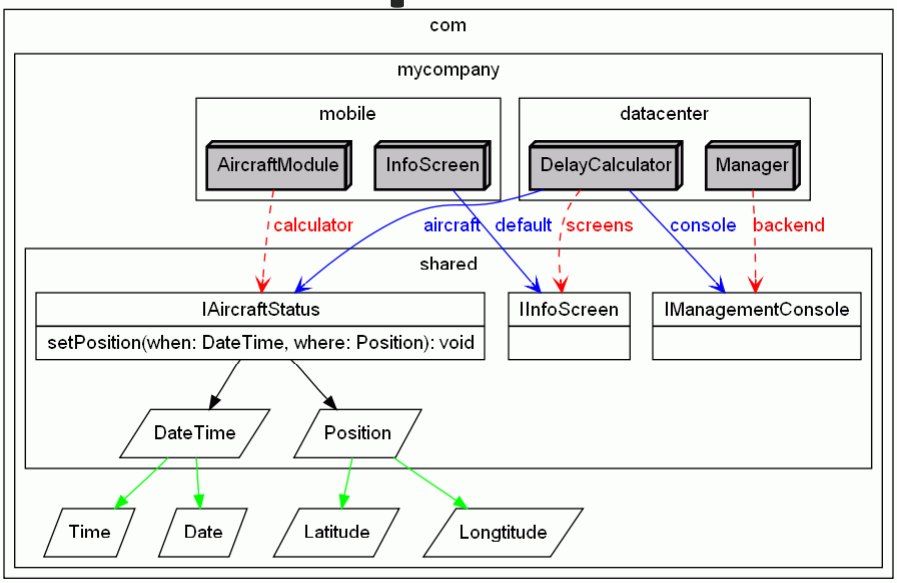
## Graphical?
## Visualization!



Via M2M
Read-Only
Auto-Layout
Drill-Down

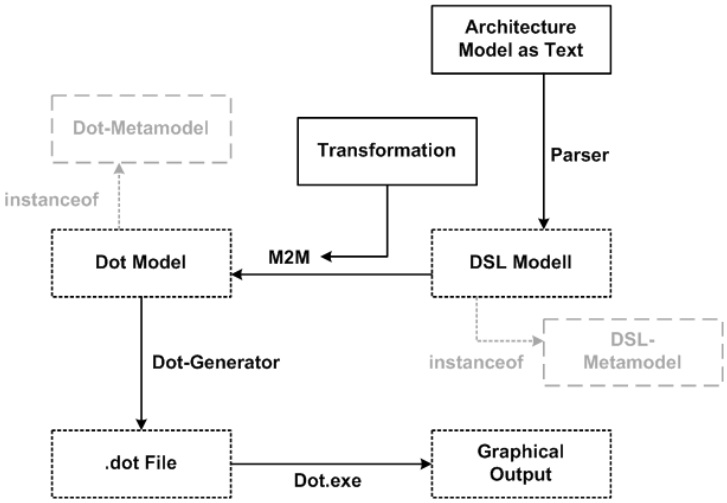
Textual DSLs
vs.
Graphical
vs.
Visualization

# Graphviz




# Prefuse

# GrapViz Overview




# GrapViz Trafo Code

```
import ads1;
import dot;

extension org::openarchitectureware::util::stdlib::io;
extension org::openarchitectureware::util::stdlib::naming;
extension org::openarchitectureware::util::stdlib::elementprops;

extension dotlib;

Object top(File file):
    toGraph(file);

create dot::graph toGraph(File file):
    setType(dot::graphtype::digraph) ->
    setName(this.metaType.toString()) ->
    stmts.add( file.topLevelNamespace.toSubgraph() ) ->
    setFont( "arial" );


create dot::subgraph toSubgraph( Namespace ns ):
    setName( ns.qualifiedName() )
    .setLabel( ns.name )
    .addStatements( ns.subNamespaces.toSubgraph() )
    .addStatements( ns.components.toNode() )
    .addStatements( ns.interfaces.toNode() )
    .addStatements( ns.datatypes.typeSelect(ComplexType).toNode() );

connectPort( Port p ):
    directedEdge( p.eContainer, p.interface, p )
        .setArrowHead("vee")
        .setStyle( ProvidedPort.isInstance(p) ? "solid" : "dashed" )
        .setColor( ProvidedPort.isInstance(p) ? "blue" : "red" )
        .setFontColor(  ProvidedPort.isInstance(p) ? "blue" : "red" )
        .setLabel( p.name );

create dot::node_stmt this toNode(ComplexType t):
    setLabel( t.name )
    .setShape( "parallelogram" )
    .setName( t.qualifiedName() );

create dot::node_stmt this toNode(Component ns):
    setName( ns.qualifiedName() )
    .setLabel( ns.name )
    .setShape( "box3d" )
    .setFillColor( "grey" )
    .setStyle("filled, bold");
```

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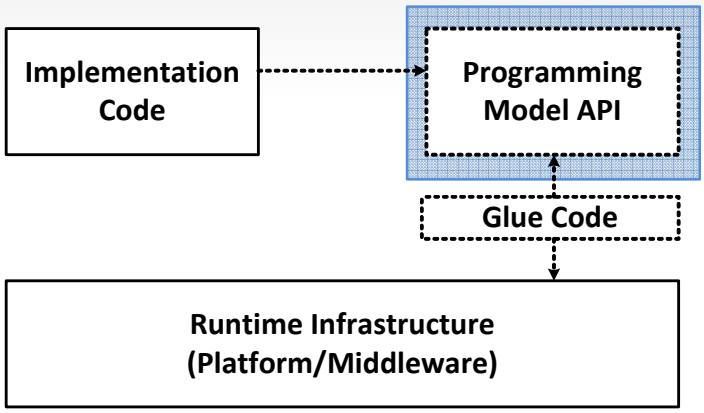
# Generating Code

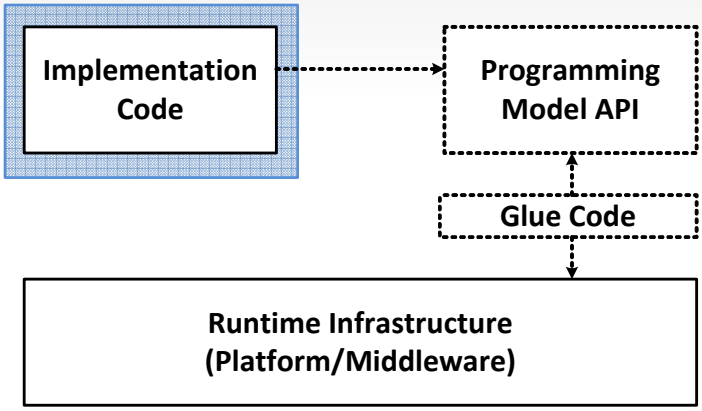
# Generate API

## Maps Architectural Concepts to Implementation language (non-trivial!)



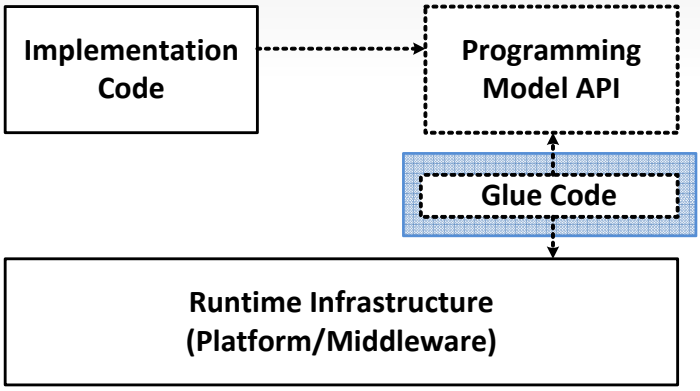

# Implementation

## Implementation only depends on the generated programming model API



# Glue Code

## Aka Technology Mapping Code
## Maps API to selected platform




# Templates

data.xpt

```
1 «IMPORT imp»
2
3 «EXTENSION dataimport::dsl::impUtil»
4
5 «DEFINE root FOR DataStructure»
6 «FILE filename()»
7
8 import java.util.List;
9 import java.util.ArrayList;
10 import dataimport.platform.DataBase;
11
12
13 public class «classname()» extends dataimport.platform.DataBase
14
15     «FOREACH attributes AS a»
16         private «a.type» «a.name»;
17     «ENDFOREACH»
18
19     «FOREACH references AS r»
20         «IF r.ismulti»
21             private List<«r.type.fqClassname()»> «r.name»List =
22         «ELSE»
23             private «r.type.fqClassname()» «r.name»;
24         «ENDIF»
25     «ENDFOREACH»
26
27     «FOREACH attributes AS a»
28         public void set«a.name.toFirstUpper()»( «a.type» value )
```

# Extensions

Extensions.ext

```
1 import imp;
2
3 extension dataimport::dsl::GenExtensions reexport;
4
5 Collection[Instance] instancesInScope( RecordHandler this ):
6     parentHandler() != null ? instances.union( parentHandler().instancesInScope() ) : instances;
7
8 parentHandler( RecordHandler this ):
9     eContainer != null ? ( RecordHandler.isInstance(eContainer) ? ((RecordHandler)eContainer) : null ) :
10        null;
11
```

## stdutil

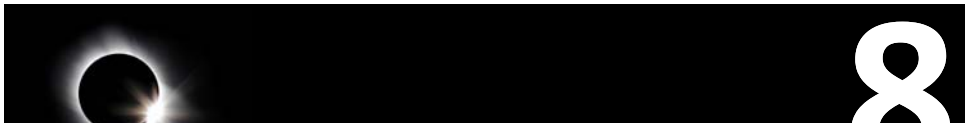
arrayindex.xpt

```
«EXTENSION templates::util»

«DEFINE roo
    «FILE i
        pac

        pub                                    » extends s
```

notaus
org::openarchitectureware::util::stdlib::io
org::openarchitectureware::util::stdlib::naming
templates::util



8

# DEMO

## A Code Generator

# 9

# Tools Summary

## EMF

**Ecore meta meta model**

**+**

Editing

Transactions

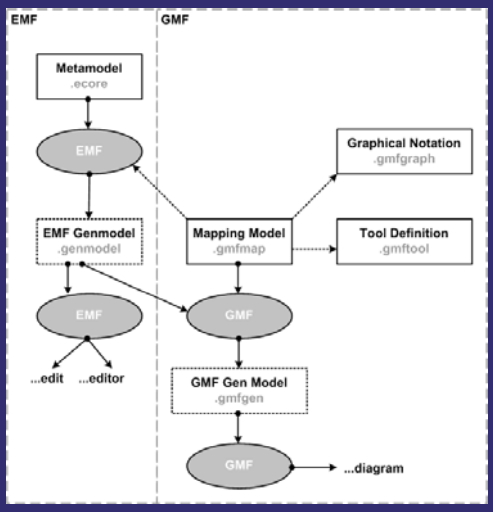
Validation

Query

Distribution/Persistence

## GMF

**Graphical Box/Line editors based on EMF**



## TMF

### Building Textual Editors

currently being built from oAW Xtext

## M2M

### Model-to-Model Transformations

INRIA's ATL
Several QVT implementations

## M2T

### Model-to-Text Transformations

JET: Java Emitter Templates
Xpand: oAW's template engine

# openArchitectureWare

www.openarchitectureware.org

## One Stop Toolkit for DSLs + X

Version **4.3.1** is current

**Lively ecosystem of tools and extensions**

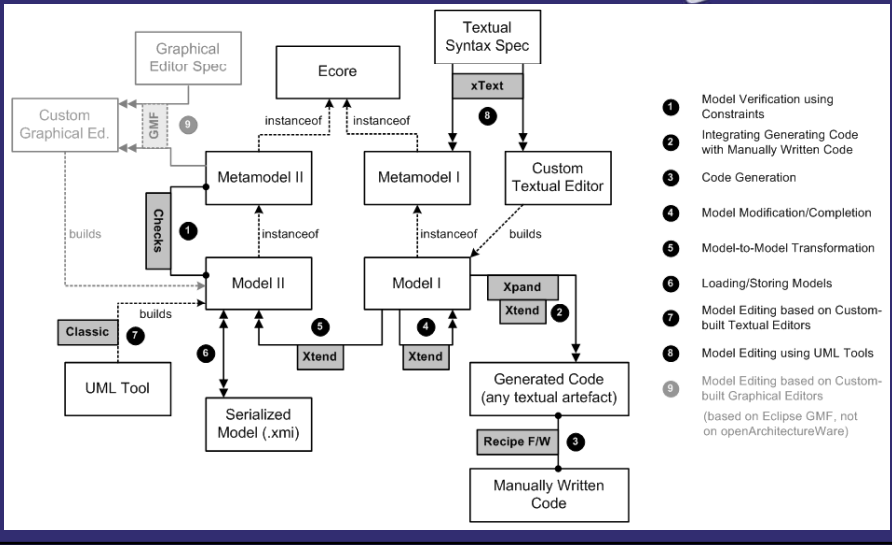
**Proven track record** in various domains & project contexts

**Stable, productive and helpful** developer, support and user **communities**

Integration with Eclipse:

- Uses EMF as a basis
- Graphical editors based on GMF
- All editors and tooling based on Eclipse

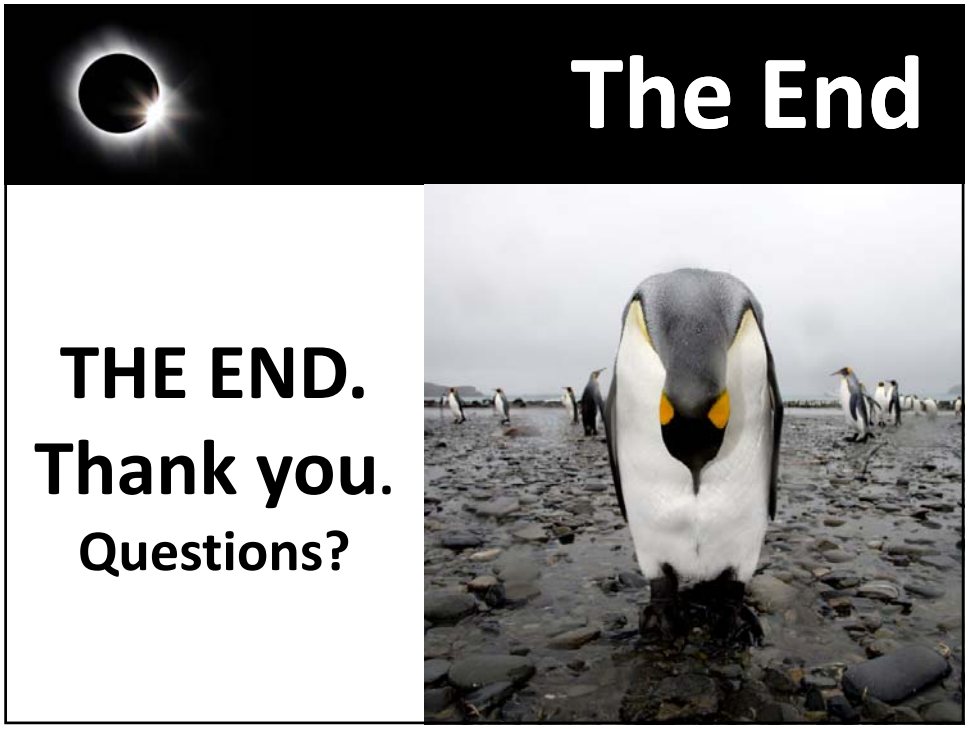
# openArchitectureWare

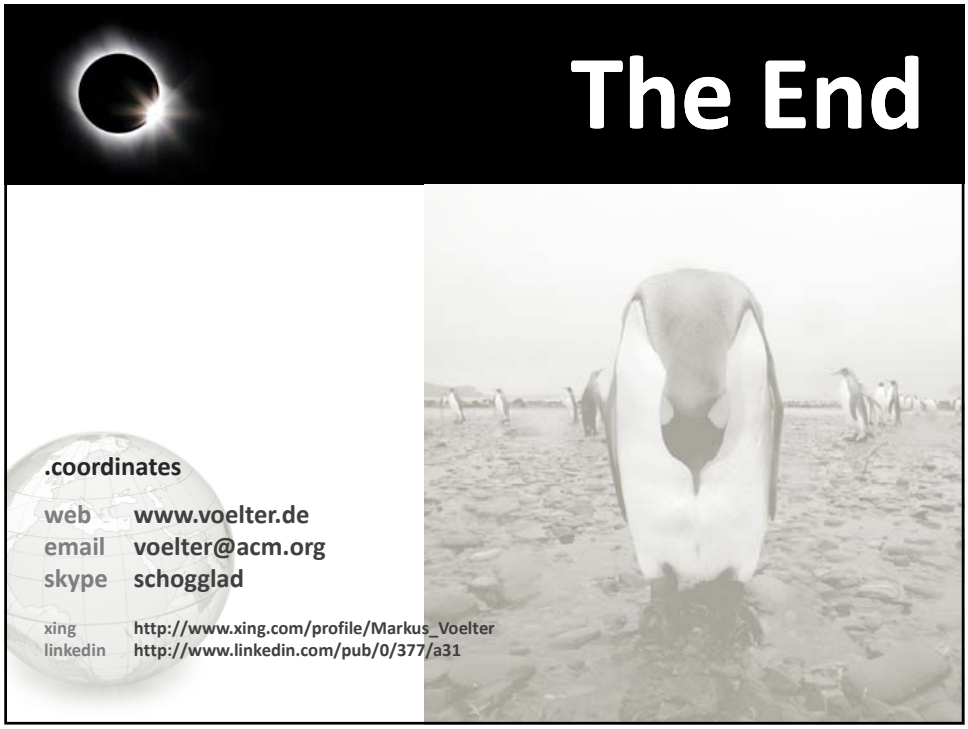


## oAW 5

### To be released in June

- Xpand, Xtend, Check, MWE migrated to Eclipse projects
- Completely new, much more powerful Xtext/TMF


The End
THE END.
Thank you.
Questions?


The End
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web www.voelter.de
email voelter@acm.org
skype schogglad
xing http://www.xing.com/profile/Markus_Voelter
linkedin http://www.linkedin.com/pub/0/377/a31

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