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Comparison of six ways to extend the scope of *Cheddar* to *AADL v2* with *Osate*

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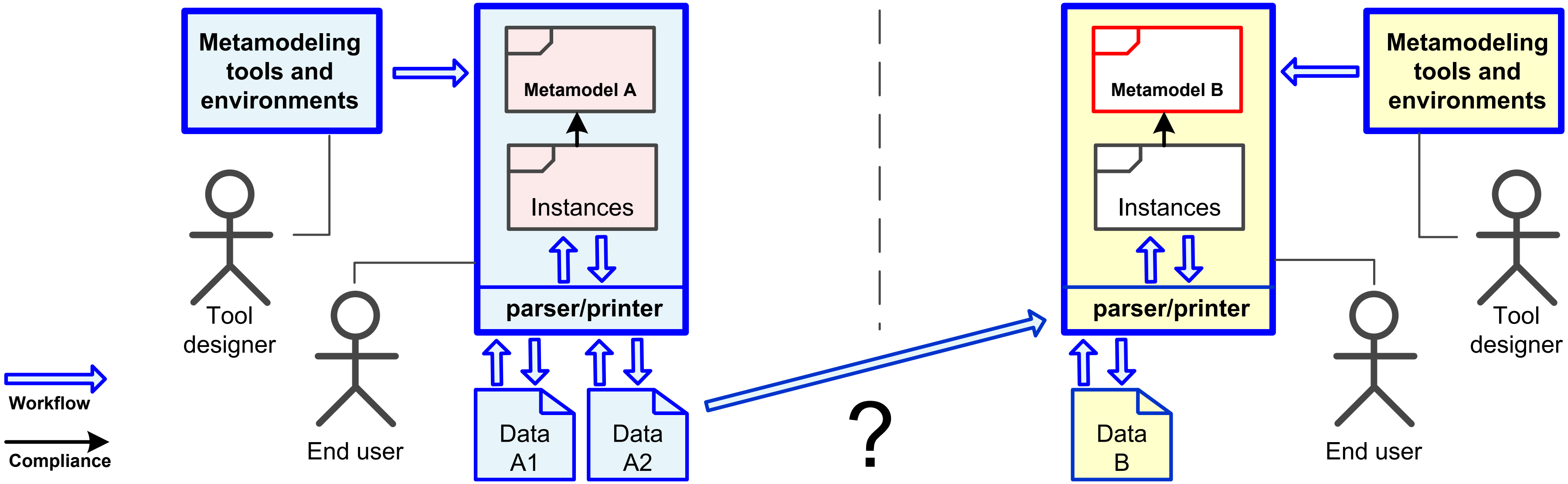
Motivation

Integration of legacy systems

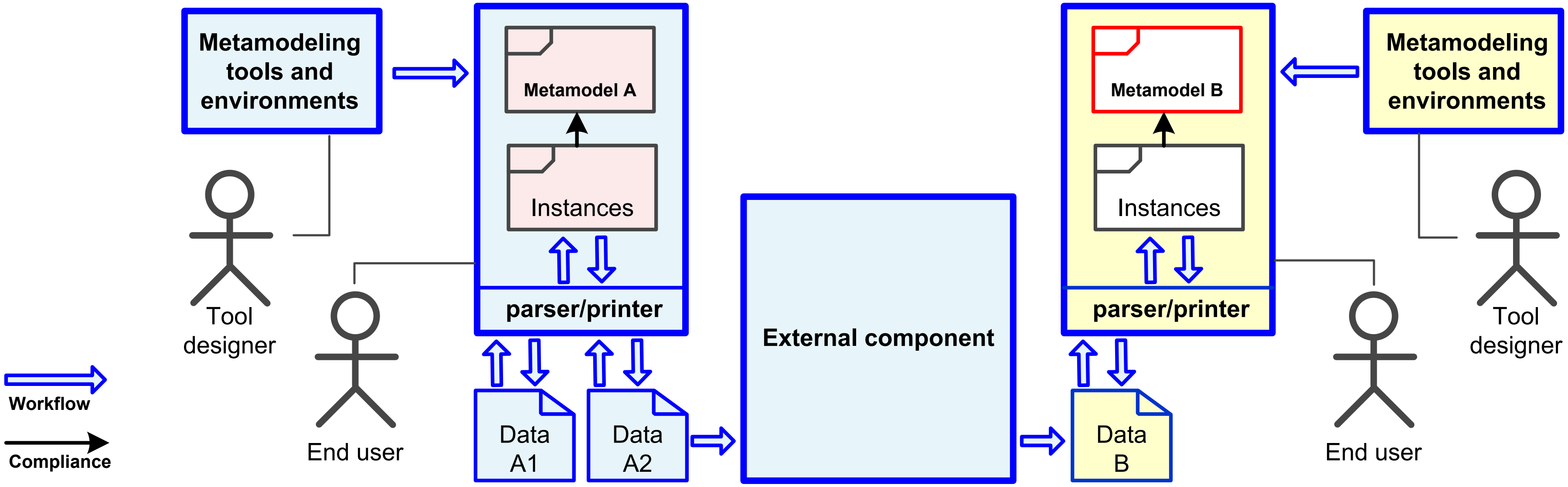
- Legacy systems
  - Widely used by different communities
  - Built upon different metamodels
  - Metamodels built with different metamodeling tools
- Integration
  - Led by a common language



Principles

Using an external data interoperability component

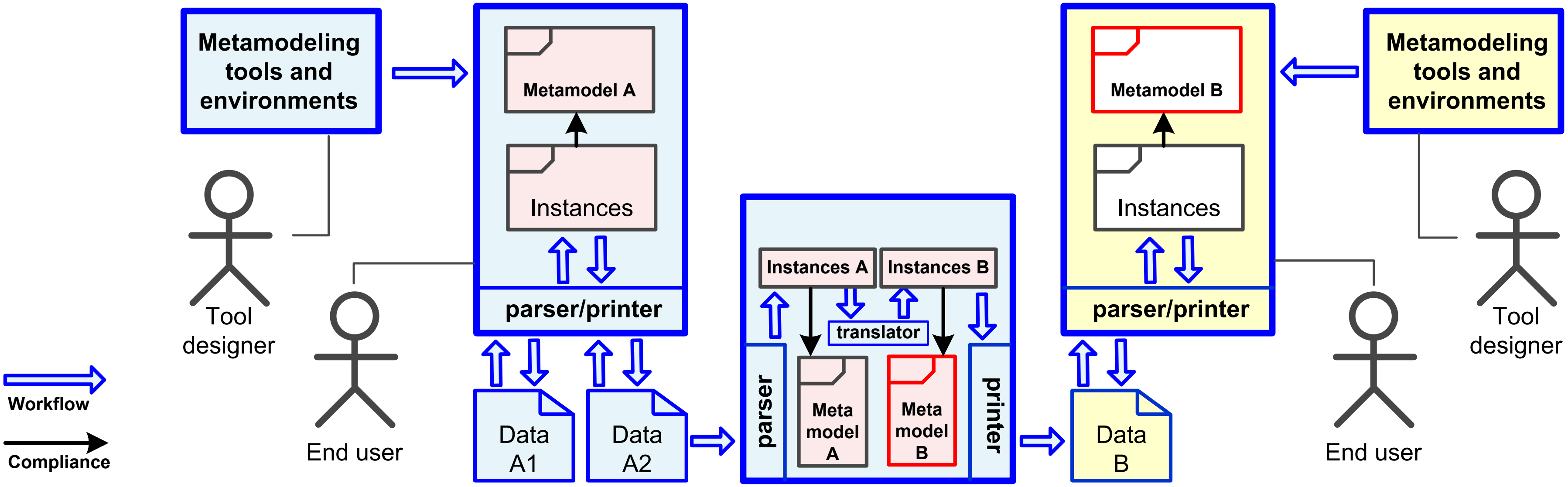
- Data interoperability
  - Relies on the common language
- *External* component
  - To keep the legacy systems unchanged



Principles

Avoiding the synchronization of metamodels

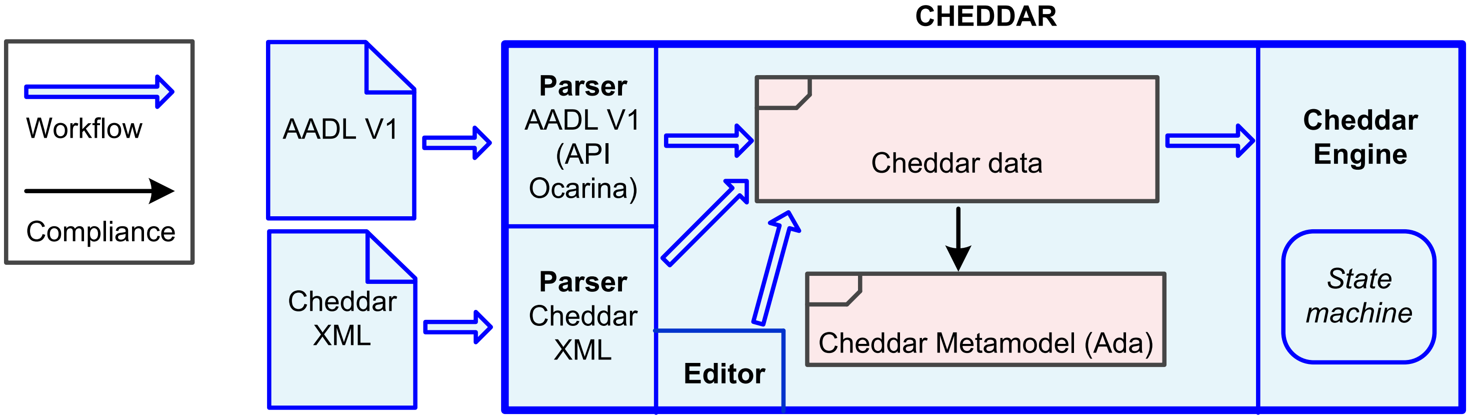
- Reusing both metamodels in a common metamodeling environment
  - Enables efficient model transformations
  - Implies
    - A tedious and error-prone translation of one metamodel
    - To check the equivalence between the 2 versions
    - To synchronize the 2 versions



Technical context

Cheddar

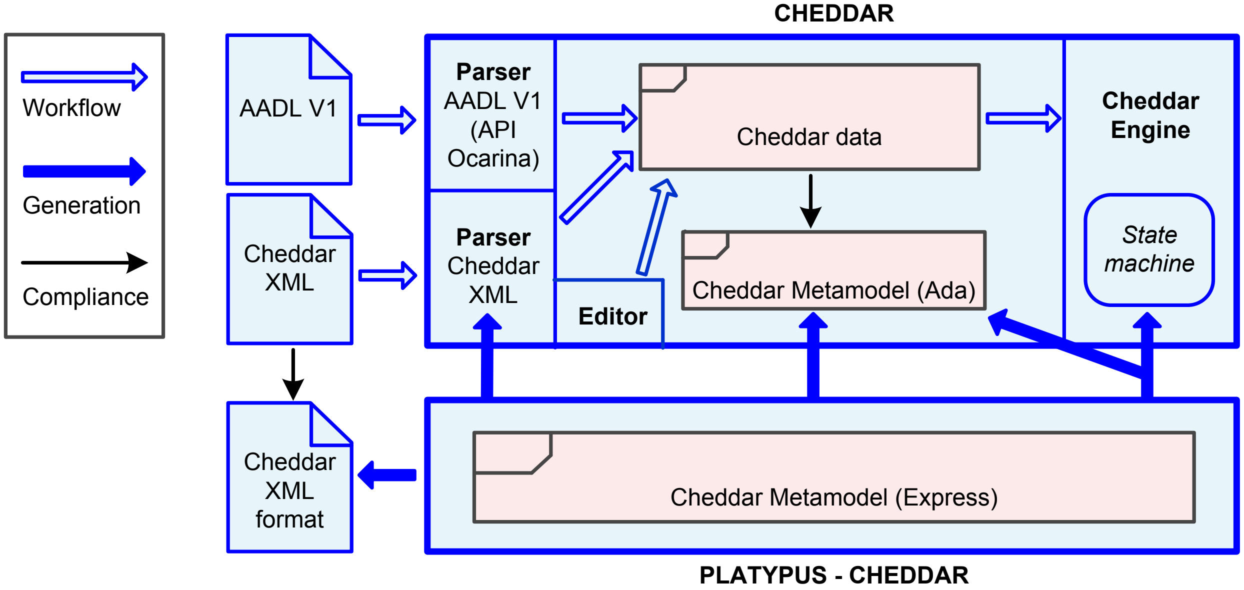
- A tool for the performance analysis of real-time applications.
  - Provides a set of standard real-time schedulers and analysis tools.
  - Can be extended with specific schedulers and analysis tools thanks to its dedicated programming language.
  - Cheddar specifications can be serialized to a specific XML format.
  - Cheddar also handles AADL v1 specifications.



Technical context

Cheddar and Platypus

- Some parts of Cheddar are generated by *Platypus* :
  - A software engineering tool fully integrated inside Squeak
  - Allows metamodel specification and transformation rules definition.
  - Provides a modeling and metamodeling language (Express).
- Specialized version of Platypus dedicated to Cheddar:
  - Involves the metamodel of Cheddar.
  - Allows to extend Cheddar with new schedulers and analysis tools.



Technical context

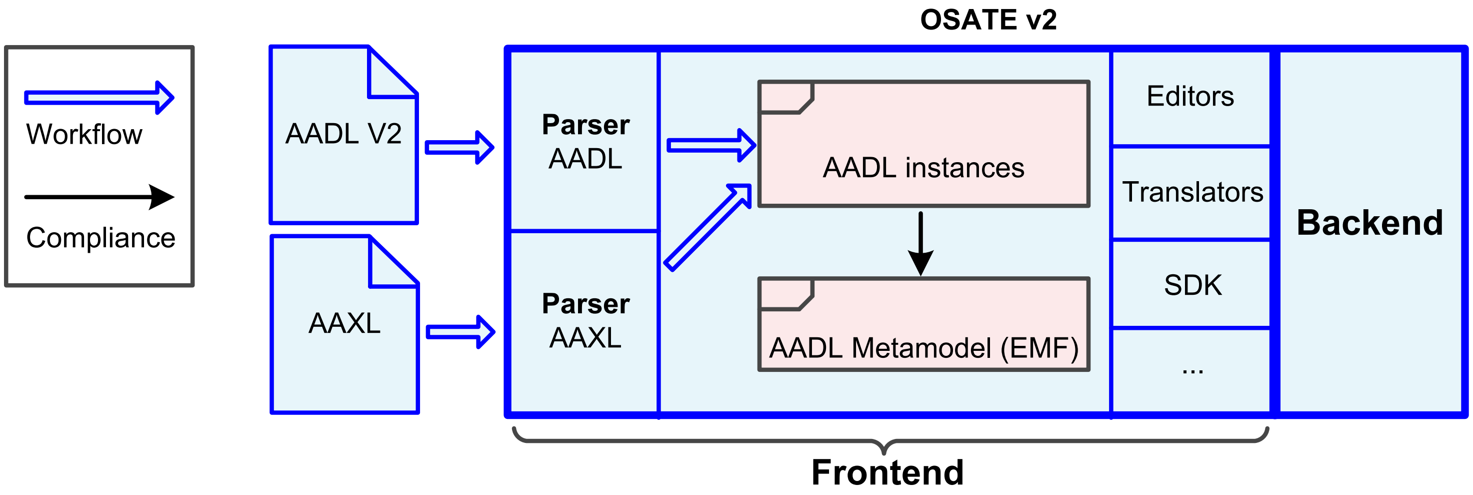
Scope extention to AADL V2

- Cheddar handles AADL v1 specifications thanks to the Ocarina API it integrates.
- To extend the scope of Cheddar to AADL v2 specifications:
  - Cheddar can be *reengineered* using the new version of the Ocarina API
  - AADL v2 specifications can be *externally* translated into Cheddar XML
- We investigate the second solution
  - The external component can reuse the frontend of *Osate v2*:
    - It avoids the reengineering of Cheddar
    - It offers a natural interface to Cheddar for regular Osate users.

Technical context

Osate

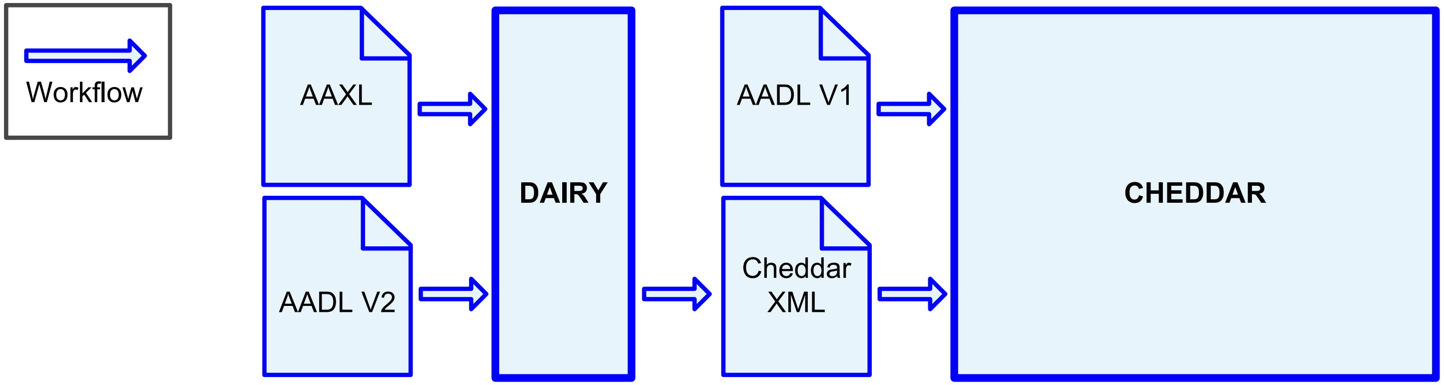
- *Osate v2*:
  - Based on EMF; includes a metamodel of AADL
  - Provides a toolset to parse and print AADL specifications
  - Provides a platform for system integration to develop AADL tools
  - Handles AADL v2 specifications



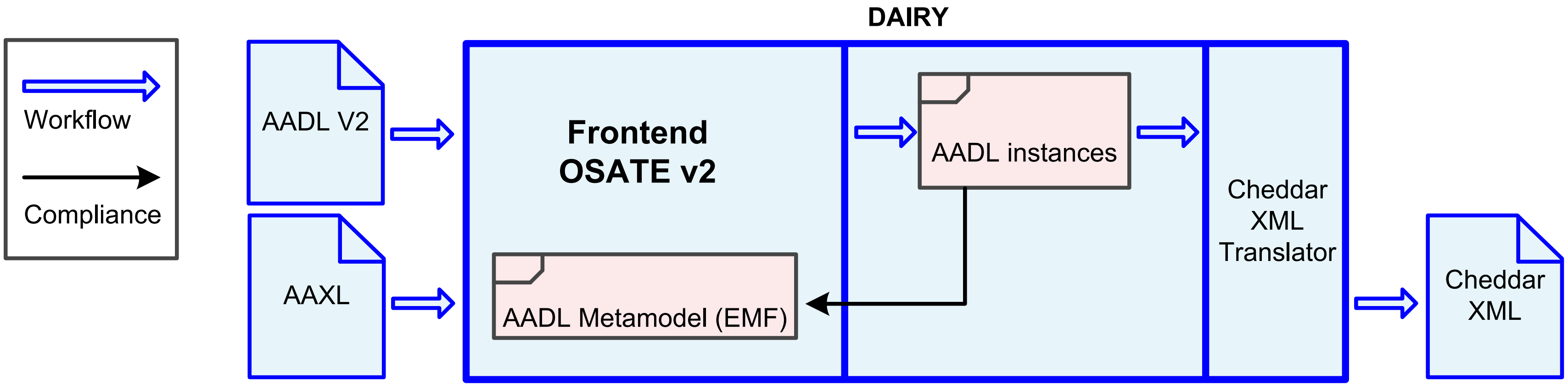
Interoperability component

Global design

- External view of *Dairy*:



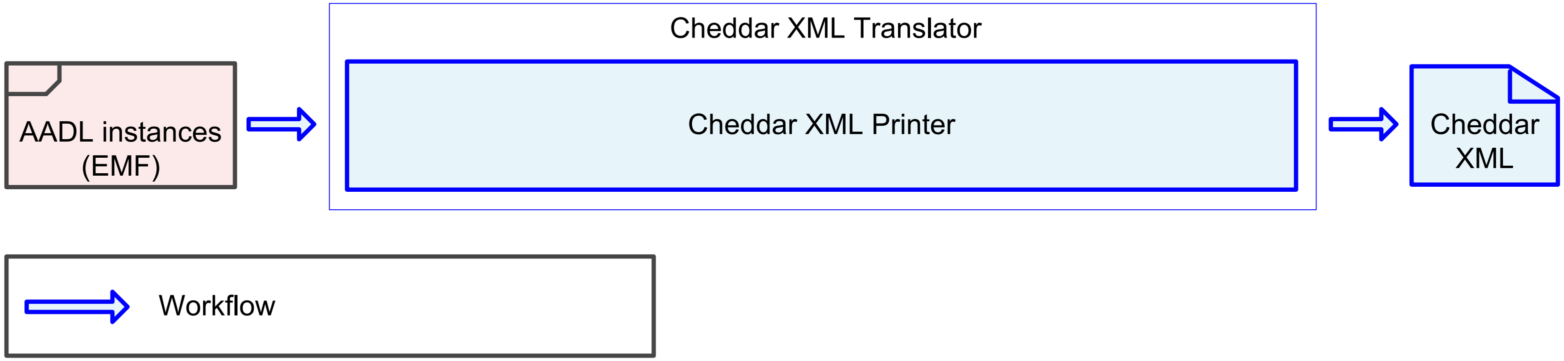
- White-box view of *Dairy*:



Interoperability component

Cheddar XML Translator - 1

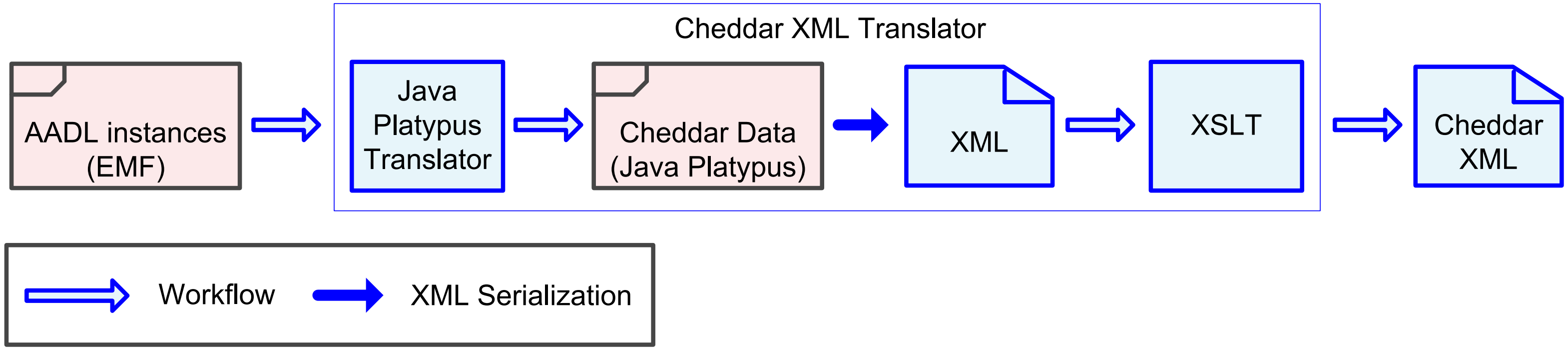
- Manual Cheddar XML Printer
  - Principle: browsing the AADL instances to manually generate strings of Cheddar XML
  - Enables to quickly develop prototypes.
  - Does not enable to capitalize on the translation rules.



Interoperability component

Cheddar XML Translator - 2

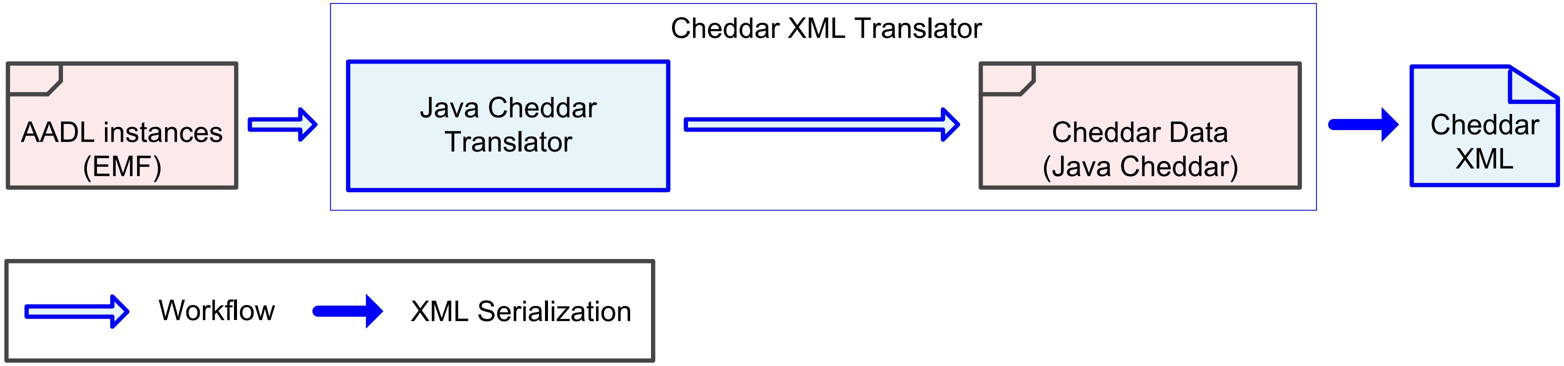
- Java generation by Platypus and XSLT
  - Principle:
    - using Platypus-Cheddar to generate java classes for each entities of the Cheddar metamodel.
    - browsing the AADL instances to create Java instances
    - using a java-serialization tool
    - defining translation rules to Cheddar XML with XSLT
  - This approach enables to capitalize on the translation rules.



Interoperability component

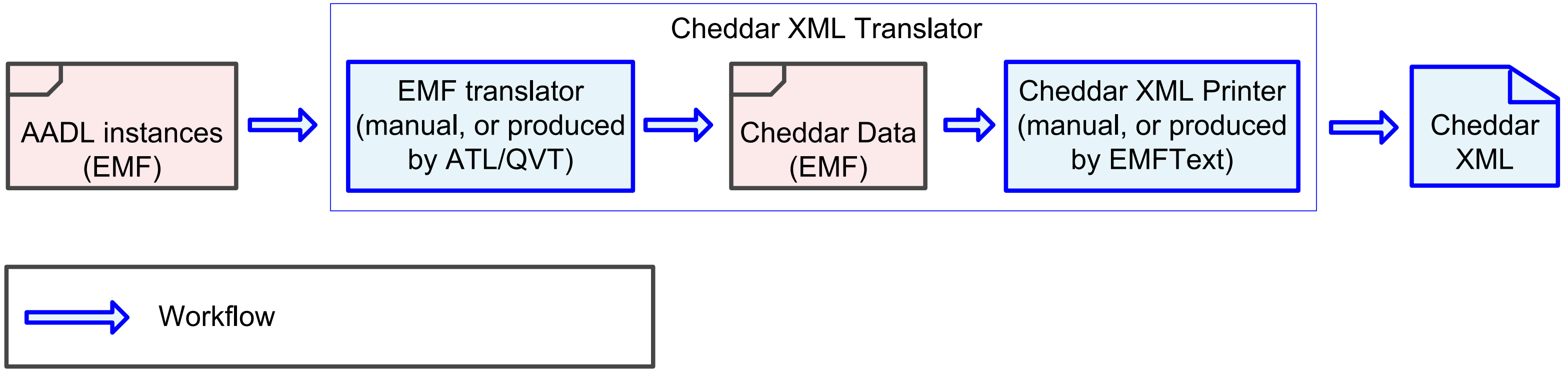
Cheddar XML Translator - 3

- Specific Cheddar-Java generation by Platypus
  - Principle: modifying Platypus-Cheddar so that it could generate Cheddar specific Java classes including direct serialization into Cheddar XML.
  - Requires a modification of Platypus-Cheddar.



Interoperability component
Cheddar XML Translator - 4

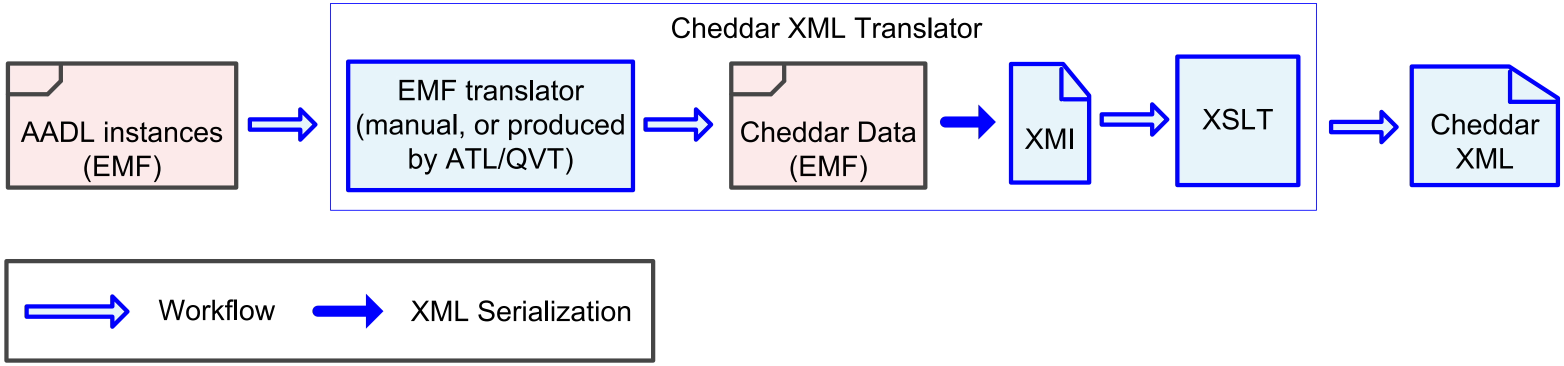
- EMF translator and XML printer:
  - Principle:
    - transforming the AADL instances into instances of a Cheddar metamodel in EMF (can be performed using ATL or QVT)
    - generating Cheddar XML from these instances (can be performed using tools like EMFText)
  - Require to synchronize two versions of the same metamodel (with EMF and with Express).


Cheddar XML Translator
AADL instances (EMF)
EMF translator (manual, or produced by ATL/QVT)
Cheddar Data (EMF)
Cheddar XML Printer (manual, or produced by EMFText)
Cheddar XML
Workflow

Interoperability component

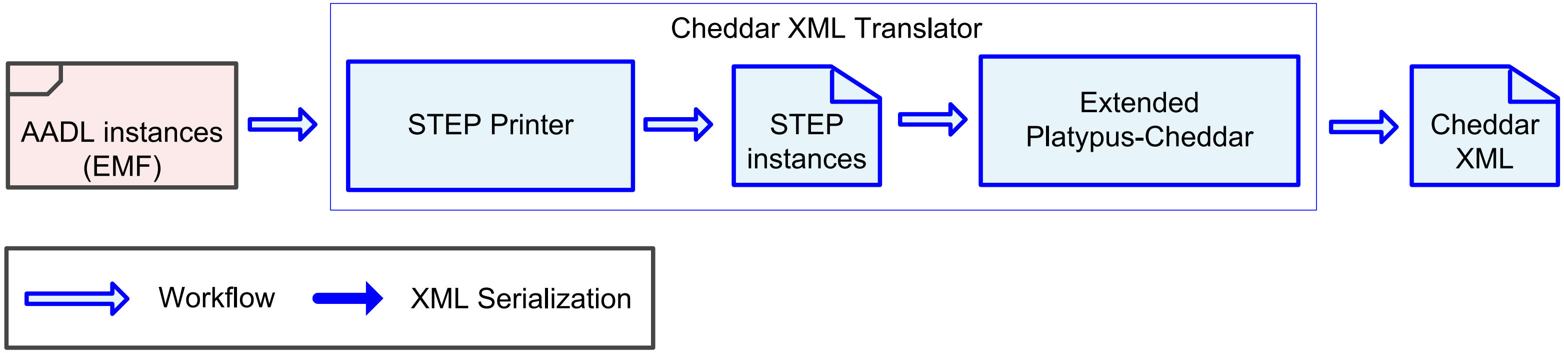
Cheddar XML Translator - 5

- EMF translator and XMI translator
  - Principle: variant of the previous solution:
    - standard XMI serialization applied to Cheddar instances
    - transformation into Cheddar XML using XSLT.



Interoperability component
Cheddar XML Translator - 6

- STEP printer:
  - Principle:
    - translation of the EMF instances into STEP instances of the Express Cheddar metamodel.
    - automatic generation of Cheddar XML.
  - Platypus-Cheddar must be updated to produce Cheddar XML from STEP instances.



Interoperability component

Cheddar XML Translator - overview

Approach	Metamodel transformation	Update of Platypus	Reused tools	Generated tools	Impact of metamodel update
1	no	no	none	none	high
2	no	no	XSLT	XML serializer	middle
3	no	yes	none	XML serializer	low
4	yes	no	none	translator and/or printer	low
5	yes	no	XSLT	translator and/or XMI serializer	low
6	no	yes	Platypus	none	low

- 1, 2: do not require any modification of Platypus; enable to quickly develop prototypes.
- 3, 6: minimize the impact of the metamodels' updates
- 4, 5: likely to be automated at the cost of a complete transformation of the Cheddar metamodel

Conclusions and perspectives

- We plan to develop a first prototype with the first approach.
- We will study in depth the impact of approaches 3 and 6 on Platypus-Cheddar.

- Typical tool chain including Dairy:
  - AADL model built with:
    - OSATE, Ocarina, Topcased
    - or with any other tool using AADL as a pivot language (*e.g.* MARTE/UML via AAXL transformation implemented with ATL)
  - Transformation into Cheddar for validation.