AN ATHENA VALIDATION PILOT SHOWCASE FOR AUTOMOTIVE INDUSTRY

By Nenad Ivezic, National Institute of Standards and Technology (NIST); and Pat Snack, Automotive Industry Action Group (AIAG)

Introduction

The Automotive Industry Action Group- (AIAG) led consortium, formed to execute an ATHENA project validation pilot, demonstrated initial results at the AIAG Enterprise Interoperability Showcase on November 15 in Detroit, Michigan.

As the basis of the ATHENA Validation Pilot Sub-project B5.10: Inventory Visibility and Interoperability (IV&I), the AIAG-led consortium proposed *Model-Based Standards for Interoperable Applications* approach to specify and implement interoperable electronic Kanban (eKanban) business processes. This demonstration showed that the ATHENA research results support well such a model-based approach to interoperability based on a real automotive eKanban inventory visibility scenario.

The demonstration participants included Ford; GM; the Korean Business-To-Business Interoperability Testbed (KorBIT); the National Institute of Standards and Technology (NIST); and the University of Belgrade – Faculty of Organizational Sciences (FOS), Serbia. From the ATHENA research side, the demo was enabled by the Semantic Mediation (A3) and Web Services Execution (A5) area participants: the National Research Council (CNR); SAP; and TXT e-solutions.

Business Need

Founded in 1982, AIAG is a global organization where the Original Equipment Manufacturers (OEMs) and suppliers unite to resolve issues affecting the worldwide automotive supply chain. Its more than 1,500 member companies include North American, European, and Asia-Pacific OEMs and suppliers to the automotive industry. A major part of the AIAG's work revolves around the development, maintenance, and dissemination of global data exchange standards to address a growing number of interoperability issues across the automotive industry.

The proposed model-based interoperability approach uses the ATHENA tools to address three central business needs: (1) Increase efficiency of standards development processes; (2) Increase reliability in, and testability of, standards interpretation; and (3) Decrease complexity of the standards life cycle management.

The AIAG Approach to Model-Based Standards for Interoperable Applications

Presently, there are three important levels at which the AIAG community develops and uses the standards development approaches, as exemplified in the case of the eKanban interoperability specifications development:

- At the enterprise modeling level, the community members worked to define the IV&I eKanban Business Process Model. This model, however, is captured using informal, non-computational methods (i.e., free-form text and diagrams).
- At the message design level, best practices message schema definition approaches were adopted and extended to specify the eKanban schemas. Also, at this level, the community defines mappings between the application interface shemas and the eKanban schemas. The meaning of data and mappings between the application interface and eKanban schemas, however, is currently captured imprecisely using syntactic (i.e., data format definition) approaches and free-form text.

- At the run-time level, the application interface-to-eKanban schema mapping definitions are used to implement the data mappings and create IV&I conformant interfaces. The actual data mapping implementations are, however, vulnerable to errors as the meaning is inferred on the basis of data format definitions and free-form text.

The AIAG approach to *Model-Based Standards for Interoperable Applications* envisions the following advances at each of the three levels that may address the business needs by making use of the ATHENA results:

- At the enterprise modeling level, the fundamental concepts and relations may be captured using the ATHENA tools as computer-processable IV&I eKanban Enterprise Models.
- At the message design level, the ATHENA tools may help to (1) expose the logic behind the application and global data exchange schemas and (2) define precisely semantic reconciliation rules between these application and global schemas.
- At the run-time level, the reconciliation rules are executed using the ATHENA semantic reconciliation engine. In that way, precise implementations of the standard conformant interfaces may be possible through logical schema reconciliation.

Initial AIAG Validation Pilot Demonstration

The presentation at the AIAG Enterprise Interoperability Showcase showed application of the ATHENA tools enabling the AIAG *Model-Based Standards for Interoperable Applications* approach. As illustrated in the figure, we demonstrated an interoperable eKanban message exchange between IV applications and an IV&I test harness using the ATHENA tools:

- At modeling/design time, the AIAG consortium created an ontology to precisely define concepts and relationships in the eKanban process and used the ATHOS Ontology Management tool to encode the ontology. Then, the ARGOS tool was used to define the reconciliation rules between a schema (i.e., either an IV application interface schema or an AIAG-specififed eKanban message schema), on one side, and the eKanban ontology, on the other. These rules, effectively, enabled alignment of semantics of the applications with the AIAG eKanban message standard using the eKanban ontology.
- At run time, these reconciliation rules enabled creation of the IV&I conformant messages and interoperable exchanges of the messages from the sending applications to the receiving test harness. The actual reconciliation was done using the ARGOS reconciliation engine. The messages were sent “over the wire” using the ATHENA Johnson Web Services (WS) execution tool.

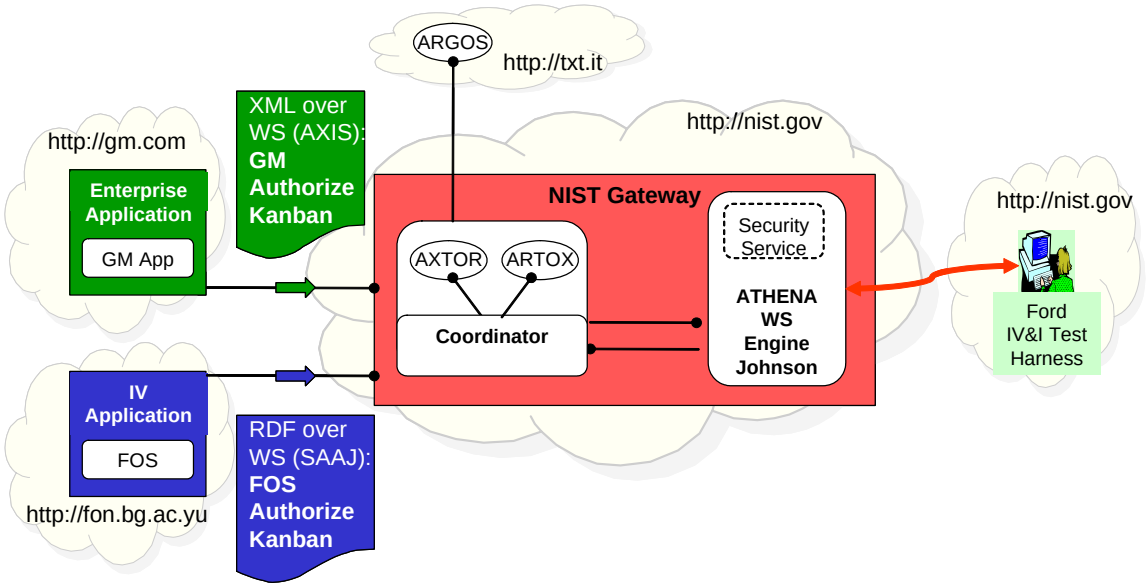
The AIAG consortium built additional tools necessary to perform the validation process:

- Transformer (i.e., AXTOR and ARTOX tools) enables the business applications that currently use XML Schema-based interfaces to use the ATHENA semantic mediation tools that expect RDF Schema-based representation. At run time, the tools transform XML message instances into a compatible RDF representation.
- Coordinator orchestrates use of Transformer, the ATHENA semantic reconciliation engine (ARGOS), and the Johnson WS execution engine to transform a proprietary message into an eKanban conformant message and to send it “over the wire”.

- Web Services Security plugin enables the Johnson WS execution engine to meet the WS-I security specifications as required by the automotive industry.
- FOS open source Inventory Visibility (IV) application is an experimental platform to assess impact of the ATHENA research results on application development. It has an RDF Schema-based proprietary messaging eKanban interface.
- GM experimental enterprise application is a platform to assesses the impact of the ATHENA research results on the users. It has an XML Schema-based proprietary messaging eKanban interface.

The figure shows a successful message exchange from the two independently developed applications (capable of sending only their proprietary versions of the *AuthorizeKanban* message) to the IV&I Test Harness. The FOS IV application (running in Belgrade, Serbia) successfully exchanged information with the Ford Test Harness (running in Gaithersburg, Maryland, USA). Also, the GM application (running in US) successfully exchanged information with the Ford Test Harness.

Both GM and FOS applications used the NIST-developed Gateway that comprises a number of modules described previously to perform the transformation functions (from XML to RDF and vice versa), to invoke the reconciliation function using the ARGOS semantic mediation engine (running on a TXT site in Italy), and, finally, to execute a WS call using the Johnson WS execution engine.



Significantly, our demonstration showed that the ATHENA results begin to form a basis of "semantic middleware" capability to manage heterogeneous applications' data exchanges by defining and implementing model-based standard messaging interfaces in a flexible, yet precise manner.

DISCLAIMER: Certain commercial software products are identified in this paper. These products were used only for demonstration purposes. This use does not imply approval or endorsement by NIST, nor does it imply these products are necessarily the best available for the purpose.