Applying Automated Methods of Managing Test and Evaluation Processes

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Outline

• Purpose

• Background and Athena Usage in OT&E

• Test Reform: “Shift Left”

• Athena Adaptive Architecture

• Current Uses

• Future Exploration

• Conclusion
Purpose

• Increasingly advanced computer simulations and faster data acquisition systems continue to yield exponential increases in quantities of data

• The sheer volume of data makes it more difficult to determine system performance trends or to identify potential problems

• This presentation highlights the evolution of the Athena software application
  – From its role in managing, processing, and analyzing large volumes of system data
  – To applying automated methods of managing overall systems engineering processes for multiple systems and system-of-systems testing and modeling and simulation
Background

- Athena concept began as a 2005 ATEC requirement to manage THAAD system operational evaluation data
- Athena Version 1 (2006 - 2011) was integral to THAAD IOT&E operational assessment
- Featured in June 2012 ITEA Journal article: “Implementation of an Accelerated Assessment Process for the THAAD System: IOT&E Supporting a Production Decision”
- Version 1 addressed one major function: OT&E
- Athena Version 2 (2012 - 2016) developed with increasing focus on Developmental Testing
- Version 3 (2016 - current) introduced a new framework, allowing for unlimited scalability and configurability
THAAD IOT&E

System Under Test

Sensor
Command and Control
Weapon

IOT&E Event

Solution

- 15 TB of data generated
- Athena SW combined with well-defined roles and procedures reduced the data down to ~ 2.5 GB
- Reduced the normal ATEC report development timeline by one-third
- Expedited final assessment report delivery to acquisition decision-makers and operational commanders
Path to THAAD IOT&E Event Database

Athena provided quick look results from authenticated data in under 24 hours.
Athena Version 1 Focus

**Technical Processes**
- Stakeholder
- Rqmts Definition
- Rqmts Analysis
- Architecture Design

**Technical Management Processes**
- Decision Analysis
- Technical Planning
- Technical Assessment

- Requirements Management
- Risk Management
- Configuration Management

**Technical Processes**
- Transition
- Validation
- Verification
- Integration
- Implementation

Operational Need
- Requirements
- Design
- Product
- Realization

Delivered Capability
- Validated Solution
- OT&E
- IOC/FOC

Validated Solution
- DT&E
- OT&E
- IOC/FOC

Operational Need
- IOC/FOC
- OT&E

**Operational Need**

**Delivered Capability**

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Approved for Public Release
Test Reform: “Shift Left”

• “To achieve the outcomes of Better Buying Power and deploy improved capability to our warfighters in an effective and timely manner, we have to get the development right and verify it through rigorous DT&E before we commit to production. We have to Shift Left!”  [Hutchison, Defense AT&L article, September-October 2013]

• “Shift-Left T&E – DoD often encounters performance issues in Operational Testing (OT) that should be identified in Developmental Testing (DT). Shift-Left enlarges operational realism throughout acquisition to accelerate knowledge of system capabilities and reduce discovery in OT by exploiting T&E opportunities, such as integrated testing and acceptance of DT data. Adopting streamlined acquisition T&E processes that increase DT robustness and incorporates earlier integration of operational realism will result in more cost effective lifecycle costs for warfighter capabilities.”  [Jimenez, Test and Evaluation Reform briefing, October 2018]

• Data available in a single interface provides an integrated knowledge base, enabling a “Shift Left” acquisition acceleration
Athena Design Overview

Athena Client

Athena Application Program Interface (API)

Framework

Athena Software Tool 1

Athena Software Tool 2

Athena Software Tool n

External Software Tool 1

External Software Tool n

Athena Server
Athena provides a single interface to integrate and interact with all available data.
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# Athena Tools

## Analytics
- Scripting
- Data Importing and Processing
- Batch Processor
- Automation Manager
- Plotting and Charting Tools
- Mapping Tool
- Globe
- Dashboard Designer
- Data-Driven Report Designer
- Project Manager (collaboration)

## Other
- System – Specific Tools
- Office Tools
- Programmatics and Reporting Tools
Data Analysis Workflow Using Scripting Tool

Step 1: Select Database

Step 2: Choose Table(s)

Step 3: Explore Data

Step 4: Visualize Data

Step 5: Automate Process

Data source - http://datasets.wri.org/dataset/globalpowerplantdatabase
Athena API

• Supports C# 7 and VB.NET
• Allows developer to add custom buttons, commands, and interfaces to Athena
• Provides current database connection to user
• Provides a mechanism to request services through the framework
  − Submit request to display data on map, chart, or globe
  − Request data analysis task
• Has ability to save/store setting unique to each plugin
• Supports ability to extend existing plugins
• Supports ability to add tabbed or docked windows
• Provides mechanism for developers to add security components to their plugin at user or group level
• Developer guide provides variety of code examples on API use
Athena Version 3 increases its capability to perform more systems engineering tasks

Technical Processes
- Stakeholder
- Rqmts Definition
- Rqmts Analysis
- Architecture Design

Technical Management Processes
- Decision Analysis
- Technical Planning
- Technical Assessment

Technical Processes
- Transition
- Validation
- Verification
- Integration
- Implementation

Technical Data Management
- Technical Data Management
• Automated test case execution and requirements verification, summary results on dashboard
• Automated 5,000 to 20,000 requirements verification tests per night
• Processed total of over 60 billion records

Athena provided continuous fully-automated requirements verification testing
Athena provided continuous fully-automated system Verification and Validation results
• Technology protection plugin mitigates risk of unintentional export of system critical technology

• To date, over 250,000 system documents (specifications, technical drawings, engineering change proposals, tech manuals) have been managed through this process for a single weapon system

• Provides an online searchable repository of every document and version produced by the program, available within seconds

Athena improves processing time from months to minutes; requires less resources (cost and personnel); reduces errors; and provides consistency in review process to meet delivery timelines
• Collects and organizes the diagnostic data into a graphical format intuitive for operators, maintainers, analysts, and evaluators

• Graphical representations of hardware components, arranged to mimic what one would see when working with the equipment

• Displays faults prominently for quick action, drawing attention to the physical location of problem areas

• Provides quick access to all tests/successes/failures on given date for historical analysis for Reliability, Availability, and Maintainability (RAM) assessments

• Provides repair steps for faults requiring further action

• Near real-time fault alert capability via TCP or UDP link message or data file parsing

Athena provides operators and maintainers the capability to address faults without impacting operational availability
Future Exploration

• Predictive Analytics in Life Cycle and Sustainment
  – ML.NET
  – TensorFlow

• Database and Application hosting via Cloud services
  – Amazon AWS
  – Microsoft Azure Commercial
  – Microsoft Azure Government

• Design Tools using Category Theory
Athena supports Shift Left acquisition acceleration by providing an integrated knowledge base of data available in a single interface.
Questions?
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<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>API</td>
<td>Application Program Interface</td>
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<tr>
<td>ASCII</td>
<td>American Standard Code for Information Interchange</td>
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<td>ATEC</td>
<td>Army Test and Evaluation Command</td>
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<td>AWS</td>
<td>Amazon Web Services</td>
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<td>CTEP</td>
<td>Certified Test and Evaluation Professional</td>
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<td>DAG</td>
<td>Data Authentication Group</td>
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<td>DT</td>
<td>Developmental Testing</td>
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<td>DT&amp;E</td>
<td>Developmental Test and Evaluation</td>
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<td>FOC</td>
<td>Full Operational Capability</td>
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<td>RAM</td>
<td>Reliability, Availability, and Maintainability</td>
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<td>SoS</td>
<td>System of Systems</td>
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<td>SQL</td>
<td>Structured Query Language</td>
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<td>SW</td>
<td>Software</td>
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<td>TCP</td>
<td>Transmission Control Protocol</td>
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<td>THAAD</td>
<td>Terminal High Altitude Area Defense</td>
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<td>UDP</td>
<td>User Datagram Protocol</td>
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