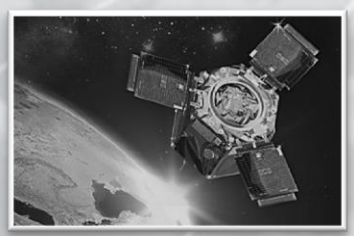

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Workshop on Simulation for European Space Programmes (SESP)
24-26 March 2015
ESA-ESTEC, Noordwijk, The Netherlands

SDYA: A Real Time and Distributed Software Verification Infrastructure for Validating Flight Software (On-Board Software) at System Integration Laboratory.

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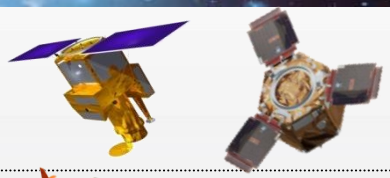
TAI – Turkish Aerospace Industries, Inc.
Space Systems Group

HISTORICAL ROADMAP

1984 1986 1989 1993 1995 2003 2014

SATELLITE



INDIGENOUS DESIGN
JOINT DEVELOPMENT

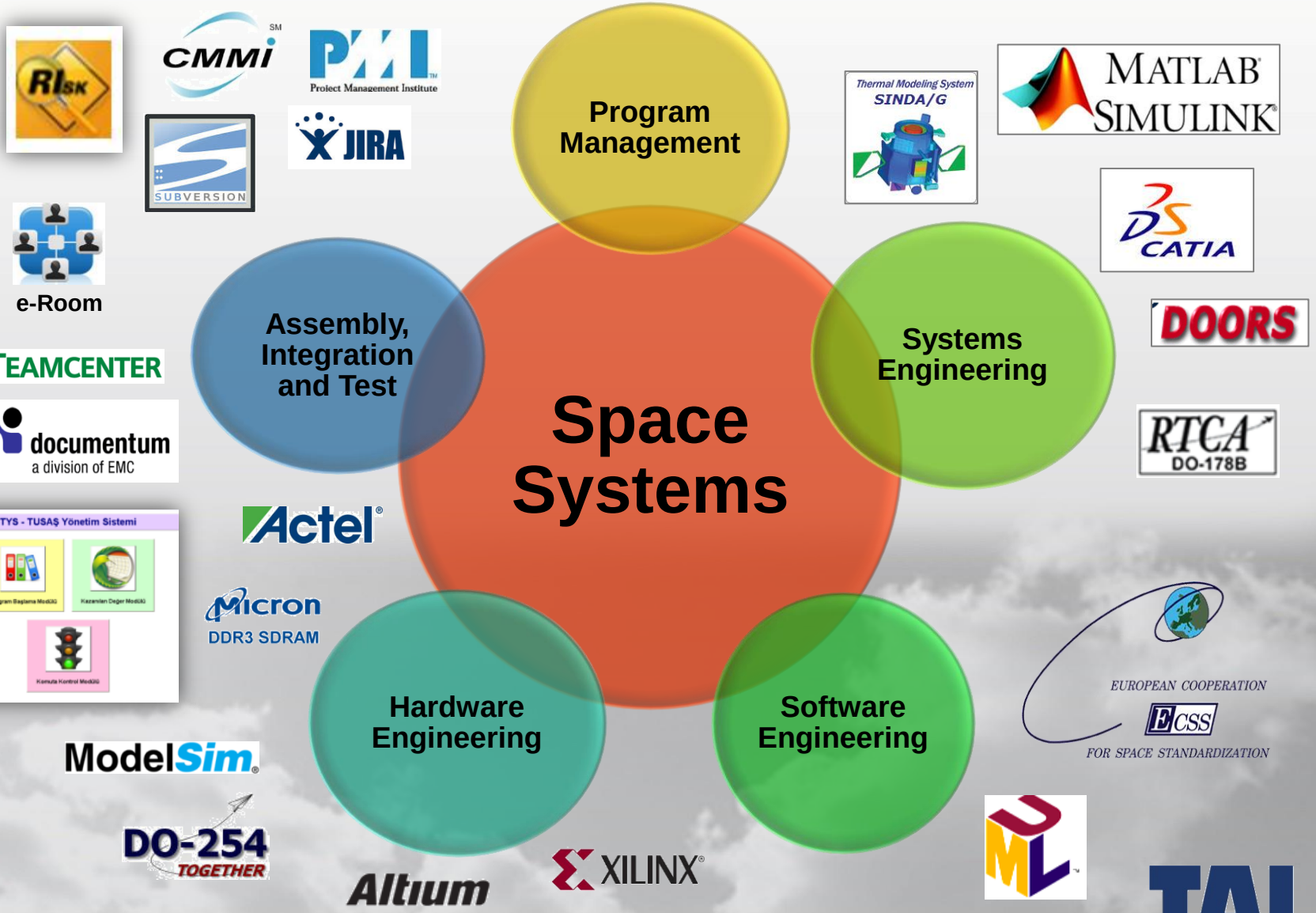
MODERNIZATION
SYSTEMS INTEGRATION

AEROSTRUCTURES

CO-PRODUCTION

1984 1986 1989 1993 1995 2003 2014

SPACE SYSTEMS



Space Systems

PROCESS DEVELOPMENT and CERTIFICATES

- AQAP-2110
- ISO-9001 : 2008
- AS/EN ISO 9100
- ISO 14001
- ISO/IEC 27001:2005
- OHSAS 18001:2007
- THALES ALENIA SPACE Manufacturing Technology Certificate

- ESA – ECSS (European Cooperation for Space Standardization)
- CMMI Level 3

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INTRODUCTION

"SDYA" stands for System Integration Laboratory (SIL) Verification Software Infrastructure

What are the main motivations, and objectives in developing SDYA ?

- Generic, real-time, distributed, and layered simulation environment
- Testing, integrating Flight (OBDH) Software at SIL
- No critical and direct third party dependency
- Supporting automated testing
- Providing API for external interfaces
- SMP-2 compliance
- Satisfying ECSS-E-ST-E40C, and DO-178B Tool Qualification requirements
- Reuse, easy integration with new simulation models
- CMMI Level-3 compliant TAI Process implementation

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ROLE OF SIL & SDYA IN SIL

System Integration Laboratory provides an environment for integraton & testing;

- Replaces the real avionics equipment with simulation model
- Communicates with Flight Software (OBDH, and Ground Station Command and Control Software)
- Uses real avionics interfaces (MIL-STD-1553, Serial, SpaceWire, Can Bus, etc.).
- Integrated test scenarios with SIL Verification Software is applied.


C-130 SIL

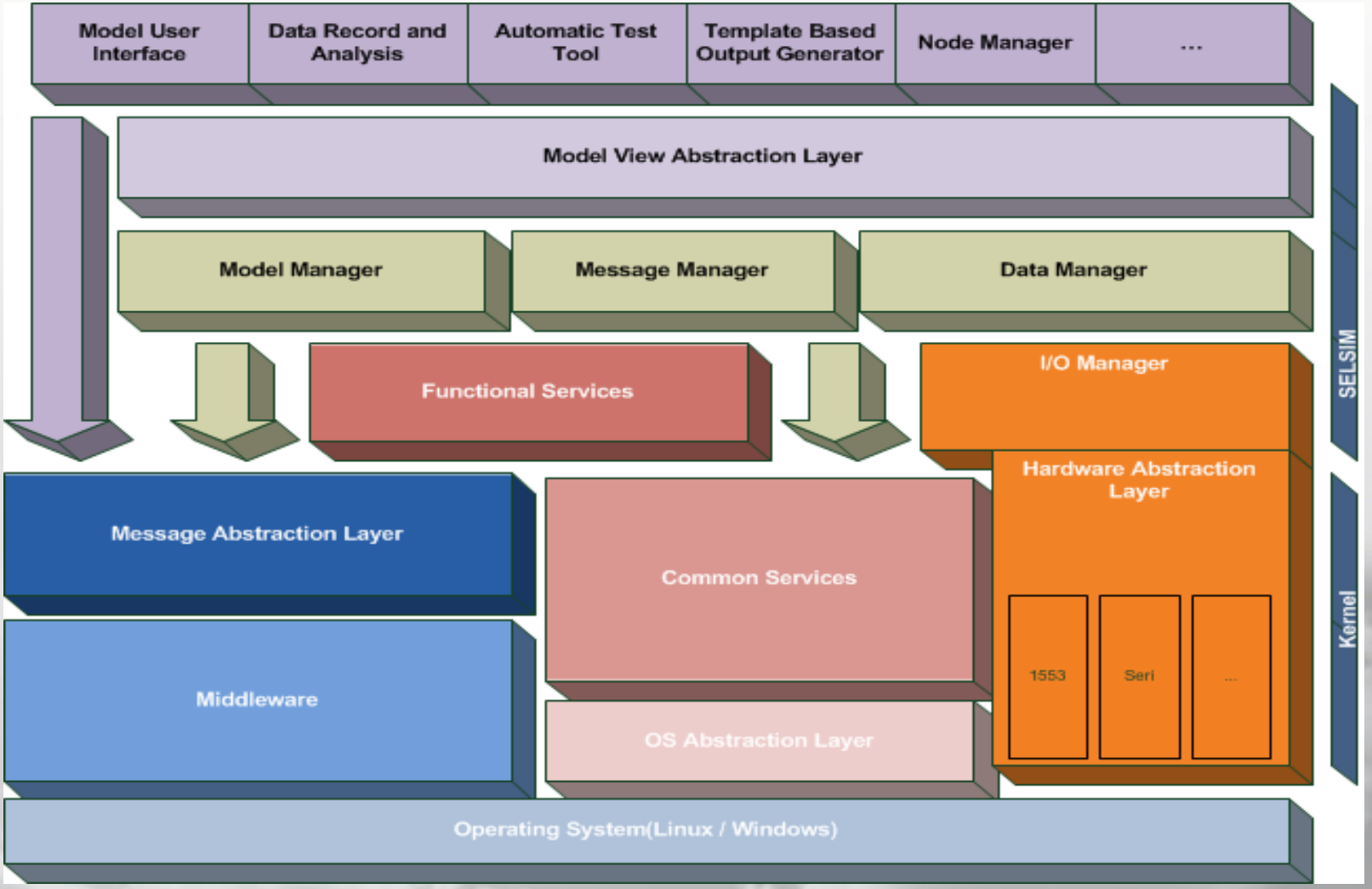
SIL Verification Software (based on SDYA) plays an important role in safety critical/reliable software development in the early stages of the projects by;

- Supporting the detection and resolution of critical errors
- Reducing technical risks and costs
- Shortening the development time.


SATELLITE SIL

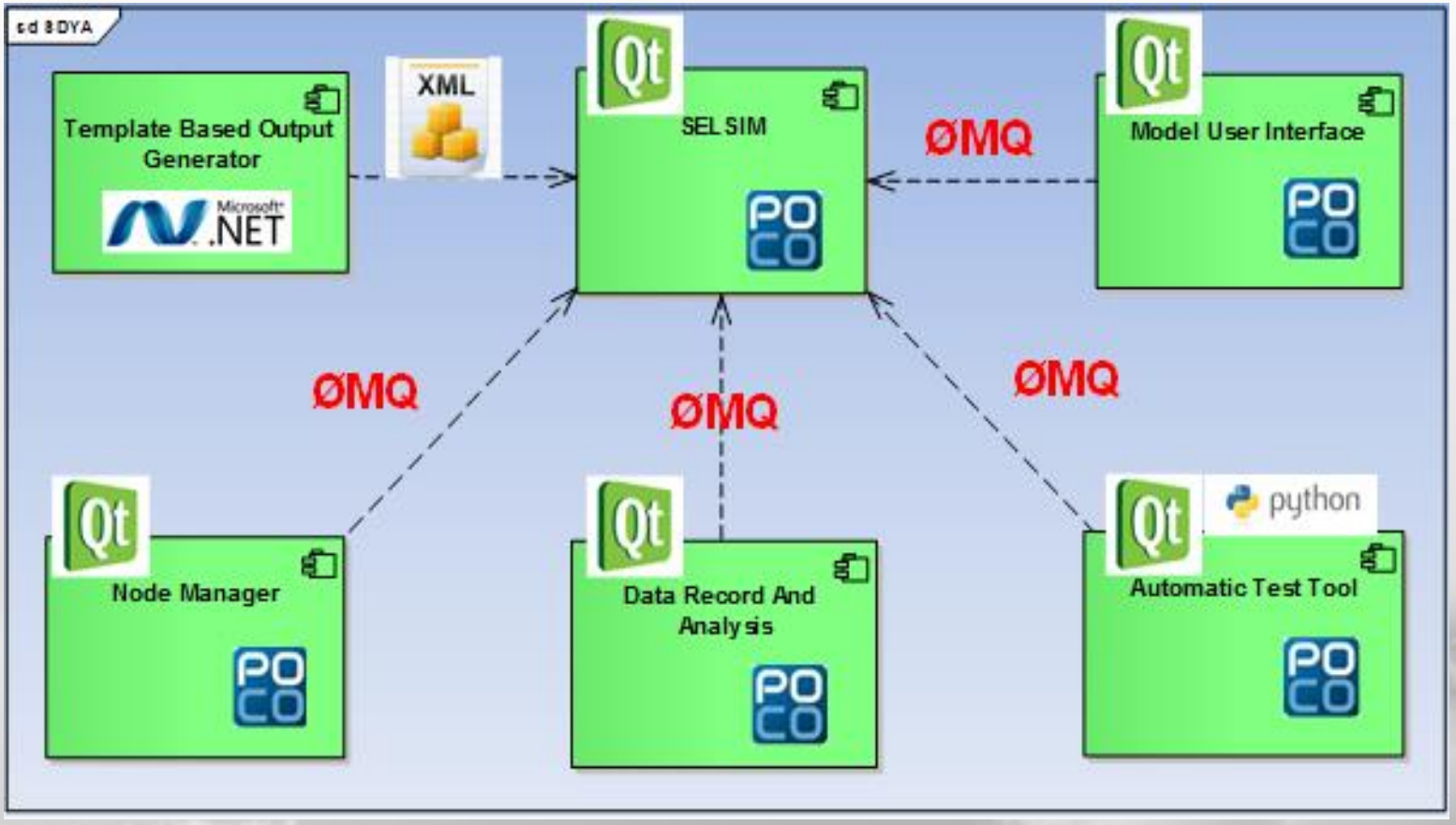
ANKA SIL

LAYERED ARCHITECTURE



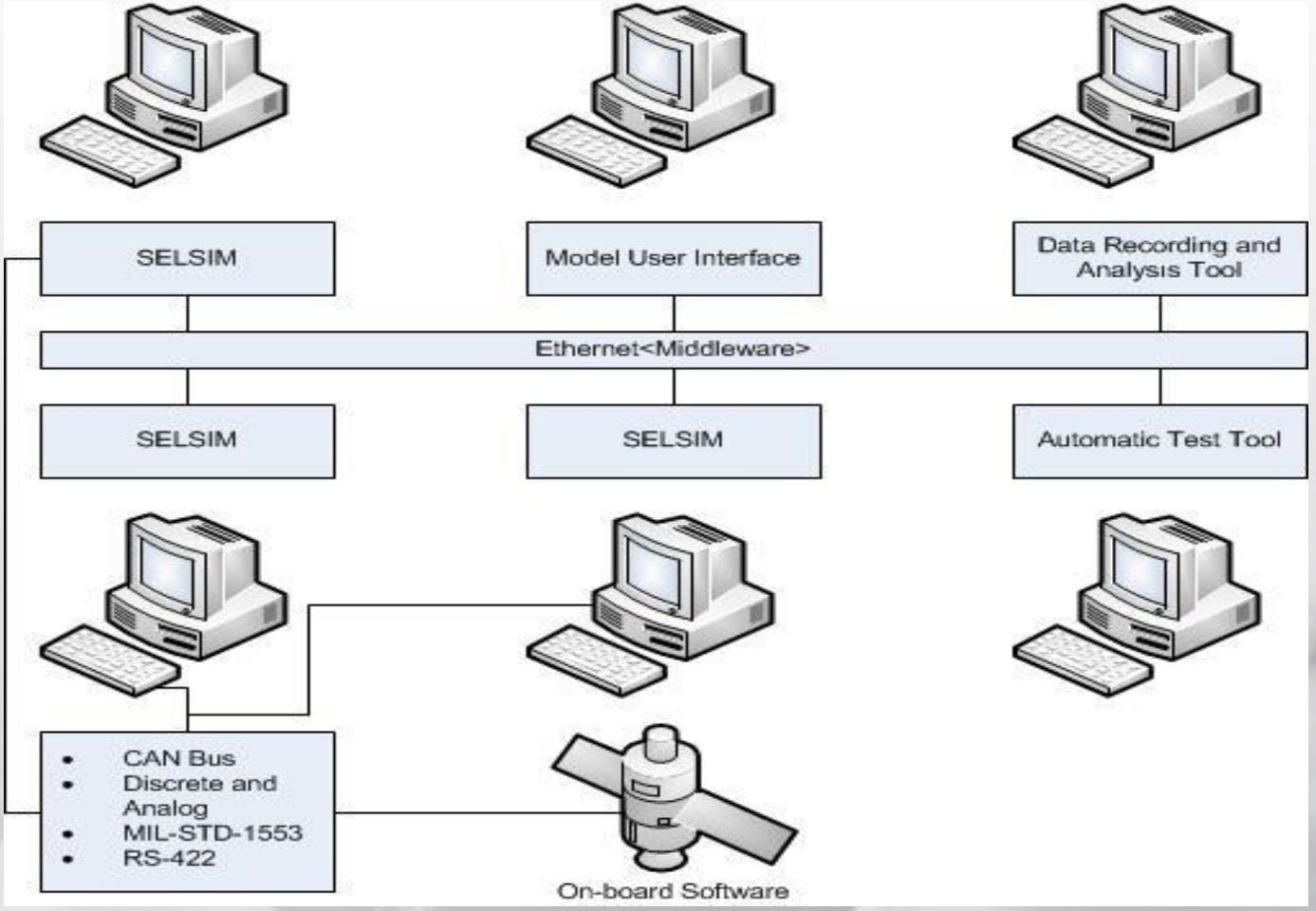
- High Level Abstractions (OS, Hardware, Middleware, Model-View, etc.)

COMPONENT BASED ARCHITECURE AND SELECTED TECHNOLOGIES



- Component based architecure describes reusable, replaceable, extensible, encapsulated, independent components
- Critical Technology selections made by Decision Analysis and Resolution (DAR) Process

SAMPLE DEPLOYMENT VIEW



- Scalability, modularity, use of middleware allows various deployment configurations

DEVELOPMENT APPROACH

- Requirements collected from internal customers
- Use of Incremental Software Development Life-cycle Model (each increment consisting of software requirement development, design, implementation, unit testing, and requirement based testing)
- Guidance of ECSS-E-ST-40C, ECSS-Q-ST-80C, ECSS-Q-HB-80-01A for Tool Qualification
- Guidance of RTCA DO-178B for Tool Qualifcation as a Verification Tool
- Compliance with CMMI Level-3 TAI Processes
- ECSS-E-TM-40-07 (SMP-2): "Simulation Modelling Platform" standard compliance as a design consideration
- Verification and validation by TAI Independent Software Verification Team
- Project/Technical Management by following Key Performance Indicators (metrics) like Earned Value, Schedule Performance Index, Cost Performance Index, Burndown Chart, SLOC (Source Line of Code), Number of Change Requests, Number of Requirements Tested, Major Milestone Achievements, Action Items Status, Risk Items Status, Cyclomatic Complexity, etc.

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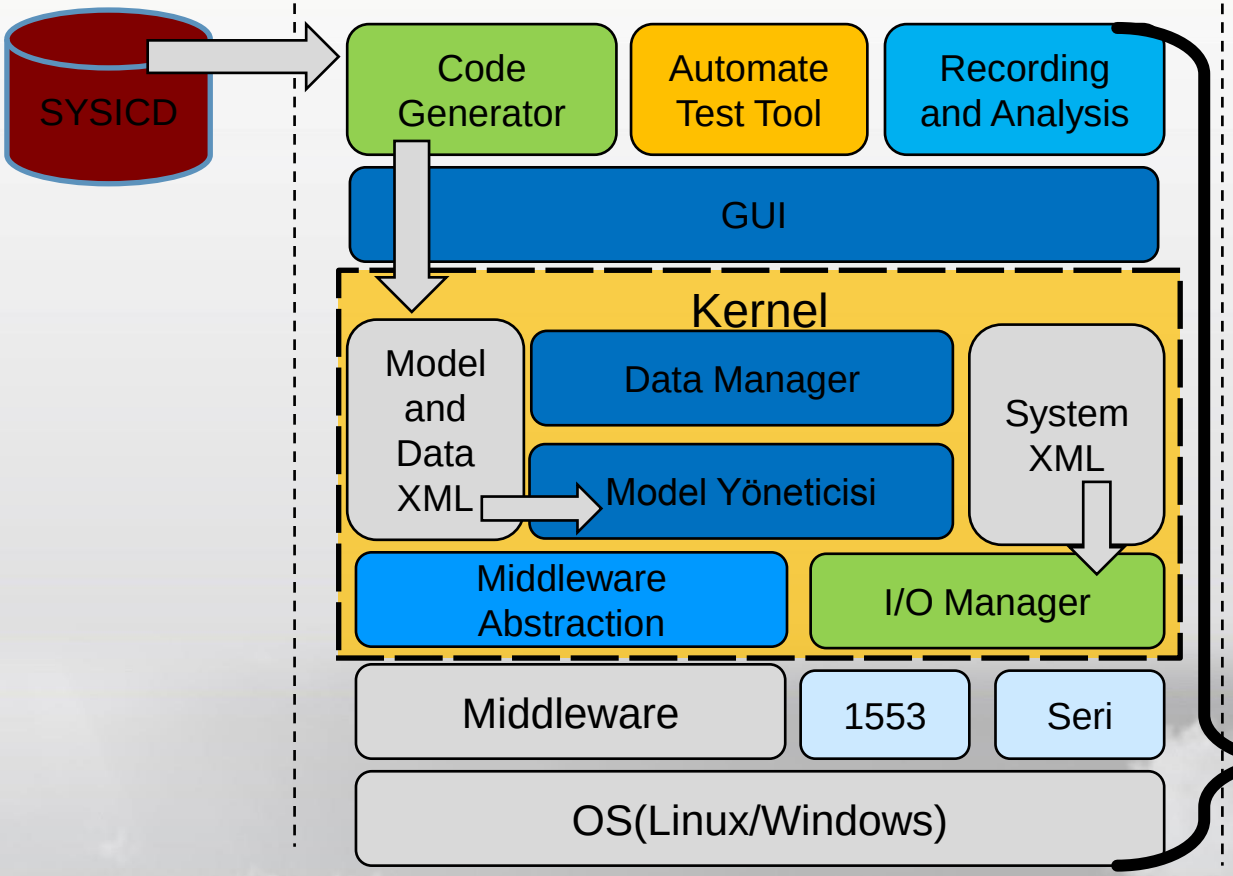
DEVELOPMENT APPROACH



- Successful completion of development and adaptation of specific “ANKA” models

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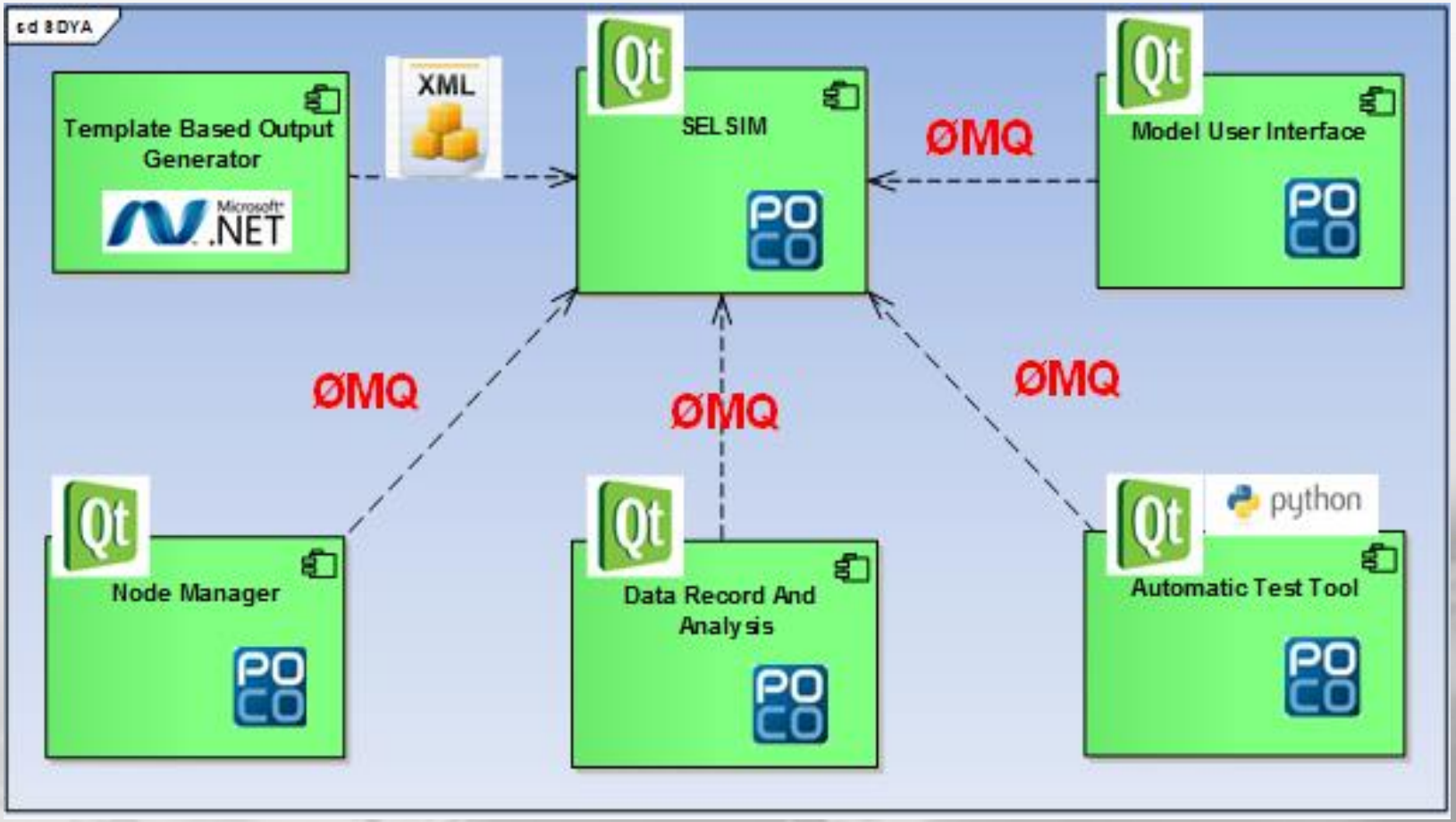
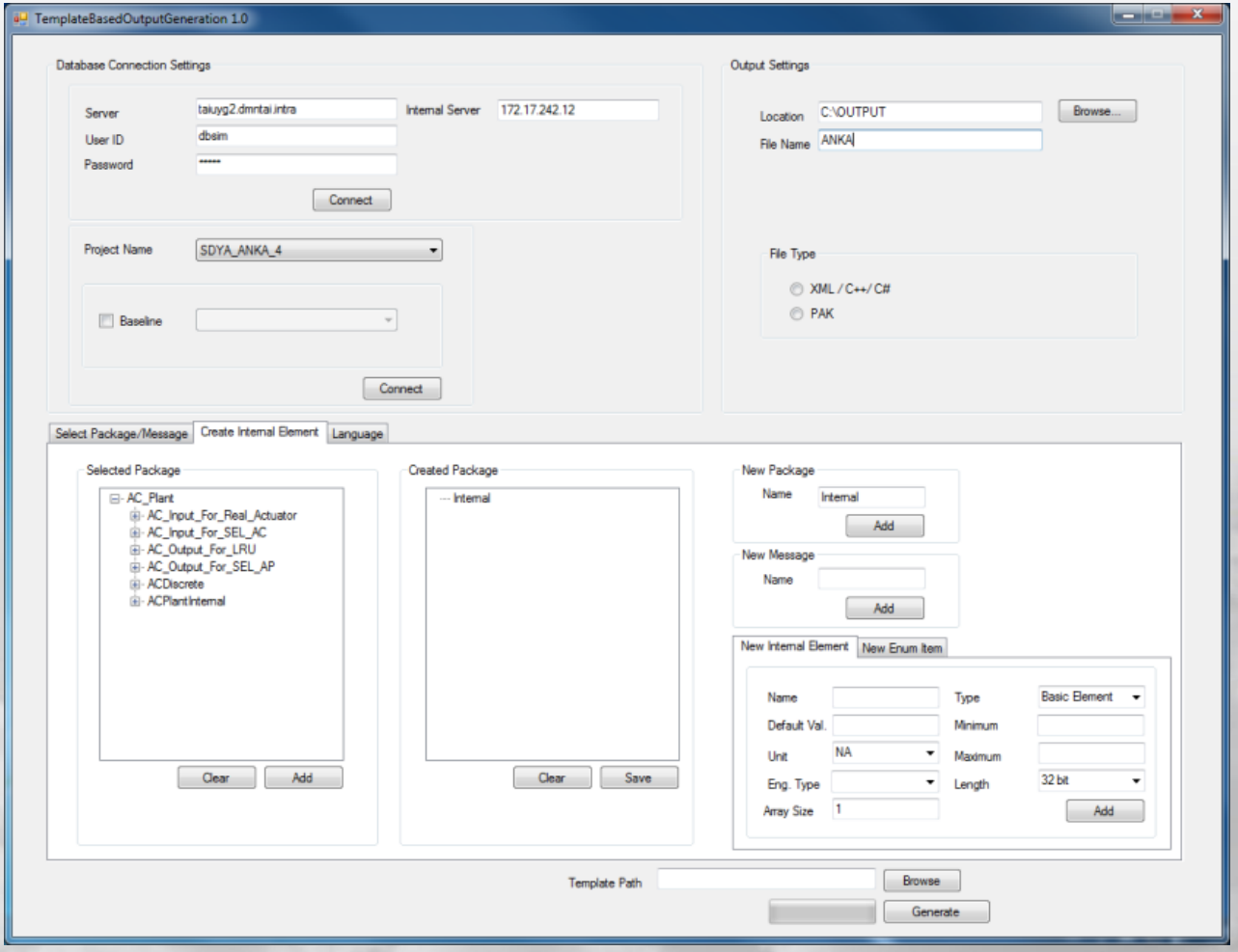
SOFTWARE CONFIGURATION ITEMS



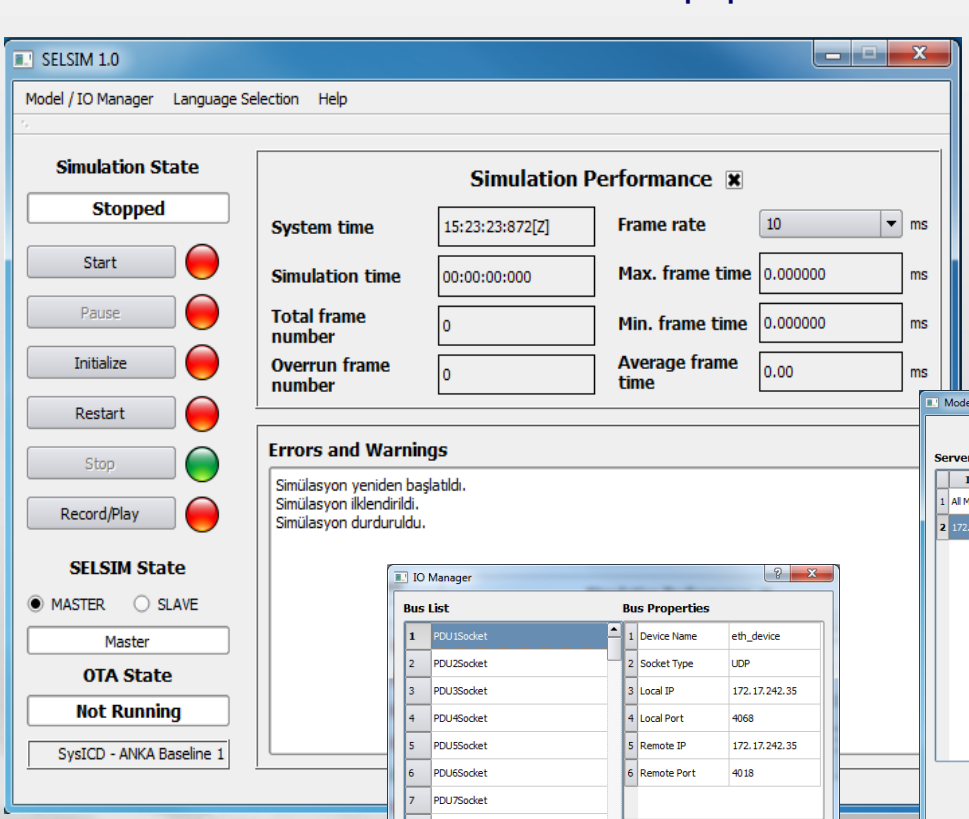
TEMPLATE-BASED OUTPUT GENERATOR

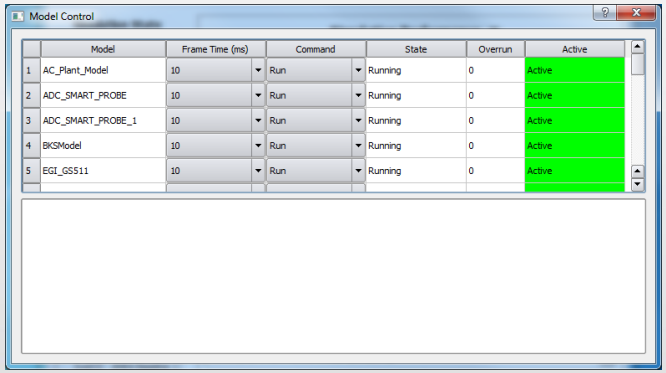
- Generates code, and build files with a given template
- Its outputs can be used by SELSIM, Model User Interface and Automated Testing Tool.

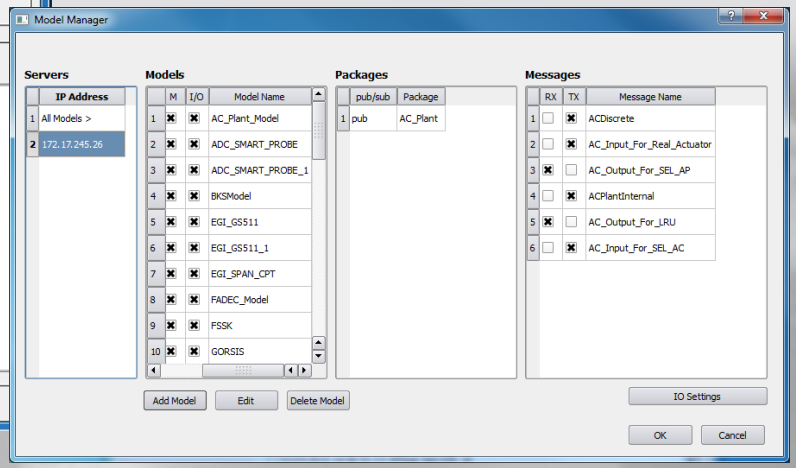


SELSIM

- Contains models required within a simulation, and controls the scheduling of models
- Publishes/subscribes information of simulation objects
- Communicates over the real equipment data buses

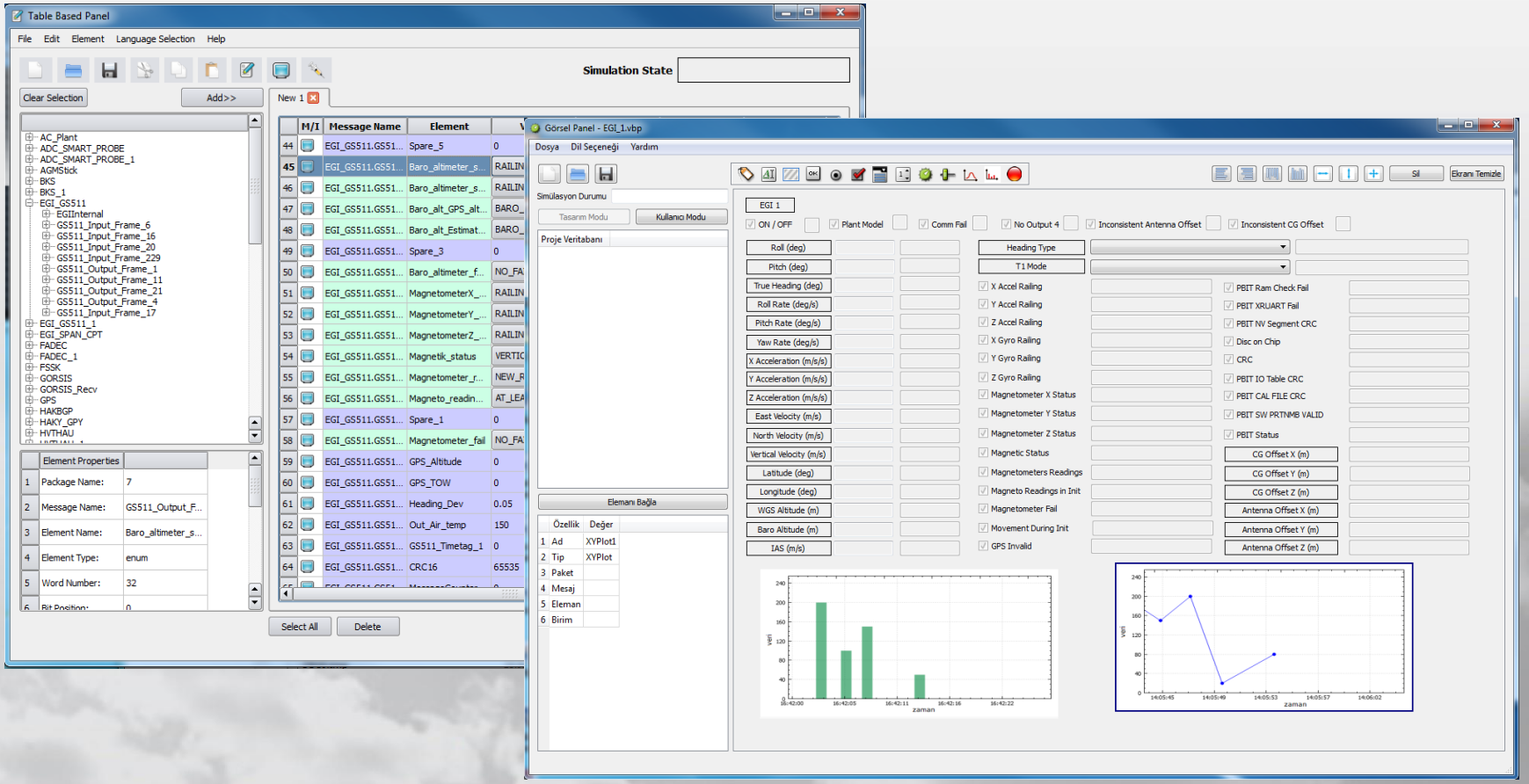






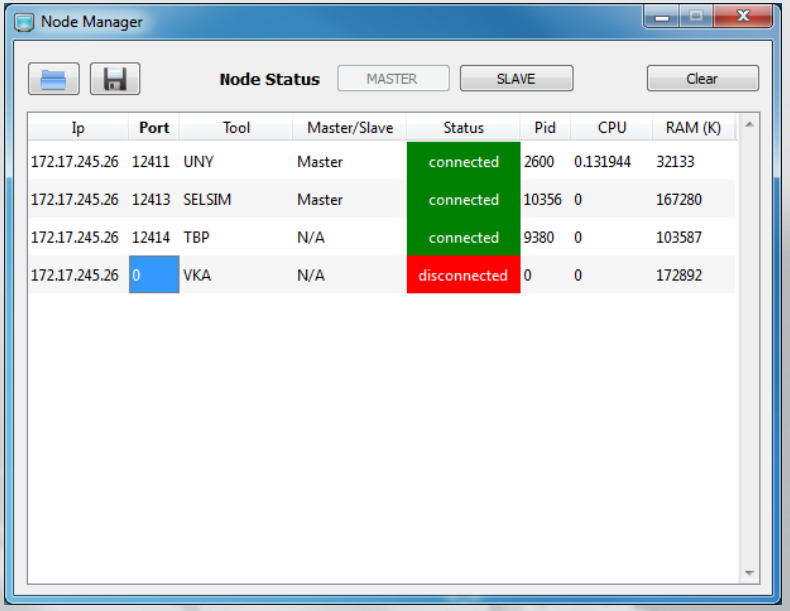
MODEL USER INTERFACE (MUI)

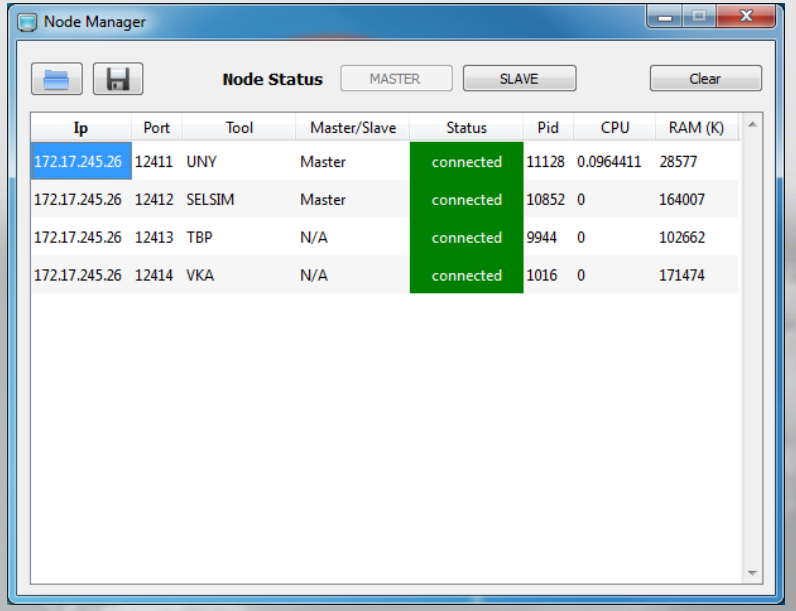
- Allows simulator runtime behavior to be monitored and for data injection
- Displays status of the simulated models
- Displays error messages for all erroneous conditions



NODE MANAGER

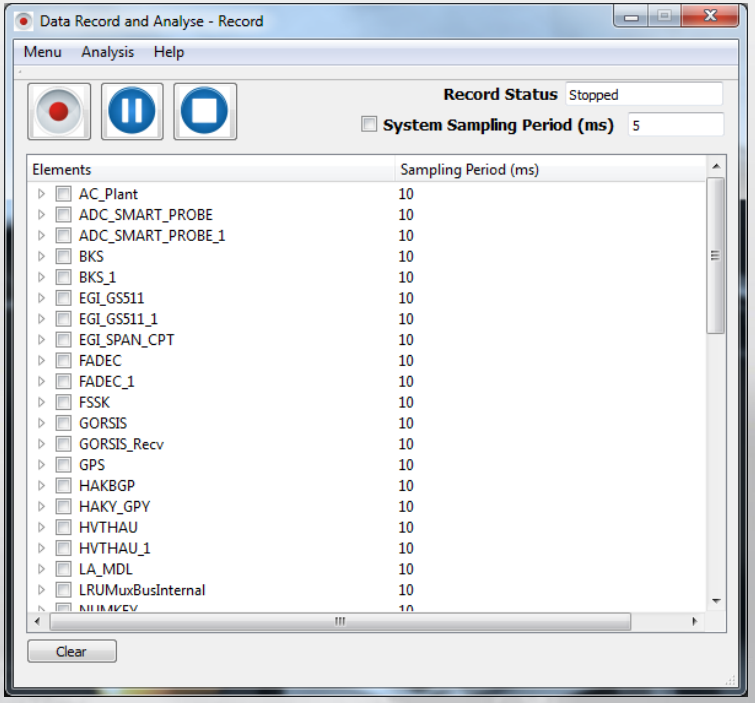
- Collects health info of simulation modules from other node managers
  - CPU utilization
  - Memory Usage of simulation modules from other node managers,
- Sends open / close or master / slave commands to nodes

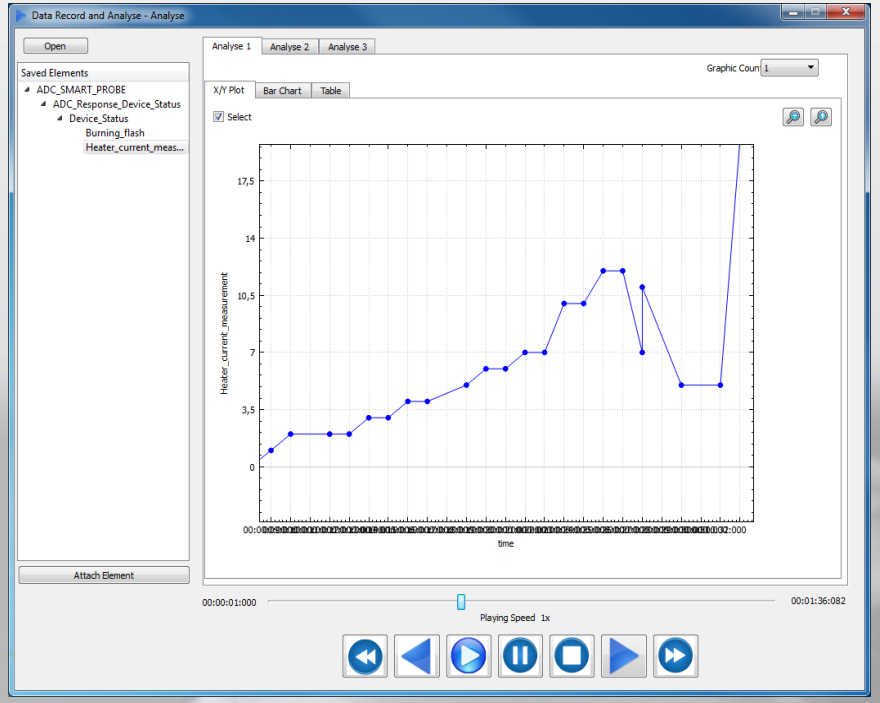




DATA RECORDING AND ANALYSIS TOOL

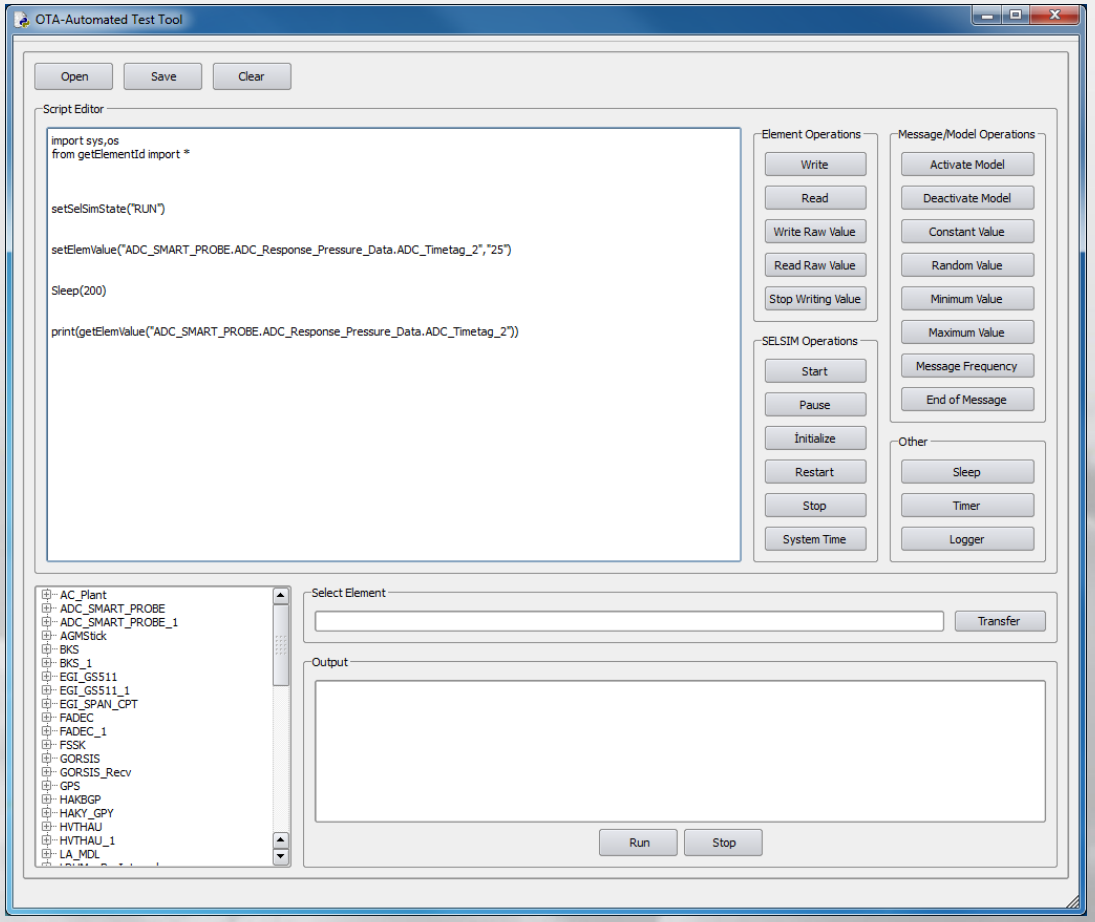
- Allows storing of model info and related messages to the file system on disk
- Analyze recorded data in x-y plot display and bar chart display





AUTOMATED TESTING TOOL

- Provides simulation Application Programming Interface (API) to other applications
- Supports Python, C#, C++ programming languages
- Allows value injection and monitoring of model elements



SPACE DOMAIN UTILIZATION OF SDYA

- SDYA potential utilization opportunities in Space Doman can be as follows:
  - A Validation tool for the :
    - Performance and Robustness Verification,
    - Software Verification Facility (SVF),
    - Avionic Functional Chain Validation (FCV),
    - Satellite Assembly, Integration and Test (AIT) procedures.
  - A support tool for the:
    - Validation of Spacecraft operational procedures,
    - Validation of Satellite Control Centre,
    - Spacecraft operators training,
    - Analyze and/or investigation of the anomalies detected in flight.

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CONCLUSIONS

- The use of SDYA in the validation process of Satellite Projects is planned and it will be the basis for a Simulator Software Product Line to be formed at TAI.

- SDYA will support a large range of Satellite integration and test activities:
  - Software Verification Facility (SVF)
  - Functional Chain Validation
  - Avionic Test Bench Simulation
  - Dynamic Satellite Simulation (DSS)

- SDYA-based systems could be developed to support integration and testing of complex systems in space domain.

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