



Vendor-Independent Testing Tools

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WRTDS
Technologies





Outline

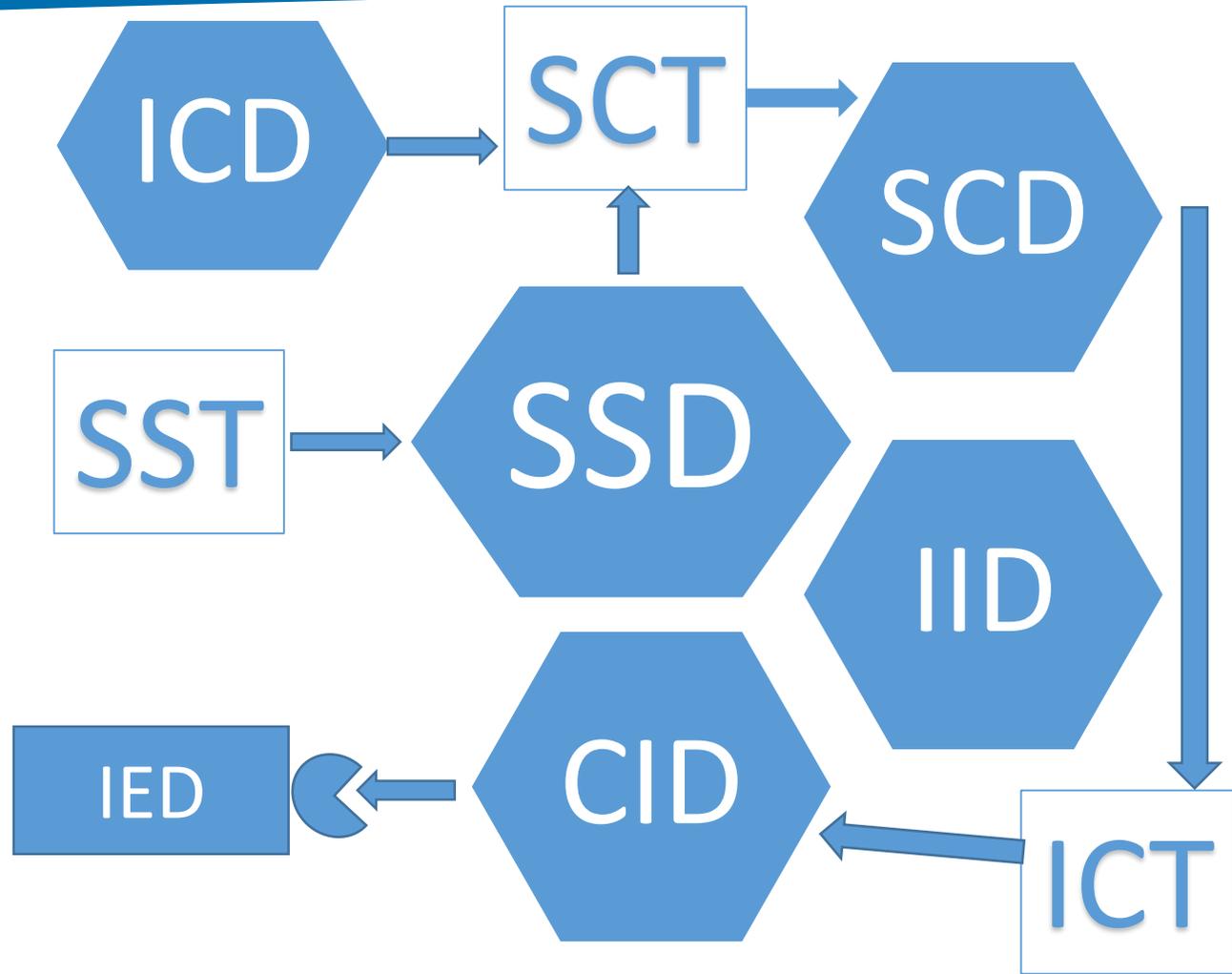
- **Challenges for IEC 61850 Tools**
- IEC 61850 Tools, what can they be used for?
- Examination of 4 tools and overview of features
- Summary and Conclusion

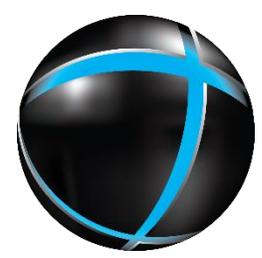


Challenges for IEC 61850 Tools

Different phases are required when specifying, designing, commissioning, and operating a SAS

- **System Specifications**
 - What is required
 - What can your IED provide





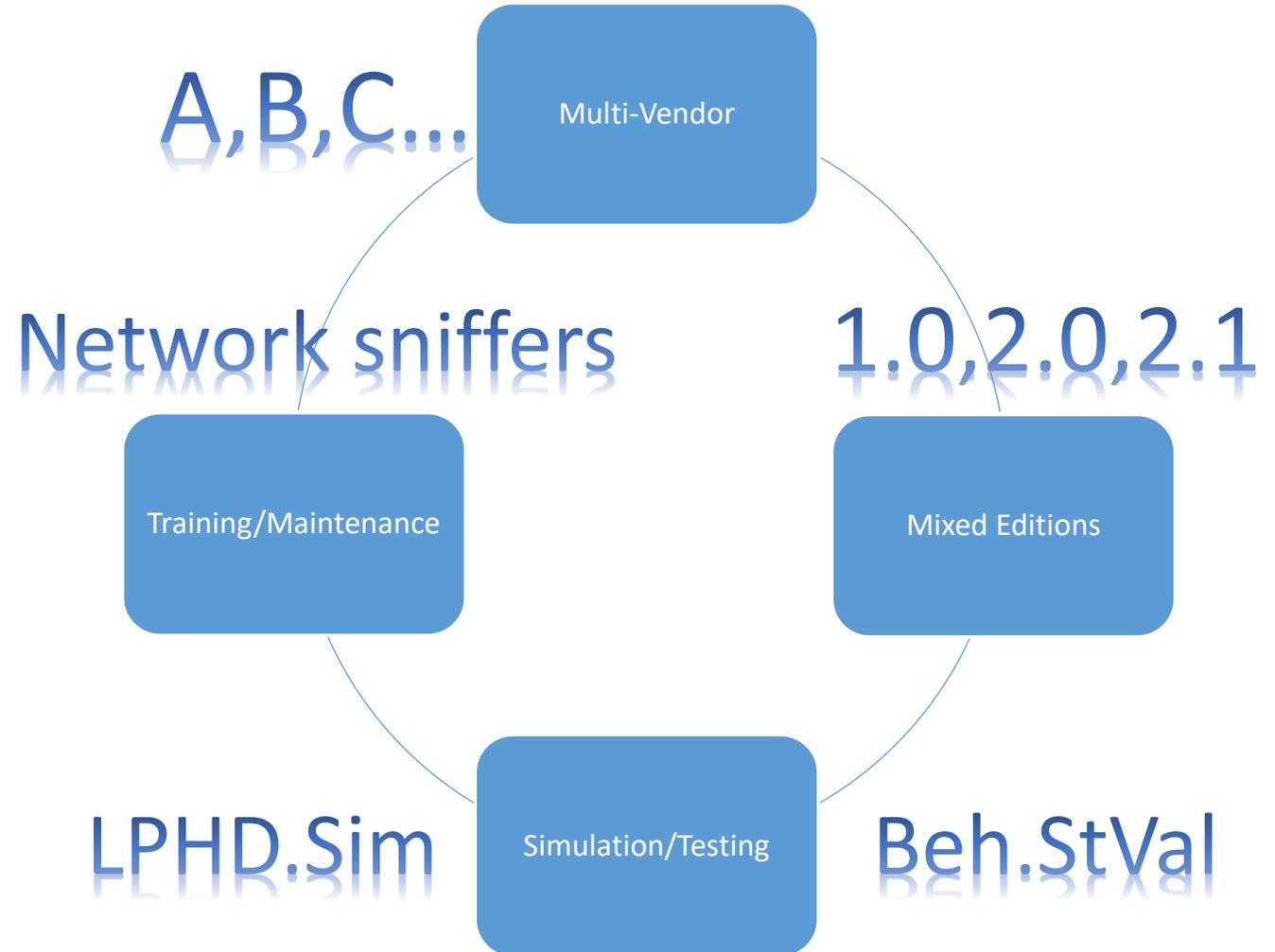
Challenges for Tools cont.

Multi-Vendor Installations

Mixed Edition Systems

Simulation/Testing

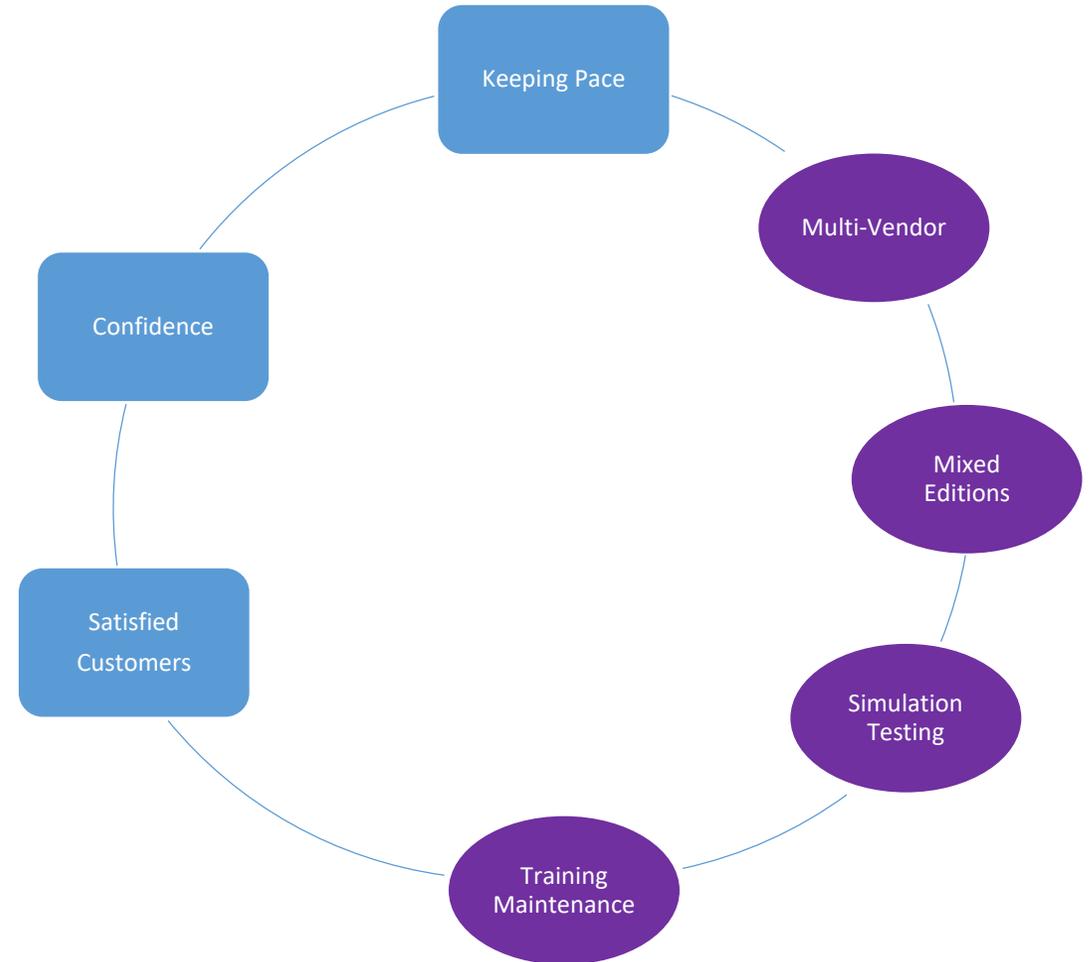
Training/Maintenance

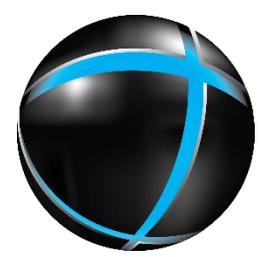




Challenges for Tools cont.

Keeping Pace with Standards
Satisfying your Customers
Industry Confidence





IEC 61850 Tools

There are many tools available in the market place, but which one(s) should I choose and what will I use it for ?

OMICRON, DOBLE, RTDS, Opal R/T

Triangle MicroWorks, SISCO, InfoTech, Monfox LLC, SystemCORP

HELlinks, SUBNET, Siemens, Schneider, ABB ...

IPCOMM GmbH

Xelas Energy

DNV-GL

Gridclone

Tekvel

Gridsoftware

GFUVE, and more...



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- Challenges for IEC 61850 Tools
- **IEC 61850 Tools, what can they be used for?**
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IEC 61850 Tools

What can these tools be used for ?

- **Design**
- **Development**
- **Validation**
- **Training**
- **Operation & Maintenance**
- **Conformance/Functional Testing**



Design

- **Does the IEC 61850 model meet the requirements?**
- **Does the MMS Client connectivity meet the requirements?**
- **Does the MMS Server have all the capabilities required?**
- **How configurable is the GOOSE publishing?**
- **How configurable is the GOOSE subscribing?**
- **How configurable is the SV publishing?**
- **How configurable is the SV subscription?**
- **Is there LGOS, LSVS?**
- **What about Reports, Logging, Testing and Simulations?**



Development

My system is designed but what about developing the design?

- **Will the chosen pieces all work together?**
- **Is there a best practices approach that I can use?**
- **How do I know which tools are necessary?**
- **Do conformance test certificates guarantee interoperability?**
- **Are there simulation and test tools available to help me?**
- **What happens when firmware changes are required?**



Validation

My system is designed but what can I do to validate the design?

- **Test the SCL files for errors**
- **Test the MMS server/client functions**
- **Reports (buffered and un-buffered)**
- **Setting Groups**
- **Control blocks, Loc/Rem relationship and behaviour**
- **LGOS/LSVS**
- **Redundancy**
- **Time synchronization**



Training

What kind of training should be undertaken?

- **Fundamentals & Principles**
- **Specification & Design Concepts**
- **Data Models**
- **Communication Services**
- **Testing & Commissioning**
- **Network Architecture**
- **Time Synchronization**
- **Cyber-Security**



Operation & Maintenance

- **Testing & Troubleshooting Techniques for Validating**
 - **Report control blocks**
 - **GOOSE messages**
 - **Sampled Values**
 - **Other supervision functions**
- **Identify functions specific to your system such as**
 - **Inspection & Test Plans**
 - **HMI, Data concentrator**
 - **Gateway Devices**
 - **Managed ETHERNET Switches**



Recap List of Items to Consider

- **System Specification** (*SLD, Automation & Control, SSD*)
- **System Integration** (*Communication, IED configuration, SCD, Gateway Configuration, GOOSE, SV, Reports, DataSets*)
- **SCL File Validation** (*multi-vendor, mixed edition*)
- **MMS Server Emulation**
- **MMS Client Functionality**
- **Automated Test Functionality**
- **Simulation and Test Capabilities**
- **Analysis** (*Network Architecture, Messages, Time Synchronization, ...*)
- **Documentation**



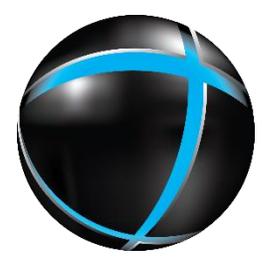
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Simulation Tools

- **Available Functionality and Features**
 - **Simulate communication and data model of a single device or many devices**
 - **Automated testing by using scripts to test control models, data paths, reports, network loading**
 - **LGOS and LSVS support**
 - **Simulation mode and processing of quality bits**
 - **Use of the actual SCD, CID, ICD file**
 - **Multi-protocols (DNP3, IEC 60870-5, Modbus)**
 - **Data Simulation/Manipulation**



RTDS Protection & Automation

- IED Simulation
- Data Model
- Data Sets
- Configuration of Report Controls
- Setting Groups
- GOOSE
- LGOS/LSVS
- Data Monitoring
- Simulation/Test
- SCL Validation
- Writing data and control structures

Protection and Automation Suite v0.20170711

Home 61850 MMS Server DNP3 Master DNP3 Outstation 60870-5-104 Master

Validate SCL OPEN SCL Validation: NONE

START Server STOP Server Use URI Address Enable All GoCB

Get All Data START Monitor STOP Monitor GOOSE Simulation/Test Show Data References

FILE SERVER DATA VIEW

Attribute	Value
SCL File	C:\RTDS_USER\MMS\d...
SCL Edition	2.0
IP Address	127.0.0.1 [Software Loo...
Port	102
IED	IED_RTDS
Access Point	P1

SubModel: IED_RTDSDiagnostic/LGOS1

Attribute	Value	Type	FC
LN LGOS1			
DO St			
DO SimSt			
DO GoCBRef			
LLN0.gcb01			
LLN0.GOOSE_outpu			
DA q		Quality	ST
DA stVal		INT32	ST
DA q		Quality	ST
DA stVal		BOOLEAN	ST
DA q		Quality	ST
DA stVal		Dbpos	ST
DA q		Quality	MX
DA f		FLOAT32	
DA q		Quality	ST
DA stVal		Dbpos	ST
DA q		Quality	ST
DA stVal		Dbpos	ST

Details and Configuration

LGOS Properties (Subscription)

Attribute	Value
ICD File	C:\RTDS_USER\MMS\GTNETGSEd2.icd
Subscription Enable	false
setSrcRef	GTNETGSECTRL1/LLN0.GCB01

Timestamp

Status Number

Sequence Number

Time Allowed To Live

Needs Commissioning

Number of Data Items

Load ICD Subscribe

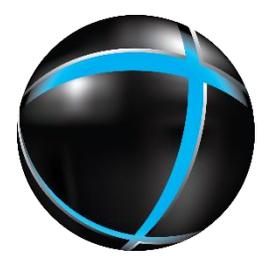
Model Reference	Data Reference	Attribute	Value	FC
IED_RTDSDiag...	IED_RTDSDiagnos...	stVal	false	ST
IED_RTDSDiag...	IED_RTDSDiagnos...	q	[00000000000000]	ST
IED_RTDSDiag...	IED_RTDSDiagnos...	t	u09/11/2017_17:36...	ST
IED_RTDSDiag...	IED_RTDSDiagnos...	stVal	false	ST
IED_RTDSDiag...	IED_RTDSDiagnos...	q	[00000000000000]	ST
IED_RTDSDiag...	IED_RTDSDiagnos...	t	u09/11/2017_17:36...	ST
IED_RTDSDiag...	GTNETGSECTRL1/...	q		ST
IED_RTDSDiag...	GTNETGSECTRL1/...	stVal		ST
IED_RTDSDiag...	GTNETGSECTRL1/...	q		ST
IED_RTDSDiag...	GTNETGSECTRL1/...	stVal		ST

Configure Read Write

IEDx x

```
STATUS: <IEDx> Server 'IED_RTDS' listening on rfc1006://127.0.0.1:102/0x0001/0x0001/0x00000001/1,1,1,999,1/12
STATUS: <IEDx> Getting all data values...
STATUS: <IEDx> Retrieved all data values.
STATUS: <IEDx> Reading data values...
STATUS: <IEDx> Retrieved data values.
STATUS: <IEDx> Getting all data values...
STATUS: <IEDx> Retrieved all data values.
```

READY



RTDS MMS Voyageur

- Connect to many IEC 61850 servers
- Discover Data Model
- Browse Data Model
- Perform control operations
- Create and delete dynamic data sets in logical nodes(persistent) or association(non-persistent)
- Read and write server data values
- Configuration of report control blocks
- Configuration of setting group control blocks
- Collect reported changes and updates of data
- Perform integrity reports and general interrogation
- File services
- Test Automation Capabilities

The screenshot displays the RTDS MMS Voyageur software interface. The main window is titled "61850 MMS Voyageur - C:\RTDS_USER\MMS\serverDatabase.txt". The interface is divided into several panes:

- Left Pane:** A tree view showing a list of servers and logical nodes (LN). The selected node is "IED_RTDS [127.0.0.1]".
- Center Pane:** A table showing the data model for the selected node. The table has columns for Name, Value, and FC. The data is organized into a tree structure under "IED_RTDSProtCtrl".
- Right Pane:** A table showing parameters for the selected node. The table has columns for Parameter and Value.
- Bottom Pane:** A table with columns for #, Report ID, Time Received, SN, and Data Set. Below the table are buttons for "Export Report" and "Clear".
- Bottom Right:** A form with fields for "SqNum:", "RptID:", "Time of Entry:", "Data Set:", "EntryID:", "ConfRev:", and a checkbox for "Buffer Overflow".
- Bottom Left:** A "Message Area" showing the text "Data values updated."



OMICRON IEDScout

- IED Simulation
- Traffic Analyzer
- Activity Monitor
- Browse Data Model
- SCL Validation
- Client Functions
- Writing data and control structures
- Simulation/Test
- Setting Groups

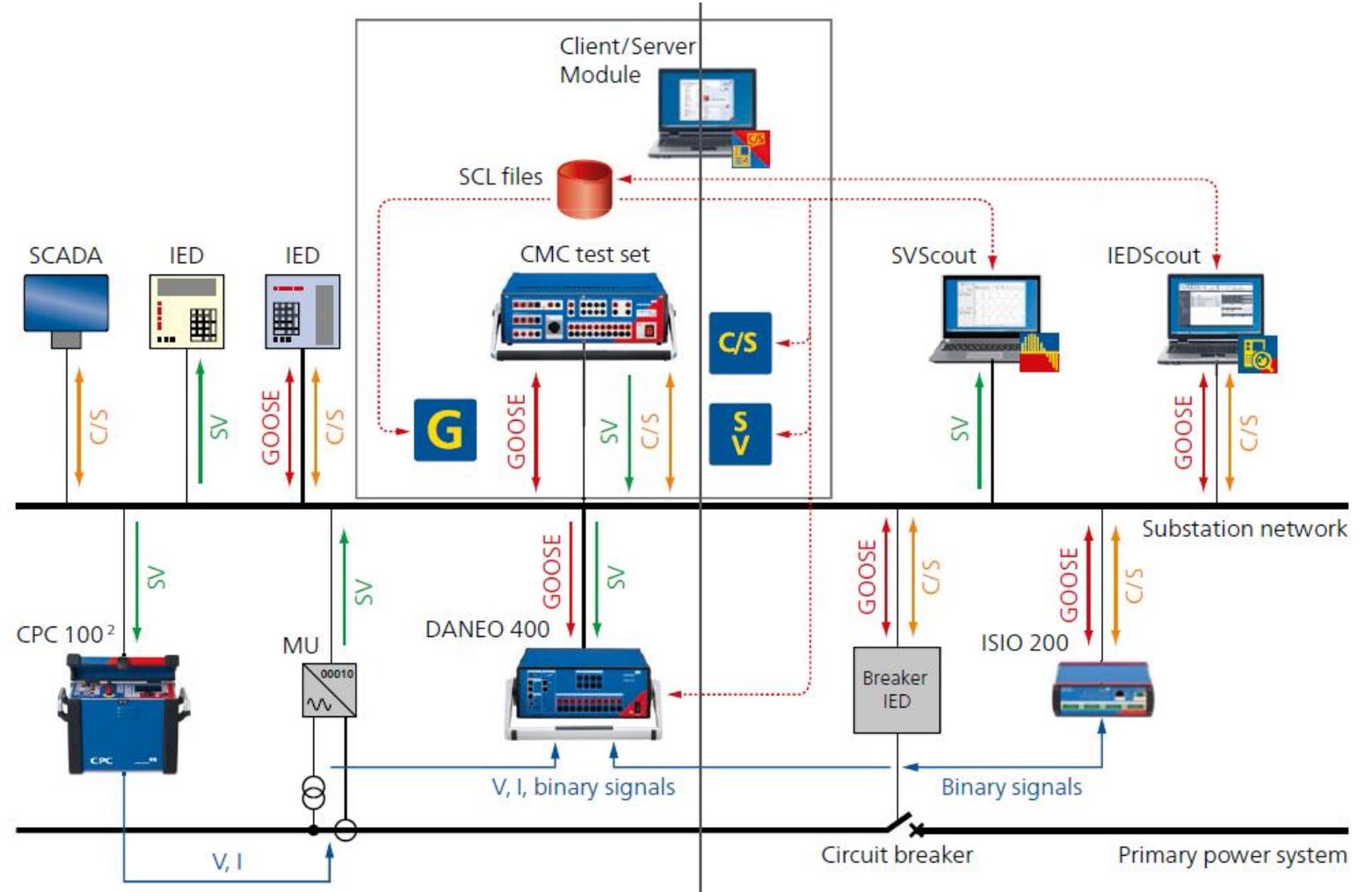
The screenshot displays the IEDScout software interface. The title bar indicates it is licensed to RTDS Technologies Inc. The main window is divided into several sections:

- Menu Bar:** Includes File, Browser, Simulator, and Sniffer.
- Toolbar:** Contains icons for Open SCL, Save SCL, Discover IED, Close IED, Online, IED properties, Subscribe GOOSE, Simulate, Read, Read all, Write, Control, Clear indications, Enable, GI, Add DataSet, Setting Groups, Copy GOOSE, Navigation, Details, Monitor, and Descriptions.
- IEDs Panel:** Shows a list of IEDs, currently displaying IED_RTDS. Below the list, it shows the IP address (127.0.0.1) and SCL path (C:\RTDS_USER\fileman\Eric\R&D\Pro...). A tree view on the left includes GOOSE, Reports, Setting Groups, Files, DataSets, and Data Model.
- IED_RTDS - GOOSE Panel:** Displays a list of GOOSE objects: LLN0.gcb1 and LLN0.gcb2.
- Activity Monitor Panel:** Features a diagram of power lines and towers. A text overlay reads: "Use 'drag and drop' to monitor GOOSE, Reports, DataSets, Data Objects and Data Attributes." The bottom of this panel shows a Polling rate of 1 s and a 100% zoom level.
- Status Bar:** Includes a Warnings icon and a dropdown arrow.



OMICRON Client/Server

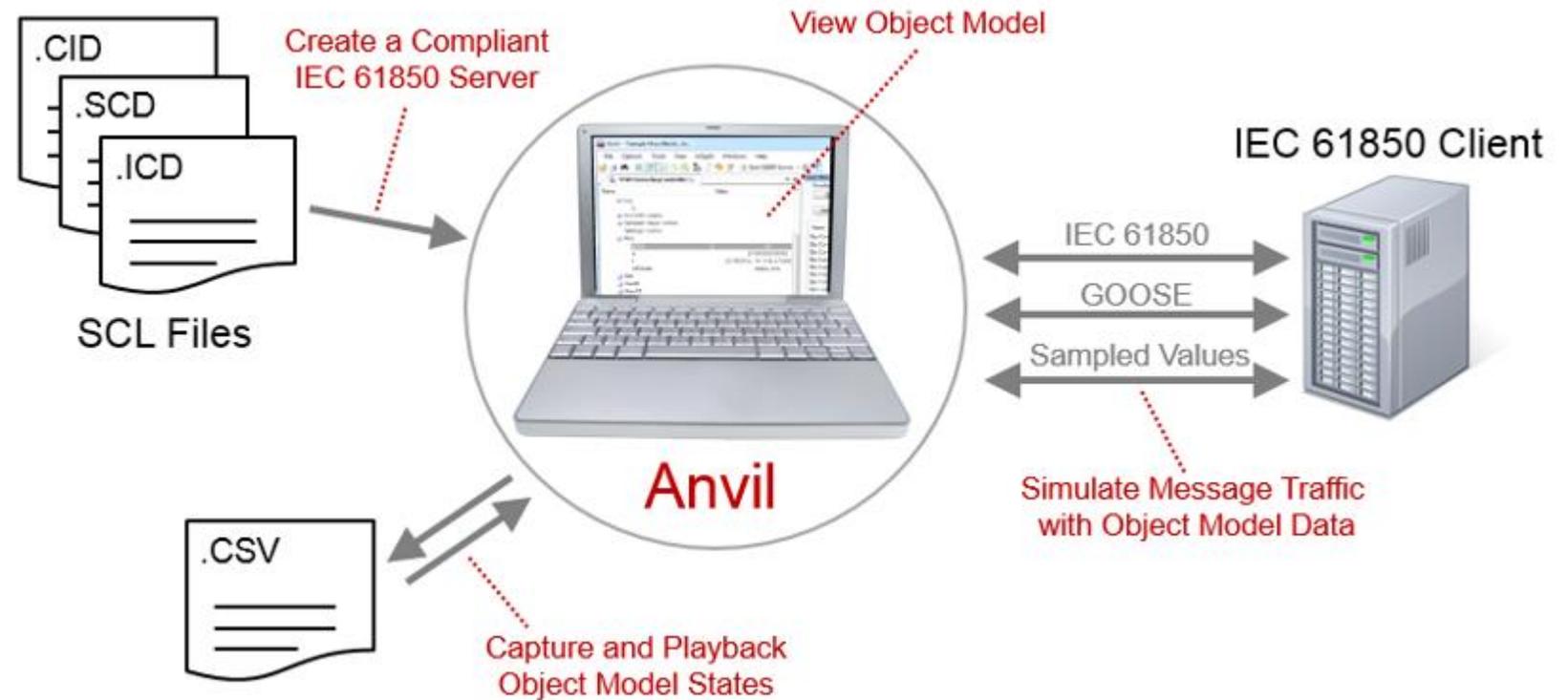
- Configuration of Report Control Blocks
- Mod/Behaviour
- Activity Monitor
- Browse Data Model
- Discover Data Model
- Auto-Assessment
- DFR Visualization
- Documentation
- Test Automation
- Perform control operations





TMW IEC 61850 Test Suite

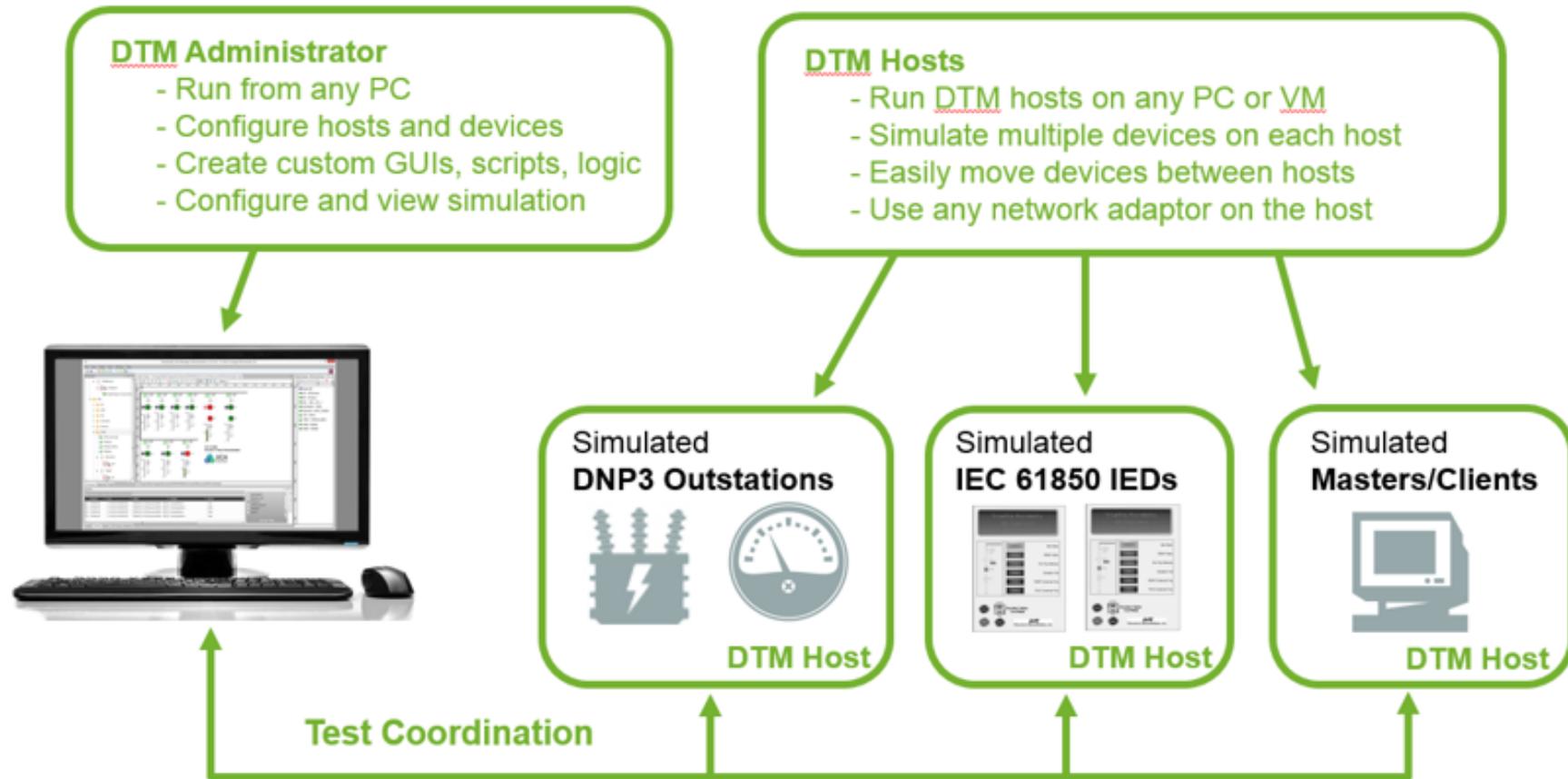
- The Test Suite is comprised of three separate products.
- **Anvil** is a test Server for testing Clients with MMS (reports, logs, etc.), GOOSE, and Sampled Values
- **Hammer** is a test Client for testing IEDs with MMS (reports, logs, etc.), GOOSE, and Sampled Values
- **SCL Forge** is a tool for creating SCL data model templates for IEDs





TMW Distributed Test Manager

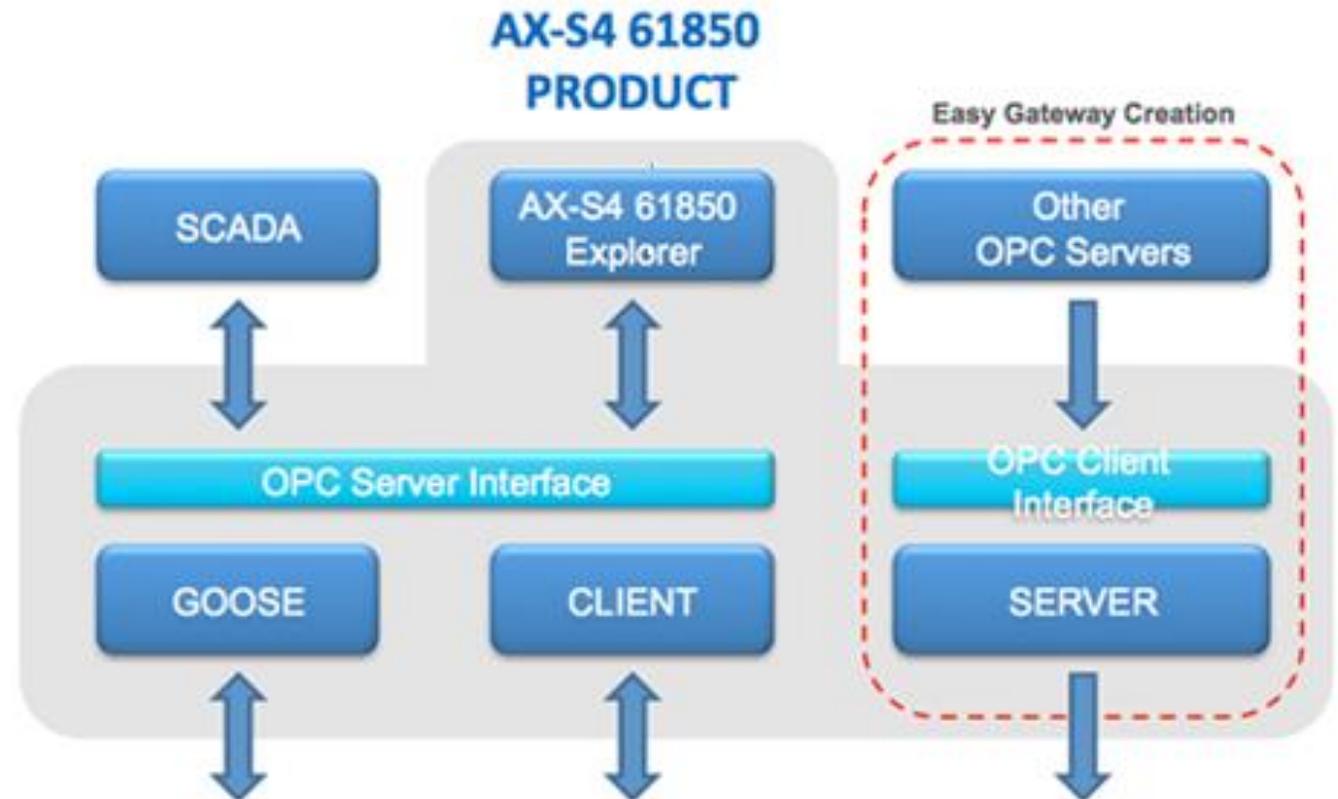
- DTM is a system level simulator that is unique with multiple options for configuring devices, creating test cases, and simulating data in the system.
- Multi-protocol
- Test Automation

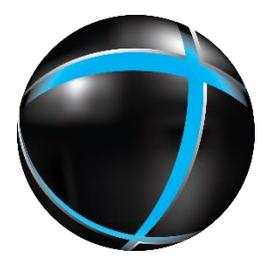




SISCO AX-S4 61850

- **61850 Client** provides an OPC V3.0 Data Access (DA) server interface
- **61850 Server** interfaces to user supplied OPC servers to convert non-IEC 61850 devices and data to IEC 61850
- **61850 Explorer** is a graphical user interface (GUI) for the AX-S4 61850 Client
- **61850 GOOSE** is an OPC Server for IEC GOOSE pub/sub
- Includes support for secure client/server communications based on IEC 62351-4





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Summary

Different phases are required when specifying, designing, commissioning, and operating an IEC 61850 System

There are many kinds of tools available and different tools are required for different phases when specifying, designing, commissioning, and operating an IEC 61850 System

Validation of any design must cover the specification

Training is essential and must cover the specification

Operation & Maintenance Techniques must cover the specification



Simulation Tools Conclusion

There are many different tools available for simulation of IEC 61850 devices and systems.

Many vendors were listed but only 4 vendors were examined

The common base for the simulation tools that were examined:

- 1 - MMS Server/Client Capability***
- 2 – IED Simulation with Data Manipulation***
- 3 – GOOSE publication/subscription***
- 4 – Test Documentation and Test Automation***