

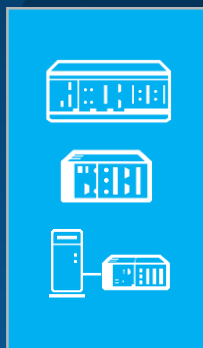
# SystemLink

## Distributed Systems and Data Management

Marcus Bengths  
TSE, National Instruments

# The Challenge of Managing Distributed Systems and Data in Test & Measurement

## T&M Assets



Deployment  
Device Mgmt  
Diagnostics

Test Monitoring  
Test Configuration  
Test Analytics

Data Collection  
Data Visualization

**CONNECT AND DEPLOY**



**MANAGE AND ANALYZE**

Measurement Data Search  
Automated Data Reporting

Alarms  
Health Reporting  
Notifications

Asset Utilization  
Asset Calibration  
Asset Tracking

## T&M Assets



# Approaches

## Custom Built Tools

- Customised to the specific system
- Add new features when needed
- Dedicated resources/expertise
- Difficult to maintain and update
- In-house training material and support

## General Asset & Data Management Tools

- Ready to go out of the box
- Vendor support
- Poor focus on T&M needs
- Missing data connectors
- New features rely on vendor

# Approaches

## Custom Built Tools

- Customised to the specific system
- Add new features when needed
- Dedicated resources/expertise
- Difficult to maintain and update
- In-house training material and support

## T&M Systems and Data Management Tools

- T&M centric but ready to go
- Smooth route from systems to data
- High level of customisation
- Vendor support
- APIs to integrate with other systems
- Less customisation than custom built
- Longer to setup than general option

## General Asset & Data Management Tools

- Ready to go out of the box
- Vendor support
- Poor focus on T&M needs
- Missing data connectors
- New features rely on vendor

**NI recommended choice**



Connected Intelligence for Automated Test and Automated Measurement



## SYSTEMS & ASSET MANAGEMENT

SYSTEM HEALTH MONITORING  
SOFTWARE DEPLOYMENT  
TEST ASSET UTILIZATION



## TEST MANAGEMENT

TEST MONITORING  
TEST DATA COLLECTION  
INTERACTIVE DASHBOARDS



## MEASUREMENT DATA MANAGEMENT

MEASUREMENT SEARCH  
DATA STANDARDIZATION  
AUTOMATED REPORTS

### SYSTEMLINK PLATFORM SERVICES

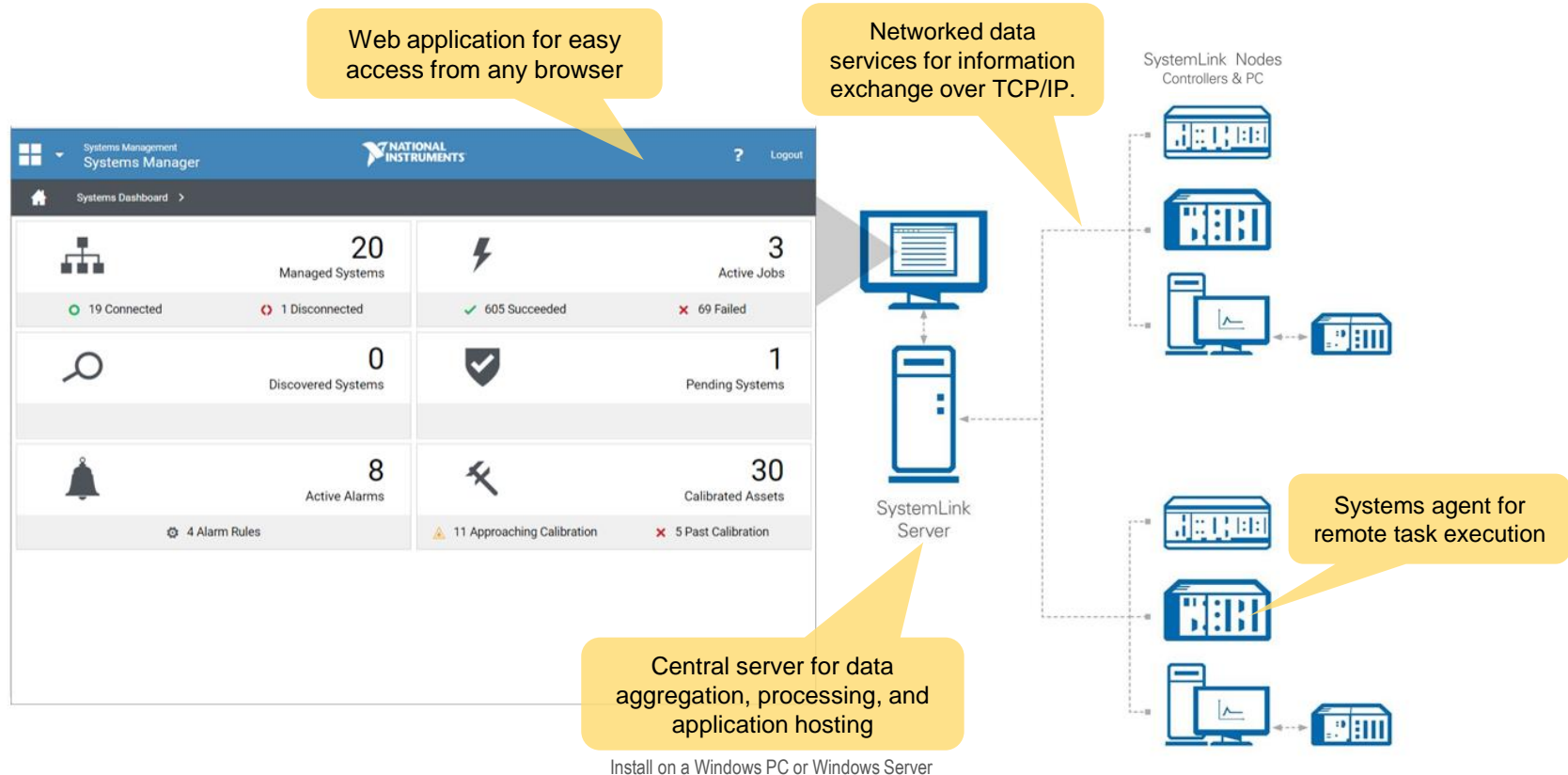
REMOTE AUTOMATION | DATA COMMUNICATIONS | DATA VISUALIZATION | ALARMS ENGINE

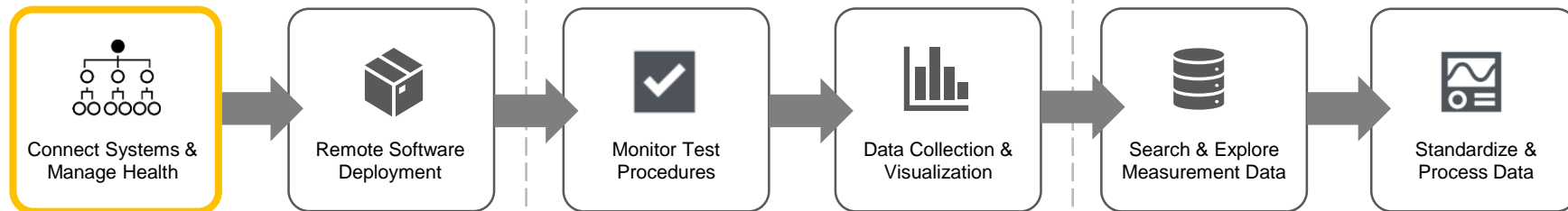
Improve system uptime, asset traceability, and configuration compliance.

Improve test continuity, test troubleshooting, and test data retrieval.

Improve data insights through standardization, cross-file searching, and reporting.

# SystemLink Architecture – How Does it Work?





SYSTEMS & ASSET MANAGEMENT

TEST MANAGEMENT

MEASUREMENT DATA MANAGEMENT

## Development Automation Software

TEST AUTOMATION

SEQUENCER:



TestStand

OR



LabVIEW

OR



3<sup>rd</sup> Party

MEASUREMENT  
PROCESSING:



LabVIEW



LabVIEW



3<sup>rd</sup> Party

DATA AUTOMATION



DIAdem



3<sup>rd</sup>-Party Tools



# Connect Systems & Manage Health



# Connect Systems & Manage Health

CHALLENGE: How do I increase system uptime & prevent minor system issues from turning into major problems?

- Are all systems connected and running optimally?
- Are there alarm states that require action?
- What is the calibration state of devices?
- What software is running on each system?



HEALTH

SOFTWARE

CALIBRATION

ALARMING



# Remote Device Management

Manage system access, configuration, and health through a central web application.

Track systems through a central web interface

Search systems across all groups

Classify systems into groups

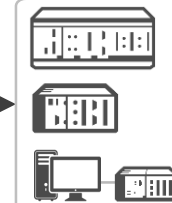
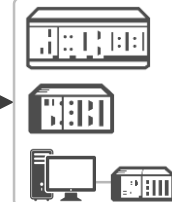
Multi-select to perform functions in parallel (e.g. install, restart).

	Name	IP Address	Model Name	Operating System	Serial Number	Connection	Comments
<b>Automated Test Systems (2)</b>							
<input type="checkbox"/>	PXIe-8840Quad-1	10.2.74.79	NI PXIe-8840 Quad-Core	Windows 7	030E1626	Connected	Test Station 1
<input type="checkbox"/>	PXIe-8840Quad-2	10.2.74.80	NI PXIe-8840 Quad-Core	Windows 7	030DDB85	Connected	Test Station 2
<b>Control Systems (4)</b>							
<input checked="" type="checkbox"/>	NI-cRIO-9068-190CB7B	10.2.74.64	cRIO-9068	NI LinuxRT 4.1	190CB7B	Connected	Test Cell 1
<input checked="" type="checkbox"/>	NI-cRIO-9068-190D5D5	10.2.74.67	cRIO-9068	NI LinuxRT 4.1	190D5D5	Connected	Test Cell 2
<input checked="" type="checkbox"/>	NI-cRIO-9068-190D673	10.2.74.65	cRIO-9068	NI LinuxRT 4.1	190D673	Connected	Test Cell 3
<input checked="" type="checkbox"/>	NI-cRIO-9068-190FDF5	10.2.74.66	cRIO-9068	NI LinuxRT 4.1	190FDF5	Connected	Test Cell 4

SystemLink Nodes  
Controllers & PCs



SystemLink  
Server

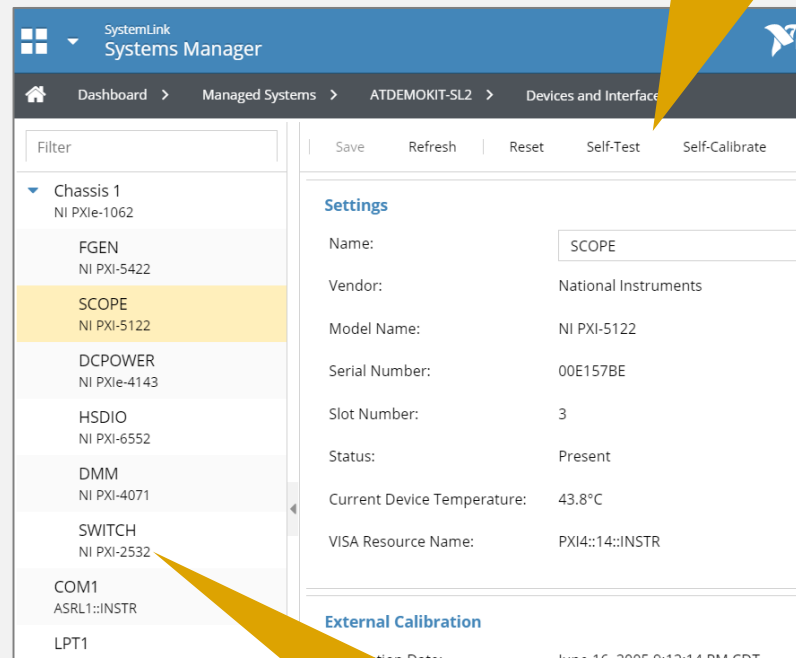


# Remote Device Management

Gain remote access to system information, such as installed devices, installed software, time settings, and job history.

- View installed devices and interfaces, such as assets connected via GPIB, USB and VISA.
- Execute remote diagnostics, such as self-test, self-calibrate, and device reset.
- View and report job history, including software updates and system errors.
- Manage time settings.
- For Linux RT devices, update password and network settings.

Execute diagnostic functions



The screenshot displays the SystemLink Systems Manager web interface. The breadcrumb navigation shows the path: Dashboard > Managed Systems > ATDEMOKIT-SL2 > Devices and Interfaces. On the left, a list of installed devices is shown under the heading 'Chassis 1 NI PXIe-1062'. The devices listed are FGEN NI PXI-5422, SCOPE NI PXI-5122 (highlighted), DCPOWER NI PXIe-4143, HSDIO NI PXI-6552, DMM NI PXI-4071, SWITCH NI PXI-2532, COM1 ASRL1::INSTR, and LPT1. On the right, the 'Settings' panel for the selected SCOPE device is visible, showing fields for Name (SCOPE), Vendor (National Instruments), Model Name (NI PXI-5122), Serial Number (00E157BE), Slot Number (3), Status (Present), Current Device Temperature (43.8°C), and VISA Resource Name (PXI4::14::INSTR). Below the settings panel, the 'External Calibration' section is partially visible. A yellow callout bubble points to the 'Self-Test' and 'Self-Calibrate' buttons at the top of the settings panel.

Filter	Save	Refresh	Reset	Self-Test	Self-Calibrate
Chassis 1 NI PXIe-1062					
FGEN NI PXI-5422					
<b>SCOPE NI PXI-5122</b>					
DCPOWER NI PXIe-4143					
HSDIO NI PXI-6552					
DMM NI PXI-4071					
SWITCH NI PXI-2532					
COM1 ASRL1::INSTR					
LPT1					

Settings	
Name:	SCOPE
Vendor:	National Instruments
Model Name:	NI PXI-5122
Serial Number:	00E157BE
Slot Number:	3
Status:	Present
Current Device Temperature:	43.8°C
VISA Resource Name:	PXI4::14::INSTR

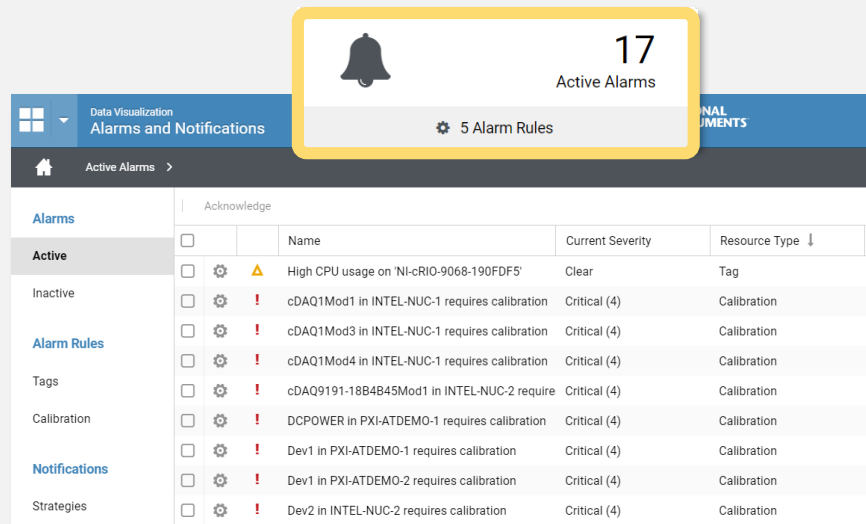
External Calibration	
Calibration Date:	June 16, 2005 9:12:14 PM CDT

View installed devices: e.g. model, serial number, connection status

# Health Monitoring

Improve system performance with pre-installed health metrics, alarms, and notifications.

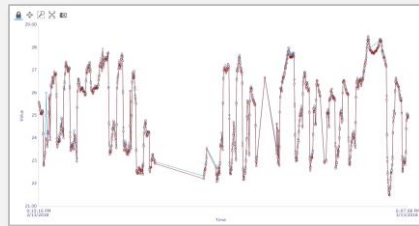
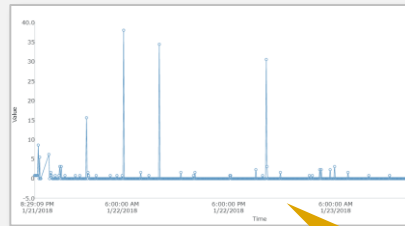
- Monitor system health metrics, such as available memory and disk space.
- Configure alarm rules and email notifications.
- Create custom monitoring services and connect to standard alarms workflow.
- Create user-defined dashboards with health monitoring inputs (live reporting).



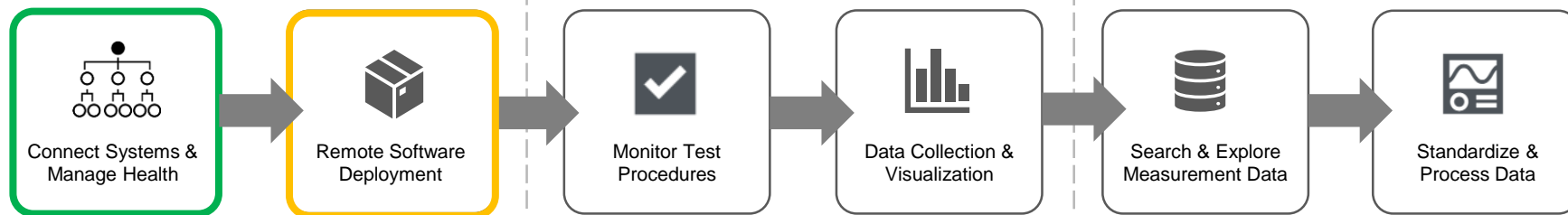
Active Alarms

5 Alarm Rules

Alarms	Acknowledge	Name	Current Severity	Resource Type
Active	<input type="checkbox"/>	High CPU usage on 'NI-cRIO-9068-190FDF5'	Clear	Tag
Inactive	<input type="checkbox"/>	cDAQ1Mod1 in INTEL-NUC-1 requires calibration	Critical (4)	Calibration
Alarm Rules	<input type="checkbox"/>	cDAQ1Mod3 in INTEL-NUC-1 requires calibration	Critical (4)	Calibration
Tags	<input type="checkbox"/>	cDAQ1Mod4 in INTEL-NUC-1 requires calibration	Critical (4)	Calibration
Calibration	<input type="checkbox"/>	cDAQ9191-18B4B45Mod1 in INTEL-NUC-2 require	Critical (4)	Calibration
Notifications	<input type="checkbox"/>	DCPOWER in PXI-ATDEMO-1 requires calibration	Critical (4)	Calibration
Strategies	<input type="checkbox"/>	Dev1 in PXI-ATDEMO-1 requires calibration	Critical (4)	Calibration
	<input type="checkbox"/>	Dev1 in PXI-ATDEMO-2 requires calibration	Critical (4)	Calibration
	<input type="checkbox"/>	Dev2 in INTEL-NUC-2 requires calibration	Critical (4)	Calibration



View historical data trends



SYSTEMS & ASSET MANAGEMENT

TEST MANAGEMENT

MEASUREMENT DATA MANAGEMENT

## Development Automation Software

TEST AUTOMATION

SEQUENCER:



TestStand

OR



LabVIEW

OR



3<sup>rd</sup> Party

MEASUREMENT  
PROCESSING:



LabVIEW



LabVIEW



3<sup>rd</sup> Party

DATA AUTOMATION



DIAdem



3<sup>rd</sup>-Party Tools



# Remote Software Deployment

# Remote Software Deployment

CHALLENGE: How can I improve the efficiency of remote software management and increase configuration compliance

- What application versions are running?
- Which driver versions are installed?
- How can I mass deploy efficiently?
- How can I best revert to a prior version?



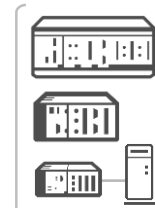
APPLICATIONS

DRIVERS

LIBRARIES / DLLS

CONFIG FILES

LANGUAGE  
VERSIONS (.NET)




# Software Deployment

Improve the efficiency of software deployment and increase software configuration compliance

- Execute remote software installs, upgrades, and downgrades
- Deploy to multiple systems simultaneously
- Update software packages at a component-level
- Establish dependent components
- Manage system availability for updates through lock/unlock feature

Deploy software remotely to one or multiple connected systems.

Manager 

Managed Systems > Software ( NI-cRIO-9068-190CB7B, NI-cRIO-9...

Filter

System Name	IP Address	Last Updated	Pending Status
NI-cRIO-9068-190CB7B	10.2.74.64	August 14, 2017 7:49:09 PM CDT	✓ Software installation succeeded
NI-cRIO-9068-190D5D5	10.2.74.67	August 14, 2017 7:49:10 PM CDT	✓ Software installation succeeded
NI-cRIO-9068-190D673	10.2.74.65	August 14, 2017 7:49:10 PM CDT	✓ Software installation succeeded
NI-cRIO-9068-190FDF5	10.2.74.66	August 14, 2017 7:49:10 PM CDT	✓ Software installation succeeded



LabVIEW



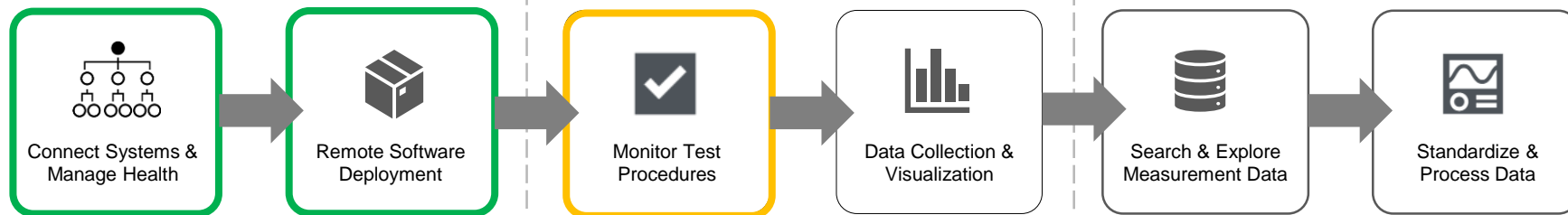
TestStand



Non-NI Software







SYSTEMS & ASSET MANAGEMENT

TEST MANAGEMENT

MEASUREMENT DATA MANAGEMENT

## Development Automation Software

TEST AUTOMATION

SEQUENCER:



TestStand

OR



LabVIEW

OR



3<sup>rd</sup> Party

MEASUREMENT  
PROCESSING:



LabVIEW



LabVIEW



3<sup>rd</sup> Party

DATA AUTOMATION



DIAdem



3<sup>rd</sup>-Party Tools



# Monitor Test Procedures

# Automated Test Insights

CHALLENGE: How can I track the operational status of automated test procedures and consolidate data reporting?

- How can I get the real-time status of my test?
- Which test sequence is currently running?
- What step failed in the latest test?
- How are tests performing across systems?



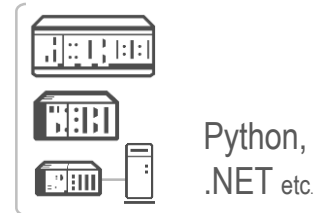
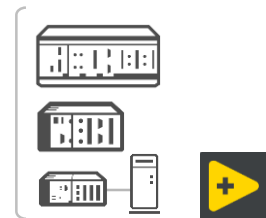
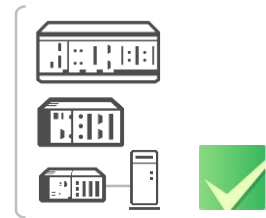
SEQUENCE STATUS

PASS/FAIL STATUS

OPERATOR INFO

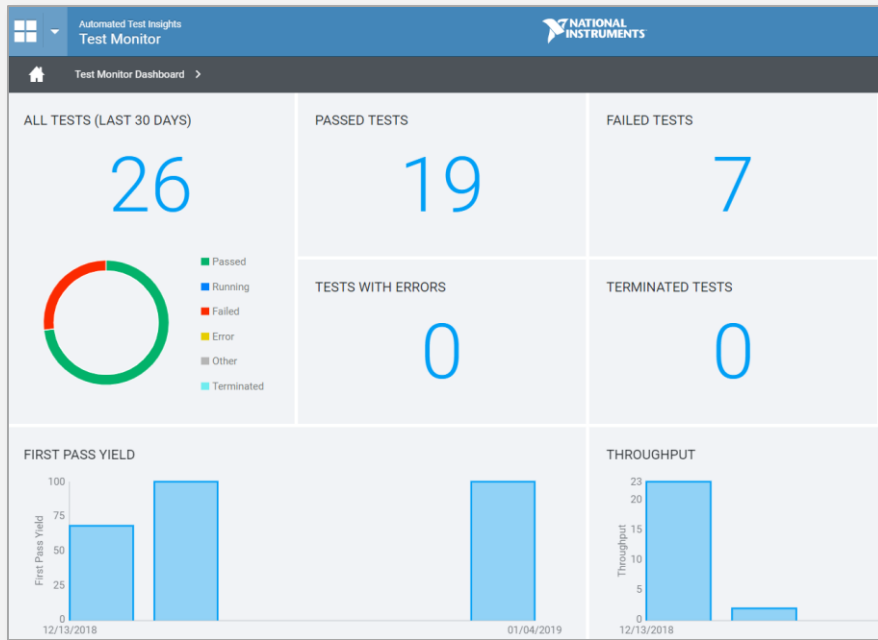
TEST RUN TIME

TEST REPORTS



# ✓ SystemLink Test Module

SystemLink Test Module provides a web application for monitoring automated test activity, as well as dynamic reporting of test results.



## Test Monitoring

Track test activity across fleet of testers

View pass/fail status at sequence and step level

Track live updates as tests execute

## Test Reporting

Pre-installed reports for common test metrics

Configurable and customizable report options

Search to locate tests by keyword/parameter

## Communication from Test Stations

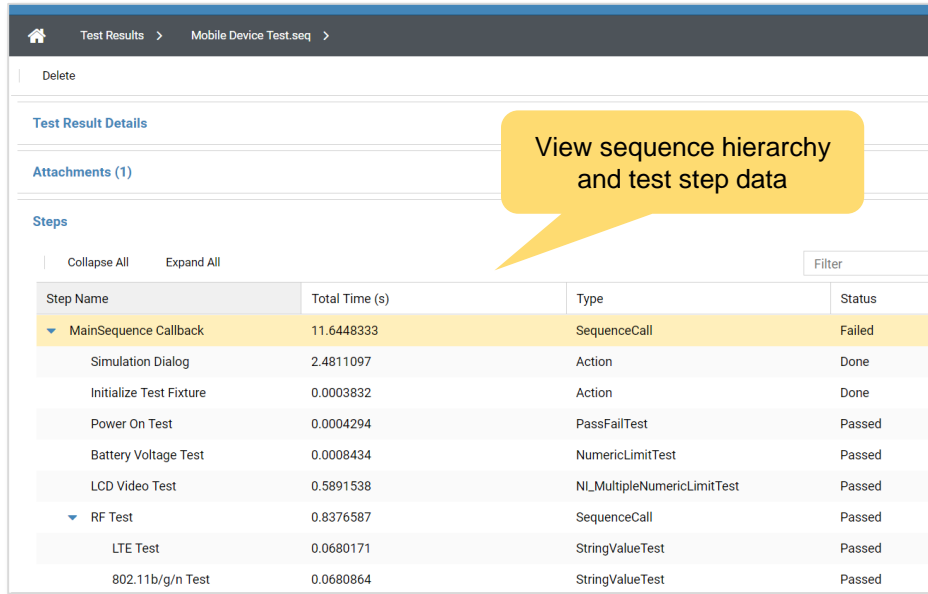
Product-level integration with TestStand

APIs for Python, LabVIEW & .NET in 2019

# Test Monitoring

Track test activities and results across a group of connected test stations.

- Access pass/fail metric per system
- Attach test data as files and transfer to server
- Add custom properties and metadata
- TestStand plug-in for version 2014+



Test Results > Mobile Device Test.seq >

Delete

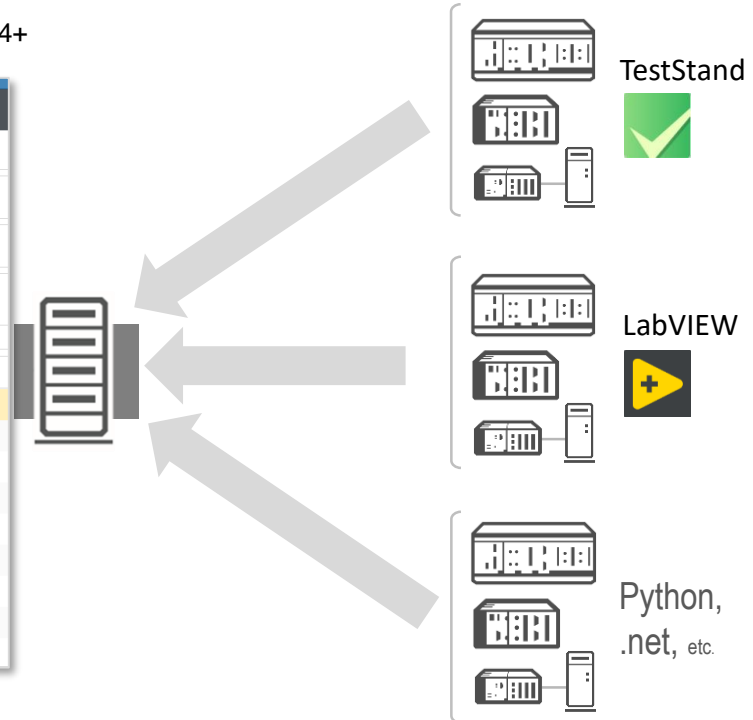
Test Result Details

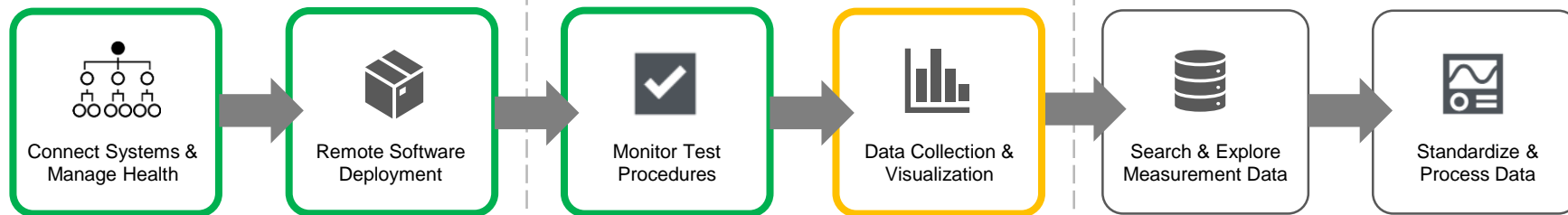
Attachments (1)

Steps

Collapse All Expand All Filter

Step Name	Total Time (s)	Type	Status
▼ MainSequence Callback	11.6448333	SequenceCall	Failed
Simulation Dialog	2.4811097	Action	Done
Initialize Test Fixture	0.0003832	Action	Done
Power On Test	0.0004294	PassFailTest	Passed
Battery Voltage Test	0.0008434	NumericLimitTest	Passed
LCD Video Test	0.5891538	NL_MultipleNumericLimitTest	Passed
▼ RF Test	0.8376587	SequenceCall	Passed
LTE Test	0.0680171	StringValueTest	Passed
802.11b/g/n Test	0.0680864	StringValueTest	Passed





SYSTEMS & ASSET MANAGEMENT

TEST MANAGEMENT

MEASUREMENT DATA MANAGEMENT

## Development Automation Software

TEST AUTOMATION

SEQUENCER:



TestStand

OR



LabVIEW

OR



3<sup>rd</sup> Party

MEASUREMENT  
PROCESSING:



LabVIEW



LabVIEW



3<sup>rd</sup> Party

DATA AUTOMATION



DIAdem



3<sup>rd</sup>-Party Tools



# Data Collection & Visualization

# Data Visualization with Distributed Applications

CHALLENGE: Develop centralized monitoring applications and remote interfaces for distributed systems.

User Location: Central Office / Field Office / Mobile



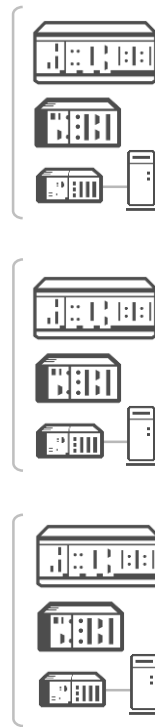
Remote  
Operation



Real-time  
Monitoring



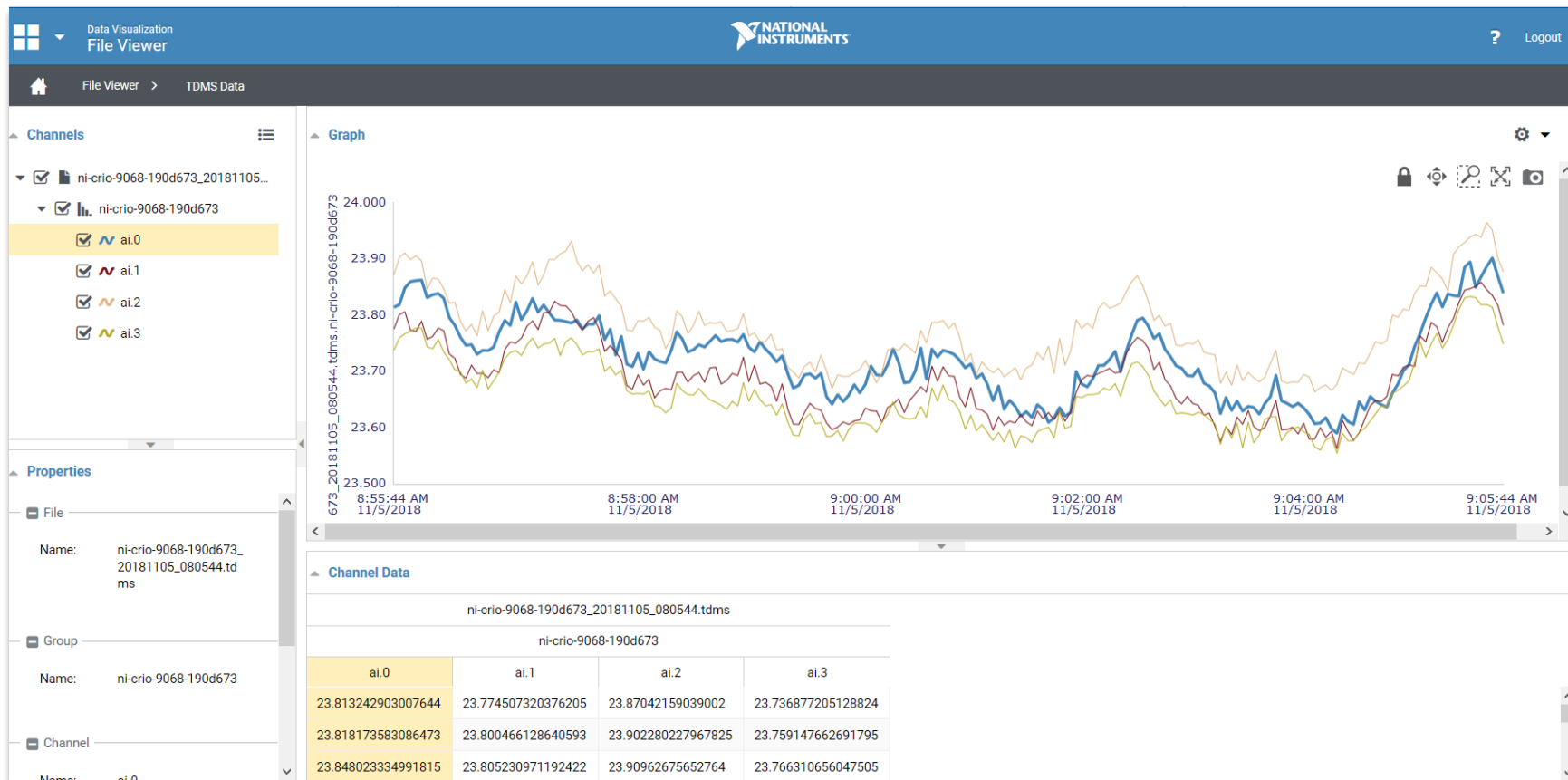
Analytics and  
Data Explorers





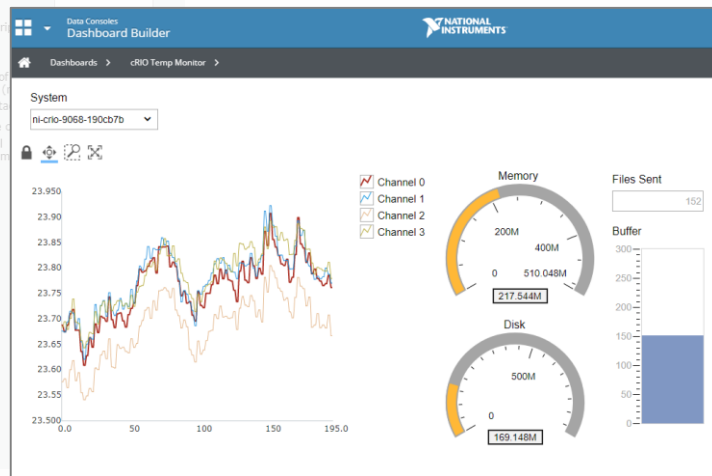
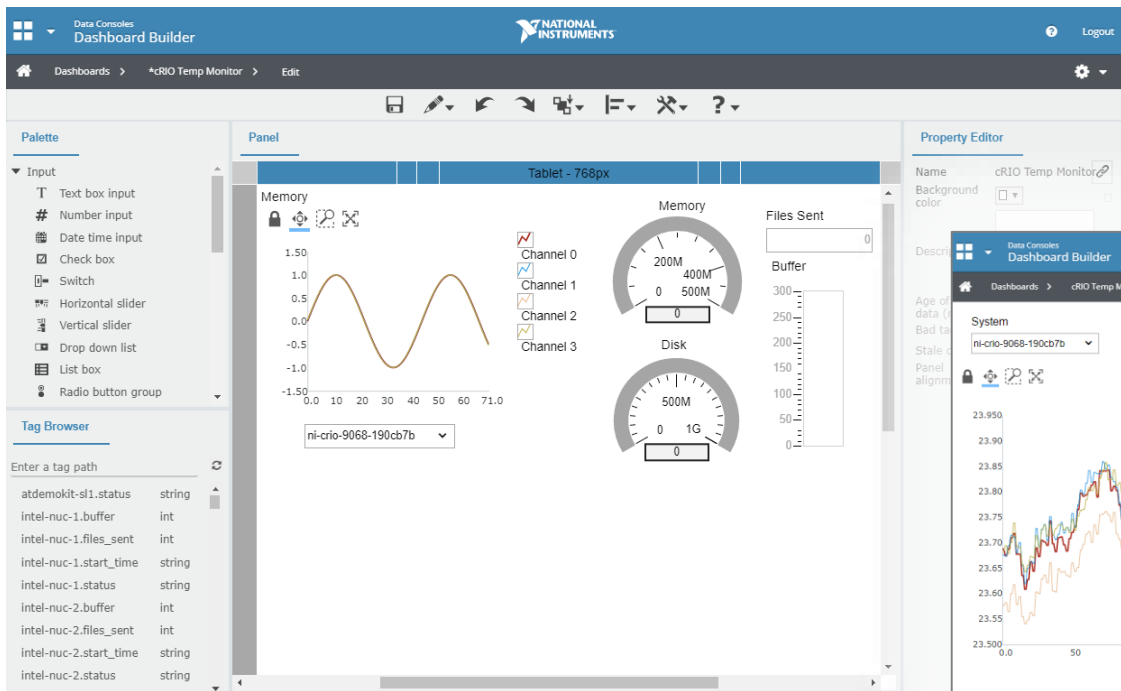
# Web Data Exploration

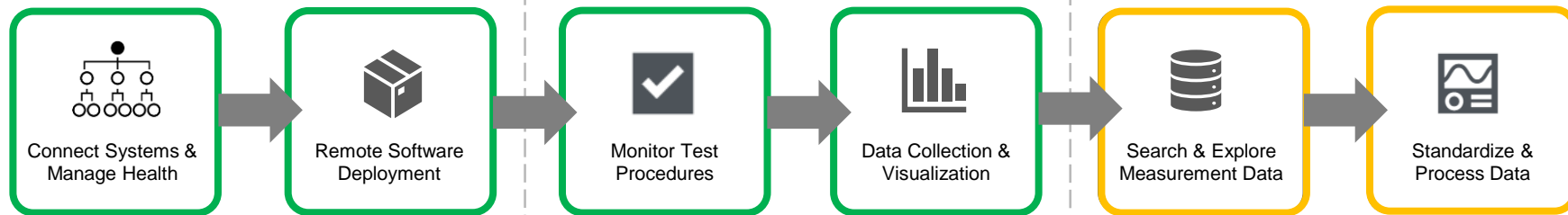
Inspect your file data and metadata in the web browser.



# Custom Web Data Visualization

Create live reporting interfaces with configuration-based dashboarding tools or with the LabVIEW NXG Module.





SYSTEMS & ASSET MANAGEMENT

TEST MANAGEMENT

MEASUREMENT DATA MANAGEMENT

## Development Automation Software

TEST AUTOMATION

SEQUENCER:



TestStand

OR



LabVIEW

OR



3<sup>rd</sup> Party

MEASUREMENT  
PROCESSING:



LabVIEW



LabVIEW



3<sup>rd</sup> Party

DATA AUTOMATION



DIAdem



3<sup>rd</sup>-Party Tools



# Measurement Data Management

# Data Management Challenges

## CHALLENGE:

- How can I trust measurement data from different sources?
- How do I access and search through our group's measurement data?
- How can I optimize data analysis and report generation?



Erroneous and  
Inconsistent Data

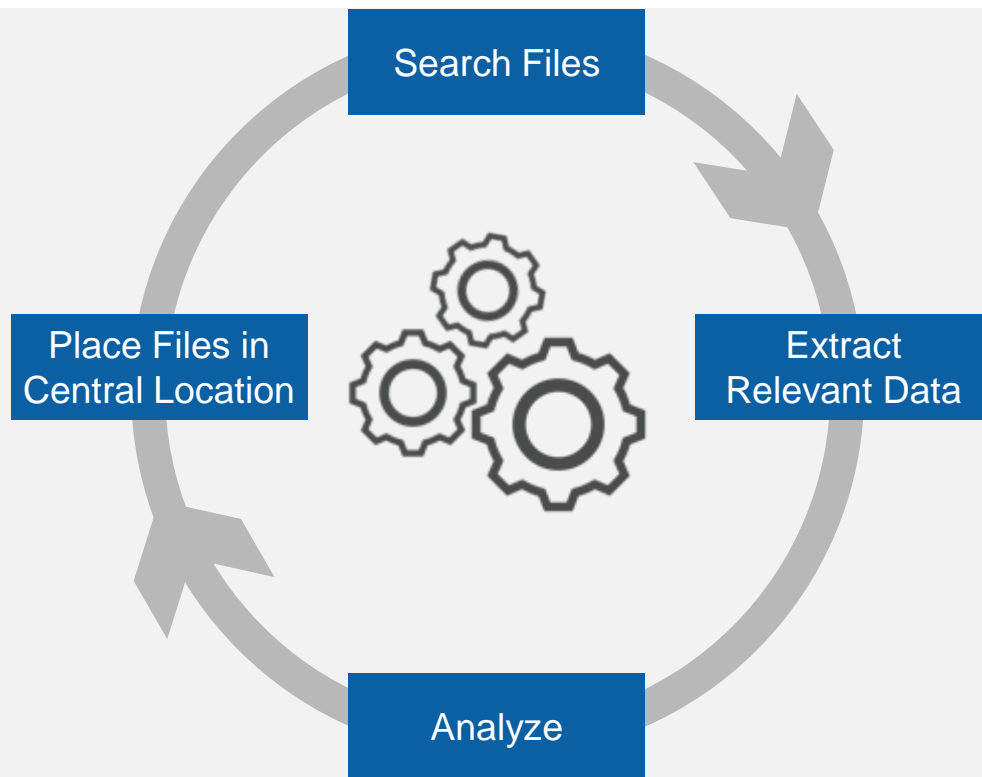


Finding  
Group Data



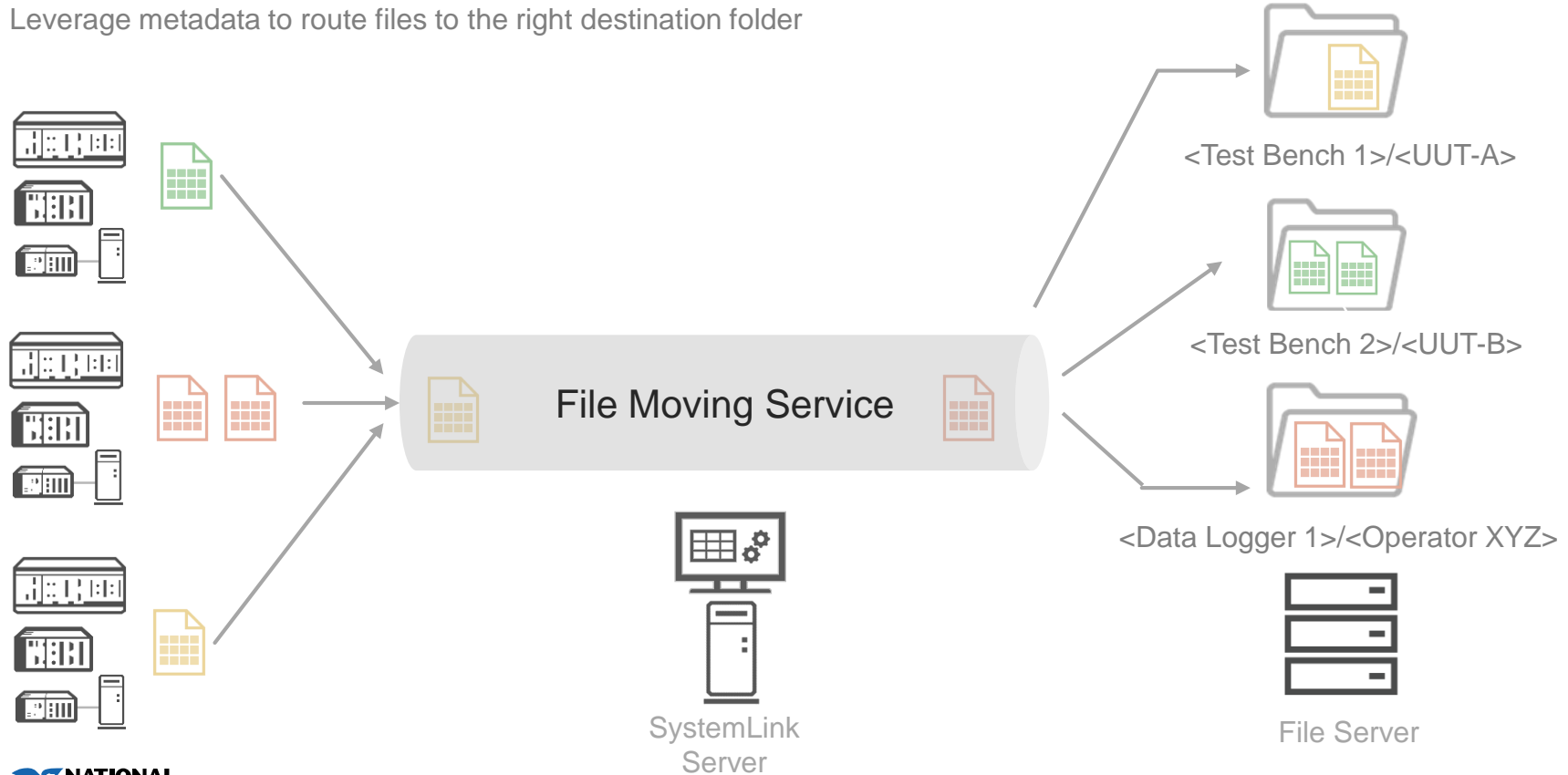
Manual Analysis  
and Reporting

# Automate Data Analysis and Reporting



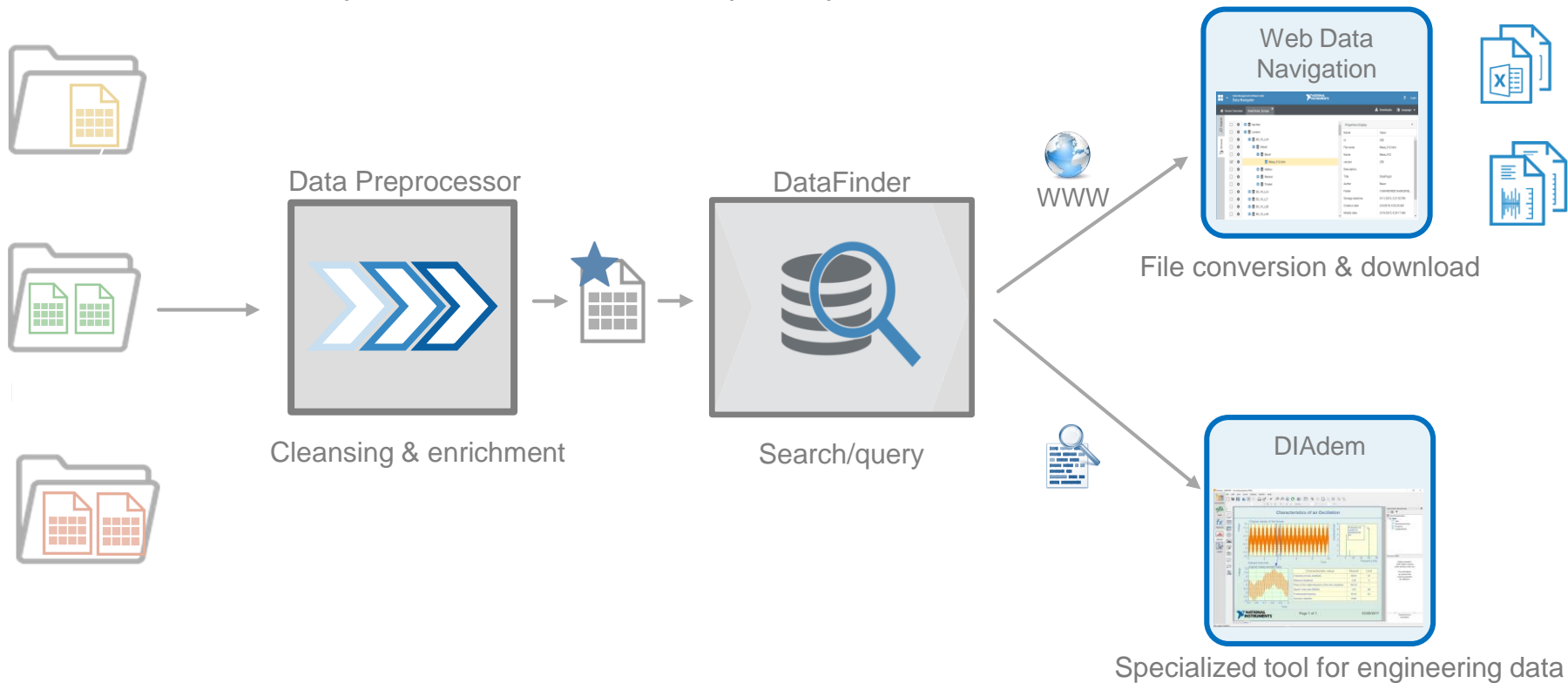
# Automated File Moving from Devices to a Data Server

Leverage metadata to route files to the right destination folder



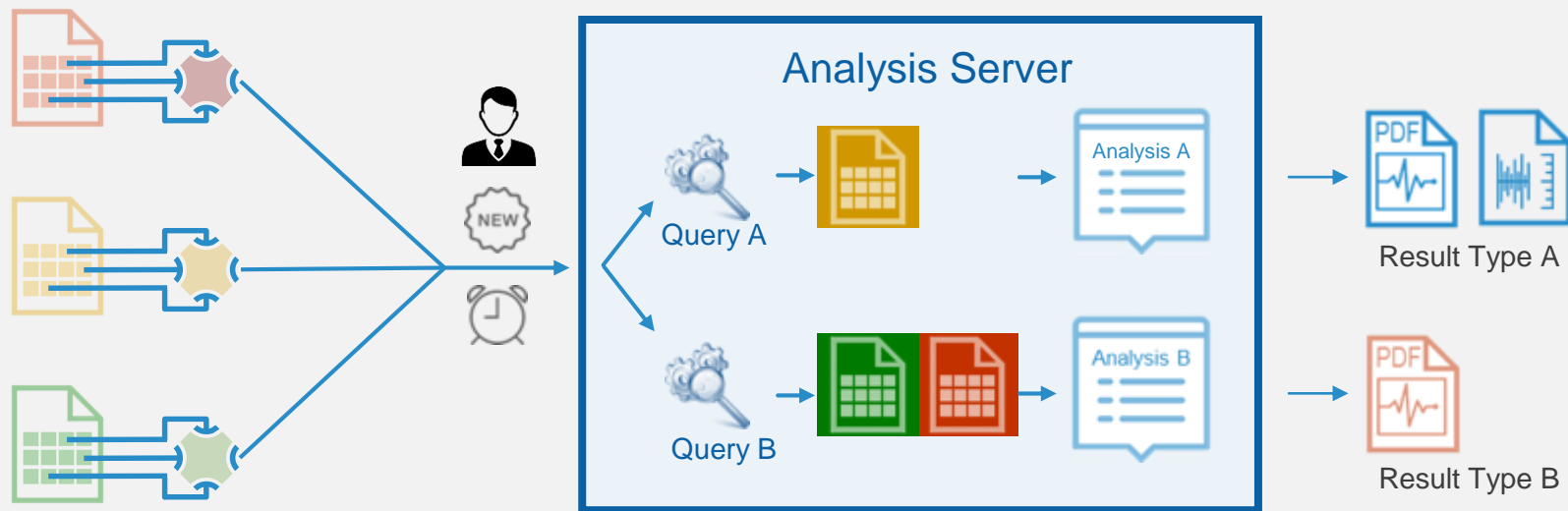
# Searching Data for Manual Analysis and Reporting

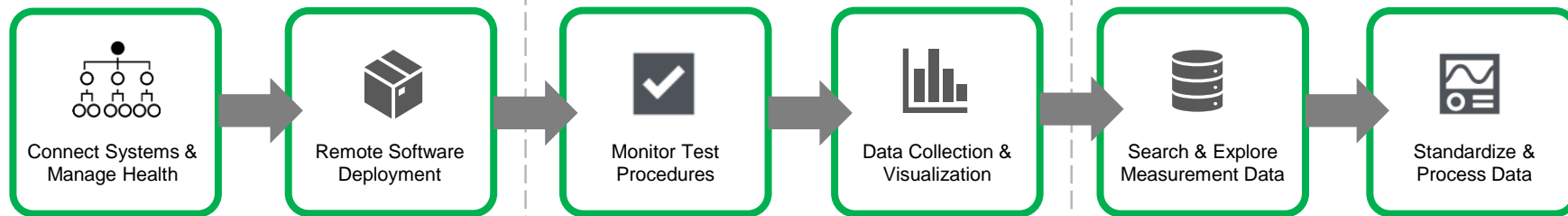
Standardize and enrich your data. Find and retrieve only those you need





# Analysis Server





SYSTEMS & ASSET MANAGEMENT

TEST MANAGEMENT

MEASUREMENT DATA MANAGEMENT

## Development Automation Software

TEST AUTOMATION

SEQUENCER:



TestStand

OR



LabVIEW

OR



3<sup>rd</sup> Party

MEASUREMENT  
PROCESSING:



LabVIEW



LabVIEW



3<sup>rd</sup> Party

DATA AUTOMATION



DIAdem

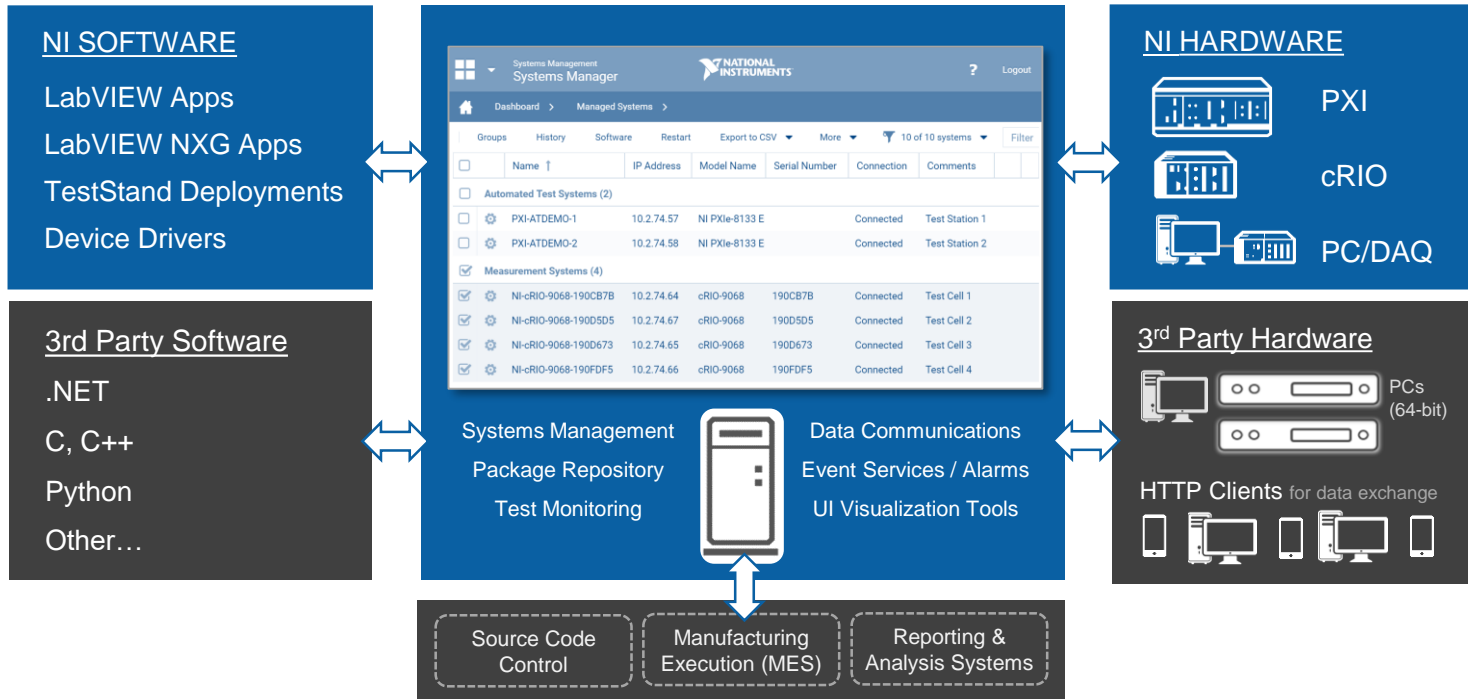


3<sup>rd</sup>-Party Tools

Questions?

# The Open Architecture of SystemLink

SystemLink is designed to support a broad spectrum of NI and non-NI technology.



# SystemLink: Supported Software & Hardware

## Deployment Software

### Native Packaging Tools

LabVIEW* (32 & 64-bit)	2014+
LabVIEW Real-Time	2017+
LabVIEW NXG	2.0+
TestStand	2017

\* A LabVIEW plug-in is available to create deployment packages with EXEs, PPLs and Source Distributions.

### Command-Line Support

#### NI & Non-NI Software

- Applications, libraries, drivers, docs, installers, etc. can be packaged using command-line interface and deployed with SystemLink



## Hardware

### SystemLink Server

 WINDOWS OS Options: 64-bit



#### Windows Server

- Windows Server 2008 R2, SP1
- Windows Server 2012 R2
- Windows Server 2016



#### Windows PC

- Windows 7+

### SystemLink Clients

 WINDOWS TARGETS: Win 7+, 64-bit



#### NI PXI



#### Windows PC



#### NI LINUX RT TARGETS



#### NI CompactRIO