

SOLUTION BROCHURE

Software for Production Test

Production Test Software for Team or Organization-Wide
Standardization

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Traditionally, test teams have been pressured to achieve maximum coverage in minimum cycle time, under increasingly higher expectations with shorter development schedules, longer station longevity, tighter regulatory compliance, and more remote systems/data management. Across the world, teams looking to execute a test strategy that balances these pressures have selected the NI test platform for its complete software offering and modular hardware architecture.

Test Station Architecture and Requirements

A functional test station is an integrated set of hardware and software that measures, analyzes, and publishes data confirming that a product or component has been manufactured in accordance with predefined specifications.

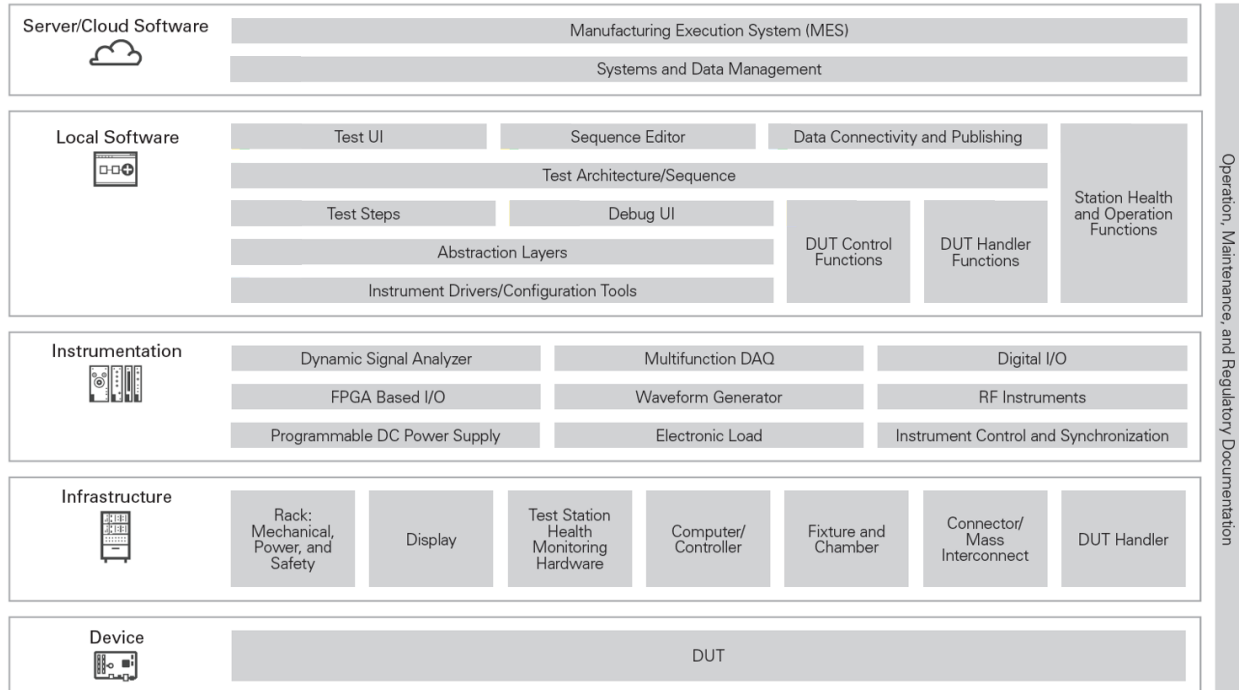


Figure 1. Test Station Architecture

Test stations are complex applications constructed of four fundamental elements: Hardware infrastructure, hardware instrumentation, local software, and server/cloud software. Each test station requires unique test steps and instrumentation types; however, many other architectural elements remain common.

Test stations must:

- Meet test coverage requirements
- Be maintainable throughout the product's market lifetime
- Operate within a cycle-time requirement
- Develop in time to meet a production schedule
- Be certified and documented to meet regulatory standards
- Deliver test data in a format accessible to all requesting departments
- Physically and operationally fit into existing manufacturing processes
- Be purchased within a test budget

NI Test Platform Benefits

Customize to Deliver Results

The NI test platform is optimized for production test. No matter the pressures on you and your test program, the NI test platform's breadth of hardware, software, and services means that you can customize it to meet specific needs.

- **Product Quality:** Industry-leading accuracy, repeatability, and reliability ensures that your test is never compromised—just like your trust in the product.
 - **Product Complexity:** The industry's widest breadth of instrumentation supports measurements including voltage, current, digital signals, audio, RF, visual inspection and more, ensuring complete test coverage.
 - **Station Longevity:** Modular instrumentation manufactured and documented with life-cycle management in mind, along with robust service program, keeps production lines running longer with less reengineering work and less recertification.
 - **Production Volume:** Built-in automatic test parallelism and FPGA processing that facilitates multi-up test architectures reduces cycle time and results in increased throughput on your line.
 - **Development Schedule:** Test-specific software tools can save more than 50% of your development time,¹ reducing the risk of missing tight schedule deadlines.
- Systems-management software ensures fast and error-free software deployment, minimizing delays in large or remote updates.
- **Regulatory Compliance:** Complete documentation, experienced system integration partners, and tools designed for long-term deployment ease regulatory certification and recertification processes.
 - **Data Insight:** Out-of-the-box enterprise data-management software collects, analyzes, and reports test data and station health, delivering greater insights into throughput, yield, station or component utilization, and overall operational efficiency.

¹Sub-Zero Group, Inc., Page 5

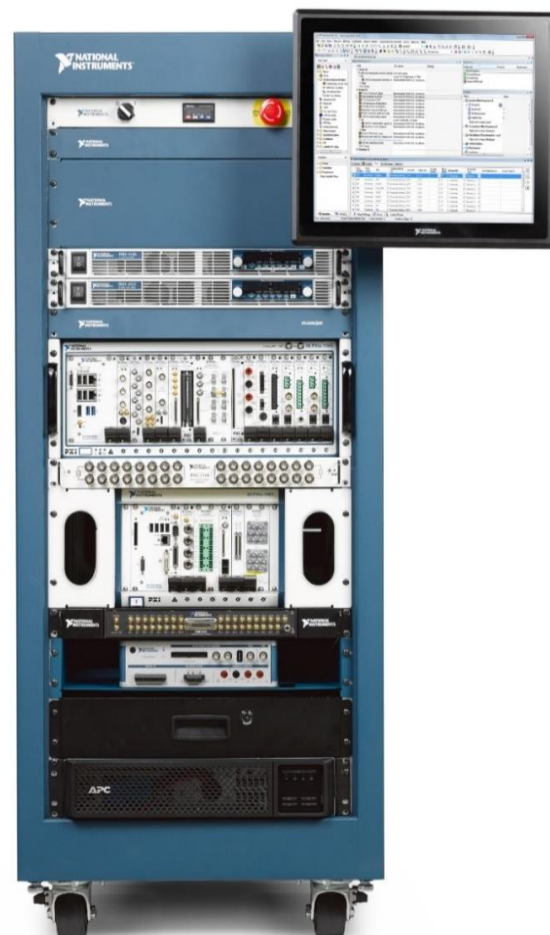


Figure 2. NI Test Platform

Support Your Business Initiatives Through Test

The NI test platform is optimized for production test. NI is committed to reach beyond a vendor/client relationship and support you by delivering the value your business requires. Most large organizations have corporate-lead initiatives designed to drive efficiency or differentiate through new technology or processes. By aligning test strategy to these initiatives, best-in-class test directors ensure visibility and success of both their department and overall business.

- **Standardization:** NI's modular hardware and software is ideal for standard platform development, as you can easily reuse and expand components with minimal redesign for wide-range functionality.
- **Digital Transformation:** Utilizing the Internet of Things for test is not a futuristic idea—you can do it today using system-management tools to deliver improved test coverage insight and significant utilization improvements. The NI approach helps businesses focus on areas of greatest value without having to make an all-or-nothing investment decision.
- **Internal Proficiency:** A single NI software toolchain that applies to multiple engineering disciplines, combined with a thriving global developer community, encourages test proficiency both at the individual and team level.
- **Outsourcing Return on Investment (ROI):** By combining consultation, support, and full integration services, reach an in-house versus outsource balance without putting deadlines or build quality at risk.
- **Operational Expense:** Industry-renowned reliability, production-optimized test and data management software, and comprehensive services and support ensure minimized downtime, real-time operational insight, and cost-effective sustaining strategies.
- **Capital Expense:** Scalable, future-proof architectures, multi-up test capability, and high-channel-count instrumentation maximize return on capital investments and protect against large unexpected costs.

“Best-in-class production test teams don’t just build test stations—they execute against a test strategy that actively supports their business. With our industry-leading systems and services, NI powers the world’s most effective test organizations.”

Kyle Voosen, Director, Electronics Production Test, National Instruments

Local Test-Station Software

Because software development monopolizes the majority of test-project development labor, software tool and architecture choices significantly impact deployment schedules. Adopting a standard software approach across a team or organization increases both efficiency and proficiency, lowering the risk of missed deadlines and improving test quality and reliability.

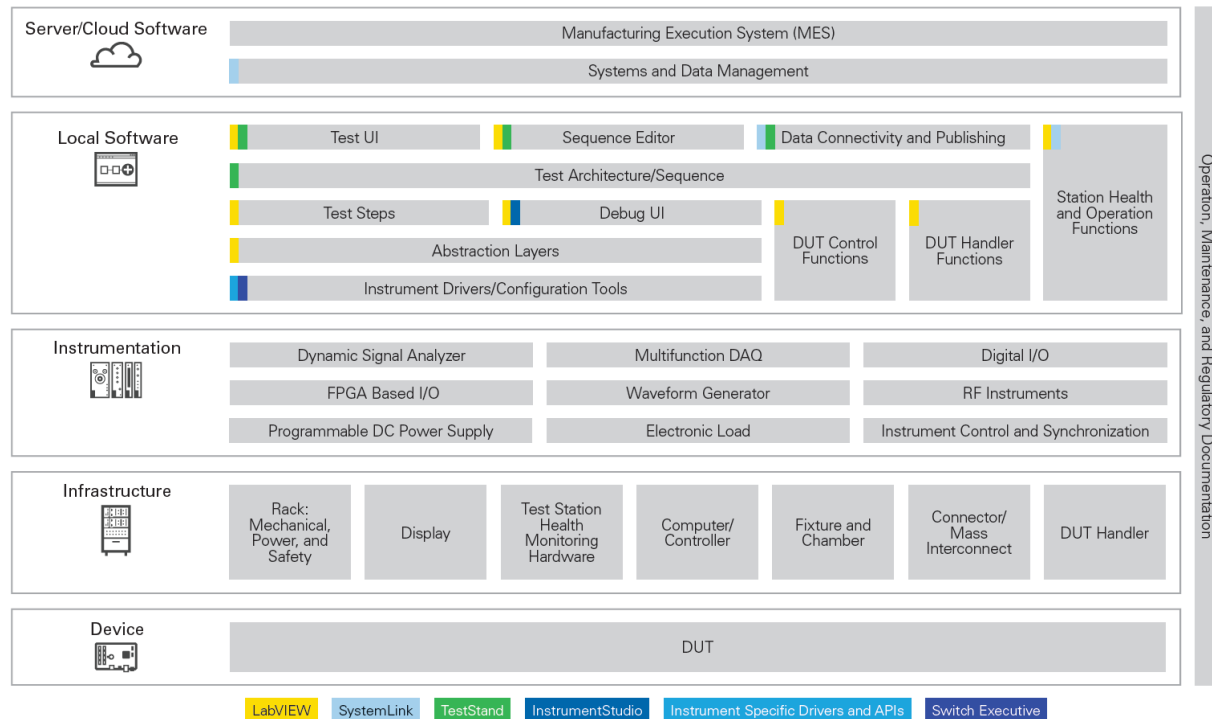


Figure 3. Test Station Software

Tens of thousands of engineers worldwide choose NI software for its rapid development environment, open architecture, and throughput-enhancing features, such as automatic parallel test-step execution. NI test software is the most complete engineering toolchain on the market, consisting of TestStand, LabVIEW, SystemLink™ software, InstrumentStudio™ software, and more.

NI test software is open and compatible with most other development languages, including C, C#, and Python, so that teams can reuse existing IP within test steps and sequences without sacrificing NI software platform-development benefits.

"The NI platform (especially LabVIEW and TestStand) has greatly increased our productivity and is a department standard. It probably saves us at least 40 hours on each project."

Makenna Shaske, Test Development Engineer, Benchmark Electronics

LabVIEW

LabVIEW offers a graphical programming approach that helps you visualize every aspect of your application, including hardware configuration, measurement data, and debugging. This visualization makes it simple to integrate measurement hardware from any vendor, represent complex logic on the diagram, develop data analysis algorithms, and design custom engineering user interfaces.

Key Benefits:

- Reduce system setup with access to thousands of instrument drivers, example programs, and documentation to connect to virtually any instrument.
- Use hundreds of instrument-specific example code modules and included measurement libraries to reduce development time.
- Reuse existing code libraries from languages including C/C++/C#, .NET, Python, and MathWorks MATLAB® software.
- Quickly create professional user interfaces to visualize test outcomes.
- Build proficiency with extensive online and in-person training options for both new users and certified NI tool architects.

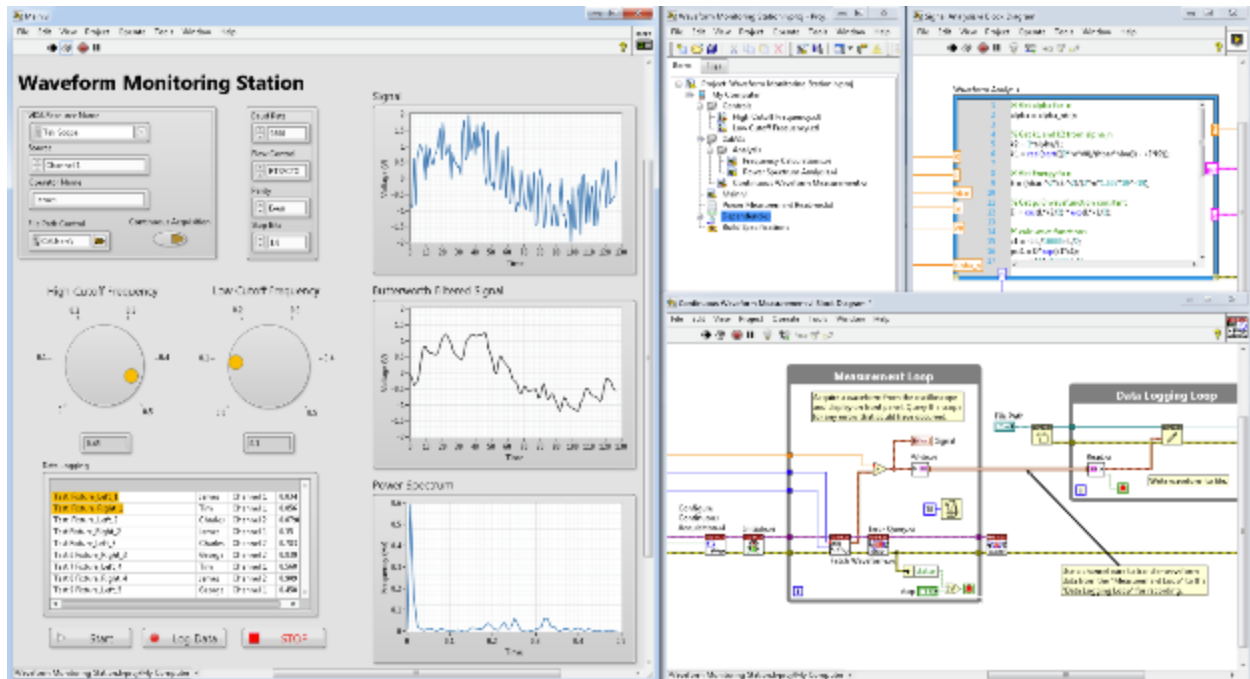


Figure 4. LabVIEW Software Interface

“Our team uses a common hardware platform across testing of numerous products. Reusability of common hardware configurations and utilization of common LabVIEW code simplifies development of new test systems.”

Brian Teschendorf, Software Engineer, Boston Scientific Corporation

TestStand

TestStand ready-to-run test management software is designed to help you quickly develop and execute transaction processing system (TPS) software. You can extend TPS functionality by developing TestStand test sequences that integrate code modules written in a variety of programming languages, including G in LabVIEW, C/C++, .NET, and Python. TestStand also provides extensible plug-ins for reporting, database logging, and connectivity to other enterprise systems. You can deploy test systems to production with easy-to-use operator interfaces.

Key Benefits:

- Customize test sequences to meet every requirement
- Automate saving and reporting test data
- Increase test throughput with parallel testing
- Efficiently replicate and deploy test systems
- Troubleshoot test systems with integrated debugging tools
- Customize user interfaces to meet testing needs

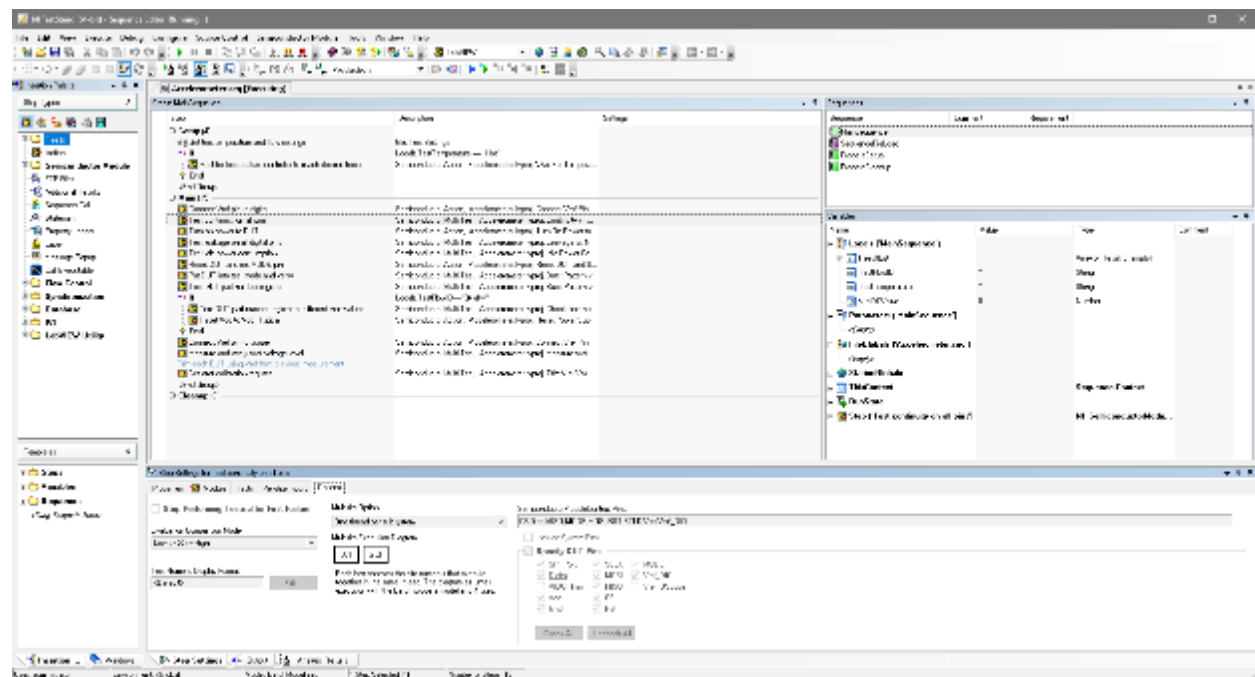


Figure 5. TestStand Software Interface

"TestStand has helped to decrease the time spent testing product and gets it to the market faster."

Jared Smith, Test Engineer, Schneider Electric

InstrumentStudio Software for Interactive Measurements

InstrumentStudio software helps you unify your display, export instrument configurations to code, and monitor and debug your automated test system. You can view data on unified displays with large, high-resolution monitors, and then capture multi-instrument screenshots and measurement results. Save project-level configurations for easier test repeatability with specific devices under test, or export instrument configurations to programming environments to simplify your code and guarantee measurement correlation. You also can use InstrumentStudio software in parallel with your code to monitor and debug running test applications. InstrumentStudio is free software included with NI-SCOPE, NI-FGEN, NI-DMM, and NI-DCPower driver downloads 18.1 and later.

Key Benefits:

- Integrate your instruments into a single view
- Capture multi-instrument screenshots, measurement results, parameter configurations, and UI layouts for broader insight and instant repeatability
- Export instrument configurations to code
- Guarantee correlation by replicating instrument configurations using a single API function call
- Monitor the state of your instruments while they are running, or take control of them interactively for debugging

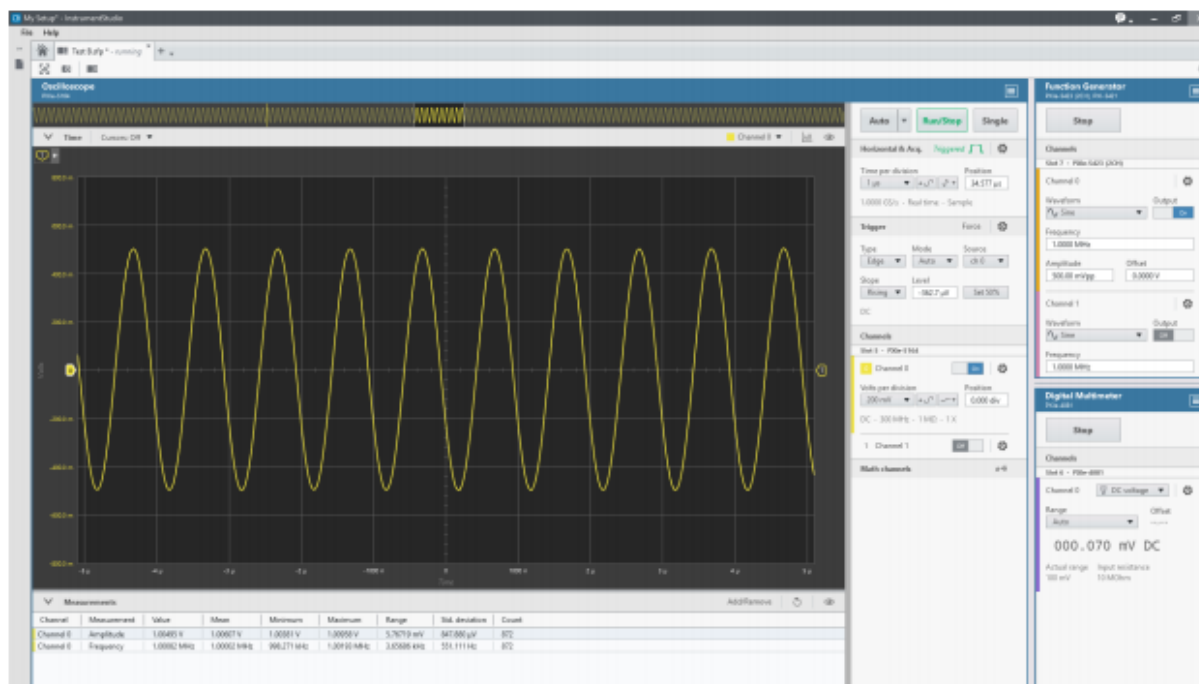


Figure 6. InstrumentStudio Software User Interface

Switch Executive Application Software

While the NI-SWITCH driver provides all low-level functionality required to program switch actions, Switch Executive is application software for intelligent switch management and routing that accelerates development and simplifies complex switch-system maintenance. Its point-and-click graphical configuration and automatic routing capabilities make it easy to design your switch system. Using intuitive channel aliases and route names keeps your system documented for future modifications. Save time and increase test code reuse by integrating your system with TestStand, LabVIEW, LabWindows™/CVI, and Measurement Studio.

Key Benefits:

- Graphically configure routes and route groups
- Develop reusable switching code and integrate it into TestStand or LabVIEW
- Automatically route signals between switch endpoints
- Scale switch configuration using Microsoft Excel
- Maintain switch configuration using route validation, reporting, and debugging features

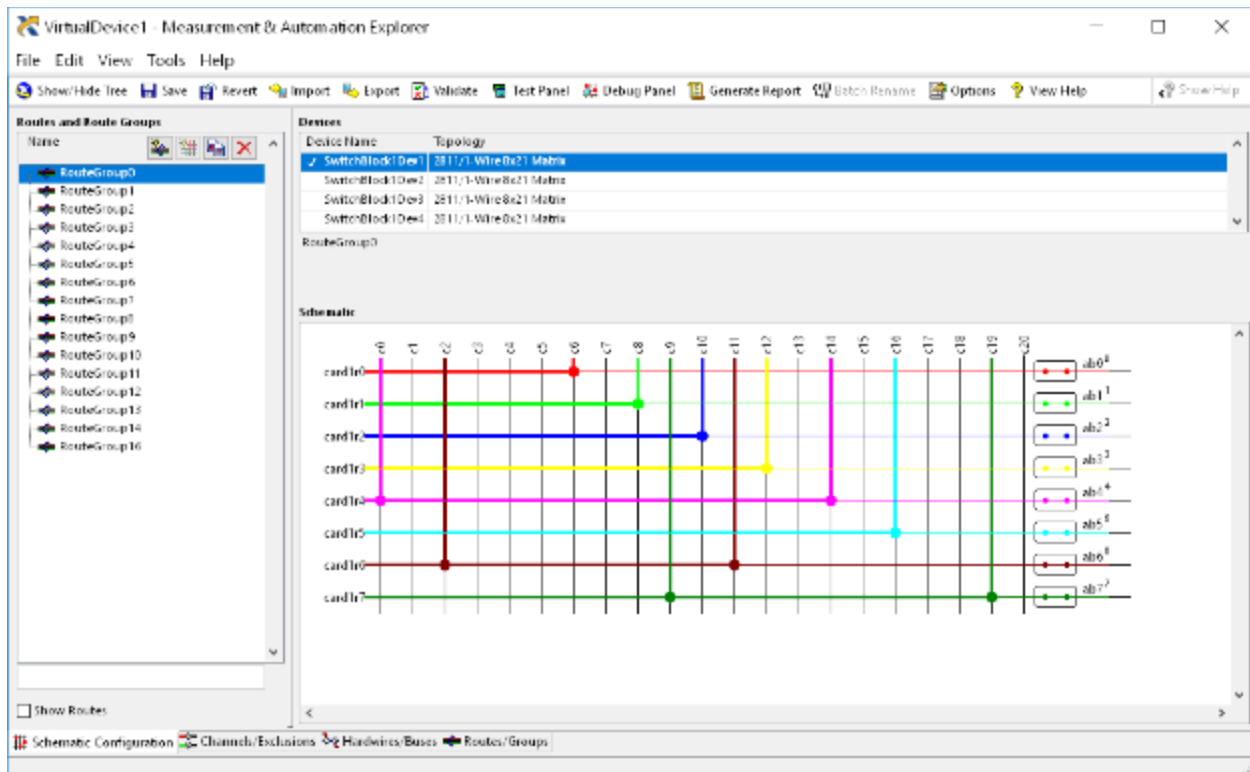


Figure 7. Switch Executive Software Interface

Instrument-Specific Drivers and APIs

NI measurement driver software includes best-in-class APIs that work with a variety of development options, such as LabVIEW, C, C#, Python, and others. To ensure long-term interoperability of our instruments, the driver APIs are the same for all past and current instruments. The driver software also provides access to help files, documentation, and dozens of ready-to-run shipping examples you can use as a starting point for your application.

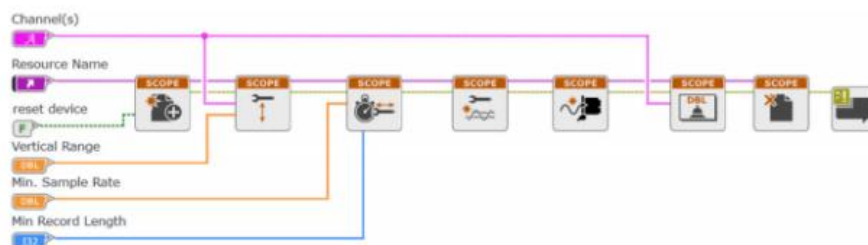


Figure 8. LabVIEW API for NI-SCOPE

```
// DAQmx analog voltage channel and timing parameters

DAQmxErrChk (DAQmxCreateTask("", &taskHandle));

DAQmxErrChk(DAQmxCreateAIVoltageChan(taskHandle, "Dev1/ai0", "", DAQmx_Val_Cfg_Default, -10.0, 10.0,
DAQmx_Val_Volts, NULL));

DAQmxErrChk(DAQmxCfgSampClkTiming(taskHandle, "", 10000.0, DAQmx_Val_Rising, DAQmx_Val_FiniteSamps, 1000));

// DAQmx Start Code

DAQmxErrChk(DAQmxStartTask(taskHandle));
// DAQmx Read Code

DAQmxErrChk(DAQmxReadAnalogF64(taskHandle, 1000, 10.0, DAQmx_Val_GroupByChannel, data, 1000, &read, NULL));
// Stop and clear task
```

Figure 9. C API for NI-DAQmx

```
import niscopes
with niscopes.Session("Dev1") as session:
    session.channels[0].configure_vertical(range=1.0, coupling=niscopes.VerticalCoupling.AC)
    session.channels[1].configure_vertical(range=10.0, coupling=niscopes.VerticalCoupling.DC)
    session.configure_horizontal_timing(min_sample_rate=50000000, min_num_pts=1000, ref_position=50.0,
    with session.initiate():
        waveforms = session.channels[0,1].fetch(num_records=5)
        for wfm in waveforms:
            print('Channel {0}, record {1} samples acquired: {2:}\n'.format(wfm.channel, wfm.record, len(wfm.samples)))

    # Find all channel 1 records (Note channel name is always a string even if integers used in channel)
    chan1 = [wfm for wfm in waveforms if wfm.channel == '0']

    # Find all record number 3
    rec3 = [wfm for wfm in waveforms if wfm.record == 3]
```

Figure 10. NI-SCOPE Code Example Capture in Python

Wireless API

NI RFmx is an easy-to-use intuitive programming API that offers advanced measurement configuration. Its highly optimized API performs tasks ranging from digital and analog modulated signal measurements to RF spectral measurements—including channel power, adjacent channel power, and power spectrum. Use it to automate programs with accurate, high-performance, standard-based measurements for LTE-A, WCDMA/HSPA+, GSM/EDGE, Bluetooth, Bluetooth LE, and more. In addition to supporting cellular and general purpose measurements with RFmx, NI offers wireless test-standards software for GPS/GNSS simulation and FM/RDS, and the NI WLAN Toolkit gives you direct, fine control over IEEE 802.11a/b/g/n/ac and ax signal and 802.11j/p/ah/af waveform generation and analysis with industry-leading speed and accuracy.

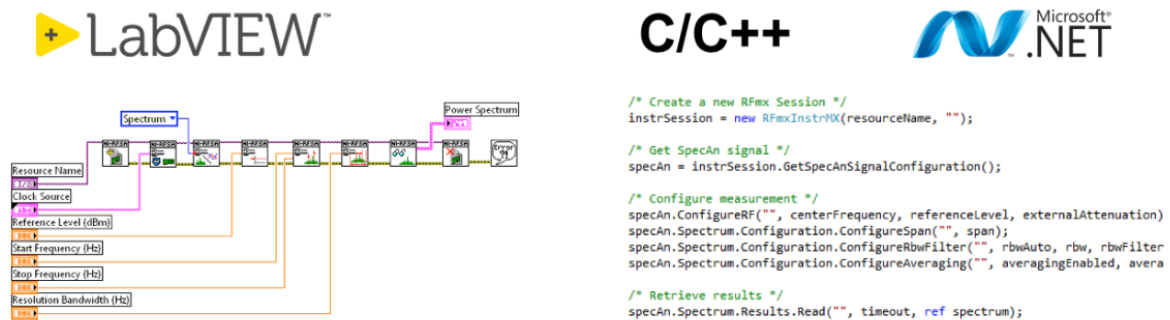


Figure 11. NI RFmx Power Spectrum Measurements in LabVIEW and C

Figure 11 illustrates a power spectrum measurement in RFmx LabVIEW with eight function calls. Get started with one of more than 100 C, .NET, and LabVIEW example programs designed to make instrument automation straightforward. The NI RFmx API includes high-level parameters that intelligently optimize instrument settings to help you achieve the highest quality measurements with the fewest software calls. Additionally, NI-RFmx features vastly simplify multimeasurement parallelism and multi-DUT measurement software complexity. The modular software architecture offers access to lower-level NI-RFSA instrument- and application-specific functions that balance ease of use and test-code flexibility. NI-RFmx works with all NI software-designed Vector Signal Transceivers (VSTs) and preserves NI-RFSA instrument driver FPGA extensions, which are available only on LabVIEW FPGA-enabled products. Achieve industry-leading measurement speeds using the latest processor technologies and easy-to-program multithreaded measurements for test-time reduction.

Wireless Soft Front Panel

VST offers the simplest software use model in its soft front panel. Quickly and easily configure the RF signal generator or analyzer to debug fixtures and obtain fast measurement results. Use the soft front panel to configure the VST for an adjacent channel power measurement, as shown in Figure 12.

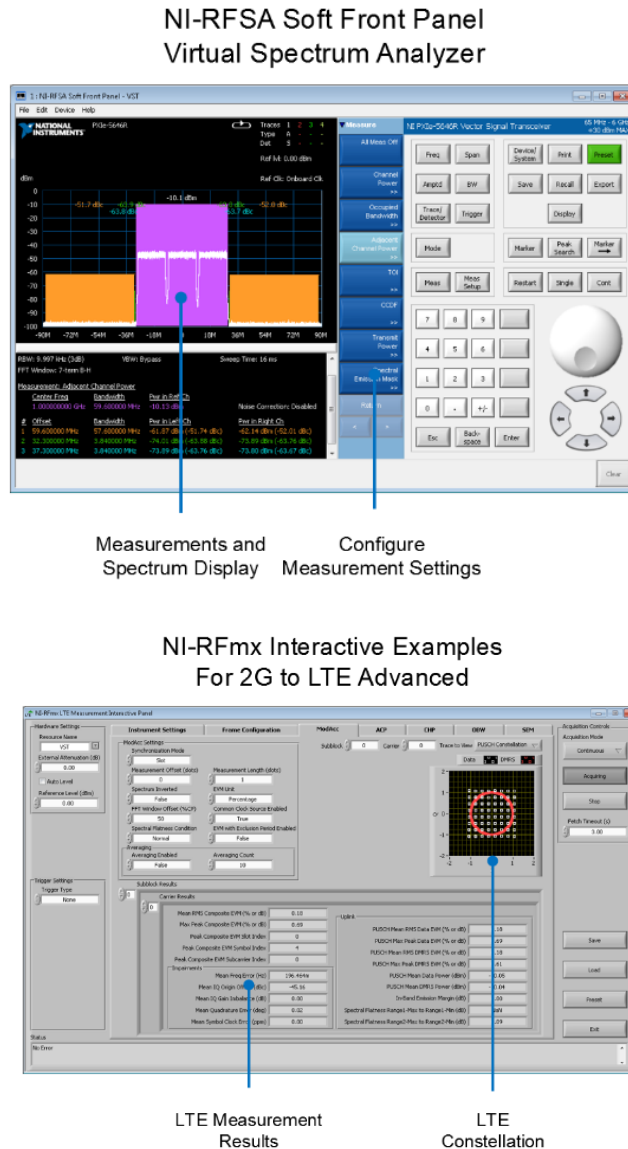
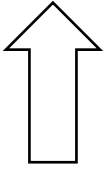


Figure 12. Configure the VST for quick measurements using the NI-RFSA and NI-RFSG soft front panels (other interactive examples act as soft front panels for different standards).

Server/Cloud Software (Enterprise)

Test data visibility is increasingly in demand. Best-in-class companies realize that scrutinizing their functional test data provides real-time insight into changes in manufacturing yield, throughput, line health, and product quality.

Data Insights	Team Requesting Data	Data Usage Need
Enterprise Data Requirement  Basic Data Requirement	Company Leadership	Business Operations Insight
	Product Returns Team	Fault Traceability
	Product R&D Team	Product Design Improvement
	Test Development Team	Tester Improvement and Optimization
	Manufacturing Floor Operations Team	Utilization and Line-Balancing Operations
	Local Test Operator	Test-Station Status

Home-grown test data management solutions are prevalent. But effectively developing and maintaining these solutions requires expertise in domains misaligned with test engineering workflows, including database connectivity, web services, IT systems, security, and visualization. Because these areas often do not contribute to key metrics by which test organizations are measured, they detract from the team's success.

To offset this, test organizations are moving towards a COTS systems and data management solution in which test engineers work within the areas that add the most business value.

NI SystemLink software is a leading solution that addresses this issue, as well as expands the capabilities of systems and data management tools far beyond what most engineering teams have experienced. SystemLink software integrates seamlessly with NI TestStand software and PXI hardware and offers an open architecture to effectively manage a wide range of third-party data and instruments.

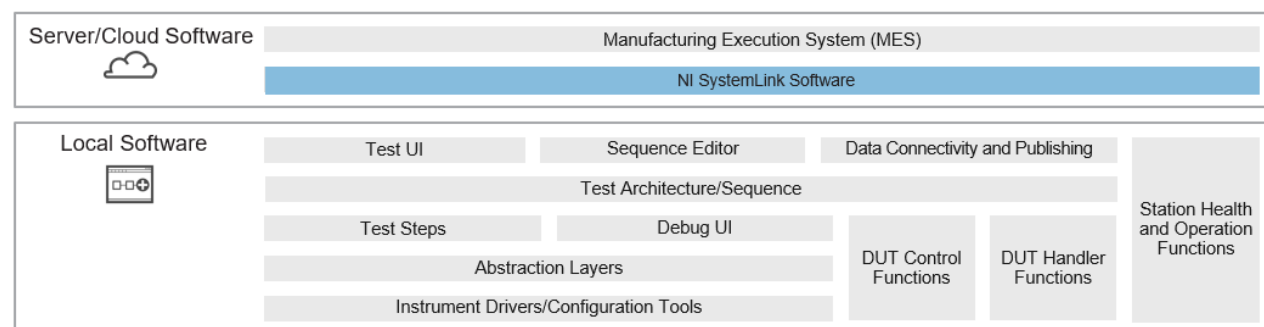


Figure 13. Software Architecture Highlighting NI SystemLink Software

SystemLink Software

SystemLink software eliminates the manual tasks related to keeping test systems current and healthy. From automating software updates to monitoring system health, SystemLink software delivers key information that improves situational awareness and test readiness. Leveraging an automation and connectivity framework, SystemLink software aggregates test and measurement data from all test systems into a centralized data repository. Users have ready access to asset utilization, calibration forecasts, and test-result history, trends, and production metrics data to make proactive decisions on capital expense, maintenance events, and test or product modifications.

SystemLink software is comprised of four modules—Software Configuration, Asset, Test, and TDM Data Finder. These modules provide application-specific capabilities that use the SystemLink server for data communication, transmission, and movement, as well as services for managing NI and non-NI instruments, software packages, alarms and notifications, and dashboards.

Key Benefits:

- Centrally manage distribution software
- Optimize your software deployment process
- Perform remote device configuration and diagnostics
- Manage TPS performance health with alarms management, notifications, and calibration reporting
- Automatically prepare your data from multiple query and analysis sources
- Quickly access and search measurement data across TPSs
- Intelligently analyze files and generate reports automatically

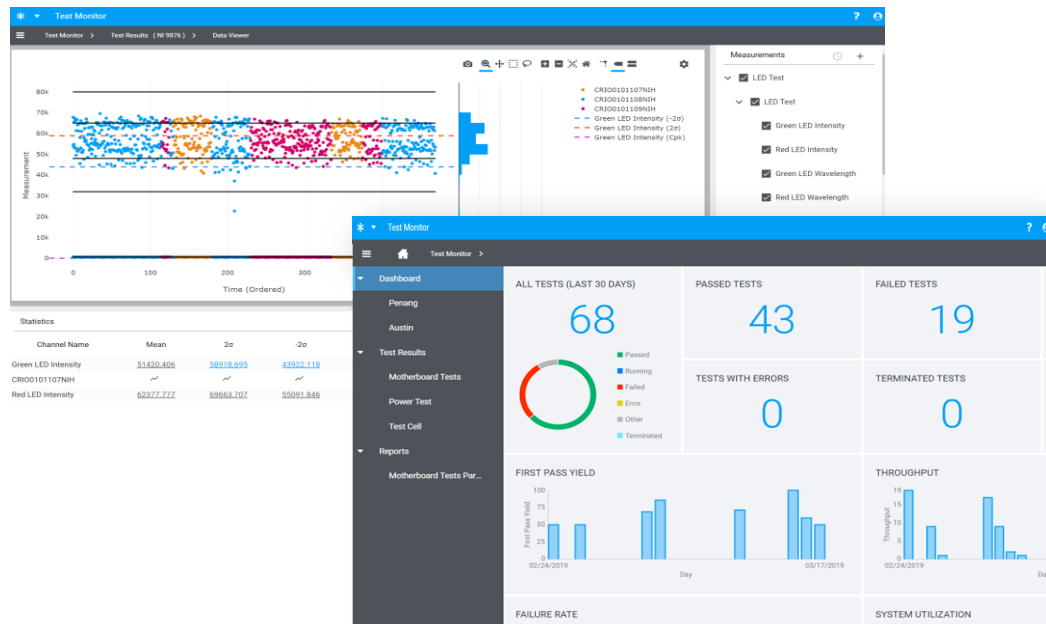


Figure 14. SystemLink Software

Services and Support

Change initiatives are common within test teams. Whether building a new test strategy, driving a technology refresh, or extending the life cycle of an existing project, product schedules and budgets are often high-risk. Managing this risk is a tricky balance between meticulous planning and agile design choices.

Utilizing consultation, educational resources, and ongoing support programs can mean the difference between a culture of missed deadlines and budgetary strain, and a culture of on-time, on-target delivery. NI consultation, integration, and education services offer guidance and industry expertise to help build and execute a practical plan to achieve your business and operational outcomes.

Methodology Consulting Services

With more than 40 years' test experience, NI is an expert in test-related processes and strategies. NI provides a framework to help you evaluate your people, processes, and technology, and recommends a test strategy appropriately customized to your business. Work with NI to solidify a business case that articulates your future state and expected program ROI to secure the funding you need.

Planning and project management consulting helps build a project-execution plan that keeps teams on track to hit major development milestones. Work together with NI to establish priorities, identify the right resources, and make trade-offs to optimize cost without putting projects at risk.

Integration Engineering Services

With global solution centers and NI engineers in more than 40 countries supported by more than 900 Alliance Partner companies, NI delivers design and development assistance in every region and industry. NI engineers help you mitigate risk, develop faster, and reduce costs through project management, architecture development, and system documentation to deliver an integrated solution.

Education Services

Test teams new to NI software and seasoned veterans of the platform alike benefit from investing in their education through learning resources designed for personal and team proficiency. NI provides a comprehensive customer education program designed to increase productivity, reduce development time, and improve your team's ability to engineer robust, maintainable applications with NI products. Tailor the experience to fit any schedule with online, in-person, and flexible programs.

Engineers who have adopted NI education services save time in development and maintenance and learn faster.

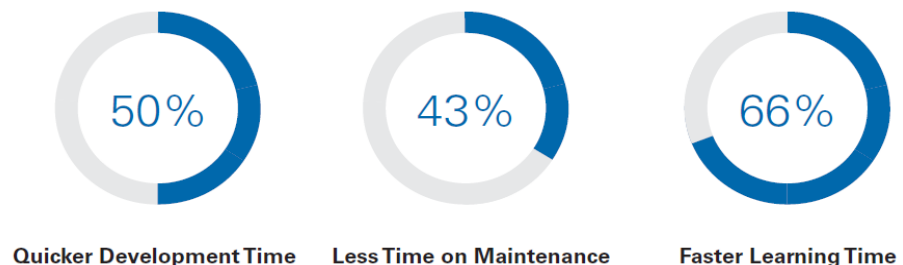


Figure 15. Save Time and Effort with NI Products and Services

NI Alliance Partners

Best-in-class test engineering teams realize that there is seldom a simple question of in-house development versus outsourced development. Instead, they realize how complex it is to decide how to balance development teams to optimize for deployment schedule, bandwidth, domain specific expertise, proficiency development, and available budget.

NI Alliance Partners are uniquely positioned to support your business with the service that it requires, including strategic design, system integration, specialist tools, software IP, and ongoing support. More than 1,000 NI Alliance Partners, each certified and vouched for by NI and positioned globally, stand ready to consult with you on projects and provide complete solutions based on NI's productive software and modular hardware.

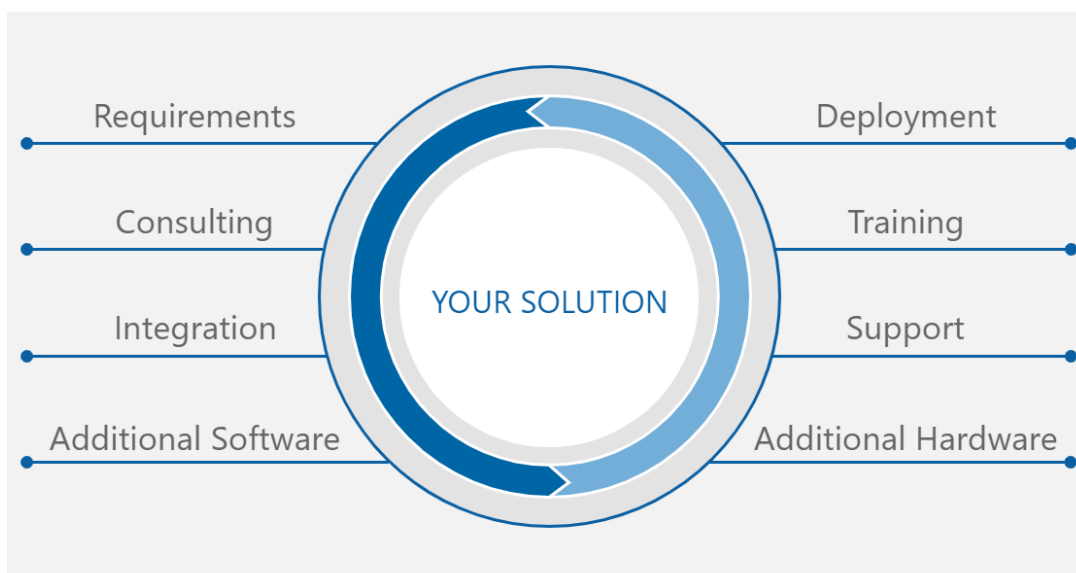


Figure 16. Alliance Partners Can Help Ensure Your Success

Partnering in Your Success

- **Integrators:** These Alliance Partner integration companies offer certified production test specialists to help reduce development time and cost by providing expertise and complete solutions.
- **Consultants:** These hourly consultants help mitigate risk and shorten design cycles through software architecture design, code review, and individual or team training.
- **Tools and Apps:** Build specialist IP into your solution to add functionality or reduce development time. The LabVIEW Tools Network offers hundreds of add-ons, toolkits, and reference applications compatible with NI and industry platforms.

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