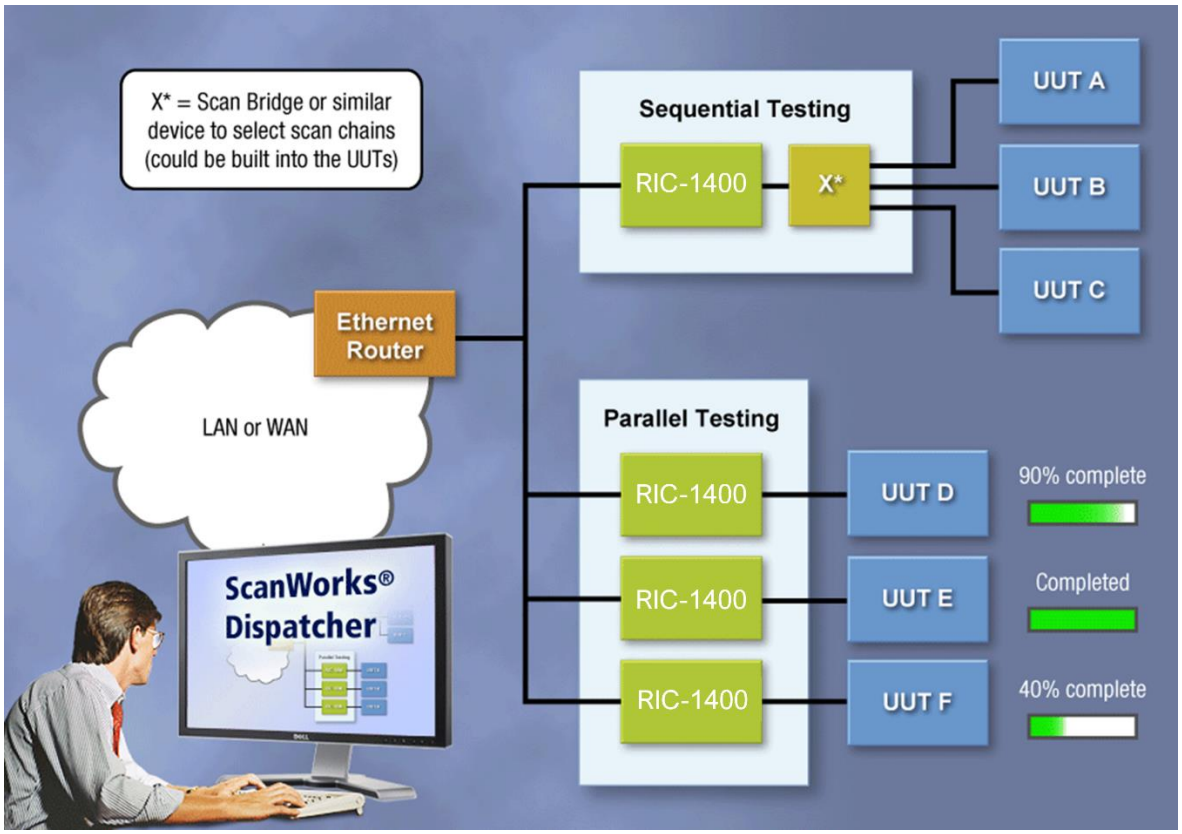
System-Level JTAG with

ScanWorks Dispatcher



Michael R. Johnson – Product Manager

Michael R. Johnson serves as Product Manager for ScanWorks Boundary Scan Test (BST) for ASSET InterTech, Inc. He also serves as manager of ASSET's Application Engineering and Professional Services organization. As Product Manager, Michael provides strategic direction for the ScanWorks BST product, ensuring an exceptional customer experience and adherence to current and future IEEE standards requirements. Michael coordinates with ASSET's cross-functional teams such as Marketing, Sales, Support, and Research and Development, to bring ASSET's business goals to fruition.

Before ASSET, Michael's background included roles as a Cellular System Engineer with Nortel Networks and a Hardware Design Engineer with Alcatel USA. While at Nortel Networks, Michael analyzed and provided handoff measurement data for Nortel's mobile and Personal Communications Services (PCS) networks. As a Hardware Design Engineer, Michael designed printed circuit board modules capable of transmitting and receiving optical signals at 622.08 Mb/s for Alcatel's transport fiber-optic systems.

Michael earned a Bachelor of Science degree with honors in Electrical Engineering from Southern University and A&M College located in Baton Rouge, Louisiana, and a Master of Business Administration degree with an emphasis in Strategic Leadership from Amberton University located in Garland, Texas.

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Executive Summary

In this eBook, we will examine a software application developed by ASSET InterTech named ScanWorks Dispatcher. ScanWorks Dispatcher is a flexible, high-speed, parallel, boundary-scan test and in-system programming application system for high test throughput. This eBook is the 4th in a Design for Test (DFT) tome which has focused on guidelines specific to boards and systems to be tested through IEEE 1149.1 JTAG/Boundary Scan. Following board-level Boundary Scan DFT guidelines during the board design phase provides a method of accessing embedded test resources for non-intrusive opens and shorts testing, along with device programming. Implementing system-level JTAG ensures boards within a system are structurally sound with device programming capabilities while ensuring the complex system functions when assembled. Structural testing of boards, individually, is an important aspect of complete system functionality since faults can occur when the entire system is assembled. Testing systems as a complex whole is useful during functional and environmental testing. With ScanWorks Dispatcher, boundary scan tests can be applied to multiple boards simultaneously. Dispatcher, along with implementing various JTAG architecture designs, multi-drop devices, multi-Test Access Port (TAP) hardware, or embedded software applications, can significantly increase board test coverage and manufacturing throughput. The following topics will be covered in this eBook. (Figure 1)

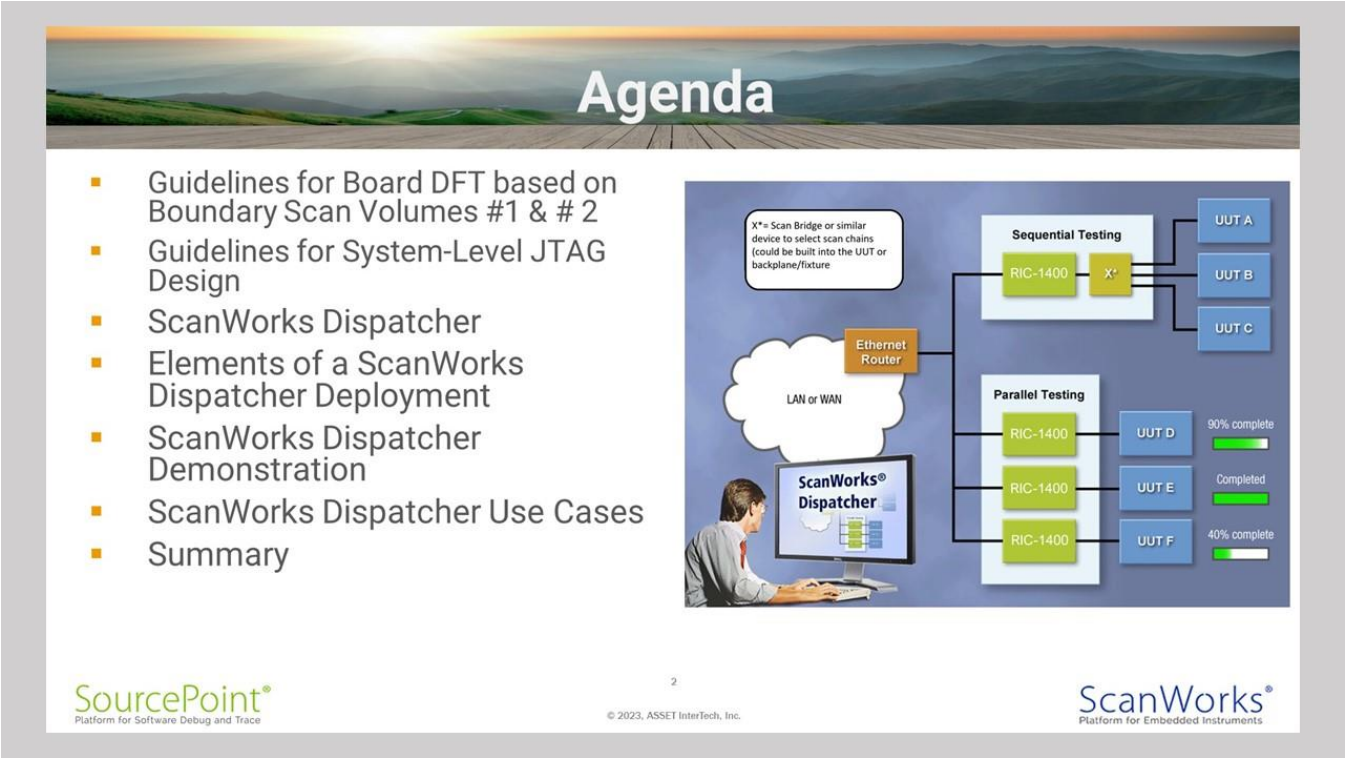

Figure 1: System-Level JTAG with ScanWorks Dispatcher – Agenda

Board DFT based on Boundary Scan – Volume #1

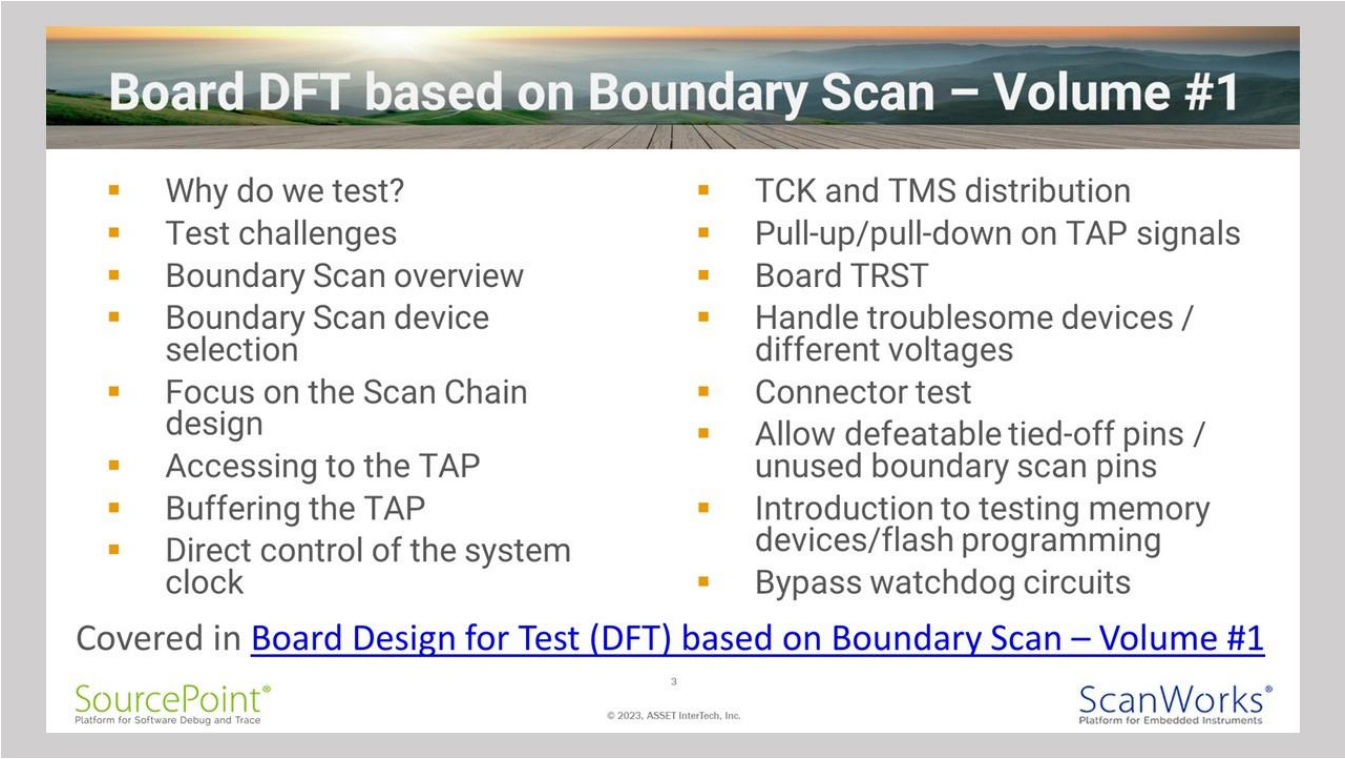

Figure 2: Board DFT based on Boundary Scan – Volume #1

These board-level DFT guidelines were covered in my 1st DFT eBook. This eBook can be accessed from the ASSET website. (Figure 2)

Board DFT based on Boundary Scan – Volume #2

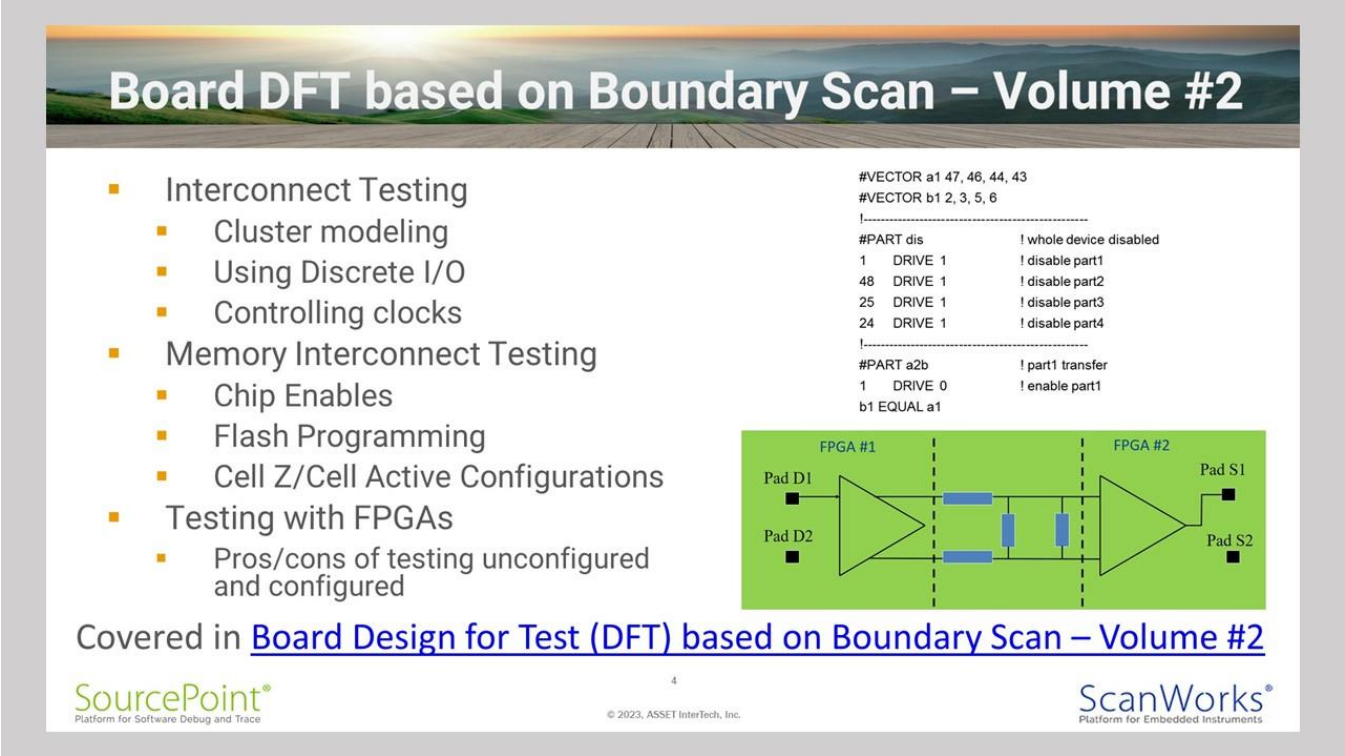

Figure 3: Board DFT based on Boundary Scan – Volume #2

These board-level DFT guidelines were covered in my 2nd DFT eBook. This eBook can also be downloaded from the ASSET website. (Figure 3)

System-Level JTAG Design

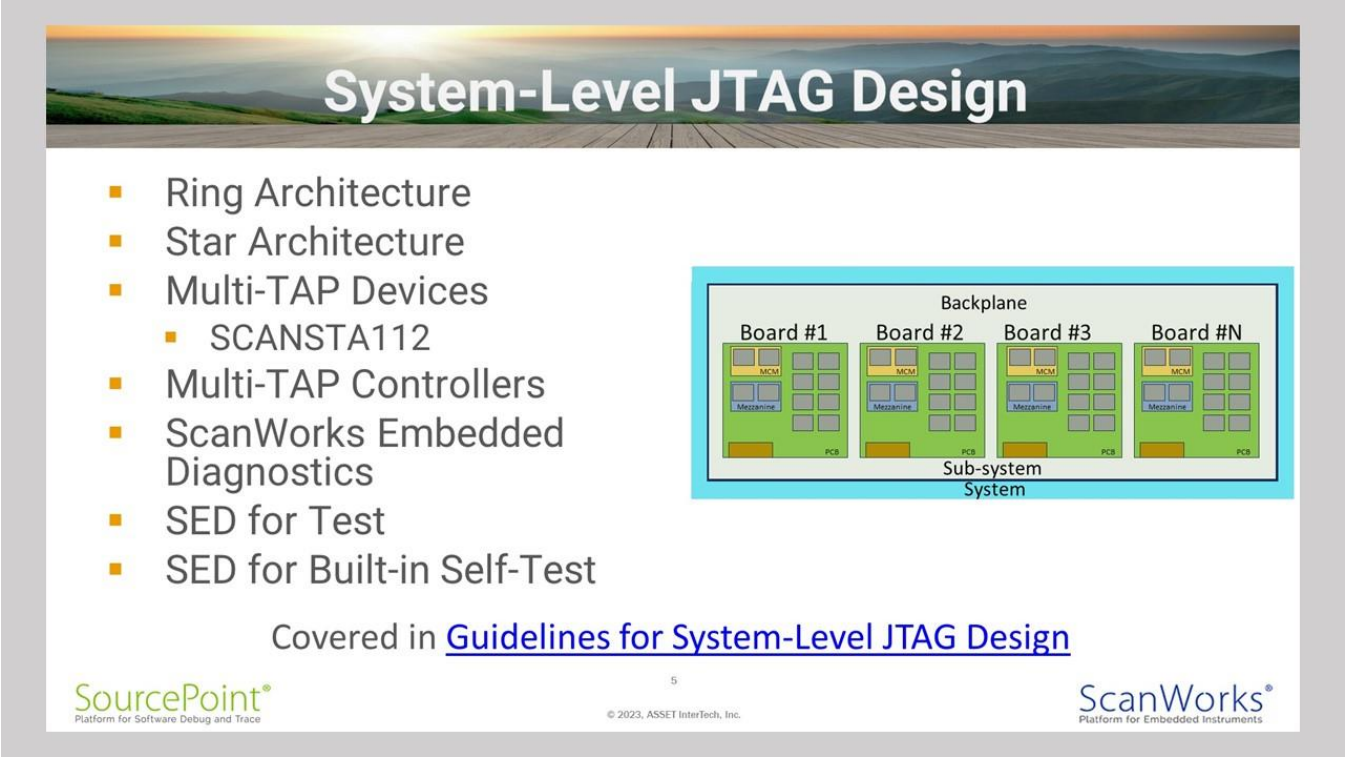

Figure 4: System-Level JTAG Design

The 1st two eBooks in this tome focused on board-level DFT for Boundary Scan. The 3rd eBook focused on implementing a system-level JTAG solution leveraging the onboard Boundary Scan resources by making architecture modifications to the backplane, using multi-drop devices to create multiple scan chains, use of multi-Test Access Port (TAP) hardware, or use of software/embedded applications to implement a system-level test solution. Combining board-level DFT guidelines along with system-level JTAG designs increases test coverage and test flexibility. (Figure 4)

System-level JTAG Design – SJTAG Universe

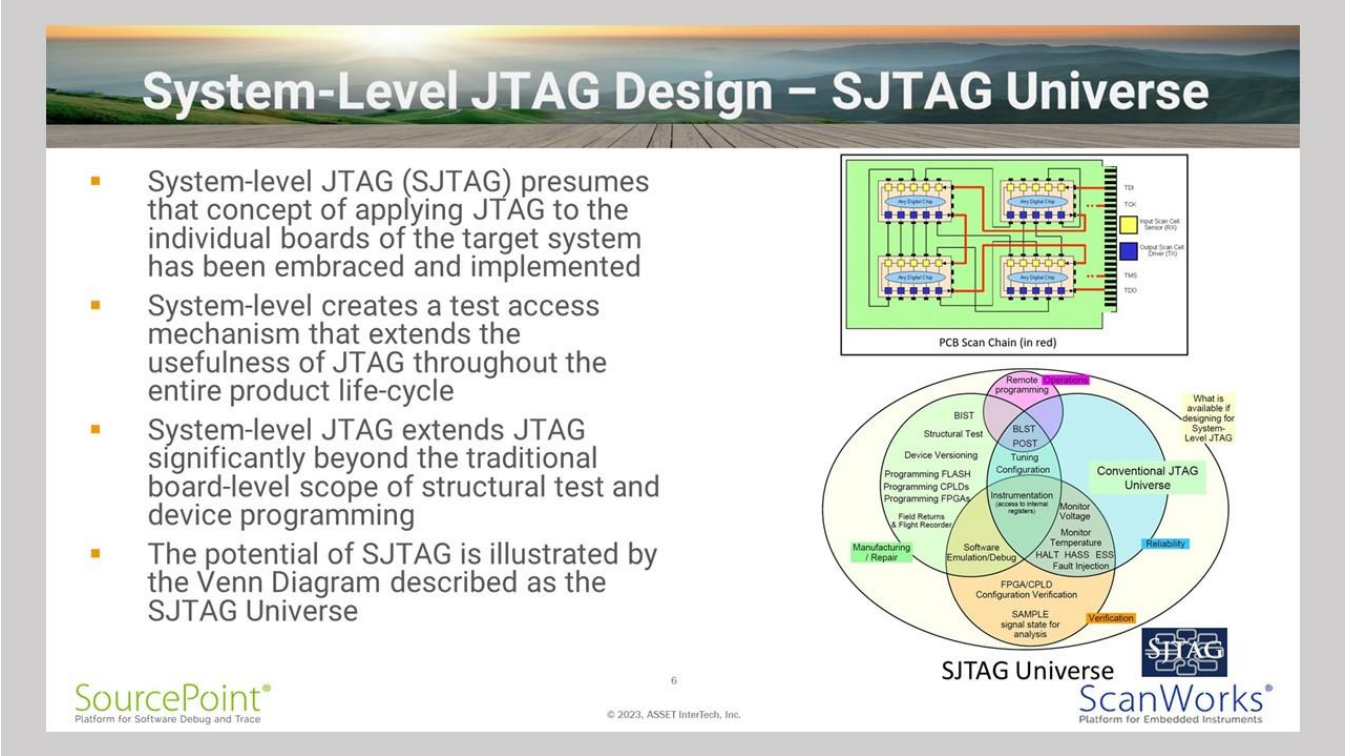

Figure 5: System-Level JTAG Design – SJTAG Universe

System-level JTAG, or SJTAG expands the application potential of JTAG significantly beyond the traditional board-level scope of structural test and device programming. By taking account of the factors that arise when creating an assembly of boards, and by applying SJTAG design principles to address those factors, the underlying board-level JTAG feature can be leveraged at the system level, creating a test access mechanism that extends the usefulness of JTAG throughout the entire product life cycle.

The Venn Diagram created by the IEEE SJTAG working group illustrates the application potential of SJTAG extends significantly beyond the traditional board-level scope of structural test and device programming. (Figure 5)

System-level JTAG Design – Architectures

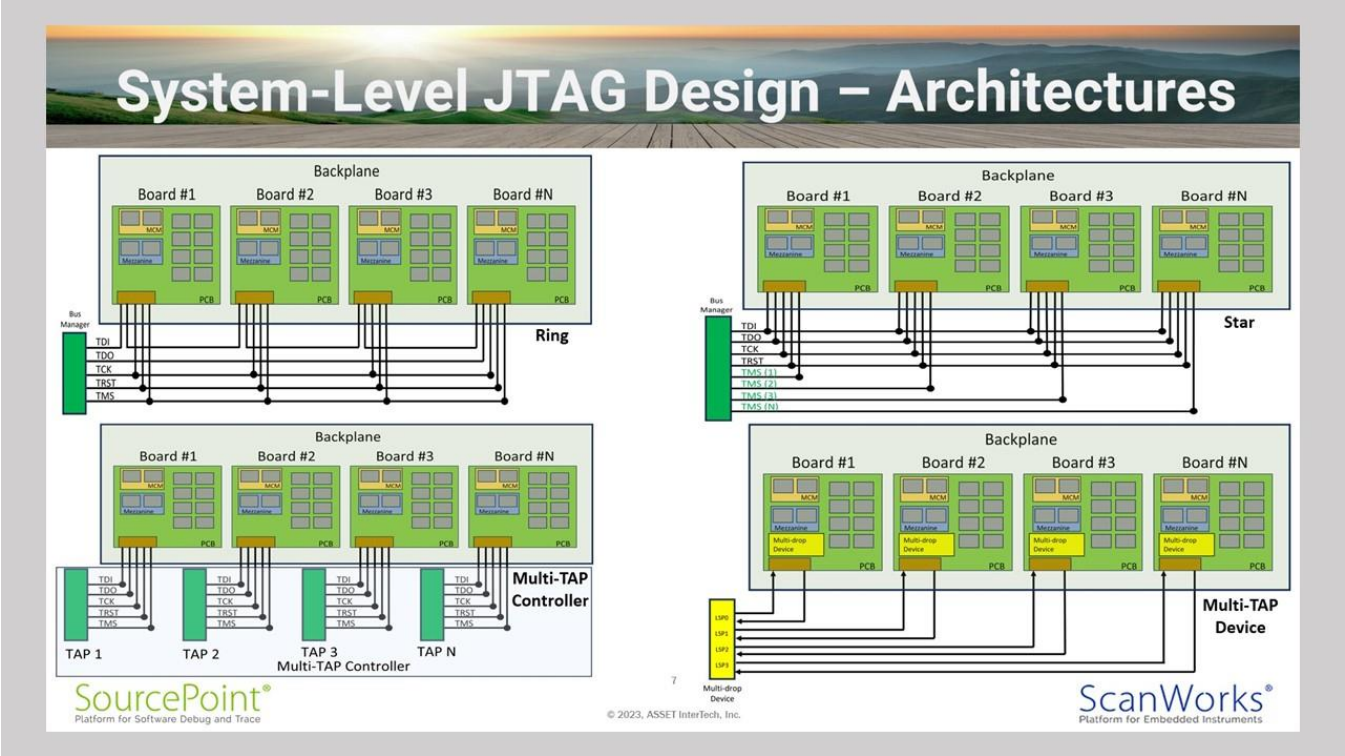

Figure 6: System-Level JTAG Design – Architectures

These system-level JTAG architectures were discussed in my last eBook. Each architecture has advantages and disadvantages in its implementation. For instance, an advantage of the Ring architecture is that it has a single scan chain per system with one access point, but a disadvantage of this implementation is that one break in the scan chain, such as a corrupt TDO signal, will disable all Boundary Scan operations.

I've covered the advantages and disadvantages of each architecture in my system-level eBook, so please take time to review each. Depending upon your test objectives, any one of these system-level architectures could be used in conjunction with ASSET's Dispatcher to add more test coverage and test flexibility in the production environment. (Figure 6)

What is ScanWorks Dispatcher?

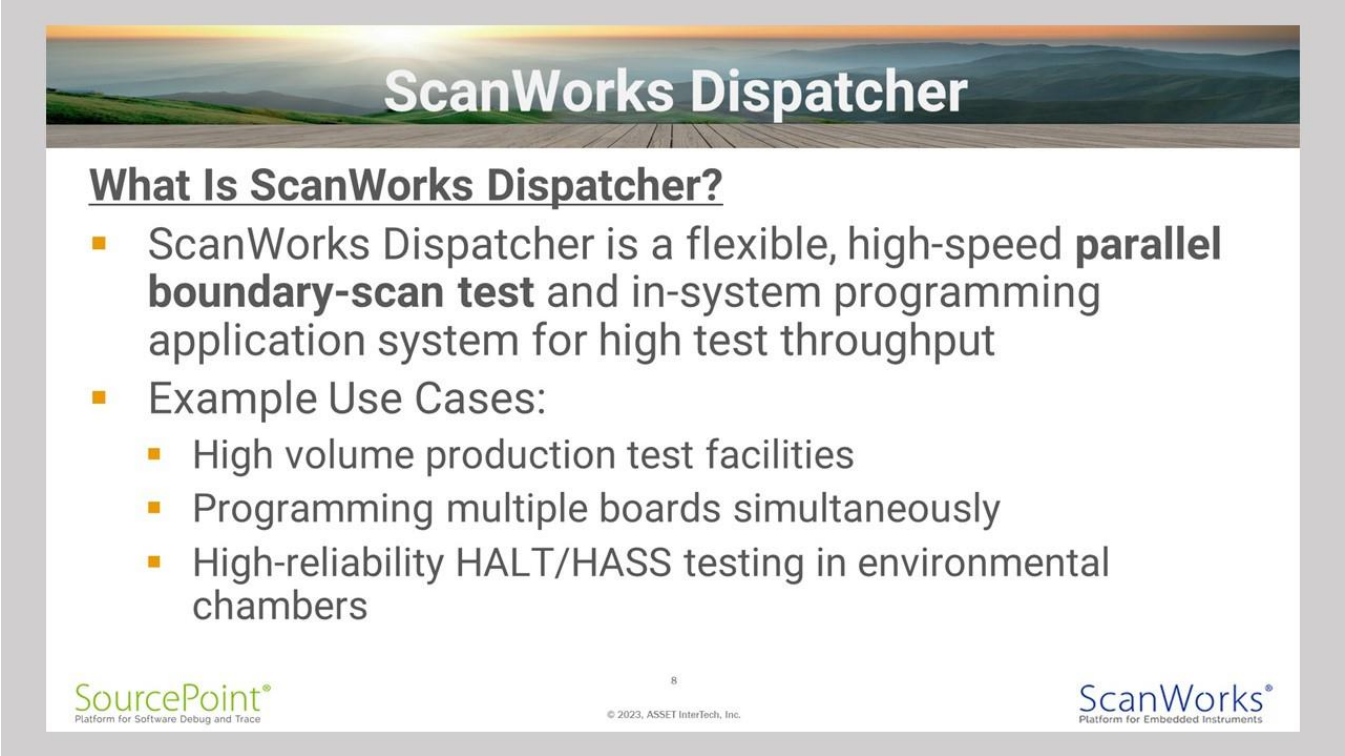

Figure 7: What is ScanWorks Dispatcher?

So, what is ScanWorks Dispatcher? ScanWorks Dispatcher is a flexible, high-speed parallel boundary-scan test and in-system programming application system for high test throughput. Example Use Cases are high-volume production test facilities, programming multiple boards simultaneously, and high-reliability HALT/HASS testing in environmental chambers. (Figure 7)

ScanWorks Dispatcher Capabilities

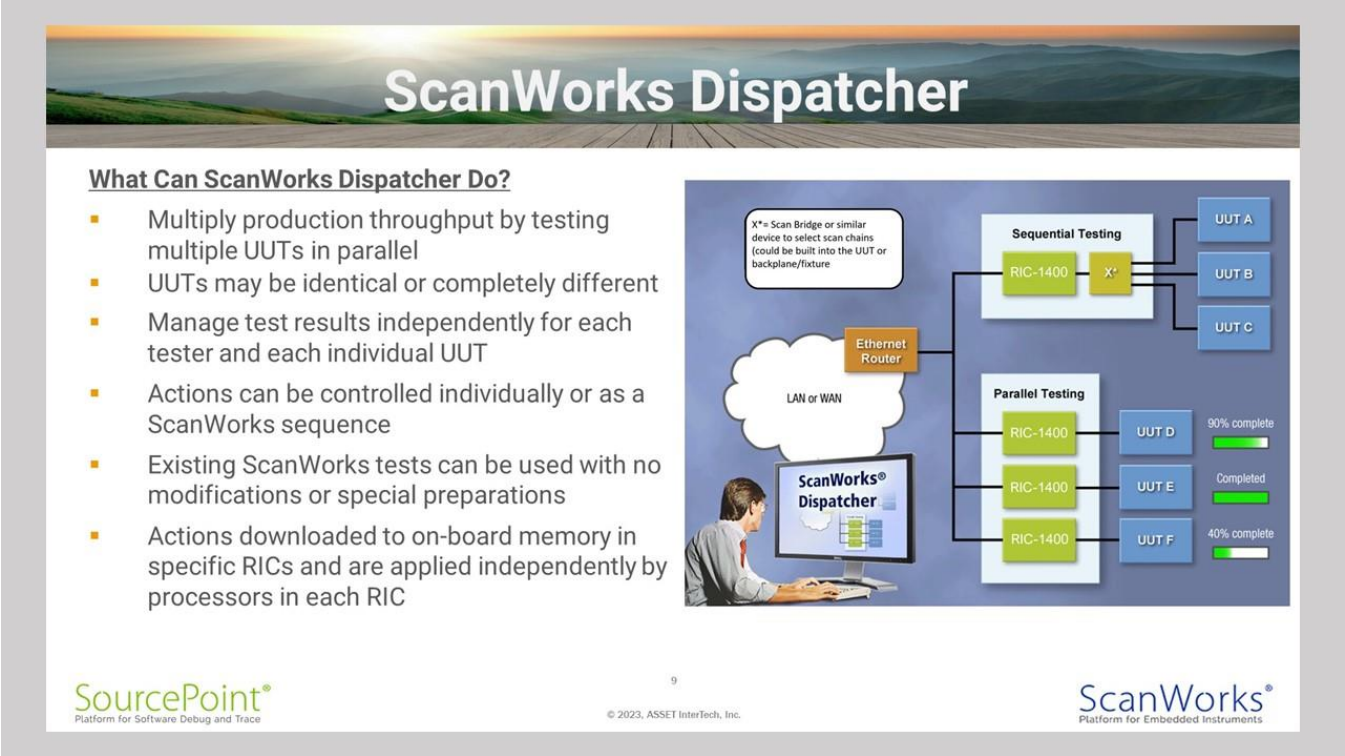

Figure 8: ScanWorks Dispatcher Capabilities

What can ScanWorks Dispatcher do? ScanWorks Dispatcher can multiply production throughput by testing multiple UUTs in parallel. The UUTs may be identical or completely different. ScanWorks Dispatcher can also manage test results independently for each tester and each individual UUT, control actions individually or as a ScanWorks sequence. Existing ScanWorks tests can be used with no modifications or special preparations. Actions are downloaded to on-board memory in specific RICs and applied independently by processors in each RIC-1400. (Figure 8)

ScanWorks Dispatcher API

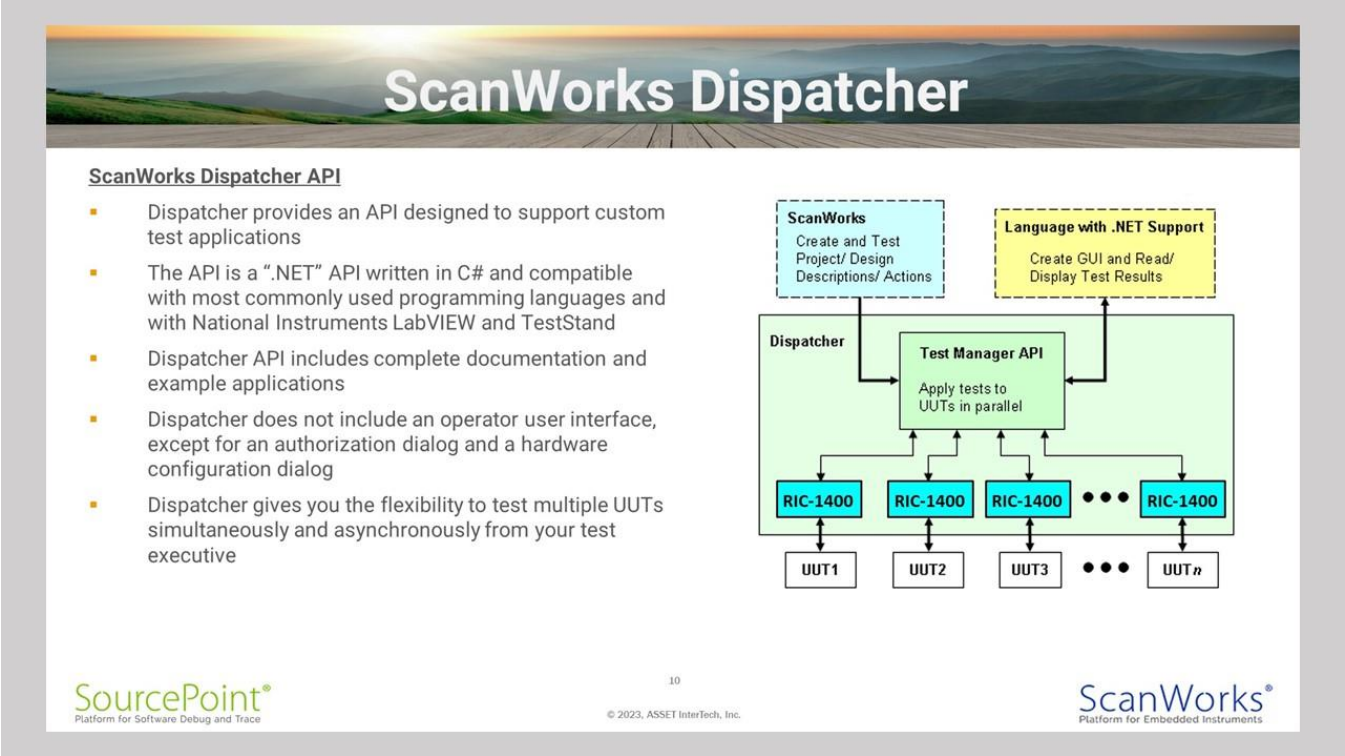

Figure 9: ScanWorks Dispatcher API

The Dispatcher provides an API designed to support custom test applications. The API is a ".NET" API written in C# and compatible with most used programming languages and with National Instruments LabVIEW and TestStand. Dispatcher API includes complete documentation and example applications. Dispatcher does not include an operator user interface, except for an authorization dialog and a hardware configuration dialog. Dispatcher gives you the flexibility to test multiple UUTs simultaneously or asynchronously from a test executive. (Figure 9)

ScanWorks Dispatcher API Object Model

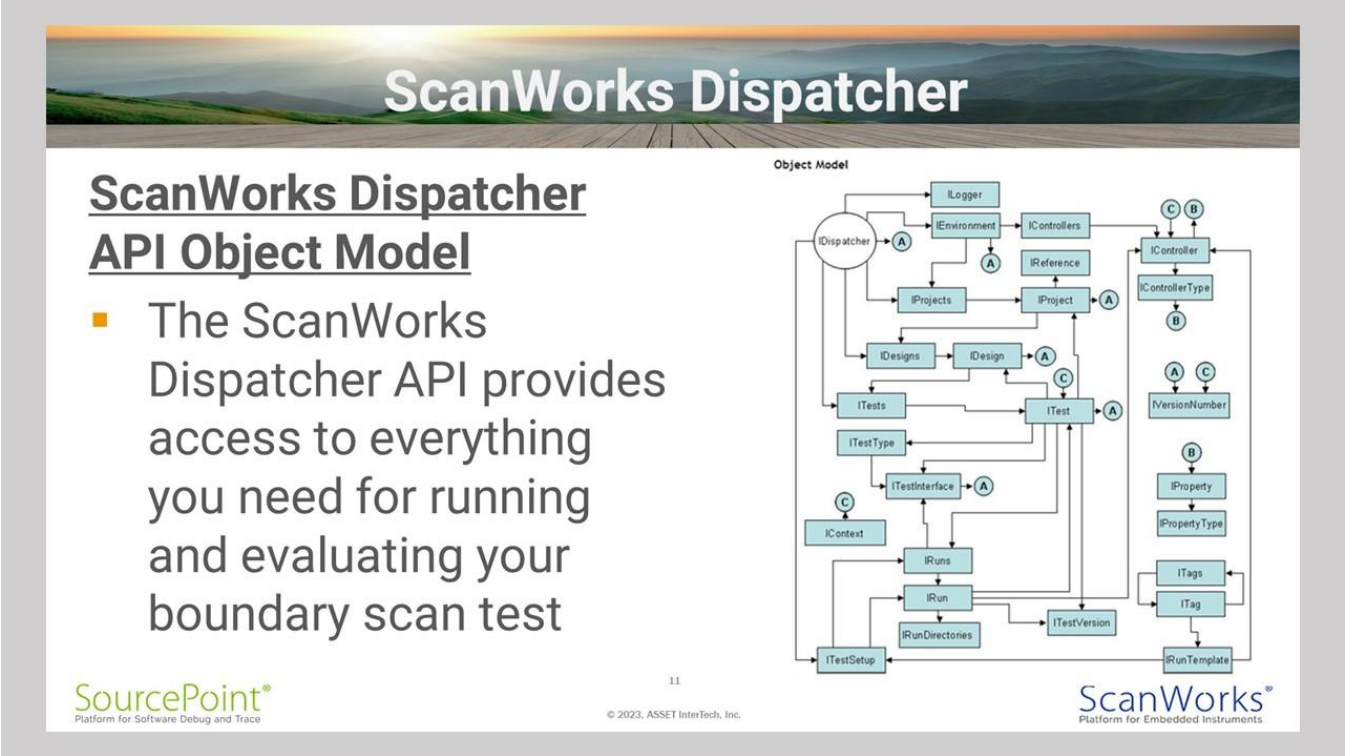

Figure 10: ScanWorks Dispatcher API Object Model

The ScanWorks Dispatcher API gives you access to everything you need for running and evaluating your boundary scan test. There is help documentation to assist you in building your GUI to run and evaluate your test. (Figure 10)

ScanWorks Dispatcher Example APIs

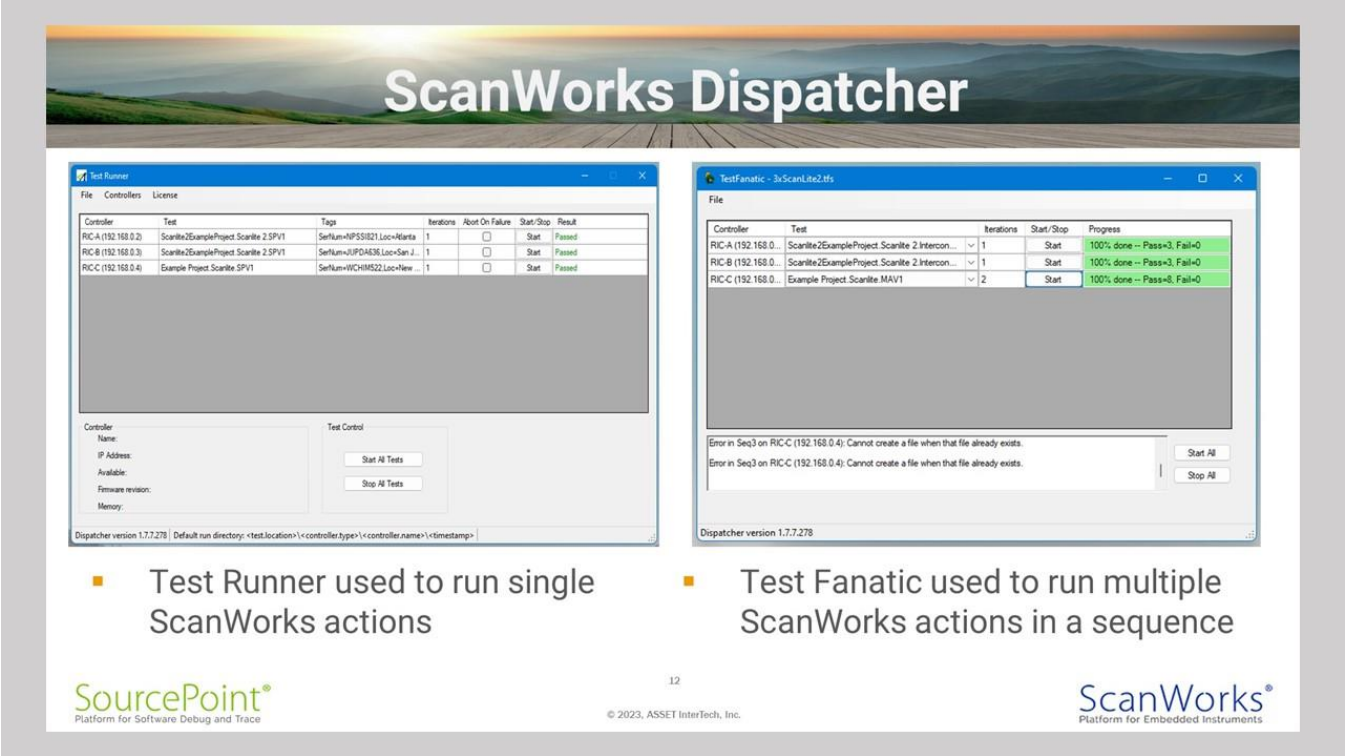

Figure 11: ScanWorks Dispatcher Example APIs

Dispatcher comes with two example APIs named Test Runner and Test Fanatic. With Test Runner, you can apply boundary scan tests individually, and with Test Fanatic you can run a sequence of boundary scan tests. The source code is available for you to review and reuse in creating your own custom API. (Figure 11)

Elements of a ScanWorks Dispatcher Deployment

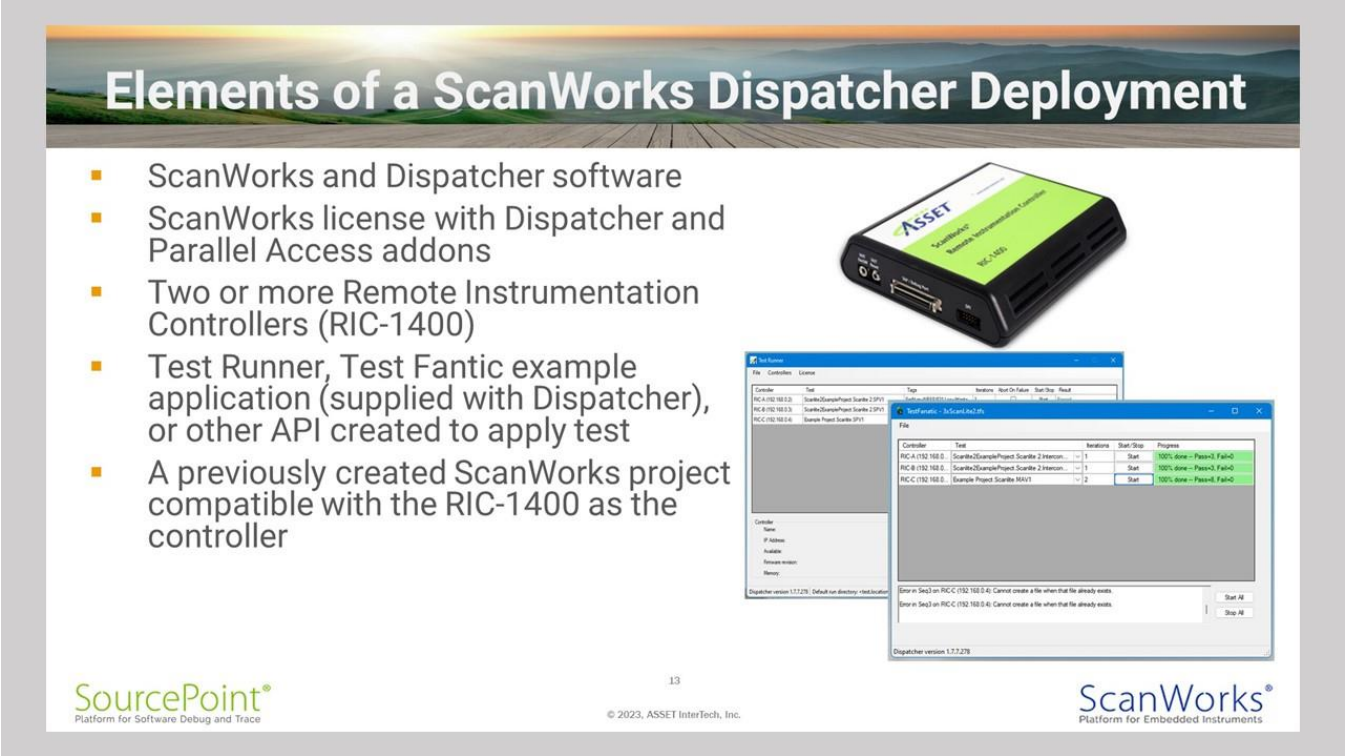

Figure 12: Elements of a ScanWorks Dispatcher Deployment

To implement a ScanWorks Dispatcher deployment the following elements are needed:

- ScanWorks and Dispatcher software
- ScanWorks license with Dispatcher addon
- Two or more Remote Instrumentation Controllers (RIC)-1400s
- Test Runner, Test Fanatic example application (supplied with Dispatcher), or other API created to apply boundary scan tests.
- A previously created ScanWorks project compatible with the RIC-1400 as the controller

(Figure 12)

ScanWorks Dispatcher Demonstration

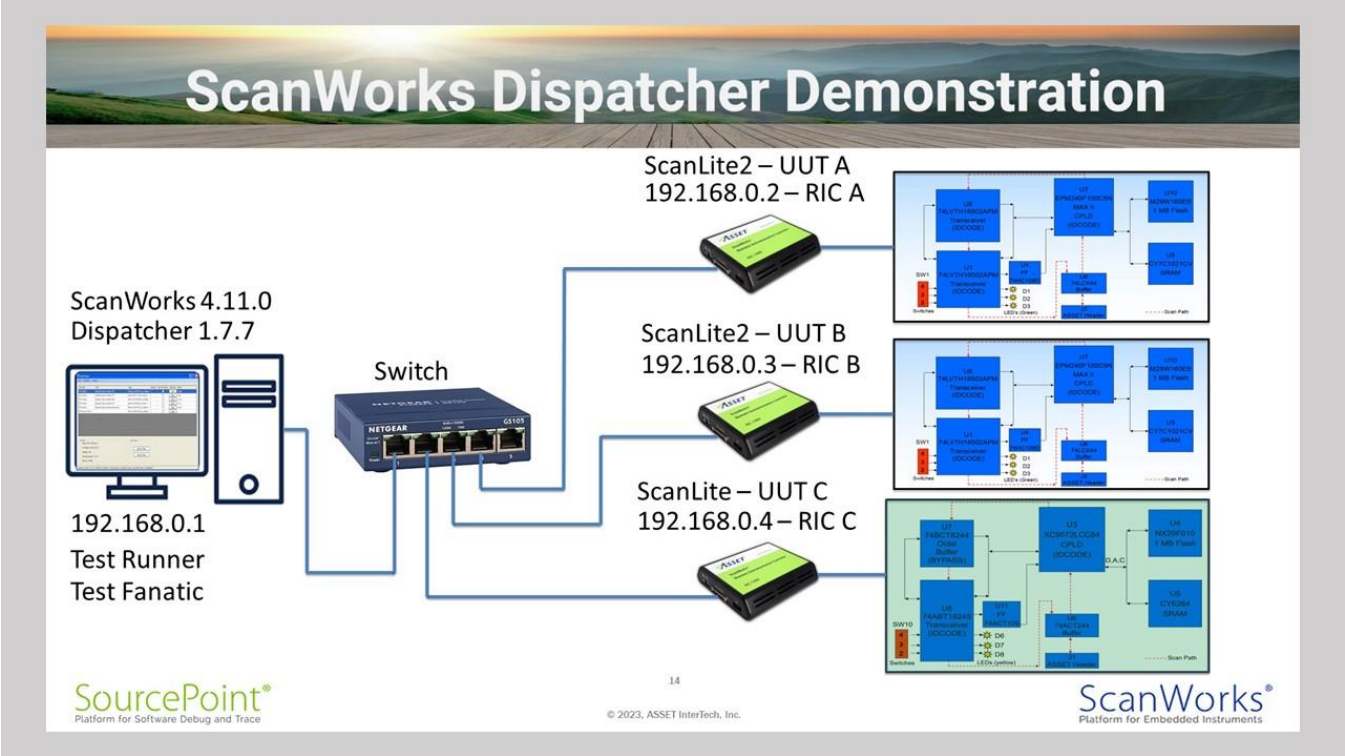

Figure 13: ScanWorks Dispatcher Demonstration

Let's move to a demonstration of how Dispatcher can be applied to test multiple UUTs simultaneously. In your production environment, these UUTs could be the same type or mixed type. With Dispatcher we can apply different ScanWorks actions to each based on the project created for the UUT.

The demonstration will involve testing two of ASSET's ScanLite2 boards and one different board, the ScanLite which is the previous iteration of this board, the ScanLite2. Although ScanLite2 and ScanLite are similar in function, they have different boundary-scan components. I've shaded the ScanLite green to distinguish it. To prepare for this demonstration, I've configured an IP address for each RIC-1400. This was easily done with an application provided in ScanWorks and applied using a Windows Command Shell. ASSET's latest version of ScanWorks 4.11.0 and Dispatcher 1.7.7 were both installed.

Please visit https://www.asset-intertech.com/resources/videos/ and view the System-Level JTAG with ScanWorks Dispatcher video. (Figure 13)

ScanWorks Dispatcher Use Cases

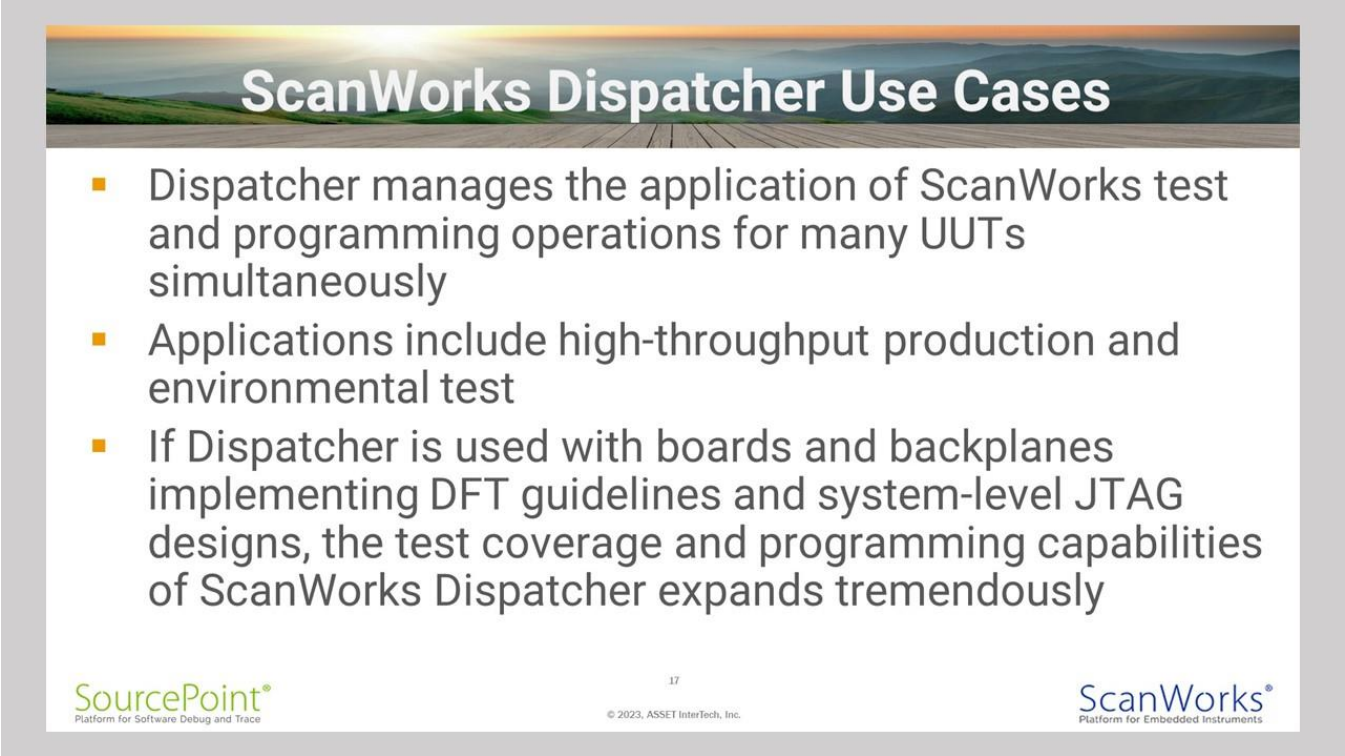

Figure 14: ScanWorks Dispatcher Use Cases

Dispatcher manages the application of ScanWorks test and programming operations for multiple UUTs simultaneously. Applications include high-throughput production and environmental tests. If Dispatcher is used with boards and backplanes implementing DFT guidelines and system-level JTAG designs, the test coverage and programming capabilities of ScanWorks Dispatcher expand tremendously. (Figure 14)

ScanWorks Dispatcher Use Cases – Fixtures and Backplanes

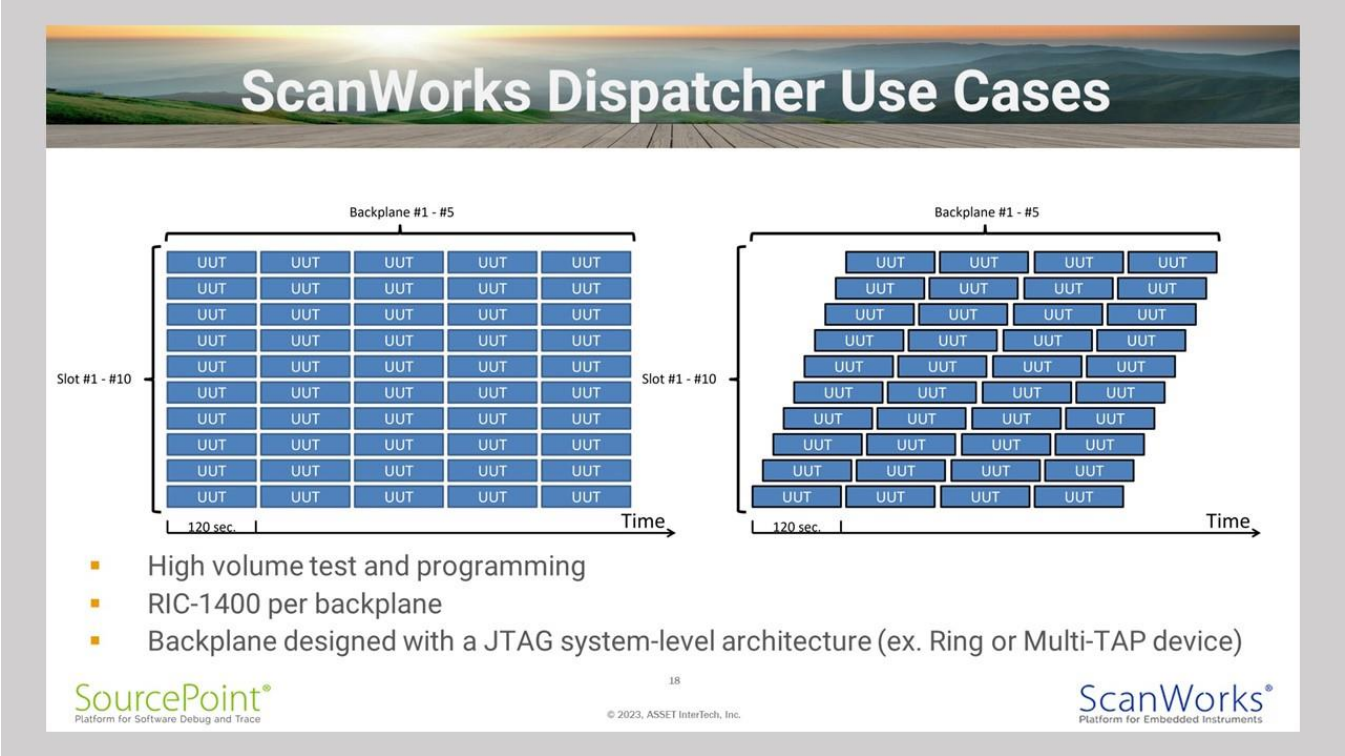

Figure 15: ScanWorks Dispatcher Use Cases – Fixtures and Backplanes

It is not unusual today in high-volume manufacturing that boards are produced on parallel lines and are tested and programmed in parallel. Testing and programming can be a bottleneck in production. Imagine a design that needs to be programmed in-system and the traditional programming over JTAG takes 120 seconds per board. Here are a couple of different scenarios on how the distributed test and programming can be configured in the production flow using Dispatcher.

The figure on the left is a scenario of parallel testing where the UUTs arrive in batches of ten. As the 10 UUTs are loaded into each backplane, the operator can begin the test of each with Dispatcher. The figure on the right is a scenario where there is time between each UUT arriving for tests. As each UUT arrives, it can be inserted in the backplane, and the tests started with Dispatcher. (Figure 15)

ScanWorks Dispatcher Use Cases – Mixed UUTs

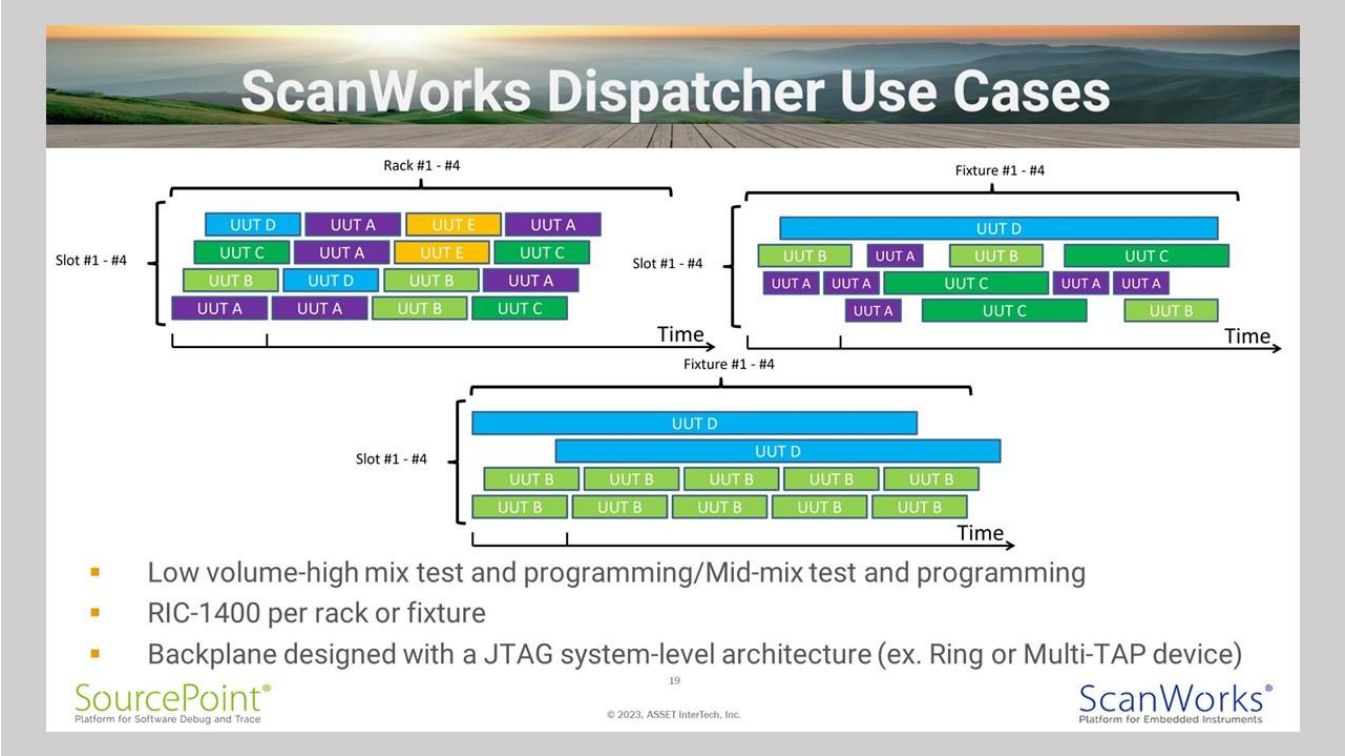

Figure 16: ScanWorks Dispatcher Use Cases – Mixed UUTs

Dispatcher could be used where there is a high mix of products, but not necessarily of high volume. Here the challenge exists in allowing the same production system to manage several unique designs simultaneously and asynchronously, but with the same requirements for in-system programming under time restrictions.

The first case is a rack-based environment where the UUTs arrive in batches of four, and the UUTs can be of multiple unique designs. The test system may be equipped with barcode scanners that automatically scan the unit identity and apply the correct ScanWorks project. The second case is a more flexible backplane solution where an operator is populating the UUTs by hand as they come off the production line. This is a powerful way to maximize the utilization of the test equipment when the high-mix designs also have different programming times. These production scenarios are of course different for different companies in different markets. The benefits of Dispatcher combined with the appropriate JTAG system-level architecture create a flexible test strategy. (Figure 16)

Summary

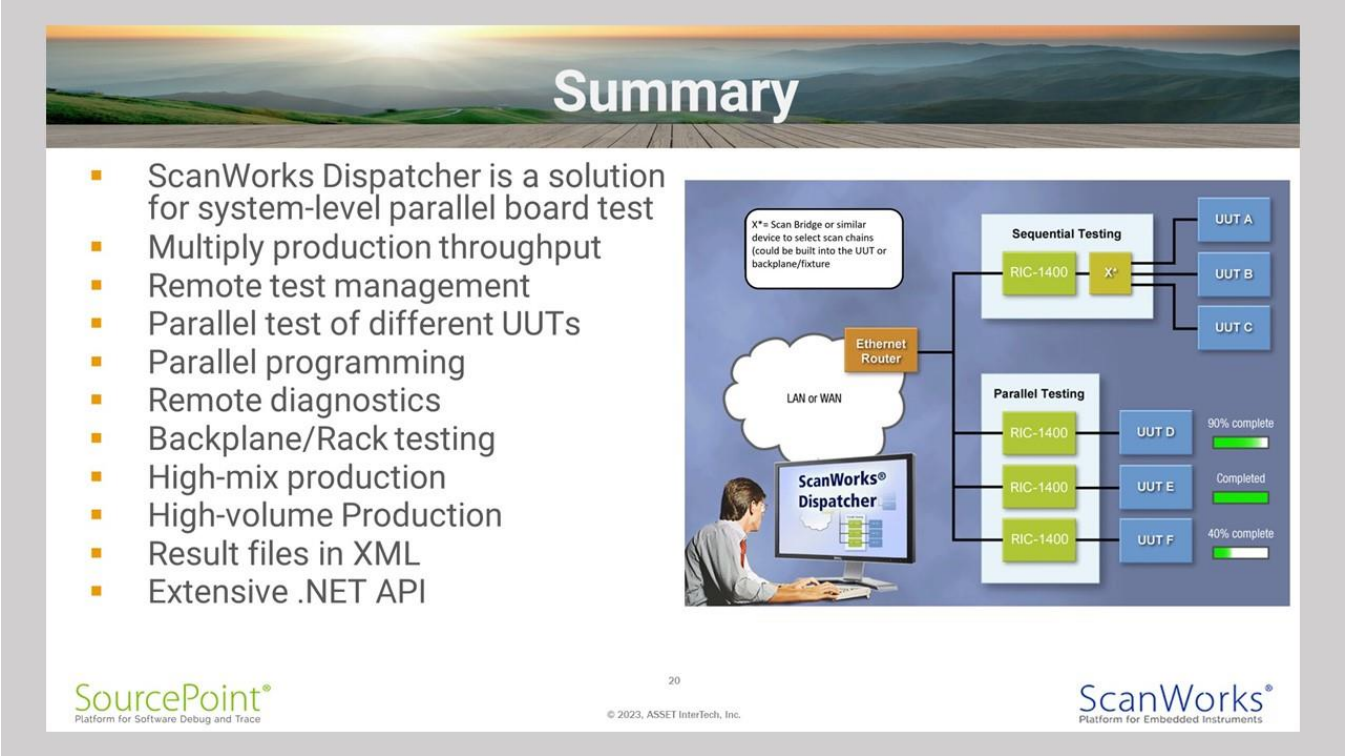

Figure 17: Summary

In summary, Dispatcher is a solution for system-level parallel board tests that provides benefits such as:

- Multiply production throughput
- Remote test management/remote diagnostics
- Parallel test/programming of different UUTs
- Rack/fixture/backplane testing
- High-mix/high-volume UUT production testing
- .XML result files and an extensive .NET API

(Figure 17)

Additional Resources

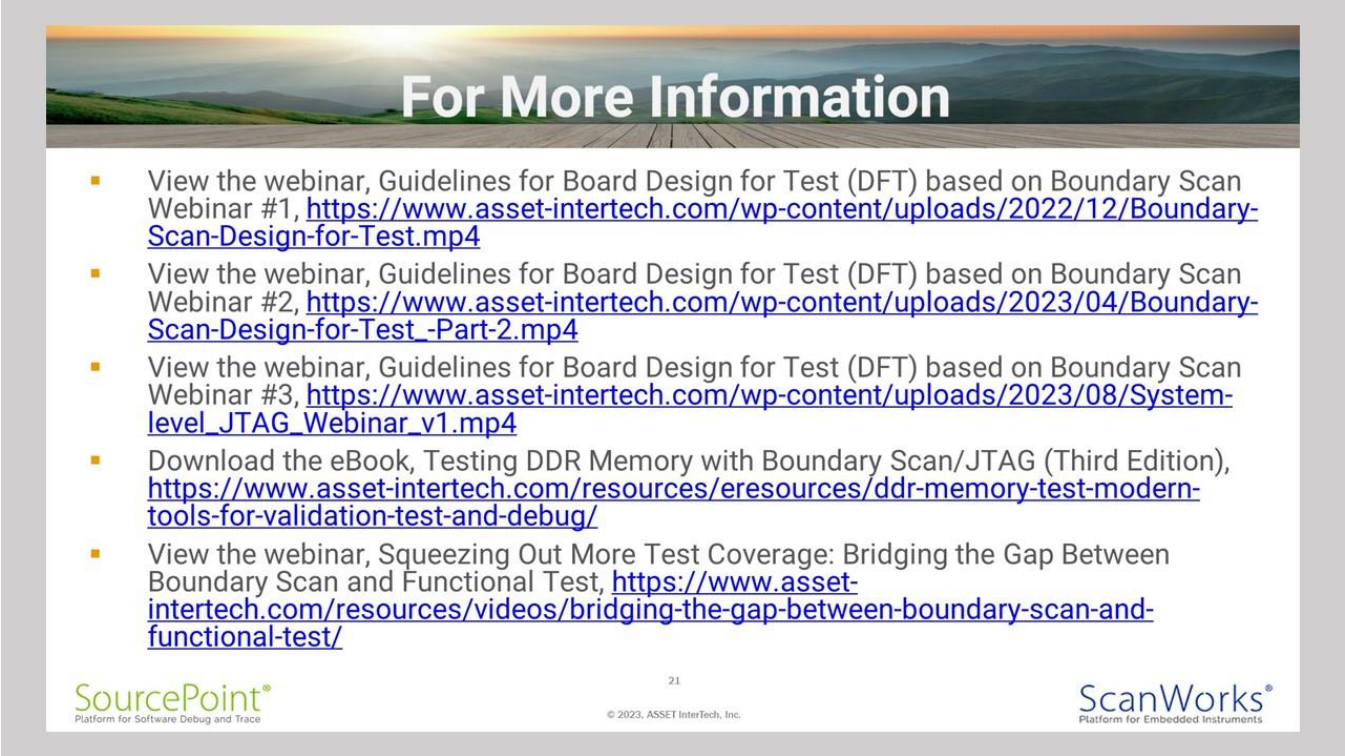

Figure 18: Additional Resources

For more information on DFT topics please visit the ASSET website. There are also eBooks, videos, and blogs on a variety of Boundary Scan and other test-related topics. (Figure 18)

Conclusion

In this eBook, we examined a software application developed by ASSET InterTech named ScanWorks Dispatcher. ScanWorks Dispatcher is a flexible, high-speed, parallel, boundary-scan test and in-system programming application system for high test throughput.

Testing boards individually with JTAG, as they are produced, is valuable. Detecting structural faults, device programming and functional testing of boards before system assembly is beneficial to ensuring proper system functionality. The overarching goal is for the complete system to function properly, system-level JTAG ensures this. Detecting and repairing faults on individual boards is key to reducing overall production costs. Several types of faults can take place when the entire system is assembled. Implementing system-level JTAG can be quite useful in testing backplane connections, connectors, and backplane passive and active circuitry.

With Dispatcher, testing a complex system can be implemented during functional testing while the entire system is undergoing environmental testing as well. There are several benefits to parallel tests and programming; just-in-time in-system configuration of products; capital equipment savings in reduction of off-line programmers; and time savings in production.

System-level JTAG can be used throughout the life cycle of the product. Starting with design, manufacturing, and eventually testing complete installed systems within installed products, system-level JTAG can play a vital role. Maximizing board test coverage and system-level test functionality is imperative to improving manufacturing yields, increasing product quality, and reducing product returns. Ultimately, Boundary Scan system test ensures a high-quality system.