



CONNECT

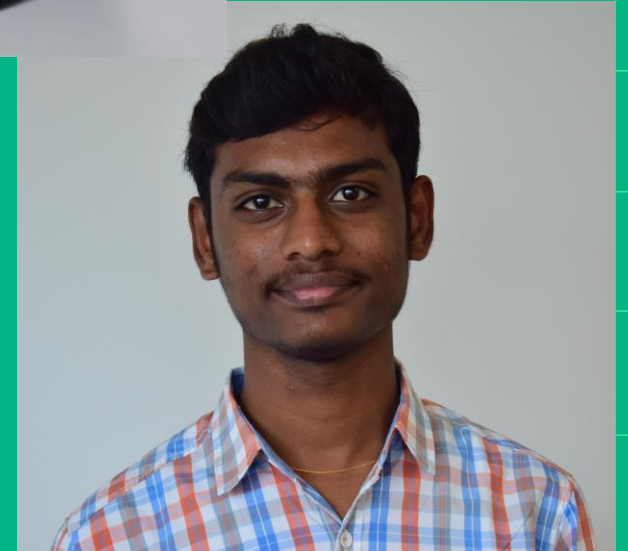
2023 AUSTIN



Protocol Analyzer for Digital Communication Validation

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Agenda

- Introduction & market challenges (5 mins)
- Overview of NI & Soliton's solution: software and hardware (10 mins)
 - PVS, PA, SDC, PXI
- Deep Dive into latest protocol software: Protocol Analyzer (20 mins)
- Q&A (remaining 10-15 mins)

About Us



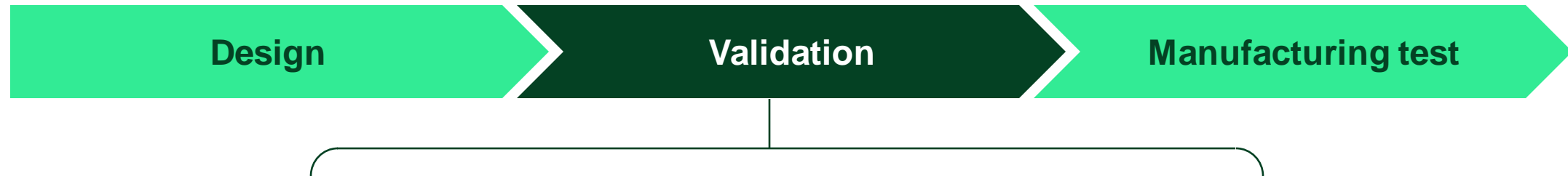
- NI equips engineers and enterprises with systems that accelerate productivity, innovation, and discovery.
- Primarily focused on the semiconductor, electronics, aerospace/defense, and transportation industries.
- \$1.3B revenue in 2020
- 22% investment in R&D
- ~40 countries with NI operations
- 35,000+ customers worldwide



- Soliton works with global companies, from startups to Fortune 500, to help them increase their competitiveness and release great products through Digital Transformation Services.
- Primarily focused on the semiconductor, electronics, medical devices, automotive and transportation industries.
- 25 years of excellence
- 3,000+ customers worldwide

NI and Soliton have signed a strategic partnership agreement to jointly develop bench and enterprise software for Semiconductor Validation automation and Spec+Data Management

Challenges with Protocol Interface Validation



Lab Validation Challenges

- Increasing device complexity
- Ever-changing requirements
- New protocol evolution, such as MIPI I3C
- Validation of these interfaces are tedious job, but critical
- Achieving full spec coverage can be difficult for DIY
- High cost of tests
- Pressure to reduce go-to-market time
- Lack of IP reuse / duplicate efforts
- Inconsistent data across teams

Standardized & Turnkey Solution Can Help

- Reduce time and cost: tool & framework development, maintenance
- Flexibility with hardware: protocol validation is done with software
- Quickly access and interpret protocol waveforms and data
- Easy debug and reporting with interactive software
- Faster RTM: reduce protocol validation time from weeks to hours
- Enable measurement IP reuse
- Reproduce & deploy solutions globally

Digital Protocol Validation Solution

Exerciser to Compliance Tester

New!



Protocol Analyzer & Decoder

- Decode & annotate captured protocol waveforms
- Measures & reports timing and voltage parameters
- MIPI I3C, I2C
- Hardware: Works with NI Scopes



Protocol Validation Solution

- Protocol compliance tester
- Validate digital interface for specific protocol compliance (e.g., MIPI I3C, I2C, SPI, SPMI)
- Timing, electrical, functional & fault reliability tests
- Hardware: Works with PXIe-657x Digital Pattern Instrument



Semiconductor Device Control (Protocol Exerciser)

- Interactive & automated device communication via digital interface
- Perform register R/W & static DIO
- MIPI I3C, I2C, SPI, RFFE
- Hardware: Works with PXIe-657x

Hardware

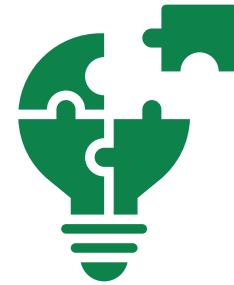


PXI Digital Pattern Instrument (PXIe-657x): Includes Digital Pattern Editor for configuring pin maps, specs, levels, timing, and patterns

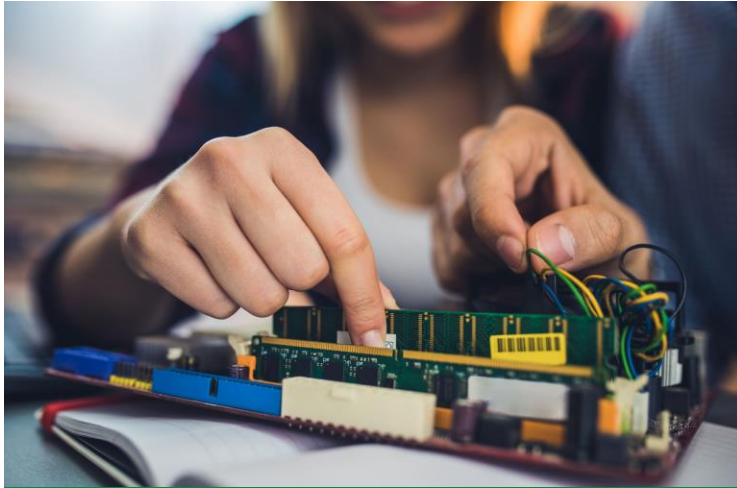
Oscilloscopes: High performance portfolio of NI scopes



Protocol Analyzer



Why Protocol Analyzer?



Protocol bus sniffer
Debug & Analyze the
waveform during DUT bring
up

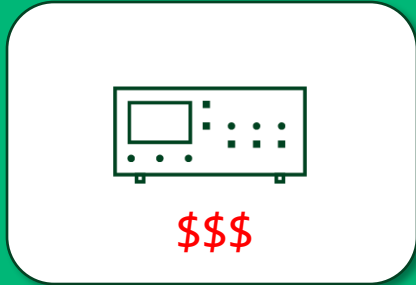


Verify device performance
in system

Signal integrity Testing
Functional Testing

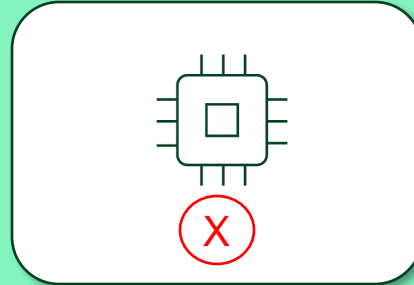
Challenges with Traditional Protocol Analyzer

Oscilloscope Based and Box Type



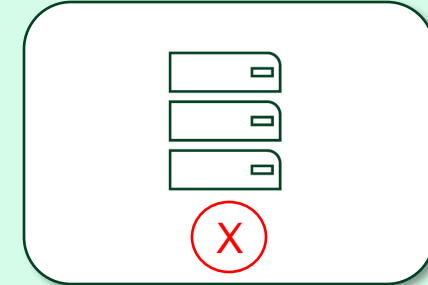
Requires Costly
Oscilloscopes that supports
Protocol Decoding

Depends on exact model of
the oscilloscope or box type
equipment



New Protocol Supports
needs additional hardware
or plugin

Limited support for protocol
electrical measurements



Doesn't provide automation
APIs

Doesn't provide automated
reporting of the capture
history

Protocol Analyzer and Decoder



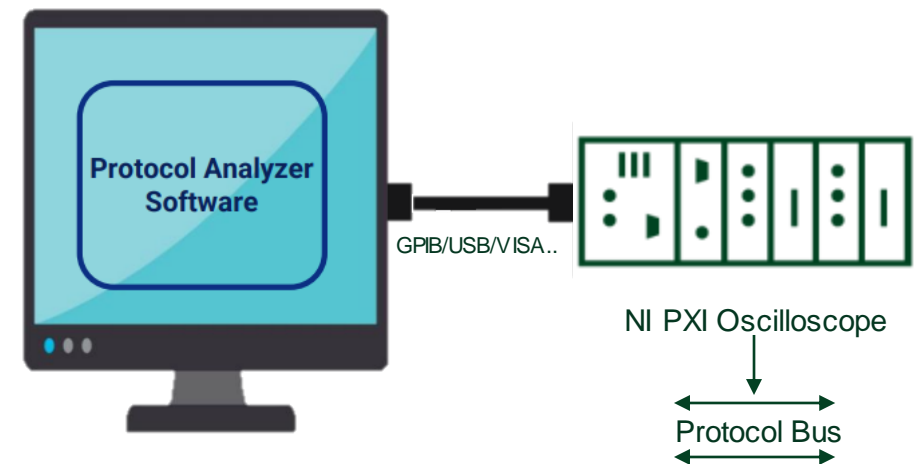
Turn your scopes into powerful protocol analyzers

SOFTWARE

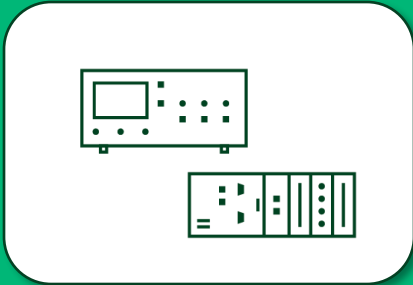
- Verifies device performance in system & signal integrity testing for MIPI I3C, I2C protocols, and more
- Decode and annotate the captured protocol waveform
- Measures and reports the timing and voltage parameters
- Open architecture to support any scopes
- Provides detailed and insightful data logs
- Easy to automate from external programming environment through APIs

HARDWARE

- Protocol Analyzer software works with Oscilloscopes
- Captures the protocol packet information while SW decodes

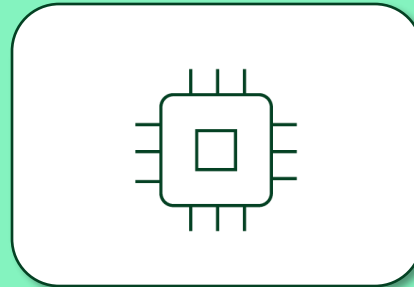


Key Advantages



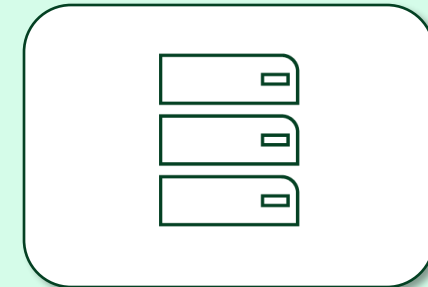
Convert your existing scopes into analyzers. Doesn't need additional hardware

Hardware Agnostic solution



Easy to add new Protocols with simple software plugin

Performs both Protocol Decoding and Full Electrical Measurements



Comes with automation APIs to enable automation from external applications

Maintains capture history and logs the decoded information into insightful TDMS files



Protocol Analyzer Software Preview

The screenshot displays the Soliton I3C Protocol Analyzer software interface, which is divided into several functional areas:

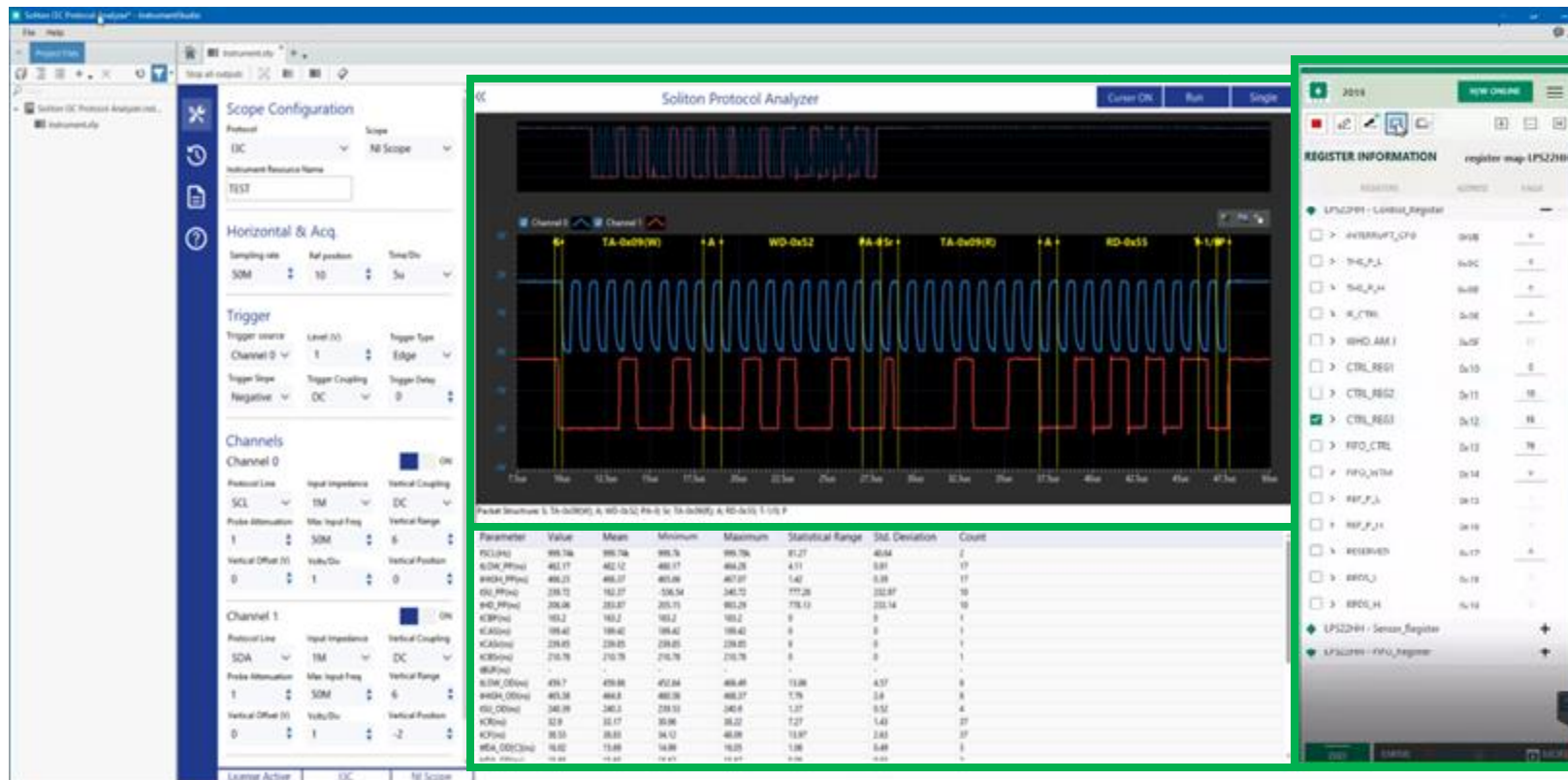
- Scope Configuration:** Shows the protocol set to I3C, the scope as NI Scope, and the instrument resource name as TEST. It includes settings for Horizontal & Acq. (Sampling rate: 50M, Ref position: 10) and Trigger (Trigger source: Channel 0, Level: 1, Trigger Slope: Negative, Trigger Coupling: DC).
- Channels:** Configures two channels (Channel 0 and Channel 1) with various settings like Protocol Line, Input Impedance, SCL, SDA, and Vertical Coupling.
- Registers (LPS22HH):** A list of registers with columns for Name, ADDRESS, SIZE, and VALUE. The **REGISTER INFO** panel shows details for the **CTRL_REG1** register (Address: 0x33), including its bit fields (INTERRUPT_CFG, THS_P_L, THS_P_H, IF_CTRL, WHO_AM_I, CTRL_REG1, CTRL_REG2, CTRL_REG3, FIFO_CTRL, FIFO_VTM, REF_P_L, REF_P_H, RESERVED, RPS_L, RPS_H) and sensor registers (INT_SOURCE, FIFO_STATUS1, FIFO_STATUS2, STATUS, PRESS_OUT_XL, PRESS_OUT_L, INT_H).
- Waveform Analysis:** A timing diagram showing multiple channels (S+, TA-0x09(W), A+, WD-0x52, PA-0 Sr, TA-0x09(R), A+, RD-0x55, N-1/MP) over time. A table below the waveform provides statistical data for various parameters.

Parameter	Value	Mean	Minimum	Maximum	Statistical Range	Std. Deviation	Count
tSCL(pps)	999.746	999.746	999.79	999.79	81.27	40.04	2
tLOW_PP(ns)	462.17	462.12	460.17	464.28	4.11	0.91	17
tHIGH_PP(ns)	466.23	466.37	465.66	467.07	1.42	0.39	17
tSU_PP(ns)	239.72	162.37	-536.54	240.72	777.26	232.97	10
tHD_PP(ns)	206.06	283.87	205.15	193.29	778.13	233.14	10
tCBP(ns)	163.2	163.2	163.2	163.2	0	0	1
tCAS(ns)	189.42	189.42	189.42	189.42	0	0	1
tCAS(ns)	239.85	239.85	239.85	239.85	0	0	1
tCBS(ns)	210.78	210.78	210.78	210.78	0	0	1
tBURF(ns)	-	-	-	-	-	-	-
tLOW_OD(ns)	459.7	459.88	452.84	466.49	13.88	4.57	8
tHIGH_OD(ns)	465.38	464.8	460.58	466.37	7.79	2.6	8
tSU_OD(ns)	240.39	240.3	239.53	240.9	1.37	0.52	4
tCR(ns)	32.9	33.17	30.96	38.22	7.27	1.43	37
tCR(ns)	38.53	38.83	34.12	48.09	13.97	2.63	37
tRDA_ODC(ns)	16.02	15.69	14.99	16.05	1.06	0.49	3
tRDA_ODC(ns)	16.42	16.42	16.42	16.42	0	0	1

Enable Interactive Debug

Semi Device Control + Protocol Analyzer

Graphical Time domain signals with Data Overlaid
 - Enables Interactive waveform debug window to identify problems



SDC Small Panel
 - Interactive Register Read write

- Key Highlights:**
1. Seamless integration with NI's SDC
 2. Can be used as Bus monitors when multiple masters act on the bus

Protocol timing measurements

MIPI I3C[®] Protocol Test Coverage

Parametric Measurements

- ✓ tLOW_OD (Low period of SCL clock)
- ✓ tHIGH_OD (High period of SCL clock)
- ✓ tfDA_OD (Fall time of SDA signal)
- ✓ tSU_OD (Data setup time during open-drain mode)
- ✓ tCAS (Clock after start condition)
- ✓ tCBP (Clock before stop condition)
- ✓ fSCL (SCL Clock Frequency)
- ✓ tLOW_PP (SCL Clock Low Period)
- ✓ tHIGH_PP (SCL Clock High Period)
- ✓ tSCO (Clock in to Data out for slave)
- ✓ tCR (SCL Clock Rise Time)
- ✓ tCF (SCL Clock Fall Time)
- ✓ tHD_PP (SDA signal Data Hold in Push-pull mode)
- ✓ tSU_PP (SDA signal Data Setup in Push-pull mode)
- ✓ tCASr (Clock after Repeated start condition)
- ✓ tCBSr (Clock before Repeated start condition)
- ✓ VIL (Low level input voltage)
- ✓ VIH (High level input voltage)
- ✓ VOL (Low level output voltage)
- ✓ VOH (High level output voltage)
- ✓ Legacy I2C Timing Parameters

Functional Validation

- ✓ Verify if the correctness of MIPI I3C[®] packet structure
 - ✓ Presence of Start, Stop, Repeated Start at right places
 - ✓ Number of clocks with proper ACK bits
- ✓ Parse and display different portions/packets of the protocol like Start, Stop, Device Address, ACK/NACK bit, etc
- ✓ Reports faults/errors in the MIPI I3C[®] packet structure
- ✓ Ability to differentiate and display Write and Read Data
- ✓ Supports below transactions
 - ✓ SDR Write
 - ✓ SDR Read
 - ✓ SDR Combined Format
 - ✓ SDR CCC Command
- ✓ Ability to detect HDR Stop and Restart Patterns

I2C Protocol Test Coverage

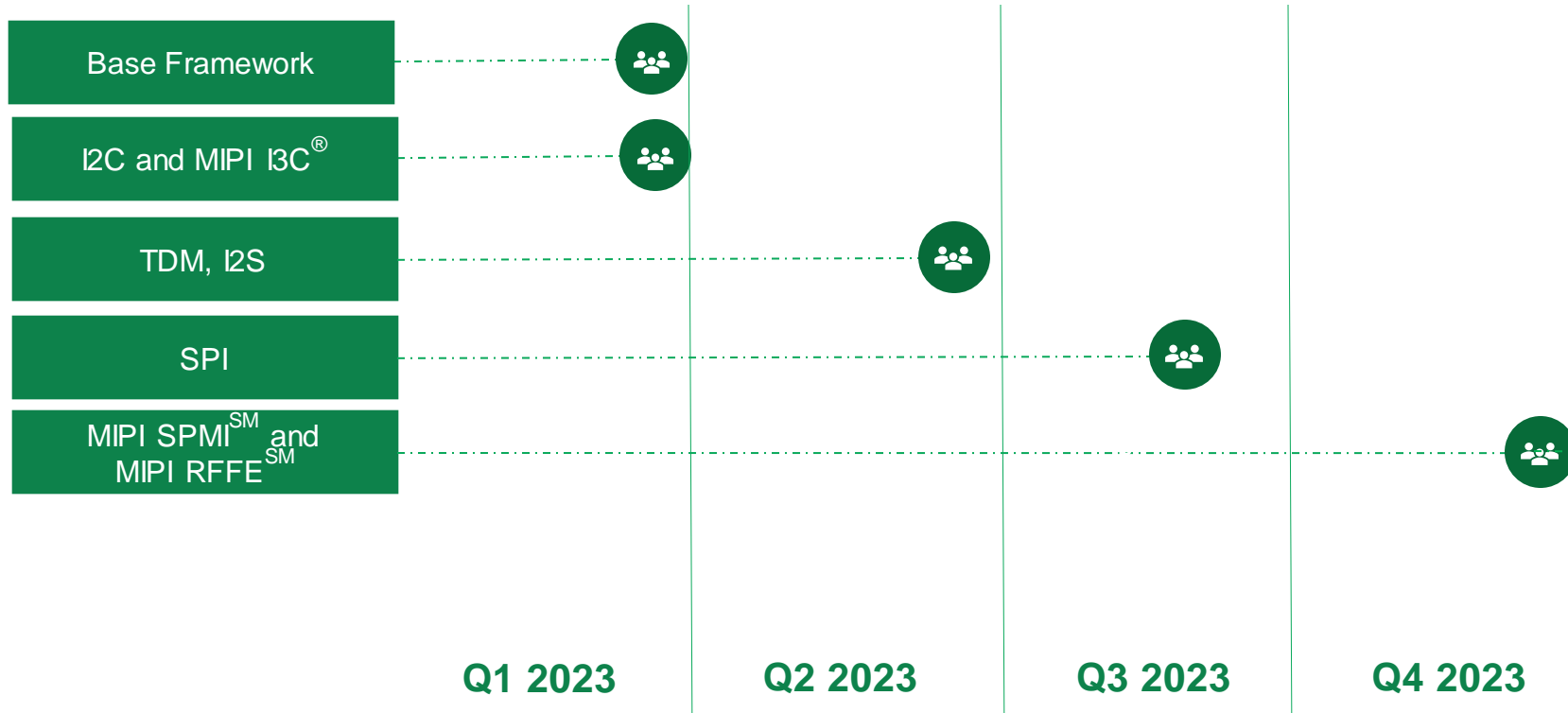
Parametric Measurements

- ✓ fSCL (SCL Clock Frequency)
- ✓ tSU;STA (Setup Time for a Repeated Start Condition)
- ✓ tHD;STA (Hold Time (repeated) Start Condition)
- ✓ tLOW (Low Period of the SCL Clock)
- ✓ tHIGH (High Period of the SCL Clock)
- ✓ tSU;DAT (Data Setup Time)
- ✓ tHD;DAT (Data Hold Time)
- ✓ trCL (Rise Time of SCL Signal)
- ✓ tfCL (Fall Time of SCL signal)
- ✓ trDA (Rise Time of SDA Signal)
- ✓ tfDA (Fall Time of SDA Signal)
- ✓ tSU;STO (Setup time for STOP Condition)
- ✓ tVD;DAT (Data Valid Time)
- ✓ tVD:ACK (Data Valid Acknowledgement Time)
- ✓ VIL (Low level input voltage)
- ✓ VIH (High level input voltage)
- ✓ VOL (Low level output voltage)
- ✓ VOH (High level output voltage)

Functional Validation

- ✓ Verify if the correctness of I2C packet structure
 - ✓ Presence of Start, Stop, Repeated Start at right places
 - ✓ Number of clocks with proper ACK bits
- ✓ Parse and display different portions/packets of the protocol like Start, Stop, Device Address, ACK/NACK bit, etc
- ✓ Reports faults/errors in the I2C packet structure
- ✓ Ability to differentiate and display Write and Read Data
- ✓ Supports below transactions
 - ✓ Write
 - ✓ Read
 - ✓ Combined Format

Roadmap



Other Protocols in Pipeline

- Dual/Quad SPI
 - eSPI
 - CAN



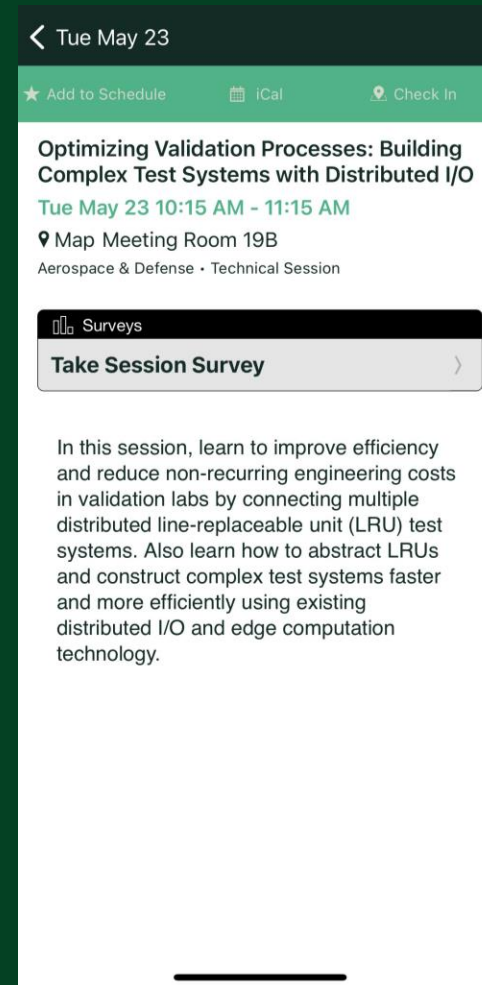
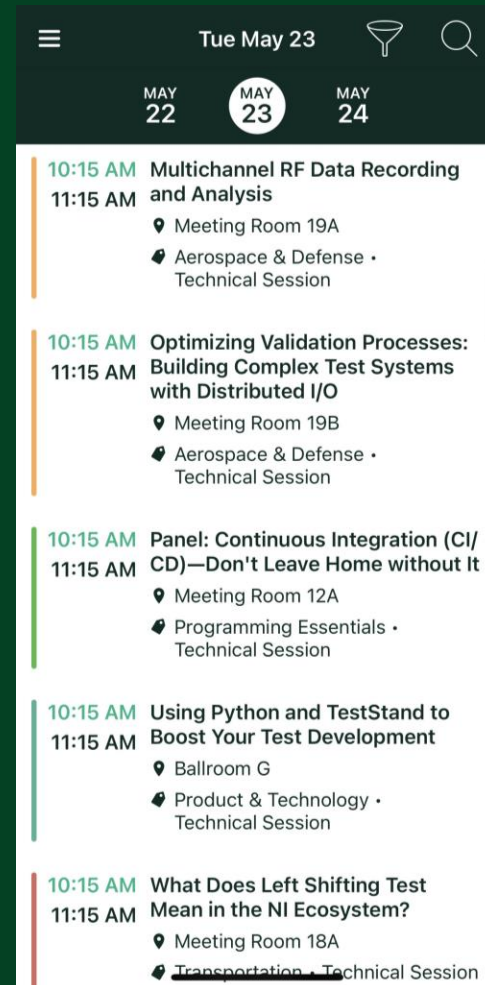
Q&A

Don't forget to check out the full demo
in the Experience Lounge in the
Semiconductor & Electronics section

Give us your feedback!

Quick 2 Question Survey

In the mobile app, click into the session you would like to provide feedback for



Click “Take the Session Survey”