mipi®
DEVCON

Victor Sanchez-Rico
BitifEye Digital Test Solutions GmbH

PHY Testing Challenges and Opportunities: The Need For a Smart Testing Approach

MIPI ALLIANCE
DEVELOPERS
CONFERENCE
TAIPEI
18 OCTOBER 2019

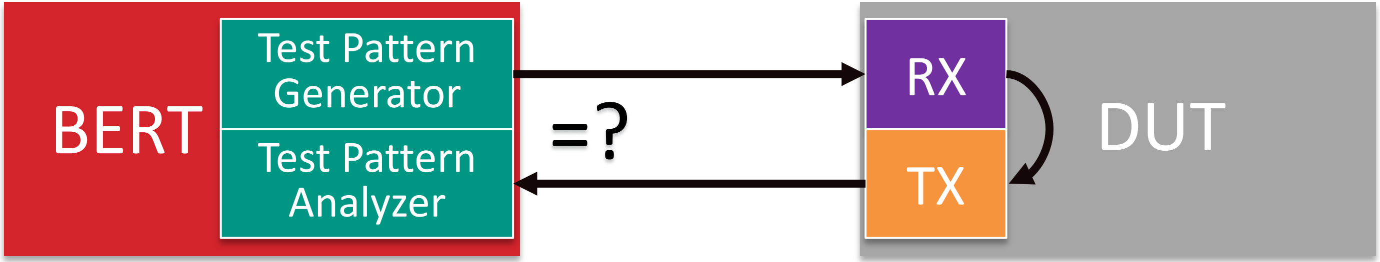
MIPI.ORG/DEVCON

PHY Testing – Ideal Scenario

	Comparable Results	Low Cost Testing	Fast Testing Speeds
InterOp	☺	☺	☺
Choice of Test Systems	☺	☺	☺
Test Houses	☺	☺	☺

Victor Sanchez-Rico - BitifEye Digital Test Solutions GmbH

Common RX Test Approaches: Loopback



- Pattern Generator in BERT sends continuous test pattern to DUT
- DUT processes the test data and sends it back to the BERT Analyzer
- Pattern compared, Bit Error Rate calculated

Victor Sanchez-Rico - BitifEye Digital Test Solutions GmbH

Common RX Test Approaches: Loopback

- Challenges:
  - DUT comes out of test mode whenever the test pattern generator is restarted
    - Manual intervention of test operator is required (time consuming) or
    - Automation scripts and side-band connection are required (customization)
  - Can’t test real world data (Burst)
  - Some tests can’t be done easily, e.g. Squelch detection in MIPI M-PHY®

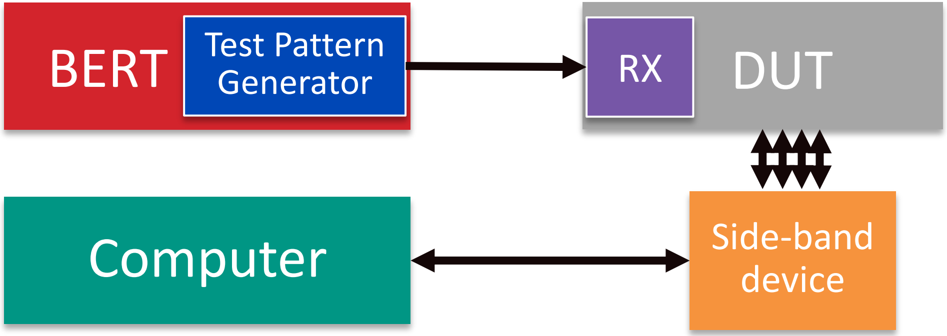
Victor Sanchez-Rico - BitifEye Digital Test Solutions GmbH

Common RX Test Approaches: Loopback

	Comparable Results	Low Testing Costs	Fast Testing Speeds
InterOp	☹		
Choice of Test Systems	☺	😐	😐
Test Houses	☺	😐	☹

Victor Sanchez-Rico - BitifEye Digital Test Solutions GmbH

Common RX Test Approaches: Side-band



- Proprietary access to built in Error Counters
- Pattern Generator in Test Equipment sends test pattern to DUT
- DUT processes the test data and counts errors
- Additional connection to the DUT to grab counters through customer-specific equipment

Victor Sanchez-Rico - BitifEye Digital Test Solutions GmbH

Common RX Test Approaches: Side-band

	Comparable Results	Low Testing Costs	Fast Testing Speeds
InterOp	😐	☹	😐
Choice of Test Systems	🙂	☹	😐
Test Houses	🙂	☹	😐

Victor Sanchez-Rico - BitifEye Digital Test Solutions GmbH

Common RX Test Approaches: Visual Test

	Comparable Results	Low Testing Costs	Fast Testing Speeds
InterOp	☹	☹	😐
Choice of Test Systems	😐	☺	☹
Test Houses	☹	☺	😐

Solution: PHY Test Mode

- Functionality that allows to configure the DUT for test exclusively with in-band control commands
- Simplified link startup for simplicity
- Bit and error counters also retrieved with Test Equipment via in-band commands
- Preferably implemented in the PHY Layer
- Optional: master device can configure test mode for slave(s), and run some tests w/o need for test equipment.

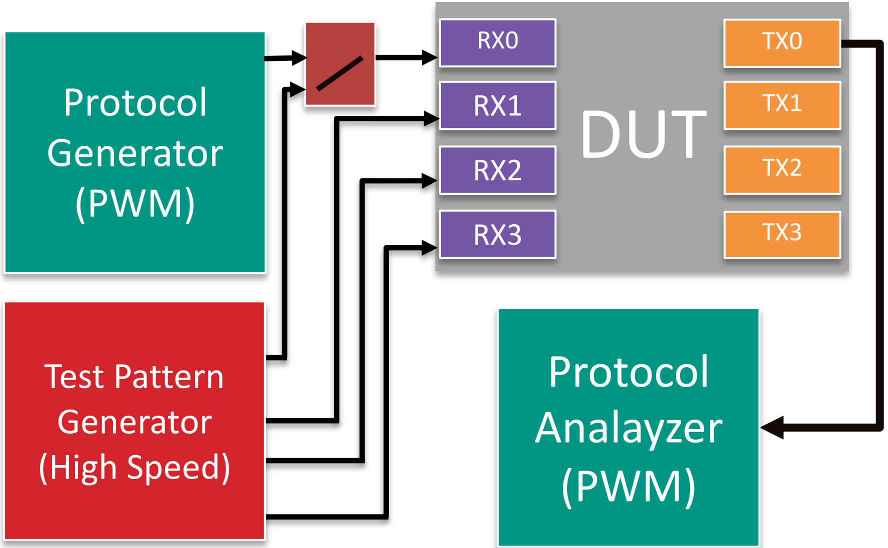
Victor Sanchez-Rico - BitifEye Digital Test Solutions GmbH

Solution: PHY Test Mode

	Comparable Results	Low Cost Testing	Fast Testing Speeds
InterOp	☺	☺	☺
Choice of Test Systems	☺	☺	☺
Test Houses	☺	☺	☺

PHY Test Mode Example: MIPI M-PHY® MIPI UniPro® RX Test

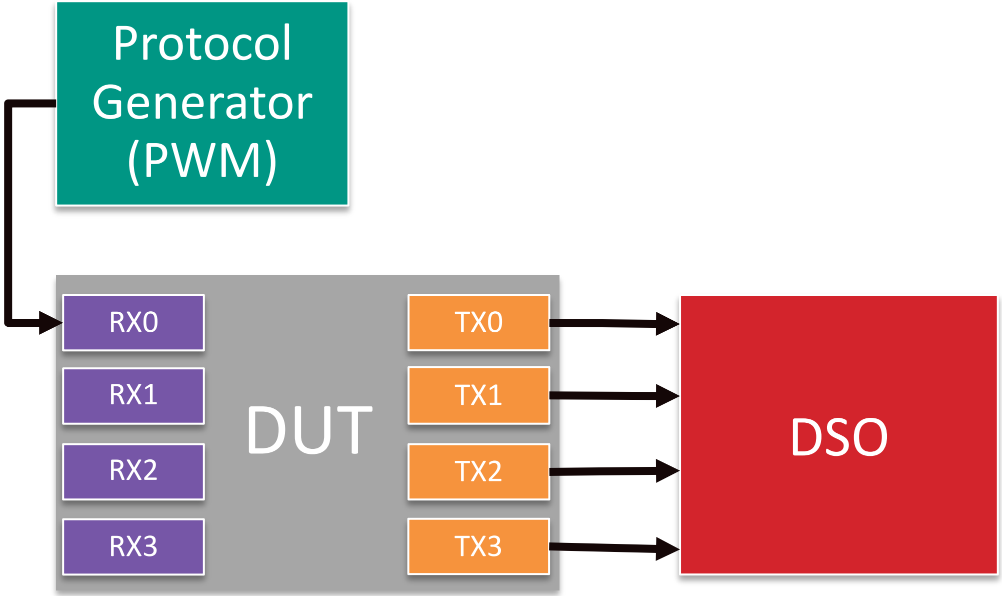
- Use Case
  - DUT Data0 RX is connected to switch that can alternate between test pattern generator and protocol generator
  - DUT Data1-3 RX connected directly to test pattern generator
  - DUT Data 0 TX connected to protocol analyzer
  - DUT RST_n also controlled to alternate test modes
- Test Flow
  - Automation connects protocol generator to DUT
  - Hardware Reset sent to RST_n of DUT
  - Protocol generator sends link configuration pattern to DUT
  - Automation connects test pattern generator to DUT
  - Test pattern generator sends test pattern to DUT, interleaving Frame and Error counter requests
  - DUT responds, protocol analyzer captures response and test automation decodes it
  - Test goes on until DUT reports errors or target BER is achieved



Victor Sanchez-Rico - BitifEye Digital Test Solutions GmbH

PHY Test Mode Example: MIPI M-PHY®" MIPI UniPro® TX Test

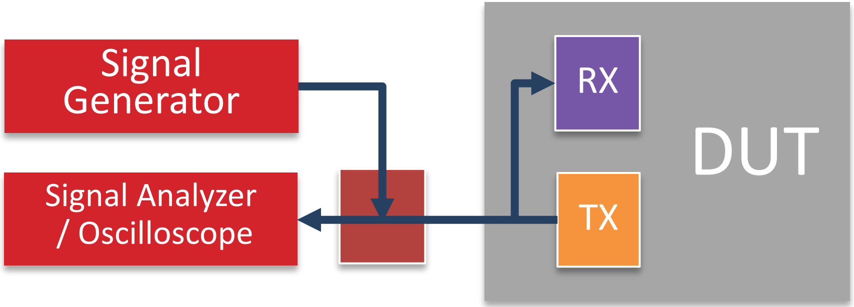
- Use Case
  - DUT Data0 RX is connected protocol generator
  - DUT TX Lane under test is connected to oscilloscope
  - DUT RST_n also controlled to alternate test modes
- Test Flow
  - Protocol generator sends Hardware Reset to DUT
  - Protocol generator sends link configuration pattern to DUT
  - Automation controls oscilloscope TX Test software to run selected tests



Victor Sanchez-Rico - BitifEye Digital Test Solutions GmbH

Outlook and suggestion: A-PHY

- Unlike MIPI M-PHY®, both bus directions are transmitted simultaneously on the same wire
  - Only one direction for High Speed data, but control data is full duplex, on the same wire
  - No fixture is available that can be used to combine and split the data



Victor Sanchez-Rico - BitifEye Digital Test Solutions GmbH

Outlook and suggestion: A-PHY

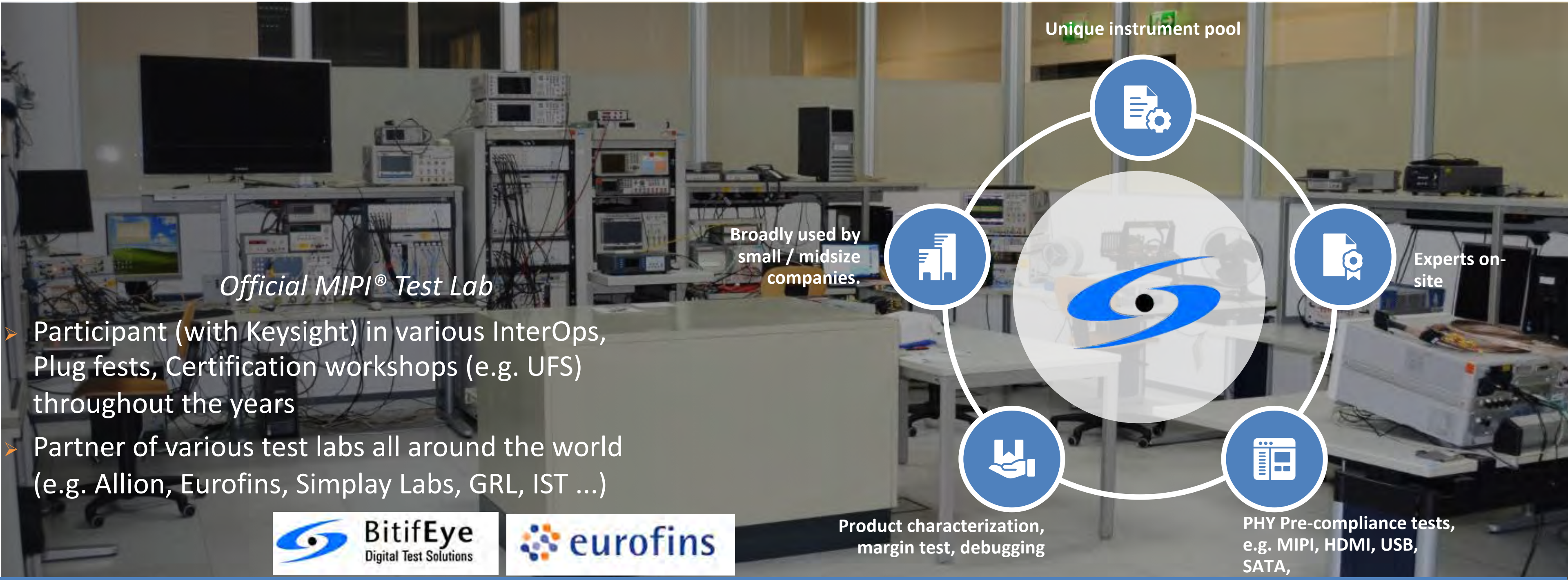
- A-PHY uses a very long channel. Embedding it (software simulation) seems like the sensible choice but it can have a very big impact on test pattern generation time

Victor Sanchez-Rico - BitifEye Digital Test Solutions GmbH

About BitifEye

- Located in Boeblingen, Germany
- Solutions Partner of Keysight Technologies, system integrator
  - integration of high-performance test instruments: bit-error ratio testers, oscilloscopes, network analyzers…
  - complementary products - software, accessories, instruments - and services
- **Experts in wireline digital high-speed interconnect test, e.g. HDMI, USB, MIPI**
  - focus on physical layer (PHY) tests - compliance tests and product characterization
  - inventor of PHY test automation for gigabit receivers/sinks, market leader since 2005
  - provider of complementary hardware, software and services

About BitifEye



Official MIPI® Test Lab

- Participant (with Keysight) in various InterOps, Plug fests, Certification workshops (e.g. UFS) throughout the years
- Partner of various test labs all around the world (e.g. Allion, Eurofins, Simplay Labs, GRL, IST ...)

BitifEye Digital Test Solutions

eurofins

Unique instrument pool

Experts on-site

PHY Pre-compliance tests, e.g. MIPI, HDMI, USB, SATA,

Product characterization, margin test, debugging

Broadly used by small / midsize companies.

Victor Sanchez-Rico - BitifEye Digital Test Solutions GmbH

mipi®
DEVCON

THANK YOU

MIPI ALLIANCE
DEVELOPERS
CONFERENCE

TAIPEI

18 OCTOBER 2019

MIPI.ORG/DEVCON