PHY Testing Challenges and Opportunities: The Need For a Smart Testing Approach
## PHY Testing – Ideal Scenario

<table>
<thead>
<tr>
<th></th>
<th>Comparable Results</th>
<th>Low Cost Testing</th>
<th>Fast Testing Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>InterOp</td>
<td><img src="image1" alt="Smiley" /></td>
<td><img src="image2" alt="Smiley" /></td>
<td><img src="image3" alt="Smiley" /></td>
</tr>
<tr>
<td>Choice of Test Systems</td>
<td><img src="image1" alt="Smiley" /></td>
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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®

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# Common RX Test Approaches: Loopback

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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

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## Common RX Test Approaches: Side-band

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## Common RX Test Approaches: Visual Test

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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.

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Solution: PHY Test Mode

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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

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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

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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

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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

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THANK YOU