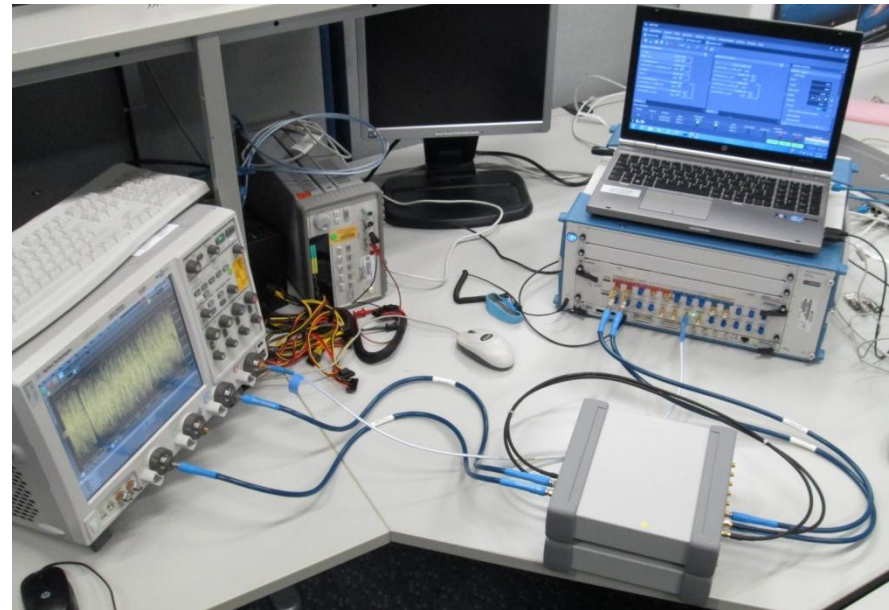


# Type-C Technologies and Solutions

September 8, 2015

**Asay Brigham**  
Oscilloscope and Protocol Division  
Keysight Technologies



# Agenda



















- Keysight Digital Standards Program
- Type-C Overview
- Type-C Power Delivery Solutions
- Solutions Summary

# Standards Expertise and Comprehensive Solutions

Industry's most comprehensive application-specific measurements

Full Simulation, Tx, Rx and Cable testing including **automation**.

Keysight experts on **standards committees** ensure proper testing

Memory Perry Keller	DisplayPort Brian Fetz	USB Jit Lim	Computer Rick Eads	Optical Greg LeCheminant	HDMI Stefan Friebe	Storage Matthew Woerner	MIPI Roland Scherzinger
Board of Directors JEDEC  Compliance Chair UFSA	Board of Directors VESA  Contributor VESA Phy Sub Group	Contributor USB-IF Thunderbolt	Board of Directors PCI-SIG	Contributor IEEE, OIF-CEI, T11 FC	Contributor HDMI	Contributor SATA-IO, T10 SAS	TSG Member UniPro Vice Chair MIPI Alliance
LPDDR4, UFS	DP 1.3 Type-C	USB 3.1, Thunderbolt 3	PCIe G3, G4	PAM-4, CEI 3.1	HDMI 2.0	SATA, SAS-3	D/M/C-PHY, UniPro
 						 	
							

# Keysight Digital Standards Program

- Our solutions are driven and supported by Keysight experts involved in international standards committees:
  - Joint Electronic Devices Engineering Council (JEDEC)
  - PCI Special Interest Group (PCI-SIG®)
  - Video Electronics Standards Association (VESA)
  - Serial ATA International Organization (SATA-IO)
  - USB-Implementers Forum (USB-IF)
  - Mobile Industry Processor Interface (MIPI) Alliance
  - And many others
- We're active in standards meetings, workshops, plugfests, and seminars
- We get involved so you benefit with the right solutions when you need them



# Type-C Overview

# Industry Drivers for Type C

- Eliminate form factor orientation dependency
- Establishes power delivery and charging infrastructure
- Enables infrastructure for adoption by other standards (i.e. video)



# Type-C Connector

## Big Discontinuity

Type A



Type B



13.35mmx2.4mm

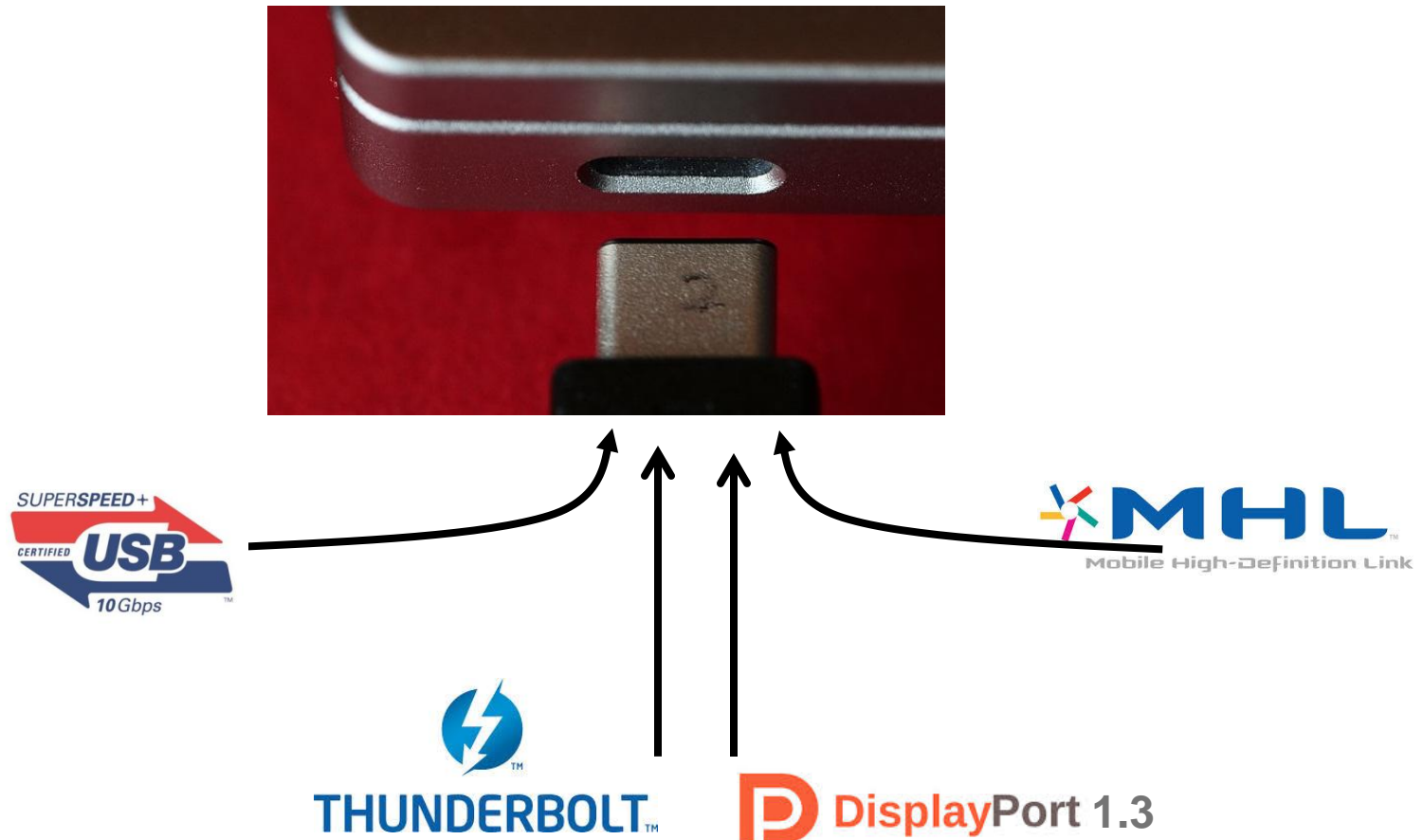
Type C



8.3mmx2.5mm

# Alt Mode

A port could wake up as USB 3.1, then get configured to DisplayPort 1.3

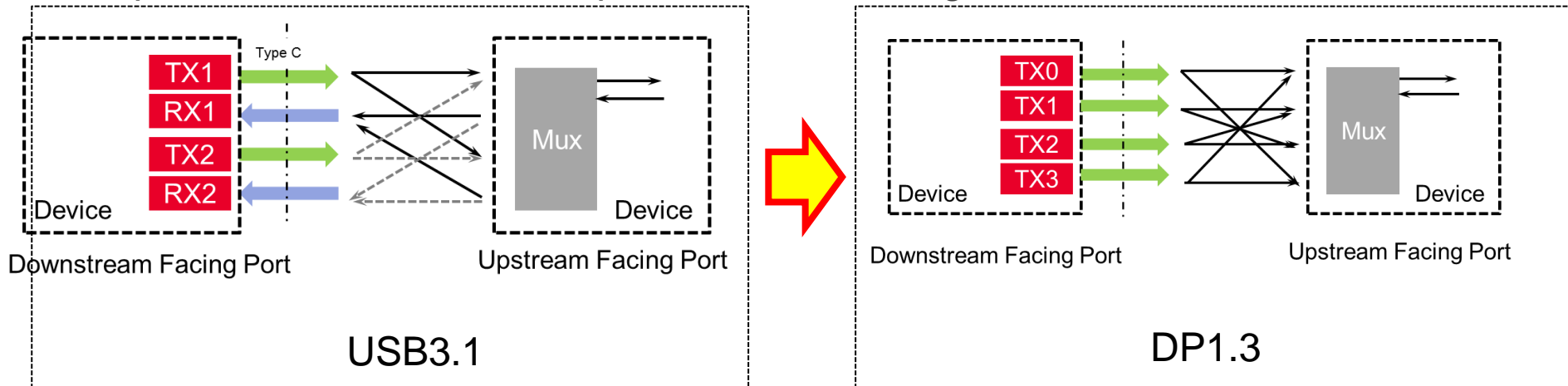




# Alternate Mode

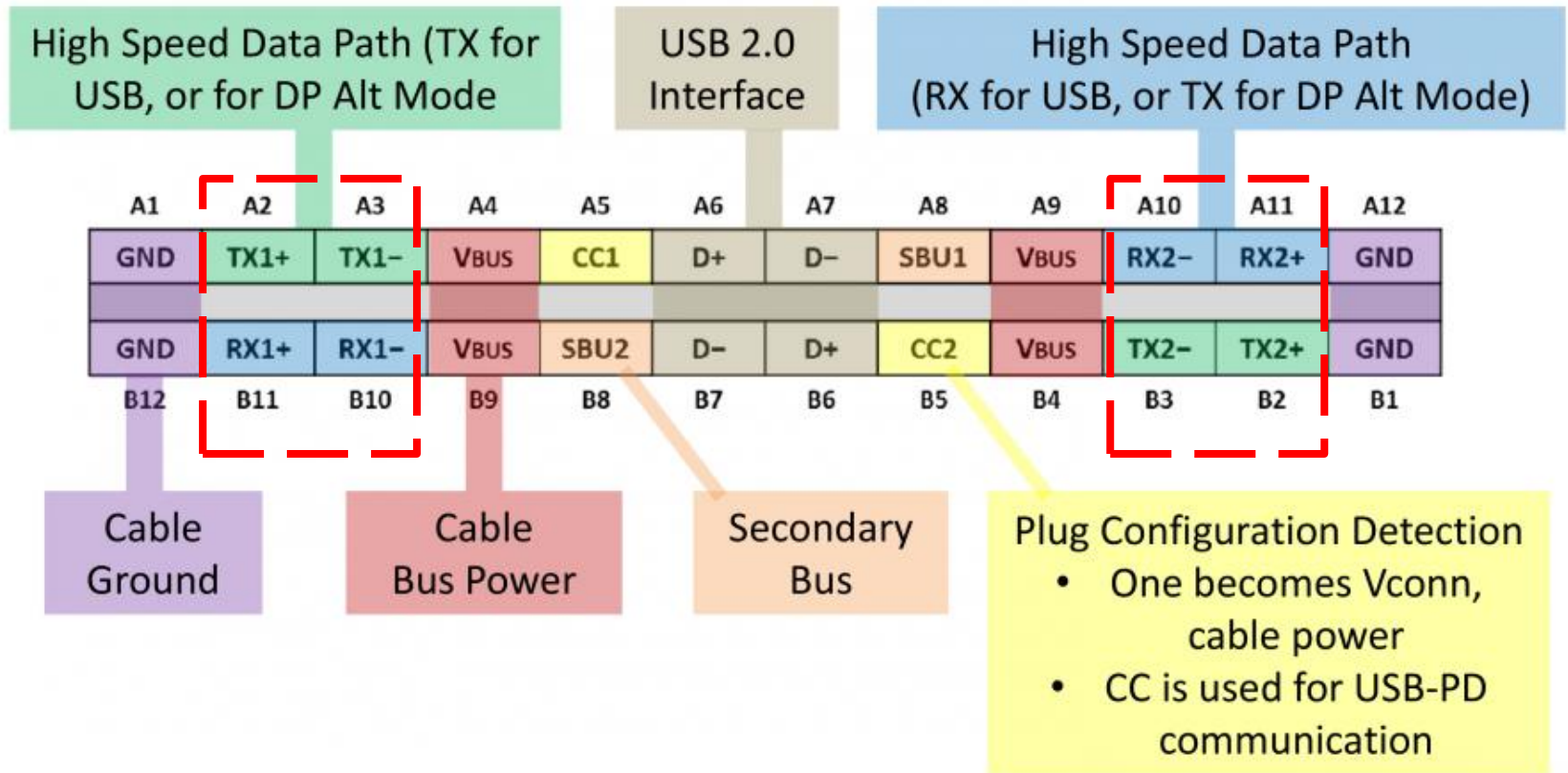
- An operational mode of devices on a link that dynamically reassigns USB Type-C pin functionality by communication via the Power Delivery channel to change the character of the link.

Example: a 'device' can wake up USB3.1 and change to DP1.3



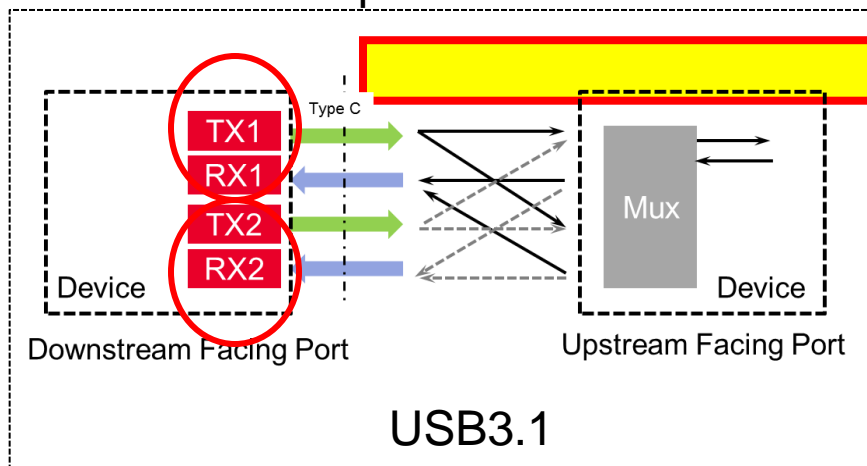
DisplayPort 1.3, MHL, & Thunderbolt

# USB Type C-Signal Plan



# Implications of Type C for Compliance Testing

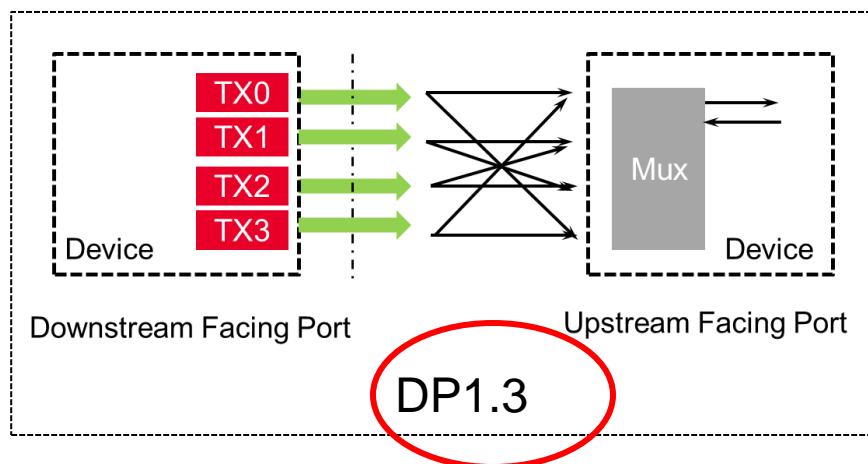
## Orientation Independence



Test time DOUBLES

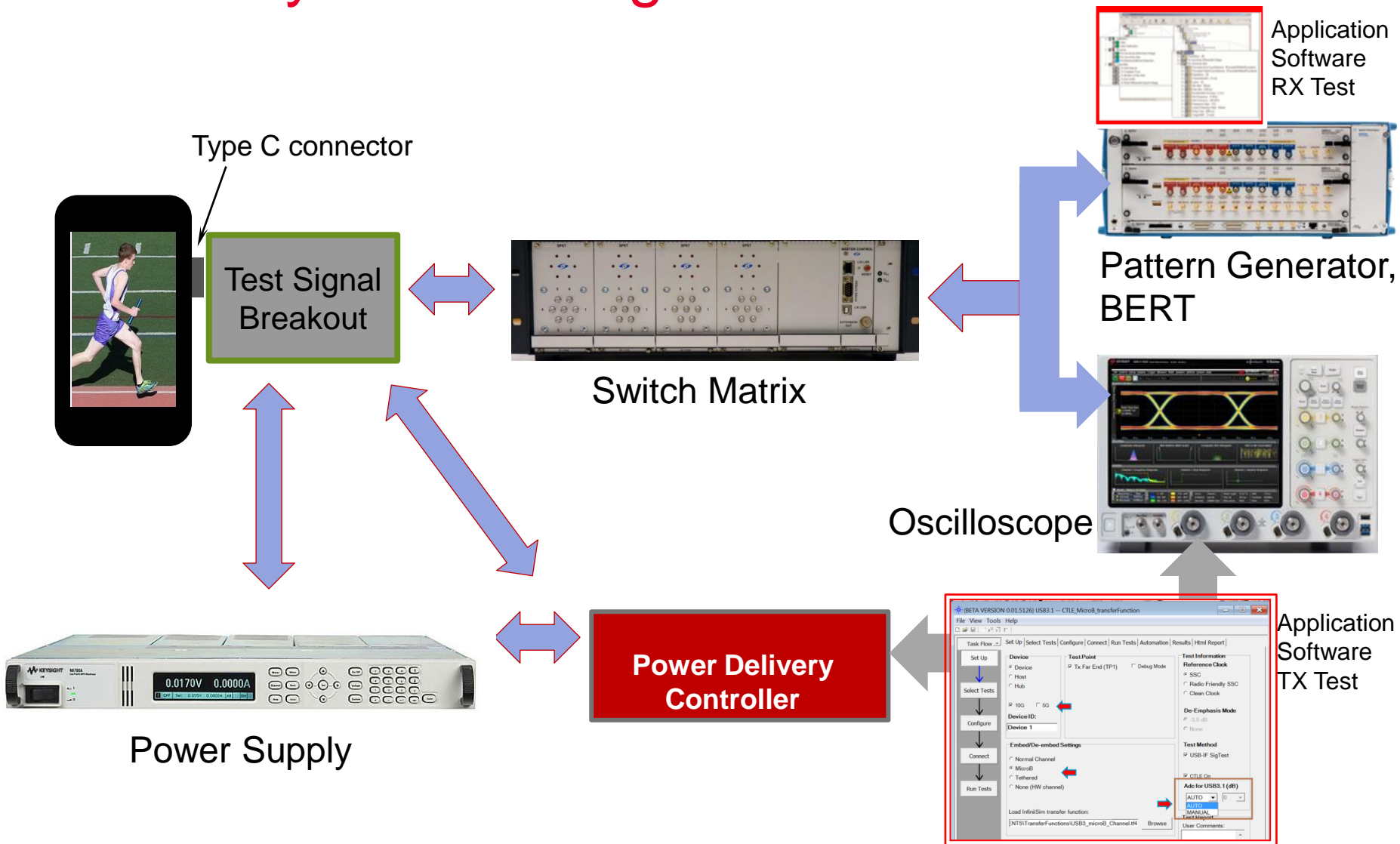
Test USB3.1 Twice, THEN

## Alternate Mode



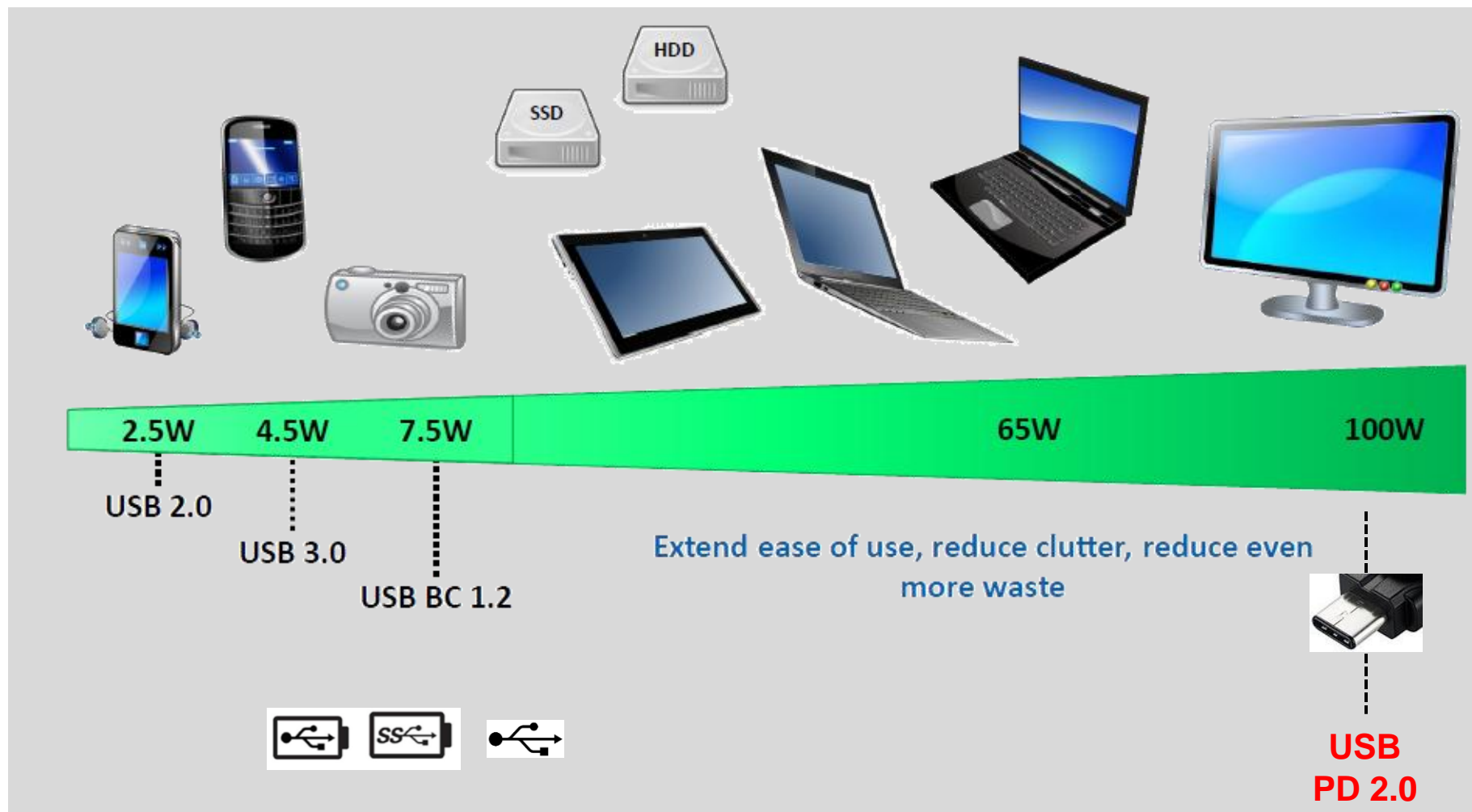
Test DisplayPort!

# Test System Changes



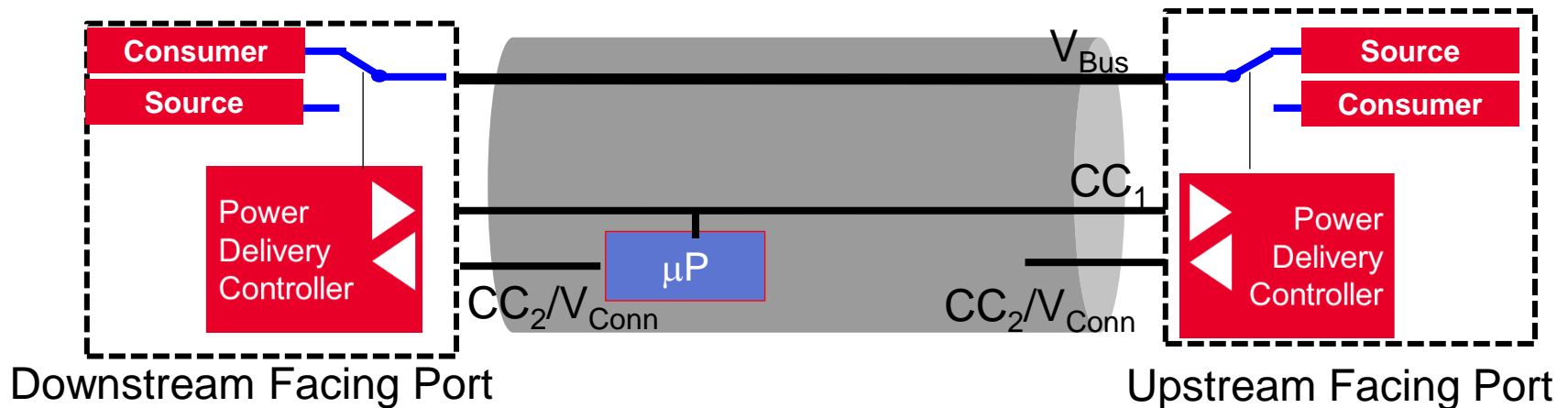
# Type-C Power Delivery

# Power Delivery 2.0



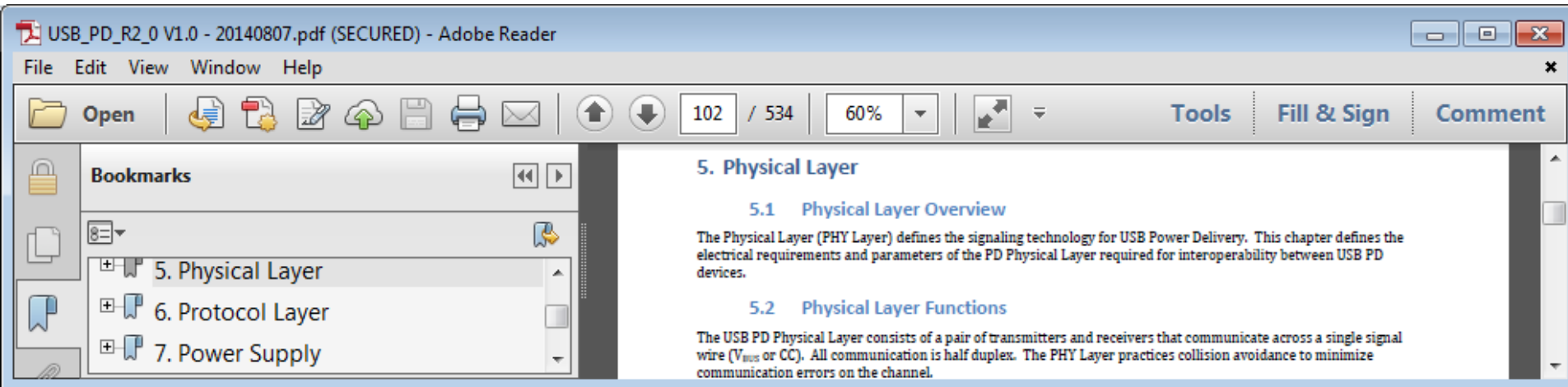
# Power Delivery 2.0

- Management of a power network and device modes through a one line interface. The interface can set up the network to quickly charge devices with up to 5 amps, supply power to active cables, discover cable functionality, enable guest protocols (Alternate Modes), facilitate device role and power direction *swaps*.



# Type-C Power Delivery Testing

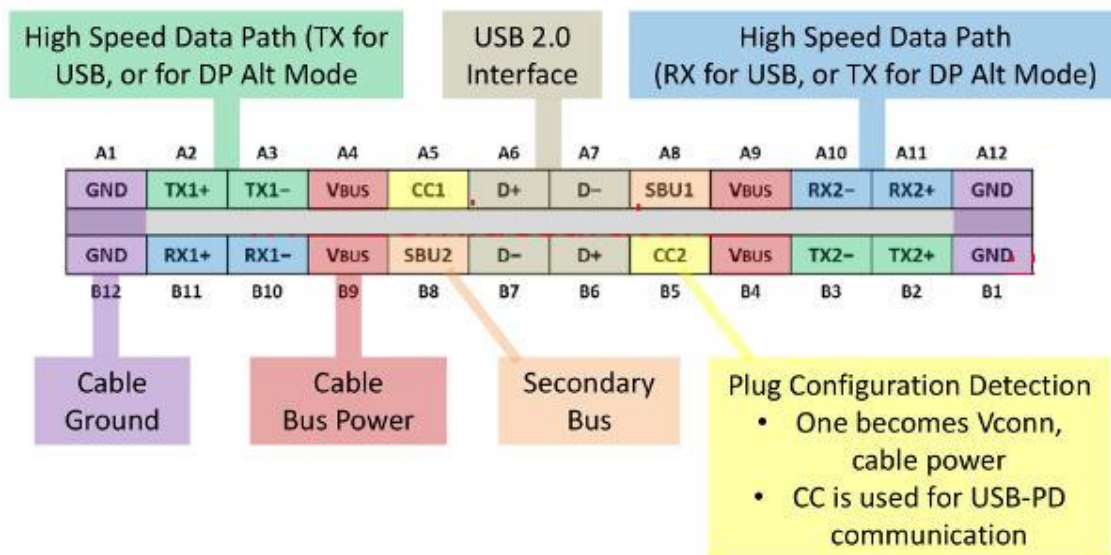
- 3 Chapters in the Power Delivery Spec responsible for:
  - Charge devices up to 20V/5A/100W
  - Supply power to active cables
  - Discover cable functionality
  - facilitate device role and power direction



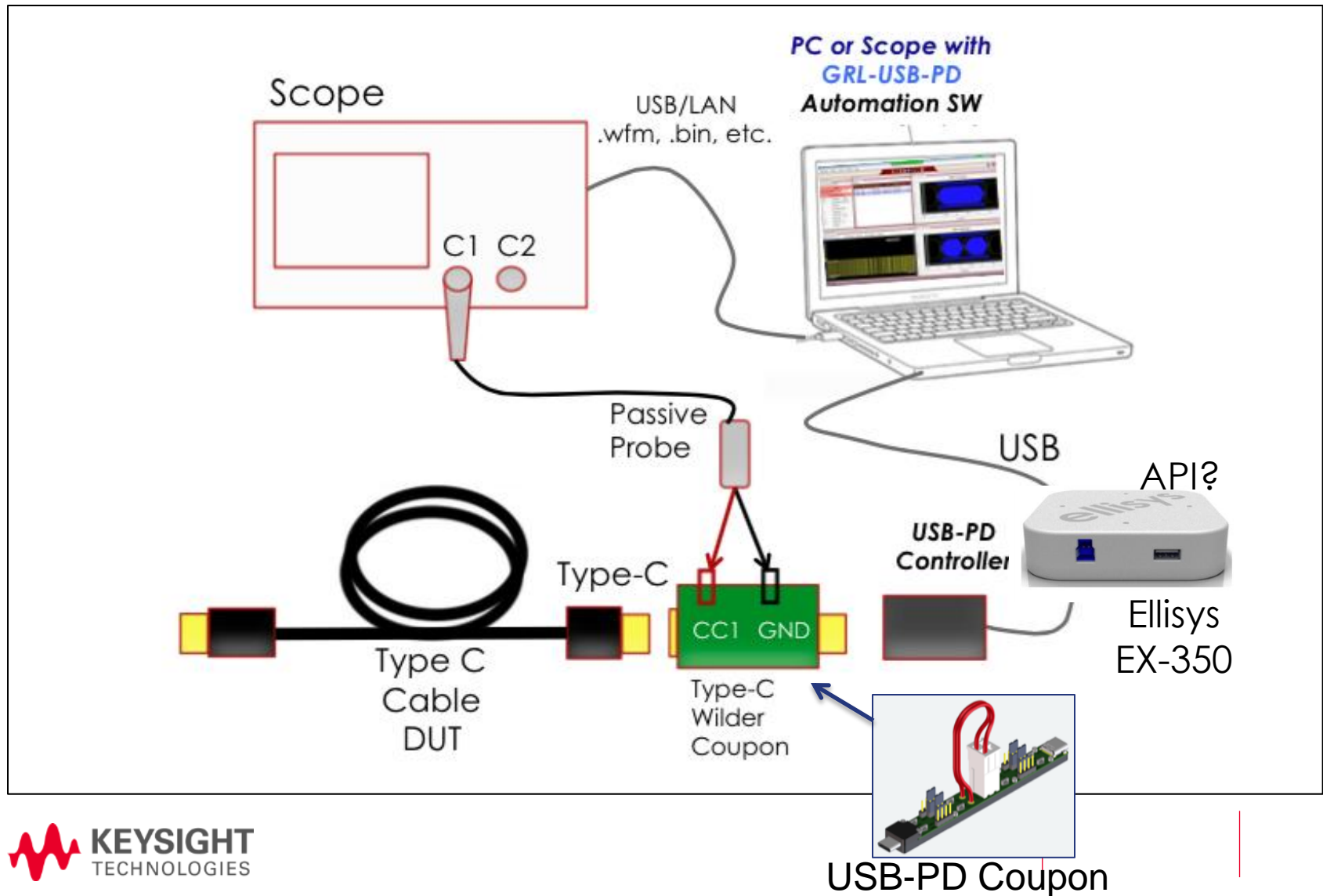


# Type-C PD Lines

- Detect attach of USB ports
- Resolve cable orientation to establish data bus routing
- Establish “host” and “device” roles between two attached ports
- Discover and configure Vbus
- Configure Vconn
- Discover and configure optional Alternate Mode

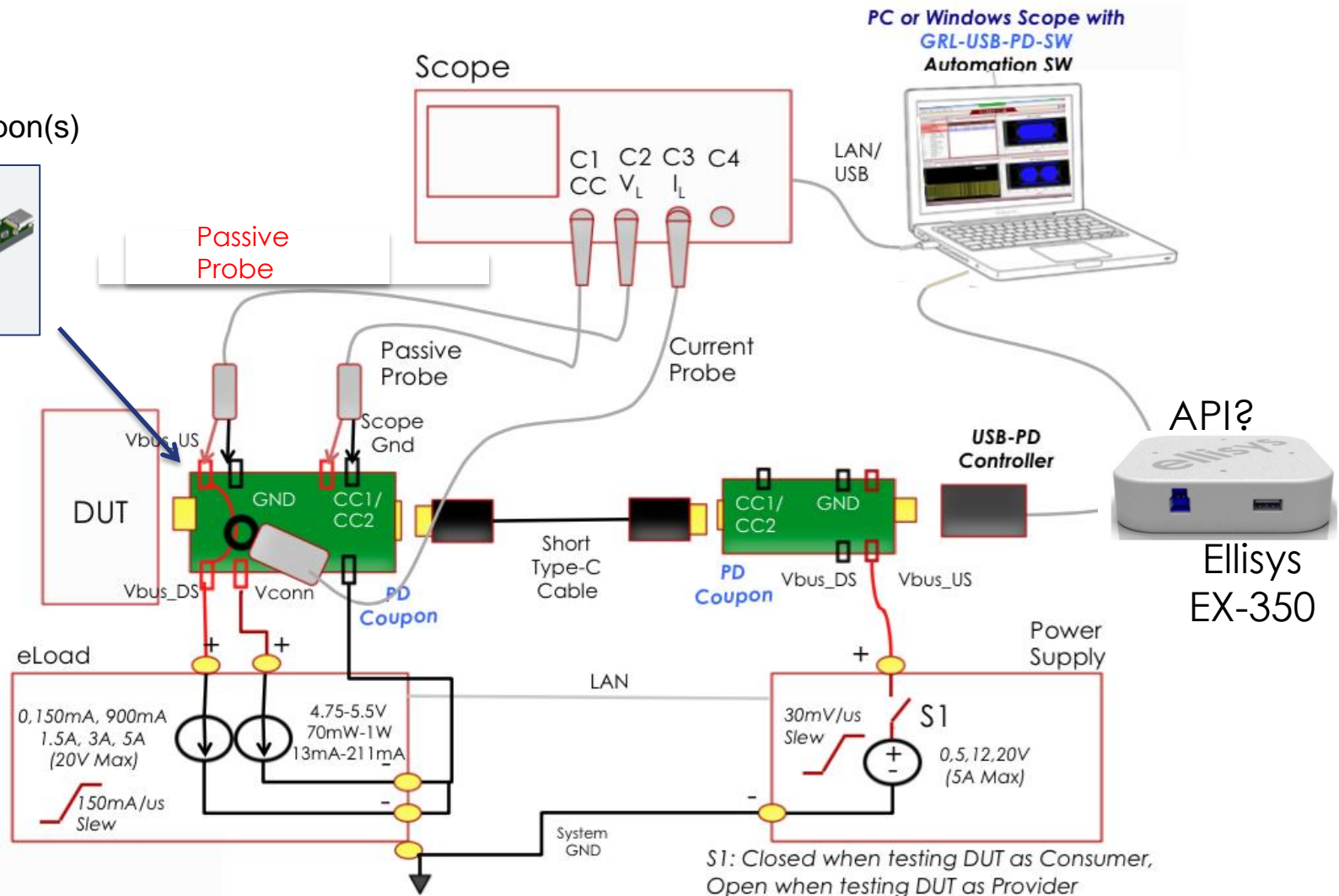
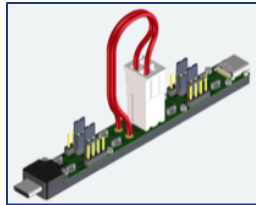


# Test Setup (eMark Cable Example)



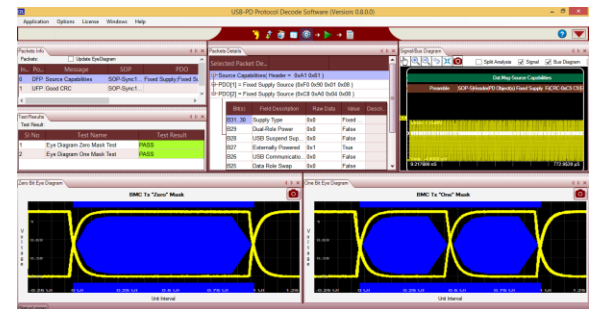
# Test Setup (Provider/ Consumer Example)

USB-PD Coupon(s)



# Type-C/USB-PD Electrical & Protocol Test Software (GRL-USB-PD)

- BMC Eye Diagram & Timing Measurements
  - BitRate, Risetime, CRC Check
- Bus Diagram and Signal View Window
- CC Line Packet Decode
- Report Generator
- VDM Decode for Cables and Adaptors



# Chapter 5: Physical Layer Results

## – BMC Eye & Measurements

Select Packet From List

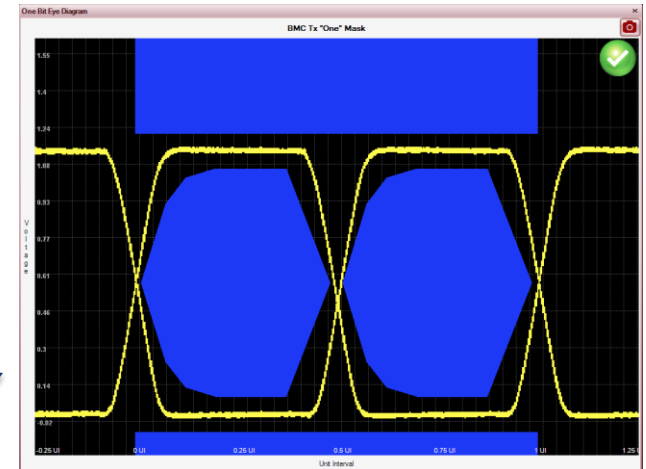
When Checked,  
All Results Update  
On Selected Packet

Packets Info									
Packets: <input checked="" type="checkbox"/> Update Test details on packet select									
Index	Port ...	Message	SOP	PDO	Message Type	M...	Header (MSB t...	Payload (MSB ...	CRC
0	DFP	Source Capabilities	SOP-Sync1 S...	Fixed Supply;Fixed Supply;Fixed ...	Data	0	0x31 0x61	0x6412C 0x...	0xC704DD7B
1	DFP	Source Capabilities	SOP-Sync1 S...	Fixed Supply;Fixed Supply;Fixed ...	Data	0	0x31 0x61	0x6412C 0x...	0xC704DD7B
2	DFP	Source Capabilities	SOP-Sync1 S...	Fixed Supply;Fixed Supply;Fixed ...	Data	0	0x31 0x61	0x6412C 0x...	0xC704DD7B
3	DFP	Source Capabilities	SOP-Sync1 S...	Fixed Supply;Fixed Supply;Fixed ...	Data	0	0x31 0x61	0x6412C 0x...	0xC704DD7B
4	UFP	Good CRC	SOP-Sync1 S...		Control	0	0x00 0x41		0xC704DD7B
5	UFP	Request	SOP-Sync1 S...	Request;	Data	0	0x10 0x42	0x3804B12C	0xC704DD7B
6	UFP	Response	SOP-Sync1 S...	Response;	Data	0	0x10 0x42	0x3804B12C	0xC704DD7B

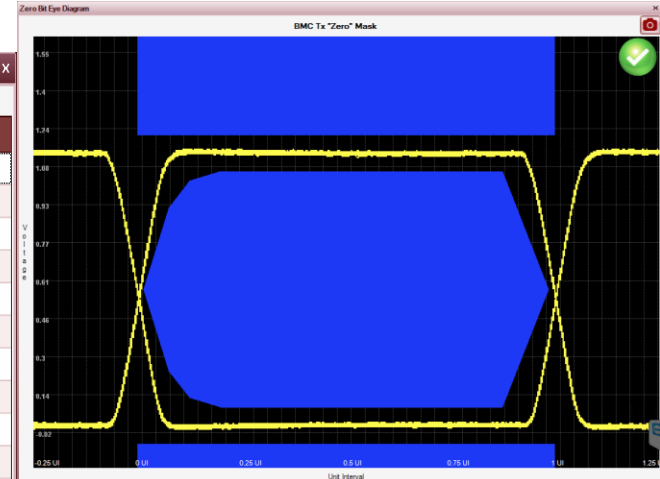
## Pass/Fail Measurements

Test Results						
Selected Packet Test Result:						
Index	Test Name	Test Result	Test Limit	Average Value	Minimum Value	Maximum Value
1	Eye Diagram One Mask Test	PASS	-	-	-	-
2	Eye Diagram Zero Mask Test	PASS	-	-	-	-
3	CRC Test	PASS	-	-	-	-
4	Rise Time Test	PASS	X > 300 ns	577.898248 nS	306.714286 nS	50.0666786 µS
5	Fall Time Test	PASS	X > 300 ns	326.930994 nS	320.798611 nS	340.279018 nS
6	Symbol Encoding Test	PASS	-	-	-	-
7	Packet Format Test	PASS	-	-	-	-
8	Bit Rate Test	PASS	(270 < X < 330) Kbps	295.931 Kbps	292.997 Kbps	304.435 Kbps
9	Inter-Frame Gap Test	PASS	X > 25µs	102.639847 mS	102.639847 mS	102.639847 mS
10	Unit Interval Test	PASS	(3.03 < X < 3.70) µs	3.37928346 µS	3.28477273 µS	3.41300000 µS
11	Voltage Swing Test	FAIL	(1.05 < X < 1.20) V	0.589 V	0 V	1.14 V
12	pBitRate Test	PASS	X < 0.25 %	0.026 %	0.026 %	0.026 %

## Pass/Fail BMC 'One'



## Pass/Fail BMC 'Zero'



# Chapter 5: Physical Layer Test Configuration

- Keysight Oscilloscope
  - **Infiniium S Series** and above
  - **2ea. Passive Probes** for CC and VBUS
  - **1ea. N2893A Current Probe** for Load Current
- USB-PD Software
  - **GRL-USB-PD** Power Delivery SW
- USB-PD Coupons
  - **USB3.1-C-PDC** from Wilder-Tech
- USB-PD Controller and Protocol Generator
  - **EX-350** from Ellisys with Rp/Rd Board



**N2893A**  
**Current Probe**

# Type-C PD Chapter 6 and Chapter 7

- Chapter 6: Protocol Layer
  - Ellisys EX-350 USB-PD Controller and Protocol Generator
- Chapter 7: Power Supply
  - Depending on Power Profile 1-5
  - Source or Load Requirements

Source capabilities organized as profiles

	PROFILE 0 Reserved	
Hand-held devices, today's peripherals	PROFILE 1 5V @ 2A	10W Default start-up profile
Tablets, netbooks, most peripherals	PROFILE 2 5V @ 2A, 12V @ 1.5A	18W
Thinner notebooks, larger peripherals	PROFILE 3 5V @ 2A, 12V @ 3A	36W
Larger notebooks, hubs, docks	PROFILE 4 5V @ 2A, 12V, 20V @ 3A	60W Limit for Micro-B/AB connector
Workstations, hubs, docks	PROFILE 5 5V @ 2A, 12V, 20V @ 5A	100W Limit for Standard A/B connector

Requires new detectable Cables for >1.5A or >5V





# Power Solutions for Type-C PD

Choose from these instruments that meet the requirements

**N6700 series**



**N6705B**



**N6752A**



**N6705B DC Power Analyzer or N6700 Modular Power System with N6752A DC power module**

Source: 50V, 10A, 100W

**N3301A**



**N3303A**



**N3301A System DC Electronic Load with N3303A load module**

Load: 240V, 10A, 250W

- Sourcing and Loading  
N6752A high performance DC source module and N3303A DC electronic load module meet stringent combination of requirements for slew rate, transient response and power demands of USB PD 2.0 validation testing
- Most ordinary power products do not meet the necessary combination of requirements



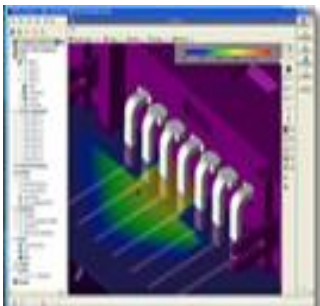
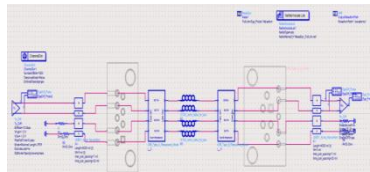
# Summary

# Keysight Type-C Solutions

Now with Power Delivery Solutions!

## Design & Simulation

### Advanced Design System (ADS)



EMPro

