



# PCI-SIG® IDF 2015 UPDATE

**AL YANES**

**President and Chairman**

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**Board Member and MWG Chair**

# PCI-SIG Snapshot



Organization that **defines I/O bus specifications and related form factors.**

- **750+** member companies located worldwide

Creating specifications and mechanisms to **support compliance and interoperability.**

- Australia
- Austria
- Belgium
- Brazil
- Bulgaria
- Canada
- China
- Czech Republic
- Denmark
- Finland
- France
- Germany
- Hong Kong
- Hungary
- India
- Ireland
- Israel
- Italy
- Japan
- Malaysia
- Norway
- Russia
- Singapore
- Slovak Republic
- South Korea
- Sri Lanka
- Sweden
- Switzerland
- Taiwan
- The Netherlands
- Turkey
- United Kingdom
- United States

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# PCI-SIG: IDF 2015 Update



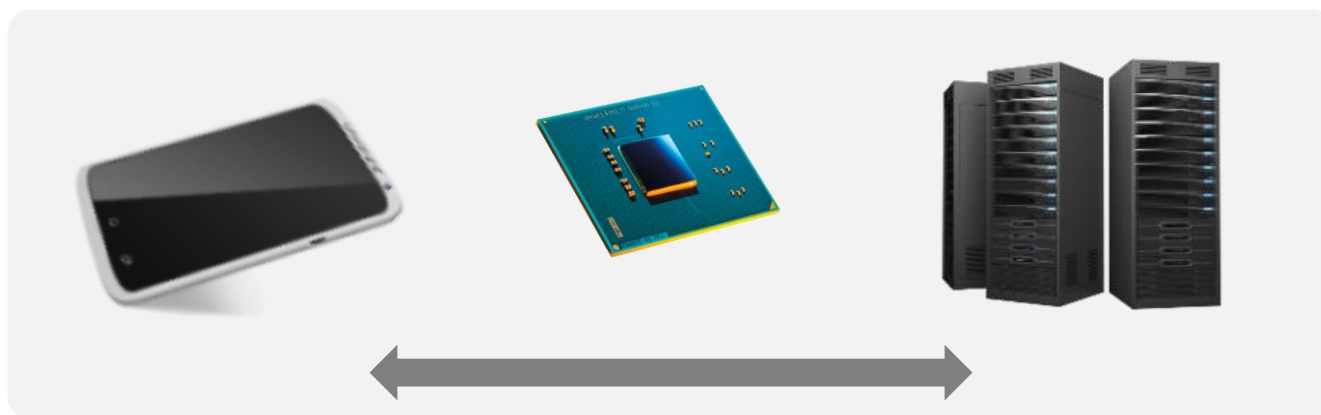
- **Discuss PCI Express adoption across the industry**
- **Highlight low power features spurring industry adoption in multiple markets**
- **Spotlight key applications and markets leveraging PCIe today**
- **Showcase today's PCIe ecosystem and member company PCIe demonstrations at IDF**

# PCI Express Adoption



PCI-SIG delivers a **low-cost, high-performance, ubiquitous and robust** interconnect for the computing industry.

**Since inception, PCI Express architecture** has been **designed with low power features** to support adoption in **multiple applications** from SoCs to high-performance servers.



***PCI Express Adoption Across the Industry***

# PCIe's Low Power Features



## ○ PCIe specifications reduce power consumption

### • L1 Sub-states

- Improves energy distribution on platforms
- Lowers power in idle mode (Near 0 link idle power)

### • Half-swing and Quarter-swing

- Half-swing introduced in PCIe 1.0 base spec
- Quarter-swing further cuts power usage in half in PCIe 4.0 spec

### • M-PCIe Specification

- Extends PCIe architecture to the handheld industry
- Operates over the MIPI® Alliance low-power M-PHY® technology

<b>Full-Swing</b>	○ 800mV
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<b>Half-Swing</b>	○ 400mV
<hr/>	
<b>Quarter-Swing</b>	○ 200mV (targeted)

# PCIe's Low Power Features



- **Expanded PCIe technology to low power and battery-based applications**
  - Embedded, handheld, mobile devices, etc.
- **Flexible lane width configurations and speed selection supporting low power solutions**
  - Desktops, servers and storage solutions



Power Sub-states		Status (On/Off)			Targets	
Link	PHY/PIPE	PLL	Rx/Tx	Common Mode Keepers	1-Lane Power	Exit Latency
L1	P1	On/Off	Off/idle	On	20's of mW 10's of mW	< 5 $\mu$ s (retrain) < 20 $\mu$ s (PLL Off)
L1.1	P1.1	Off	Off	On	< 500 $\mu$ W	< 20 $\mu$ s
L1.2	P1.2	Off	Off	Off	< 10 $\mu$ W	< 70 $\mu$ s

Note: These are targets; actual power may vary per implementation.

## **PCI Express technology continues to gain traction in markets that require low power, high performance I/O.**

- IoT and Mobile Device Applications
  - PCIe technology's inherent low power features meet power requirements for IoT, embedded, handheld and mobile devices
- Storage Applications
  - PCIe architecture delivers performance with low power features and new form factors deliver increased flexibility in storage expansion
- Big Data Applications
  - PCIe 4.0 specification delivers 16GT/s bit rate

# Key Applications: IoT and Mobile

- The growth of IoT and the data explosion on wireless and mobile devices is...
  - Driving demand for faster data rates
  - Driving demand for more power-efficient, battery-operated devices
- PCIe 3.0 delivers 8GT/s and PCIe 4.0 will deliver 16GT/s data rates, meeting demand for higher bandwidth
- PCIe low power features such as L1 sub-states deliver significant power savings for power-constrained devices



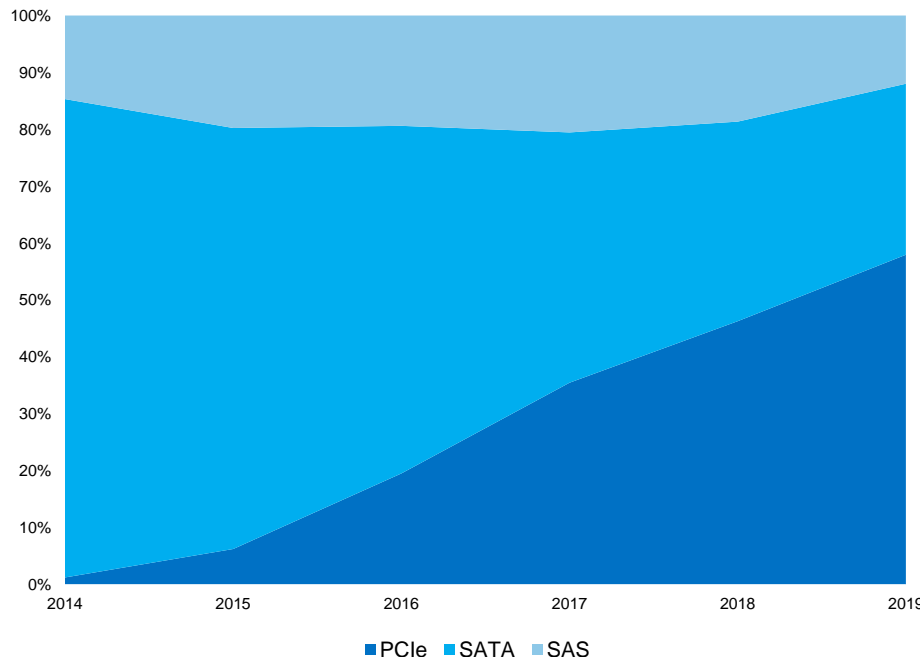


# Key Application: Storage

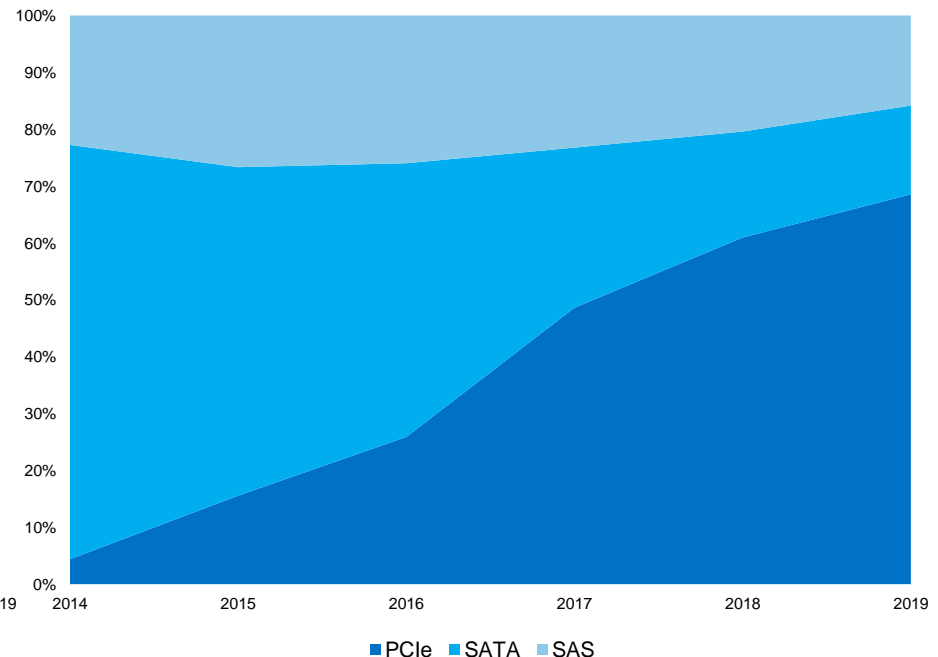


- Data explosion is driving SSD adoption
- PCIe technology is outpacing other interconnect technologies in both units and bandwidth/capacity
  - PCIe 4.0 architecture at 16GT/s provides unbeatable performance headroom with low power features for storage applications

Data Center SSD Units by Interface



Data Center SSD total GB by Interface

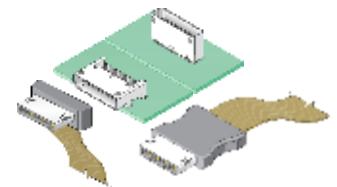
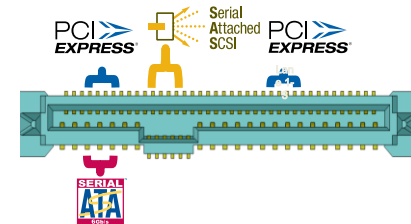


Source: Forward Insights Q1'15

# Key Application: Storage



- PCI-SIG's form factors deliver connectivity and expansion for storage applications
  - SFF-8639 (U.2) server module for high-density SSD storage attach
    - 2.5" dense SSD packing, hot-plug, serviceable, x1/x2/x4, multi-topology
    - FYI testing at August Compliance Workshop #94
  - M.2 form factor specification
    - 42/80/110mm, boot or max storage density, compliancy
    - New BGA form factor and electrical pin-out being defined
  - OCuLink cable form factor
    - Supports up to four PCIe lanes, with all cables supporting 8GT/s; providing up to 32 Gbps in each direction within a four lane configuration
    - Internal: PCIe-attached storage facilitates SATA transition
    - External: PCIe I/O expansion and external PCIe-attached storage
    - Rev 0.9 under review; Rev 1.0 expected in Q4



# Key Application: Big Data



- PCIe 4.0 specification delivers 16GT/s bit rate required by big data applications
  - Meets Big Data application requirements at lowest cost
    - HPC, Data Center, workstation/client platforms, embedded systems, peripheral devices and more
    - HVM processes and materials
  - Doubles I/O bandwidth over PCIe 3.0 specification
    - Preserves backward compatibility with all previous PCIe specifications
  - Low-cost, high-performance I/O technology
    - Facilitates narrower link widths and cost savings through pin reduction
  - Rev 0.7 anticipated for Q4
  - Rev 0.9 anticipated in 2H 2016

	RAW BIT RATE	LINK BW	BW/ LANE/WAY	TOTAL BW X16
PCIe 1.x	2.5GT/s	2Gb/s	~250MB/s	~8GB/s
PCIe 2.x	5.0GT/s	4Gb/s	~500MB/s	~16GB/s
PCIe 3.x	8.0GT/s	8Gb/s	~1GB/s	~32GB/s
PCIe 4.0	16GT/s	16Gb/s	~2GB/s	~64GB/s

# PCIe Technology Portfolio



## PCI EXPRESS ECOSYSTEM

**DELIVERING A CONSISTENT AND INTEROPERABLE USER EXPERIENCE  
ACROSS MULTIPLE PLATFORMS**

### 2002 TO PRESENT

HIGH PERFORMANCE I/O WITH  
LOW POWER FEATURES



### 2013 TO PRESENT

HIGH PERFORMANCE AND LOW  
POWER FOR HANDHELD DEVICES



- INDUSTRY-LEADING COMPLIANCE PROGRAM
- NATIVE OS SUPPORT FOR DEVICE DISCOVERY AND CONFIGURATION
- MANY LINES OF CODE, DELIVERING UBIQUITOUS SOFTWARE SOLUTIONS

# PCI-SIG Members at IDF



## Booth #852

Demonstrating processor-to-processor communication using standard PCIe technology and a non-transparent binding. Demo includes a PCIe network using Intel Xeon's NTB function and PCIe 3.0 card.



## Booth #876

Demonstrating a Protocol Analyzer & Exerciser for PCIe testing, specifically SFF-8639 testing for SSD drives.



## Booth #454

Demonstrating new PCIe 3.0 linear re-drivers, as well as other products oriented with new CPU chipsets.



## Booth #651

Demonstrating DesignWare IP solutions for PCI Express 4.0, including a PCIe 4.0 Root Port Controller interoperating with PCIe 4.0 PHY on a DesignWare IP Prototyping Kit.



## Booth #941

Demonstrating a 5K and 4K camera using PCIe interface that delivers 12 and 20Mpixel, crystal clear images at 130 and 33 frames per second respectively over distances as long as 300 meters with the help of fiber-optic cable.

PCI-SIG continues its solid reputation of delivering **low cost, high-performance, low-power specifications** for **multiple applications** and **markets**

- PCI Express architecture was designed from the beginning with low power features, reducing active and idle power consumption
- Storage is implementing PCI Express at a rapid pace
- PCI-SIG's industry-leading compliance program delivers end-to-end interoperability

[www.pcisig.com](http://www.pcisig.com)

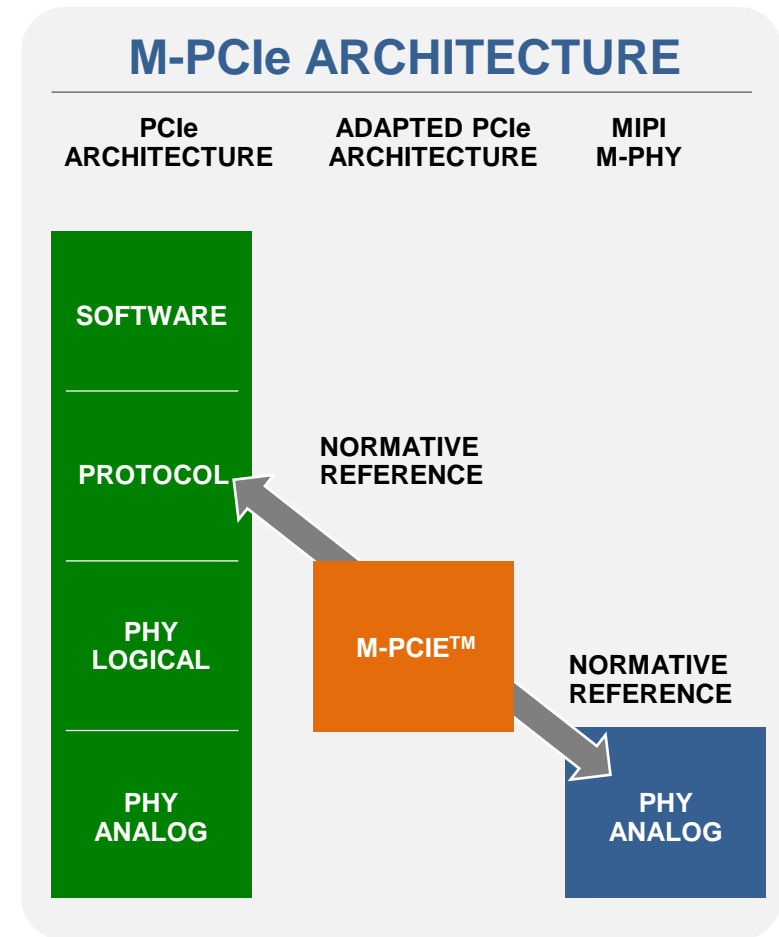
Back-up

# M-PCIe for Mobile Applications



- **PCIe architecture adapted to operate over the MIPI® Alliance M-PHY® technology**

- Extends the benefits of PCIe architecture to the mobile and handheld industry
- Specification delivered with support for M-PHY G1/2/3
  - Seamlessly extends to Gear 4 (11.6Gbps/lane)
- Compliance and interop scope is being investigated

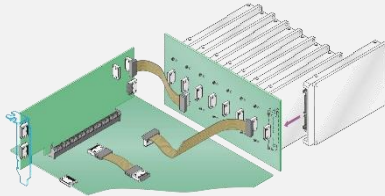




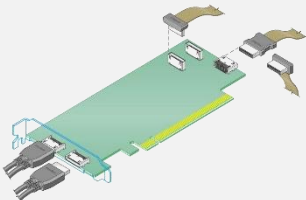
# OCuLink Usage Models

- **Internal Usage**  
PCIe-attached storage

## STORAGE SYSTEMS



## PCIe ADD-IN CARD



- **External Usage**  
PCIe I/O expansion  
External PCIe-attached storage

