



PCIe 的過去、現在與未來



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Confidential

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PCIe 簡介

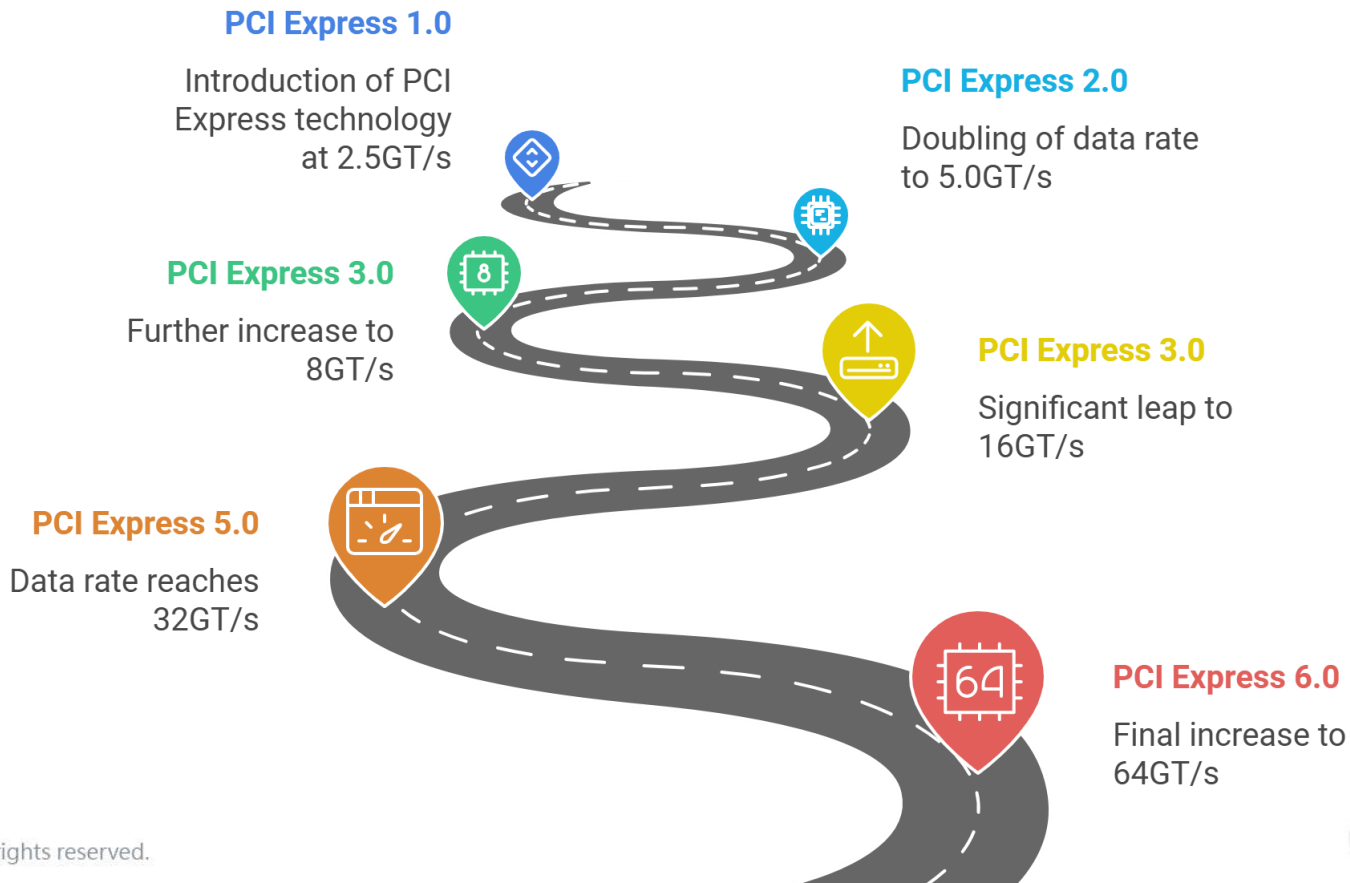
PCIe 的發展與應用

- Early parallel versions of PCI technology accommodated speeds of **hundreds of megabytes/second**, well matched to the **graphics, storage and networking** demands of the 1990s.
- In 2003, PCI-SIG evolved to a serial design that supported speeds of **gigabytes/second** to accommodate **faster solid-state disks** and **100MbE Ethernet**. Almost like clockwork, PCI-SIG has doubled PCIe specification bandwidth **every three years** to meet the challenges of emerging applications and markets.
- Today's announcement of PCI-SIG's plan to double the channel's speed to 512 GB/s (bi-directionally) puts it on track to double PCIe specification performance for another 3-year cycle.

PCIe 發展與應用

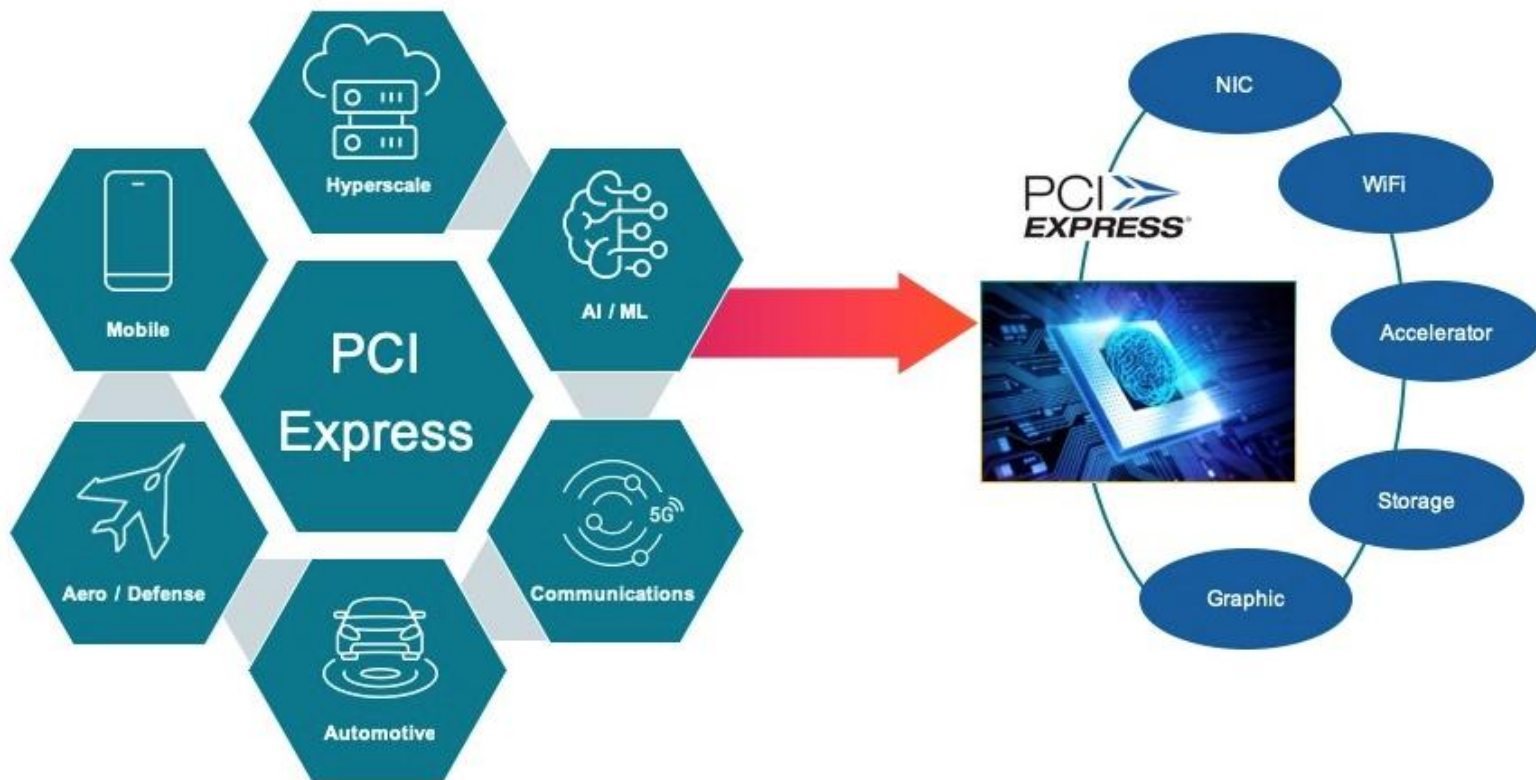
PCI Express Generational Evolution

資料來源: PCI-SIG



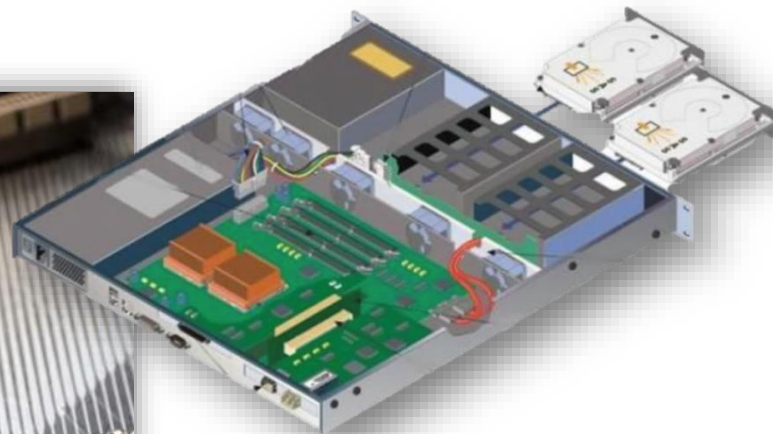
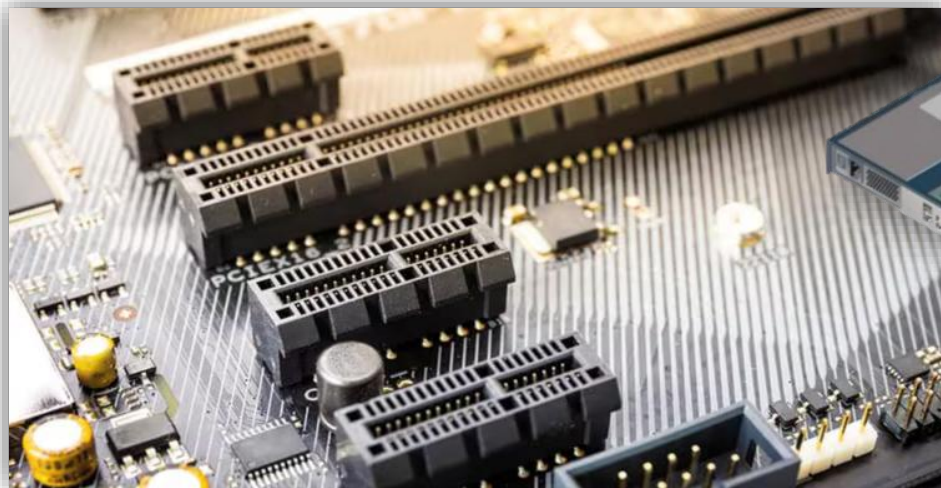
PCIe 發展與應用

來源: PCI-SIG



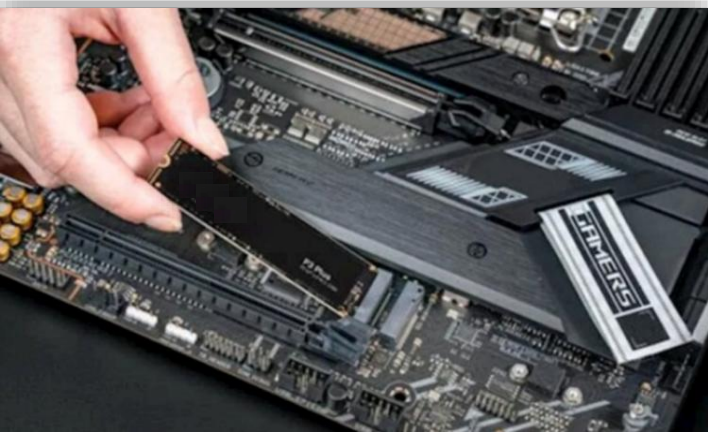
- 隨著越來越多的系統升級，市場上也有越來越多的產品上市，PCIe 5.0 的應用正在加速。話雖如此，PCIe 3.0 和 4.0 仍然是目前最成熟的 PCIe 介面，作為各種 I/O 用例的主要互連形式，被廣泛部署在大量的應用中。
- 產業應用：
 - Ethernet: PCIe 4.0 可以用於 100G 和 200G。PCIe 5.0 可將其性能提升到 400G，目前已經可供使用。而在未來，PCIe 6.0 將把這一數位提升到 800G。
 - Storage: PCIe 4.0 可以使傳輸速率達到約 7000MB/s，PCIe 5.0 將其提升到約 14GB/s，而 PCIe 6.0 應該會將其進一步提升到 28GB/s。
 - Memory: 需要利用PCIe 5.0 & PCIe 6.0的高性能。
 - Automotive: 目前ADAS(高級駕駛輔助系統)使用的是PCIe 4.0，未來的自動駕駛會需要更高的性能來處理所有的攝像頭、雷達和其所接收到的資料。
 - Data Center: AWS、Microsoft Azure、Google Cloud...等，這些用於超大規模資料中心可以透過PCIe來充分利用所能獲得的所有頻寬。
 - AI: 人工智慧 (AI) 和 機器學習 (ML) 需傳輸海量資料，PCIe 介面造成了瓶頸。幾乎所有的應用都是如此，比如自動駕駛、醫療成像、基因組測序、資料採擷等等。無論是在 CPU、GPU、FPGA，還是在 ASIC/SoC (如 Google 的 TPU) 上進行訓練/推理，瓶頸都是 PCIe。

- 在現今雲端技術蓬勃發展推波之下，伺服器 (Server) 具有相當重要的地位，舉凡全球眾所熟知的Google服務、Amazon AWS、Microsoft Azure等服務之關鍵效率都須借重設計精良的高速大容量Server才能精準實現其服務效能，而Server內部則必須配備高速的傳輸能力才能有效回應複雜系統的需求。
- 在Server的運用環境下，大致上可分為：
 - Storage
 - High-Speed Ethernet
 - Graphic



PCIe 發展與應用 – M.2

- 儲存裝置速度的提升與 NVM(Non-Volatile Memory)的普及化，消費性的儲存裝置由 2.5" SATA，逐漸演進至 M.2 並採用 PCIe 作為傳輸介面。
此一規格在空間上更加精簡，速度也遠遠超過 SATA 6Gbps 的限制，成為新一代消費性產品的主流儲存介面。
此外，M.2 也廣泛應用在不止 Server 端的儲存介面。
- M.2 連接器最多可提供 PCIe x4 的頻寬，再加上 PCIe 新規範的加持，使其傳輸速度加倍。



PCIe NVME SSD

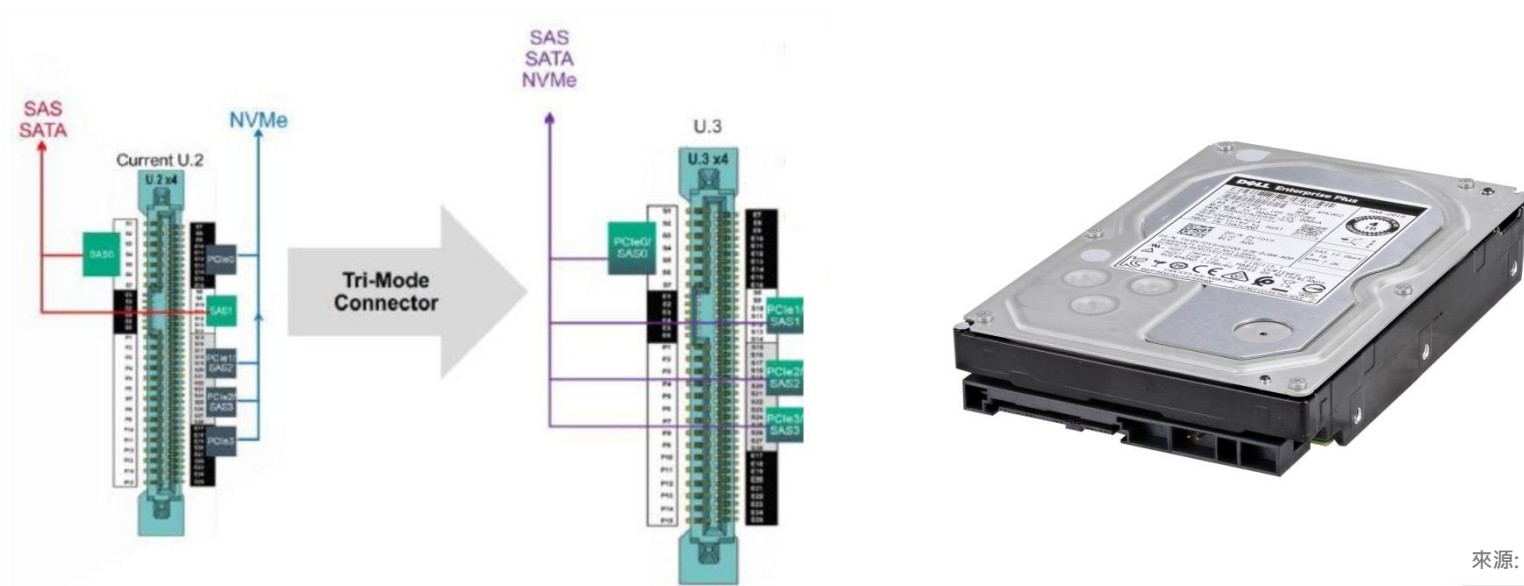


Support PCI-E NVME
M.2(M KEY) SSD



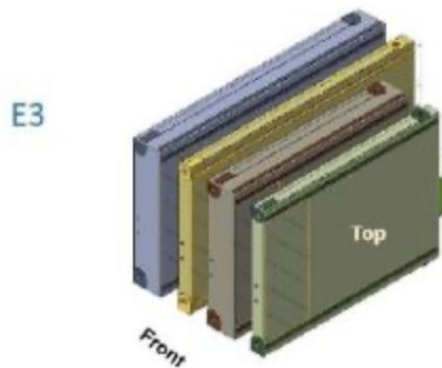
PCIe 發展與應用 – U2 & U3

- U.2 /U.3 (SFF-8639) 連接器應用於工業級固態硬碟或機械硬碟的背板接口，作為伺服器的緩衝器，由於 PCIe 介面支援熱插拔，因此可大幅提升介面穩定性。
- SSFF-8639 包括此 PCIe、SATA 和 SAS 三種標準，實現單個連接器中整合 SAS 和 PCIe 並兼容 SSD 和 HDD 標準。



PCIe 發展與應用 – EDSFF E.1 & E.3

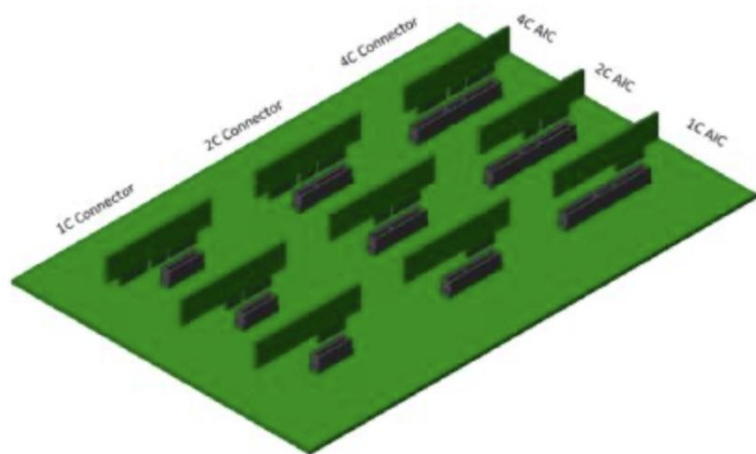
- 隨著更大儲存容量以及外型尺寸規格的需求不斷提升，目前U.2/ U.3 規格已無法再滿足產業需求。伺服器產業又推出了 EDSFF (Enterprise and Datacenter SSD Form Factor) 標準，以因應市場發展。
- EDSFF系列規格的目標在於解決舊有外觀規格的限制外，並滿足目前資料中心散熱、功耗與擴充性的需求，並考量到未來能與PCIe 4、PCIe 5與PCIe 6相容，提高EDSFF標準的發展。
- EDSFF系列規格主要有三種，E1.L、E1.S 以及 E3。



PCIe 發展與應用 – GenZ / OCP NIC 3.0

- 隨著時代的進步加上科技日新月異，傳統的PCIe Slot也到了使用性的臨界點，使用者需要更多的PCIe 通道以及更快的傳輸速度，來連接主板與背板，或是處理高速網路訊息量。

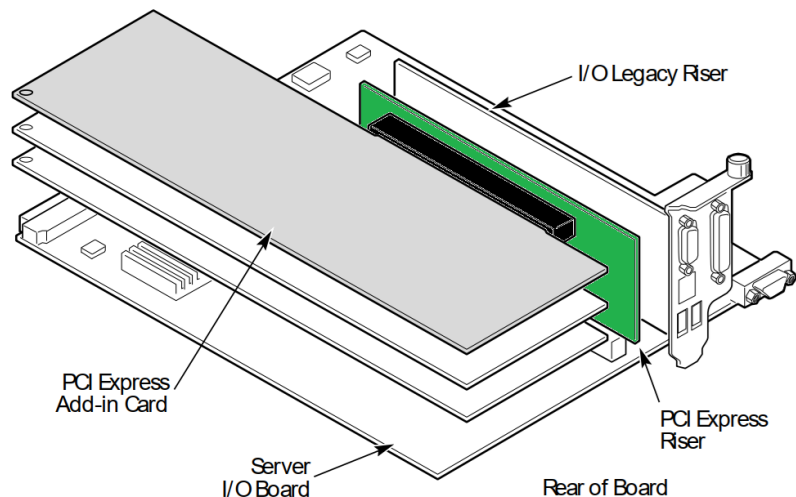
有鑑於此，新一代外型規格Gen-Z / OCP NIC 3.0採用的SFF-TA-1002: 1C/ 2C/ 4C / 4C+ 連接器，也如雨後春筍般的出現。



來源: Broadcom

PCIe 發展與應用 – Riser Cable

- 延伸的Riser Card or Riser Cable可擴展或延伸PCIe Slot使其連結擴充更多的設備。
- 改變資料傳輸連結來滿足特定的系統要求，以確保穩定運作。PCIe Riser Card or Riser Cable 就是此類組件的一個範例。
- 用於將顯示卡連接到主機板，從而允許將顯示卡安裝在 PC 機箱支援的不同位置。

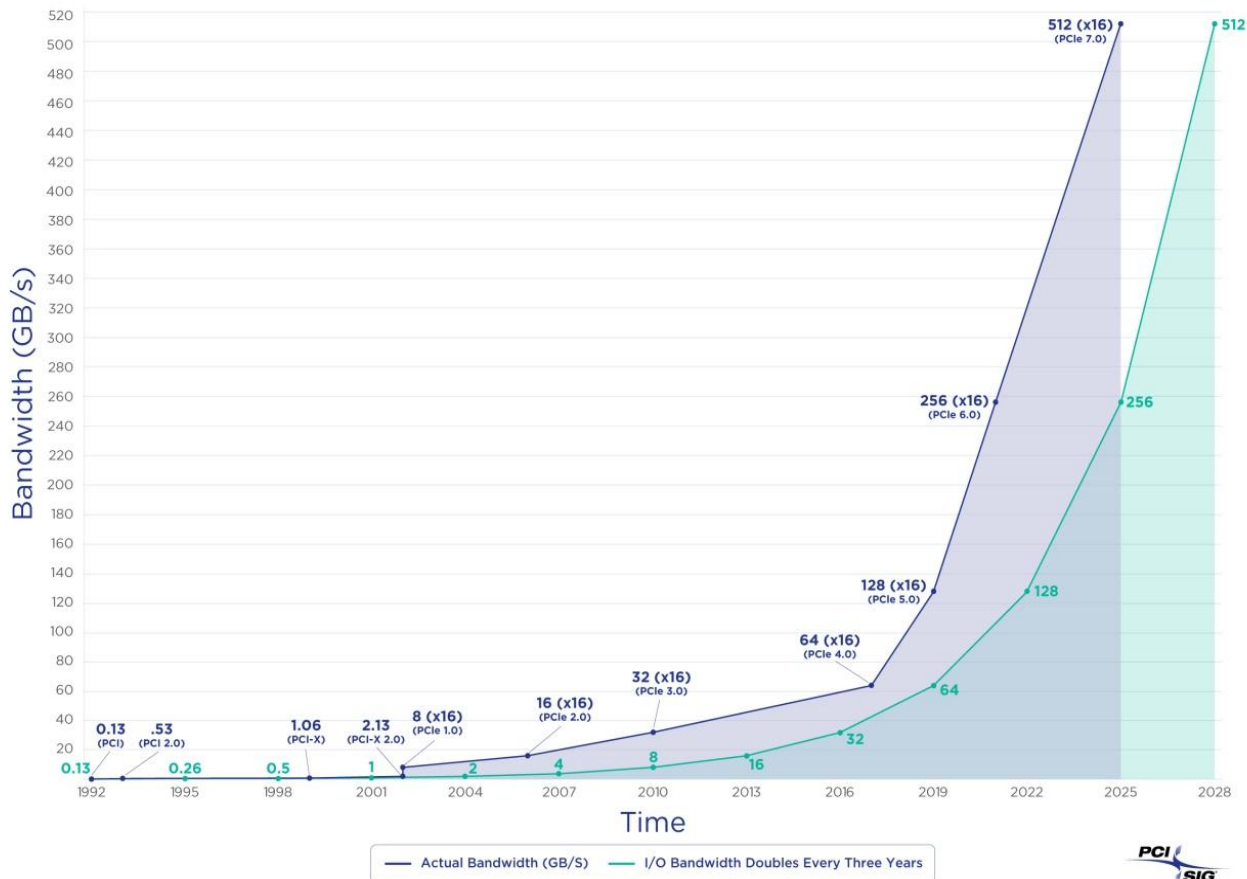


來源: Amazon

PCIe 7.0

PCIe 7.0

I/O BANDWIDTH DOUBLES EVERY 3 YEARS



PCIe 7.0

- With the forthcoming PCIe 7.0 specification, PCI-SIG continues our 30-year commitment to delivering industry-leading specifications that push the boundaries of innovation, said Al Yanes, PCI-SIG President and Chairperson.
- As PCIe technology continues to evolve to meet the high bandwidth demands, our workgroups' focus will be on **channel parameters** and **reach** and **improving power efficiency**.
- The PCIe 7.0 specification is targeted to support emerging applications such as **800 G Ethernet, AI/ML, Cloud and Quantum Computing**; and data-intensive markets like **Hyperscale Data Centers, High-Performance Computing (HPC) and Military/Aerospace**.

PCIe® Speeds/Feeds - Pick Your Bandwidth

- Flexible to meet needs from handheld/client to server/HPC
- ~Max Total Bandwidth = Max RX bandwidth + Max TX bandwidth
- 35 Permutations yielding 11 unique bandwidth profiles
- Encoding overhead and header efficiency not included

Specifications	Lanes				
	x1	x2	x4	x8	x16
2.5 GT/s (PCIe 1.x +)	500 MB/S	1 GB/S	2 GB/S	4 GB/S	8 GB/S
5.0 GT/s (PCIe 2.x +)	1 GB/S	2 GB/S	4 GB/S	8 GB/S	16 GB/S
8.0 GT/s (PCIe 3.x +)	2 GB/S	4 GB/S	8 GB/S	16 GB/S	32 GB/S
16.0 GT/s (PCIe 4.x +)	4 GB/S	8 GB/S	16 GB/S	32 GB/S	64 GB/S
32.0 GT/s (PCIe 5.x +)	8 GB/S	16 GB/S	32 GB/S	64 GB/S	128 GB/S
64.0 GT/s (PCIe 6.x +)	16 GB/S	32 GB/S	64 GB/S	128 GB/S	256 GB/S
128.0 GT/s (PCIe 7.x +)	32 GB/S	64 GB/S	128 GB/S	256 GB/S	512 GB/S

+ = data rate supported by this and subsequent spec revisions.

PCIe 7.0

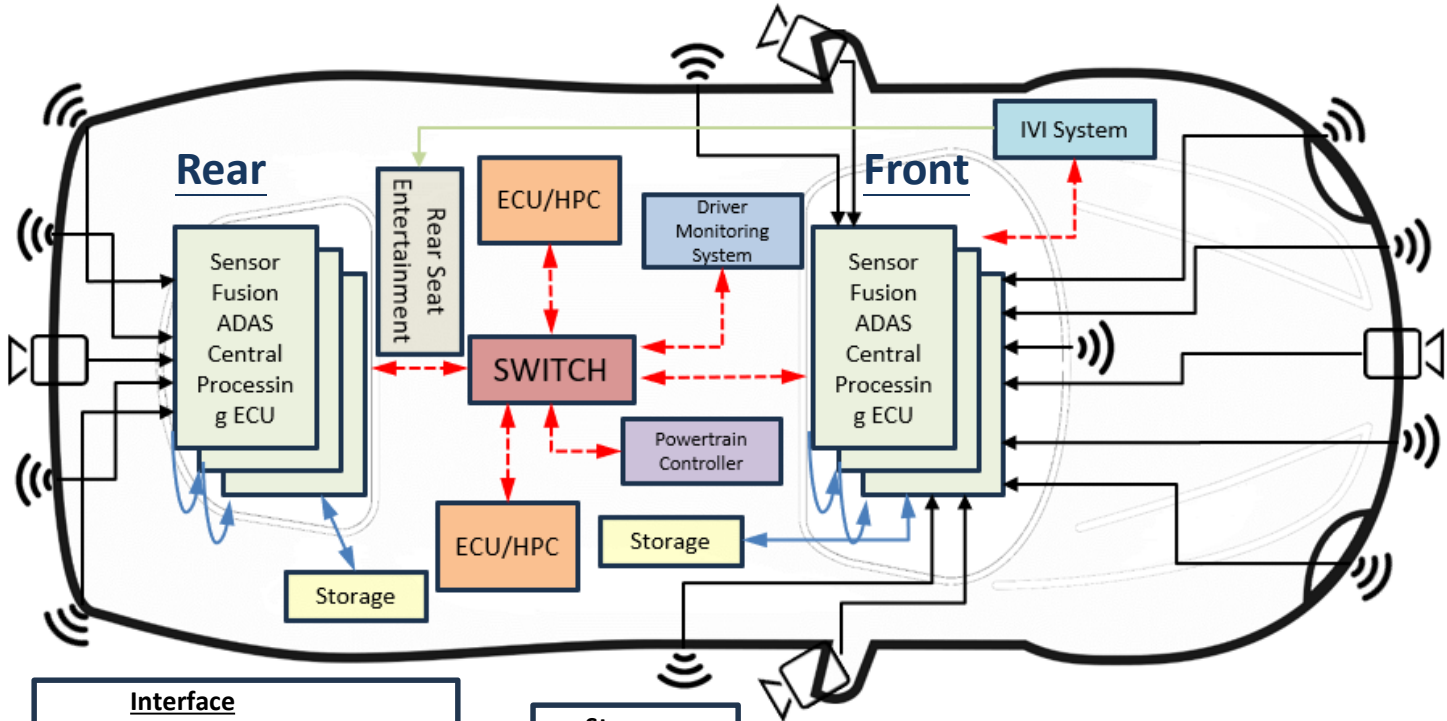
- PCIe 7.0 specification with the following feature goals:
 - Delivering 128 GT/s raw bit rate and up to 512 GB/s bi-directionally via x16 configuration
 - Utilizing PAM4 (Pulse Amplitude Modulation with 4 levels) signaling
 - Focusing on the channel parameters and reach
 - Continuing to deliver the low-latency and high-reliability targets
 - Improving power efficiency
 - Maintaining backwards compatibility with all previous generations of PCIe technology

PCIe 於汽車展業之高速運用

Current and Possible Future Automotive Usages (Level 3 ~)

- Sensor**
- Cameras
 - GPS
 - Ultrasonic
 - Radar
 - LiDAR

- ECU/HPC**
- SoM
- 8 cores@ above 2Ghz
- Memory
- LPDDR5
 - eMMC 5.1
- I/O
- Automotive Ethernet
 - PCIe
 - USB 3.2
 - HDMI 2.1
 - DP/eDP
 - MIPI



- Interface**
- ← - - - - - → PCIe or Multi-Gig Ethernet
 - ↔ PCIe
 - MIPI/ MultiGBASE-T1/ 1000Base-T1
 - DP/eDP/HDMI

- Storage**
- LPDRAM
 - eMMC
 - SSD

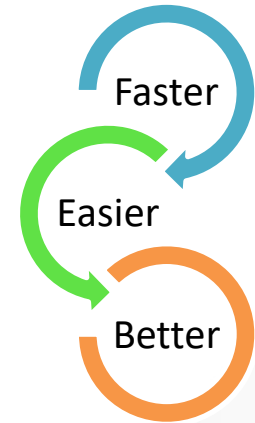
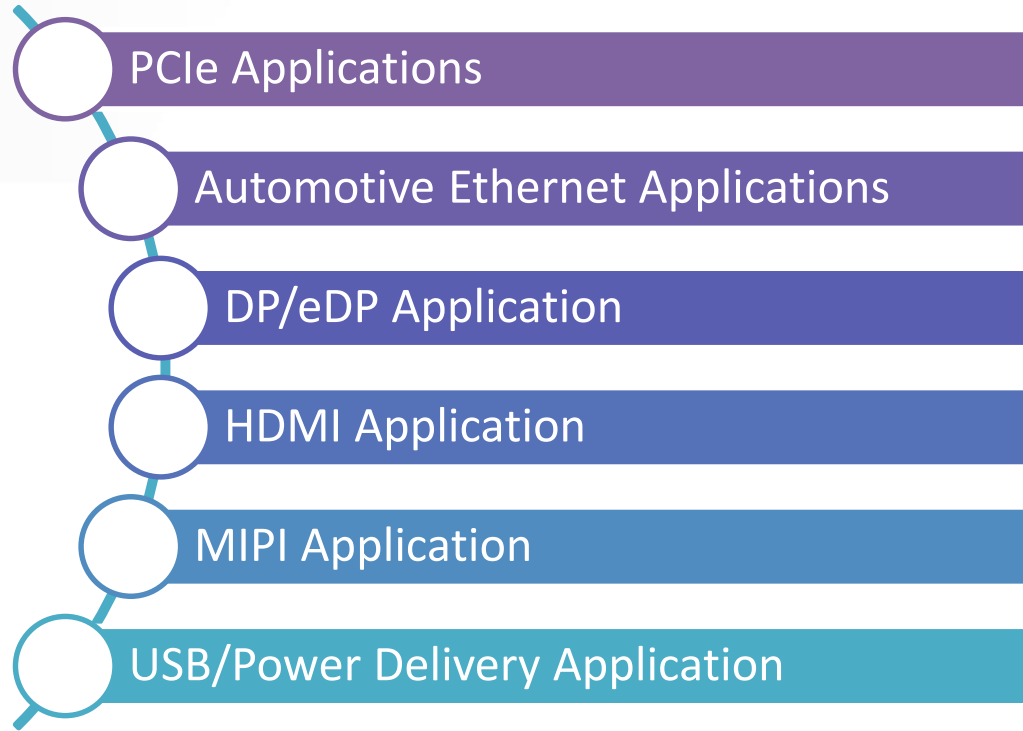
HPC Applications in Automotive Ecosystem

High-Performance Computing (HPC) plays an important role in the automotive ecosystem and requires powerful computing capabilities to meet the demands of the following applications.

- Sensor Data Analysis
 - Using HPC for large-scale data analysis and optimization can help drivers improve fuel efficiency, performance, and safety of vehicles.
- Autonomous Driving
 - HPC provides the necessary computational power to implement complex algorithms and models, making autonomous driving systems more reliable and efficient.
- Real-Time Applications
 - Autonomous vehicles require processing large amounts of sensor data to make real-time decisions and responses.

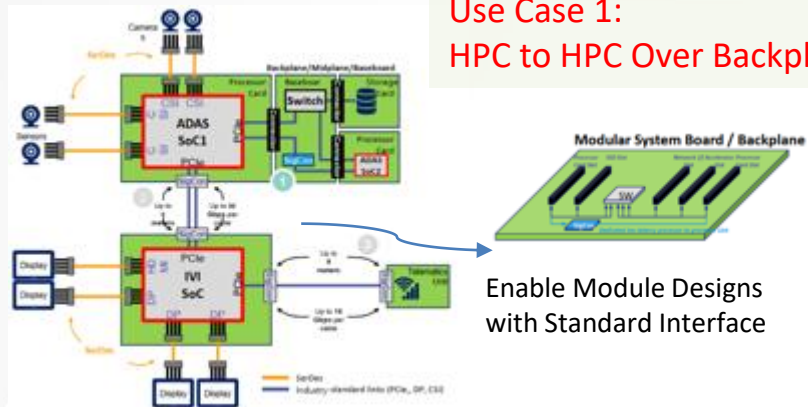


High-Speed Technology Applications for the Automotive Industry

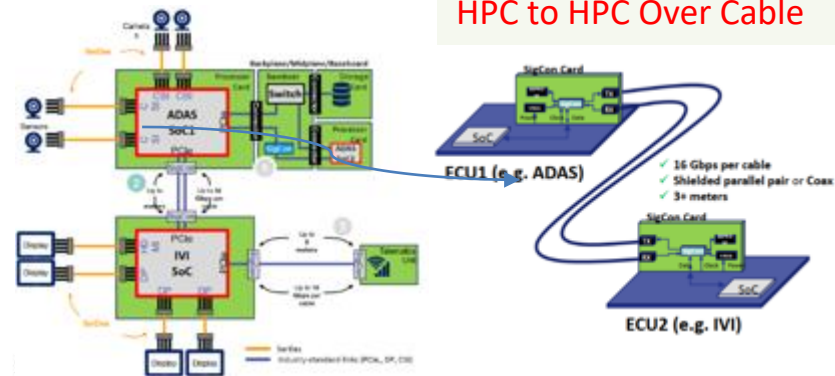


PCIe Use Case

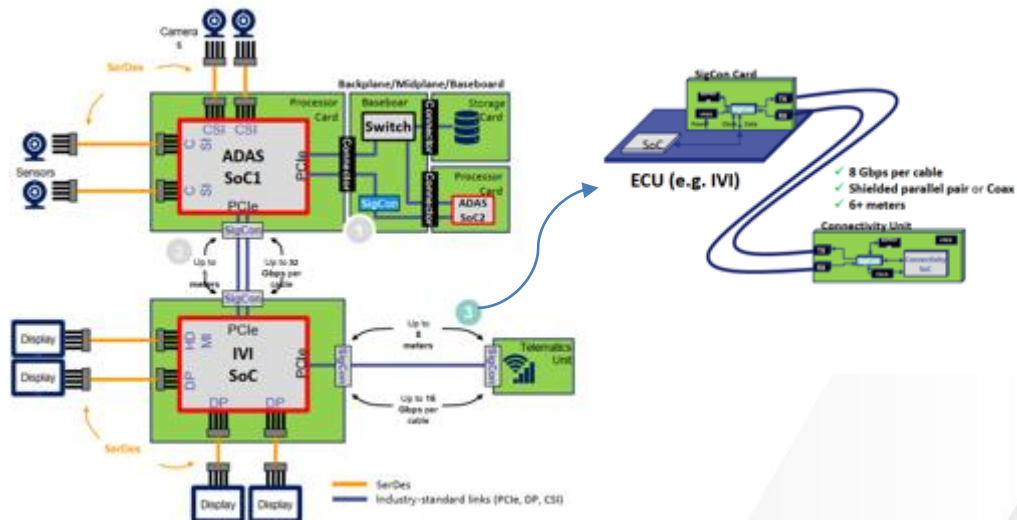
Use Case 1:
 HPC to HPC Over Backplane



Use Case 2:
 HPC to HPC Over Cable



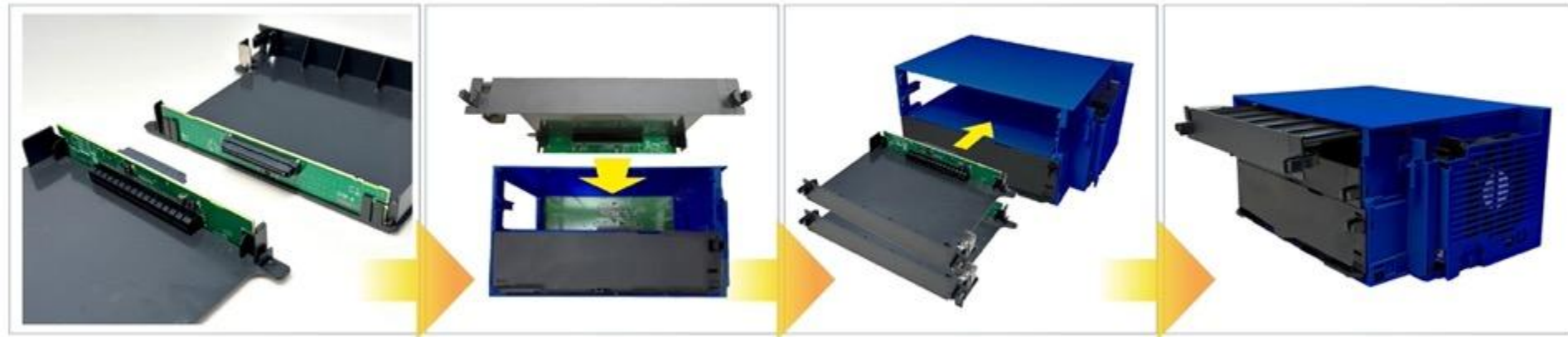
Use Case 3: HPC to Peripheral Over Cable



The information serves as a reference from PCI-SIG

Use Case 1: HPC to HPC Over Backplane

- Automotive HPC adopts PCIe Interface to support the High-Speed application.



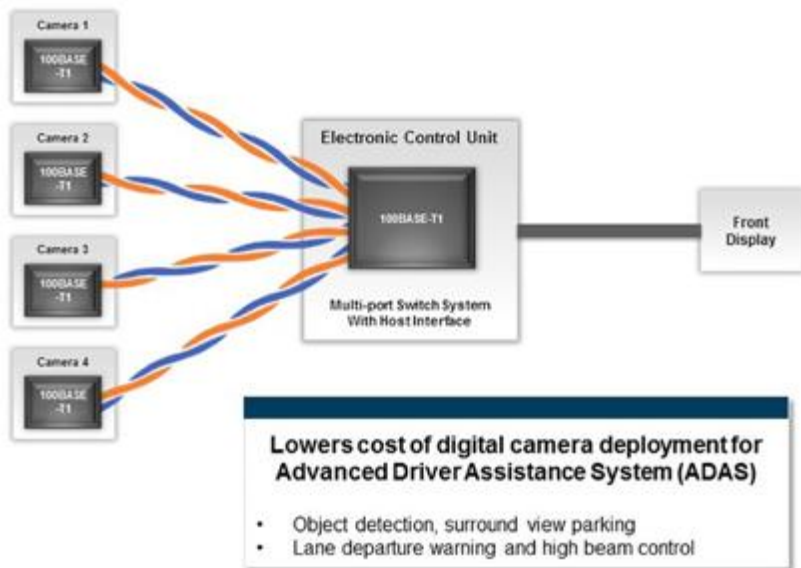
PCIe Standard Interface

Backplane

System Box

Automotive Ethernet Use Case

Use Case 1: ADAS



Use Case 2: Infotainment

100 Mbps Dedicated Bandwidth Per Port

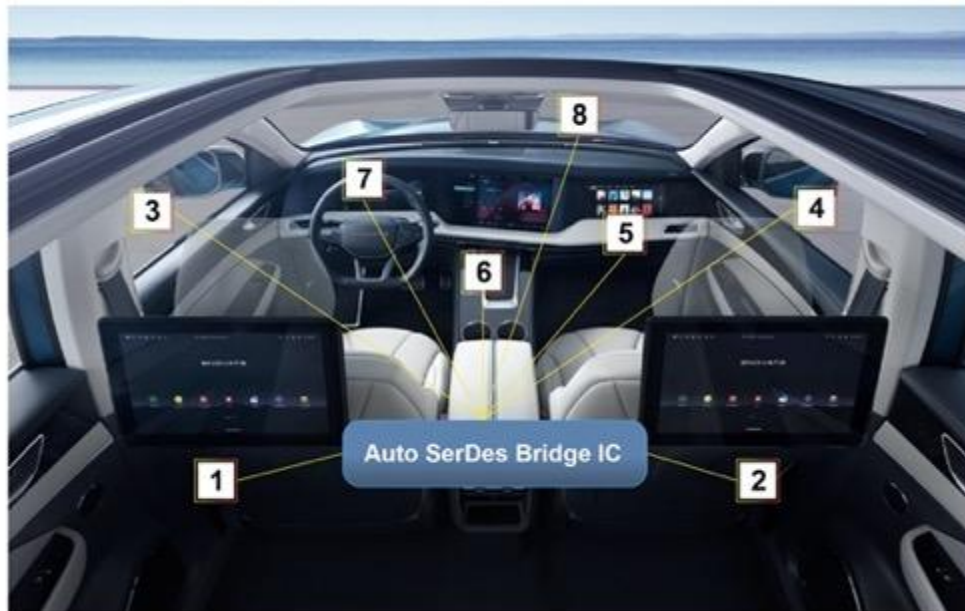
The diagram shows a car interior with various components connected to a central network hub. Components include: Multimedia Charger, ADAS Camera, ADAS, Control Network, Head Unit, Instrument Cluster, Car Audio, Rear View Camera, Rear Seat Entertainment, Rear Seat Entertainment, Rear Seat Entertainment, and High Speed Amplifier. A red line represents the network connection between these components.

- **Supports key requirements:**
 - Dedicated bandwidth per port
 - Flexible speed per port
 - Advanced cable diagnostics for each link
 - Redundancy for failover mechanism
 - IEEE standard (AVB) for audio/video QoS

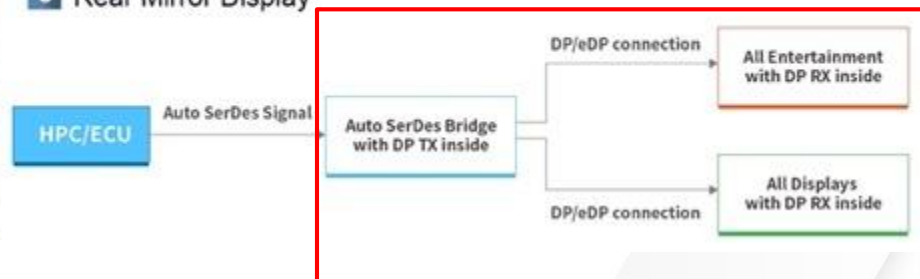
MOST: Maximum 150 Mbps Shared

The diagram shows a car surrounded by various infotainment devices connected to a central network hub. Devices include: a laptop, a tablet, a smartphone, a speaker, a TV, a camera, and a printer. A red line represents the network connection between these devices and the car.

DP/eDP Use Case: ECU to Modules of DisplayPort Technology



- 1 Rear Seat Entertainment (LEFT)
- 2 Rear Seat Entertainment (Right)
- 3 Side Mirror Camera (LEFT)
- 4 Side Mirror Camera (RIGHT)
- 5 Front Seat Entertainment (Right)
- 6 Centre Info Display
- 7 Driver Instrument Display
- 8 Rear Mirror Display



HDMI Use Case:

Use Case 1:

Type E to Type E

(Built-in device to Built-in device)



Use Case 2:

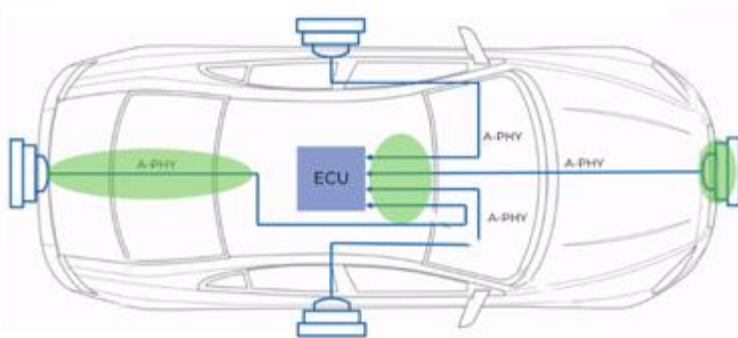
Type A to Type E

(Portable device to Built-in device)



MIPI Use Case

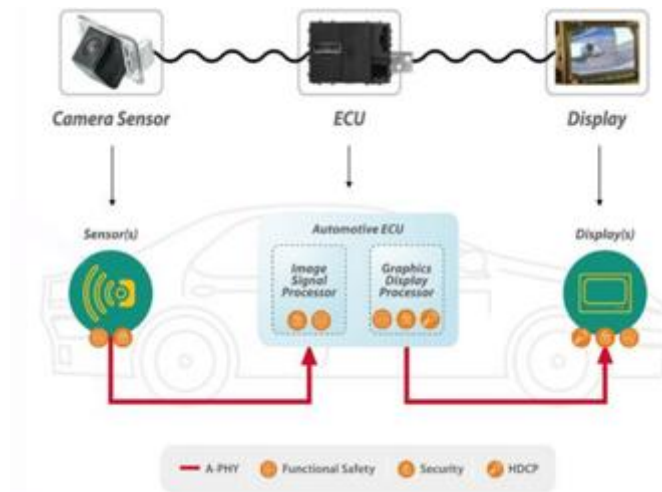
Use Case 1: Surround View



Use Case 2: Display Cockpit



Use Case 3: Digital Camera



USB Type-C and USB Power Delivery Use Case



Use Case	Position USB-C in Headunits	USB-C in Rear-Seat-Entertainment	USB-C in Rear-Seat-Chargers
USB Data Storage	O	O	
240W up Fast Charging	O	O	O
Multimedia Sharing (Alternate Mode)	O	O	
Apple CarPlay	O		
Android Auto	O		



PCIe Cable 的測試挑戰

終端客戶的問題

Background

- The AIPC era is near, led by advanced data infrastructure with ever-faster data flows.
- High Speed Cable quality is vital for signal clarity and product integrity.
- Variable quality in cable production underscores the importance of thorough pre-shipment inspections.
- Random post-production tests for high-frequency traits are insufficient; stronger measures and 100% testing are needed at the IQC/OQC stage.



What Problems will Customers Encounter?



- Inferior cables in data centers may trigger signal problems, jeopardizing connectivity and risking global service outages.
- In autos, faulty cables can cause critical vehicle malfunctions, risking safety.
- The costs of recalling systems or replacing faulty cables far outweigh those 100% of the comprehensive cable testing.
- For ODMs, consistently performing incoming quality checks on externally sourced cables is challenging.

ACMS Series – HF Cables Testing Application Overview



實現 100% Cable 檢測

ACMS Series Software Solution Advantage

- Allion's ACMS software is an advanced software solution designed for R&S (Rohde & Schwarz) network analyzers and test equipment. ACMS is committed to providing maximum flexibility, reliability, and efficiency to ensure that users can achieve 100% cable testing in a production line.
- The following are the main advantages of ACMS:
 1. Complete Integration
 2. User-Friendly Interface
 3. Flexible Customization



ACMS Series Software Solution Advantage – con't

- The following are the main advantages of ACMS:
 4. Efficient Automation Functions
 5. Rich Data Analysis Tools
 6. Continuous Updates and Support

In summary, ACMS software is a powerful and advanced software solution that provides users with a reliable and efficient testing solution to help customers achieve 100% quality control in high-speed cable verification and testing.

ACMS's Advantage – Part 1

With the increasing demand for testing of 100% production cables by the server vendors, data center & automotive makers, ACMS offers a comprehensive solution:

1. Reduced Testing Time

- Slashes traditional cable testing times from 20 minutes to just 40 seconds, boosting your production line's speed and capacity for greater efficiency."

2. Manpower Savings

- Simplifies the testing process to a one-person operation, markedly cutting down on labor costs versus the conventional three-person team requirement.

3. Automated Testing and Analysis

- Delivers seamless, automated testing and analysis, minimizing manual effort and human error. It autonomously processes and presents results post-test.

ACMS's Advantage – Part 2

4. Improved Accuracy and Consistency

- The software manages all testing and analysis, guaranteeing uniform precision and reliability while reducing human error.

Allion ACMS boosts manufacturer's production line's efficiency and cost-effectiveness, providing a substantial competitive advantage.



Faster Cable Testing



Manpower Reduction



Automated Testing and Analysis



Enhanced Accuracy and Consistency

Faster, Easier, Better about your Quality Control

- For example: MCIO Cable



Other Brand: 20 hours
ACMS4: 40 minutes

30 times quickly
compared to the other
brand

**Calibration
(64 Ports Switch)**



Manual: 8 hours
ACMS4: 5 minutes

96 times quickly
compared to the
manual test

Testing



Manual: 20 hours
ACMS4: 60 sec

1200 times quickly
compared to the
manual reporting

Report

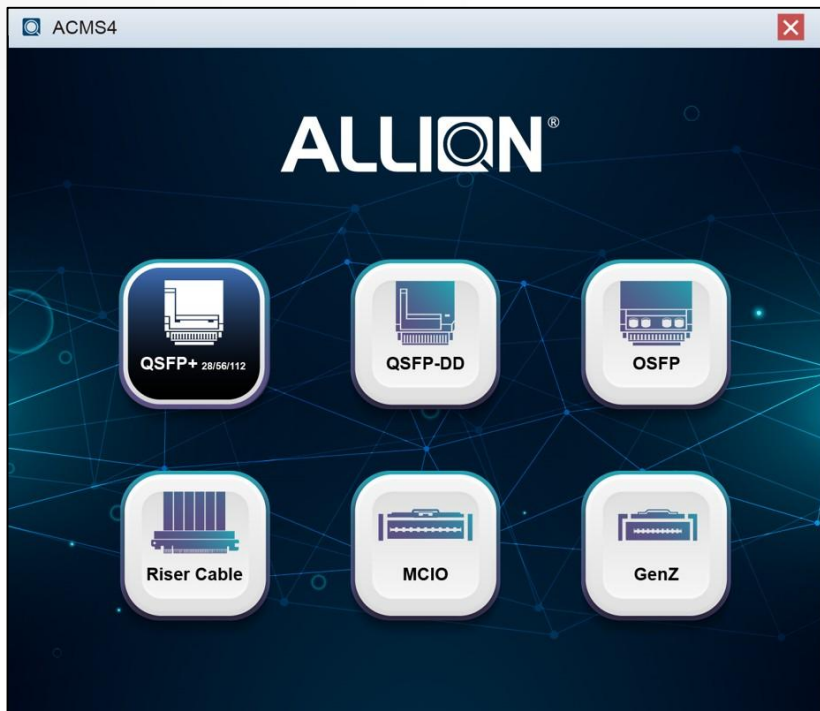


No operate:
Equipment
Control PC
Only:
Change Cables
One button
Scan OR Code

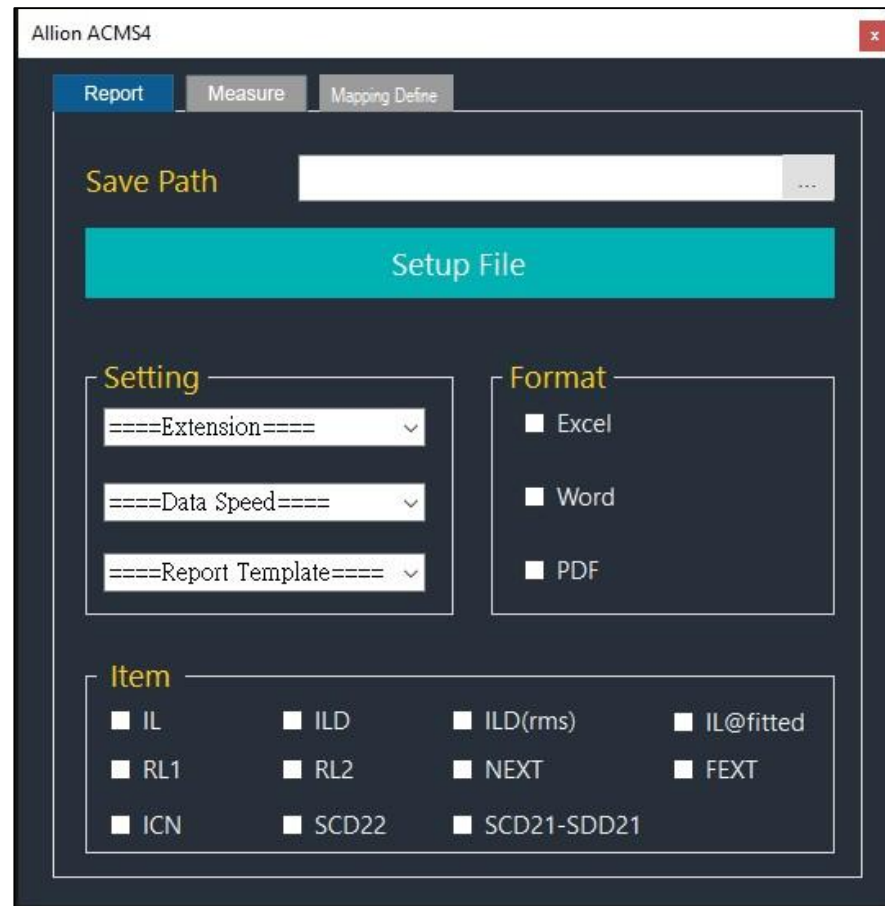
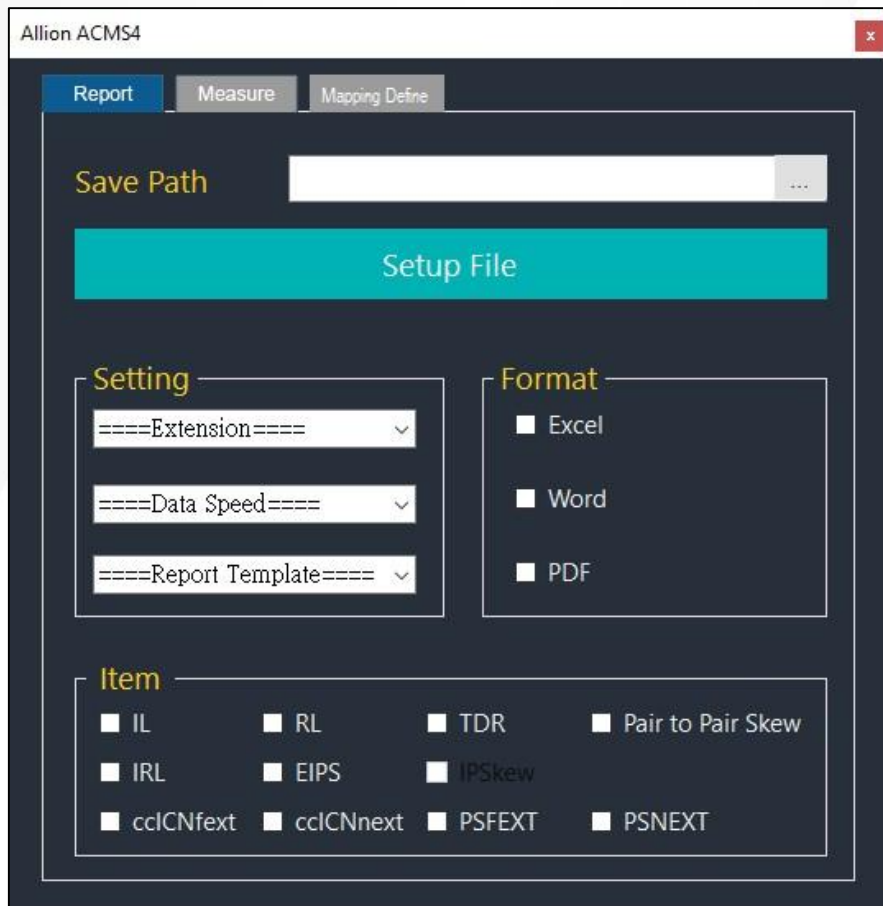
Operate



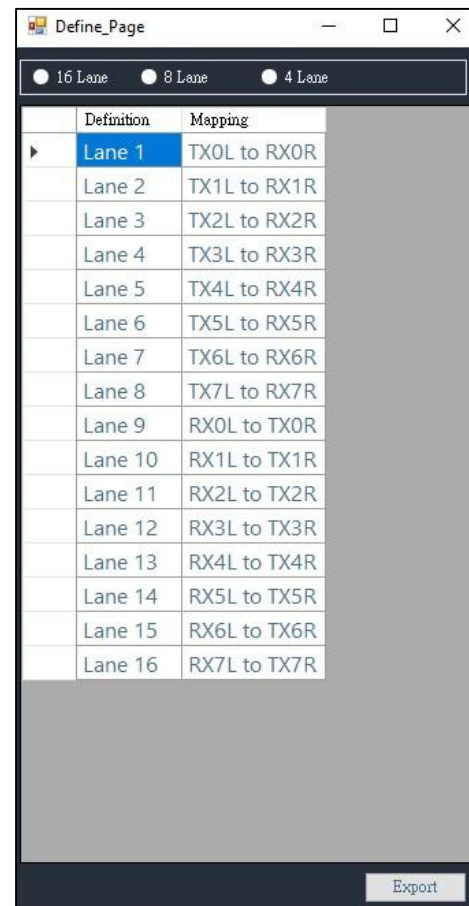
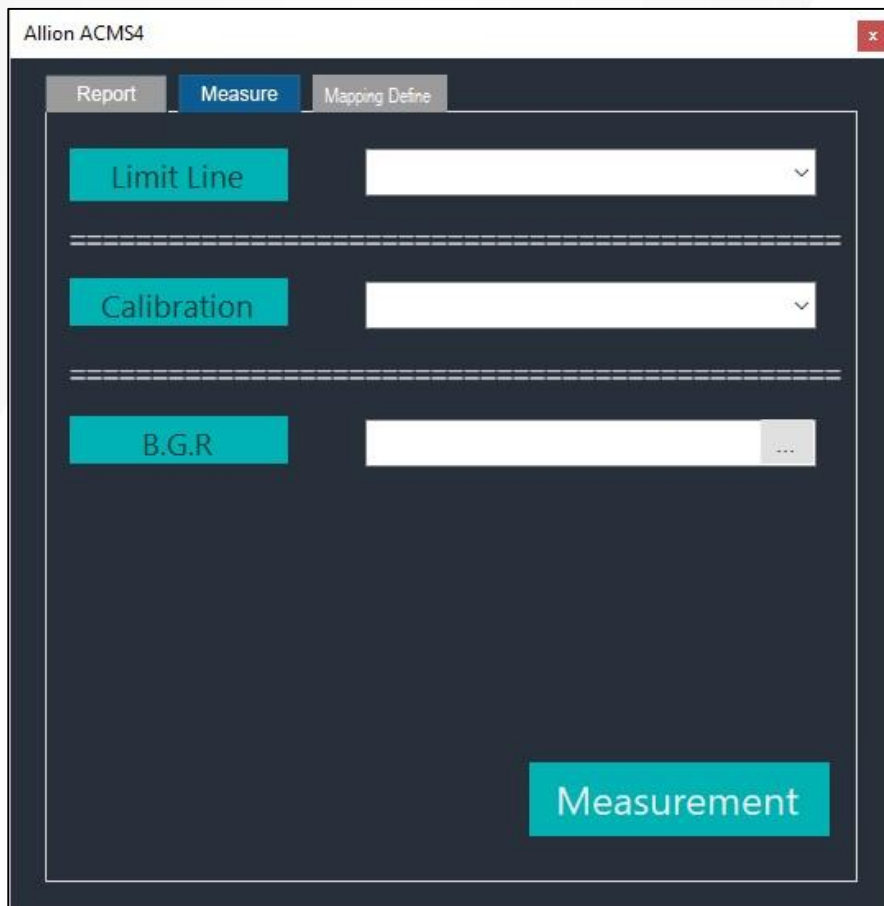
Software Home Page



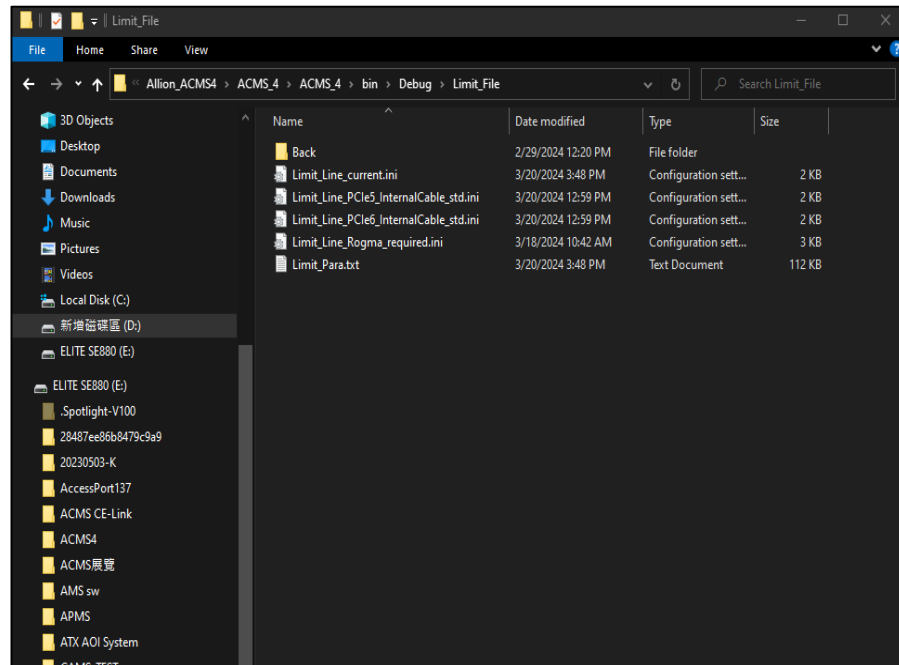
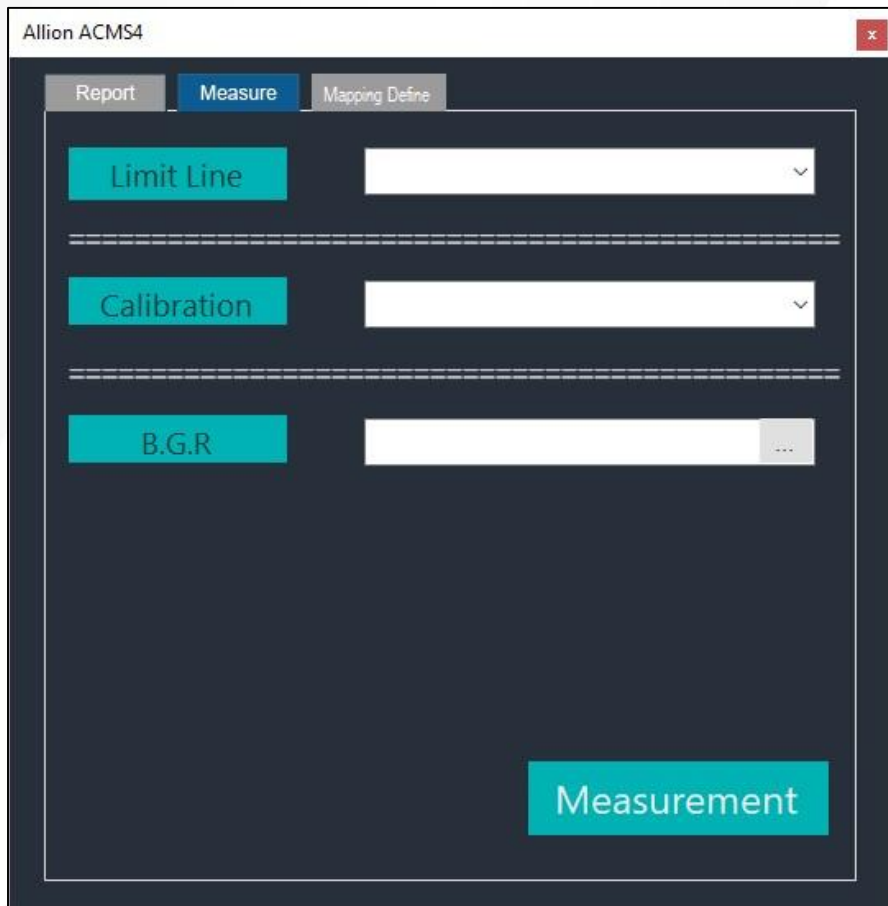
Software UI - Report



Software UI - Measure



Limit Line Setup Page



Limit Line File

De-Embedded Work

2X THRU Fixture A 2X Thru Type Selection

PCB top side Measure

PCB bottom side Measure

DUT
Balanced

2X THRU Fixture B 2X Thru Type Selection

PCB top side Measure

PCB bottom side Measure

Enable DUT + Fixture (Impedance Correction)

Fixture A Top TX0 ~ TX3 Connected
< [Progress Bar] >

Fixture A Bottom TX4 ~ TX7 Connected

Fixture B Top TX0 ~ TX3 Connected
< [Progress Bar] >

Fixture B Bottom TX4 ~ TX7 Connected

Unused

ISD Run

ISD Run

Calibration Software Page

Calibrate

< 1. >

2 Steps

Matrix001 A1

CalUnit

Matrix001 C1

1 2

ZN-Z54 CALIBRATION UNIT 9 kHz ... 40 GHz

Calibrate (1/63)

Testing Page

THRU_CHL12_0 01:42:04 PM
THRU_CHL13_0 01:42:07 PM
THRU_CHL14_0 01:42:10 PM
THRU_CHL15_0 01:42:13 PM
Measure Finish 01:42:17 PM
run_acms4_analyzer.exe Done 01:42:18 PM
MoveAndDeleteFolder 01:42:19 PM
word_repo_main.exe start 01:42:21 PM
Result: Fail 01:42:27 PM
word_repo_main.exe Done 01:42:27 PM
Time difference: 00:01:03.4353855 01:42:27 PM

Speed up List Function Disable

New Thread

THRU_CHL0_0
THRU_CHL1_0
THRU_CHL2_0
THRU_CHL3_0
THRU_CHL4_0
THRU_CHL5_0
THRU_CHL6_0
THRU_CHL7_0
THRU_CHL8_0
THRU_CHL9_0

TX1p ● TX2p
TX0p ● TX3p
TX5p ● TX4p
TX6p ● TX7p
TX9p ● TX8p
TX11p ● TX12p
TX10p ● TX13p
TX15p ○ TX14p

TX1n ● TX2n
TX0n ● TX3n
TX5n ● TX4n
TX6n ● TX7n
TX9n ● TX8n
TX11n ● TX12n
TX10n ● TX13n
TX15n ○ TX14n

RX1p ● RX2p
RX0p ● RX3p
RX5p ● RX4p
RX6p ● RX7p
RX9p ● RX8p
RX11p ● RX12p
RX10p ● RX13p
RX15p ○ RX14p

RX1n ● RX2n
RX0n ● RX3n
RX5n ● RX4n
RX6n ● RX7n
RX9n ● RX8n
RX11n ● RX12n
RX10n ● RX13n
RX15n ○ RX14n

THRU_CHL12_0 01:42:04 PM
THRU_CHL13_0 01:42:07 PM
THRU_CHL14_0 01:42:10 PM
THRU_CHL15_0 01:42:13 PM
Measure Finish 01:42:17 PM
run_acms4_analyzer.exe Done 01:42:18 PM
MoveAndDeleteFolder 01:42:19 PM
word_repo_main.exe start 01:42:21 PM
Result: Fail 01:42:27 PM
word_repo_main.exe Done 01:42:27 PM
Time difference: 00:01:03.4353855 01:42:27 PM

Speed up List Function Disable

New Thread

THRU_CHL0_0
THRU_CHL1_0
THRU_CHL2_0
THRU_CHL3_0
THRU_CHL4_0
THRU_CHL5_0
THRU_CHL6_0
THRU_CHL7_0
THRU_CHL8_0
THRU_CHL9_0

TX1p ● TX2p
TX0p ● TX3p
TX5p ● TX4p
TX6p ● TX7p
TX9p ● TX8p
TX11p ● TX12p
TX10p ● TX13p
TX15p ○ TX14p

TX1n ● TX2n
TX0n ● TX3n
TX5n ● TX4n
TX6n ● TX7n
TX9n ● TX8n
TX11n ● TX12n
TX10n ● TX13n
TX15n ○ TX14n

RX1p ● RX2p
RX0p ● RX3p
RX5p ● RX4p
RX6p ● RX7p
RX9p ● RX8p
RX11p ● RX12p
RX10p ● RX13p
RX15p ○ RX14p





RX1n ● RX2n
RX0n ● RX3n
RX5n ● RX4n
RX6n ● RX7n
RX9n ● RX8n
RX11n ● RX12n
RX10n ● RX13n
RX15n ○ RX14n

Testing Page (HDMI)

C:\ToughScreen\HDMI\meas_HDMI_1.mea

RM | [Circuit Diagram] | [Folder Icon] | STOP | [Green Arrow Down] | CLEAR | DeEm | Load

StartUIController

Time difference: 00:00:11.6562629	12:19:23 下午	Cable 1	Serial Number	1	Completed	 PASS
Time difference: 00:00:11.0588830	12:19:34 下午	Cable 2	Serial Number	2	Completed	 Fail
Time difference: 00:00:11.8206392	12:19:46 下午	Cable 3	Serial Number	3	Completed	 PASS
Time difference: 00:00:12.8303806	12:19:59 下午	Cable 4	Serial Number	04	Completed	 PASS
Time difference: 00:00:11.7198072	12:20:11 下午					
Time difference: 00:00:13.0986908	12:20:24 下午					

List Function Disable

- StartUIController
- HDMI_CHL0_0
- HDMI_CHL1_0
- HDMI_CHL2_0
- HDMI_CHL3_0
- HDMIFEXT_CHL2_3
- HDMIFEXT_CHL2_0
- HDMIFEXT_CHL2_1
- HDMIFEXT_CHL3_0
- HDMIFEXT_CHL3_1
- HDMIFEXT_CHL0_1

AUTO Report - 01

Record DUT Name and Test Result

Rina Cable Test Report

Company Name: Rina

Part Number: Rina

Serial Number: sefds

Report Date: 20th Mar, 2024

Test Result: **Fail**

Tester: Rina

Data Summary

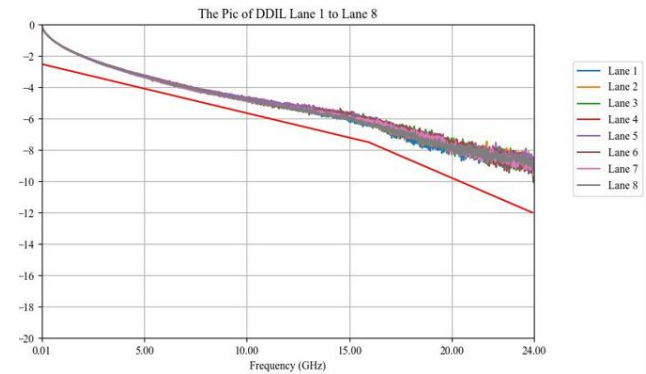
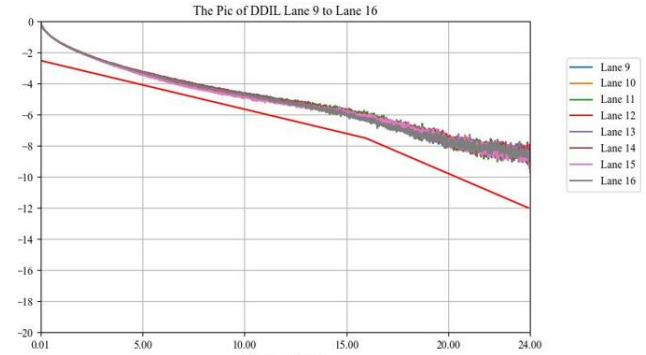
Test Item and Results	
Test Item	Result
The Results of DDIL Test	Pass
The Results of DDRL Test	Pass
The Results of jRL Test	Pass
The Results of Impedance Test	Pass
The Results of EIPS Test	Pass
The Results of Inter-Pair Skew Test	Pass
The Results of PSNEXT Test	Fail
The Results of PSFEXT Test	Fail
The Results of ccICNNEXT Test	Pass
The Results of ccICNFEXT Test	Pass

Definition Mapping

Definition	Mapping
Lane 1	TX0L to RX0R
Lane 2	TX1L to RX1R
Lane 3	TX2L to RX2R
Lane 4	TX3L to RX3R
Lane 5	TX4L to RX4R
Lane 6	TX5L to RX5R
Lane 7	TX6L to RX6R
Lane 8	TX7L to RX7R
Lane 9	RX0L to TX0R
Lane 10	RX1L to TX1R
Lane 11	RX2L to TX2R
Lane 12	RX3L to TX3R
Lane 13	RX4L to TX4R
Lane 14	RX5L to TX5R
Lane 15	RX6L to TX6R
Lane 16	RX7L to TX7R

The Results of DDIL Test

Test Item	Test Port	Test Results
DDIL	Lane 1	Pass
	Lane 2	Pass
	Lane 3	Pass
	Lane 4	Pass
	Lane 5	Pass
	Lane 6	Pass
	Lane 7	Pass
	Lane 8	Pass
	Lane 9	Pass
	Lane 10	Pass
	Lane 11	Pass
	Lane 12	Pass
	Lane 13	Pass
	Lane 14	Pass
	Lane 15	Pass
	Lane 16	Pass


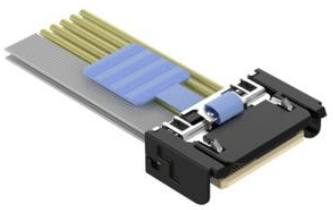
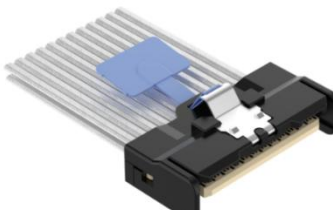



多種高速 Interface 的測試應用

High-Speed Cable Test: IO Interface

USB-IF	HDMI 2.1	DP 2.1	TBT5
<p>USB-C Cable</p>  <p>4 Differential Pairs 40 Gbps 80 Gbps</p>	<p>HDMI Ultra High-Speed</p>  <p>4 Differential Pairs 48 Gbps</p>	<p>DP54 & DP80</p>  <p>5 Differential Pairs 54 Gbps 80 Gbps</p>	<p>Thunderbolt Cable</p>  <p>4 Differential Pairs 40 Gbps 80 Gbps</p>

High-Speed Cable Test: Datacenter & Servers

SAS 4/PCIe Gen4	PCIe Gen5	PCIe Gen5	16X Interface
<p>Slimline SAS</p>  <p>4 TX/4 RX Lane 8 TX/8 RX Lane</p> <p>24 Gbps (SAS 4) 16Gbps (PCIe Gen4)</p>	<p>GenZ</p>  <p>4 TX/4 RX Lane 8 TX/8 RX Lane</p> <p>32 Gbps (PCIe Gen5)</p>	<p>MCIO</p>  <p>4 TX/4 RX Lane 8 TX/8 RX Lane</p> <p>32 Gbps (PCIe Gen5) 16 TX/16 RX Lane</p>	<p>PCIe Riser Cable</p>  <p>16 TX/16 RX Lane</p> <p>32 Gbps (PCIe Gen5)</p>

High-Speed Cable Test: IEEE 802.3 (Direct Attach Copper Cables)

1X Interface

SFP+/28/56/112



1 TX/1 RX Lane

10 Gbps

4X Interface

QSFP+/28/56/112



4 TX/4 RX Lanes

	Per Lane Rates
QSFP+	10 Gbps
QSFP28	25 Gbps
QSFP56	50 Gbps
QSFP112	100 Gbps

8X Interface

QSFP-DD





8 TX/8RX Lanes

Being deployed for up to 100 Gbps per lane

OSFP/OSFP RHS



ACMS4 ~ ACMS6 (VNA + 64 Ports Switch)

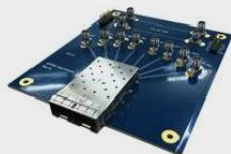
ACMS4 (VNA + 64 Ports Switch)	VNA Mode	Frequency Range	Application
 The image shows the ACMS4 VNA + 64 Ports Switch. It is a rack-mountable device with a large color display showing a graph and various control buttons and knobs on the right side.	ZNB	100KHz~43.5GHz	<ul style="list-style-type: none">■ PCIe Gen5/Gen6■ MCIO GenZ■ SAS/Slimline SAS■ SFP/SFP+■ QSFP+/28/56/112
ACMS6 (VNA + 64 Ports Switch)	VNA Mode	Frequency Range	Application
 The image shows the ACMS6 VNA + 64 Ports Switch. It is a rack-mountable device with a large color display showing a graph and various control buttons and knobs on the right side.	ZNA	10MHz~67GHz	<ul style="list-style-type: none">■ PCIe Gen7■ MCIO GenZ■ QSFP-DD 800G■ OSFP 800G■ Future High-Speed Interface

Test Fixtures for Cable Testing

SFP Test Fixture



SFP



SFP28

QSFP Test Fixture



QSFP28



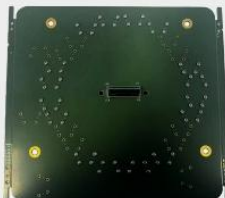
QSFP-DD

PCIe Gen5 Test Fixture



PCIe Riser Cable

MCIO Test Fixture



MCIO Plug Test Fixture



Why Allion?

- Allion's ACMS Automation Solution ensures each cable in the production or incoming quality check (IQC) process, giving you a 100% confidence level of the quality.
- Allion actively shapes testing standards through our engagement with leading associations, ensuring we stay ahead with the most current specifications.
- Our multidisciplinary EE, ME, and SW RD teams excel in creating tailored AI/Auto solutions that align perfectly with client needs.
- Allion specializes in crafting high-frequency fixtures for a range of interfaces, including PCIe, High-speed Ethernet, SAS, USB, and HDMI, enhancing our ACMS offerings.

Allion is the premier resource for all of your third party testing needs. Our services bring products to market more quickly, reliably, and cost effectively to protect your brand quality and that of your suppliers.



Thank you

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