



PCIe In Industrial Application

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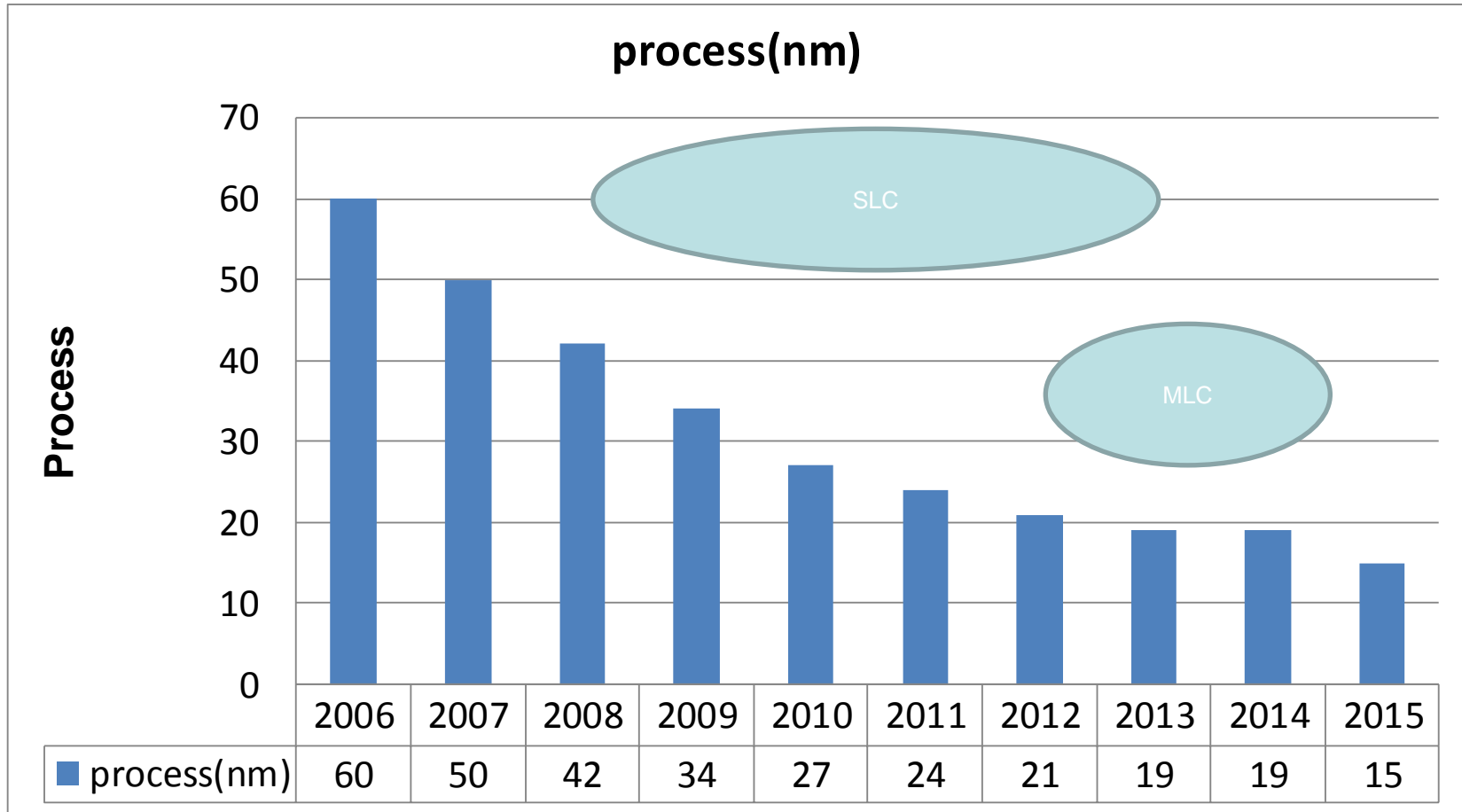
Embedded Flash VP of innodisk



Agenda

- Flash Storage for Industrial Applications
- Generations of Storage Interface
 - IDE
 - SATA
 - Other Interfaces
- PCIe Interface & Form factor
- Summary

NAND Flash Process





Flash Performance

High Speed Performance:

DDR2 Interface

	ONFI 3.1/3.2			ONFI 4.0 Preliminary
	<i>SDR</i>	<i>NV-DDR</i>	<i>NV-DDR2</i>	
	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes
	50	DDR-200	DDR-400 (3.1) DDR-533 (3.2)	DDR-800 (NV-DDR3)
	1.8V/3.3V*	1.8V/3.3V*	1.8V, SSTL_18	1.2V (NV-DDR3)

Source by www.onfi.org

Performance

ONFI 3.2 NV-DDR2 Flash Performance

19/20nm flash supports 400Mbps

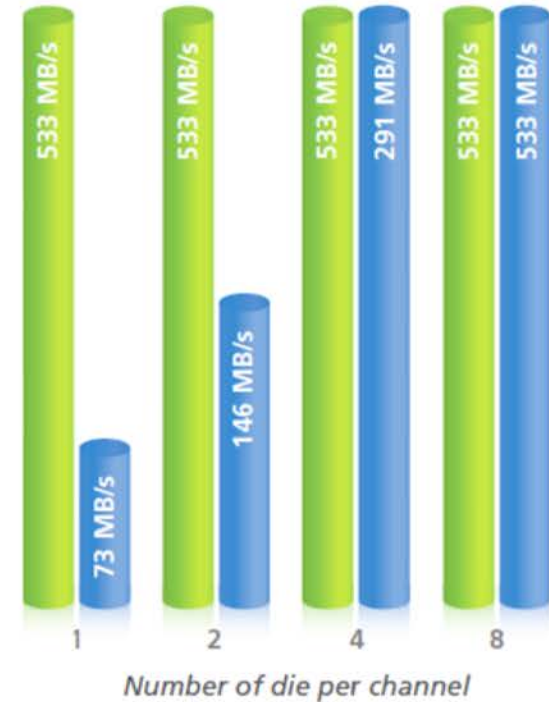
MLC Flash
16KB Page Performance*



*Maximum sequential performance assuming no controller overhead



SLC Flash
16KB Page Performance*



*Maximum sequential performance assuming no controller overhead









High-Speed Flash



*The speed of Flash
Interface is not a bottleneck
anymore.*

You can design a high speed SSD with the Flash that is currently available on the market.
It's time to move to the next-gen interface for SSDs.

Flash For Industrial Applications

<p>SLC High demand for devices under 2GB.</p> <ul style="list-style-type: none"> • Embedded OS drive • Higher reliability • Better lifespan 	 <p>Industrial PC</p>	 <p>Gaming</p>	 <p>Automation</p>	 <p>Military Equipment</p>
<p>MLC High demand for devices over 32GB.</p> <ul style="list-style-type: none"> • Application data drive • Higher SSD capacity • Cost-driven orientation 	 <p>surveillance</p>	 <p>POS</p>	 <p>Networking</p>	 <p>Digital Signage</p>



Many Different Interfaces Are Used For Industrial Applications

1.8" SATA SSD
2.5" SATA SSD

SATADOM
mSATA, SATA Slim
Cfast, CF-SATA

PATA CF/IDE DOM

USB Module

SD / micro SD

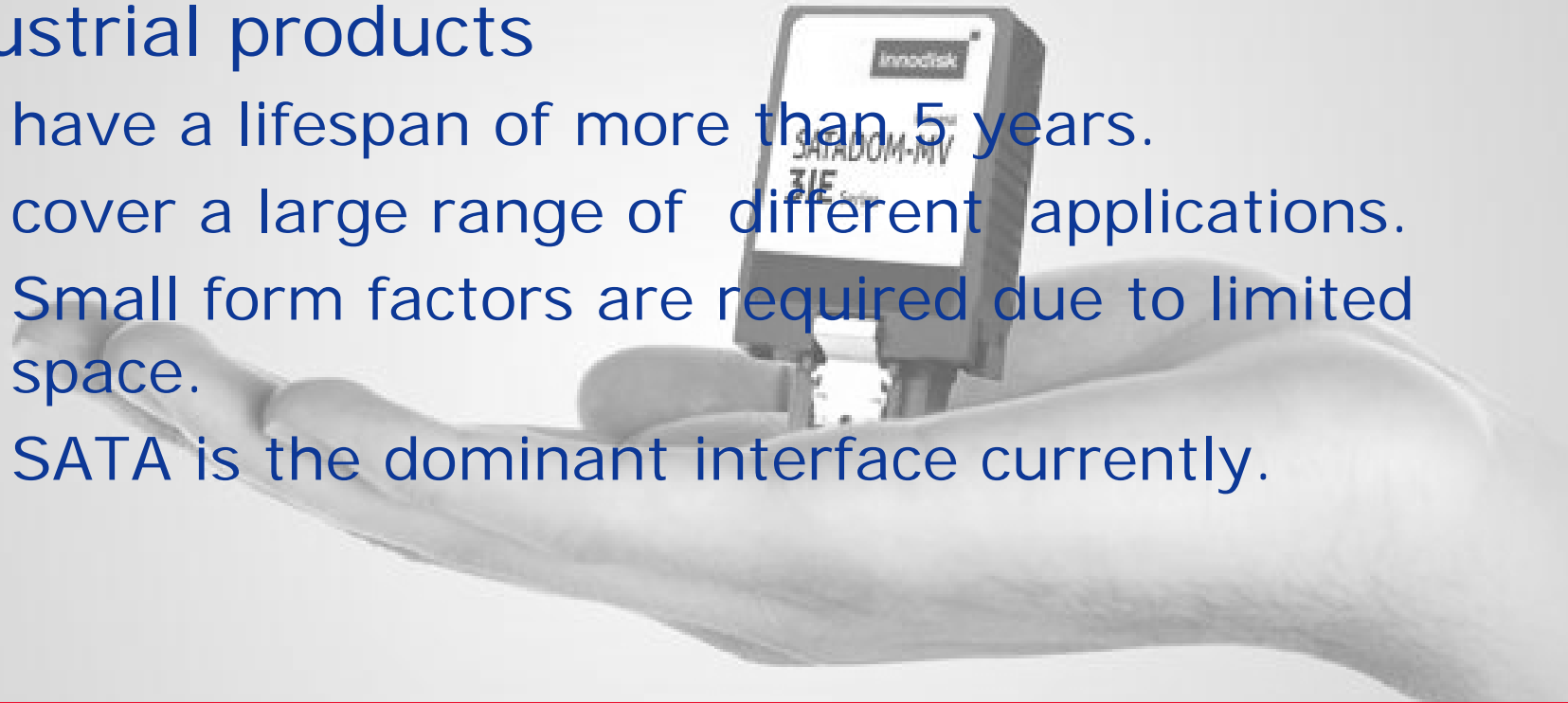
eMMC, uSSD



All Interfaces Will Remain In Demand For A Few More Years.

Industrial products

- have a lifespan of more than 5 years.
- cover a large range of different applications.
- Small form factors are required due to limited space.
- SATA is the dominant interface currently.



What is next?



SSD Form Factor Evolution, 1995 - 2003

CompactFlash
Revision 1.0,
8.3 MByte/s
(PIO mode 2)

1990

1995



1999

2000



2003

Jan



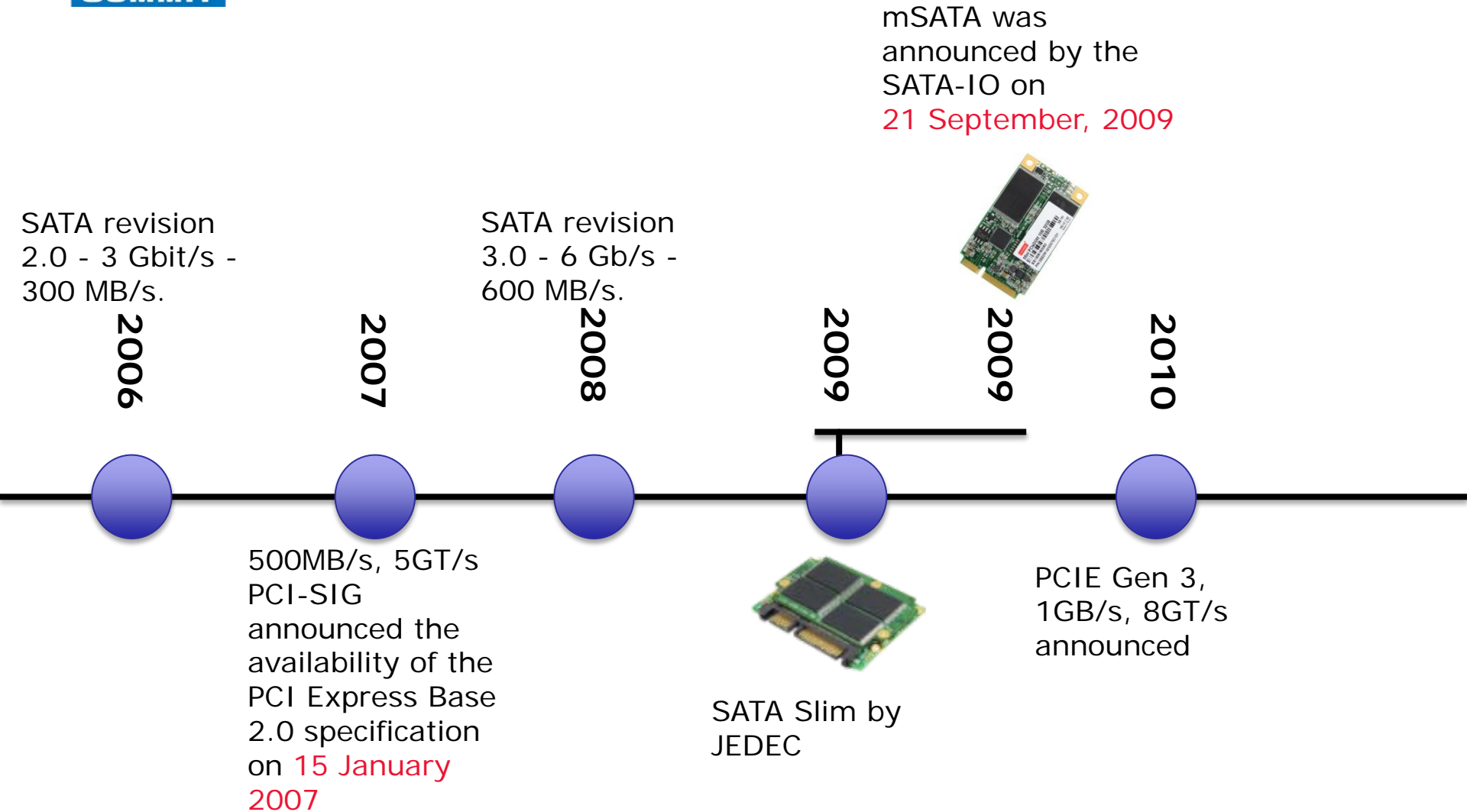
2003

In 1999, SanDisk, Matsushita, and Toshiba agreed to develop and market the Secure Digital (SD) Memory Card

Revision 1.0a was released on 7 January, 2003
150MB/s, 1.5G

In 2003, PCI-SIG introduced PCIe 1.0a, with a per-lane data rate of 250 MB/s and a transfer rate of 2.5G

SSD Form Factor Evolution, 2006 – 2010



SSD Form Factor Evolution, 2011 & 2012



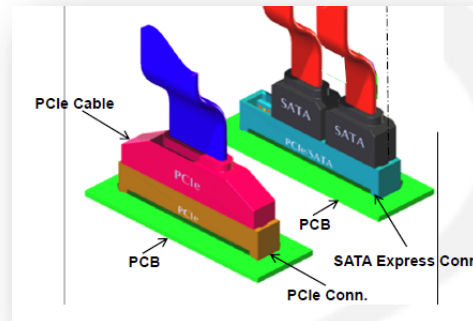
M.2 (NGFF)
By Intel

2011

2012

The Evolution
Continues...

SATA Express on
2011



PCIe Interface

Gen	Transfer Rate	Encoding	x1	x16
1.0	2.5GT/s	8b/10b	250MB/s	4GB/s
2.0	5.0GT/s	8b/10b	500MB/s	8GB/s
3.0	8.0GT/s	128b/130b	1GB/s	16GB/s
4.0	16GT/s		2GB/s	~32GB/s



PCIe performance

PCIe I/F	Gen 2 x 2 or Gen 3 x 1	Gen 2 x 4 or Gen 3 x 2	Gen 3 x 4
Theoretical Speed	1GB/s	2GB/s	4GB/s
SSD Real Speed	800~900 MB/s	1600~1800 MB/s	3200~3600 MB/s





PCIe Form Factor



Mini PCIe



Cloud Computing



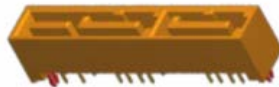
Data Center

52-pin card edge type connector



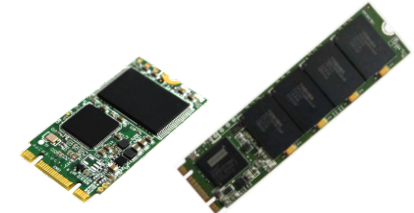
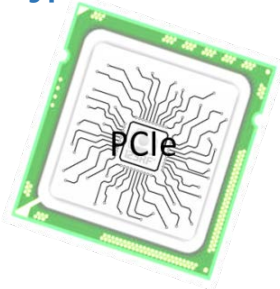
PCIe 3.0 x16; 16GB/s

PCIe SSD



PCI Express 3.0 x2;
2GB/s

SATA Express



NGFF: 2242/2260/2280

M.2



Sever

Enterprise serviceability

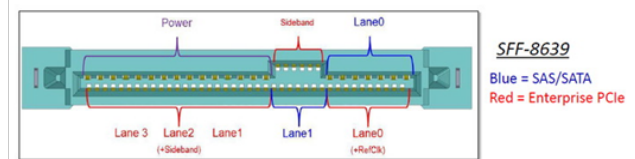
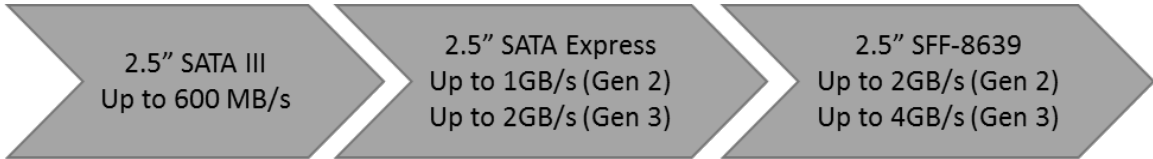


SFF 8639

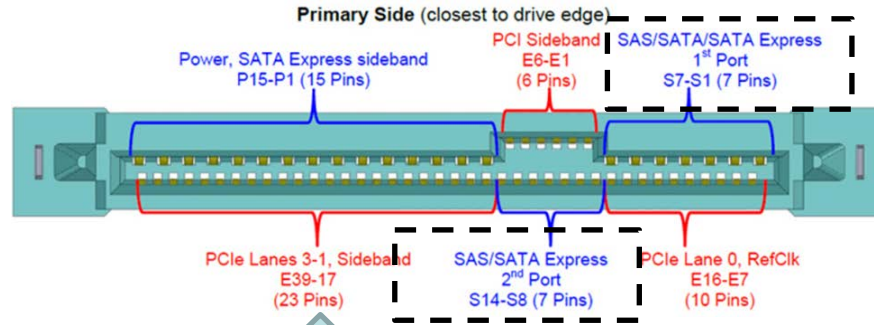
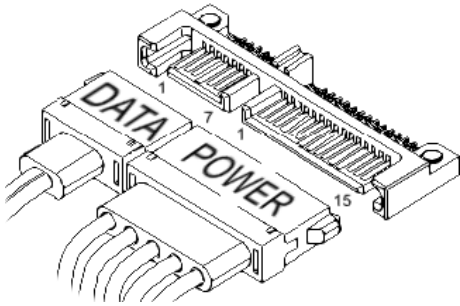
PCI Express 3.0 x4;
4GB/s



Ultrabook



2.5" SSD Trend



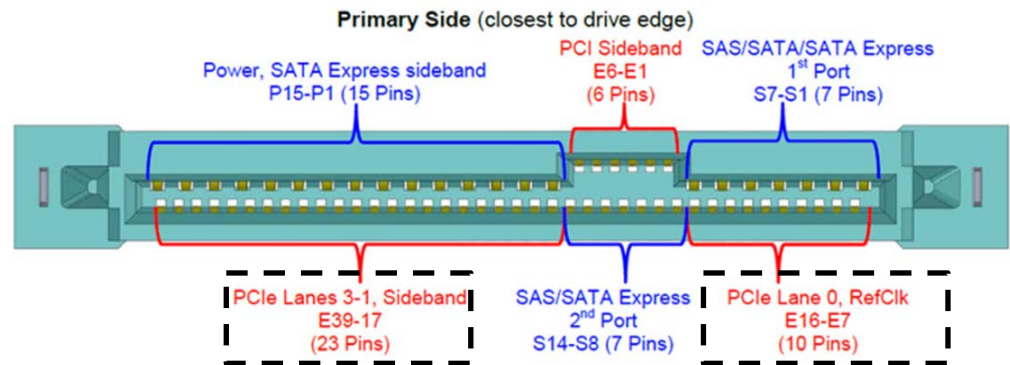
2.5" SATA SSD
600MB/s (SATA III)



2.5" SATA Express
1GB/s (Gen2x2)
2GB/s (Gen3x2)



2.5" SFF-8639
2GB/s (Gen2x4)
4GB/s (Gen3x4)

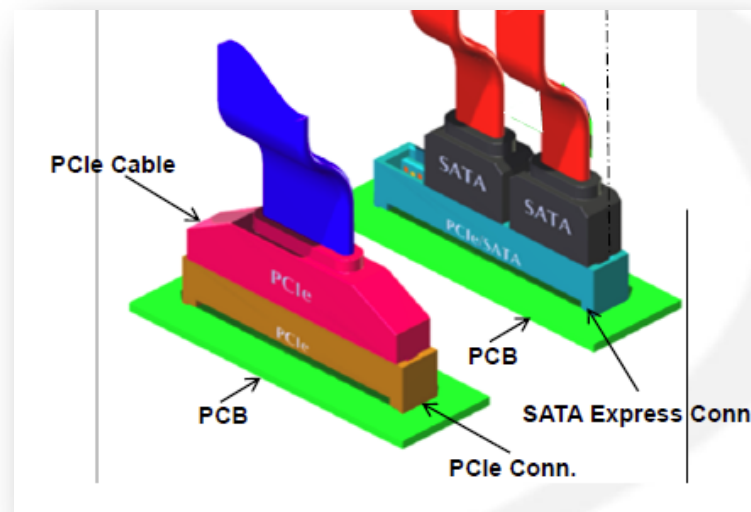
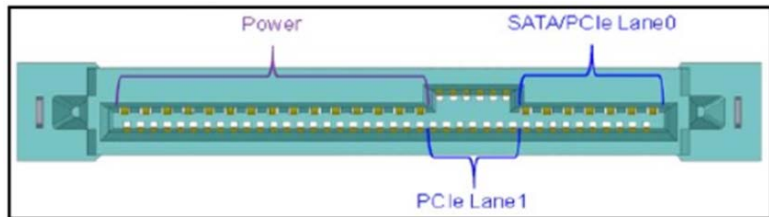
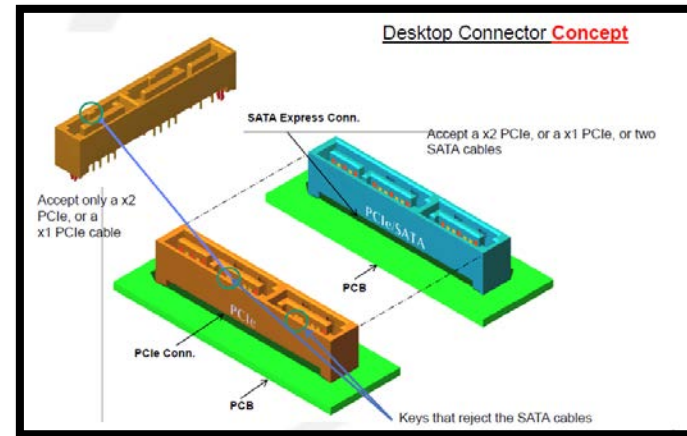


SATA Express(F1)

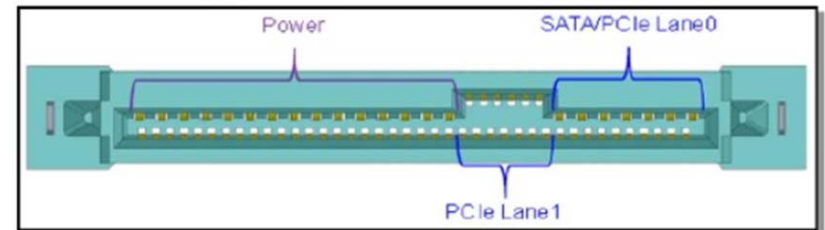
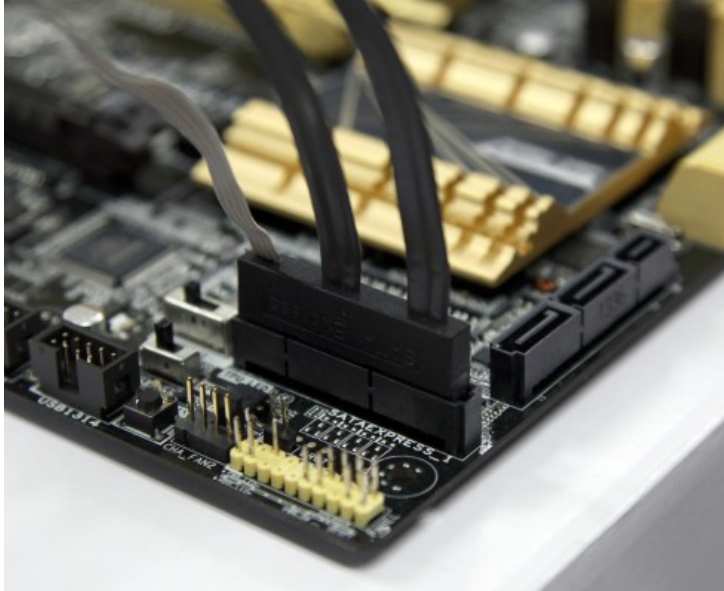
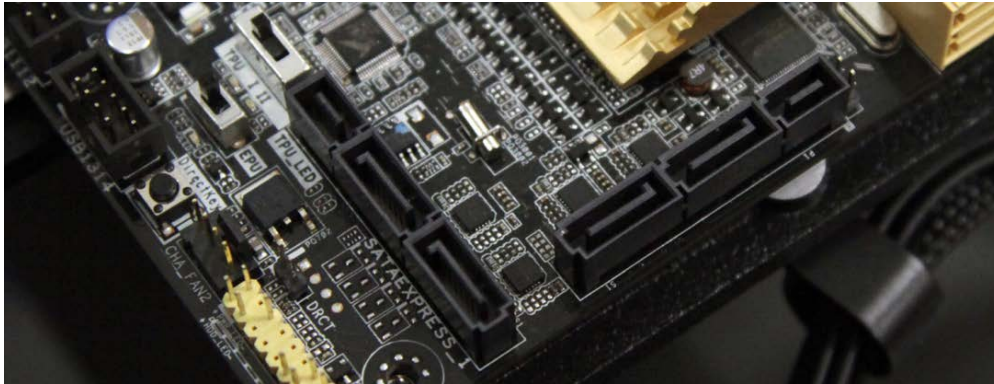
SATA Express is designed for Desktop Applications



SATA Express PCIe Drive
Up to 2GB/s

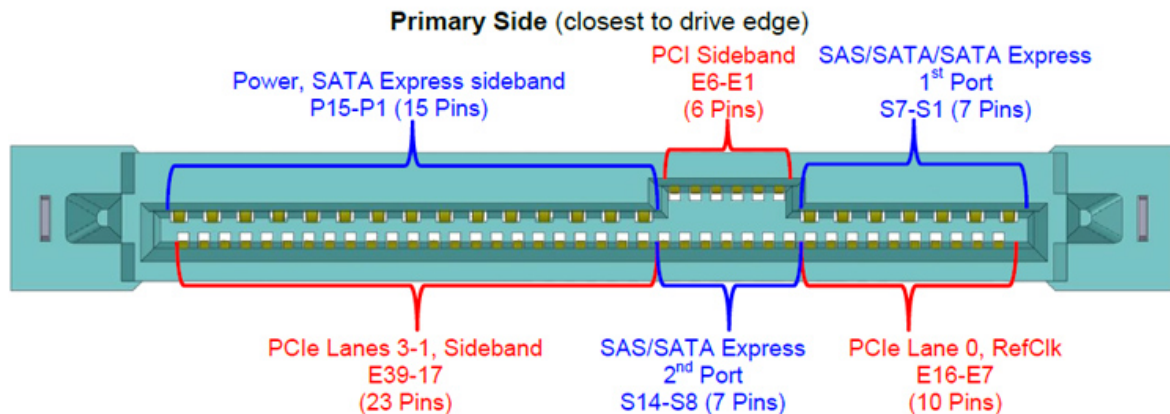


SATA Express Client SSD



Trend: SFF-8639 Connector(F2)

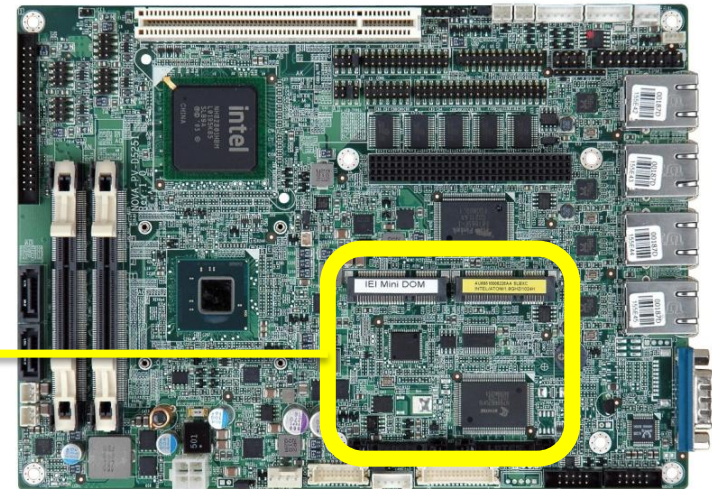
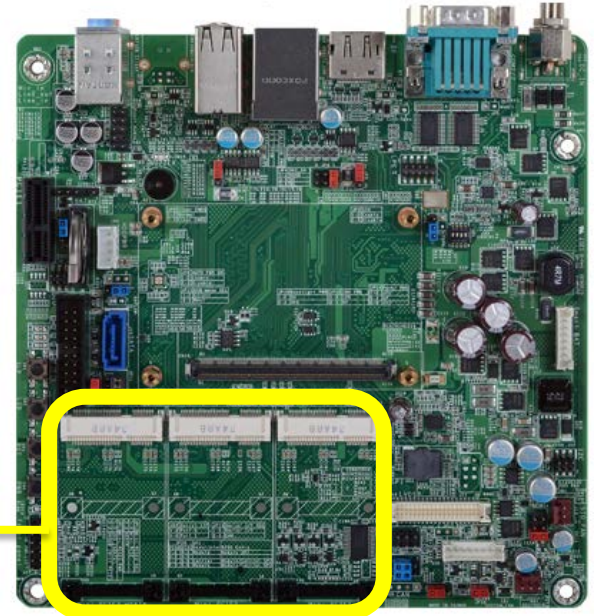
- Enterprise backplane connector for 2.5" storage connects PCIe, SATA*, and SAS* devices
- SFF-8639: Supports 6 lanes, but only 4 lanes are used at one time
 - PCIe: 4 red lanes on CPU PCIe lanes
 - SATA & SAS: 2 blue lanes on HBA/RAID controller or chipset
- Compatible with SATA and SAS devices



miniPCIe(F4)

Over the years, module form factors and interface protocols have evolved and changed along with chipsets, but most industrial manufacturers are still using the miniPCIe form factor for various modules, including wireless devices, Bluetooth, some communication devices, and even for storage– mSATA.

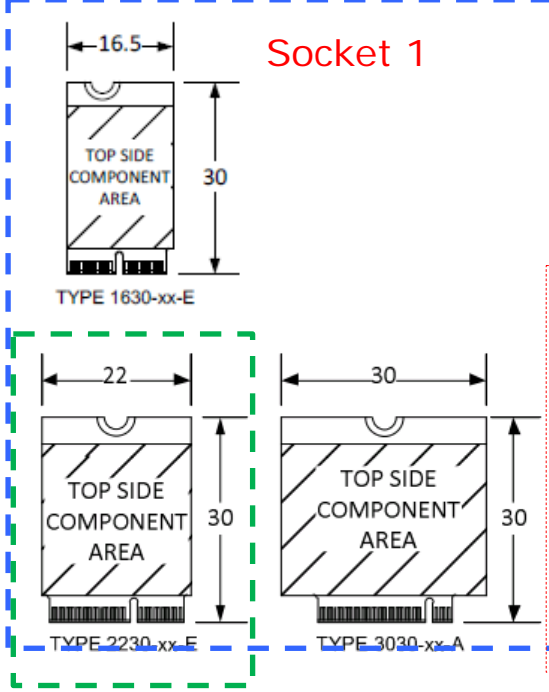
The miniPCIe form factor is suited for space-constrained applications and swap-ability (swapping different miniPCIe modules could bring more benefit in flexibility of product matrix).



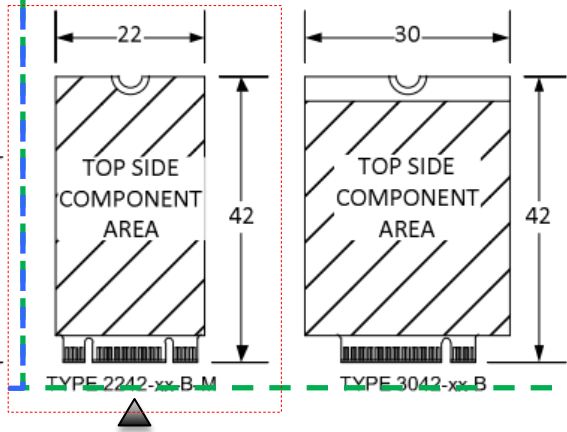
M.2 (NGFF) (F5)

Objective: Make three sockets available for Notebooks, Ultrabooks™ & Tablets
 Support Interfaces: **PCIe/USB/SDIO/UART/PCM/I2C/SATA**

- **Socket 1:** Connectivity
- **Socket 2:** An SSD cache/ WWAN / Other slot
- **Socket 3:** SSD high performance

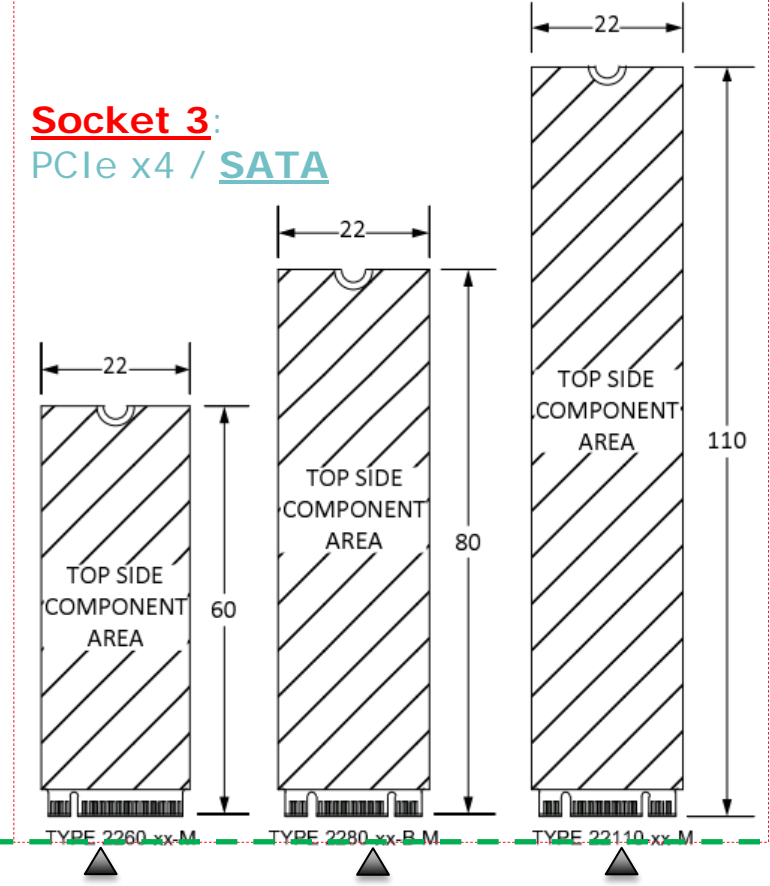


Socket 2:
PCIe x2 / SATA



2242
SSD & Cache

Socket 3:
PCIe x4 / SATA



2260
SSD & Cache

2280
SSD

22110
SSD

PCIe Interface SSD



	Mini PCIe	M.2	SFF-8639		PCIe SSD(Card)
			2.5" SATA Express SSD	2.5" PCIe SSD	
Specification	PCI-SIG	PCI-SIG M.2	SATA Express	SFF-8639	PCI-Express
Dimensions	(L) 50.8mm (W) 29.8mm (H) 4.4mm	2280/22110 2242/2260 mm	(L) 100.45 mm (W) 69.85 mm (H) 5/7mm	(L) 100.45 mm (W) 69.85 mm (H) 7mm	(L) 176.65mm (W) 111.15mm
Speed(Gen3)	1GT/s	1GTx4=4GT/s	1Gtx2=2GT/s	1GTx4=4GT/s	1GTx16=16GT/s
Lanes	1	1,2,4	1,2	1,2,4	1-16



Summary

More on the PCIe Interface:

- SFF-8639 will be 2.5" connector
- M.2 will become the next popular form factor for industrial application.
- SATA Express is designed for desktop PC now, and industrial field may use it in near future.
- PCIe SSD (Card) is still used for high IOPS server applications



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