Extending PCIe® NVMe™ Storage to Client

John Carroll

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Agenda

- Background on Storage Form Factors
- Using the same U.2 drives in Data Center and Client
- Power usage and time to throttle

Storage Form Factor Overview

Small form factor

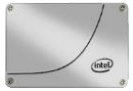
BGA SSD

mSATA

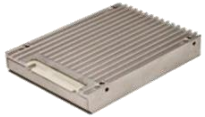
M.2

2.5” and 3.5”

SATA* (2.5”/3.5”)



SATA Express Device



U.2 SSD

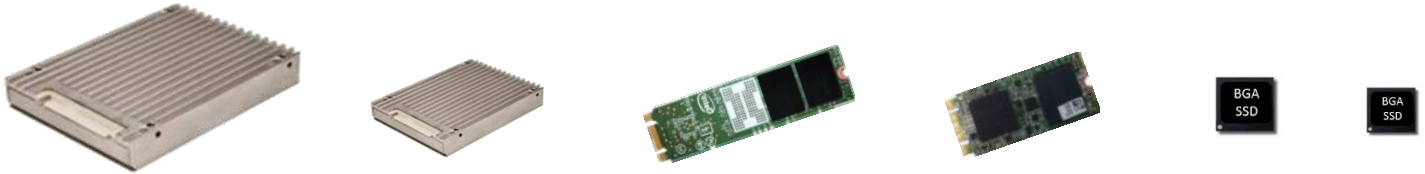
Add in Card

PCIe® add-in card (CEM)

Client Storage Background

Devices are getting smaller, thinner, and lighter

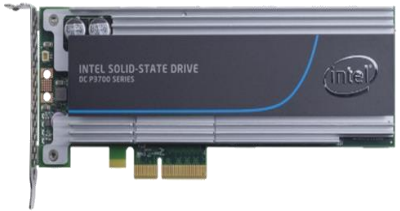
Client storage continues to get smaller…



High performance and capacity still expected in small form factors

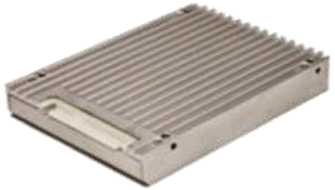
PCIe® Client Storage Form Factors

Add-in-card



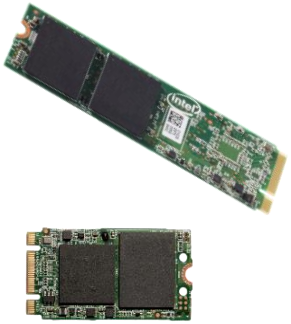
- Higher performance (up to 16 lanes)
- Legacy form factor
- Higher thermal capabilities
- Disadvantage: size

2.5” drives



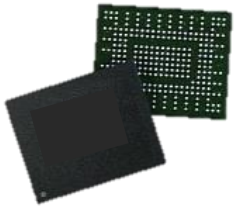
- Flexibility for SSDs, SSHDs, and HDDs
- High performance (U.2 up to PCIe x4, Sata Express PCIe x2)
- Cabled solution for larger platforms

M.2



- Smallest PCIe SSD with a connector
- SATA* or up to PCIe x4
- Prefer 30mm and 80mm length

BGA



- Ideal for small and thin platforms
- Up to PCIe x4
- Prefer 11.5x13mm and 16x20mm

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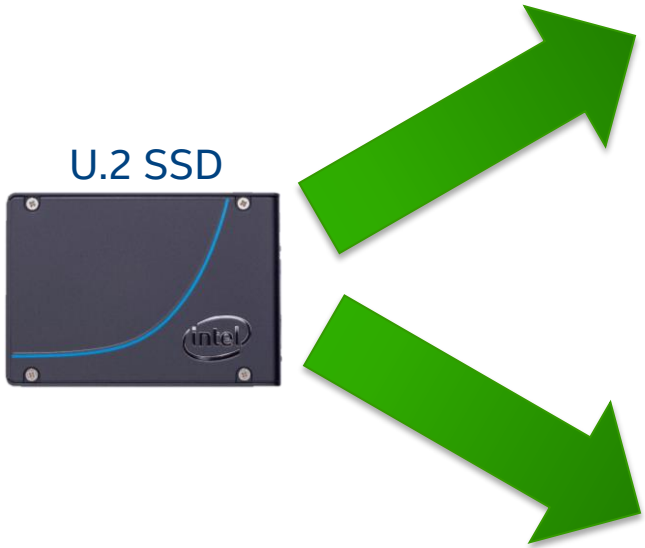
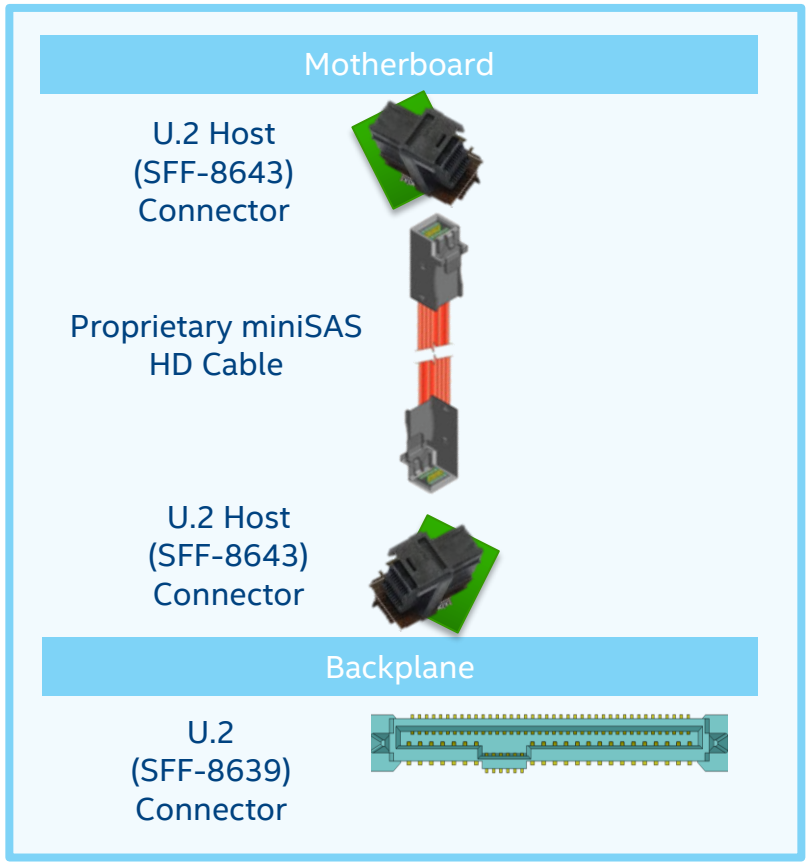
Objective: The same U.2 drives in Data Center and Client



Source: http://hyvesolutions.com/solutions/ambient/

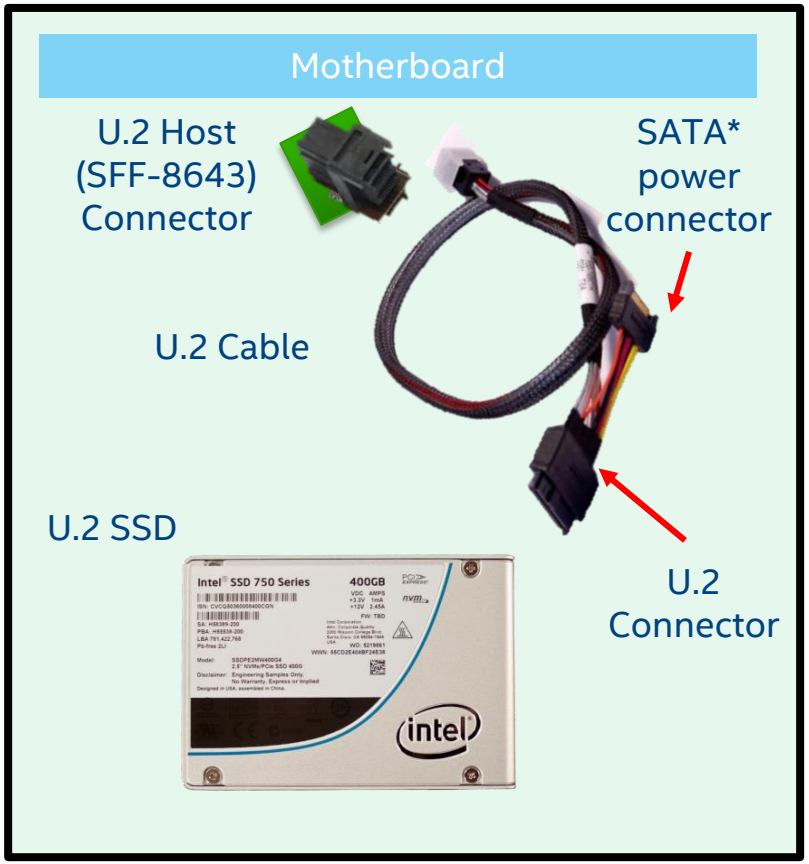
U.2 Host (SFF-8643) Pinout Vendor Specific in Data Center



- Data center uses additional pins on the host connector in a proprietary way
- The pinout for the U.2 Host Connector used in data center varies per platform
- The U.2 connector and pinout on the backplane is standard

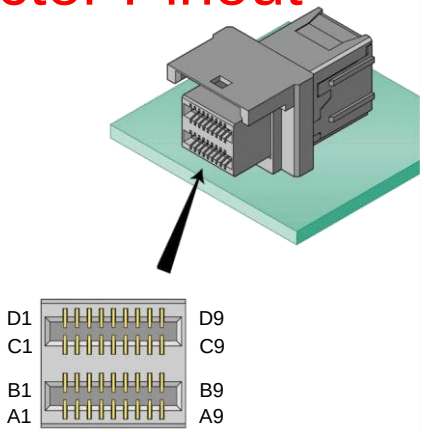
A Consistent U.2 Host Pinout and Cable is Required for Client

- The same U.2 Host connector is used in client, but a different pinout
- Motherboard, cable and SSDs each come from different vendors
  - The host connector and cable need to be standard
- The connector and pinout for the drive remains the same for both client and data center



More on the Client U.2 Host Connector Pinout

	3	4	5	6	7	8	9
D	GND	PETp0	PETn0	GND	PETp2	PETn2	GND
C	GND	PETp1	PETn1	GND	PETp3	PETn3	GND
B	GND	PERp0	PERn0	GND	PERp2	PERn2	GND
A	GND	PERp1	PERn1	GND	PERp3	PERn3	GND



	1	2
D	SMBus Data	SMBus Clk
C	Reserved	Reserved
B	PERST#	CLKREQ#
A	REFCLK+	REFCLK-

- 7 pins per row used for PCIe lanes (pins 3-9)
- 2 pins per row used for sideband signals (A1, A2, …, D1, D2)
- Intel releasing a whitepaper with more info

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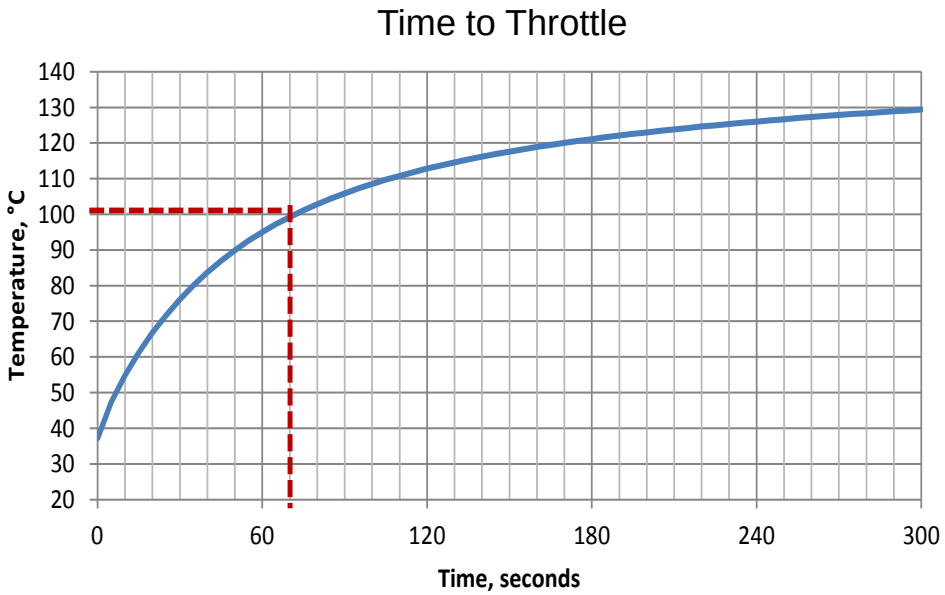
Importance of Power usage on Client Storage

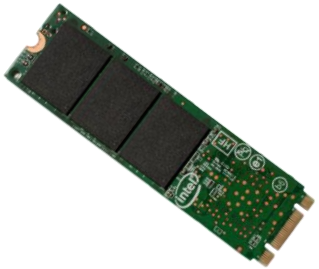
- With smaller form factors, thermals can be more challenging
- High activity and power usage could lead to SSDs throttling sooner
- Max power and idle power are two levers to adjust time to throttle
  - Max power determines worst case time to throttle
  - Low idle power reduces temperature in typical client workloads
- Consider “data to throttle” instead of “time to throttle”
  - Time to throttle * performance



Example based on Intel internal model for a BGA SSD

M.2 Provides Flexibility for M.2 or U.2

- M.2 to U.2 adapters enable flexibility for M.2 SSDs or U.2 cabled solutions
  - Enables flexibility to support SSD/SSHD/HDDs in the same M.2 connector
  - Allows for larger form factor drives which may use more power without a motherboard change



M.2 to U.2 Host Adapter

Summary

- Client platforms and storage form factors continue to get smaller
  - Going forward, innovation on physical size as important as performance for client

- Add-in-cards, 2.5” drives, M.2, and BGA are leadership PCIe® solutions