FleX: Bringing CXL to the Motherboard

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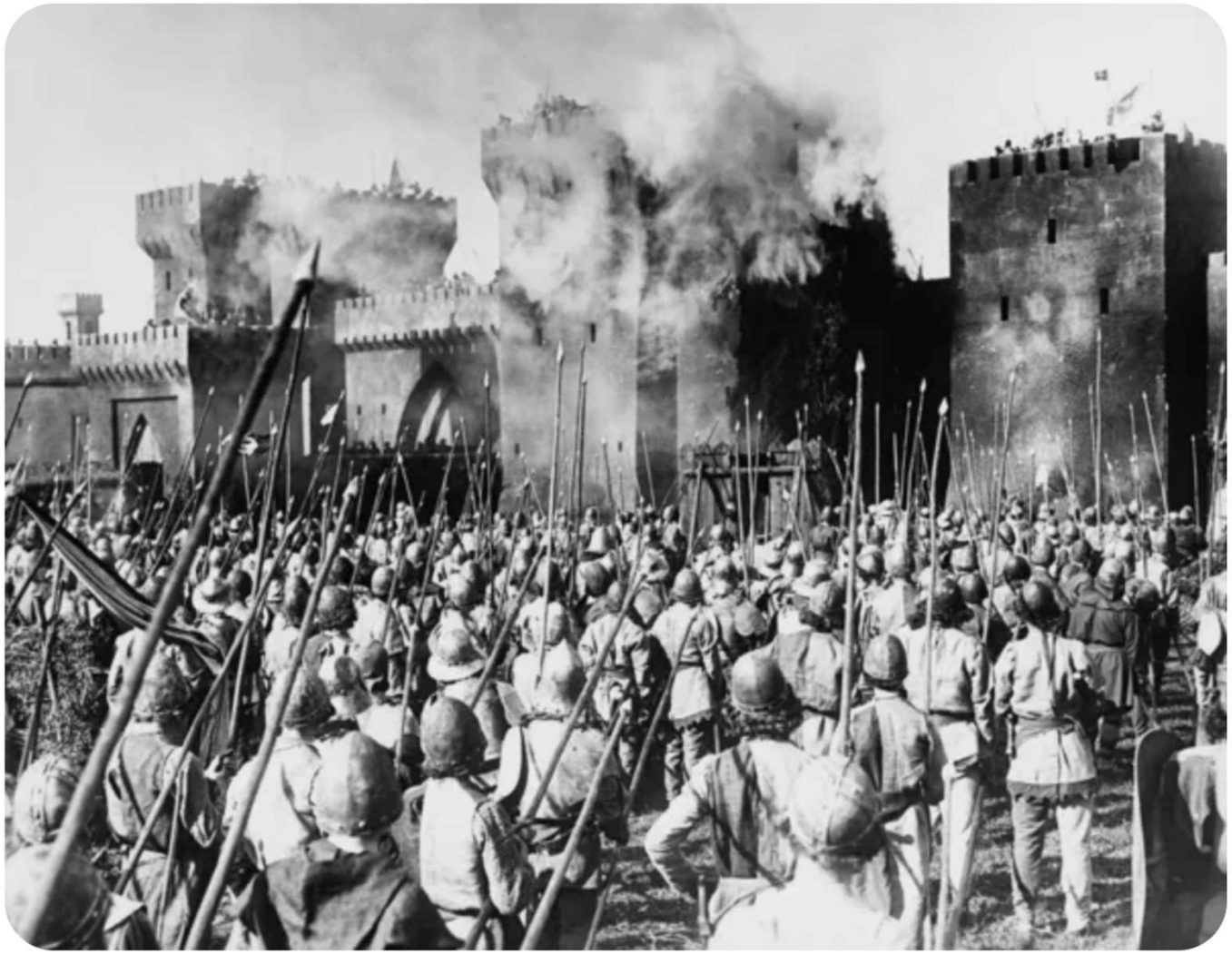


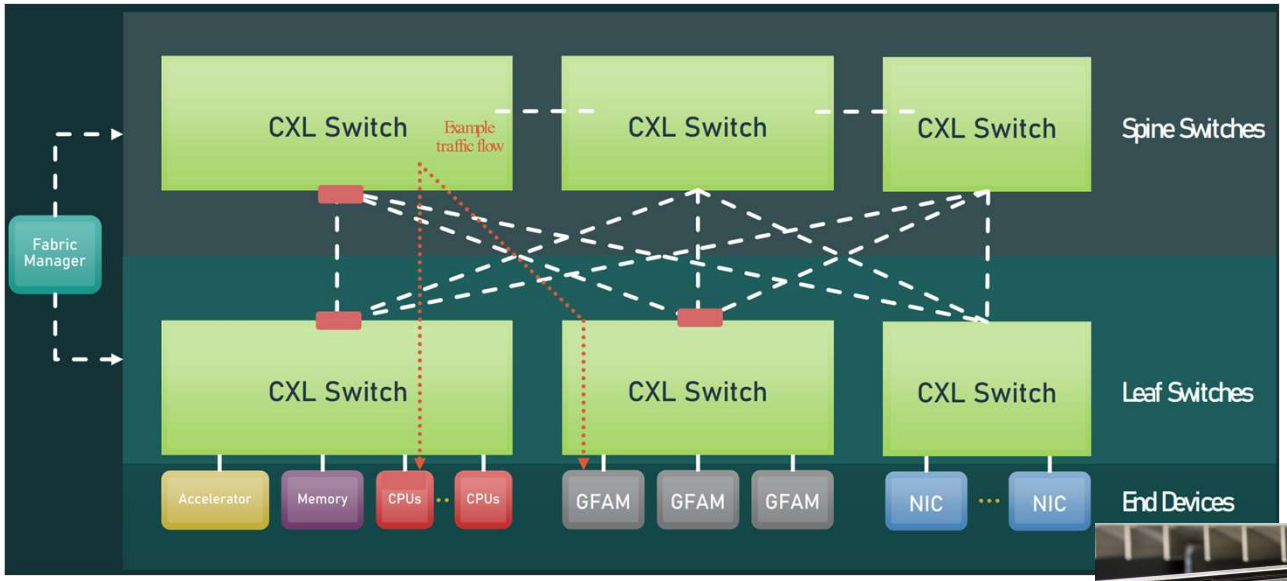
The good news is that CXL® finally ended the fabric wars

Finally, companies can invest in standard silicon solutions with the promise of a large market

As usual, big iron will be the early adopters

Yes, I assume that NVLink/UALink are complementary to CXL

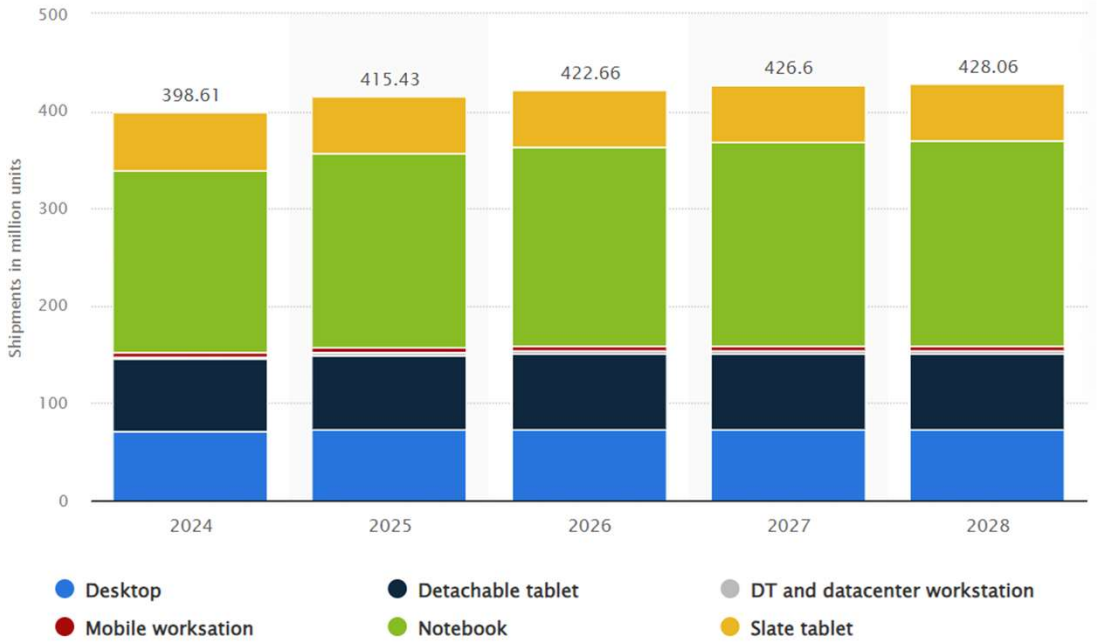
CXL Type 2 may go away though…



CXL brings a unified view of processing, memory, storage, communications…

However, <u>all</u> computing environments need these

Pray, Tell, Why Do We Care?

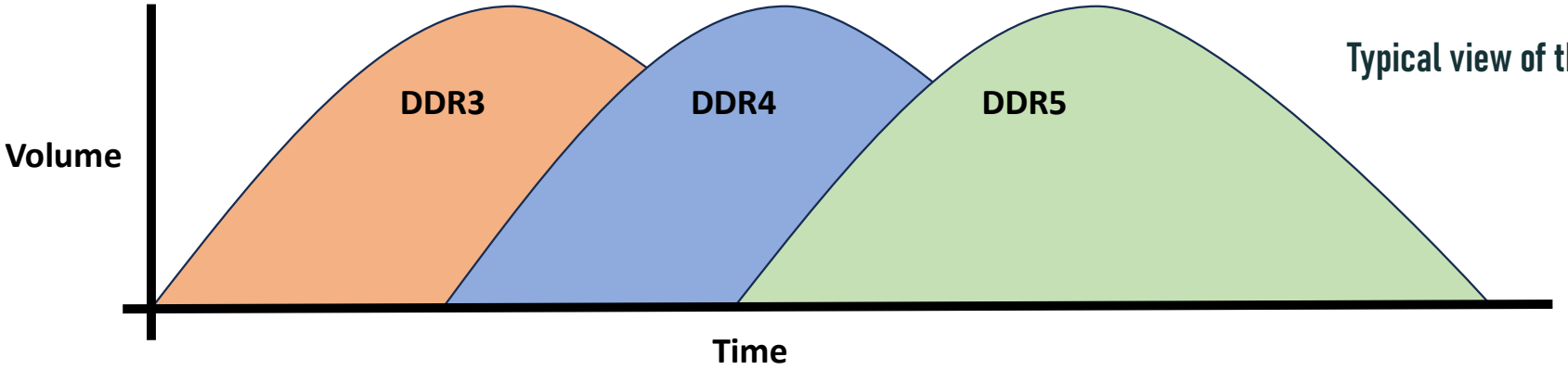


Market	2026 Mu
Desktop	73
Mobile Workstation	3.4
Detachable Tablet	77
Notebook	205
DT & data center workstation	3.4
Slate tablet	59
Total	423

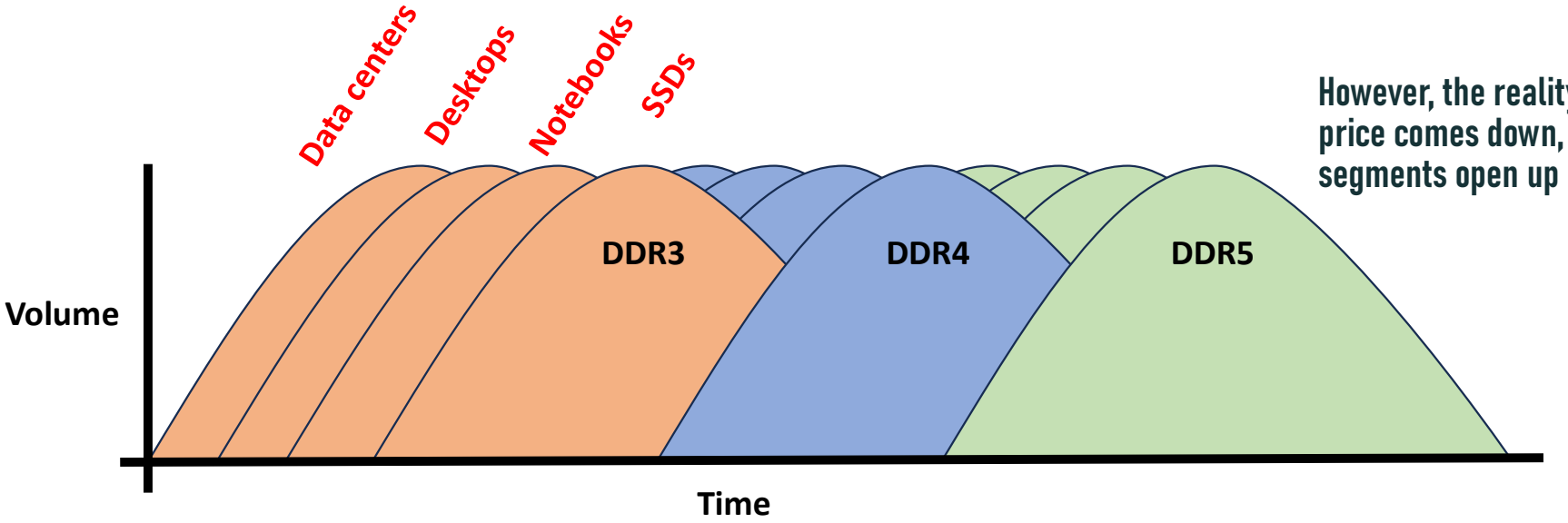
https://www.statista.com/statistics/272595/global-shipments-forecast-for-tablets-laptops-and-desktop-pcs/

Um, 'cuz the market volumes dwarf the data center market

CXL chip makers need volume to justify fab costs

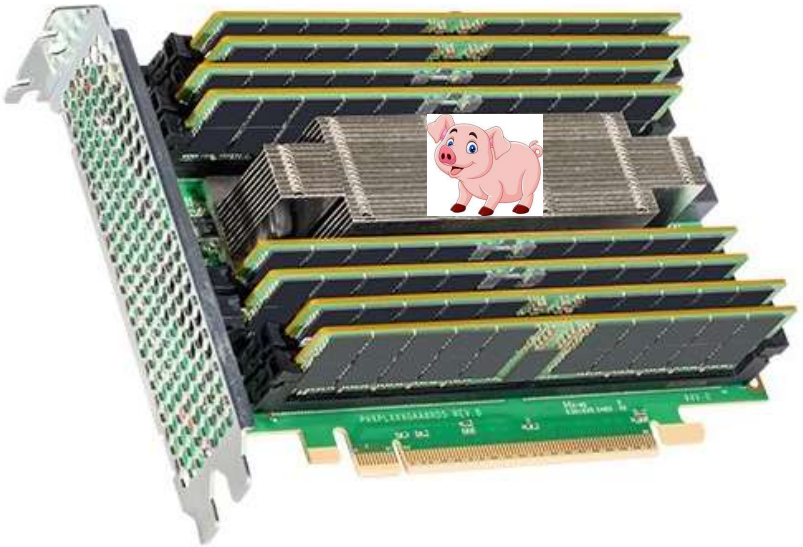


Typical view of the DRAM generations



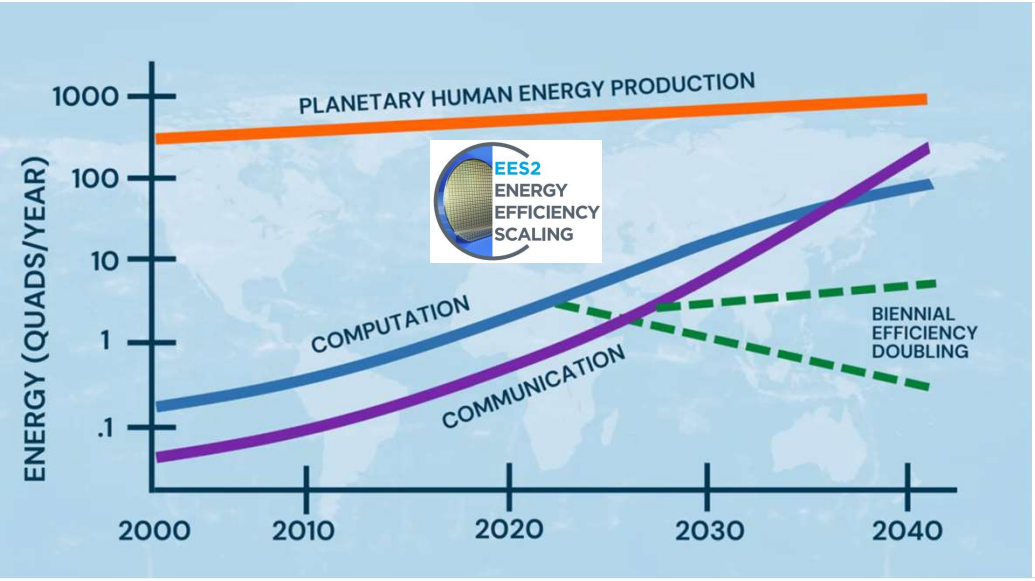
However, the reality is that as the price comes down, new market segments open up

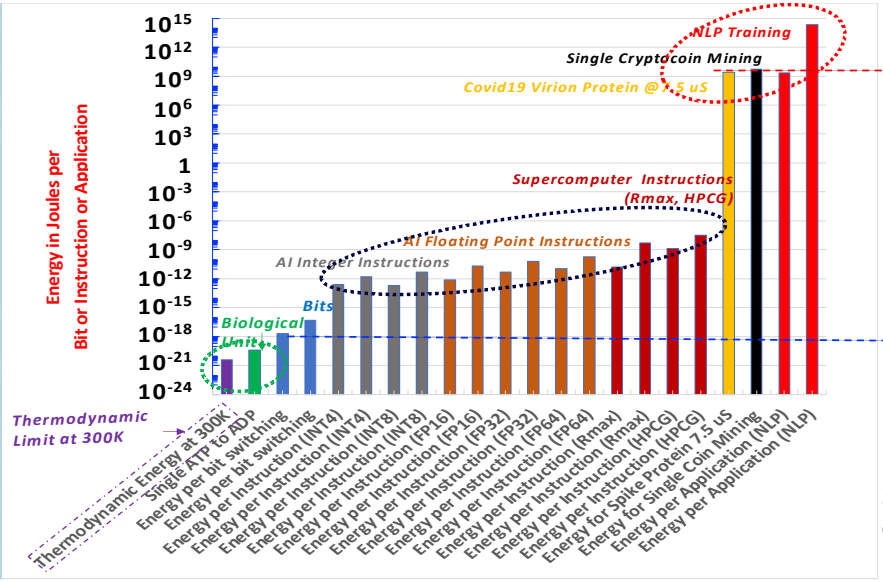
CXL adoption should similarly phase in… later…



The bad news?
CXL memory solutions today are bloated power pigs

The good news?
Climate change has people rethinking nuclear power plants to support CXL





10^{9} to 10^{15}

10^{-18} to 10^{-21}

27 to 36 orders of magnitude
(From Algorithms to Atoms)

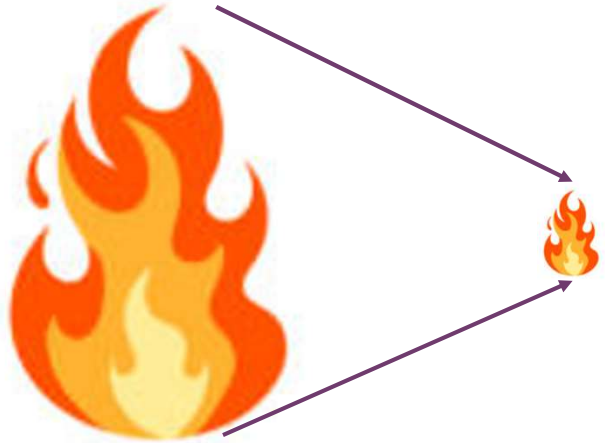
Just kidding!

According to the US Department of Energy, even with nuclear power, we run out of energy around 2055

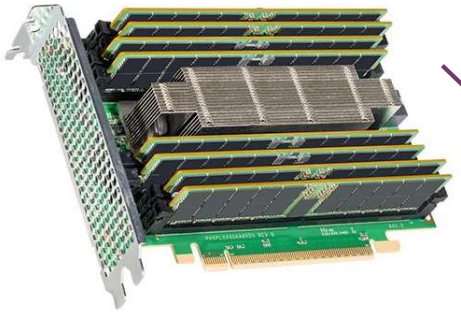
Probably sooner given how AI is taking off

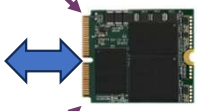
Moving CXL to the motherboard is the next logical step

We must address the limitations of the current CXL solutions



Reduce the power

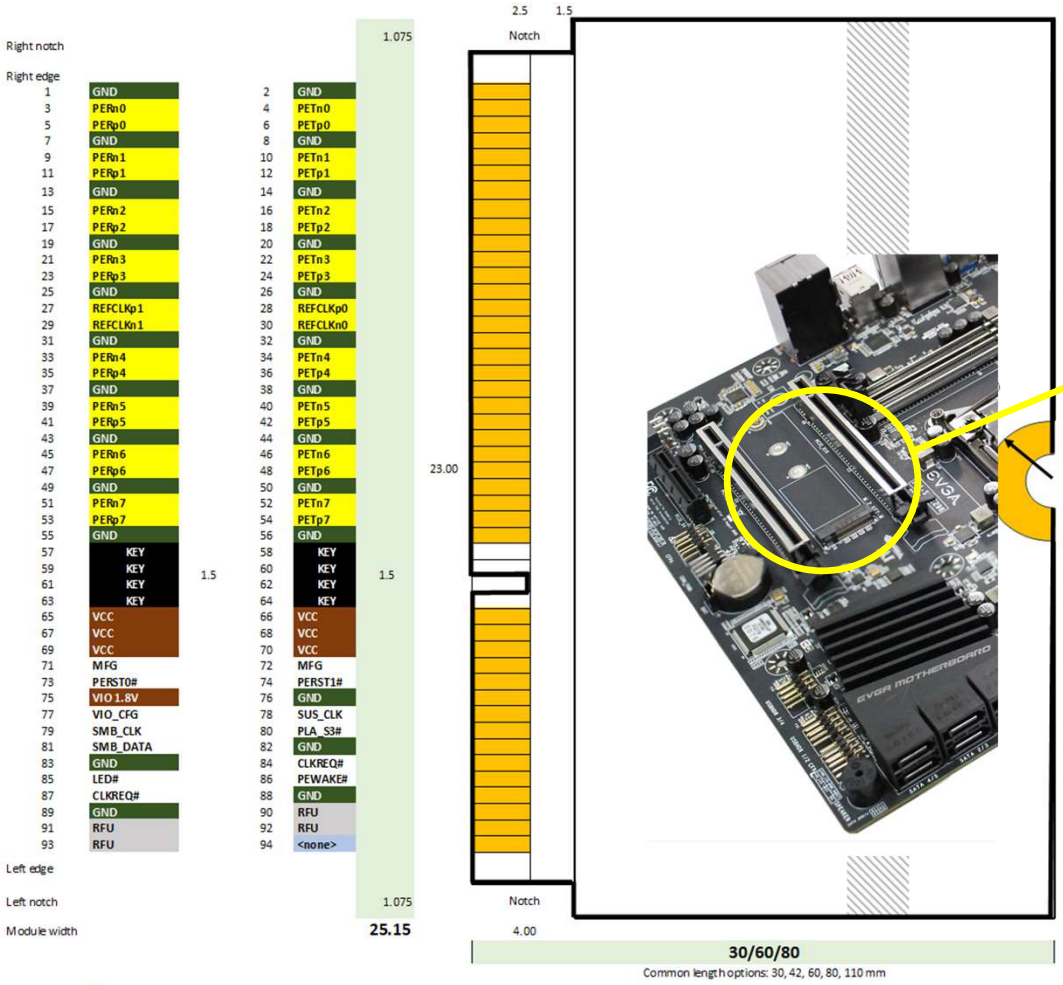




Shorten the channel

Shrink the footprint

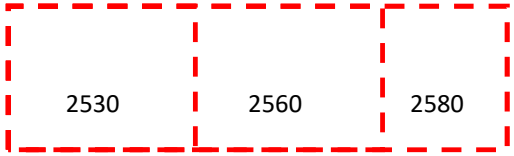
Proposing FleX at PCI-SIG, a flexible CXL module for motherboards



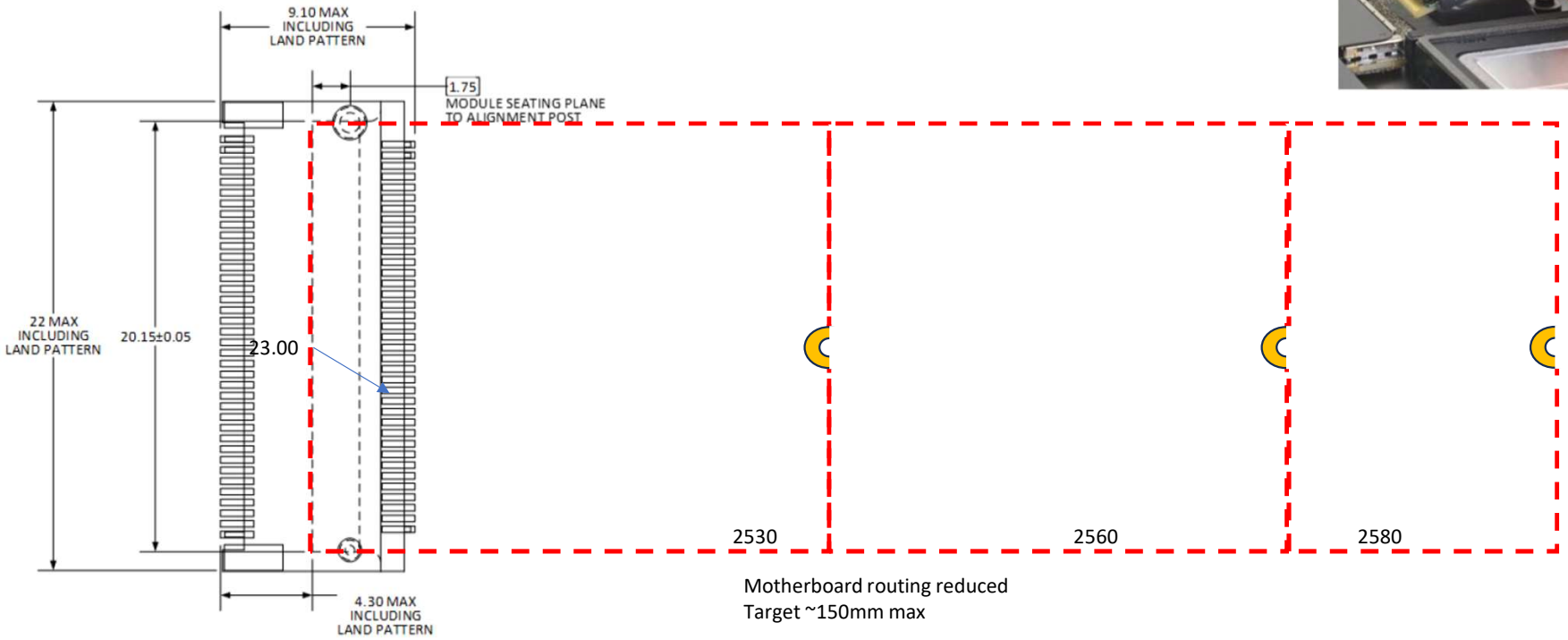
FleX (M.28) at 25.15mm width has
PCIe Gen6 x8 support + CXL
Desktop/Workstation: 12V input + on-module regulation
Mobile: 3.3V or 5V input + on-module regulation
Power ~ 11W
Fits between two PCI slots
Channel length 150mm max

M.28 lengths TBD; starting estimates:
30 mm
60 mm
80 mm

Actual ratios:



Edge connector socket = wider M.2 (PCIe x8 versus PCIe x4)



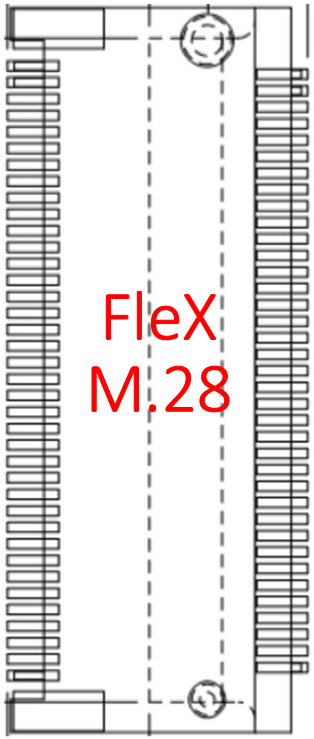
Motherboard routing reduced
Target ~150mm max

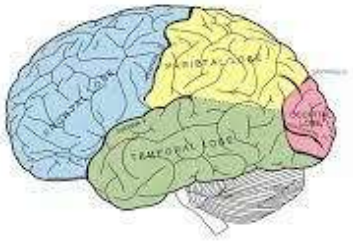
What goes into a FleX socket?

Anything you want…

PCIe or CXL

Same expansion elements supported by CXL



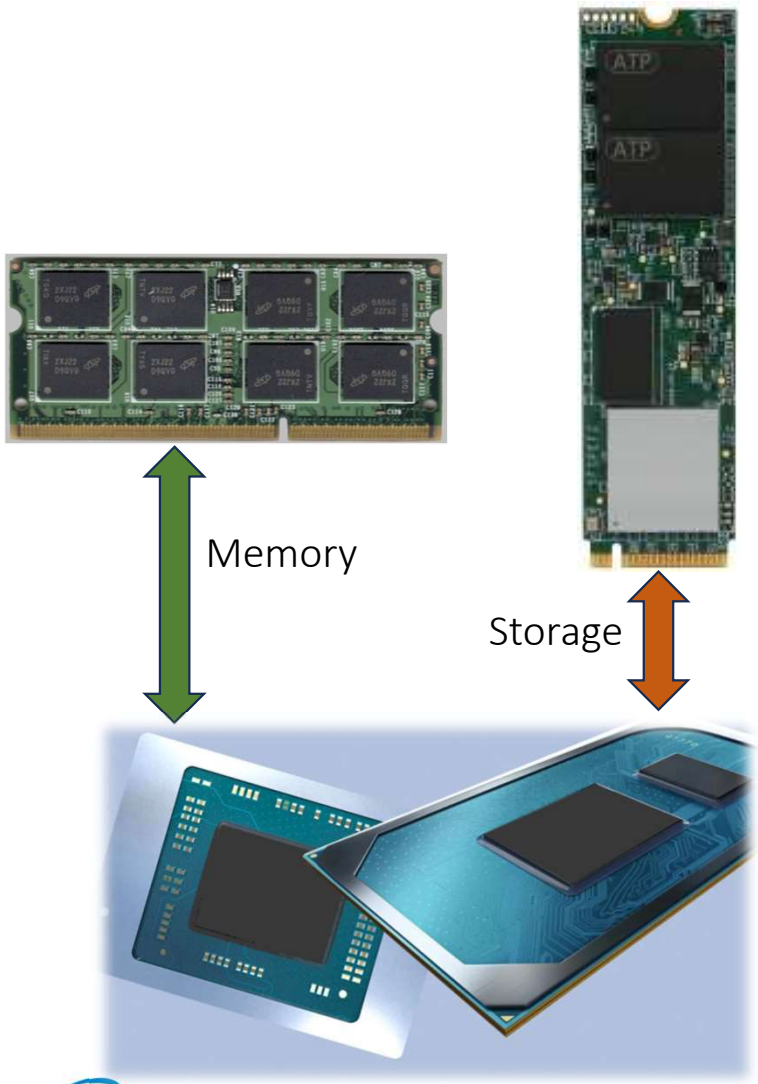


Memory

Storage

Communications

Processing



Currently, systems have distinct separation of memory and storage resources

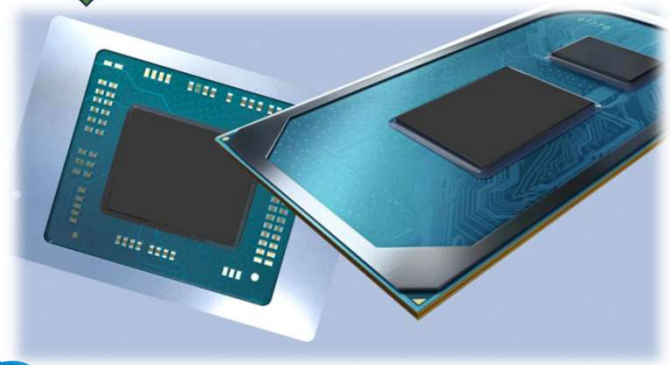
CXL provides the ability to blur the lines

The DDR protocol will always be memory centric, but…

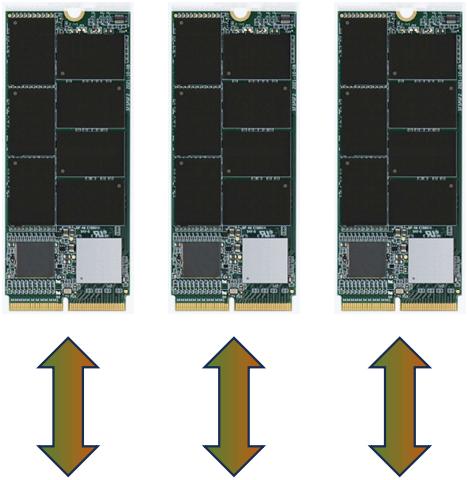
…the M.2 interface based on PCIe is a starting point for rethinking expansion

Memory

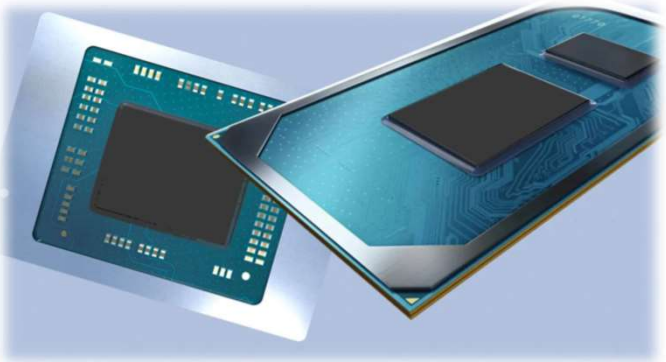
Storage



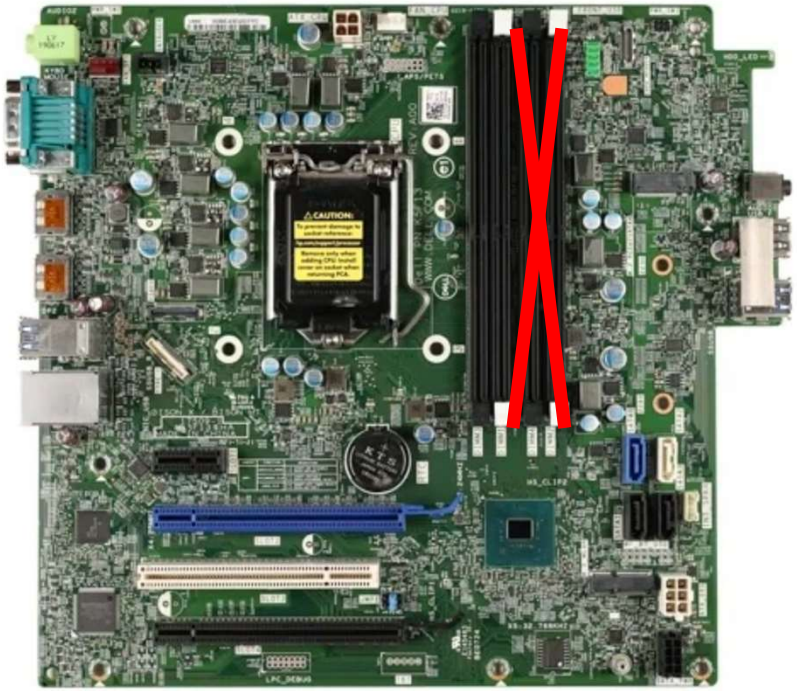
With CXL for motherboards, we're able to transition to generic expansion



Memory, Storage, Coprocessing



What is pulling on this rope?



DELL Technologies

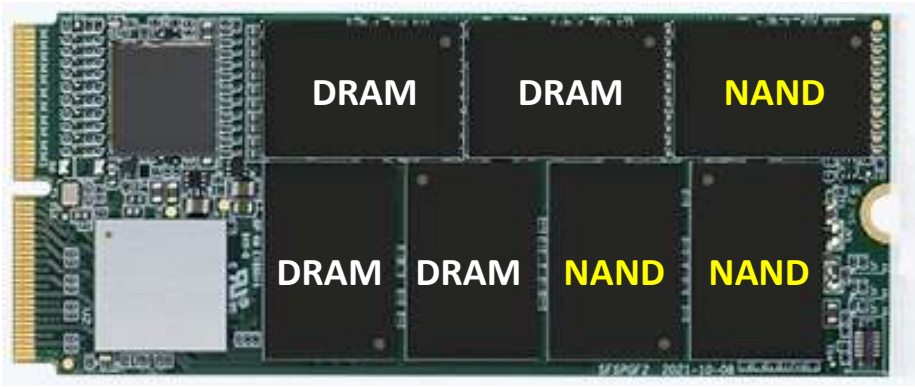
DDR5 dropping down to one module per channel means system capacity is being cut in half – memory expansion on CXL can replace the lost DDR

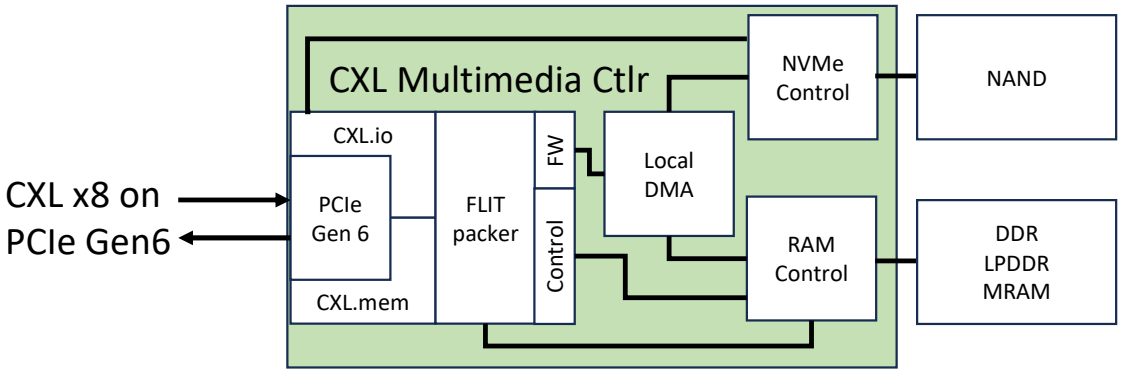
AI algorithms and chips are changing daily, each demanding more memory than before – AI on CXL can be upgraded

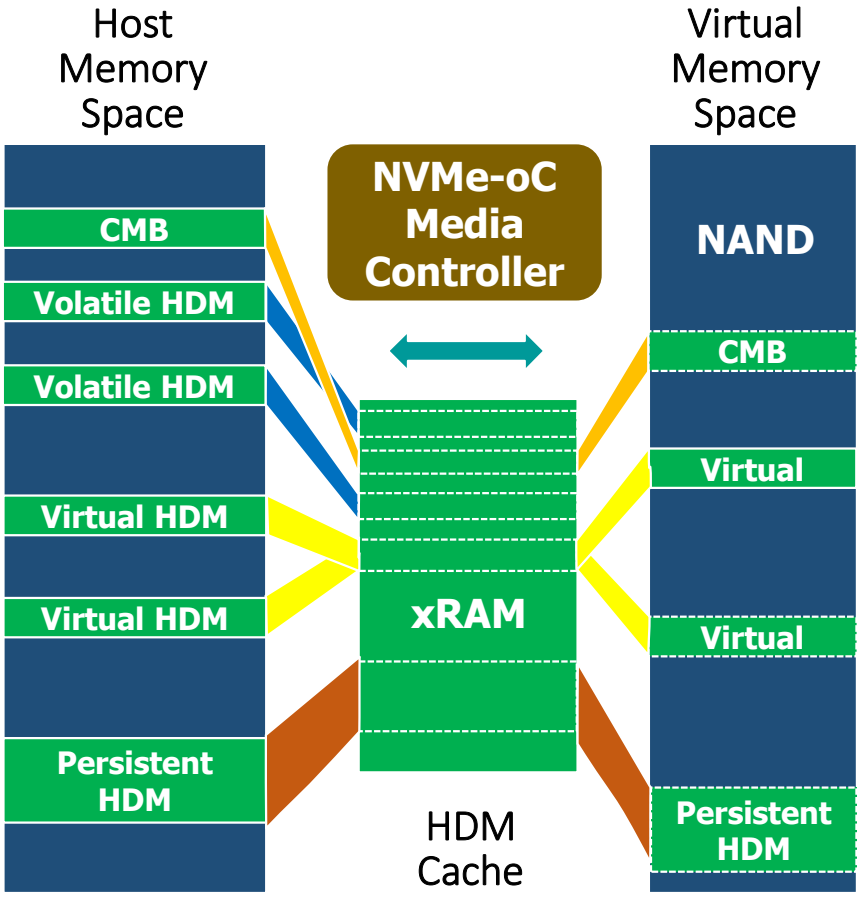
Industry innovation is stalled by fixed designs

CXL on the motherboard is like PCI in 1992… opening the door to new ideas for next generation PCs

Example of innovation: NVMe Over CXL™ combines NAND and DRAM







Summary

The industry NEEDS to grow the market!

Different markets phase in over time

CXL for enterprise needs change for DT, mobile

CXL helped resolve the fabric wars

FleX (M.28) form factor(s) for DT, mobile

Other innovations are enabled by CXL

NVMe Over CXL is an example of virtualization

CXL allows resource virtualization

Thank you for your time

Any more questions?

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