PCle® Enclosure Compatible Form Factor (PECFF)

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Gen-Z PECFF Requirements

- Goal: Develop an Add-in-Card (AIC) form factor capable of spanning multiple market segments that advances the state-of-the-art and reduces solution cost and complexity

- Requirements:
  - Mechanically compatible with enclosures that support the PCI Express® CEM AIC
  - Support the fully interoperable SFF-TA-1002 and Gen-Z Scalable Connectors
  - Support an optional second connector to provide incremental scalability
  - Support 12V and 48V AIC
  - Support high-power without requiring discrete high-power cables
  - Support multi-AIC connectivity
PECFF Fundamentals

- PECFF is mechanically compatible with enclosures that support a PCI Express CEM Add-in-Card (AIC)
  - Supports the 4 PCIe® CEM AIC sizes
- PECFF complies with the SFF-TA-1002 mating interface
  - Supports the 1C, 2C, and 4C connectors
    - Supports PCIe up to 32 GT/s
    - Supports 802.3 electrical up to 112 GT/s PAM 4
    - 1C-4C supports up to 80W through the card edge
  - Supports an optional second connector to enable solutions with up to 64 differential pairs
    - Enables a PCIe AIC to support up to a single x32 link (symmetric—equal number of Tx / Rx lanes)
    - Enables a Gen-Z AIC to support up to a x32 (symmetric) or multiple links (symmetric or asymmetric)
- PECFF supports 48V—48V provides appreciable power efficiency gains compared to 12V
  - AICs that support 48V can improve OPEX savings
- PECFF supports high-power solutions using the Gen-Z 4C-HP Scalable Connector
  - Up to 660W @ 12V
  - Up to 1024W @ 48V

Readers are strongly encouraged to review the Gen-Z Scalable Connector tutorial and specification to learn more.
**PECFF Fundamentals** (continued)

- Supports any component type—Flash, SCM, DRAM, GPU / GPGPU, FPGA, DSP, ASIC, etc.
- Supports multiple interconnect technologies including PCIe and Gen-Z
- PECFF supports optional AIC top-edge connectivity to provide more bandwidth to the AIC, ability to interconnect AICs, etc.
- PECFF supports active and passive cooling solutions using air and liquid-based mediums
- PECFF shifts the card edge 60 mm closer to the processor
  - Recovers ~4 dB @ 16 GT/s and ~8 dB @ 32 GT/s of motherboard loss budget
  - Recovers AIC loss budget through improved trace and device layout
  - Loss recovery can eliminate the need for retimers and high-cost, low-loss board materials
To increase the channel loss available to the motherboard and reduce solution cost, the high-mass retention mechanism is shifted towards the rear of the AIC to enable the connector to be 12 mm closer to the processor. In all other respects, the retention mechanism is fully compatible with the PCIe CEM retention mechanism.

- PECFF specifies a mechanically compatible I/O bracket that improves AIC stacking
- Though the high-mass retention mechanism is shifted backwards, it is mechanically compatible
This example illustrates a PECFF NIC that uses a second 4C connector to deliver massive network bandwidth (up to 1.6 Tbps in each direction).
Instead of using a discrete high-power cable routed from the power supply to the top edge of the AIC, PECFF can use the Gen-Z 4C-HP Scalable Connector. The Gen-Z 4C-HP provides up to 660W at 12V and up to 1024W at 48V. Further, this connector enables components that do not require high power to take advantage of 48V’s superior power efficiency compared to 12V.

This slide also illustrates how a PECFF AIC can support double-wide solutions which are commonly used in high-power applications. PECFF AIC can support single, double, and triple-wide solutions just as PCIe CEM can.
An AIC top-edge provides significant board space that can be used to provide additional connectivity. If top-edge connectivity is not used, then this board space is available for AIC-specific purposes.

Top-edge connectors should be able to scale to at least 112 GT/s PAM 4.

Signal groups can be organized into wide links or multiple narrow links to meet solution-specific needs.

Due to the wide-variety of potential solutions, Gen-Z members chose to not standardize the top-edge connectors and cables. This enables members to innovate and differentiate to meet solutions-specific needs.
Side-view of PECFF Top-Edge Signal Groups
Example Enclosure

- The figure on the right illustrates how an enclosure can support any mix of PECFF and PCIe CEM AIC

- The figure also illustrates the different PECFF sizes and connectivity possibilities
PECFF Benefits

• Simplifies supply chain
  • Does not require new mechanical enclosures and visual similarity to PCIe CEM reduces manufacturing costs
  • Uses the high-volume, fully-interoperable SFF-TA-1002 / Gen-Z Scalable Connector
    • Up to 112 Gb/s signaling support will provide many years of use across multiple markets without requiring redesign
    • Eliminates the need for a separate high-power cable and associated connector
  • When combined with Gen-Z, PECFF can support any component type

• Reduces CAPEX
  • PECFF simplifies platform design and manufacturing
    • Can support any component type
    • Can eliminate the need for high-cost, low-loss board materials and retimers
    • Can use Gen-Z Scalable Connector with cables to repurpose slots or to provide additional bandwidth / connectivity without requiring customized motherboards
  • Can support multiple links and multiple connectors to eliminate single points of failure and stranded resources
    • Can reduce the amount of replicated hardware, and can enable optimal resource use and provisioning

• Reduces OPEX
  • Supports 48V which provides greater power efficiency
  • Supports active and passive air and liquid-based cooling
  • Reduces AIC service type and probability of damage / errors by eliminating discrete high-power cables
Thank you