SMART Technical Brief

Gen-Z Micro Development Kit (µDK)

The Gen-Z Micro Development Kit (µDK) is a standalone hardware platform, which includes all necessary hardware and software components required to test and develop the eco-system around Gen-Z protocol. The Gen-Z µDK is the smallest and simplest system, which allows the development and test of Gen-Z in-band management and fabric manager software from a computer desk.

The Gen-Z Micro Development Kit (µDK) has the potential to serve use cases beyond the basic hardware and software enablement, and has the potential to support Gen-Z collective operations, which enable Memory-Driven Computing (MDC) applications.

Industry Shift towards Fabric Based Interconnects like RDMA, NVMe-oF and now Gen-Z

- As network speeds are increasing, the latency difference between local attached memory and remotely accessible memory is decreasing. The addition of specialized hardware accelerators running cache coherent protocols is reducing the latency gap.

- Latest HPC models and AI/ML algorithms require large memory pools to store intermediate data sets. These data sets require concurrent access from multiple compute nodes. Thus, such workloads need large pools of shared memory, independent of any compute node.

- Memory bandwidth has not been able to match the steep increase in number of CPU cores available in a given server, leading to memory bandwidth starved CPU cores. Gen-Z serial attached ZMM (Gen-Z Memory Modules) memory increases memory bandwidth per core, increasing system performance.

Applications

The Gen-Z µDK is a self-sufficient stand-alone platform for software and hardware development for Gen-Z ecosystem, without requiring any hardware infrastructure, like in a data-center lab. The whole kit can be hand carried or placed on lab bench and accessed remotely. Gen-Z uDK itself cannot run heavy workloads, but various components of the uDK can be repurposed to fit a rack scale server. A sample of use-cases of uDK are:

1. Aid development of a Gen-Z software eco-system like Linux framework and drivers for Gen-Z devices, including bridges.

2. Support testing of advanced Gen-Z protocol features like Collectives, Atomics, Coherency, and Buffer Ops.

3. Validate and test memory access load/store latencies over Gen-Z fabric.

4. Out-of-box reference design for end-use case demo purpose.

What Gen-Z µDK cannot do:

1. Run workloads/high performance workloads like in-memory databases or compute intensive functions.

2. Emulate large memory capacities in tera-bytes or peta-bytes. Current version of Gen-Z µDK supports up to 224GB of memory.

3. Emulate latencies of Gen-Z switched fabric. Current version of the Gen-Z µDK supports 4 lanes of Gen-Z traffic running directly between ARM Host card and ZMM Memory device, without any Gen-Z switch in between. Thus this topology may not accurately represent latencies of a Gen-Z switched fabric.

Micro Development Kit (µDK) Components

Gen-Z µDK is a complete system that allows developers to run and test load-store memory accesses to a device across the Gen-Z fabric. This kit comes with hardware and software components configured together to work out-of-box in a form-factor which can sit on a lab bench.

| Components	Quantity	Description
Orthus ARM Host card (2xQSFP28)	1	PCIe Add-In-Card of full-height, 3/4 length form-factor, pre-programed with Gen-Z Host logic. Supports Linux on Quad Core A53.
Gen-Z backplane	1	Electrical board which provides electrical connectivity for ZMM Memory modules.
Gen-Z Memory Module (ZMM)	1-3	3-inch EDSFF DDR-4 memory device. Compatible to EDSFF E3 standards. Available in two capacities of 64GB and 256GB.
QSFP28 to Gen-Z 1C Cable	1	DAC cable to converts QSFP28 interface into Gen-Z 1C interface. Supports up to 25GT/sec
Micro Development Kit fixture with power supply	1	Mechanical fixture to house all the components and provide power and connectivity to the entire system.
Gen-Z 1C to Gen-Z 1C Cable	1-3	(Optional) cable to connect multiple back-planes in serial cascade mode using Gen-Z 1C connectors.
Xilinx Programmer	1	Off-the-shelf FPGA programmer USB-II Platform programming cable.

Orthus ARM Host card

The Orthus ARM Host card, comes in full-height, 3/4 length PCIe Gen3 x16 form-factor, along with Xilinx Zynq MPSoC FPGA which has a Quad core ARM A53 processor.

The Orthus ARM Host card comes with:

- Pre-programmed with Gen-Z bridge component bitstream, which supports a dual interface using a 4x high speed Gen-Z lane.

- Preloaded with Boot-loader, Linux Kernel and applications utilities supporting Gen-Z protocol, which enable this kit to demonstrate basic Gen-Z traffic out of the box. Source code for these binaries is available through open-source repositories.

- Attached JTAG debug board for FPGA programming and ARM debug capabilities.

- Attached Ethernet debug board for remote management.

- 2x QSFP connectors, each providing 4-high speed Gen-Z serial links at a data rate of 25Gbps NRZ.

- 2 x OCuLink adapters, which can be used for adding off-the-shelf Storage devices over PCIe bus, for targeted applications. This feature is not supported in the base IntelliProp Orthus Bridge design. Contact IntelliProp if this use case is of interest.
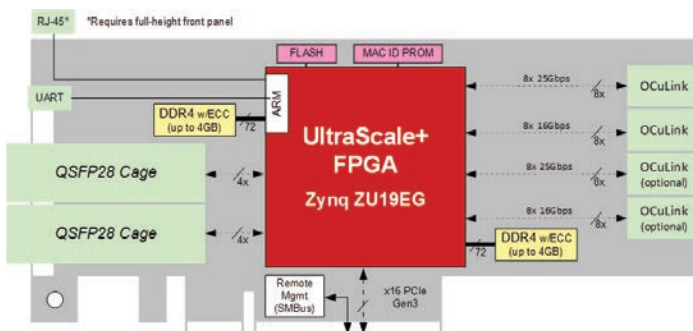
The Orthus ARM Host card comes pre-programmed with a Gen-Z Host image, and includes a setup guide, but no additional support. The Gen-Z requester FPGA bit-stream provided along with the kit is time-limited to one hour**. When the bit-stream times out after 1 hour, then the host card will need to be power cycled to restore functionality.

** Contact Larry Cleland at lcleland@intelliprop.com to inquire about longer or unlimited time-out bit-stream for the Orthus ARM Host card.

Gen-Z Memory Device (SMART™ ZMM Memory Module)

The Gen-Z memory module from SMART Modular Technologies, also called "ZMM" comes attached to this kit in two different capacities of 64GB and 256GB.

- Preprogrammed with IntelliProp® Mamba controller®[1] image, which supports four x4 Gen-Z interfaces and implements Gen-Z media controller functionality.

- Mechanically compliant to EDSFF 3-inch E3 (SFF-TA-1008) form-factor.

- Supports 16 Gen-Z lanes over 4C connector, pin compatible to SFF-TA-1009 standards.

- Supports DDR-4 @2400 dual channel memory configuration.

- Supports remote upgrade, when available from IntelliProp®.


To learn more about the ZMM, please go to: www.smartm.com/gen-z or email Product Director, Arthur Sainio at arthur.sainio@smartm.com

[1] For questions about the Mamba controller or to request customization of the Mamba controller, please contact Larry Cleland at lcleland@intelliprop.com.

Gen-Z Backplane

The Gen-Z backplane provides mechanical support and electrical connectivity to ZMM memory devices in the chassis. Each backplane can accommodate up to three (3) ZMM devices, with independent connectivity to Host through DAC copper cable. Multiple backplane can be cascaded together to provide a collective memory pool in Tera-Bytes of memory in a single 2U server, Media Box and/or JBOM.
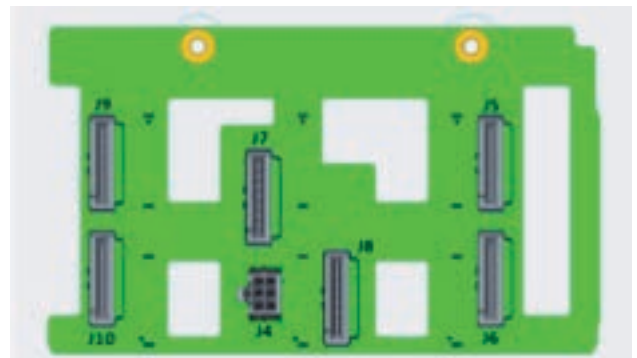
QSFP28 to Gen-Z (1C) Cable

Gen-Z protocol between ARM Orthus ARM Host card and ZMM memory modules run over DAC cables which are provided along with the µDK. Each cable supports transfer rates up to 25GT/s, and convert QSFP28 to 4C connector.
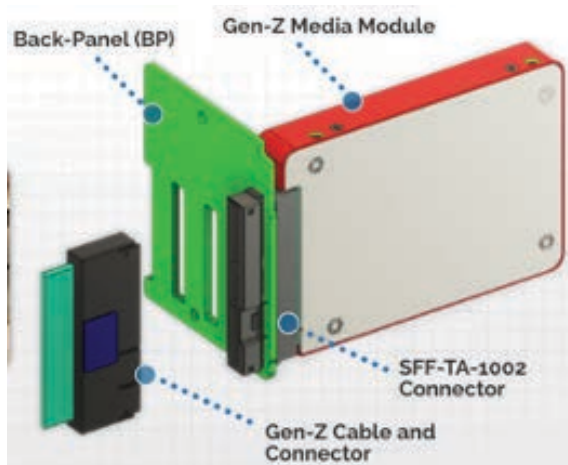

Gen-Z device (1C) to Gen-Z device (1C) cable

Gen-Z device to Gen-Z device cables are custom built to match the high speed data-rates to get the best performance out of the Gen-Z fabric. These cables have a Gen-Z 1C connector on both the ends, and can be used to create a serial chain of multiple Gen-Z ZMM devices. A mesh topology using multiple Gen-Z back-planes is also possible to support.

Micro Development Kit (µDK) chassis

This Micro Development Kit (µDK) open frame chassis includes a cooling fan, mechanical support, and power adapter, which combines the Orthus ARM Host card, backplane, cabling, and ZMMs into a single bench top system. One chassis is required for each µDK.
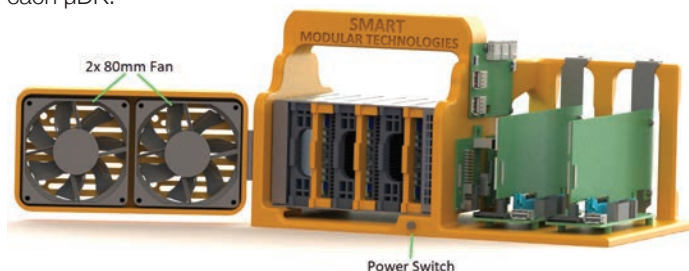
Xilinx FPGA Programming Platform Cable USB II

The Xilinx programming cable is a USB to JTAG convertor which is used to program the FPGA inside the Orthus ARM Host card or ZMM memory module, when you may want to upgrade the FPGA image. This cable requires installing the Xilinx Vivado Lab software, which is available on Xilinx website, without any additional licensing cost. The instructions to program the FPGA or upgrade the existing image are provided with individual components.

https://www.xilinx.com/products/boards-and-kits/hw-usb-ii-g.html

How many Xilinx USB II programmers are required?

Order can be directly submitted to SMART Modular. You may also request a quote for a custom kit though our web-form below https://www.surveymonkey.com/r/GenZ_micro_dev_kit

Gen-Z Micro Development Kit Ordering Information

SMART Part Number	Description
KZAB25G7B4Q36SM0X	Base Micro Development Kit without Orthus
KZAB25G7B4Q36SM01	Base Micro Development Kit with Orthus Card but no ZMM
STZAB25G7B4Q36SM	256GB ZMM
STZAB64G7B4S36SA	64GB ZMM
MOD-00000001	Full-Height, ¾ length PCIe Orthus Card including daughter cards for Gen-Z Host debugging and development

For other ordering options, questions or quotes please send e-mail to Arthur Sainio arthur.sainio@smartm.com.