Virtual Open Systems

Virtio-FPGA: a virtualization solution for SoC-attached FPGAs

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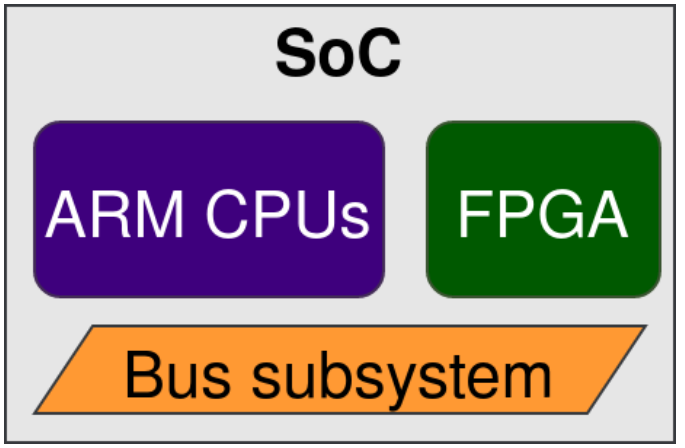
EVEREST
DESIGN ENVIRONMENT
FOR EXTREME-SCALE BIG DATA ANALYTICS
ON HETEROGENEOUS PLATFORMS

SoC-attached FPGAs and virtualization

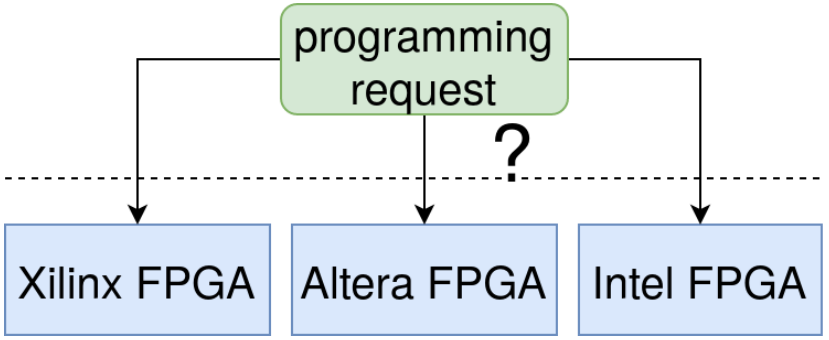
- SoC-attached FPGAs in the embedded domain
  - FPGAs to handle specific workloads

- Virtualization of FPGAs
  - Resource sharing
  - Isolation
  - Security

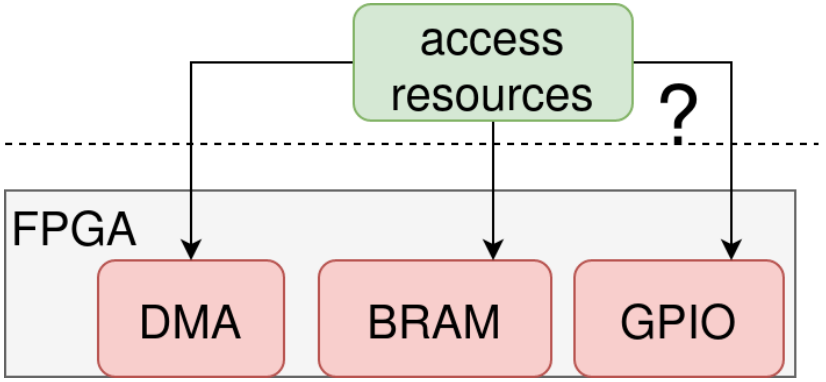


FPGAs virtualization is challenging

- Programming operation is vendor-specific



- Heterogeneity on the configured resources



Virtio-FPGA objectives

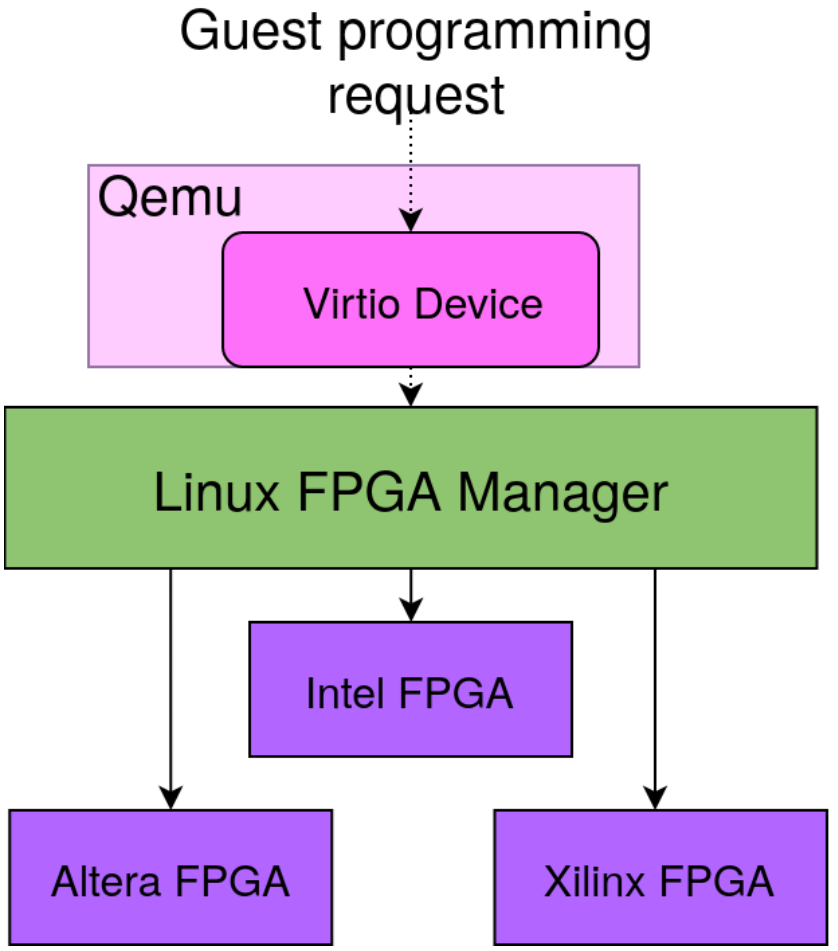
- Guests to **program** and **interact** easily with the FPGA fabric

- Exploit capabilities of a Linux and Qemu/KVM setup

Virtio-FPGA: Programming of FPGAs

- Created **virtual view** of the Linux FPGA Manager

- **Virtio protocol** for communication between guests and host



Virtio-FPGA: Using the FPGA resources

- Qemu exploitation of VFIO pass-through
  - FPGA devices can be **assigned to** guests
  - FPGA devices can be **utilized from** guests

- How to be flexible on the available FPGA resources?
  - Modifiable FPGA hardware on time
  - We need alternative to **hotplug**!

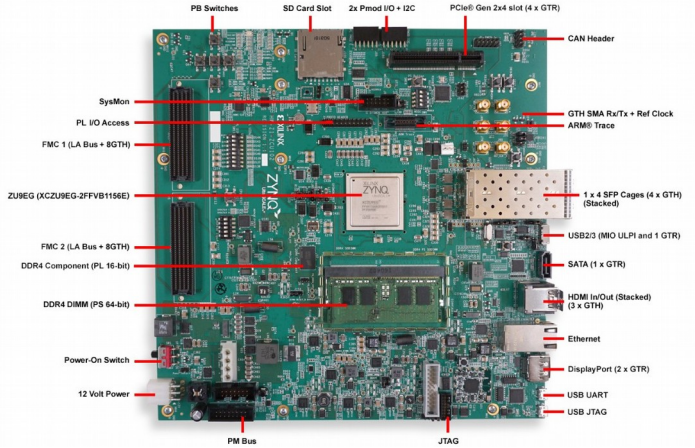
Virtio-FPGA: Using the FPGA resources

- ARM Device Tree Overlays with VFIO
  - Alternative to hotplug
  - Devices activated on the guest upon FPGAs configuration

- Virtio-FPGA: Full path for **dynamic programming** and **utilization** of FPGA resources from guests

Experimentation environment

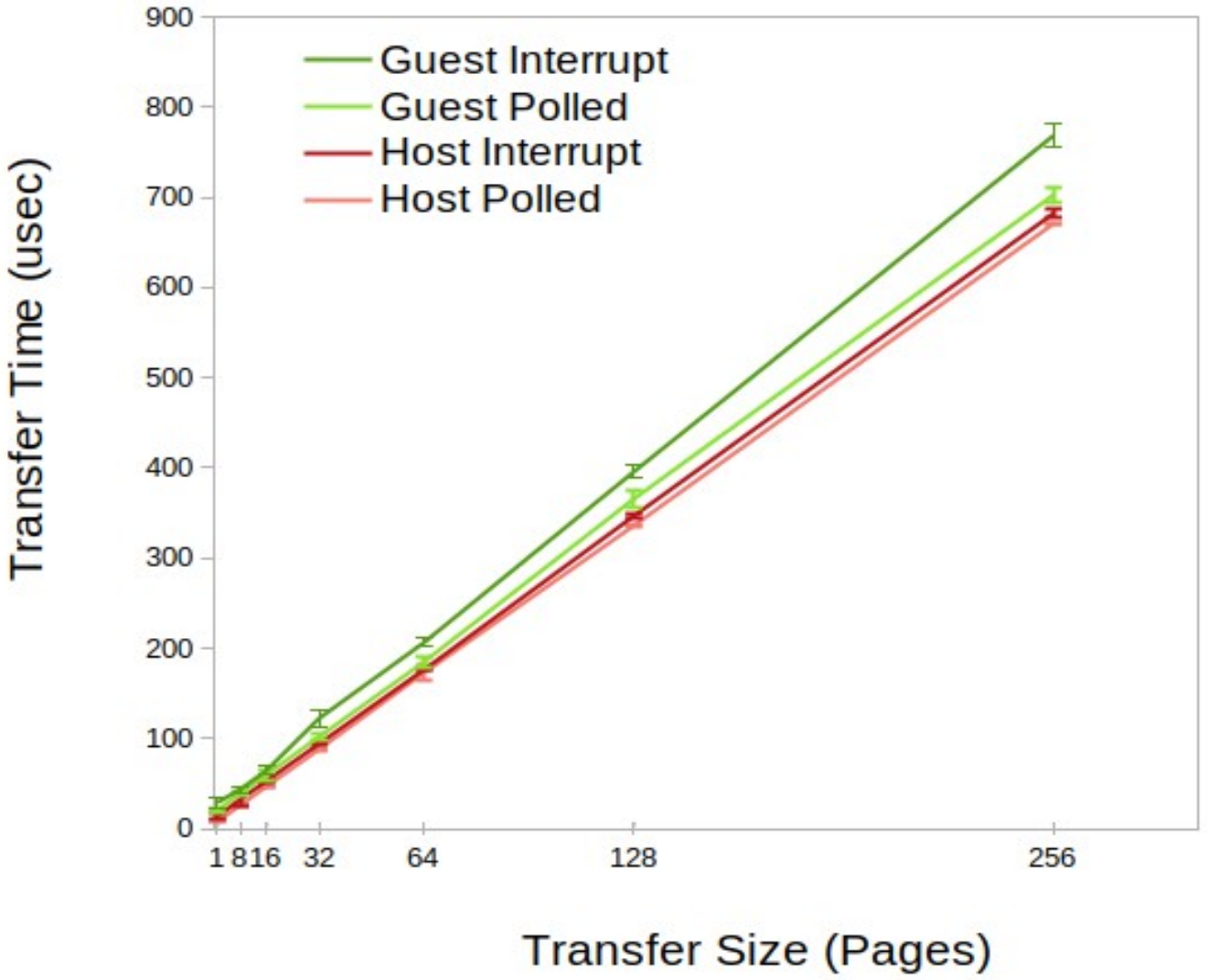
- Target to measure the **virtualization** overhead
- Xilinx **ZCU102** MPSoC
  - Host: Xilinx Linux 5.10.0
  - Guest: Qemu virt, Linux 6.0.0



Performance test with CDMA

- Linux DMA test client
- Configured **CDMA device** on the FPGA
- Virtio-FPGA: CDMA is accessible to the guest
- DMA test results from guest **compared** to DMA test results from host

DMA test results



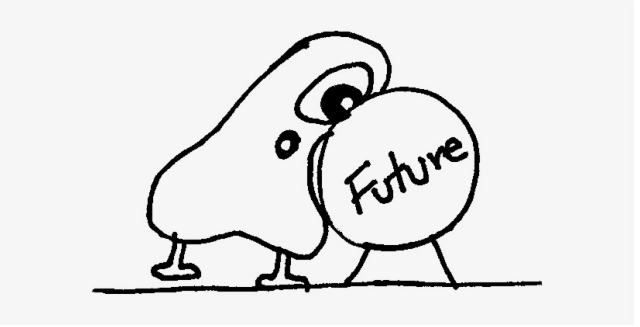
Virtio-FPGA summed up

- Guests dynamically **re-configure** and **access** FPGA resources
- Flexibility? Linux FPGA Manager
- Efficiency? Virtio and VFIO technologies

Future directions

- Partial reconfiguration support in virtualized FPGA Manager

- Monitoring tool for the hardware tasks



Thank you !

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