

MICHIGAN STATE

UNIVERSITY

Alpha Presentation

SmartSat™ Heterogeneous Computing in Space

The Capstone Experience

Team Lockheed Martin Space

Gorman, Thomas

Kurkowski, Jacob

Langer, Nolan

Mondol, Shawn

Pargan, Bilal

Department of Computer Science and Engineering

Michigan State University

Fall 2023



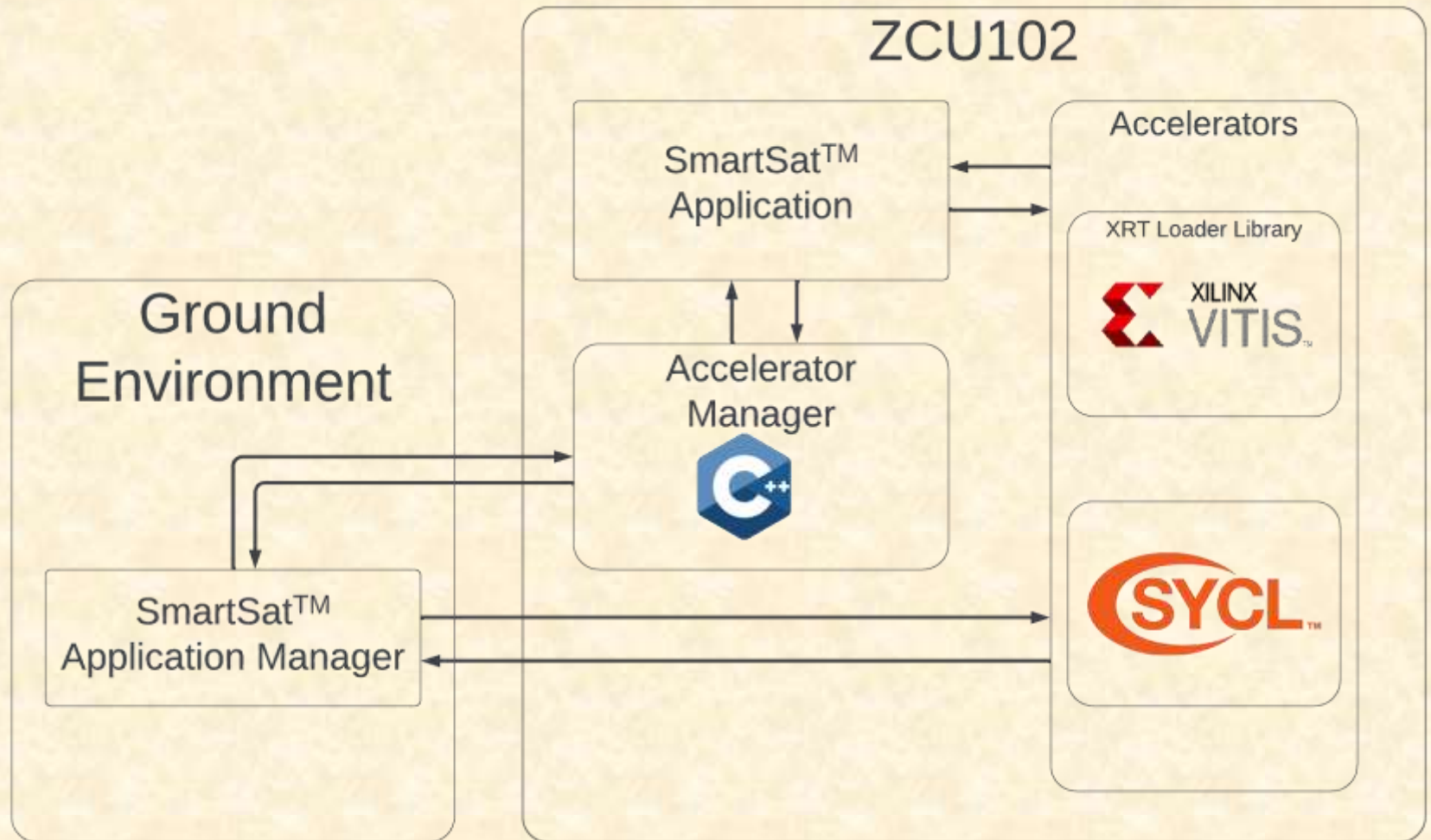
*From Students...
...to Professionals*

Project Overview

- Enable data to be processed faster by distributing algorithms across dissimilar and workload optimized processing devices.
- Minimize processing delays by determining which hardware component to use based on status of the satellite and resource utilization.
- Reduce hardware knowledge required to develop with XRT



System Architecture



Connecting Accelerator Manager

Accelerator Manager

```
Server Connection Successful
Server listening on port 12345...
Waiting for command...
Received command: 1: Add Accelerator #1
Adding Accelerator #1
Waiting for command...
Received command: 2: Add Accelerator #2
Adding Accelerator #2
Waiting for command...
Received command: 6: Close Connection
```

System User Interface

```
Select a command to send:
  1: Add Accelerator #1
  2: Add Accelerator #2
  3: Remove Accelerator #1
  4: Remove Accelerator #2
  5: Show Accelerator Status
  6: Stop Connection

Command Selection: 1
Server response: Successfully started Accelerator #1
Select a command to send:
  1: Add Accelerator #1
  2: Add Accelerator #2
  3: Remove Accelerator #1
  4: Remove Accelerator #2
  5: Show Accelerator Status
  6: Stop Connection

Command Selection: 2
Server response: Successfully started Accelerator #2
Select a command to send:
  1: Add Accelerator #1
  2: Add Accelerator #2
  3: Remove Accelerator #1
  4: Remove Accelerator #2
  5: Show Accelerator Status
  6: Stop Connection

Command Selection: 6
Server response: Closed Connection
```



Error Handling with Accelerator Manager

Accelerator Manager

```
Server Connection Successful
Server listening on port 12345...
Waiting for command...
Received command: 1: Add Accelerator #1:
Adding Accelerator #1
Waiting for command...
Received command: 1: Add Accelerator #1:
Adding Accelerator #1
Waiting for command...
Received command: 5: Show Accelerator Status:
Waiting for command...
Received command: 4: Remove Accelerator #2:
Waiting for command...
```

System User Interface

```
Select a command to send:
  1: Add Accelerator #1
  2: Add Accelerator #2
  3: Remove Accelerator #1
  4: Remove Accelerator #2
  5: Show Accelerator Status
  6: Stop Connection

1
Server response: Successfully added Accelerator #1
Select a command to send:
  1: Add Accelerator #1
  2: Add Accelerator #2
  3: Remove Accelerator #1
  4: Remove Accelerator #2
  5: Show Accelerator Status
  6: Stop Connection

1
Server response: Successfully added Accelerator #1
Select a command to send:
  1: Add Accelerator #1
  2: Add Accelerator #2
  3: Remove Accelerator #1
  4: Remove Accelerator #2
  5: Show Accelerator Status
  6: Stop Connection

5
Server response: Accelerator : Status
#0 xilinx-zcu : idle#
#1 xilinx-zcu1: idle
Select a command to send:
  1: Add Accelerator #1
  2: Add Accelerator #2
  3: Remove Accelerator #1
  4: Remove Accelerator #2
  5: Show Accelerator Status
  6: Stop Connection

4
Server response: Failed to remove accelerator(AMD Radeon RX 7700) accelerator does not exist or could not be found
Select a command to send:
  1: Add Accelerator #1
  2: Add Accelerator #2
  3: Remove Accelerator #1
  4: Remove Accelerator #2
  5: Show Accelerator Status
  6: Stop Connection
```



Vitis Accelerator with XRT Output

```
zynqmp-common-20231:/mnt# ./jacobKernelTest
argc = 2
argv[0] = ./jacobKernelTest
argv[1] = binary_container_1.xclbin
Initializing Device
Opening Device
Loading Binary File
Bitstream load successful
Loading User-hosted kernel
Allocate Buffer in Global Memory
```

Terminal Output Continued

```
loaded the data
synchronize input buffer data to device global memory
INFO: Setting IP Data
Setting Register A (Input Address)
Setting Register B (Input Address)
INFO: IP Start
INFO: IP Done
Get the output data from the device
Shawn's TEST PASSED
zynqmp-common-20231:/mnt#
```



Vitis Accelerator with Image Processing



What's left to do?

- Include additional base functions to the XRTLlibrary
- Advanced AdaptiveCpp Accelerator
- SmartSat SDK Integration
- Advanced Vitis Accelerator
- Ability to display Vitis Accelerator properties outside of the XRTLlibrary



Questions?

?

?

?

?

?

?

?

?

?

