BLADE: ALLEN TELESCOPE ARRAY

GPU ACCELERATED REAL-TIME BEAMFORMER

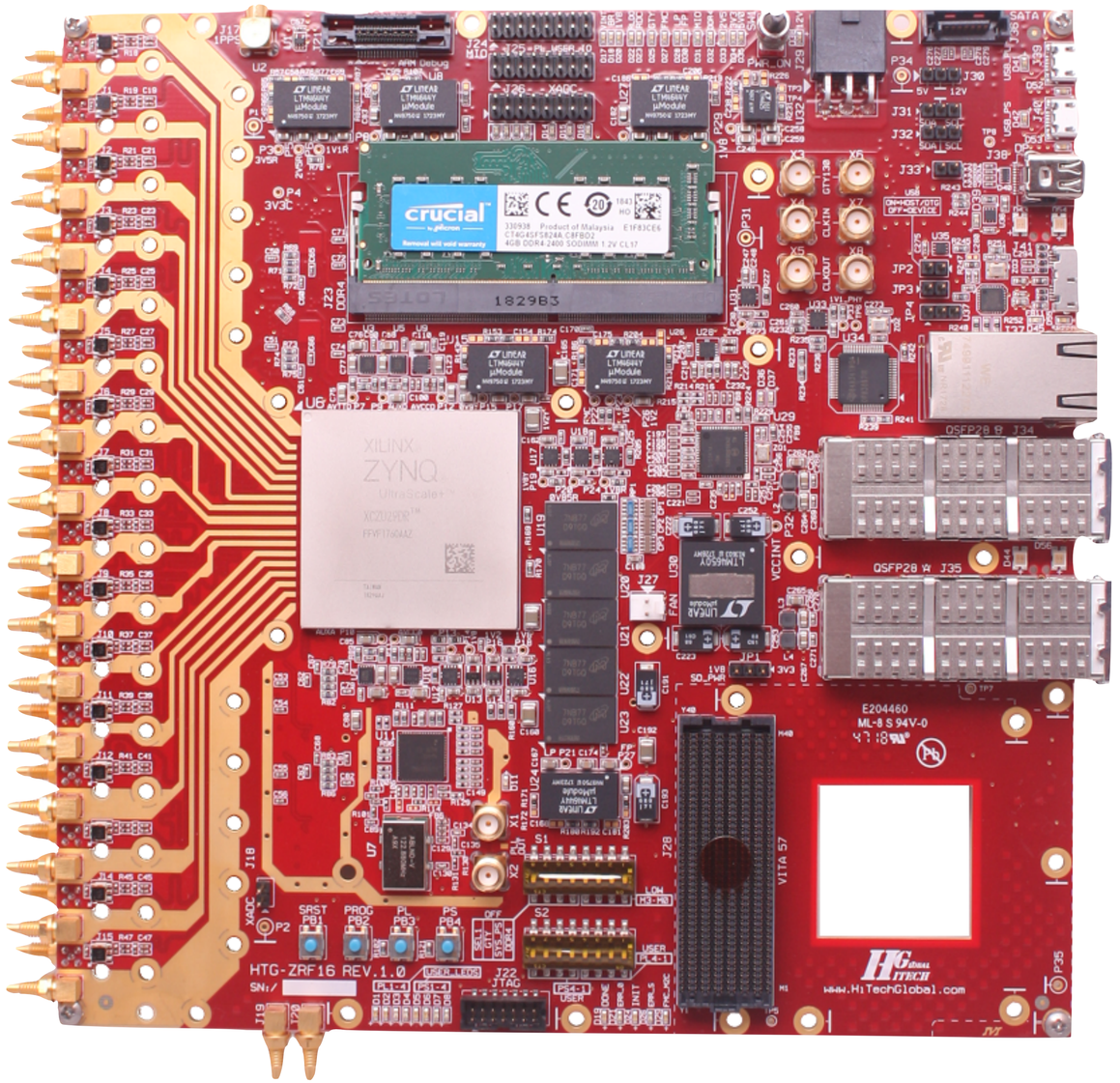
Luigi Cruz, Staff Engineer, SETI Institute

75th International Astronautical Congress

Allen Telescope Array

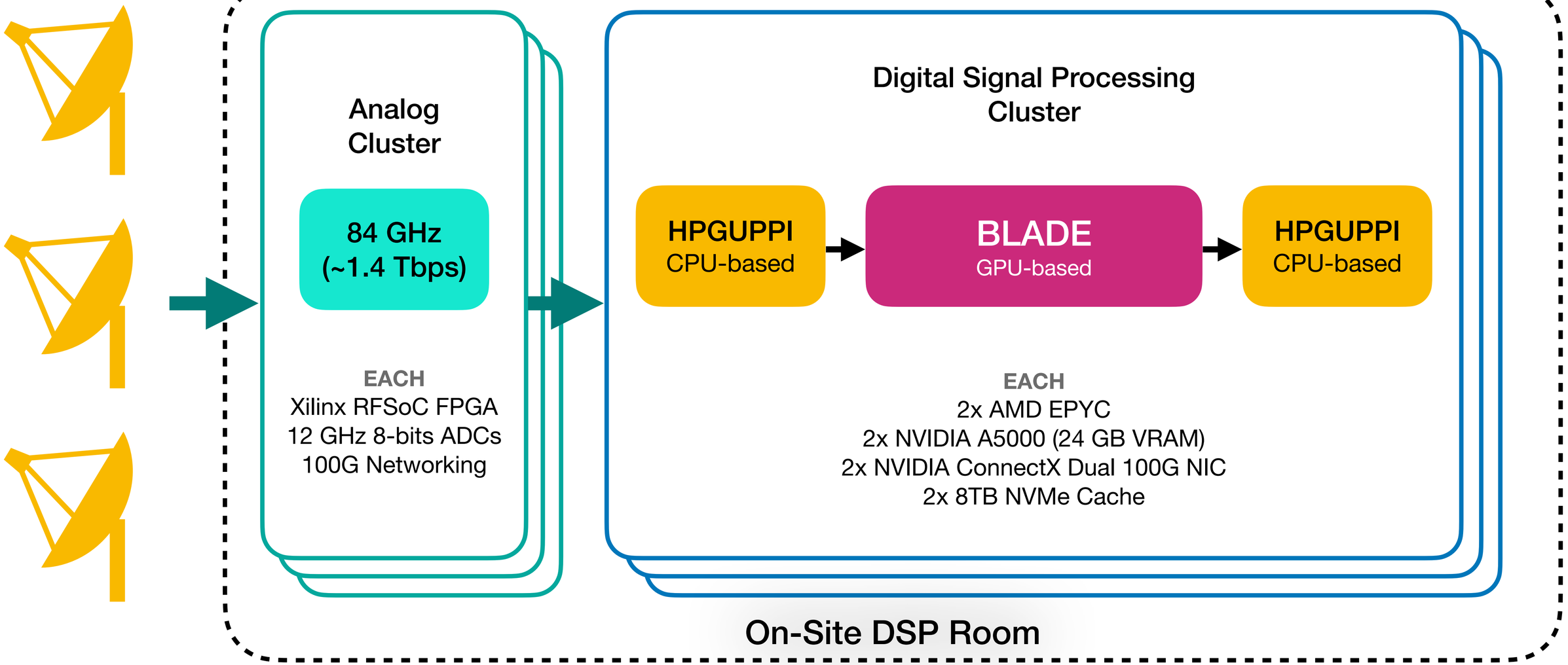
Data Acquisition

- Received radio signal is transmitted to the DSP room via RF over fiber.
- Signal is converted back to copper, pre-amplified, mixed, and distributed to the data-acquisition boards.
- Signal is digitized using RFSoC FPGA boards where it is pre-channelized, packetized, and sent over the network via 100G fiber.
- Data is received in the processing nodes.



Data Processing

Current Pipeline




BLADE

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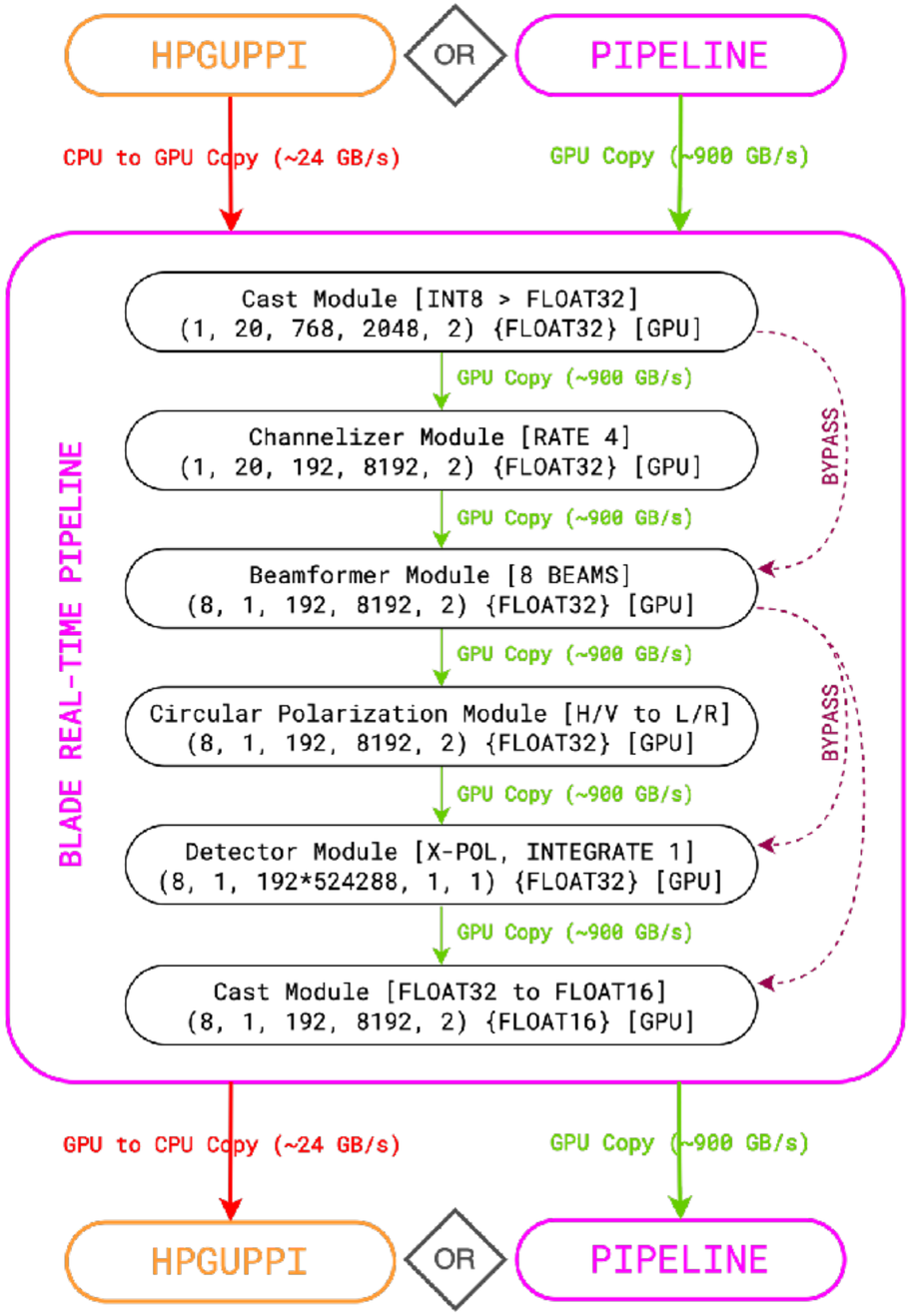
Breakthrough Listen Accelerated DSP Engine

- Responsible for most of the Digital Signal Processing of the ATA.
- Currently processing data incoming from 28 antennas with more soon!
- Each antenna represents ~3.0 GHz of bandwidth in 8 bits samples.
- Equates to an aggregated ~1.4 Tbps in 16 instances (~90 Gbps/instance).
- Currently implements 9 processing modules (beamforming, correlator, etc).
- Design:
  - Common interface between astronomy oriented DSP modules.
  - Just-in-time compilation of CUDA kernels.
  - Performant while hackable.



HOLOSCAN

Holoscan

NVIDIA’s Streaming Sensor Platform

What is Holoscan?

- High-performance platform for sensor data processing and AI inferencing.
- Leverages the power of NVIDIA GPUs for efficient data movement and computation.

Benefits

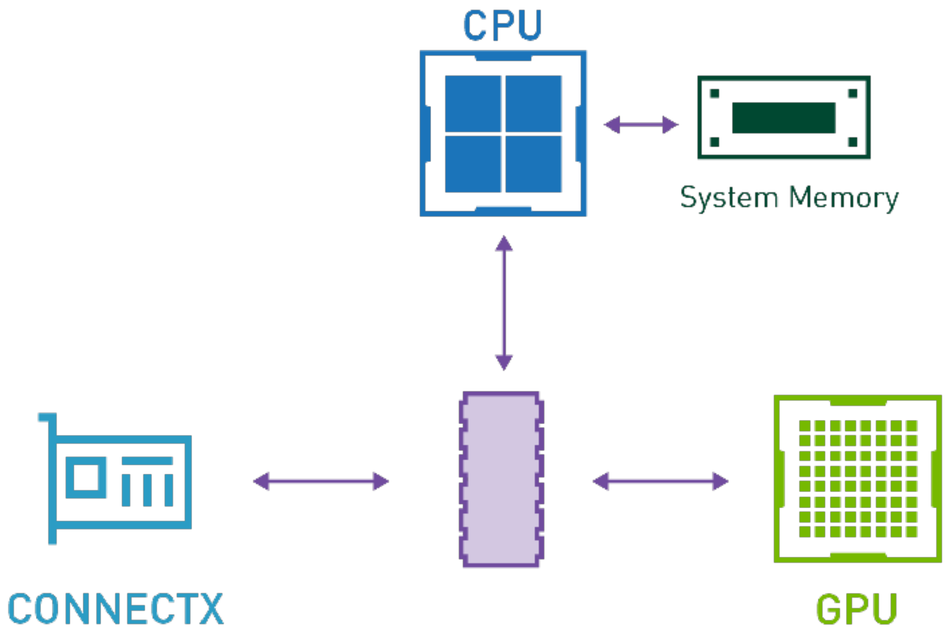
- Scalability: Handles high data volumes and scales with additional hardware.
- Simplicity: Easier to build and deploy sensor processing applications.

Advanced Network Operator (ANO):

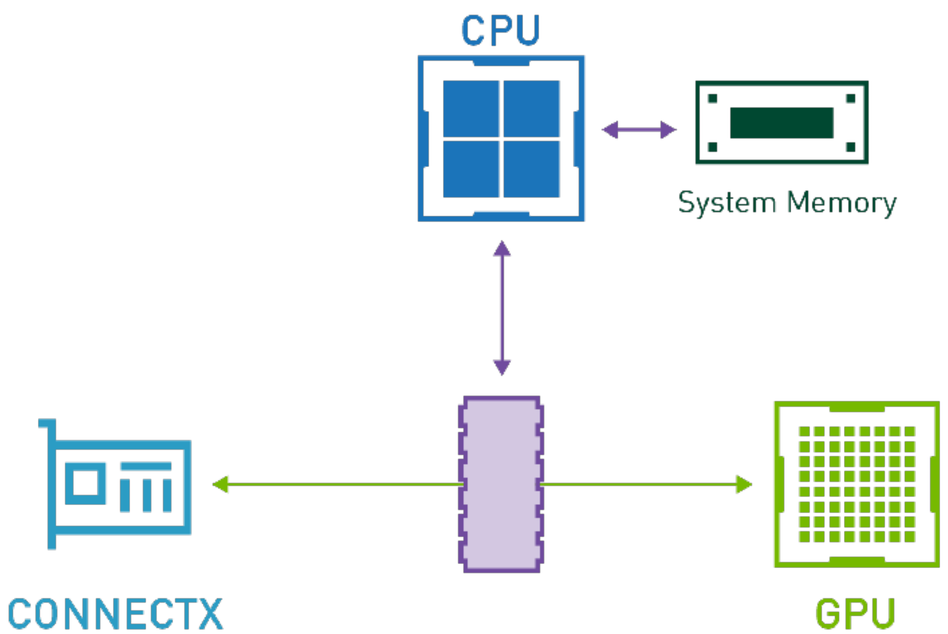
- Abstracts system tuning and **GPUDirect RDMA** implementation.
- Enables data to bypass CPU and directly reach GPUs for faster processing.

Holoscan

Advanced Network Operator (ANO)



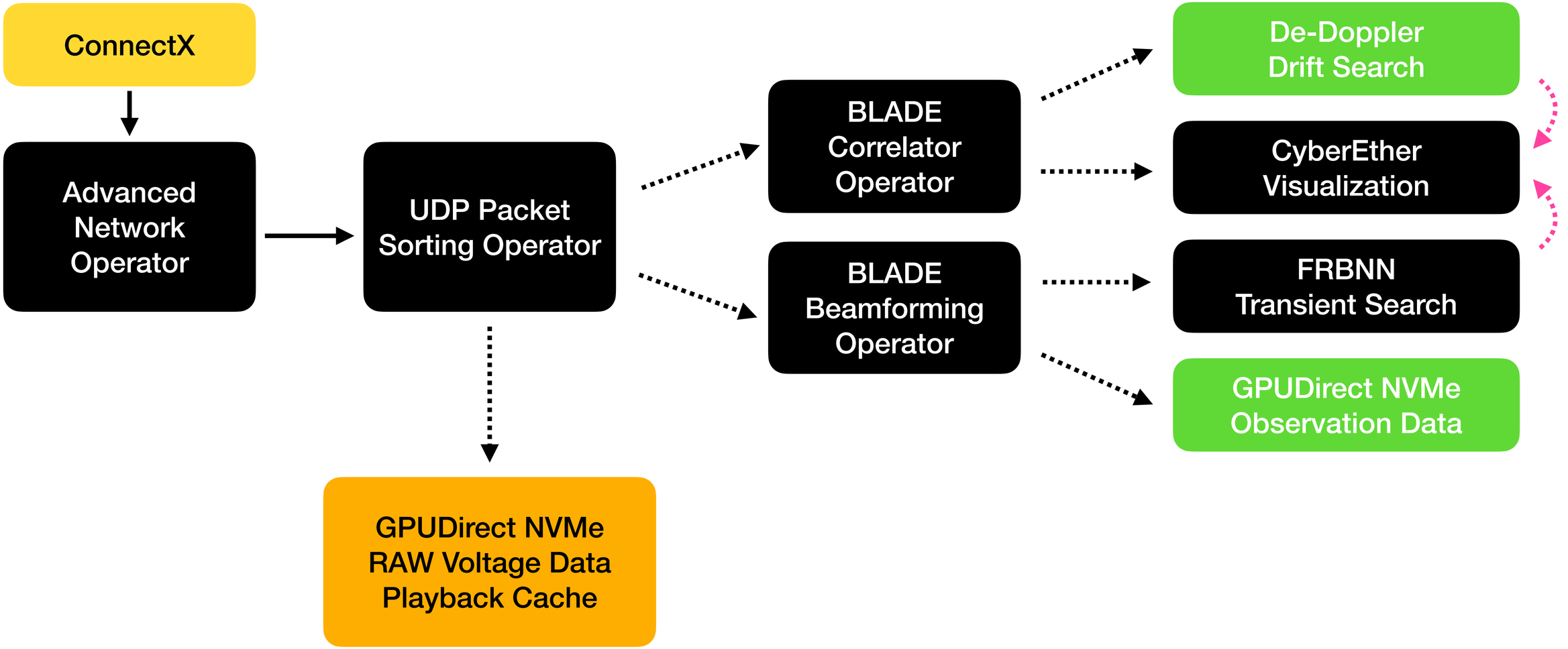
Two Transfers
(NIC -> CPU -> GPU)



Single RDMA Transfer
(NIC -> GPU)

Near Future

Extending the ATA's Capabilities with Holoscan



Next Compute Platform Trials

NVIDIA IGX Orin

- 12-core ARM CPU (Cortex-A78)
- NVIDIA ConnectX-7
  - 2x 100 GbE
  - 32-lane PCIe 5.0 Switch
- NVIDIA A6000 Ada
- OpenBMC (Aspeed AST2600)

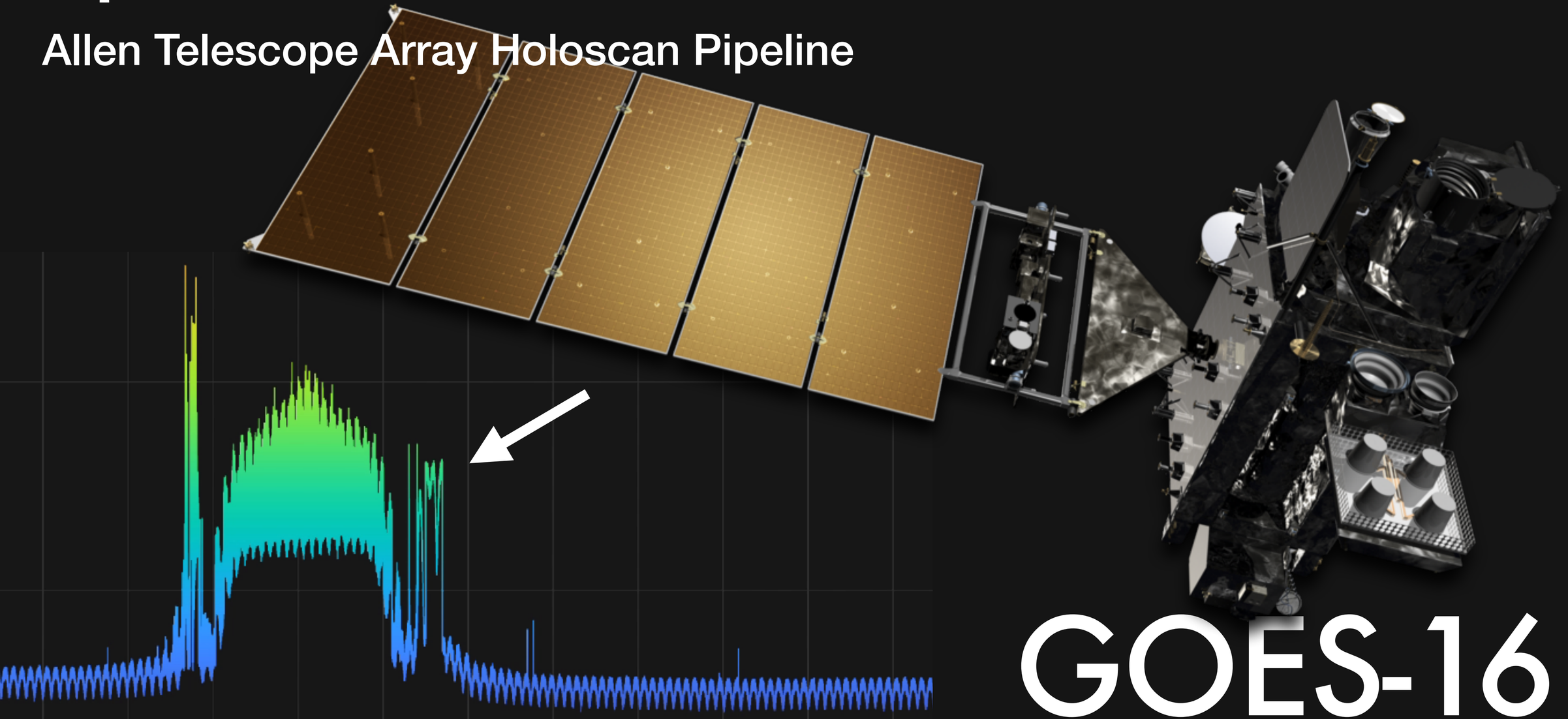

TESTING

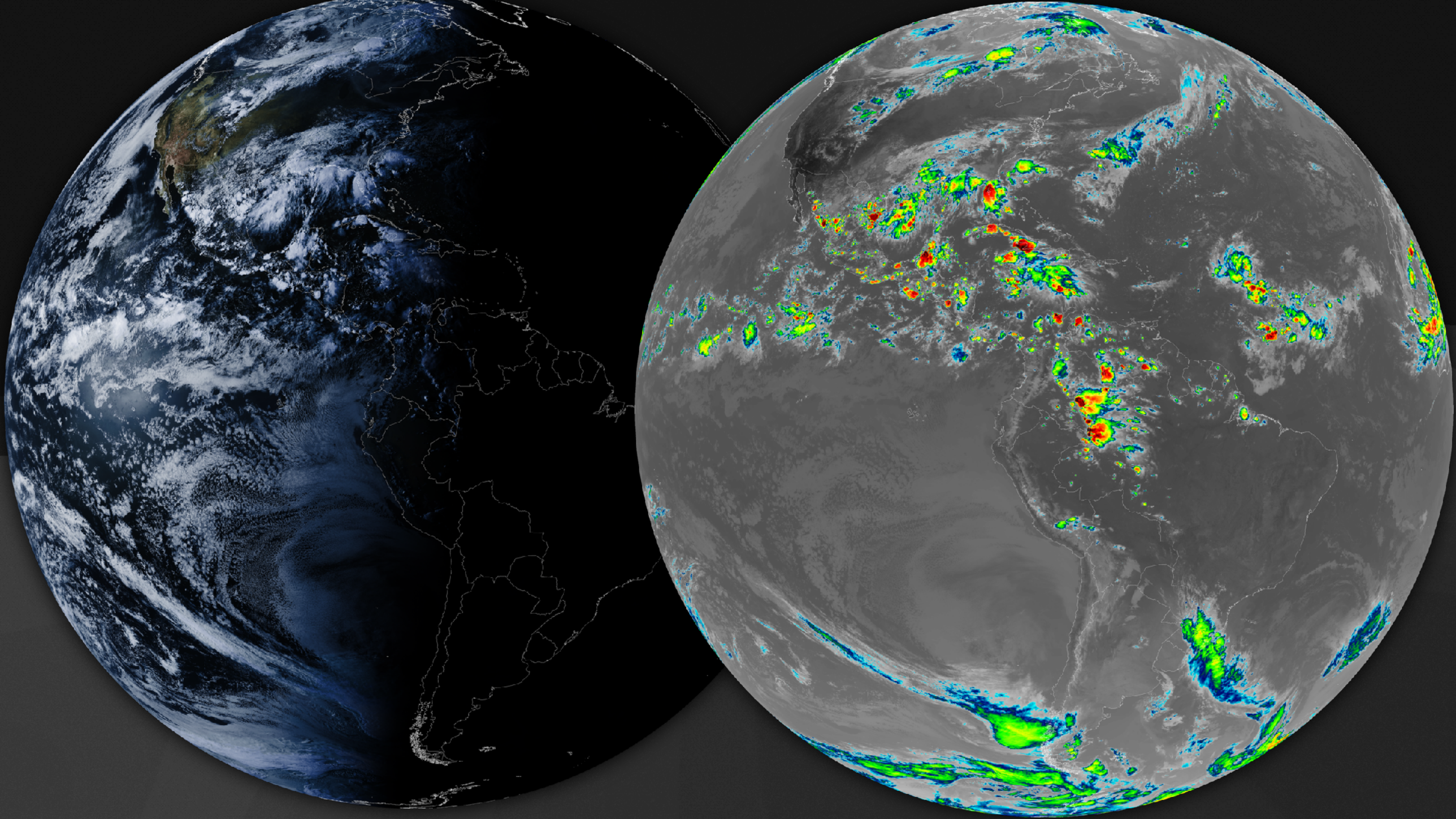
Deep Space Demonstration

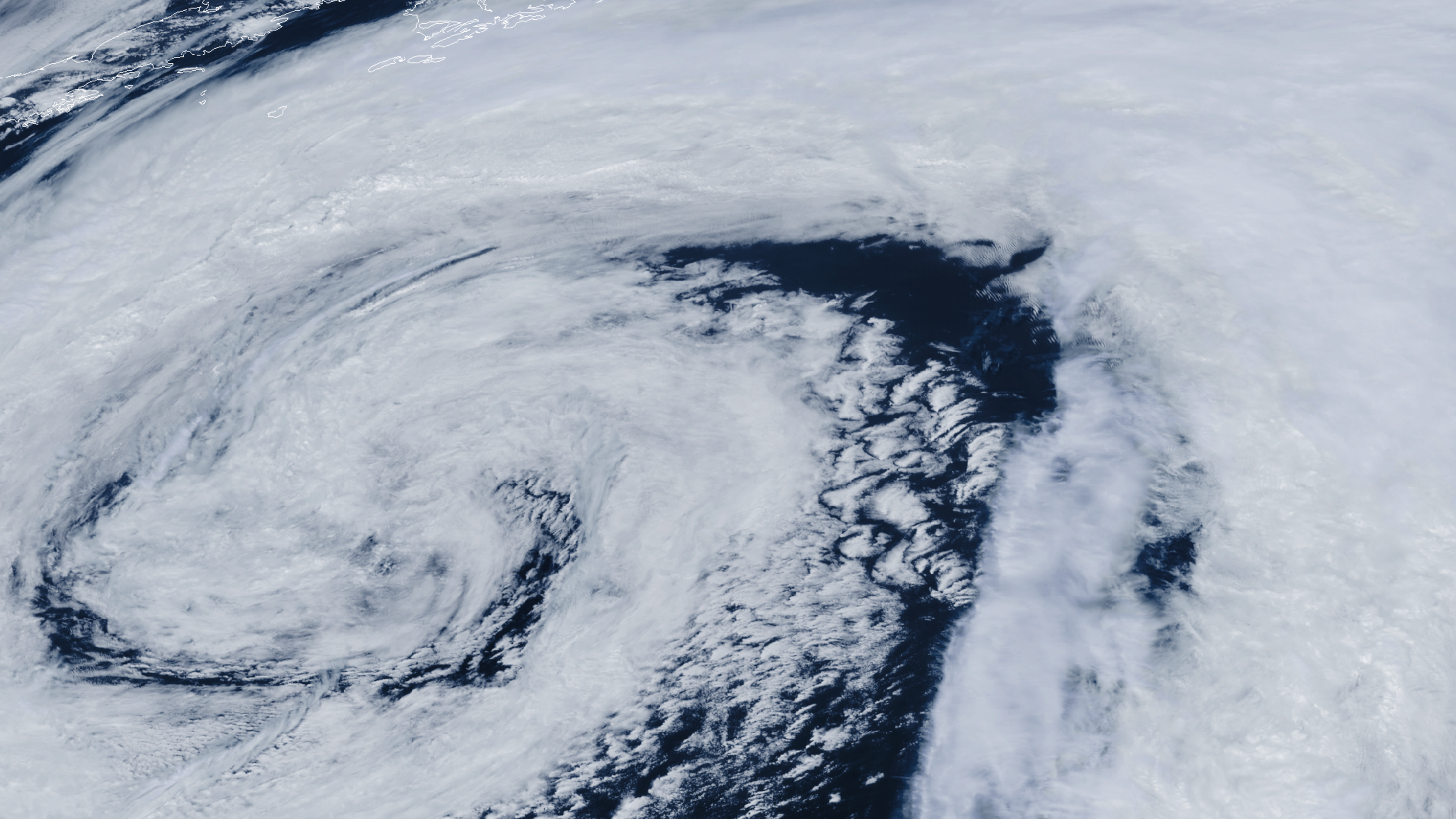
Allen Telescope Array Holoscan Pipeline

Space Demonstration

Allen Telescope Array Holoscan Pipeline







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Thank You!

Questions?