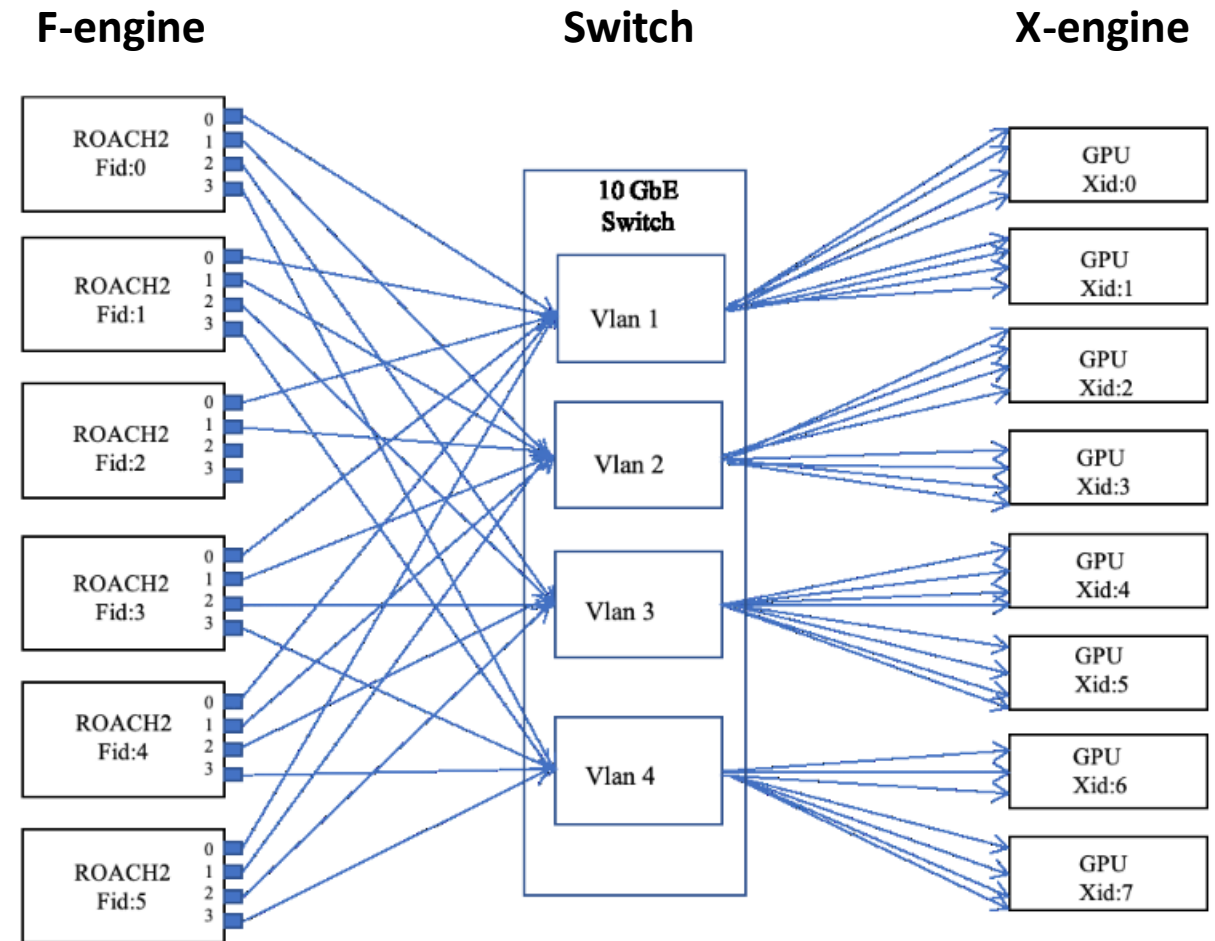


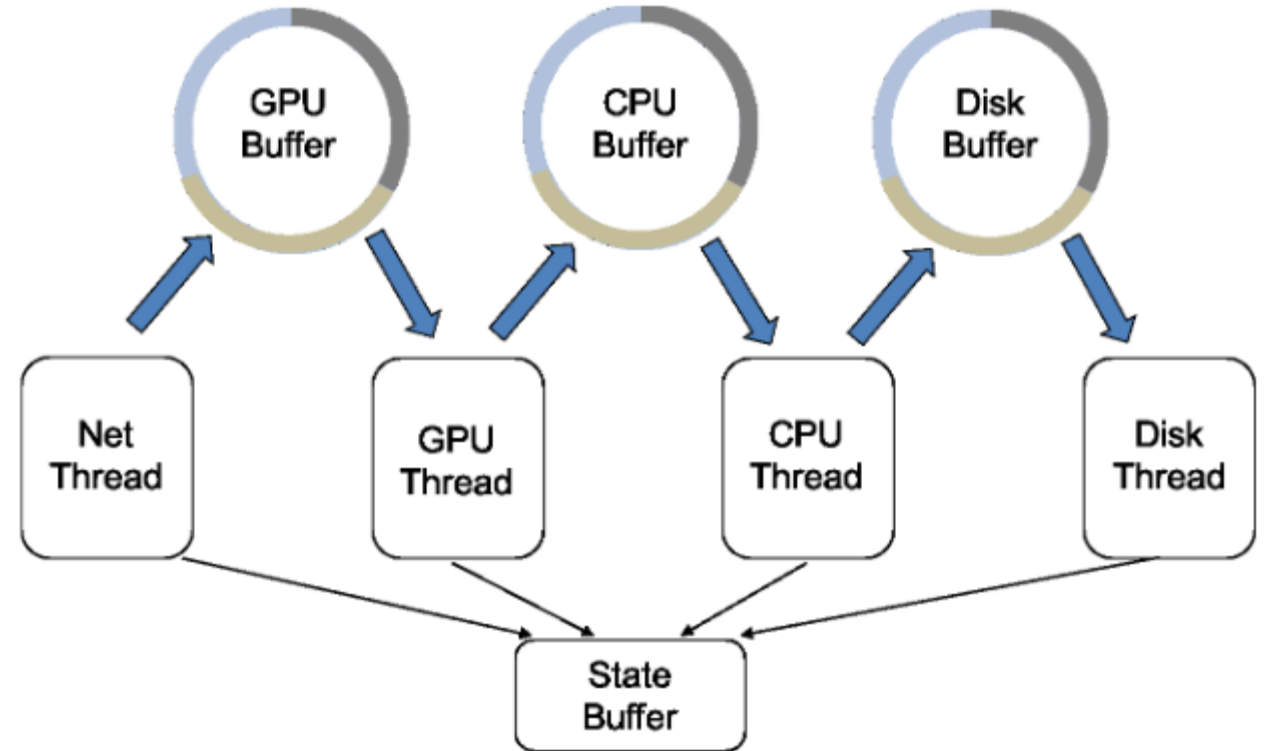
Roach+GPU Correlator

- F-engine: ADC, PFB, FFT, Frequency fragment
- Roach
 - 32 inputs \times 6 = 192 inputs for Tianlai Cylinder Array
 - AD: 250MSPS, 8bit
 - FFT: 1024 Frequency channel
 - 1024 frequency \rightarrow 32 frequency * 32 parts
- Switch
 - Switching FFT data by frequency to X-engine
 - Port: 10Gb * 48 + 40Gb * 12
 - Easily expanded for future Tianlai demand.



Roach+GPU Correlator

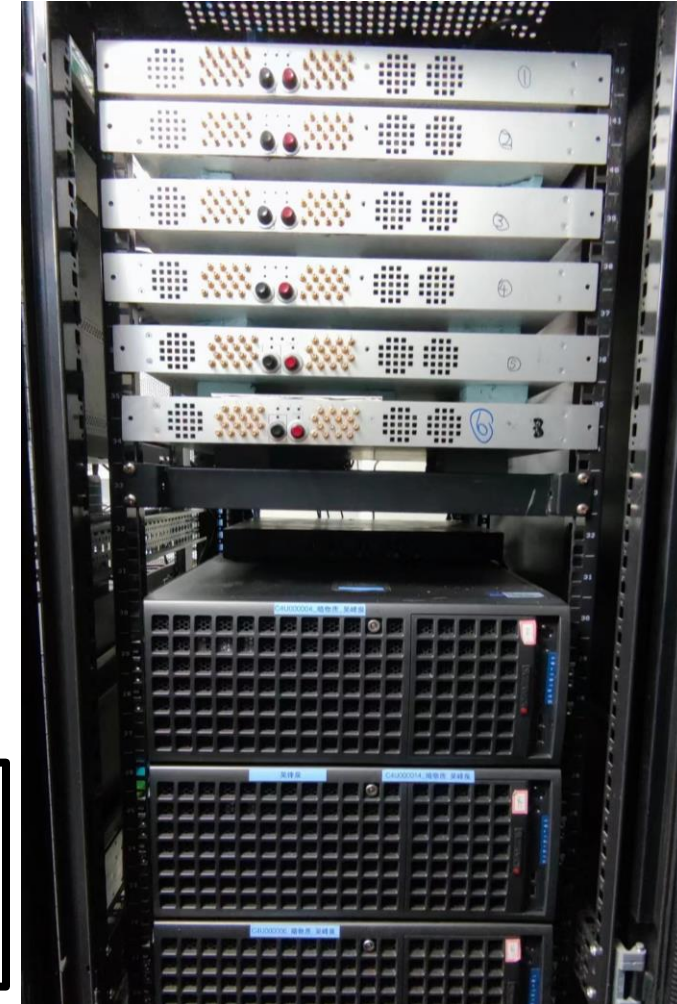
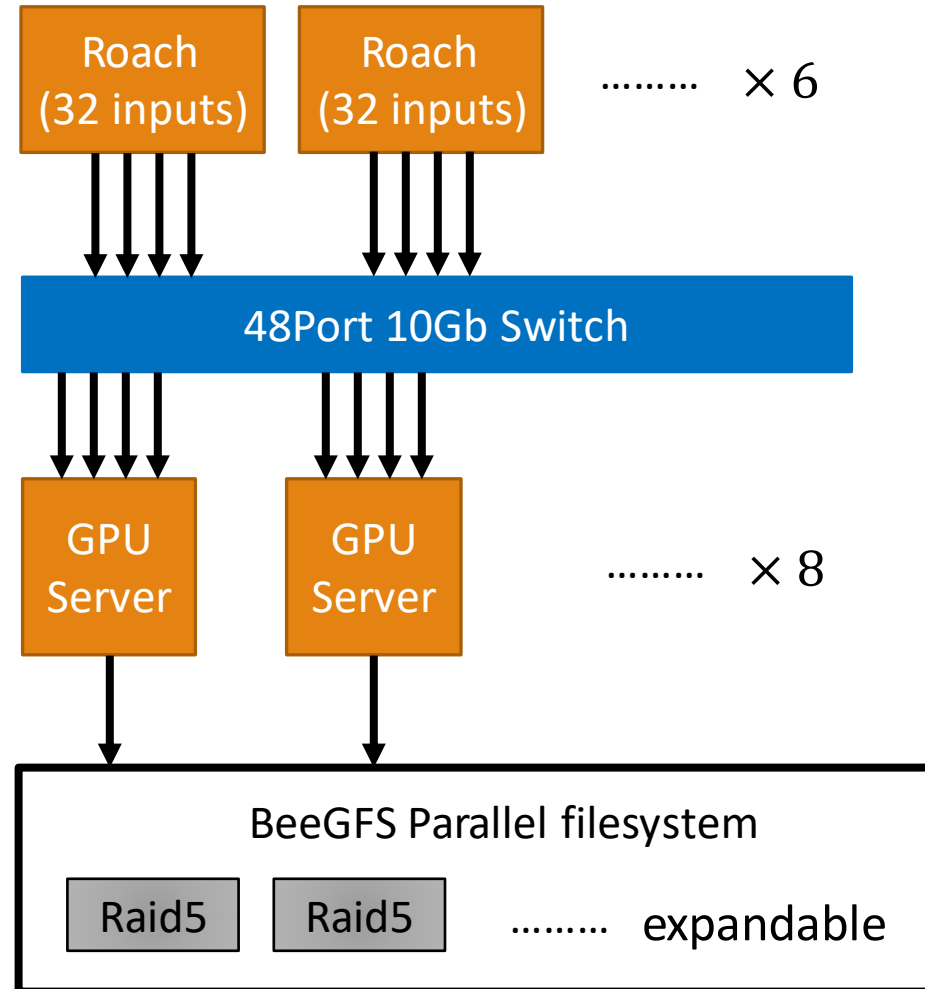
- ❑ X-engine: correlation of FFT data.
- ❑ Software
 - ❑ Hashpipe
- ❑ Hardware
 - ❑ GPU: GTX690 (2 cores)
- ❑ For Tianlai:
 - ❑ 1 instance (32 frequency) for 1 GPU core
 - ❑ 4 instances (128 frequency) per GPU server
 - ❑ 32 instances (1024 frequency) for Cylinder whole system.



Hashpipe pipeline

Roach+GPU Correlator

- F-engine
 - 32 inputs \times 6 = 192 channels
- X-engine
 - 32 frequency channels per gpu core
 - 2 cores per GTX690 (2 cores)
 - 4 cores per GPU server
 - 128 frequency channels per Server
 - 1024 frequency channels in total
- Storage
 - BeeGFS high performance filesystem
 - Multi storage targets
 - Raid 5 for both high throughput and redundancy.
 - Expandable for future Tianlai correlator of more inputs.



Roach+GPU Correlator

□ Check by Noise Generator.

□ Phase: $\Phi = 2\pi f\Delta t$

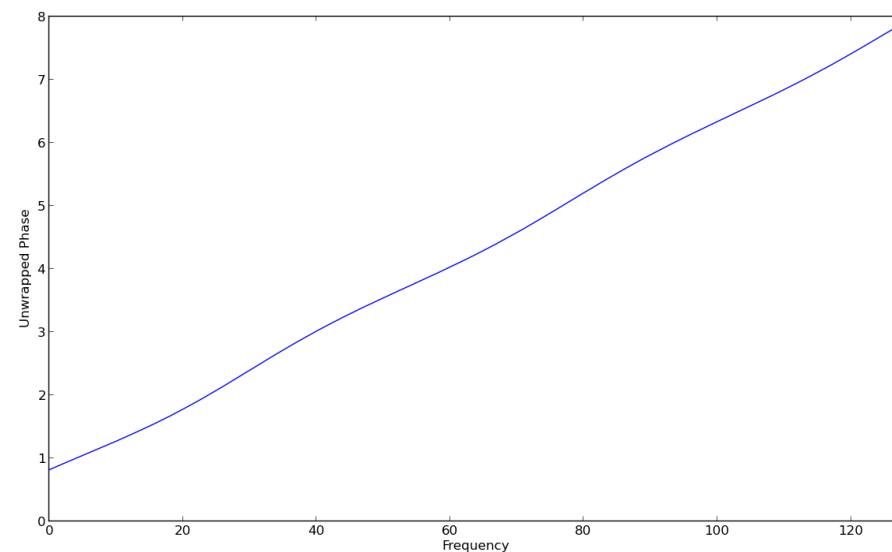
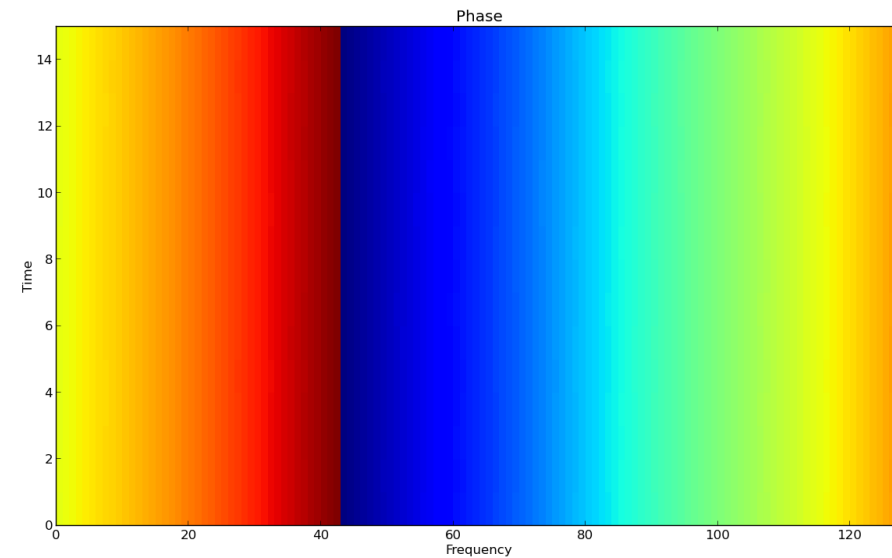
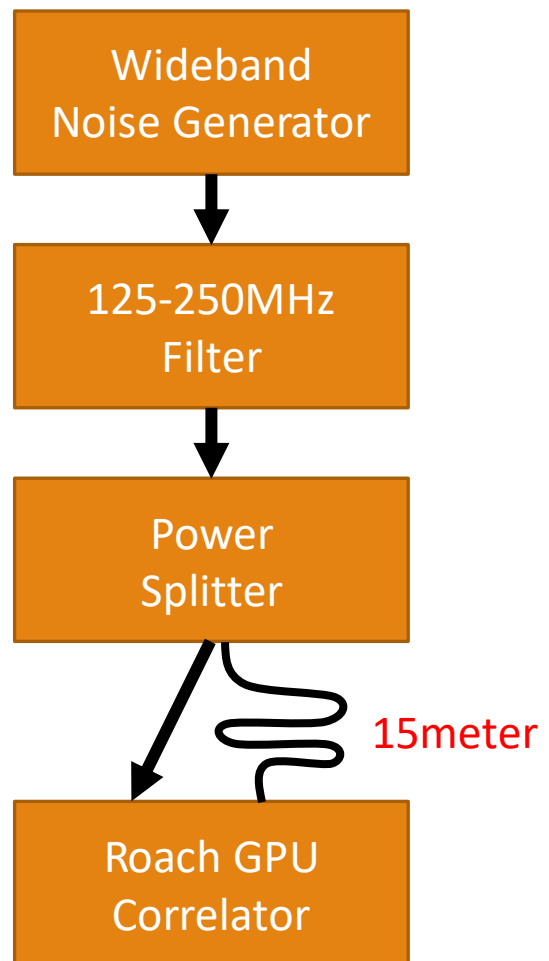
□ Time delay: $\Delta t = \frac{\Delta l}{c_{\text{cable}}}$

□ Light speed in radio cable:

□ $c_{\text{cable}} = 0.7c$

□ Experiment result:

□ $\Delta l = 15.03\text{m}$



Roach+GPU Correlator

□ Check by Sun observation data

Baseline: A1Y-B8Y

Transit Time: 625s

Beam width: 2.5deg (2.54deg in *Zuo et al 2019*)

