Data Acquisition Enhancements for Gyrotron Test Facility Pulsed Mode Upgrade

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Overview

1. Introduction D-TACQ
2. Gyrotron Test System : Original Requirement
3. Data Archive: EPICS or MDSplus?
4. Gyrotron Test System: Pulsed Mode Upgrade
5. Architecture
6. Streaming and Storing data at high rates: How?

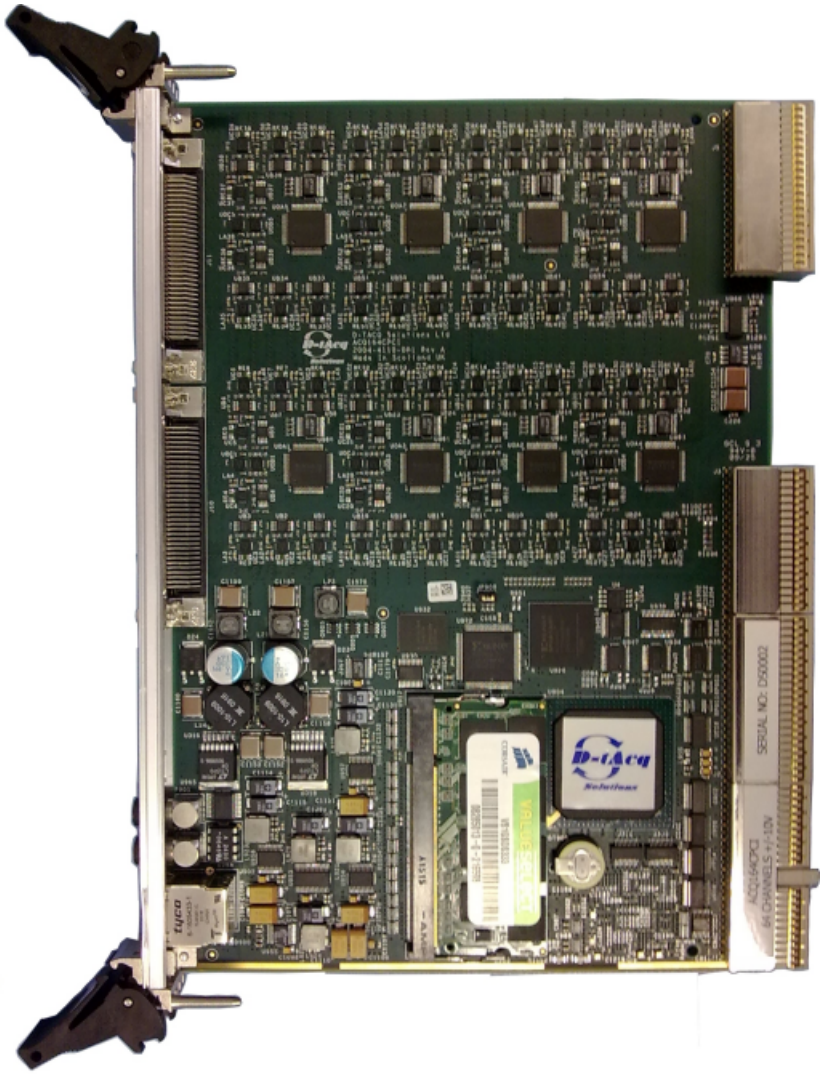
Intelligent Simultaneous Digitizer

Example: ACQ164CPCI

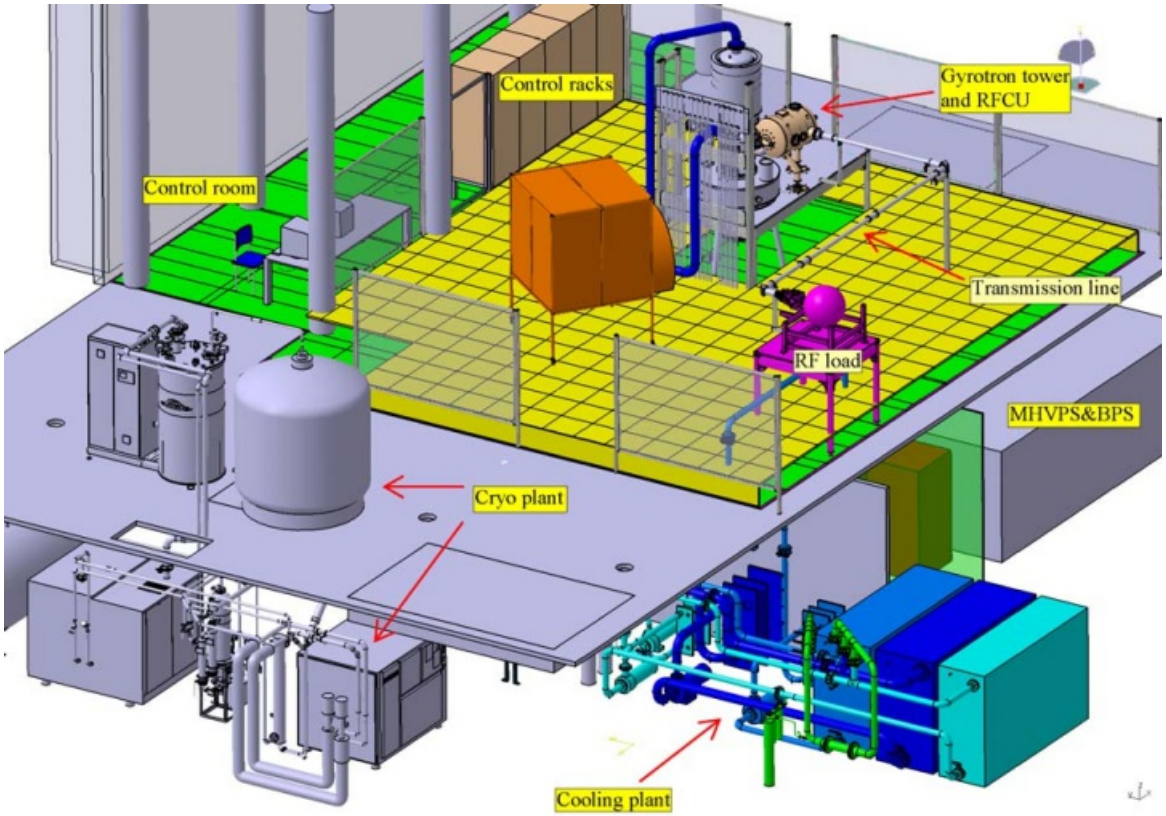
- 64 channels x 128kS/s continuous operation
- 24 bit resolution.
- High quality differential analog front-end
- New technology sigma delta converters, with excellent DC performance characteristic.
- 56kHz Bandwidth, brick wall filtering
- Compact PCI. standalone and system slot card
- Ethernet Transient Recorder, 1GB memory.
- Gigabit Ethernet
- Runs Linux. EPICS IOC included.

Application:

- Power supply monitoring



Gyrotron Test System Physical



2005: Original Data Acquisition System Requirement

400 Channels

Continuous Monitoring at 10Hz

Test Shot Duration : 3600s

Streaming Data 1kHz

Fault Transients - 250kHz, 10MHz

Preprogrammed Transients - 250kHz

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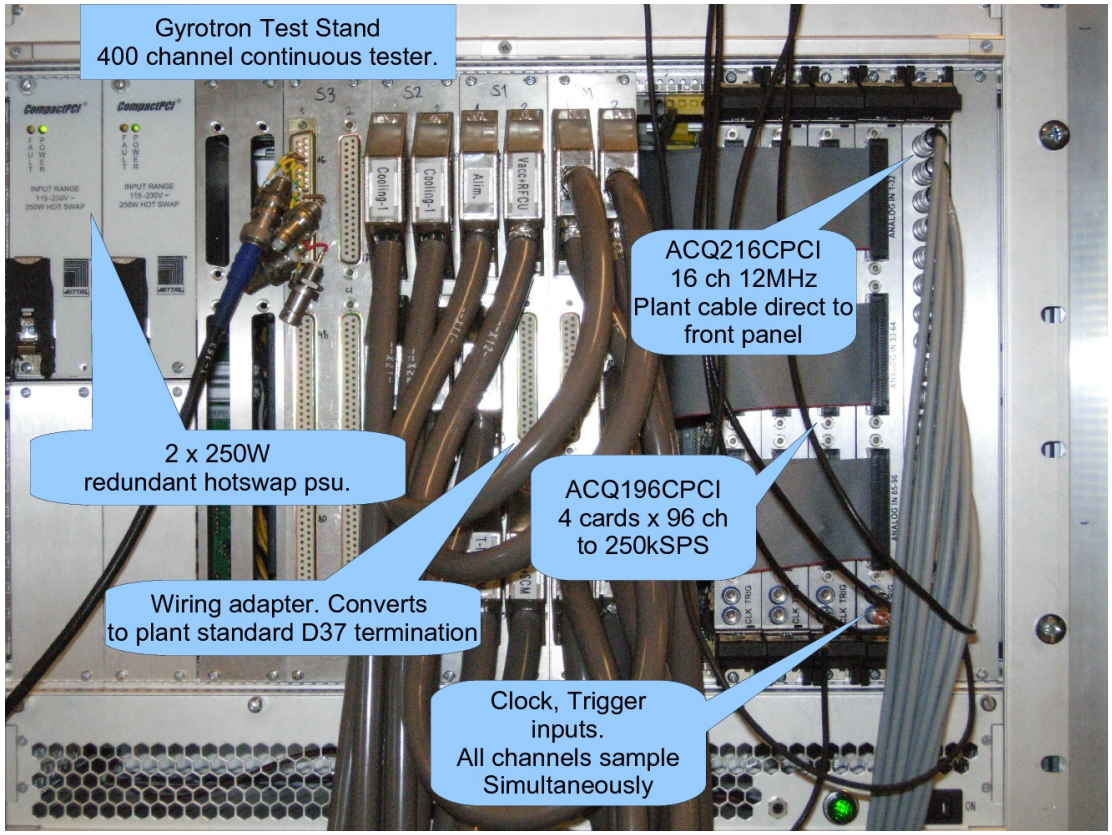


EPICS

- Control System with Data Archive Capability
- System is defined by DB Records
- Focus on live PV's published and subscribed on Network

MDSplus

- Data Archive System with Initial Value Setting.
- Data is stored in a tree after the shot.
  The tree defines the entire experiment
  One file per tree per shot
- Data is retrieved from a Tree, a fixed archive.
- Powerful Expression Language : everything is an expression.
- Data items may be unlimited length - 1M samples typical
- Most installations are shot-based... but
  ** NEW ** Long Pulse extensions are aimed at continuous operation
- EPICS to MDSplus bridge

2011: Pulsed Mode Operation

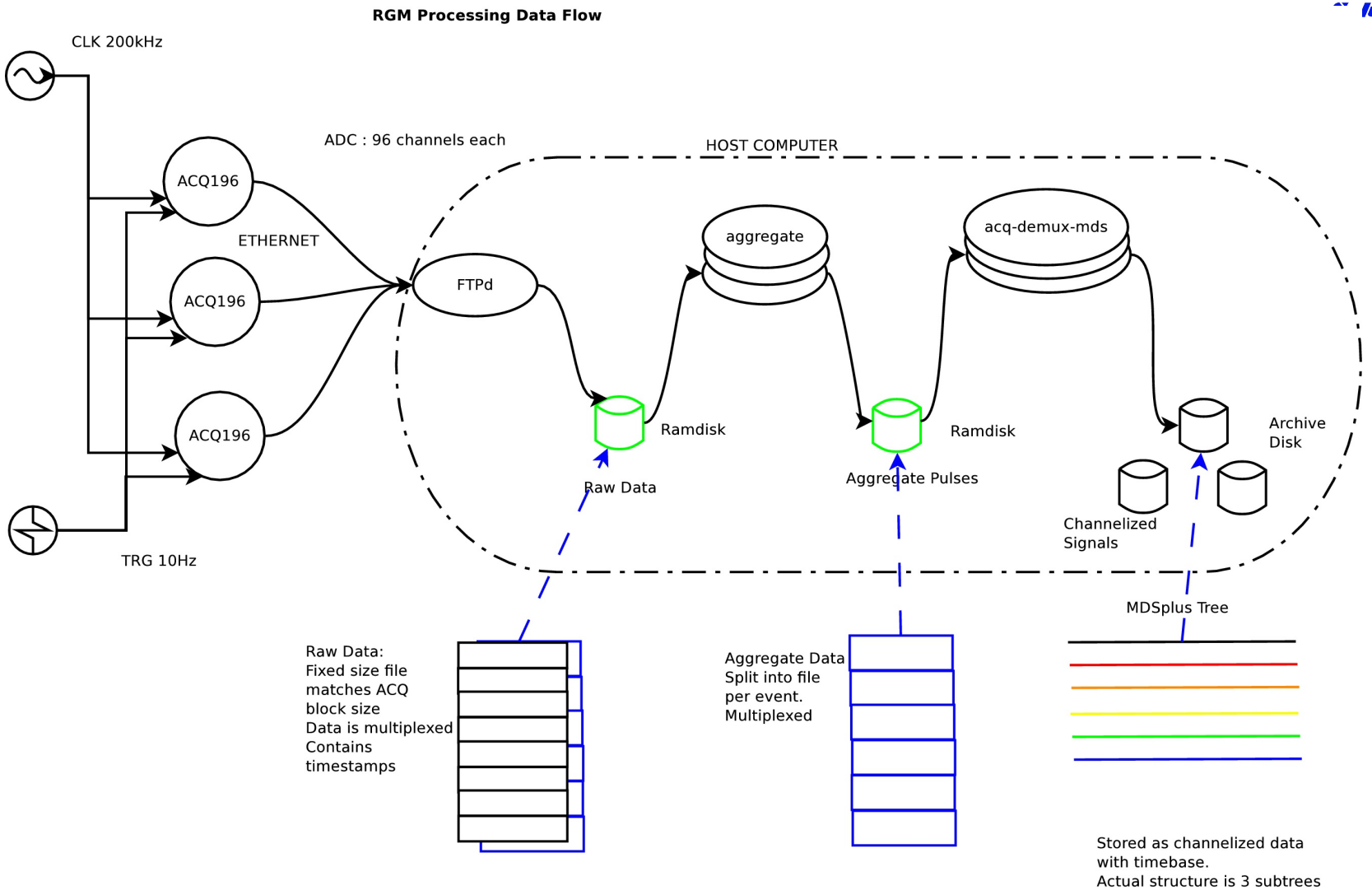
Requirements

- Gyrotron is pulsed at 1..10 Hz
- Each pulse variable duration 10..100 msec
- Sample 288 channels at 250kHz.
- Use the same hardware

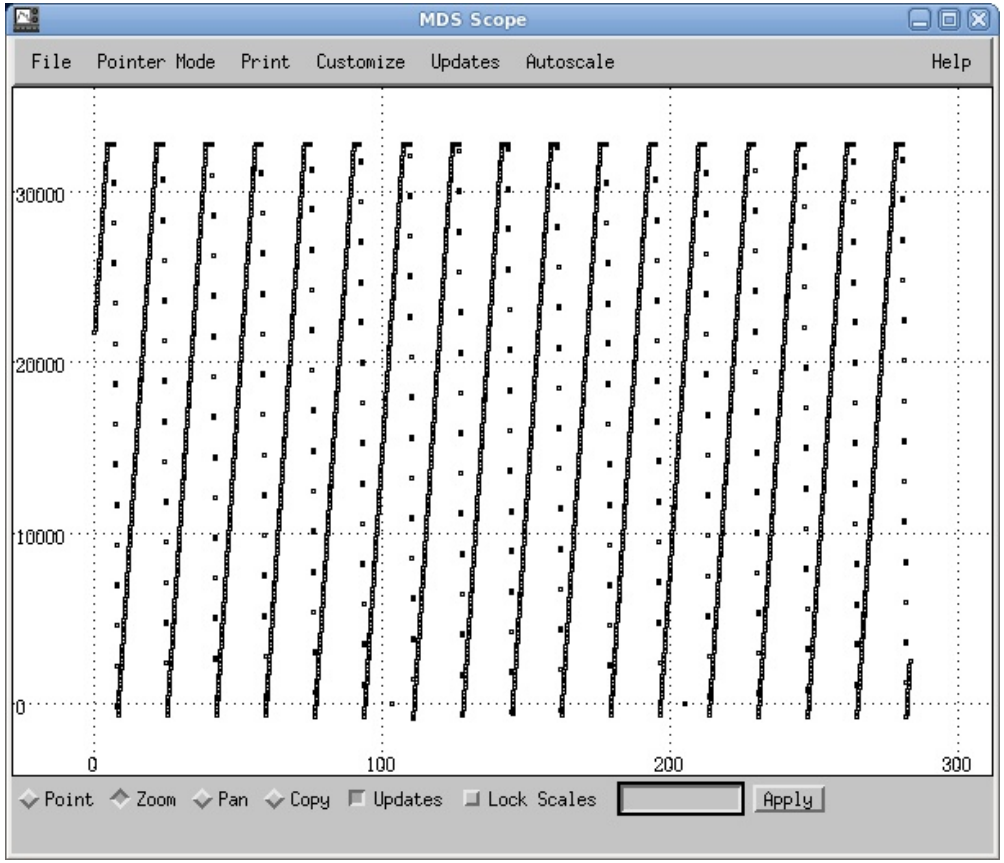
Design Changes:

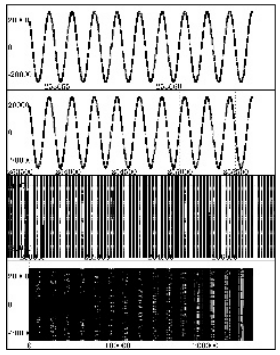
- New Firmware: supports Repeating Gate Mode
  - "Target Push" mode on Ethernet
- New method to access data archive system

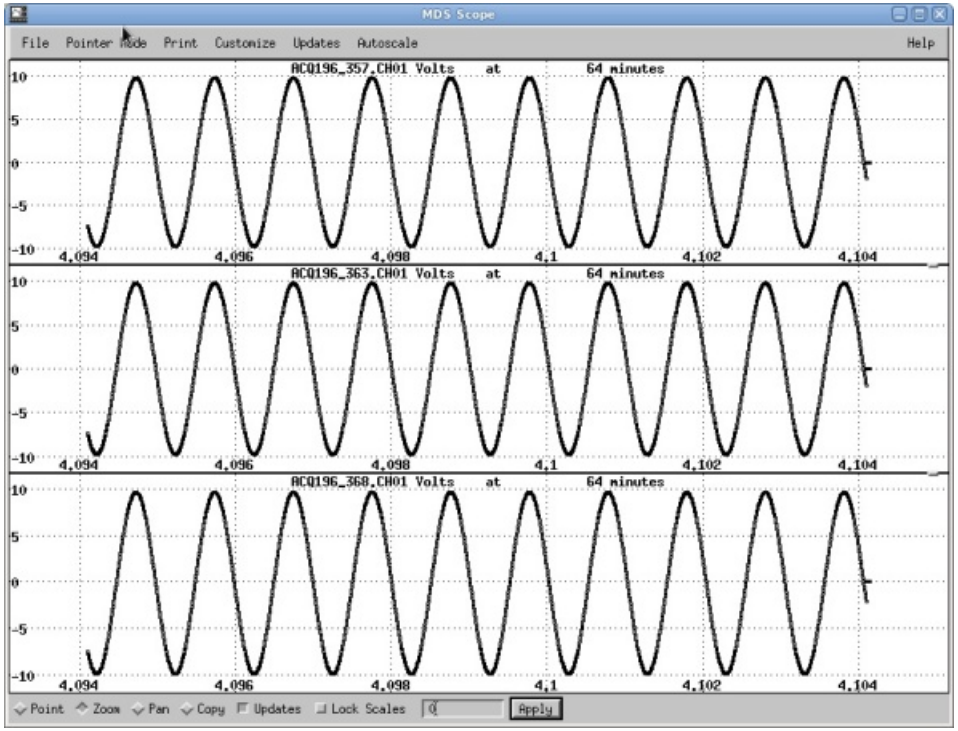
Pulsed Mode Streaming Architecture



Display timebase with 8 decades of zoom

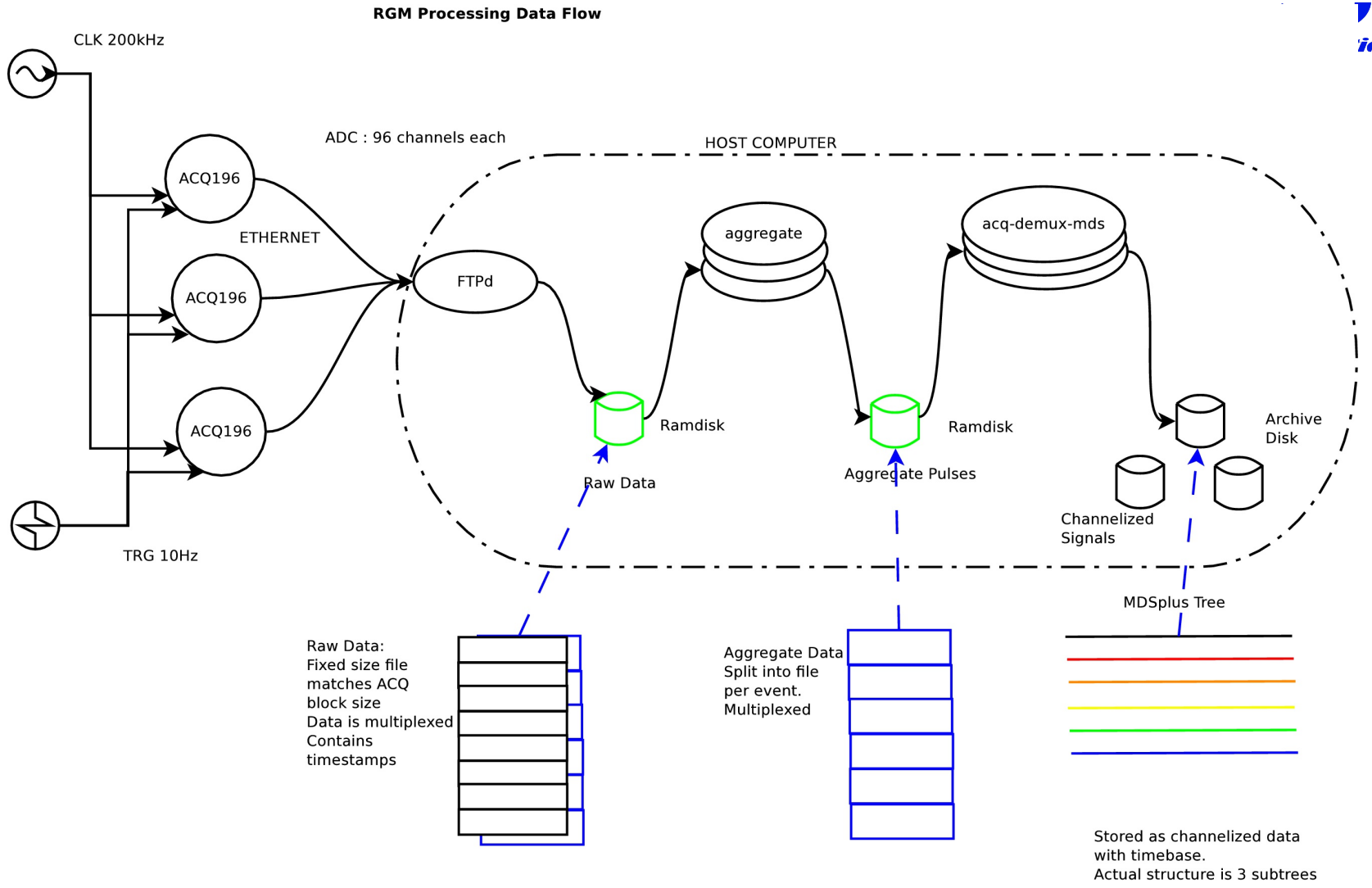




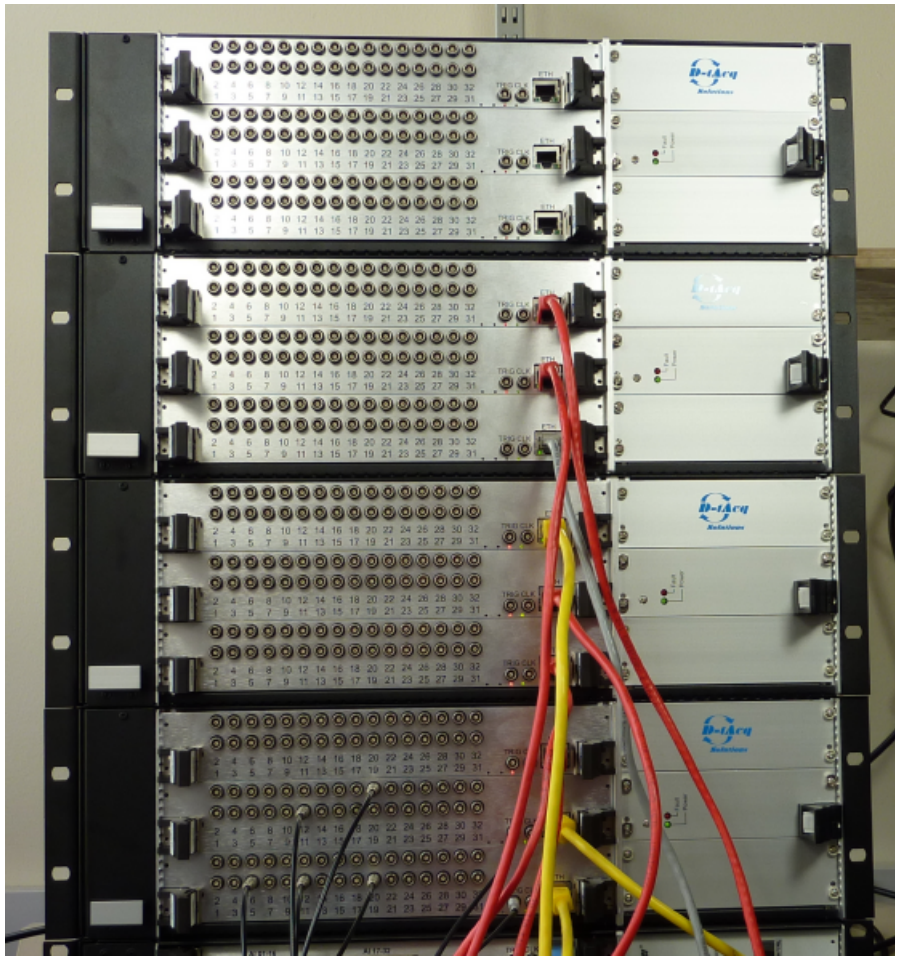


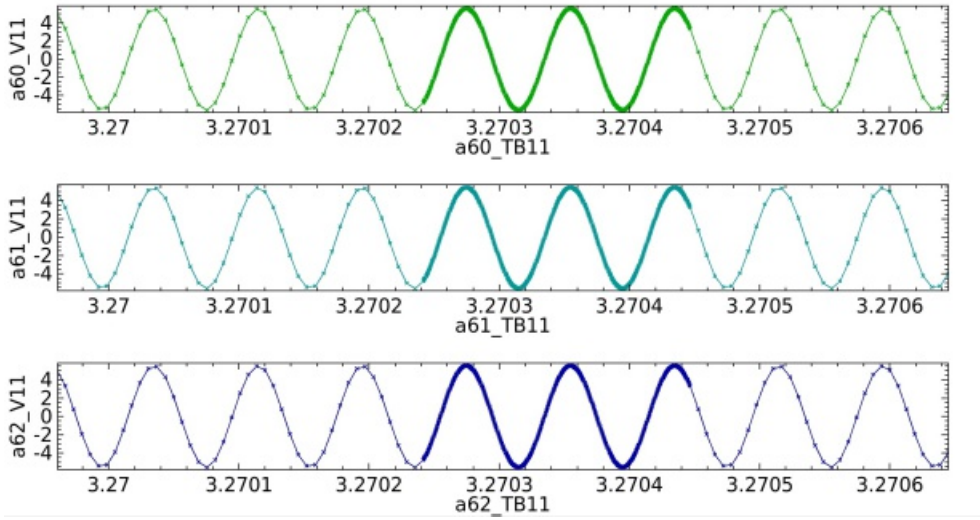
- Pulsed Operation
- 10Hz pulse, 200kHz sampling, 10ms bursts

Pulsed Mode Streaming Architecture: Performance Limit



Dealing With Higher Data Rates



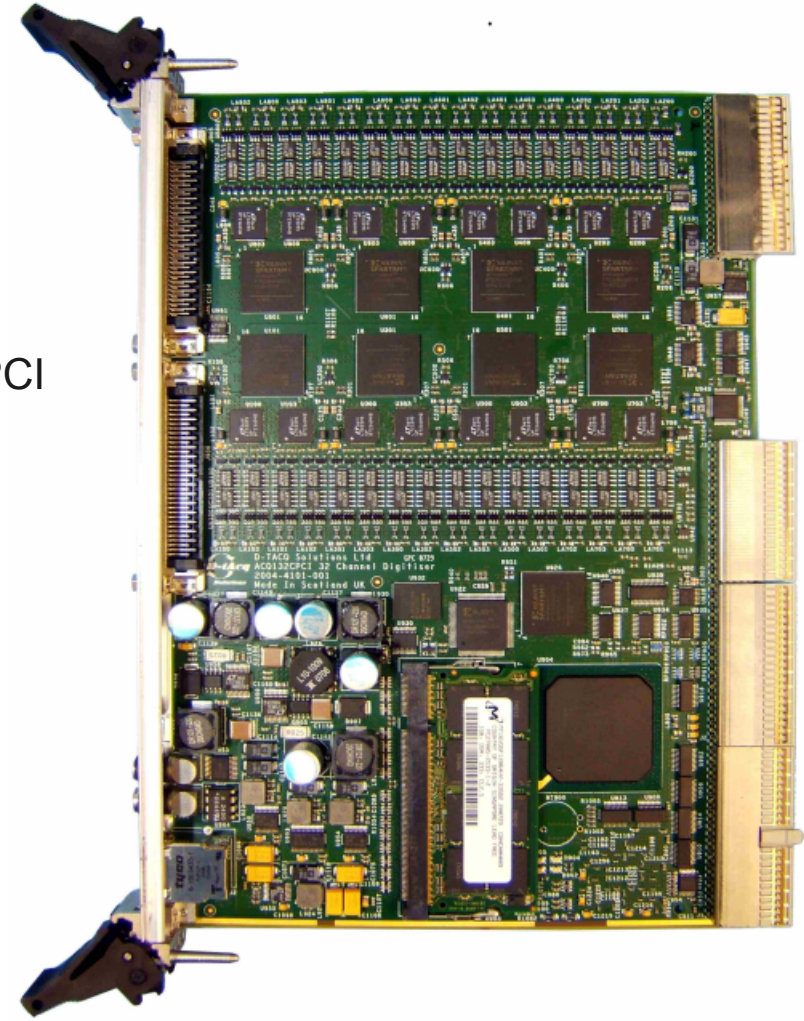


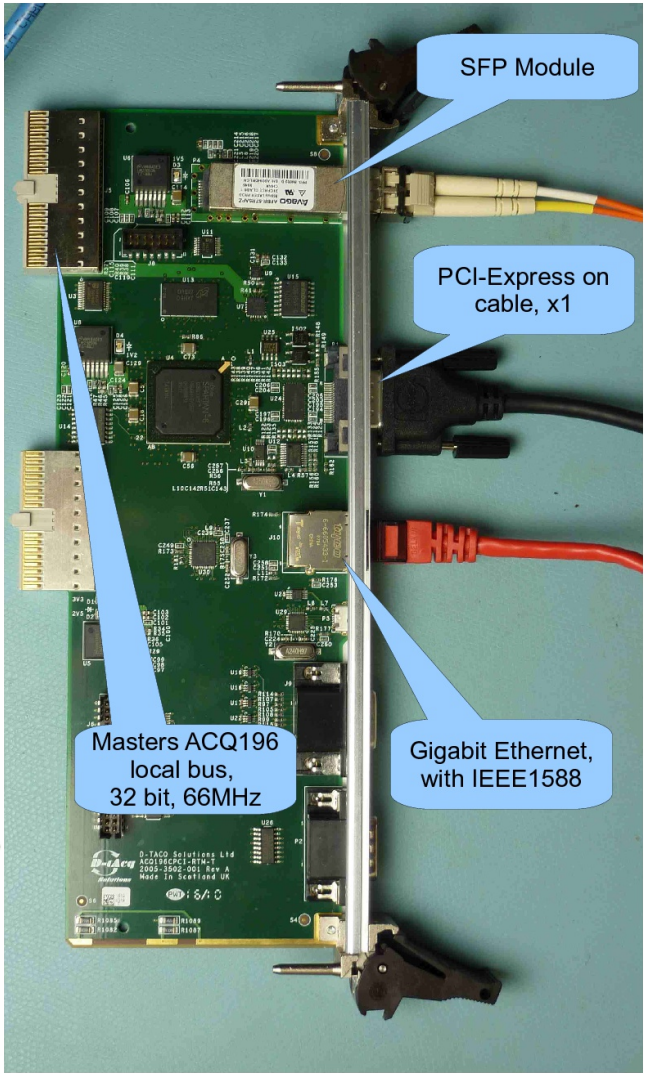
System based on ACQ132CPCI:
12 x 32 ch x 2 MSPS

Application:
Radio Imaging Diagnostic.

Stream Full Rate Data : PCI-Express

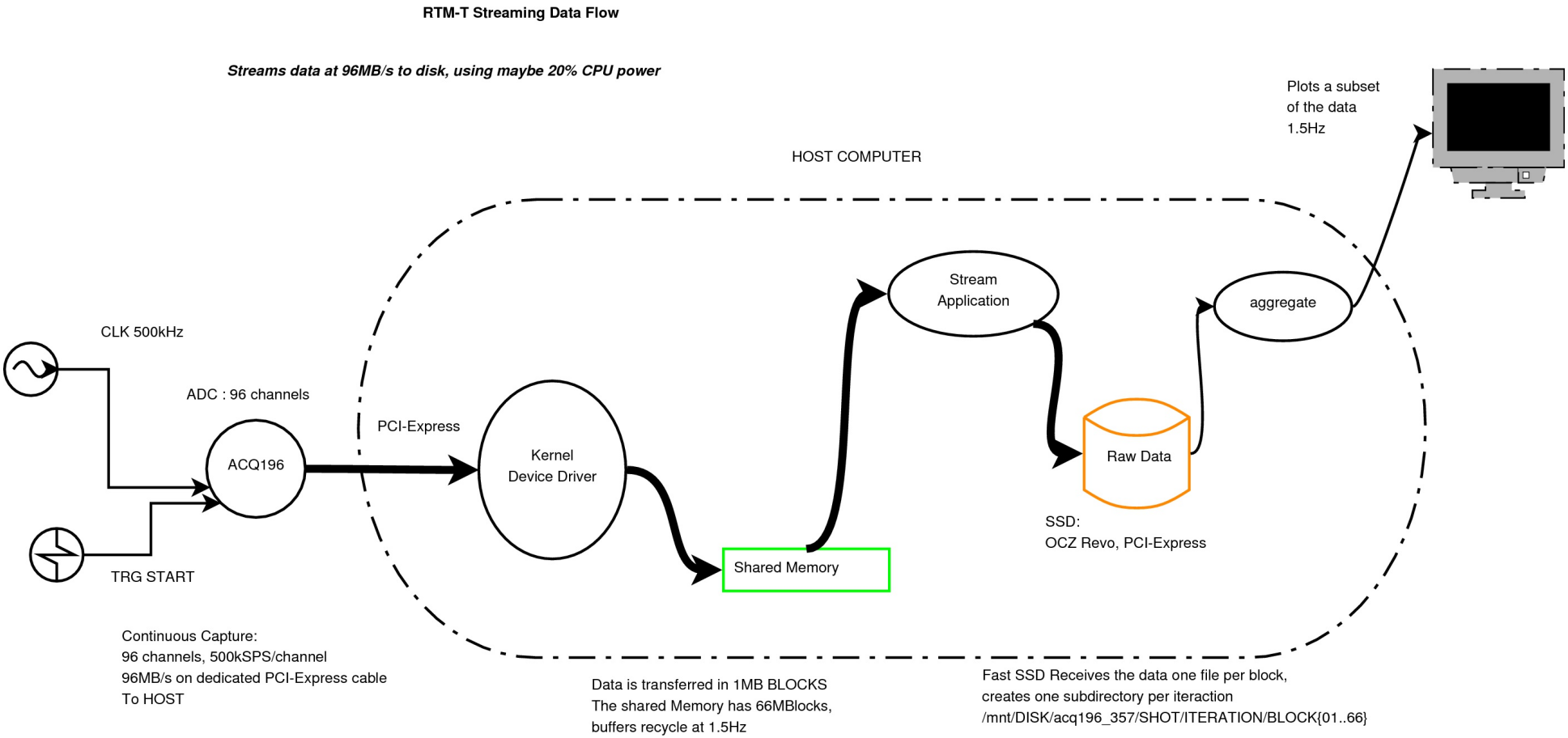
ACQ132CPCI





RTM-T

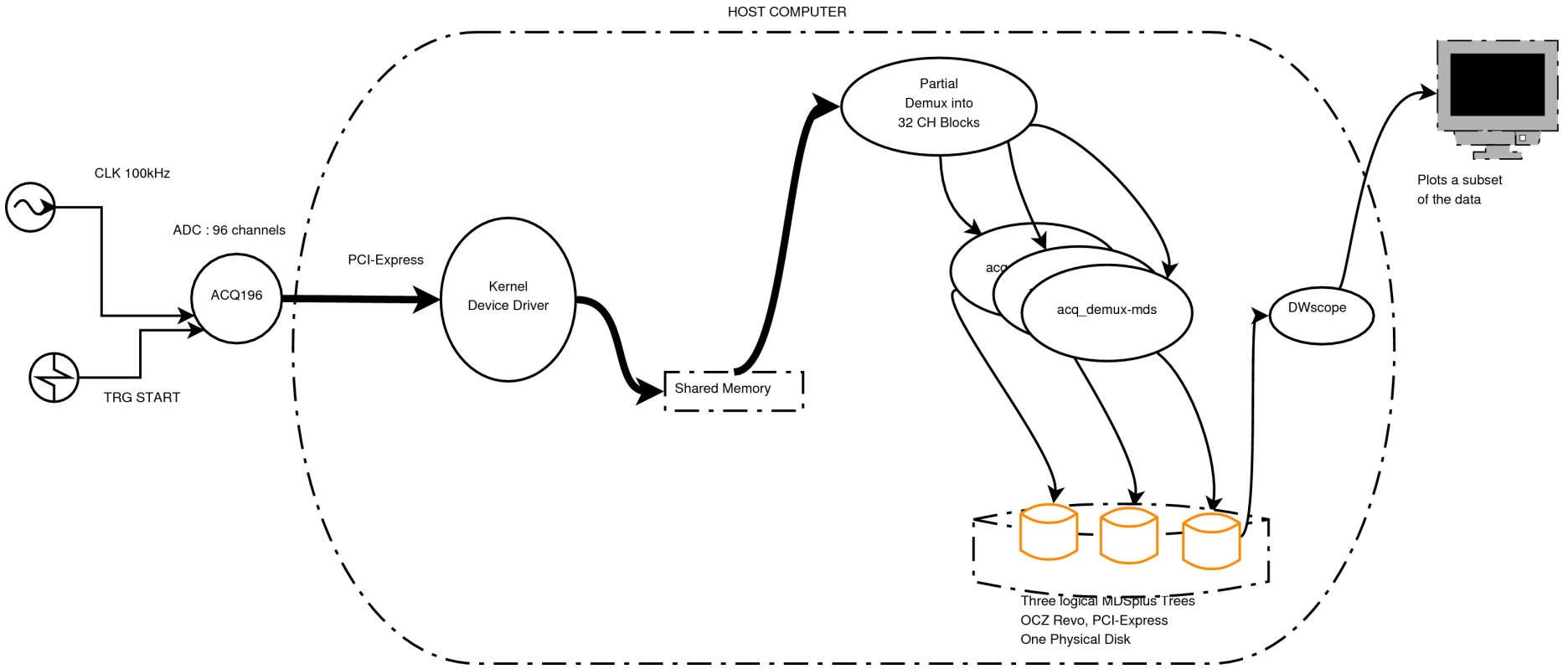
Full Rate Streaming To Disk



Full Rate Streaming to Archive

RTM-T Streaming Data Flow

ACQ196, 100kHz -> MDSplus is feasible, uses 3 trees and 4 concurrent processes



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Conclusion

• At moderate data rates, Ethernet to disk archive, is a good match with a multicore cpu

• Think carefully before acquiring ALL the data - Repeating Gate, Dual Rate are good strategies to reduce the data set size.

• Modern gigabit links make it easy to stream high rate data. Fast SSD's make it easy to store. But archiving in real time is still hard. Existing archiver implementation may be too inefficient : can we make it store references instead?

• Is there a better way ?

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