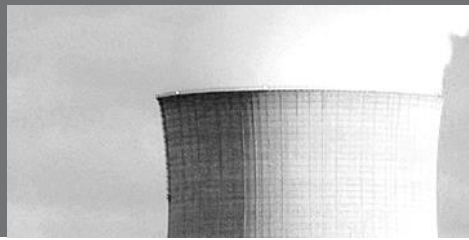
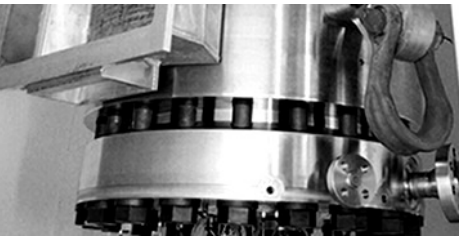
Modern High Speed FTI Systems utilizing Recorders & Switches





Goal of this Paper

- **Discuss Trends in Flight Test Instrumentation**
- **How these Trends can have an effect on the system design of a FTI system**
- **How does one design the architecture for an FTI System**
  - Recorded Data
  - Transmitted Data
- **What are the components to an FTI system**
  - Designing for Bulk & Selected data for Real Time Telemetry
- **How can we plan for the future**
- **What are some use cases for 10G for future planning**
- **Highlight some TMNS features**

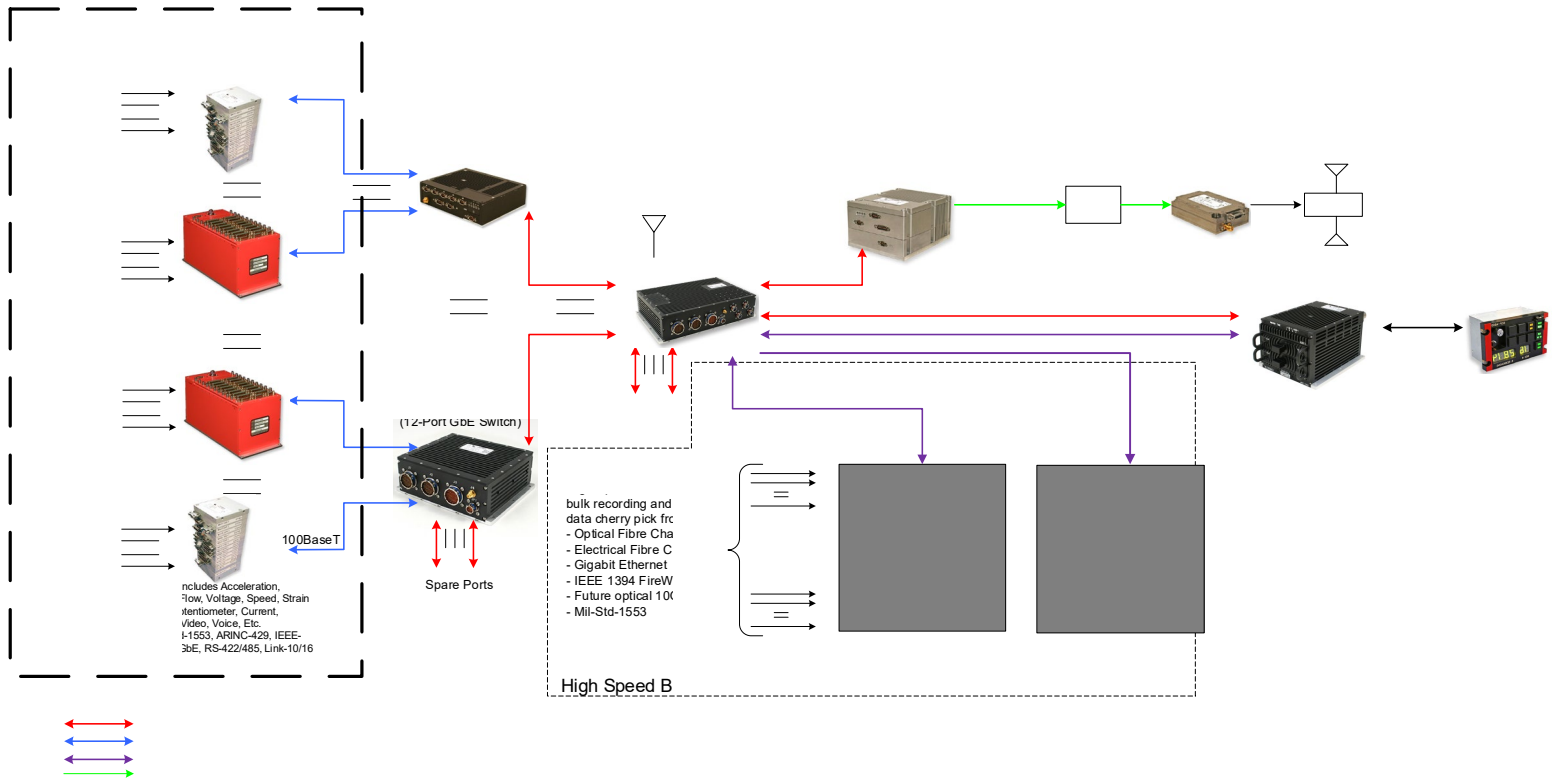
Recent Trends in FTI

- **Modernization is happening across FTI Systems due to increased data rate requirements**
  - Aggregation of Data from multiple sources
  - Upgrades from existing systems with low data rates to networks with 10Gbps or higher
  - Applications requiring data from sensor suites, vastly increasing data rate capture by magnitudes
- **How the data is being recorded is critical to most operations due to existing post processing software**
- **FTI needs for collection of bulk data, and selection for messages / data real time TM is growing**

How can we plan for these factors?

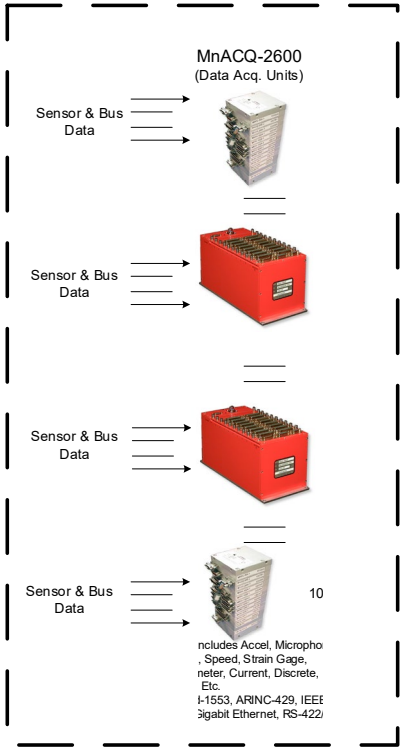
- **FTI Switches solve many issues that need to be addressed**
  - Data Aggregation to various data sinks on network
  - Time synchronization (IEEE 1588), system wide programming, and control (SNMP)
- **FTI Recorders drive recorded data formats**
  - Need to support what data processing needs (PCAP, DARv3, Chapter 10/11, TMNS)
- **FTI Architecture (DAQ's, Recorders, and Switches) designed as a single system**
  - Is there TM?
    - Bulk Bus Data + Selected?
    - Is all this data being sent to the recorder?
  - Chapter 4 or Chapter 7?

FTI Network Architecture



FTI Network Architecture -DAS

DATA ACQUISITION

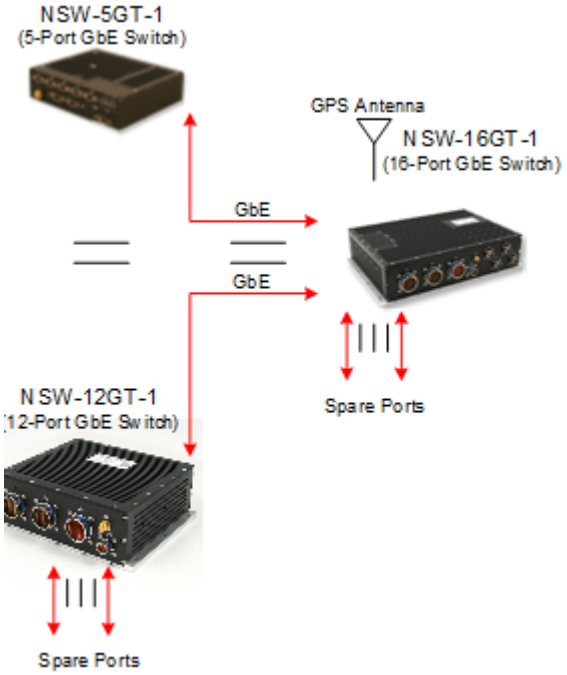


FUNCTIONS

- **Time Synchronization (1588 Slave)**
- **Analog Sources**
  - Accel's, Strain Gages, Temperature, Pressure, etc.
- **Digital Sources**
  - MIL STD 1553, IEEE 1394, ARINC 429, Ethernet
  - Bulk & Selected
- **Data Outputs (PCM or UDP Network Base)**
  - DARv3, TMNS, CH10 UTH

FTI Network Architecture – Switches

SWITCHES

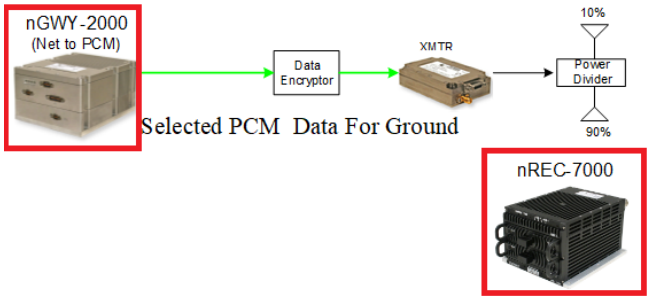


FUNCTIONS

- **Time Synchronization**
  - 1588 Master or Slave
- **Time Inputs – IRIG DC, GPS**
- **Health & Status from System**
  - SMNP MIB support
- **System Programming**
- **Data Aggregation**
- **Data Routing**

FTI Network Architecture – Data Sinks

SWITCHES

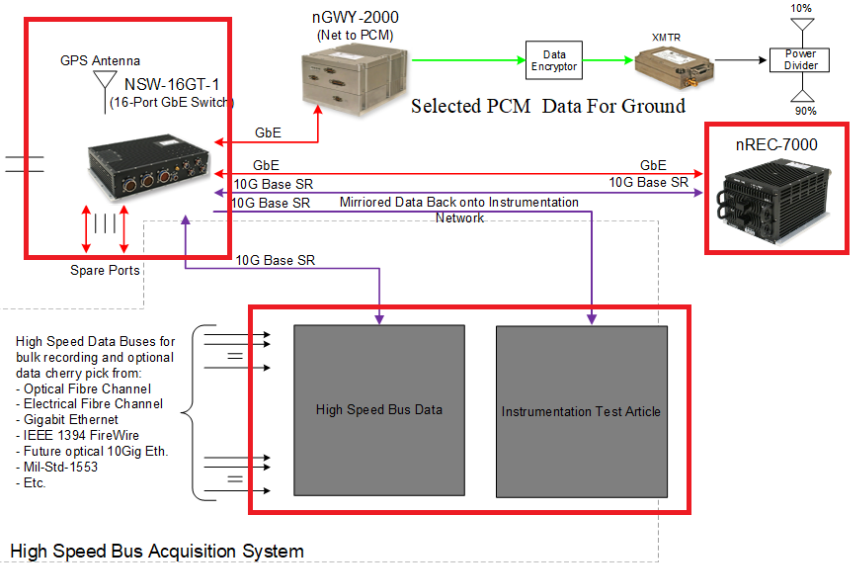


FUNCTIONS

- **Time Synchronization**
  - 1588 Master or Slave
- **Record All Data on Network**
  - Ch10, iNET, PCAP, DARv3
- **TMNS Compatible Recorders – PCM Back Fill**
- **Ability to send safety of flight data to ground**
- **Ability to potentially send data back onto network**
- **Encrypted Data for TM & Record**

FTI Network Architecture – Distributed System 10G Modernization

SWITCHES



FUNCTIONS – 10G EQUIPMENT

- **nREC-7000 (10G) Recorder**
  - Provides all previous requirements of a Recorder
  - Provides ability to record 10G data on a different partition
- **NSW-16GT (10G) Switch**
  - Provides 4 10G SR Fiber Optical Interfaces to route, and manage high speed data

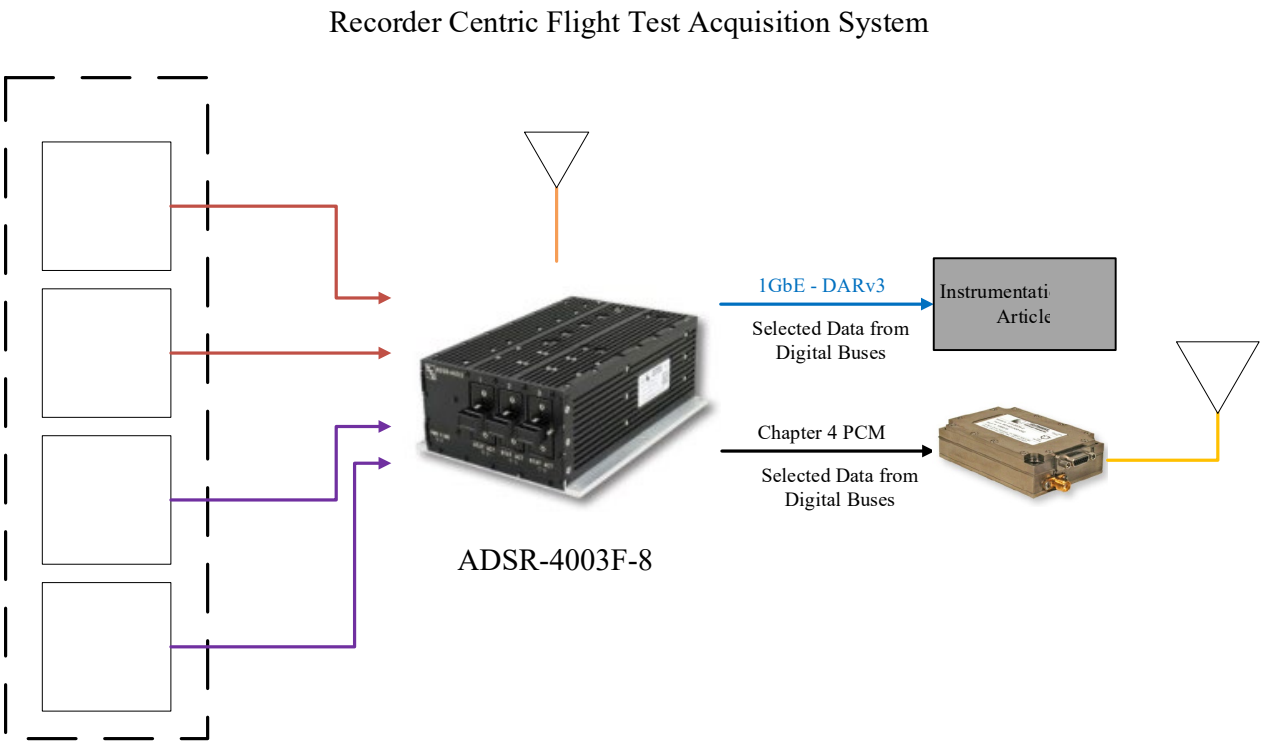
Distributed FTI System – Take-aways

FUNCTIONS

- DAU's Collect Data
- DAU's send data to switches
- Switches manage network, and send data to data sink's
- Network Gateway provides selected PCM data for TM to ground
- Recorder Bulk Records Data as necessary
- Addition of 10G to existing network system can be seamless

FTI Network Architecture – Recorder Centric FTI System

RECORDER CENTRIC SYSTEM



Recorder Centric FTI System– Take-aways

FUNCTIONS

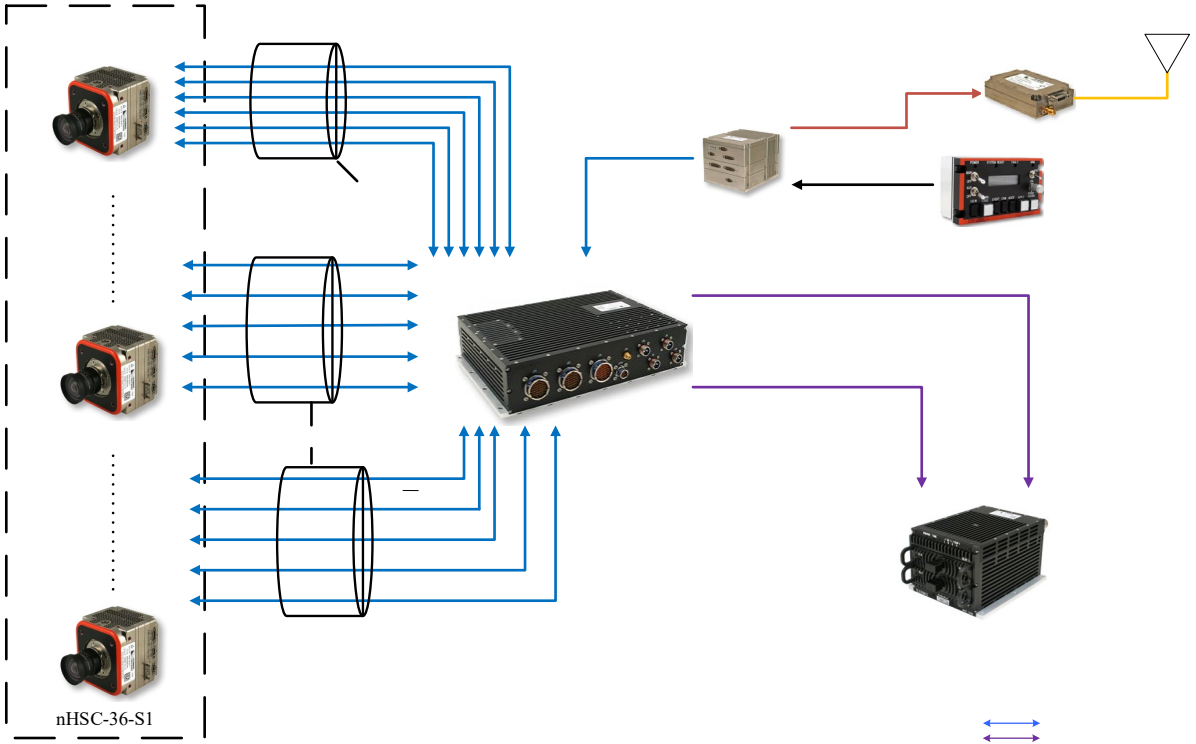
- **Similar needs as a typical FTI System**
  - Interfaces to Data Source
  - Timing Requirements
  - Bulk & Selected Data Capture
  - Ideal for targeted applications
- **Requirements for TM**
  - Similar ‘Network Gateway’ functionality to provides selected PCM data for TM to ground
- **CW has been able to leverage a lot of COTS equipment to make these compact recorder acquisition based solutions**

Recorder Centric FTI System – Currently Developed or Planned

	ADSR-4003F-1	ADSR-4003F-2	ADSR-4003F-3	ADSR-4003F-5	ADSR-4003F-6P	ADSR-4003F-7	ADSR-4003F-8	ADSR-4003F-10
ADSR Base	1*	1*	1*	1*	1	1	1	1
1 Channel GPS & PCM Output					1	1	1	1
2 Channel IEEE 1394 Card					2		2	
2 Channel 10G Base - SR							1	
4 Channel MIL-STD 1553 Card						2		3
1 Channel HD-SDI Input		4						
1 Channel DVI/ HDMI Input			4					
2 Channel 1GbE Input				1				

FTI Network Architecture – High Speed Camera System with 10G Improvements

HIGH SPEED CAMERA SYSTEM



Recorder Centric FTI System– Take-aways

FUNCTIONS

- **Similar needs as a typical FTI System**
  - Interfaces to Data Source
  - Timing Requirements
- **Requirements for TM**
  - Similar ‘Network Gateway’ functionality to provides selected RS-170 data for TM to ground
- **10G Addition vastly improves the speed at which the cameras can be ready for the next event**

Wrap Up

- Switches & Recorders are vital to the design of a FTI System
- The ability to provision for the future allows 10GbE to easily integrate into existing systems

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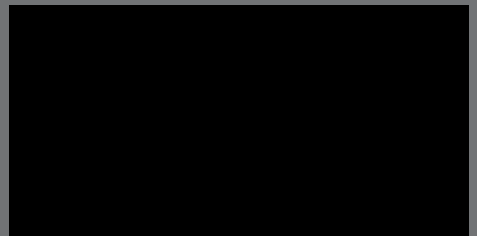

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