



The AMC13 Project

*E. Hazen - Boston University
for the CMS Collaboration*

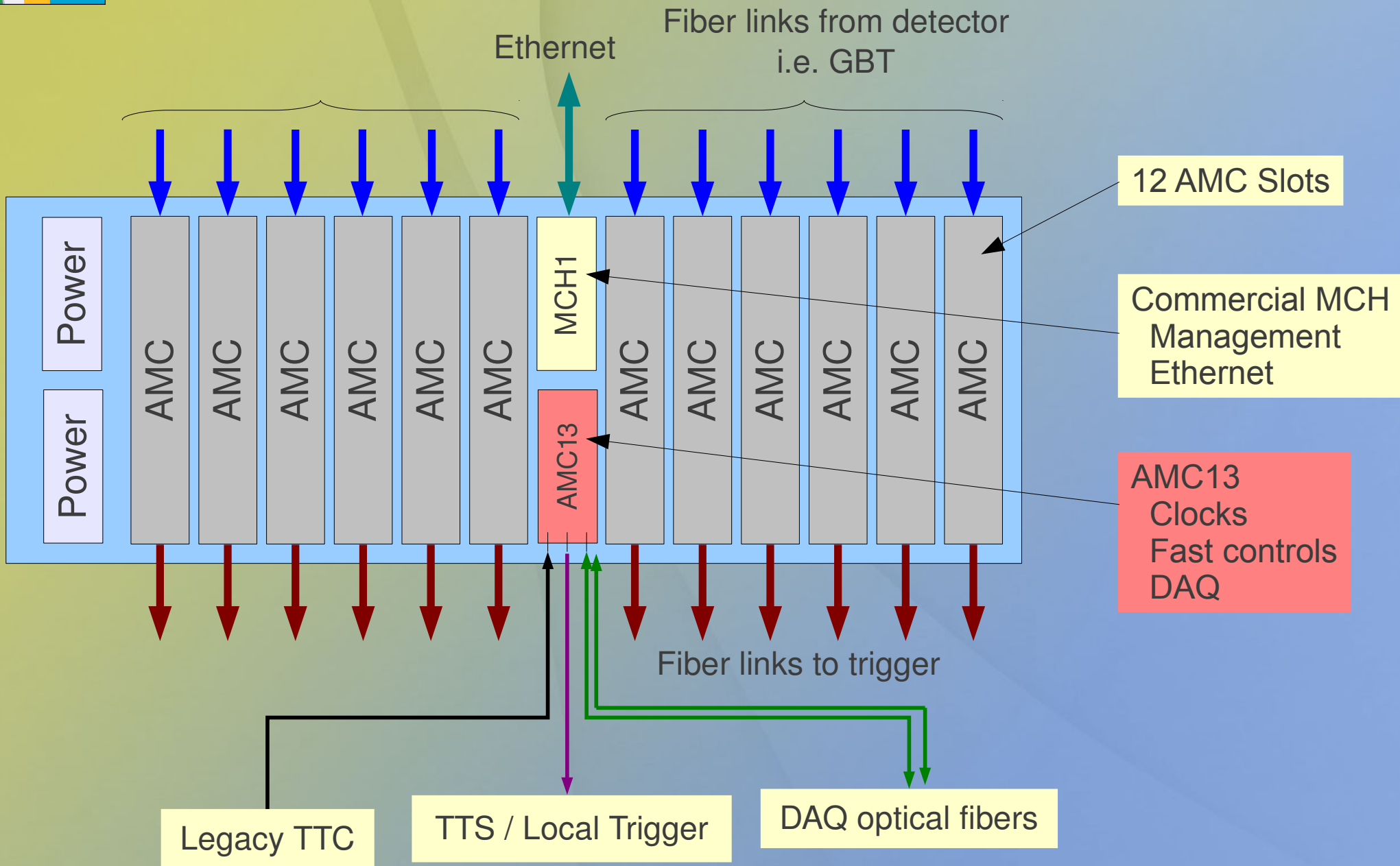


What is AMC13?

- It is *not* an MCH! It is a 13th AMC in MCH-2 slot (as permitted by MicroTCA standard)
- It distributes LHC clock / timing / controls to AMCs
- It collects DAQ data from AMCs
- It provides standard interface to CMS subdetectors:
 - CMS DAQ via optical fibers (currently 2 at $\sim 5\text{Gb/s}$)
 - TTC via 1300nm fiber @ 160Mb/sec biphasic mark code
 - Future TTC upgrade may be supported via spare SFP site
 - TTS via 1300nm fiber with protocol *t.b.d.*
- It is expected to evolve somewhat to comply with evolving new standards from central services

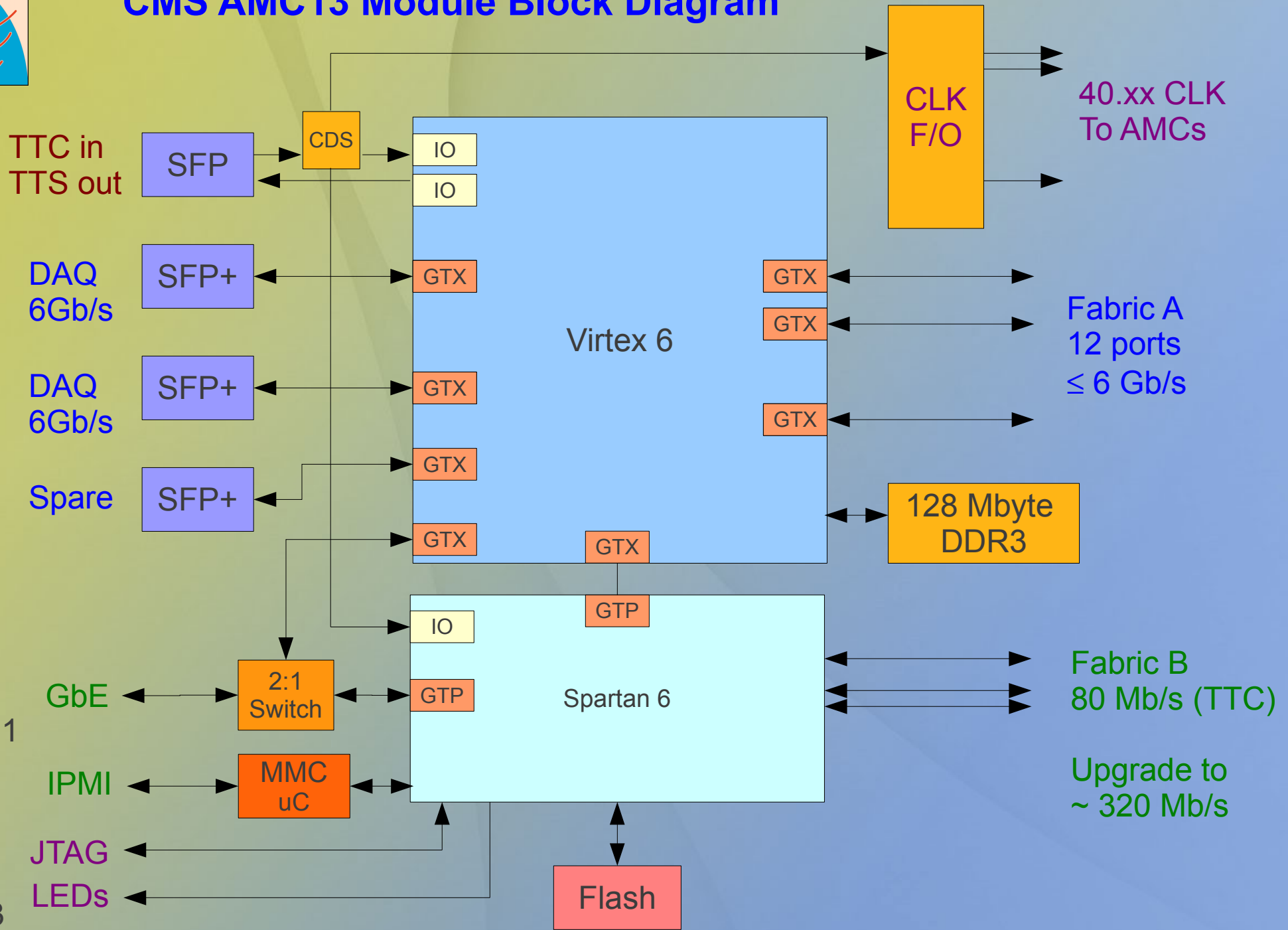


CMS uTCA Readout Crate (i.e. HCAL)



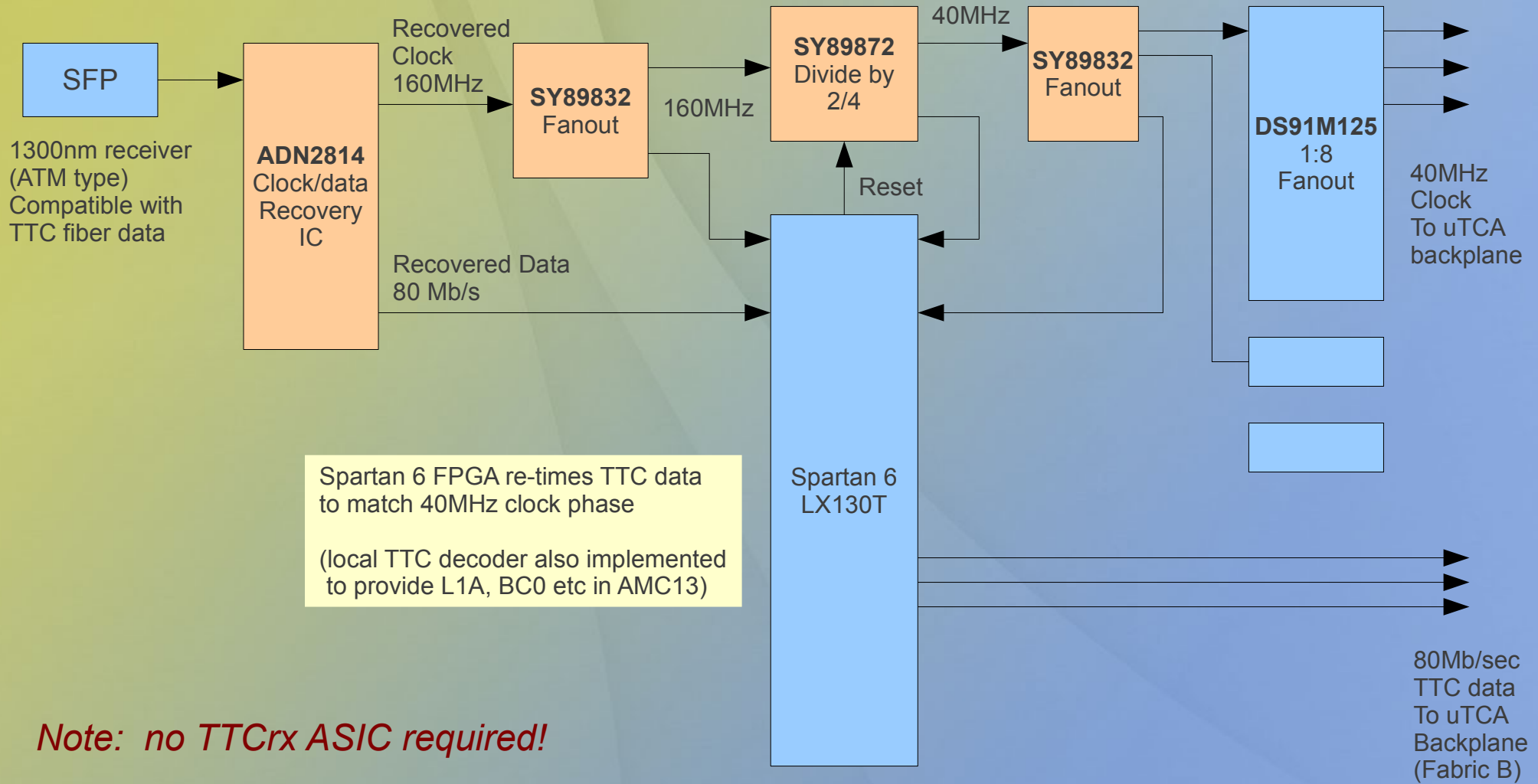


CMS AMC13 Module Block Diagram



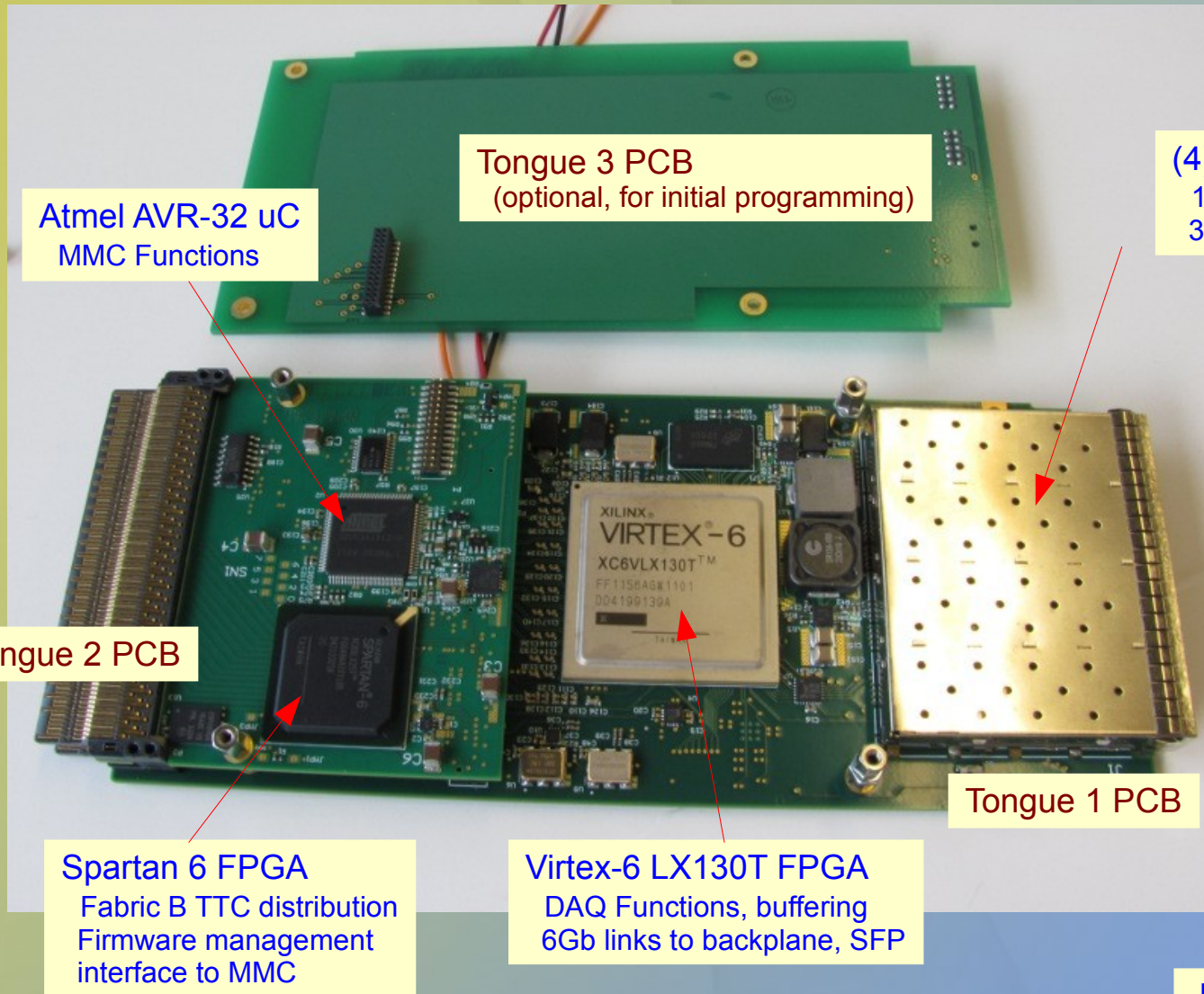


TTC / Clocks

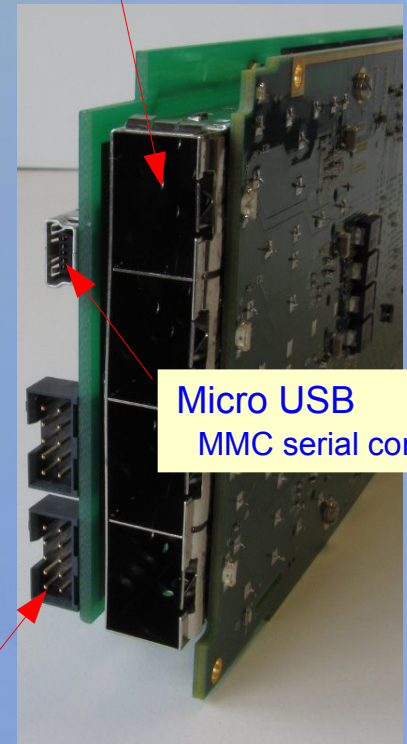


Note: no TTCrx ASIC required!

AMC13 Hardware

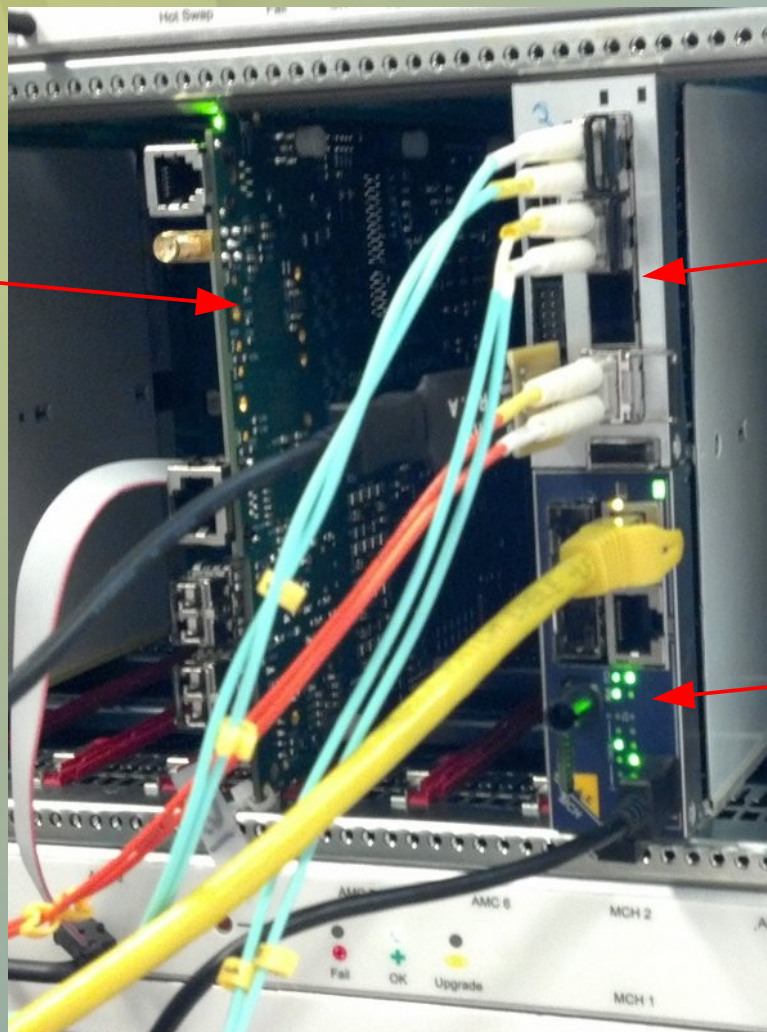


(4) SFP+ Sites
1 for TTC (160Mb)
3 for DAQ/etc 6.2Gb



AMC13 in VT892 Crate

Custom AMC
(HCAL MiniCTR2)



AMC13
In MCH2 site

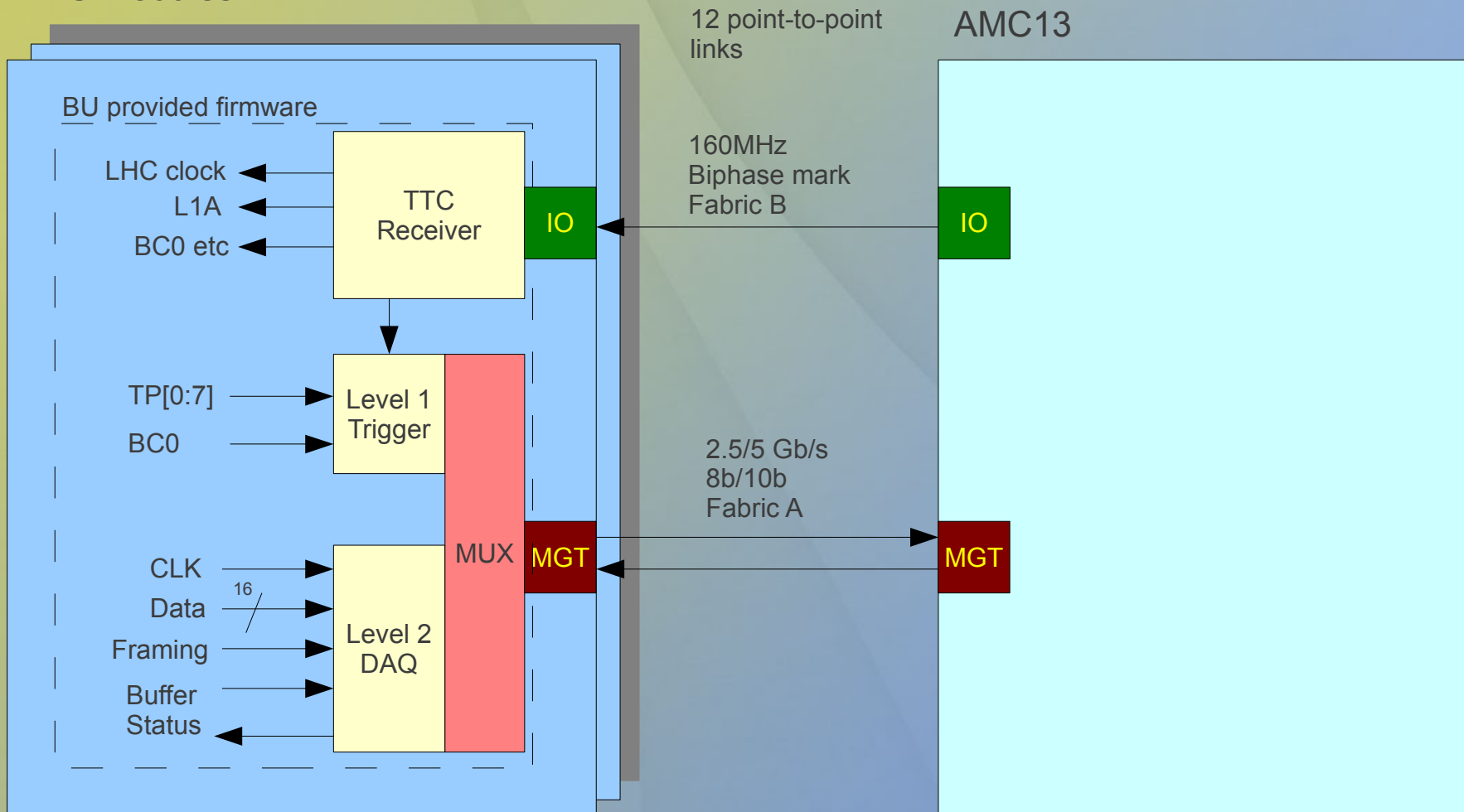
Commercial MCH
(NAT or Vadatech)



Backplane Links

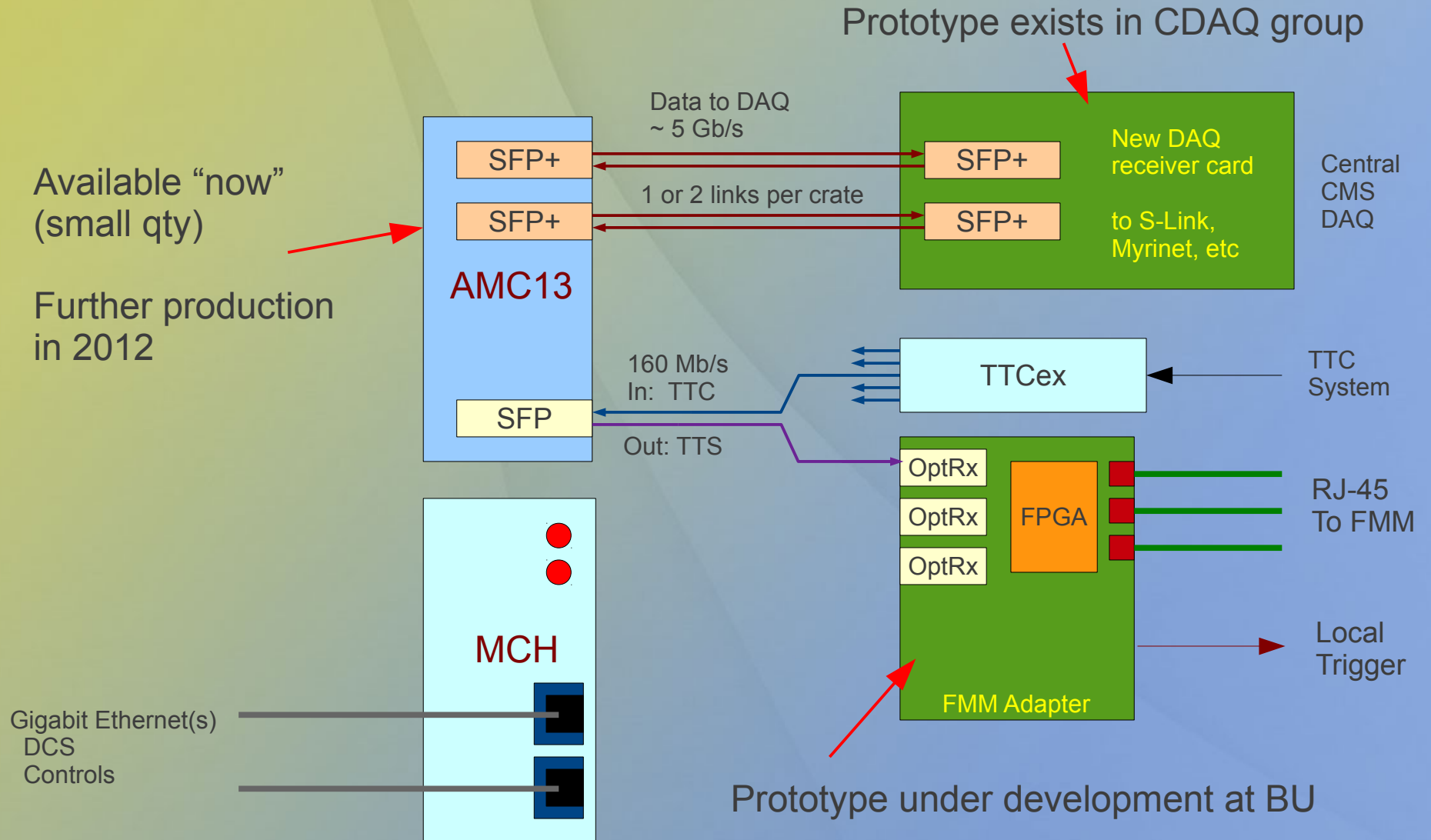
This is the configuration planned for HCAL, and the firmware will be provided as a reference design for other subdetectors.

AMC Modules



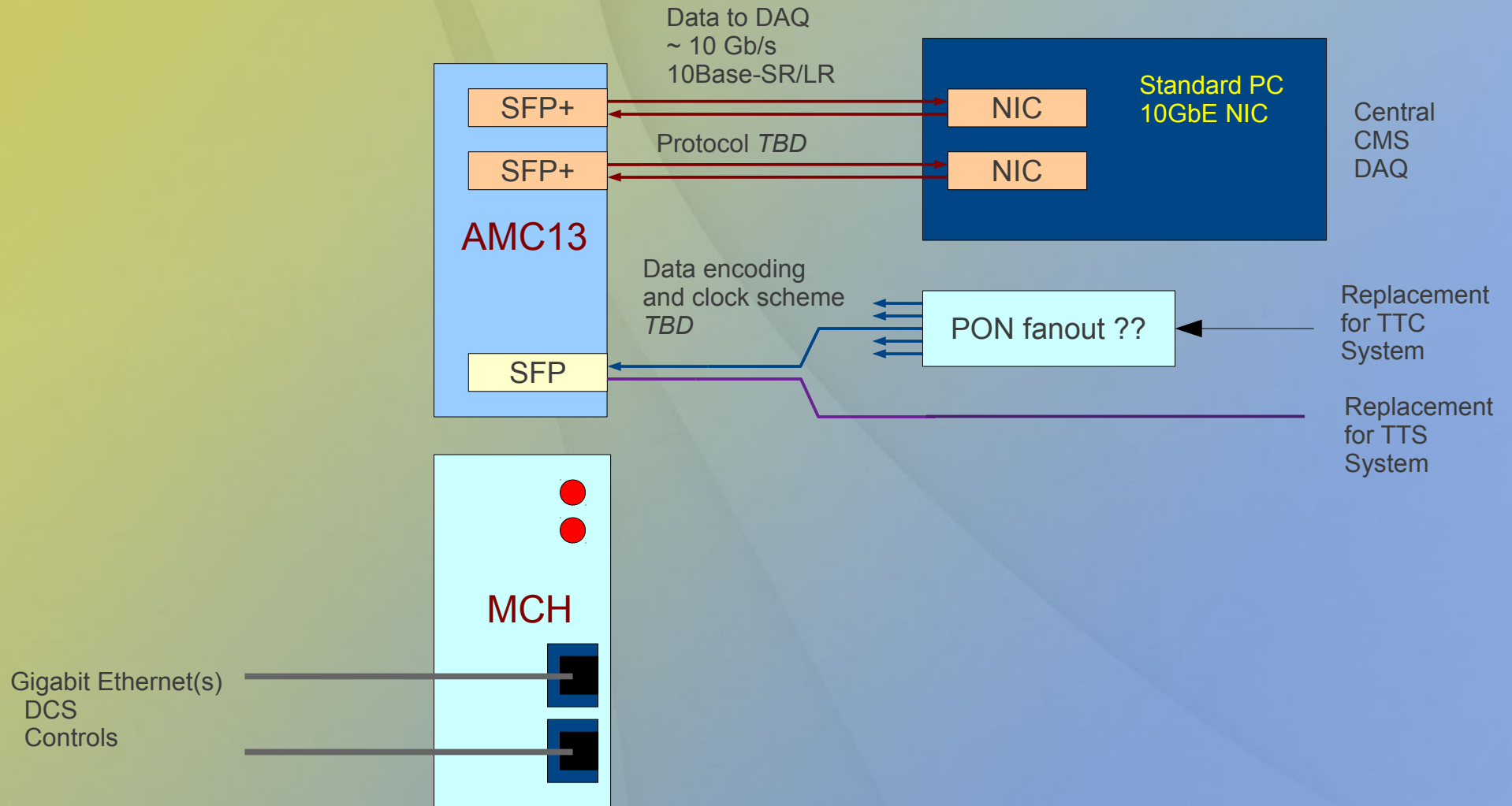


MicroTCA Interface to CMS (Interim)





MicroTCA Interface to CMS (Ultimate?)





Status and Schedule

- **12 boards assembled and tested**
Most distributed to users, 1-2 still available
- **Initial Firmware development:**
 - MMC (AMC standard plus useful extensions) by University of Wisconsin ✓
 - Ethernet interface with IPBus / MicroHAL by Minnesota, Bristol, others ✓
 - TTC / Clock distribution by Boston University ✓
 - Flash programming via GbE ✓
(with backup sector support)
 - **Prototype/demo DAQ for CMS HCAL (May 2012)**



Highlights for Potential Users

- Documentation at <http://www.amc13.info> including draft crate/protocol definition document
- Backplane ports use and protocol (under) specification
 - If AMC designs comply with specifications, interface to i.e. CMS central systems is handled by AMC13
- MCH tongues 3, 4 available for users, i.e. for crosspoint switch.
 - Current no standard for T2/T3 connection :(so, commercial T3/T4 cannot be used.



Backup / Review Slides



AMC13 Board Stack

- Base configuration has only tongues 1, 2
- Base board - With optics and HS links (Fabric A)
- Clocks board - distributes LHC clock and controls
- Mezzanine connector for T3 with I2C
 - T3 has JTAG and LEDs

T3 board

Provides JTAG / LEDs on front panel
Can be removed after initial programming

Crosspoint switch or other custom board
can be installed here (but see notes!)

T1 base board

MMC functions (Wisconsin firmware)
TTC optical rx
3x SFP+ cage
Cross-over GbE from MCH1
for controls and local DAQ

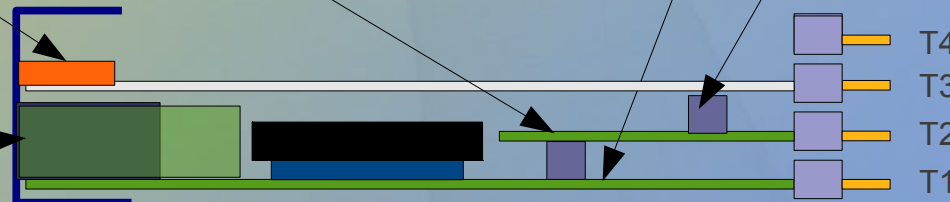
T2 Clocks board

Clock / controls fanout

Quad SFP+
Cage

Connector to T3 provides:

Power
JTAG (MMC and Xilinx)
Utility SPI
MMC serial console





uTCA Ports Use for CMS

Fabric	AMC Port	MCH	AMC13	Category	MCH Finger	CMS Use
A	0	Yes		Common Options	1	GbE
	1		Yes			DAQ
B	2	Yes			2	Spare
	3		Yes			Fast controls (TTC)
Clock	TCLKA	CLK1/2		Clocks		Spare
	FCLKA		CLK1/2			LHC Clock
D-G	4-7	Yes		Fat Pipes	3, 4	User
	8-11		Yes[2]			
H-K	12-15			Extended Fat Pipes		
	16-19					

Notes:

1. Port 1 (DAQ link) will be operated at a multiple of the 125 MHz GbE reference clock (2.5, 3.125, 5.0GB/s) in the AMC13 reference firmware. AMC designers are advised not to count on this... certain users may prefer to use the LHC clock as a reference for port 1.

2. "Fat pipes" fabrics D-G are routed to the T3/T4 connectors of the AMC13 but the standard AMC13 does not make any connection to these tongues. Users may implement their own boards. Contact me for details!



μTCA Dual-Star Backplane

Note: Interconnections can be customized by the backplane manufacturer inexpensively.

Bi-directional serial (up to 10Gb/sec) point-to-point links from each AMC to MCH (redundant links to each MCH)

Fabric A (1 link)
Gigabit Ethernet

Fabric B (1 link)
Spare

Fabric D-G
Spare

CLK1
Spare

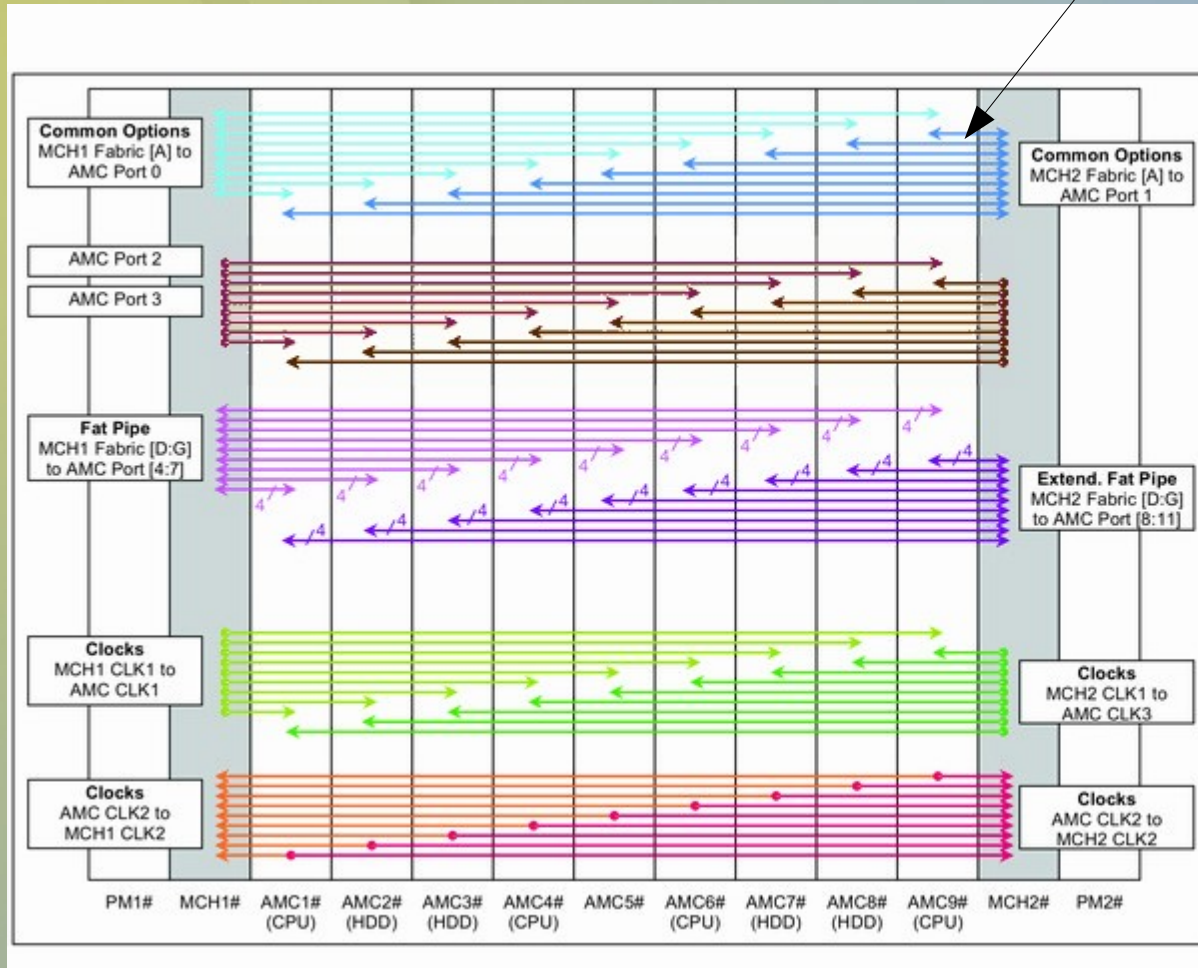
CMS Use

Fabric A (1 link)
DAQ @ 2-4 Gb/s

Fabric B (1 link)
LVDS TTC

Fabric D-G (4 links)
Spare

CLK1
MLVDS LHC clock



MCH 1
Commercial /Std

MCH 2 aka "AMC13"
Custom design for CMS



Clocking Issue

- AMC13 provides LHC clock (40.xxx MHz) on MicroTCA CLK1.
- “Redundant Clock” Vadatech backplane routes this to AMC CLK3 (FCLKA).
- Some users have proposed to use commercial AMC which *requires* a 100MHz PCIe clock on this pin.
- This is incompatible with AMC13 clock scheme



DAQ Interface Upgrade

- We've invented a simple fiber-based demonstraton protocol for DAQ for AMC13 hardware testing (and possible HCAL TB use). This protocol can use two fibers per AMC13 (two HCAL FEDs).
- Tested extensively at 5Gb/s in lab using two AMC13
- We are working with the CMS central DAQ group to develop interim and ultimate solutions for the DAQ link.