Electronics Platform Reference Design

EDR Controls Kickoff Meeting
August 20-22, 2007
Ray Larsen

Outline

1. Platform Basic Functional Requirements
2. Candidate Platform Detailed Requirements
3. R&D Work Packages
4. EDR Work Packages
5. Summary EDR WP Goals for 2010

1. Platform Basic Functional Requirements

- Modernized hardware-software platform to accommodate latest available instrumentation & controls core technologies
- Highly improved reliability/availability due to huge numbers in each subsystem and large numbers of systems in the ILC
- Broad industry support of core components for cost effectiveness

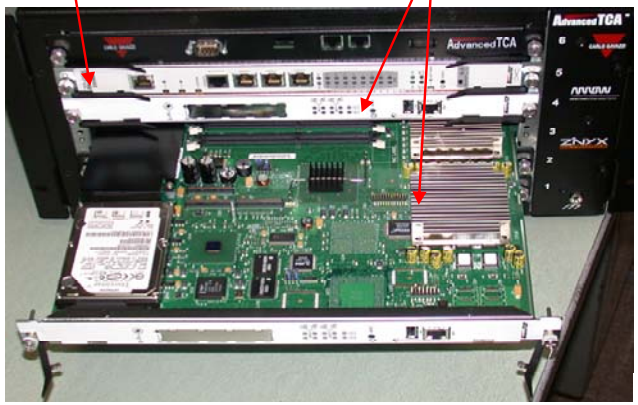
2. Candidate Platform Detailed Requirements

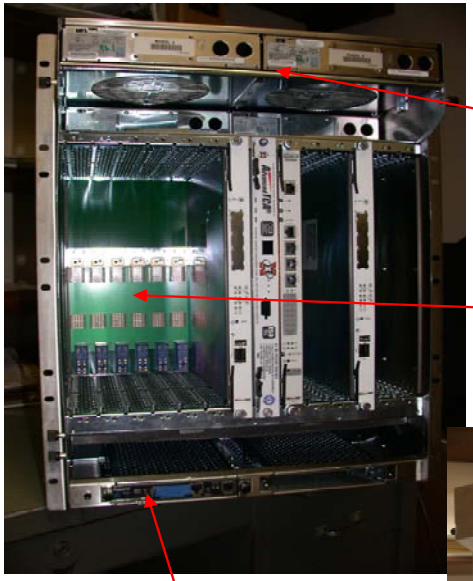
- Standard modular architecture at level of core control, communication nodes
- Options to accommodate wide range of standard Commercial Off The Shelf (COTS) modules as well as instrumentation modules
- Intelligent Platform Management to achieve up-time performance
- Highly improved diagnostics capabilities in all electronics subsystems
- Module hot-swap options to eliminate unnecessary downtime due to single component failures

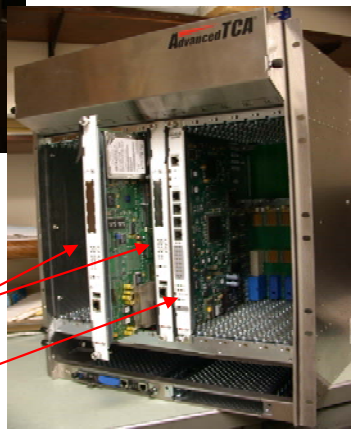
Candidate: ATCA

- Advanced Telecom Computing Architecture
  - *Unique open standard designed specifically for 0.99999 (5-9's) availability at crate level*
  - *Core components available from industry*
    - Crates with intelligent platform management of power, module type & ID, load shedding & re-routing
    - N+1 redundancy options for core controllers, communication, power, cooling fans
    - All serial multi-gigabit communications by wire for short distance or fiber for long distance
    - Controllers, switches and high performance processors
  - *Ideal for core of controls system*

ATCA Core Products



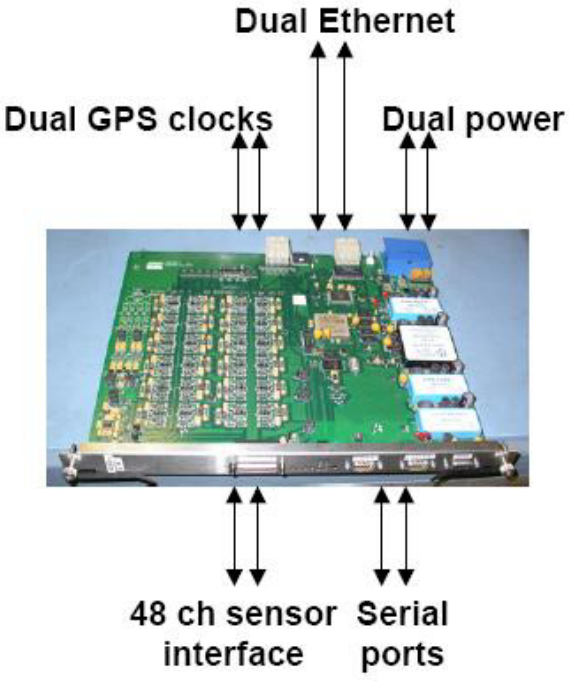




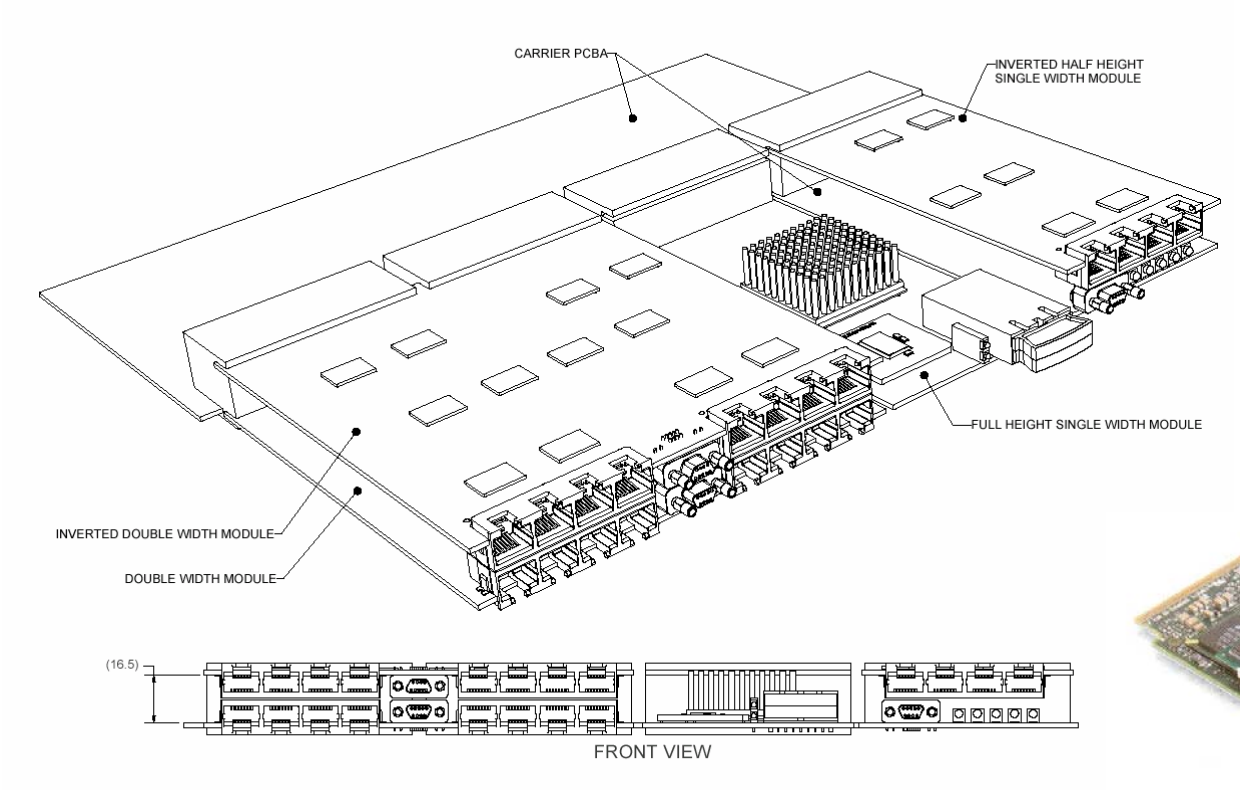
Adapting Instrumentation to ATCA

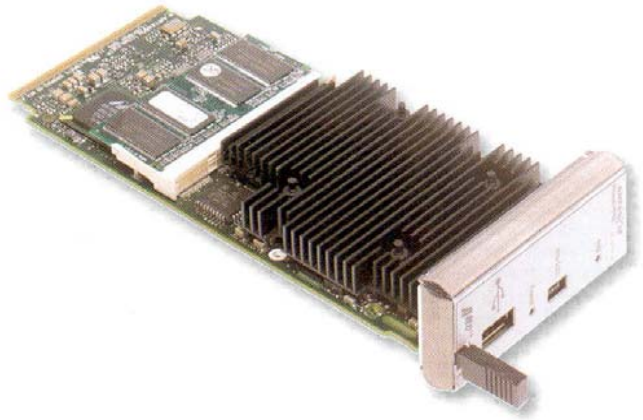
- Instrument modules very limited availability on ATCA base platform
  - *ADC/DAC, digital I/O, fast and slow control, RF receivers & processors (LLRF, BPM)*
- Solutions: Carriers, Daughter Cards, Adapters
  1. *ATCA Carrier card designed to handle sub-modules (Advanced Mezzanine Card, AMC)*
  - *Up to 8 sub-modules per card*
  - *Single high, Intermediate and Double high*
  - *Same carrier card design can be tailored to many uses*

Example:
Commercial 48 Ch ADC on ATCA
Low Power, Low Noise
Remote undersea experiment



ATCA AMC Carrier





Added Versatility via Adapters

2. *Third party vendors offer small-card adaptors*
   - Range of sub-module adapters to accommodate existing commercial analog and digital I/O products
     - AMC
     - AMC as sub-carrier for Industry Pack (IP), PCM

AMC as Carrier for IP Module

The Embedded I/O Company

TEWS TECHNOLOGIES

TAMC100 Carrier for 1 IndustryPack®

Application Information

The TAMC100 is a standard single width / mid-height AMC.1 compliant carrier for one single-size IndustryPack (IP) module allowing to build up modular, flexible and cost effective I/O solutions for all kinds of applications like process control, medical systems, telecommunication and traffic control. A HD50 SCSI-2 type connector provides access to all IP I/O lines.

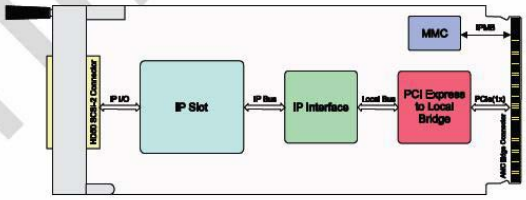
The TAMC100 is a versatile solution to upgrade well known legacy I/O solutions to a high performance form factor.

All IP interrupt request lines are mapped to PCIe INTA, alternatively Message Signaled Interrupts (MSI) can be used. For fast interrupt source detection the TAMC100 provides a special IP interrupt status register.

The IP power lines are fuse protected by self healing fuses and RF filtered. The operating temperature range is -40°C to +85°C.

Technical Information

- Form Factor: PCIMG AMC.1 Module
  - Board size: 180.6mm x 73.5mm
  - Single width / Mid-height
- PCIe single lane (x1) port (AMC.1 Type 1 compliant)
- IPMI Support
- Front Panel LEDs:
  - Blue Hot-Swap LED
  - Red Power Good LED (LED1)
  - Green IP-Activity LED (LED 2)
- ANSI/VITA 4-1995 compliant interface to one IndustryPack module
  - IndustryPack slot: one single-size
  - 8/32 MHz interface, no DMA
  - 8 Mbytes IP memory space
  - Routing of all IP interrupts to PCIe INTA/MSI, local interrupt status register
  - I/O access: HD50 SCSI-2 type connector
- Self Healing fuses and RF-filtering on all IP power lines
- Operating temperature: -40°C to +85°C



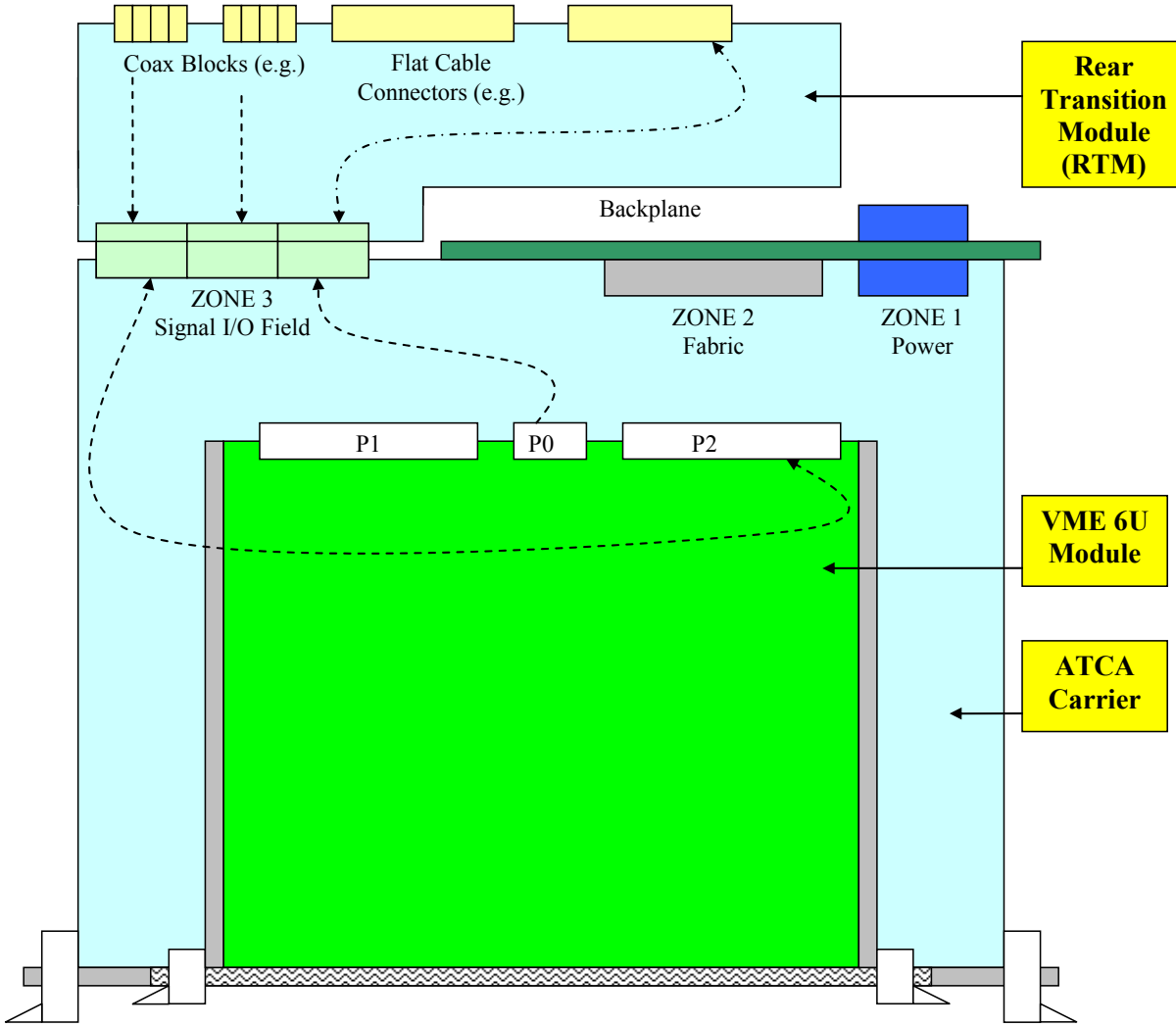
Order Information

Adapters – Cont'd

3. VME 6U ATCA Adapter (SLAC, UIUC)

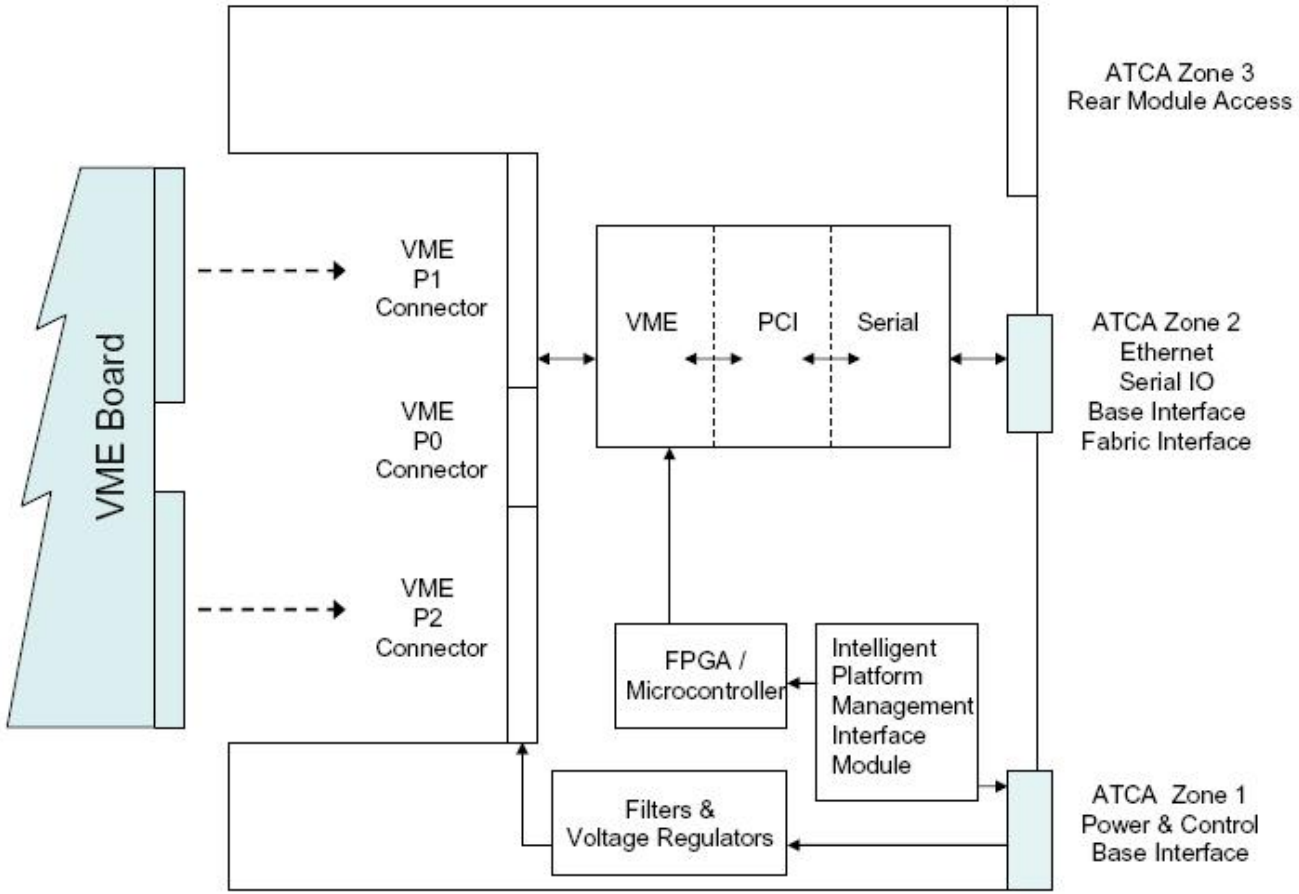
- *ATCA single card 6U VME slave adapter under development at SLAC/UIUC/ Vendor*
- *Allows use of existing commercial, custom modules on ATCA platform*
- *Achieves all high availability (HA) features including power management, hot swap*

VME Adapter



- Features
  - *Adapts slave VME module to ATCA platform*
  - *Provision for hot swap with all-rear I/O*
  - *Optional signal pins routed to Zone 3*
  - *RTM provides connector transition, power for optional signal conditioning*
  - *Full Platform management of VME via ATCA Shelf Mgr*

ATCA-VME Adapter BD

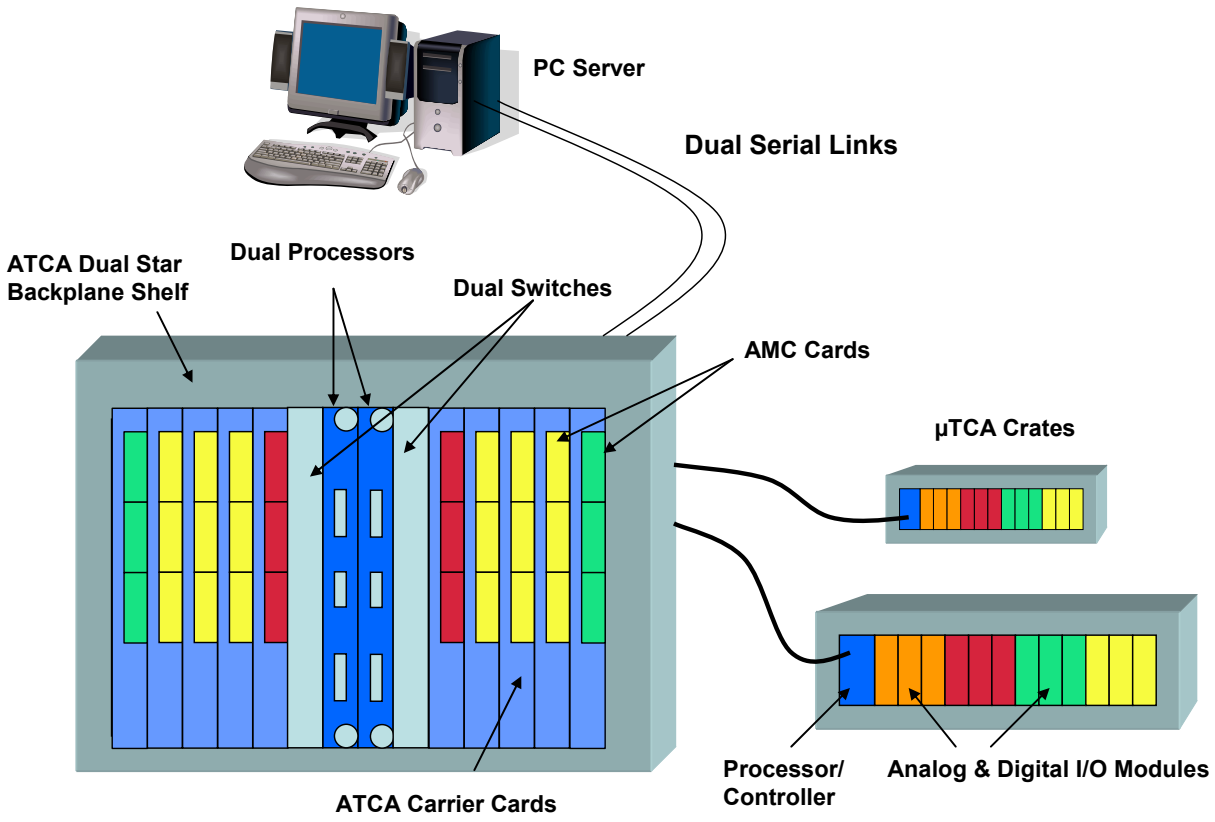


Courtesy R. Downing

3. R&D Work Packages

1. Basic ATCA hardware and software platform development for test facility, R&D applications
   - *Test commercial core products: Controllers, switches, shelf manager, communications, support software*
2. Investigate instrumentation products on Advanced Mezzanine Cards (AMC), PMC adapters and carriers, IP adapters and carriers, VME adapters and carriers
3. Investigate Racks, power supply systems, water-air cooling, platform remote monitoring & control
4. Evaluate state-of-the-art connectors for high density high speed rear panel signal interconnect options (needed for hot-swap)
5. Initiate new module, sub-module designs for test systems: BPM, LLRF, Analog/Digital IO, Interlocks…

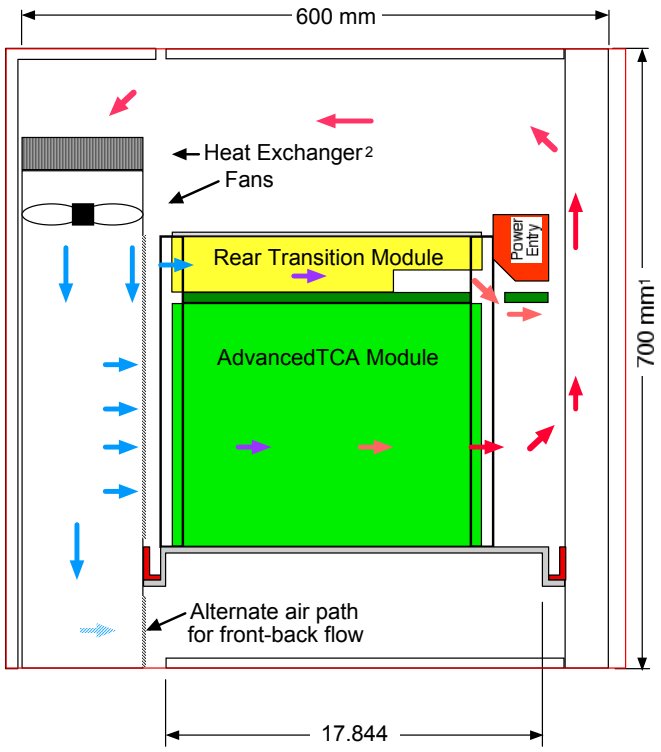
3.1, 3.2 DAQ Test Station Concepts



- Develop test station hardware & software
- Acquire development tools to explore hardware, software options

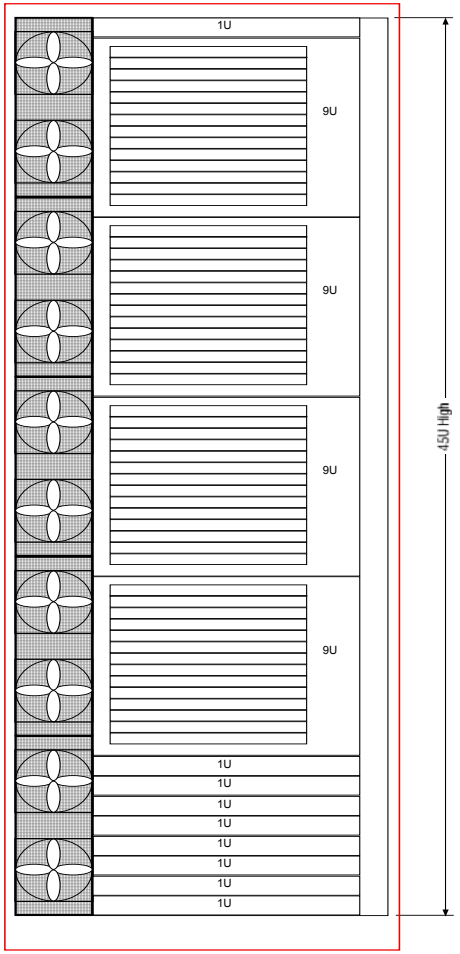
3.3 IPM Rack Assembly

Top View



NOTES:
1. ADJUST DEPTH AS REQUIRED FOR CABLE PLANT.
2. FANS AND HEAT EXCHANGERS SHOULD BE FRONT SERVICABLE

Front View

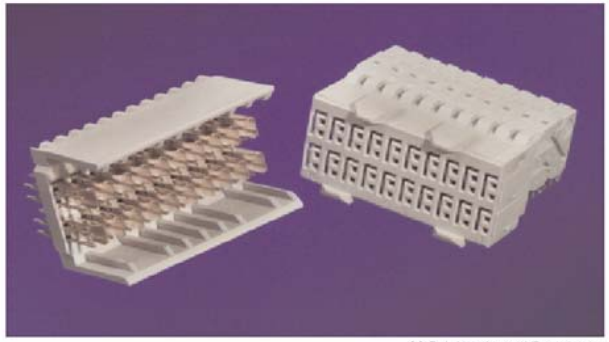


- Intelligent Platform Management of Racks
- Air-to-water cooling
- Horizontal flow
- Heat exchangers in separate channel
- Power supplies at bottom
- All modules, PS, fans hot swappable

Courtesy B. Downing

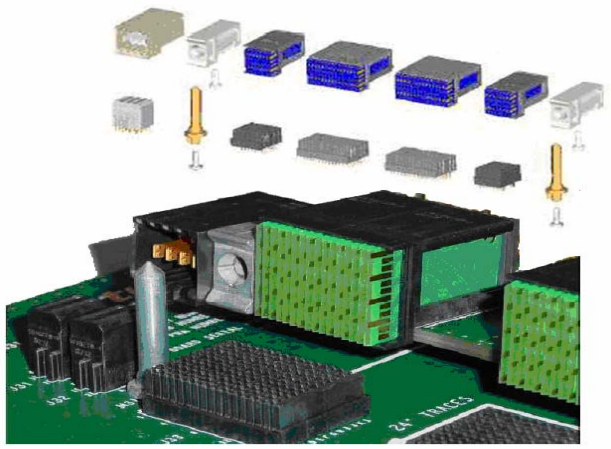
3.4 Connectors for RTM Zone 3

- Handle frequencies DC to 1.3 GHz
  - *Coaxial blocks (e.g. Harting, Amp, …)*
  - *Mass terminated high density cable mating*
  - *Fabric types – shielded differential box type, printed board blade type (Multi-Gig)*
  - *High isolation requires matched Z many-layer boards or possibly mini-coax jumpers board to Zone 3*



20 Pair Header and Receptacle

- Data Fabric, Update Channel, and Timing Clocks
- Up to 3.125Ghz clock rates
- Pins protected by ground shield from bending
- Up to 5 connectors can be used on a backplane per slot



4. EDR Phase Work Packages

4.1 Develop WP Plan and schedule; identify EDR phase collaboration needs & opportunities; manage program

1. *Adapt representative demonstration units to test facility applications in three ILC regions*
2. *Develop core test systems to share R&D efforts broadly*
3. *Track development of applications to ILC Detector areas (e.g. Trigger processors, online front end processing, other)*

4.2 Build user group communications, collaboration between labs, with detector community, with other projects (XFEL, ITER, …)

4.3 Develop project-level documentation for all EDR, R&D activities

5. Summary EDR WP Goals for 2010

5.1 Demonstrate standard solutions to cover 90+% of foreseen ILC requirements

5.2 Investigate industrial solutions to prototype production of core components

5.3 Prepare to down-select prior to start of construction

5.4 Complete new bottom-up cost estimates based on prototype systems experience with hardware and software

5.5 Complete documentation of proposed solutions, EDR Document