mTCA.4 Q & A

MicroTCA Review Committee
June 5, 2012
PICMG Technical Committees for Physics

• Technical Committees formed June 2009
  – Hardware (I/O, Timing & Synchronization)
  – Software (Architecture and Protocols)
  – Coordinating Committee (Oversight, definition of projects, deliverables)

• Lab & Industry members apply, voted in
  – Participate and/or track work results
  – Under IPR rules while standards in development
  – Current membership 12 labs, ~40 companies
  – Active true believers, passive, tire-kickers, spies, etc.
Q3.

• Please provide slides comparing mTCA.4 with ATCA based solution. Reasons for the new standard?
A3. Common Goals for ATCA, mTCA.4

- High Availability (HA)
  - Hot swap is critical for High Availability
  - ATCA designed to swap blades with all I/O in rear via RTM; no front panel cables to disturb
  - In ATCA practically all I/O is high speed network cabling, not controls, DAQ sensors or output devices
  - Automatic load switchover feasible for failure of 1 among N identical blades in shelf
  - In mTCA.4 Controls-DAQ with mixed function analog-digital AMCs and I/O cabling in shelf, rarely can switch sensors over to a separate module, but hot swap, rear I/O remain very high priority for HA
A3. ATCA Carrier w/ RTM Solution (LLRF)

• ATCA Shelf Zone 3 to RTM
  – Original RTM area of Zone 3 left as user defined option for rear I/O
  – Small area RTM intended as simple module with little circuitry
  – Quickly became loaded up with circuits by vendors, in turn requiring IPMI, cooling requirements
A3. ATCA LLRF AMC Carrier Implementation details

• S. Simrock team LLRF system
  – First LLRF prototype for XFEL (FLASH) based on ATCA Carrier boards with 3 AMC modules, each digitizing IF from 8-1m 1.3 GHz SC cavities in Cryomodule w/ TEWS 125 MSPS 14 bit ADC w/FPGA
  – Goal was intra-pulse feedback low latency vector summing to single 10MW klystron
  – Klystron drove 3-4 Cryo-modules of 8 cavities each, 24 cavities per ATCA carrier
  – AMC modules on single carrier communicated directly by Rocket IO for vector summing, ~100 nsec latency
  – Replaced older system based on VME
XFEL – LLRF Carrier Board (DESY)

- 8 ch. ADC-AMC
- AMC - Vector Modulator
- AMC - Timing Module
- 8 ch. AMC-DAC
- Down-converter
A3. Details 2

- Digitizer AMC was COTS 1-wide 14 bit 125 MSPS 8 Ch ADC with single input connector via *front panel (TEWS)*
- AMC required complex piggy back I/O boards on top of each AMC to route IF inputs from ATCA Zone 3 to *front panels* of digitizers, 2 tongue connector, very dense routing on ATCA board
- Down converters 1.3 GHz to 54 MHz mounted in special subassemblies totally fill RTM
XFEL LLRF Components

TEWS TAMC900

ADlink CPU 6900

Analog tongue AMC-VM

Digital tongue AMC-B+

June 4-5, 2012

FLASH Seminar, Waldemar Koprek, DESY
A3. Details 3

- Simrock team succeeded to make system work with noise, crosstalk better than VME predecessor
- In meantime ATCA deemed unsuitable for accelerator distributed controls for reasons of large board complexity, cost, limited I/O, inadequate RTM and analog space
- Parallel mTCA development efforts ensued at DESY
- Solution for clean analog space and separate RTM for applications adapters to generic modules strongly pursued.
A3. Details 4

- mTCA solution quickly advanced to RF also
- Demonstrated superior integrated digitization & down-conversion on mTCA.4
- DESY management down-selected LLRF to mTCA.4 solution; engineering resources were limited & could not pursue both; mTCA.4 was clearly superior package
- PICMG Committee already working on mTCA solution for controls did not abandon ATCA solution but gave it lower priority; not revived to date
- mTCA.4 (& PICMG3.8) took 2 years to develop; committee did not have manpower or motivation to work on 2 solutions in parallel once DESY made decision.
Q5.

- 5.1 What decisions have been made in the areas of the uTCA.4 specification defined as “user-defined”?
- 5.2 How do these decisions impact future deployment of uTCA? Interconnect selection? Timing distribution?
A5.1 User defined areas

• All mandatory features of platform are defined by the standard. The hardware set chosen is generic and will be implemented at some level in most cases. The standard is specific on “shall” vs. “should” where choices are offered.

• However the goal is to offer a platform to which many users and industry can contribute in a compatible manner so that products can be as interchangeable as possible, saving large engineering costs in both labs and industry.

• Judgment is needed by the user when exercising options or deviating from the standard.
A5.2 User defined decisions impact on future deployment?

• As just stated, judgment is necessary. The more specialized a platform becomes with user-defined features the more difficult it is to maintain module interoperability.

• If standards become a part of lab culture as they should, collaboration ensues and there is good chance of avoiding needless annoying conflicts.

• The CERN xTCA Interest Group open-source design repository is one useful vehicle.

• Interconnects and timing selections will work for hopefully 80% of cases; no doubt some will find it necessary to add features or deviate from the choices made.

• Standards do not dictate as much as offer sound choices. Sound choices will not negatively affect deployment.
Q6.

- What areas of the uTCA,4 specification are most likely to require modification in future? (Affect) backward compatibility?
A6. Likelihood of future modifications

- Modifications of standards are necessary as technology evolves and MTCA.4 has excellent “hooks” to accommodate needed changes with minimum disruption.
- For example VME underwent 4-5 major changes in a decade while maintaining reasonable, but not perfect, backward compatibility.
- One mTCA.4 vendor has issued a module with a higher density IO connector and produced a matching RTM to go with it (3-IP carrier). This type of deviation is expected and may or may not lead to a new extension.
- DESY is designing an auxiliary small backplane for HF LO distribution to RTMs. Committee has not discussed but this type of extension is user optional and back-compatible.
Q7. Future Roadmap

• (What is) the future roadmap of uTCA.4? Will the backplane BW per serial lane increase as in ATCA?
A7. Future Roadmap

- The only major item on the roadmap at the moment is to document the utilization of extended options lines for timing and triggering in both ATCA and mTCA.4. This is well underway and should be completed soon.
- The PT shelf, as already discussed, is designed in complete compliance with mTCA.4 mechanical standards but, aiming at telecom markets, has doubled power and cooling capacity while achieving a 40Gbps backplane capability.
- Experimenters at CERN and other labs are highly interested in the increased performance for high data bandwidth and maximum throughput requirements. If this product is a success in telecom it helps the whole mTCA.4 market.
Q8.

• Which companies and laboratories are currently active on the mTCA.4 Committee?
A8. Active Committee Members

• Companies
  1. Agilent
  2. Arroyo
  3. Cypress
  4. Foxconn
  5. ELMA
  6. GE
  7. Hytec
  8. Intel
  9. I-Tech
  10. Pentair Schroff
  11. Teledyne
  12. Positronix
  13. Performance Tech

• Labs
  1. CERN
  2. DESY
  3. FNAL
  4. IHEP Beijing
  5. IPFN Lisbon
  6. IN2P3 Saclay
  7. ITER
  8. KEK
  9. LBNL
  10. Sincrotrone Trieste
  11. SLAC
  12. Spring 8 (in process)
# A8. Labs Using or Initiating mTCA.4

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<th>No.</th>
<th>Lab Name</th>
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<td>4.</td>
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<td>16.</td>
<td>UCL Rutherford</td>
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Conclusions

- mTCA.4 is established successful standard
  - PICMG considers mTCA.4 as opening new markets
  - Naturally growth does not happen instantly
  - Design is very sound and forward-looking
  - Solid COTS infrastructure, commitment exists
  - Markets include not only physics but telecom and military
  - Long term success depends on the users and marketing skills of promoters in industry and active involvement of labs in maintaining, upgrading standards