uTCA

Micro Telecommunications Computing Architecture

A Common Hardware Platform for CMS Trigger Upgrades

20090303

Magnus.hansen@cern.ch

People and Institutes

- **Matt Stettler: LANL**

- **Costas Foudas, Greg Iles: IC**

- **John Jones: Princeton**

- **Jeremy Mans: Minnesota**

- **Wesley Smith, Tom Gorski: Wisconsin**

- **Anton Taurok, Claudia Wulz: Vienna**

- **Drew Baden, Tullio Grassi: Maryland**

- **Magnus Hansen: CERN**

- **Others that I have forgot or that I am unaware of**

Change of Data Transfer and Sharing method for upgrades

- **The world is going High Speed Serial**
  - **Large and fast parallel busses tend to change behavior when bandwidth increases**
    - ➔ **Leaves room for late bad surprises**
    - ➔ **CMS subsystems have some experience in the matter**
  - **Newly (well, not THAT new…) developed FPGA technology**
    - ➔ **Integrated High Speed Serial interfaces**
  - **FPGA Gates per IO ratio rapidly increasing**
    - ➔ **Max IO count essentially constant since >10 years and subject to mechanical constraints**

M. Hansen, CERN. magnus.hansen@cern.ch

Choice of form factor for upgrades

- **VME *U**
  - **Known old friend or enemy**
  - **Infrastructure installed**
  - **Large front panel area**
- **Something else?**
  - **Again, the world is going High Speed Serial**
  - **It would make life simpler if the standard would address Reliability, Availability, and Serviceability issues**

Why Choose MicroTCA?
Or rather: Why choose AMC?

- **Rare multiple options to support module**
  - **On a carrier card, e.g. ATCA**
  - **In a crate, e.g. Micro-TCA**
- **FPGA IO capacity matches size of backplane and front panel already within the standard**
- **Nice size of module**
- **Growing market**
  - **Potentially falling cost**
    - → **At least partially confirmed**
  - **Potentially many manufacturers of hardware**
    - → **At least partially confirmed**

M. Hansen, CERN. magnus.hansen@cern.ch

ATCA
Advanced Telecommunications Computing Architecture

- **≤16 slots of 8U boards**

- **Full Mesh or Dual Star serial backplane**

- **1/10G Ethernet for slow control**

- **Mature**
  - Specified in ~2002

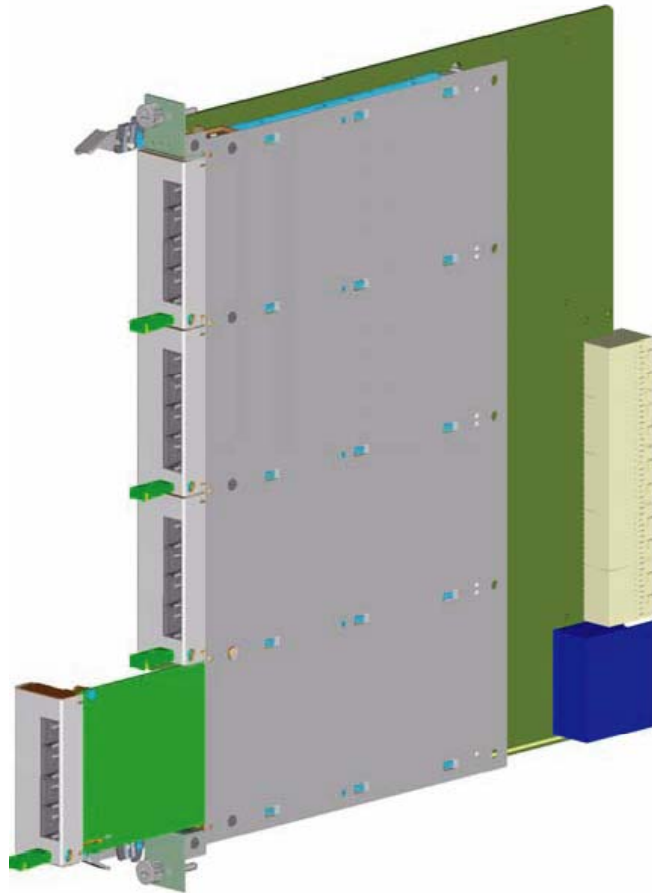- **Complicated**
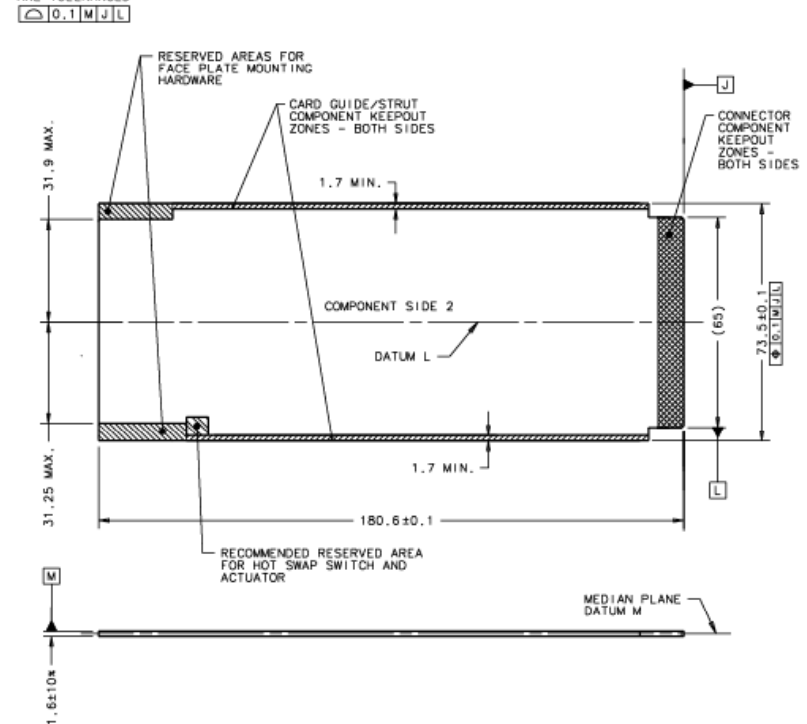
- **Recommends AMC**
  - Advanced Mezzanine Cards

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AMC on ATCA

ATCA

AMC

AMC
Advance Mezzanine Card

- **Preferred mezzanine card form factor on ATCA carrier**

- **The form factor used for the uTCA open standard**

- **Single: 73 by 180 mm**

- **Double:148 by 180 mm**

- **Multitude of connector options and bay dimension**

Micro-TCA

General

- **Up to 16 slots**
  - ➔ **2 power, 2 hub, 12 AMC**
- **Managed by an MCH**
  - ➔ **MicroTCA Carrier Hub**
  - ➔ **Possibly redundant for HA**
  - ➔ **Possibly integrated in active backplane**
- **Large freedom within specification**
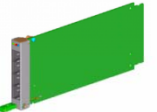 - ➔ **Double Edged Sword**
    - ↘ **Interoperability an issue**
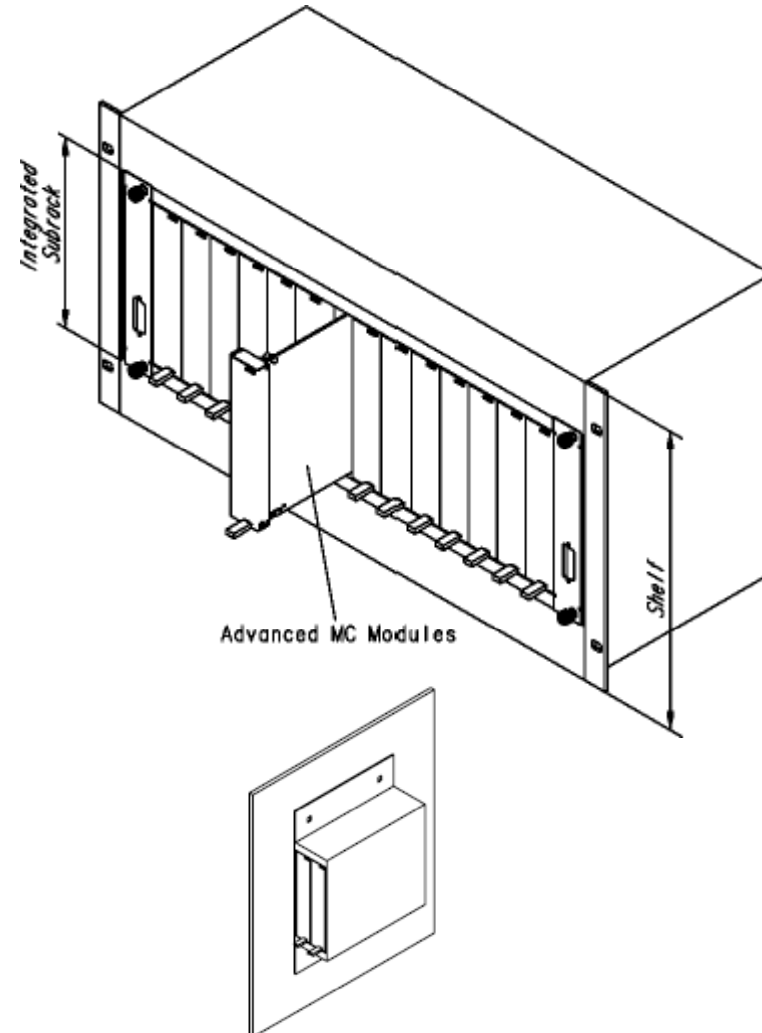
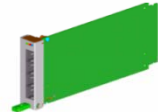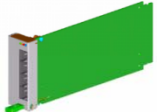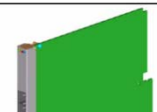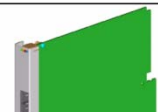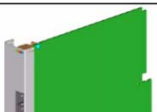# Physical dimensions

- **Several possibilities available**
  - **All have one AMC "B+" connector with 170 contacts**

|	Compact-Size (3HP)	Mid-Size (4HP)	Full-Size (6HP)
Single modules	73.8x13.88x181.5mm	73.8x18.96x181.5mm	73.8x28.95x181.5mm
Double modules	148.8x13.88x181.5mm	148. 8x18.96x181.5mm	148. 8x28.95x181.5mm

Connections

- **A MicroTCA Tongue has:**
  - **40 signal pairs allocated to the Fabric Interface**
    - ➔ **20 bidirectional pairs**
  - **5 signal pairs allocated to the AMC Clock Interface**
  - **5 contacts allocated to the JTAG Test Interface**
  - **9 contacts allocated to the System Management Interface**
  - **8 contacts allocated to Payload Power**
  - **56 contacts to allocated to Logic Ground**

Micro-TCA Backplane

- **Backplane connections are loosely defined**
  - **Source / Destination user defined**
    - ➜ **Common topologies on "example" crates**
  - **Protocol user defined**
    - ➜ **Different profiles exist**

- **Note**
  - **The uTCA crate can in principle be a COTs ATCA AMC carrier module if suitable**
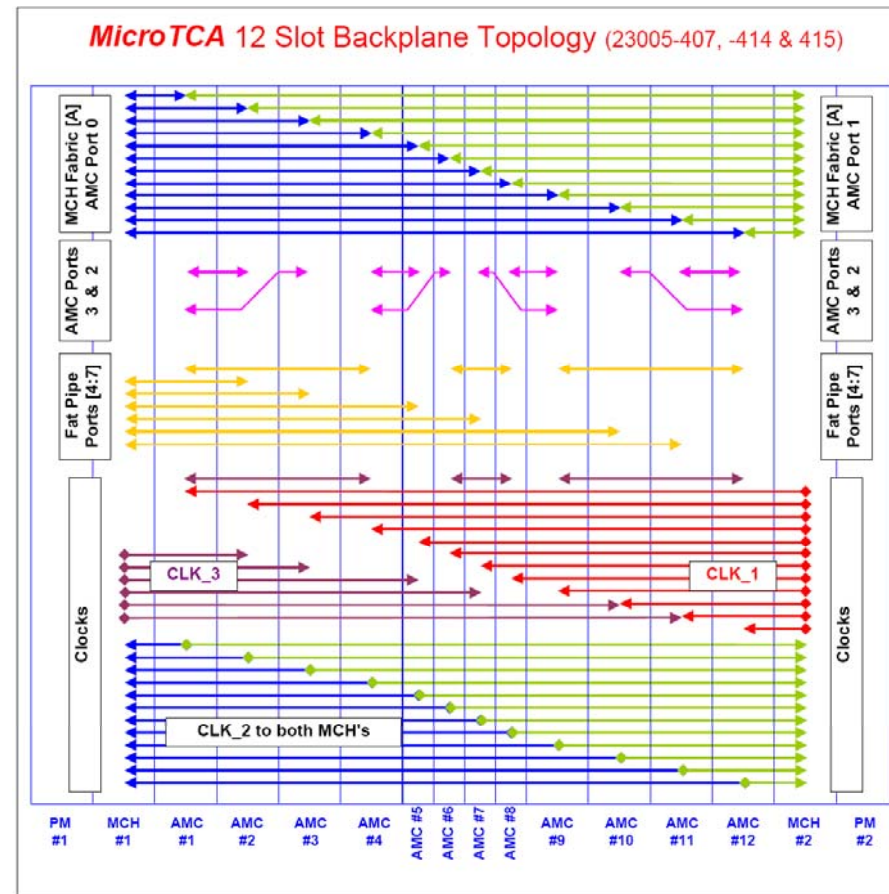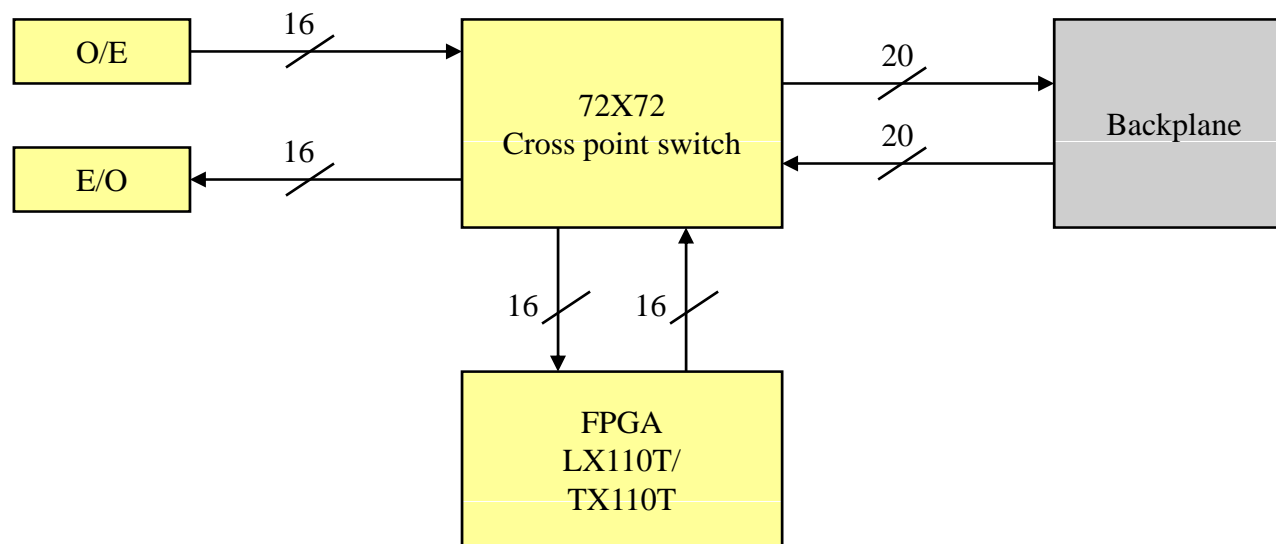

Source: SCHROFF

Current Developments

- **Matrix Processor**
  - ♦ **Full height single width sporting Xilinx V5 LX110T (or FX100T), a cross point switch providing full freedom for routing and sharing of data up to 20 links on backplane and 16 optical in/out on front panel.**

M. Stettler
J. Jones
G. Iles
M. Hansen

M. Hansen, CERN. magnus.hansen@cern.ch

Current Developments

- **Matrix**
  - Prototypes successfully tested.
  - Aimed directly at small demonstrator or production systems
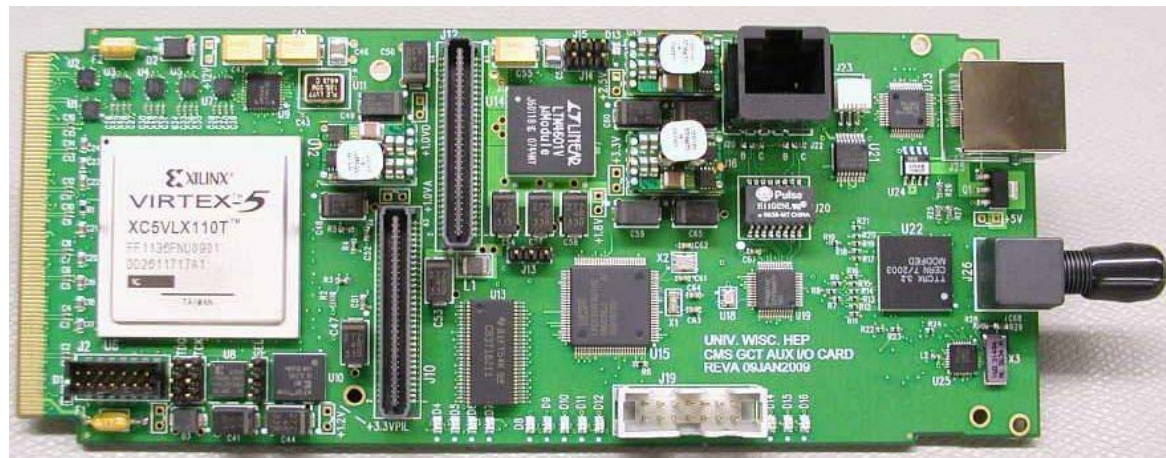

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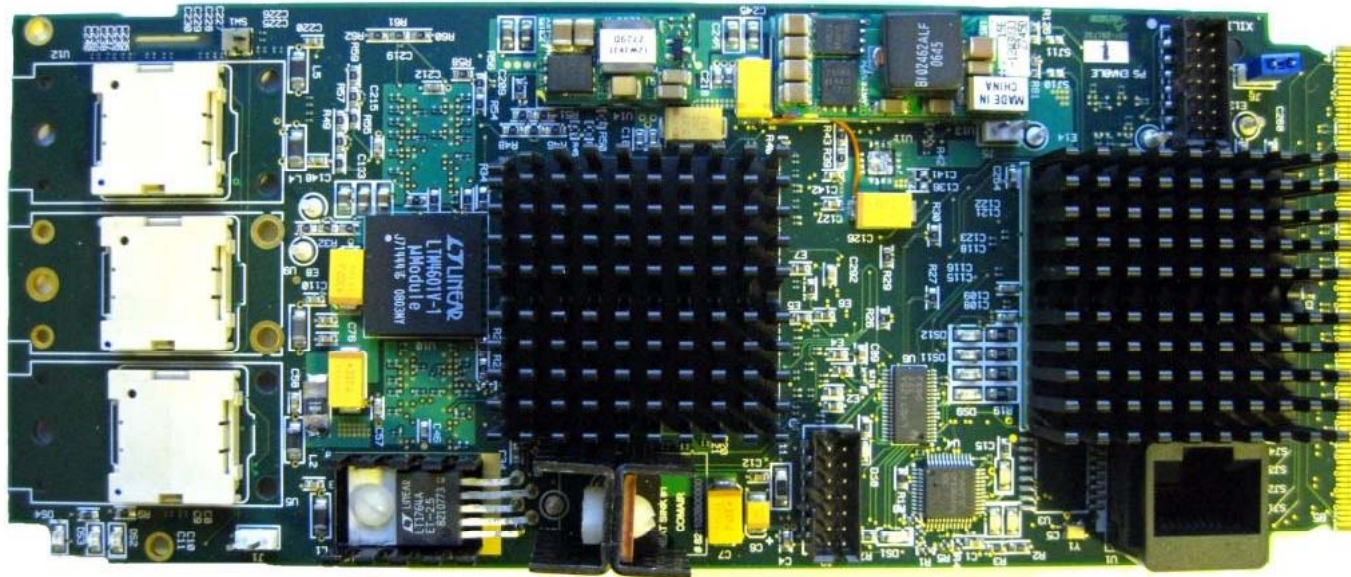
Current Developments

- **Aux Card**
  - **Effectively integrates a uTCA system in the current CMS DAQ and trigger environment**
    - ➜ **SLINK64 slot**
    - ➜ **TTC interface**
    - ➜ **TTS interface**

T. Gorski

Current Developments

- **CTR**
  - ♦ **Full height dual width card**
  - ♦ **Under development**
  - ♦ **Aimed at CMS HCAL and ECAL pre-RCT processing**
    - ➔ **HCAL HTR replacements**

This is not a CTR but a pre-pre-decessor

J. Mans

M. Hansen, CERN. magnus.hansen@cern.ch

Current Developments

- **Matrix backplane (THIS is uTCA)**

  - "Cube" backplane sporting Xilinx V5 LX110T/FX100T, a micro-controller plus an ethernet switch for MCH functionality and a cross point switch providing flexible routing for sharing of data up to 10 links per AMC slot

  - Under development

  - Aimed at small demonstrator or production systems

    ➔ **Implementation of a generic production and maintenance test system is trivial**

"Cube" shelf

144X144 Cross Point Switch

M. Stettler
J. Jones

M. Hansen, CERN. magnus.hansen@cern.ch
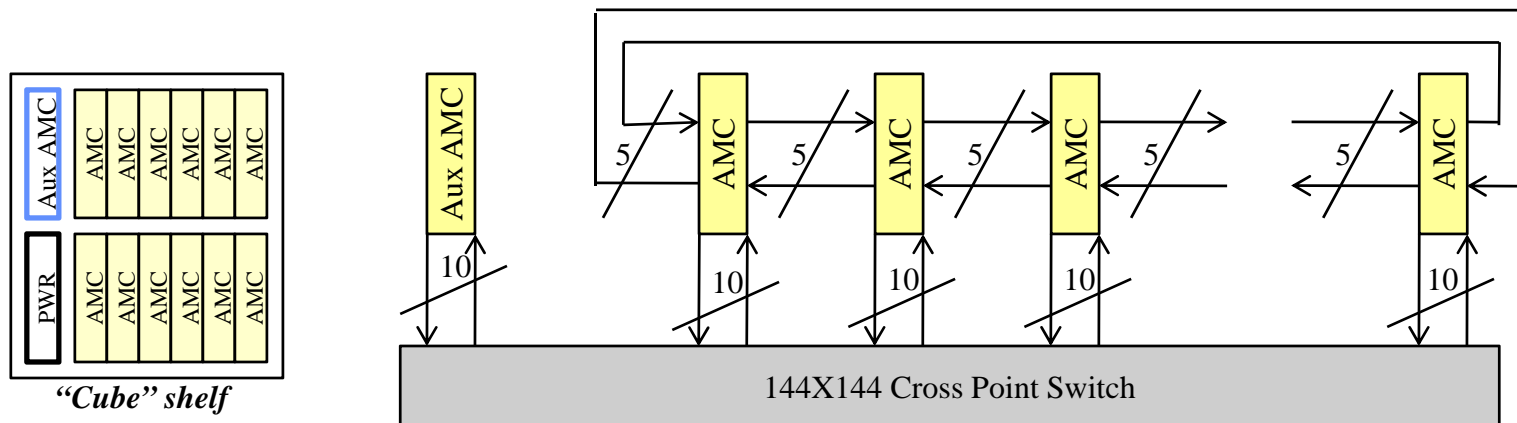
Current Developments

- **xTCA Physics Profile?**
  - ◆ **External to CMS**
  - ◆ **Discussions are ongoing whether a specific physics profile of xTCA would be useful**
  - ◆ **The Questions**
    - ➔ **What are specific CMS/physics needs?**
    - ➔ **Is it Synchronous trigger processing?**
    - ➔ **Is it DAQ?**

- **Standardization of shelf management hardware, firmware and thus software within CMS is a requirement**
- **Standardization of configuration and local readout channel could be as well**

M. Hansen, CERN. magnus.hansen@cern.ch

Links

- **ATCA**
  - **http://www.picmg.org/pdf/PICMG_3_0_Shortform.pdf**

- **AMC**
  - **http://www.picmg.org/pdf/AMC.0_R2.0_Short_Form.pdf**

- **uTCA**
  - **http://www.picmg.org/pdf/MicroTCA_Short_Form_Sept_2006.pdf**

Conclusion

- **We Believe that aiming at using a uTCA approach for the development of upgrade trigger hardware and for the final implementation will give the required flexibility for late modifications in specification of algorithms**