Evaluation of vertically cooled shelves from Schroff

xTCA IG Meeting

CERN EP-ESE-BE

Vincent Bobillier, Stefan Haas, Markus Joos, Julian Mendez, Sylvain Mico and Francois Vasey
Advanced TCA status

Specifications
- 14 ATCA slots (400W) with RTM (50W)
- Vertical or Horizontal cooling
- Dual Star or Full Mesh topology
- 40Gbps or 100Gbps backplane
- Bussed IPMB
- 1 Shelf man. included

Timescale

<table>
<thead>
<tr>
<th></th>
<th>Horizontal shelf</th>
<th>Vertical shelf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical specification</td>
<td>Q4 2016</td>
<td>Q4 2016</td>
</tr>
<tr>
<td>Technical evaluation</td>
<td>Q1-Q2 2017</td>
<td>NA</td>
</tr>
<tr>
<td>CERN price enquiry</td>
<td>Q2 2017</td>
<td>Q2 2017</td>
</tr>
<tr>
<td>Select contractor (pre-series)</td>
<td>NA</td>
<td>Q3 2017</td>
</tr>
<tr>
<td>Final qualification</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

- ATCA Shelf Procurement contract ready for purchase orders by Q2/Q3 2018
AdvancedTCA Status: Selected crate

- Pentair/Schroff ATCA shelves
  - 14 ATCA slots w. RTM
  - Vertical or Horizontal cooling
  - DS or FM topology
  - 40 or 100G backplane
  - Bussed IPMB
  - 1 Shelf man. included

<table>
<thead>
<tr>
<th>Type</th>
<th>Price FCA (Euro)</th>
<th></th>
<th>Type</th>
<th>Price FCA (Euro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batch of 1</td>
<td>EUR 6,586.00</td>
<td></td>
<td>Batch of 1</td>
<td>EUR 7,736.00</td>
</tr>
<tr>
<td>Batch of 2</td>
<td>EUR 6,242.00</td>
<td></td>
<td>Batch of 2</td>
<td>EUR 7,405.00</td>
</tr>
<tr>
<td>Batch of 5</td>
<td>EUR 5,886.00</td>
<td></td>
<td>Batch of 5</td>
<td>EUR 7,102.00</td>
</tr>
<tr>
<td>Batch of 10</td>
<td>EUR 5,603.00</td>
<td></td>
<td>Batch of 10</td>
<td>EUR 6,806.00</td>
</tr>
</tbody>
</table>

**Type A:** Vertical airflow, Dual Star Bkpl 40G, 1 shelf man.
**Type B:** Vertical airflow, Full mesh Bkpl 40G, 1 shelf man.

Cost increase for 100G: 15%
Discount for std horizontal airflow: 1.5%
Evaluation of vertically cooled shelves

Cooling qualification

Air temperature sensors (top)

Crate outlet T sensor

Crate inlet T sensor
Evaluation of vertically cooled shelves

Cooling qualification

- Cooling performance measured using the ASIS load blade @450W
  - Fan speed at 100%

Well below the 35 deg. C specified
Cooling qualification

- Comtel vs. Asis cooling
  - Load blades @250W
  - Fans @100%

Comtel average: 9.2 deg.C
Asis average: 14.5 deg. C

Good cooling capacity
Cooling study

- Optic must be cooled enough in order to work below 50 deg. C

**A word of caution to backend board designers:**
- Do not preselect your favorite on-board optics module
- VL+ is presently considering freezing module type and giving you advance notice
- Run your optics cool or make it replaceable
- Running at elevated temperature is possible, but will affect life-time
  - Data from one supplier (T is heatsink temperature)
  - T<50degC will result in <1% wearout failures in 15 years (to which random failures will add ~3.7%)
  - T<57degC will result in <10%

Is it possible to keep a “cold” zone on ATCA blade located in the selected crate?
Cooling study

- Dissipate homogeneously 450W per slots except in the slot under test

Is it a safe place for the optic?
Evaluation of vertically cooled shelves

Cooling study

Fan at max. speed

< 6deg. C

0W zone - delta T.
Evaluation of vertically cooled shelves

Cooling study

1px = 0.13cm
5px = 0.65cm

< 6deg. C

Evaluate the distance?

0W zone - delta T.

Fan at max. speed
Cooling study

- Optic must be cooled enough in order to work below 50 deg. C

- A word of caution to backend board designers:
  - Do not preselect your favorite on-board optics module
  - VL+ is presently considering freezing module type and giving you advance notice
  - Run your optics cool or make it replaceable
  - Running at elevated temperature is possible, but will affect life-time
    - Data from one supplier (T is heatsink temperature)
    - T<50degC will result in <1% wearout failures in 15 years (to which random failures will add ~3.7%)
    - T<57degC will result in <10%

Is it possible to keep a “cold” zone on ATCA blade located in the selected crate?

Looks positive!
Cooling vs. noise

- **Selected fan speed = 80%**
  - Low gain above this fan speed
  - Within the spec (delta T. < 35 deg. C)

- **Noise around 82.7db (average) at 1m**
  - Without noise isolation
  - From Claudio’s talk (ACES), a gain of up to 10db can be achieved using noise isolation

![Graph showing noise and average delta T.](image-url)
Backplane quality

- Qualification using the ieee standard (100G-KR4 / 40G-KR4)
  - Performed out of the crate
  - Using qualified adapter cards
  - Using a VNA
  - Selected links: Between slots 1 and 2 and 1 and 14

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Logical Slot</td>
<td>13</td>
<td>11</td>
<td>9</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>
Backplane quality

- Slot 1 to 14

Schroff 40G

Comtel Air+plane backplane

Insertion loss (ieee)

Return loss (ieee)
Evaluation of vertically cooled shelves

Summary

- Cooling study
  - Cooling a column to get a low delta T. seems feasible
  - Firmware and placement/layout have to be though in term of cooling

- Backplane quality
  - Within the IEEE 40G-KR4 standards
  - Qualification at 100Gbps still have to be done (DS ordered)

- Procurement status
  - Qualification is on-going
  - Measurements from the first crate are encouraging
  - Goal: Contract to be ready in June 2018
Thank you

julian.mendez@cern.ch
Advanced TCA blade cooling

- Placement proposal: