Communication in ATCA-LLRF System

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Agenda

- Requirements
- Concept
- Communication interfaces in ATCA standard
- Channel definition on a fabric interface
- Proposed backplane topology of an ATCA shelf
- Schedule

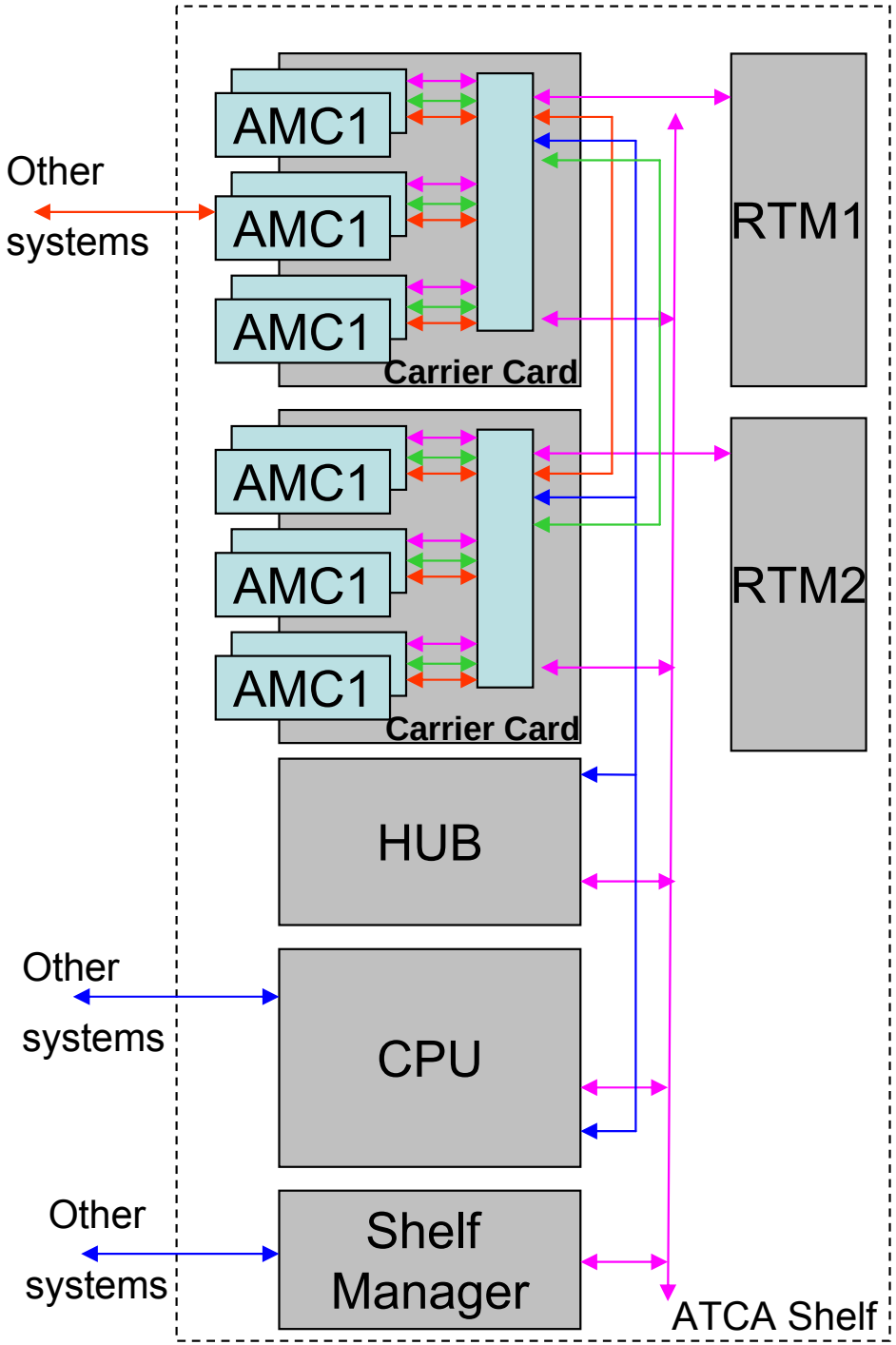
Requirements

1. **Fast, low latency links for fast feedback loop, piezo control**
2. **High throughput between pulses for DAQ systems – sending a lot of data recorded during pulse**
3. **Boards management mechanism**
4. **Boards control in ATCA Shelf**
5. **Control of RTMs**
6. **Interfaces to other systems**

Communication interfaces offered by ATCA standard

- **PICMG3.0 – General Specification, ATCA Backplane Topology,**
- **IPMI**
- **E-Keying**
- **Subsidiary Specifications:**
  - **PICMG3.1 Ethernet / Fibre Channel**
  - **PICMG3.2 Infiniband**
  - **PICMG3.3 PCI Express / Advanced Switching**
  - **PICMG3.4 Starfabric**
  - **PICMG3.5 RapidIO**
  - **PICMG3.6 PRS fabric**

General concept



I²C
- IPMI over ATCA Backplane
- IPMI on a carrier card
- Control link to RTM

Low Latency Link
- Data transport from ADC to a carrier card
- Partial vector sum between carrier cards
- Interface to piezo system

PCIe
- DAQ system between AMC modules, carrier cards for LLA and HLA

Ethernet
- Modules configuration and software management
- Control system to all modules
- NFS over backplane
- IPMI over ethernet
- Interfaces to other systems

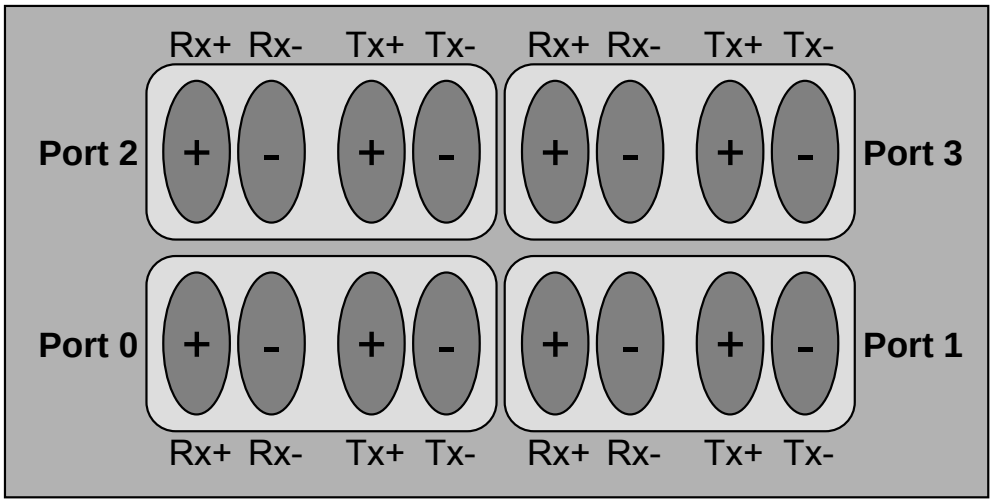
Latency in selected communication standards

- Rocket IO
  - direct peer-to-peer connections
  - latency around 300 ns (Virtex 2 Pro) and 100 ns (Virtex 5)
- PCI Express
  - connections via switch
  - minimum latency 500-700 ns depending on payload size
  - up to 10 us with higher switch load
- Gigabit Ethernet
  - 2.5 us
- 10 Gigabit Ethernet
  - 250-600 ns

ATCA-LLRF Channel Definition for Shelf Backplane

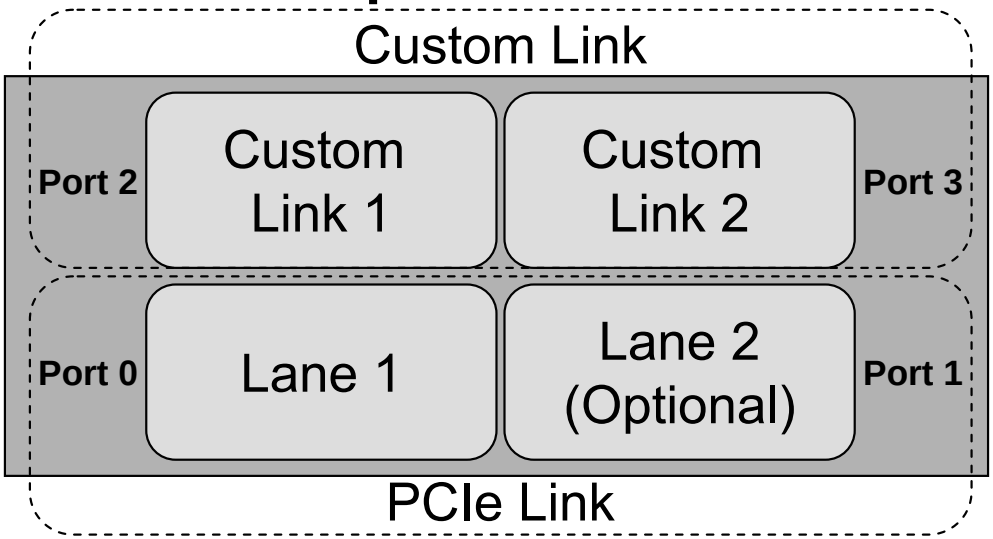
Fabric Channel

PICMG 3.0

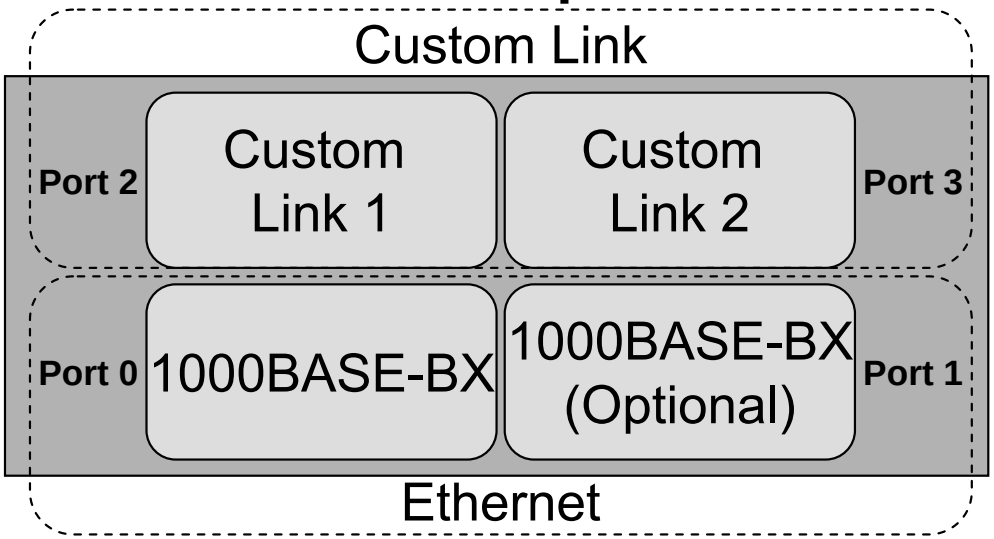


ATCA-LLRF Channel

Option 1



Option 2



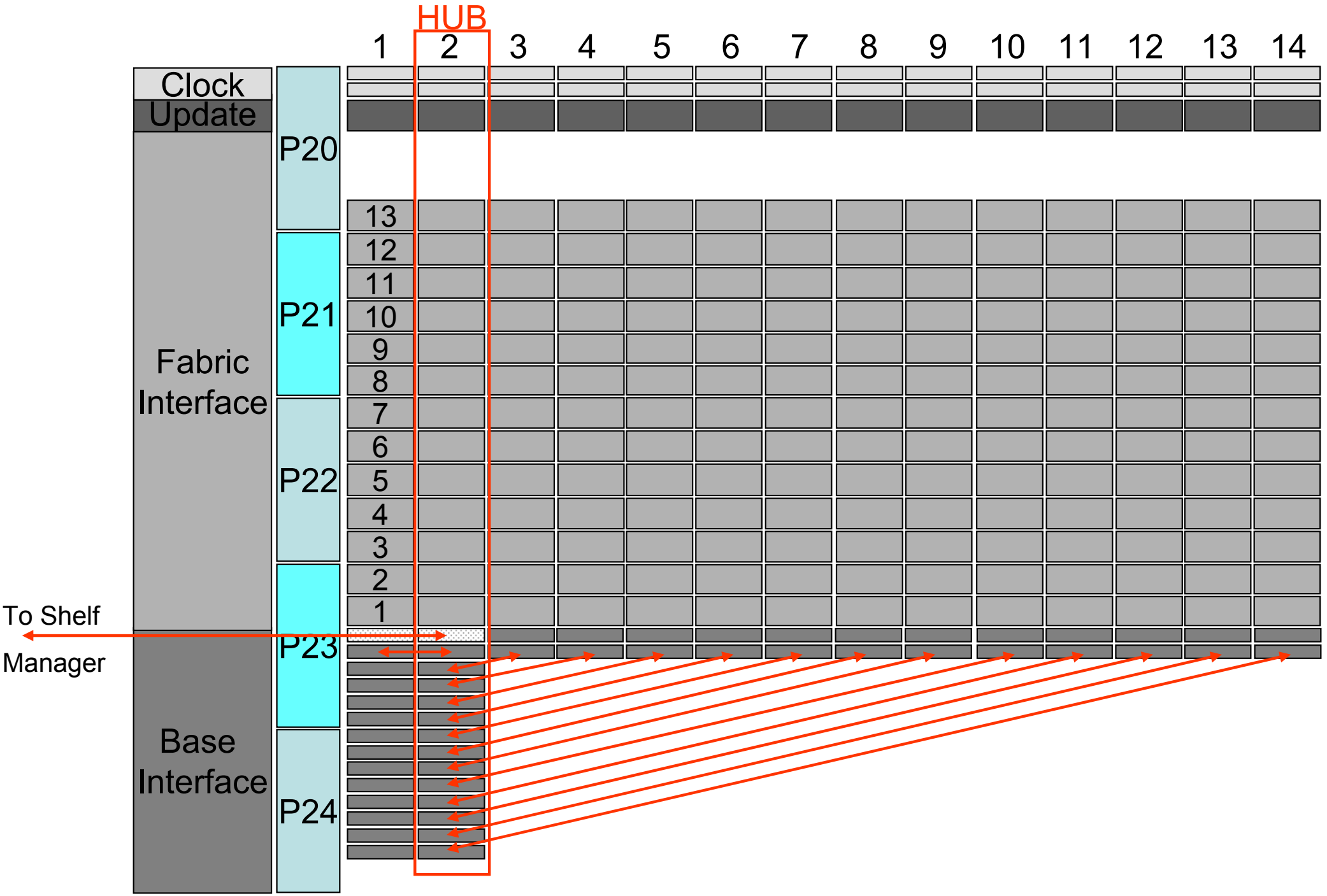
How many slots do we need in one ATCA shelf?

- 5 x Carrier Boards (2 slots each) – 10 slots
  - 4 cards for 4 cryo-modules
  - 1 card as a main controller
- 1 HUB (or 2 for redundancy) – 1 or 2 slots
- CPU – 0,1 or 2 slots
  - 1 CPU without redundancy
  - 2 CPUs with redundancy
  - 0 CPU in case of distributed control system (AMC-CPU cards, processors on carrier cards)

TOTAL: 12-14 slots ATCA shelf

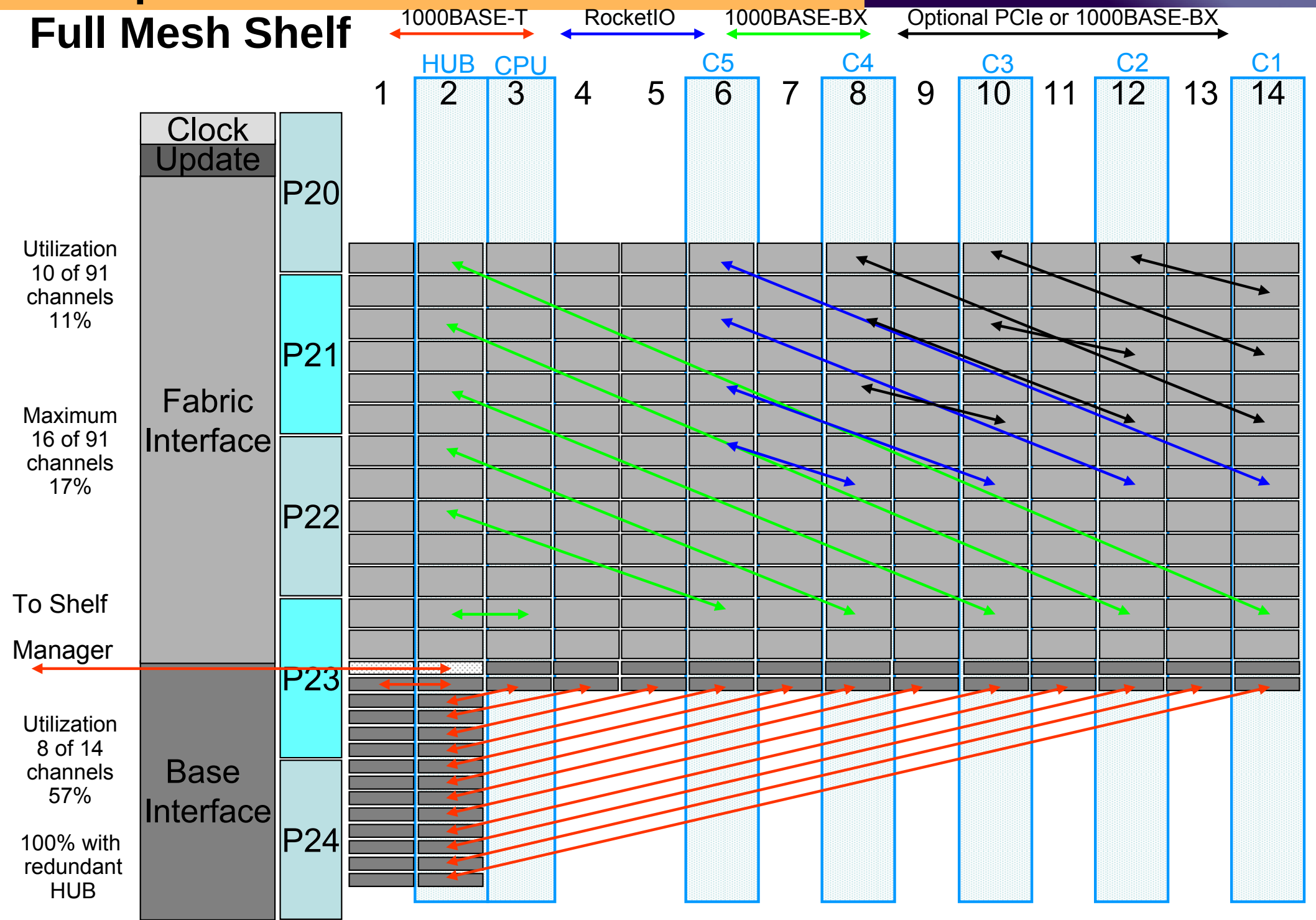
Base Interface in 14 Slots Shelf

The European X-Ray Laser Project XFEL X-Ray Free-Electron Laser



Backplane Links in the 14 Slots

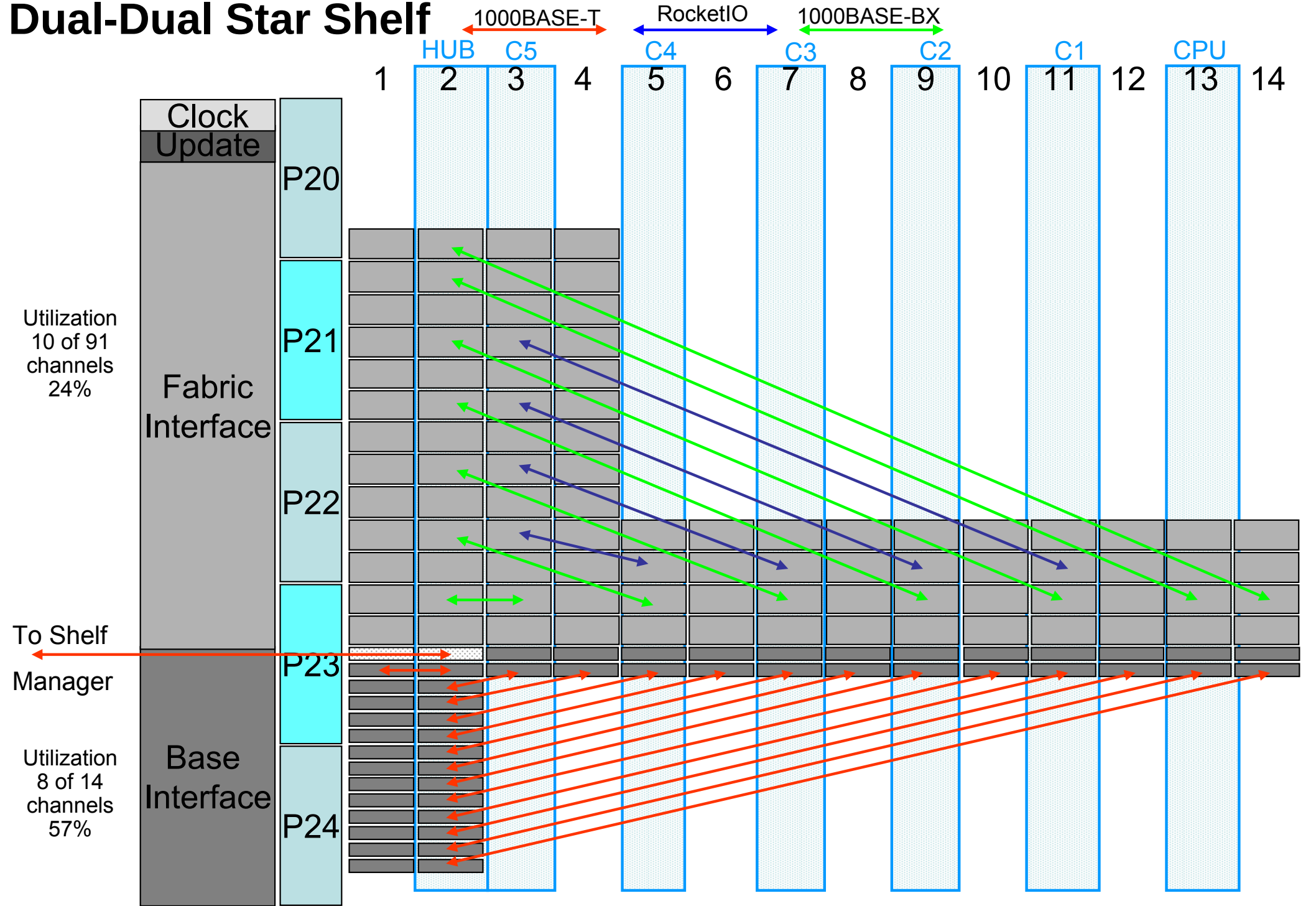
Full Mesh Shelf



Backplane Links in the 14 Slots

The European X-Ray Laser Project XFEL X-Ray Free-Electron Laser

Dual-Dual Star Shelf



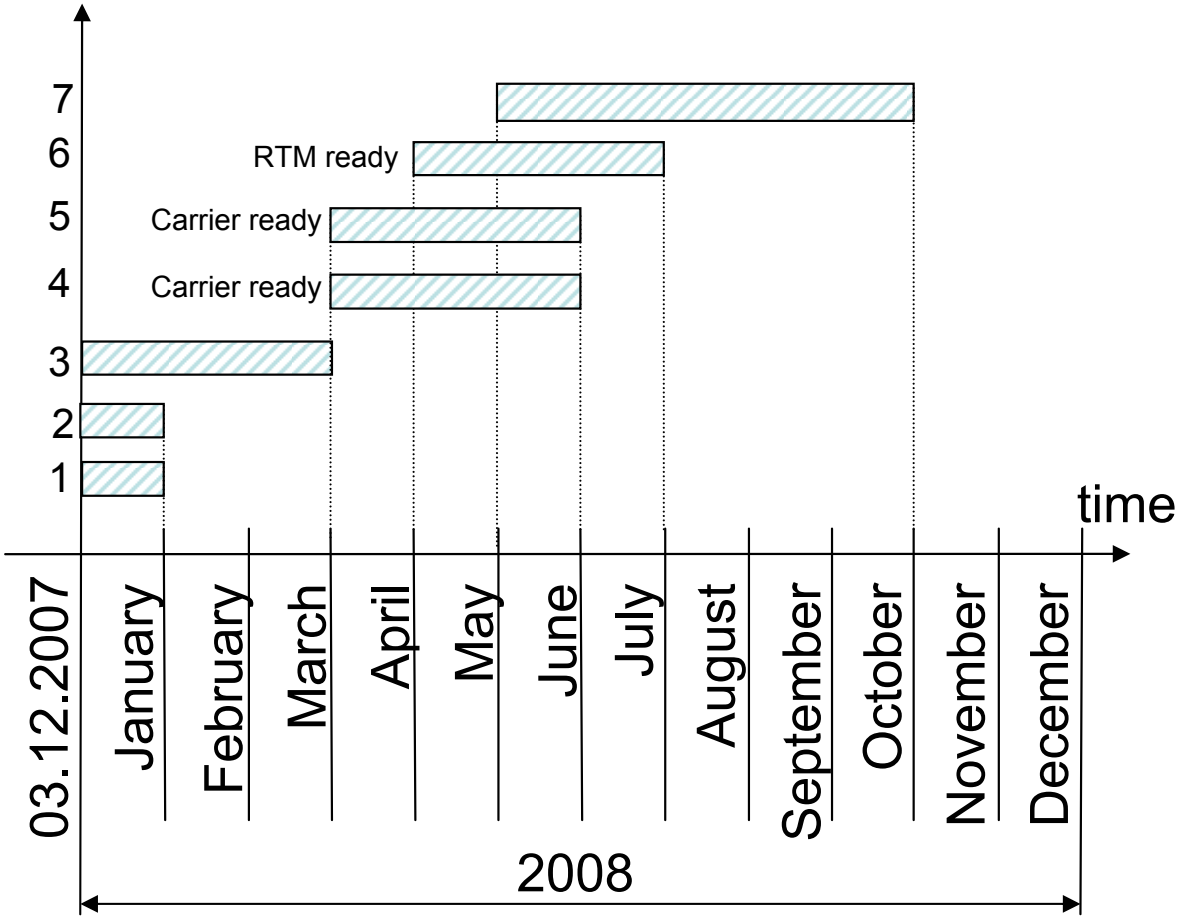
Derived Requirements for the Carrier Card and E-Keying

- One 1000BASE-T ethernet on base interace
- Configurable RocketIO connection to any of 14 channels on fabric interface for low latency link – port 2 and 3 in the channel
- Configurable 1000BASE-BX ethernet on any of 14 channels on fabric interface for DAQ
- I^2C connection from carrier board to RTM

Other requirements

- Universal AMC card with optical link to other systems

Schedule



1. E-Keying definition for IPMI
2. Purchasing HUB card
3. Ethernet communication
   - 1Gb Ethernet on base interface tests using CPU
   - 1Gb Ethernet on fabric interface using CPU
   - HUB configuration
4. PCIe tests
   - Communication between carrier cards on shelf backplane
   - Communication between AMC and carrier cards
5. Low latency link tests on a carrier cards and on a shelf backplane
6. Control link between carrier card and RTM
7. System integration

Thank You