

# LFD Correlator

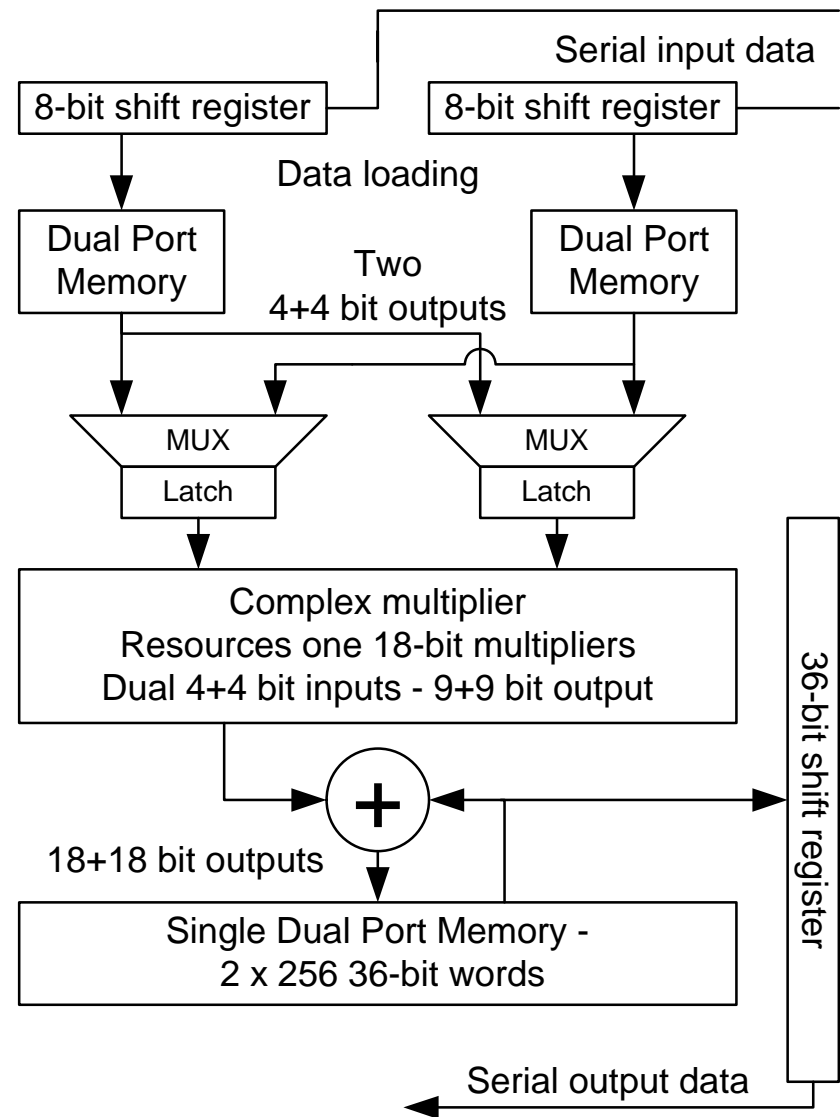
MWA-LFD Kick-off Meeting  
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CSIRO ICT Centre, Sydney

- How do we implement so many?
- Traditionally – Systolic array of multipliers and calculate all at once. Need 2800 FPGAs and we process 300MHz of bandwidth.
- Make each multiplier process multiple baselines per input data set.
- Correlation Cell – currently under development for SKAMP
- LFD to piggy back on this

# Correlation Cell

- Input 16 pairs of data
- Calculate 256 correlation
- 49,152 correlation/FPGA
- For LFD 12 FPGAs
  - 1.2-1.5 MHz of bandwidth
- SKAMP design has six per board
- For LFD up to 12 MHz per card cage
- 4bit complex multiply in 18-bit multiplier
- Accumulation to block RAM

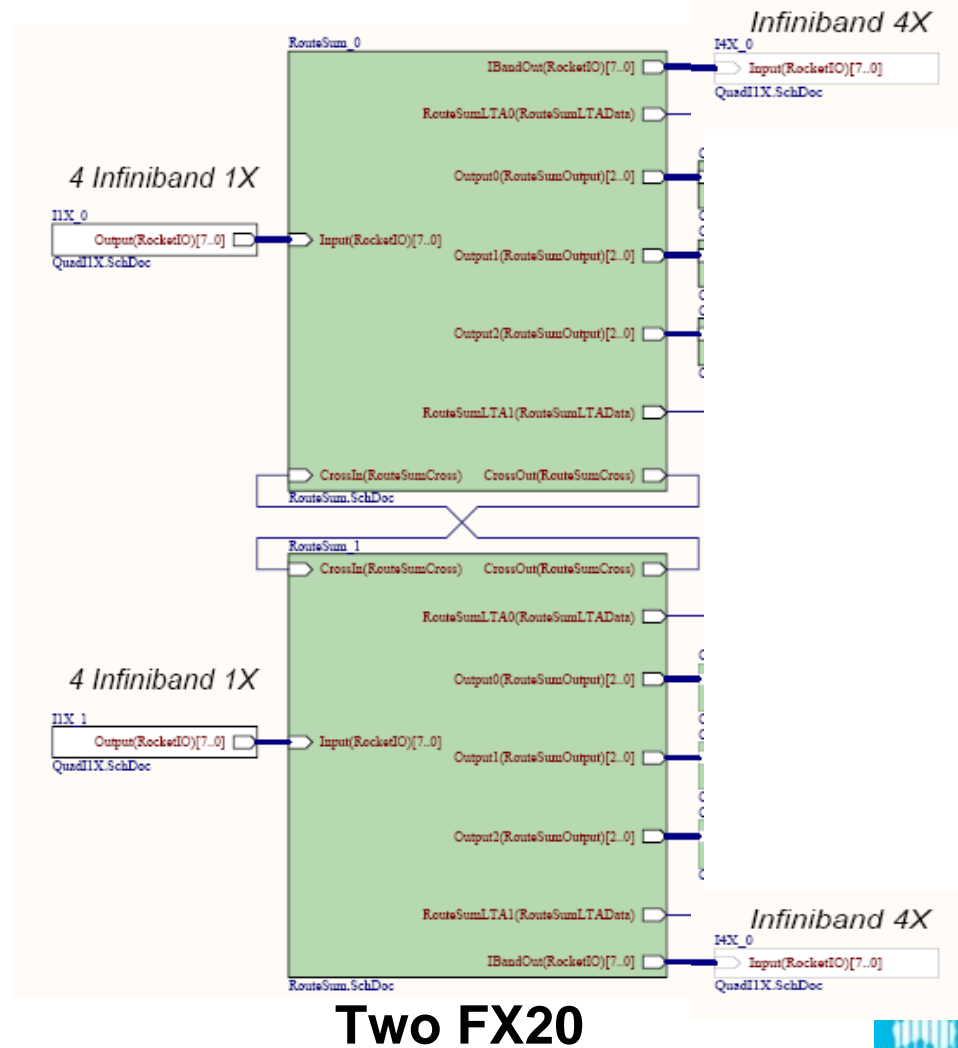


- Based on AdvancedTCA standard
- 8U Boards
- Three connector areas – Power, backplane and free
- Use free area to connect to Rear Transition Module (RTM)
- RTM connectors only - easy to change
- Inbuilt temperature control



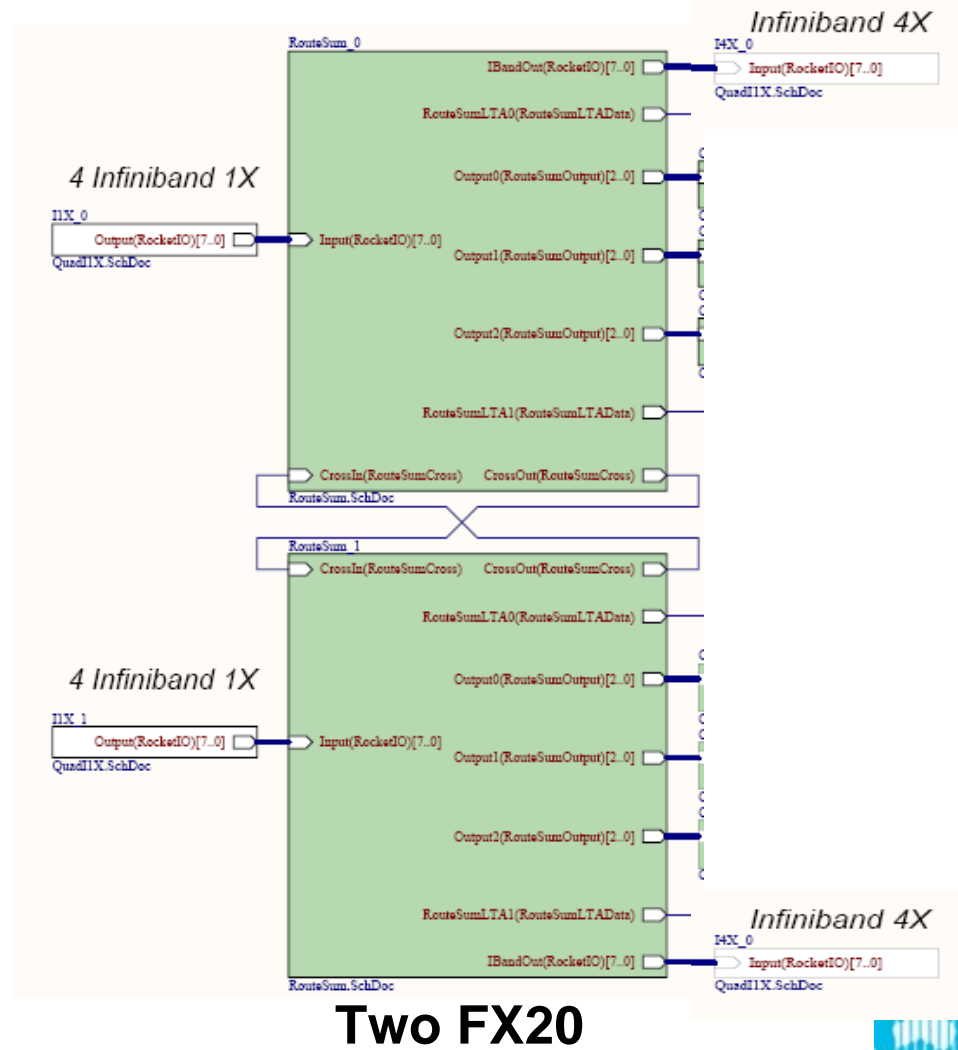
# Input/Output and Route-Autocorrelate

- Two FX20
- Input 16 rocket I/O use unidirectional
- Output 16 Rocket I/O unidirectional
- Can daisy chain modules
- Connector on Rear Transition Module RTM
- Infiniband for SKAMP
- Ethernet CX4 for LFD



# Routing to boards

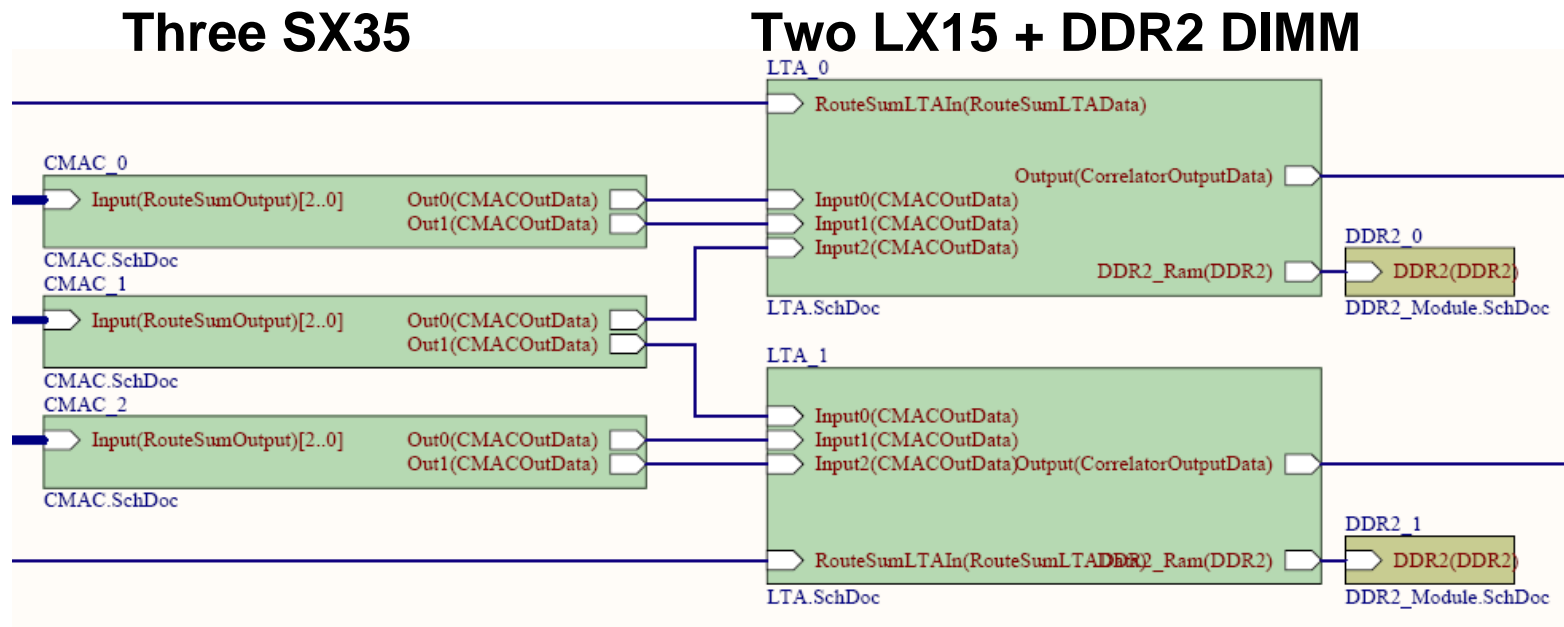
- Pair of boards process 1-1.5 MHz
- Ethernet Switches route appropriate spectral data to appropriate board
- This then daisy chains data to second board
- Can then daisy chain to later generation processing module – pulsar binner?



- Six SX35 FPGAs
- 1152 Correlation cells
- Up to 294k correlations at a time, need 2 boards for full set
- Input requirements 1024 bytes in 256 clock cycles - 4 bytes per clock cycle. Each FPGA needs a subset of the data

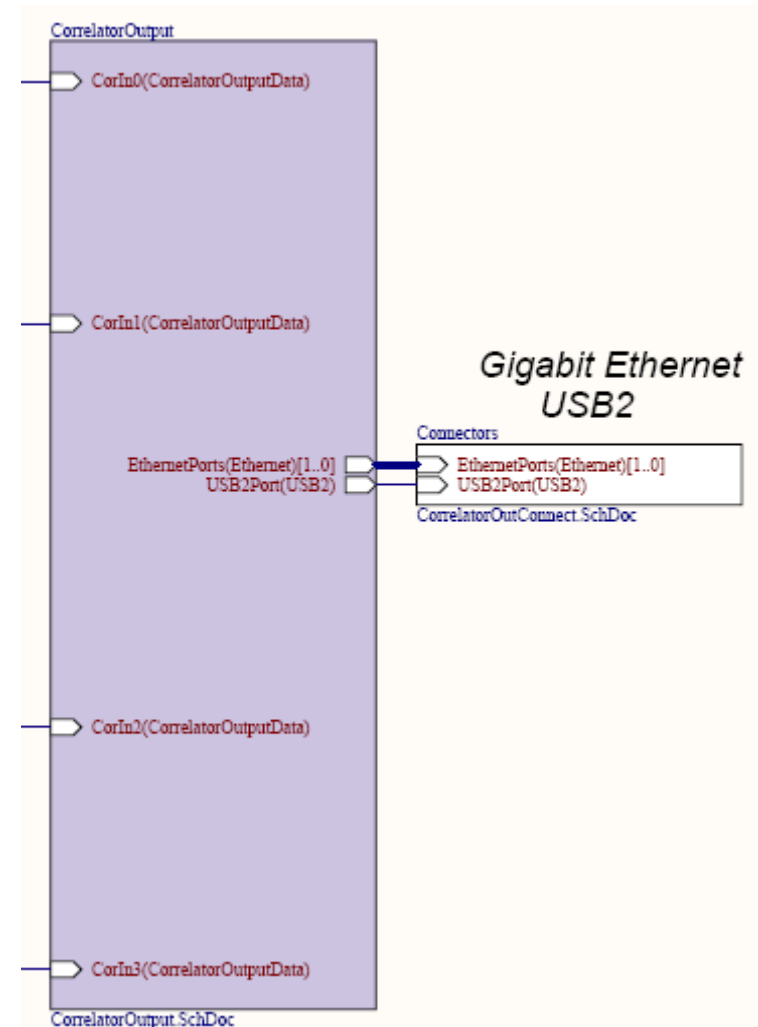
# Long Term Accumulator - SKAMP

- Number of Correlation require DRAM for storage
- Data rate requires two DIMM modules for 3xSX35

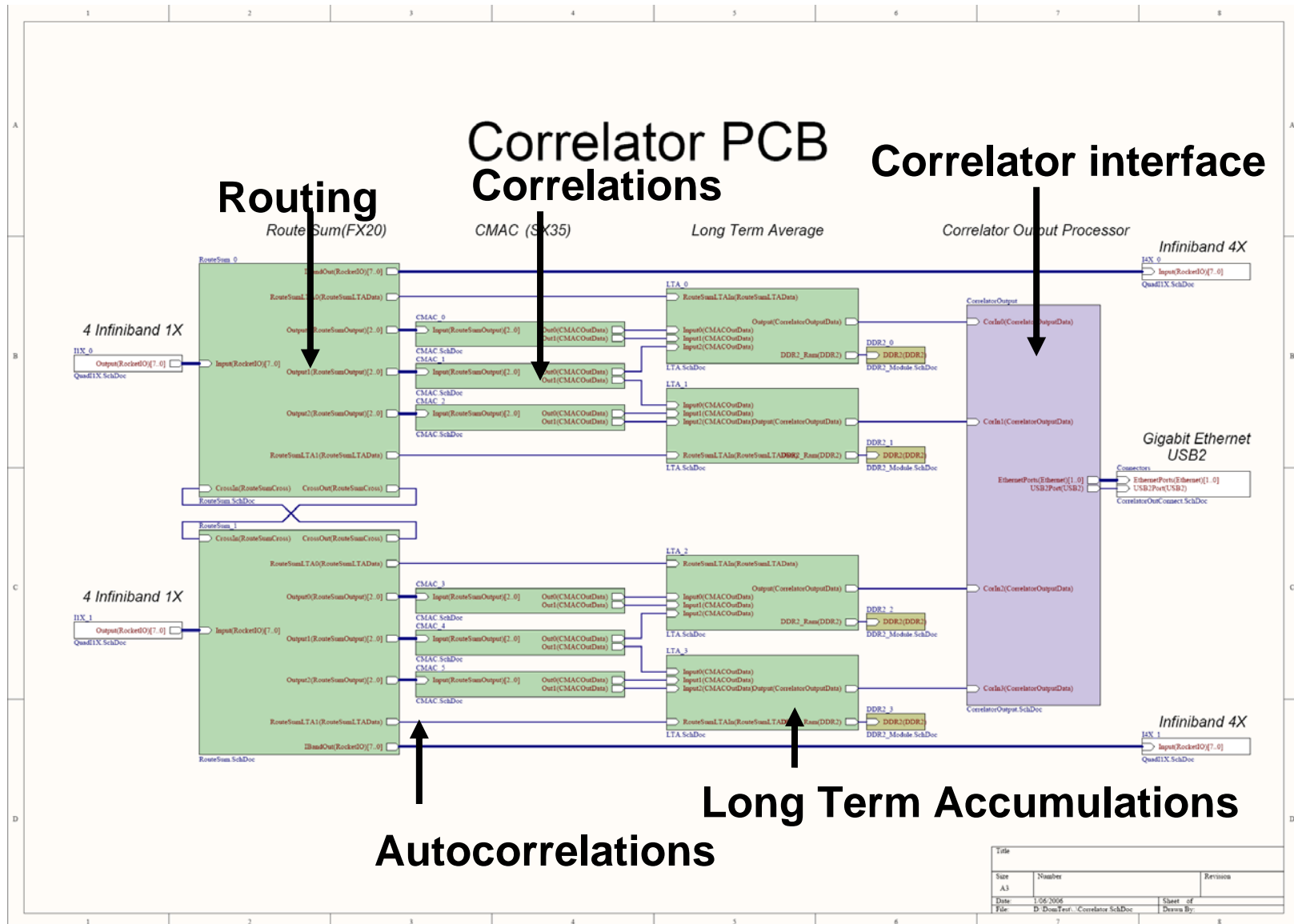


Half of Correlation and LTA hardware

- SKAMP FX12 with flash RAM to configure board
- Two Ethernet connections one is a data pipe, second for control
- USB2 for diagnostics with laptop
- Upgrade to FX20 – adds 8 Rocket I/O for LFD output data rate

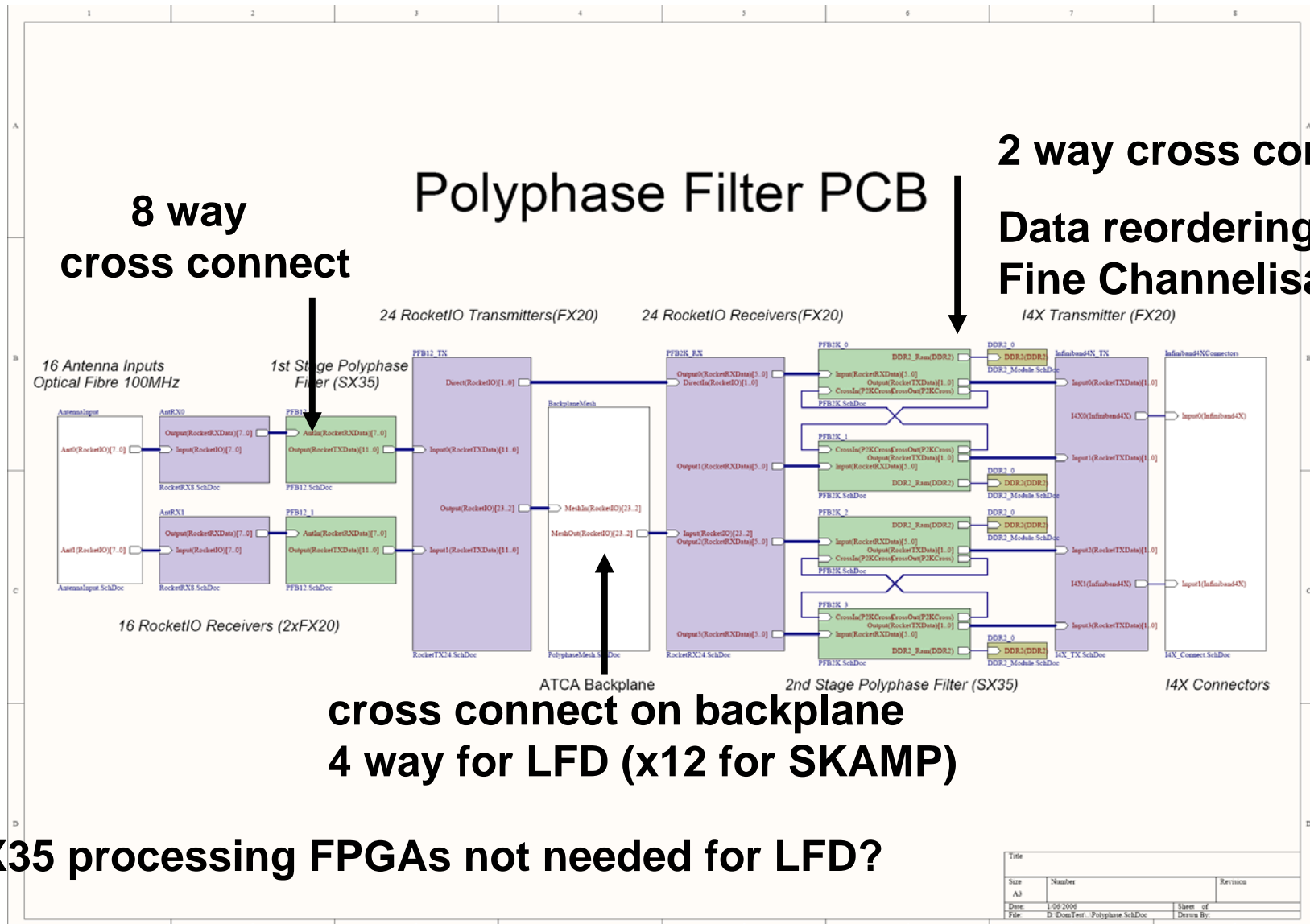


# Schematic of SKAMP Correlator board



- Current LFD concept uses commercial switches
- Process 8 tiles at node – 8 way cross connect.
- Need 64 way at correlator plus data reorder
- 3Gbit fibre has 8 dual pol. @ 16MHz bandwidth
- SKAMP filterbank boards accept 2 x 8 inputs first stage FPGAs.
- 4 way backplane and 2 way in output FPGAs gives full cross connect.

# Cross connects in SKAMP filterbanks



- Schematics being finalised and board definition started. Boards in 3-6 months
  - John Russel & Chris Weimann
- Initial simulation show full utilisation of FPGA memory and multipliers possible.
- More VHDL coding resources needed
  - Currently Ludi de Souza half time