

iFDAQ XCKU Card

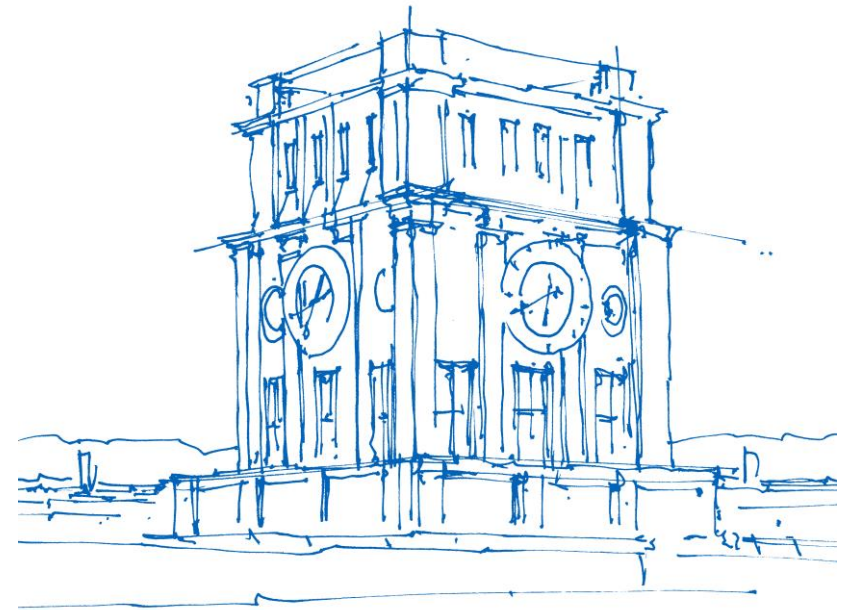
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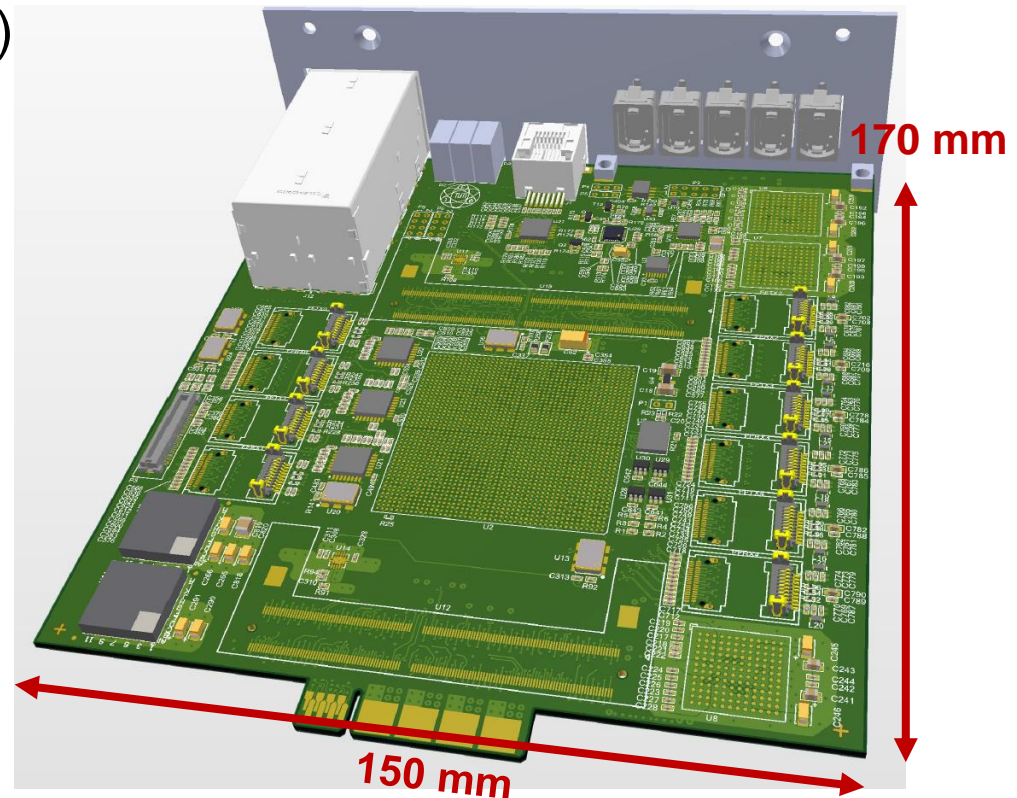
München, February 11th, 2019



Uhrenturm der TUM

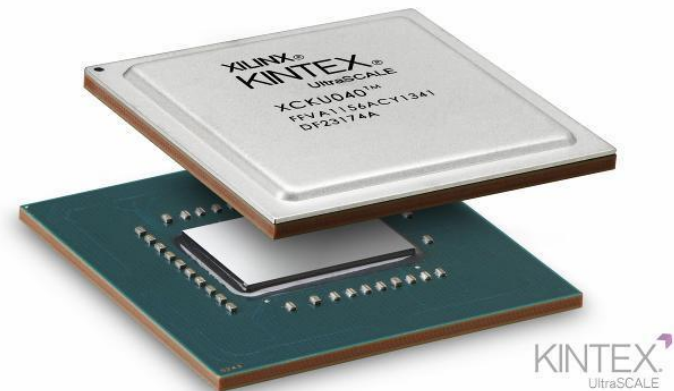
Key Facts – iFDAQ XCKU

- Xilinx Kintex UltraScale XCKU095
- 64 optical links (up to 16 Gb/s)
 - 60 via MPO connectors
 - 4 via SFP+ connector
- 2 DDR4 memory interfaces
- Up to 16 GB total storage
- Clock Jitter Cleaning



iFDAQ XCKU – FPGA

- Xilinx Kintex UltraScale XCKU095
- Package B2104
- 702 I/Os (52 HR, 650 HP)
- 64 Transceivers up to 16.3 Gb/s
- 4 DDR4 memory interfaces
- 59.1 Mb block RAM
- 1,176,000 Logic Cells
- 1,075,200 Configurable Logic Blocks



iFDAQ XCKU – FPGA

UltraScale™ Device Footprint Compatibility								
HR I/O, HP I/O, GTH 16.3Gb/s; GTY 30.5Gb/s								
Package Dimensions (mm)	45x45		47.5x47.5			50x50	52.5x52.5	55x55
	D1924	F1924	A2104	B2104	C2104	B2377	A2577	A2892
XCKU035								
XCKU040								
XCKU060								
XCKU085		104, 520, 56, 0						
XCKU095		N/A		52, 650, 32, 32 ⁽¹⁾				
XCKU115	156, 676, 52, 0	104, 624, 64, 0	156, 676, 52, 0	104, 598, 64, 0				
XCVU065			N/A	N/A				
XCVU080			52, 780, 28, 24	52, 650, 32, 32				
XCVU095			52, 780, 28, 24	52, 650, 32, 32	52, 364, 32, 32			
XCVU125			52, 780, 28, 24	52, 650, 40, 36	52, 364, 40, 40			
XCVU160				52, 650, 40, 36	52, 364, 52, 52			
XCVU190	Footprint compatibility is indicated by shading per column.			52, 650, 40, 36	52, 364, 52, 52		0, 448, 60, 60	
XCVU440						52, 1248, 36, 0		52, 1404, 48, 0

KINTEX.
UltraSCALE

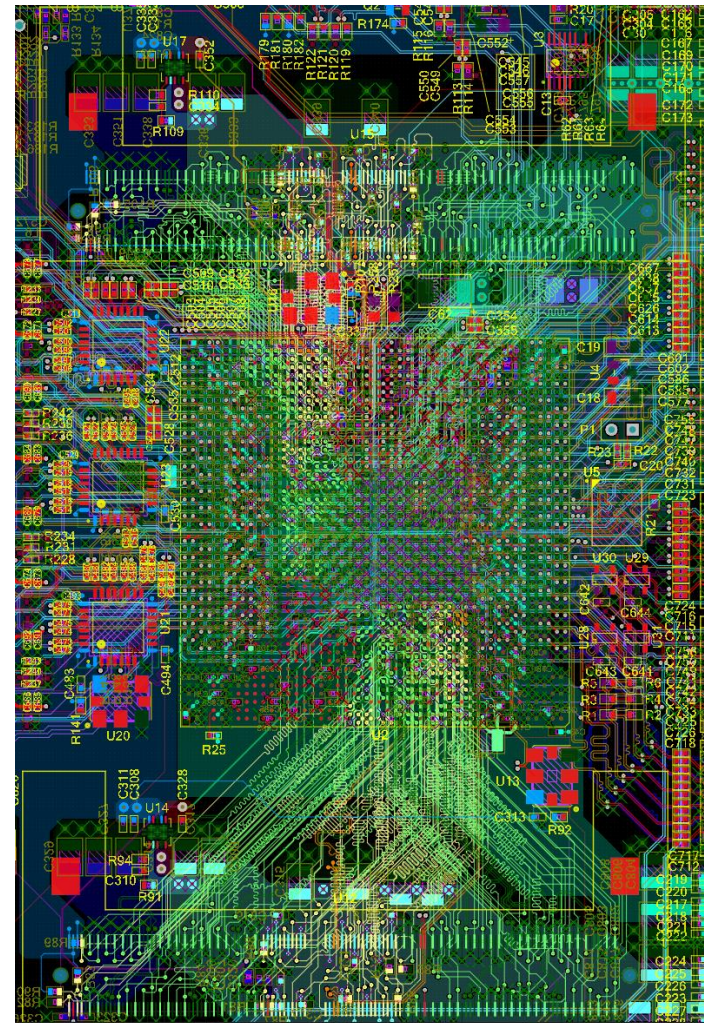
VIRTEX.
UltraSCALE

iFDAQ XCKU – Memory Interface

- 2 DDR4 memory interfaces
- 5 GB/s throughput
- Total of 16 GB (2x 8GB) of storage
- Placement of memory on opposite sites to distribute load
- Update to new faster GDDR6 standard potentially possible (>>10 GB/s throughput)

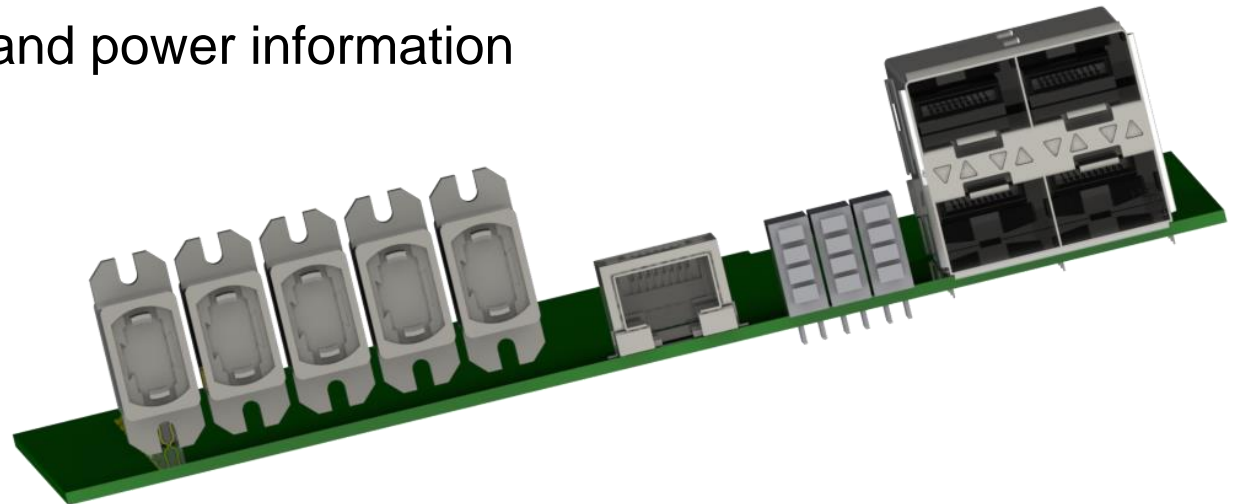


Micron MTA16ATF1G64HZ-8GB



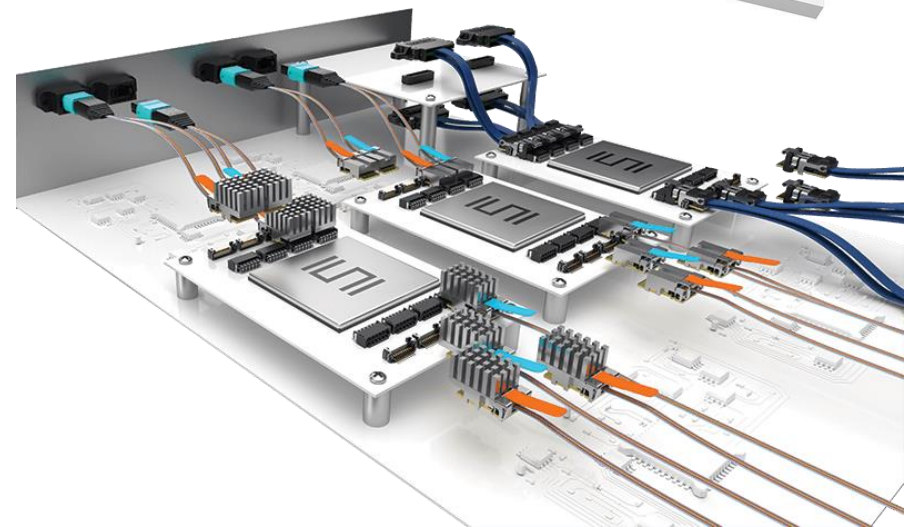
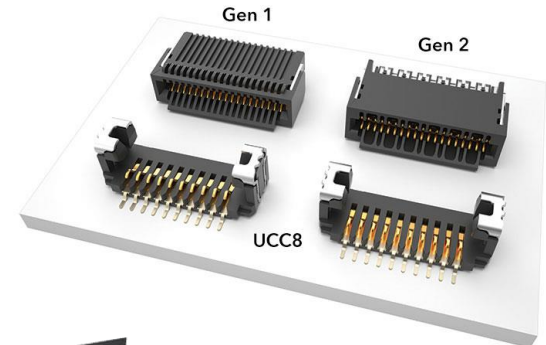
iFDAQ XCKU – Front Panel

- 4 SFP+ ports
 - Slow Control
 - Trigger/Timing
- Ethernet port
 - Trigger/Timing
- LEDs for status and power information



iFDAQ XCKU – Samtec FireFly

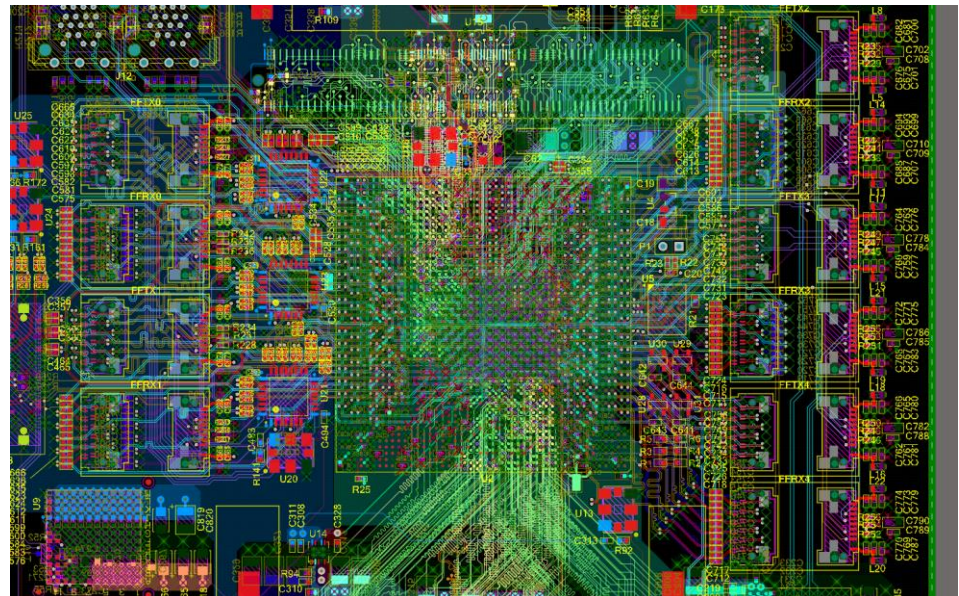
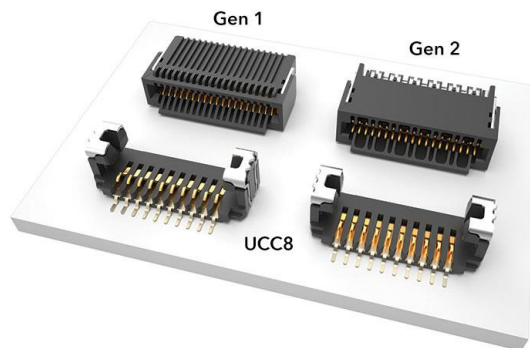
- 60 links via 5 ECUO-Y12-16-180-0-2-1-1-21
- 12 RX/TX pairs per FireFly module
- Y configuration with one transceiver for RX and one for TX
- Configurable via I2C
- Monitoring via I2C
- Up to 16 Gb/s
- Faster FireFlies currently under development
- Easily exchangeable



Samtec ECUO-Y12-16-180-0-2-1-1-21

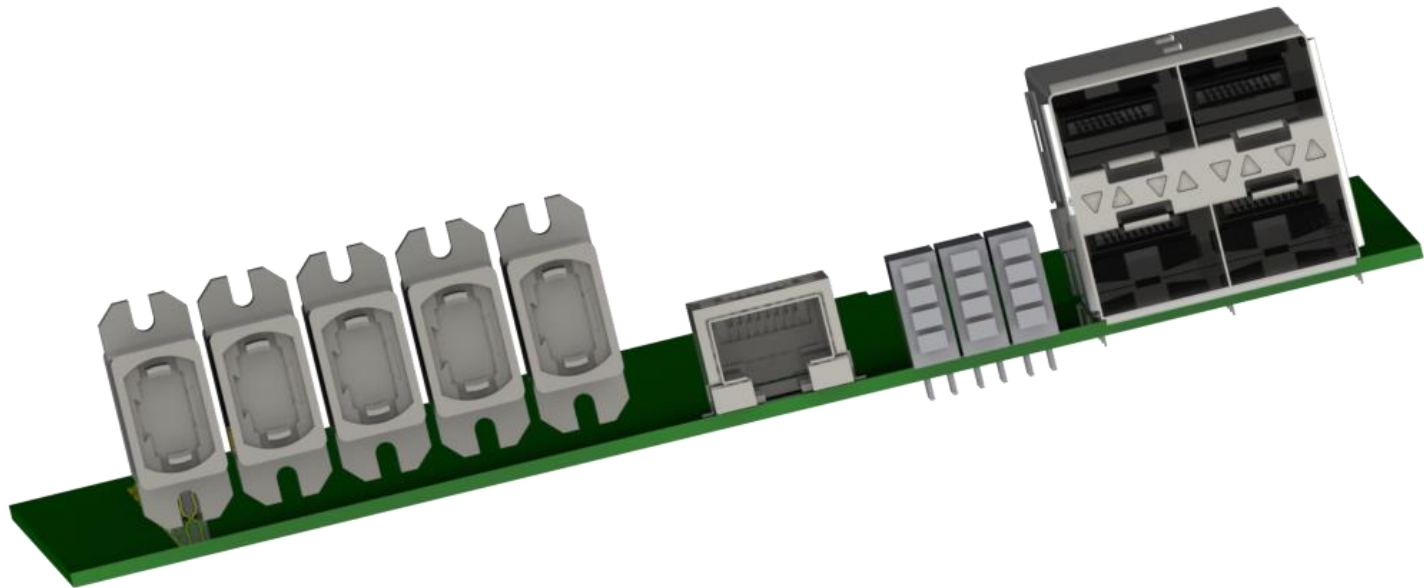
iFDAQ XCKU – Samtec FireFly

- Distributed over the board
- Equal load throughout the FPGA
- Space saving
- Easier routing



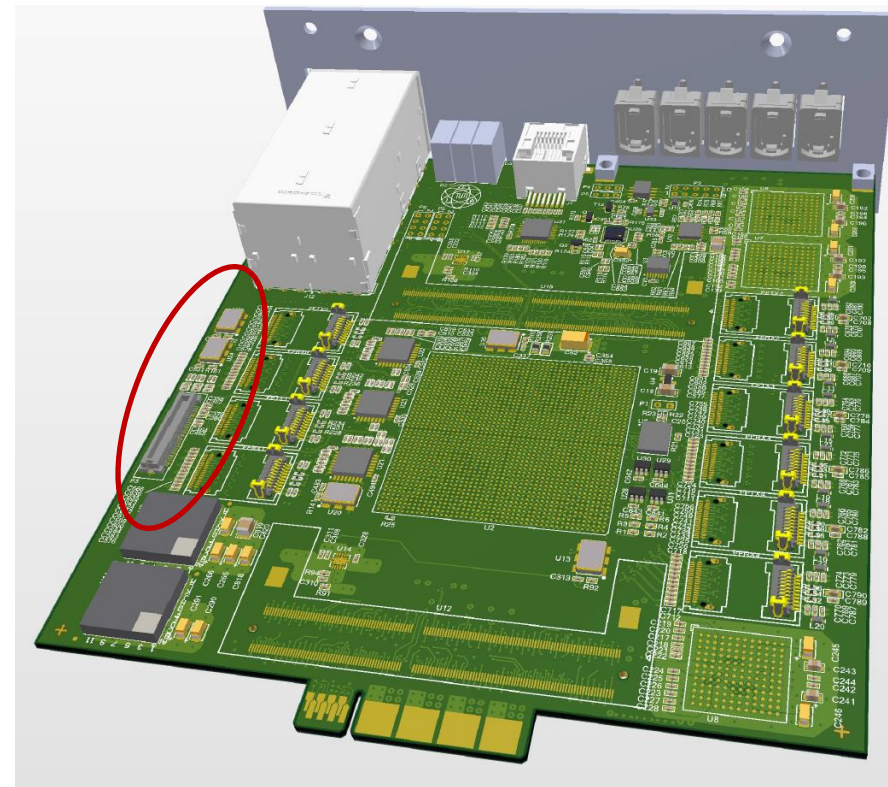
iFDAQ XCKU – Samtec FireFly

- Space saving front panel
- 5 MPO connectors
- 12 Channel fully duplex per MPO
- Easy interface with current FPGA switch



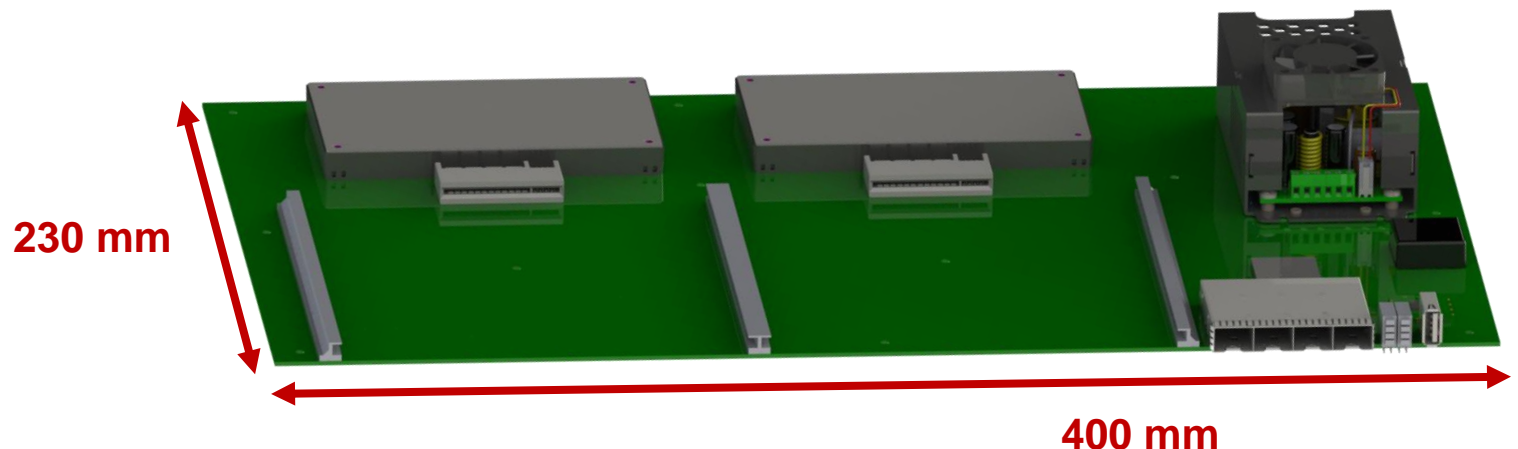
iFDAQ XCKU – Clocking

- Three frequencies available on all transceivers
 - 125 MHz
 - 155.52 MHz
 - 127.76 MHz
- High-Speed connector for attaching clock synthesizer and cleaner
- Synthesized clocks also available on transceivers
- Phase locking to external clock



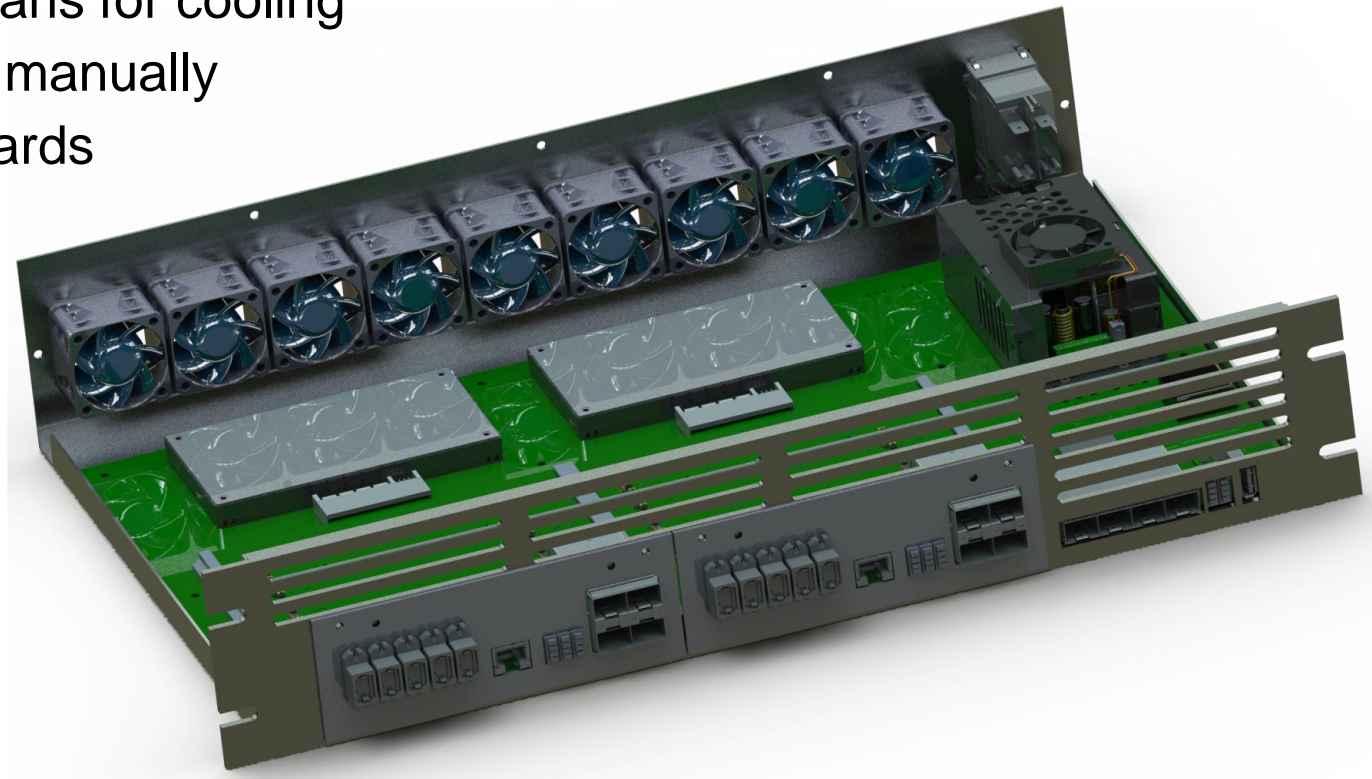
iFDAQ XCKU – Carrier

- Xilinx Artix 7 XC7A100T FPGA
- 4 optical links via SFP+ connector
- USB JTAG connection
- Configuration of XCKU card
- Switching On/Off XCKU cards remotely
- One PFE500F 12 V 500 W AC/DC converter per XCKU
- Fan control for cooling



iFDAQ XCKU – Carrier

- 2U 19 inch rack box
- Holds two XCKU cards plus carrier
- 9 high power fans for cooling
- 3 switches for manually powering all cards



Why don't we take the
ATCA standard?

ATCA Standard

- Advanced Mezzanine Card (AMC)
- 19-inch rack-mountable shelves
- Rear Transition Modules
- Backplane connections
- 100 Ω impedance high-speed connectors
- Hot pluggable
- Shelf management module
- Up to 600 W single AMC module
- Up to 800 W double AMC module



aTCA-H8606C

ATCA Standard

- A lot of overhead which we don't need
- Bad quality of links via the backplane
- Bad connections of modules in the shelf
- NOT hot pluggable → many broken DHx modules
- AMC connector only distributed by one small company and only rarely available

How does the system
compare to recent
developments?

Alveo – U250 Data Center Accelerator Card

- XCU250 Xilinx FPGA
- 16-lane PCIe Gen3 interface
- 4 16 GB DDR4/GDDR6 memories
- 2 QSFP28 (100 GbE)
- 8 optical links
- 77 GB/s off-chip total bandwidth



Comparison - Conclusion

- Trend goes to
 - faster links
 - higher throughput
 - DDR4/GDDR6 memory
 - FPGA technology also in data centers and AI
- iFDAQ XCKU card is at the cutting edge of this development

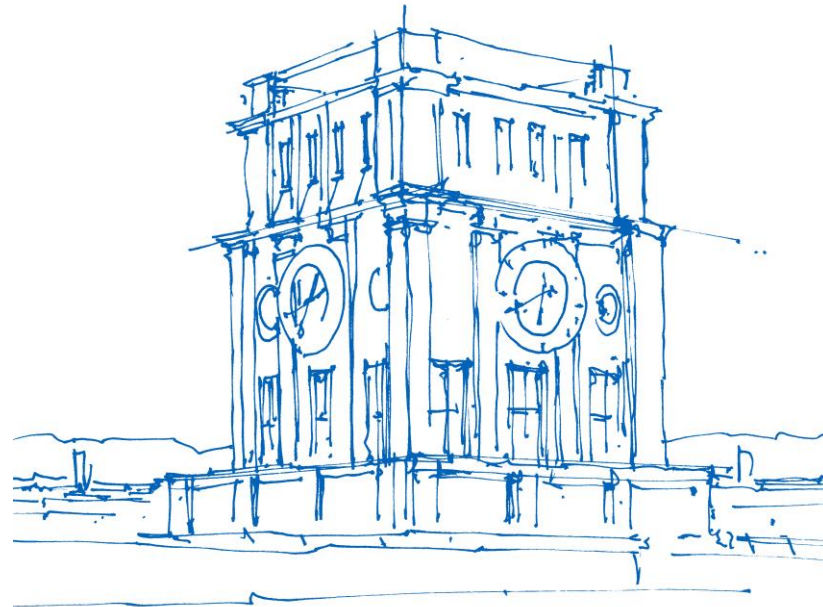
Conclusion

- New FPGA card developed
 - 64 optical links up to 16 Gb/s
 - 16 Gb of memory
 - 4 Gb/s throughput
 - Replaces up to five old DHx cards
 - Multipurpose
- Cutting edge transceiver technology

Outlook

- XCKU prototype card ordered
- Tests are in preparation
- Radiation test of transceivers are in preparation
- Carrier card ordered
- Complete system test in the next 2 month

Thank you for your attention



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