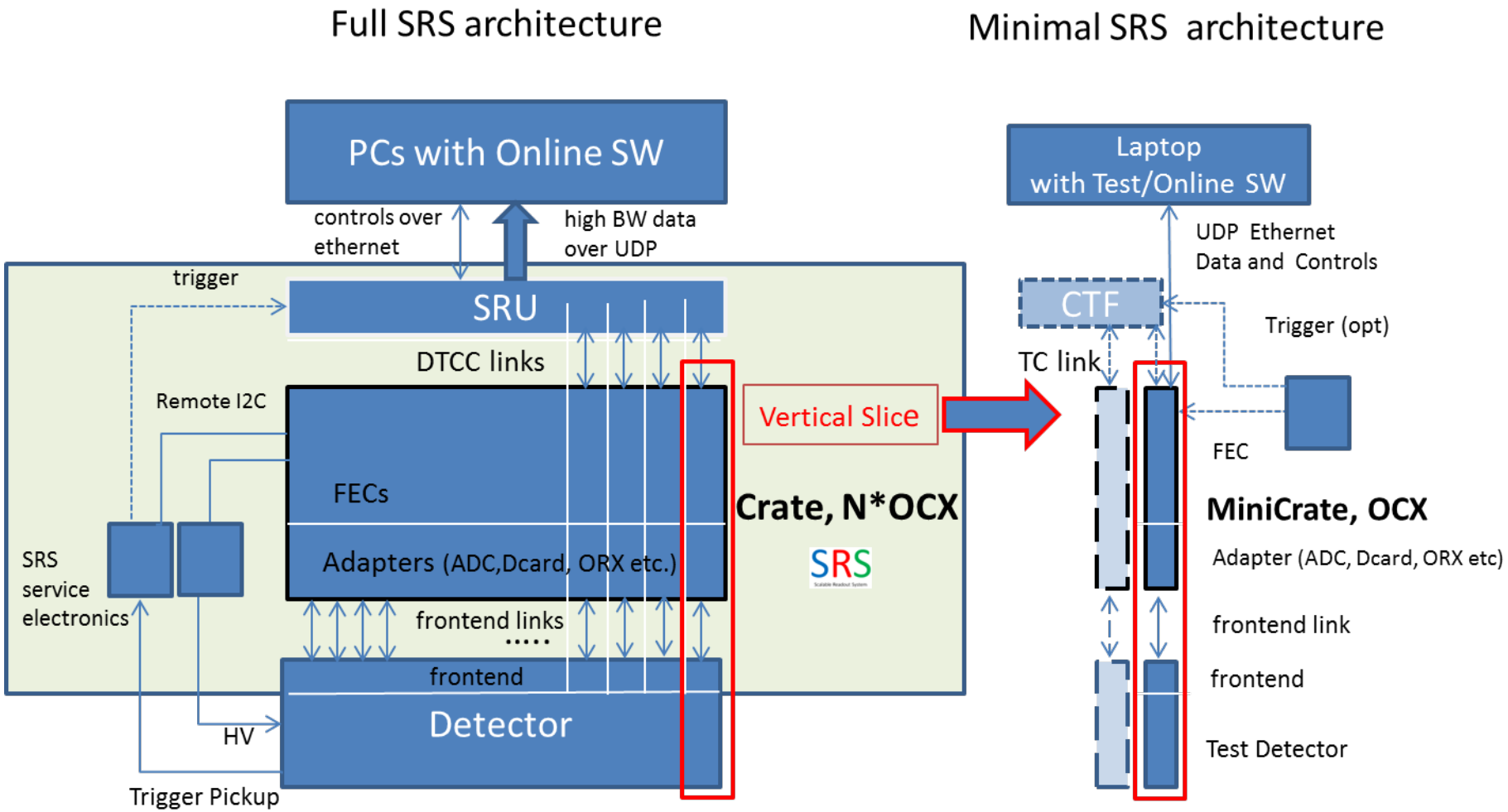
Optical SRS systems

Optical-Copper media for SRS frontends

a new implementation of the scalable SRS slice for distributed frontend readout via optical fibres

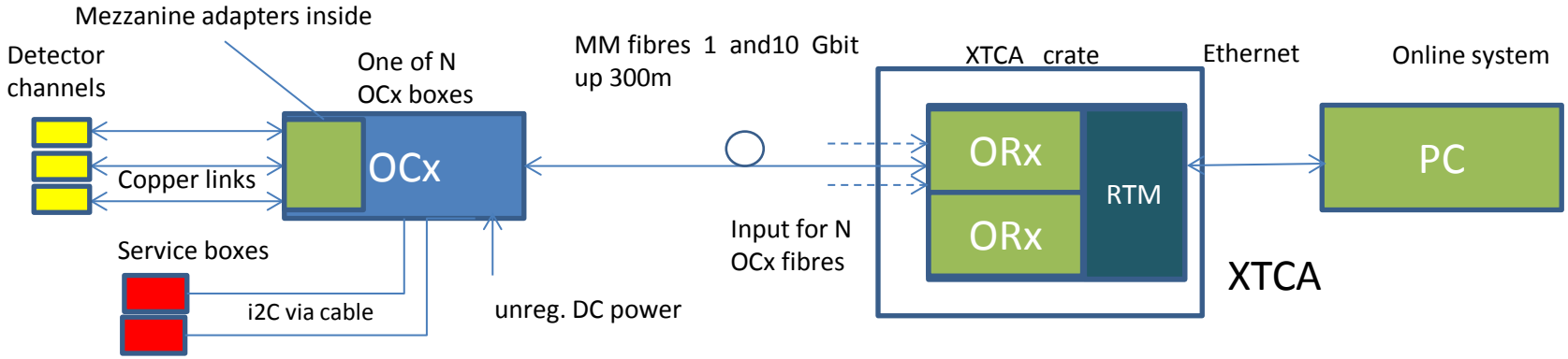
CERN, UPV-Valencia, IFIN-HH Bucharest
RD51 collaboration

SRS architecture



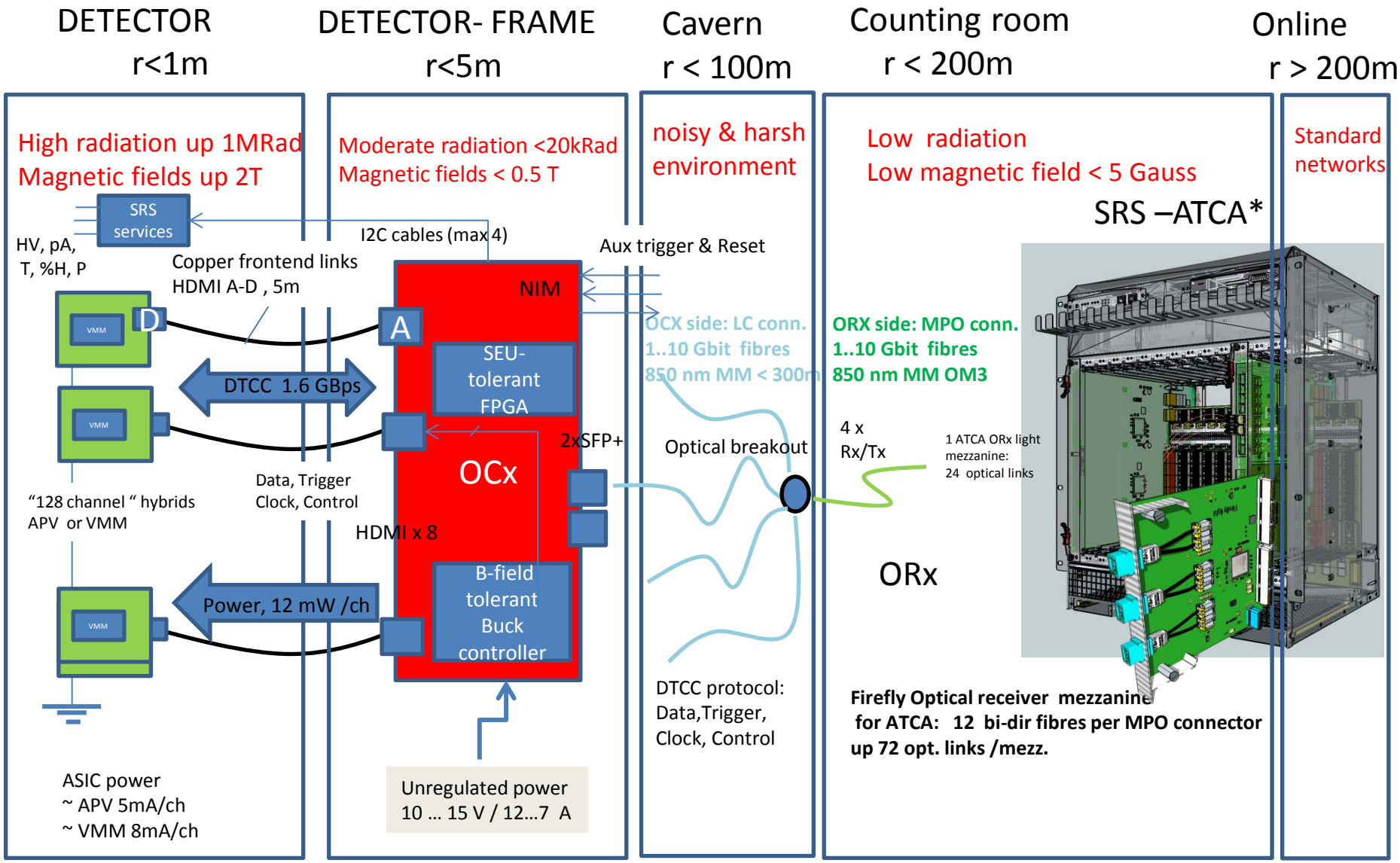
Optical SRS overview

OCx: **O**ptical-**C**opper Junction box for SRS frontends
ORx: **O**ptical **R**eceiver mezzanines for xTCA



- Extension of SRS readout architecture **over distance**
- Readout of **spatially distributed detectors**
- Operation in **magnetic fields**
- Same Mezzanine adapters for XTCA and for OCx (analogue, digital etc)
- ORx typically multi - fibre optics receivers
- OCx close to points of high radiation (copper links to detector hybrids)
- Power via 2-wire unregulated DC 10-15 V (max 120 W)

LHC experiments: from detector to counting room

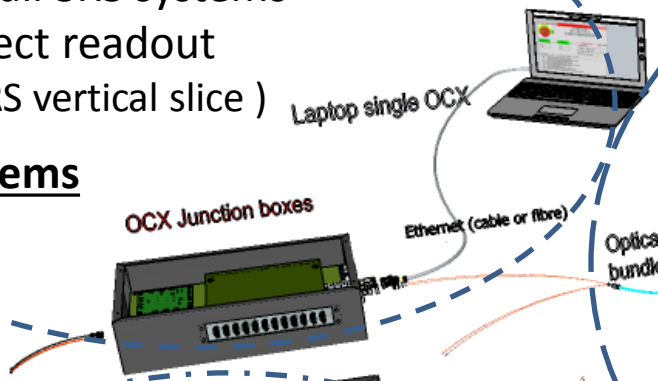


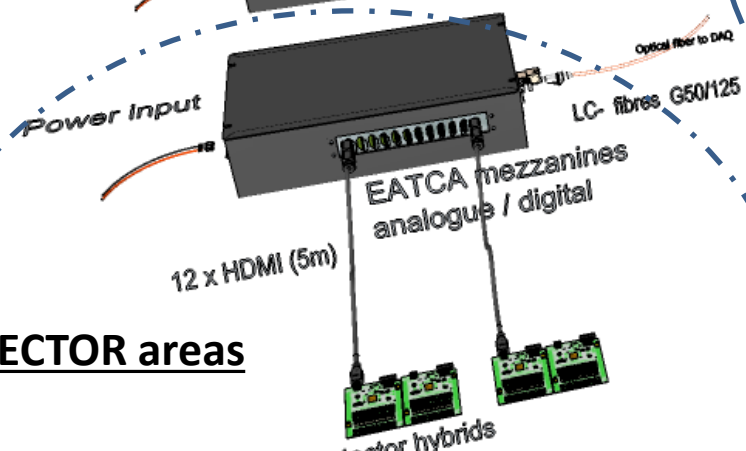
OVERVIEW

Optical SRS for distributed Mini systems

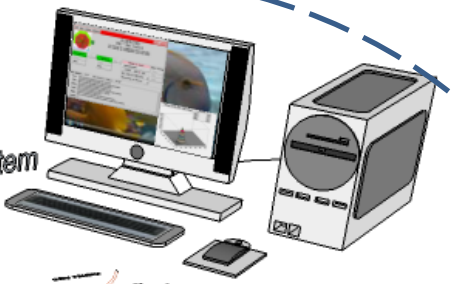
Small SRS systems
direct readout
(SRS vertical slice)

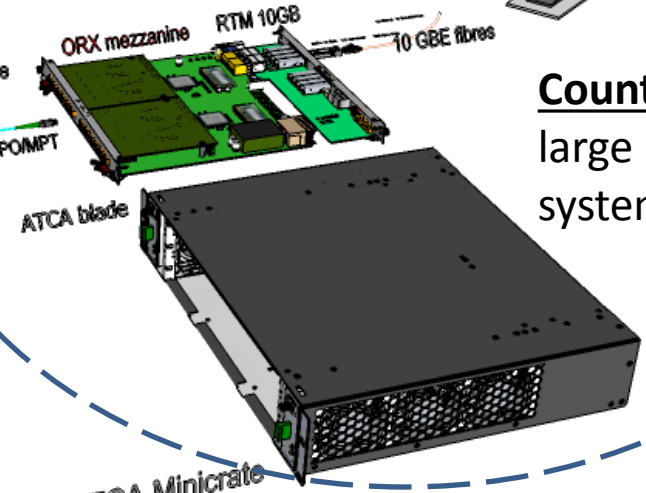
TEST systems





DETECTOR areas





Counting room
large channel SRS system

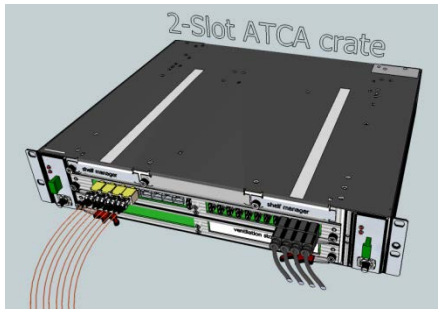
Remote OCx frontend clusters up 3k ch
unregulated DC input power max 100W
operation inside strong B fields
SEU auto-reboot

SRS-ATCA
for spatially distributed detectors

10GBE links

Online system
for all detector channels
PC in counting house

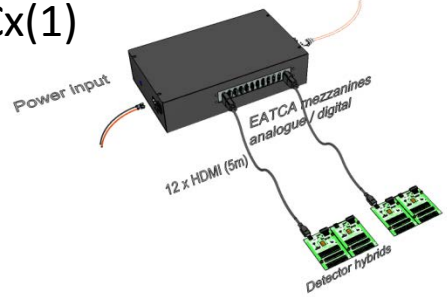
Concentrator
crate for
optical fibres
(SRS ATCA)



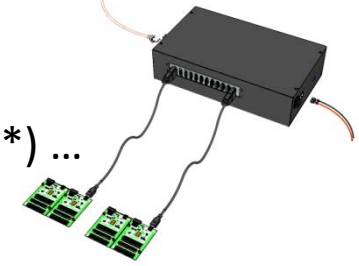
OCx(1)

n optical MM fibres up 300m

OCx(n)



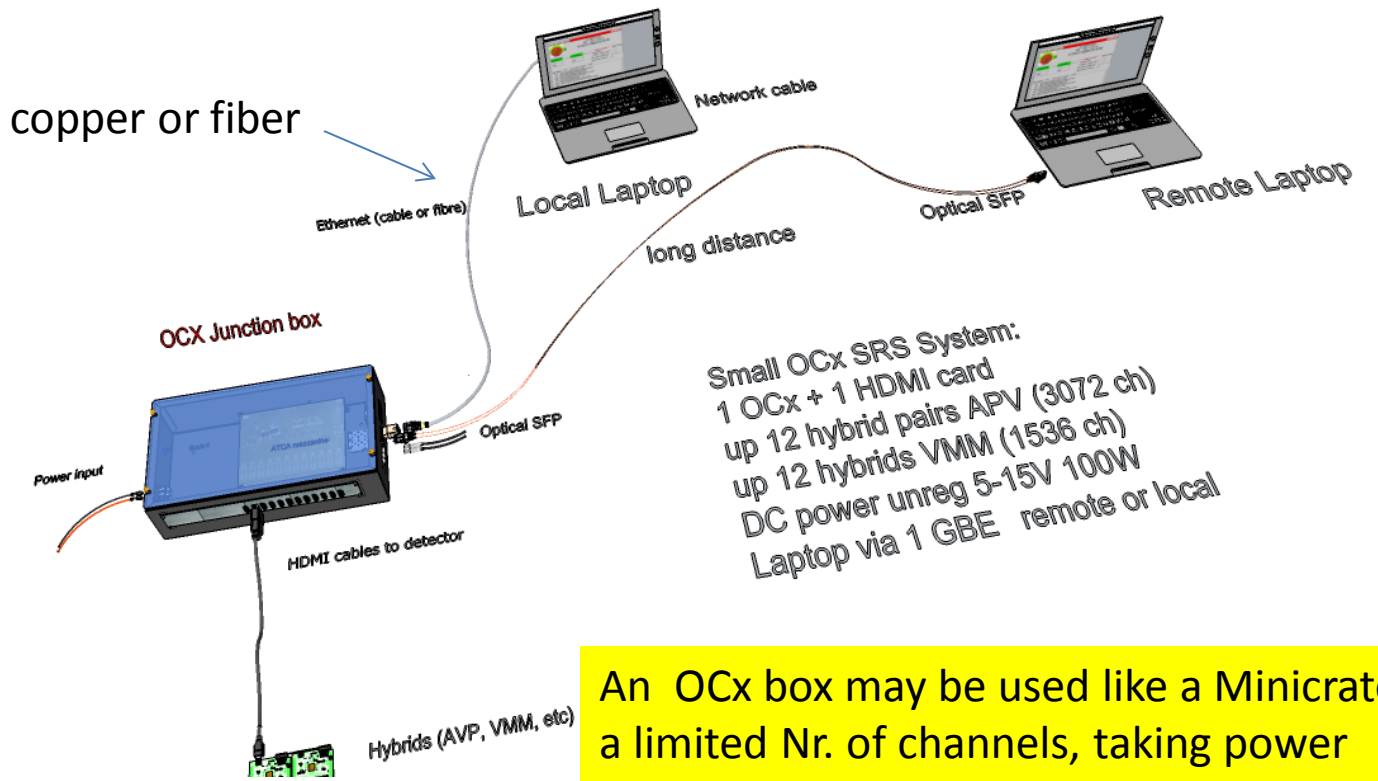
….distance (10 .. 200m*) …



up 3k APV frontend channels

* distance further with 36 –way Firefly mezzanines

Small OCx SRS systems (Test systems)



An OCx box may be used like a Minicrate for a limited Nr. of channels, taking power from an unregulated 12V DC line, and connected to a local or remote Laptop via fibre or network cable

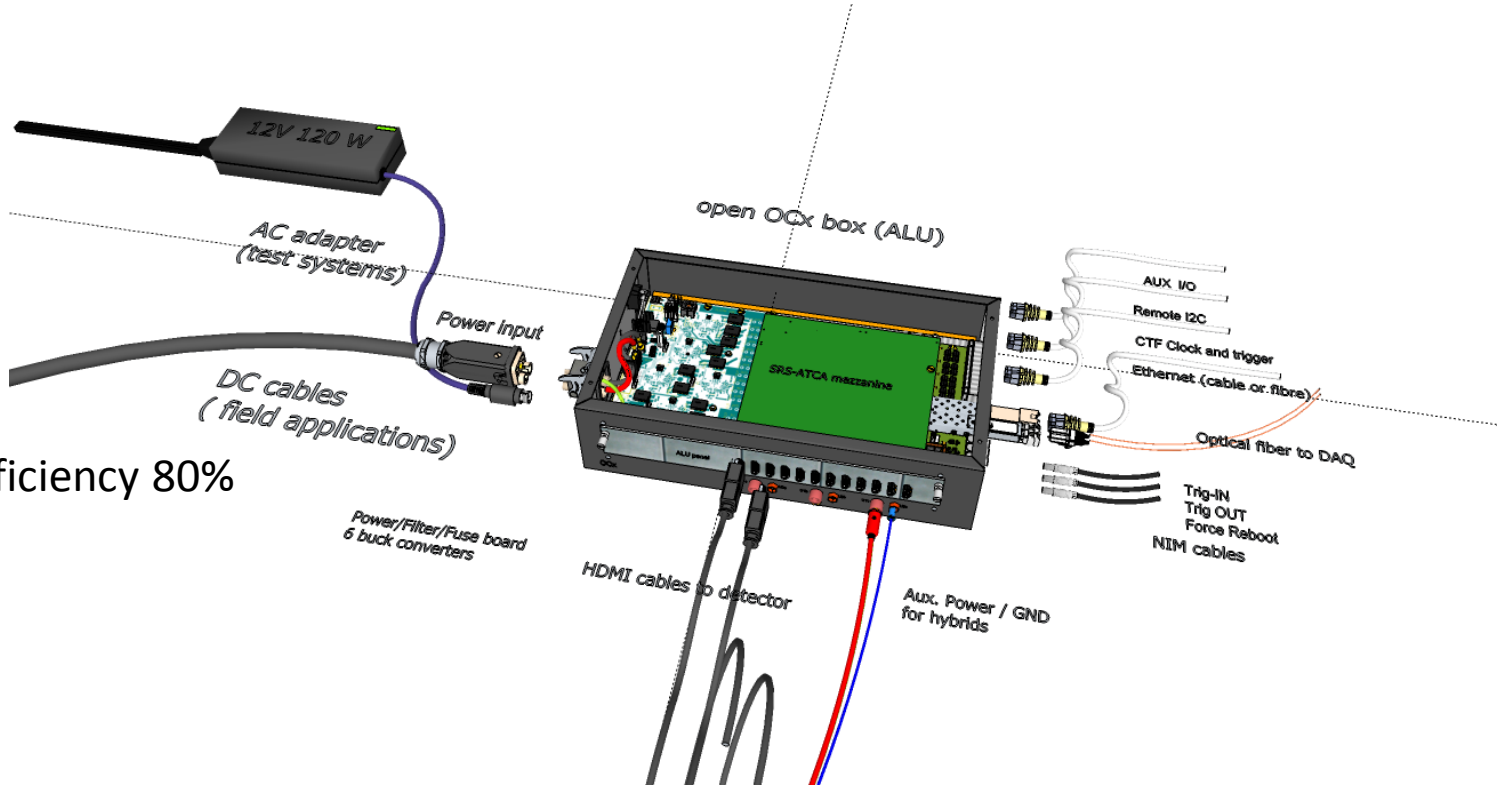
OCx Junction box

OCx: Optical-Copper junction box

SRS for detectors (also in magnetic fields)
readout via fibre or copper

OCx is another implementation
of a complete SRS vertical slice.
It may be used stand –alone with
a Laptop connected via GBEthernet

OCx box works in moderate magnetic fields < 0.5 T
Powers up to 3 k channels (APV or VMM chips on detectors)
Implements safe boot from backed- up Flash
Accepts ATCA mezzanines with copper links to frontend
Accepts SRS classic mezzanines (ADC-DCARD) via adapter
Transmits and receives data via DTCC protocol
1 Gbit or 10 Gbit Ethernet for direct readout



Power efficiency 80%

OCx Connections

3x NIM 50 OHM
- Remote RESET
- AUX IN (Trig, test)
- AUX out (Trig, test)

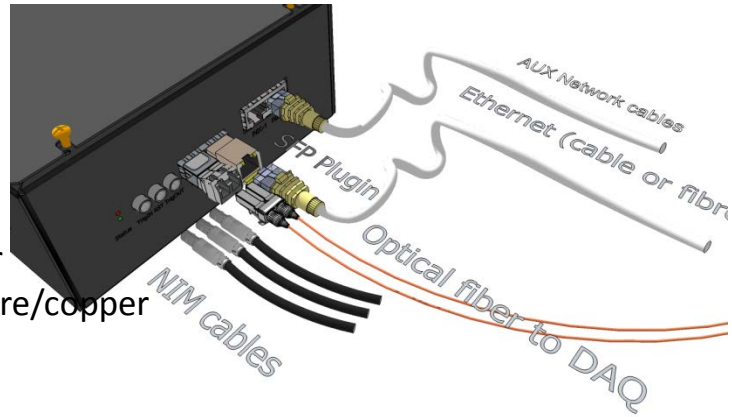
2x SFP+
- 3Gbit DTCC fiber /copper
- 1 or 10 Gbit Ethernet fibre/copper

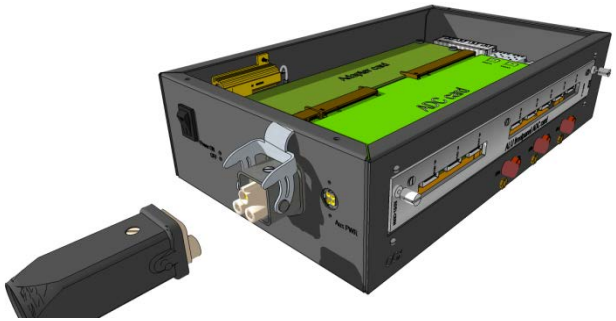
4 x RJ45 LVDS

CTF, remote I2C, 2 x AUX

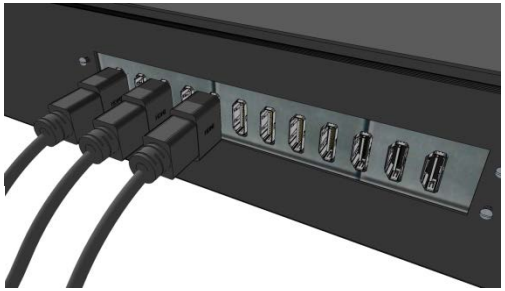
2x LED indicators
- Event Upload (green)
- Configuration Download (red)
- Error (red blink code)
- Reboot (green blink code)

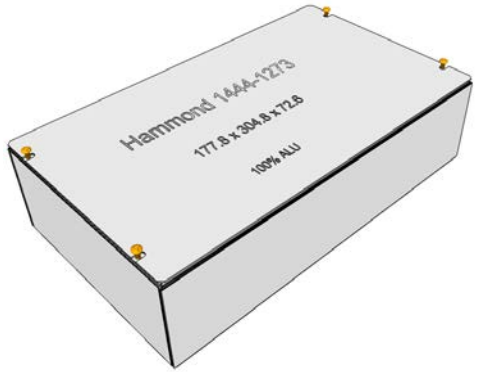
Input Power
- DC Underground installations: via Harting Q3/s 10-15 V / 20A
- Test systems: commercial 12 V /10A AC adapters with 4 pin KYCON Power connector





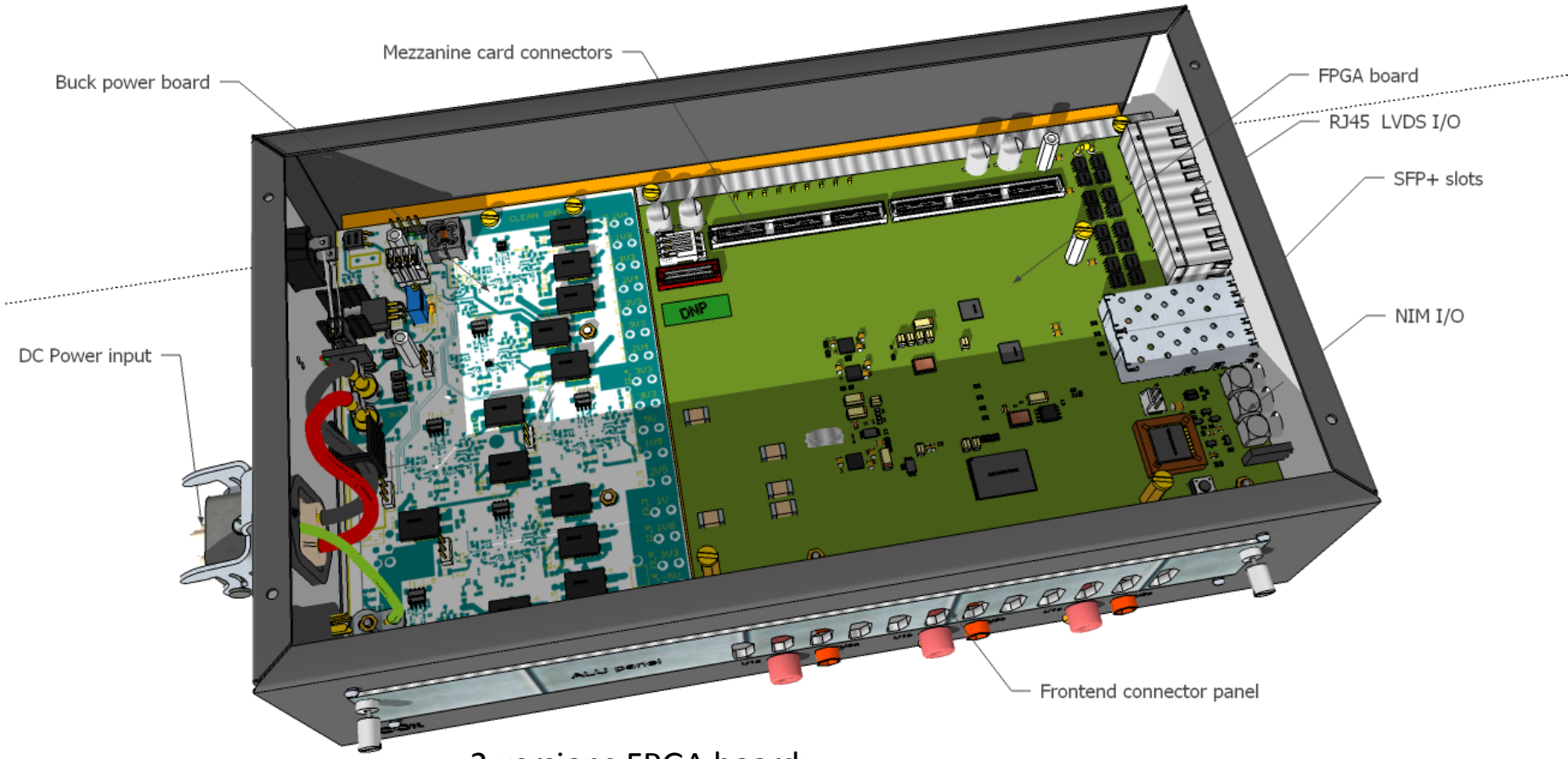
Frontend links (default)
- 12 x HDMI-A
- Individually fused (resettable)
- OC-D: DTCC protocol
- OC-A: Analogue APV protocol





Box: 100% ALU
- magnetics free
- Bracket mountable

Buck and FPGA board in OCx

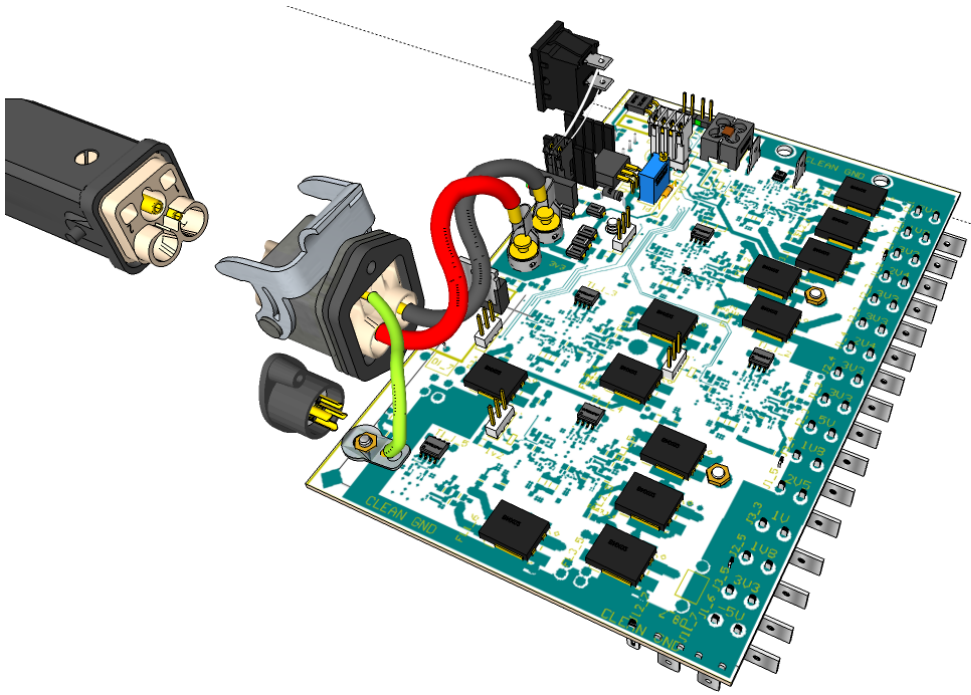


2 versions FPGA board:

standard low cost for test systems (Kintex FPGA)

high performance with high speed network buffer (UltraScale FPGA)

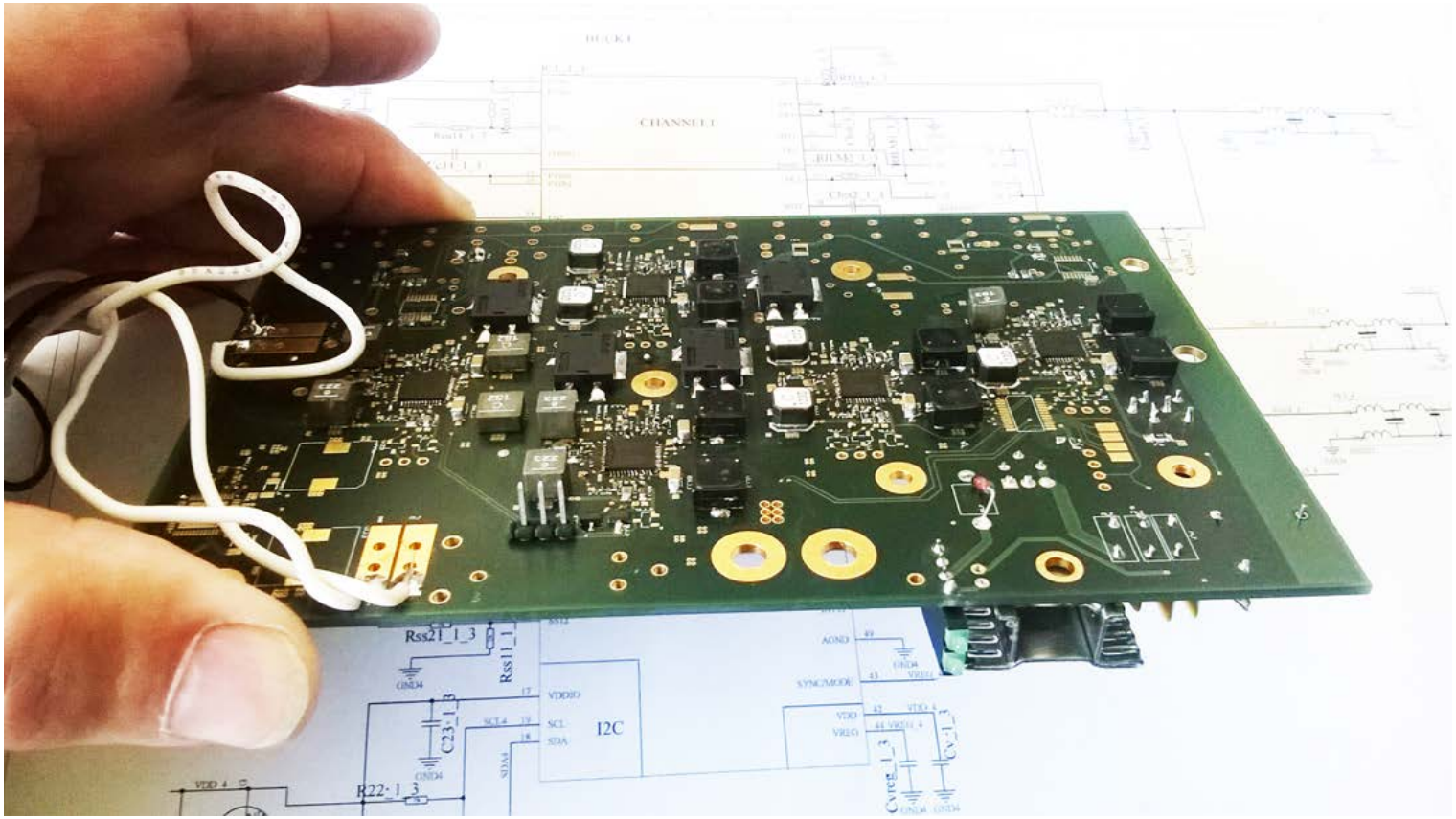
Buck board in OCx



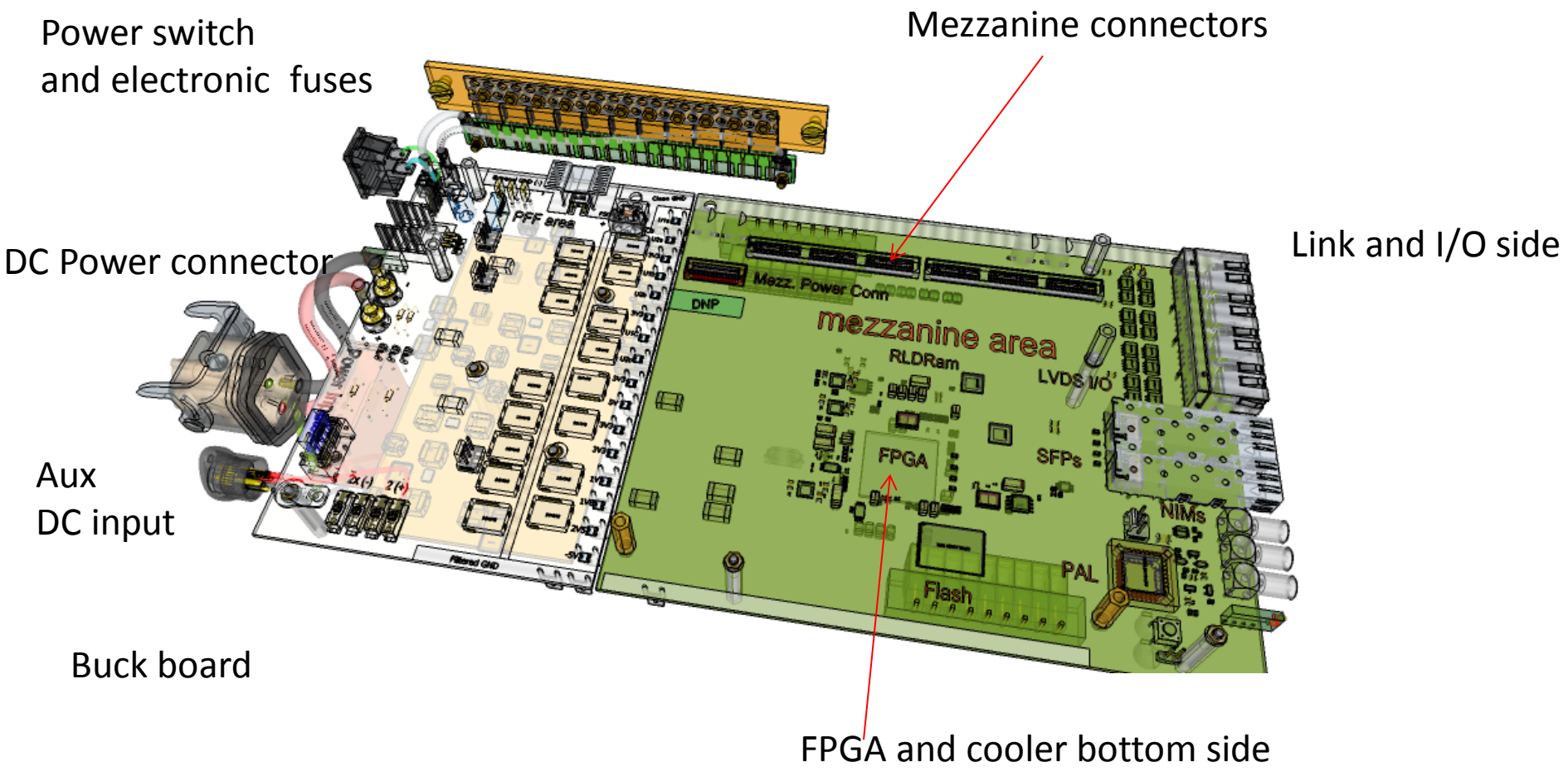
General Purpose,
I2C configurable
Power supply

-electronically fused
-filtered and protected
-no transformers
-no ventilators
-no magnetic parts
-input 10-15 V DC
-80% efficient
-15 pos. Voltages up 5A
- 1 neg Voltage -5V 5A

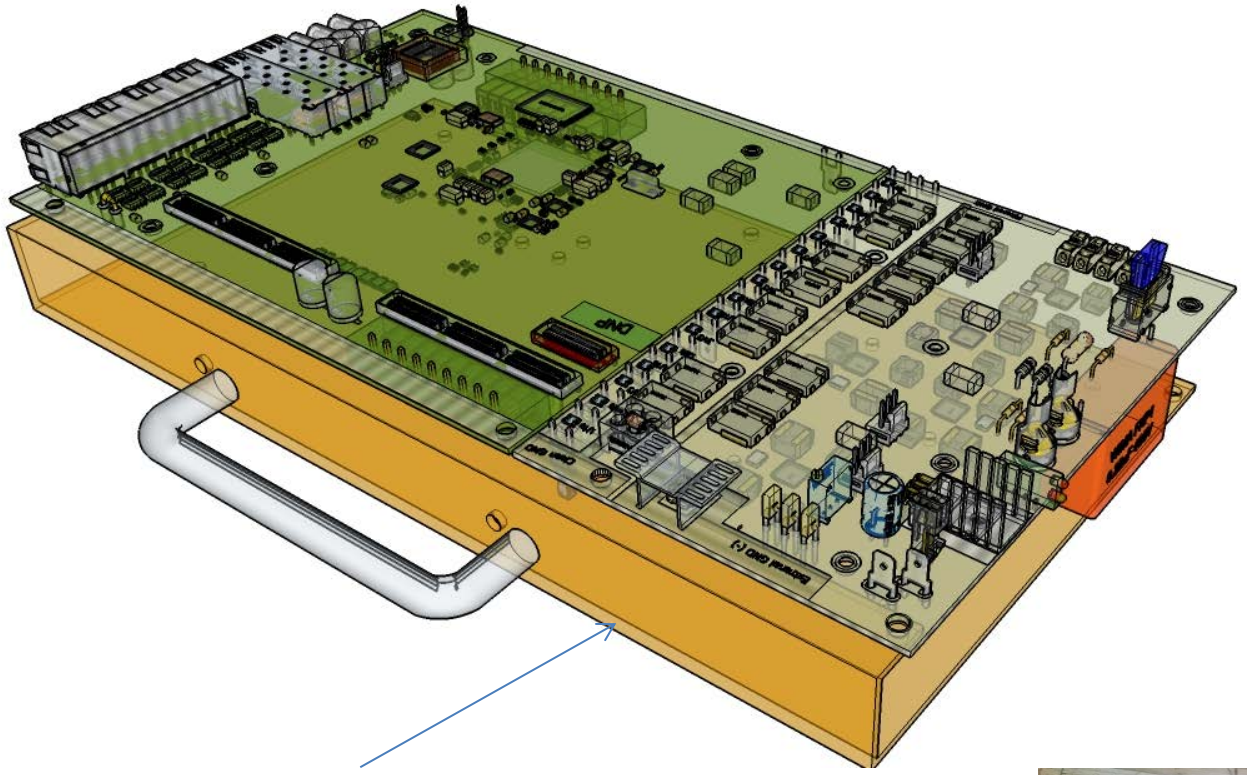
Photo 16- channel OC buck converter



OCx internal



Inner cooling frame



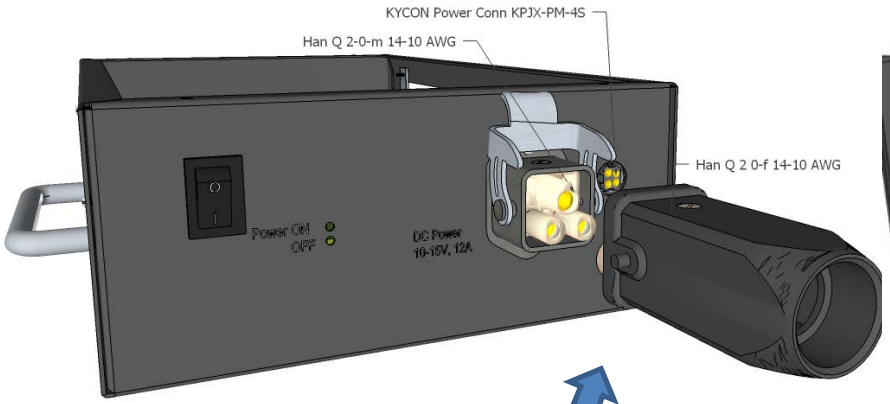
Copper

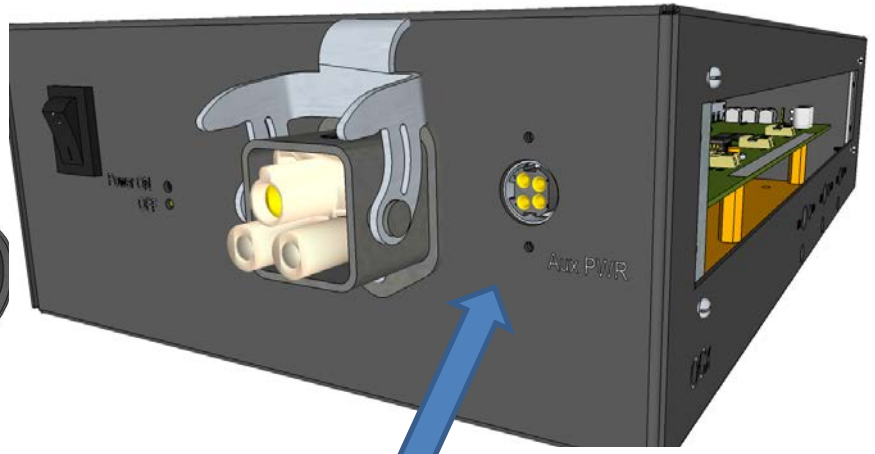
Photo
Mechanical Protobox

Powering of test systems

Commercial 120 W adapters 12V with
4-pin DIN power connector

Power connectors



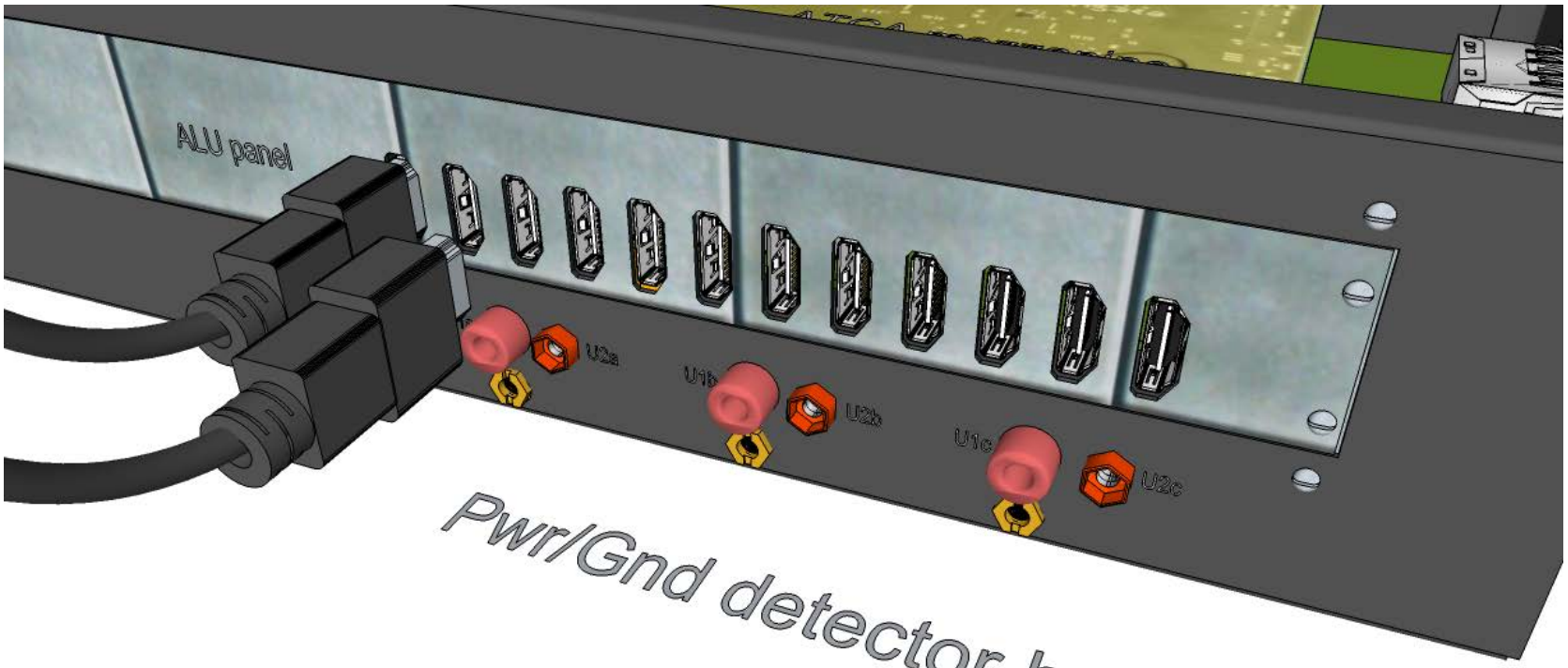


Standard DC Power for underground installations
Min 10…max 15 Volt 12- 8 A DC lines connected via Harting Han Q/3 Power connectors

Auxiliary DC Power for test systems: via 12V, 120W AC adapters* with 4 –pin DIN Connector
PIN 1+2 = +12V
PIN 3+4 = Power return

* example Stontronix: **T4845ST - 12Vdc 10A**

Frontside Power connections



Banana plugs 3 Power Groups a,b,c
GND: cable to detector hybrids
U1: 4 mm Banana plugs, fused
U2: 2 mm Banana plugs, fused

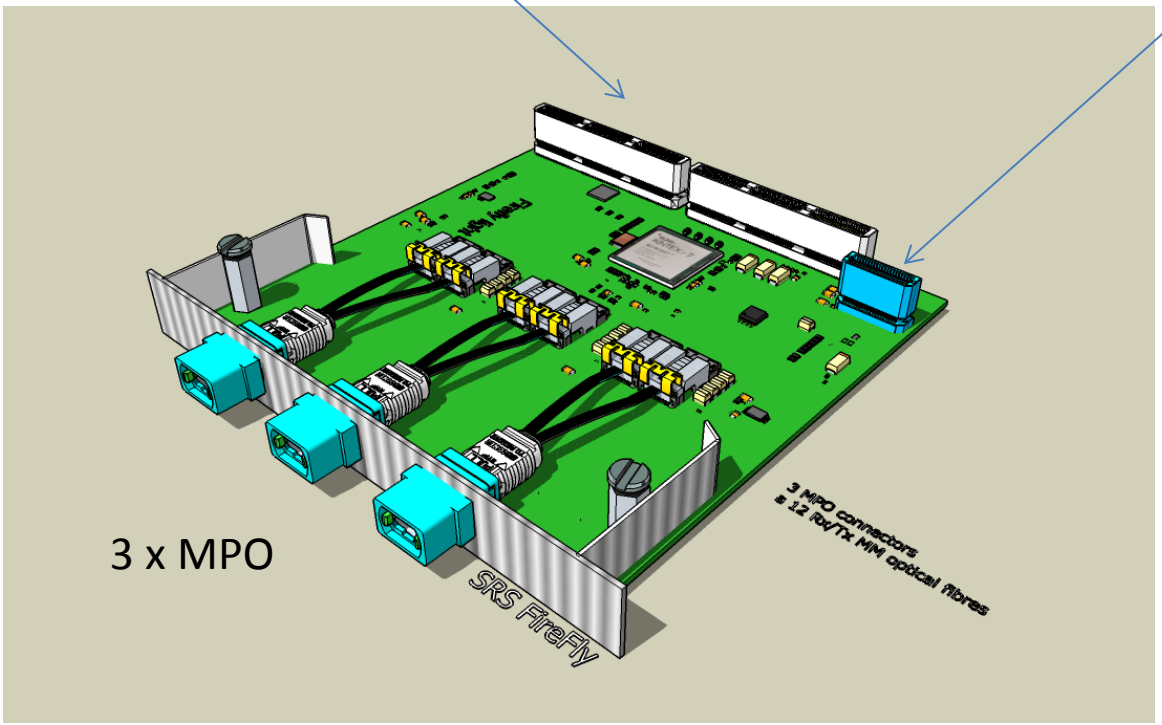
SRS Firefly mezzanine

for use on ATCA blade and/or in OCx

Note: **the Firefly PCB connectors can also be used with micro coax Firefly plugins**

Data connectors for ATCA SRS blade or OCx

Power connector for ATCA SRS blade OCx



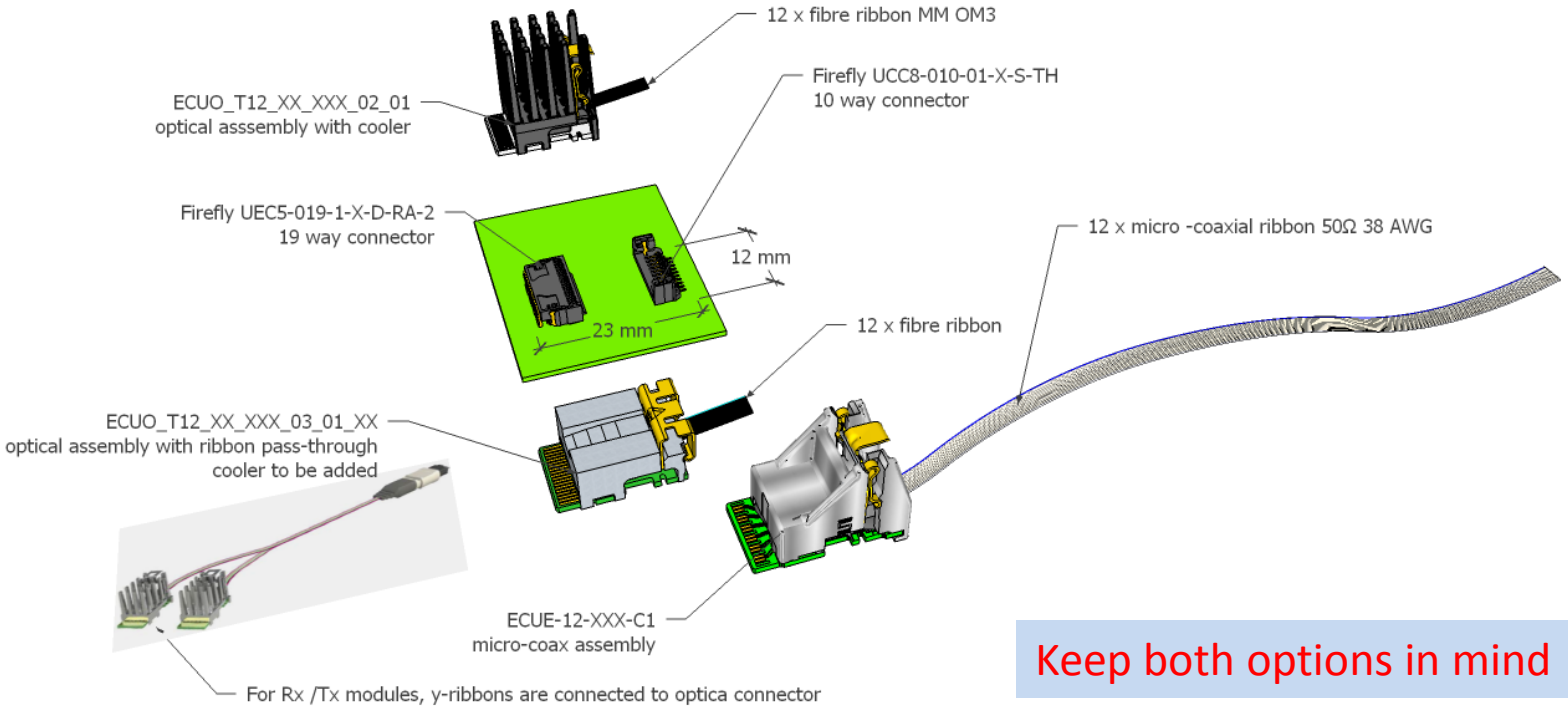
Shown with:

12, 24 or 36 bidir. optical links

MPO / MTP on frontpanel
MM OM3 fibre
1 x FPGA

Samtec Firefly

The UCE5 and UCC8 connectors may be used for both
FireFly optical ribbon plugins as well as for micro-coax ribbons



Keep both options in mind

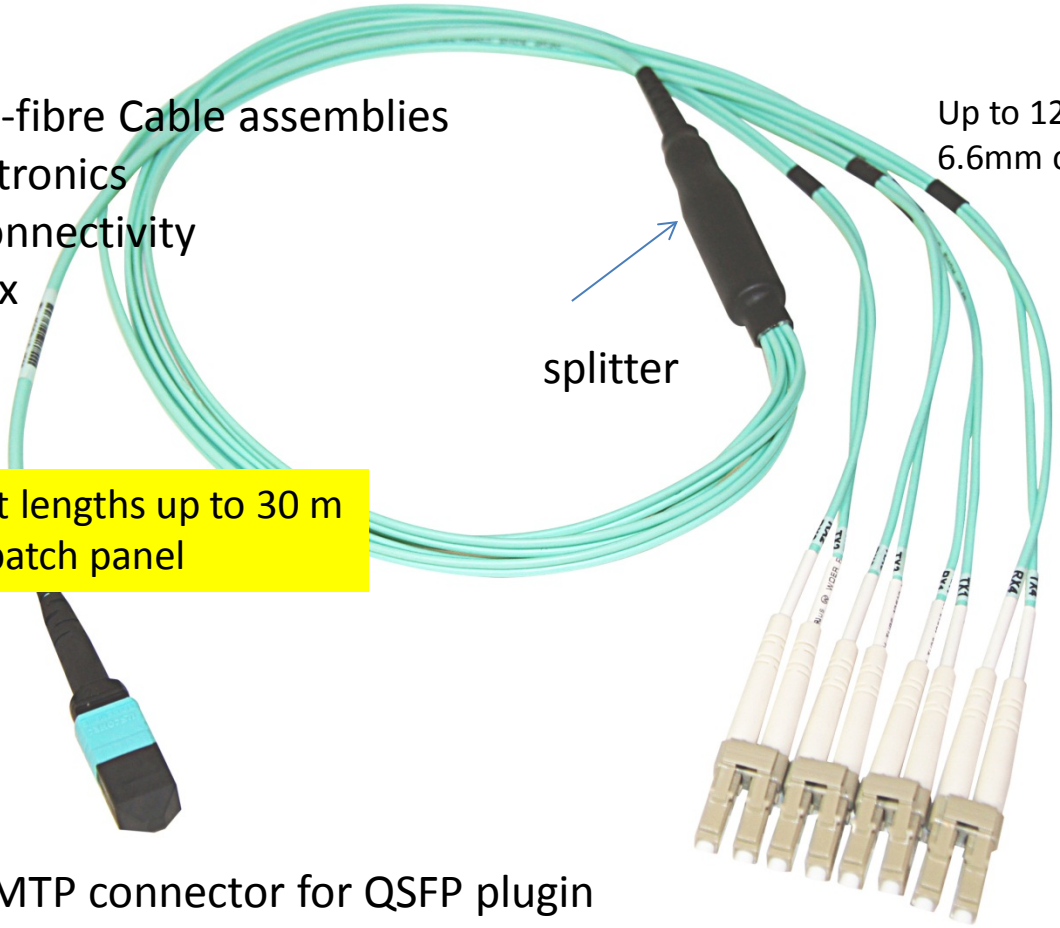
Multimode breakout fibres
MPO <-> ST

Multi-fibre Cable assemblies
Fibertronics
TE-connectivity
Molex

Up to 12 MM fibres 50u /125u
6.6mm cable diameter

splitter

Standard breakout lengths up to 30 m
to long distance patch panel



MPO -F / MTP connector for QSFP plugin

MTP connector is a high performance MPO connector engineered for better mechanical and optical performance

LC connector
for SFP+ plugin

Detector Hybrids for OCx

connected and powered via HDMI

➔ OC-D for VMM, OC-A for APV

VMM 128

128 channel Mini-2 boards

digital with zero suppression, self triggering

ITAR compliance, no export restrictions

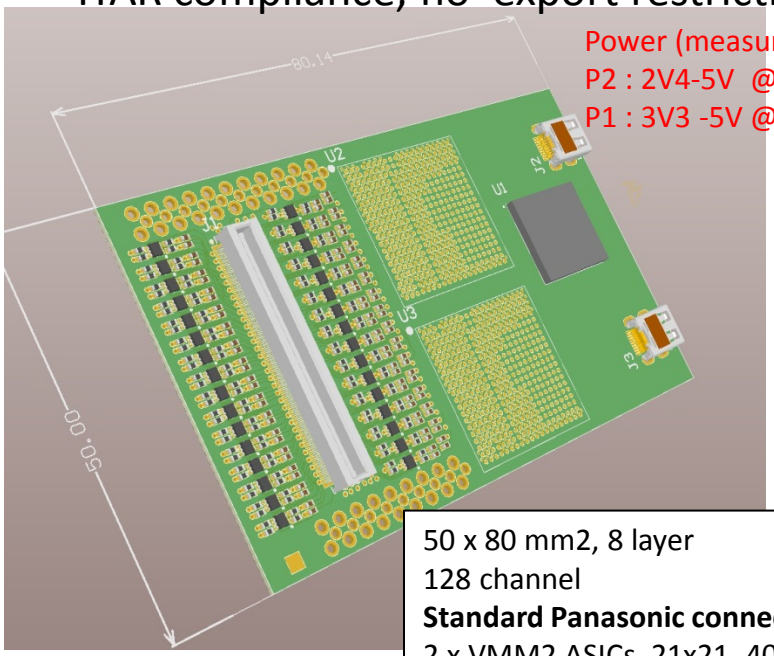
APV 128 V4

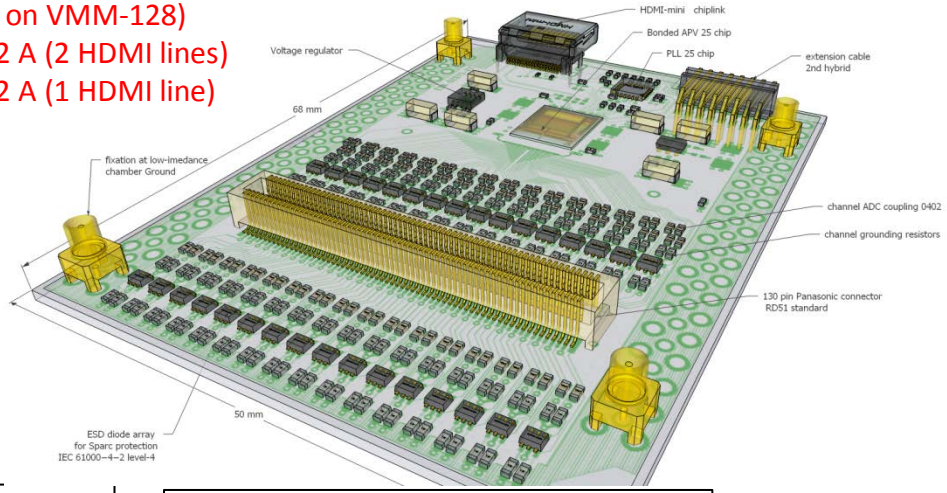
SRS standard

analogue without zero suppression

Rad-hard restricted export !

Power (measured on VMM-128)
P2 : 2V4-5V @ 1.2 A (2 HDMI lines)
P1 : 3V3 -5V @ 0.2 A (1 HDMI line)





50 x 80 mm2, 8 layer
128 channel
Standard Panasonic connector
2 x VMM2 ASICs, 21x21, 400 pin BGA
1 x Spartan + 1 Flash
dual readout 2x HDMI-Micro
7-10 mA/ch average

50 x 60 mm2, 4 layer
128 channel
Standard Panasonic connector
1 x APV ASICs, Radhard, wire bonded !
1 x PLL radhard, limited qty
1 x HDMI-Micro
3-4 mA/ch average

VMM-128 hybrid

VMM-128 fully assembled in 2014 as Mini-2 cards

See report by G.Iakovidis and S. Maroiu

1st PCB revision started (March 2015)

70 test boards for NSW

10 test boards for RD51

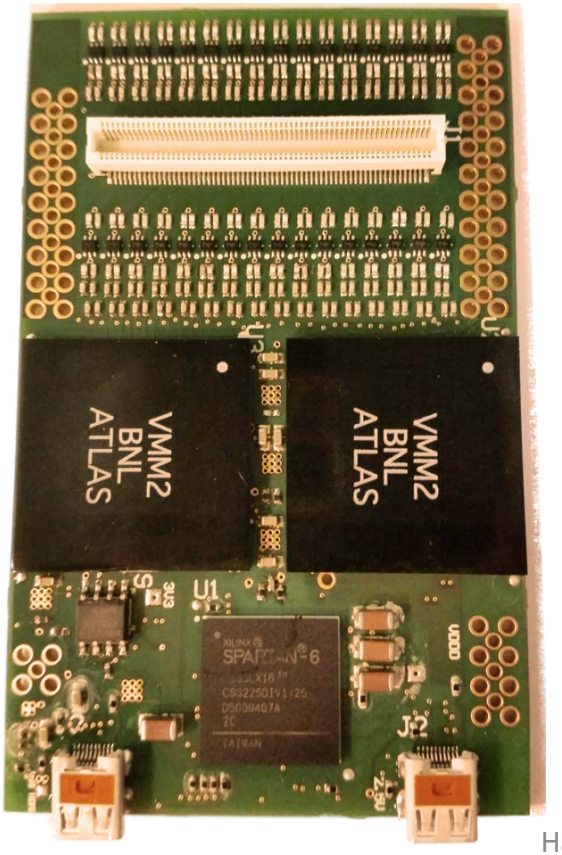
Measured Power consumption 2 VMM:

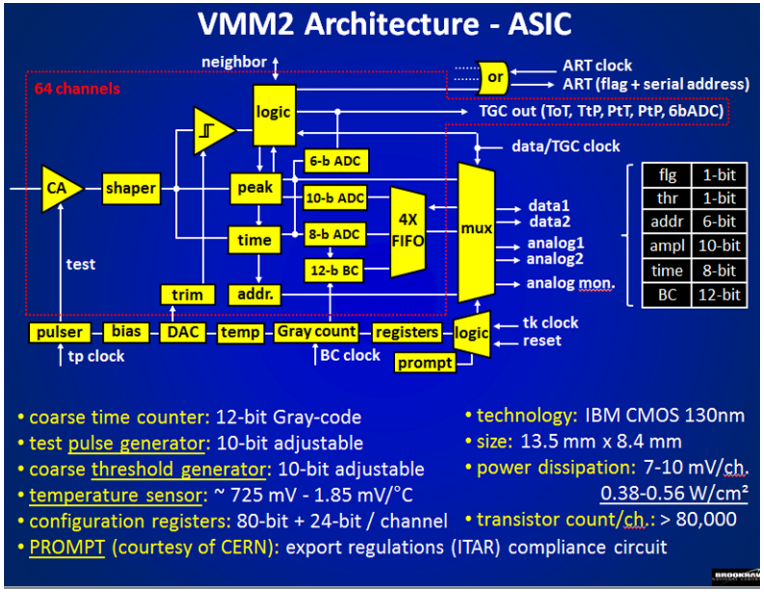
1.2A @ 1.2V ~ 10 mA /ch

0.2A @2.5V (FPGA)

2 x 64 channel VMM2 chips

BGA 21x21mm2 / 400 balls 20x20

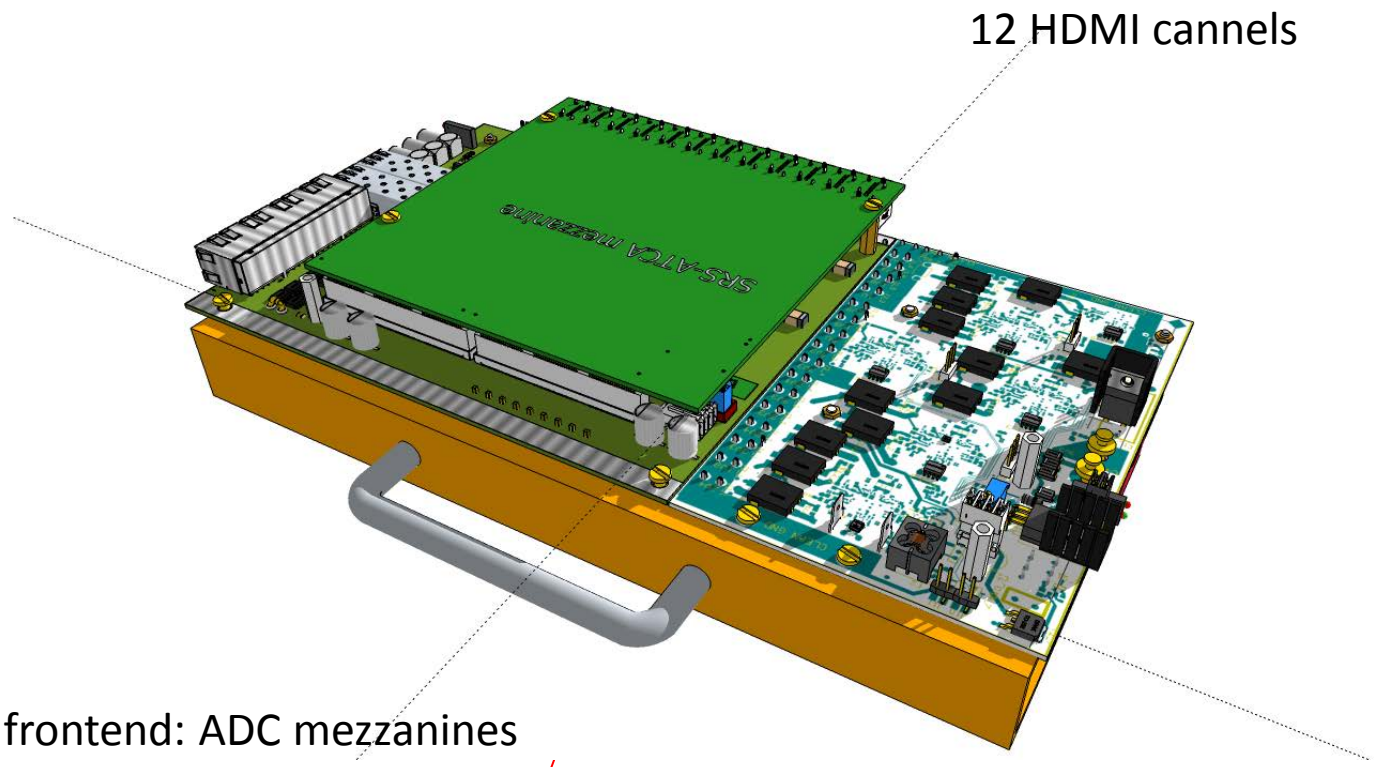




From: Gianluigi Gironimi TEWPP 2014

Mezzanines for OCx

ATCA mezzanine
on OCx carrier board

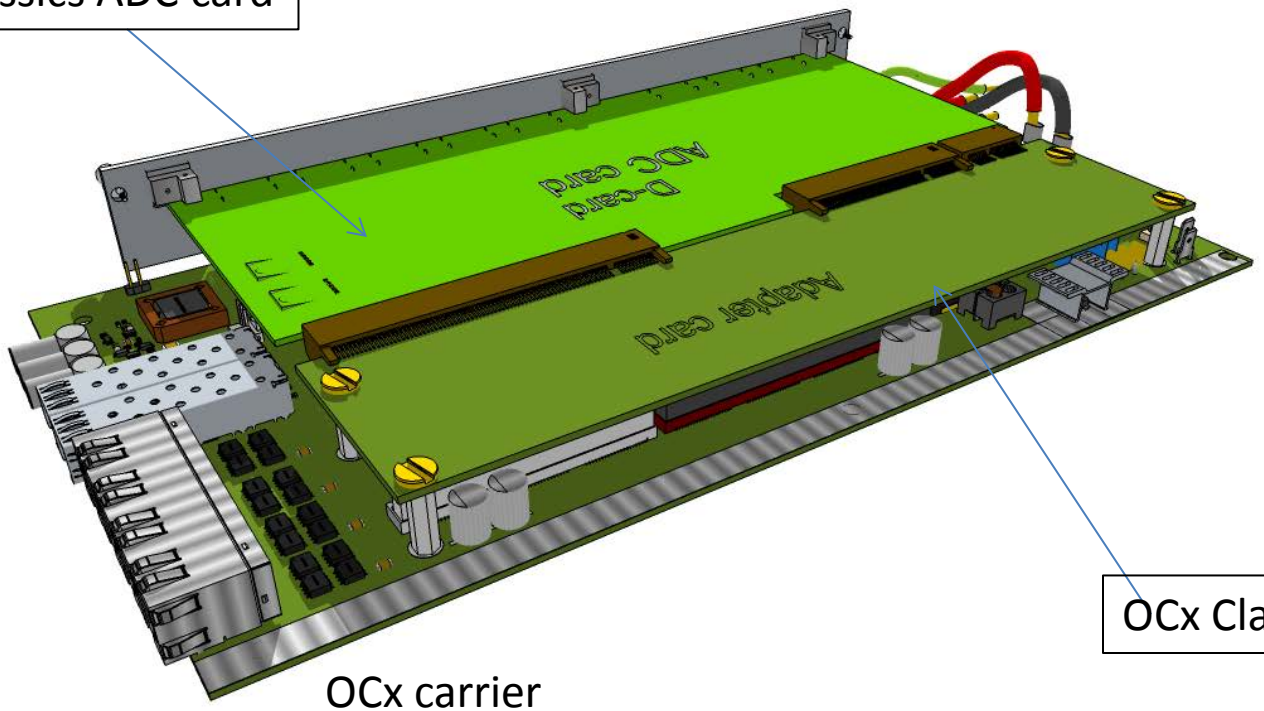


APV frontend: ADC mezzanines
VMM frontend: Digital mezzanines
LVDS frontend: CDT12 mezzanines
Spatially frontends: Firefly mezzanines

Classic SRS mezzanines

8 HDMI channels

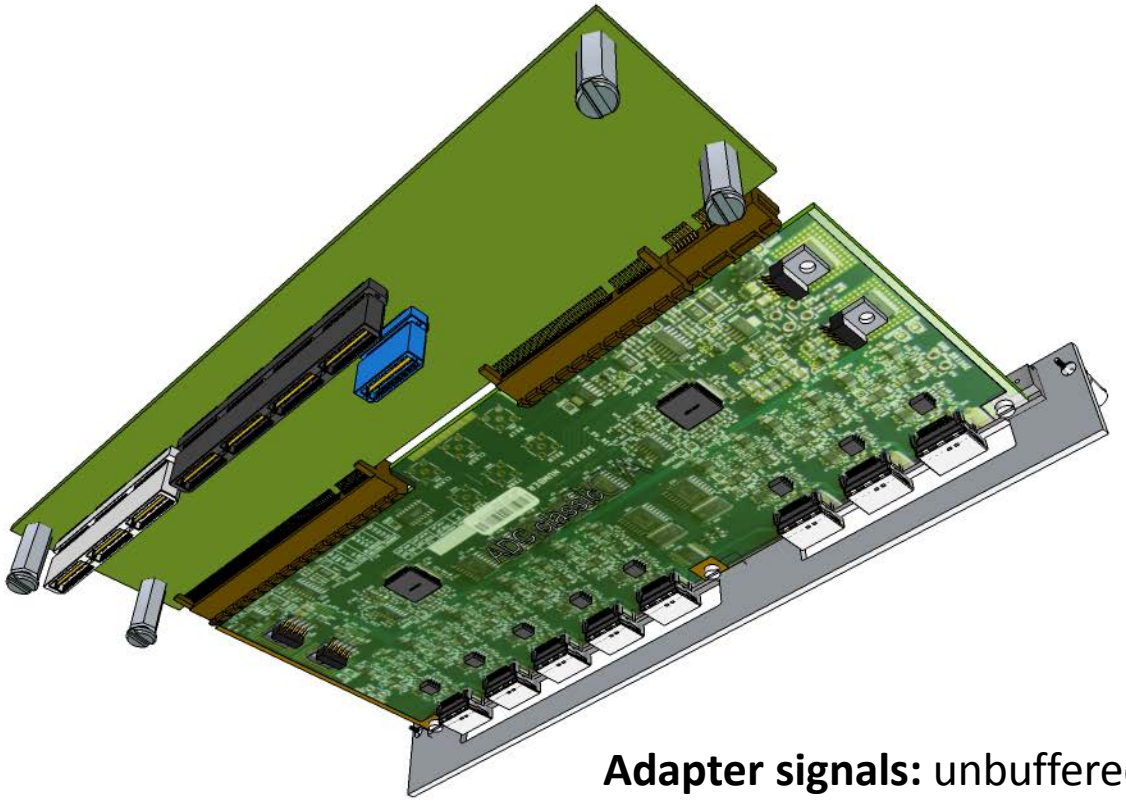
SRS Classics ADC card



OCx Classic adapter

OCx carrier

OCx adapter for SRS classic



Adapter signals: unbuffered routing
Adapter power: pick up from blue connector and convert to required voltages for classic cards

Summary

- OCx ORx allows for distributed SRS detectors
- SRS scalable architecture is fully maintained
- Single OCx boxes may be used as test systems
- Larger systems require ATCA backbone system
- OCx and frontend powered by buck converter
- OCx accepts same mezzanines as ATCA blade
- Classic SRS adapters usable in OC via Adapter

Project status

- 3D mechanical and power blueprints = OK
- Buck board received and under test at CERN
- ATCA/OCx mezzanines (EicSys, IFIN, UPV)
- Standard FPGA board design started (CERN –IFIN)
- Components and parts for 10 Ocx have been purchased
- High-End FPGA board under discussion
- Optical fibre link , DTCC (UPV) to be ported
- ATCA -blade Firmware (tbd)
- OC firmware (tbd)
- Mezzanine Firmware (tbd)