uTCA RF Backplane

LLRF Collaboration Workshop, 15 december 2011

The Ideas,
The expectations,
The challenges
and
How it all came together

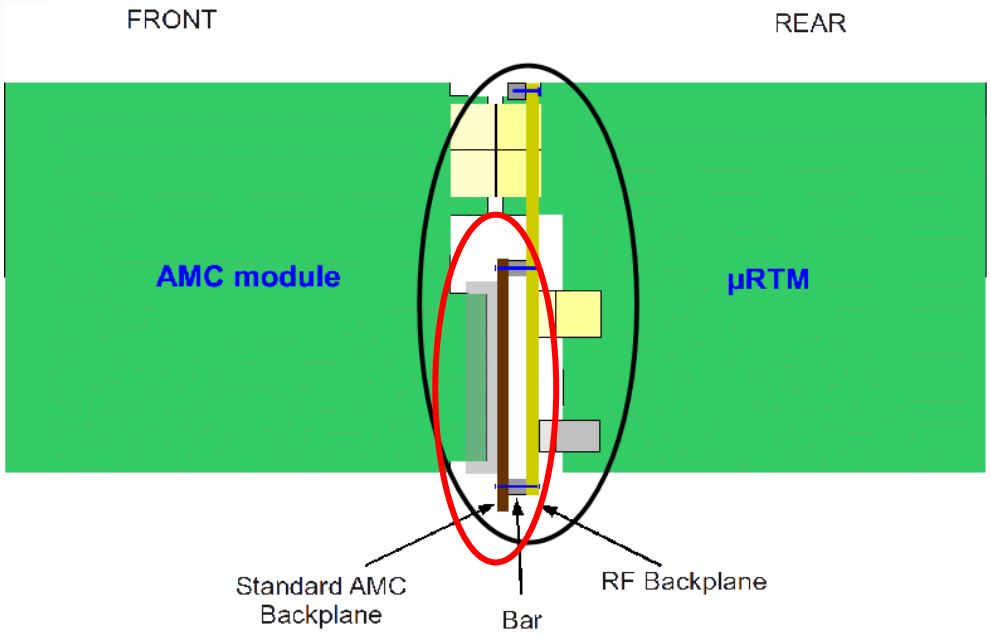
Paweł Przybylski, ISE WUT, Warszawa 2011

uRFB Project, v1.0

The introduction

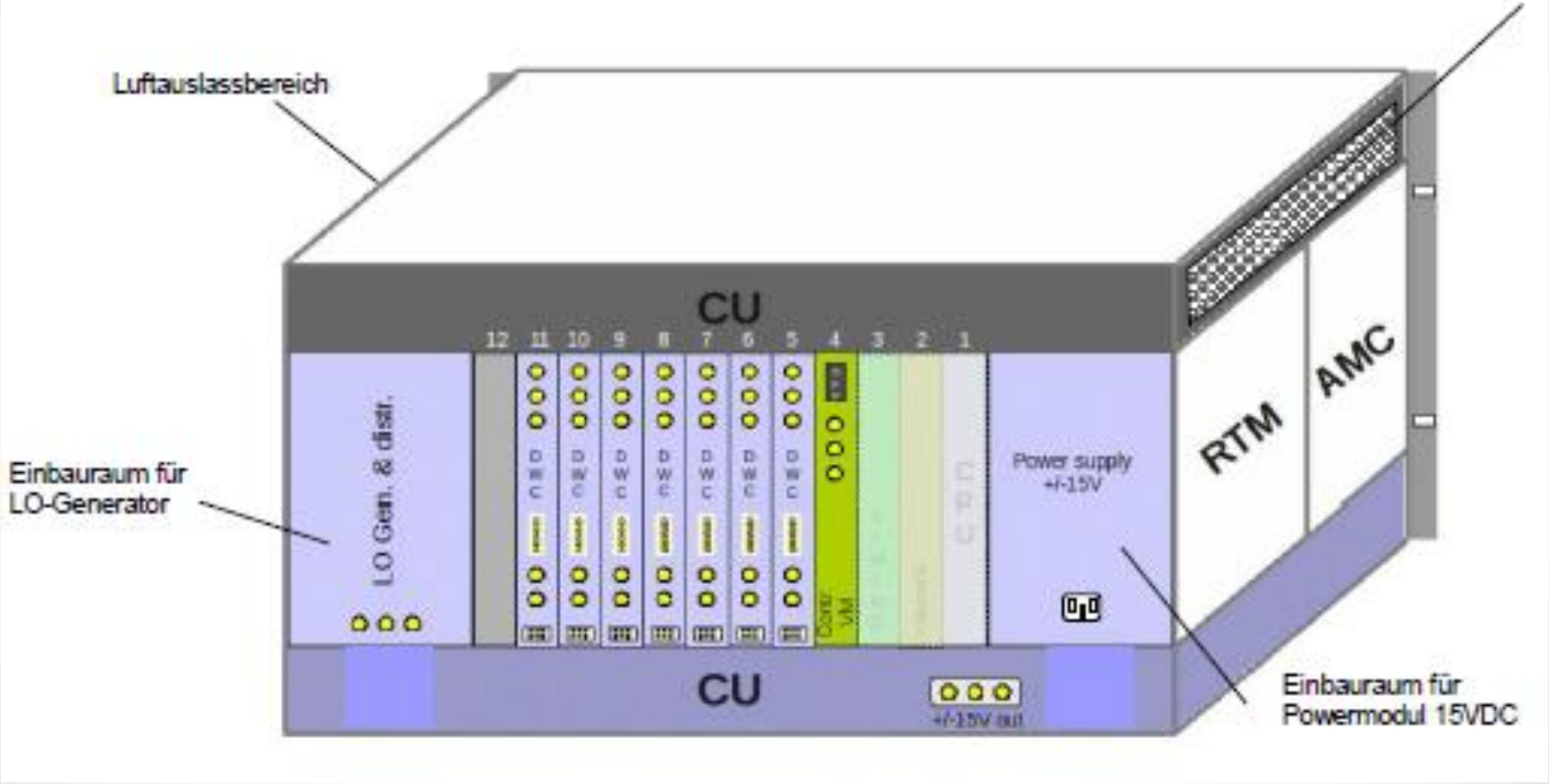
Paweł Przybylski, ISE WUT, Warszawa 2011

uRFB Project



- AMC Backplane in uTCA crate suplement
- Distribution of CLK and Analog RF signals beetwen uRTM boards
- Power supply for uRTM boards

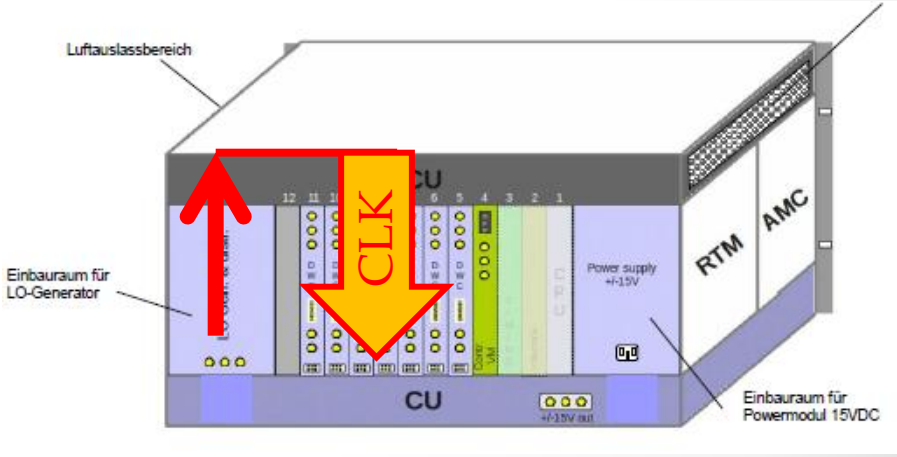
uRFB Project, v1.0



uRFB v1.0 requirements: CLK

Signals:

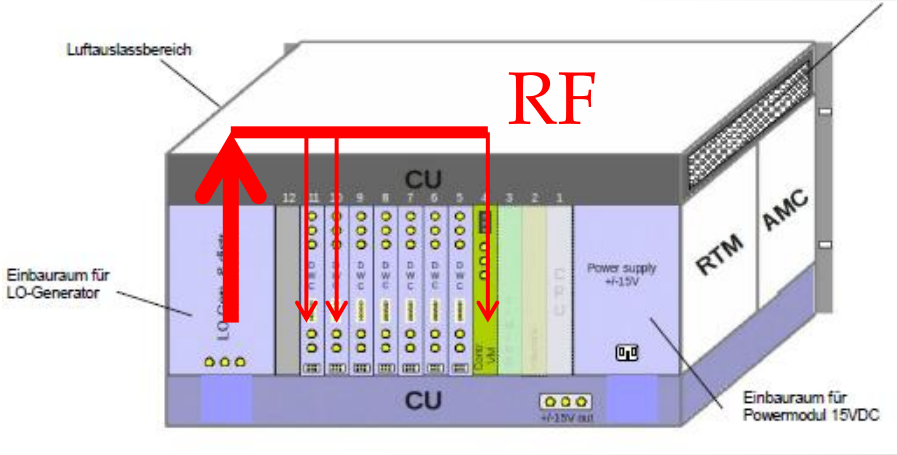
- Digital
  - 18 differential clock signals, 81MHz LVPECL
  - Distributed from slot #15 to slots #12-#14 two pairs each.
  - Additive jitter not higher than 100fs



uRFB v1.0 requirements: RF

Signals:

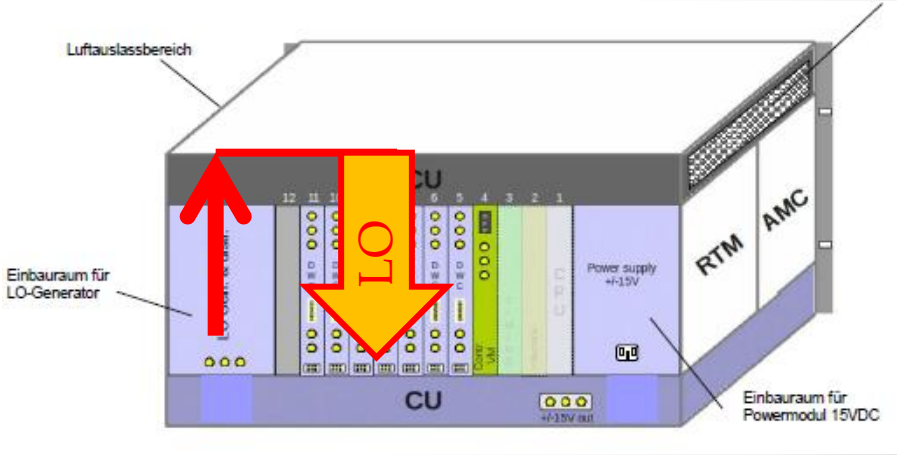
- Analog
  - Single-ended analog signal, 1300MHz sine wave
  - RF signal from slot #15 to slots #12, #11, #4
  - Additive jitter not higher than 10fs for both signals



uRFB v1.0 requirements: LO

Signals:

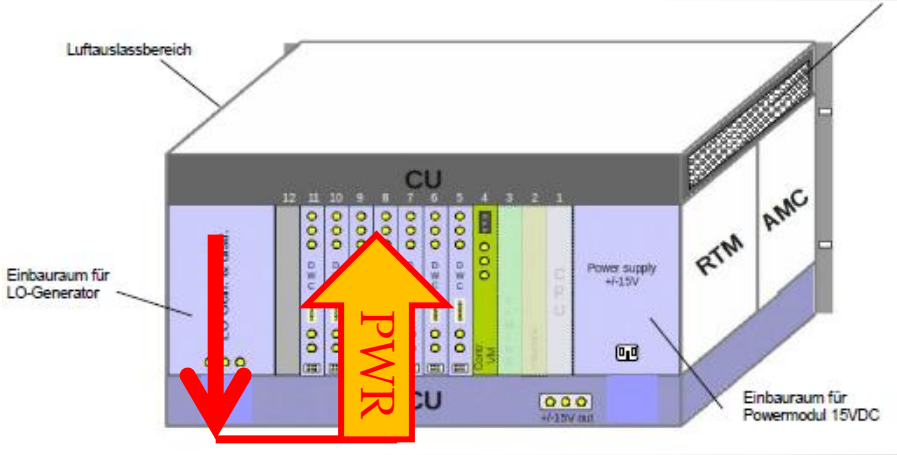
- Analog
  - Single-ended analog signal, 1300MHz sine wave
  - LO signal from slot #15 to slots #5-#12
  - Additive jitter not higher than 10fs for both signals



uRFB v1.0 requirements: PWR

Power supply:

- +7v, GND, -7V from uTCA crate to all uRFB slots
  - High input current - up to 20A for fully loaded crate



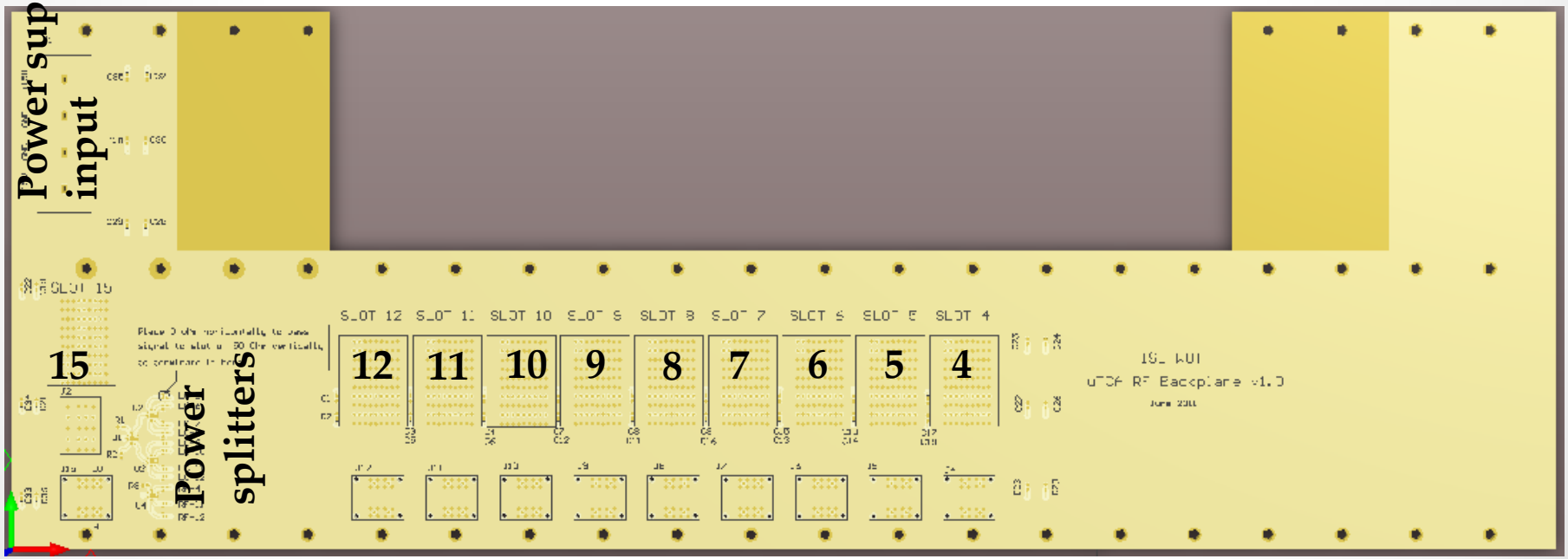
uRFB – the board

Physical design

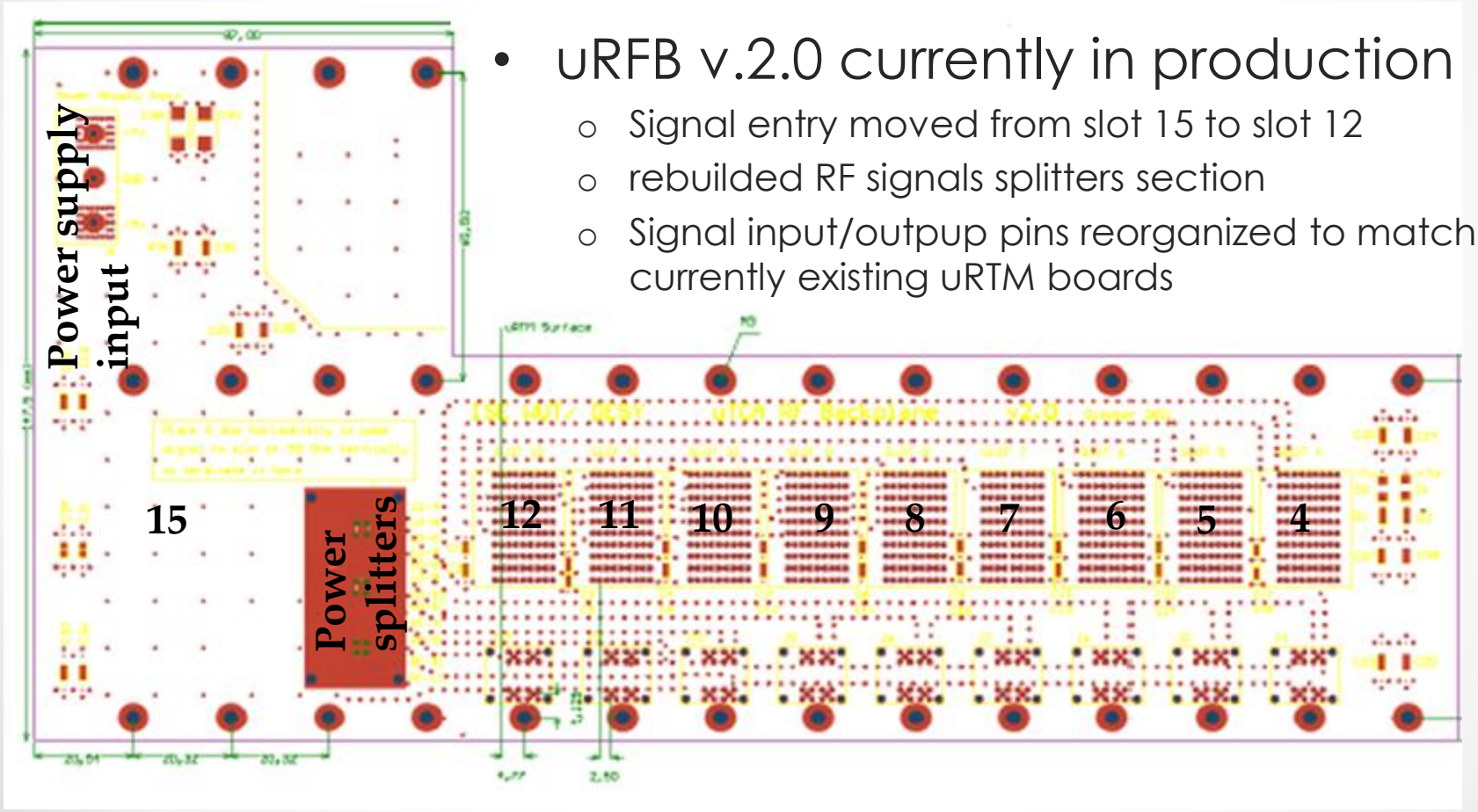
uRFB – the board

- 10-layers RF board design
- Hybrid construction – main board + uRFB shield
- Edge plating for further shielding
- Additional test boards for testing and out-of-crate maeasurements

uRFB – the v1.0 board



uRFB – the v2.0 board



- uRFB v.2.0 currently in production
  - Signal entry moved from slot 15 to slot 12
  - rebuilded RF signals splitters section
  - Signal input/outpup pins reorganized to match currently existing uRTM boards

uRFB v1.0 – measurements

uRFB v1.0 – measurements

Measurements of v1.0:

- Signals losses
  - RF ~10dB
  - LO ~14dB
  - CLK: 9-14dB depending on frequency
- Added jitter:
  - CLK: ca. 90 - 270 fs deppending on signal line (target slot, layer etc)
- Crosstalks:
  - Unmeasurable - below -90db noise floor

Challenges and solutions

Main difficulties
and way around them

Challenges and solutions

- Board needed to fit mechanically into the uTCA board
- Crate not ready at the time of board design
- Specs changes along the way
- High signal power loss due to splitters for LO signal (1:8 split)
- High signal density vs. low additive jitter
- High current for power supply
- Manual board assembly (small parts soldering)

The future

Things to be done

The future

- Production and assembly of uRFB v. 2.0
  - currently at ILFA.
  - Shipment to DESY ca. 1st week of 2012
  - Assembly and first test in January.
- Out-of-crate measurements of uRFB v. 2.0
  - Scheduled for February
- In-crate tests & measurements
  - In cooperation with „digital" team
  - Fully loaded crate to simulate full scale comunication by AMC backplane

Thank you