DBBC3: next generation versatile VLBI backend

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DBBC3: Introduction

DBBC3 has been developed with support by RadioNet3 in the Joint Research Activity DIVA

DBBC3 is the next generation digital backend for VLBI and other applications

DBBC3 is fully backwards **compatible with the DBBC2**, the most widely adopted VLBI backend

DBBC3 is a versatile backend, as it can serve the needs of the **EVN, EHT, and geodesy**

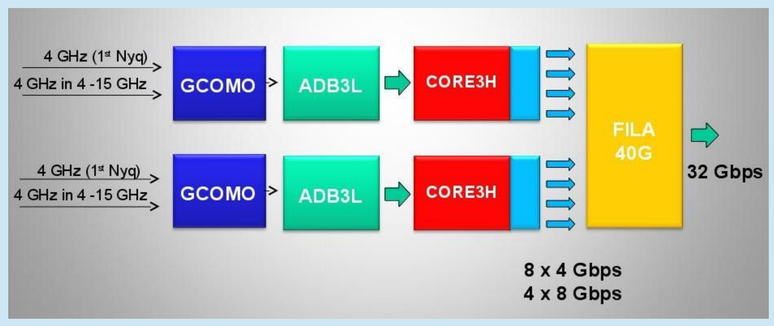
DBBC3 offers from **1 IFs to 8 IFs** on input with **16 Gbps to 128 Gbps** on output (2-bit samples)

DBBC3 is a cost-effective backend which out-competes other less flexible solutions

DBBC3 Status: in production; fringes Hobart-Ishioka & Onsala-Effelsberg; DBBC2 firmware porting ongoing

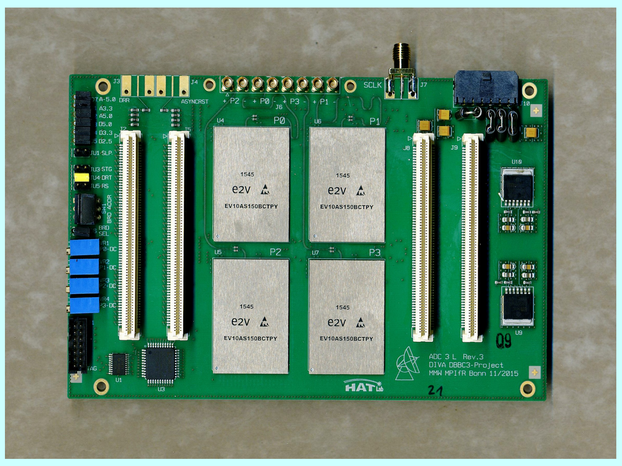
DBBC3 components

- **GCOMO:** analogue conditioning: 0-4 GHz direct and and down-converter for pre-filtered 4 GHz portion in the range 4 GHz – 15 GHz
- **ADB3** sampler board: sampling w. interleaved 4 samplers
- **CORE3** processing unit: single FPGA board with up to 8x 10 Gb Ethernet output
- **FIIA40G** post-processing & recording unit (optional; developed by Onsala Observatory)
- DBBC chassis (compatible with DBBC2)
- Ancillary boards: computer, GCAT (GHz Clock And Timing), PHA (Phase adapter for the ADB3 board; GPS distribution etc.



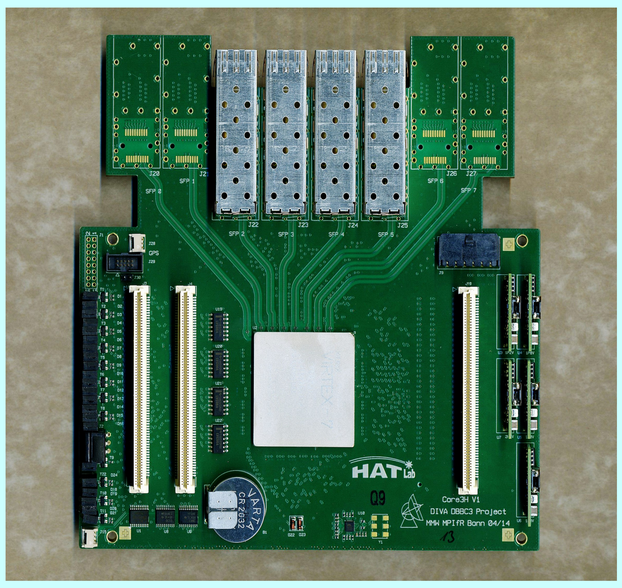
ADB3 Sampler specifications and architecture

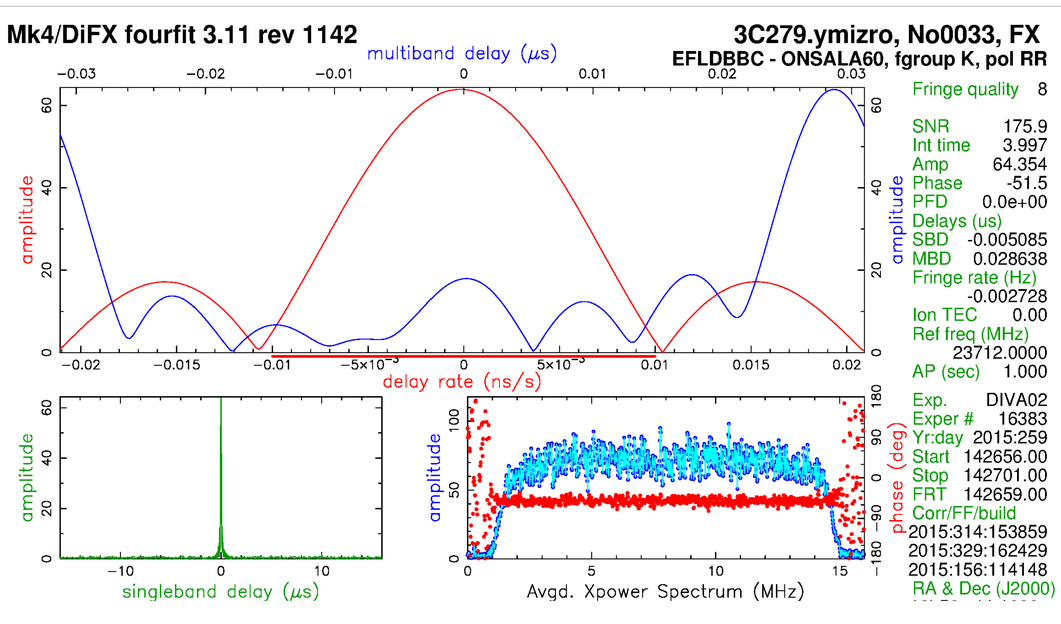
- 4 samplers: **1x 4 GHz, 2x 2GHz, 4x 1GHz**
- Interleaved sampling with novel automatic calibration routine
- Number of IFs: **1 - 2 - 4**
- Equivalent sample rate ea. IF: **8 GSps**
- Instantaneous bandwidth ea. IF: **4 GHz**
- Sampling representation: **10 bit**
- Real/complex sampling



CORE3 processing unit

- Number of inputs: **max 48 serial links 11.2 Gbps**
- Number of Outputs: **max 8 serial links 10 Gbps Ethernet**
- Input sampling representation: **8-10 bit**
- Processing capability: max 5 TMACS (multiplication-accumulation per second)
- Output: VDIF Ethernet packets, **≥ 32 Gbps**
- Pass-band filtering with 100 dB out of band suppression possible
- Processing capability: **wide-band DDC, wide-band PFB, DCS**
- VLBI modes:
  - Direct sampling conversion: **4 GHz / 1 GHz**
  - Polyphase filterbanks: **256 MHz - 64 MHz - 32 MHz**
  - Digital downconverters: **128 MHz - 64 MHz - 32 MHz - 16 MHz - 8 MHz - 4 MHz - 2 MHz**
    - **16 down-converters possible for bandwidths ≤ 16 MHz**





First fringes with a DBBC3 at Onsala against a DBBC2 at Effelsberg. The bandwidth used is that of the DBBC2. The DBBC3 used a 4 GHz wide band. The correlation was done using "zoom mode" to cut out the pieces common to both backends.

DBBC3:

VGOS model for 8 IFs with 8 groups of ADB3 samplers and CORE3 processing boards.

The chassis is the same as the DBBC2 chassis.

This unit can deliver 128 Gbps @ 2-bit

(output limit is 512 Gbps)
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