# An Italy-China collaboration for the "MiniDBBC" development

G. Tuccari[1], W. Wenren[2], S. Buttaccio[1], G. Nicotra[1], Y. Xiang[2], R. Zhu[2];

1) Istituto di Radioastronomia CNR, Sezione di Noto, Italy
2) Shanghai Astronomical Observatory, CAS - China

## Abstract

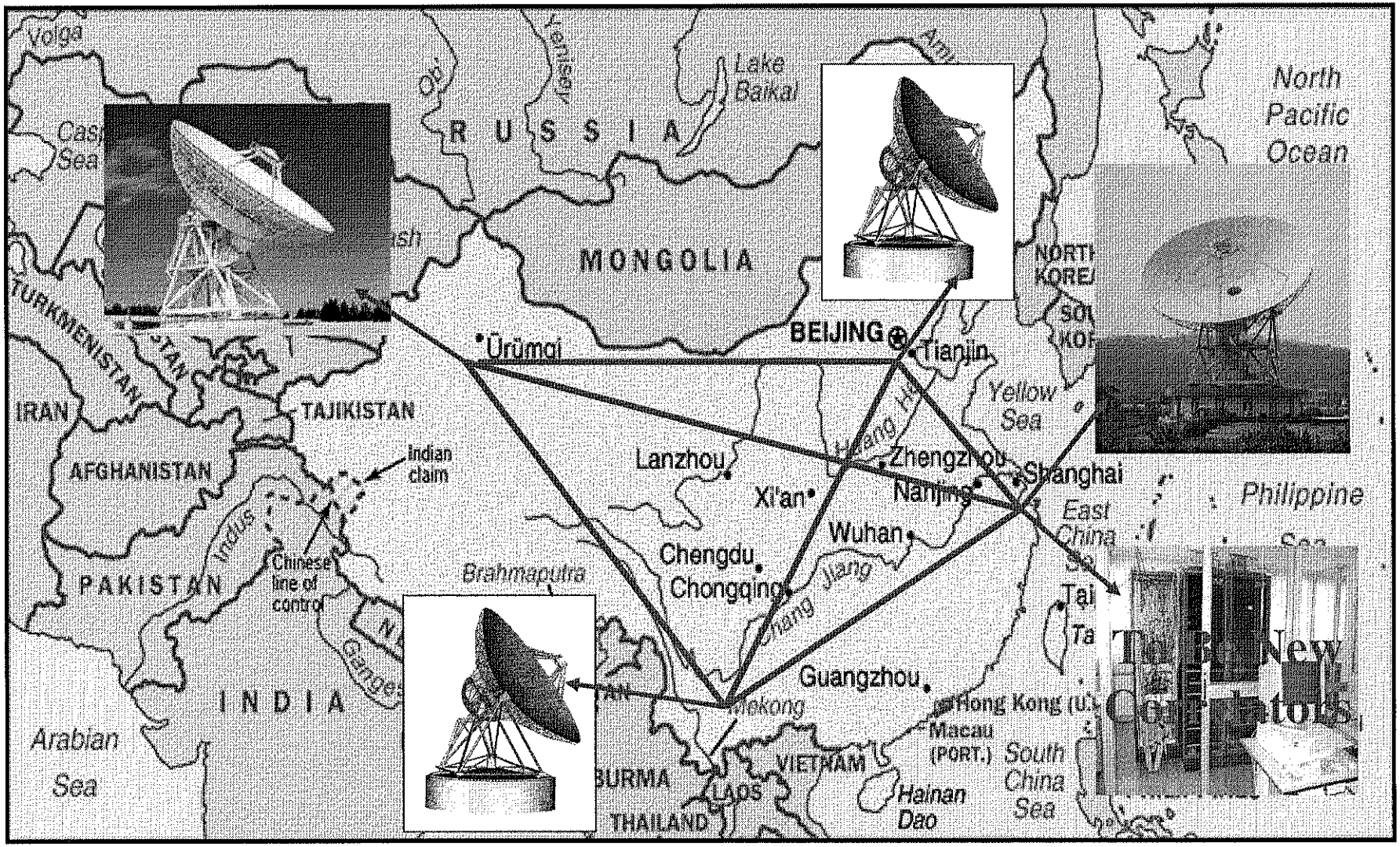
VLBI is a very important part of the radio astronomical research both in Italy and China. The Chinese VLBI radio telescopes near Shanghai and Urumqi are two of the five major facilities of the National Astronomical Observatories of the Chinese Academy of Sciences (NAOC, CAS). Together with the Italian radio telescopes in Medicina and Noto of Instituto di Radioastronomia (IRA), and six more antennas located in Europe, they are part of the European VLBI Network and regularly take part in the global observing sessions three times/year.

In recent years, the two countries are very active for VLBI developments. Italian colleagues are building a new antenna with diameter of 64 meters in Sardinia and Chinese colleagues are building two new antennas with diameters of 50 and 40 meters near Beijing and Kunming, respectively. The three new antennas will be get to use in 2 years.

The present hardware (analog BBCs, IF distributors) is very old and very difficult to maintain. Fully digital BBCs offer stability, flexibility, phase stability over channels, no IF distributor, reproducible flat band-pass, affordable price, reduced maintenance cost. A new generation of stations without a VLBI terminal could even greatly benefit from a new development. In such view both institutes together with the other EVN institutions are going to develop a complete back-end system under the DBBC Project, able to replace the present used old one.

Beyond of the EVN DBBC Project the so-called 'Chinese Lunar Project' gave the opportunity to accelerate such a process even if in a reduced format, so the MiniDBBC Project was born as a bilateral collaboration Italy-China. An overview of such project is presented with the main elements and expected performance. Two working prototypes are in development and their use for a full evaluation is planned in the summer 2005.

# Real-time VLBI in the Chinese Lunar Project



# Configuration

- Four Stations:

  Antenna

  Miyun(Peking): 50m(new)

  Kunming: 40m(new)

  Shanghai and Urumqi: 25m

  Receiver

  Miyun and Kunming: S/X band

  VLBI Terminal

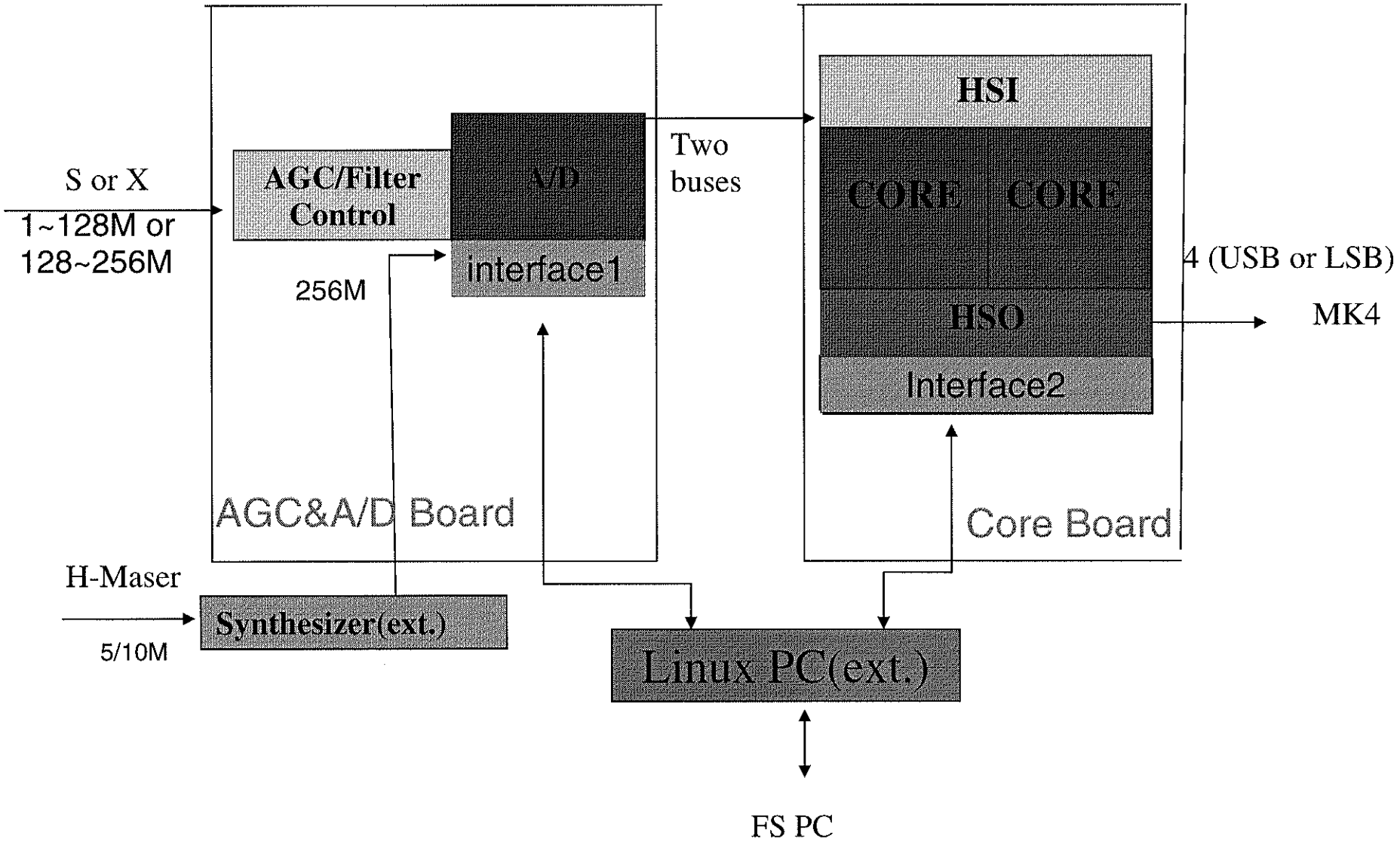
  Miyun and Kunming: Mini DBBC

- Fiber link between stations
- Real-time VLBI Correlator

# MiniDBBC General Features

- Two IF Input in the range 1-128 or 128-256 MHz
- 2 polarizations/bands available for a single group of output data channel selection
- 256 MHz fixed frequency sampling clock, with external synthesizer
- Channel bandwidth 500 KHz, 1-4-8 MHz
- Tuning step 50 KHz
- Multiple architecture using fully re-configurable FPGA Core Modules
- Modular realization for possible cascaded processing
- Data out as single ECL interface for MKIV formatter
- Total power measurement capability
- Digital to analog converter monitor output
- Digital AGC with external PC control

# MiniDBBC General Schematic View for One IF



# Digital Down Converter FPGA Configuration

Main features:

- Direct conversion typically between high data rate sampled IF band and lower data rate base band
- LO as a Numerically Controlled Oscillator
- Mixer as Complex as Look Up Table multiplier
- Low-pass band filter Finite Impulse Response (FIR) filters cascade
- Decimation because of the high ratio between IF and output data rate performed with multirate/multistage FIR
- Digital Total Power measurement at base-band level
- Gain Control
- Narrow bandwidth: 8, 4, 1, 0.5 MHz

Narrow Band SSB Down Converter Configuration Elements:

- Parallel demultiplexed 2 data buses flow
- Output clock 32 MHz
- Numerically Controlled Oscillator (NCO)
- Multistage FIR filtering
- Hilbert Transform filter
- Gain control
- Inverse distribute FIR typology
- Digital total power meter