Geodetic VLBI observations for the CMONOC project

Fengchun Shu, Weimin Zheng, Xiuzhong Zhang, Bo Xia
Shanghai Astronomical Observatory, CAS
Min Wang
Yunnan Astronomical Observatory, CAS
Yusup Aili
Xinjiang Astronomical Observatory, CAS

陆态网络
CMONOC

7th IVS General Meeting
Madrid (Spain), March 4-9 2012

Outline

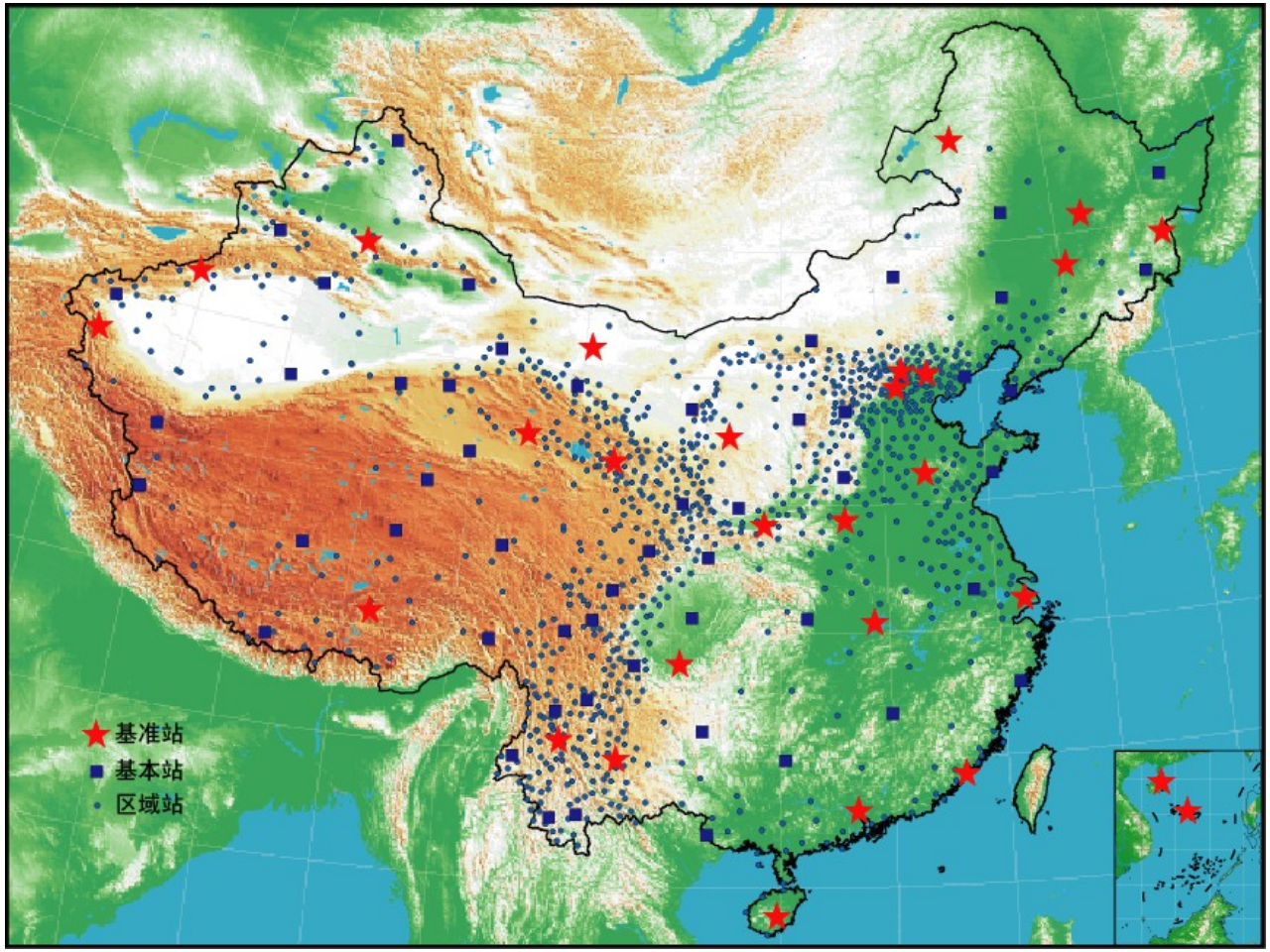
- CMONOC project
- Chinese Geodetic VLBI observing system
- Future development

CMONOC project

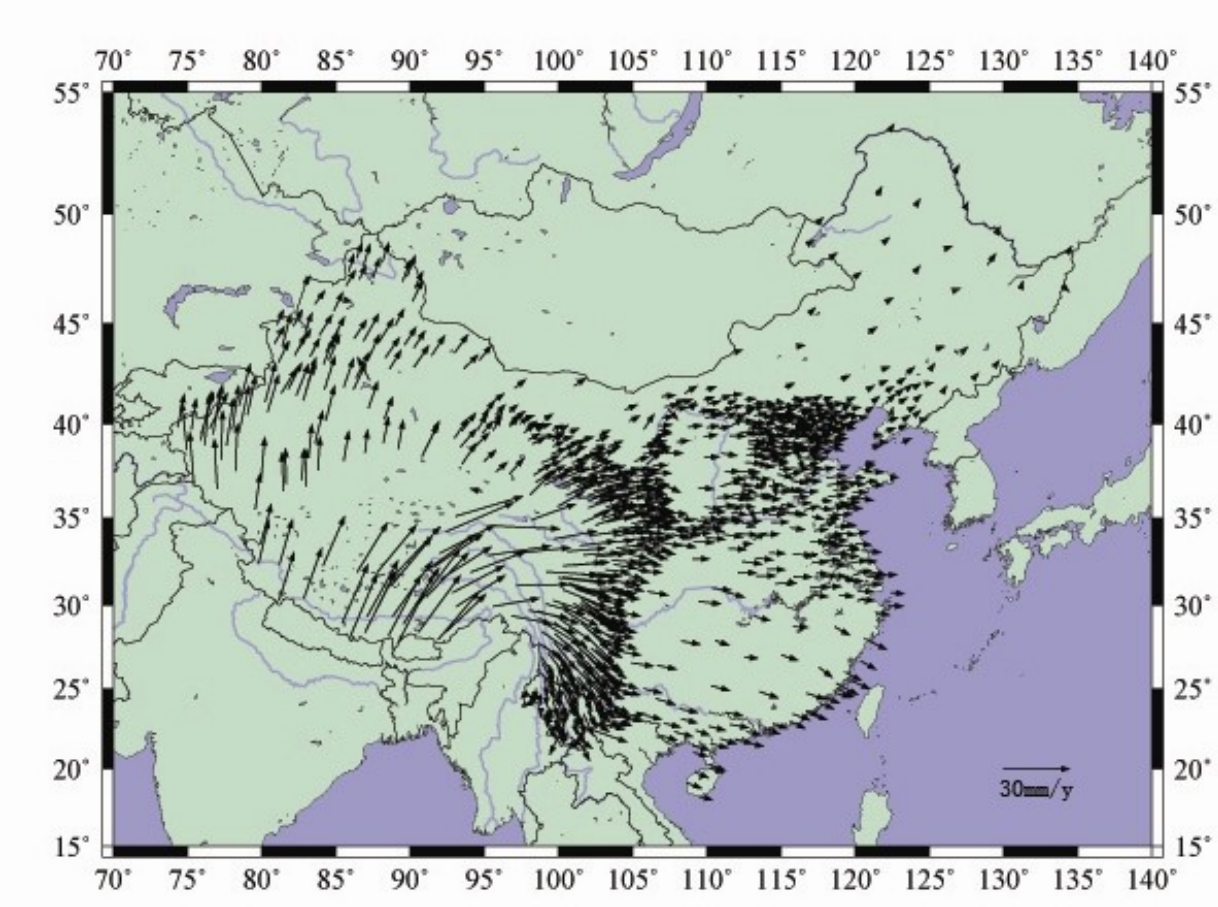
- the National Key Scientific Infrastructure Project --- Crustal Movement Observation Network of China

	CMONOC-1	CMONOC-2
Construction period	1998 ～ 2000	2008 ～ 2010
Permanent GNSS stations	27	260
Other GNSS sites	1000	2000
SLR stations	5	7
Domestic VLBI obs.	No	8 sessions/year

CMONOC-1 stations



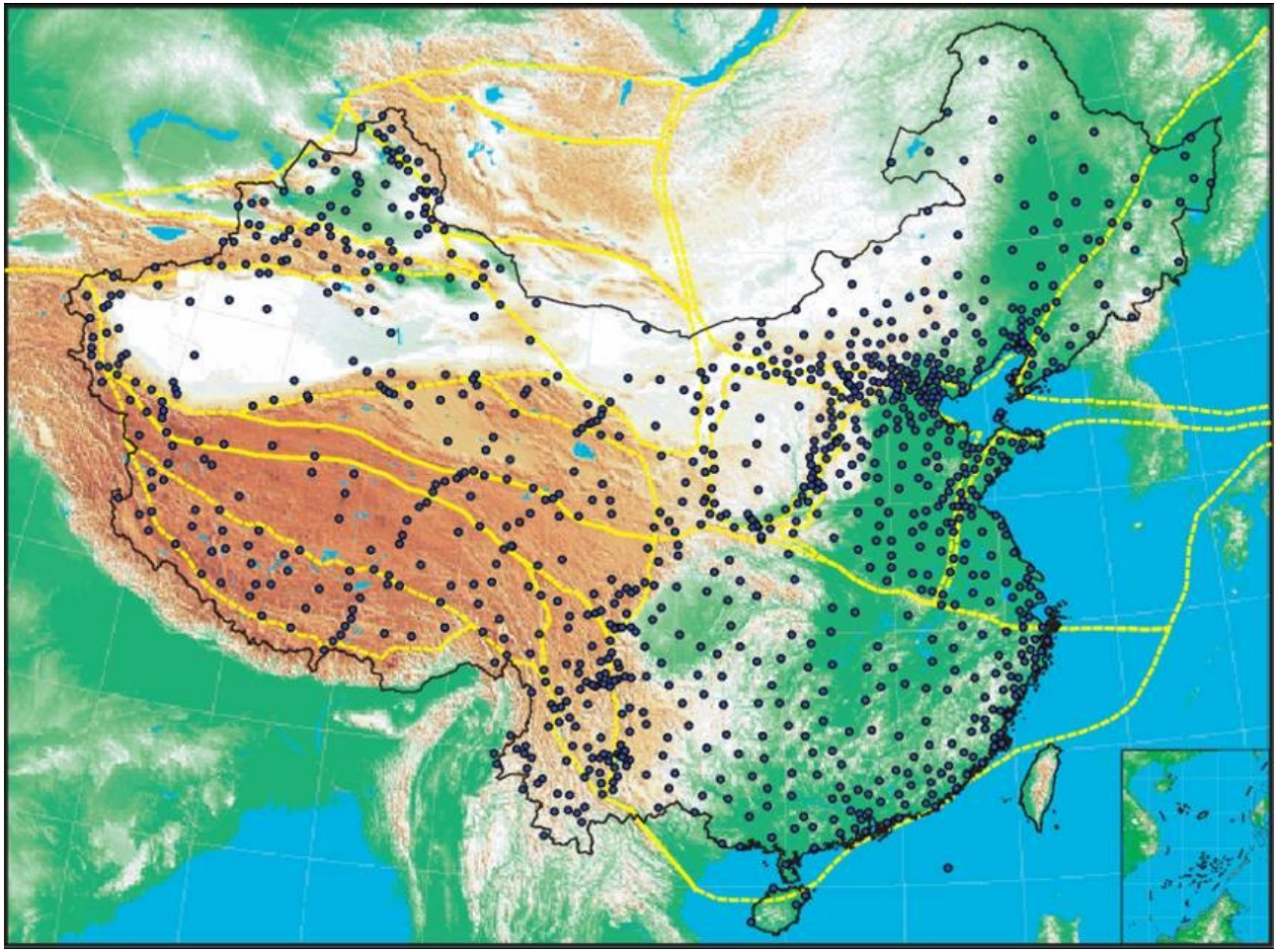
CMONOC-1 measurement



Velocity field relative to NNR-NUVEL1A Eurasia plate model (provided by Dr. Liu)

CMONOC-2: fiducial network stations

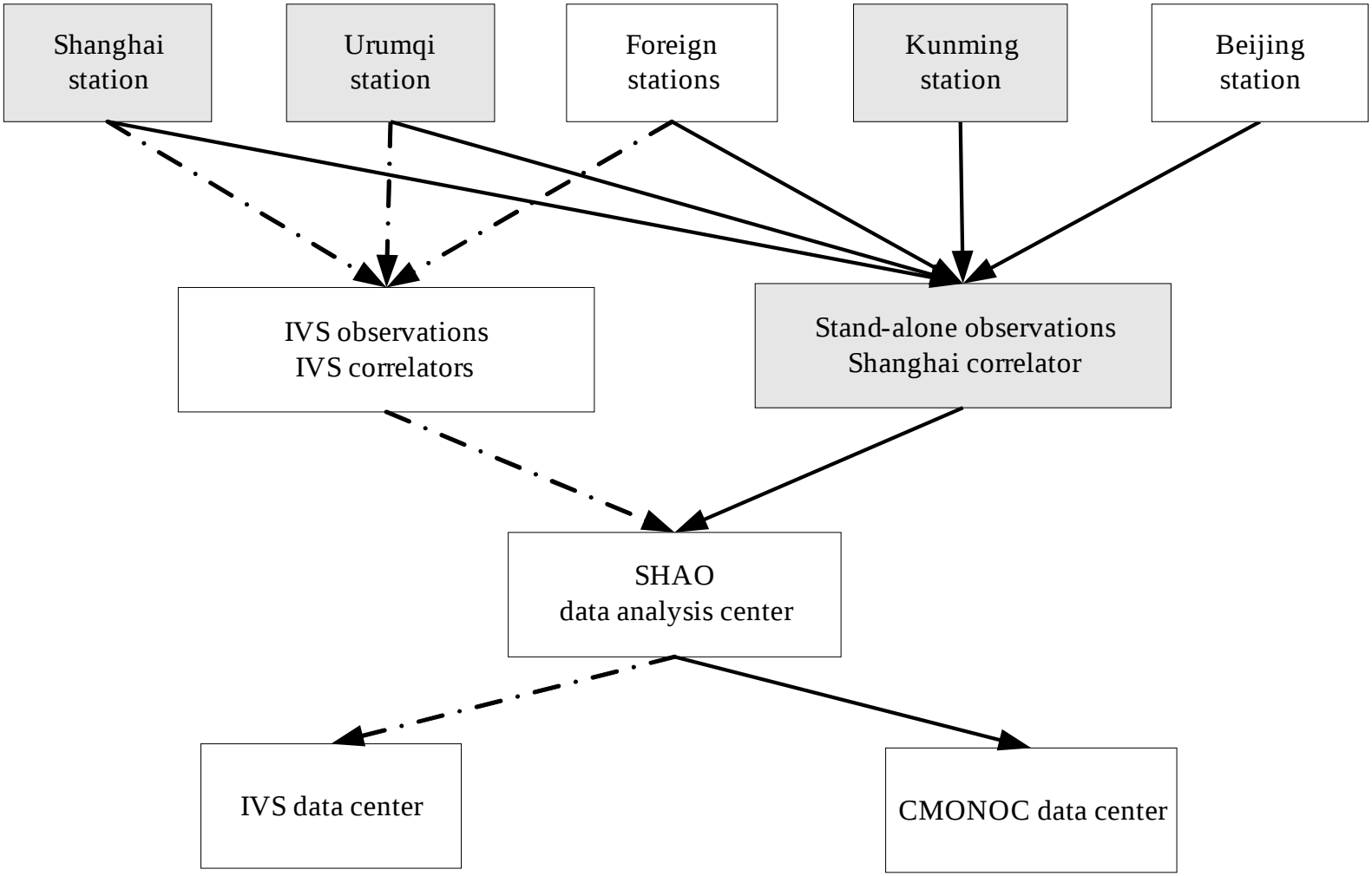
CMONOC-2: regional network stations



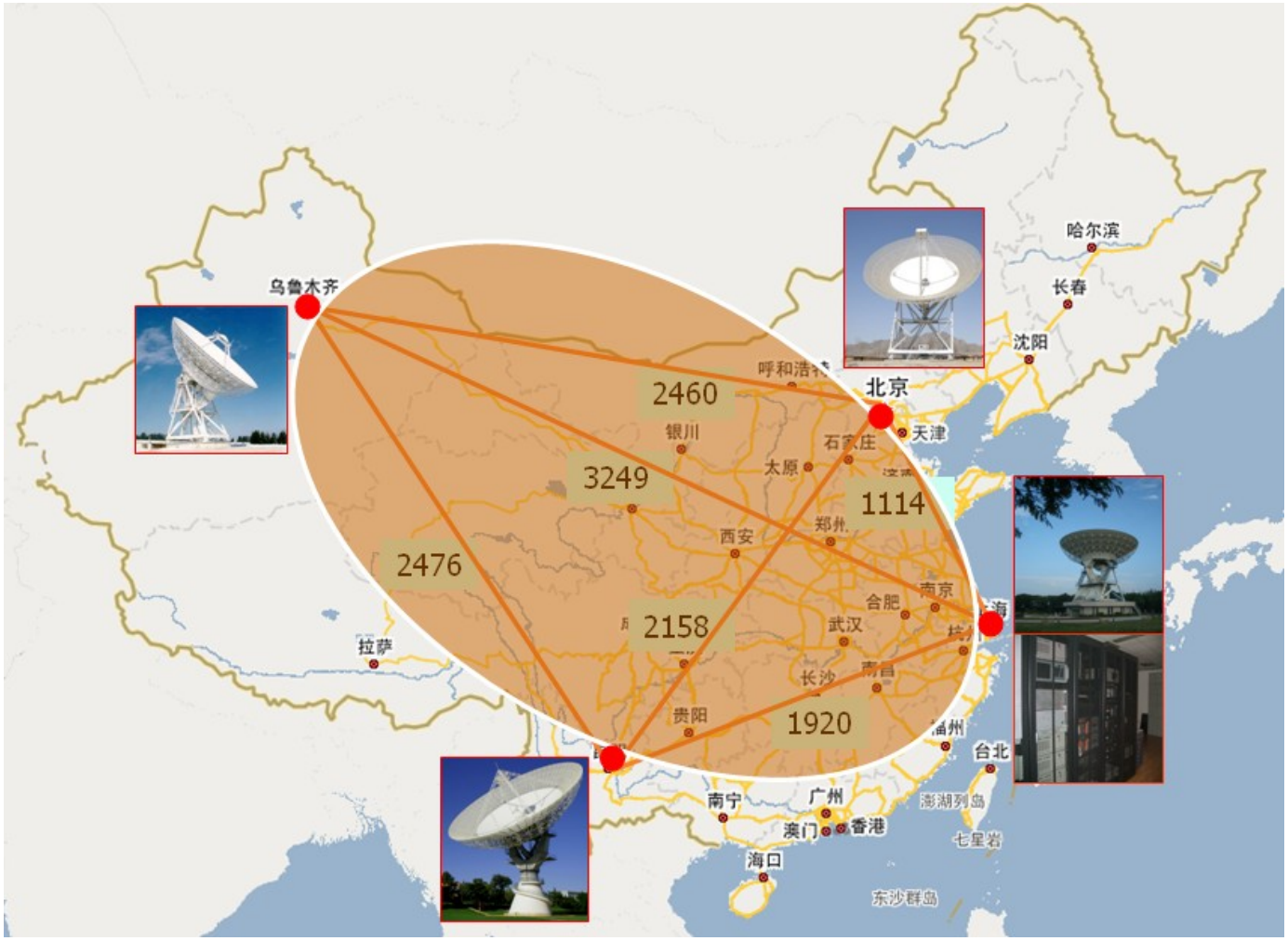
Goals of VLBI in CMONOC-2

- Establishing an operational geodetic VLBI observing system
  - Full functional system
  - Full compatible with international VLBI community
  - Operational in stand-alone mode with Chinese domestic stations
  - Routine service with product quality data
- Performing regular geodetic VLBI observations
  - Connection between global reference frame and Chinese regional network.
- Supporting navigation of future deep space missions in China
  - Precise Position measurement of tracking stations
  - EOP and reference radio sources measurement

Chinese geodetic VLBI observing system



Distribution of Chinese VLBI Network



Seshan25 station

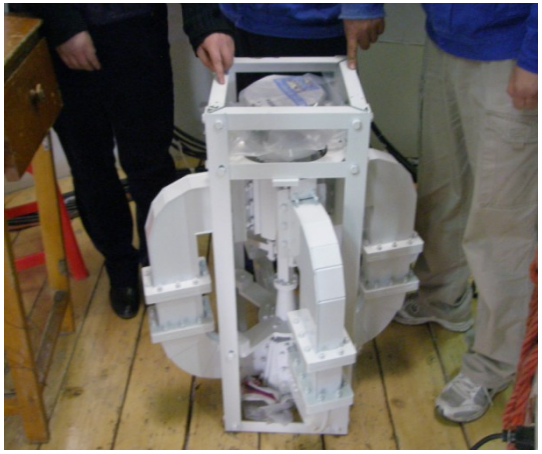
- April, 2010
  - VLBA4 analog system was upgraded with VSI interface to connected with Mark5B recorder, but Mark5A recorder was still remained for international e-VLBI and IVS sessions
  - CDAS & Mark5B+ was installed for the domestic observations
- December, 2010
  - Mark5A is not used for recording

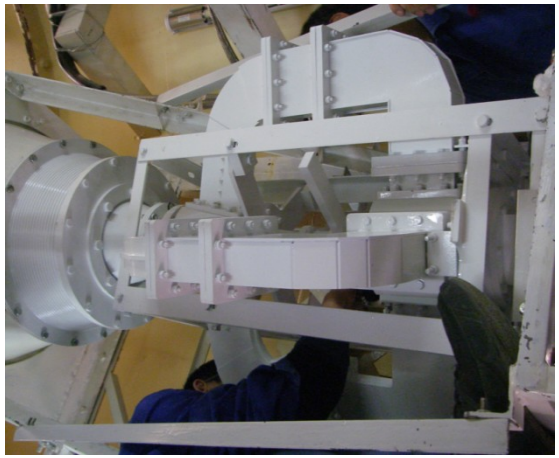
Kunming station

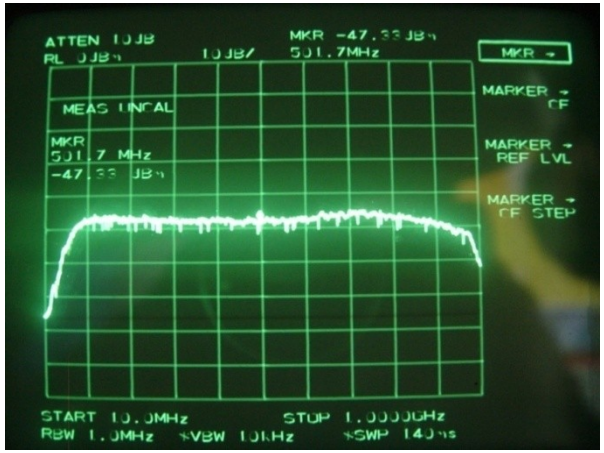
- January, 2011
  - Began to participate in the domestic geodetic observations with CDAS
- July, 2011
  - Began to participate in IVS-T2 and IVS-APSG sessions with CDAS
  - To get more precise station coordinates on global scale.
  - To further validate the performance of CDAS in geodetic observations.

Urumqi station

- New S/X feed installed at Urumqi with wider frequency coverage: 8.0～9.0GHz



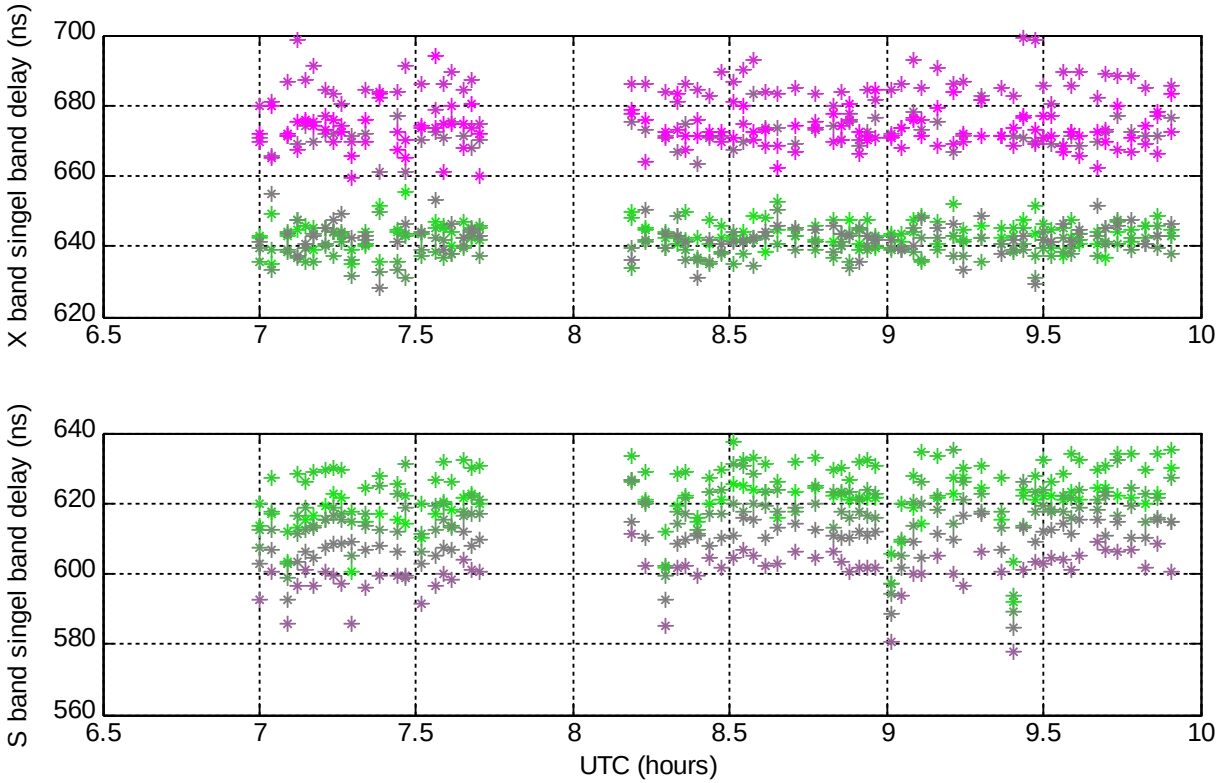




- X band SEFD measured by FS < 700

Fringe test for wider X band feed

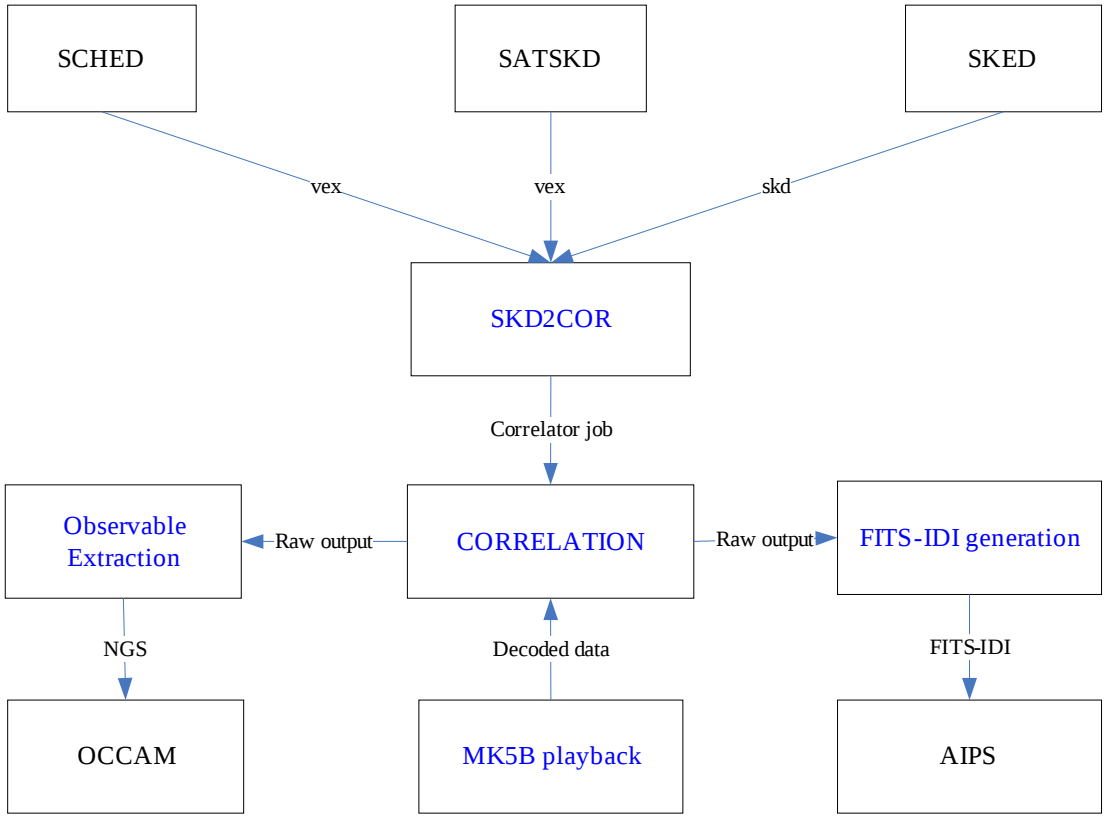
- Fringe test was performed on the Sh-Ur baseline on Dec. 16, 2011



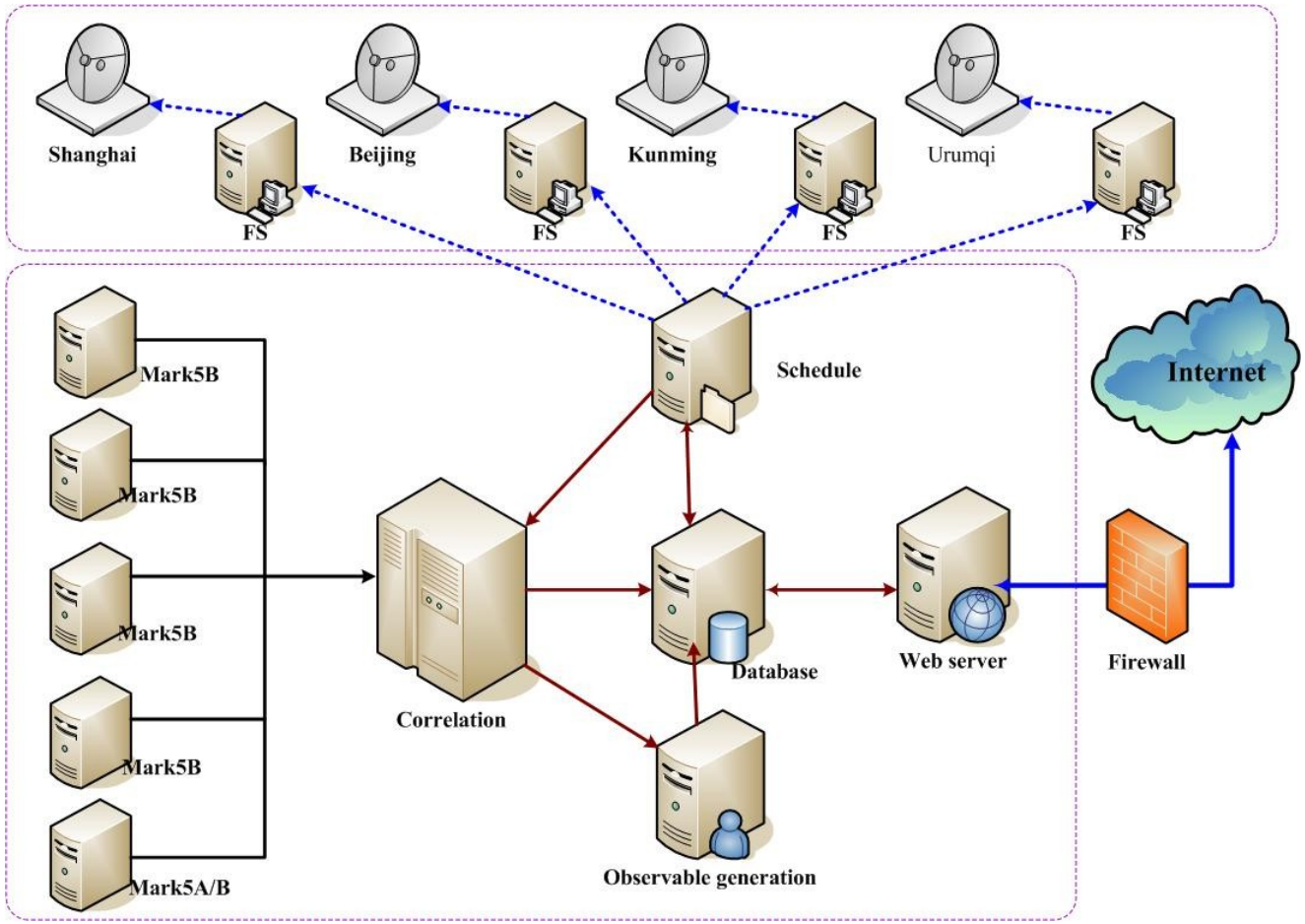
Shanghai correlation system

- correlator control system
  - SKED/SCHED/SATSKD interface
  - Scan-based processing
- MK5B playback capability
- observable extraction
  - flag, fringe fit, manual phase calibration, bandwidth synthesis, NGS format output
  - Graphic display, data quality statistic

Software architecture



Correlation system hardware



Platform for correlation

- Blade Cluster
  - 6 x Blade Server
  - Blade Configuration: 2xIntel Xeon 5570 (2.93G),
  - 12G DDR3 Memory,
  - 10GbE NIC with TOE && RDMA
- Storage
  - 3x10TB Raid,10GbE NIC

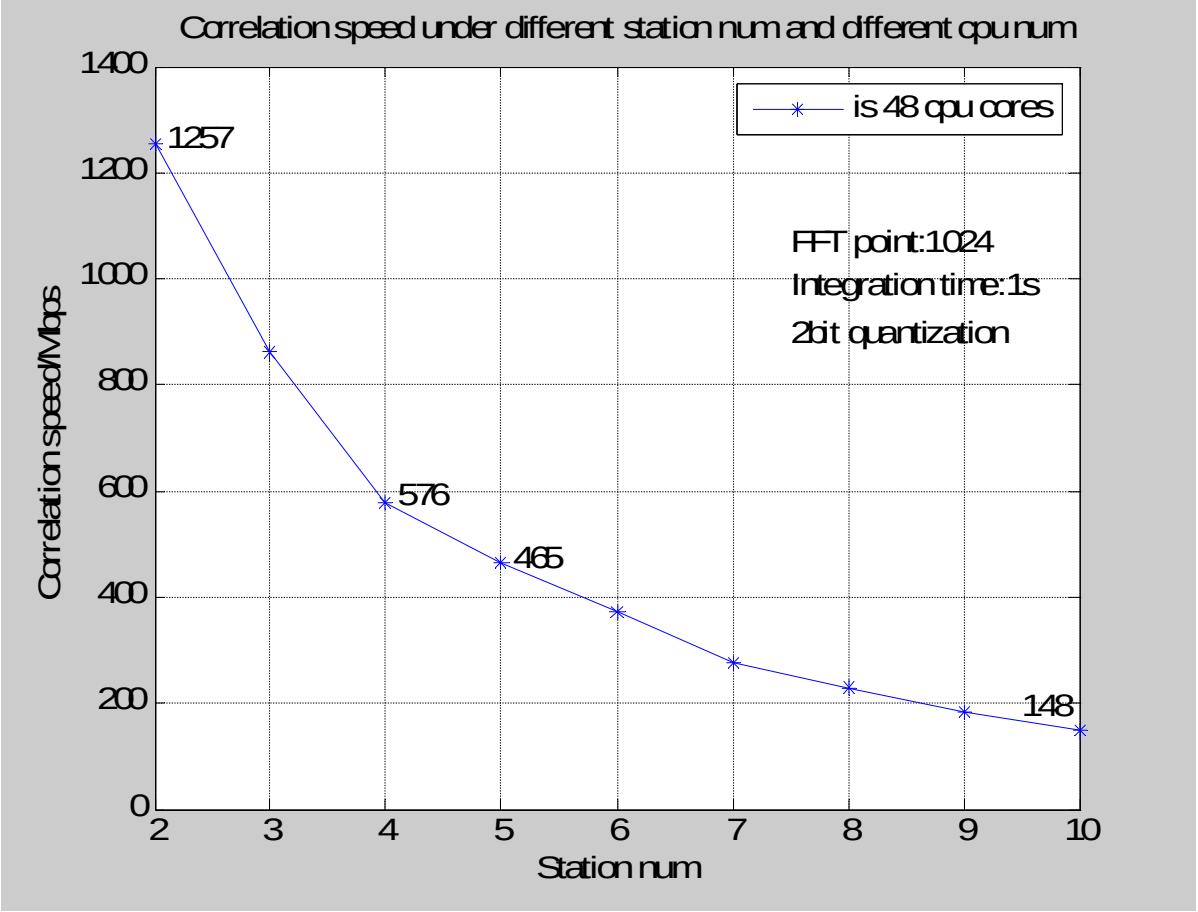
MARK5 system

Mark5 data playback

30 disk modules, 8TBytes

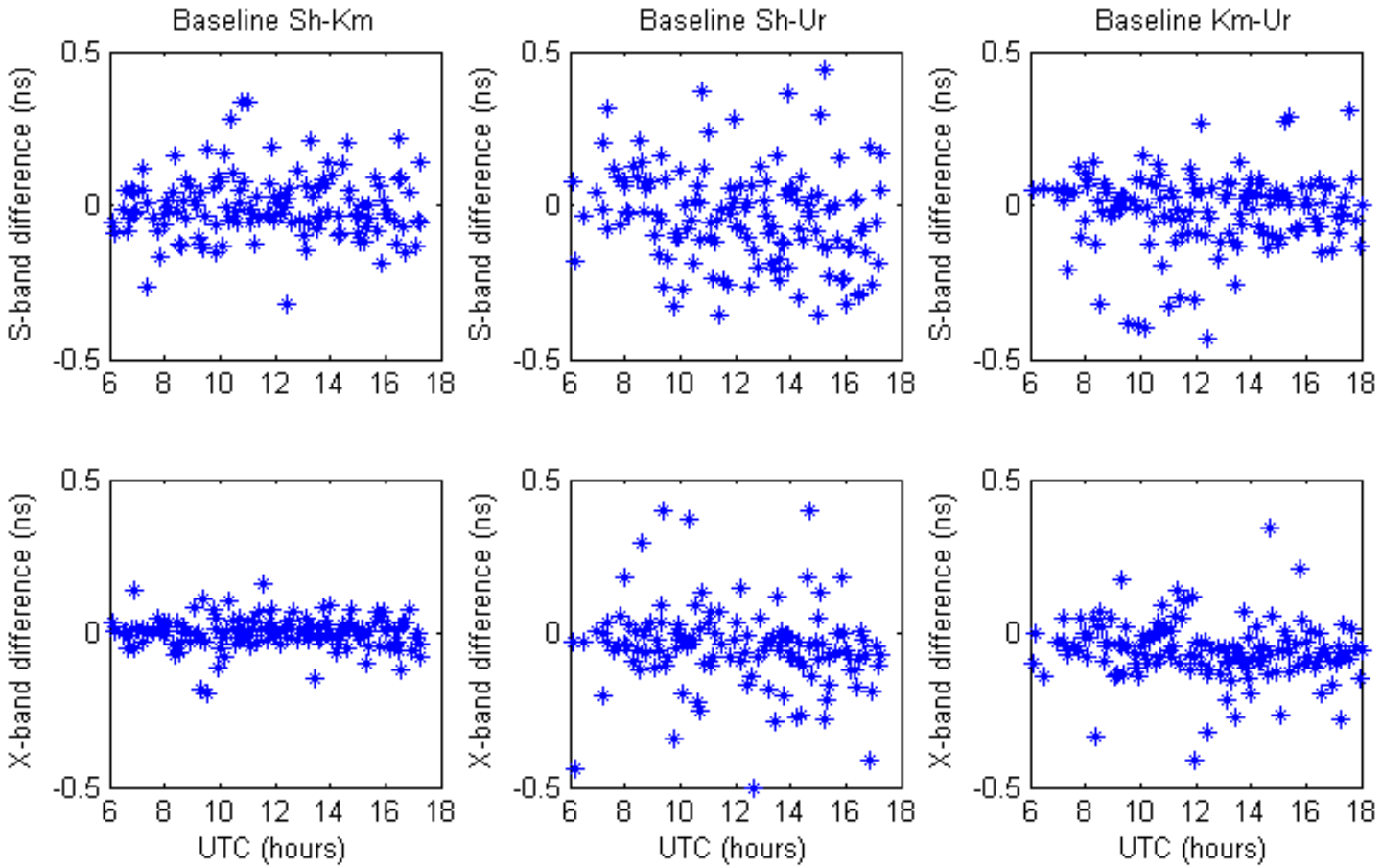
Performance evaluation of the correlator

- 3 stations:
  - ~800Mbps
- 5 stations:
  - ~400Mbps
- 10 stations:
  - ~140Mbps



Validation of CDAS performance

- MBD difference between ABBC and CDAS



MBD comparisons

Baseline	Band	ABBC error（ps）	DBBC error（ps）	MBD agreement（ps）
Sh-Km	S	106	46	105
Sh-Ur	S	110	140	157
Km-Ur	S	77	76	126
Sh-Km	X	35	31	52
Sh-Ur	X	73	115	131
Km-Ur	X	52	61	97

Chinese domestic observations

- Observing time
  - Lower priority than satellite tracking/IVS/EVN
- Observing mode
  - 128(data rate)-8(channel)-1(bit)
  - 256-16-1
- Observing sources
  - ~35 sources from ~80
  - ~65 sources from ~100
- Observing sessions
  - 6~12 very year

Data analysis of NGS output files

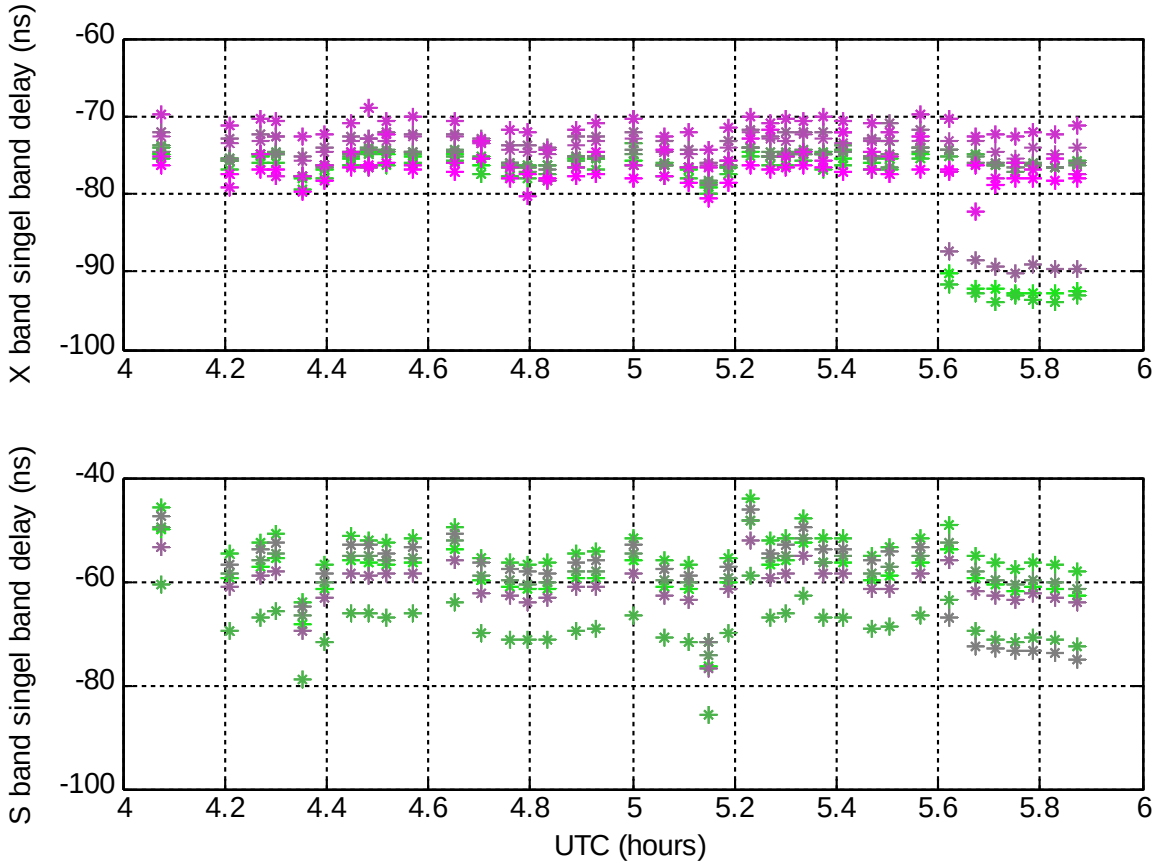
- So far ~15 domestic sessions have been performed
- Determination of site coordinates of Kunming
  - The result of the first IVS session agrees well with those of domestic sessions in ~1cm

Obs.time	X (m)	Y(m)	Z(m)	Sx (m)	Sy (m)	Sz (m)
20100114	**-1281152.8161**	**5640864.4358**	**2682653.5154**	**0.0061**	**0.0163**	**0.0127**
20100810	**-1281152.7970**	**5640864.4236**	**2682653.5143**	**0.0057**	**0.0156**	**0.0094**
20110720	**-1281152.8016**	**5640864.4199**	**2682653.5123**	**0.0036**	**0.0088**	**0.0051**
Adopted Kunming station velocity （m/yr）				**-0.0311**	**0.0007**	**-0.0182**

  - There is a systematic bias of ~ 5cm among different data analysis software

CDAS fringe test on 1Gbps geodetic obs.

- Jan.12, 2012
- Mark5B.16ch32MHz1bit



Summary

- After the new S/X band receivers installed at the middle of 2012, wider frequency coverage at X band (8.2-9.0GHz) will be used for experiments.
- The performance of CDAS on Mark5B 16ch32MHz 1bit mode should be improved.
- produce better quality data by making further comparisons with the results of any other correlators
  - Improve software performance: clock jump, MBD delay ambiguity, graphic display, data quality statistic, et al.
  - Verify the algorithms in the software

Thank you!