TECHNICAL DEVELOPMENT CENTER NEWS No.6

International Earth Rotation Service - VLBI Technical Development Center News

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April, 1995

In October 1990, the International Earth Rotation Service (IERS) designated the Communications Research Laboratory (CRL) and Haystack Observatory, USA, as the Technical Development Centers (TDC). These centers are supposed to do

1) the development of new observation techniques and new systems for advanced Earth's rotation observations by VLBI and other space techniques,

2) the promotion of research in Earth rotation by advanced methods in VLBI,

3) the distribution of new VLBI technology.

The TDC meeting, attended by the ordinary members from inside the CRL and the special members from the outside, is held twice a year. The special members advise the committee, concerning the plan of technical developments. The TDC newsletter is published biannually by CRL to inform the IERS community its current activities.

The Sixth TDC Meeting

The Sixth meeting of the TDC was held on March 3, 1995 at the conference room of the Kashima Space Research Center, CRL.

Agenda

1. Opening address by Fujinobu Takahashi, director of the Standards and Measurements Division, CRL
2. Introduction of Technical Development Center
3. Activity reports by the special members
4. Technical reports

4.1 Keystone project

4.2 Other technical development activities

5. Discussion
6. Closing address by Akira Sugiura, director of the Kashima Space Research Center, CRL

Attendees

CRL members

Takahashi, Fujinobu

Imae, Michito

Kunimori, Hiroo

Sugiura, Akira (Kashima Space Research Center)

Takahashi, Yukio (Kashima Space Research Center)
Takaba, Hiroshi (Kashima Space Research Center)
Iwata, Takahiro (Kashima Space Research Center)
Kurihara, Noriyuki (Kashima Space Research Center)
Kiuchi, Hitoshi (Kashima Space Research Center)
Koyama, Yasuhiro (Kashima Space Research Center)
Hanado, Yuko (Kashima Space Research Center)
Nakajima, Junichi (Kashima Space Research Center)
Gotoh, Tadahiro (Kashima Space Research Center)
Kondo, Tetsuro (Kashima Space Research Center)

Special members

Kawano, Nobuyuki (National Astronomical Observatory)
Kawaguchi, Noriyuki (National Astronomical Observatory)
Saito, Takashi (Geographical Survey Institute)
Kanazawa, Teruo (Hydorographic Department, Maritime Safety Agency)
Hirabayashi, Hisashi (Institute of Space and Astronautical Science)
Shibuya, Kazuo (National Institute of Polar Research)
Okada, Yoshimitsu (National Research Institute for Science and Disaster Prevention)

Teruyuki Kato (Earthquake Research Institute, University of Tokyo) could not attend the meeting.

Minutes of the Sixth TDC Meeting

3. Activity reports by the special members

Each special member reported current status and activities of each institute.

• Current Status of IRIS-P Network *(Nobuyuki Kawano)*

VLBI measurements on the IRIS-P network will be continued. The K-4 aquisition terminals will be distributed to stations in China, Tasmania, and Hawaii (or Alaska) gradually starting in June, 1995. Correlation processing will use the VSOP correlator.

Q&A

Q: How often are you planning to conduct experiments?

A: So far, we don't have an answer, because it depends on the agreement made between the countries involved.

• Outline of VLBI System Development at National Astronomical Observatory *(Noriyuki Kawaguchi)*

TCU (Timing Control Unit) has been developed. TCU enables timing control at recording and/or replaying without use of any formatted data.

A VSOP type data aquisition system is developed on the basis of the sampler (DFC-2000) developed by CRL.

A sampler with 4 GHz sampling rate and 2 bits resolution was developed and has been evaluated. Test observations start.

Burst sampling system, consisting of 4 GHz sampler and 32 Gb memories, can take the data for only 4 sec for fuge amount of data such as required to 500 sec when K-4 is employed.

Q&A

Q: Who determines the orbit of VSOP?

A: JPL and ISAS.

- **VLBI Observations at Geograpphical Survey Institute** *(Takashi Saito)*

In FY1994, we conducted domestic VLBI observations on baselines Tonami-Kashima and Kanozan-Kashima. Two sets of VLBI systems equiped with 3.8-m dish antennas are newly installed. One is used as a fixed station at Shintotsugawa in Hokkaido. The other is used as a mobile station and is now stationed at Tsukuba. A hundred and ten GPS receivers are distributed in Japan by GSI. Besides this, a hundred GPS receivers are deployed in the South-Kanto area.

Q&A

Q: Are GPS observations always carried out?

A: Yes for the whole Japan network. As for the South-Kanto area, observations are made for 6 hours a day.

Q: Do you have a plan to install a super computer for GPS data analysis?

A: Under consideration.

Q: How about VLBI observations in the South-west islands.

A: Next year, a mobile VLBI will visit Okinawa island.

Q: What is a ground for the density of GPS receiver's distribution.

A: It is determined from the size of precursor for the South-Kanto area and from budgetary reason for the whole Japan network.

Q: Do you summarize the each GPS site's data?

A: Yes.

Q: Do you have a plan to contribute GPS data to IERS?

A: Yes.

- **Introduction of SLR** *(Teruo Kanazawa)*

Stations in the world, satellite itself, and evolution of acuracy for SLR is briefly introduced.

Q&A

Q: What is the lifetime of the satellite?

A: Degradation of the reflectors is the main lifetime factor. Twenty years have been past since the launch of Lageos, but the reflector is still in good condition.

Q: What is the reason for Lageos2 being launched?

A: To improve the accuracy by increasing the spatial coverage.

- **Current Status of VSOP** *(Hisashi Hirabayashi)*

Current status is introduced.

Q&A

Q: How about foreign project for space VLBI?

A: There is the Radioastron project of Russia. The satellite is scheduled to be launched in 1997, but there is a possibility that this will not take place. In addition, there is a plan proposed to NASA.

• **Status Report of Geodetic Observations in Antarctica** *(Kazuo Shibuya)*

There is no progress for the Antactic VLBI project. GSI made absolute gravitational measurements. DORIS is installed at Syowa station and working well. A campaign observation promoted by Germany was carried out from January 20 to February 10, 1995.

Q&A

Q: Is there any fixed GPS station at Syowa station?

A: No. A pillar for a fixed station is under the construction.

Q: What is the accuracy of DORIS results?

A: ±2cm for each component.

Q: Are the results included in IERS?

A: From now on.

Q: Do you have detailed information concerning the 9-m antenna at Macmurdo station, especially concerning installation of the VLBI system?

A: At the moment there is no plan to install a VLBI system.

C: GPS or DORIS will detect the plate motion of Antactica for the first time.

• **Status Report of Borehole Observations at National Research Institute for Science and Disaster Prevention** *(Yoshimitsu Okada)*

Eearthquake activity in the Kanto area has been low for sixty years since the big Kanto earthqukae. However M4-class earthquakes began to occur recently. Borehole observations are very useful to monitor small-magnitute earthquakes in the Tokyo metropolitan area covered with thick loam. Four 3000m-depth and twelve-2000m depth boreholes are now instrumented.

Q&A

Q: You say that daytime observation is often affected by blasting. Is it possible to remove these effects from the data?

A: Yes. We actually remove such effects from the data.

Q: How small does the noise become at 3000m depth in a borehole?

A: About 1/200.

Q: Do you have a plan to deploy borehole observation system to cover the whole of Japan?

A: No.

Q: What is the cost of a 3000m depth borehole.

A: About two billion Yen.

Q: Is interferometry technique applicable for seismic waves?

A: Array of seismographs at a point is already utilized for observation. However, interferometry is difficult since the wave-form itself usualy varies between distant stations.

Q: How do you relate the borehole observationss to prediction of earthquakes?

A: We detect small earthquakes considered as precursors of big earthquake.

4. Technical Reports

4.1 Key Stone Project

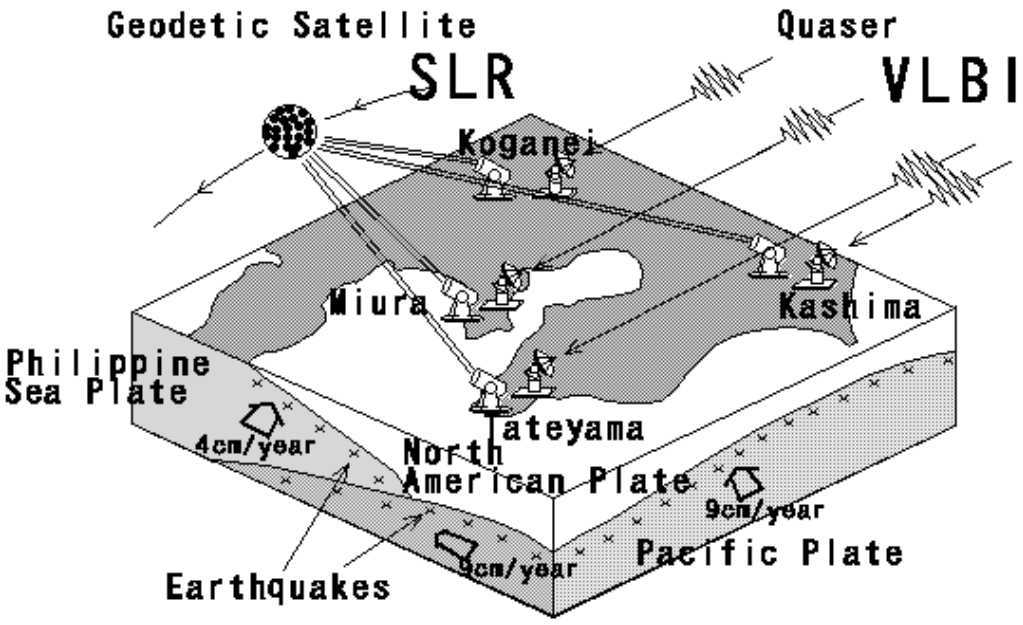

Figure 1: Key Stone Project

• **Outline of the Key Stone Project** *(Taizoh Yoshino)*

The system of Key Stone Project **(KSP)** is designed to monitor the crustal deformation in the Tokyo metropolitan area every day by the VLBI and SLR techniques with the several mm precision.

1994 Central station for data processing was built at Koganei in Tokyo. VLBI stations were constructed at Koganei and Kashima.

1995 VLBI stations was constructed at Miura in Kanagawa. Daily VLBI observations started between Koganei and Kashima. Real time VLBI using optical fiber network is under discussion. Data delivery to the JMA (Japan Meteorological Agency) and CCEP (Coordinating Committee for Earthquake Prediction) was discussed.

• **Current Status of Project** *(Noriyuki Kurihara)*

VLBI stations

Development of VLBI stations dedicated to the KSP including a new building started in FY1993. The observation system consists of three parts, i.e., (1) data acquisitions (2) system monitoring, and (3) remote controlling. Current timetable of development of each KSP station is as follows.

year	KOGANEI Center	KASHIMA Sub-Center	MIURA	TATEYAMA
March, 1995	Data acquisition	Data acquisition		
July, 1995	System monitoring Concentrated controlling	System monitoring	Data acquisition (System monitoring?)	
1996		Concentrated controlling	System monitoring	Data acquisition System monitoring

Data processing and analysis system

VLBI data are processed and analyzed routinly at Koganei Central station. New correlator dedicated to the KSP is under development. So is software for data processing and analysis. Presently tests combining both hardware and software are going on. We will enter the routine operation phase of the correlator in FY1995.

Test observations on the Koganei-Kashima baseline

We carry out test observations on this baseline to check the whole performance of the KSP VLBI system. First fringes were succesfully detected on July 25, 1994. The first full 24-hour experiment was carried out on August 29, 1994. Daily observations, whose main purpose is system performance check, have been carried out since January, 1995.

• **Automatic Observation System** *(Takahiro Iwata)*

VLBI is one of the most accurate technique for geodetic measurements. However, it is not suitable for daily observations because much man-power is necessary for both observations and data processing. The purpose of the Keystone project promoted by CRL is to detect regional crustal deformations, considered as precursors of large earthquakes, therefore continuous daily observations are strongly desirable. Especially high reliability is required for the system to perform the continuous observations not disturbed by instrument malfunctions. Fully automatic operation is also required. We have designed the KSP system so as to meet both these requirement.

Stations

Each station is equipped with two kinds of computers. One is a controlling computer which controls the observation instruments, such as an antenna and a recorder according to schedule prepared in advance. The other is a monitoring computer which gathers basic data, such as meteorological data, sytem noise temperature, and status of each instrument.

Central station

Koganei and Kashima function as a central station and a sub-central station. Both stations are equipped with concentrated controlling computers which control and monitor systems at each station via a computer network. An operator at the central or sub-central station can therefore know the status of each station.

Computer network

A WAN (Wide Area Network), which is a dedicated digital communication link, connects Kashima, Koganei, Miura and Tateyama. Furthermore we plan to have a backup digital link between Kashima and Tateyama. Each station is also equipped with a telecommunication line for data transfer. Remote operation through this line is planned to recover the computer system as a backup.

Data recording

The data recording is performed by the K4 data recorder built in the DMS-24 automatic tape changer. The DMS-24 enables operatorless observations for 24 hours. We aim to do real-time data transfer to the correlator at the central station in the future.

• **Data Acquisition System** *(Hitoshi Kiuchi)*

The local oscillator synthesizes the local frequency signal (500-1000 MHz : 10 kHz step) for the video converter. The measured phase noise is better than 3 deg, which is calculated according to the value of the measured Allan variance. Coherence loss caused by this phase instability is less than 0.04%. The local oscillator has now been fully developed and is in commercial use. The video converter converts windows in the IF signal input (500-1000 MHz) to video signals (0 - 32 MHz). The input interface unit samples the 16-channel (max.) video signal, and sends the sampled data to the data recorder following a time data block, and produces a data train of up to 256 Mbps. The format does not include a time code but only a digitized signal. It was designed to make the best use of the K-4 recorder's abilities at levels of up to 256 Mbps. The anti-aliasing filtering is made in analog (32 MHz), and sampling is carried out by an 8 bit A/D converter of 64 Msps. The quantization threshold level of the A/D converter is adjustable. After sampling, the 16 MHz, 8 MHz, etc. filtering and bit discriminations are accomplished by digital filter. The digital filter is good for producing excellent phase characteristics, and for reducing coherence loss. It is possible to select suitable coefficients for the digital filter, for example, the digital filter is used as a band pass filter during line observations. The configuration for one- and two-bit sampling is shown in the table. It is possible to support the Mark-III, the VLBA, and the VSOP data acquisition modes. This Input interface unit is adopted to the VSOP data acquisition sub-system.

Sampling rate [Hz] 1 bit (2-level)						*Sampling rate* [Hz] 2 bit (4-level)					
Number of input ch.	*Data recording rate [bps]/Recorder*					Number of input ch.	*Data recording rate [bps]/Recorder*				
	256M	128M	64M	32M	16M		256M	128M	64M	32M	16M
16 ch	16M	8M	4M	2M	1M	16 ch	8M	4M	2M	1M	0.5M
8 ch	32M	16M	8M	4M	2M	8 ch	16M	8M	4M	2M	1M
4 ch	64M	32M	16M	8M	4M	4 ch	32M	16M	8M	4M	2M
2 ch		64M	32M	16M	8M	2 ch	64M	32M	16M	8M	4M
1 ch			64M	32M	16M	1 ch		64M	32M	16M	8M

• **Correlation Processing System — Hardware** *(Hitoshi Kiuchi)*

KSP correlator

In the multi-baseline correlation processing, all the output interface units are daisy-chain connected via GPIB and a timing control line. Therefore, the tape position data and the status data of all the data recorders can be exchanged via the output-interface units. The main replay system (the main output interface unit and the data recorder) and the sub replay system (the sub output interface unit and the data recorder) can be synchronized in one-bit steps. The delay adjustment is done by controlling the Track set ID and subsequent programmable shift registers (PSR). The signal (raw data) is unformatted instead of in the Mark-III format. We are developing an XF type VLBI correlation processor for the K-4 system by making use of a Field Programmable Gate Array. The outline of the correlator is;

(1) Automatic bit synchronization during multi-baseline processing,

(2) Network Filing System for storing correlated data,

(3) 2-bit sampled data processing capability,

(4) 16ch high speed (32 Mbps/channel) processing,

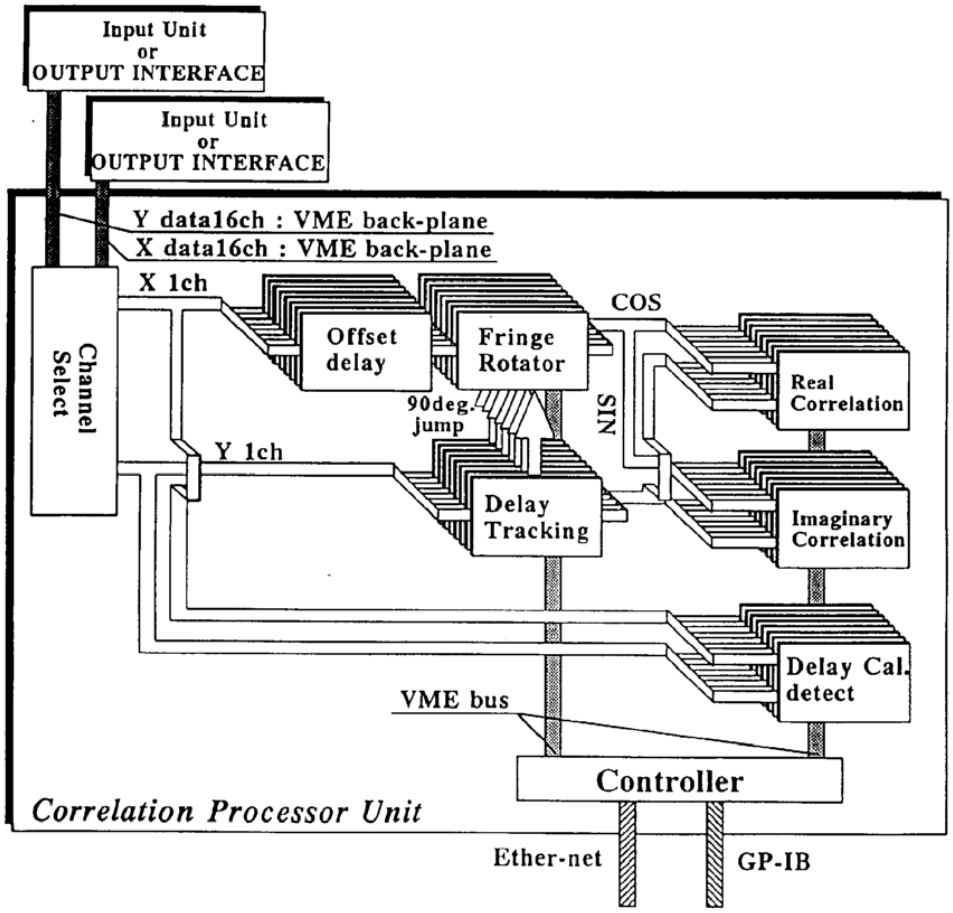

Figure 2: Block diagram of KSP correlator

(5) Signal provided by VME back plane.

This correlator was specially designed for the Keystone Project, which is concerned with measuring crustal deformation in the Metropolitan area. The project utilizes 4 stations in the Metropolitan area, and each station has a new K-4 system and an 11 m antenna. Using this new correlator, we can improve the precision of the geodetic VLBI and also contribute to radio astronomy VLBI. A part of the multi-baseline correlation processor has been developed. And we are now checking its performance. We plan to produce a multi station (4 or 5) correlation processor and are also developing new software that will be compatible with our current software.

Q&A

Q: What is the number of lags in a correlation unit?

A: 32 lags.

Q: Why are 16 units necessary?

A: For applications other than the KSP.

• **Correlation Processing Control Software** *(Tetsuro Kondo)*

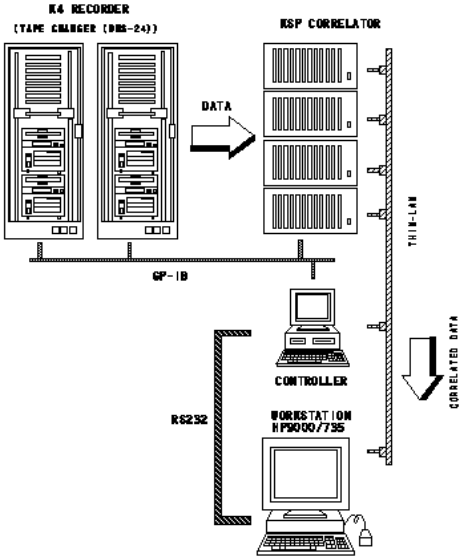

Figure 3: KSP correlation system

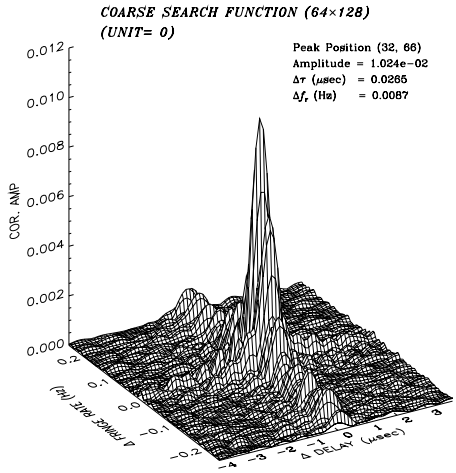

Figure 4: Coarse search function using KSP correlator out

We named correlation processing control software "KATS" (KAnameishi (= keystone) data processing Togo (= unified) Software). KATS unifies the steps from correlation processing to just before the creation of database. It aims at realizing an easy operator interface. The function of KATS is summarized as follows:

(1) Set up of parameters passed to correlator

(2) Automatic clock search

(3) Dynamic clock offset correction

(4) Operatorless operation except for initial tape setting

(5) Automatic execution of band-width synsthesizing software

(6) Execution of database creation software

(7) Archive correlation data

Presently debugging of the whole correlation system is being carried out.

Q&A

Q: When the sampling frequency is 8 MHz, a 32 bit-lag window merely covers a range of 4 micro seconds. Is dynamic clock offset correction working well for such a narrow window?

A: At first, clock search is carried out on extended lag windows by connecting 16 unit correlators serially. Once fringes are detected, we think that change of clock offset is much less than 4 micro seconds for time interval between scans (= about several minitutes).

• VLBI Data Analysis Software System for Key Stone Project (TAKEMIKADZUCHI)
(Yasuhiro Koyama)

After each site of KSP (Key Stone Project) network performes VLBI observations every day, recorded data tapes are transported to the Koganei Processing Center and correlated with the KSP correlator by **KATS** (KAnameichi data analysis *Togo* [= unified] Software). Once **KATS** finished the correlation processing including the bandwidth synthesis, the remaining data analysis is done by the software **TAKEMIKADZUCHI**. The role of the software is (1) to create and maintain databases, (2) to estimate site coordinates along with other model parameters, and (3) to interpret the estimated results and make the results available on the network. This software is presently under development and is expected to be ready for operation soon. The conceptual design of the software is explained in the following sections.

Database

A database is created from a set of **KATS** output files to prepare for following data analysis procedures. Kicked off by a command executed in the last phase of **KATS**, **TAKEMIKADZUCHI** extracts required information from the **KATS** output files, calcurates ionospheric calibrations and planetary ephemerides, interporates meteolorogical data and then creates a database using the Mark-3 Database Handler developed by Goddard Space Flight Center (GSFC) of National Aeronautics and Space Administration (NASA). **TAKEMIKADZUCHI** also updates these databases automatically when it receives a bulletin (either Bulletin A or Bulletin B) issued from International Earth Rotation Service (IERS) via e-mail.

Analysis

Right after a database is either created or updated, theoretical values of a time delay and a delay rate for each observation and their partials with respect to the various parameters are calculated by the CALC software [version 8.1] which has also been developed by GSFC. In the case of initial creation of the database, other software (called REMAMB and MRKOBS) resolve ambiguities and remove bad observations respectively. Then in the final step, VLBEST is run to estimate site coordinates along with other parameters such as clock offsets and atmospheric delay in the zenith directions. In case the root mean squared delay residual exceeds a certain threshold, the operator is notified before the results are released. The operator then can look into the raw data and change clock epochs or remove bad data points manually using a graphical user interface in an X windows / Motif environment.

Data release

Estimated site coordinates are interpreted as motions of sites in the horizontal and vertical components, and as rates of change in baseline lengths. These results are stored in text files and, at the same time, graphic figures are generated. Any researchers on the Internet network can access these text files and figures from their World Wide Web browser such as MOSAIC at the URL `http://apollo.crl.go.jp/` (the URL is preliminary and may change in the future). If the latest data exhibits a large offset from the linear trend of the site motion or baseline length change, the data points will be distinguished in color to attract attention for a possible pre-seismic signal. The results are updated everytime when **TAKEMIKADZUCHI** updates databases according to the new set of earth orientation parameters in IERS Bulletins and they are reported to related organizations by daily e-mail messages. We are expecting that these data will be used by earthquake prediction research communities worldwide.

Q&A

Q: Please consider to release radio source flux density information along with geodetic results by means of WWW for Astronomical community.

A: We are already considering this issue, and the preliminary results from three experiments can be accessed as a test.

Q: What is the version of CALC, you are going to use?

A: The version of CALC is 8.1 and is the latest available version at present.

Q: Are there any means of data distribution other than WWW?

A: We are thinking of using e-mail distribution to related organizations like Japanese Meteorological Agency.

Q: What is the policy on public availability of released data? Are you planning to give priority to a restricted group to use your results?

A: We are expecting wide research communities to use our data for geophysical research. Therefore the data should be freely available without any restrictions.

Q&Afor the whole of the KSP

Q: Is KSP antenna to be equipped with 22 GHz receiver in the future?

A: No.

Q: How about comparison with other techniques?

A: GSI will use VLBI stations as fiducial points for GPS observation. Therefore the KSP antenna is designed to permit easy connection of its AZ-EL axes intersection to ground marker.

4.2 Other IERS Related Technical Development Activities

• **Introduction and Outline of the Activities** *(Michito Imae)*

Change on the organization at CRL for TDC

A new section named "Space Geodesy Section" was established at CRL Koganei Headquarters in July 1994. TDC is managed by three sections, Space and Time Measurements Section, Space Geodesy Section and Radio-astronomy Applications Section.

According to this change, the research field for each section is categorized as followings:

Space and time measurements section:

Precise measurement of time and frequency in the space and time project

Space geodesy section:

Precise measurement of space in the space and time project Research on SLR

Radio astronomy applications section:

Observation and analysis using 34m antenna system and technical development

Research and development activities at CRL's VLBI TDC

a. Status of Kashima 34m

The repair of the 34m antenna was almost finished. CRL is making efforts to full automatic VLBI observations by the K-4 VLBI system using cassette tape auto-changer (DMS-24).

b. Technical developments of VLBI system

New K-4 Input Interface for VLBI

The development of the new K-4 Input Interface was completed and it is applied to the Key Stone Project observation system.

New generation VLBI system

Design of the new generation VLBI terminal that will have Gbps class sampling rate has started.

Milli-meter wave receivers

Development of a compact and low noise SIS 40 GHz band receiver for 34m antenna. It will be expand to the 100GHz band low noise receiving system.

High speed data transfer for real time VLBI.

Basic study of real-time VLBI using ultra-high speed ATM network, as a breakthrough for VLBI technique.

c. VLBI experiments

Earth rotation VLBI experiments

Once or twice a month VLBI experiments are performed under the cooperation with the Mizusawa Earth rotation network center of IRIS-P.

Kashima-Urmuqi VLBI experiments using K-4 system

Japan-Russia pulsar VLBI experiments

Domestic VLBI experiments

Experiments for the movement after the eastern part of east-north Japan earthquake under the cooperation between Mizusawa VLBI station of National Astronomical Observatory are being performed.

Sea level monitoring VLBI

VLBI experiments in cooperation with Geographical Survey Institute were performed.

Metropolitan Diamond Cross(MDX) experiments

VLBI experiments in cooperation with Geographical Survey Institute were performed for connection with KSP stations.

Domestic VLBI experiment with Nobeyama Radio Observatory and Usuda station of ISAS

Cooperation to the Japanese VLBI network

d. Related activities for TDC

Satellite Laser Ranging

International SLR symposium was held in Australia using the fund of STA (Science and Technology Agency). Infra-red SLR experiment has been performed with the international cooperation.

Pulsar study

Development of a precise timing observation system using AOS (Acoustic Optic Spectrometer) has been performed and continuous observation will be started. Pulsar VLBI with Russian station was performed.

Basic research for space VLBI

Research target is changed to only the transmission of reference signal to the ETS-6 satellite because of the failure of the ETS-6 satellite to achieve geostationary orbit.

• Status Report of the CRL 34-m Antenna at Kashima *(Hiroshi Takaba)*

Antenna control system

Automatic antenna stow software was incorporated in the VLBI automatic observation software to protect the antenna from the strong winds. A maximum wind speed of 20m/s or a mean wind speed of 13m/s limit antenna operation.

The five axis sub-refrector controller is being replacing and will be available in April 1995.

Receiver system

1.5 GHz Receiving Syetem	Good
2/8 GHz Receiving Syetem	Good
5/10 GHz Receiving Syetem	Problem on the vacuum of the Dewar. not available
15/22 GHz Receiving Syetem	Good
43 GHz Receiving Syetem	A new system using an SIS mixer was installed. Tesing.

Backend syetem

A new VLBA data recorder was installed. The Mark-IIIa mode C is available using the VLBA data recorder.

An automatic tape changer system (Digital Mass Strage DMS-24) became available. Up to 24 K-4 tapes are automatically changed and about one week's automatic observation become possible with the normal 64Mbps recording mode.

Q&A

Q: How earthquake-proof is the performance?

A: The specifications state says seismic intensity 6 (about 400 Gal)

• **Milli-meter Wave Receiver Development** *(Junichi Nakajima)*

The new 43GHz receiver have been completed. We employ an SIS device and wideband IF system for high sensitivity observation. The receiver had been installed in the feed system of the Kashima 34m antenna. The cryogenic system test is in progress.

Project status

There are strong requirements to move to higher frequency to achieve high-sensitivity observations and avoid artificial interference. Extension of VLBI technology to mm-wavelength is a very important objective itself. Furthurmore, mm-VLBI capability will enable us to observe new kinds of astronomical sources. The development of mm-wave receiver started in 1993.

The receiver is planned for use in KNIFE (Kashima Nobeyama Intere FErometer) VLBI cooporative observations. We have developed a new compact GM-cryogenic and a cold head offset dewar with Sumitomo Heavy Industries. Without beam transmission waveguide, the 4K cooled receiver is installed in the secondary focus of 34m telescope (Fig.5). The cooling capacity of the cryogenics is 0.4W and is still improving the performance. We have succeed to retain superconductive temperatures in any elevation angle of the telescope.

The recever employs the SIS device produced in Nobeyama receiver group (Fig.6). The received signal is down converted to 5-7GHz wideband IF. This enables high sensitivity observations, accompanied by an ultra high speed acquisition terminal which is being developed. Sensitive observations of QSO relativistic jets, cores and the Galactic center become possible. SiO observation also throw light on the circum stellar radio source nature and sources of extragalactic origin.

Currently, we have carried out the receiver cooling test. Local signal and downconversion system will be equipped successively. After completion of the the electronics, we need to obtain sub-refrector position parameters. Then the KNIFE operation with normal IF band width (0.1-0.6GHz) will be started from April 1995. In 1996 full range GUN-local souce and wideband IF transmission are planned.

This is a joint project of Nobeyama Radio Observatory, Ibaragi University and CRL. The project is partially supported by Nobeyama Radio Observatory.

Q&A

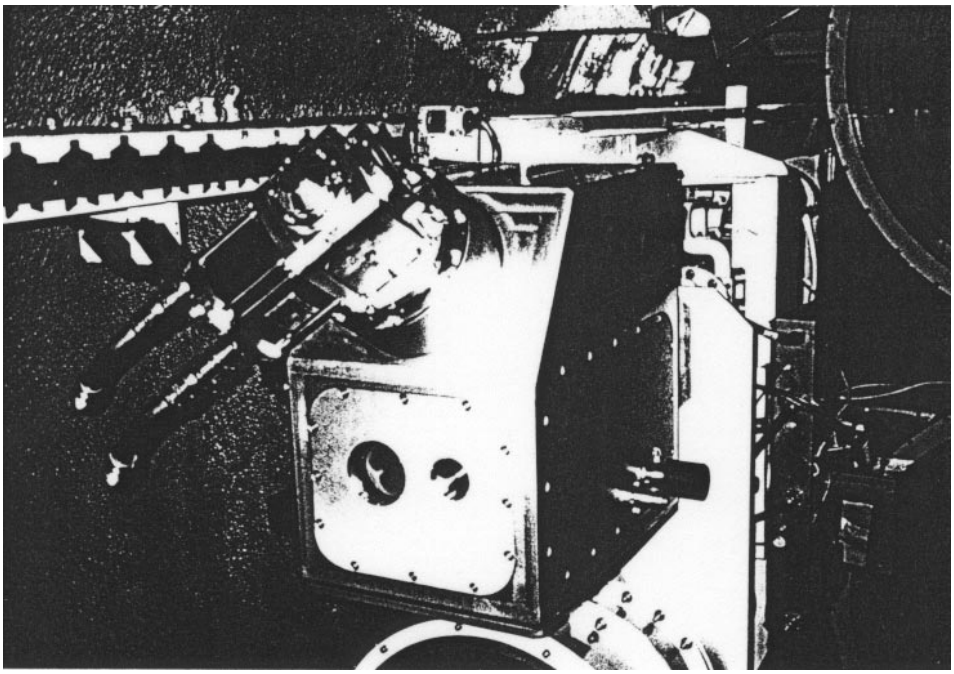

Figure 5: Photo of the receiver installed in the feed system

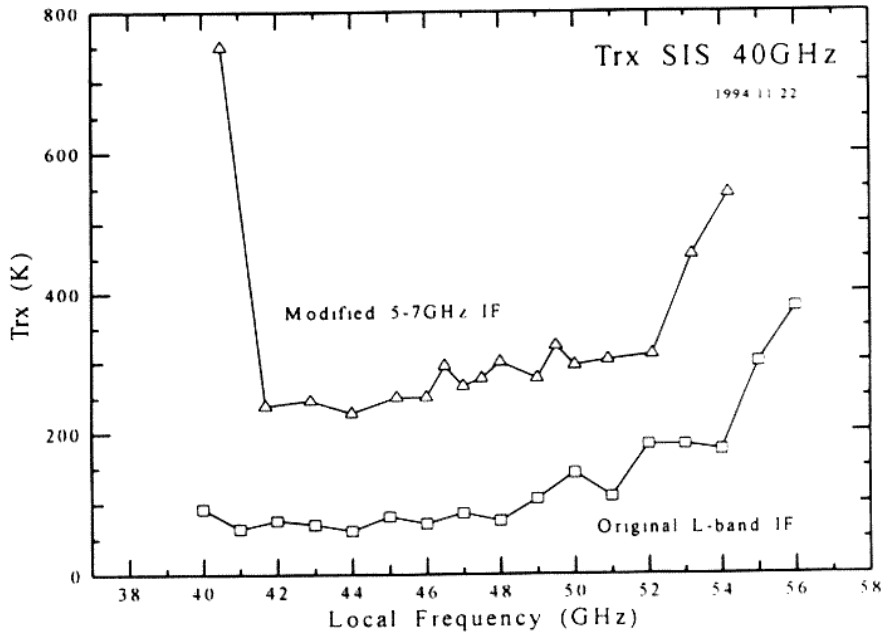

Figure 6: Receiver temperature data

Q: Performance of cryogenics is affected by change of the mount angle. How about your system?

A: So far, we get good stability of perfomance with angle change.

- **Next Generation VLBI System** *(Hitoshi Kiuchi)*

In developing new VLBI data acquisition system for astronomical applications, it is the most important to take into consideration the requirement of the multi-bit sampling, the high-speed (wide-band) data sampling. We are developing a new sampling system for K-4 data recorder: its sampling rate is increased to 2 (or 4) Gsps, 8-bit quantization. The block diagram is shown in Fig.7. We are developing a real time VLBI system for the KSP system, which is shown in Fig.8.

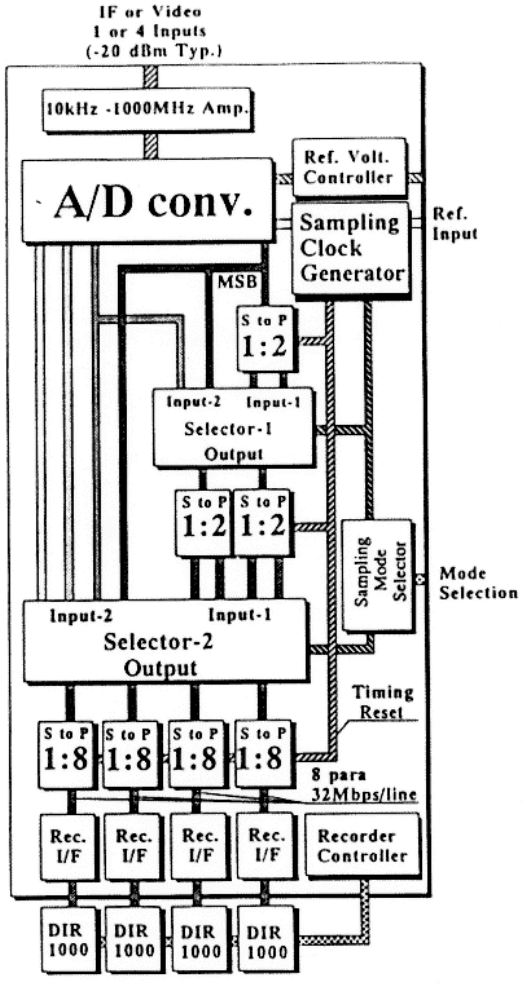

Figure 7. A high-speed sampling head.

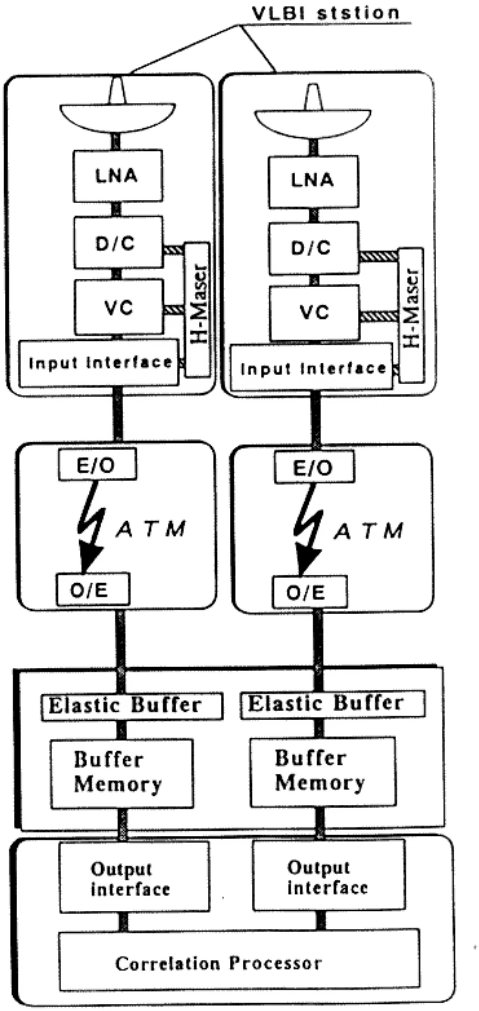

Figure 8. ATM data transfer system for KSP.

• **Pulsar VLBI** *(Yuko Hanado)*

Pulsar observation study at CRL

Timing measurement : Application of millisecond pulsars to frequency reference.
Pulsar VLBI : Measure the pulsars' positions and proper motions, and comparison of reference frames.
Survey : Search for the new observation targets.

Pulsar VLBI

Significance:

·Information concerning the pulsar's position, proper motion and distance are required.

·By comparing the position defined from VLBI and the position defined from timing analysis, different reference frames and connected.

Attention points in observation:

·Pulsars' intensities are weak.

·Dispersion effect causes pulse-smearing.

↓

·Large antenna is required.

·Observation bandwidth and integration time must be considered.

·Signal processing is required for improvement of S/N ratio.

Observation at CRL up to now:

'91	34m(Kashima)-25m(Shanghai)	PSR0329+54	L-band	K-3 correlator	X
'92	26m(Kashima)-64m(Usuda)	PSR0329+54	S-band	K-3 correlator	O(gating)
'94	34m(Kashima)-64m(Usuda)	PSR1937+21	L-band	K-3 correlator	X

Japan - Russia pulsar VLBI

Pulsar VLBI is planned between Kashima 34m antenna (Japan) and Kalyazin 64m antenna (Russia). This project is carried out based on the international cooperation between CRL and Puchino Radio Astronomy Station Astro Space Center of P. N. Lebedev Physical Insitute. Observation frequency is L-band. The K-4 VLBI system is transported from CRL and used in Russia. The correlation processing will be done at CRL.

Experiments in 1995 (preliminary experiments):

'95. 3. 4 Fringe test (= system check)
'95. 3.15 1st pulsar VLBI (for rather strong pulsars)
'95. 3.27 2nd pulsar VLBI (for rather weak pulsars)

Future plan:

Based on the preliminary results in 1995, observations will be carried out during 2 or 3 years. They may be expanded to the Japan-Russia-Australia pulsar VLBI network.

Q&A

Q: Why were fringes not obtained for the 1994 experiments?

A: Because the elevations of selected sources were low and S/N ratios were not high enough.

- **Space VLBI** *(Takahiro Iwata)*

(English version of documents is not available)

Q&A

Q: How do you cope with the time difference between time of the frequency of up-link being changed and arrival time of returned signal from the satellite?

A: Not yet considered.

- **Asia Pacific Radio Telescope** *(Yukio Takahashi)*

(English version of documents is not available)

Q&A

C: GSI plans to conduct the Japan-Korea VLBI experiment.

Q: What kind of K-4 will the network be equipped with?

A: It is the National Astronomical Observatory version.

Q: What is the current status of antennas in India and Southeast Asia?

A: India has some antennas, but the receiver frequency is lower than that of usual VLBI.

- **The Status of SLR R&D Experiment** *(Hiroo Kunimori)*

Table 1. Summary of Activities

Classification	Project Name	Fiscal Year	Status Summary
Geodetic Observation and Analysis	Earthquake Prediction Measurement in Metropolitan Area	1990-1995	-Comparison Results of Coordinates from collocation of SLR,VLBI and GPS in MDX exp.
	Evaluation of Earthquake Potential in East Edge of the Japan Sea	1994-1996	-Improvements of range bias calibration -Short arc solution of station position by Ajisai tracking campaign in east Asia network (Fig.9 and Table 2)
International Network	Western Pacific Laser Network	1994-	-WPLS Symposium at Canberra -Japan as Secretariat of WPLS (Australia, China Japan and Russia)
Next Generation R&D	Synchronous Laser Ranging System	1992-1994	-Synchronous Timing Precision : 70ns
	Orbit Determination of Remote Sensing Satellite	1995-	-System Design of Laser Radar to ADEOS satellite
	Spin Observation of AJISAI	1994-1995	-Prototype system
	Eye-Safe Laser Ranging System	1994-	-Introduction of Raman-1.5um generation and SPAD detector system
KSP SLR System		(1995-)	-Phase of Specification

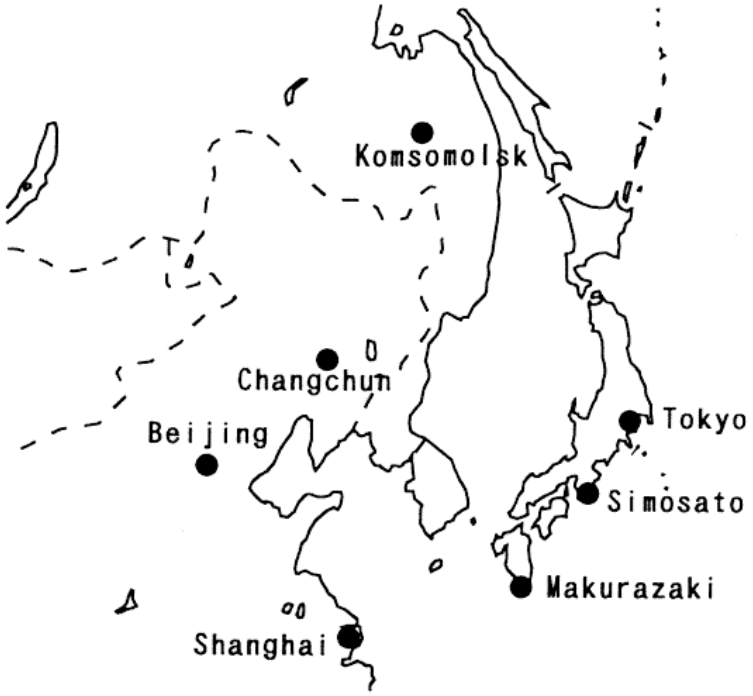

Figure 9. The stations participated in AJISAI tracking campaign (SLR-Japan)

Table 2. The short arc solution of station position in SLR-Japan.

Station		Coordinates	Internal Error	Deviation from ITRF92	Error in ITRF92	(Analysis)
Tokyo(7308)	x	-3942020.074	0.007	0.085	0.116	(Single-pass)
	y	3368097.479	0.007	-0.067	0.112	
	z	3702191.094	0.007	0.044	0.138	
Tokyo(7308)	x	-3942020.066	0.015	0.093	0.116	(SRD)
	y	3368097.464	0.017	-0.082	0.112	
	z	3702191.093	0.005	0.043	0.138	
Shanghai(7837)	x	-2831087.946	0.025	-0.004	0.011	(Single-pass)
	y	4676203.317	0.024	-0.021	0.011	
	z	3275172.789	0.026	0.018	0.012	
Changchun(7237)	x	-2674386.952	0.031	-0.048	0.084	(Single-pass)
	y	3757189.569	0.026	0.067	0.068	
	z	4391508.492	0.024	-0.150	0.053	
Komsomolsk(1868)	x	-2948543.462	0.850			(Single-pass)
	y	2774313.435	0.496	Not listed in ITRF92		
	z	4912307.097	1.026			

Simosato fixed UNIT:METERS

Q&A

Q: Why do VLBI results (for Koganei) have larger errors than those from GPS?

A: No ionospheric correction is applied for this case. Moreover, VLBI measurements were only made seven times in a span of 6 years, but GPS measurements were made only for three days. Thus they can not be compared with each other directly.

This news was edited by Tetsuro Kondo, Kashima Space Research Center, who is the current representative of TDC. The editer wishes to thank Dr. O. J. Sovers for his kind help in the correction of the news translated from Japanese to English.

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VLBI and related activities at the Communications Research Laboratory is now available from the home page of the Radio Astronomy Applications Section of the Kashima Space Research Center on the World Wide Web (WWW). The URL to view the home page is : *http://apollo.crl.go.jp/*