



Rapid turn around UT1 estimation with e-VLBI

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IVS Products Status and Goals

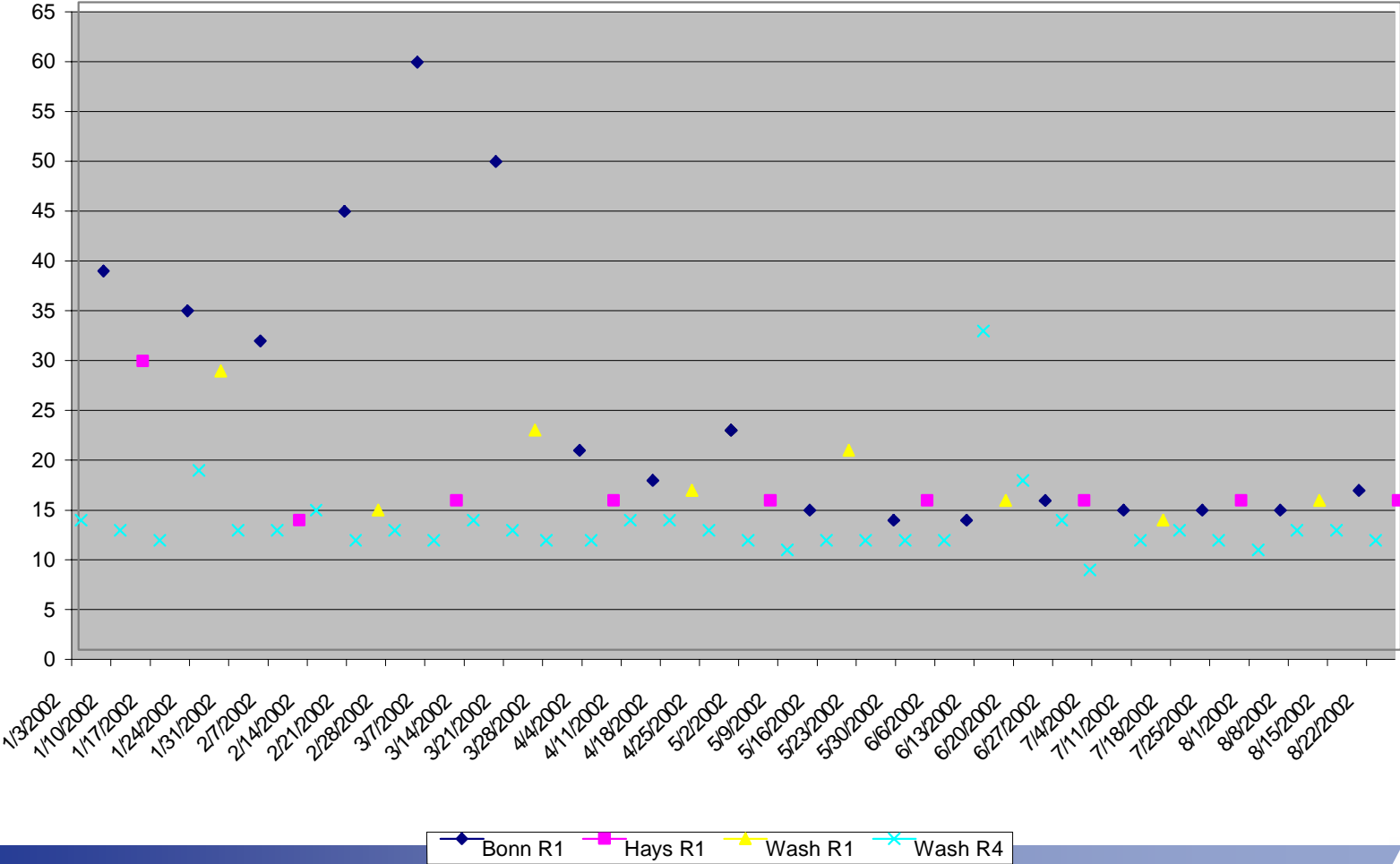
(some examples from WG2 Report)

Products		Status	Goals(2002-2005)
■ polar motion x_p, y_p	accuracy	$x_p \sim 100 \mu\text{as}$, $y_p \sim 200 \mu\text{as}$	x_p, y_p : 50 - 25 μas
	latency	1 - 4 weeks - 4 months	4 - 3 days - 1 day
	resolution	1 day	1 day - 1h - 10min
	freq. of sessions	~ 3 d/week	~ 7 d/week
■ UT1-UTC	accuracy	5 - 20 μs	3.- 2 μs
	latency	1 week	4 - 3 days - 1 day
	resolution	1 day	1 day - 10 min
■ celest. pole $\Delta\epsilon, \Delta\psi$	accuracy	100 - 400 μas	50 - 25 μas
	latency	1 - 4 weeks... 4 months	4 - 3 days - 1 day
	resolution	1 day	1 day
	freq. of sessions	~ 3 d/week	~ 7 d/week
■ TRF (x,y,z)	accuracy	5 - 20 mm	5 - 2 mm
■ CRF(a, d)	accuracy	0.25 - 3 mas	0.25 mas (improved distribution)
	freq. of solution	1 year	1 year
	latency	3 - 6 months	3 - 1 month(s)

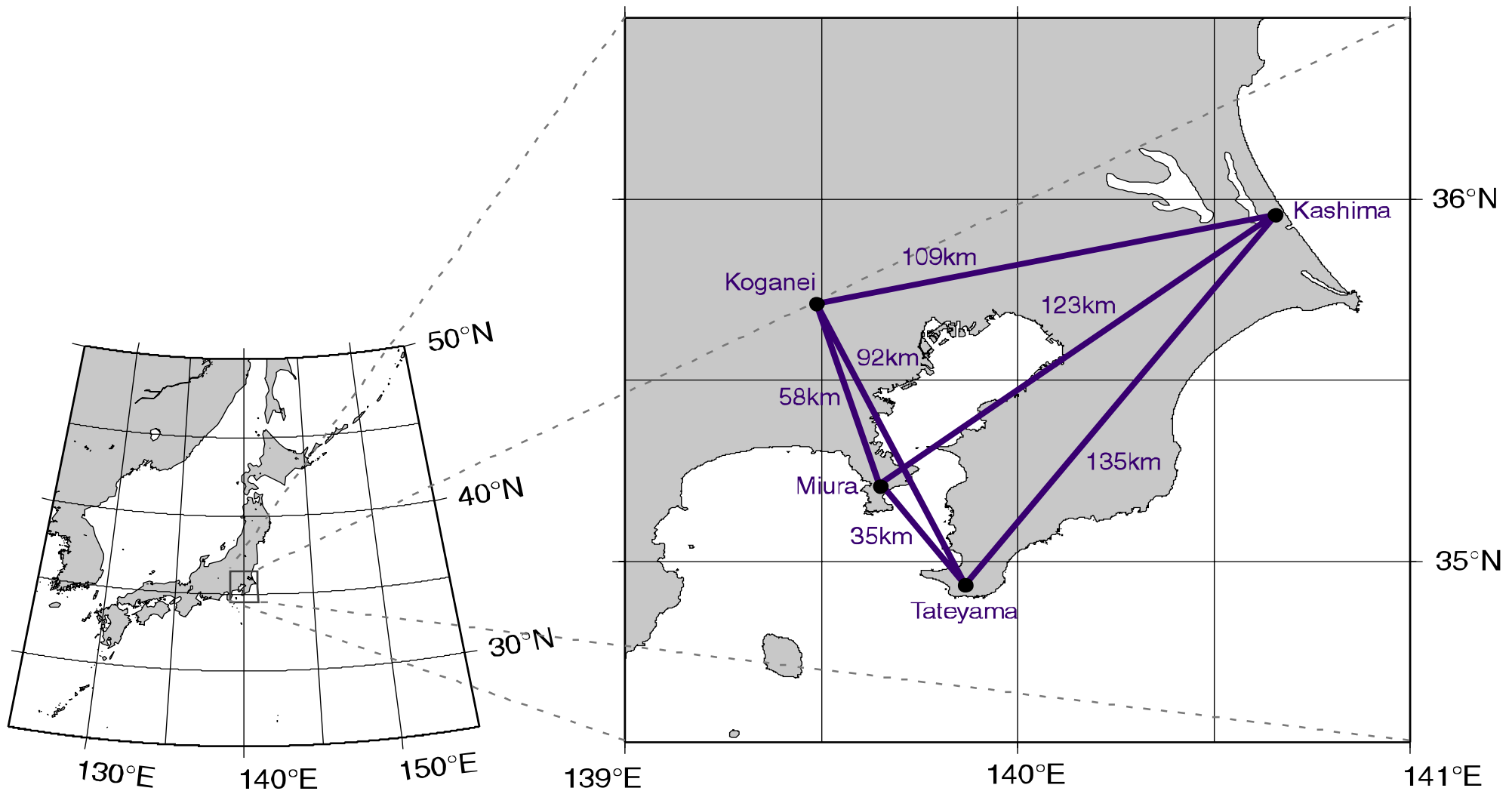
Number of Days Required to Deliver Products

Situations in 2002 (January to August)

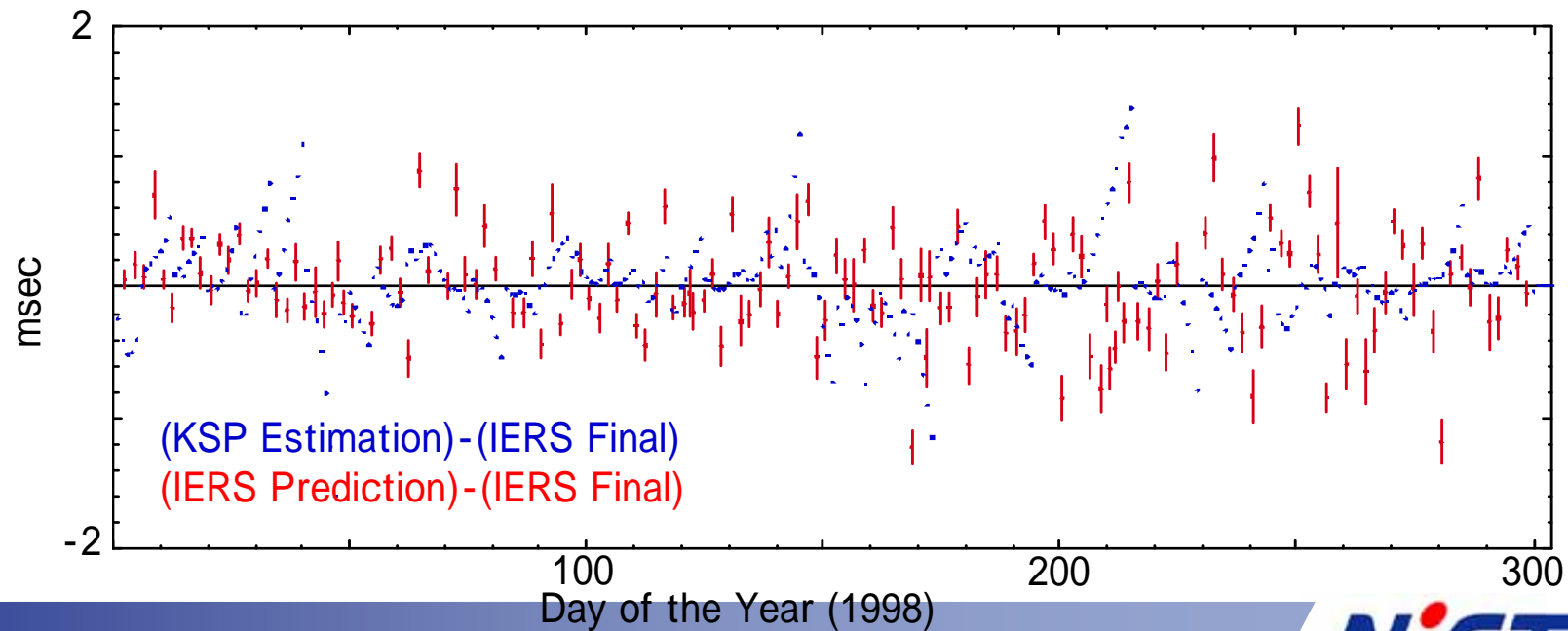
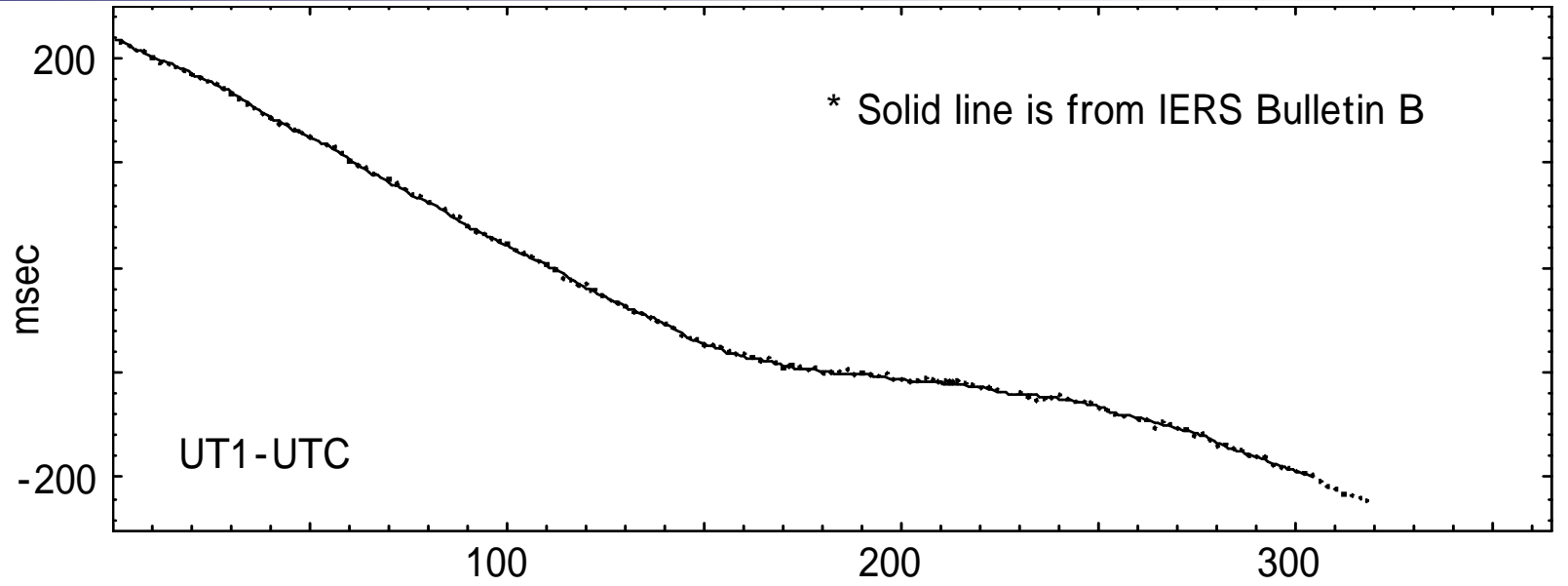
R1 & R4 Time Delay Over Time
September 11, 2002 - CCT



Key Stone Project VLBI Network (1994-2001)



EOP estimation by KSP Network



VLBI Systems for e-VLBI



K3 Correlator (Center)
K3 Recorder (Right)

K3 System

1983~
Longitudinal Recorder
Open Reel Tapes
Hardware Correlator



K4 Terminal

K4 (KSP) System

1990~
Rotary Head Recorder
Cassette Tapes
Hardware Correlator
e-VLBI with ATM



K4 Correlator



K5 Data Acquisition Terminal

K5 System

2000~
PC based system
Hard Disks
Software Correlator
e-VLBI with IP

KASHIMA-WESTFORD Experiments

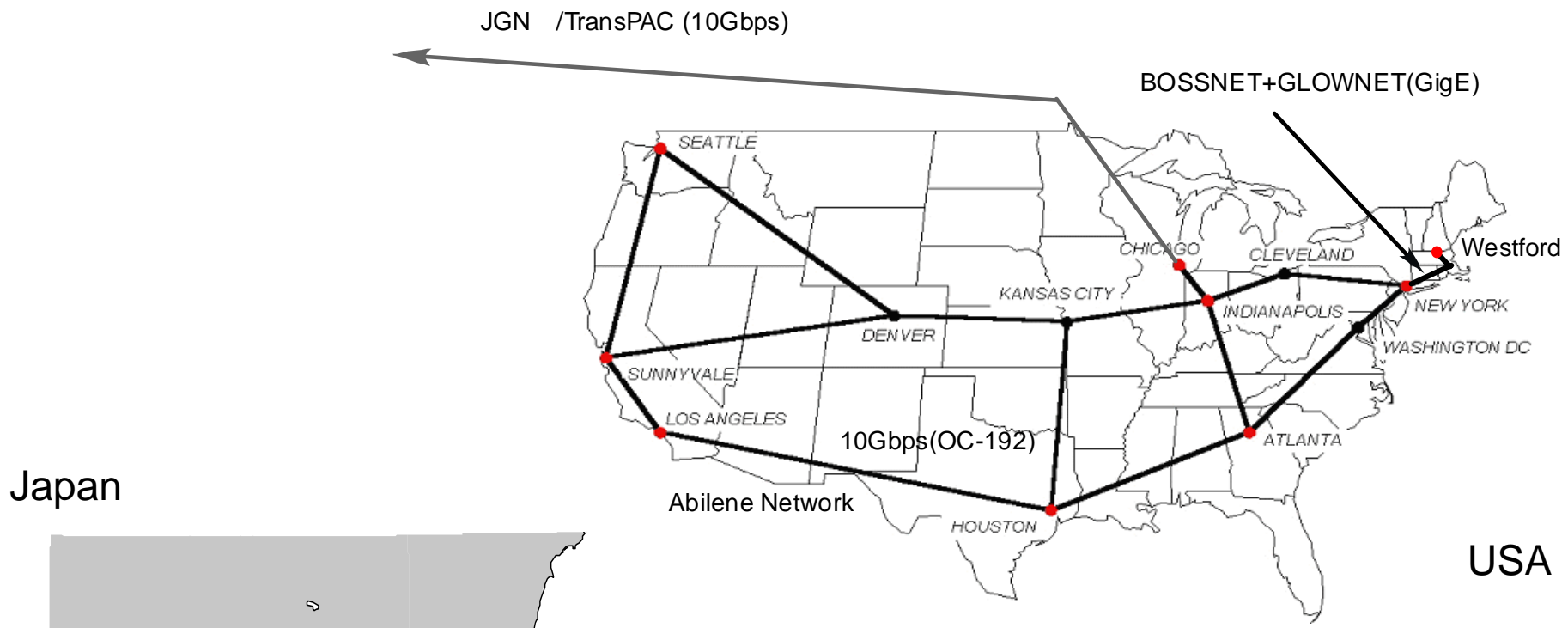


Kashima 34m

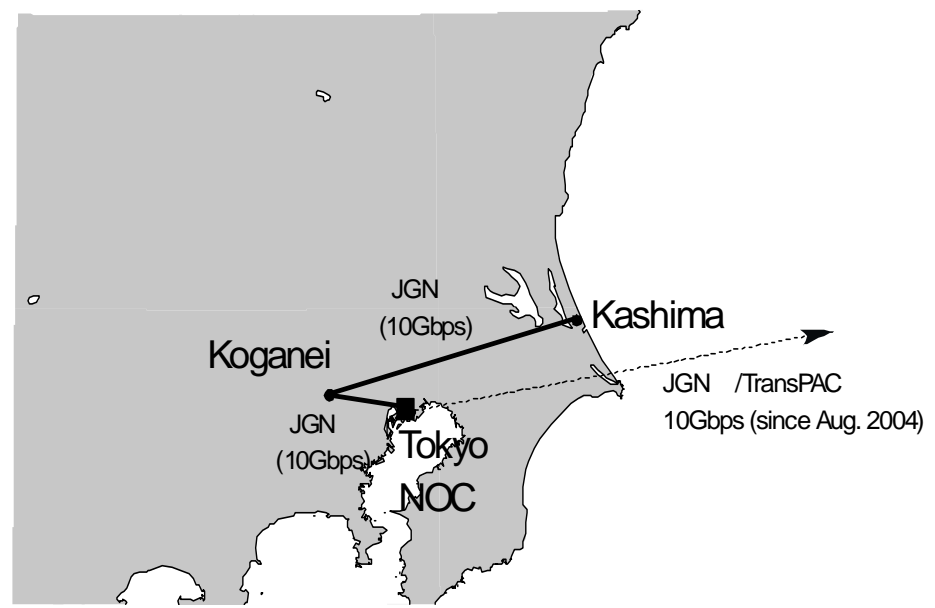


Westford 18m

- Baseline Length = 9502km
- The first test : October 8, 2002
- Feasibility check to estimate UT1 : March 25, 2003
- UT1 challenge #1 (tsev6) : June 27, 2003
- UT1 challenge #2 (tsev8) : June 29, 2004



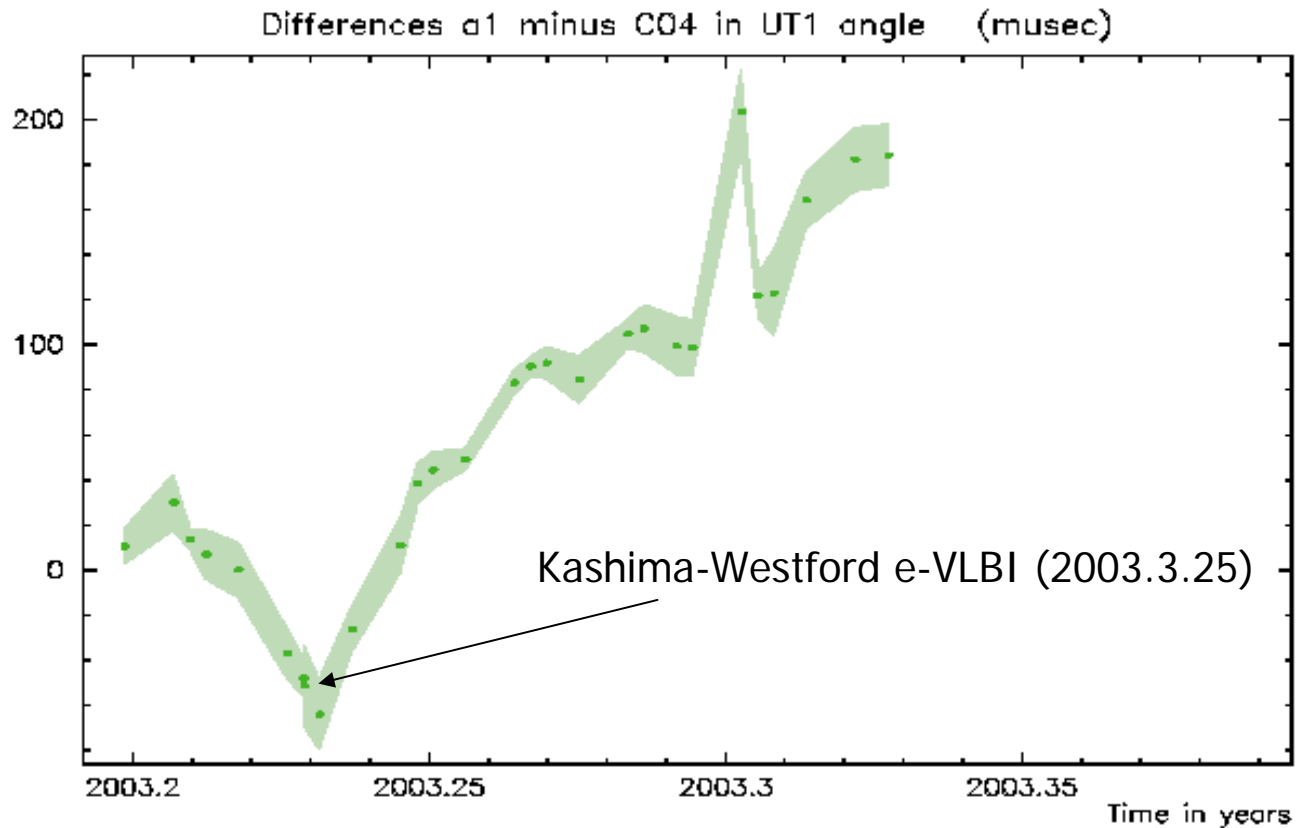
Japan



Current Network Route

Consistency of the UT1-UTC estimation

UT1-UTC estimation compared with NEOS Intensive VLBI sessions



* Data analysis done by Goddard Space Flight Center, NASA

Kashima-Westford Experiment : June 27, 2003



Kashima 34m



Westford 18m

■ Time Sequence (JST)

- 22:00 Observations Started
- 00:00 Observations Finished
- ~04:20 File extraction and transmission
 - From Kashima to Westford : 107Mbps 41.54GByte in 51m 35s
 - From Westford to Kashima : 44.6Mbps 41.54GByte in 2hr 04m 02s
- ~08:10 File Conversion (Mark5 to K5)
- ~20:30 Software Correlation
- ~21:20 Bandwidth Synthesis Processing, Database Generation, Data Analysis

Kashima-Westford Experiment : June 29, 2004



Kashima 34m



Westford 18m

■ Time Sequence (JST)

- 4:00 Observing Started
- 5:00 Observing Finished
- 5:13 Data Transfer Started (from Haystack to Kashima)
- 6:28 Data Transfer Finished (~30Mbps)
- 9:16 Correlation Processing Completed (used 21 CPUs)
- 9:30 Data Analysis Completed : UT1-UTC sigma=22 microsec.

New World Record!!
4.5 hours

CPU array for Software Correlation

K5cor-status - Microsoft Internet Explorer

http://ryuu.crlgo.jp/k5cor/

K 5 相関処理ステータス

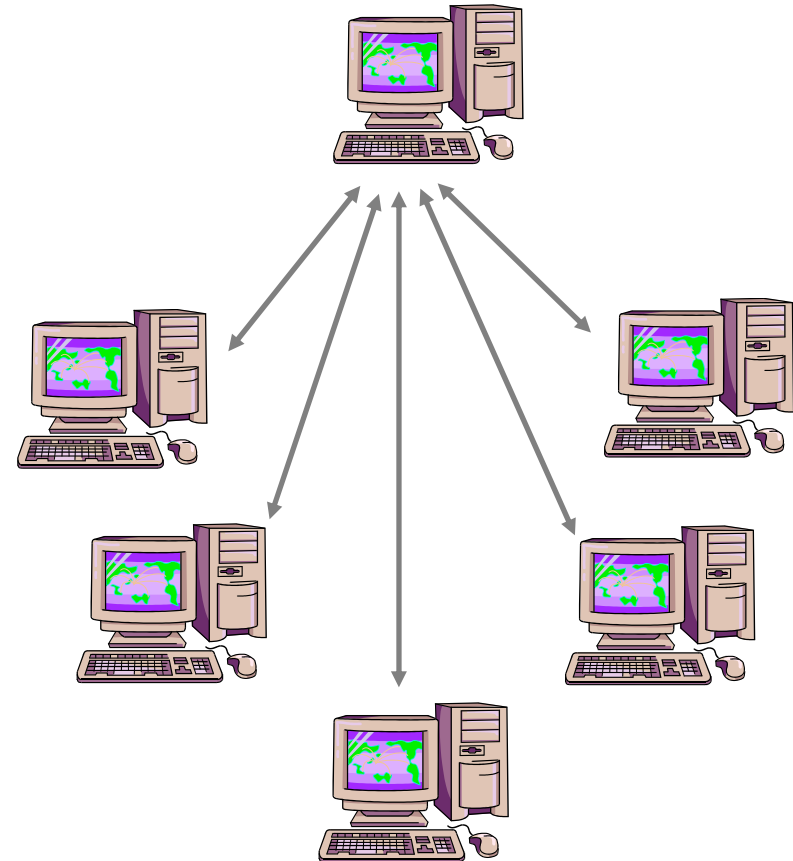
通信総合研究所 鹿島宇宙通信研究センター
Communication Reserach Laboratory

実験コード名	データ総数	処理済	処理中	処理待ち
JD0306	28	3	3	22

Obs	Baseline	Apri file	Mark	host	Start	Stop
1	KASHIMA-GIFU11	ape197020000RYc.bt	●	byakko	031118180719	031118183127
2	KASHIMA-GIFU11	ape197020610RYc.bt	●	seiryuu	031118180733	031118211308
3	KASHIMA-GIFU11	ape197021950RYc.bt	●	byakko	031118183128	031118113510
4	KASHIMA-GIFU11	ape197022640RYc.bt	●	seiryuu	031118211309	*****
5	KASHIMA-GIFU11	ape19702305RYc.bt	●	byakko	031118213511	*****
6	KASHIMA-GIFU11	ape19702305RYc.bt	●	K5la	031118213623	*****
7	KASHIMA-GIFU11	ape19702305RYc.bt	●	*****	*****	*****
8	KASHIMA-GIFU11	ape19702305RYc.bt	●	*****	*****	*****

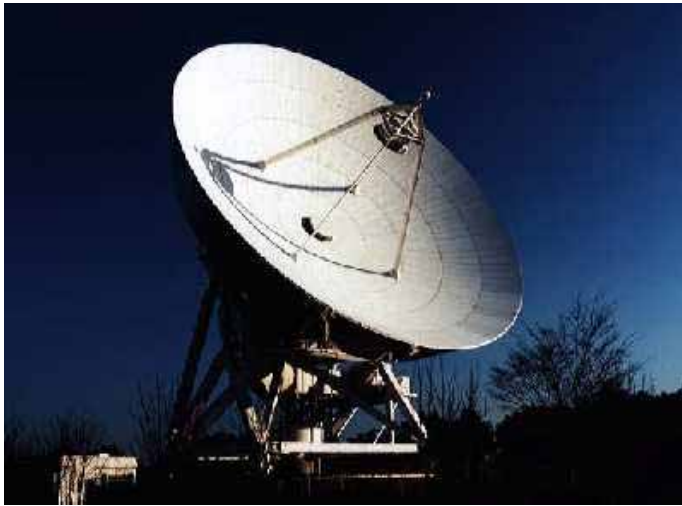
処理済 赤
処理中 黄
処理待ち 青

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Correlation Master Table/Database

Tsukuba-Wettzell Intensive Experiments : August 29, 2004~



Tsukuba 32m



Wettzell 20m

- Second Intensive Session Series on Sundays
- Saturday sessions are currently done by using K4 system
- Sunday sessions are intended to be e-VLBI
 - One e-VLBI session every month, initially (the other sessions using K4)
 - Will migrate into weekly e-VLBI
 - Plan to do e-VLBI in both Saturday and Sunday sessions

Current Bottle Necks and Ideas for Improvements

■ NFS (Network File System)

- Convenient : Software correlation program can assume as if all files are local files
- But, slow : especially when multiple access occurs
- ⇒ server-client programs designed for the software correlation program

■ File Format Conversion

- K5 to Mark5, Mark5 to K5, etc.
- ⇒ direct K5-Mark5 correlation

■ Disk Buffering

- Prevents real-time VLBI
- ⇒ data transfer during observations

To Do...

Short Term

- Automate set-ups for routine/regular sessions
- Use of CPU array recently introduced at Tsukuba (GSI)

Longer Term

- Develop K5 read/write module working with VSI-E libraries
- Software correlation programs to receive VSI-E streams

Conclusions

- Rapid turn-around estimation of UT1-UTC within a few hours was successfully demonstrated.
- Regular/Routine Intensive e-VLBI sessions for UT1 will become operational and smooth as experiences accumulate.
- Next targets will be
 - to demonstrate real-time UT1 estimation
 - larger scale IVS sessions with e-VLBI

Acknowledgements

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