

Results of test e-VLBI experiments with the K5 VLBI system



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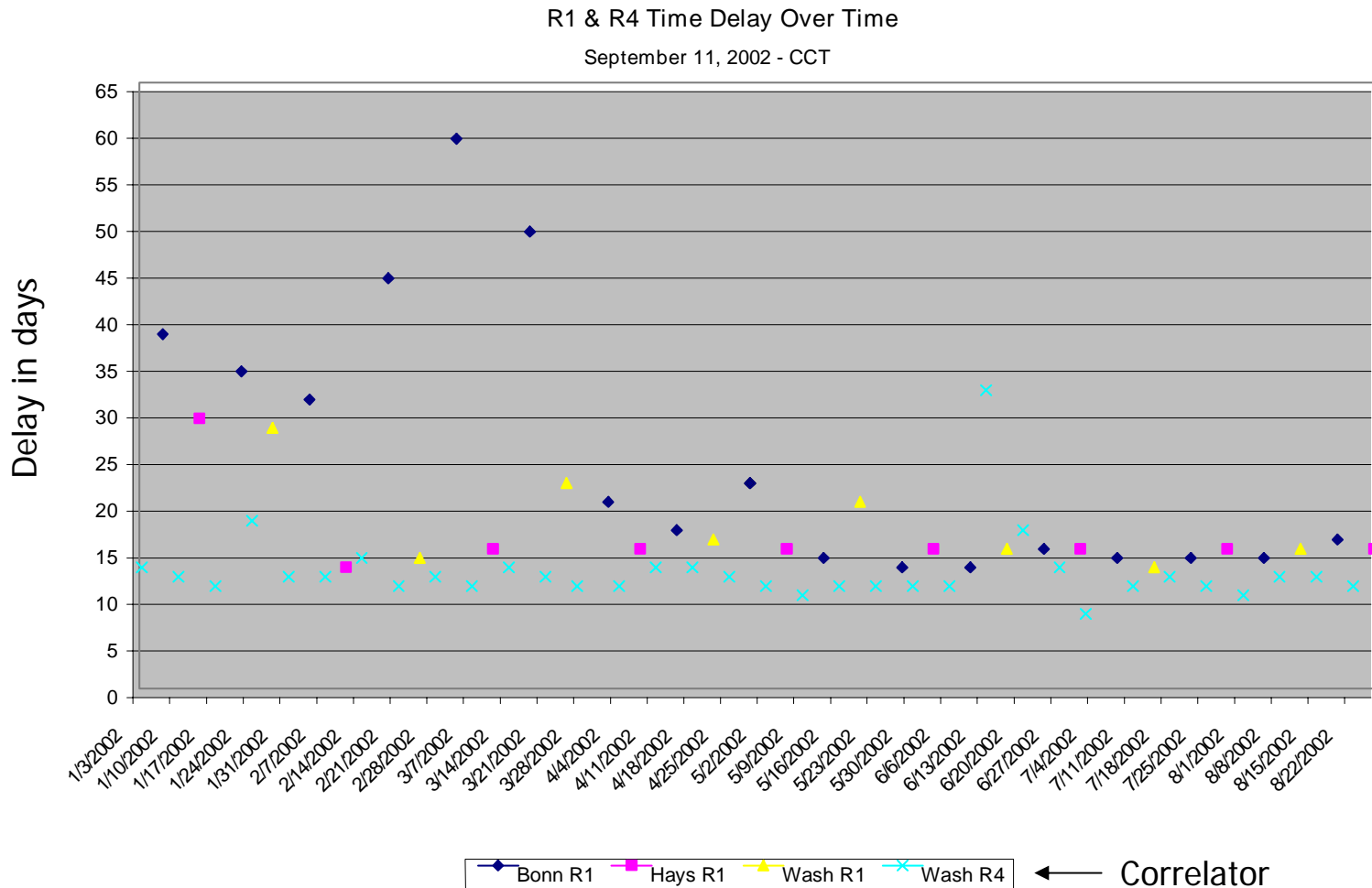
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Outline

- Why e-VLBI?
- How?
 - K5
 - Network
- Test Experiments
 - Jan.31-Feb.1, 2003 KASHIMA-KOGANEI
 - Mar.25, 2003 KASHIMA-WESTFORD
- Future Plan

Why e-VLBI?

To improve timeliness of global VLBI data processing



Why e-VLBI?

- Currently it takes at least 2 weeks to process (mainly shipping time)
- If it become 2 hours, it will improve accuracy of
 - positioning
 - navigation
 - real-time orbit determination of satellites and spacecrafts
- It potentially expands correlation capacity
 - Currently ~8 stations with hardware correlator
 - Easy scalability with PC software correlator

What is K5?



K3 Correlator (Center)
K3 Recorder (Right)

K3 System

1983~
Longitudinal Recorder
Open Reel Tapes
Hardware Correlator



KSP Backend

K4 (KSP) System

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



KSP Correlator



K5 Data Acquisition Terminal

K5 System

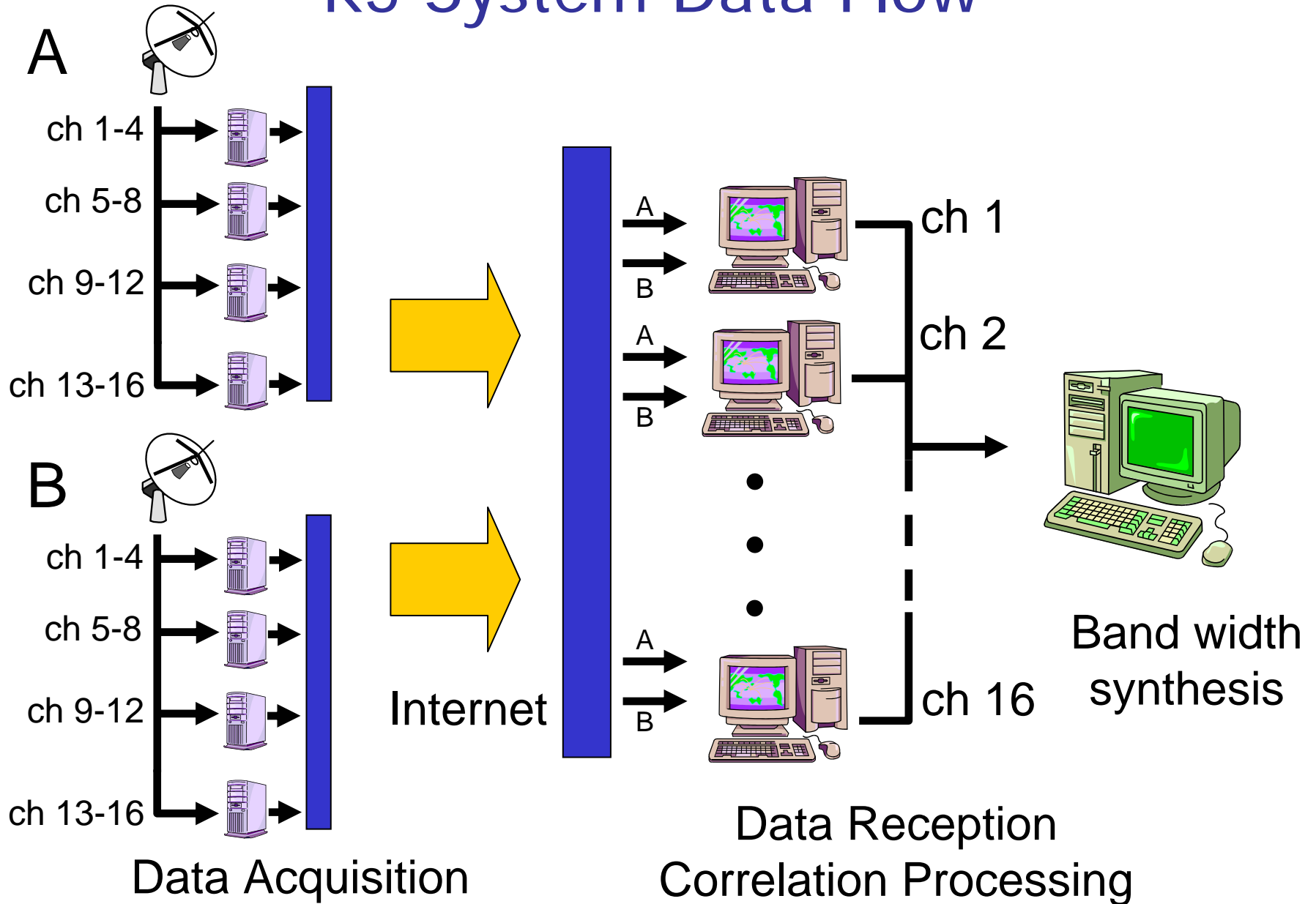
2002~
PC based system
Hard Disks
Software Correlator
e-VLBI with IP

K5 Data Acquisition Terminal (Prototype)

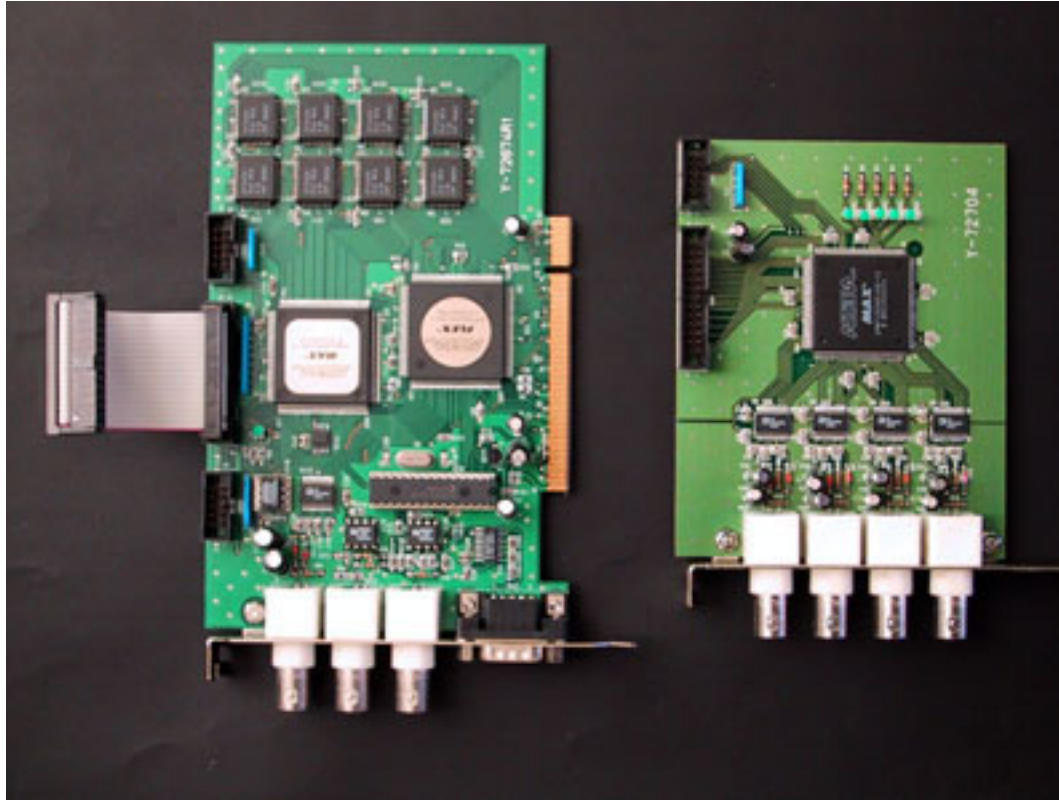
- 4 Pentium PCs
 - CPU : Pentium-4
 - 1.2GHz (1st Unit) or 2.4GHz (2nd Unit)
 - OS : FreeBSD (Linux is also possible)
 - An IP-VLBI board (PCI) in each PC
 - 120Gbyte HDx4x4 ~ 2.8days@64Mbps
- 16ch base-band signal amplifier
- Standard Signal Distributor
 - 10MHz and 1PPS signals for 4 units



K5 System Data Flow



PCI Data Sampling Board (IP-VLBI Board)



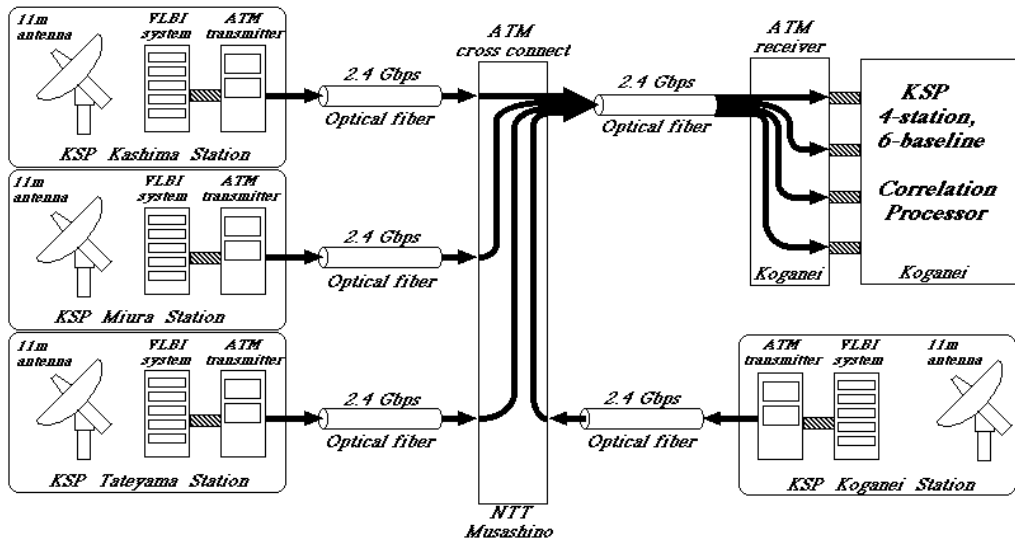
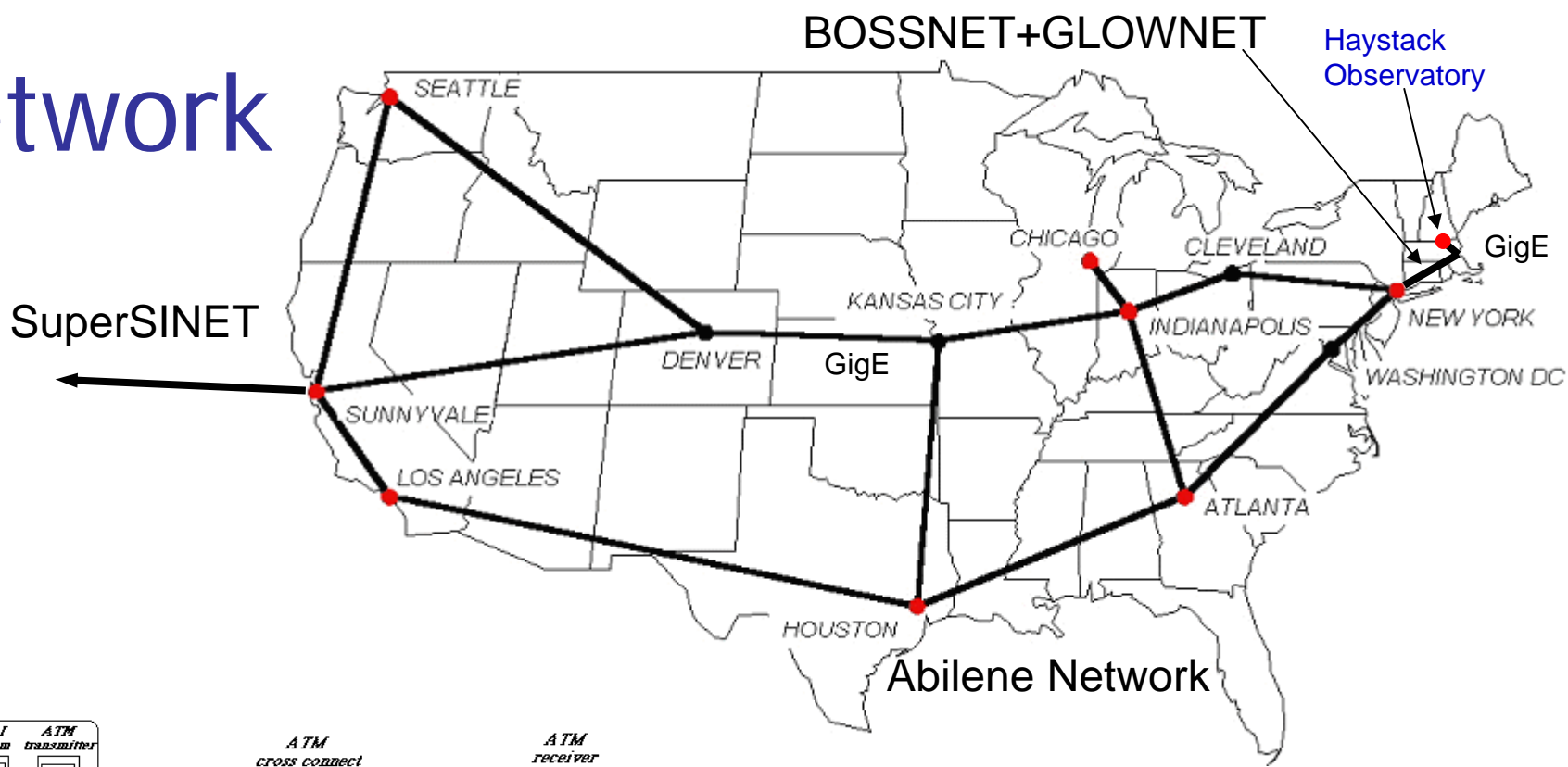
Left : Main board

Right : Auxiliary board

Specifications of the board

Reference signals	10MHz +10dBm, 1PPS
# of INPUT CH	1 - 4ch
A/D	1, 2, 4, 8 bits
Sampling Freq.	40kHz, 100kHz, 200kHz, 500kHz, 1MHz, 2MHz, 4MHz, 8MHz, 16MHz

Network



Galaxy Network

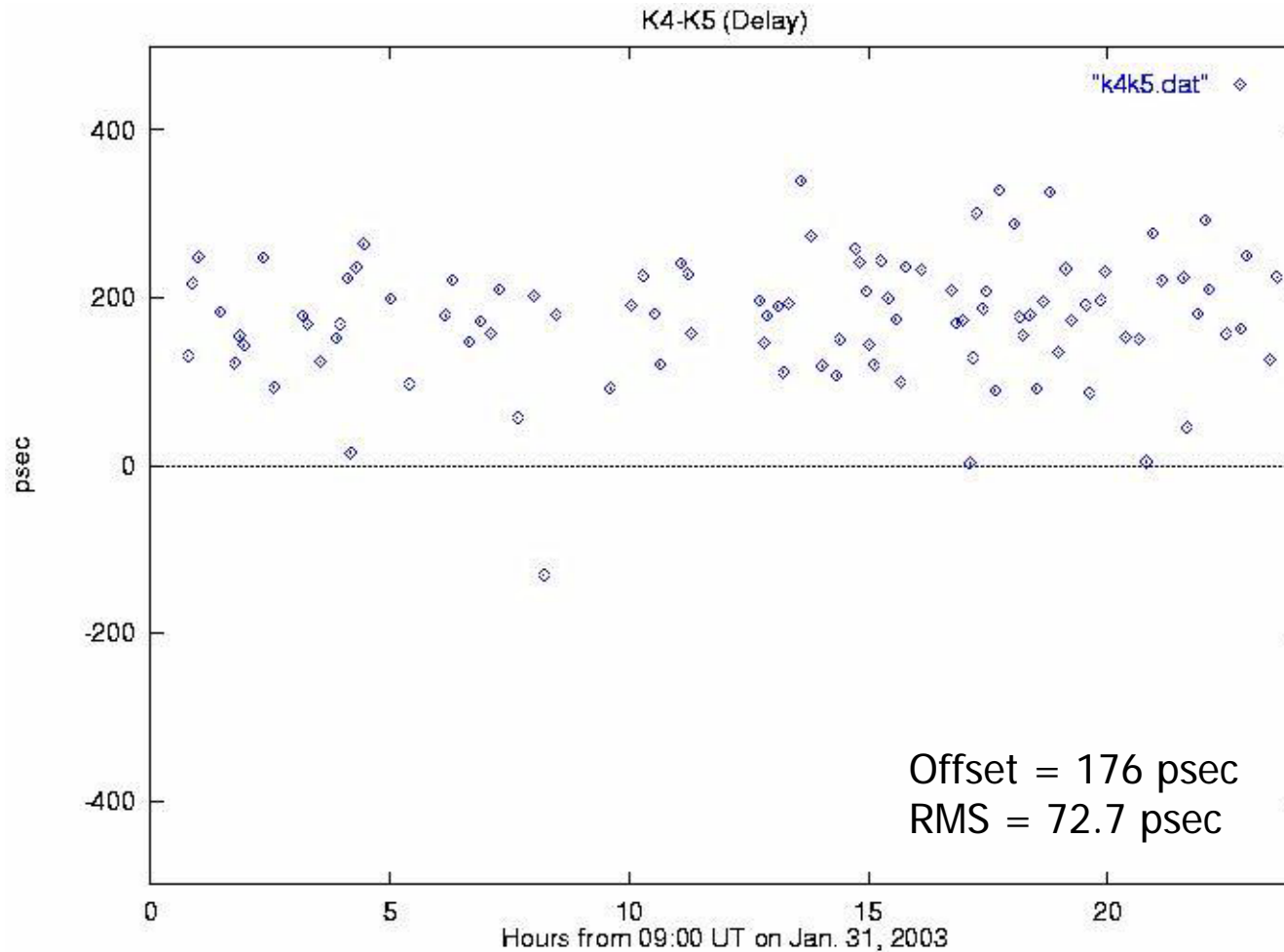
▨ D-1 Interface 256 Mbps

Test Experiments 1

- Jan.31-Feb.1, 2003
 - Kashima11m(K5)-Koganei11m(K5)
 - 24 hours, 56Mbps
 - Comparison with K4

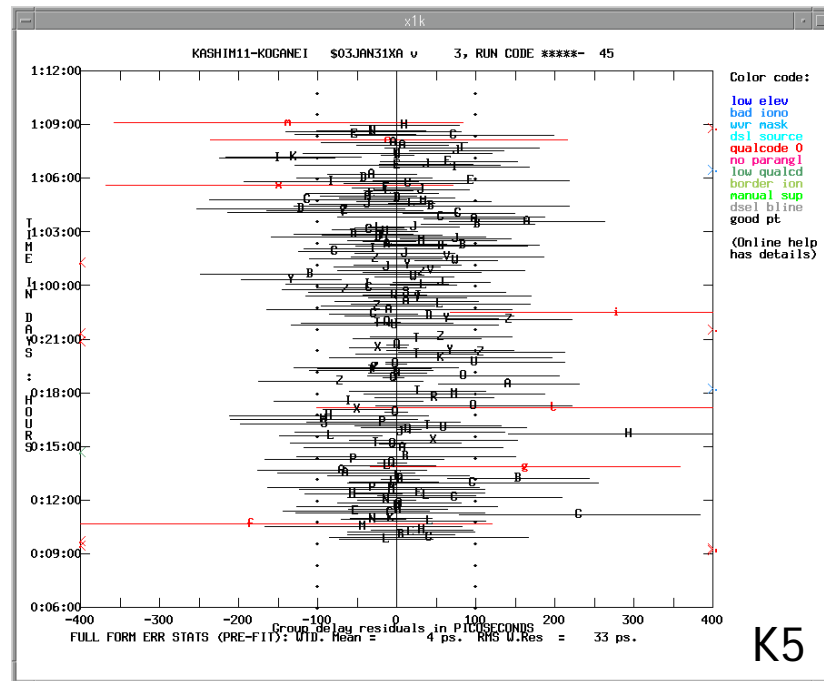
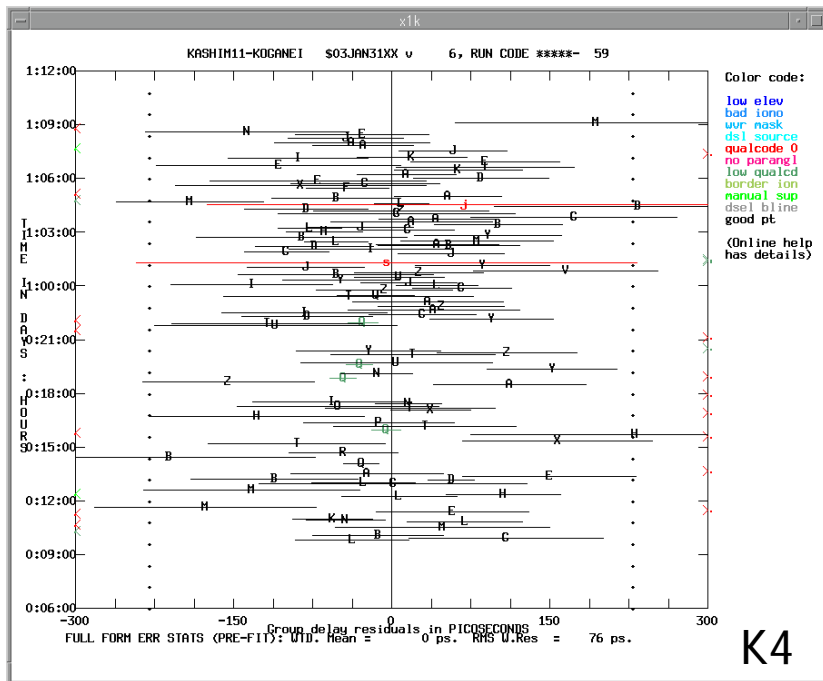


K4-K5 comparison



K4-K5 comparison

Delay Residual



Data Analysis Results

	Baseline Length	Delay RMS	Delay Rate RMS
K4	109099657.0 ± 6.7mm	76 psec	136 fsec/sec
K5	109099641.2 ± 3.2mm	33 psec	92 fsec/sec

Test Experiments 2

- Mar. 25, 2003 (evlbi4)
 - Westford (Mk5)-Kashima34m(K5), 2 hours, 56Mbps
 - Fringes were found on Mar. 27!



	Source Name	Duration (sec)	File Size (Mark5)	File Size (K5)
1	4C39.25	90	1,620 Mbytes	180 Mbytes x 4
2	1736+455	200	3,600	400 x 4
3	1357+769	90	1,620	180 x 4
4	0059+581	250	4,500	500 x 4
5	2234+282	310	5,580	620 x 4
6	1300+580	140	2,520	280 x 4
7	0955+476	90	1,620	180 x 4
8	2113+293	300	5,400	600 x 4
9	1739+522	500	9,000	1,000 x 4
10	1357+769	90	1,620	180 x 4
11	0059+581	270	4,860	540 x 4
12	2234+282	510	9,180	1,020 x 4
13	1044+719	784	1,4112	1,568 x 4
14	1128+385	180	3,240	360 x 4
15	1300+580	130	2,340	260 x 4
16	0955+476	90	1,620	180 x 4
17	2113+293	390	7,020	780 x 4
18	1739+522	530	9,540	1,060 x 4
19	1357+769	90	1,620	180 x 4
Total		5,034	90,612 Mbytes	40,272 Mbytes

File Transfer ~ 20 hours

Delay = 234 msec

Buffer Size = 64 kbytes

Speed

= 2.2 Mbps / Connection

= 11 Mbps (5 connections)

Correlation ~ 20 hours with 1 PC

Bandwidth Synthesis ~ 10 min.

Data Analysis ~ 1 hour

UT1-TAI

= -32338.7280 +/- 23.90

(micro sec)

Future Plan

- Repeat ftp-VLBI with Kashima-Westford a few times
 - Speed up by expanding buffer size
 - Try 256 Mbps observations
- Develop Correlator CPU Array System in 2003
- Software developments for real-time data transfer in 2003
- Regular (weekly) Mk5-K5 e-VLBI using Tsukuba-Westford baseline in 2004

Acknowledgements

- Internet2
- SuperSINET
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