

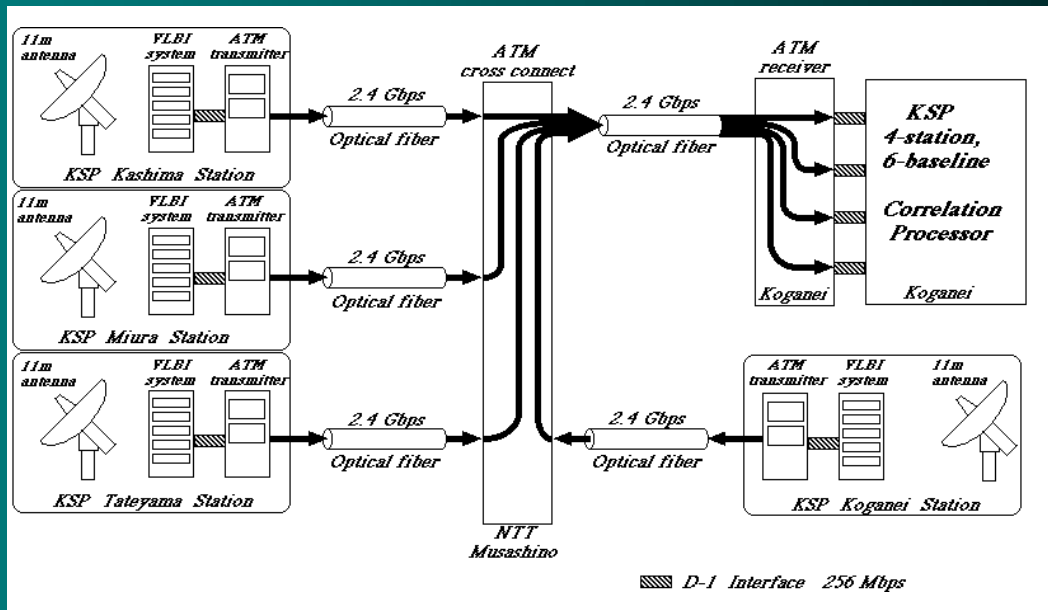
# Realtime VLBI experiences and future plans of CRL

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# Realtime VLBI over ATM

## Key Stone Project (1993-2001)

- 2.488 Gbps STM-16/OC-48 connection to 4 sites
- data recorder was transparently replaced by the network (ID-1 format data stream is transmitted to the correlator)



# ATM and IP

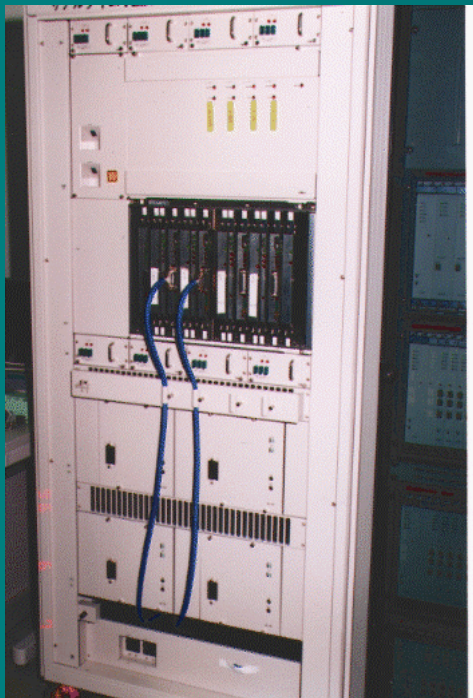
## ATM : Asynchronous Transfer Mode

- low level protocol, good for high speed communications
- bandwidth can be guaranteed
- stable time delay and data sequence
- **expensive, mainly used for backbone networks**

## IP : Internet Protocol

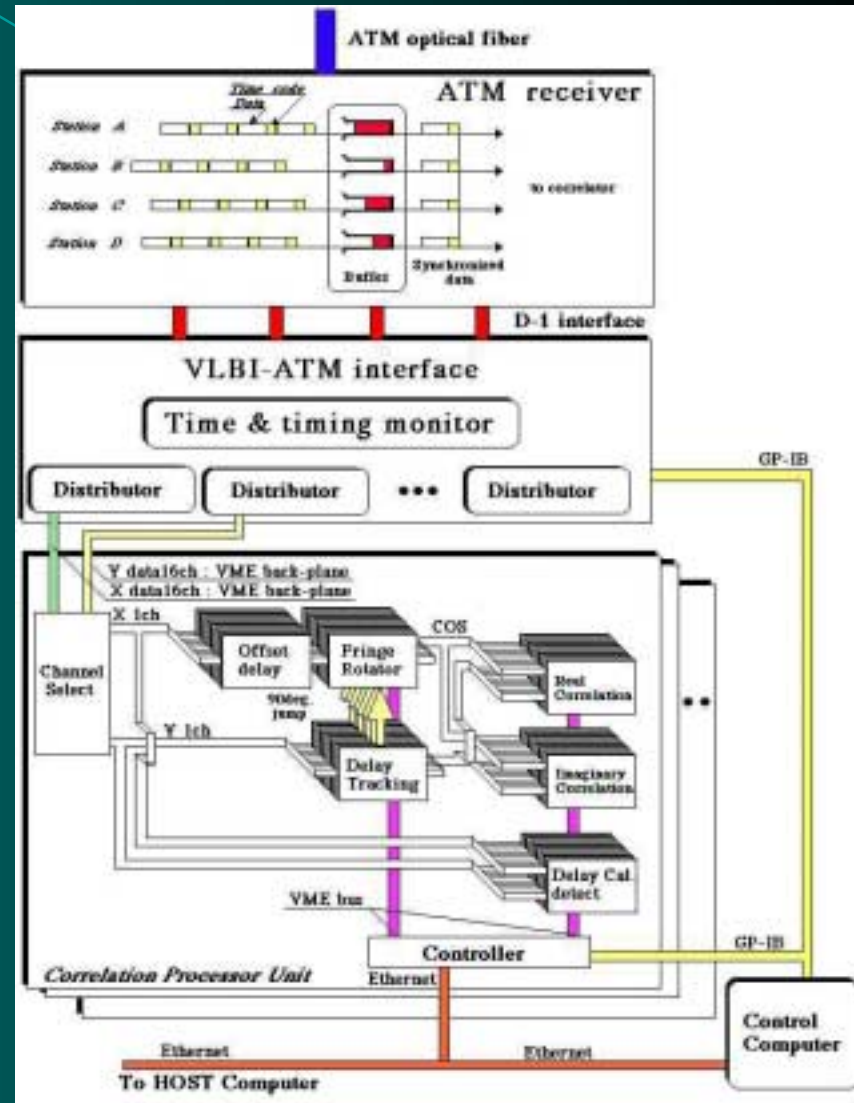
- network layer protocol which enables packet switching
- outstanding universality
- **unstable time delay and data sequence**
- **data rate is not guaranteed**

# Realtime VLBI Correlator



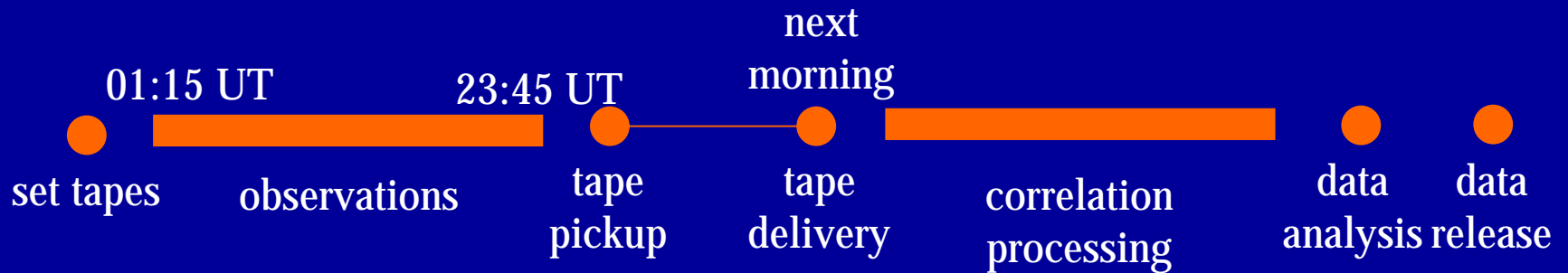
ATM receiver  
+  
VLBI ATM interface

Correlator



# Full automation with realtime VLBI

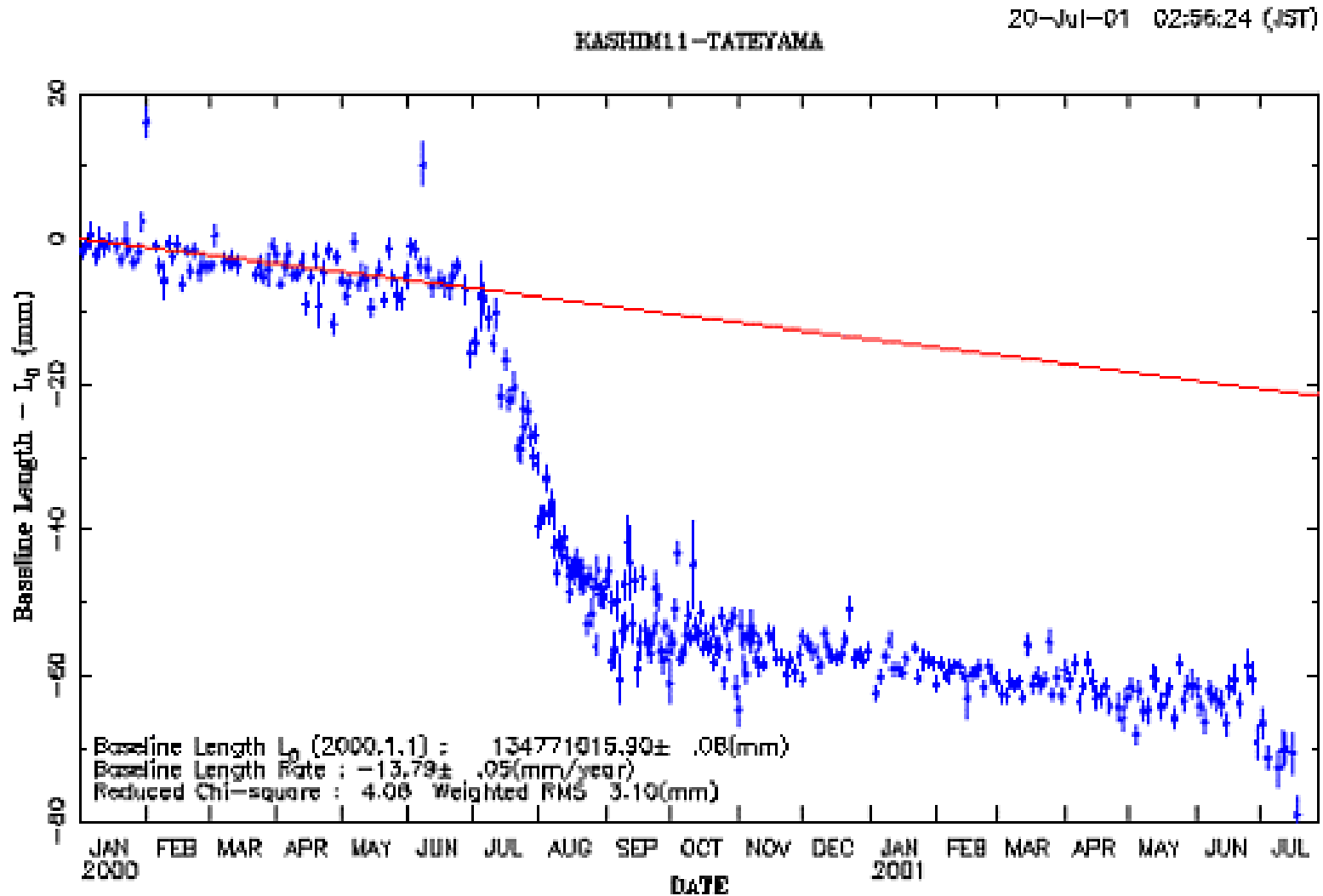
## Conventional tape-based VLBI



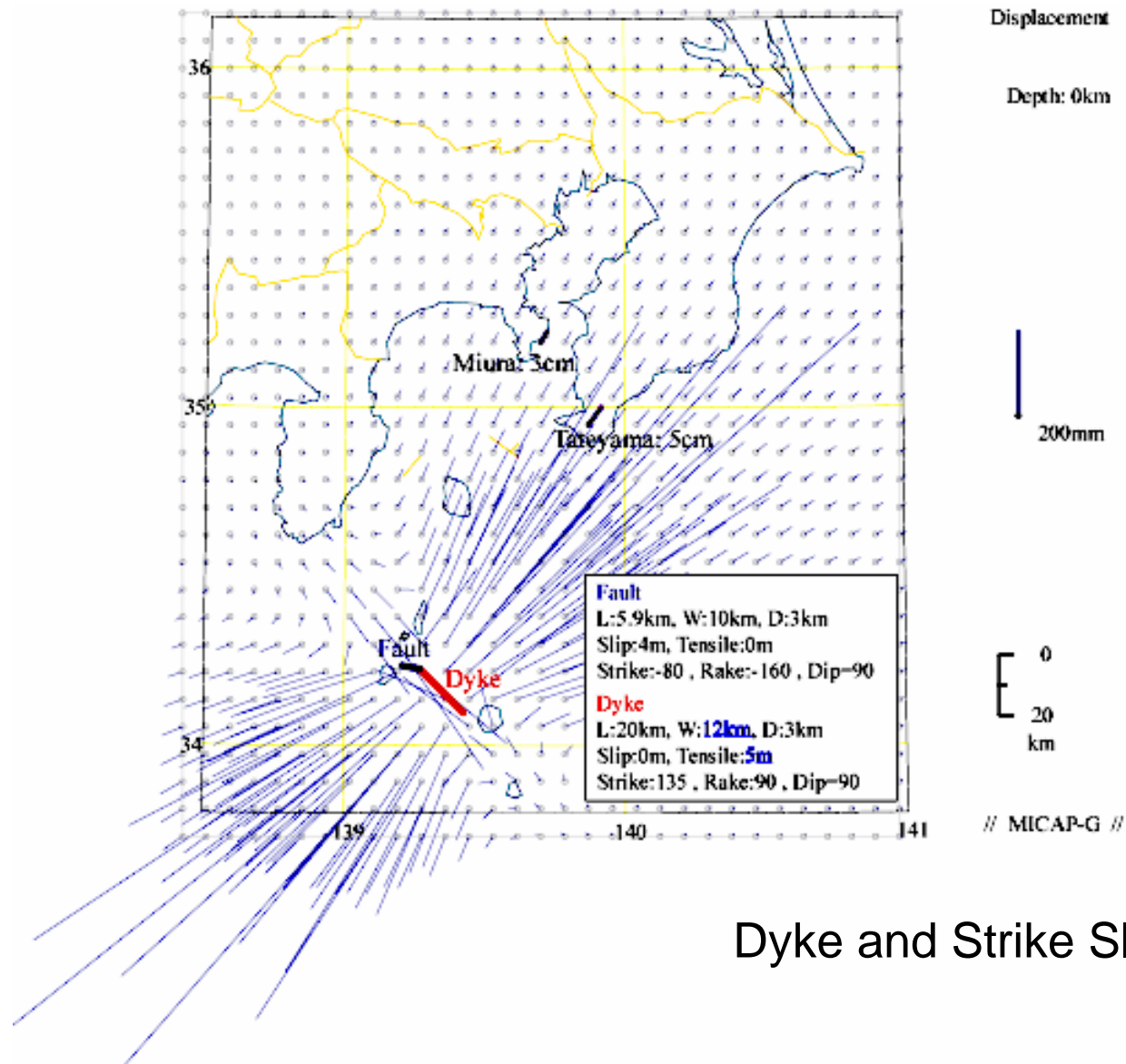
## Realtime VLBI



# Site motion monitoring with realtime VLBI

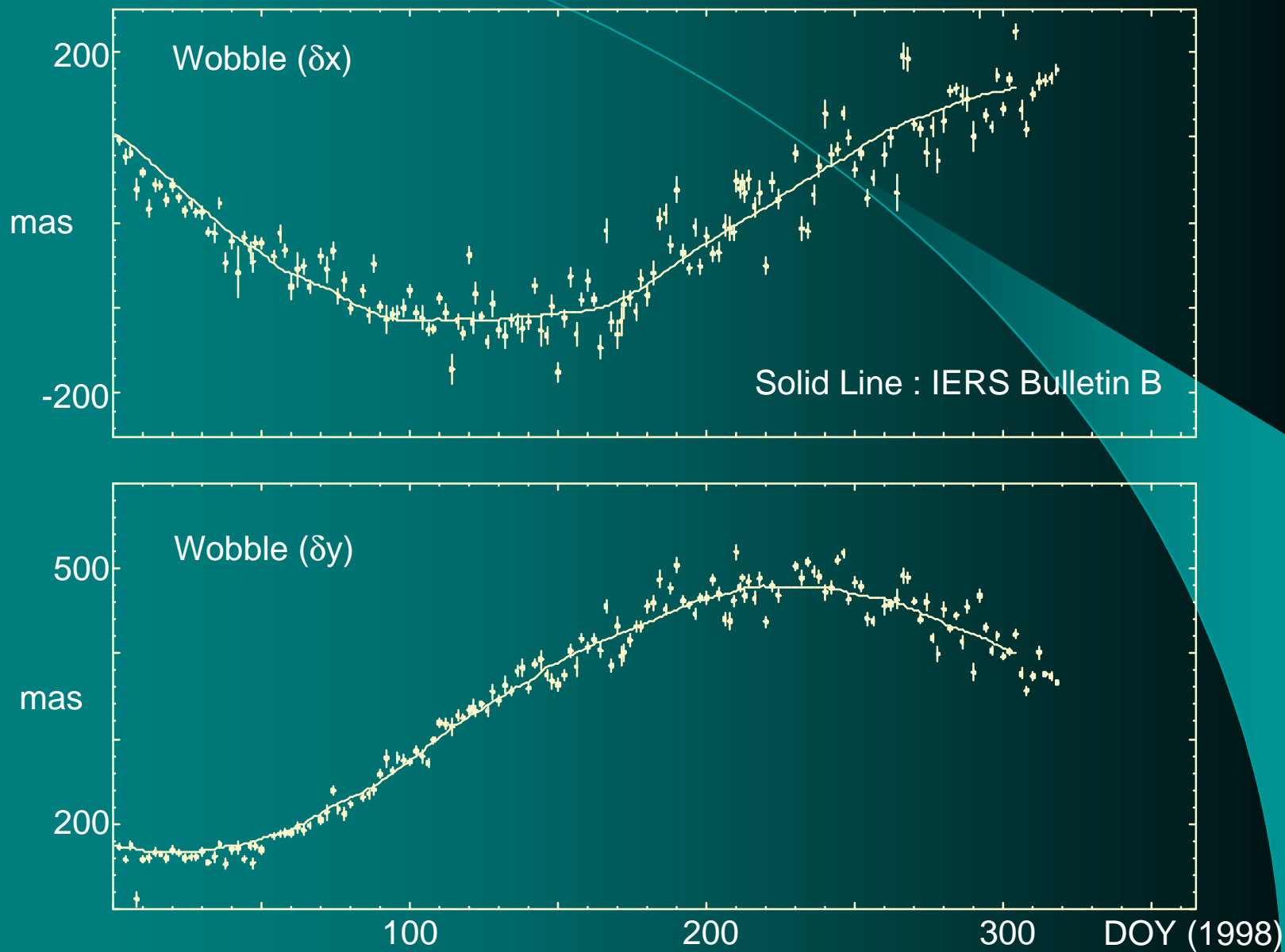


# Geophysical Interpretation



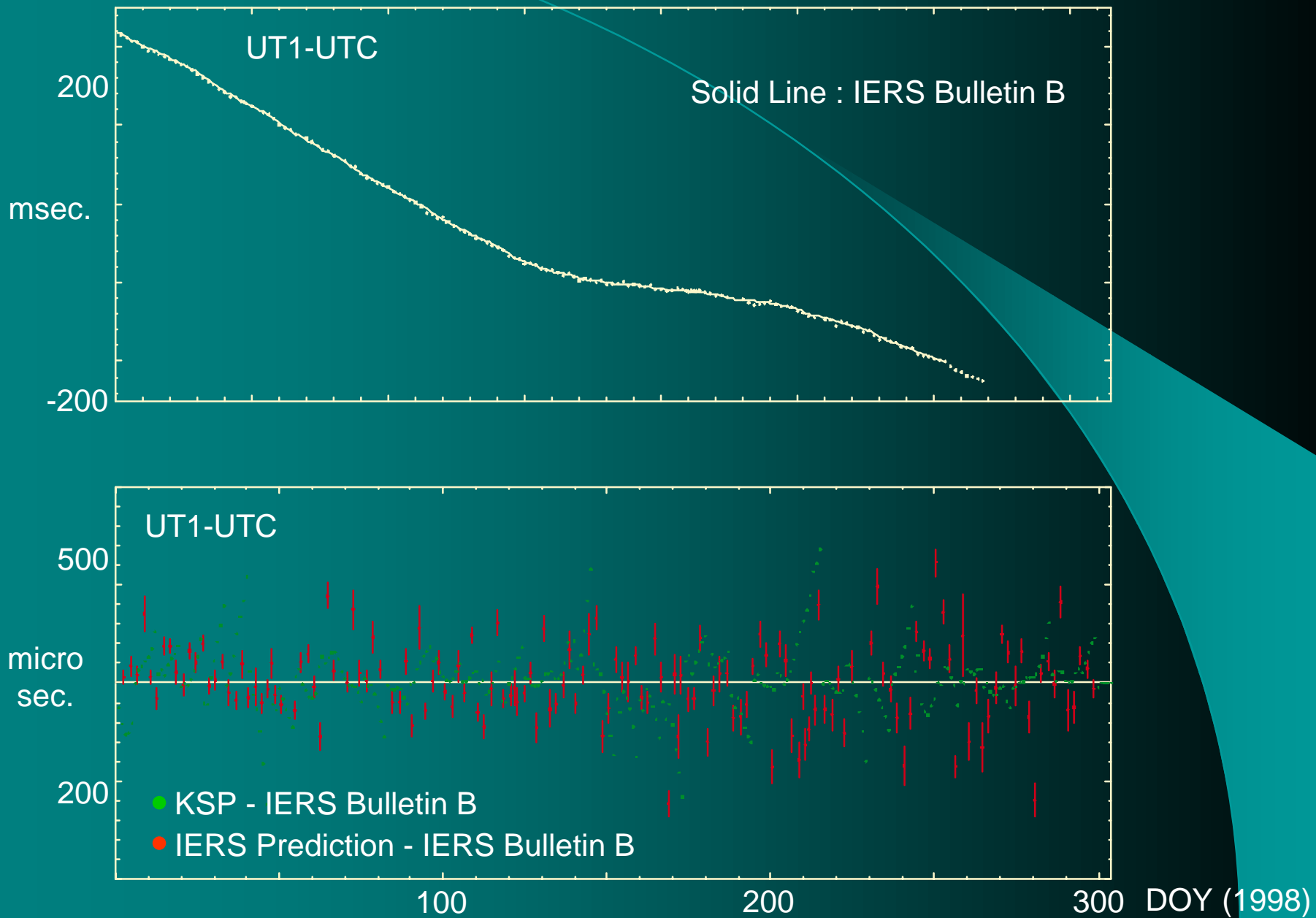
Dyke and Strike Slip Model

# EOP estimation with realtime VLBI

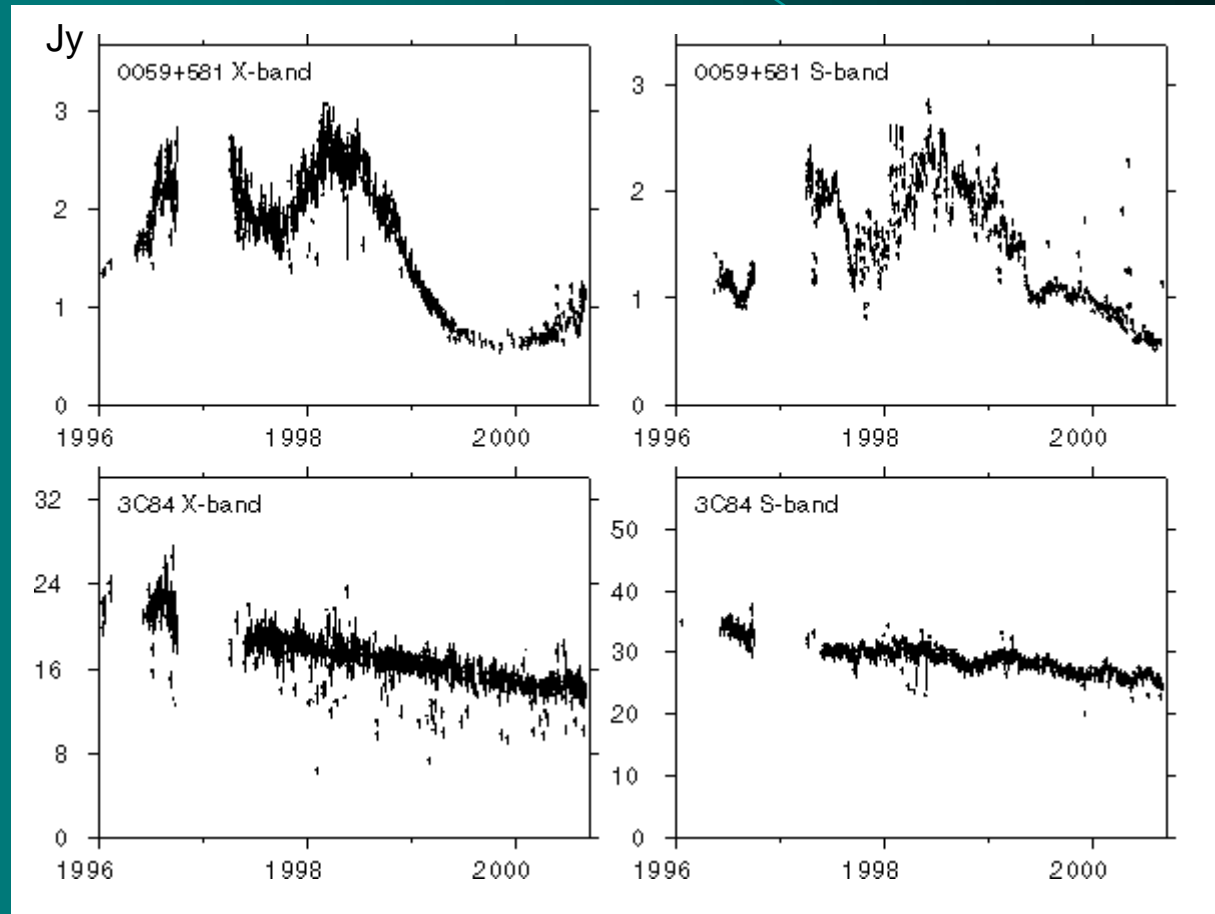




# EOP estimation with realtime VLBI



# Radio source flux monitoring with realtime VLBI



# the next step : IP

## high speed continuous data stream by using IP

- high demand from many applications
- challenging research theme for network specialist
- possibilities to use existing infrastructure

## possible strategies

- use existing protocol like FTP : ftp-VLBI
- transparent replacement of ATM system : Uose-san *et al.*
- develop a protocol which can identify the BBC channel, observing station, and radio source information : Kondo-san *et al.*

# IP VLBI board

- PCI PC board which includes
  - 4 ch. A/D sampler
  - programmable chip to generate formatted data stream
- cheap realization of VLBI data acquisition system
  - adequate for small groups to join the development project
  - has possibilities to be used for other purposes  
ex. spectrometer, spacecraft tracking, planetary radar

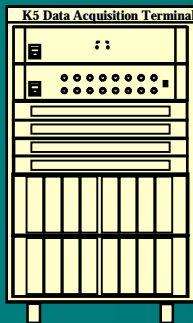


Reference signals	10MHz (+10dBm), 1PPS
Number of INPUT CH	1 : main board only 4 : with auxiliary board
A/D	1, 2, 4, 8 bits
Sampling Freq.	40kHz, 100kHz, 200kHz, 500kHz, 1MHz, 2MHz, 4MHz, 8MHz, 16MHz

# PC correlator

- each PC unit correlates 1 ch./baseline data
  - freely expandable
  - can process realtime VLBI, e-VLBI, and even tape-based VLBI if VSI-DOM is available

## K5 PC-based Terminal

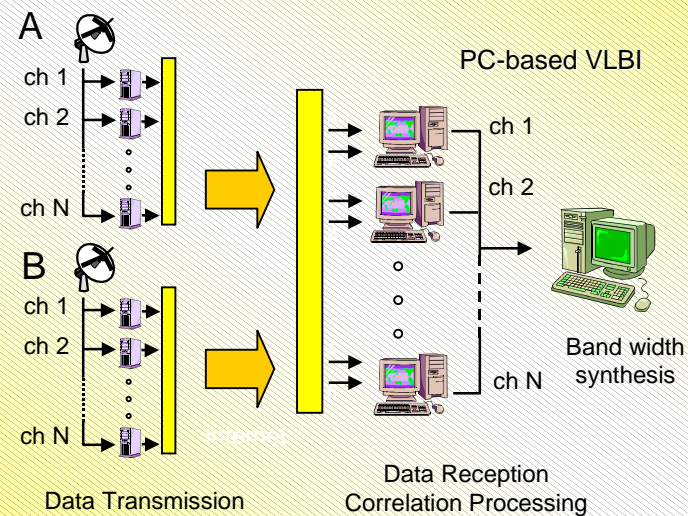


Reference signal distributor  
16 ch. video amps

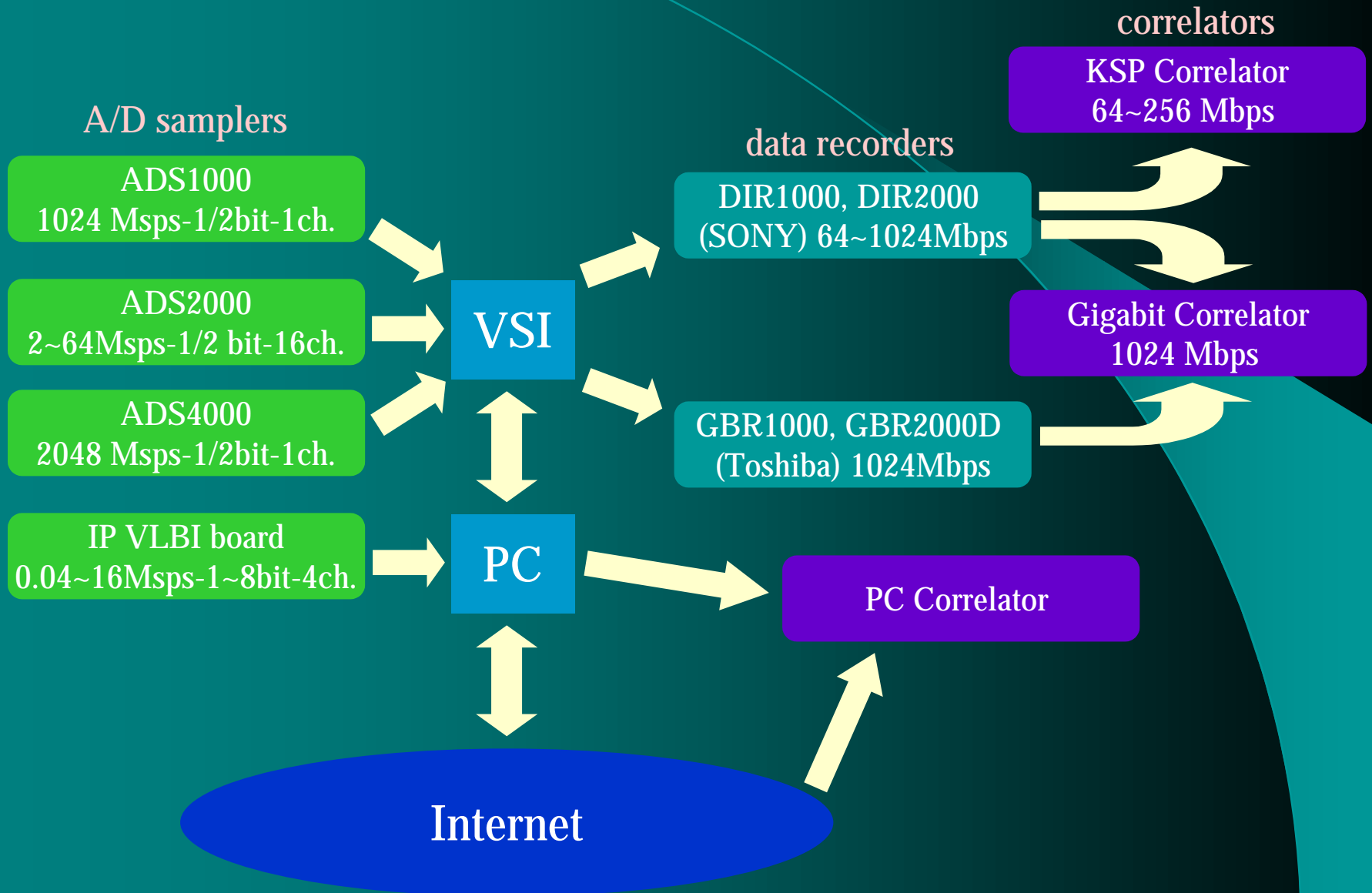
Rack mount server with  
IP-VLBI board (x 4)

Hard disk drive 120GB x 16

## Multi-channel Internet VLBI system



# Improved connectivity with VSI



# Future Plans

- realtime IP-VLBI and e-VLBI demonstration between Haystack and Kashima
  - investigations of the feasibility just began
- 2 Gbps ATM real-time VLBI
  - Galaxy project : Kashima(34m)-Usuda(64m) baseline
- hardware/software developments
  - K-5 system (or Versatile Scientific Terminal?)
  - PC correlator : data format
  - VSI interfaces