

Keeping Compatibility in International VLBI Systems

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Abstract. VLBI system compatibility is recognized as a serious problem to extend international VLBI networks. To see the background of the problem, history of VLBI development is outlined, first. Two types of ideas to solve the problem are tape copying and hybrid correlation. Advantages and disadvantages of these ideas are described. Status report made at an *ad hoc* meeting during the VLBI'93 conference is also included.

1. Introduction

Development of VLBI (Very Long Baseline Interferometry) systems has been made independently in several countries to acquire higher precision in geodesy, astrometry and astronomy. As a result, we are facing a compatibility problem. There are at least four kinds of VLBI systems, which are VLBA, Mark III/IV, K-4 and S-2. Since compatibility is essential for international VLBI experiments, this is a serious problem to extend observation networks.

The compatibility problem was discussed at the iRiS'93 international workshop (Jan. 18–23, 1993) regarding space geodesy at CRL/Tokyo, and was also discussed at the Space VLBI Working Group (March 1–5, 1993) at JPL. At the iRiS'93 workshop, it is proposed to establish a working group under the IRIS subcommission of the CSTG. At the working group meeting held by the members of the space VLBI, the idea of data copier between different VLBI systems was discussed (WIETFELDT, 1993). According to this idea, a generic interface is being designed. History and current status of the compatibility problem are outlined here.

2. History of the VLBI Development

VLBI is one of the most advanced technologies for geodesy, astrometry and astronomy. VLBI experiments can be performed only between compatible systems, since the data from the individual stations have to be correlated each other. Nevertheless, the necessity of higher performance has led to the development of better VLBI systems by using the state-of-the-art technologies. We see three stages of VLBI development (Table 1). In 1960's and 1970's, VLBI experiments are mostly performed with the Mark I and Mark II systems. In 1980's, international VLBI

Table 1. Development of VLBI systems.

U.S.A.	Japan	Canada
Mark I (1967)		
Mark II (1973)	K-1(1976) domestic	
Mark III(1983)	K-2(1980) K-3(1984) K-4(1989)	
VLBA (1991)		S-2(1991)
MarkIV (under development)		

Table 2. VLBI recording system.

	VLBA/MarkIV	K4	S2
Type	Longitudinal	Helical	Helical
Transport	Modified Metrum 96	ID-1	Modified VHS
Max. Rec. Rate (Mbps)	256/1024	256	128
Tape	14" Reel	D1-L Cassette	VHS Cassette

experiments were made with Mark II, Mark III and its compatible system. In the third stage, several kinds of incompatible VLBI systems are used for international networks (Table 2). Following meetings concerning VLBI compatibility were held to solve the problem:

- 1993 Jan. IRIS Working Group established at iRiS '93 Workshop (CRL/ Tokyo, Japan),
- 1993 Mar. Space VLBI Working Group of Compatibility (JPL, USA),
- 1993 Sept. IRIS Working Group of Compatibility at VLBI '93 (Kyoto, Japan).

3. Tape Copying

When VLBI data is correlated at a certain data processing center, data tape and recording format should be compatible with the ones adopted at the center (Fig. 1). Hence, tape copying has been made. Possible paths of the tape copying are shown in solid lines in Fig. 2. Although the tape copying is an easy solution for the problem, an operator has to take care of the difference of recording time in each tape. When data are copied, slower data rate is selected. Hence, the tape copying is time consuming and is not always simple. If we continue the tape copying, we may need tape copy centers.

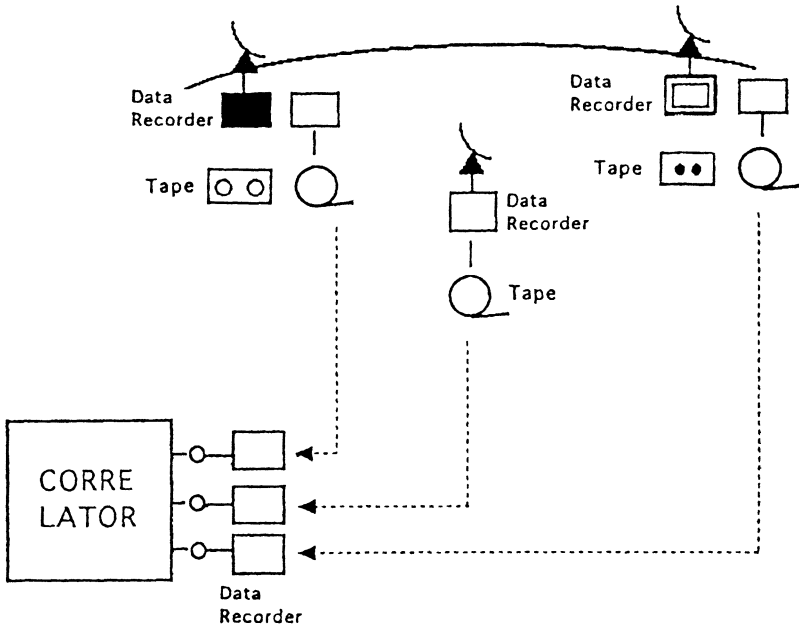


Fig. 1. Tape copying before shipping the same type of tapes to the data processing center.

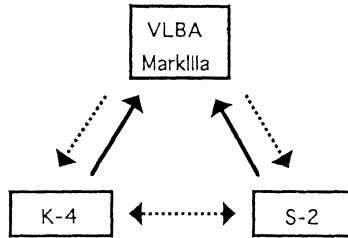


Fig. 2. Possible paths of tape copying.

4. Hybrid Correlation

If we take the option of a direct connection to a correlator, we can avoid the above problems. In fact, hybrid correlation between K3 (Mark III compatible) and K-4 systems is made at Kashima Space Research Center in the case of two-station data processing (Fig. 3; HAMA, 1993). For a future plan, we can influence the designers of the Mark IV and EVN correlators so that they will take this fact into

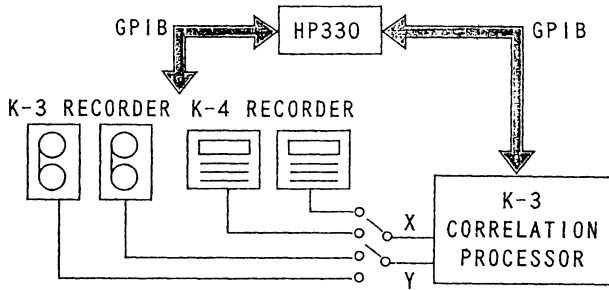


Fig. 3. Hybrid correlation at Kashima Space Research Center.

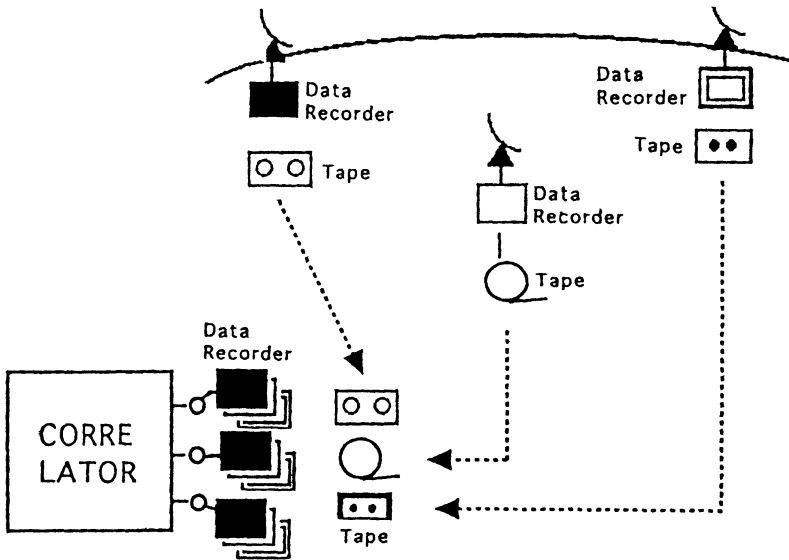


Fig. 4. Hybrid correlation with different type of data recorders installed at the data processing center.

account. However, the limitation on the number of data recorders and interfaces installable at the processing center has to be taken into account (Fig. 4). It may be already unacceptable to install a hybrid correlator which can simultaneously process data from six stations or more.

5. Possible Solution

First meeting of the IRIS Working Group on Compatibility of VLBI-systems was held on September 9, 1993 as an *ad hoc* meeting of VLBI'93 in Kyoto. From the

members of the Working Group, status on VLBI compatibility in each institution was reported as follows.

STS (Canada) Assuming Mark III system, interface is developed to export to and import from S-2 system.

NAO (Japan) According to the agreement on the VLBI generic interface, the interfaces between VLBA and K-4 and between S-2 and K-4 are under development.

JPL (USA) Compatibility issue was discussed at Pasadena and in Russia for space VLBI cooperation.

Haystack (USA) Compatibility between Mark III and other systems are studied.

CRL(Japan) Hybrid data correlation and tape copying are currently made to process data and to send tapes to the data processing station. Except for time tag problem, data conversion is technically possible.

If only existing tools are used, what we can do is limited. Hence, it is agreed to copy tapes as an immediate action for VLBI compatibility. All the participants, however, agreed on having unique international VLBI system as a final goal.

Since information exchange is essential to have compatibility with the other systems, relevant references I have are listed below. As a result, all the papers or reports are not referred in the above manuscript.

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