Developmet of highspeed programmable formatter for earth observation satellite downlink data formatting

Hideyo Yokotsuka* Toshibumi Sakata* Haruhisa Shimoda*
Shinichi Sobue** Mineo Sekiguchi***

* Tokai University Research and Information Center
** National Space Development Agency of Japan
*** Remote Sensing Technology Center of Japan

Abstract: Formatting process of earth observation satellite downlink data is usually performed with custom made hardware which designed for one satellite or a sensor. In this paper we introduce a high speed programmable formatter system which is able to process many kinds of satellite downlink data without changing the hardware.

KEY WORDS: programmable formatter,downlinkdata,software processing

1. Introduction

The various sensor data acquired with earth observation satellites are transmit to ground receiving stations. The sensor data and multiplexed with telemetry using special format called downlink format.

The transfer rate of the down link data to ground receiving station exceeds to 100Mbps,and the quantity of the downlink data per reception exceeds to several GB.Generally, this downlink data is processed through two step as follows.In the first step, the data is record in High Density Digital Tape(HDDT) in real time using High speed Digital Data Recorder (HDDR).In the second step, the downlink data is reproduced from HDDT, sensor data is extracted/divided into each scene unit, and output to certain medium for computer peripheral equipment. Generally, "The format processing of downlink data" corresponds to the second step. In order to perform format processing a large quantity of down link data ,in high transfer to rate. most of the processing systems are consist of customized computer for certain sensor or satellite.

However, in the near future lunch of various kinds of multi sensor satellite such as ADEOS are planned.If we make hardware for each sensor for format processing, it the system , and operation becomes very complicated. It also causes degradation of reliability of the format processing system. This is a very big problem. We have developed a programmable formatter

which solved these problems.The hardware dependency was reduced and made multiusable,highspeed processing was realized.

2. Hardware formatter

Fig.1 Shows the block diagram of MOS-1 MESSR formatter as a typical example of synchronizer. The figure shows that the important processing parts such as synchronization of minor frame, synchronization of major frame and serial to parallel conversion,are done by hardware. It is not only in case of MOS-1 MESSR formatter system, but also in the other sensor formatters. Each formatter hardware are not so different from others. But there is no interchangeability between each formatter at all. It is because we designed speed priority to cope with a large quantity of data .In each system, hardware are customized to realize high speed processing

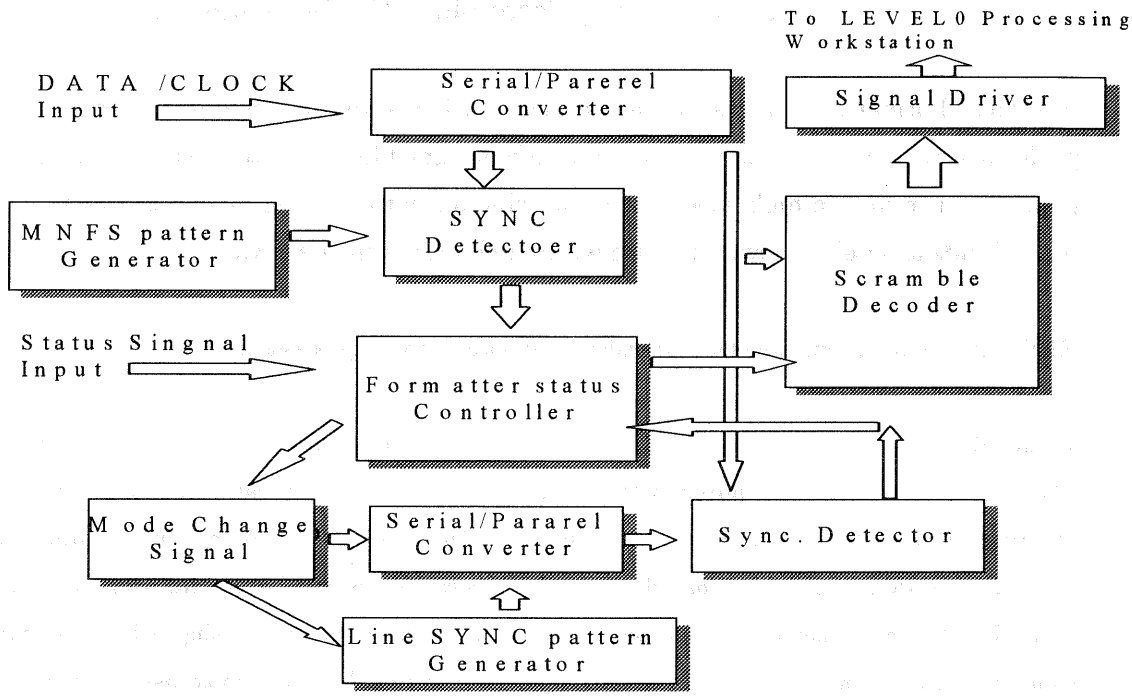


Fig.1 : Block diagram of MOS-1 MESSR hardware synchronizer.

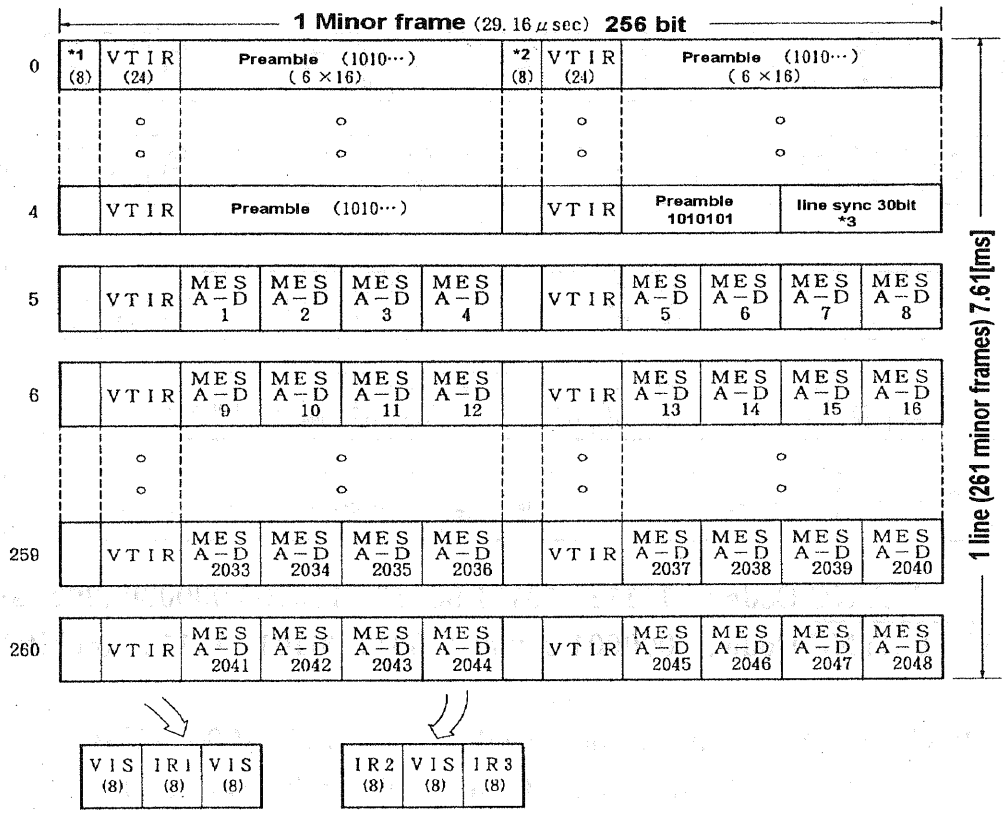
3. Investigation of downlink data format of earth observation satellite

Fig.2 Shows the downlink data format of MOS-1 MESSR/VTIR and Fig.3 Shows the downlink data format of JERS-1 OPS as typical examples.

Through for our investigation of many satellite downlink data format we have found that the way to specify recording start location of sensor data from minor frame sync pattern is same.*(1),*(2)

If we make a circuit which is able to take

synchronization for minor frame of any kind of patterns, we can process all downlink format. Paying attention to this facts,we have developed a new formatter system with low hardware dependency.

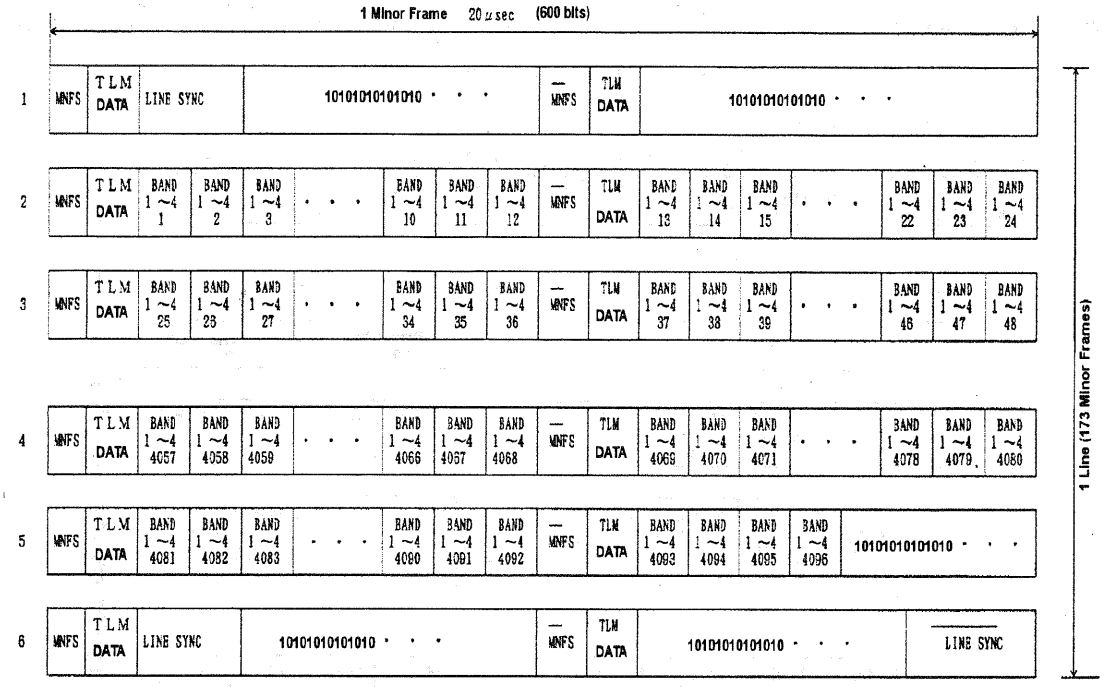


*1:MNFS Minor Frame sync pattern signal 7bits (1011000) + TLM signal 1bit

*2:$\overline{\text{MNFS}}$ Minor Frame sync pattern signal 7bits (reversed) 0100111 + TLM signal 1bit

*3:Line sync pattern code (30bits) 11111010 ,11110011, 0110100 ,000000

Fig.2 : Downlink data format of MOS-1 MESSR/VTIR



LINE SYNC Code : 111110 10111 001100 110100 000000 (30bits)
LINE SYNC Code : 000001 01000 110011 001011 111111 (30bits)

MNFS (MiNor Frame Sync) Code : 101101 11000 (11bits)
MNFS (MiNor Frame Sync) Code : 010010 00111 (11bits)

Fig.3 : Downlink data format of JERS-1 OPS

4. Programmable formatter system

It is a very important point in formatter system to keep high efficiency of processing speed when serial data is reproduced from HDDR.However,if the ratio of hardware processing too high the multiusability drops.By our system, processing by the hardware is only limited to detection of minor frame and addition the time code for format processing as shown on Fig.4.This system is allows to take synchronization by only setting a parameter in programmable sync hardware for various minor frame patterns.It adapts to many downlink data format without changing the hardware.Processing difference due to types of sensor or satellites are solved by a software on a WS with high speed and high multiusability.

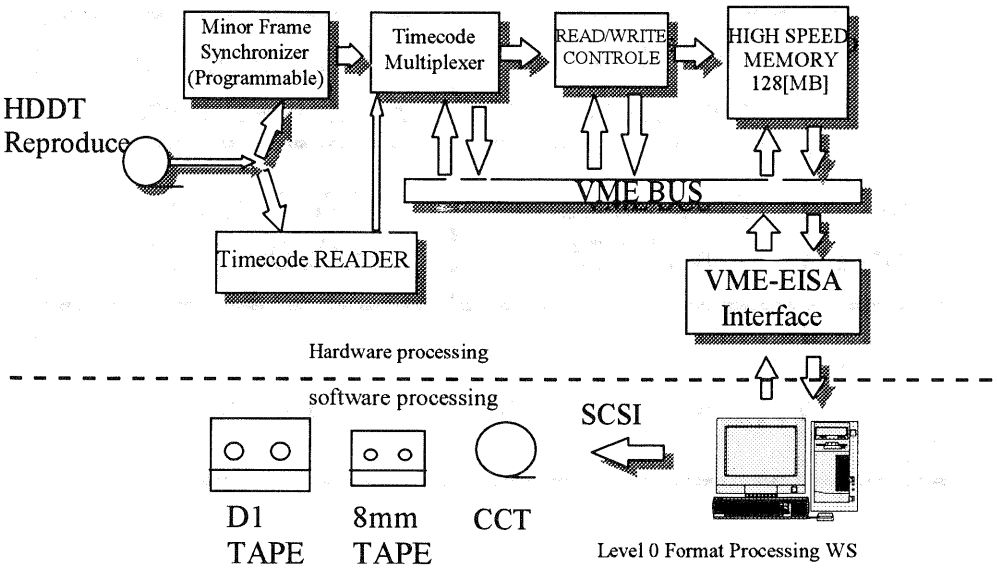


Fig.4 : Block diagram of the programmable formatter system

5. Analysis and result

We used the downlink data of MOS-1 MESSR/VTIR for analyzing the performances of the programmable formatter.Fig.5 shows the processing time result compared with the hardware formatter currently used at our ground station.But, due to the from a difference of the system structure , we could not use the same output equipment for analysis. So,we measured time of the main processing, and the write time to CCT is not included.And both were equal as a result of having done format processing.The processing time of the programmable formatter was a tenth times faster than the previous hardware formatter.This result proves the high speed performance of the programmable formatter.

	Hardware Formatter System	Programmable Formatter System
Control Computer	Minicomputer MS-175	Workstation HP9000 / 755
Processing Time [S]	Approx. 600	Approx. 60

Fig.5 : Result of Processing Time of MOS-1 MESSR LEVEL 0 Processing at one scene.

6. Summary

Recently it is becoming necessary to process downlink data of earth observation satellites at ground receiving station if distribute it to end users in timely manner.More over,in order to adjust to various satellite programs construction of flexible data reception & processing system with has become important.It was the aim of our study to develop the high speed programmable formatter to cope with such actual situation.The sensor data used in this experiment was of MESSR of MOS-1.We are planing to perform the quantitative analysis of the programmable formattfer in this with other sensor data and intend to upgrade of the system.

7.References

*(1)JERS-1 SAR / AMI IMAGE MOS-1 DATA USERS HANDBOOK National Space Development Agency of Japan ,Earth observation center 2nd.edition (HE93065A) April,1995

*(2) JERS-1 OPS data format instrucrion National Space Development Agency of Japan ,Earth observation center 2nd.edition (HE93064A) April,1995