Special Article on Satellite Packet Communication Service
Base Station Equipment

The introduction of the Satellite Mobile Packet Communication System required the development of the Transmission Power Controller (TPC) for the Base Station (BS) and of the Satellite Packet Modulation and Demodulation Equipment (SPMDE).
This article describes the overviews of TPC and SPMDE.

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1. Introduction

The Satellite Mobile Packet Communication System was introduced to handle the increasing volume of packet communications on the N-STAR Satellite Mobile Communication System, resulting from the increasing use of data communications.

The new Transmission Power Controller (TPC) and the new Satellite Packet Modulation and Demodulation Equipment (SPMDE) (Photo 1) were developed for the Base Station (BS) of this system (Figure 1).

Photo 1 Satellite Packet Modulation and Demodulation Equipment

This article describes the TPC and the SPMDE and discusses the related new technologies.

2. Transmission Power Controller (TPC)

2.1 Overview

The Transmission Power Controller (TPC) secures quality of service and efficient usage of satellite transmission power. For each beam of the forward link (from BS to mobile terminals), the TPC keeps the received power at the constant level on the earth's surface. As shown in Figure 1, this equipment is connected to the Up Converter (U/C) to secure quality, not only for packet system, but also for the entire N-STAR Satellite Communication System. The TPC are full redundant to ensure high reliability.

2.2 Function

As illustrated in Figure 2, the TPC transmits pilot signals in the 6GHz band on each beam and receives pilot signals in the 2.5GHz band loop-back level from the satellite. The fluctuations (deviations) in the volume of the received signals are used in a feedback mechanism to control the transmission level.

2.3 Configuration

The TPC has two control units, which are shown in Figure 2.

(1) Transmission power control unit

One unit controls the transmission power. It has a duplex configuration: one working device and one standby device. Output signals from the SPMDE and the Satellite Modulation

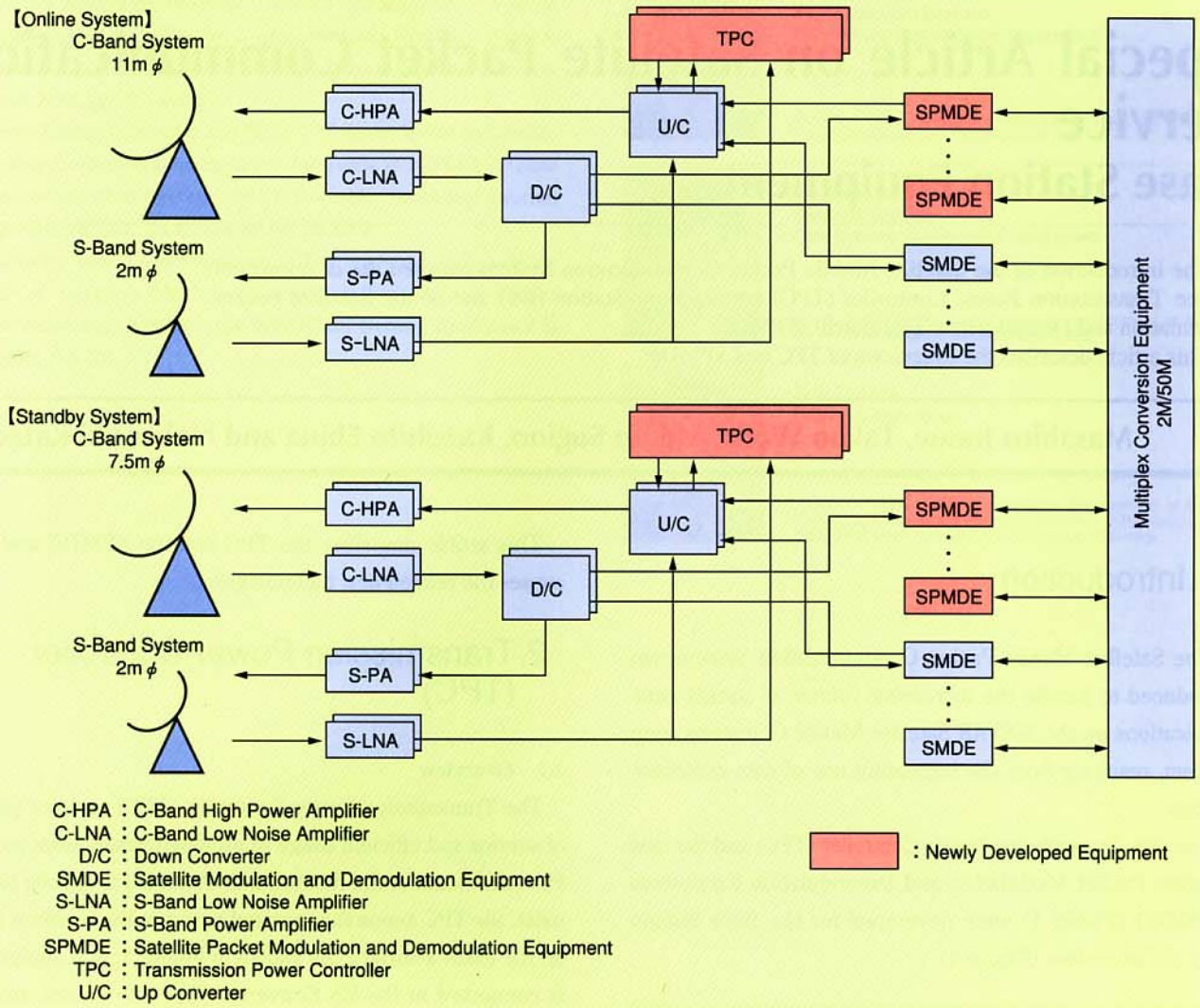

Figure 1 Satellite Base Station Configuration

and Demodulation Equipment (SMDE) are separated into the frequency bands occupied by beams 1-4 by using narrow-band filter groups for each beam. The TPC synthesizes pilot signals for level measurement and synthesize for each beam after applying transmission level control to the U/C. The TPC measures the 2.5GHz band loop-back level from the satellite.

(2) Monitoring and control unit

The other unit calculates the degree of level control needed, beam-by-beam, on the basis of the received signal level measured at the transmission power control unit, and returns an indication so that the transmission power control unit can apply the required control. It also has a duplex configuration : one working device and one standby device. It has a contact input/output interface and a serial link interface with other equipment (Transmission power control unit, U/C, SMDE).

3. Satellite Packet Modulation and Demodulation Equipment (SPMDE)

3.1 Overview

The major functions of the SPMDE can be broadly classified as either signal relay/processing or operational control. The SPMDE relays and processes call processing signals, such as connection control signals and user packets, that are transmitted/received between the Mobile Station (MS) s and the Satellite Packet Processing Module (S-PPM). The SPMDE also has operational control functions such as monitoring and control functions, for the equipment itself. Data operated transmission and continuous transmission functions are included in the SPMDE as new operational control functions.

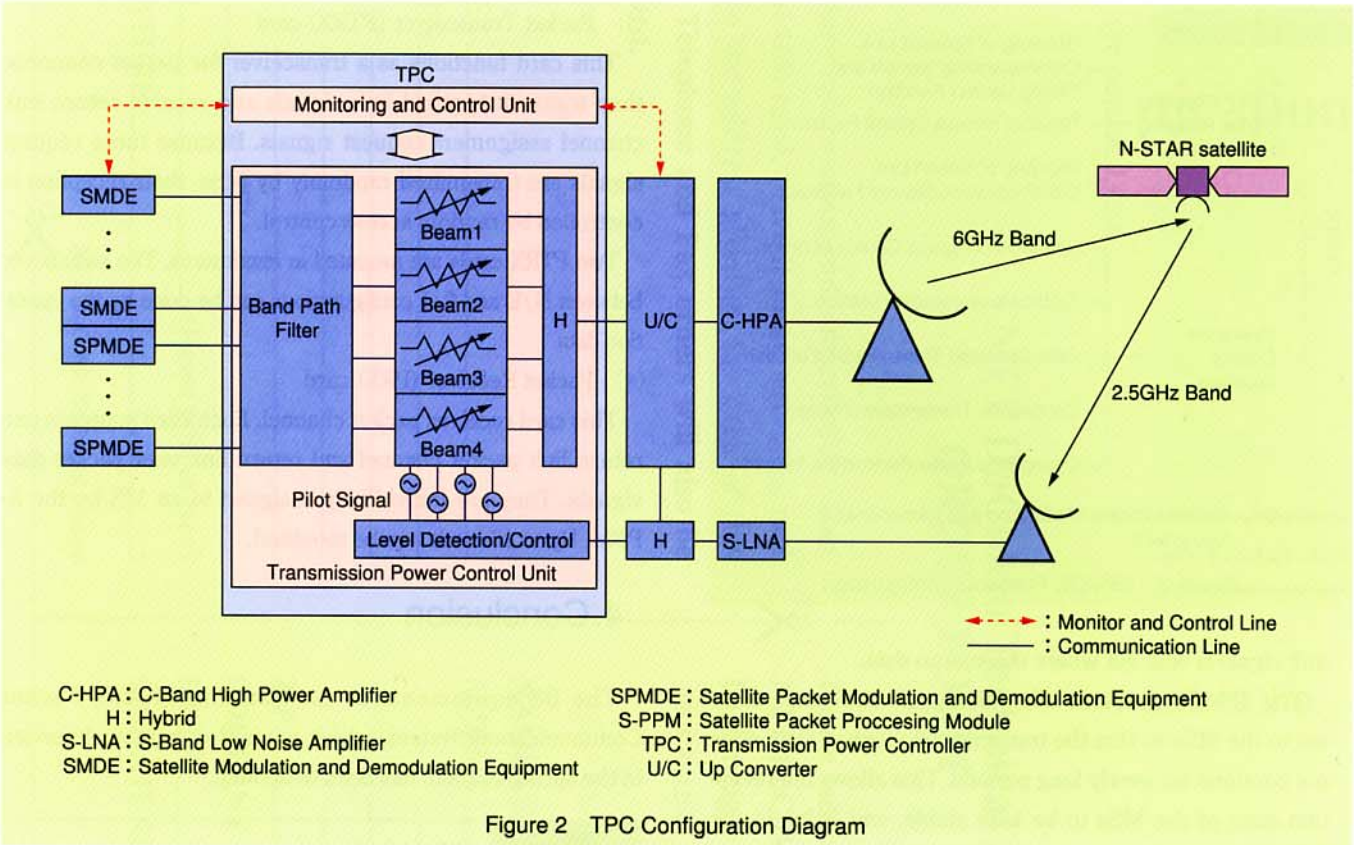

Figure 2 TPC Configuration Diagram

The SPMDE is connected to existing radio equipment at the BS, so that SPMDE and SMDE share the same radio equipment. This reduced the cost of installing the Satellite Mobile Packet Communication System and has resulted in reduced operational costs.

3.2 Functions

(1) Call-processing signal relay functions

The call-processing signal relay functions can be classified into three broad areas (Figure 3).

① Relaying of forward link call-processing signals and timing control

One function of the SPMDE is to control signals the forward link channel so that multiple MSs can all receive the signals they require.

② Random access control

Assignment request signals random access channels on the return link are recieved and transferred to the S-PPM.

③ Relaying of return link call-processing signals

Call-processing signals on the return link packet communication channel are received and transferred to S-PPM.

(2) Operational control

Operation control functions can be classified into five broad areas.

① Self-monitoring and control

The SPMDE monitors the state of each of its cards. When it detects an abnormality, it sends alarm signals to the S-PPM and autonomously switches to the standby system card and resets the abnormal card.

The state of each card in the SPMDE can also be monitored from the satellite operation terminal at the operation center. Each card can be blocked, switched to, or reset remotely by operations at the satellite operation terminal.

② Traffic measurement

The SPMDE constantly measures the level of radio waves on idle channels and the degree of utilization of busy channels. The results are regularly reported to the S-PPM.

Threshold values for alarm signals are also assigned, and when the value of a result exceeds the threshold, the SPMDE sends alarm signals to the S-PPM.

③ Data Operated Transmission (DOX)

The SPMDE has a DOX function so that it can turn off transmission power when there is no data to be transmitted.

DOX can be stopped or made operational by control signals from the S-PPM.

When DOX is stopped, transmission power is always turned on even if there is no data to be transmitted. An idle

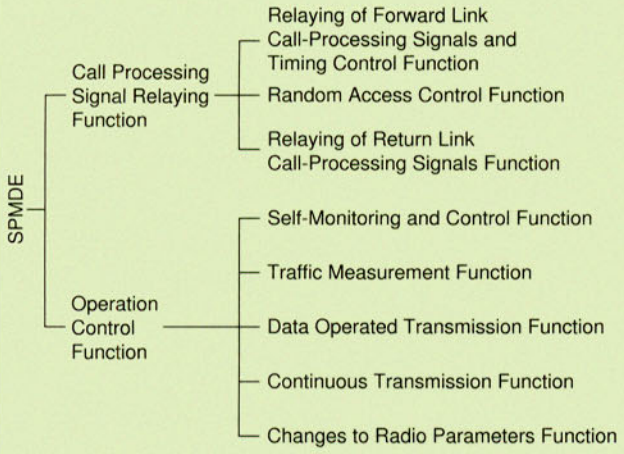

Figure 3 SPMDE Function Configuration

unit signal is sent out where there is no data.

The SPMDE prepares idle unit signals and sends them out to the MSs so that the transmission stopped state does not continue for overly long periods. This allows the reception state of the MSs to be kept stable, and helps in the synchronization of MSs that are changing from one channel to another.

④ Continuous transmission

The SPMDE can also transmit specific signals to MSs continuously, or with a specific timing, over a period specified by the S-PPM.

This is useful for the highly reliable transmission of control to multiple MSs.

⑤ Changes to radio parameters

The setup of the transmission carrier can be changed, according to instructions received from the S-PPM.

3.3 Configuration

(1) Repeater Control (REPCONT) card

This card is used for the overall control and relaying of maintenance and monitoring control signals. It includes a memory card that is used to store their own application programs/data, plus application program/data for the packet transceiver and the packet receiver cards. Two REPCONT cards are mounted, one for normal (N) operation and one for emergency (E) operation.

(2) Highway Interface (HWIF) card

This card can interface with the S-PPM. It has a link edit function to multiplex/divide the channels for the S-PPM and a function to generate various clocks. Two HWIF cards are mounted in a N/E configuration.

(3) Packet Transceiver (PTRX) card

This card functions as a transceiver for packet channels, they transmit forward link signals and receive return link channel assignment request signals. Because these request signals are transmitted randomly by MSs, their reception is controlled by random access control.

Two PTRX cards are mounted in maximums. The switchover between N/E and 0/1 configurations can be done by the operation data.

(4) Packet Receiver (PRX) card

This card receives packet channel. Each card supports one return link packet channel and return link user packet data signals. They are individually assigned to an MS by the S-PPM. Up to 16 cards can be mounted.

4. Conclusion

The BS equipment for the Satellite Mobile Packet Communication System, which entered commercial service in the spring of 2000, has been described.