

# **PALAPA C2 PAYLOAD TELEMETRY SYSTEMS FOR SIMULTANEOUSLY UPLINK AND DOWNLINK RAIN ATTENUATION MEASUREMENTS IN INDONESIA**

<sup>1</sup>Joko Suryana, <sup>1,3</sup>Utoro Sastrokusumo, <sup>2</sup>H.Minakoshi, <sup>2</sup>K.Igarashi

<sup>1</sup>POST-PARTNERS project ; Laboratory of Radio Telecommunication and Microwave, Electrical Engineering Department, ITB  
Jl.Ganesha 10 Bandung, Ph.+62-22-2501661, e-mail : joko@ltrgm.ee.itb.ac.id

<sup>2</sup>POST-PARTNERS project ; Upper Atmosphere Section, Space Science Division, CRL,MPT,Japan  
4-2-1, Nukui Kita-Machi, Kogane-Shi, Tokyo 184, Japan

<sup>3</sup>Department of Electrical Engineering,Ahmad Yani's University, UNJANI, Cimahi-Bandung

## **Abstract**

The Ku band propagation experiments using beaconless Indonesian geostationary satellite: Palapa C2 has been performed at the Daan Mogot and Bandung earth stations. The uplink and downlink rain attenuation measurements have been accomplished by utilizing the CW beacon simulator in the ground combined with payload telemetry systems. By combining telemetry data, uplink level, and downlink level together with meteorological data, we expect to obtain slant-path Ku band propagation data, especially for Indonesia to confirm the present ITU Rain-Climate Zone model and to improve it if necessary.

## **1.Introduction**

The propagation characteristics of Ku band transmissions are significantly different than at the lower spectrum bands. The presence of hydrometeor in the radio-wave path, particularly rain, can produce major impairments to earth-space communication links. Therefore, it is necessary to characterize the statistics of precipitation effects on Ku band propagation before reliable communication systems can be designed.

Extensive experimental research has been performed on the direct measurement of precipitation effects on earth-space paths, with availability of propagation beacons on geostationary satellites. Another important experiment methods such as sky temperature, point rainfall rate and radar backscatter measurements also have been accomplished to determine the rain attenuation indirectly.[1].

In this paper, we will present rain attenuation measurements in Indonesia using Palapa C2 Satellite. Since the Palapa C2 have no Ku band beacon, the rain attenuation measurements will be done indirectly, by using CW beacon simulator in the ground combined with communication payload telemetry systems (equipped by Satelindo and IPTN ). Uplink rain attenuation are calculated by flux density variations that have correlation I bus current measurements, while downlink rain attenuation by calculation of difference between satellite EIRP and downlink signal level. By combining telemetry data, uplink level, and downlink level together with meteorological data ( installed by POST-PARTNERS project ) we expect to obtain slant-path Ku band propagation data, especially for Indonesia to confirm the present ITU model and to improve it if necessary.

## 2.Experimental Configuration

In this experiment, the Ku band CW beacon simulator signal at Daan Mogot is transmitted to Palapa C2 and received by beacon receiver at Bandung. During transmission, the Ku band transponder is monitored by telemetry systems at TT&C station at Daan Mogot. The meteorological observation equipment is installed at both of Daan Mogot and Bandung ( equipped by POST-PARTNERS project ). Figure 1 shows us the configuration of the experiments :

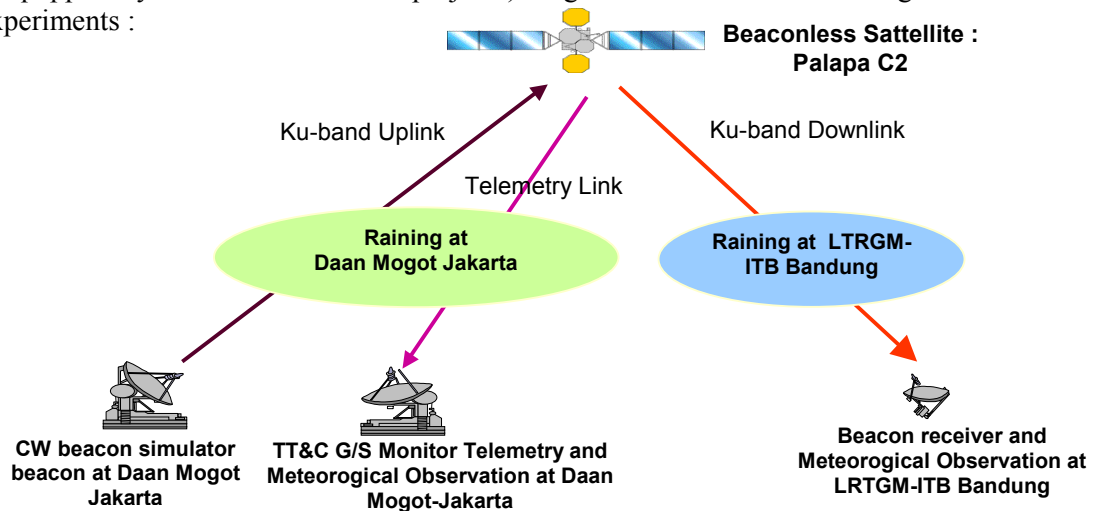


Figure 1. Configuration of experiment

## 3.Calibration of Payload Telemetry Systems

Generally, the principal objectives for telemetry systems are to provide information of operational use, failure analysis and prediction of the system performance [2]. In routine operations, the telemetry verifies commands and equipment status and alerts personnel of any unusual occurrences. In case of failures or anomalies telemetry data is used to determine the causes, the events and ways to counteract or alleviate the problems produced by a failure. Telemetry can also be used to analyze any degradation that might affect performance and predict its effect on the system lifetime.

By virtue of the principal function of telemetry systems, it is possible to utilize the communication payload telemetry for verifying the rain attenuation measurements, particularly for beaconless satellite systems. Therefore, in this experiment we utilized payload telemetry systems, namely I bus current telemetry and I helix current telemetry.

These parameters will be used to determine the TWTA drive level of Ku band transponder. Figure 2. shows the typical communication payload of a satellite and the graphic of TWTA drive level vs I bus current :

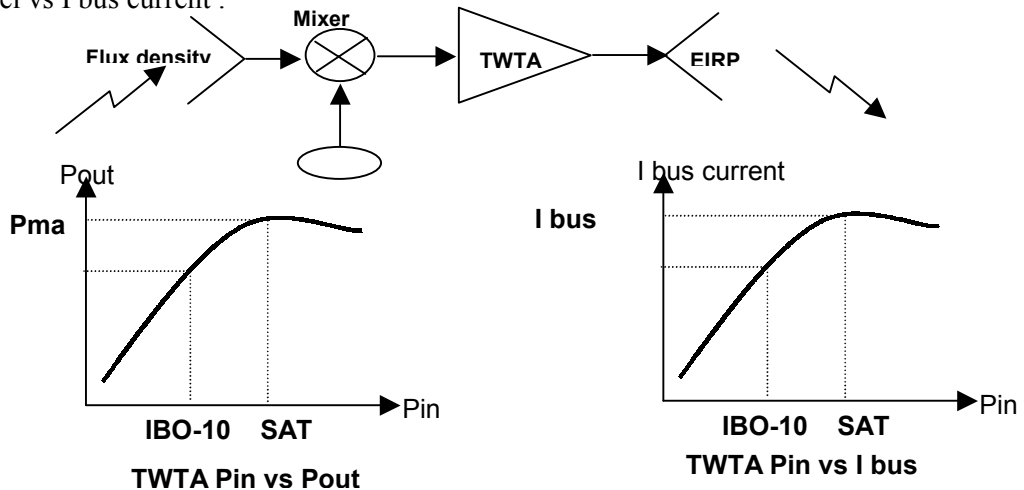


Figure 2. Typical communication payload and graphic of TWTA drive level vs I bus current

Before using the payload telemetry system for indirect rain attenuation measurement, we must determine the characteristics of TWTA drive level vs I bus current by running this procedure [3] :

1. Make sure that the sky is clear and free from cloud or no rain. Transmit the uplink signal and receive the downlink signal only at Daan Mogot.
2. Set the attenuation at Ku band transponder to high attenuation ( approximately 15 dB ) to avoid unknown user.
3. Transmit the CW beacon simulator signal to Ku band payload at saturation region and record the uplink level at power meter, downlink level at SA, I bus current, Helix current and TWTA temperatur.
4. Remove the uplink signal, and retransmit at level SAT IBO-30 ( 30 dB below the saturation level ), then record the uplink level, downlink level, I bus current, helix current and TWTA temperatur.
5. Increase the uplink transmit power by 0.5 dB step and continue to record until SAT +5 dB.
6. To verify the consistency of the data, run the procedure three time.
7. Plot the results to present the characteristics of TWTA drive level vs I bus current.

#### **4.Rain Attenuation Data Processing**

The data processing are performed at Daan Mogot earth station as well as at LTRGM-ITB Bandung . The raw data which are measured and recorded on harddisks at a measuring rate of 1 sampel per second for uplink level, downlink level and meteorological parameters and at a measuring rate 1 sampel per 2 minutes for I bus current and I helix current telemetry data. For statistical data processing and analysis, the uplink level, downlink level and meteorological parameters data are reduced to 1 sampel per 2 minutes through averaging procedure. Uplink rain attenuation are calculated by flux density variations that have correlation I bus current measurements, while downlink rain attenuation by calculation of difference between satellite EIRP and downlink signal level.[3]

#### **5.Acknowledgement**

The authors gratefully acknowledge to Promotion Council of the POST-PARTNERS project for the R&D supports, specially to Dr.Kiyoshi Igarashi and Dr.Hisamitsu Minakoshi; and to Mr.Hermanuddin from IPTN for his valuable data of TWTA measurements.

#### **6.References**

1. L.J.Ippolito, Jr, **Radiowave Propagation in Satellite Communications**, Van Nostrand Reinhold Company, 1986
2. K.Igarashi et al, **Satellite Communication network for the earth-satellite propagation study in the POST-PARTNERS Project**, Research proposal, CRL-Japan, 1998.
3. Hermanuddin et.al, **TWTA Characteristics Measurement by Telemetry System on Palapa C2**, IPTN-Interim report, 1999
4. J. Peter Paul ,Joko Suryana and Utoro Sastrokusumo, **Permodelan Sederhana Redaman Hujan untuk Propagasi Satelit Ku-band di kota Bandung**, Tugas Akhir, 1999

# CONFIGURATION OF UPLINK AND DOWNLINK RAIN ATTENUATION MEASUREMENTS

## A. Daan Mogot –Jakarta ( Equipped by Satelindo and IPTN )

