VGOS Station in the South of Thailand

N. Thoonsaengngam[1], P. Jareonjittichai[1], A. Leckngam[1], N. Kruekoch[1], J.A. López-Pérez[2]

Abstract Following the development of the 40-m Thai National Radio Telescope and the Thai VLBI Network, the project to build a VGOS station in the South of Thailand was approved for the years 2022–2025 to probe tectonic activities in the South East Asia region. The site is located in the vicinity of NARIT's Regional Observatory for the Public in Songkhla. A wideband 2–14 GHz receiver system is being developed in collaboration with Yebes Observatory.

Keywords VGOS, Thailand, wideband-receiver

Fig. 1 A map from google pinned positions of the Chiang Mai and Songkhla stations.

1 Introduction

The National Astronomical Research Institute of Thailand (NARIT) aims to expand the astronomy research horizon by developing national radio telescopes and related systems. This goal led to the proposal of a project called the Radio Astronomy Network and Geodesy for Development, or RANGD. The first phase of RANGD includes:

- The 40-meter Thai National Radio Astronomical Telescope (TNRT),
- The 13-meter VGOS telescope (under collaboration with SHAO).

In particular, it devotes much attention to geodetic outputs from the facilities. Developments in both sciences alongside will push research works and innovations to a higher level and gain more benefits for nation and international collaborations. The Chiang Mai VGOS telescope aims to be a part of the IVS sessions, dedicated to the determination of the global parameters.

Recently, NARIT has begun building another VGOS telescope in southern Thailand. The goal is to gain more benefits for the domestic geodesy and geological studies from the approximately 1,300-kilometer baseline (Figure 1), while Thailand sits on two tectonic plates, Eurasia and Sunda.

2 VGOS Station in Songkhla, Thailand

2.1 Location

The Songkhla province is in southern Thailand at 7.15°N, 100.61°E. The site for the VGOS station is

1. National Astronomical Research Institute of Thailand (NARIT)
2. Yebes Observatory, Instituto Geográfico Nacional (IGN)

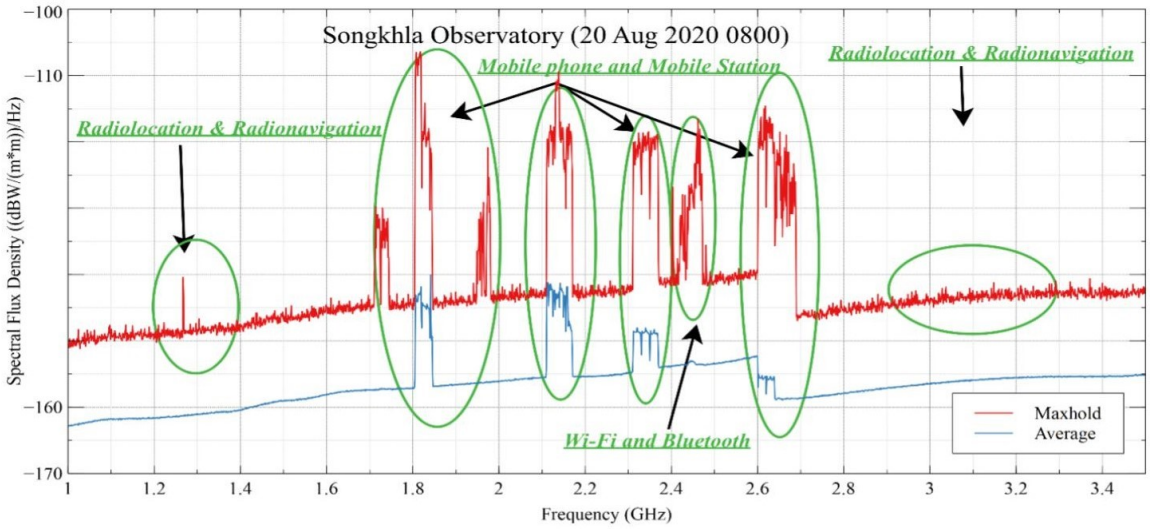

Fig. 2 Report of RFI measuring on site at Songkhla observatory.

at the NARIT Songkhla Regional Observatory. This location makes observations of these two stations in Thailand and can achieve almost the same UV coverage and observing sessions both in the Northern and Southern hemispheres by comparing $+41.5°$ and $-29°$. Results from the baseline determination will be a key to increasing the national geodetic network accuracy up to the millimeter level when combined with the GNSS CORS network and the national geoid model.

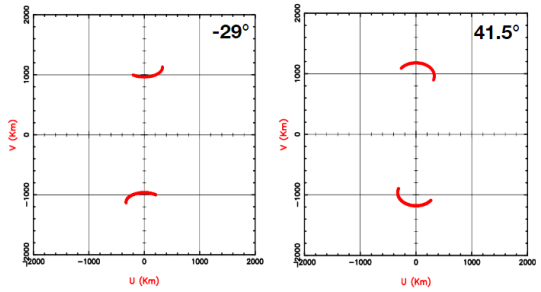

Fig. 3 UV coverage of Chiang Mai and Songkhla observations at $+41.5°$ and $-29°$ (Sukiyama, K.).

The radio frequency situation at Songkhla was measured and reported as an example in Figure 2. The results are considered for the design of the receiver system.

2.2 Receiver System

To perform VGOS observations, the receiver is expected to perform at 30 K over the whole band between 2 and 14 GHz. Songkhla will be equipped with the wideband receiver designed by Yebes Observatory, IGN, Spain.

The block diagram in Figure 4 shows details of the frontend system, being developed under collaboration and consultation with the Yebes group. The cryogenic dewar is composed of the QuadRidge Flared Horn (QRFH). The receiver is cooled using a two-stage cryostat (15 and 50 K). The frame labeled as number 1 is under development at YEBES.

The parts listed as number 2 will be supplied by NARIT and shipped to be assembled and tested on-site. The Antenna Cal Unit (Number 3) is being developed at NARIT.

From the construction site plan, the backend room will be located in a separate building, approximately 60 meters from the receiver room. The radio frequency (RF) signals will be sent from the telescopes via optical fibers so that RF-over-fiber (RFoF) transmitters and receivers (Parts number 4) are required. The dual linear polarizations are split into a low (2.0–6.0 GHz) and a high-frequency part (3.6–14.0 GHz). The corresponding RFoF receivers are located in the control room, close to the backends.

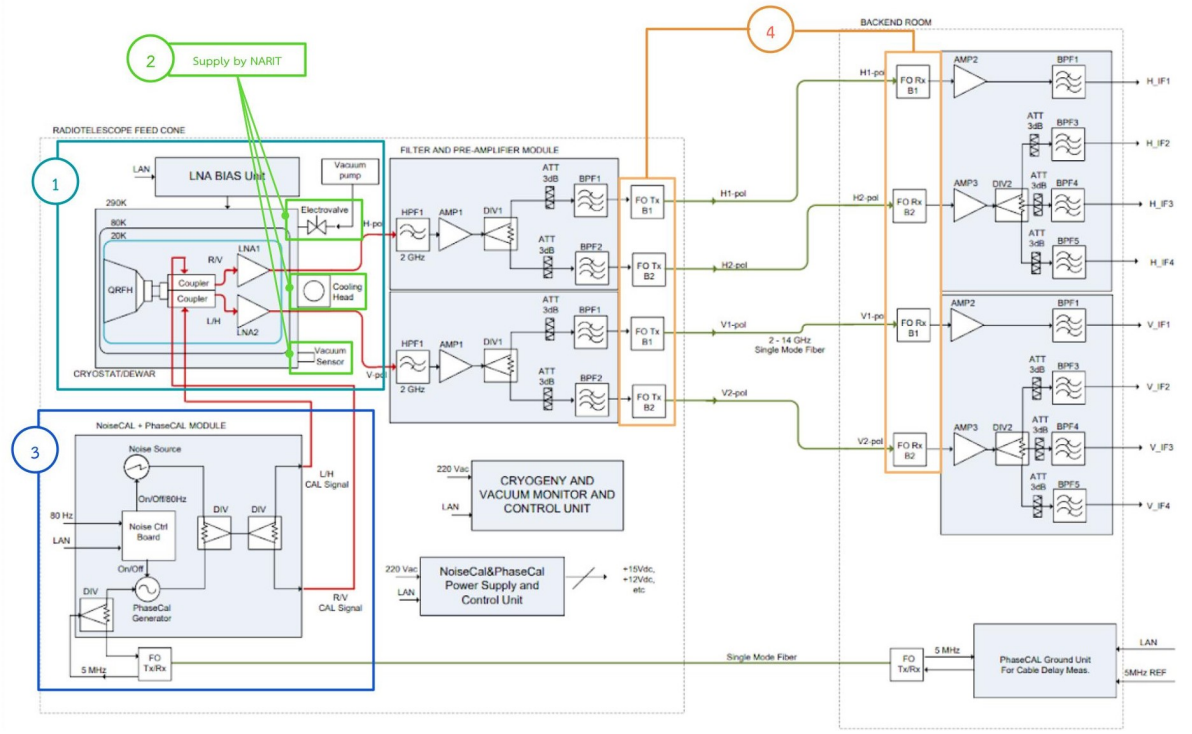

Fig. 4 The frontend block diagram developed at Yebes Observatory.

3 Summary

According to aforementioned details and other relevant components, the specifications of the Songkhla station can be summarized as in Table 1.

Table 1 Station specifications.

Antenna diameter	13 meter
Antenna type	Ring-focus
Slew speed	12°/s
Feed	QRHF
Frequency	2–14 GHz
Receiver temperature	$\leq$ 30 K
Backend unit	DBBC3-8L8H
Data recorder	Mark 6

The digital backend (DBBC3) and the VLBI storage system (Mark 6) were purchased and have arrived at NARIT, the RFoF modules included. The team is now focusing on the integration of the DBBC3 and Mark 6 controls into the VLBI Field System.

In Table 2, the estimated project timeline is presented. According to the plan, parts of the telescope will be delivered to the site in September 2023. The installation will take approximately 115 days until the first movement, and then the receiver system will be installed in February 2024. The commissioning of VGOS Songkhla station is expected to be by mid-2024.

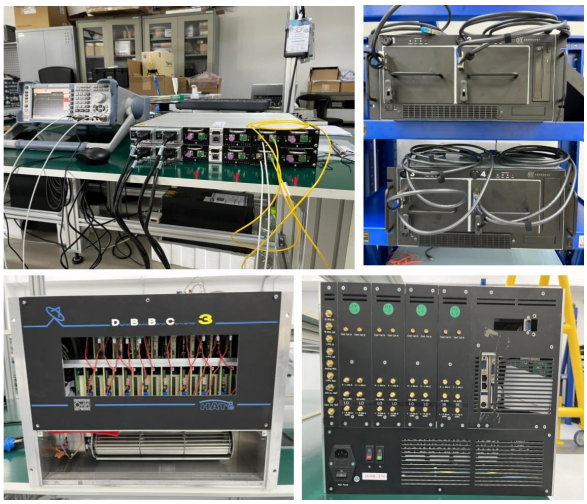

Fig. 5 Parts that are at NARIT: RFoF, Mark 6, and DBBC3-8L8H.

Table 2 VGOS Songkhla timeline.

Time schedule	Activity
October 2021	Telescope design phase
July 2022	Telescope manufacturing
December 2022	Site Preparation
January 2023	Tower construction
September 2023	Telescope on site installation
February 2024	Telescope commissioning
March 2024	Receiver system installation
August 2024	Station commissioning

References

1. Lopez Perez A, de Vicente P, Lopez Fernandez J A, et al., "Instrumentation Developments for VGOS at IGN Yebes Observatory." In: R. Haas, S. Garcia-Espada, J. A. Lopez Fernandez (eds.): Proc. 24th EVGA Working Meeting, pp. 22–26, 2019.