

## Geodetic Observatory TIGO in Concepción

*Sergio Sobarzo, Cristobal Jara, Eric Oñate, Cristian Herrera, Carlos Verdugo, Hayo Hase, Armin Böer, Bernd Sierk*

### Abstract

2007 was the sixth year of TIGO operation with 107 successful 24-hour observations.

### 1. General Information

The operation of TIGO is based on an agreement between Chile and Germany, in which Universidad de Concepción, Instituto Geográfico Militar, and the Bundesamt für Kartographie und Geodäsie secured their cooperation until the end of 2011. This year Universidad del Bío Bío finishes its participation in the consortium; however the VLBI staff remains warranted. TIGO is located near the Universidad de Concepción, at longitude 73.025 degrees West, latitude 36.843 degrees South and at an altitude of 180 m, 500 kilometers south of Santiago, Chile's capital.

### 2. Component Description

The IVS network station TIGOCONC is the VLBI part of the Geodetic Observatory TIGO, which was designed to be a fundamental station for geodesy. Hence the VLBI radiotelescope is co-located with an SLR telescope (ILRS site), a GPS/Glonass permanent receiver (IGS site), and other instruments such as water vapor radiometer, seismometer, superconducting gravity meter and absolute gravity meter.

The atomic clock ensemble of TIGO consists of 2 hydrogen masers, 3 cesium clocks and 3 GPS time receivers realizing the Chilean contribution to the Universal Time scale (Circular T, BIPM).

The technical parameters of the TIGO radiotelescope as published in [1] have not changed.

In 2007 the entire TIGO computer network infrastructure was upgraded to 1 Gbps allowing the testing of new e-VLBI protocols and algorithms. Now any existing limiting factor is located outside TIGO facilities.

### 3. Staff

The VLBI group remained unchanged as compared to 2006. In 2007 the TIGO VLBI group consisted of the persons listed in Table 1. In 2007, Hayo Hase was elected to be an IVS Network Representative on the IVS Directing Board for a four-year term.

### 4. Current Status and Activities

During 2007 TIGO was scheduled to participate in 111 IVS experiments (see Table 2). The four failed experiments were mainly associated with problems related to cooling.

Apart from the regular IVS observation load, the TIGO VLBI group is involved in three development areas: e-VLBI, Remote Control User Interface for the FS and Sattrack testing.



Figure 1. Current VLBI Staff (Jara, Sobarzo, Hase, Herrera, Verdugo and Oñate).

Table 1. TIGO VLBI support staff in 2007.

Staff	Function	Email
Hayo Hase	head	hayo.hase@tigo.cl
Sergio Sobarzo	chief engineer	sergio.sobarzo@tigo.cl
Cristobal Jara	electronic engineer	cristobal.jara@tigo.cl
Eric Oñate	electronic engineer	eric.onate@tigo.cl
Cristian Herrera	informatic engineer	cristian.herrera@tigo.cl
Carlos Verdugo	mechanical engineer	carlos.verdugo@tigo.cl
any VLBI-operator	on duty	vlbi@tigo.cl
all VLBI-operators		vlbistaff@tigo.cl

Table 2. TIGO's IVS observation statistics for 2007.

Name	# of Exp.	OK	Failed
R1xxx	41	40	1
R4xxx	51	50	1
R&D	7	7	0
OHIGxx	7	6	1
T20xx	3	2	1
RDVxx	2	2	0
Total	111	107	4

#### 4.1. e-VLBI

During 2007, TIGO continued its participation in the EXPReS project, which aims at connecting 21 VLBI radiotelescopes in 6 continents using high speed networks allowing real-time

VLBI. The previously mentioned TIGO network upgrade was done to support the realization of the objectives of this project.

TIGO also had presence at the 6th International e-VLBI Workshop held in Bonn, Germany on September 17 and 18. Hayo Hase presented the development work of Sergio Sobarzo under the title *Multipath and Singlepath Routing for e-VLBI*. This research aims at a new protocol, which will allow that parallel flows of VLBI data can be sent over different routes using different constraints resulting in an increase of the data transfer speed proportional to the number of alternative routes. Also development work is being done to look into new algorithms for UDP congestion control and congestion avoidance, which can be applied to e-VLBI data.

On July 12th, the First Research Virtual Communities Global Forum was held. TIGO, among 14 other research organizations, made an online presentation in the Networking session called *Connectivity of Chilean NREN*.

## 4.2. Remote Control User Interface

New improvements were made to the Remote Control Software developed in 2005 (see [2]). Now the client is a standalone application written in Python running in the Linux Graphical Environment (see Figure 2).

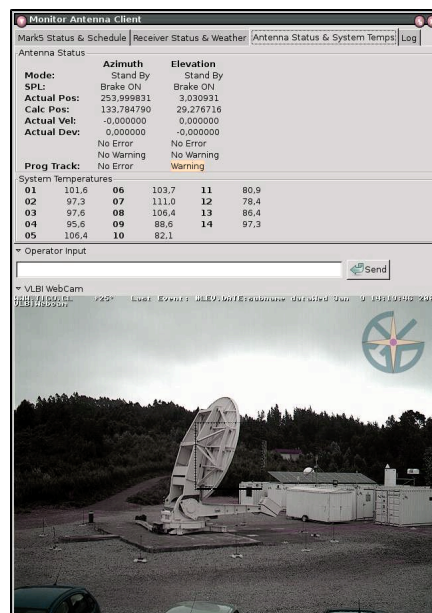


Figure 2. Screenshot of the software for remote control VLBI operation with the Field System. The upper part displays antenna status and receiver temperatures; in the middle there is an operator input area, and at the bottom there is a live image of the telescope. Also there are tabs for Mark 5 status & schedule, receiver status & weather, and log with additional information.

### 4.3. Sattrack Testing

In January, Michael Moya, a visitor from Chalmers University of Technology in Gothenburg, Sweden, made the final tests of the satellite tracking software at TIGO [3]. Since in the southern sky there are not that many suitable radio sources to perform pointing tests, there was the need to find a way to do these calibrations using artificial sources, like AQUA and TERRA, with carrier signals inside the X-Band. (See Figure 3 for a successful observation.) The written software was included in the FS station software and uses the North American Aerospace Defense Command (NORAD) two line elements (TLE) as input. As a future work this software should be included in the main distribution of the Field System.

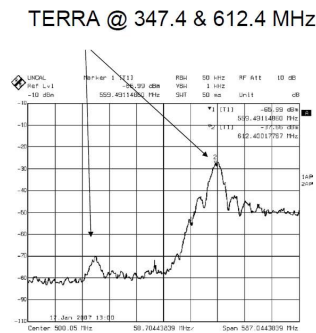


Figure 3. Successful pointing on TERRA using sattrack software [3].

## 5. Future Plans

The VLBI activities in 2008 will focus on

- execution of the IVS observation program for 2008
- participation in the CONT08 campaign
- continuation of developments:
  - investigations related to e-VLBI
  - remote control user interface for the FS
  - new monitor and control solution for the receiver
- repetition of the local survey

## References

- [1] Vandenberg, N.R.: International VLBI Service for Geodesy and Astrometry 1999 Annual Report, NASA/TP-1999-209243, 1999.
- [2] Gonzalo Remedi, Sergio Sobarzo and Hayo Hase, *Remote Control of VLBI Operations*, Proceedings of the Fourth IVS General Meeting, 2006, pp 127-131.
- [3] M. Moya Espinosa and R. Haas, *SATTRACK A Satellite Tracking Module for the VLBI Field System*, Proceedings of the 18th European VLBI for Geodesy and Astrometry (EVGA) Working Meeting, 2007, pp 53-58.