Alexander Neidhardt et al.: Two Weeks of Continuous Remote Attendance during CONT11, IVS 2012 General Meeting Proceedings, p.38–41
http://ivscc.gsfc.nasa.gov/publications/gm2012/neidhardt1.pdf

Two Weeks of Continuous Remote Attendance during CONT11

Alexander Neidhardt [1], *Martin Ettl* [1], *Jim Lovell* [4], *Christian Plötz* [2], *Cristian Herrera Ruztort* [3], *Hayo Hase* [2]

[1] *Forschungseinrichtung Satellitengeodäsie (TUM), Geodetic Observatory Wettzell*
[2] *Bundesamt für Kartographie und Geodäsie, Geodetic Observatory Wettzell*
[3] *Universidad de Concepción, Transportable Integrated Geodetic Observatory*
[4] *University of Tasmania*

Contact author: Alexander Neidhardt, e-mail: `neidhardt@fs.wettzell.de`

Abstract

September 15-29, 2011 saw a continuous VLBI session that was organized by the International VLBI Service for Geodesy and Astrometry (IVS). This CONT11 campaign is a continuation of the series of very successful continuous VLBI campaigns that were observed at irregular intervals since 1994. Within these two weeks, fourteen telescopes contributed to this experiment. Therefore, this was a perfect opportunity to demonstrate the stability of e-RemoteCtrl over a long time period. Furthermore, it was very useful to gather experience in remote attendance over a longer time period. The software, developed by the Geodetic Observatory Wettzell, was used to attend the sessions at TIGO in Concepción, Chile during the night shifts without any problems. This remote control experiment showed the usability of the new observation strategies for future experiments and developments. In parallel, a second testing connection was established to the Australian telescope at Katherine for a monitoring and integration test. Overall, the CONT11 experiment was very productive for demonstrating, testing, and collecting experience using station remote control capabilities with e-RemoteCtrl over long distances and over a longer time period.

1. Introduction: e-RemoteCtrl Observations during CONT11

A continuous VLBI campaign was carried out by IVS in September 2011. This campaign was held for a period of two weeks with continuous measurements; fourteen telescopes contributed in operation. The main goal of this campaign was to gather precise data for supporting high resolution Earth rotation studies, investigating reference frame stability, and investigating daily to sub-daily site motions. Therefore, this was a perfect chance to demonstrate and test shared observation strategies using "e-RemoteCtrl" [1]. This software uses remotely accessible, autonomous process cells as server extension to the NASA Field System, based on Remote Procedure Calls (RPC) [2][4]. With this technology, several remote control and attendance tests were successfully shown with telescopes in Germany, Chile, Antarctica, and foreign sites like Hobart and Katherine. During CONT11, Wettzell ran the TIGO telescope, remotely attending the whole two weeks during night shifts. Additionally, it was possible to establish a connection to the Australian telescope Kathrine for a monitoring and integration test. For security reasons, the whole communication was tunneled using Secure Shell (SSH) with automatic connection control. It re-establishes broken SSH tunnels without user interaction [3].

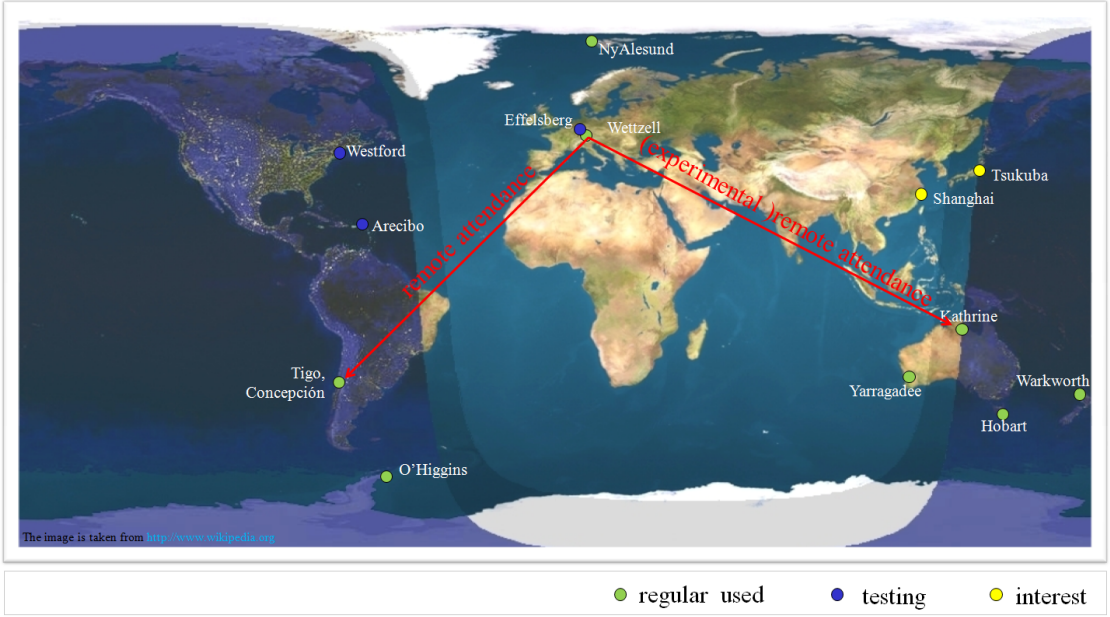

Figure 1. The "e-RemoteCtrl"-network (stations using or having the remote control software) and the operated sites during CONT11.

2. The Results

During the shared observation the round-trip delays (time for sending a request and receiving a response) of commands were captured for more than two weeks. The results for the round-trip delays of these survey are illustrated in Figure 2 (the broad blue value band). For a better interpretation an aggregated mean calculation for 15-minute intervals over the round-trip delays are used (the yellow line in the middle of the measured values). The red rectangles show the operated night shifts for TIGO during the 15 days of CONT11. In general, higher network loads can be seen, influencing the remote control. The mean round-trip delay to Chile and back is about 0.34 seconds, meaning that each command takes a third of a second from sending to responding.

With this test during the two-week interval, regular observations and very important conclusions could be made: (1) The used SSH-stabilization without human interaction worked quite well and without large connection losses. (2) The test usage gathered further information to improve the usability of the graphical user interface. (3) Additional system monitoring data are necessary to get a better overview of the system status remotely. (4) Authentication and authorization mechanisms as well as user role management become more important with a growing number of participating stations.

Nevertheless, the IVS CONT11 was an ideal playground to test the new observing strategies during real observation sessions.

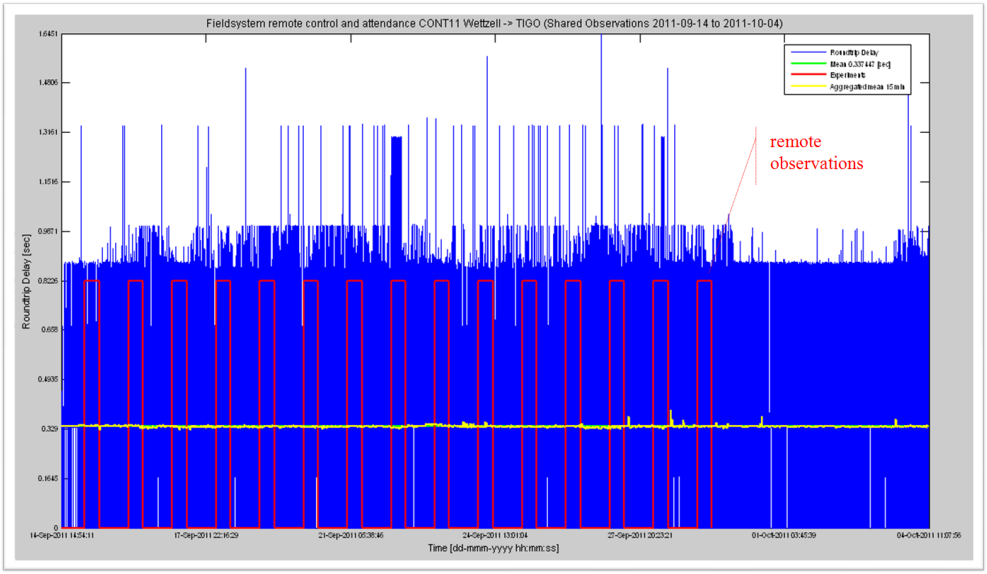

Figure 2. The round-trip delays as a continuous plot over the whole CONT11 time period including aggregated mean values for 15 minute intervals and the time intervals of the operated night shifts (red rectangles).

3. The Possible "e-RemoteCtrl Network"

At the Geodetic Observatory Wettzell several possible observation strategies were detected. Local, remote, and unattended observations have been proven to be reliable in past tests (see Figure 3). The successful CONT11 experiment has shown how a network of telescopes like TIGO (Chile), Wettzell (Germany), and Katherine (Australia) can be operated remotely. Therefore, routinely sharing of the control between operators at different sites is the next challenge [5].

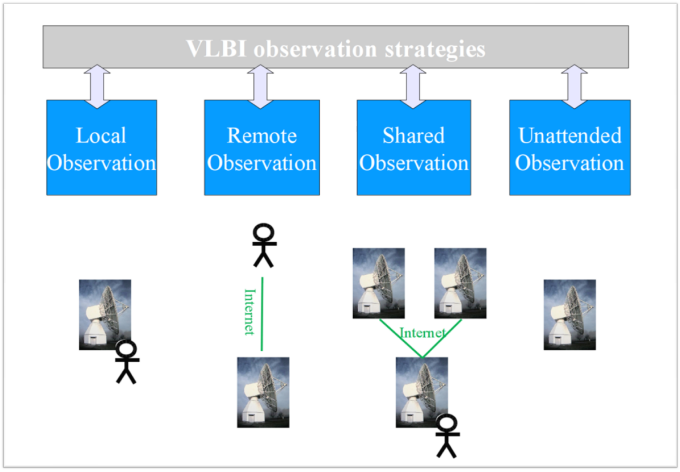

Figure 3. Defined observing strategies in the remote control network.

Currently, all Australian geodetic VLBI telescopes (in the AuScope network) are able to cooperate in a global network of telescopes using the e-RemoteCtrl techniques. Together with the already tested control of TIGO and Wettzell it is possible to shift the control around the world following the daylight zone. Then the control during a local night shift can be done by another station in the daylight zone. This may reduce the burden of operator night shifts, while keeping the number of observations.

4. Summary and Outlook

In conclusion, the shared observation test showed new possibilities and was very successful. These new strategies can therefore offer technical realizations for the Global Geodetic Observing System (GGOS) or the new Square Kilometer Array (SKA), where a set of telescopes must be flexibly controlled by few operators. The current development steps are organized in the Novel EXplorations Pushing Robust e-VLBI Services (NEXPReS).

Acknowledgements

The authors would like to thank everyone who contributed to this paper. Special thanks go to the staff at Wettzell for doing double shifts, the staff at TIGO for preparing everything and working the on-call-service, and the staff at Hobart and Katherine for opening the firewalls and supporting the work to do parallel connectivity tests.

References

[1] Neidhardt (2009)-1: Neidhardt, A., Ettl, M., Zeitlhöfler, R., Plötz, C., Mühlbauer, M., Dassing, R., Hase, H., Sobarzo, S., Herrera, C., Alef, W., Rottmann, H., Himwich, E. A concept for remote control of VLBI-telescopes and first experiences at Wettzell. *In Proceedings of the 19th Working Meeting on European VLBI for Geodesy and Astrometry, Bourda, G., Charlot, P., Collioud, A. (eds.), 136–140, 2009.*

[2] Neidhardt (2009)-2: Neidhardt, A. Manual for the remote procedure call generator *idl2rpc.pl Geodetic Observatory Wettzell, 2009.*

[3] Ettl (2010)-1: Ettl, M.; Neidhardt, A; Dassing, R.; Hase, H.; Sobarzo Guzmán, S.; Herrera Ruztort, C.; Plötz, C.; Mühlbauer, M.; Onate, E.; Zaror, P. First proof of concept of remote attendance for future observation strategies between Wettzell (Germany) and Concepción (Chile) *Proceedings of Science (PoS) - 10th European VLBI Network Symposium and EVN Users Meeting: VLBI and the new generation of radio arrays, EID PoS(10th EVN Symposium)075, Scuola Internazionale Superiore di Studi Avanzati (SISSA), 2010.*

[4] Bloomer (1992): Bloomer, J. *Power Programming with RPC* O'Reilly, 1992, ISBN 0-937175-77-3.

[5] Neidhardt, A.; Ettl, M.; Plötz, C.; Mühlbauer, M.; Hase, H.; Sobarzo Guzmán, S.; Herrera Ruztort, C.; Alef, W.; Rottmann, H.; Himwich, E.: Interacting with radio telescopes in real-time during VLBI sessions using e-control *Proceedings of Science (PoS) - 10th European VLBI Network Symposium and EVN Users Meeting: VLBI and the new generation of radio arrays, EID PoS(10th EVN Symposium)025, Scuola Internazionale Superiore di Studi Avanzati (SISSA), 2010.*