e-RemoteCtrl: Concepts for VLBI station control as part of NEXPReS

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Abstract

In the Novel EXploration Pushing Robust e-VLBI Services-project (NEXPReS) the Technische Universität München (TUM) realizes concepts for continuous quality monitoring and station remote control in cooperation with the Max-Planck-Institute for Radio Astronomy, Bonn. NEXPReS is a three-year project, funded within the European Seventh Framework program. It is aimed to develop e-VLBI services for the European VLBI Network (EVN), which can also support the IVS observations (VLBI2010). Within this project, the TUM focuses on developments of an operational remote control system (e-RemoteCtrl) with authentication and authorization. It includes an appropriate role management with different remote access states for future observation strategies. To allow a flexible control of different systems in parallel, sophisticated graphical user interfaces are designed and realized. The software is currently under test in the new AuScope network, Australia/New Zealand. Additional system parameters and information are collected with a new system monitoring (SysMon) for a higher degree of automation, which is currently under preparation for standardization within the IVS Monitoring and Control Infrastructure (MCI) Collaboration Group. The whole system for monitoring and control is fully compatible to the NASA Field System and extends it.

1. Introduction: Observation strategies

At the Geodetic Observatory Wettzell several possible observation strategies were identified (fig. 1). The standard case is, that an observer controls a VLBI observation locally on site at the telescope (local observation). But with new remote control technologies it is not required anymore that the operator resides on location. He can control the telescope from remote (remote observation). Additionally, this technology can be used to run more than one telescope by a single operator (shared observation). As communication transfer around the Internet have some delay times, the telescope must run unattended during this time periods. Therefore also completely unattended observations have been done at Wettzell during the last three years, mostly for the weekend sessions. For these the antenna runs completely autonomous and automatic without an operator (unattended observation). Especially remote and shared observations offers a lot of new possibilities to the international service: a passive data access can be granted for live monitoring of the network. There are prospects for tele-working with full control access where specialists can

assist the local operators by remote. Very remote telescopes as in Antarctica can be controlled from remote over large distances. And shared observations can reduce the manpower for shifts or help to re-act on current research needs. But in order to manage different users with varying system access rights an authentication and authorization mechanism is required [5].

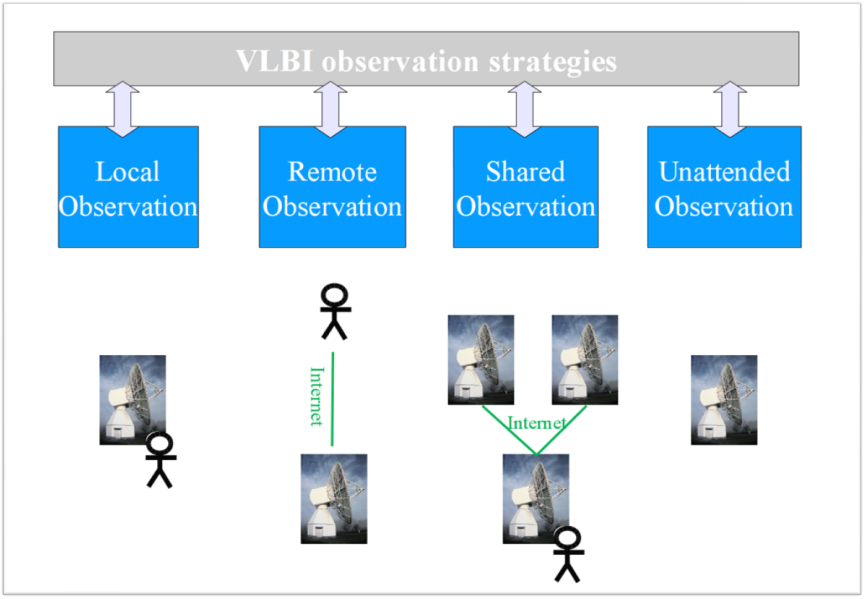

Figure 1. An overview about possible observation strategies.

2. Authentication and Authorization

The current version of the software generator (`idl2rpc.pl`[1]), which is used for generating the communication layer, was extended to support authentication and authorization techniques. The authentication is based on the Linux user authentication mechanism, where the user name and password are stored encrypted on the operating system level. Therefore a user with valid user credentials is authorized to set up a connection to the telescope.

In order to prevent potential security issues while transferring data over the Internet, the connection between the remote operator (client) and the telescope (server) is encrypted, using a save connection based on the Secure Shell (SSH) network protocol. A tool for an automatic connection control (*sshbroker*) was developed to (re-)establish the connection automatically after a potential breakdown of the connection to the telescope. In order to increase security at the client side the required password to tunnel through firewalls and for authentication can be stored, using the AES-256 encryption standard.

Once a user is authenticated on the system, the access rights have to be defined. This is done by associating each user to a dedicated role.

[1] more information at [2]

3. Role management

In order to give the telescope-staff the possibility to control the access rights on their system, a role management is important. Each client, which is allowed to access a telescope, is associated to a dedicated role. This basic association can managed by a responsible person at the station. A set of available roles is depicted in fig.2. These roles are categorized into dynamic and static roles. A static role is a fixed role, which cannot be changed during runtime. Whereas a dynamic role can be changed during runtime to allow alteration of control rights of clients, e.g. a notifier can become an active operator. This changing of the active control is realized by a three-way-handshake strategy, to inform both relevant operator clients about the handover of the control.

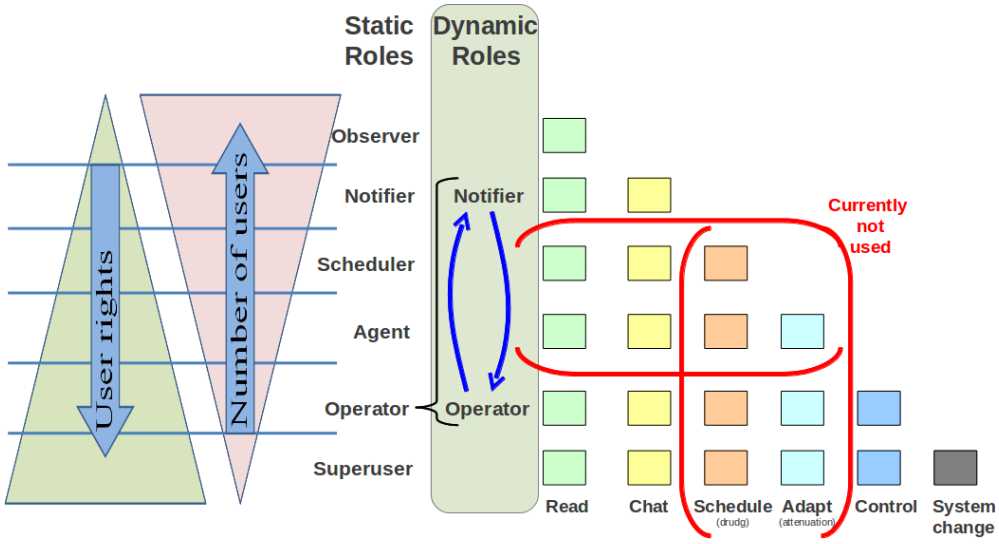

Figure 2. The different roles in the role management strategy for remote operation.

The following fine grained access levels (roles) are defined (a higher credential include all of the lower ones):

- *Observer*
  The *observer* is allowed to passively monitor the system state without having any control or influence to the running system. This is the default associated role.
- *Notifier*
  The notifier can monitor the system but can also send signals. For instance, if a session scheduler (or a correlator) detects a problem during an observation, but has no rights to control the telescope, he can directly forward a notification to the local staff in real-time.
- *Scheduler*
  A *scheduler* is capable of manipulating observation schedules and of triggering events. Therefore a responsible person for a dedicated session can change the schedule relevant parts and inject it into the field system. During the run he can change complete sequences to replace sources or change frequencies. An extension to the NASA field system is needed to realize these dynamic scheduling possibilities if needed.

- *Agent*
  An *agent* can change dedicated procedures during an observations, where specific observer tasks are used. But he can't move the antenna beside of the schedule.
- *Operator*
  An *operator* has all rights to access the NASA Field System and several control units on location of the telescope, which is similar to a remote version of a current operator on site.
- *Superuser*
  The *superuser* has complete access to the computer system and can change user rights or system features. Normally only the telescope staff should have these exclusive permissions.

4. Integration of a system monitoring into e-RemoteCtrl

The graphical user interface (GUI) of e-RemoteCtrl has been developed using wxWidgets[2]. It is a well tested, popular and platform independent development kit for the C++ programming language. The current version of the GUI was developed for Linux operating systems. In case of unattended or remote observations, an automated monitoring of operational parameters of VLBI systems is essential. Such a monitoring system has to be reliable, flexible and stable in case of network, system or human failures. It hides the complexity of the network communication and allows standardized, individual remote procedure interfaces. First realizations of such a system monitoring (SysMon) at the radio telescope Wettzell (RTW) and at the newly installed laser ranging system at Wettzell are complete. This SysMon concept, is developed within the VLBI2010 MCI Collaboration Group to specify a standardized interface for monitoring. The integration of SysMon in the e-RemoteCtrl concept is part of the NEXPReS project. This is already done, by integrating a GUI into e-RemoteCtrl for graphical outputs of data from an Invar strain meter at the radio telescope, which is based on the standardized interface for system monitoring.

5. Summary and outlook

It is discussed that e-RemoteCtrl will become part of the next NASA field system release. In addition, the system monitoring concept will be further refined within the MCI Collaboration Group[3]. Having a standardized monitoring concept is essential for a network wide system monitoring and remote control. This is the first step towards a technical control realization of a Global Geodetic Observation System[4] (GGOS[4]).

6. Acknowledgements

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[2]available at http::://www.wxwidgets.org
[3]more information at https://groups.google.com/group/vlbi2010-mci-collaboration?hl=de
[4]more information at http://www.ggos.org/

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