

Real-time Data Streams from “e-RemoteCtrl” to Central VLBI Network Status Monitoring Services Like IVS Live

Alexander Neidhardt¹, Arnaud Collioud²

Abstract A central VLBI network status monitoring can be realized by using online status information about current VLBI sessions, real-time, and status data directly from each radio telescope. Such monitoring helps to organize sessions or to get immediate feedback from the active telescopes. Therefore the remote control software for VLBI radio telescopes “e-RemoteCtrl” (<http://www.econtrol-software.de>), which enables remote access as extension to the NASA Field System, realizes real-time data streams to dedicated data centers. The software has direct access to the status information about the current observation (e.g., schedule, scan, source) and the telescope (e.g., current state, temperature, pressure) in real-time. This information are directly sent to “IVS Live”. “IVS Live” (<http://ivslive.obs.u-bordeaux1.fr/>) is a Web tool that can be used to follow the observing sessions, organized by the International VLBI Service for Geodesy and Astrometry (IVS), navigate through past or upcoming sessions, or search and display specific information about sessions, sources (like VLBI images), and stations, by using an Internet browser.

Keywords IVS Live, e-RemoteCtrl, real-time status

1 Introduction

In the future, and especially for the expected VLBI Global Observing System (VGOS), a fast and infor-

mative feedback about the status of the observing network of globally distributed radio telescopes is essential to derive health states, error situation, or session setup mistakes. Real-time data streams with relevant information from the telescopes such as current activity, observed source, meteorology, or disk states, help to realize such a quick feedback to schedulers, coordinators, and the telescope staff. Therefore a new attempt realizes for the first time a sophisticated way for such status information, which can easily be requested with Internet browsers over the World Wide Web. This solution combines the functionality of the remote control software “e-RemoteCtrl” with the presentation abilities of the IVS Web tool “IVS Live”. “e-RemoteCtrl” is used to standardize the sending of status information to a centralized presentation server, while “IVS Live” integrates this real-time information into its functionalities to follow observing sessions live. This new status workflow under the name “e-QuickStatus” is also flexible enough to integrate legacy systems, which do not have or do not want to upgrade to “e-RemoteCtrl”.

2 Participation

A participation in the real-time status of the IVS network is possible for all telescopes. The only requirement is that they regularly send status files of a dedicated format (see Figure 1) to the Web server of the Technische Universität München (Technical University Munich, TUM), Germany. In the best case, the status file is updated for each of the following events:

- Field system startup
- Field system terminated
- Starting schedule

1. Forschungseinrichtung Satellitengeodäsie, Technische Universität München, Geodetic Observatory Wettzell, Germany
2. Laboratoire d’Astrophysique de Bordeaux, Université de Bordeaux – CNRS, France

- Schedule finished
- Pointing/slewing
- Recording
- Recording stopped
- e-RemoteCtrl startup
- Halt
- Continue

The status file should also be updated after each occurrence of an error from the extended error message facility of the NASA Field System (FS) log. The errors consist of an error code, an error number, and an error message from the control files “fserr.ctl” and “sterr.ctl” in the control directory of the FS [2]. At least the error codes and error numbers should be added to the status text in the sent status file. “e-RemoteCtrl” additionally evaluates and prioritizes the errors with different warning levels to separate critical errors from less critical. These warning levels are also printed in the status field.

```
<eQuickStatusInfo>
  Service = IVS
  Stationname = WETTZELL
  StationIVSCode = Wz
  Schedule = rd1403wz
  Status = [eRC] Recording
  DateTime = 2014.113.20:55:32
  TimeNext = 20:55:33
  Source = 2353+816
  Scan = rd1403_wz_113-2055
  Mark5VSN = USN-0121
  Mark5Volume = 3984.5
  Mark5Used = 3.3
  RightAscension = 23h56m22.79s
  Declination = 81d52m52.30s
  Azimuth = 359.8751
  Elevation = 41.1038
  CableDelay = 0.006513
  SystemTemperatureIFA = 36
  SystemTemperatureIFB = 75
  SystemTemperatureIFC = 27
  SystemTemperatureIFD = 0
  MeteorologyTemperature = 13.5
  MeteorologyHumidity = 54.3
  MeteorologyPressure = 947.9
</eQuickStatusInfo>
```

Fig. 1 An example status file showing the required structure.

2.1 Legacy Systems

While the status update is already part of the “e-RemoteCtrl” software, legacy systems without this remote control functionality have to setup their own realization of the status injection if they want to participate. The injection can be done, using scripts or

other programs, which send the status files to the Web server at the TUM with Secure Copy (SCP) or Secure File Transfer Protocol (SFTP). A potential participant should follow the following steps:

1. Request a Secure Shell (SSH) key for the access to the Web server “econtrol.iapg.bv.tum.de” from the TUM (by sending an email to neidhardt@fs.wettzell.de).
2. Create a status file in the defined form (see below) for each specific event and status change while running an observation schedule.
3. Send the status files with SCP or SFTP to the Web server “econtrol.iapg.bv.tum.de” into the directory “statusincoming”, by using the user account “equickstatus” and the SSH key file, e.g., with:

```
/usr/bin/scp -I .iapg_key ./WETTZELL.info  
equickstatus@econtrol.iapg.bv.tum.de:  
./statusincoming/1.
```
4. Check your status data at:
<http://econtrol.iapg.bv.tum.de>
 and at:
<http://ivslive.obs.u-bordeaux1.fr/>
 (under the tab “Real time”).

2.2 VGOS Systems with “e-RemoteCtrl”

For stations, using the “e-RemoteCtrl” software (e.g., possible VGOS sites), it is much easier to send out the status information automatically, as all required parts are already integrated into “e-RemoteCtrl”. It can be switched on with a section in the configuration file for the server “ercd”. A possible configuration section is shown in Figure 2.

A potential participant should do the following steps:

1. Request an account for the download of the “e-RemoteCtrl” software (by sending an email to neidhardt@fs.wettzell.de) and install the software according to the manual.
2. Request an SSH key for the access to the Web server “econtrol.iapg.bv.tum.de” from the TUM (by sending an email to neidhardt@fs.wettzell.de).

¹ “iapg_key” must be replaced by the name of the requested SSH key file.

```

<eQuickStatus>
  SendStatus      = yes           # Send status (yes) or not (no)
  SSHCopyClient   = /usr/bin/scp   # Used secure copy client
  SSHServer       = econtrol.iapg.bv.tum.de # Server, to which the status
                                      # should be sent to
  SSHUsername     = equickstatus   # User on the e-QuickStatus server
  # ATTENTION: The user rights of the following key file must fit to the user,
  # who starts the ercd (e-RemoteCtrl server), e.g. "-rw----- oper rtx",
  # if oper should start the remote control server.
  SSHKeyfilePath  = $(HOME)/.ssh/iapg_key # Key file, used for login
  LocalInfoPath    = /tmp/           # Temporary path, from where is
                                      # copied from
  RemoteInfoPath   = ./statusincoming/ # Remote location, to which should
                                      # be copied to
</eQuickStatus>

```

Fig. 2 An example configuration of the automatic status sending service of the “e-RemoteCtrl” server (“*iapg_key*” must be replaced by the name of the requested SSH key file).

3. Configure the <eQuickStatus> section of the configuration file for the “e-RemoteCtrl” server, e.g., as shown in Figure 2 and configure the rest of the server according to the “e-RemoteCtrl” manual.
4. Start the server “ercd” with the changed configuration file.
5. Check your status data at:
<http://econtrol.iapg.bv.tum.de>
 and at:
<http://ivslive.obs.u-bordeaux1.fr/>
 (under the tab “Real time”).

2.3 Technical Background to Provide Real-time Data Automatically with “e-RemoteCtrl”

“e-RemoteCtrl” is a software extension to the NASA FS to operate and control radio telescopes remotely. Its server has access to the shared memory of the NASA FS and also reads the log file information, which is parsed to find defined patterns. Usually the data are prepared to be requested by the “e-RemoteCtrl” clients that are used to enable a safe and secure remote control possibility on the basis of SSH-encrypted remote procedure calls [3].

Additionally, the available status data can be broadcast as a status file stream (“e-QuickStatus”). Every file contains the status information after each schedule or radio telescope status change or if errors occur. After a status change, a new file is created and copied with SCP to the data collecting Web server, which is located at the TUM, Germany. To enable the secure copy, a key for SSH is required, which is used to authenticate the participating station at the TUM server. The key

can be requested by any station from the distributor of the “e-RemoteCtrl” software, as described before. Also legacy systems can send in their status information in a similar way.

The TUM server scans the directory for incoming files every second. Each scan updates the local e-QuickStatus Web page. From there, “IVS Live”, located at the University of Bordeaux / CNRS, France, fetches the data regularly to present them interactively.

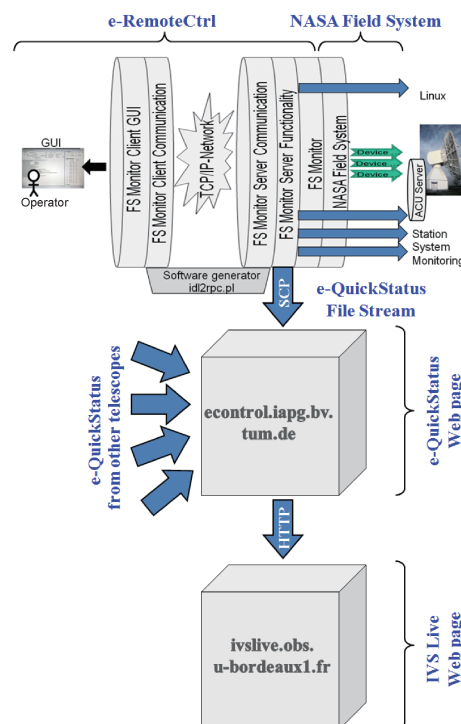


Fig. 3 Providing real-time data from radio telescopes to “IVS Live”: “e-RemoteCtrl” provides a status file stream to the e-QuickStatus server, where a Web page is updated every second. From there “IVS Live” fetches the data sets and presents the information centrally in a compact way.

2.4 “IVS Live” and Real-time Data

The main reason for the existence of “IVS Live” is the monitoring of IVS sessions. It is a fully dynamic Web site, developed with Javascript and PHP, with a MySQL database as back-end, which contains almost 6,000 sessions (starting from 2 January 2003), more

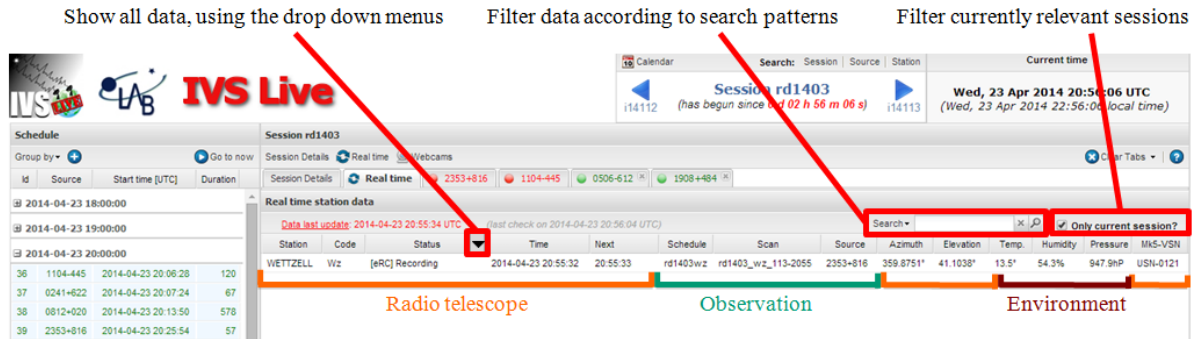


Fig. 4 Example of a presentation of real-time data in “IVS Live”, captured during the IVS session rd1403 (2014-04-23) at 20:56:06 UTC from the 20m Radio Telescope Wettzell (RTW), Germany.

than 1,750 sources, and 68 stations at present. “IVS Live” is organized as a single user interface divided into several sub-panels (schedule of the session, main panel with an overview of the session, etc.). By default, the ongoing IVS session (if any) or the upcoming session is displayed. While the session is running, the main interface is automatically updated by a synchronization procedure with the displayed master clock. It offers a calendar tool to search for IVS sessions and allows to navigate through all IVS master schedules since 1979. Additional facts, e.g., station and source positions, source images, map locations, Web cam link, and several more, give detailed information about the IVS network and its work [1].

All information displayed in “IVS Live” (with exception of the Web cam streams/images) come from the IVS session schedules, which are frozen before the sessions start. In contrast, the “e-RemoteCtrl” software gives access to real-time information about the current observation (schedule name, scan name, source name, source coordinates), the telescope (station name and code, current state and errors, pointing azimuth and elevation, recording Mark 5 VSN number, volume and filling level), and the environment (temperature, pressure, humidity, cable delay measurement), stored on a global monitoring server. All this information is available in the “IVS Live” main interface as a separate tab with the name “Real time” (see Figure 4). This tab contains a table, which displays information related to all radio telescopes, participating in the status updates in a legacy mode or automatically with “e-RemoteCtrl”.

An example of a table with real-time values in “IVS Live” is displayed in Figure 4. The user can select the different columns, which should be shown or hidden,

using a drop-down menu. The data table also can be filtered by any specific value or string, which have to be entered into the search field located above the table. In addition, the right-hand side check-box allows to only display the real-time data of the session, which is currently operated and presented on the “IVS Live” page.

3 Conclusion

Thanks to the “IVS Live” Web page, which can be used to monitor the IVS observing sessions, in combination with the “e-RemoteCtrl” software, which streams real-time status information, a wealth of information is accessible to the IVS coordinators, schedulers and users. Stations are encouraged and are very much welcome to participate with their real-time status streams to increase the real-time information about the VLBI network and its observations. Having these data centrally available, provides a convenient global network view of the VLBI network and of any IVS session.

References

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