A New Generation of Wettzell's Remote Access to the NASA Field System using Web-based Techniques

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Abstract The origin of the remote control software e-RemoteCtrl for VLBI antennas was in the year 2008. After ten years, it is still the only software to operate the NASA Field System remotely implementing secure and save techniques. The software is in use at several sites, but there have been almost no official releases over the past years. But, there is still an on-going development of the software at the Geodetic Observatory Wettzell. To support the requirements of "smart observations" reducing the required manpower for operator tasks, the e-RemoteCtrl server was extended with its own web server to enable a web-based monitoring access using just a simple web browser. It is not yet a complete replacement of the classic graphical e-RemoteCtrl client user interface, but it is a first step to converting a VLBI antenna to a web-enabled device.

Keywords NASA Field System, web interface, monitoring

1 Introduction

The operational data from IVS or other telescope networks (e.g., the EVN) are interesting for operations, diagnostics, and analysis. Such data are written to log files for each observation session and copied to a central File Transfer Protocol (FTP) server after a session ends. Currently, there is still no real-time information available showing the telescope's health state. There were some attempts, like the real-time extension to IVS Live web pages [Neidhardt(2014)], struggling with software and security problems to get the data with Secure Copy (SCP) from the observatory to the central web page. Besides monitoring of health states of telescopes, a continuous data set of seamless auxiliary data (like meteorological sensor data, clock data) which are produced in addition to the actual observation data would be appreciated by analysts. The IVS started a task force to discuss and implement the continuous collecting of such data in real-time [Neidhardt(2015)]. With the experience from the previous live monitoring implementations, staff at the Wettzell observatory started to first implement a technical solution for the monitoring before more decisions can be made about which data should be collected from the IVS sites. On the way to becoming a "smart observatory" where operational tasks are mainly managed by computers, real-time monitoring is a synergy between reacting to critical health states and the collection of seamless, auxiliary data. Therefore, e-RemoteCtrl software was extended to support both. The result is a web-based access to the NASA Field System using web pages and an Internet browser.

2 The Data Sender on the NASA Field System Computer: e-RemoteCtrl Software

The e-RemoteCtrl software was extended with a web server functionality. It has good performance to serve a few different users but cannot be compared to specialized web servers, like Apache. The server reads template files containing Hypertext Markup Language (HTML) code including tags representing monitoring

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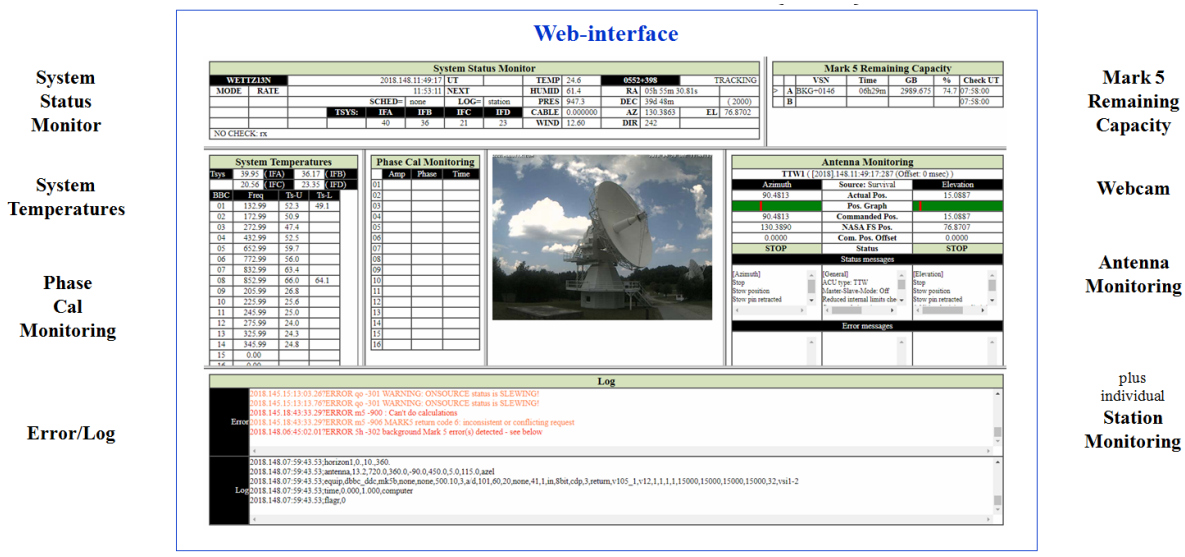

Fig. 1 The new web interface to the NASA Field System.

values with a keyword. The tags are predefined words in the form of HTML comments. The rest of the HTML structure can be changed individually. HTML was explicitly chosen instead of other web-based protocols (like e.g., JavaScript Object Notation (JSON)), to enable two aspects with one implementation: a new, modern, and straightforward Graphical User Interface (GUI) for the NASA Field System and a standardized format to exchange data with a central monitoring archive using web ports.

The HTML GUI uses a flat structure. The main page is defined in "FieldSystemMonitoring.html". It contains a frame with sub-pages for individual monitoring screens. Each single sub-page consists of two files: an IFRAME page (e.g., "SystemStatusMonitor_iframe.html") and a content page (e.g., "SystemStatusMonitor.html"). The IFRAME-file is used to manage the updates with up to several milliseconds update time avoiding white flashing between the reloads of the pages. The white flashing usually shows up with different browsers (e.g., Chrome, MS Internet Explorer, etc.). This behavior is annoying and not useful for GUIs. The content web page contains the actual data and layout structures. This setup of the web pages reduces the use of Javascript and other active elements to a minimum to limit maintenance tasks and security issues. It also separates predefined control tasks of the web pages from layout and data presentation which can be designed individually by each telescope site.

The new GUI only requires the e-RemoteCtrl server. The latest release can be requested from the author of this paper (neidhardt@fs.wettzell.de). After unpacking the code archive and building the executable, the configuration file must be edited. Especially the two-letter-code of the antenna and the section "<WebServer>" with the settings for the web server are important. After adapting the configuration, the program "ercd" can be started with the path to the configuration file as an argument. The latest software release already contains a set of web pages, so that the GUI (see Figure 1) can already be accessed on the defined port using an Internet browser connecting to the IP address of the NASA Field System PC via Hypertext Transfer Protocol (HTTP).

The server reads the HTML templates and replaces the tags representing monitoring values with the corresponding numbers read from the shared memory or log file of the NASA Field System. For example, "<!−−PRESSURE−−>" might be replaced by "<!−−PRESSURE−−> 941.9 <!−−−−>", where the number is the air pressure from the Field System shared memory. Therefore, Internet browsers just see the value, while scripts and programs of the central seamless, auxiliary data server can search for the tag and extract the single number. Meanwhile,

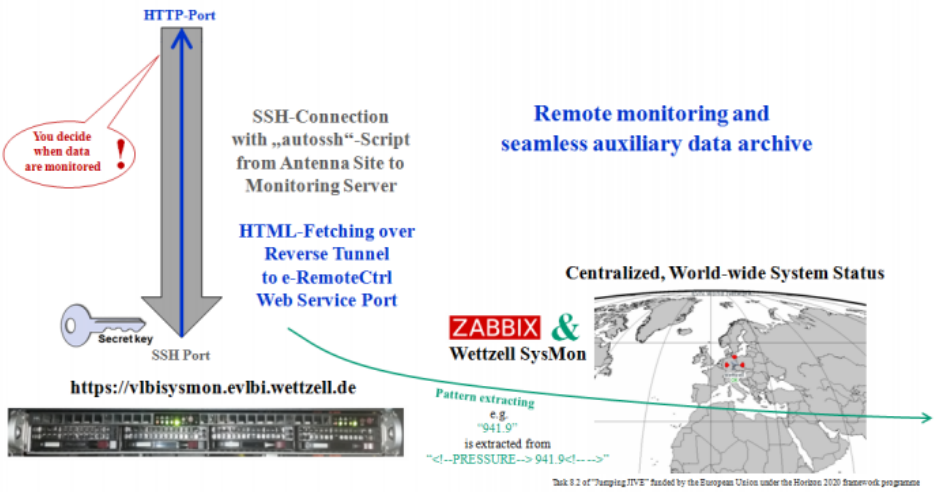

Fig. 2 The way to the central monitoring archive.

172 parameters from the NASA Field System can be streamed with this technique. Each number is assigned to a time tag created from the NASA Field System time and hidden in an HTML comment, so that always the original time of the value creation on the Field System PC is applied.

3 Supporting a Centralized Monitoring Archive

While the local HTTP access is designed for local operations within a secure network of an observatory, a central monitoring server at the Wettzell observatory offers world-wide access to the data using Hypertext Transfer Protocol Secure (HTTPS).

To enable a secure way of data exchange between an antenna site and the central server, the NASA Field System PC must open an SSH connection to the central monitoring server (see Figure 2). Therefore, the staff at an observatory gets an SSH key to open an SSH connection to the central server. The authentication with a key is the only way to do the login on the monitoring server. The SSH connection is used to open a reverse tunnel from the monitoring server to the NASA Field System to access only the HTTP server port. It is also possible to open further reverse ports if other features are wished. Therefore, the local staff always keeps control of whether data can be monitored by opening and closing the SSH connection, as well as which data are available by writing their own web pages with the tags of just the enabled values.

After a successful connection to the monitoring server at Wettzell, a script on that machine starts to request all web pages of the site once per second. The server runs Zabbix 3.2.4 [Zabbix(2018)]. Zabbix is a monitoring platform supporting the collecting and presentation of monitoring data. Scripts on the server are used to extract the HTML values. The scripts are triggered by ZABBIX hosts, where also individual update times can be defined to import an individual value into the ZABBIX database. The script also supports Wettzell's version of the Monitoring and Control Infrastructure (MCI) software "SysMon" ([Ettl(2010)]) and can be used to create archive files with individual, time-tagged values (currently as a test version).

A template definition of a presentation screen combines graphs of the history of the most important values (see Figure 3). Each site is also registered on a world map. Trigger levels are used to convert limits into health states shown as colored severity states. Staff from the observatories can get access to these web pages by requesting a user account for the Zabbix web front-end. It is easy to extend the monitoring archive with web pages for additional telescope sites using the template definition.

Fig. 3 ZABBIX screen with graphs of the most important data from the NASA Field System.

4 Conclusions

The new release of the e-RemoteCtrl software not only supports central monitoring attempts, it can also be used by staff to easily check the NASA Field System during observation sessions using a web browser. Using the central monitoring archive, such web pages can be accessed from anywhere, and real-time data can be used to get snapshots of the health states of VLBI networks.

Acknowledgements

Jumping JIVE has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 730884.

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