Automatic Monitoring of the Network Performance

IVS Success Analysis and Station Feedback

A. Neidhardt[1], L. McCallum[2], T. McCarthy[2], H. D. Son[1], S. Seidl[1]

Abstract Measuring performance of the global VLBI network is essential. An idea was born during EVGA 2023 to enable regular performance feedback about IVS sessions to the Network Stations. The goal is to automatically evaluate log, correlator, and analysis files and to use first code implementations to regularly and automatically offer individual feedback to sites about session performance. Another goal is to standardize feedback. The paper briefly explains ideas and the current status and gives a vision for the future. Regular updates about the project will be given in the IVS Newsletter.

Keywords performance, success feedback, software

1 Introduction

The idea of an official and regular station feedback showing network performance and quality of resulting products again came up in 2023 during discussions at the EVGA in Bad Kötzting. Several new sites asked for feedback to offer relevant data for their administration and to support solving of operational issues on time, also partly showing individual quality. An ideal way would be an automated workflow which regularly sends basic feedback via email. Additionally, there should be a session overview with graphs showing data from log, correlator, and analysis files.

A small Working Group was founded and introduced to the IVS Directing Board. The Group regularly meets via Zoom, discusses ideas, collects and combines existing software, and supports and makes implementations of software. The goal is to have a demonstration for some antennas and then to finally extend the possibilities to the whole network.

The following paper gives a quick overview about existing developments and tools and describes the plans for the next steps to create something like a service of "IVS Success Analysis and Station Feedback". It also meets well with other requirements like a new management of Network Station Configuration Files and Station Logs, coordination of data flows, the IVS Seamless Auxiliary Data Archive, automatic generation of biennial statistics, and so on.

1. Technical University of Munich
2. University of Tasmania

2 Already Existing Software Packages

2.1 AuScope Station Feedback

It is currently difficult to get direct feedback on your station's performance without reading correlation and/or analysis reports carefully. This results in problems potentially going unnoticed for long periods of time.

Therefore, software was developed for all AuScope antennas based on a set of Python scripts for extracting relevant information from IVS correlation and analysis reports and ingesting the information into a MariaDB database. The goal is a system that provides both rapid feedback of station performance and a way to summarize/visualize recent station performance.

The scripts currently:

- Generate a MariaDB database,

- Download relevant auxiliary files and reports,
- Process files and extract relevant information,
- Update the MariaDB database,
- Generate PDF reports with some graphs of performance over time.

Currently, the scripts pull a wide array of information which provides the most useful diagnostics of station performance, e.g., the following:

Detection rates for S- and X-band: These are the ratio of good observations (Q-code 5+) versus all correlated observations. They are a good metric of S- and X-band sensitivity performance. They are obtained from parsing the Q-code table in correlation reports and are less affected by outages from other stations.

Ratio of used observations versus scheduled: The information is extracted from analysis reports and is defined as the "performance" statistic in the reports. The values can give insights about station downtime during sessions, but they are very affected by outages/downtime at other stations, so that they are not as useful for looking at sensitivity performance.

Post-fit station W.RMS delay: This is another useful statistic to monitor performance over time. These values are included in the post-analysis spool files.

Station positions: These are the values of the X, Y, Z and E, N, U positions from the spool files.

Reported problems: The software tries to grab notes about station issues from analysis reports. But as notes are not machine input they are difficult to parse, so that not all of the useful information can be extracted.

Dropped channels: It is a list of any dropped channels from the correlation reports.

Manual phase calibration: This binary value shows if a station had manual phase calibration applied during post-processing.

Some meta data: Some additional data from the different files are also extracted to extend the performance feedback, like session dates, VgosDB names, and responsible Analysis Centers.

Finally, there is a basic script for summarizing and visualizing station performance in the form of a PDF report that covers a requested time range of observations. The PDF contains the total number of observations for the station, median values for performance statistics, graphs of performance statistics over the time range, graphs of X, Y, Z and E, N, U positions over the time range, noted 'Problems', and so on. A sample first page is shown in Figure 1.

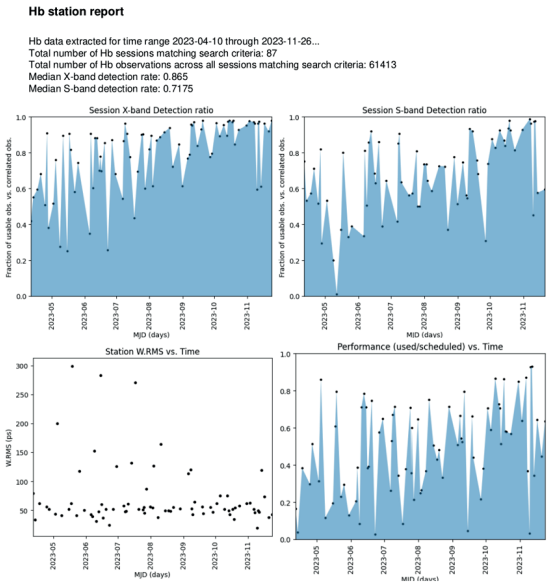

Fig. 1 Sample first page of a PDF report for the AuScope antenna Hb.

VGOS sessions are currently not handled well. Scripts that parse reports need to be updated. It is necessary to add a parameter to the database to describe if a session is VGOS or Legacy to help more accurately summarize results.

The primary goal of the system is to be able to provide a way for stations to generate their own quality database OR provide reports for them. The current state of all the scripts is available on GitHub: https://github.com/tiegemccarthy/stationFeedbackDB.

2.2 TUM Log File Parser

The log file parser at the system monitoring archive at Wettzell is based on a Python script developed during a student project funded by the Technical University of Munich. A first version parses log files created by the VLBI Field System to extract values into separated text files or to generate plots. The idea is to offer a service for all sites preparing HTML reports directly after a new log file is available on the IVS data servers CDDIS, OPAR, or BKG.

The following values are extracted:

- Site information,
- Scan statistic,
- Clock offset,
- Meteorology,
- Cable delays,
- System temperatures (in a separate test version).

The software is already tested, with the log files of the antennas Wz, On, Is, Ny, Ns, Hb, Ag, Ht, Ke, Kk, and Yg. But the test software is not yet active for regular use and is still under development. A sample output of an HTML page is shown in Figure 2.

2.3 Session Quality Report at Wettzell Observatory

There are also many other local programs and scripts available at different observatories. An example is the extraction of scheduled and observed sources from log files for the local quality management system at Wettzell. All relevant files for a session of one of the antennas at Wettzell are sent to an archive server. Software reads log and summary files created by the VLBI Field System. The software extracts scheduled sources from the summary and compares them to commanded sources in the log file. These operated sources are split into observations with or without quality issues. Reduced quality is derived from error messages e.g. about higher system temperatures, meteorological issues, missing cable calibration, or missing phase calibration. Additionally, lost sources can be detected if a scan is scheduled in the summary file but does not appear in the log file, or if the antenna does not point to the correct quasar position right on time.

The result is a statistic for every session (see Figure 3) showing:

- scheduled sources,
- operated sources with good and maybe bad quality,
- and failed sources.

The system has been active since 2022 and is therefore well-proven. It currently just uses the Wettzell antennas Wz, Wn, and Ws. Results can be found at https://vlbisysmon.evlbi.wettzell.de/monitoring_archive/session_archive/. Additional tools which are planned to be integrated e.g. for RFI monitoring are described in the paper "Toolbox for the Detection of Strong RFI Sources with Station Onboard Methods from DiFX" in these proceedings [2].

Fig. 2 Sample HTML page of a report from the log file of session "i24123wz".

```
Quality report:
===============
Session: i24057
Antenna: wz
Scheduled sources:      23
Operated sources:       23
Failed sources:          0
Successful sources:     23
   - normal quality:    19
   - reduced quality:    4 (ONSOURCE, TSYS, METEO)
===============
List of scans and sources which might have reduced quality:
     |---> i24057_wz_057-1734(1039+811), i24057_wz_057-1742(0016+731),
           i24057_wz_057-1811(1144+402), i24057_wz_057-1820(2000+472)
===============
```

Fig. 3 Resulting quality report at Wettzell directly after each session.

2.4 IVS Seamless Auxiliary Data Archive

The IVS Seamless Auxiliary Data Archive (IVS SADA) and the EVN Monitor was explained in detail in "IVS Seamless Auxiliary Data Archive (SADA) and EVN Monitor" in the IVS 2022 General Meeting Proceedings (see [1]). IVS SADA is a database with auxiliary meta data from radio telescopes. The data are sent in real-time with update times of one second or more. They contain health information, system status, and other helping data. The data injection done by antenna computers is described in the paper mentioned before.

The data can also be easily extracted again using a Python script on the basis of an Application Programming Interface (API) via HTTP and JSON requests. The continuous, auxiliary data, which can be seamlessly requested, would be a nice extension to the already explained reports. They represent time periods where no observation happened, so that problems between observations can be detected, like clock jumps. They offer a better view on drifts and changes because of the higher and equidistant sampling.

A disadvantage is that only a few antennas participate either in IVS SADA or in EVN Monitor. Nevertheless, derived graphs would ideally fit into existing reports.

3 Conclusion and Outlook

The main goal for the next time period is to combine the different developments. It is essential to organize working meetings.

There are additional other projects ongoing, like the VLBI data archive of the ETH Zurich (https://glovdh.ethz.ch/). They can be used to integrate existing software packages. The student project there is funded by the ETH Zurich and creates a very sophisticated Web page based on Python Django. Almost all existing log, correlator, and analysis files are already included there. Users can select individual information interactively.

Not yet mentioned are scripts used by NVI to create the IVS reports. It would also be beneficial to integrate parts of such tools and scripts.

Finally, the Technical University of Munich funded a public server, which should be used to offer a public service together with the ETH Zurich to enable performance feedback and other helpful information.

References

1. A. Neidhardt, Ch. Plötz, M. Verkouter, A. Keimpema, S. Weston "IVS Seamless Auxiliary Data Archive (SADA) and EVN Monitor", in IVS 2022 General Meeting Proceedings, NASA/CP-20220018789, https://ivscc.gsfc.nasa.gov/publications/gm2022/12_neidhardt_etal.pdf, 2023.
2. A. Neidhardt, L. Rigon, Plötz, "Toolbox for the detection of strong RFI sources with station onboard methods from DiFX", In this volume.