Network Coordinator Report

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Abstract

This report includes an assessment of the network performance in terms of lost observing time for the 2008 calendar year. Overall, the observing time loss was about 15.1%, an increase of about 3.7% from the previous year. A table of relative incidence of problems with various subsystems is presented. The most significant identified causes of loss were antenna reliability (accounting for about 19.2%), RFI (14.8%), and receiver problems (13.8%), Unidentified problems accounted for about 17.7% of the loss. There are prospects for Korea, India, and New Zealand to start contributing to IVS. New antennas are being purchased by Australia and New Zealand.

1. Network Performance

The network performance report is based on correlator reports for experiments in calendar year 2008. This report includes the 155 24-hour experiments that had detailed correlator reports available as of March 23, 2009. Results for 29 experiments were omitted because either they were correlated at the VLBA, they have not been correlated yet, or correlation reports were not available on the IVS data centers. Experiments processed at the VLBA correlator were omitted because the information provided is not as detailed as from Mark IV correlators. The experiments that have not been correlated yet include mostly RD, JD, and T2 experiments from the second half of the year, as well as some OHIG experiments. In summary, roughly 85% of the scheduled experiments for 2008 are included in this report.

An important point to understand is that in this report the network performance is expressed in terms of lost observing time. This is straightforward in cases where the loss occurred because operations were interrupted or missed. However, in other cases, it is more complicated to calculate. To handle this, a non-observing time loss is typically converted into an equivalent lost observing time by expressing it as an approximate equivalent number of recorded bits lost. As an example, a warm receiver will greatly reduce the sensitivity of a telescope. The resulting performance will be in some sense equivalent to the station having a cold receiver but observing for (typically) only one-third of the nominal time and therefore recording the equivalent of only one-third of the expected bits. In a similar fashion, poor pointing can be converted into an equivalent lost sensitivity and then equivalent fraction of lost bits. Poor recordings are simply expressed as the fraction of total recorded bits lost.

Using correlator reports, an attempt was made to determine how much observing time was lost at each station and why. This was not always straightforward to do. Sometimes the correlator notes do not indicate that a station had a particular problem, while the quality code summary indicates a significant loss. Reconstructing which station or stations had problems—and why—in these circumstances does not always yield accurate results. Another problem was that it is hard to determine how much RFI affected the data unless one or more channels were removed and that eliminated the problem. It can also be difficult to distinguish between BBC and RFI problems. For individual station days, the results should probably not be assumed to be accurate at better than the 5% level.

The results here should not be viewed as an absolute evaluation of the quality of each station's performance. As mentioned above, the results themselves are only approximate. In addition, some problems are beyond the control of the station, such as weather and power failures. Instead the results should be viewed in aggregate as an overall evaluation of what percentage of the observing time the network is collecting successfully. Development of the overall result is organized around individual station performance, but the results for individual stations do not necessarily reflect the quality of operations at that station.

Since stations typically observe with more than one other station at a time, the average lost observing time per station is not equal to the overall average loss of VLBI data. Under some simplifying assumptions, the average loss of VLBI data is roughly about twice the average loss of observing time. This approximation is described in the Network Coordinator's section of the IVS 2001 Annual Report.

For the 155 experiments from 2008 examined here, there are 1,121 station days or about 7.2 stations per experiment on average. Of these experiment days about 15.1% (or about 169 days) of the observing time was lost. For comparison to earlier years, see Table 1.

Table 1. Lost observing time

Year	**Percentage**
1999-2000*	11.8
2001	11.6
2002	12.2
2003	14.4
2004	12.5
2005	14.4
2006	13.6
2007	11.4
2008	15.1

* The percentage applies to a subset of the 1999-2000 experiments.

The lost observing time for 2008 was more than for 2007 and all other previous years. It is not clear whether the year-to-year variations in lost observing time reflect real changes in the performance level or simply variations due to inaccuracies in the analysis method. It does seem, however, that despite the approximations in the analysis method, the calculated observing time loss has been running fairly consistently at the 12-14% level for several years. The breakdown of the causes of these losses is discussed below. If the observing time losses are converted into VLBI data yield losses, then 2008 had about a 30% VLBI data loss.

It should be noted that in the CONT05 experiments in 2005, where a special effort was made to achieve high reliability at some of the most reliable stations in the network, an observing time loss of only 4.0% was achieved for 165 scheduled station days. The performance during CONT08 was not as good, primarily due to LO, RFI, and rack problems for the 165 scheduled station days; about 9.3% of the observing time was lost.

An assessment of each station's performance is not provided in this report. While individual station information was presented in some previous years, this practice seemed to be counter-productive. Although many caveats were provided to discourage people from assigning too much significance to the results, there was feedback that suggested that the results were being overinterpreted. Additionally, some stations reported that their funding could be placed in jeopardy if their performance appeared bad even if it was for reasons beyond their control. Last and least, there seemed to be some interest in attempting to "game" the analysis methods to improve the individual results. Consequently, only summary results are presented here. Detailed results are presented to the IVS directing board. Each station can receive the results for their station by contacting the Network Coordinator (Ed.Himwich@nasa.gov).

For the purposes of this report, the stations were divided into two categories: **large N**: those that were included in 18 or more network experiments among those analyzed here, and **small N**: those in 10 or fewer (no stations were in 11-17 experiments). The distinction between these two groups was made on the assumption that the results would be more meaningful for the stations with more experiments. The average observing time loss from the large N group was much smaller than the average from the small N group, 14.4% versus 23.2%, The losses for both groups were larger than in previous years. There are many fewer station days in the small N group than the large N group, 93 versus 1028, so the large N group is dominant in determining the overall performance.

There are 16 stations in the large N group. Eight stations observed in 65 or more experiments. Of the 16, five stations successfully collected data for approximately 90% of their expected observing time. Six more stations collected 80% or more of the time. Three more stations collected data for more than 70% of their observing time. Two stations of the 16 collected data slightly less than 70% of their scheduled observing time. These statistics are not much worse than last year's. There is a difference though in that there are more station days among the stations that lost the highest percentage of observing time, whereas in the past the stations with more station days have been the stations that typically lost the lowest percentage of observing time.

There are 19 stations in the small N group. The range of lost observing time for stations in this category was 0%-57%. The median loss rate was about 15%, much worse than last year.

The losses were also analyzed by sub-system for each station. Individual stations can contact the Network Coordinator (Ed.Himwich@nasa.gov) for the sub-system breakdown (and overall loss) for their station. A summary of the losses by sub-system (category) for the entire network is presented in Table 2. This table includes results since 2003 sorted by decreasing loss in 2008.

Table 2. Percentage observing time lost by sub-system

Sub-System	**2008**	**2007**	**2006**	**2005**	**2004**	**2003**
Antenna	19.2	34.6	19.0	24.4	32.9	17.8
Unknown	17.7	14.9	4.0	3.3	10.1	12.6
RFI	14.8	10.4	11.6	6.2	5.0	9.3
Receiver	13.8	14.9	20.8	24.2	18.0	25.2
Miscellaneous	12.8	7.6	18.0	8.0	8.0	6.0
Rack	8.7	11.4	16.3	5.1	6.8	5.0
Shipping	5.4	1.0	0.0	0.2	1.4	6.1
Recorder	4.1	4.6	3.3	8.9	11.1	10.9
Operations	2.3	0.0	2.0	4.7	6.1	3.6
Clock	0.5	0.3	4.9	14.5	0.5	3.4
Software	0.1	0.4	0.1	0.5	0.1	0.1

The categories in Table 2 are rather broad and require some explanation, which is given below.

Antenna This category includes all antenna problems including mis-pointing, antenna control computer failures, non-operation due to wind, and mechanical breakdowns of the antenna.

Clock This category includes situations where correlation was impossible because the clock offset either was not provided or was wrong, leading to "no fringes". Maser problems and coherence problems that could be attributed to the Maser were also included in this category. Phase instabilities reported for Kokee were included in this category.

Miscellaneous This category includes several small problems that do not fit into other categories, mostly problems beyond the control of the stations, such as power, (non-wind) weather, cables, and errors in the observing schedule provided by the Operation Centers. Starting with 2006, this category also includes errors due to tape operations at the stations that were forced to use tape because either they didn't have a disk recording system or they did not have enough media. There were no tape operations in 2008. Tape operation has now ended. This category is dominated by power and weather issues.

Operations This category includes all operational errors, such as DRUDG-ing the wrong schedule, starting late because of shift problems, operator (as opposed to equipment) problems changing recording media, and other problems.

Rack This category includes all failures that could be attributed to the rack (DAS) including the formatter and BBCs. There is some difficulty in distinguishing BBC and RFI problems in the correlator reports, so that some losses are probably mis-assigned between these categories.

Receiver This category includes all problems related to the receiver including outright failure, loss of sensitivity because the cryogenics failed, design problems that impact the sensitivity, LO failure, and loss of coherence that was due to LO problems. In addition, for lack of a more clearly accurate choice, loss of sensitivity due to upper X band Tsys and roll-off problems were assigned to this category.

Recorder This category includes problems associated with data recording systems. Starting with 2006, no problems associated with tape operations are included in this category.

RFI This category includes all losses directly attributable to interference including all cases of amplitude variations in individual channels, particularly at S-band. There is some difficulty in distinguishing BBC and RFI problems in the correlator reports, so that some losses are probably mis-assigned between these categories.

Shipping This category includes all observing time lost because the media were lost in shipping or held up in customs or because problems with electronic transfer prevented the data from being correlated with the rest of the experiment's data.

Software This category includes all instances of software problems causing observing time to be lost. This includes crashes of the Field System, crashes of the local station software, and errors in files generated by DRUDG.

Unknown This category is a special category for cases where the correlator did not state the cause of the loss and it was not possible to determine the cause with a reasonable amount of effort.

Despite the notable antenna and receiver problems during the year, the combined losses due to these two sub-systems was only about 33%, down from the more typical value of about 50% that was seen in previous years. This is primarily due to a reduction in antenna related losses. Most notably, Svetloe and Zelenchukskaya had greatly improved antenna reliability. On the other hand, Fortaleza and HartRAO suffered significant non-typical problems. For 2008 the stations with significant antenna problems include Fortaleza, Zelenchukskaya, and HartRAO.

It should be noted that HartRAO, perennially one of the best performing stations, suffered a catastrophic antenna failure in October 2008. It is unknown when or if the antenna will return to operation, but it does not appear to be likely for 2009. The statistics reported here include antenna related losses for approximately six weeks after the antenna failed. After that, for the remaining approximately six weeks in 2008, HartRAO was no longer scheduled in any experiments.

Stations with significant receiver problems include Ny-Ålesund, TIGO, Westford, and Fortaleza. The most significant problems were LO and cryogenic failures. The harsh conditions at Ny-Ålesund can prevent timely receiver repair.

The “Unknown” category loss is larger this year than the previous year, which was already higher than the level in years before that. This would appear to be due to the correlators being under increasing resource pressure and therefore not being free to chase down the cause of every little problem. It is also extremely time consuming to do this when constructing this report. An effort will be made to get more information included up-front in the stations’ reports to help reduce this lack of information for next year’s report. The impression created by the pattern of unknown losses does not suggest that it is particularly due to antenna problems.

The “Miscellaneous” category loss is larger than last year and worse than the results in all other years except one. This year there were several weather related losses and cable problems. The cable problems occurred primarily at Ny-Ålesund; the harsh conditions at Ny-Ålesund can prevent timely repair of outdoor cabling. This category is a “grab bag”. More specific categories will be used for next year’s report.

The “Rack” category loss was smaller this year than for the previous one. This is due to the rack at Seshan being fully populated due to a loan of modules by NASA. There has been some improvement in the BBC situation at Zelenchukskaya and Badary as well. Some of the decrease may be due to the difficulty in distinguishing BBC and RFI problems in the correlator reports, so that some losses are mis-assigned. This has probably been a problem for previous years as well.

The “RFI” category loss level is higher than in previous years. No doubt this is at least partly due to increasing RFI levels, particularly at European stations. However at least some of increase may be due, as mentioned above, to mis-assigning the losses due to BBC and RFI. The station with the most significant RFI problem continues to be Matera.

The “Clock” category continued the low loss level seen last year. There were no major Maser failures or other timing problems this year.

The “Recorder” category continued its low loss level from the two previous years. The decrease in observing time loss due to recorder operations from about 11% to about 4% probably represents the “disk dividend” we have been hoping to get as tape use has been eliminated.

The “Shipping“ category has significantly more loss than in previous years, primarily because of customs difficulties in getting modules to Fortaleza.

In summary, there is no specific sub-system to point to for the increase in losses in 2008. There were general increases in “Unknown”, “Miscellaneous”, “RFI”, and “Shipping” problems. On the other hand there were decreases in “Antenna” and “Rack” problems.

2. New Stations

There are prospects for new stations on several fronts. Both Australia and New Zealand are in the process of obtaining and commissioning new antennas—three and one, respectively. Korea is planning to build one antenna primarily for geodesy. There is also interest in using the Korean VLBI Network (KVN), which will consist of three stations intended primarily for astronomy, for geodesy. There is interest in India in building a network of four telescopes that would be useful for geodesy. Many of these antennas may become available for use in the next few years. Efforts are being made to ensure that these antennas will be compatible with VLBI2010.