



## MLLN Note #5

### Tracking Log File

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### ABSTRACT

The MLLN Tracking Pass Log file will contain a summary of measured parameters of the 43m status during a single MLLN tracking pass. The file will communicate the success of NRAO in implementing the events scheduled by MIT-Lincoln Labs long term schedule. The log file will include the commanded and measured antenna pointing parameters, weather data, 43m antenna drive power/flow measurements. The list will also include an interpretation of selected monitor data, in the form of pre-defined "Anomalies" indicating either proper or anomalous operations. This document specifies the tracking pass log file format.

*Change Record*

Revision	Date	Author	Sections/Pages Affected
			Remarks
1.0	2005-Apr-01	G. Langston	All
	Initial version.		

## 1. Background

The MLLN facility will be operated based on exchanges of a small number of files. These files will be usually generated by computers and read by computers, so binary format would be acceptable. The common properties of all MLLN interface files are described in MLLN Note 2.

The 43m station log of measurements during a tracking pass are written to a single log file for each tracking pass. One log file will be generated for each entry of a "Track Start" of a date of observations in the long term schedule (see MLLN Note 3). The log file will contain rapidly sampled measurements of the actual 43m orientation, flags of antenna on and off spacecraft and other 43m parameters only measured during tracking. File extension is .log. The file will be generated within 30 minutes of each tracking pass. The contents and rate of data sampling of items in the log file are described in a separate MLLN note.

The NRAO files may be retrieved at site `ftp.gb.nrao.edu` in sub-directory `mlln/out`. The copies of the files generated at MIT-Lincoln Labs will be stored at `mlln/in`.

## 2. Log Entry Types

The Tracking Log file will contain a variety of log entries. Each entry will have its own unique data format. Each log entry will contain a UTC log entry time and an entry type identifier. The initial set of log entry types are listed below:

- A:** Anomaly entries which mark changes of the system state from normal to anomalous and also when the system status is restored to nominal. An example anomaly is the case when the 43m is not on target.
- H:** Hydraulic pressures and flow rates for a selection of 43m antenna monitor points.
- O:** Operator comment entry. This entry is a copy of a free format operator entry occasionally made to note a check of the system status.
- P:** Pointing data. The pointing entries note the commanded hour angle and declination of the 43m and the measured positions at the same time. The measured positions will include pointing model corrections, so that the measured and commanded positions difference will normally be very small.
- W:** Weather data will be recorded to allow interpretation of station performance.

The log file will contain a number of comments that are not normally required for interpretation of the tracking pass quality. The log will also contain a parameter indicating the date corresponding to all following UTC time tags (ie `DATEOBS=05NOV13` for log entries from November 13, 2005). The following log entry selections show the style of log entries.

# MLLN Tracking Pass Log file created 2005APR01 16h15m31s UTC

# HAD File: 30d\_max\_el\_23546\_317\_23.point

#P Time	Cmd HA	Cmd Dec	Track HA	Track Dec
#P (utc)	(deg)	(deg)	(deg)	(deg)

DATEOBS=05NOV13

23h39m02.0 A ONSOURCE OK

23h39m02.0 O Strong Signal on Spectrum Analyzer

23h39m02.0 P	104.7423	60.7060	104.7423	60.7060
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23h39m03.0 A ONSOURCE ERROR

23h39m03.0 P	104.2962	60.5120	104.4090	60.5120
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23h39m04.0 P	103.8530	60.3150	104.0757	60.3150
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23h39m05.0 P	103.4148	60.1160	103.7423	60.1160
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23h39m06.0 P	102.9806	59.9150	103.4090	59.9150
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...

23h39m59.0 P	85.3492	46.5790	85.7423	46.5790
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23h40m00.0 P	85.1050	46.2900	85.4090	46.2900
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#W Time	T Amb.	Humid.	Pres.	Wind
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#W (utc)	(C)	(Percent)	mm	(m/s) (deg)
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23h40m00.0 W	15.0	25.000	91800	5.0 321.1
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23h40m01.0 P	84.8628	46.0000	85.0757	46.0000
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23h40m02.0 P	84.6236	45.7080	84.7423	45.7080
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23h40m03.0 P	84.3865	45.4160	84.4090	45.4160
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23h40m04.0 A ONSOURCE OK

23h40m04.0 O Strong Signal on Spectrum Analyzer

23h40m04.0 P	84.1523	45.1230	84.1523	45.1230
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23h40m05.0 P	83.9201	44.8300	83.9201	44.8300
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23h40m06.0 P	83.6909	44.5350	83.6909	44.5350
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...

23h41m00.0 P	74.3363	28.1990	74.3363	28.1990
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23h41m00.0 W	15.0	25.000	91800	5.0 321.1
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23h41m01.0 P	74.2071	27.9000	74.2071	27.9000
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...

23h48m56.0 P	62.1536	-37.8720	62.1536	-37.8720
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23h48m57.0 P	62.1644	-37.9300	62.1644	-37.9300
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23h48m58.0 P	62.1752	-37.9870	62.1752	-37.9870
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23h48m58.0 A ONSOURCE ERROR

# Max HA rate -119.33 (d/m) at 23h39m31.0s

# Max Dec rate -18.36 (d/m) at 23h40m34.0s

# Time on tracking position 535.0s; Time off 61.0s

**Selection of an example Track Pass Log File**

The example selection of the tracking log shows a few important features of the log. The log will start with comments indicating the date of the file creation. The first few lines will document the file format. The start of good tracking data will be identified by the "ONSOURCE OK" anomaly value.

The example log is based on a spacecraft prediction provided by George Zogbi at MIT/LL. In this example, at the start of tracking, the spacecraft hour angle rate exceeded the 43m maximum. In this case after initial tracking, the 43m fell behind. This causes the "ONSOURCE ERROR" anomaly to be raised, until one minute later in the pass, when the rate had decreased to an acceptable level. The "ONSOURCE OK" anomaly value again marks that good data could be anticipated.

### 3. Anomaly

The station anomalies are defined to facilitate data reduction by clarifying times when good data are expected. The anomaly definitions are defined in the positive sense; ie "ONSOURCE OK" indicates that the antenna is tracking the target as required. It is anticipated that the angular rate of some satellites will be too great for 43m tracking. In the case of excessive rates, the "ONSOURCE ERROR" anomaly will be logged. Only the *changes* in anomaly status are recorded.

The anomaly levels are defined as follows:

**OK:** Acceptable functionality.

**WARN:** Data values out of nominal, but acceptable functionality is probable.

**ERROR:** Data values exceed pre-determined acceptable levels, data quality are likely to be compromised.

**SEVERE:** Data values exceed pre-determined values, indicating probable hardware failures. Operator attention is required.

**EMERGENCY:** Monitor parameters indicate that immediate attention is required by staff.

Additional Anomalies will be defined during the implementation of the station control system. The fill anomaly definition will be provided near the end of the station implementation phase.

### 4. Hydraulic

The hydraulic oil pressures and flow rates are the primary indicators of good antenna drive performance. Several sensors will be mounted on the structure. The format of this log entry will be determined after implementation is further advanced.

## 5. Operator

The Operator log entries are a flexible mechanism of transmitting a variety of station operations notes. These entries are expected to be relatively rare, as the station will normally operate un-attended.

## 6. Position

The vast majority of the log entries are the antenna position measurement. These data are logged at a 10 Hz rate. Each pointing entries contains the commanded hour angle and declination of the 43m and the measured positions at the same time. The measured positions will include pointing model corrections, so that the measured and commanded positions difference will normally be very small.

The units of the log entries are degrees. The commanded positions will be interpolated values from the hour angle declination (.had) file provided by MIT-Lincoln Labs (see MLLN Note 3).

## 7. Weather

Weather data will be recorded to allow interpretation of station performance. Each weather entry will contain 5 parameters

**Temperature:** Ambient temperature at the telescope, units Celsius.

**Humidity:** Relative humidity, units percentage (range 0 to 100).

**Pressure:** Barometric pressure in SI units (Pa = Pascals). Standard atmospheric pressure is 101,325 Pa = 101.325 kPa = 1013.25 hPa = 1013.25 mbar = 760 Torr (ISO 2533).

**Wind Speed:** Wind speed in meters/second.

**Wind Direction:** Wind direction in degrees. Zero corresponds to North, 90 to East, 180 South and 270 to West. (range 0. to 360.)

The weather data will be recorded once a minute.

The pascal (symbol Pa) is the SI unit of pressure. It is equivalent to one newton per square meter. The unit is named after Blaise Pascal, the eminent French mathematician, physicist and philosopher ( $1Pa = 1N/m^2 = 1(kg/m/s^2)/m^2 = 1kg/ms^2 = 0.01millibar = 0.00001bar$ ).

## 8. Conclusion

The MLLN tracking log summary is defined in this document. The log file is an ASCII file with time tagged entries. There are several types of entries defined, each with a separate data format.

A more detailed description of the log entries will be provided near the end of the implementation phase.

## REFERENCES

This and all other MLLN notes are available on the web at:

<http://wiki.gb.nrao.edu/bin/view/Projects/MLLNProjectNotes>

Glen Langston, Larry D'Addario, 1993, NRAO. The OVLBI Memo Number 44. "Global Schedule File Design Document".

[http://www.gb.nrao.edu/ovlbi/memos/es44\\_globalSched.pdf](http://www.gb.nrao.edu/ovlbi/memos/es44_globalSched.pdf)

Glen Langston, Mike Shields, John Stueve, 2005, NRAO. MLLN Note 2. "MLLN Interface file formats"

<http://wiki.gb.nrao.edu/pub/Projects/MLLNProjectNotes/mllnNote002.pdf>

Glen Langston, Mike Shields, John Stueve, 2005, NRAO. MLLN Note 3. "Long Term Sequence of Events and Local Hour Angle Declination Files"

<http://wiki.gb.nrao.edu/pub/Projects/MLLNProjectNotes/mllnNote003.pdf>