IVS Memorandum 2022-001v01

23 February 2022

“FSLOG Analysis for VR2201”

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FSLOG Analysis for Session VR2201

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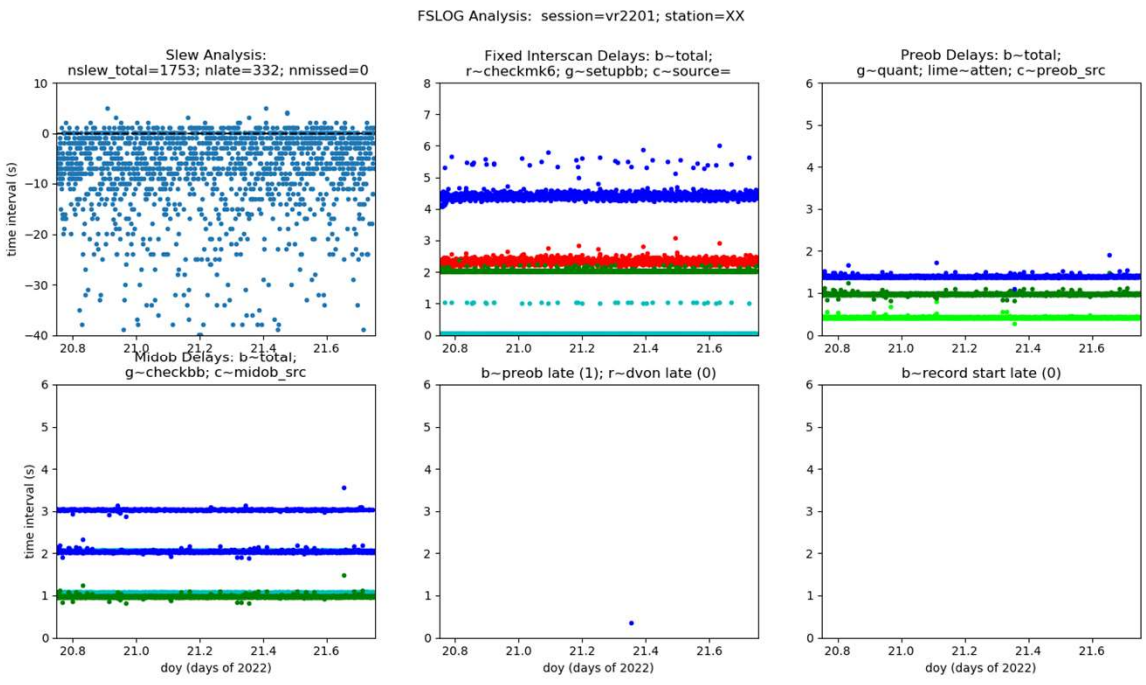
- A set of python scripts has been developed to read FSLOGs and analyse the length of time to execute various components of a snap file. These scripts are available on request.
- Since PROCs vary from station to station, a number of scripts were required to handle the requirements of the different stations.
- Analysis was performed by noting the time in the snap file when a component began and ended.
- This analysis is required to develop strategies to shorten the overhead in a snap file in order to maximize the number of scans per session at a station.
- The results of the analysis are a text file including statistics representing each of the components in the file along with a figure with six plots to visually summarize the data.

- The six plots represent:
  - Top left: The difference in time between when the “antenna,acquired” marker is received and the start of preob
  - Top middle: Fixed Interscan Delay and its subcomponents. This delay occurs in parallel to antenna slewing. At stations using two mk6 modules, no buffer flush is required so requirements for this delay are fairly relaxed. At stations using a singe mk6 module, this delay happens after the buffer flush and is hence added to it. In this case, it would be beneficial to limit the Fixed Delay to say ~<5s.
  - Top right: Preob Delay and its subcomponents. The goal is to have preob<2s, which is the length of time of preob in the R&D sessions.
  - Bottom left: Midob Delay and it’s subcomponents. The goal is to have midob<5s and eventually midob<3s to accommodate very short integration times
  - Bottom middle: Amount that preob and data_valid=on are late
  - Bottom right: Amount that start of recording is late
- Examples for the stations involved in vr2201 are presented below and discussed.
- Station names have been removed but can be provided on request.

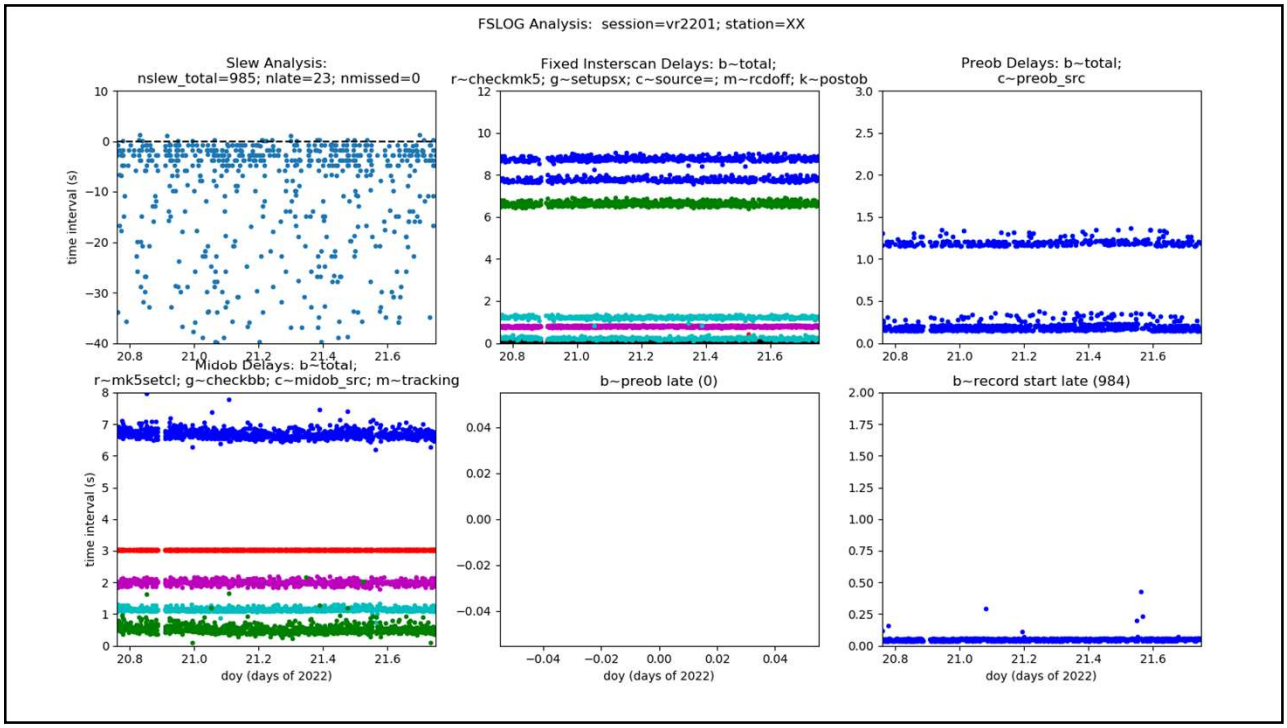
Station 1 (next slide)

- Top Left. Slew Analysis:
  - According to this analysis, most slews arrive at the target before the start of preob although 332 of 1753 scans arrive a few seconds late. It should be noted that the “antenna,acquired” marker is a very conservative estimate of antenna arrival time; hence it is likely, at this station, that the antenna always arrives on target on time for the start of preob.
- Top middle. Fixed Delay:
  - The Fixed Interscan Delay is broken down into the time for checkmk6 (red), setupbb (green) and the source= commands (cyan). Checkmk6 requires a little more than 2s to execute with some scatter, setupbb requires about 2 s with almost no scatter, and source= usually executes very quickly but occasionally takes about 1 s. The total Fixed Interscan Delay is generally less than the target of 5s.
- Top Right. Preob Delay:
  - The Preob Delay is broken down into the time to set attenuation (lime green) and the time to set quantization levels (dark green). The total is consistently less than the target of 2s with very little scatter.
- Bottom Left. Midob Delay:
  - The Midob Delay is broken down into the onsource delay (cyan) and the checkbb delay (green). The onsource delay varies between 1 s and 2 s (with the 2 s component hidden behind the blue markers) and checkbb is approximately 1 s. The total varies between 2 s and little over 3 s so it supports integration periods as short as 3 s.
- Bottom Middle. Preob Late:
  - Start of Preob is late once and data_valid=on is never late.
- Bottom Right. Record start Late:
  - The start of record is never late.
- Summary. This is a very good station and supports integrations as low as 3 s.



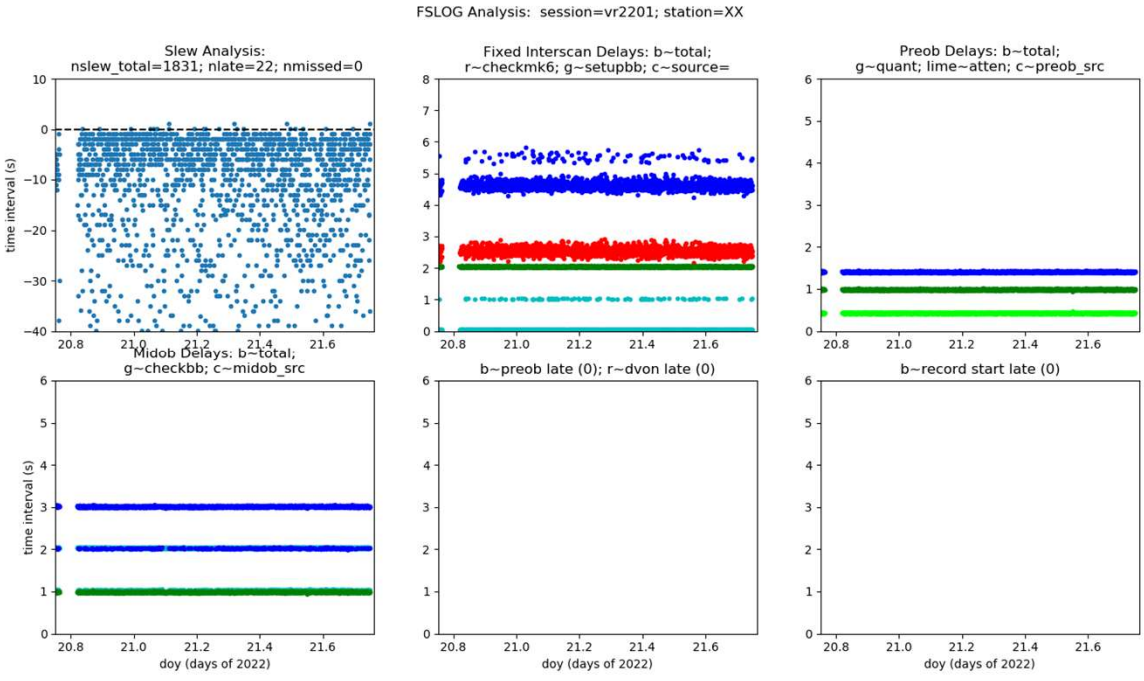
Station 2 (next slide)

- Top Left. Slew Analysis:
  - According to this analysis, almost all slews arrive at the target before the start of preob. Since the “antenna,acquire” marker is a very conservative, it is likely that the antenna always arrives on target on time for the start of preob.
- Top middle. Fixed Delay:
  - The Fixed Interscan Delay is broken down into the time to turn off recording (magenta), the time for postob (black, nearly 0 and hidden), the source= command (cyan), checkmk5 (red, nearly 0 and hidden), and setupsx (green). The Fixed Delay is dominated by setupsx, the time to reset the backend system. If the backend system is stable, the resetting could be removed (as has been done at at least one station) which would bring the Fixed Delay to <3s which is well within the target of 5 s.
- Top Right. Preob Delay:
  - The Preob Delay only involves an onsource command (cyan, hidden). The preob onsource command is not required in the VGOS R&D sessions to save time. All the same the Preob total is less than the target of 2 s anyway.
- Bottom Left. Midob Delay:
  - The Midob Delay is broken down into the mk5setcl commands (red) which include fixed delays of 1 s and 2 s respectively, checkbb (green, ~0.5 s), onsource delay (cyan, ~1 s) and the tracking delay (magenta, ~2 s). The onsource and tracking functions could be removed to reduce this delay significantly.
- Bottom Middle. Preob Late:
  - Start of Preob is never late.
- Bottom Right. Record start Late:
  - This is a FlexBuff system. The start of record is generally <~0.05 s with a few outliers.
- Summary. This station could perform very well with a few tweaks to the PROCs.



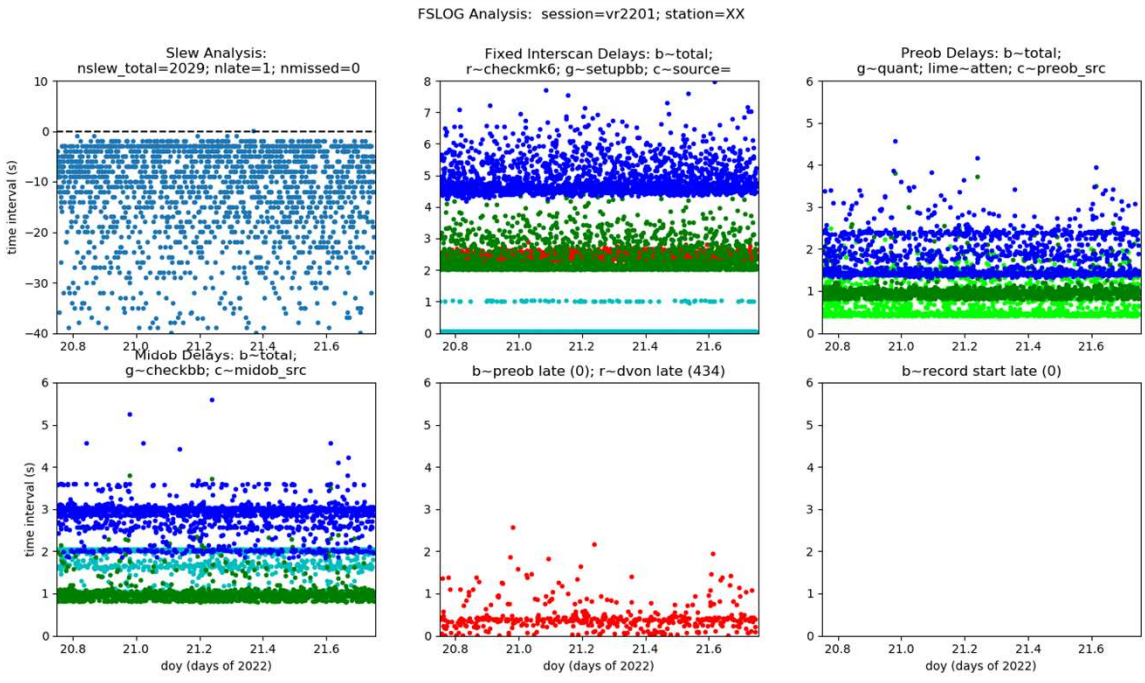
Station 3 (next slide)

- Top Left. Slew Analysis:
  - According to this analysis, almost all slews arrive at the target before the start of preob. Since the "antenna,acquired" marker is a conservative estimate of antenna arrival time, it is likely that the antenna always arrives on target for the start of preob.
- Top middle. Fixed Delay:
  - The Fixed Interscan Delay is broken down into the time for checkmk6 (red), setupbb (green) and the source= commands (cyan). Checkmk6 requires a little more than 2s with some scatter, setupbb requires about 2s with almost no scatter, and source= usually executes very quickly but occasionally takes about 1 s. The total Fixed Interscan Delay is generally less than the target of 5s.
- Top Right. Preob Delay:
  - The Preob Delay is broken down into the time to set attenuation (lime green) and the time to set quantization levels (dark green). The total is consistently less than the target of 2s with almost no scatter.
- Bottom Left. Midob Delay:
  - The Midob Delay is broken down into the onsource delay (cyan) and the checkbb delay (green). The onsource delay varies between 1 s and 2 s (with the 2 s component hidden behind the blue markers) and checkbb is approximately 1 s. The total varies between 2 s and little over 3 s so it supports integration periods as short as 3 s.
- Bottom Middle. Preob Late:
  - Start of Preob and data_valid=on are never late.
- Bottom Right. Record start Late:
  - The start of record is never late.
- Summary. This is a very good station and supports integrations as low as 3 s.



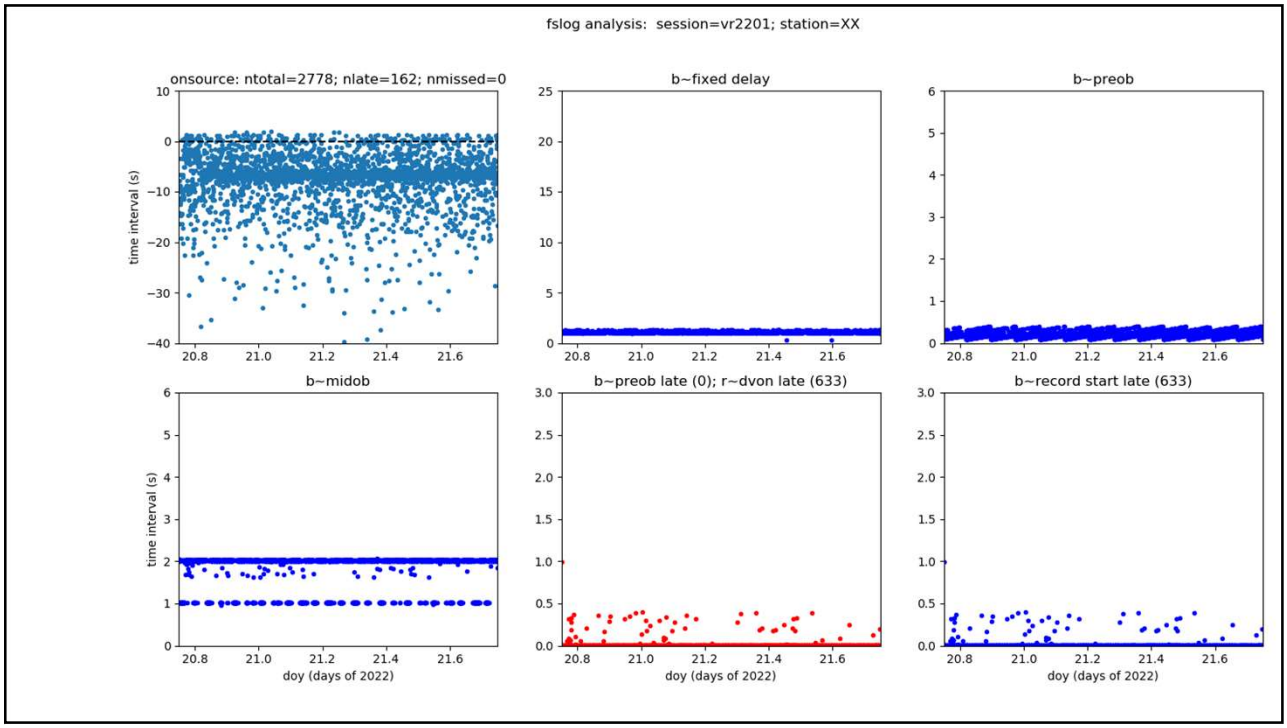
Station 4 (next slide)

- Top Left. Slew Analysis:
  - According to this analysis, all slews arrive at the target before the start of preob.
- Top middle. Fixed Delay:
  - The Fixed Interscan Delay is broken down into the time for checkmk6 (red), setupbb (green) and the source= commands (cyan) to execute. Checkmk6 requires a little more than 2s with some scatter, setupbb requires considerably more than 2s with a lot of scatter, and source= usually executes very quickly but occasionally takes about 1 s. The total Fixed Interscan Delay tops out at around 7s dominated mainly by scatter of setupbb. It would be beneficial to understand and correct the scatter in setupbb.
- Top Right. Preob Delay:
  - The Preob Delay is broken down into the time to set attenuation (lime green) and the time to set quantization levels (dark green). The time to set attenuation has a lot of scatter resulting in a total that is >2 s 434 times out of 2029 times. It would be beneficial to understand and correct the scatter in time to set the attenuation.
- Bottom Left. Midob Delay:
  - The Midob Delay is broken down into the onsource delay (cyan) and the checkbb delay (green). The onsource delay varies between 1 s and 2 s (with a lot of scatter) and checkbb is approximately 1 s. Other than a few outliers the total tops out at <4 s.
- Bottom Middle. Preob Late:
  - Start of Preob is never late and data_valid=on is late 434 times out of 2029 scans due to the times when the Preob Delay is >2 s.
- Bottom Right. Record start Late:
  - The start of recording is never late.
- Summary. This station suffers from a large amount of scatter in the times to execute some functions, especially notable in comparison to stations with similar back ends. It would be beneficial to understand and correct the scatter.



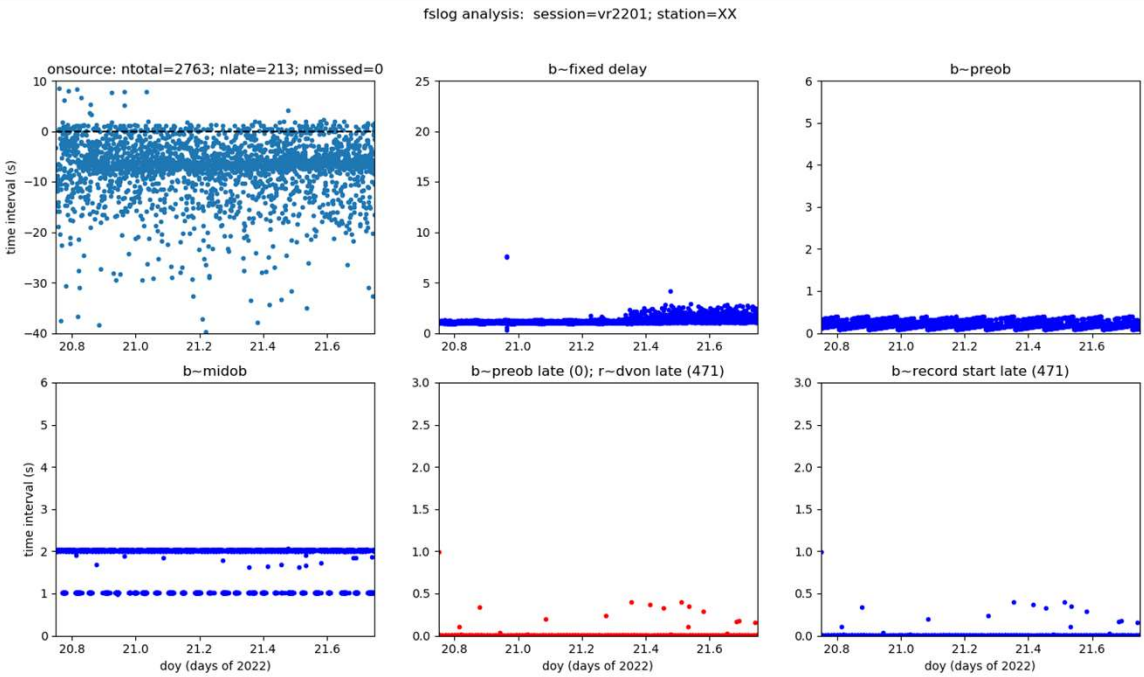
Station 5 (next slide)

- Top Left. Slew Analysis:
  - According to this analysis, most slews arrive at the target before the start of preob although 162 of 2778 scans arrive one or two seconds late. It should be noted that the "antenna,acquired" marker is a conservative estimate of antenna arrival time; hence it is likely that the antenna always arrives on target on time for the start of preob.
- Top middle. Fixed Delay:
  - The Fixed Interscan Delay is near 0 in all cases.
- Top Right. Preob Delay:
  - The Preob Delay is well under 2 s in all cases.
- Bottom Left. Midob Delay:
  - The Midob Delay includes only the onsource delay (cyan). The total is well under 3 s in all cases.
- Bottom Middle. Preob Late:
  - Start of Preob is never late and, with the exception of a few outliers, data_valid=on <<0.1 s late due to the delay is the start of recording.
- Bottom Right. Record start Late:
  - With the exception of a few outliers, the start of recording is <<0.1 s late.
- Summary. This is a very good station. Many of the legacy functions have been stripped from its PROCs. It has the potential to support integrations <<3 s.



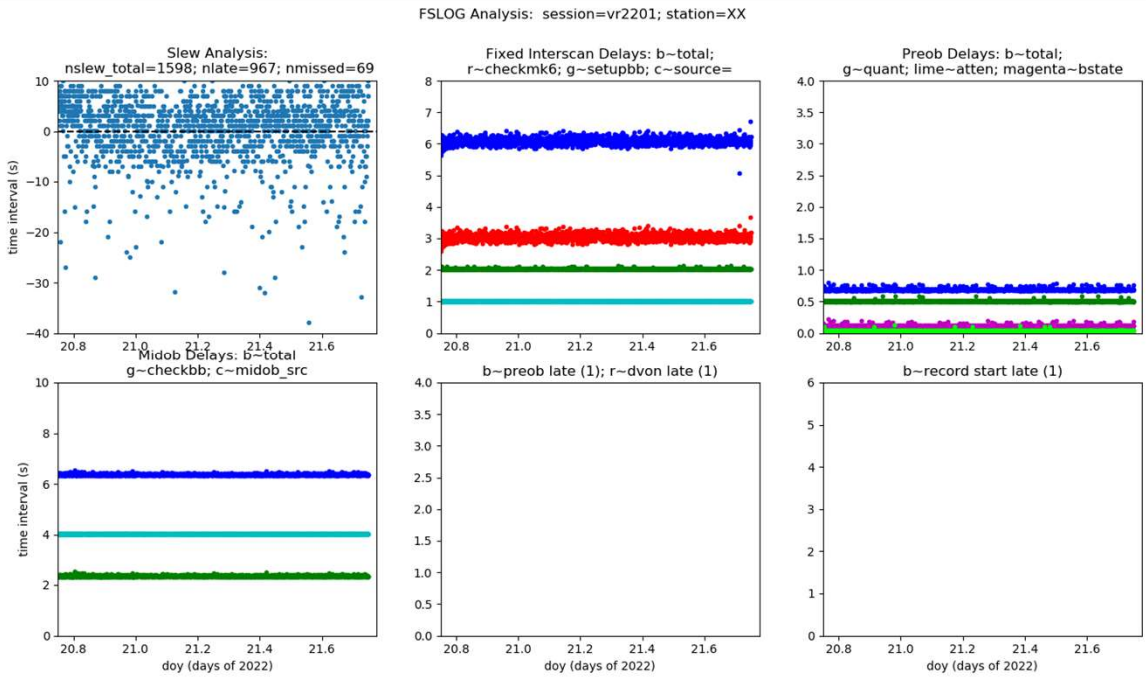
Station 6 (next slide)

- Top Left. Slew Analysis:
  - According to this analysis, most slews arrive at the target before the start of preob although 162 of 2778 scans arrive one or two seconds late. It should be noted that the "antenna,acquired" marker is a conservative estimate of antenna arrival time; hence it is likely that the antenna always arrives on target on time for the start of preob.
- Top middle. Fixed Delay:
  - The Fixed Interscan Delay is near 0 in all cases.
- Top Right. Preob Delay:
  - The Preob Delay is well under 2 s in all cases.
- Bottom Left. Midob Delay:
  - The Midob Delay includes only the onsource delay (cyan). The total is well under 3 s in all cases.
- Bottom Middle. Preob Late:
  - Start of Preob is never late and, with the exception of a few outliers, data_valid=on <<0.1 s late due to the delay is the start of recording.
- Bottom Right. Record start Late:
  - With the exception of a few outliers, the start of recording is <<0.1 s late.
- Summary. This is a very good station. Many of the legacy functions have been stripped from its PROCs. It has the potential to support integrations <<3 s.



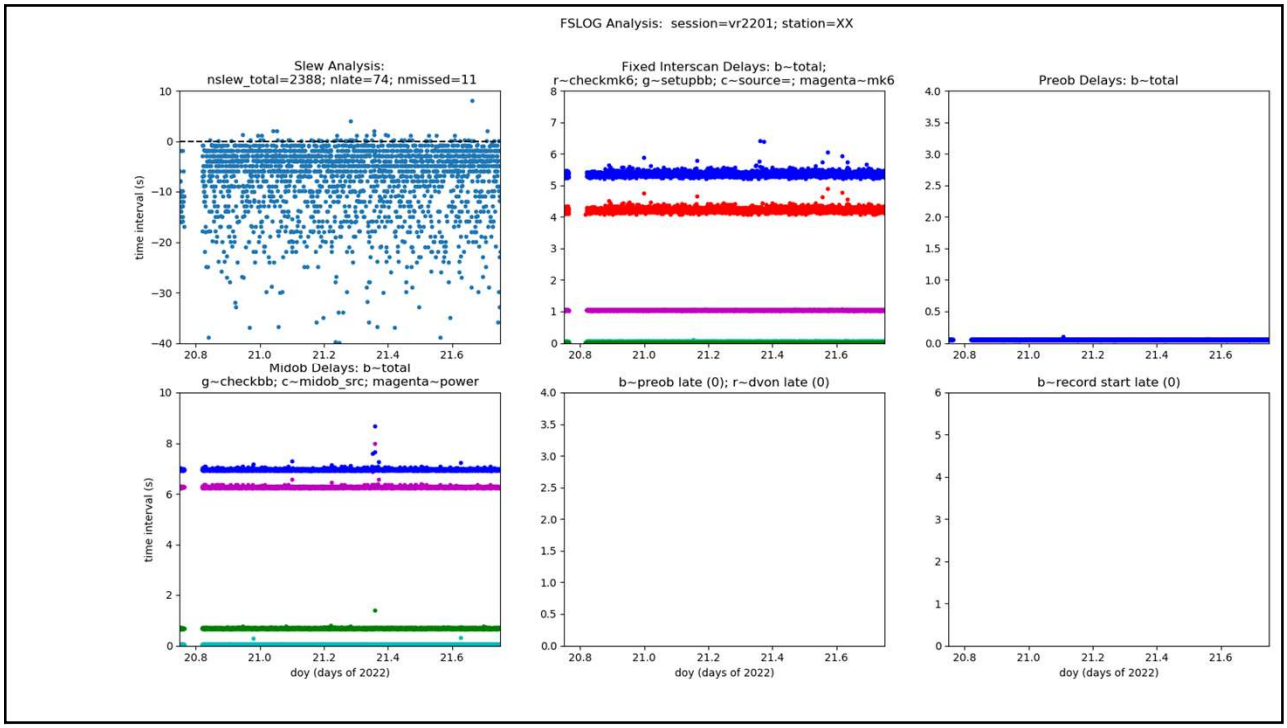
Station 7 (next slide)

- Top Left. Slew Analysis:
  - According to the 'antenna,acquired' marker, 967 of 1597 slews were late and 69 were missed entirely. However, the 'antenna,acquired' marker is a very conservative indicator of late on source, especially at this antenna. Tests with correlated data show no evidence of late on source.
- Top middle. Fixed Delay:
  - The Fixed Interscan Delay is broken down into the time for checkmk6 (red), setupbb (green) and the source= commands (cyan). Checkmk6 requires a little more than 2s with some scatter, setupbb requires about 2s with almost no scatter, and source= executes in 1 s for a total of about 6 s, which is very close to the 5 s target.
- Top Right. Preob Delay:
  - The Preob Delay is broken down into the time to set attenuation (lime green), to set quantization levels (dark green) and to do a bstate measurement (magenta). The total is easily within the 2s target.
- Bottom Left. Midob Delay:
  - The Midob Delay is broken down into the onsource delay (cyan) and the checkbb delay (green). The onsource delay is about 4 s and checkbb is somewhat over 2 s. The total is over 6 s which is beyond both the 5s and 3 s target. However, the onsource command can be removed without great loss to functionality bringing the total to under 3 s.
- Bottom Middle. Preob Late:
  - Start of Preob and data_valid=on are never late.
- Bottom Right. Record start Late:
  - The start of record is never late.
- Summary. With a very few tweaks to the PROCs this station can perform very well.



Station 8 (next slide)

- Top Left. Slew Analysis:
  - According to this analysis, most slews arrive at the target before the start of preob although 74 of 2388 scans arrive a few seconds late and 11 scans are missed entirely. It should be noted that the “antenna,acquired” marker is a conservative estimate of antenna arrival time; hence it is likely that the antenna almost always arrives on target on time for the start of preob.
- Top middle. Fixed Delay:
  - The Fixed Interscan Delay is broken down into the time for checkmk6 (red), setupbb (green), the source= (cyan) and the mk6 (magenta) commands. Checkmk6 requires a little more than 4s with some scatter, while the others take about 1 s or less. The total Fixed Interscan Delay is about 0.5 s longer than the target of 5s.
- Top Right. Preob Delay:
  - The Preob Delay is negligible.
- Bottom Left. Midob Delay:
  - The Midob Delay is broken down into the onsource delay (cyan), the checkbb delay (green) and a series of power monitor commands that are technically part of checkbb. The onsource delay and checkbb are both less than the 1 s and the power commands take a little over 6 s. If the power commands are not essential and can be eliminated, the Midob Delay can easily be brought below the target of 3 s.
- Bottom Middle. Preob Late:
  - Start of Preob and data_valid=on are never late.
- Bottom Right. Record start Late:
  - The start of record is never late.
- Summary. With the removal of the power commands in checkbb, this can become a very good station supporting integrations of 3 s.



Station 9 (next slide)

- Top Left. Slew Analysis:
  - According to this analysis, most slews arrive at the target before the start of preob although 185 of 2635 scans arrive a few seconds late. It should be noted that the "antenna,acquired" marker is a conservative estimate of antenna arrival time; hence it is likely that the antenna always arrives on target on time for the start of preob.
- Top middle. Fixed Delay:
  - The Fixed Interscan Delay is broken down into the time for checkmk6 (red), setupbb (green), the source= (cyan) and the mk6 (magenta) commands. All of the delays are in the 1-3 s range with a total between 8 and 9 seconds. It should be noted that the source= command is executed during the buffer flush (if that is required) so that it can be removed from the total when analyzing operation using a single mk6 module. The total Fixed Interscan Delay then drops into the 5-6 s range.
- Top Right. Preob Delay:
  - The Preob Delay is broken down into the time to set attenuation (lime green) and the time to set quantization levels (dark green). The time to set attenuation is about 0.5 s while the time to set quantization levels varies in tiers between about 1 and 3 s. In all but a few cases the total Preob Delay is below about 2.4 s. All the same it would be beneficial to understand and correct the tiered behaviour of the quantization setting.
- Bottom Left. Midob Delay:
  - The Midob Delay is broken down into the onsource delay (cyan),the checkbb delay (green) and the delay to read the cdms. The total Midob Delay is dominated by the cdms, which is fairly evenly scattered between 0-3 s. The total is nearly always below the 3 s threshold.
- Bottom Middle. Preob Late:
  - Start of Preob is late once and data_valid=on is late 452 of 2635 times. This is due to the longer than expected time to set quantization
- Bottom Right. Record start Late:
  - The start of record is never late.
- Summary. This could be a very good station if the longer than expected time to set quantization can be understood and reduced.