Proposal Submission Tool (PST) Software Requirements: Removing Sessions

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12 September 2017

ABSTRACT

The NRAO Proposal Submission Tool (PST) enables the creation, editing, and submission of observing proposals for the GBT, VLA, VLBA, and GMVA. PST Sessions connect sources with telescope resources to provide the information necessary for the review process and telescope scheduling. This has caused some confusion since the PST Sessions do not map directly into observing sessions. Here we provide software requirements on how to remove Sessions from the PST along with Use Cases.

1. Background

The NRAO Proposal Submission Tool (PST) was released in 2005 and currently includes NRAO's North American facilities: GBT, VLA, and VLBA, plus the global mm VLBI array (GMVA). An important feature within the PST is the concept of "Sessions". PST Sessions connect sources with telescope resources along with several other parameters (e.g., total time, LST range, etc.). PST Sessions were implemented slightly differently as a function of telescope and this has evolved with time. For example, the VLA used to include a mechanism in Sessions to specify sub-arrays, but this has since been removed. Currently, there is only one major difference between telescopes. For the GBT, the author specifies a Session to connect one Source group and one Resource group, whereas there are *no* Resource groups for the VLA, VLBA, and GMVA. Here multiple Resources can be added within a given Session. Source groups are just a list of sources with names, coordinates, and velocity information. Resource groups are a list of different resources that typically include the receiver, list of frequencies, backend name and configuration, etc.

The problem with this design is that PST Sessions do not map directly into telescope observing sessions. Each telescope has different approaches to scheduling and observing for good reasons. As a result this has caused two major problems: (1) it has confused our users who expect their PST Sessions to map to their telescope observing sessions (e.g., VLA scheduling blocks.); and (2) software downstream of the PST has to correct for these differences.

On 25 September 2014, a small group of NRAO managers, scientist, and developers met in Socorro, NM to discuss at a high level the software tools that provide the functionality from proposing to scheduling for the GBT, VLA, and VLBA.[1] During this meeting Barry Clark proposed a way to remove Sessions in the PST to "a more primitive version of how to specify observing time requests".[2] Dana Balser developed a series of Use Cases and in the process suggested a slight modification in how to define overhead.[3] In Fall 2015, a series of informal discussions were held with small groups of stakeholders to flesh out some of the details.

After these discussions and feedback from the Users Committee, it was generally agreed that we should replace or significantly modify the Telescope Time Allocation tool suite. It was decided to proceed in a phased approach where in Phase I we would remove Sessions in the PST and make improvements to the VLA Prioritizer. Here we provide software requirements to remove Sessions from the PST based on Barry Clark's proposal. This document is for the PST and does not directly include software downstream (e.g., VLA Prioritizer, PHTs, DSS, OPT, etc.).

2. Observing Time Requests

Currently, observing time requests are specified by the Sources, Resources, and Sessions pages in the PST. The Sessions page should be removed (at least in the user interface), but the concept of Source Groups and Resource Groups should be maintained. Below is an abridged list of fields for Resources and Sources where we have underlined new fields. The procedure should be to first add Resources, where each Resource is connected to a Resource Group and has a time per source and overhead factor. Next Sources are added to a Source Group, where each Source Group is connected to one and only one Resource Group.

- **Resource Group Name**
  - *Resource Name*
    - Array Configuration (VLA only)
    - Receiver Name

[1] See https://staff.nrao.edu/wiki/bin/view/OSO/ProposingToScheddulingBrainstorm2014.

[2] See https://staff.nrao.edu/wiki/pub/OSO/ProposingToScheddulingBrainstorm2014/sessions_BarryClark.txt.

[3] See https://staff.nrao.edu/wiki/bin/view/OSO/ProposalSessionUseCases.

    - Back-end Name
    - Integration Time
    - Time Per Source
    - Overhead Factor
    - Monitoring Visits (optional)
    - Monitoring Interval (optional)
    - Connected Resources (optional)
    - Number of Sub-arrays (optional; VLA only)

- **Source Group Name**
  - *List of Sources*
    - Source Name
    - Position Info
    - Velocity Info
  - Minimum Elevation
  - Optional Number of Sources
  - Resource Group (one and only one)
  - Comments

The total telescope time is calculated by specifying the time per Source within each Resource. The overhead time is estimated for each Resource. The total time is given by

$$t_{\rm total} = \sum_{\rm i}^{\rm srcgrp} \sum_{\rm j}^{\rm rsc} N_{\rm i}\, f_{\rm j}\, t_{\rm j}^{\rm eff} \tag{1}$$

where $N_{\rm i}$ is the optional number of sources in source group i; $f_{\rm j}$ is the overhead factor for resource j; and $t_{\rm j}^{\rm eff}$ is the effective time on source for resource j. The optional number of sources implies that the number of sources that will be observed may not equal the number of sources listed. This occurs when the proposer does not know *a priori* which sources will be observed and because the NRAO demands that all potential sources be included. Each source group is connected to one resource group. So for each source group we multiply the optional number of sources, $N_{\rm i}$, times the product $f_{\rm j}t_{\rm j}^{\rm eff}$ which is the effective time per source including overhead. The overhead factor includes any start up time, calibration, and slew time. If 10 hours are spent on source and 2.5 hours on overhead, then the overhead factor is 1.25. The calibration might be flux, bandpass, phase (VLA); flux, bandpass, OOF (GBT);

or fringe amplitude (VLBA). *One option is to separate out the overhead into two parts: a start-up overhead and an overhead for everything else (e.g., slew time, etc.).*

In most cases the effective time equals the time on source, $t_{\rm j}$. For monitoring (observing a source multiple times) the integration time is multiplied by the number of visits (i.e., $t_{\rm j}^{\rm eff} = M_{\rm j}\, t_{\rm j}$, where $M_{\rm j}$ is the number of monitoring visits). For VLA sub-arrays the integration time is divided by the number of sub-arrays (i.e., $t_{\rm j}^{\rm eff} = t_{\rm j}/S_{\rm j}$, where $S_{\rm j}$ is the number of sub-arrays). For cases where each source in a group has a different integration time then $t_{\rm j}$ corresponds to the average time on source. Alternatively one could specify a different Resource name for different integration times (e.g., Resource_short and Resource_long for short and long integration times). In some situations it is important to use different resources in the same observing session or SB. In these cases the Connected Resource field should be used.

This approach is really not too different than the current implementation of PST Sessions. The subtle, but important, difference is that the author does not provide certain details relevant to scheduling and observing, such as defining the unit of an observation (a Session) with an LST range and a number of iterations. Only information required for the proposal review process is required. This is why we still need to connect sources to resources. For example, we need to measure how much high frequency time is requested at the Galactic Center. But we do not need to know exactly how those observations will be scheduled. Scheduling or observing constraints that are important for the TAC can be included in the Comment section. For example, a radar experiment that requires observations at a specific time.

We require that PST Sessions are maintained in the database. We need to query the database for metrics, allow users to copy old proposals, and to be able to generate Sessions for new proposals. The proposal copy functionality should still work. When an old proposal is copied the Resource and Sessions pages should be ignored. The Source Group page should be copied to the new format leaving any new fields (e.g., Resource Group) blank. Sessions should not be generated for new proposals automatically but functionality should exist to do this at a specified time. This is necessary at least in the near term to be compatible with software downstream (e.g., GBT PHT). Here is the procedure to generate PST Sessions.

1. Generate one PST Session for each Source Group. Use the Source Group name as the Session name.

2. Calculate the LST min and max values using the list of source coordinates within the Source Group. There is already code in the PST to perform this calculation.

3. Calculate the number of sessions as the total time for the Source Group divided by the LST range.

4. Set the separation equal to the monitoring interval (default is zero).

5. Set the Session time equal to the total time for the Source Group divided by the number of Sessions. For the VLA, VLBA, and GMVA this should be specified for each Resource separately.

6. Copy any text in Comments to the Session comments field.

3. Use Cases

A series of use cases follows. Examples that include a proposal ID are based on proposals that have already been submitted. For clarity not all of the fields are listed. For example, some info on the resources and details about individual sources (e.g., coordinates).

3.1. GBT/14B-431: Standard Spectral Line

Summary: Detect radio recombination line (RRL) emission from several normal galaxies. The goal is to use RRLs as an unobscured tracer of star formation. The total time = 5*1.25*4 hr = 25 hr.

Issues: The exact time per source is not known and will depend on whether a line is detected or not. The strategy would be to integrate some on all sources first and only follow up on the sources with no detections. So the time for each position will not be accurate.

Resource Groups:

- RRL
  - Resource: C-band
    - Receiver: C-band
    - Backend: VEGAS mode 24
    - Frequencies: 3.95213, 4.05388, 4.15917, 4.26814, 4.38095, 4.61879, 4.74418, 4.87416, 5.00892, 5.1487, 5.29373, 5.44426, 5.60055, 5.76288, 5.93154, 6.10685, 6.28914, 6.47876, 6.67607, 6.88149, 7.09541, 7.31829, 7.55061, 7.79287
    - Sample integration time: 5 sec
    - Time Per Source: 4 hr
    - Overhead factor: 1.25

Source Groups:

- Extragalactic HII
  - Sources: 5
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 5
  - Resource Group: RRL

3.2. GBT/14B-256: Survey Then Follow-up

Summary: GBT survey of large, diffuse Galactic HII regions. The goal is to observe multiple radio recombination lines at C-band to detect diffuse ionized emission from large Galactic HII regions. The total time = 75*1.25*32 min + 3*1.25*48 min = 3180 min = 53 hr.

Issues: The exact time per source is not known and will depend on whether a line is detected or not. The strategy would be to integrate some on all sources first and only follow up on the sources with no detections. So the time for each position will not be accurate.

Resource Groups:

- RRL
  - Resource: C-band
    - Receiver: C-band
    - Backend: VEGAS mode 25
    - Frequencies: 3.95213, 4.05388, 4.15917, 4.26814, 4.38095, 4.61879, 4.74418, 4.87416, 5.00892, 5.1487, 5.29373, 5.44426, 5.60055, 5.76288, 5.93154, 6.10685, 6.28914, 6.47876, 6.67607, 6.88149, 7.09541, 7.31829, 7.55061, 7.79287
    - Sample integration time: 5 sec
    - Time Per Source: 32 min
    - Overhead factor: 1.25
- RRL-Test
  - Resource: C-band-Test
    - Receiver: C-band
    - Backend: VEGAS mode 25
    - Frequencies: 3.95213, 4.05388, 4.15917, 4.26814, 4.38095, 4.61879, 4.74418, 4.87416, 5.00892, 5.1487, 5.29373, 5.44426, 5.60055, 5.76288, 5.93154, 6.10685, 6.28914, 6.47876, 6.67607, 6.88149, 7.09541, 7.31829, 7.55061, 7.79287
    - Sample integration time: 5 sec
    - Time Per Source: 48 min
    - Overhead factor: 1.25

Source Groups:

- Diffuse HII
  - Sources: 414
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 75
  - Resource Group: RRL
- Test
  - Sources: 3
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 3
  - Resource Group: RRL-Test

3.3. GBT Pulsar Monitoring Project

Summary: This use case was suggested by Toney Minter. Consider pulsar monitoring of two Globular Clusters with the GBT at S-band. Here they share the same Resource. Four hours of integration time is required for each visit and each observing block needs to be separated by 3 months give or take a month. They need to be visited 4 times. The total time = 4*4*1.25 hr + 4*4*1.25 hr = 40 hr.

Issues: Some details of the scheduling have to be captured since such observations have constraints that will impact the overall schedule and should be considered by the TAC. So we specify information about monitoring.

Resource Groups:

- Globulars
  - Resource: S-band
    - Receiver: S-band
    - Backend: VEGAS Pulsar
    - Bandwidth: 800 MHz
    - Polarization: Search
    - Channels: 512
    - Dedispersion: Coherent
    - Time Per Source: 4 hr
    - Overhead Factor: 1.25
    - Monitoring Visits: 4
    - Monitoring Interval: 90 days

Source Groups:

- Globular_1
  - Sources: 1
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 1
  - Resource Group: Globular

  - Comment: Observations should be scheduled close to the start of Jan, Apr, Jul, and Oct. The separation should be 3 ± 1 months.

- Globular_2
  - Sources: 1
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 1
  - Resource Group: Globular
  - Comment: Observations should be scheduled close to the start of Feb, May, Aug, and Nov. The separation should be 3 ± 1 months.

3.4. GBT/16A-235: ARGUS Mapping

Summary: The goal is to map a regions $6' \times 4'$ in HCN across the entire disk of a normal galaxy. The total time ON source is estimated to be 32 hr with an overhead of 2.0 so the total time is 1*32*2.0 = 64 hr.

Issues: The authors specified one session with length 64 hr. Clearly not realistic. The exact overhead factor will depend on the typically length of a session. This is not known *a priori* but we can use a recommended minimum session time as a guideline to users to be conservative.

Resource Groups:

- ARGUS-HCN
  - Resource: HCN/HCO+
    - Receiver: ARGUS (75-116 GHz)
    - Backend: VEGAS
    - Bandwidth: 1500 MHz
    - Frequencies: 88.910065
    - Sample integration time: 0.5 sec
    - Time Per Source: 32 hr
    - Overhead factor: 2.0

Source Groups:

- n6949
  - Sources: 1
  - Minimum Elevation: 30 deg
  - Optional Number of Sources: 1
  - Resource Group: ARGUS-HCN
  - Comment:

3.5. GBT/16B-210: High Redshift CO (multiple frequencies and modes)

Summary: The goal is to observe two high z sources in different CO lines. For one source we observe CO(1-0), CO(2-1), and CO(3-2), whereas for the other we only observe in CO(1-0) and CO(3-2). The total time is 1*3*1.83 + 1*1*2.5 + 1*2*1.25 + 1*1*3.75 + 1*2*2 = 18.25 hr.

Issues: Since we need different configurations for each source this is a fair amount of work but relatively straight forward.

Resource Groups:

- S69-RG
  - Resource: S69-CO10
    - Receiver: KFPA (18-26.5 GHz)
    - Backend: VEGAS mode 3
    - Bandwidth: 1080 MHz
    - Frequencies: 25.9 GHz
    - Sample integration time: 5.0 sec
    - Time Per Source: 3 hr
    - Overhead factor: 1.83
  - Resource: S69-CO32
    - Receiver: W-band MM2 (73-80 GHz)
    - Backend: VEGAS mode 3
    - Bandwidth: 1080 MHz
    - Frequencies: 77.7 GHz
    - Sample integration time: 5.0 sec
    - Time Per Source: 1 hr
    - Overhead factor: 2.5
- S82-RG
  - Resource: S82-CO10
    - Receiver: KFPA (18-26.5 GHz)
    - Backend: VEGAS mode 3
    - Bandwidth: 1080 MHz

        * Frequencies: 22.8 GHz
        * Sample integration time: 5.0 sec
        * Time Per Source: 2 hr
        * Overhead factor: 1.25
    - Resource: S82-CO21
        * Receiver: Q-Band (38.2-49.8 GHz)
        * Backend: VEGAS mode 3
        * Bandwidth: 1080 MHz
        * Frequencies: 45.6 GHz
        * Sample integration time: 5.0 sec
        * Time Per Source: 1 hr
        * Overhead factor: 3.75
    - Resource: S69-CO32
        * Receiver: W-band MM2 (73-80 GHz)
        * Backend: VEGAS mode 3
        * Bandwidth: 1080 MHz
        * Frequencies: 68.5 GHz
        * Sample integration time: 5.0 sec
        * Time Per Source: 2 hr
        * Overhead factor: 2.0

Source Groups:

- s69
    - Sources: 1
    - Minimum Elevation: 30 deg
    - Optional Number of Sources: 1
    - Resource Group: S69-RG
    - Comment:
- s82
    - Sources: 1

- Minimum Elevation: 30 deg
- Optional Number of Sources: 1
- Resource Group: S82-RG
- Comment:

3.6. GBT/17A-277: MUSTANG-2

Summary: The goal is to measure the S-Z effect in a small sample of high z galaxy clusters. They plan to observe 7 sources and require 1.5 hours ON time per source, with an estimated overhead factor of 2. The total time is 7*1.5*2.0 = 21 hr.

Issues: No issues.

Resource Groups:

- MUSTANG-2
  - Resource: M-2
    - Receiver: Mustang 2
    - Backend: Mustang 2
    - Time Per Source: 1.5 hr
    - Overhead factor: 2.0

Source Groups:

- Clusters
  - Sources: 7
  - Minimum Elevation: 25 deg
  - Optional Number of Sources: 7
  - Resource Group: MUSTANG-2

3.7. GBT/14A-507: All Sky Survey

Summary: The goal to continue the all-sky 350 MHz pulsar survey. From past experience the observing efficiency is about 75%, or about a factor of 1.3. The total time is 1.0*1384.6*1.3 = 1800 hr.

Issues: Only one source is specified to cover the entire sky but included in the source position is a range which is set to cover the entire sky. All sky surveys do not map well into the DSS. The proposer could have defined several region to cover the sky and split the time between them.

Resource Groups:

- GBT350-GUPPI
  - Resource: GBT350
    - Receiver: PF1 340 MHz (0.290-0.395 GHz)
    - Backend: GUPPI
    - Time Per Source: 1384.6 hr
    - Overhead factor: 1.3

Source Groups:

- GBT350 Pointing
  - Sources: 1
  - Minimum Elevation: 0 deg
  - Optional Number of Sources: 1
  - Resource Group: GBT350-GUPPI
  - Comment: Separations do not need to be 6 days. Scheduling in about a week duration blocks with 8-12 hr of observations per day would be optimal.

3.8. GBT/15B-368: Bistatic Radar

Summary: The goal is to perform bistatic radio observation on a near-Earth asteroid. There is no overhead specified in the technical justification so we just assume an overhead factor of 1.25. The total time is 1.0*1.2*1.25 = 1.5 hr.

Issues: The target is moving so an ephemeris will be provided. In the PST the position was set to zero RA/Dec.

Resource Groups:

- NEA
  - Resource: 2015 SZ
    - Receiver: S-Band (1.73-2.60 GHz)
    - Backend: Radar Backend
    - Frequencies: 2.38 GHz
    - Desired Frequency: 0.00001 kHz
    - Sample integration time: 0.0001 msec
    - Time Per Source: 1.2 hr
    - Overhead factor: 1.25

Source Groups:

- NEA
  - Sources: 1
  - Minimum Elevation: 0 deg
  - Optional Number of Sources: 1
  - Resource Group: NEA

3.9. GBT/13B-306: Polarization (LST Range Constraints)

Summary: The goal is to confirm the variable polarization-dependent HI absorption in quasars. They need two 8 hr long tracks on two targets and then a calibration run on 3C286 across transit. The total time is 1*3.67*1.09 + 2*8*1.094 = 21.5 hr

Issues: These are polarization observations that require a long track for each source. Also, the calibration has to be performed around transit. These constraints are included in the comments.

Resource Groups:

- HI-Cal
  - Resource: L-Band
    - Receiver: L-Band (1.15-1.73 GHz)
    - Backend: Spectrometer
    - Bandwidth: 12.5 MHz
    - Frequencies: 1.4 GHz
    - Time Per Source: 3.67 hr
    - Overhead factor: 1.09
- HI-Pol
  - Resource: L-Band
    - Receiver: L-Band (1.15-1.73 GHz)
    - Backend: Spectrometer
    - Bandwidth: 12.5 MHz
    - Frequencies: 1.4 GHz
    - Time Per Source: 8 hr
    - Overhead factor: 1.094

Source Groups:

- Cal
  - Sources: 1
  - Minimum Elevation: 0 deg

  - Optional Number of Sources: 1
  - Resource Group: HI-Cal
  - Comment: A single 4 hr track between LST 11:30 - 15:30 is required for calibration.

- Quasars
  - Sources: 2
  - Minimum Elevation: 0 deg
  - Optional Number of Sources: 2
  - Resource Group: HI-Pol
  - Comment: A single 8 hr long track is required.

3.10. GBT/16B: Comets (Range of Dates)

Summary: The goal is to observe OH in a specified comet as it approaches as part of a multi-wavelength effort. They request 5 observing sessions across any of 5 date ranges. They also request some calibration. The total time is 5*1.8*1.11 = 10 hr

Issues: Since these are coordinated observations and comets move the positions are only approximate though they give a range in the positions. I think they underestimated the overhead since they requested five distinct sessions that will need to point/focus etc. for each one.

Resource Groups:

- 45PHMP_spectra
  - Resource: Vegas_OH_16
    - Receiver: L-Band (1.15-1.73 GHz)
    - Backend: VEGAS mode 16
    - Bandwidth: 11.72 MHz
    - Frequencies: 1.6673590, 1.6654018, 1.6122310, 1.7205300 GHz
    - Sample integration time: 5.0 sec
    - Monitoring Visits: 5
    - Time Per Source: 1.8 hr
    - Overhead factor: 1.11

Source Groups:

- 45P
  - Sources: 1
  - Minimum Elevation: 0 deg
  - Optional Number of Sources: 1
  - Resource Group: 45PHMP_spectra
  - Comment: Approximate source RA/dec are given for center of each range: constraints are 14-21 Dec; 24-30 Dec; 7-12 Jan; 17-25 Jan; 5-12 Feb.

3.11. VLA/15B-178: Survey of 100+ Sources

Summary: Determine the metallicity structure in the Galaxy using HII regions. The goal is to observe the radio recombination line (RRL) and free-free continuum emission toward 120 Galactic HII regions. The exact sources are not known since this will depend on the success of the selection strategy. That is, they will iterate on the source list based on the results of each execution block. The total time = 6*(20*1.5*10 min) = 1800 min = 30 hr.

Issues: For some source groups the optional number of sources is more than the sources listed. Therefore we cannot precisely calculate the positions. But there is really no way to do this since they are not known a priori.

Resource Groups:

- RRL
  - Resource: Xband
    - VLA configuration: D
    - Receiver: X-band
    - Backend: WIDAR Spectral Line
    - Frequencies: 8.04761, 8.31148, 8.58696, 8.87478, 9.17560, 9.49018, 9.81931, 9.88555 GHz
    - Integration time: 3 sec
    - Time Per Source: 10 min
    - Overhead factor: 1.5

Source Groups:

- RA_0_3
  - Sources: 18
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 20
  - Resource Group: RRL
- RA_15_18

  - Sources: 17
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 20
  - Resource Group: RRL
- RA_18_21
  - Sources: 375
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 20
  - Resource Group: RRL
- RA_21_24
  - Sources: 53
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 20
  - Resource Group: RRL
- RA_3_6
  - Sources: 18
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 20
  - Resource Group: RRL
- RA_6_9
  - Sources: 13
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 20
  - Resource Group: RRL

3.12. VLA/15B-013: Mosaic

Summary: VLA mosaic of the end of the northern and southern Galactic bars. The goal is to mosaic the radio recombination line (RRL) and free-free continuum emission over a one square degree region at the end of the northern and southern bars. There will be 634 pointing per mosaic. The total time = 2*(643*1.261*49 sec) = 22 hr.

Issues: This is a mosaic with a relatively short integration time (42 sec). The slew time between pointing (7 sec) was added to the integration time so the standard VLA overhead time could be used. This might not be the appropriate way to do it but follows what was done in the proposal.

Resource Groups:

- RRL-N
  - Resource: X-band-N
    - VLA configuration: D
    - Receiver: X-band
    - Backend: WIDAR Spectral Line
    - Frequencies: 8.04761, 8.31148, 8.58696, 8.87478, 9.17560, 9.49018, 9.81931, 9.885558 GHz
    - Integration time: 5 sec
    - Time Per Source: 49 sec (includes extra slew time for mosaic)
    - Overhead factor: 1.261
- RRL-S
  - Resource: X-band-S
    - VLA configuration: DnC
    - Receiver: X-band
    - Backend: WIDAR Spectral Line
    - Frequencies: 8.04761, 8.31148, 8.58696, 8.87478, 9.17560, 9.49018, 9.81931, 9.885558 GHz
    - Integration time: 5 sec
    - Time Per Source: 49 sec (includes extra slew time for mosaic)
    - Overhead factor: 1.261

Source Groups:

- Northern Bar
  - Sources: 1 (center of map)
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 643 (pointings)
  - Resource Group: RRL-N
- Southern Bar
  - Sources: 1 (center of map)
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 643 (pointings)
  - Resource Group: RRL-S

3.13. VLA Multi-frequency Project

Summary: This use case was suggested by Bryan Butler. Consider a project that requires observations of 2 sources for 20 min at C-band, X-band, and Ka-band with the constraint that the C-band and Ka-band observations have to be observed in the same SB. The total time = 2*20*1.261 + 2*20*1.261 + 2*20*2.747 = 210.8 min = 3.5 hr.

Issues: The VLA prioritizer will set priorities differently between high and low frequencies. Therefore we need to indicate that the C-band observations will be connected to the Ka-band observations and thus be observing under high-frequency weather conditions.

Resource Groups:

- Multi-Freq
  - Resource: C-band
    - VLA configuration: B
    - Receiver: C-band
    - Backend: WIDAR Wideband
    - Basebands: 2 x 1 GHz (8-bit)
    - Baseband Centers: 5.5, 6.5 GHz
    - Integration time: 5 sec
    - Time Per Source: 20 min.
    - Overhead factor: 1.261
    - Connected Resources: Ka-band
  - Resource: X-band
    - VLA configuration: B
    - Receiver: X-band
    - Backend: WIDAR Wideband
    - Basebands: 2 x 1 GHz (8-bit)
    - Baseband Centers: 8.5, 9.5 GHz
    - Integration time: 5 sec
    - Time Per Source: 20 min.
    - Overhead factor: 1.261
  - Resource: Ka-band
    - VLA configuration: B

        * Receiver: Ka-band
        * Backend: WIDAR Wideband
        * Basebands: 2 x 1 GHz (8-bit)
        * Baseband Centers: 33, 34 GHz
        * Integration time: 5 sec
        * Time Per Source: 20 min.
        * Overhead factor: 2.747
        * Connected Resources: C-band

Source Groups:

- Sources
    - Sources: 2
    - Minimum Elevation: 10 deg
    - Optional Number of Sources: 2
    - Resource Group: Multi-Freq

3.14. VLA Sub-array Project

Summary: The VLA can be split into multiple sub-arrays using different resources and/or sources. In this example, we want to observe one source for 5 hours using two sub-arrays using L-band and S-band. The total time = 1*(5/2)*1.261 + 1*(5/2)*1.261 = 6.3 hr.

Issues: Since we have specified sub-arrays we have to divide the time per source by the number of sub-arrays to get the correct total time.

Resource Groups:

- TwoSubArrays
  - Resource: L-band
    - VLA configuration: Any
    - Receiver: L-band
    - Backend: WIDAR Wideband
    - Basebands: 2 x 512 MHz (8-bit)
    - Baseband Centers: 1.264, 1.776 GHz
    - Integration time: 0.1 sec
    - Time Per Source: 5 hr
    - Overhead factor: 1.261
    - Number of Sub-arrays: 2
  - Resource: S-band
    - VLA configuration: Any
    - Receiver: S-band
    - Backend: WIDAR Wideband
    - Basebands: 2 x 1 GHz (8-bit)
    - Baseband Centers: 2.5, 3.5 GHz
    - Integration time: 0.1 sec
    - Time Per Source: 5 hr
    - Overhead factor: 1.261
    - Number of Sub-arrays: 2

Source Groups:

- FlareStar
  - Sources: 1
  - Minimum Elevation: 10 deg
  - Optional Number of Sources: 1
  - Resource Group: TwoSubArrays

3.15. VLBA Astrometry Project

Summary: In this example they want to measure the parallax of a water maser in a source to derive the distance. They require 6 tracks separated by about 30 days around specific times. Based on past experience each track needs to be 6 hours including overhead. The total time = 6*6*1.0 = 36.0 hrs.

Issues: Astrometry projects are fairly common on the VLBA and they tend to have some scheduling constraints. Here we capture some of these constraints in the monitoring parameters and comment field. The exact monitoring periods are not regular so we capture the details in the comment field. Based on experience they need 6 hours per track, including overhead. So in the example below we just assume 6 hr per source and an overhead factor of 1.0.

Resource Groups:

- WaterMaser
  - Resource: WaterMaser
    - Wavelength: 1.3 cm
    - Processor: Socorro-DiFX
    - Observing Mode: Standard/Shared Risk
    - Observing System: DDC System
    - Bandwidth: 16 MHz
    - Integration period: 1.0 sec
    - Stations: VLBA
    - Time Per Source: 6.0 hr
    - Overhead factor: 1.0
    - Monitoring Visits: 6
    - Monitoring Interval: 30 days

Source Groups:

- WaterMaser
  - Sources: 1
  - Minimum Elevation: 20 deg

- Optional Number of Sources: 1
- Resource Group: WaterMaser
- Comment: Observations should be near the following dates: 01Feb2018, 10May2018, 20Aug2018, 25Sep2018, 25Oct018, and 01Feb2019.