

# SWIFT-SAT: Operational Data Sharing (ODS)

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**Session OS1 - 14**

**Bang D. Nhan**

*Assistant Scientist*

*SWIFT-SAT Co-PI*

National Radio Astronomy Observatory (NRAO)

*Electromagnetic Spectrum Management*

Charlottesville, Virginia, USA

[bnhan@nrao.edu](mailto:bnhan@nrao.edu)

**ODS Development team:**

Daniel Faes (NRAO)

Dawn Pattison (NRAO)

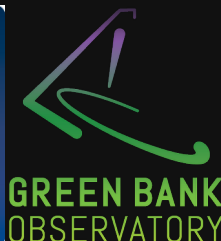
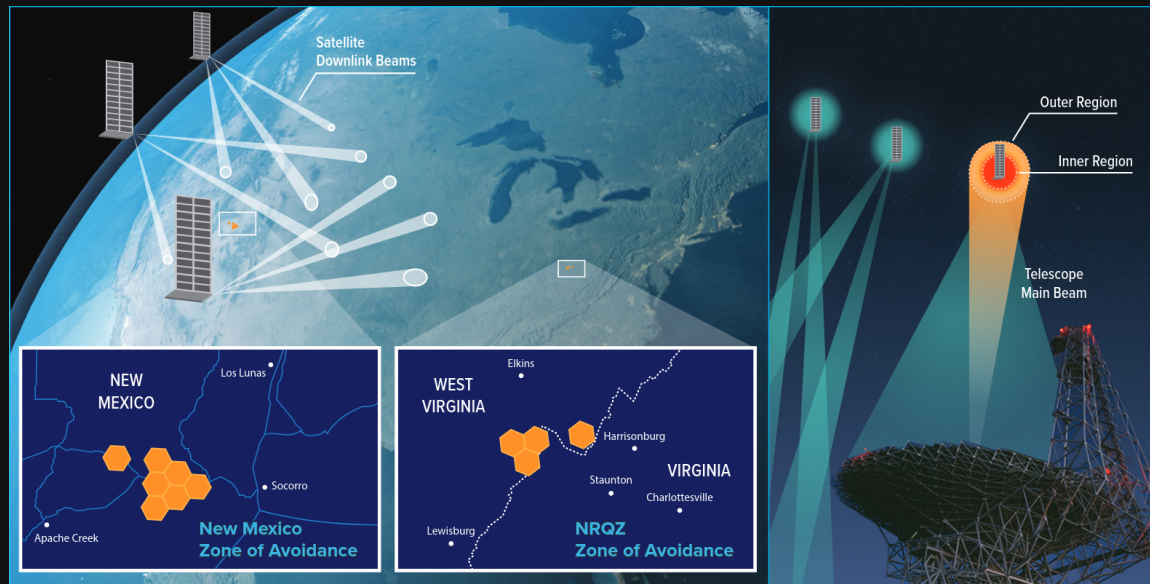
Thomas Chamberlin (NRAO/GBO)

Mark Whitehead (NRAO)

Kevin Ryan (NRAO)

Randall Arnold (NRAO)

Chris De Pree (NRAO, SWIFT-SAT PI)



# Coordination & coexistence schemes with SpaceX Starlink

- **Zone avoidance**

- Task downlink beam placement to avoid radio quiet zones (orange hexagonal service cells)

- **Telescope boresight avoidance**

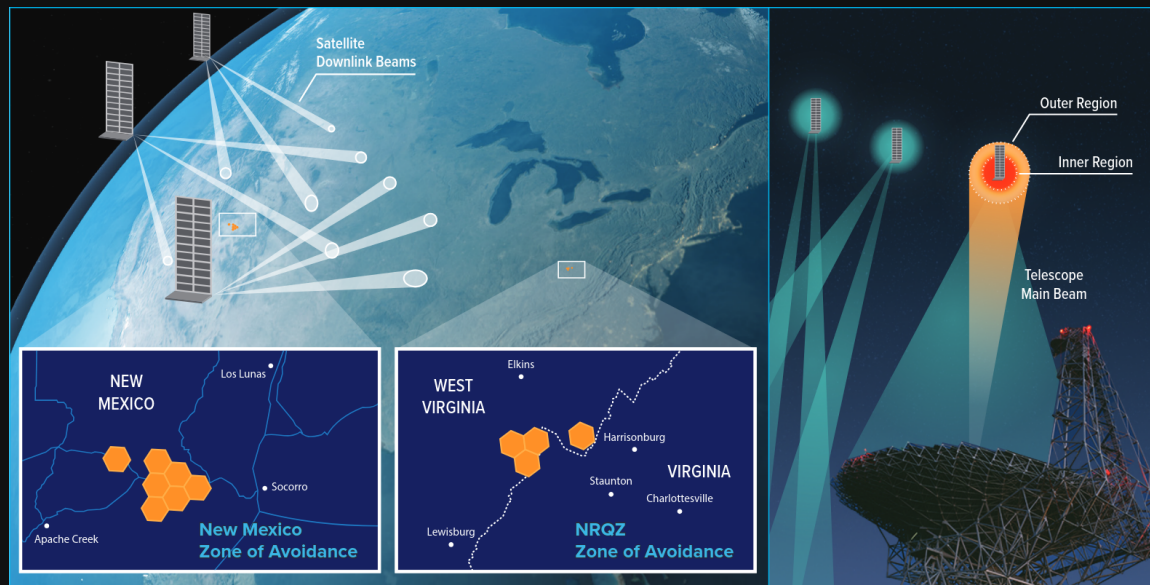
- Two angular thresholds:
  - Inner: Momentarily (~ 1-2 seconds) disable downlink
  - Outer: Place downlink beams far away

- **Frequency avoidance**

- Only downlink at subbands not being used by the telescope receivers

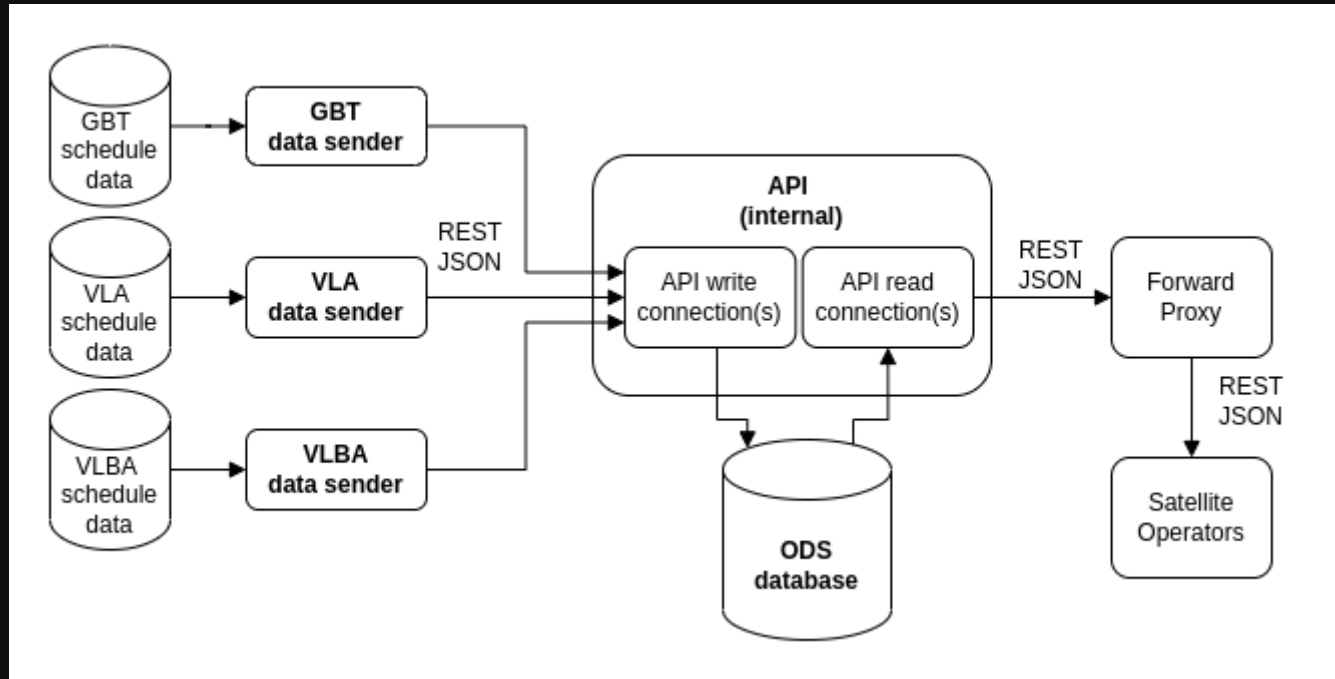


<https://new.nsf.gov/news/statement-nsf-astronomy-coordination-agreement>



Credit: NRAO/ESM/Paul Vosteen

# ODS software framework



GBT: Green Bank Telescope (West Virginia)

VLA: Very Large Array (New Mexico)

VLBA: Very Long Baseline Array (10 locations across the continental US & territories)

# ODS's REST API JSON data format

Provides information of upcoming observations in an array of JSON objects for observatories participating in the project.

## Response

200 Successful Operation - Returns array of JSON objects with these attributes:

## Description

| Attribute                | Type    | Format                     | Example                    | Description                                                                                                                                                                                                                                 |
|--------------------------|---------|----------------------------|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| site_id                  | string  |                            | vla_D                      | Identifier of the observatory/instrument. In the example 'D' indicates VLA 'D' configuration. The possible 'site_id's for the VLA are: vla_A, vla_A-to-D, vla_D, vla_D-to-C, vla_C, vla_C-to-B, vla_B, vla_B-to-BnA, vla_BnA, vla_BnA-to-A. |
| site_lat_deg             | number  | decimal-degrees +/- DD.D   | 34.07874917                | the latitude of the observatory/instrument                                                                                                                                                                                                  |
| site_lon_deg             | number  | decimal-degrees +/- DDD.D  | -107.6177275               | the longitude of the observatory/instrument                                                                                                                                                                                                 |
| site_el_m                | number  | decimal-meters             | 2124                       | the elevation of the observatory/instrument                                                                                                                                                                                                 |
| src_id                   | string  |                            | J1056+7011                 | identifier of source/target observed during time interval                                                                                                                                                                                   |
| src_is_pulsar_bool       | boolean |                            | false                      | true = src is a pulsar, false = src is not a pulsar                                                                                                                                                                                         |
| corr_integ_time_sec      | number  |                            | 3                          | correlator integration time in seconds (if 'src_is_pulsar_bool'=false)                                                                                                                                                                      |
| src_ra_j2000_deg         | number  | decimal-degrees            | 70.88181332916666          | right ascension of the source/target                                                                                                                                                                                                        |
| src_dec_j2000_deg        | number  | decimal-degrees            | 34.68518446944444          | declination of the source/target                                                                                                                                                                                                            |
| src_radius               | number  | decimal-degrees            | 0.0034                     | radius of beam around the source/target                                                                                                                                                                                                     |
| src_start_utc            | string  | date-time                  | 2023-08-16T15:23:47.000541 | start time of this observing interval                                                                                                                                                                                                       |
| src_end_utc              | string  | date-time                  | 2023-08-16T15:26:16.000723 | end time of this observing interval                                                                                                                                                                                                         |
| slew_sec                 | number  |                            | 130.8                      | the time taken for the array to reach the source (counted from 'src_start_utc')                                                                                                                                                             |
| trk_rate_dec_deg_per_sec | number  | decimal-degrees per second | 0                          | declination tracking rate of src (if not sidereal)                                                                                                                                                                                          |
| trk_rate_ra_deg_per_sec  | number  | decimal-degrees per second | 0                          | right ascension tracking rate of src (if not sidereal)                                                                                                                                                                                      |
| freq_lower_hz            | number  | decimal-Hz                 | 26000000000                | lower limit frequency used during this interval                                                                                                                                                                                             |
| freq_upper_hz            | number  | decimal-Hz                 | 40000000000                | upper limit frequency used during this interval                                                                                                                                                                                             |
| notes                    | string  |                            | inAdv:True                 | notes that add context to the data                                                                                                                                                                                                          |

404 Resource Not Available

500 Internal Server Error

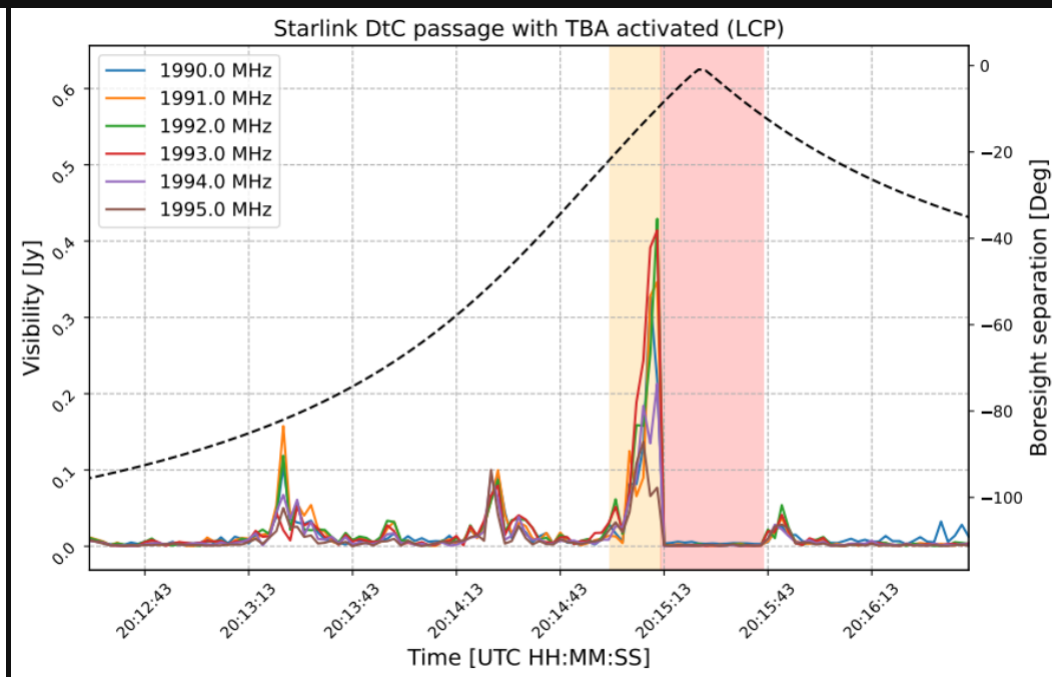
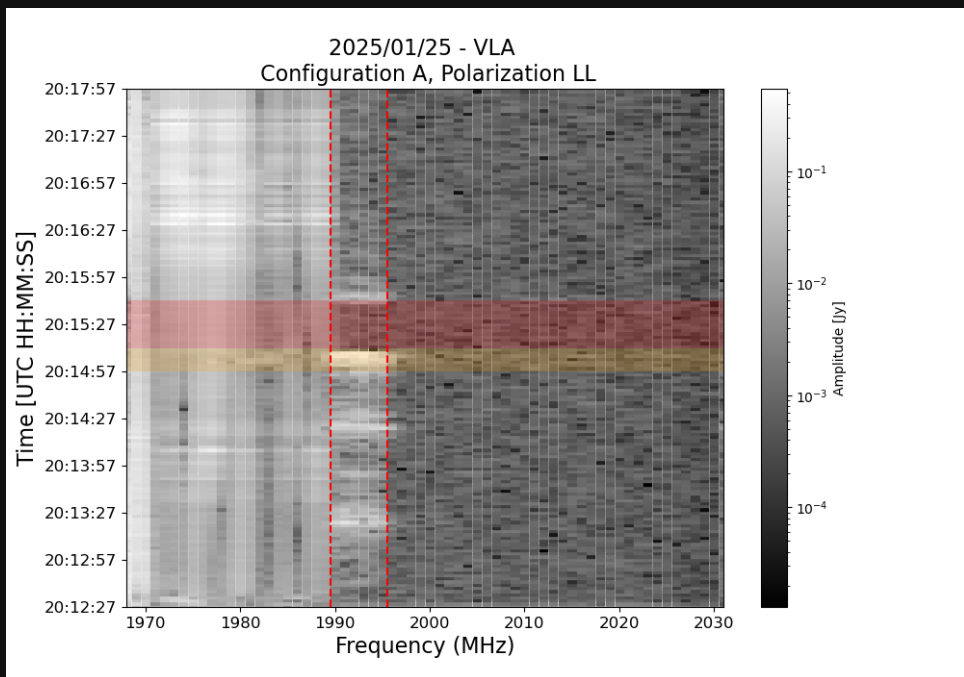
Where

When

What

Online documentation: <https://obs.vla.nrao.edu/ods/>

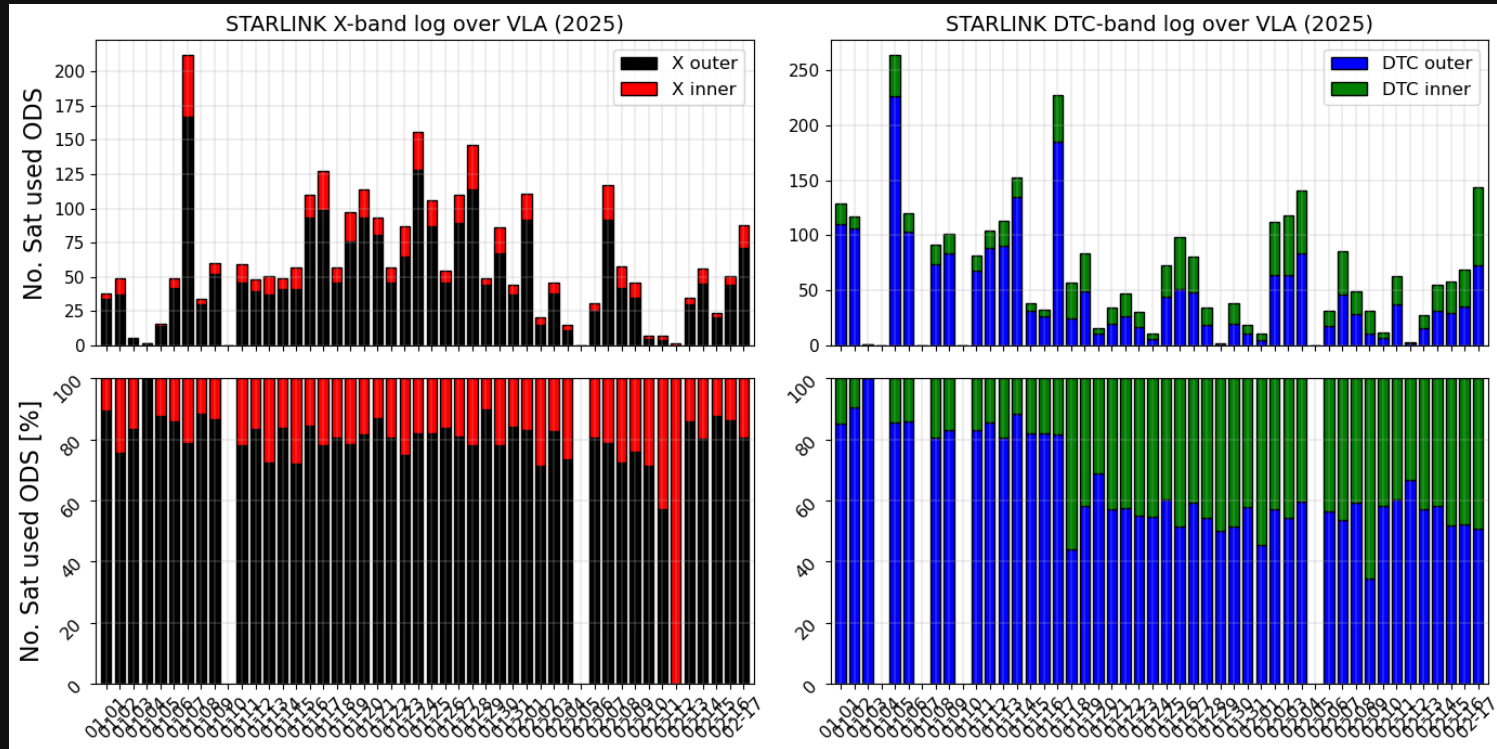
# VLA SCS (1990-1995 MHz) TBA example



Orange = Outer TBA  
(Downlink beam placed far away)  
Red = Inner TBA (DL disabled)

Nhan, et al. (2025), *IEEE Communication Mag*  
<https://arxiv.org/abs/2502.15068>

# VLA Starlink TBA logs (Jan & Feb 2025)



Nhan, et al. (2025), *IEEE Communication Mag*

<https://arxiv.org/abs/2502.15068>



# Current ODS community

- Hat Creek Radio Observatory (HCRO-ODS)
  - Telescope Boresight Avoidance (*TBA*) active with SpaceX
- CSIRO Australia Telescope National Facility (CSIRO-ODS)
  - *TBA* active with SpaceX
- MIT Haystack Observatory (Haystack-ODS)
  - *TBA* active with SpaceX
- Owens Valley Radio Observatory (OVRO-ODS)
  - Under development

# Current status

- ODS-VLA operational (X-band/Aug 2024, DTC/Jan 2025)
- Initial ODS test for 10 VLBA stations with SpaceX (19 Aug 2025)
- Improving reporting accuracy for GBT's X-band receiver users
- Transitioning the current Node.js (JavaScript) API to a new FastAPI (Python) server
- Adopting API token authentication from the current IP whitelisting for non-NRAO clients
- NSF held world-wide ODS workshop with non-US radio observatories (02 Jul 2025)
- NSF signed coordination agreement with Amazon Kuiper & AST SpaceMobile in 2025





[www.nrao.edu](http://www.nrao.edu)  
[science.nrao.edu](http://science.nrao.edu)

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