

Libre Space Foundation



SLIDE 1

Libre Space Foundation



SLIDE A

Satellite Hunting NORAD ID Assignment

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What is NORAD ID?

- 5 digit number
- We find it within Two Line Elements (TLE) set
- Catalog of NORAD IDs (and TLEs) generated by USSTRATCOM (United States Strategic Command) part of US Defense Department
- Catalog is maintained by 18th Space Control Squadron (18 SPCS) part of US Air Force



What is TLE set?

- Data format that encodes orbital elements and other info of a satellite in two lines of 70 chars.
- Actually there is a third line (Line 0 or Title Line) which contains the “Common Name” of the satellite.
- With TLE set and following one of the simplified perturbations models, like SGP4, we can calculate the position of satellite at a specific time.
- Fun Fact: TLE sets were affected by Y2K problem more about it at: <https://celestrak.com/columns/v04n03/#FAQ04>



How TLE set looks like?

0 ISS (ZARYA)

1 25544U 98067A 19282.43003472 .00001541 00000-0 34810-4 0 9996

2 25544 51.6447 154.7553 0007509 130.4610 229.6297 15.50184021192977



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```

- Common name
- NORAD ID
- International Designator (COSPAR)
- TLE Epoch



NORAD ID assignment stages

- Successful launch and deployment
- NORAD IDs generation for each of the launch by-products
 - It could take from a couple of hours to a couple of days
 - No common name in Line 0
- Satellite Owner/Operator finds the satellite's NORAD ID either by comparing satellite's Doppler shifted transmission to the expected one from TLE or by using satellite's telemetry data
- Satellite Owner/Operator informs the data provider (18 SPCS)
- The common name is now updated and shared with the rest of the TLE set



- Simple right? - Not at all!

- Deployment order doesn't follow NORAD IDs
- Satellite are not always fully functional
 - Never transmit
 - Fail after some transmissions
 - Work only in special conditions, like when on light, or over a specific area
- Satellite Owners/Operators misidentify satellites
- Satellite Owners/Operators don't have the ability to track and identify their satellite



Disclaimer

- There isn't any source of Truth due to the complicated nature of the problem
- The presented method doesn't use calculations with high accuracy



Process

We are going to compare waterfalls with Doppler shifted signal to the expected one when we use specific TLE.

Try to unwind TBEx-A and TBEx-B stories. Both launched by Falcon-Heavy b5 on 2019-06-25.



Tools

- SatNOGS Network to observe the satellite and get waterfall images
- Ikhnos - <https://gitlab.com/adamkalis/ikhnos>
 - Based on initial code that Cees Bassa (cgbassa) wrote
 - Changed to draw expected signal path over SatNOGS Network observation waterfalls
- Gpredict
- Satellite sites and Social Media
- IARU Amateur Satellite Frequency Coordination site



Demo Time!

Thank you!