Indian ASAT Test Post-Event Analysis

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India ASAT test occurred 27 March 2019

- Indian government announced “Mission Shakti” successful test of new ASAT weapon
- Reconstructed plausible scenario based on their disclosures and public data
- Key elements of information:
  - Time to intercept was less than 3 minutes
  - NOTAM blocked out area of Indian Ocean
    - Indicated Microsat-R satellite (282 km alt.)
      - Military imaging satellite mass of 740 kg
      - Launched January 2019
  - 18SPCS announced tracking of 250 debris
  - As of 3 May, orbital elements for 94 fragments have been published
Notice to Airman (NOTAM)

NAVAREA VII 248
CENTRAL BAY OF BENGAL AND NE INDIAN OCEAN
CHARTS IN 31.351 352 271 (INT 71).

1. EXPERIMENTAL FLIGHT TRIAL SCHEDULED FROM 27 TO 30 MAR 19 FROM 0630 UTC IN DANGER AREA BOUNDED BY
   2040 000N 00702E, 18067 02501E, 01462 00702E, 00702 093504E, 1833 00824621E, 2048 0090670601E. WIDE BERTH ADVISED.
2. CANCEL THIS MSG 300930 UTC MAR 19.

https://i.imgur.com/AYMhKBj.jpg
Representative scenario of intercept
18SPCS TLEs confirm assumed impact location

- First 58 TLEs released 5 Apr
- Cross-plane convergence of fragments consistent with our reconstructed time of 05:42 UTC
India published mission details 7 April
Note high apogees for some RSOs
Impact of Solar Cycle on debris lifetime

• Unfortunately “between” solar cycles #24 and #25, maximizing lifetime
Most pieces reenter within months, although some remain for a year or more.
Fragments tracked by 18th SPCS

Note high apogees for some RSOs
Fragments tracked by 18\textsuperscript{th} SPCS – 5 weeks later

ISS orbit shown for relative altitude comparison
Lifetime Analysis of tracked fragments

Indian ASAT Debris
Estimated Orbital Lifetime

Over 3 years
Potential effect on operational spacecraft

- Using its volumetric assessments and data, DREAD* tool flies active spacecraft through the fragment likelihood 3D characterization to assess spacecraft placed at greatest risk of secondary collision
- “Top 25” list correctly identifies Microsat-R (nice quality control check)
- Quite a few commercial CubeSat missions placed at risk
- ISS (ZARYA), SSC 25544, is #58 on the list

<table>
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<th>SSC</th>
<th>Intl Design</th>
<th>Integrated likelihood of fragment’s presence</th>
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* Debris Risk Evolution And Dispersal tool
Conclusions

• Both debris fragmentation modeling and post-event orbital data show
  – Debris spread different than was claimed
    • At least a dozen tracked, publically released pieces pushed into higher orbits, resulting in higher risk for operational spacecraft
  – Debris lifetime different than was claimed
    • Most debris will reenter within several months (not 6 weeks)
    • Some debris will be up for a year or more
Thank you and Questions ...

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