NEW CHALLENGES: ORBIT DETERMINATION, SPACE DEBRIS AND IONIC PROPULSION

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TRACKING FOR ORBIT DETERMINATION

- Classical ranging and pointing data systems
- Turn-around
- Two-Way Satellite Time and Frequency Transfer (TWSTFT)
- Global Navigation Satellite System
- Other types of navigation (landmarks, attitude sensors, ...)
- Telescopes and SLR
- (...)

Diagram showing satellite tracking through various methods.
TURN-AROUND

Ground Delays

Range Measurements

Transponder Delays
TWO-WAY SATELLITE TIME AND FREQUENCY TRANSFER (TWSTFT)
GLOBAL NAVIGATION SATELLITE SYSTEMS
TELESCOPES AND SATELLITE LASER RANGING
IONIC PROPULSION

- Cost/weight saving
- Complexity of operations. Need for more automation?
- Plans in manufacturers?
- Plans in operators?
- Plans affected by reduction in launch costs?
- Full ionic propulsion? Also applicable to orbit raising
A **disease** in space

- **Prevent** → Rules and recommendations (disposal)
- **Diagnose** → Cataloguing, conjunction prediction and collision risk assessment
- **Recover** → Active Debris Removal and In-Orbit Servicing

 Growing population, growing risk → *Kessler syndrome*

 Risk in GEO → librating objects, high area-to-mass ratio objects, etc

 But... do GEO operators care about the risk?

 Existing services: JSpOC, SDA, ESA (almost there...)

**SPACE DEBRIS**
IN-ORBIT SERVICING

- A real credible alternative? Not trivial!
- Many concepts proposed... None operating
- Still new concepts appear
- Strong synergies with **Active Debris Removal**
- Legal aspects
- Viability?
- Agencies? Operators? Manufacturers?
ORBIT DISPOSAL

- Protected regions in space
- Graveyard orbits in GEO
- Not unique regulation
- Many recommendations
- IADC and UN-CUPOUS initiatives
- Disposal strategies
Thank you