Hispasat and Electric Propulsion

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Hispasat and Electric Propulsion

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1. About Hispasat
2. Impact of electric propulsion in geostationary operations
3. Present and future of electric propulsion in GEO platforms

About Hispasat

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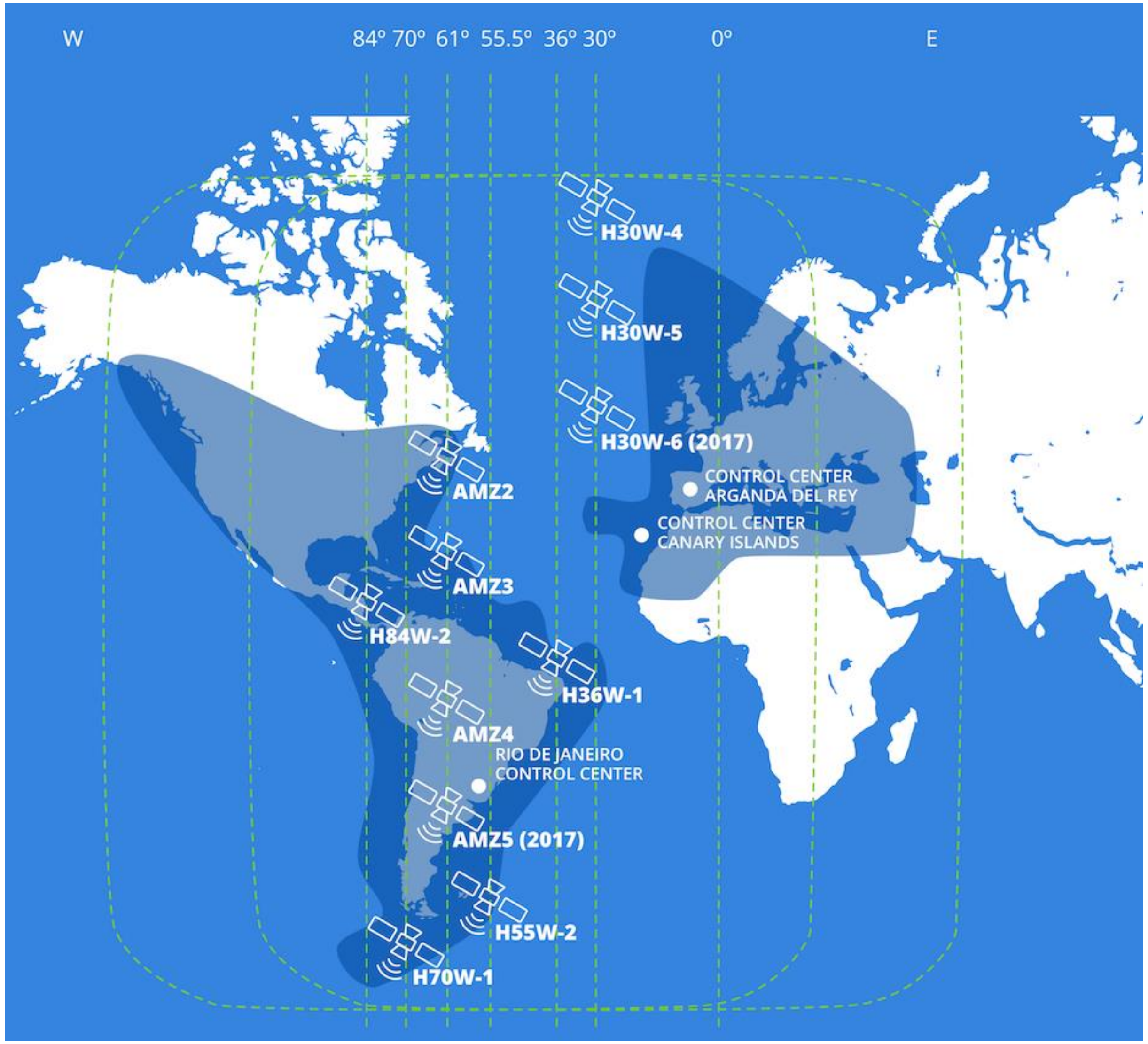
About Hispasat

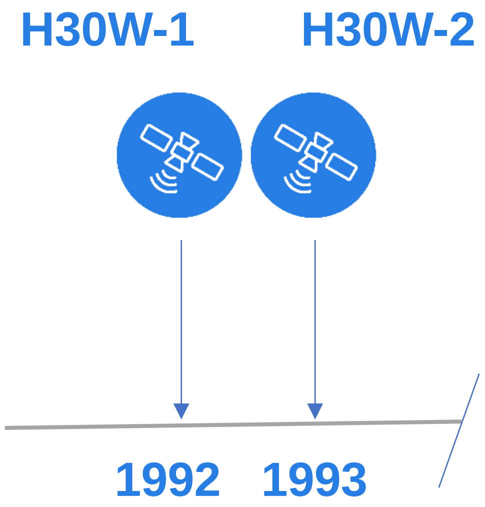
Main facts

- Satellite communications operator with a significant presence in the Iberian Peninsula and Latin America.
- Leader in broadcasting of contents in Spanish and Portuguese.
- More than 1,250 TV and radio channels, including major DTH platforms.
- Driving force behind the Spanish aerospace industry.

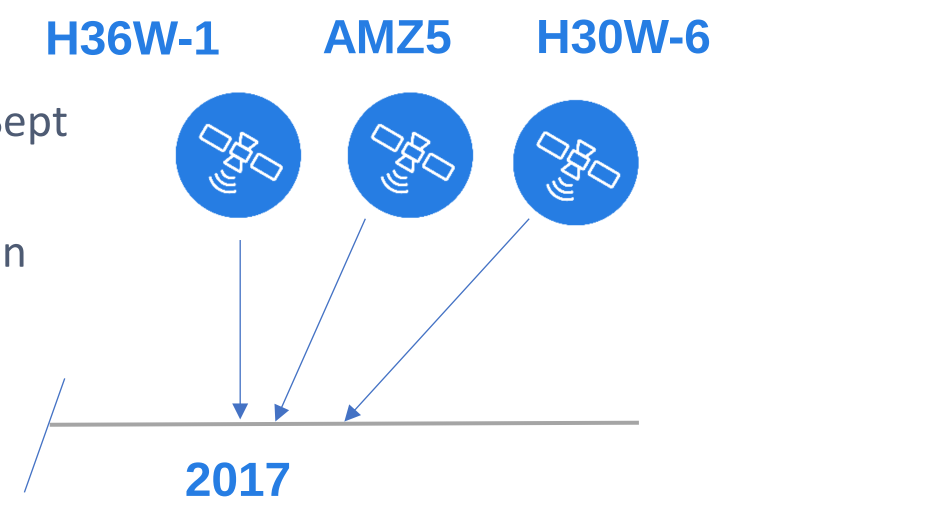


About Hispasat

Hispasat fleet



- 1st Hispasat satellite launched in Sept 1992
- 1st satellite with electric propulsion launched in Jan 2017



About Hispasat

Hispasat fleet: electric platforms

H36W-1

- Developed by OHB System AG with the European Space Agency and HISPASAT
- First mission of the SmallGEO platform
- **8 SPTs- 100 fixed to the bus**
- 6 manoeuvers per day using 4 different SPTs
- Launched January 2017: 1st Soyuz mission to GTO

AMZ5 & H30W-6

- Developed by Space Systems Loral
- Based on SSL 1300 Omega 3 platform
- **4 SPTs- 100 mounted on 2 articulated booms**
- 2 manoeuvers per day using 2 different SPTs
- AMZ5 launched in Sept 2017 (Proton)
- H30W-6 scheduled for end of 2017 (Falcon 9)

Operational impact of Electric Propulsion

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- Main differences
- Flight dynamics
- Localization
- Manoeuver monitoring

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Operational impact of Electric Propulsion

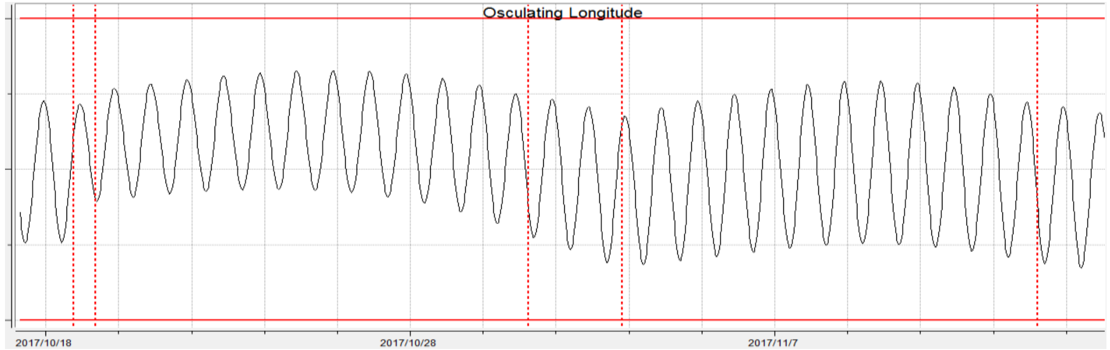
Main differences

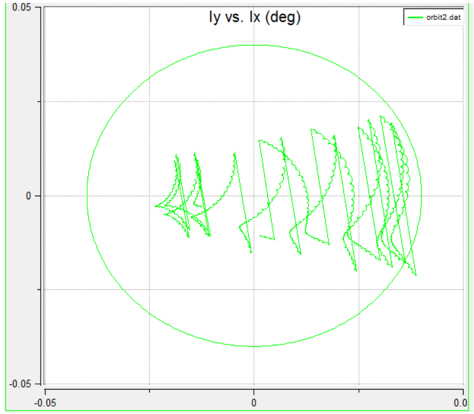
Bi-propellant -> High thrust	Electric -> Low thrust
• Short manoeuvres ~5-10 minutes • 2-3 manoeuvres every 2 weeks • Uncoupled longitude and inclination corrections • Different manoeuvres and thrusters for EW and NS • High torque -> potential impact on attitude	• Long manoeuvers ~20-40 min • Manoeuvres every day, up to 6 per day • Coupled effect: longitude and inclination corrected at the same time • Low torque -> small impact on attitude

Operational impact of Electric Propulsion

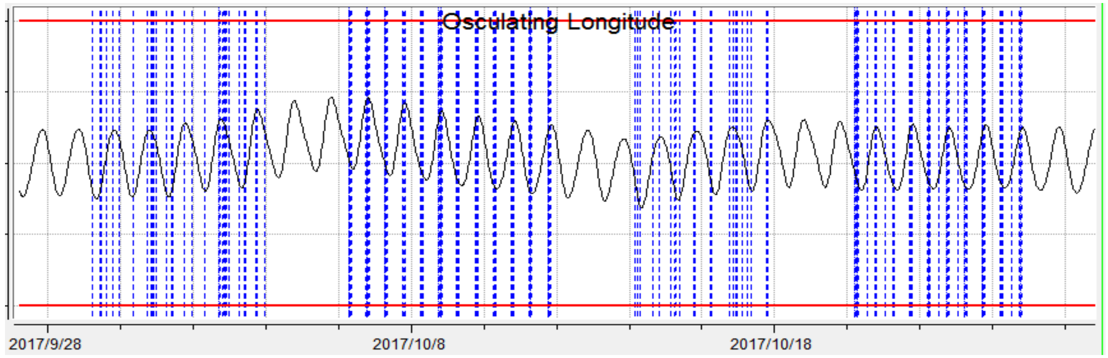
Flight dynamics

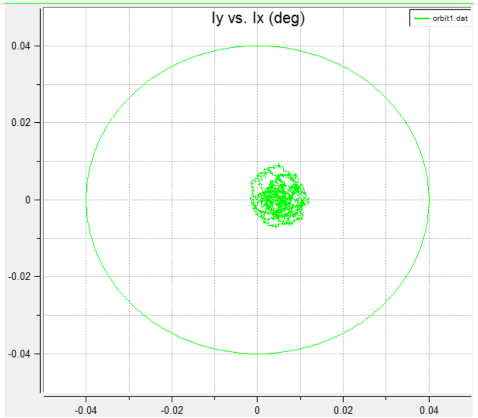
- Coupled corrections require more complex FLD algorithms (non-linear optimization)
- Possible to control to tighter limits without penalty





Bi-prop



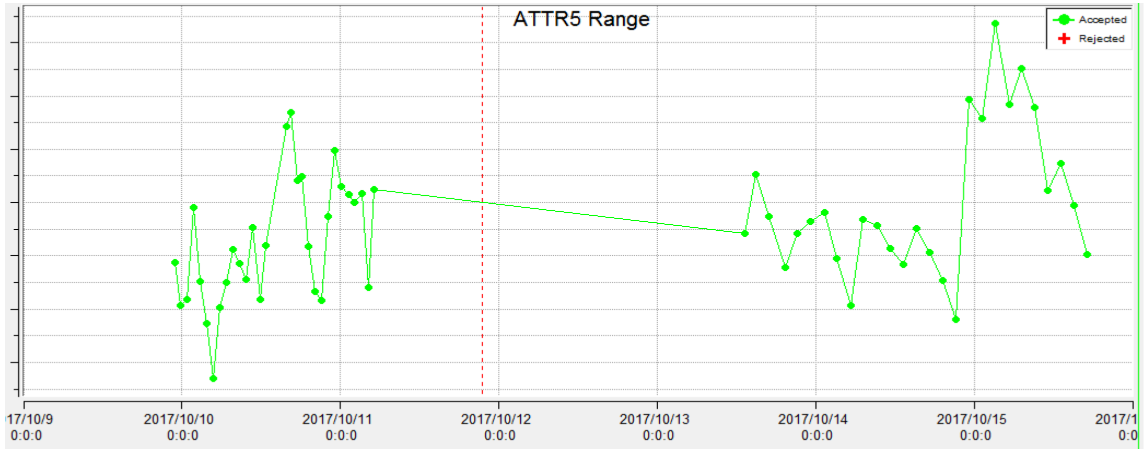


Electric

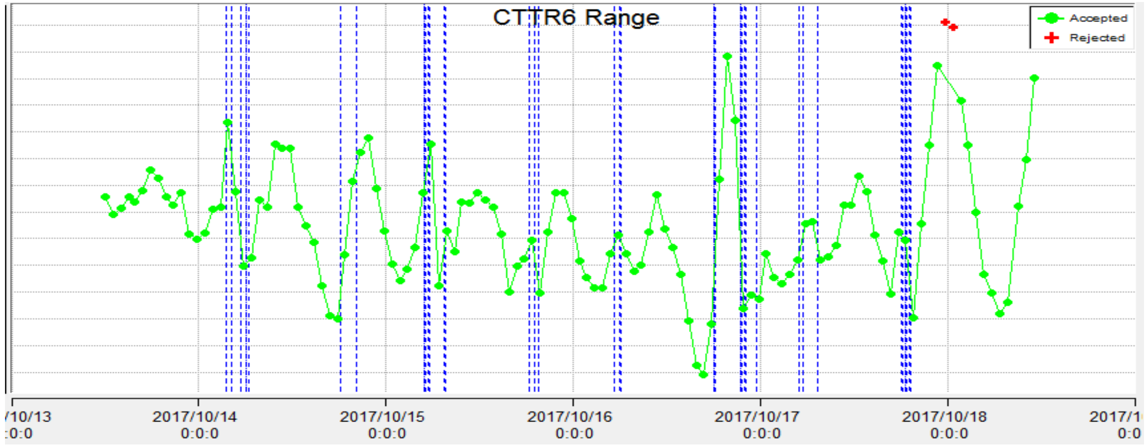
Operational impact of Electric Propulsion

Localization / orbit determination

- Manoeuvers every day requires continuous tracking of the satellite position
- From ranging campaigns to continuous ranging
- Evaluation of manoeuver and thruster performances is not deterministic -> statistical methods



Bi-prop

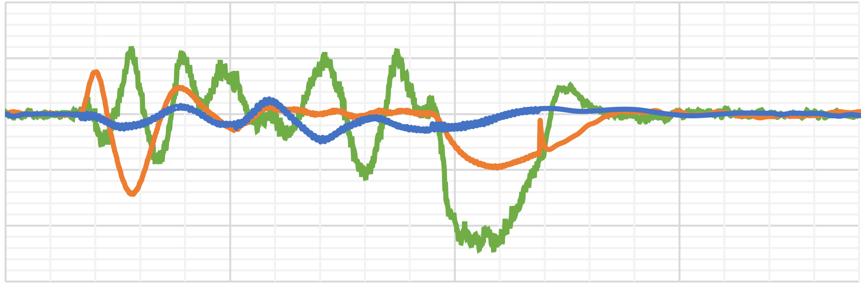


Electric

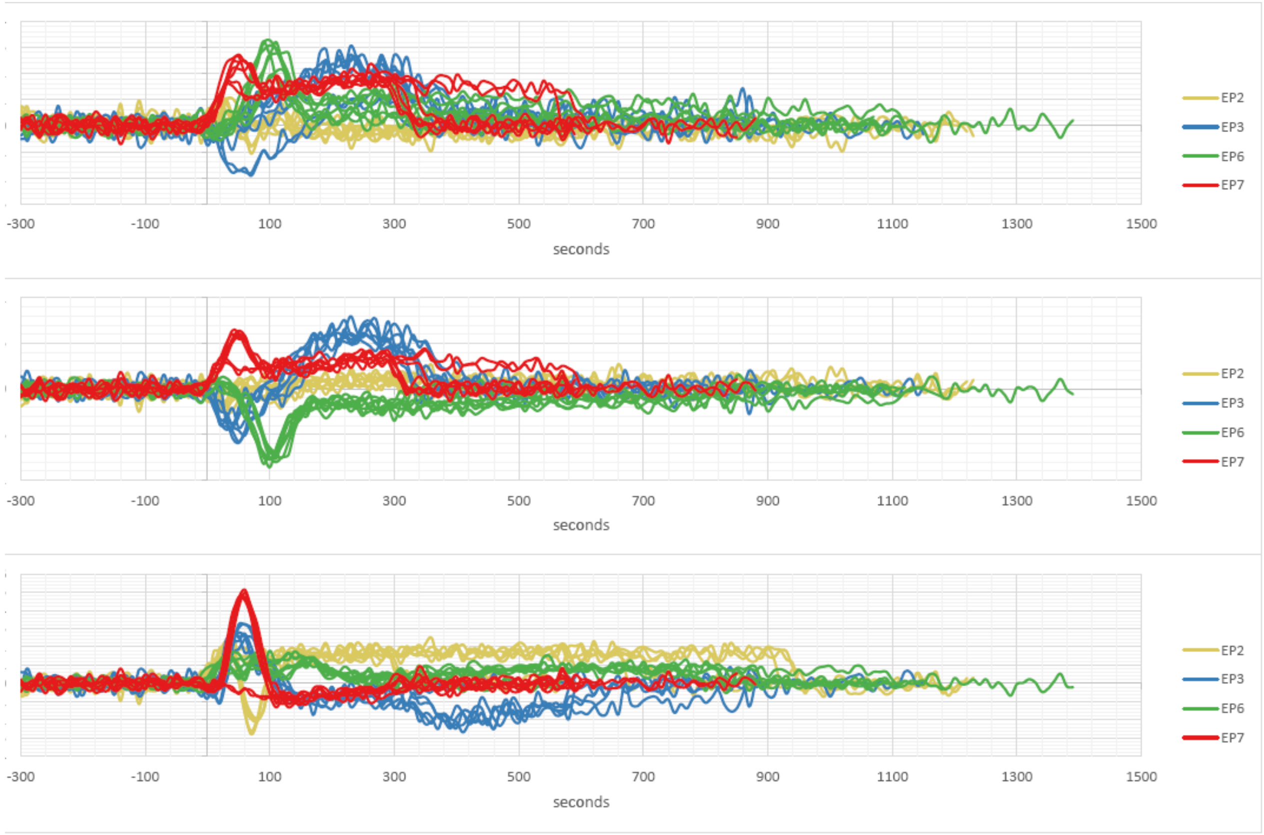
Operational impact of Electric Propulsion

Manoeuver monitoring

- Real-time monitoring becomes less critical
- Amount of data to be processed and monitored increases
- More automation and new ways of visualizing data



Bi-prop



Electric

Present and future of electric propulsion in GEO platforms

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Present and future of electric propulsion in GEO platforms

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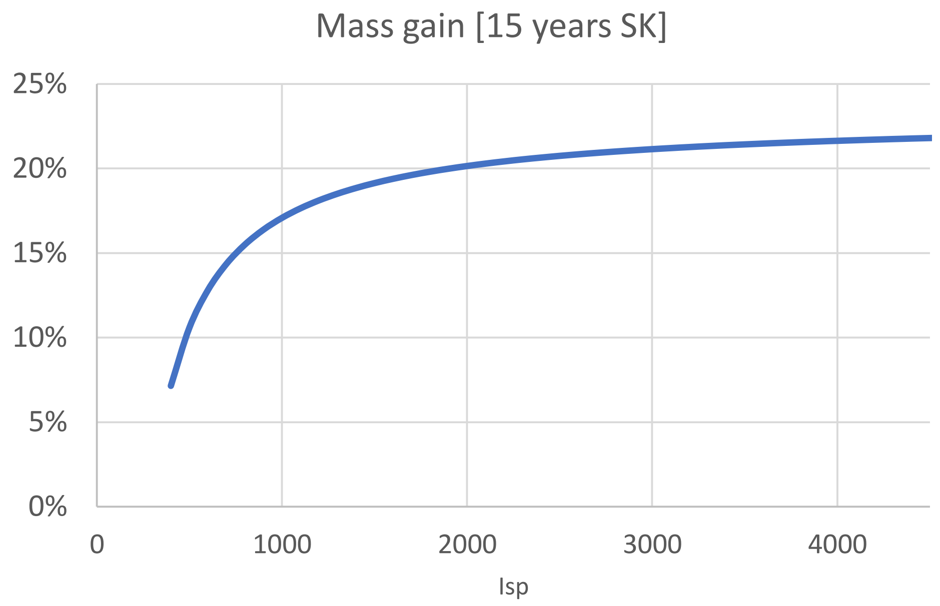
Hybrid satellites

- Evolution of all bi-prop satellites
- Bi-prop LEOP
- Electric thrusters added (extra dry mass) for stationkeeping
- Potential mass gains ~ 20 %
  - Allows less performance launchers (i.e Falcon 9) to compete in the mid-sized geosynchronous satellite range
  - Typically not all the mass gain is used -> extra orbit manoeuvre lifetime



Present and future of electric propulsion in GEO platforms

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All-electric satellites: Electric orbit raising

- Potential mass gain from **GTO** ~ 50 %
- Potential mass gain from **LEO**: above 100 %
- Main drawback: mission duration
- A reasonable transfer duration can be easily accommodated in some cases (i.e. replacement satellites)
- Not suited for applications where time to market is critical

		GTO	GEO	Dry Mass	
Ariane 5	Up	**6000** kg	3600 kg	**2700** kg	Bi-prop
	Low	**3500** kg	2900 kg	**2800** kg	Electric

Present and future of electric propulsion in GEO platforms

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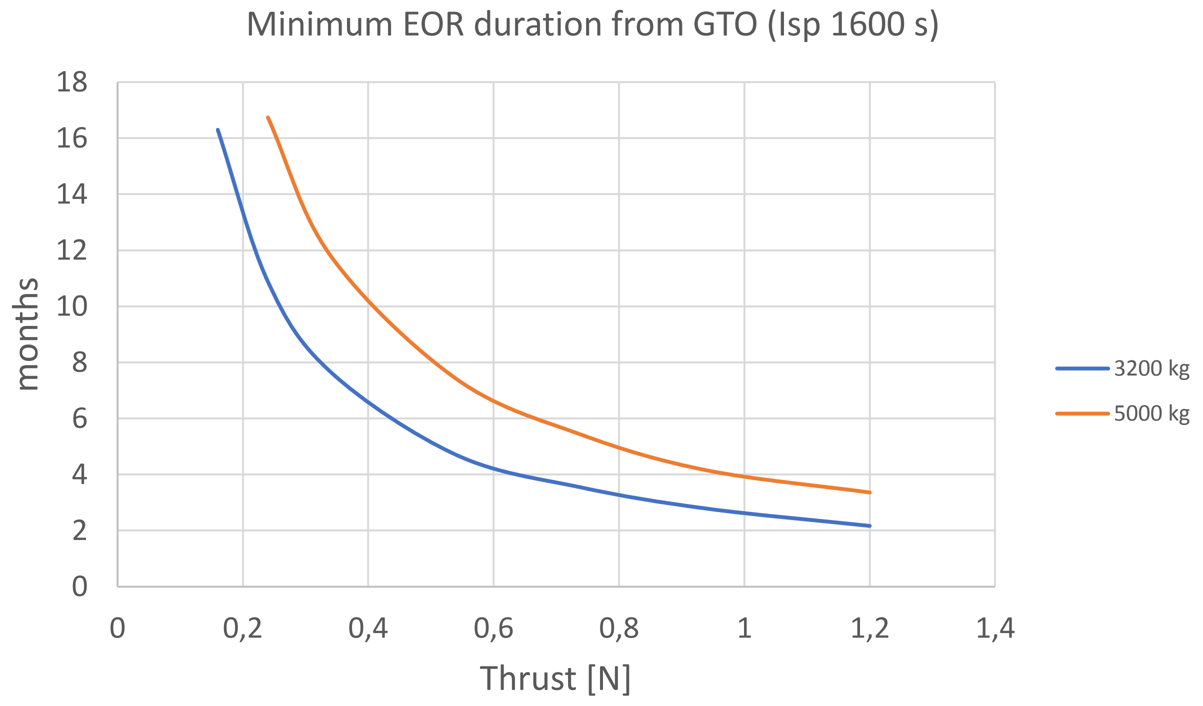
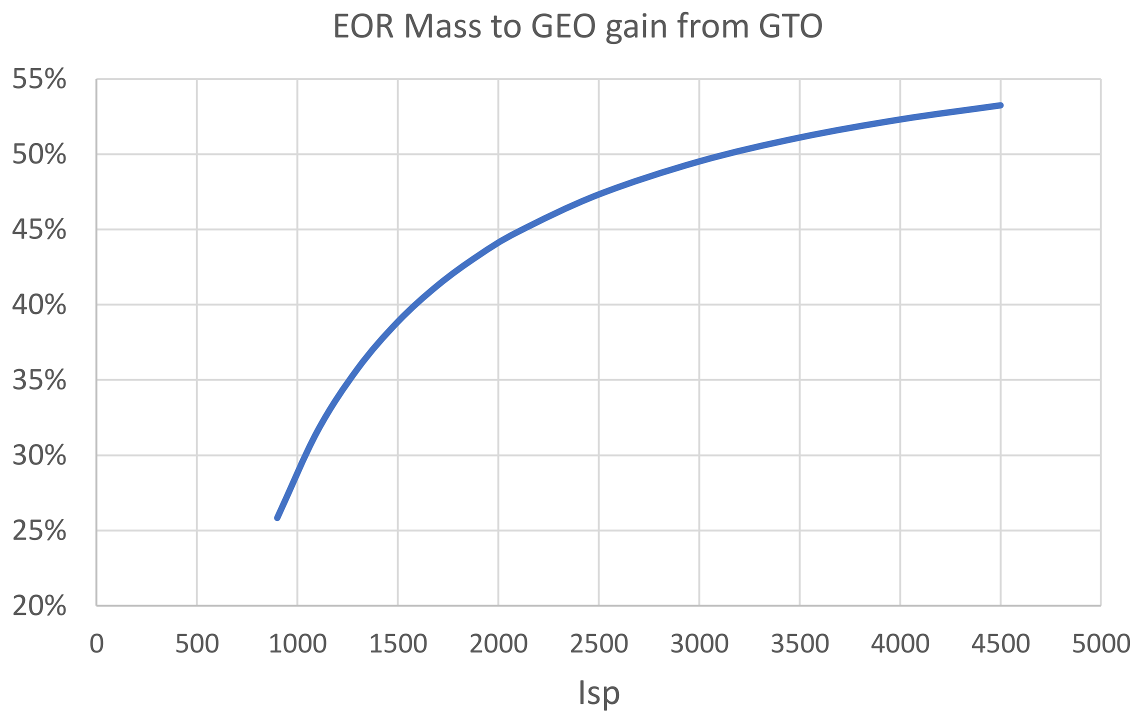
All-electric satellites: Electric orbit raising





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Conclusions

- Electric propulsion is a successful way to enhance competitiveness of GEO satellites
  - **More operational lifetime**
    - Not very interesting beyond ~20 years
  - **Higher payload mass**
    - Interesting for some applications (VHTS, replacement satellites)
  - **Lower launch mass**
    - Possibility of using smaller and less expensive launchers
- Current state of the art is adequate for station keeping
- Improving thrust-to-power ration would have great impact on electric orbit raising
  - Minimizing transfer duration
  - Allowing injection in lower orbits

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