

A close-up, high-magnification photograph of a propellant nozzle. The nozzle is cylindrical and features a series of concentric rings or grooves around its central opening. The surface appears metallic and slightly worn. The background is a blurred, light-colored surface.

Nanosat propulsion systems

Technologies, Applications, Impacts

Innovative Solutions In Space

the nanosatellite specialist



Established in 2006

Small satellite company (1 – 30 kg)

Vertically integrated organization

- Research and development
- Components and subsystem production
- Satellite mission design and implementation
- Satellite launch services
- Satellite operations

- >80 FTE based in Delft, The Netherlands



Satellite solutions

Launch services

R&D and services

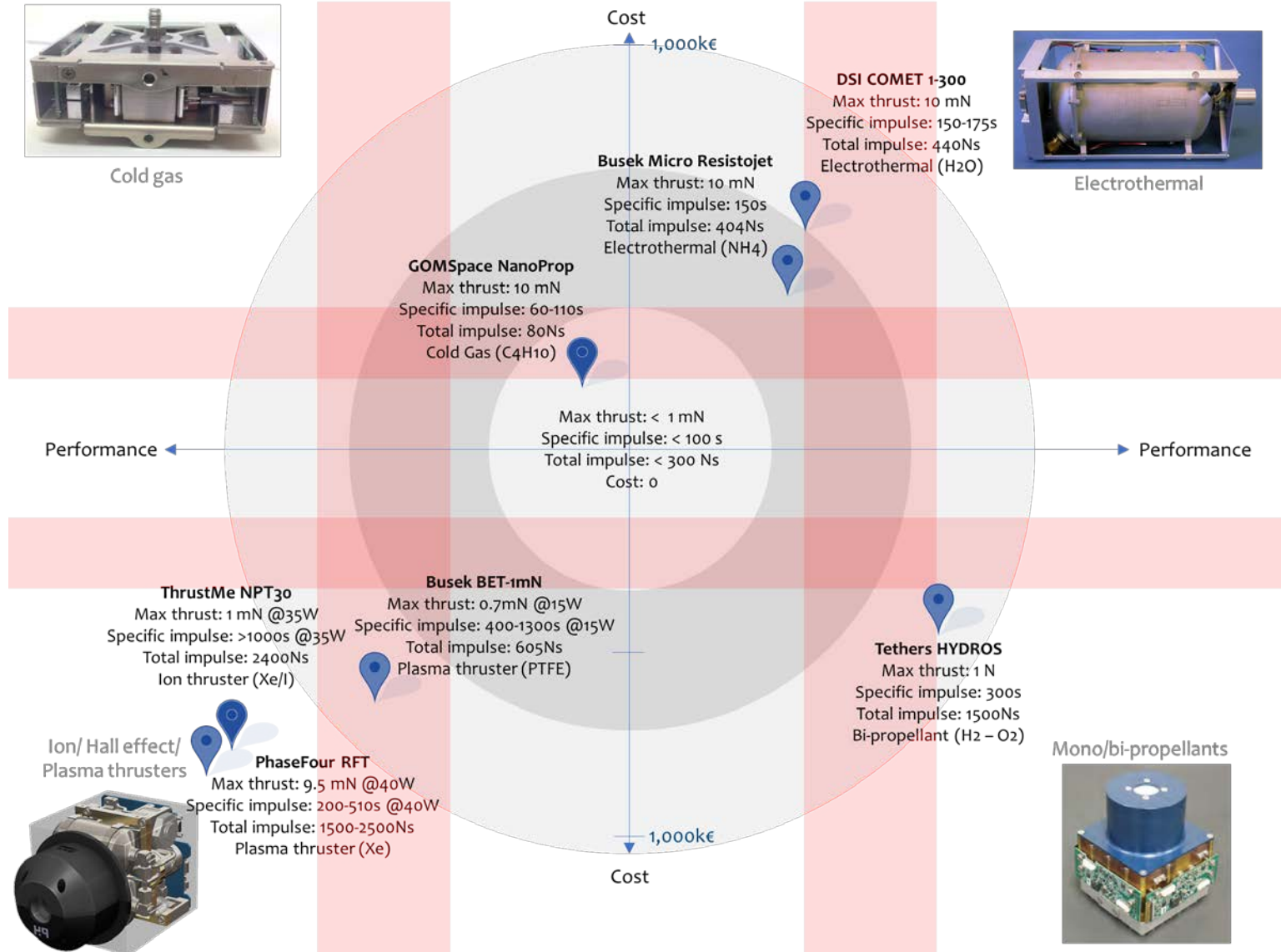
Products



Nanosatellite Propulsion Systems



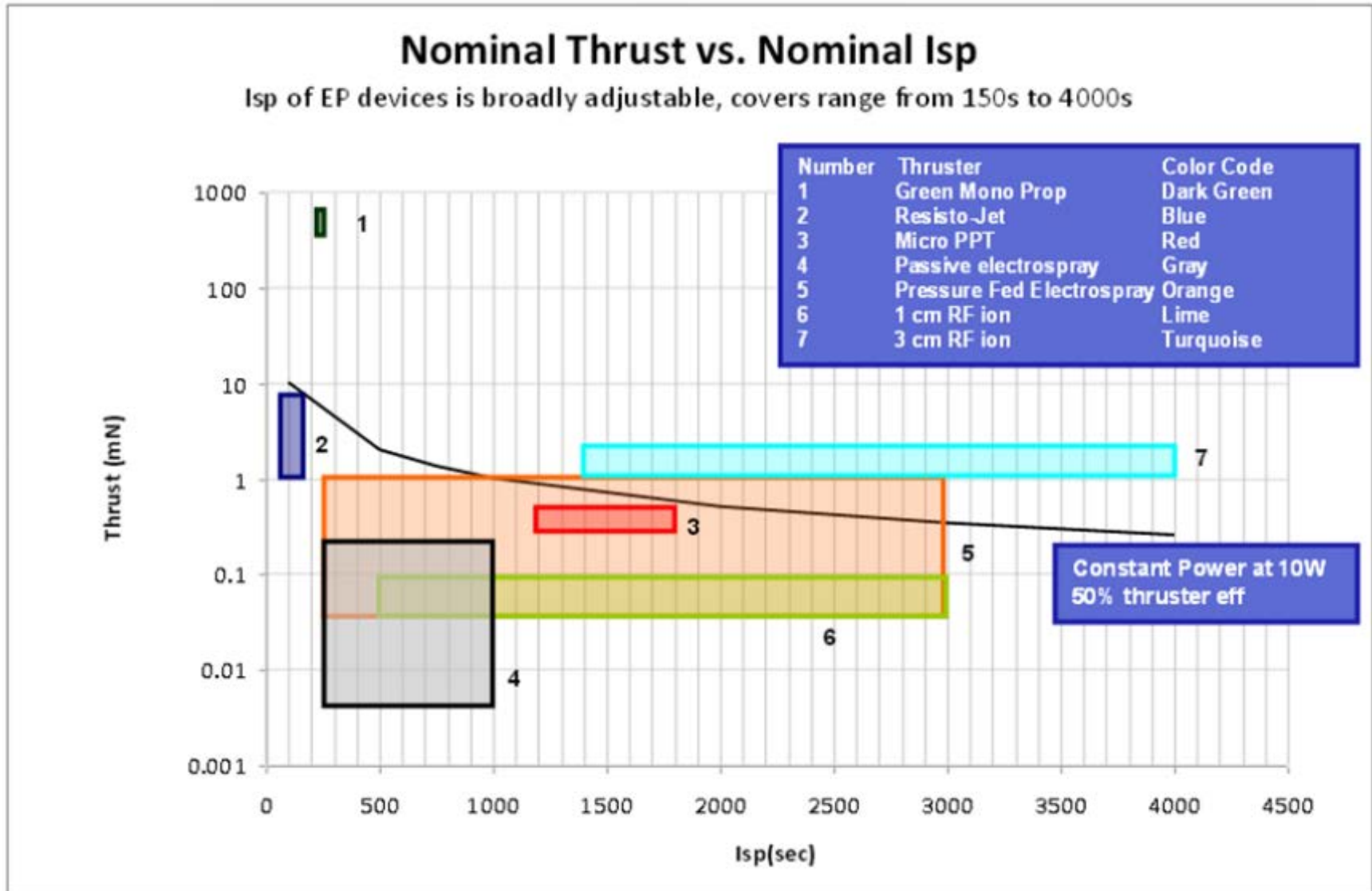
“Available” technologies



Nanosatellite Propulsion Systems



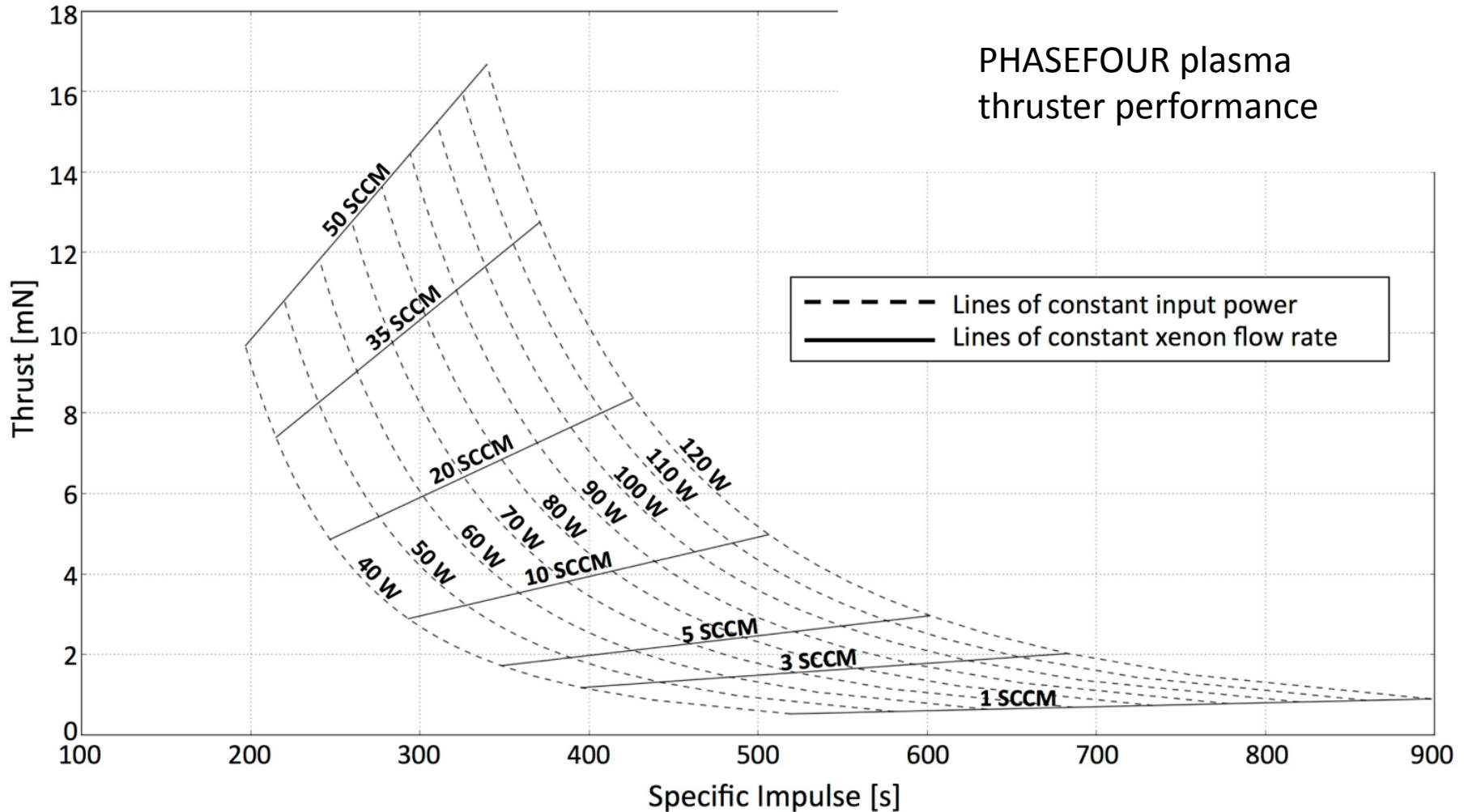
Technologies



Nanosatellite Propulsion Systems



Technologies



Nanosatellite Propulsion Systems



Typical applications

- Orbit change (e.g. Launcher injection correction)
 - Higher thrust reduces commissioning time, Isp not critical
- Constellation phase acquisition
 - Higher thrust reduces commissioning time, Isp not critical
- Constellation phase maintenance
 - Preferably high Isp to extend lifetime, thrust not critical
- Altitude maintenance
 - Preferably high Isp to extend lifetime, thrust not critical
- End of Life De-orbit
 - High thrust to reduce lifetime quickly, Isp not critical, reliability crucial
- Attitude control (e.g. wheel desaturation in non-LEO missions)
 - High Isp to extend lifetime, low impulse bit required for accuracy, multiple thrusters
- Rendezvous and docking, close formation flying
 - High Isp to extend lifetime, low impulse bit required for accuracy, multiple thrusters

e. Inspector mission requires these 3

Impacts

- Propulsion systems can have a large impact on platform resources
 - Power, requiring large batteries for pulses or increase solar arrays
 - Thermal, generated heat needs to be dissipated which is especially an issue for smaller platforms
 - EMC, pulsed behaviour of electric propulsion units do not allow these systems to be as “plug and play” as advertised
 - Attitude control, higher thrust systems cause large attitude disturbance
 - Mechanical configuration, the thrust vector preferably points through the spacecraft CoG

Nanosatellite Propulsion Systems



Impacts

- Also consider integration and launch
 - Launch site activities are minimal for cluster launches
 - Safety issues for launches through ISS (restrictions on pressurised volumes)



Nanosatellite Propulsion Systems



ISIS examples

- ISIS-APP-TNO Nanosatellite Kickstage for de-orbit

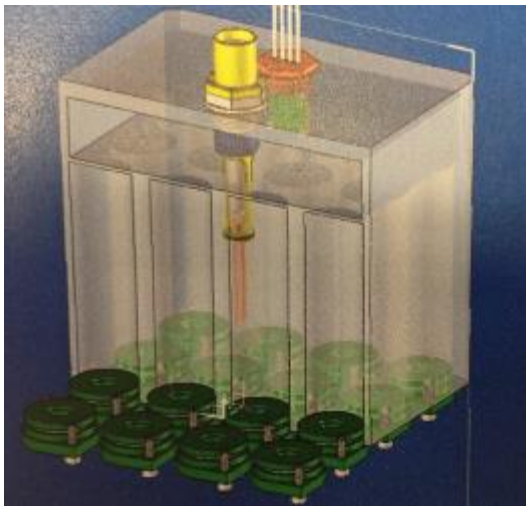


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ISIS examples

- ISIS-Hyperion-TNO TKI resistojet development
 - Using N₂ (possibly in cool-gas generators) or other inert gases
 - Achieve a high I_{sp} (close to 200 s) with a medium thrust of 10 mN and reasonable DC power (<30 W)
 - 40 m/s to a 6U using 1U for the propulsion system

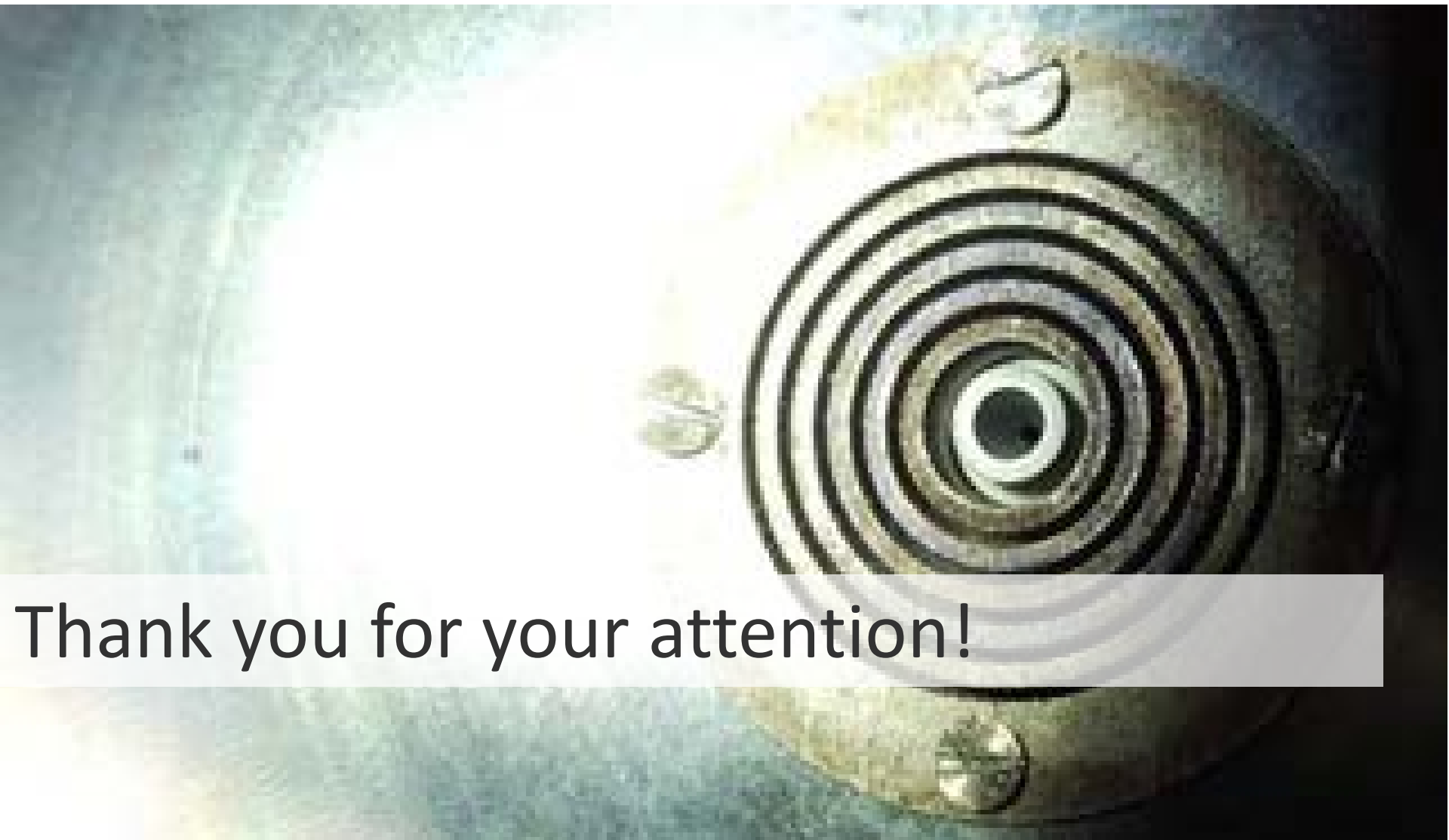


Nanosatellite Propulsion Systems



Conclusions

- A lot of activity ongoing in developing propulsion systems for nanosatellite missions
 - Using different technologies
- Different applications require different technologies
- Propulsion systems have significant impacts to a satellite mission



Thank you for your attention!