

SAFRAN ELECTRONICS & DEFENSE EPIC MADRID OCT. 2017

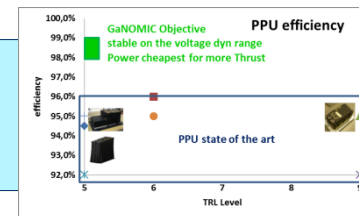
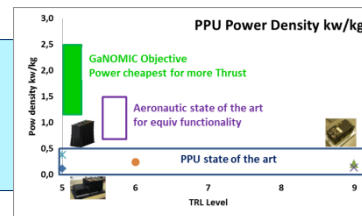
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Status of Electrical Propulsion (EP)

Current generation EP

- ✓ **HET plasmic: 5 kW / 300 V** 
- ✓ **IONIC: 5 kW / 2000 V**
- ✓ **HEMPT plasmic: 2 kW / 1000 V**



Next generation EP

- **Applications:** GEO, Exploration, Space tugs

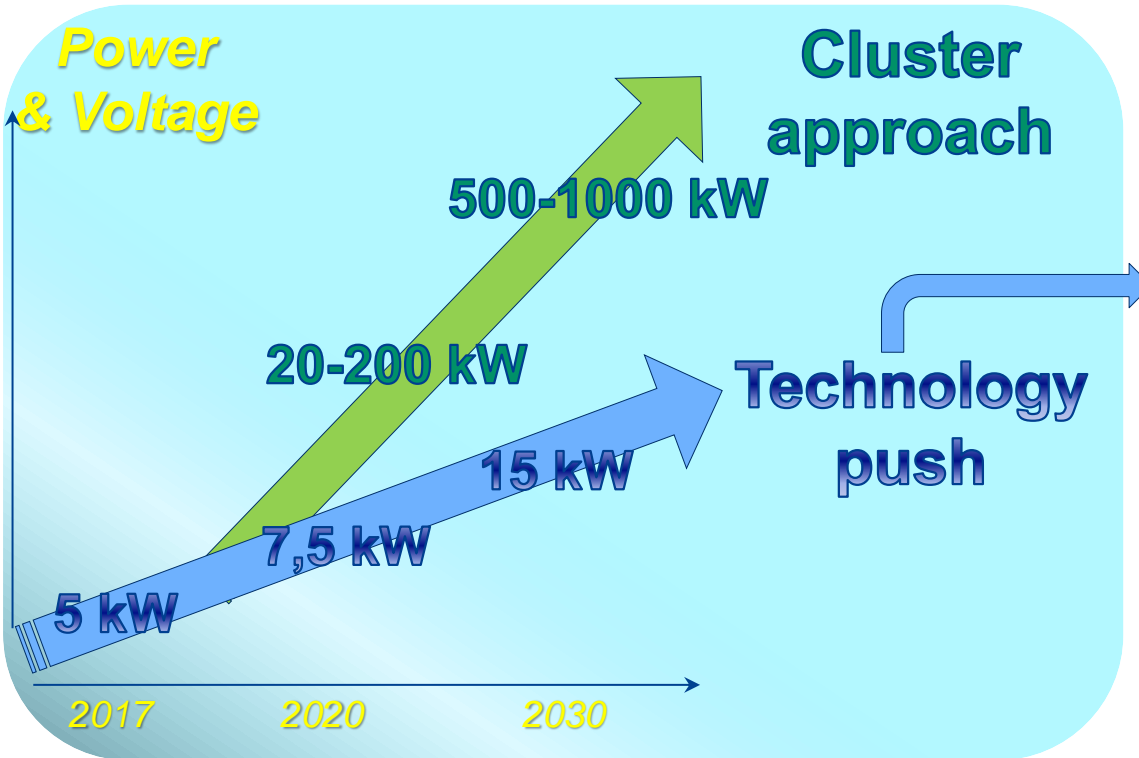
- ✓ **EU research** H2020~H2024
 - ◆ GaNOMIC: **7,5 kW / 650 V**
 - Democritos: cluster **10 x 20 kW / 540 V** (up to 5 times, 1 MW)

- ✓ **NASA projects**, Solar Electric Propulsion
 - **13 kW HET** → 2019
 - **50 kW HET** → 2020 (Deep Space Gateway, lunar orbit)
 - **200-500 kW** → 2030-2040 (Deep Space Transport)
 - HET modules 10-15 kW, and/or ionic propulsion



Status of Electrical Propulsion (EP)

- General trend: drastic increase of power & voltage



Drivers for technology gaps:

Mass & Thermal dissipation & Cost

Technological requirements:

Density & Efficiency & Dynamic range

- Power density & efficiency
 - *mass/volume*
 - *cost*
- Dynamic range
 - *flexibility of mission*
 - *platforms architectures*
 - *cost*

Technological & modular mid term achievable roadmaps

• Technology

- Power density & power efficiency
 - new power switches topologies
 - new semiconductors: GaN, SiC
 - new inductance technologies: planar, magnetic materials
- Thermal management
 - new packaging: dissipation constraints in switches design, System In Package and embedded 3D-packaging
- Cost
 - dual-application technologies with aeronautical mass production
 - power modules

• EU Challenges / New Space

- Reliability and robustness of new EEE parts (GaN, connectors, ...)
- Specific derating rules

• Architectures



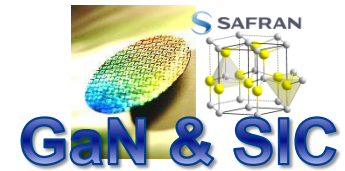
2017



2020



2030



Micropackaging SIP



Aero mass production

