

EXOTRAIL



Agile Space

Déjeuner - Pitch - Supaero

Paul LASCOMBES

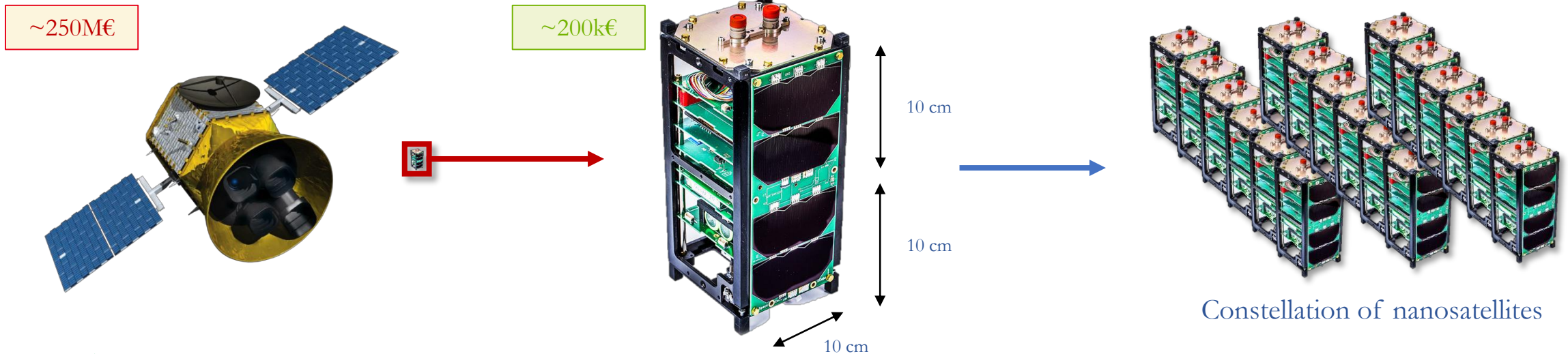
Mai 2017

paul.lascombes@exotrail.com

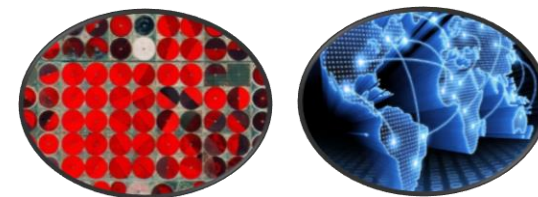


The “New Space” Industry

Miniaturization of spacecraft is leading to new space-based services



- ✓ Reduction of size
- ✓ Decrease in costs
- ✓ Use of constellation
- ✗ Lack of propulsion



Remote sensing
Earth Observation
Daily revisit

IoT / Internet
connectivity
Worldwide coverage

CAGR 19% (2016-2022)

Possibilities of small satellites are constrained

The lack of a suitable propulsion system limits the performances of these constellations

✘ Launch constraints

✘ Lack of agility

✘ Limited lifespan

✘ Space pollution



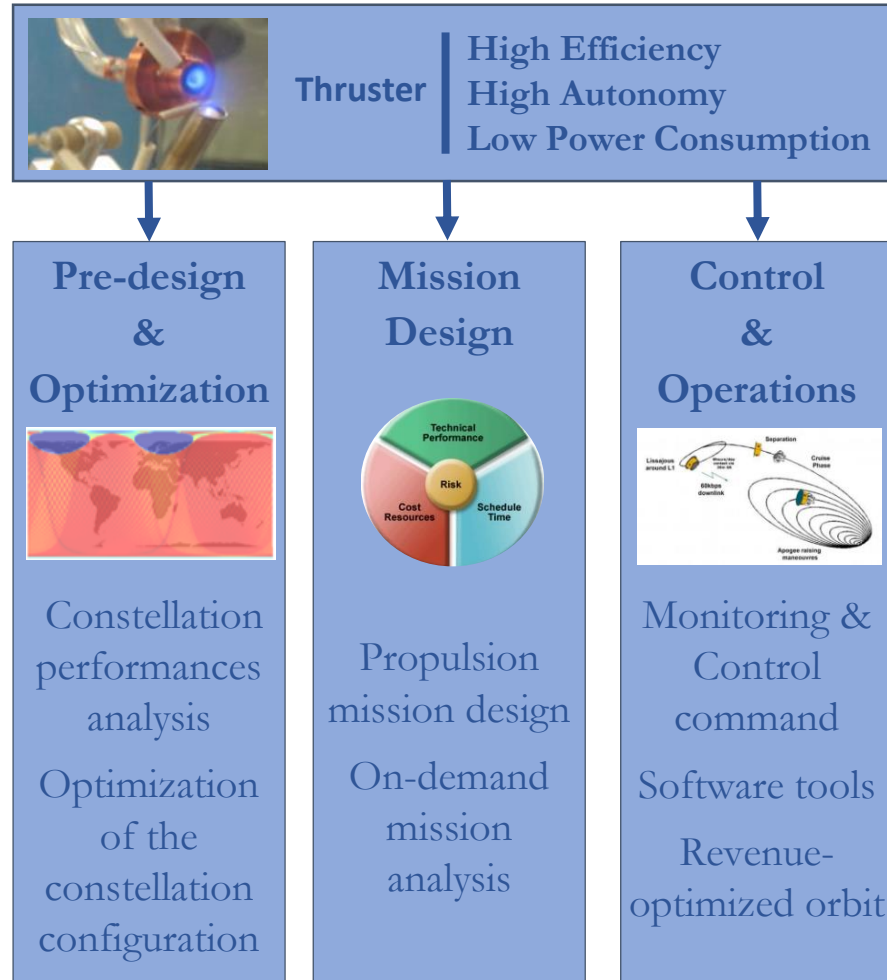
Suboptimal performances



Suboptimal costs

Our solution

An integrated propulsion service



An **efficient** and **integrated** solution to enhance small satellites constellations performances

“**Business finder**” role of the pre-design offer

A **profitable** business model:
we don't sell only a hardware product,
we sell a service

The value of propulsion

The value proposition of propulsion solves customers most important requirements

➤ Increase lifespan <500 km
→ *higher resolution*

➤ Reach altitude >600 km
→ *better coverage*

➤ Launch flexibility
→ *Shorter development time*

➤ Increase performances
→ *Better products*

➤ Avoid space debris
→ *International regulations*

✓ Drag compensation

✓ Altitude change

✓ Post-launch maneuvers

✓ Phasing & orbital optimization

✓ Deorbitation

Our technology

Expected performances and how we differentiate from competition

Expected performances (prototype):

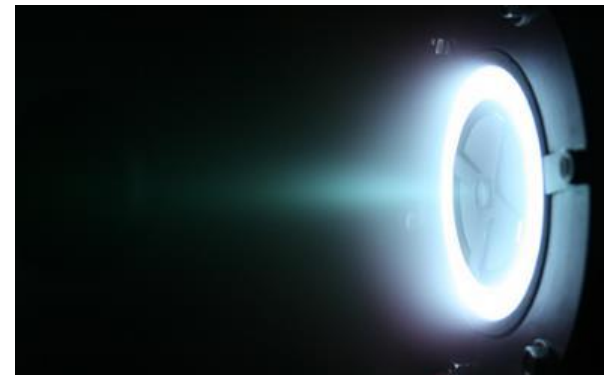
- ✓ Low electric consumption : <math>< 30\text{W}</math>
- ✓ Thrust range : 0,5mN (adjustable)
- ✓ High Total Impulse : >2000 N.s, adjustable
- ✓ Low volume: <math>< 1\text{U}</math> (10x10x10 cm)
- ✓ Low weight: <math>< 1\text{kg}</math>
- ✓ Low price : <math>< 15\text{-}20\%</math> of the satellite cost



Product performances will be improved and easily scalable

Development stage and IP :

- **Current TRL: 4. Objective 6 beginning of 2018**
- Protected by one patent and several know-how that will be **exclusively licensed to Exotrail**



HET (200W) as described in the 2007 patent CNRS/UVSQ/CNES



20W prototype (on going)

Competition











Main differentiators & competitors

Differentiators

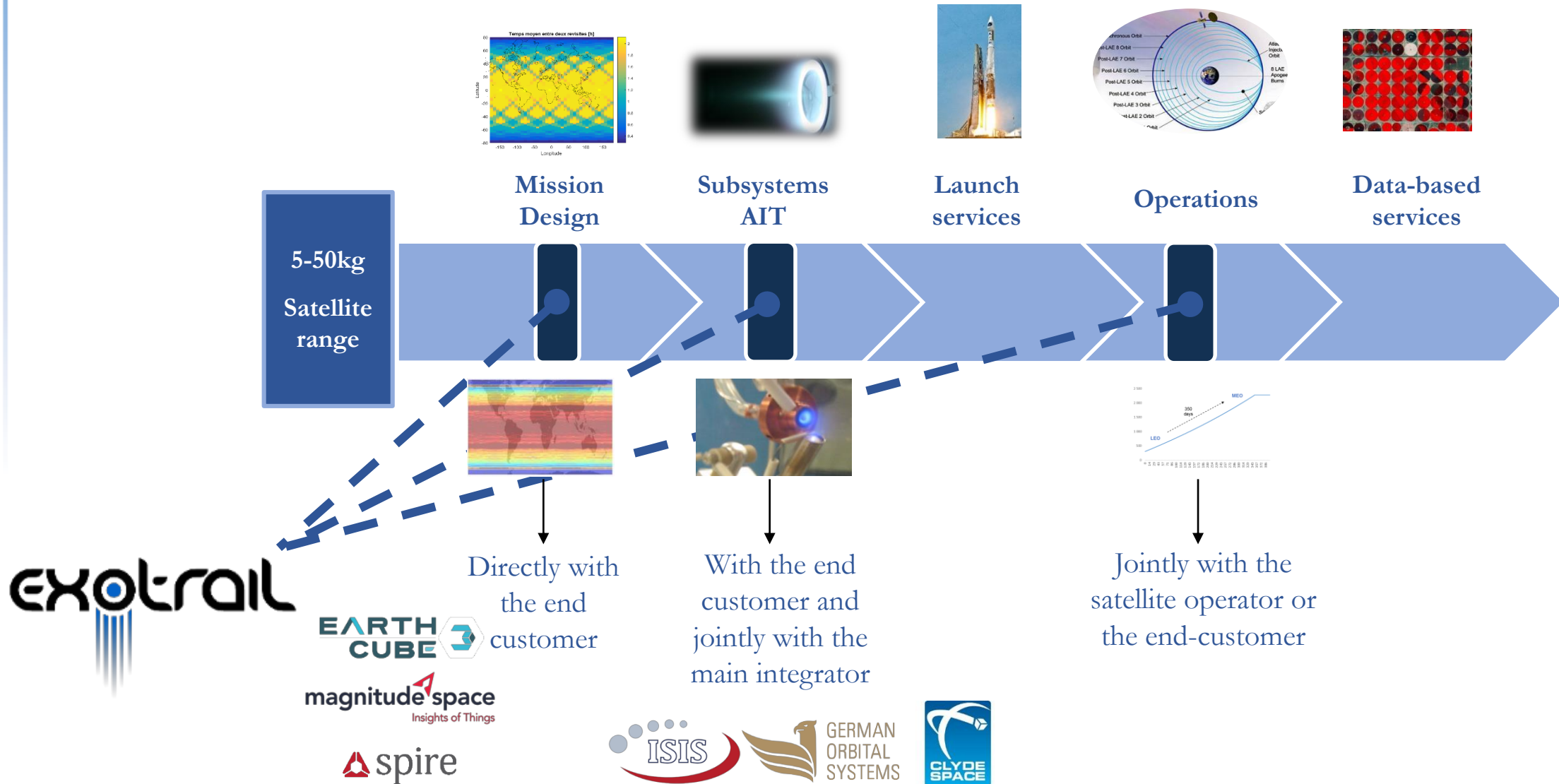
- ✓ High thrust-to-power ratio
- ✓ High total impulse per volume unit and easily scalable
- ✓ Non-pollutant fuel
- ✓ Hall Effect Technology: **reliable** and used in space for decades. **Mature technology**
- ✓ ITAR-free solution
- ✓ **Integrated offer** with a set of value-adding mission services, including design & optimization of orbits

Main competitors

- 5-6 “serious” competitors

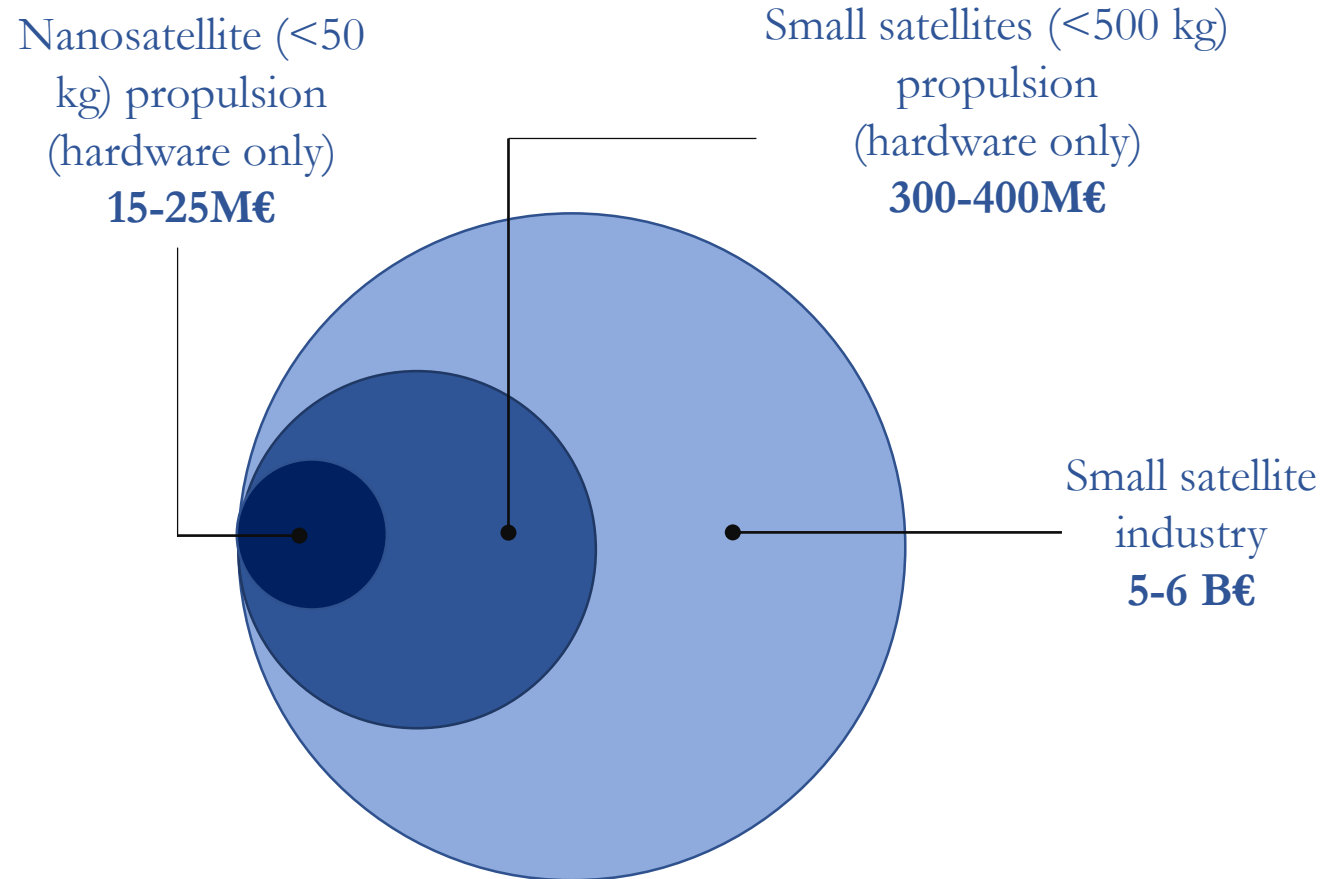
		High Thrust-To-Power	High Total Impulse	Non toxic or pollutant fuel	Mature technology	ITAR-Free	Integrated service offer
		✓	✓	✗	✗	✗	✗
		✗	✓	✗	✓	?	✗
		✓	✓	✓	✓	✗	✗
		?	✓	✓	✗	✗	✓
		✓	✓	✓	✓	✓	✓

Our position in the value chain



Market Sizing

Addressable market size depends on the target market in the long term

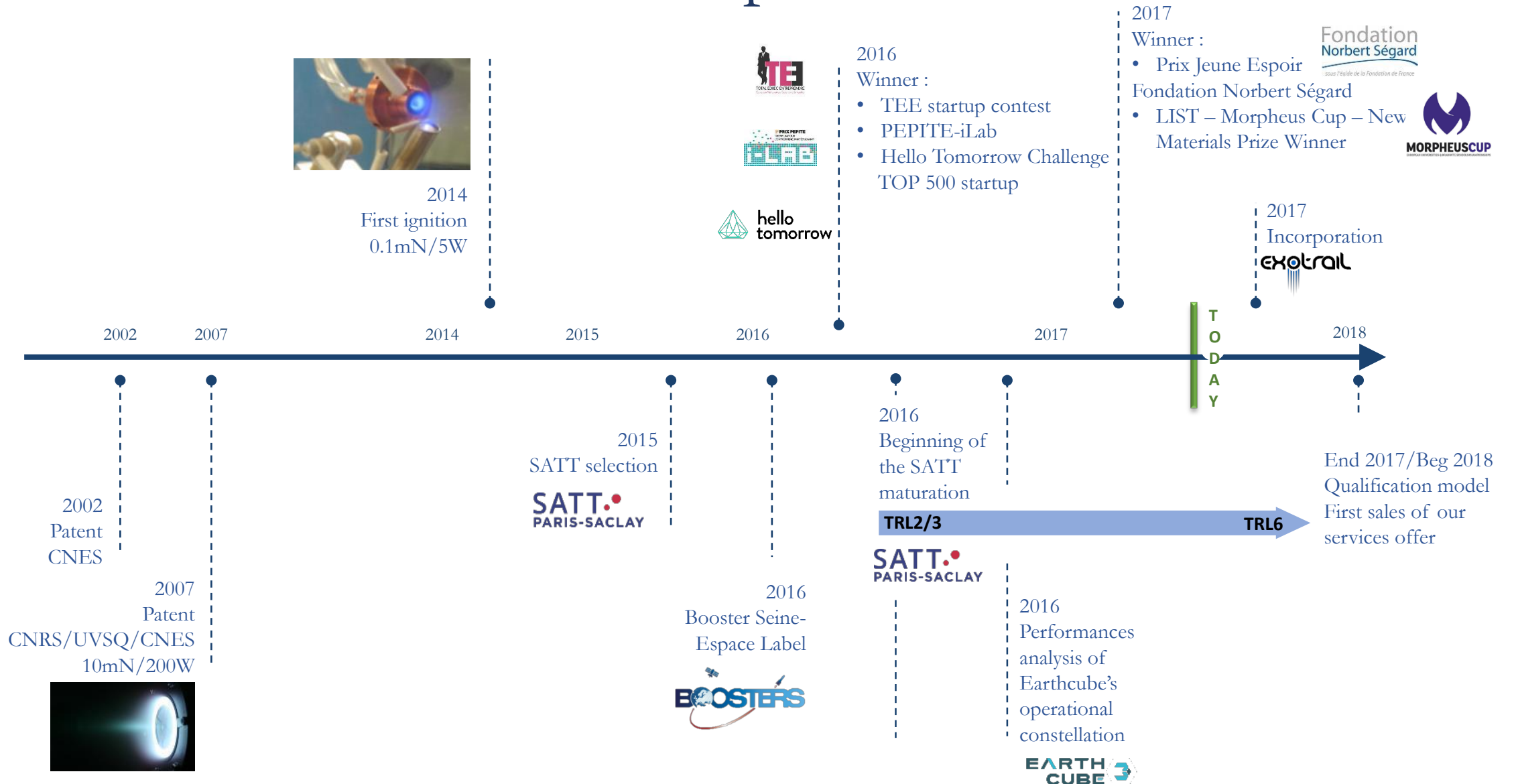


- **Estimation in 2020**
- **New market**, hard to value, estimated **CAGR 19% (2016-2022)**
- Exotrail's **addressable market** depends on the **targeted market in the long term**
- What about the **future value of optimization and mission services?**

Source: Markets & Markets, Allied Market Research. Propulsion market sizing based on the following:

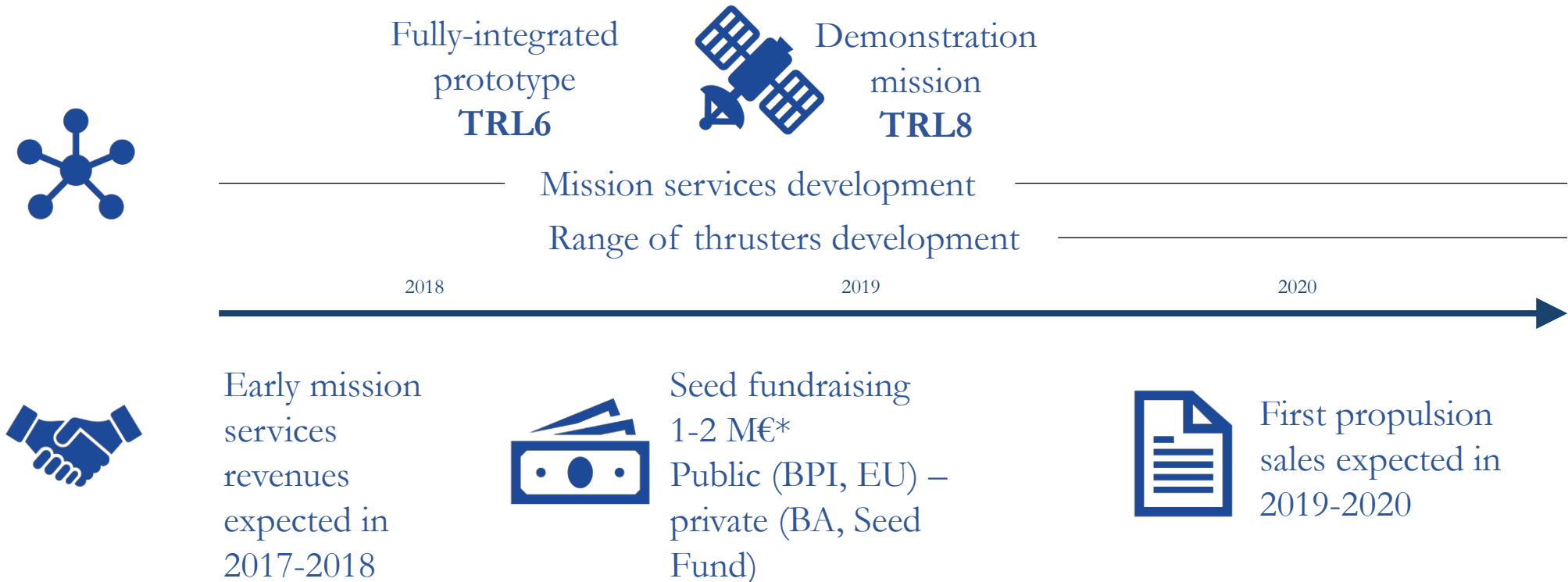
- 50% of small satellites using propulsion in 2020
- Propulsion ~10-15% of manufacturing costs
- Manufacturing costs ~50% of the whole market (Source: Markets & Markets)

Achievements & Roadmap



What's next?

Our roadmap for the future



*Not currently raising money
Precise amount will be disclosed H2 – 2017.
Already some interest shown.

Our team

A mix of complementary skills, business education and technical experience

Leading Team



Nicolas Heitz

Finance
HR
Admin

- ENSMA/ESSEC/ Centrale Paris
- Altran / Project management & consulting
- Adionics / 5 years entrepreneurship experience – Co-founder and admin director



David Henri

Strategy
Bus dev
Operations

- Polytechnique/ Cambridge
- Majors in Strategy, Innovation management and Industrial systems
- Internships in a VC and in a new space start-up



Paul Lascombes

R&D
Missions
Software

- Polytechnique/ Supaero
- Majors in Innovation management and Aerospace engineering
- Internships in Caltech and in a new space start-up

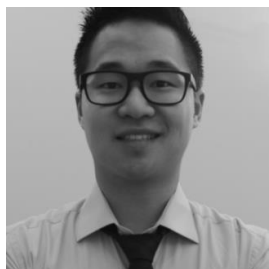


Jean-Luc Maria

Technology mgt
Supply Chain
Quality

- Mines/Supaero
- Director at PIT - Space systems testing laboratory
- 10+ years of experience in ESA space program management

Full-time engineers



Bastien Duong
SATT
System Engineer



Romain Coulomb
SATT
Elec. Engineer

Technical Advisors



Gérard Auvray



Marcel Guyot



Michel Tessier



Fabrice Marteau

Strategic Advisors



Bruno Martinaud
MSc Innovation & Entrepreneurship
(Polytechnique)



Daniel Vidal-Madjar
Senior Scientist
Former CNRS & UVSQ Executive



Fabio Ferrari
Serial Entrepreneur
CEO SymbioFCell

contact@exotrail.com
paul.lascombes@exotrail.com
www.exotrail.com
[@ExotrailSpace](https://twitter.com/ExotrailSpace)

EXOTRAIL

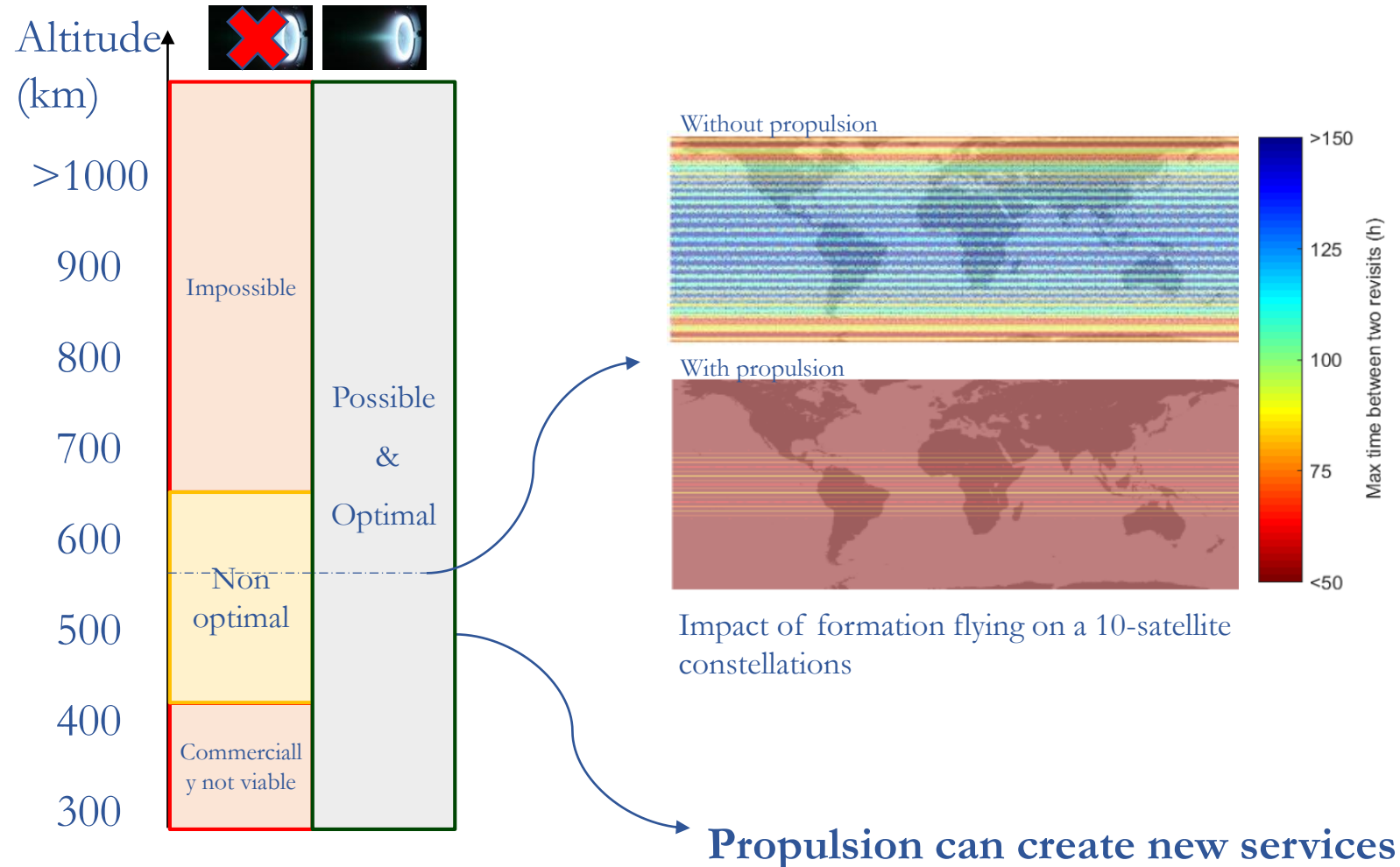
Agile Space



Do not disclose without the explicit consent of Exotrail

Propulsion increases performances of nanosatellites

New services are possible and performances are increased



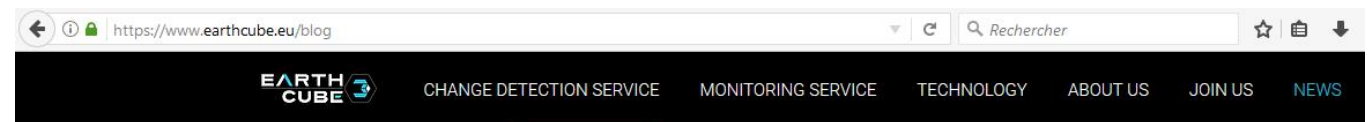
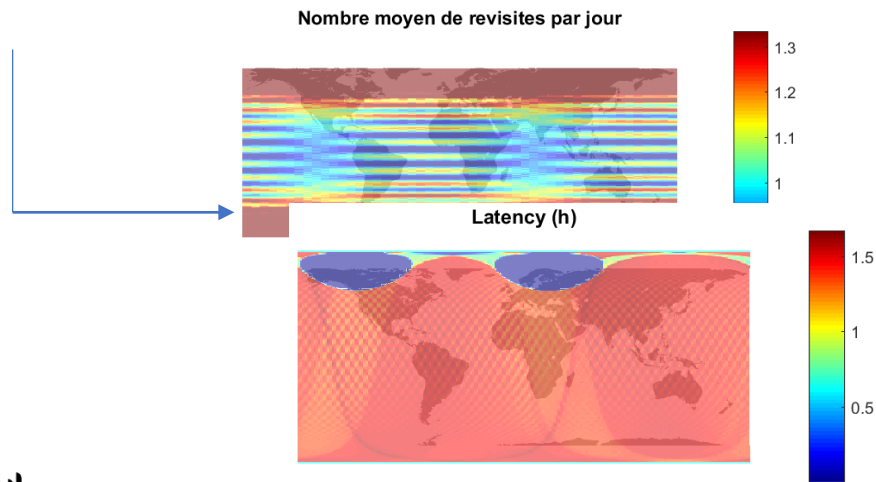
Mission Performances Analysis

POC – Exotrail/EarthCube



- Start-up visant à fournir un service d'imagerie infra-rouge, notamment pour les secteurs du Oil & Gaz, de l'environnement et de la défense, grâce à une première constellation de 10 nanosatellites (3-6U)
- Intéressée par l'ajout de propulsion sur les nanosatellites pour améliorer les performances de leur constellation
- Propulsion et design de mission ne sont pas dans leur cœur de métier

- Gain en compétence sur les aspects technique de conception d'une mission avec une constellation propulsée
- Cas d'étude pratique permettant de valider l'apport de la propulsion vis-à-vis des performances et du coût final
- Expérience directe du marché d'un acteur du New Space
- Vitrine technologique permettant de gagner en crédibilité sur nos compétences



Earthcube partners with Exotrail

December 14, 2016 | Earthcube



Earthcube and Exotrail have just signed a MoU to frame our collaboration and define our common goals. Exotrail is a French startup who is developing a fully-integrated propulsion solution for small satellites, from an innovative electric thruster to a set of services and software to design, analyse a...

[Read More](#)



Maturation SATT



■ Historique :

- Démarrage du programme de maturation : Juillet 2016. Financement SATT Paris-Saclay de 530k€ pour le développement technologique.
- Porteur de projet : OVSQ-PIT (Jean-Luc Maria).
- Etablissements impliqués : CNRS, UVSQ, SOLEIL, Polytechnique
- PI : CNRS / UVSQ / CNES

■ Objectifs :

- Conception et fabrication d'un prototype intégré de système propulsif HET au format CubeSat (1U) pour Juillet 2017.
- Caractérisations du prototype pour décembre 2017.