

Small Innovative Launcher for Europe: Achievement of the H2020 project SMILE

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Space Tech Expo Europe, 24 October 2017 | 1

SMILE Project



- EU Horizon 2020 framework programme
- 14 partners from 8 European countries; coord. by NLR
- 4 M€ grant
- Jan 2016 – Dec 2018
- Activities:
 1. Business development
 2. Launcher & ground segment design
 3. Demonstration of critical technologies



Business Development



- Market assessment of satellites up to 500 kg from Euroconsult July 2017
 - Mega-constellations (OneWeb, SpaceX) distort picture
 - Small satellites (1-50 kg) are a multi-billion dollar market
 - Mainly in US
- Launch service
 - Both CubeSats and micro-satellites -> flexible deployer
 - Reliable launch rate -> efficient, parallelised organisation
 - Logistics -> easy transport of payload and stages
 - Price -> cost-effective launcher and launch site

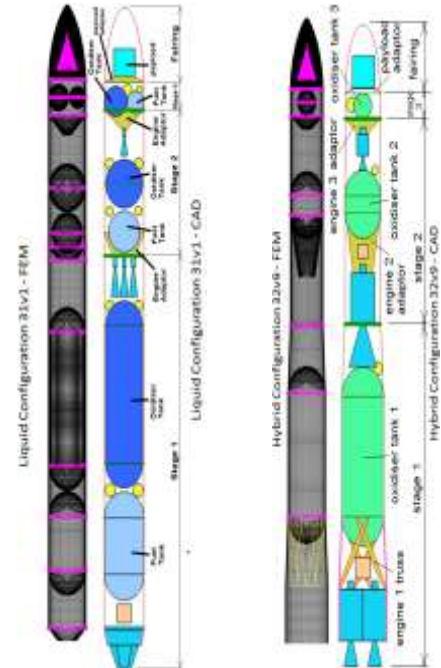


Launcher Design

- Two concept configurations
 - 80 kg into 500 km SSO
 - Three-stage hybrid: high TRL, time-to-market
 - Three-stage liquid: more payload, recovery option
- Design drivers
 - Unitary stage diameter (production, manufacturing)
 - Length of hybrid stages driven by unitary motor (technology)
 - Length of stages limited by container length (logistics)
 - Pump-fed versus pressure-fed (costs vs. mass)
 - Maximum acceleration ('smooth ride')
 - Identical separation mechanisms (commonality)
 - Intelligence in upper stage (simplicity)
 - Margins for losses and uncertainties (realism)

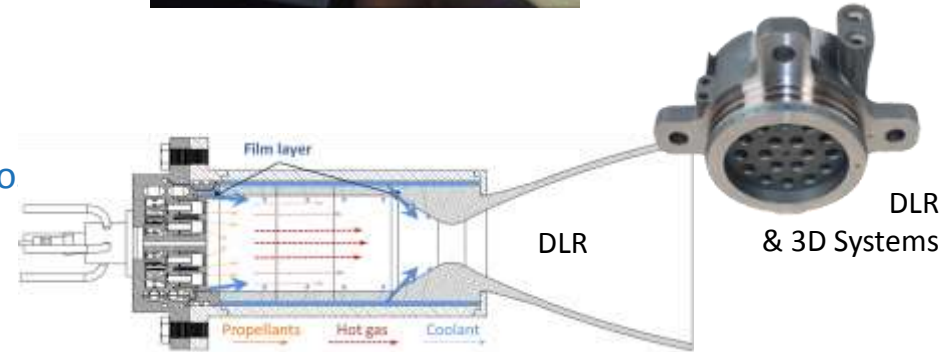
Hybrid:
70 kg @ 600 km
80 kg @ 500 km

Liquid:
115 kg @ 600 km
130 kg @ 500 km



Critical Technologies

- Propulsion
 - Hybrid (Nammo)
 - H_2O_2 (87.5%) and HTPB
 - Low development and operational cost
 - Liquid (DLR, PLD Space)
 - LOX and kerosene (Jet A-1)
 - Ceramics & transpiration: reusability
 - First stage: aerospike
- Avionics (NLR, TERMA)
- Automated Manufacturing (3D Systems, Airborne, NLR)



NLR



Next Steps



- Re-iterated Detailed Design:
 - Aerodynamics (CFD analyses, also plume interaction)
 - Propulsion (liquid vs. hybrid engines)
 - Structures (CAD models)
- Testing: Liquid engine firing campaigns, Wind tunnel test campaign
- Prototyping:
 - Structures prototype
 - Payload deployer M3S prototype
 - Avionics experiment launch, hardware-in-the-loop demonstration
- Business development plan:
 - Technology roadmap



End With A



... thank you for your attention!

www.small-launcher.eu

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Space Tech Expo Europe, 24 October 2017 | 7