UK Orbital Launcher: Landscape, Market and Business Case

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Airbus DS Motivation for Internal Study

- Emerging market for a dedicated small orbital launcher
  - Reducing opportunities for low-cost rideshare (converted ICBMs)
  - Need expressed by small sat operators in numerous conferences
  - Growing number of companies developing small launchers (sub-orbital/orbital)

- An opportunity for UK to provide an integrated service
  - Integrated Service = payload + launch + operations

- Revival of long standing UK interest in space access
  - 2009 Innovation and Growth Strategy: Access to Space topic
  - Small launcher requirement identified by NSTSG “Access to Space” group
  - SSTL-led SpaceCITI study: Towards a UK Launch Infrastructure
  - 2014: UK Spaceport identified as part of the Space Growth Action Plan
  - 2015 UKSA to open a Spaceflight Office and a commercial spaceflight capability in UK by 2018 (UKSA Corporate Plan 2015/16: PI 3.11)
  - 2015 National Space Policy Dec 2015 - > orbital launch mentioned
Overview

**Landscape**
- Smallsat Applications
- UK Spaceport

**Market**
- Small Launch Market:
  - Segment, Volume, Value
  - Trends
  - Forecast
  - Launch Demand: Global & UK

**Launcher Service**
- Solutions
- Business Case
- Roadmap

Material presented is extracted from an internal study conducted last year.
Content and conclusions are the views of the study authors and should not be taken as any indication of Airbus DS position.
Smallsat Applications

• Growth in the number of applications for small satellites
  ➢ Proliferation of COTS components (commercial off-the-shelf)
  ➢ Short development times allowing rapid evolution
  ➢ Lower cost in-orbit validation
  ➢ The rise of LEO constellations (OneWeb, PlanetLabs …)

• The UK is a global leader in small satellite and micro sat platforms
  ➢ Commercial constellations (DMC, Formosat-7, OuterNet, Spire)
  ➢ National missions (TDS-1, UKube-1)
  ➢ Technology demonstrators (Strand-1, Carbonite-1)

• The UK has the capability to provide all mission aspects except launch
  ➢ Auxiliary launch/ride-share the primary route to space
  ➢ Growing demand for a dedicated and reliable small launch service

Picture Credits: SSTL, Clydespace, OneWeb
Orbital Launch – Environment and Regulatory

- UK launch pad selection
  - Dedicated vertical launch site assessment
  - Range safety assessment using FAA guidelines
  - Inclinations limited due to ground overflight
    - Polar and sun-synchronous achievable supporting EO and some communications constellation concepts

- UK range safety challenges
  - Busy airspace
    - Potential to use Flexible Use Airspace (FUA)
  - Benign weather conditions needed
    - min. cloud cover, low wind, no lightning
  - Down range tracking -> low cost approach

- ITAR, MTCR, Wassenaar
  - Resolve potential showstoppers
  - Minimise impact on manufacture and operations costs
Small Satellite Launch Market to Date

- Small launch market (<500 kg) ≈ $932M in 5 years
  - cf Arianespace 2014: $1.6 billion
  - 50:50 split between 0 - 200 and 200 - 500 kg satellite classes
  - 2013 – 2014 significant growth in <10kg satellites
    - but only 5% of the market value
  - 0 - 200 kg platforms are under-served by existing launchers
  - Analyse business case for Minisats 100-200 kg
    - supplemented by rideshare opportunities < 100 kg
  - Questions asked:
    - future growth, price point, launch solutions
Small Satellite Launch Market Growth

- Forecast for UK launcher
  - Accessible payloads = 70%
  - Non-military
  - China, Russia and India excluded
  - Market capture = 40% (optimistic?)
  - Rideshare compatibility = 80%

- Significant Upside
  - Constellations:
    - Nanosat and smaller
    - Mini-sat
    - Precursors
    - Maintenance
  - Institutional

Sources: Euroconsult, Spaceworks, Airbus internal
Buy, Make or Blend? Examples of New Entrants

- Zero 2 Infinity: 45
- 350
- Microcosm: 160
- CALT
- Virgin Galactic: 590
- JAXA: 110
- Rocket Lab: 200
- Firefly: 250

See also: Niederstrasser and Frick (Orbital ATK), Small Launch Vehicles 2015 Survey, 29th AIAA Conference on Small Satellites
Small Launch – How Much?

Small Satellite Launch - Dedicated Options with a Maximum Performance to Reference Orbit < 1000 kg (Jan 2015 data)

- 45 k$/kg
- 34 k$/kg
- 23 k$/kg
- 59 k$/kg

Launcher Target ≈ $6.8M per 200 kg (500km, SSO) … challenging…
European Large Launchers – How Much?

**Delivery to LEO SSO**

- **ARIANE 5**
  - Typical Liftoff Mass: 780 t

- **SOYUZ**
  - Typical Liftoff Mass: 308 t

- **VEGA**
  - Typical Liftoff Mass: 137 t

- **Public domain figures**
  - $10k/kg
  - $17k/kg
  - $23k/kg
Bus vs Taxi

Low cost
- Waiting Time
- Inconvenient Start and End Points
- Rideshare

Higher cost
- No waiting/book in advance
- Convenient Start and End Points
- Exclusive

More competition?

Picture Credit: Wrightbus International
Business Cases: Make vs Blend

200kg to 500km SSO

Make
• £4.4M ($6.8M) recurring price
• £67M ($102M) development

Blend
• £4.4M ($6.8M) recurring price
• £25M ($37M) development

Assumptions: Inflation = 1.5%, Discount Rate = 8.5%, Development Schedule = 3yrs, Development start = 2015, Launch Price = 1/3 of following years launch price paid in current year, Management: 5% of total operations price. Amortization set to target $6.7m launch price.

Blend price same as Make but Blend has a much lower NREC, so IRR is larger and breakeven period shorter.
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Conclusions

- 200kg orbital launch business case holds up with 4/5 launches per year from 2020
  - Caveat: an uncertain forecast
  ... but stimulating effect of a local small launcher and continued growth in mini-sat demand gives upside

- Integrated Service Offering is attractive for UK – and also for customers in Europe
  - Only space access is missing

- UK payloads are needed to prime the market
  - UK focused evaluation of need for both commercial and institutional missions
  \[\rightarrow\] requires active engagement from small sat builders/operators and Government customers

- Three routes identified to establish a UK small launch capability:
  - Conventional “make” solution (expendable) is commercially challenging at this price-point
  - Buy-in options are possible but face some challenges (export control, launch site loyalty)
  - A blended solution anchors small launch in the UK, stimulates UK growth and returns investment faster
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