AN INTRODUCTION TO LAUNCH BROKERAGE

Presentation to:
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Management & Trading

- Facilitate trade of components from Western companies to Russia
- Management of satellite development projects between Russia and the West (e.g. Kanopus)

Consultancy

- CST began as a general space consultancy
- All fields of technical consultancy (except communications)
- International expertise
- Extensive report library
- Broad client base:
  - Insurance
  - Space agencies
  - Government departments
  - Private industry

Launcher Brokerage

- Representative Moscow office
- Native Russian team
- Specialising in Russian and Ukrainian launch vehicle procurement
- Services include:
  - Launcher selection and price negotiations
  - Contract support (drafting and implementation of MOU, LSA, ICD)
  - Customs and logistics support
  - Fit check support
  - Pre and post launch campaign support
<table>
<thead>
<tr>
<th>YEAR</th>
<th>DATE</th>
<th>LAUNCHER (MODE)</th>
<th>SATELLITE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>August 31</td>
<td>Tsyklon (1 piggy-back)</td>
<td>Fasat Alpha</td>
</tr>
<tr>
<td>1998</td>
<td>July 10</td>
<td>Zenit (2 piggy-back)</td>
<td>Fasat Bravo + TM Sat</td>
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<tr>
<td>1999</td>
<td>April 21</td>
<td>Dnepr (1 dedicated)</td>
<td>Uo Sat 12 (first commercial use of SS-18)</td>
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<tr>
<td>2000</td>
<td>June 28</td>
<td>Cosmos (2 piggy-back)</td>
<td>Tsinghua 1 + Snap (first SSO flight of Cosmos)</td>
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<tr>
<td>2000</td>
<td>September 26</td>
<td>Dnepr (1 piggy-back)</td>
<td>Tiung Sat</td>
</tr>
<tr>
<td>2002</td>
<td>November 28</td>
<td>Cosmos (main in cluster)</td>
<td>Alsat-first Disaster Monitoring Constellation (DMC)</td>
</tr>
<tr>
<td>2003</td>
<td>September 27</td>
<td>Cosmos (3 in cluster)</td>
<td>NigeriaSat-1, BilSat-1 and UK-DMC (all DMC)</td>
</tr>
<tr>
<td>2004</td>
<td>June 29</td>
<td>Dnepr (main in cluster)</td>
<td>Demeter (CNES, first SSO flight of Dnepr)</td>
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<tr>
<td>2005</td>
<td>October 27</td>
<td>Cosmos (3 in cluster)</td>
<td>TopSat, ChinaSat (DMC), SSETI Express+cubesats</td>
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<tr>
<td>2008</td>
<td>August 29</td>
<td>Dnepr (5 in cluster)</td>
<td>RapidEye constellation</td>
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<tr>
<td>2009</td>
<td>July 29</td>
<td>Dnepr (2 in cluster)</td>
<td>UK-DMC2 + DEIMOS-1 (both DMC)</td>
</tr>
<tr>
<td>2009</td>
<td>September 17</td>
<td>Soyuz/Fregat (1 piggy-back)</td>
<td>SumbandilaSat (South Africa, first piggy-back from this launcher combination)</td>
</tr>
<tr>
<td>2010</td>
<td>June 15</td>
<td>Dnepr (1 of a pair)</td>
<td>Picard (CNES, paired with Prisma)</td>
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<tr>
<td>2011</td>
<td>August 17</td>
<td>Dnepr (2 in cluster)</td>
<td>NigeriaSat-2 and NigeriaSat-X</td>
</tr>
<tr>
<td>2012</td>
<td>July 22</td>
<td>Soyuz/Fregat (1 piggy back)</td>
<td>ADS-1B</td>
</tr>
<tr>
<td>2014</td>
<td>June 19</td>
<td>Dnepr (1 in cluster)</td>
<td>KazEOSat-2</td>
</tr>
<tr>
<td>2014</td>
<td>July 8</td>
<td>Soyuz/ Fregat (2 piggy back)</td>
<td>TechDemoSat-1 (TDS-1), UKube-1</td>
</tr>
<tr>
<td>2017</td>
<td>July 14</td>
<td>Soyuz/ Fregat (48 CubeSats)</td>
<td>Flock 2K</td>
</tr>
</tbody>
</table>
**LAUNCH DEMAND VS SMALL SATELLITE DEMAND**

- Preferable launch rates (improves exponentially with satellite size)
- Launch providers offer preferable rates
- Immediate experience
- Cost saving
  - Brokers have the relevant contacts and can save
  - Risk mitigation

**Rideshare**
- Comparatively low-cost:
  - Underwritten development (defence, ex-govs, national progs)
  - Comparatively low labour rates
  - Shared management costs
  - Otherwise wasted capacity
- Restrictions on schedule and orbit

**New Demand**
- Cubesats - commercial and educational
- Megaconstellations – OneWeb, SpaceX, IoT, etc.

**Focus on value over low-cost**
UPCOMING LAUNCHERS

There are over 100 small LVs under development
LAUNCH VEHICLE RESTRICTIONS

- Export Restrictions
  - International Traffic in Arms Regulations (ITAR) – China
  - Missile Technology Control Regime (MTCR) – China

- Geopolitics
  - Russia Ukraine conflict – Dnepr, Zenit
  - Israeli Shavit launcher
  - Civil unrest Kourou

- Technical restrictions
  - Restricted inclinations
  - Schedule restrictions – Japanese fishing
WHY USE A LAUNCH BROKER

What Does This Mean?

Preferable launch rates (greatly improves with satellite size)
  • Launch providers save money working through brokers
  • Sharing launch costs across multiple customers

Cost saving
  • Time saved researching launch options
  • Time saved in negotiations
  • Less in-house expertise (licencing, contract construction, integration, etc.)
  • Time saved in export and logistics

Risk mitigation
  • Experience on what can go wrong as well as right
THE CST EXAMPLE

**Stage 1 – 20%** - Location of suitable launch options, preliminary price negotiations, report to customer, signing of CST contract (represents up-front cost)

**Stage 2 – 35%** - Construction of Launch Services Agreement (LSA), which represents the master contract dictating the conditions of collaboration between the spacecraft customer and launch provider

**Stage 3 – 30%** - Management of LSA through to Interface Control Documentation (ICD), Fit Check and other meetings

**Stage 4 – 15%** - Management of launch campaign up to integration of payload with launcher, launch and return of EGSE after the launch campaign
  - Daily rate after Stage 4 completion to end of campaign
  - Expenses (e.g. travel to customer) agreed and modest
  - Historically, Stages 1 & 2 have saved customer more than CST fees

**Note:** Contract can be abandoned after Stage 1 if no launch is found
BROKERAGE STYLES

Spaceflight
• Research launch options
• Licensing support
• Price negotiations
• Insurance support
• Integration
• Logistics

ISIS
• Research launch options
• Deployer aggregation
• Price negotiation
• Integration

CST
• Research launch options
• Price negotiation
• Insurance support
• Contract construction and execution
• Full Representation
• Export and Logistics

Launch costs don’t scale with satellite size!
IN CONCLUSION

• Small Satellite market on the rise
• Launch demand is growing and evolving
• Pressure on launch providers to move with the times
• Launch challenges always evolving
• Demand for brokers also evolving
• Symbiosis between brokers and launch providers strengthening
UNIQUE LAUNCH OPTIONS 1

Always potential of emerging and re-emerging launch vehicle options

ICBM derived options
• SS18 – Dnepr
• SS19 – Strella
• Topol – Start-1
• Shtil – Shtil 2.1

Civil launch options
• Zenit
• Proton
• Angara family
UNIQUE LAUNCH OPTIONS 2

Recoverable Payloads

Bion and Foton missions:

- Upcoming Bion in 2023 (prone to slippage)
- Additional rideshare available

Experimental opportunities:

- Biocontainers at 37,28°C and ambient temperature:
  ▪ Contains 36 Corning tubes 5ml each and 12 petri dishes 6cm in diameter
  IBMP can deliver up to 12 tubes and up to 5 petri dishes from each container
- Microbial fuel cell
- Exobiofrost container located in biopan-like container on the outer surface of biosatellite. one can store solid biomaterial in 0.5 ml Eppendorf tubes. 20 tubes in total
- External "Meteorite" containers - 4 wheel-like pieces of basalt 7cm in diameter, each with 25 wells 7mm in depth. Re-entry subjects biomaterial to overheating
- Control - the same units, protected by biopan-like container