ISIS – Innovative Solutions In Space

ISIS Missions, Services and Technology Trends

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Why start a space company?

"The way to make a small fortune in space is to start with a big fortune.

Space is a good place to lose a lot of money real fast."

John Pike
American Federation of Scientists
ISIS – 5 years old

- January 06, 2006 - founded as Spin-off of Delfi-C3
- March 2006 – moved to first office: 5 people, 18 m2 office
- Summer 2007 – first products sold and delivered
- April 2008 – Launch of Delfi-C3 gave first heritage of designs
- May 2008 – moved to new office: ~10 people, 200 m2 office
- July 2009 – first daughter companies:
  - Innovative Space Logistics – for the ISILaunch Services
  - Innovative Data Services – for applications
- September 2009 – ISILaunch01 launched 4 European CubeSats
- July 2010 – moved to new building: ~20 people, 400 m2 office
- March 2011 – delivered full CubeSat Development Kits
- June 2011 – delivered full CubeSat Mission & Ground Station
ISIS – 5 years old

Current Status:

• August 2011 (now): 32 people, 650 m² office
  – 80 m² Clean Room
  – Ground Station + Mission Control Center
  – Test facilities

• From subsystem developer to system integrator with end-to-end solutions:
  – Mission definition
  – System design & development
  – Assembly, integration & verification
  – Launch Services
  – Mission operations
  – Applications
Company Structure

- Separate ‘business units’ for:
  - Missions, Platforms, Custom systems
  - Off-the-shelf systems from CubeSat system developers
  - Small Satellite Launch Services
  - Nanosatellite Applications
ISIS Missions & Platforms

• Development kits:
  – Flight representative hardware
  – Ground Support Equipment included
  – Training and fast project initiation

• Platforms / Busses:
  – All necessary avionics, solar panels, etc.
  – Custom payload interfaces
  – Engineering Models / Flight Models
  – Ground Support Equipment

• Complete Missions:
  – Full satellite platforms incl. payload (integration)
  – Mission software development
  – Ground segment, Launch Services, Mission operations
Development Kit

• Developed for: SUPAERO University, France
• Used for training of student teams in education

• 2U CubeSat setup:
  – Power System
  – Computer
  – Transceiver
  – Antenna module
  – GSE interfaces

• Basic functionality embedded
• Ground Support Equipment:
  – Mechanical jigs
  – Power/data interfaces
  – RF checkout box
FUNcube Platform

- Developed for AMSAT-UK
- Used for educating young people about radio, space, physics and electronics.

1U CubeSat

AMSAT-UK:
- Payload development
- Control board development
- Mission Control SW

ISIS:
- Platform development
- Payload Board Manufacturing
- System level Assembly, Integration and Verification
- Arrange for Launch
NanosatC-BR Platform & GS

• Developed for Brazilian Space Agency INPE and University of Santa Maria
• Used as educational magnetometer mission

• 1U CubeSat
• Full EM and FM Platform
• Payload interface support
• Ground Support Equipment
  – Mechanical jigs & tooling
  – RF Checkout equipment
• Turnkey Ground Station
  – On-site installation
  – On-site training
• Delivered end of June
Carbon Monitoring Mission & GS

- Developed for Indian university customer
- Used as educational mission for carbon monitoring with a Thoth Argus spectrometer

- 2U CubeSat
- Full EM and FM Mission
- Payload interfacing
- Mission control software
- Ground Support Equipment
- Turnkey Ground Station
- On-site training and support
- Delivered in June
- Training in July
CubeSatShop.com

- One-stop-shop for CubeSat & nanosat systems
- Single point of contact for inquiries, purchasing, technical and after sales support
- Many partners for all different categories
- And we keep expanding …
ISILaunch Services

www.ISILaunch.com

“Our mission is to launch yours …”
Example: ISILaunch01 on PSLV (2009)

- Successful launch campaign (ISILaunch01)

ISILaunch

PSLV-C14

BEESAT    SwissCube

ITUpSAT1   UWE-2

UWE-2    BEESAT    ITUpSAT1    SwissCube
Cooperation between ISL and Spaceflight Services

• Access to all international launch opportunities
• Clustering satellites from all over the globe
• Flexibility in launch contracting

… but it’s (still) not easy…
A launch provider perspective:

Goals:

- optimal use of launch vehicle capacity
- flexibility of having ‘gap-fillers’ on the shelf
A satellite developer perspective:

Goals:

• multiple launch opportunities to choose from
• flexibility of having ‘backup launches’ available
• airline ticket approach to booking a launch
# Upcoming opportunities

<table>
<thead>
<tr>
<th>Date</th>
<th>Orbit</th>
<th>Vehicle</th>
<th>Containerized Payloads</th>
<th>Other Micro</th>
<th>Lightband Adapter type</th>
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<td></td>
<td></td>
<td>1U</td>
<td>2U</td>
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<td>Y</td>
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<tr>
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<tr>
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<td>Y</td>
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<tr>
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<tr>
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<tr>
<td>Q4 2012</td>
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<tr>
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<tr>
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<td>Russian</td>
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<td>H1 2014</td>
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<td>Y</td>
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<td>H1 2015</td>
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<td>US</td>
<td>Y</td>
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</tbody>
</table>
QB50 – Launching 50 Cubes

• “An international network of 50 CubeSats for multi-point, in-situ measurements in the lower thermosphere and for re-entry research.”

• Launch of 50 CubeSats to very Low Earth Orbit (~320 km) using Shtil-2.1 in 2014

• Pre-cursor flight with Shtil-1 in 2013
QB50 – Launching 50 Cubes

• How to fit 50 CubeSats in the limited available mass and volume of a Shtil-2.1 …?

From ‘QuadPack’ for Shtil-1 to full integrated deck on Shtil-2.1
Trends: Numbers

More small satellites, nanosatellites and CubeSats, driven by availability of miniaturized / commercial components

In numbers (estimated):

2005: few 1U/3U CubeSats (~10)
      few nanosatellites

2010: many 1U/2U/3U CubeSats (~250)
      6U and higher upcoming
      various nanosatellites

Various CubeSat and nanosatellite constellations of 10 or more CubeSats planned for the coming years.
Trends: Technologies

• Higher performance – a circle:

- Data rates
- Link Margin
- Frequencies

COMMS

- Stabilization
- Pointing
- Accuracy
- Agility

POWER

- Orbit average power
- Solar panels
- Deployables
- Battery sizing

CONTROL

...
Trends: Improved capabilities

• From 1U to 12U
  – Accommodating more voluminous payloads

• Deployable Solar Arrays
  – Accommodating high power payloads

• Startrackers, CMG’s
  – Accommodating highly agile payloads
  – Accommodating more capable imagers

• High end on board processing
  – Signal processing payloads
  – Image compression
Trends: Improved Quality

- Improving success rate of CubeSat missions

- Making the most of single string designs
  - High quality parts
  - Improved systems engineering

- Leveraging know-how from ‘traditional’ space organizations
  - Beefing up Qualification Testing
  - Miniaturizing high end concepts
New small launch vehicles:

- Shtil 2.1
- Vega
- Soyuz-1
- PSLV-mini
- Epsilon
- Air launched
Trends: Improved Access

- Clustering of payloads
- Rideshare on large vehicle
- ‘Dedicated Cluster Launches’ (e.g. QB50)
Conclusions

- CubeSats are evolving fast:
  - Fast increasing numbers …
  - Higher performance, higher quality missions
  - From 1U/3U to 6U/12U

- Traditional bottlenecks still apply:
  - More data -> more power -> better control -> etc

- Constellations for scientific and commercial app’s

- Access to space is still a key issue – may be for a while if the number of CubeSats keeps increasing

- But still … building CubeSats is still a lot of fun!
Thank you for your attention!

We’ve made it through the first 5 years … looking forward to the next 5! 😊

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web:  www.isispace.nl | www.isilaunch.com
      www.cubesatshop.com | www.innovativedataservices.com
Celebrate with us ... you’re invited:

September 1st, 2011

Delft Nanosatellite Symposium

www.isispace.nl/symposium