CubeSat Developments and Future Challenges

ISIS – Innovative Solutions In Space
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Outline

• Company history
• Company overview
• Milestones of the past year
• Current activities
• What does the future hold … ?
November 2004 - Delfi-C3 Starts

- 4th Dutch Satellite after ANS, IRAS and SloshSat
- 1st Dutch university satellite to be actually launched into orbit (28 April 2008)
- Project largely run by students
- Industry payloads
April 2005 – the idea was born
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
January 6, 2006 – ISIS founded
March 2006 – Office at YES!Delft Incubator
At the time: 18 m2 for 5 engineers (founders)

May 2008 – New office at Rotterdamseweg 380
At the time: about 200 m2 for ~10 engineers (incl. management)
July 2009 – initiated two daughter companies

Name: Innovative Space Logistics BV
Goals: All-in Launch Services for Small, Auxiliary Payloads

Name: Innovative Data Services BV
Goals: Full Service Applications with nanosatellites

July 2010 – New office with more lab space
About 400 m2 for ~20 engineers (excl. management)
Company Overview

• Spin-off of Delfi-C3 nanosatellite project of TU Delft
• Founded January 06, 2006
• Office locations:
  – Delft, near Delft University of Technology Campus
  – Noordwijk, in the European Space Incubator at ESTEC
• Current team: 20+ engineers, plus management, support
• Fully owned by the management team:

  Jeroen Rotteveel  
  Managing Director

  Abe Bonnema  
  Marketing Director

  Wouter Jan Ubbels  
  Technical Director

  Eddie van Breukelen  
  Financial Director
Company Structure

- Separate 'business units' for:
  - Missions, Platforms, Custom systems
  - Off-the-shelf systems from CubeSat system developers
  - Small Satellite Launch Services
  - Nanosatellite Applications
Milestones over the past year

- Successful launch campaign (ISILaunch01)
Milestones over the past year

- involvement in ESA's nanosatellite research projects
- OTS-products successfully demonstrated in orbit (e.g. Antenna system on STUDSat)

- Move to a new building:
  - Clean room 80m2
  - Operations room and Ground Station
  - doubled our lab space
  - building up end-to-end in-house environmental test facility line
Current Activities

• Ongoing Product Developments:
  – Communication Systems (UHF, VHF, S-Band)
  – ISIPOD Deployer systems in various form factors (e.g. 6-Pack)
  – Test & Ground Support Equipment Kits

• Ongoing CubeSat R&D Projects:
  – Track & Trace payloads (with Dutch partners)
  – Miniaturized Star trackers (with TNO)
  – Deployable Solar Arrays (with Dutch Space)
  – Cool Gas microPropulsion Module (with TNO / Bradford)
  – Modular Payload Deck Elements (with Stork/Fokker/Mecon)
Current Activities

• Ongoing Missions & Platforms:
  – Triton-1 Tech Demo Mission (with SystematIC / NLR)
  – Triton-2 AIS Demo Mission (with ClydeSpace / GomSpace)
  – FUNcube Platform and MAIV (for AMSAT UK)
  – De-Orbit Sail Demo Mission (EU project with SSC, DLR, ASTRIUM, Universities in Greece, Turkey, South Africa)
  – Delfi-n3Xt (Payload Partner of TU Delft)
  – 2U environmental monitoring mission (undisclosed customer)
Current Activities

• Ongoing Studies / Involvement in Programs
  – IDS / CubeSat SAT-AIS constellation (in house)
  – QB50 (VKI)
  – OLFAR (TU Delft, UTwente, ASTRON, SME's)
Knowing where *you* are is not enough
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**Solution:**
Cell phone cell density and radio feeds to locate congested areas

**Additional Requirements:**
- Cellular phones, GSM Antenna stations
- Car Radios, traffic information broadcasts
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**Solution:**
IMO mandated transponder system improves local information needs for safety

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- Cellular phones, GSM Antenna stations
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**Additional Requirements:**
- AIS transponders on ships (since 2007)
- Reception stations (coastal and in space)
Implementation

- **Space Segment**
  - S-AIS Receivers
  - 16 Spacecraft
  - Launch into 4 orbits

- **Ground Segment**
  - 4 Ground Stations
  - 1 Operations Center
  - 1 Data Center
  - Distribution channels
“An international network of 50 double CubeSats for multi-point, in-situ, long-duration measurements in the lower thermosphere and for re-entry research.”

- Consortium led by VKI – Von Karman Institute (J. Muylaert)
- Supported by space agencies

- ISIS involved for:
  - Satellite Platform Technical Advice
  - Launch Configuration and Orbit Dynamics Analysis
  - Payload Deck, Deployment System and Integration Support
  - Launch Campaign Support
Advanced Application - OLFAR

• OLFAR is a new concept of a low frequency radio telescope in space using small satellites.
• Correlation must be done in space.
• Distributed processing with centralized downlink transmission is the preferable option.
• Inter satellite link is the communication challenge.

5 major subsystems:
• spacecraft
• antenna design
• frontend
• backend
• data transport
CubeSatShop.com

• Objectives:
  – One-stop-shop for all your off-the-shelf CubeSat systems
  – Single portal for questions and system comparison
  – Ultimate goal: CubeSat configurator interface

• Partners (new partner/products always welcome)
CubeSatShop.com

• Current range of products already extensive:
  – Structures, mechanisms, deployers
  – Comm systems, antenna systems, ground stations
  – Power systems, batteries, solar panels
  – Attitude control systems, computers, camera
  – Standard kits and support equipment

• Opportunities and Needs:
  – The ‘big gaps’ (examples): GPS, CMGs, DPUs
  – Additional needs: cameras, payload systems, etc.
Some challenges for the future

• Frequencies and downlink of data, operations:
  – Amateur frequencies
    • Need for improved coordination?
    • Re-use / sharing of frequencies?
  – Networks of CubeSats
    • How do you coordinate 25+ Cubes deployed at the same time (e.g. QB50)?
    • Scheduling (TDMA)?
  – Shared ground stations
    • Licensing & regulatory aspects?
    • Training of operation?
    • Data policies?
Some challenges for the future

- Improved Cooperation
  - Develop your strengths, do not re-invent the wheel
  - Regulatory issues and restrictions
    - E.g. ITAR vs non-dependence movement in Europe
    - Licensing
  - IPR issues in cooperation between parties
    - Industry / Industry: competitors vs. partners
    - Industry / Academia: risk your IPR to become public domain
    - Academia / Industry: risk of not being allowed to publish your work
    - Industry / government: risk w.r.t. IPR ownership
Some challenges for the future

• Improve access to space
  – Launches are **not** cheap
    • Launch fees
    • Testing and procedures
    • Campaign cost
  – More often regulations apply
    (e.g. national space laws, NOAA, ITU/FCC)
  – Do not underestimate the level of testing and prove of conformance required by the LSP
  – Take into account end-of-life
Some challenges for the future

• Standardization and modularity
  – CubeSat Standard, universally adopted?
    • Depends very much on the type of deployer used for things like envelope, mass, etc
    • Variations on CubeSats are not very well covered
    • Mostly covers form, fit, mechanical aspects

  – Standardization of internal interfaces:
    • No real solution or consensus (mech, data, power, etc)
    • If you say: “we use our own standard”, it’s not a standard.
    • Commercial CubeSat systems providers struggle with this quite a bit…
Thank you for your attention!

Let’s discuss your needs …

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