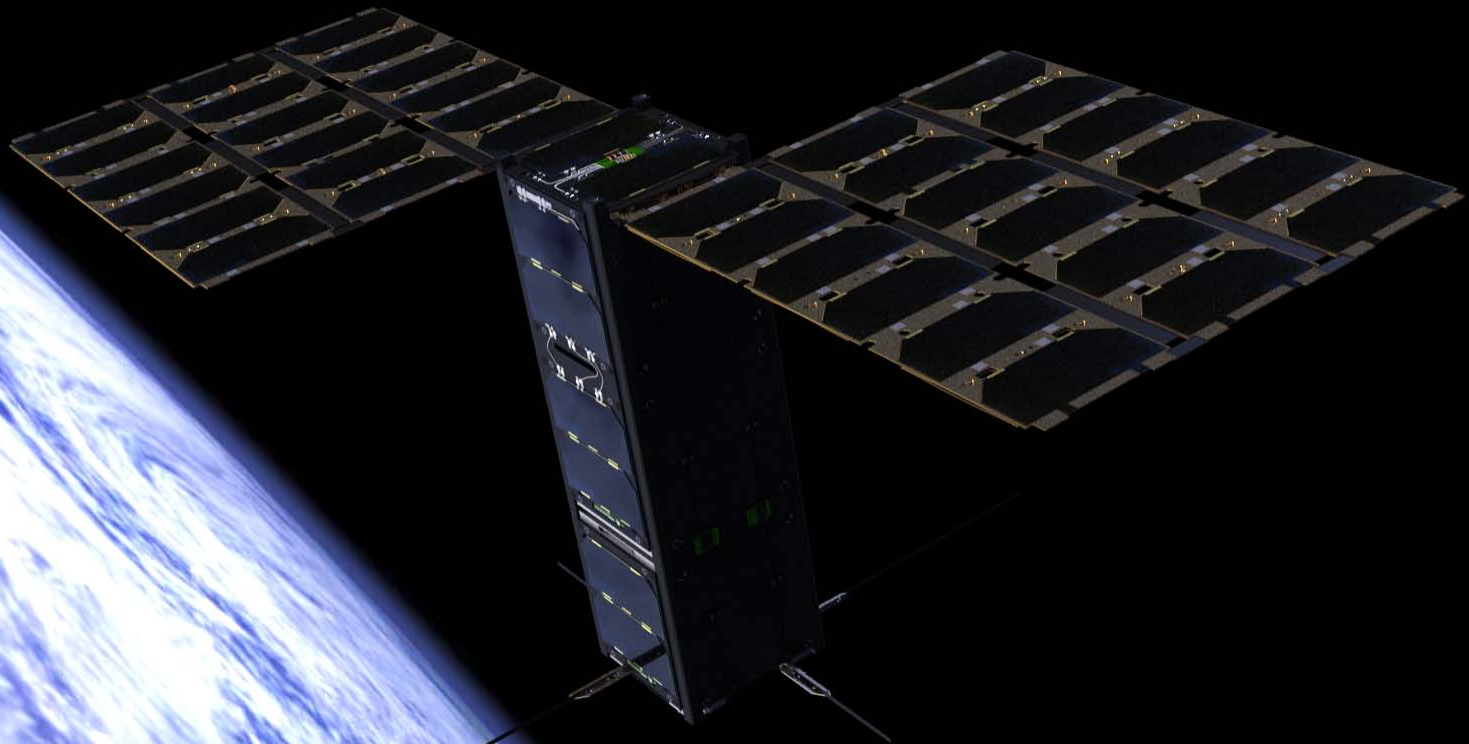




Access To Space

Developments and visions for the CubeSat launch market



Joost Elstak, ISIS – Innovative Solutions In Space BV
CubeSat Workshop, San Luis Obispo, April 2012

Contents

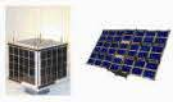
- Launch Services
- Trends in size and numbers
- Challenges in launching CubeSats
- Recommendations
- Conclusions

www.ISILaunch.com

“Our mission is to launch yours ...”

CubeSat

Cluster Launches

Nanosatellites


Microsatellites


Other Payloads
Attached Payloads
Miniature Payloads




INNOVATIVE SPACE LOGISTICS BY
**ISILaunch
Services**

Launch Adapters


Test Services


Launch Insurance
% € \$
risk £
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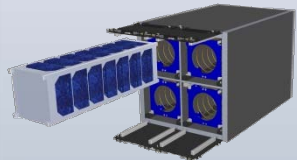
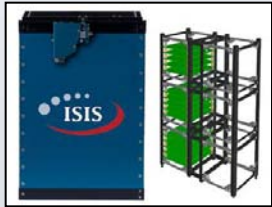


Launch Services overview

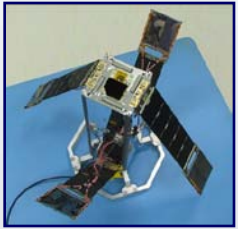
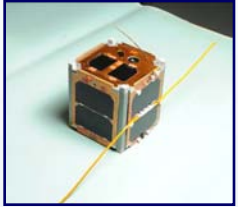
Launch Services generally includes:

- Launch service negotiation and contracting
- Planning and logistics management
- Technical management and interface control
- Launch adapter selection and supply
- Environmental test and verification coordination
- Launch preparation campaign coordination
- Satellite – Launch Vehicle integration support

Customers range from inexperienced, 'first-time' satellite developers to established satellite developers that like to have a fully arranged launch.



Trends: satellite numbers



of CubeSats and nanosats just keeps increasing:

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

2010: many 1U/2U/3U CubeSats (~200)
various nanosats
tens of microsats

2012: few hundred of CubeSats
tens of nanosats
tens of microsats

Multiple CubeSat and nanosat constellations planned.

Trends: launch vehicle size

Developments of smaller launch vehicles:

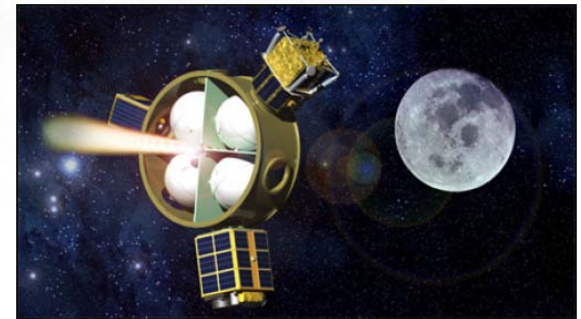
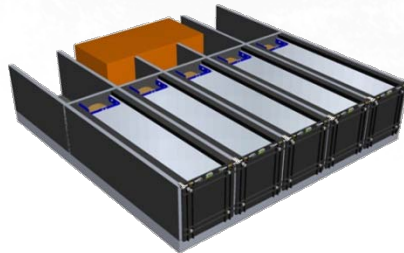
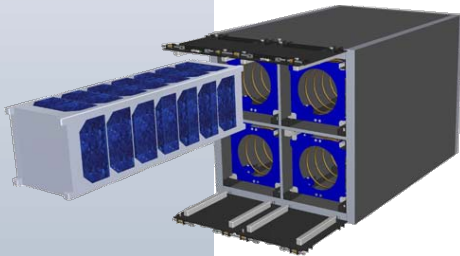
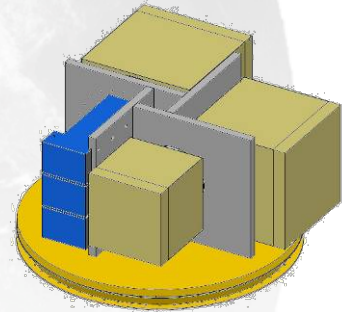
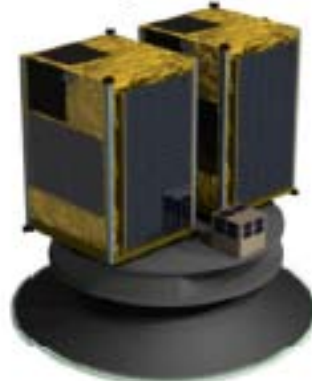
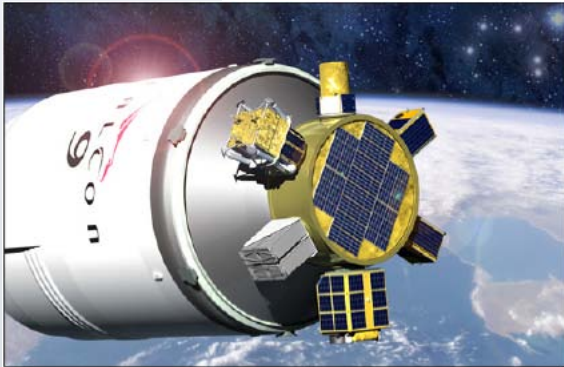
- Vega
- Shtil
- Soyuz-1
- PSLV-mini
- Epsilon

- Air launched



Trends: launch clusters (numbers)

- Clustering of payloads
- Rideshare on large vehicle
- 'Dedicated Cluster Launches' on small vehicles





Global Launch Service Model

- Partnership with Spaceflight Services for US launches and US launch customers:



- ISIS nanosatellite dispensers (ISIPOD) on Antares- maiden flight for US payloads
- Falcon-9 (first launch campaign in 2013)
- Follow-on cooperation on other US launch vehicles

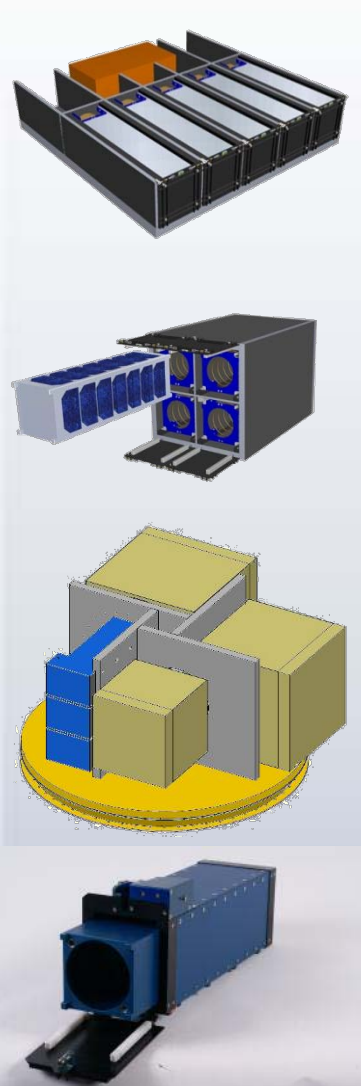
- Regular launch services on non-US launches



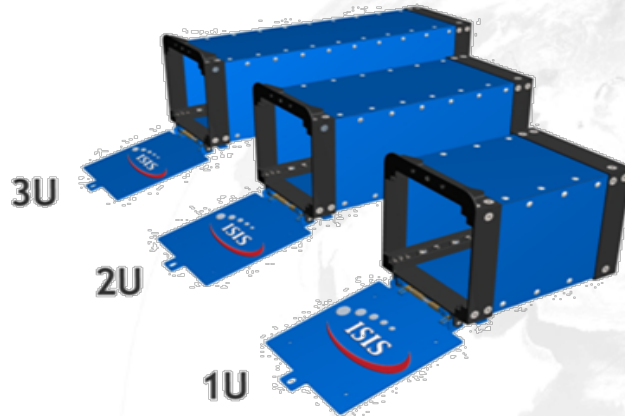
- PSLV (first launch campaign was in 2009, 4 S/C)
- DNEPR (first launch campaign in 2012, 12 S/C)
- Soyuz (first launch campaign in 2012, 1 S/C)
- Various other launch vehicles under discussion

- QB50

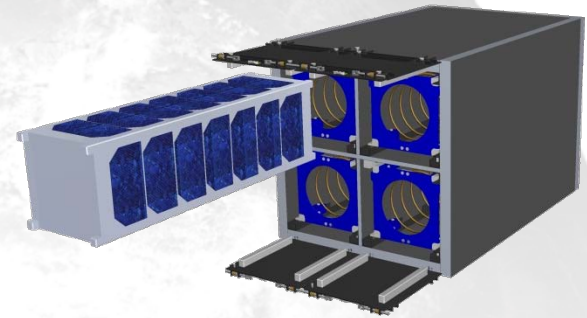
- 50 2kg spacecraft to be launched as a primary payload



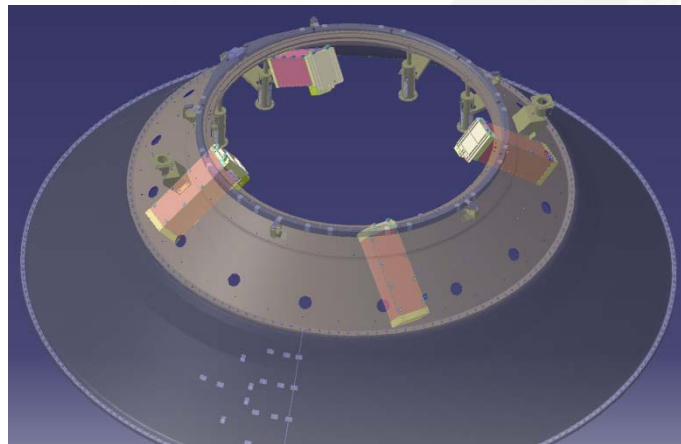
Technical Challenges: Accommodation



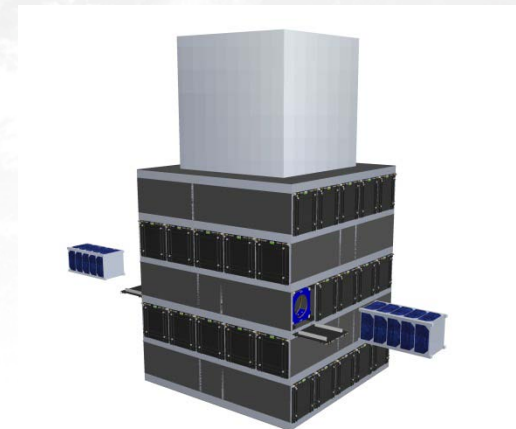
Stand Alone Dispensers



Modular Multi-satellite Dispensers



Integrated on Payload adapters



Special purpose cluster launches



Technical Challenges: Managerial

- Launch opportunity availability:
 - Orbit and schedule depend on primary payload(s)
 - Not all vehicles accessible for (all) CubeSats
 - Sign up time varies from 8-18 months prior to launch
 - Flexibility versus time; the earlier to sign up, the more is possible
- Challenge to have all payloads in a single cluster ready at the same time
- Planning of launch and checkout campaign may be difficult for larger clusters

Technical Challenges: Legislation

- Export control and restrictions
 - May rule out opportunities from certain countries
 - Getting an export license can take several months
- Space Debris Mitigation rules ('25yr rule')
 - CubeSats (also) will have to de-orbit within 25 years
 - Adhered to by most countries already
 - Typically limiting the altitude to which CubeSats can be launched -> fewer opportunities
- Licensing / Registration of space objects
 - Laws and rules vary per country
 - Registration in National Space Object Register
 - Links to Space Debris Mitigation rules and frequency notification with ITU

What can you do to make it easier?

- Be flexible in terms of orbit requirements
- Try to minimize use of export controlled items and/or arrange for a license in time
- Start procedures for frequency coordination and notification early
- Make sure to get acquainted with national legislation and authorities -> we may be able to help with that
- Be in touch for launch opportunities early on in the development of your project -> we can help you to prevent some unwanted surprises

Conclusions

- Number of (very) small satellites to be launched increases significantly
- Small launch vehicles under development worldwide
- Smart clustering of small payloads is essential to optimize the use of scarce launch opportunities
- Legislative constraints and restrictions also apply to CubeSats
- 'Dedicated Cluster Launches' will be key to the future of CubeSats...



Thank you for your attention!



ISIS - Innovative Solutions In Space BV

Joost Elstak

Missions Manager

e-mail: j.elstak@isispace.nl

Abe Bonnema

Marketing Director

a.r.bonnema@isispace.nl

Molengraaffsingel 12-14

2629 JD Delft, The Netherlands

web: www.isispace.nl

www.cubesatshop.com

www.isilaunch.com

www.innovativedataservices.com