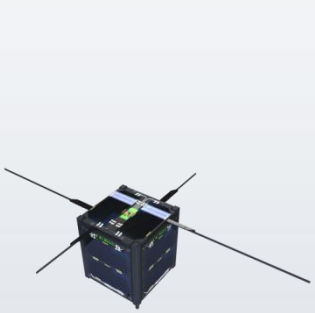
Highly effective and affordable access to in-orbit qualification for micro and nano technology subsystems



Contents

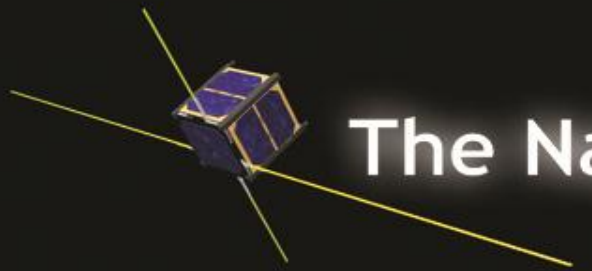
- Introduction
- Nanosatellite Landscape
- Enabling Technologies for Nanosat Techdemo
- Nanosat Techdemo
- Conclusions

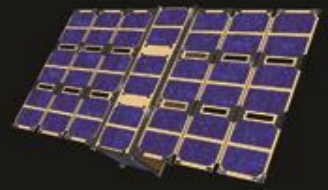
Outline

- Need
  - Need for better, more cost-effective and time effective in-orbit qualification of new subsystems
- Approach
  - Use a rolling nanosat programme with regular launches and dedicated platforms for small qualification missions
- Benefit
  - Cost-effective
  - Time effective
- Context
  - Step down in cost compared to existing platforms
  - Step up in availability

ISIS

The Nanosatellite Specialist





End-to-end small satellite solutions:

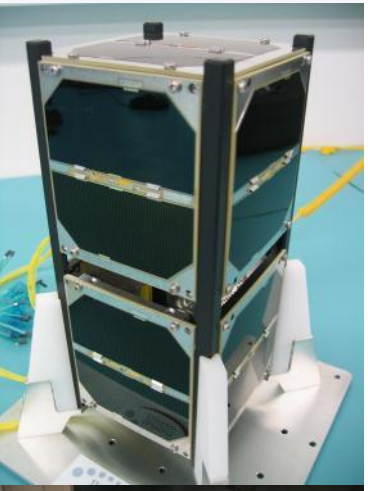
- Integrated space applications & services
- Nanosatellite missions and platforms
- Launch services for auxiliary payloads
- Ground stations and mission operations
- Innovative small systems and products

www.isispace.nl info@isispace.nl

Company Overview

- Spin-off of Delfi-C3 nanosatellite project of TU Delft
- Founded January 06, 2006
- Office locations:
  - Delft (NL), near Delft University of Technology Campus
  - Noordwijk (NL), in the European Space Incubator at ESTEC
  - Somerset West (ZA), since January 2012
- Current employment: ~40 engineers

Nanosatellite Applications



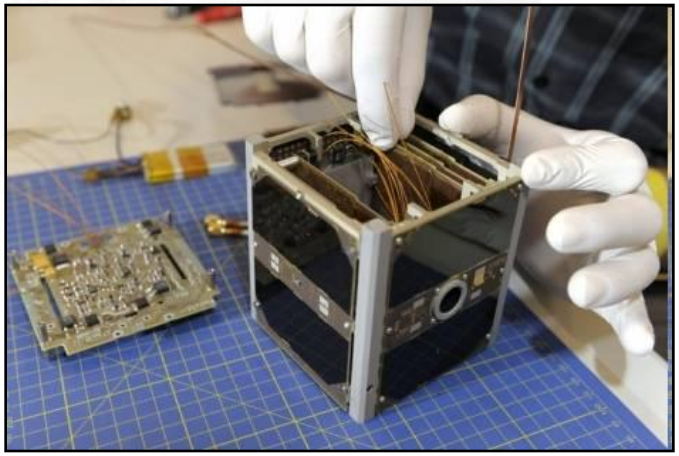
- Nanosatellite Market growing rapidly
  - Cubesats: Conception in 1999
  - First missions launched in 2003
  - 10-20 projects in 2004
  - >250 projects ongoing now (estimate)
- Change of users from educational and institutional to application focused
- The hype is a bit over, now let's figure out what we can do with these things!

Europe's Position in the Nanosat World

- Europe has some of the biggest players in the Nanosatellites market and a leading role in developing innovative systems for nanosatellites

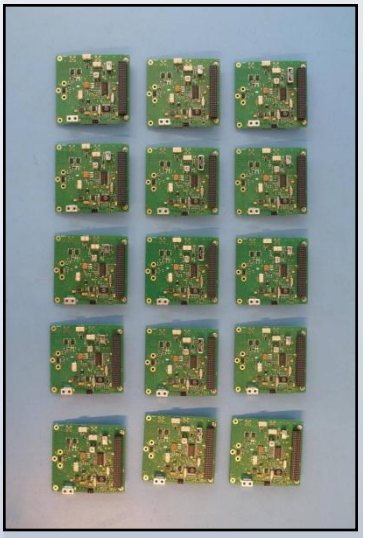
Nanosatellite Progress

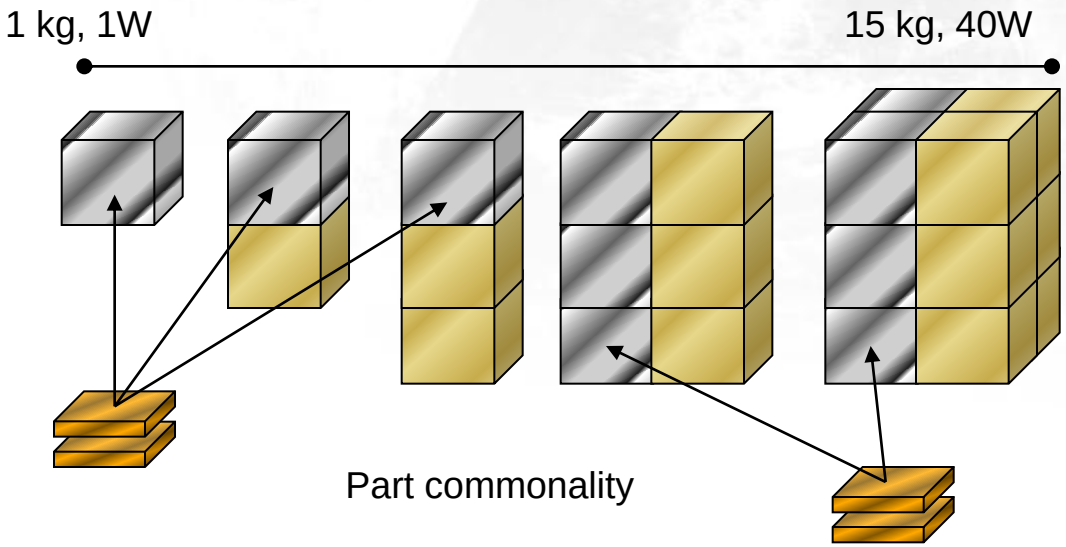
- Advances in Microelectronics and MicroSystems Technology now enables sufficient performance in small satellites
- Low mission and hardware cost enable non-space organizations to become active in space
- Existing space organizations are able to perform missions faster and cheaper



Nanosatellite Design Aspects

- Small Teams
- Short Mission Lifecycles
- Modular systems
- Standard avionics modules and interfaces
- Plug and Play Payload capability
- Off-the-shelf systems – series production





Existing techdemo

- UKUBE: 3U national programme in UK
  - New 3-unit system (platform and payloads)
- Techdemosat: National programme in UK
  - ‘Conventional’ 100 kg microsat
  - Set of payloads share resources

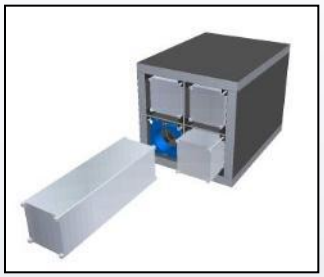
- Why are nanosats useful?
  - Technology ready (next slides)
  - Affordable lifecycle cost
  - Low up front investment
  - Allows step down in size and cost and step up in launch frequency

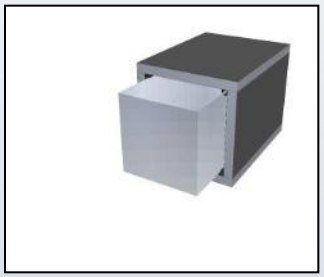
Enabling Technologies:
CubeSat building blocks

- The biggest strength of specifically CubeSats is not their size, but their modularity and standard interfaces.
  - Enables many system providers and ensures compatibility
  - Provides a generic building block for much bigger systems

"There are few useful applications for a 1U mission, but an unlimited amount of applications for systems based on the systems one finds in a 1U system"

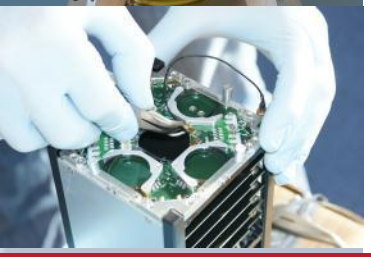
Enabling Technologies:
6-packs & 12-packs





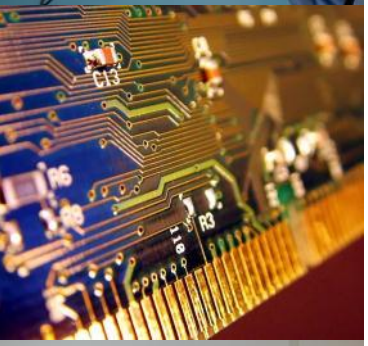
- Size matters
  - Increase in platform sizes
  - from 1-3 kg or liter
  - to 6-12 liter
- More payload carrying capability
  - EO payloads
  - Bigger comms payloads
- More surface area for solar panels and deployables: more power -> more capabilities

Enabling Technologies:
Communication



- Biggest bottleneck perceived
  - €/bit is metric to be optimized for effective systems
- Current downlinks fairly slow
- S-Band emerging for payloads
  - Up to 1 Mbit/s in next 6-12 months
  - Up to 5-10 Mbit in next 24 months
- Move to X-Band before 2015?
- More powerful platform can support these higher data rate systems

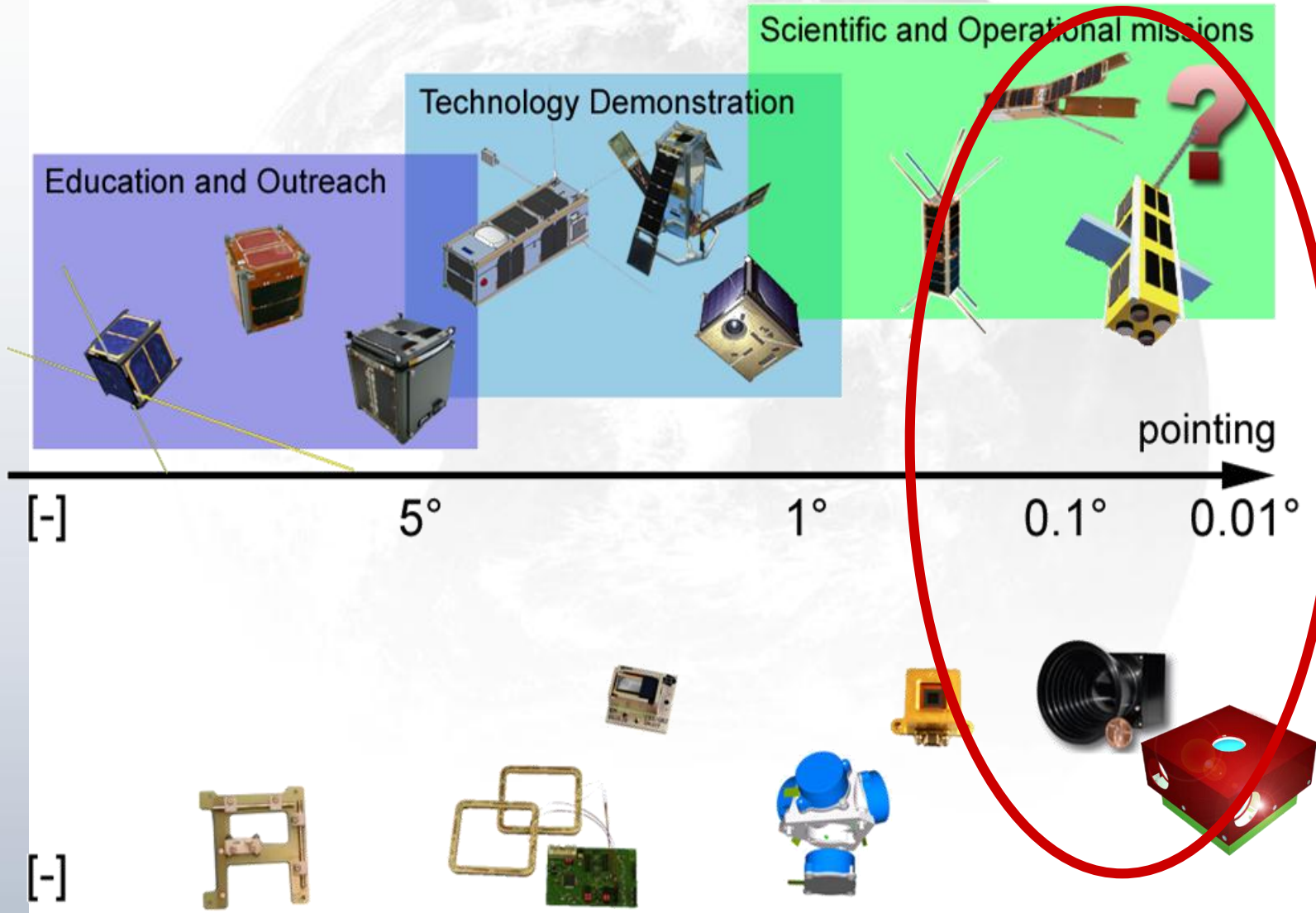
Enabling Technologies:
ADCS



- New generation of ADCS products enables better performance
- Heritage:
  - Magnetic determination & control
- Now:
  - Magnetic, Star tracker determination
    - Earth horizon sensors, gyros also available
  - Magnetorquer, reaction wheels
  - Integrated ADCS packages incl CPU

Enabling Technologies:

ADCS – CubeSat pointing trends



Nanosat Techdemo

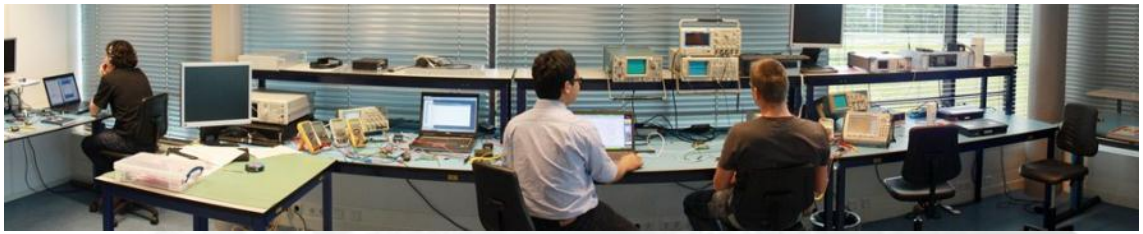
- We now have these very capable nanosat systems, Why not using them for establishing frequent opportunities to verify new technologies in orbit?

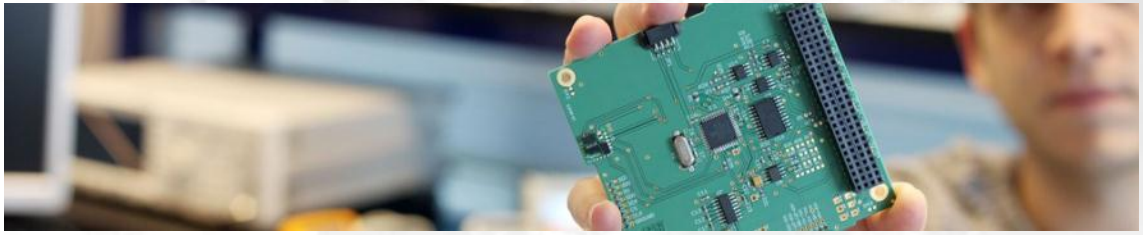
- Current systems can host payloads that
  - Are up to 20x20x20 cm^3 (12 unit)
  - Weigh 5-10 kg
  - Require several tens of watts of power

- Launch in a standardised container
  - Provides maximum flexibility wrt launch vehicle and launch opportunities

Conclusions

- Nanosats maturing and now coming into operational missions
- Main benefits of nanosatellites:
  - Cost Effectiveness
  - Response Time (development cycle)
- Systems available to create an affordable, standardised, in-orbit demo platform for a dedicated payload





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