CAL POLY
SAN LUIS OBISPO

tyvak
NANO-SATELLITE SYSTEMS INC.

Small Sats: Present and Future

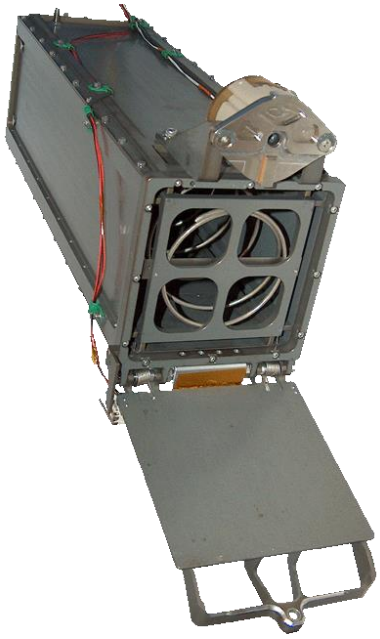
Jordi Puig-Suari

Founder & CSO: Tyvak Nano-Satellite Systems Inc.

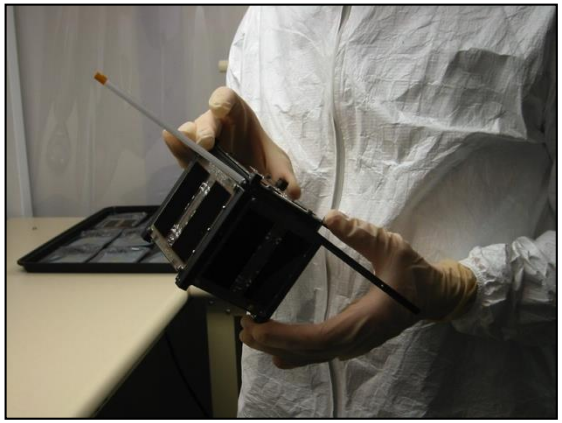
Professor: Aerospace Engineering, Cal Poly SLO

ITU Symposium and Workshop on Small Satellite Regulation and Communication Systems
Prague, Czech Republic
March 2015

Cal Poly Activities

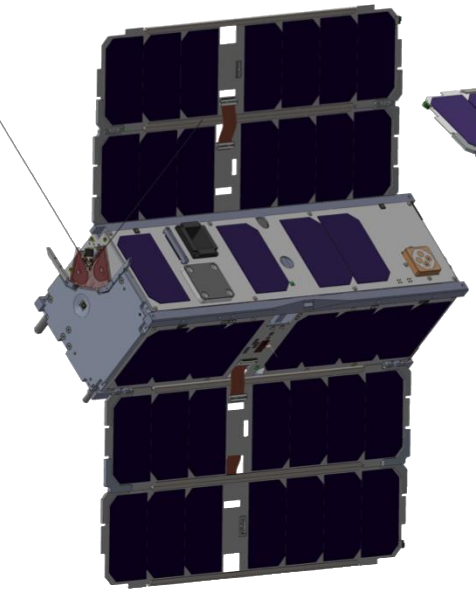


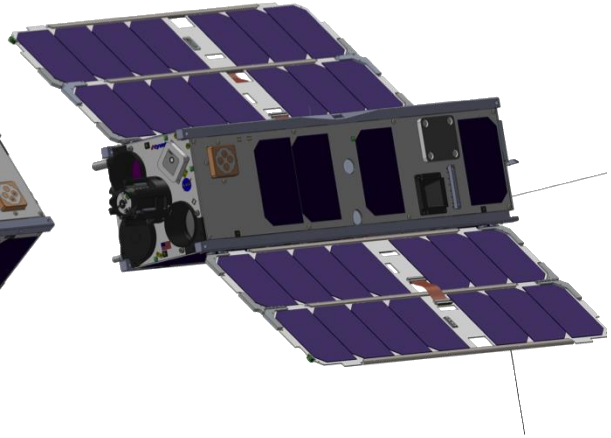
- Create & Maintain CubeSat Standard
- Develop Cal Poly CubeSats (CP series)
  - 8 CubeSats launched + 2 CubeSat in Development
- Integrating and Launching CubeSats
  - Successfully Completed 18 Launch Campaigns
    - >100 CubeSat integrated, >50 P-PODs
    - 13 Different launch vehicles and 8 ranges

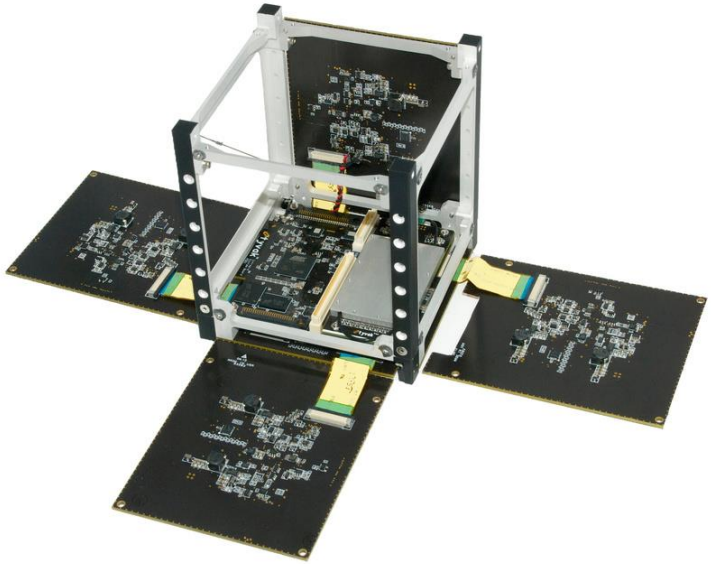


Tyvak: Small Start-Up

- Commercialize Advanced NanoSat Systems
- Develop Advanced Nano-Sat Missions
- Commercial Launch Services





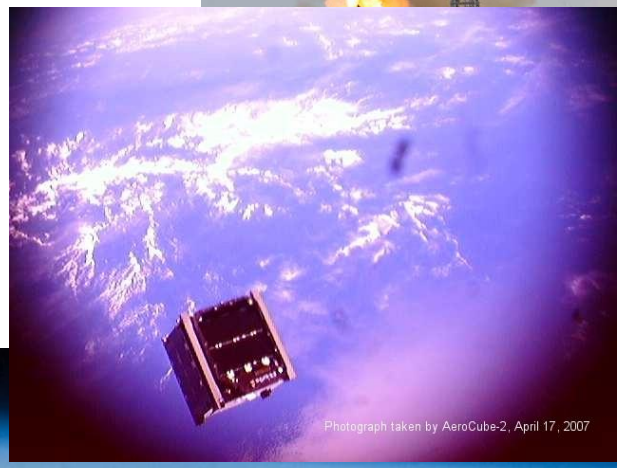


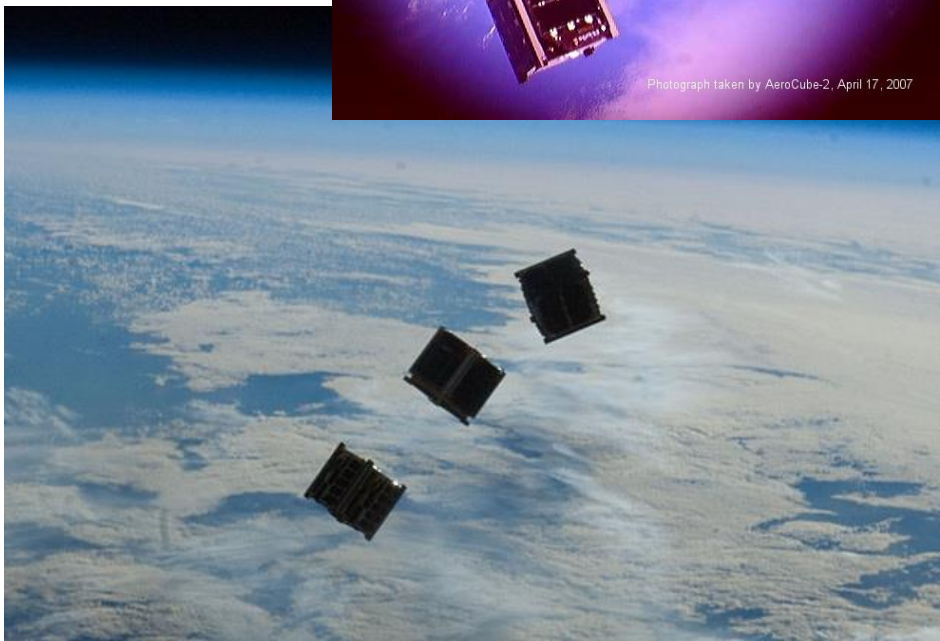
CubeSat Program Objectives

- Started in 1999: Stanford-Cal Poly Team
- Facilitate Student Access to Space:
  - Rapid Development Time (Student academic life)
  - Low-Cost
  - Launch Vehicle Flexibility
- Use Simple Standards
- University Projects
- Industry Testbed (funding?)

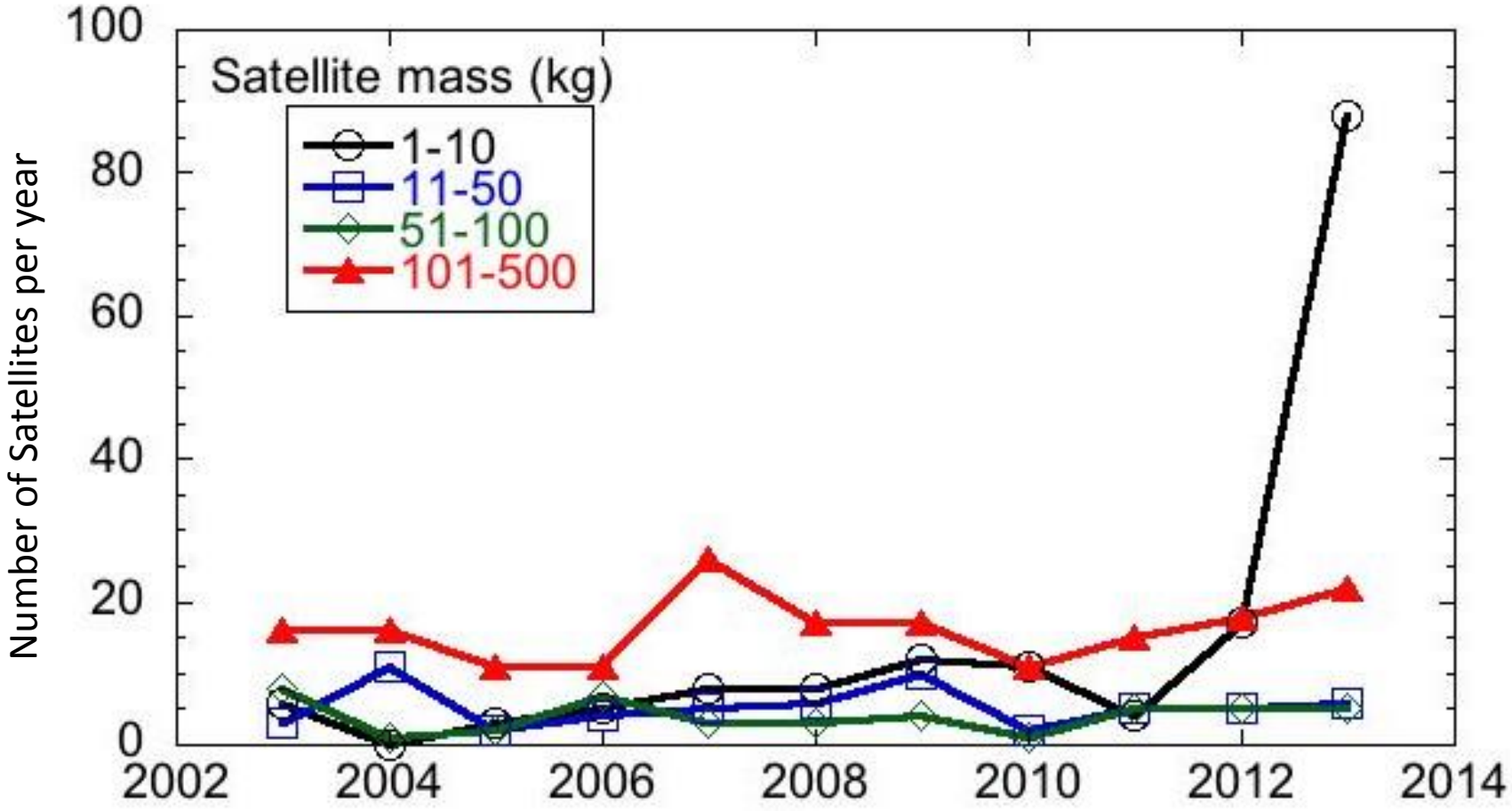
Successful Standard

- Many CubeSats in Orbit (>150)
  - Launches in US, India, Russia, Europe, ISS
  - Regular Launches Now Available
- Large Developer Community
  - University/Gov/Industry
  - Worldwide
  - Dedicated Workshops
  - NEW PLAYERS!!
    - New Countries
    - New Universities





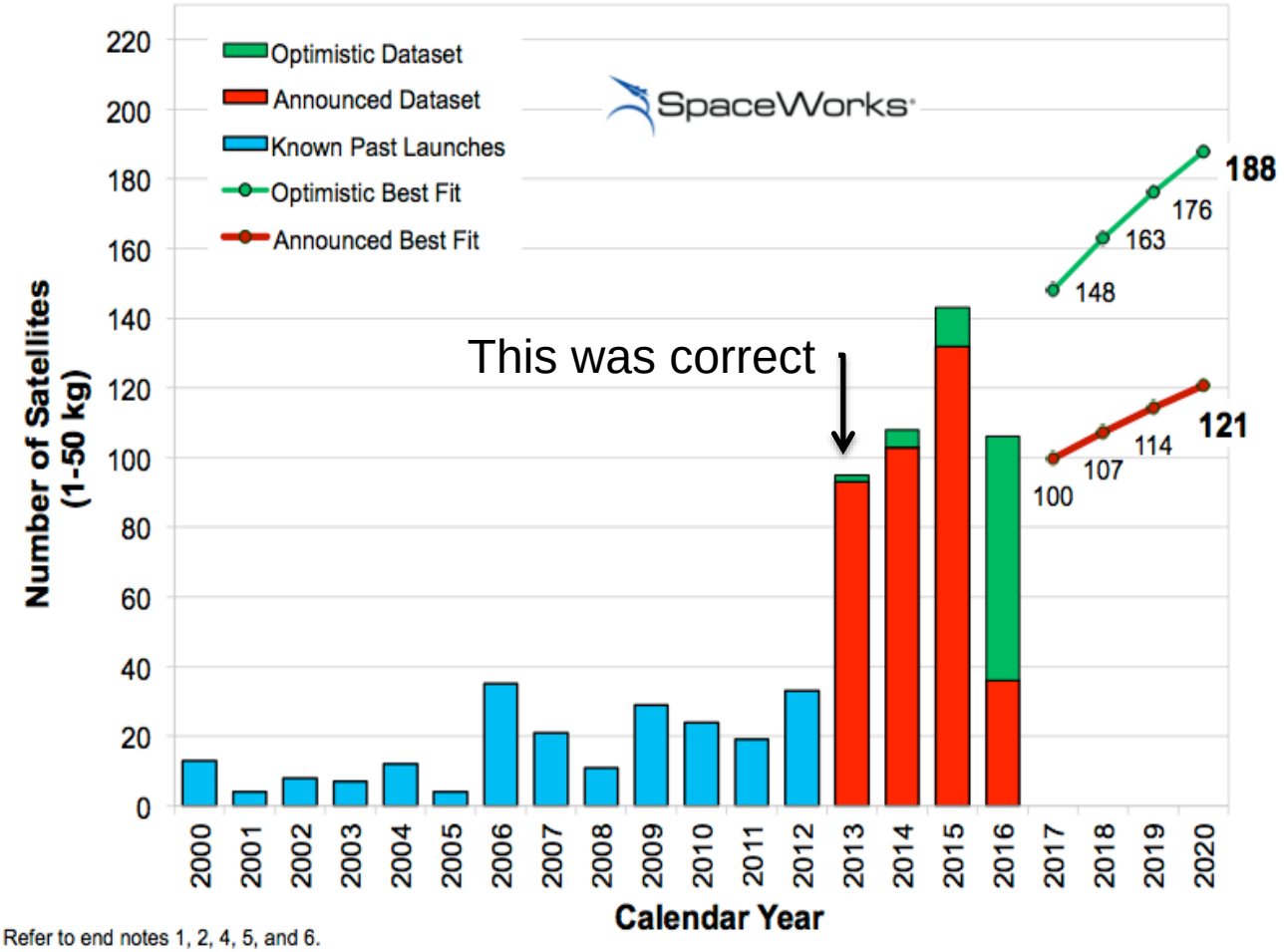
Small Satellite Launch Trends



Source: Kyushu Institute of Technology

Nano/Microsatellite Launch History and Projections

Projections based on the announced plans of nano/microsatellite developers and programs indicate a range of 121 to 188 nano/microsatellites requiring launch by 2020



Notes: Refer to end notes 1, 2, 4, 5, and 6.

http://www.sei.aero/eng/papers/uploads/archive/SpaceWorks_NanoMicrosat_Market_Feb2013.pdf

Who is doing it?

GLOBAL !!!!

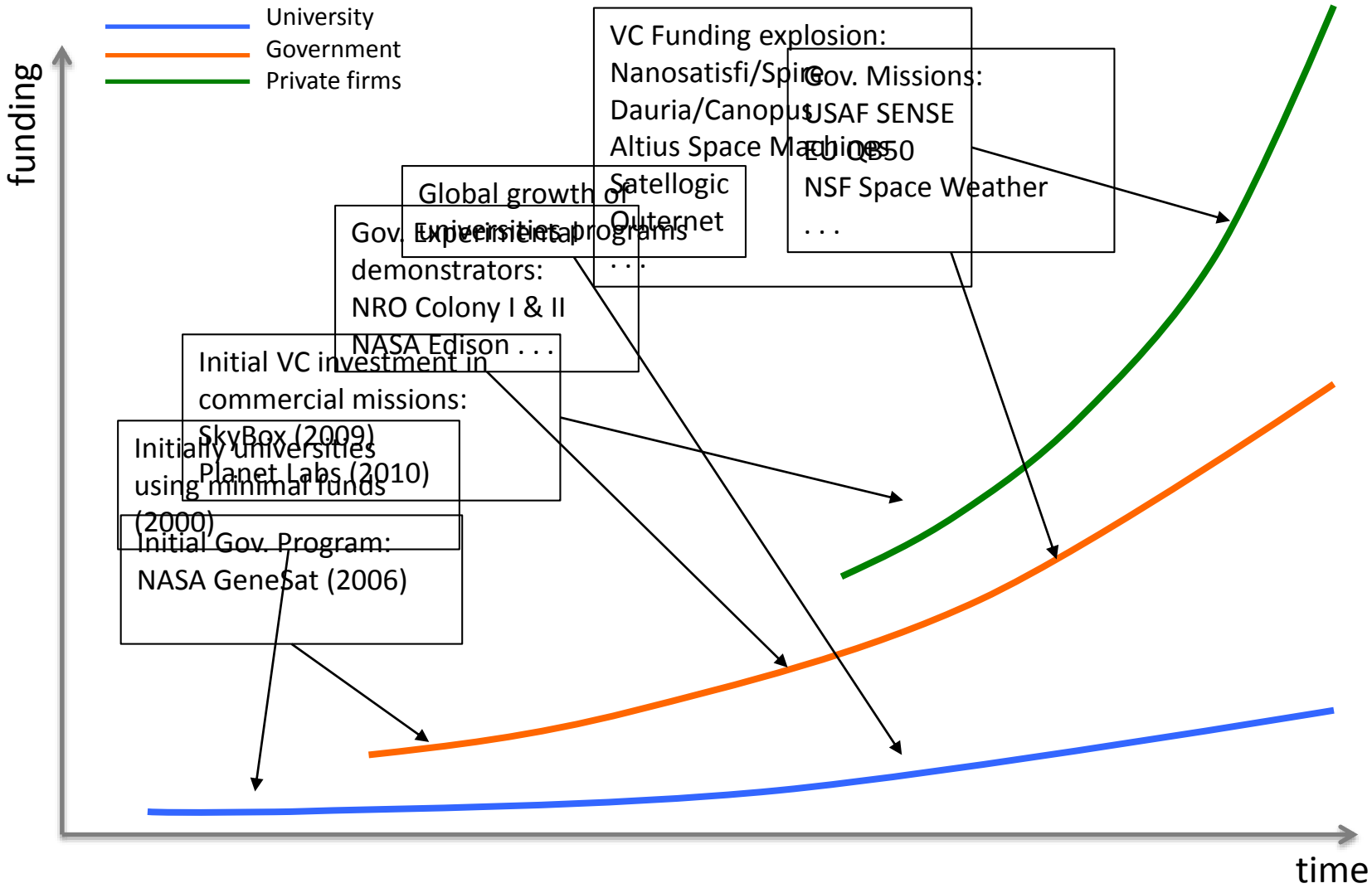
Revolution or Evolution?

- Evolution:
  Smaller Spacecraft
- Revolution:
  New Way of Doing Space
  - Higher Risk Tolerance
  - More Flexible Launches
  - **Higher Numbers**
  - **Lower Cost** / Complexity
  - Standardization
  - COTS Electronics
  - **Faster Development**

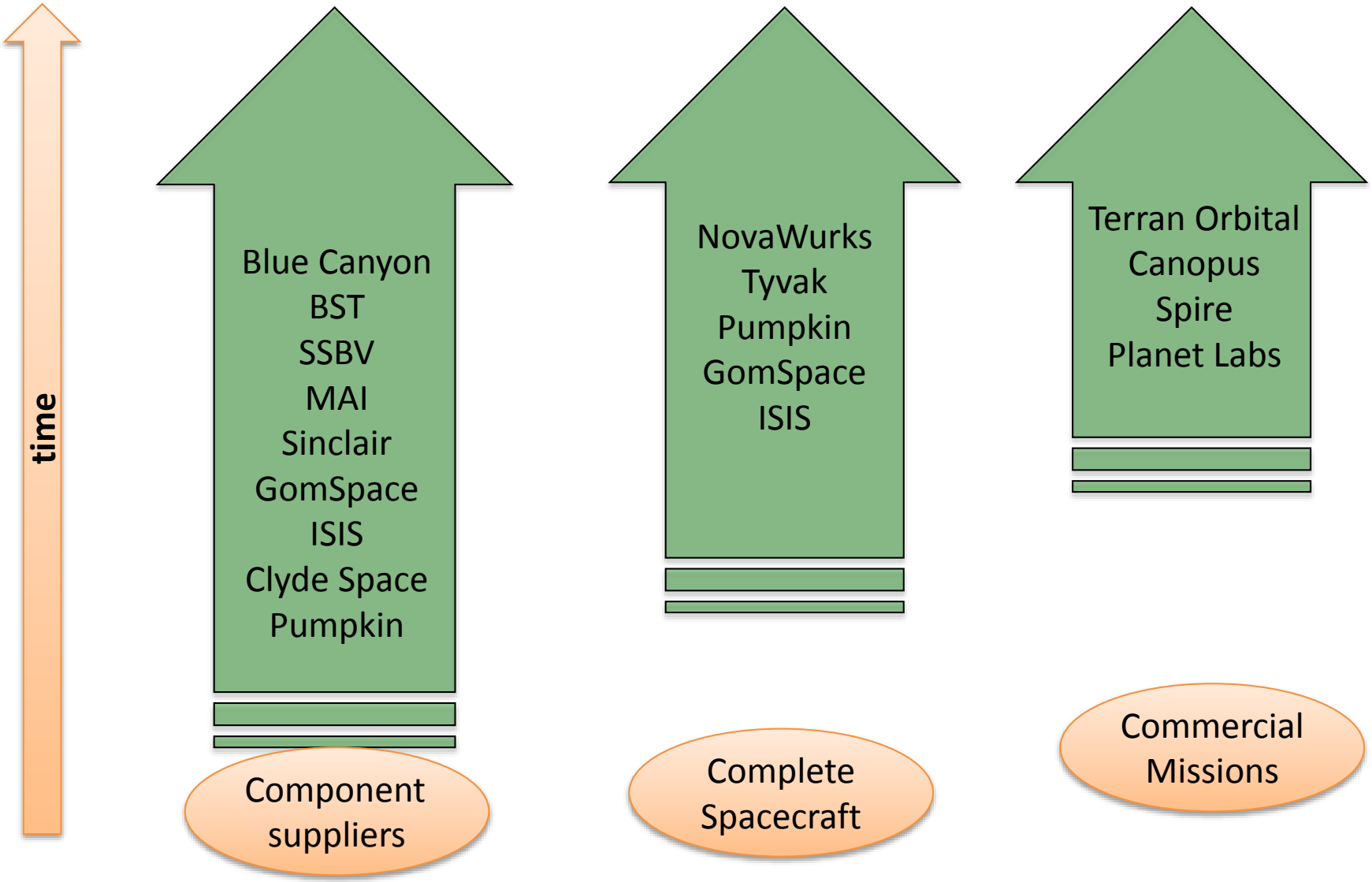
Interesting Observations

- This is not a new thing
  - Surrey, AmSat, Shuttle Gas Can, . . .
- CubeSat took it too new level
  - Standardization
  - Worldwide Interest
  - Electronics Revolution
  - Very High Performance/cost ratio
- "*Small Spacecraft*" is not a good definition

Industry Evolution



Company Evolution



Regulatory Challenges

- Many New Developers with Little Experience
  - Unaware of regulation
- Limited Budgets
- Very Fast Development
- Very Large Numbers of Spacecraft
  - Can overwhelm regulators
- New Operational Concepts
  - Very large constellations
  - Regular replenishment/augmentation
  - Global coverage

Required Responses

- Educate Developer Community
  - Must be good citizens
  - Community support of newcomers
  - Clear divide between commercial and educational missions
- Simplify and Streamline Regulatory Processes
  - Is it possible?
  - Ease regulators and developers workloads
  - Minimum required paperwork
- Launch providers can play coordinator role
- Already happening
  - e.g. NOAA, FCC, IRAU, . . .

Conclusions

- New Space ecosystem emerging
  - Exponential growth
- Developers must follow the law
- Regulators must get ready for new reality
- Collaboration is key to success
  - Confrontational attitude is counterproductive
  - Developer community can contribute new process & standardization ideas


Thank You
Questions?