

No Satellite Experience? No Problem. Put a CubeSat in Space!

Andrew E. Kalman, Ph.D.

Slide 1



Don't leave Earth without it

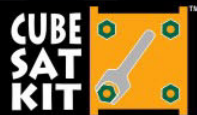
strong light modular scalable customizable affordable
www.cubesatkit.com

*Primer Congreso Internacional en
Ciencia y Tecnología Aeroespacial (CICTA)
Bogotá, Colombia Octubre 2007* **PUMPKIN**
INCORPORATED

Historically Speaking

- Space race driven by superpowers.
- Lots of know-how and money required.
- Eventually other countries joined in, often as a matter of national prestige.
- Science & exploration from early on.
- Communications satellites primary early commercial driver.
- With weather, mapping, etc., line is blurred between commercial and scientific endeavors.
- Now, some of the fruits are free – e.g. Google Earth.

Slide 2



Don't leave Earth without it

strong light modular scalable customizable affordable
www.cubesatkit.com

*Primer Congreso Internacional en
Ciencia y Tecnología Aeroespacial (CICTA)
Bogotá, Colombia Octubre 2007* **PUMPKIN**[™]

Current Situation

- A new space race is on, with many governments playing, often as teams.
- Science & exploration missions continue, but with a new emphasis on efficiency. No longer “succeed at all costs.”
- Some space systems in dire need of replacement.
- After a long lull, there is now a sense of urgency. We are playing catch-up
- Seem more willing to accept disruptive technologies by using the latest “new thing” – trying to keep up with the rapid pace of technology.
- No longer an isolated industry – lots of new players (Virgin Galactic, SpaceX, Ratan, etc.) in new markets.
- Tangible personal connection to space.

Slide 3



Don't leave Earth without it

strong light modular scalable customizable affordable
www.cubesatkit.com

*Primer Congreso Internacional en
Ciencia y Tecnología Aeroespacial (CICTA)
Bogotá, Colombia Octubre 2007*



Who Uses Space?

- The usual suspects
 - Military
 - Commercial
 - Science & exploration
- The new kids on the block
 - Tourists
 - Prize seekers
 - “New Pioneers”
 - Educators
 - Data gatherers
 - The usual suspects, trying to invigorate their people, processes, profile, etc.
 - Advertisers

Slide 4



Don't leave Earth without it

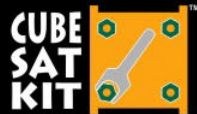
strong light modular scalable customizable affordable
www.cubesatkit.com

*Primer Congreso Internacional en
Ciencia y Tecnología Aeroespacial (CICTA)
Bogotá, Colombia Octubre 2007* **PUMPKIN**

Fundamental Changes?

- Large, expensive satellites won't disappear any time soon.
- For small satellites, access to space is increasingly a matter of simply showing up at the right time with the right amount of money. The door is open, and you have many doors to chose from.
- The “FedEx satellite” has become a reality.
- For small satellites, space is definitely open for business. And science, too. And education. And ...

Slide 5



Don't leave Earth without it

strong light modular scalable customizable affordable
www.cubesatkit.com

*Primer Congreso Internacional en
Ciencia y Tecnología Aeroespacial (CICTA)
Bogotá, Colombia Octubre 2007* **PUMPKIN**

Why CubeSats?

- Level of technology entirely manageable.
- “Arrive and orbit” means no previous experience required.
- Timelines, success rates, costs incurred, data collected, etc. from previous missions all point to manageable projects with results in 2-5 years.
- Highly interdisciplinary:
 - Electrical, mechanical, computer & systems engineering
 - Communications
 - Program management
 - And more ...
- Low per-mission costs.
- Regional / global communities.
- Failure is not catastrophic.

Slide 6



Don't leave Earth without it

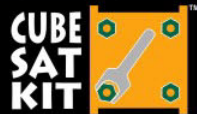
strong light modular scalable customizable affordable
www.cubesatkit.com

*Primer Congreso Internacional en
Ciencia y Tecnología Aeroespacial (CICTA)
Bogotá, Colombia Octubre 2007* **PUMPKIN**[™]

What Usually Happens?

- Someone gets excited about an idea.
- Idea turns into a CubeSat mission proposal.
- Choose launch opportunity. This sets the timeline.
- Realize all the different aspects of a successful mission program. Recruit friends from academia & industry. Offer students pizza.
- Obtain funding (the hard part). Beg, borrow, steal.
- Move through PDR, CDR, etc. to complete the CubeSat.
- Deliver CubeSat for integration.
- Cross fingers on launch date.
- Celebrate!

Slide 7



Don't leave Earth without it

strong light modular scalable customizable affordable
www.cubesatkit.com

*Primer Congreso Internacional en
Ciencia y Tecnología Aeroespacial (CICTA)
Bogotá, Colombia Octubre 2007*



And the Benefits Are?

- Project
 - Academic / educational.
 - Cooperation between academia, government & industry.
 - Workforce development.
 - New departments, companies & industries.
 - Confidence to do bigger / better satellites.
- Mission
 - Improve scientific understanding.
 - New companies & markets.
 - Exposure on a global scale.

Colombia

- Libertad-1
 - Universidad Sergio Arboleda, Bogota
 - No previous space experience
 - Infected with initial idea by Stanford's Prof. Bob Twiggs in 2004
 - Small team
 - Low budget
 - Purchased first CubeSat Kit components March 2005
 - Launched April 17, 2007
 - Success!
 - A 21st-century Sputnik
- Colombia-1, Cubesat-UD
 - Universidad Distrital



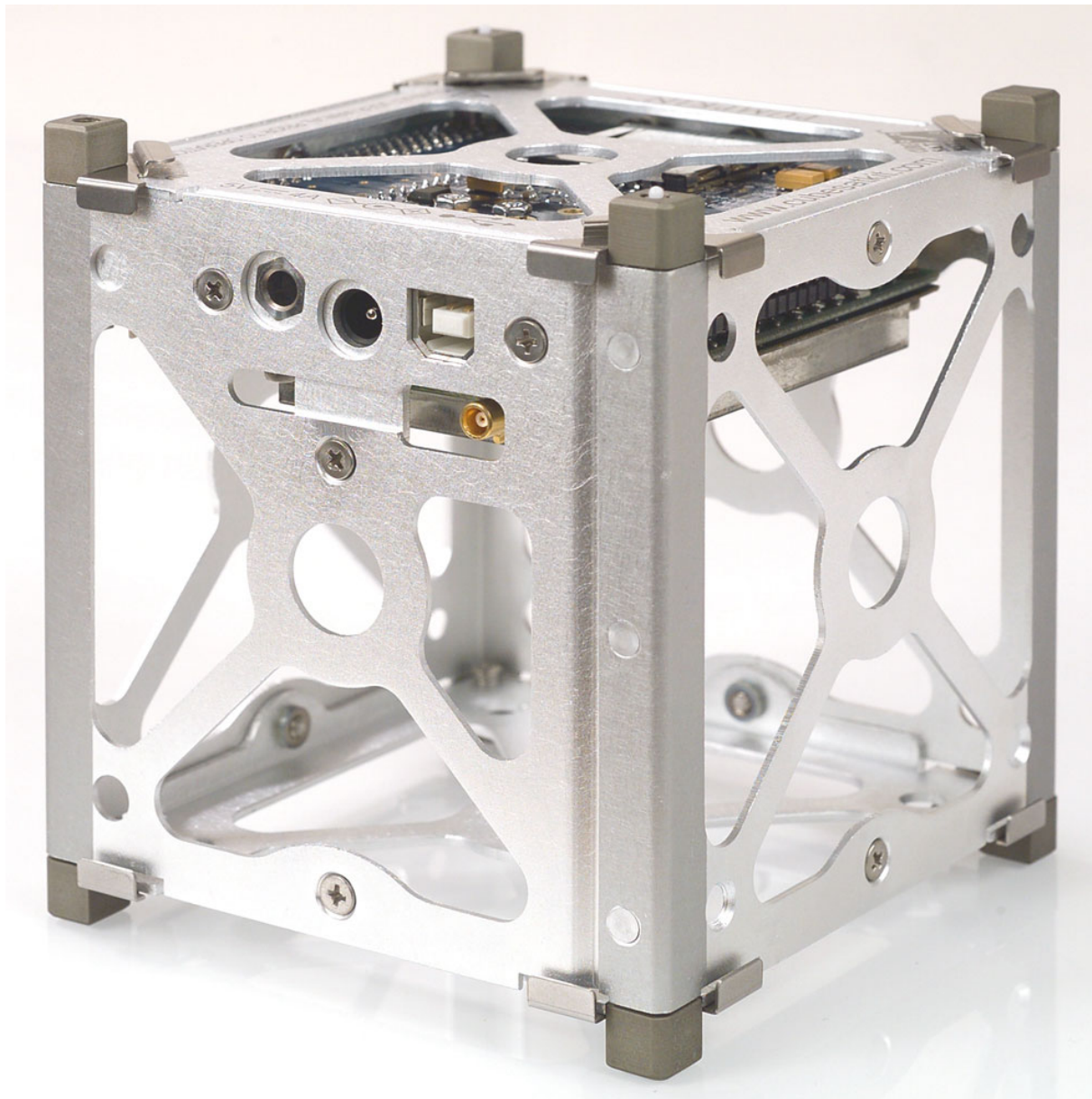
Slide 9



Don't leave Earth without it

strong light modular scalable customizable affordable
www.cubesatkit.com

Primer Congreso Internacional en
Ciencia y Tecnología Aeroespacial (CICTA)
Bogotá, Colombia Octubre 2007 



Q&A Session

Thank you for
attending!

Slide 10



Don't leave Earth without it

strong light modular scalable customizable affordable

www.cubesatkit.com

*Primer Congreso Internacional en
Ciencia y Tecnología Aeroespacial (CICTA)
Bogotá, Colombia Octubre 2007*



Notice

This presentation is available online in Microsoft® PowerPoint® and Adobe® Acrobat® formats at:

www.pumpkininc.com/content/doc/press/Kalman_CICTA2007.ppt

and:

www.pumpkininc.com/content/doc/press/Kalman_CICTA2007.pdf

Appendix

• Speaker information

- Dr. Kalman is Pumpkin's president and chief technology architect. He entered the embedded programming world in the mid-1980's. After co-founding Euphonix, Inc – the pioneering Silicon Valley high-tech pro-audio company – he founded Pumpkin, Inc. to explore the feasibility of applying high-level programming paradigms to severely memory-constrained embedded architectures. He is the creator of the Salvo RTOS and the CubeSat Kit. He holds two United States patents and is a consulting professor in the Aero & Astro department at Stanford University. Contact Dr. Kalman at aek@pumpkininc.com.

• Acknowledgements

- Stanford Professors Bob Twiggs' and Jamie Cutler's continued support for the CubeSat Kit, and their inputs on enhancements and suggestions for future CubeSat Kit products, are greatly appreciated.
- Pumpkin's Salvo and CubeSat Kit customers, whose real-world experience with our products helps us improve and innovate.

• Salvo, CubeSat Kit and CubeSat information

- More information on Pumpkin's Salvo RTOS and Pumpkin's CubeSat Kit can be found at <http://www.pumpkininc.com/> and <http://www.cubesatkit.com/>, respectively.

• Copyright notice

© 2000-2007 Pumpkin, Inc. All rights reserved. Pumpkin and the Pumpkin logo, Salvo and the Salvo logo, The RTOS that runs in tiny places, CubeSat Kit, CubeSat Kit Bus and the CubeSat Kit logo are all trademarks of Pumpkin, Inc. Don't leave Earth without it is a service mark of Pumpkin, Inc. All other trademarks and logos are the property of their respective owners. No endorsements of or by third parties listed are implied. All specifications subject to change without notice.

First presented at the 1st International Congress on Science and Aerospace Technology (Primer Congreso Internacional en Ciencia y Tecnología Aeroespacial - CICTA) in Bogotá, Colombia on October 11, 2007.

Slide 12



Don't leave Earth without it

strong light modular scalable customizable affordable
www.cubesatkit.com

Primer Congreso Internacional en
Ciencia y Tecnología Aeroespacial (CICTA)
Bogotá, Colombia Octubre 2007 PUMPKIN™