Pumpkin's Colony I CubeSat Bus: Past, Present and Future

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Outline

- Past: How did the Colony I buses come about?
- Present: What's the status of the Colony I buses?
- Future: What's next for Pumpkin's CubeSat bus?

Past: MISC 2 Bus Origins

- CubeSat Design Specification:
  - Bob Twiggs / Stanford University
  - Jordi Puig-Suari / Cal Poly SLO

- CubeSat Kit™ Rev. A 2003-12-31 to first customer.
- To date, >150 CubeSat Kits delivered to customers.
- Heritage on 4 missions + other components (e.g., MHX).
- 4th-generation modular architecture introduced in 2008.
- All developed on Pumpkin internal R&D - no external funding (government or otherwise).

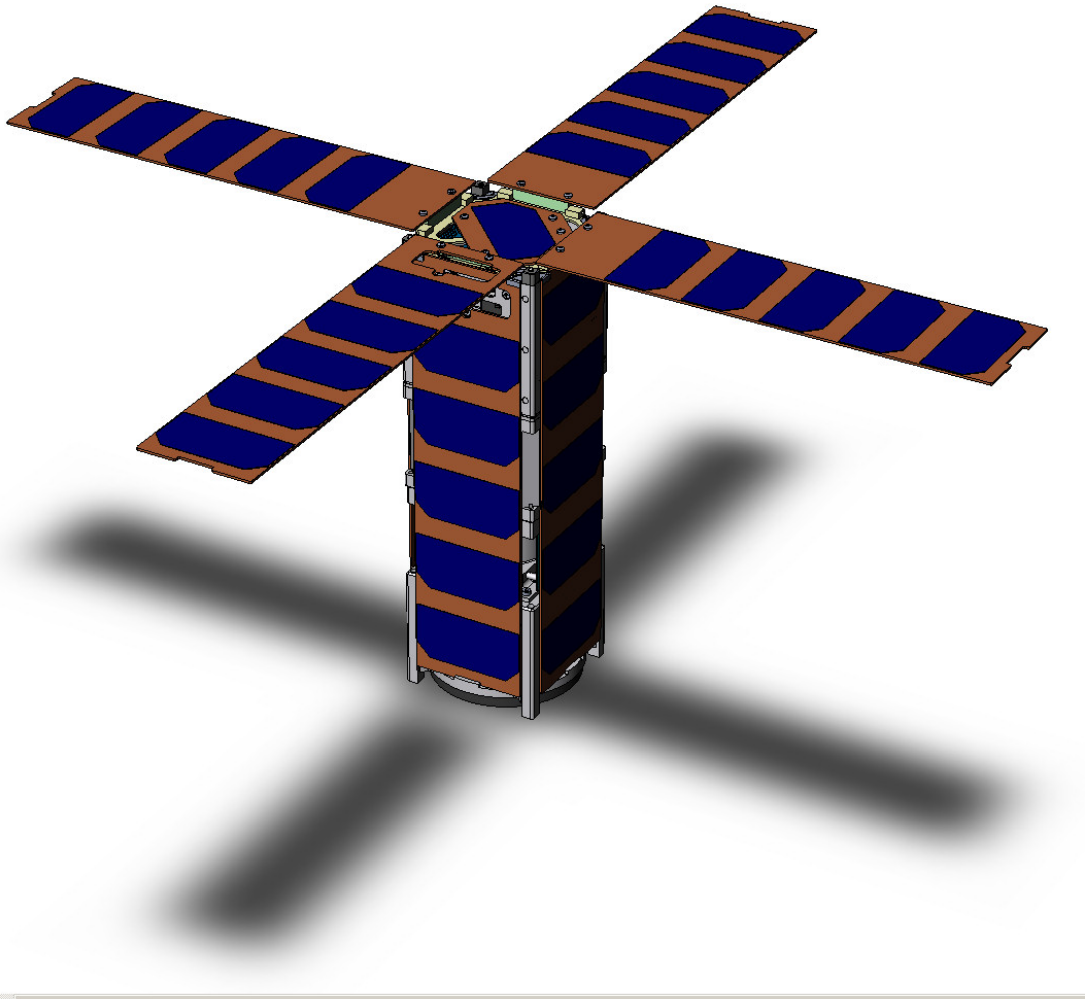
- MISC family of CubeSat buses:
  - Q: What is the largest lens that fits in a CubeSat?
  - A: MISC - The Miniature Imaging SpaceCraft

Past: MISC 2 Bus Origins

- In 2008 a MISC CubeSat prototype was built with:
  - Pumpkin CubeSat Kit Rev C. FM430
  - Pumpkin custom 3U structure
  - Pumpkin-designed panels w/Spectrolab UTJ cells
  - Pumpkin camera w/16MP Kodak full spectrum imager
  - 600mm diffraction-limited optics
  - COTS parts:
    - IMI 3 Axis ADACS – repackaged by Pumpkin
    - Clyde Space EPS / batteries
    - Microhard MHX-series radio

- MISC presented at SSC 2008.
- SSC Paper: *A Novel Approach to Low Cost Imaging Satellites.*

Past: MISC: The Original 3U Imaging CubeSat



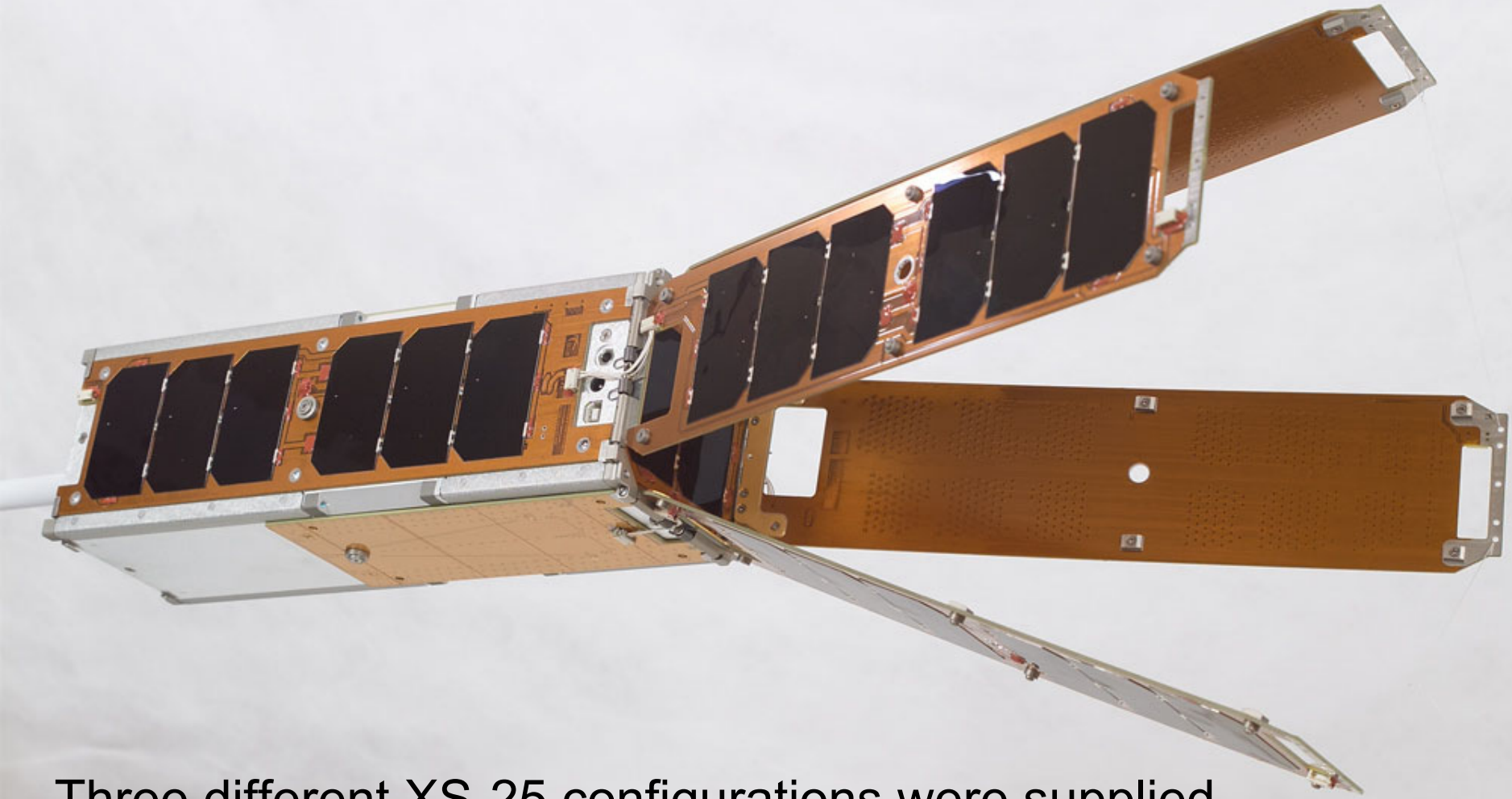
Past: MISC 2 = Colony I = XS-25a/b

- Pumpkin submitted four IEI proposals in 2008.
- IEI Award in October 2008 for 3 Pluggable Processor Modules (PPMs).
- Separate contract in October 2008 for 2 MISC 2 *buses* (QbX bus *only*, no payload), with CubeSat Kit Hinge™.

- Buses to include deployable panels and other mods.
- Both contracts Firm Fixed Price.
- 8051 PPM done & delivered first to accommodate existing customer code-base.
- Buses delivered Q1 2009, after testing at Cal-Poly.

- Customer exercised option in H1 2009 for ten more identical units.

Past: XS-25a/b in Space Dart Config



Three different XS-25 configurations were supplied

Past: All Buses Delivered

- All twelve buses + five EMs delivered on FFP contract in under 12 months.
- QbX #015 to ISI/USC with customer-specified alternate solar panel arrangement.
- Want to know more? Ask us, or ask our customers.

Present:

- Post-sales support on integration, minor modifications, etc.

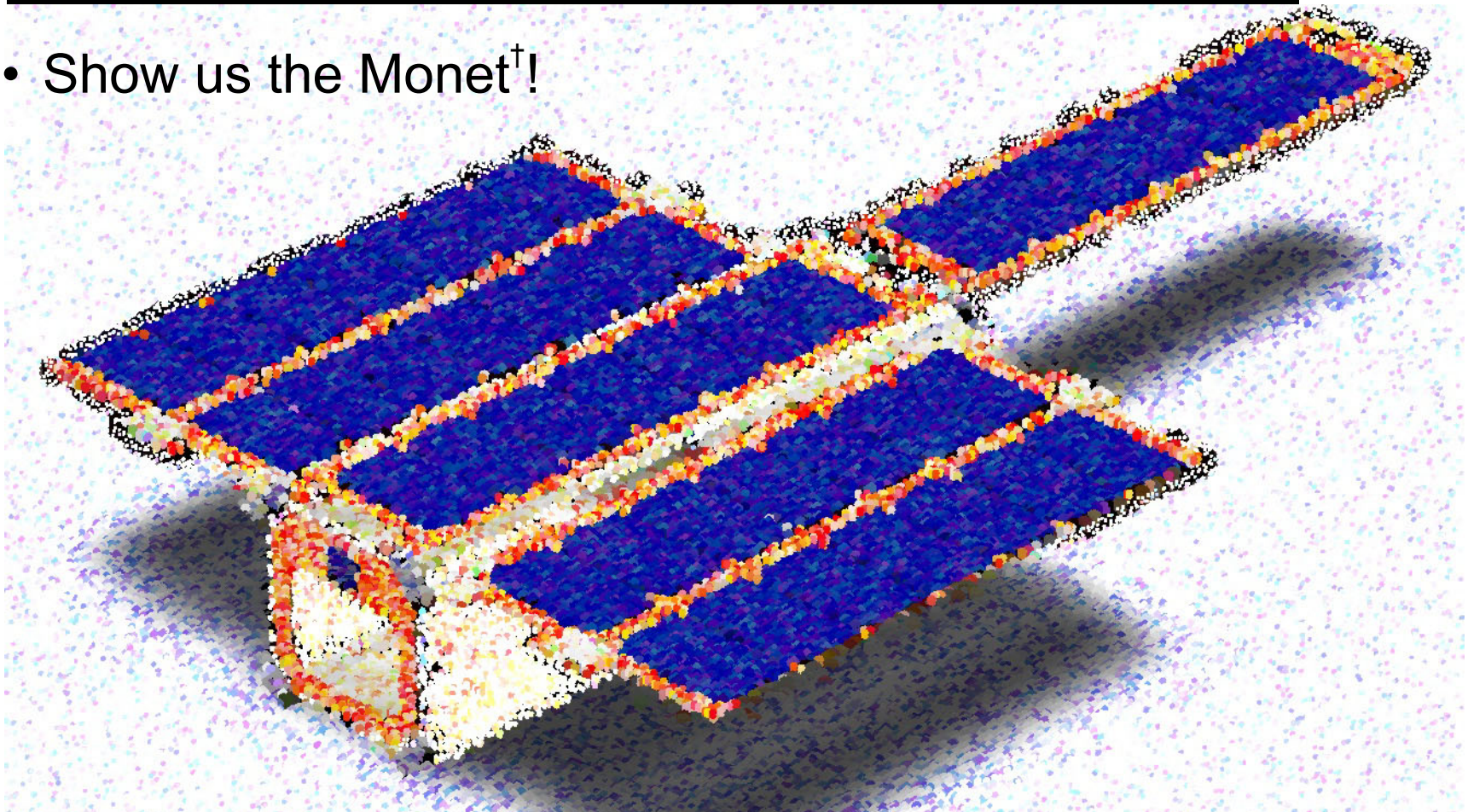
- Supplying additional CSK components for payloads, etc.
  - Dev. Boards, software and tools
  - PPMs for payloads processing, alternate bus PPMs
  - Payload structures, etc

- Eagerly awaiting news on launches.

- Continuing development of MISC 3, which began once the MISC 2 design was locked down.

Future: MISC 3 Multipurpose Bus

- Show us the Monet†!



- A peek at our Colony II bus (C2B) – MISC 3

†: With apologies to Georges-Pierre Seurat

Future: MISC 3 Imaging CubeSat

- Complete Satellite, bus and imaging payload together.
- For 3U CubeSat envelope or 3U + large(r) optics.
- Modular imaging payload, wide selection of optics and imagers possible.
- Available soon.

Future: MISC 3-based Systems

- Pumpkin prime on DARPA Phase I SBIR for emergency '9-1-1' communications network using a CubeSat constellation.

- Your nanosat project ?

Q&A Session

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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. He is a consulting professor in the Department of Aeronautics & Astronautics at Stanford University and directs the department's Space Systems Development Laboratory (SSDL). Contact Dr. Kalman at aek@pumpkininc.com.
- Acknowledgements
  - Pumpkin's Salvo and CubeSat Kit customers, whose real-world experience with our products helps us improve and innovate.
- CubeSat Kit information
  - More information on Pumpkin's CubeSat Kit can be found at http://www.cubesatkit.com/.
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