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CubeSat

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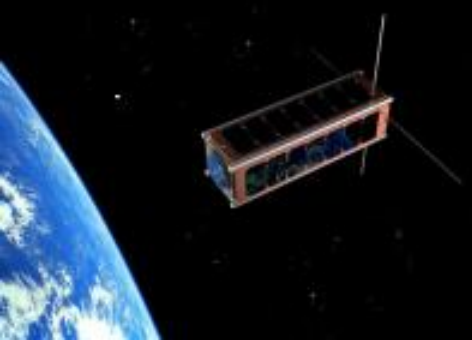

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1. What is CubeSat?

- Used for space research
- Lowcost: 50 to 100 k$

  COTS hardware
- Modular design
- Miniaturized: 1U to 12U

  1U= 10 × 10 × 10 cm (1 liter)
- More launch opportunities

  Secondary payload on launcher

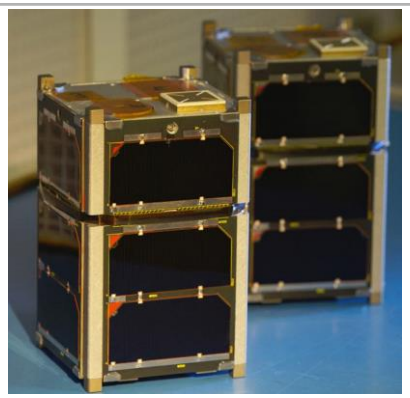

Figure 1: FIREBIRD-II CubeSat

Figure 2: NanoRacks CubeSat Deployer

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2. On-Board Computer

- Microcontroller: power efficient
  - STM32 family chips
  - ARM cortex M4/M7 processor
- Language: C/C++
- OS: FreeRTOS
  - Task scheduling, semaphore and queue operations
- Controls all subsystems:
  - ADCS (Attitude Determination and Control System)
  - Communication System
  - Power System
  - Payload
- Use Finite-state machine
- Use semaphore programming

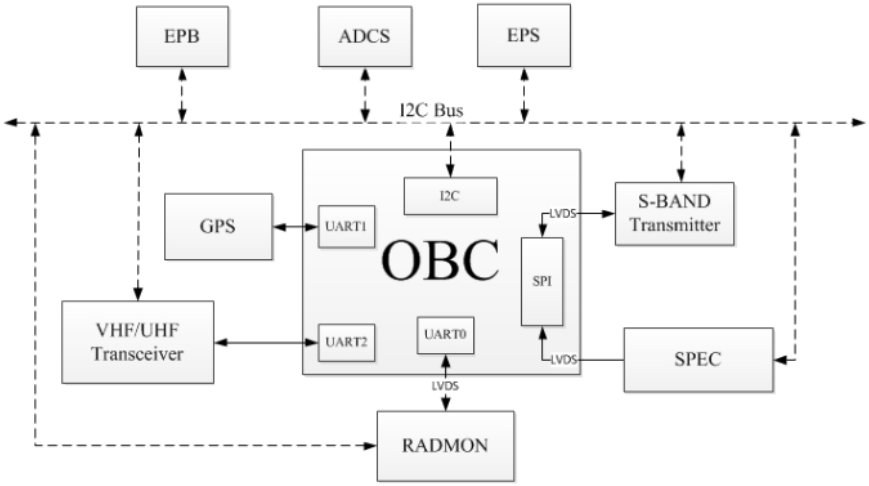


Figure 3: System Block Diagram

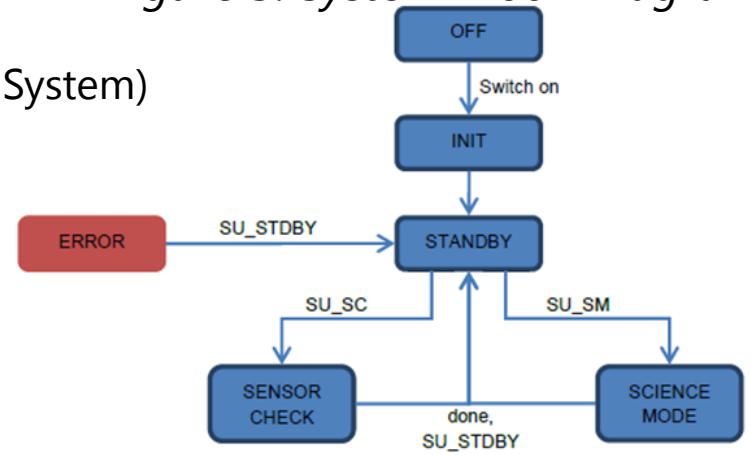
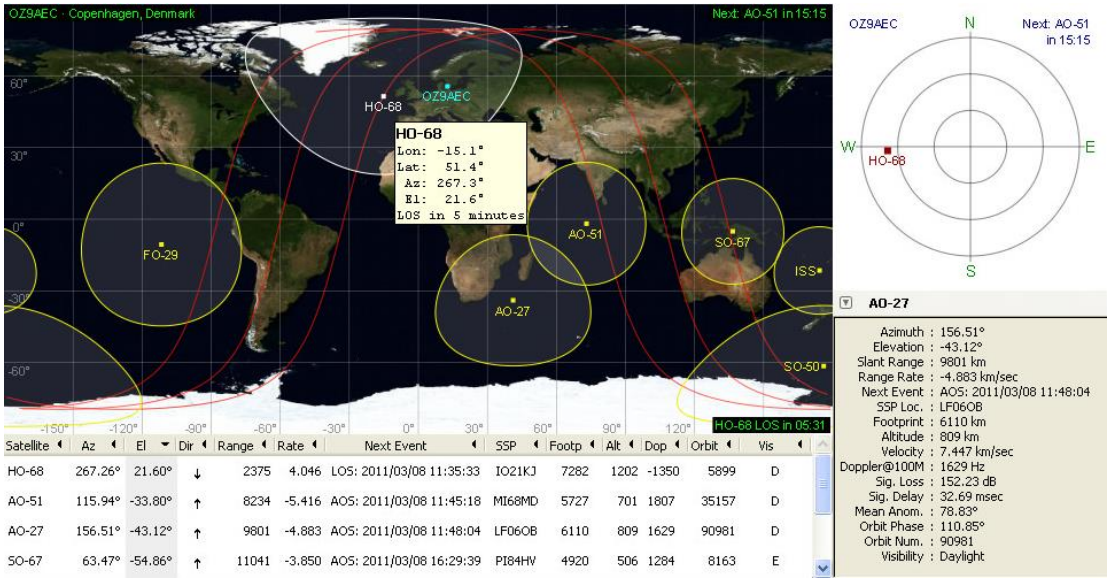


Figure 4: State Transition Diagram

3. Ground Station

- Satellite tracking software
  - Real-time satellite tracking and orbit prediction
- Antenna Tracking
  - Elevation and azimuth position
- Send Telecommand
- Receive WOD (Whole Orbit Data)
  - FEC (forward error correction) and analysis



Satellite	Az	El	Dir	Range	Rate	Next Event	SSP	Footp	Alt	Dop	Orbit	Vis
HO-68	267.26°	21.60°	↓	2375	4.046	LOS: 2011/03/08 11:35:33	IO21KJ	7282	1202	-1350	5899	D
AO-51	115.94°	-33.80°	↑	8234	-5.416	AOS: 2011/03/08 11:45:18	MI68MD	5727	701	1807	35157	D
AO-27	156.51°	-43.12°	↑	9801	-4.883	AOS: 2011/03/08 11:48:04	LF06OB	6110	809	1629	90981	D
SO-67	63.47°	-54.86°	↑	11041	-3.850	AOS: 2011/03/08 16:29:39	PI84HV	4920	506	1284	8163	E

Figure 6: Satellite tracking (Gpredict)

Figure 7: Antenna UHF/VHF

Conclusion

CubeSats facilitate access to space and offer more opportunities to innovation

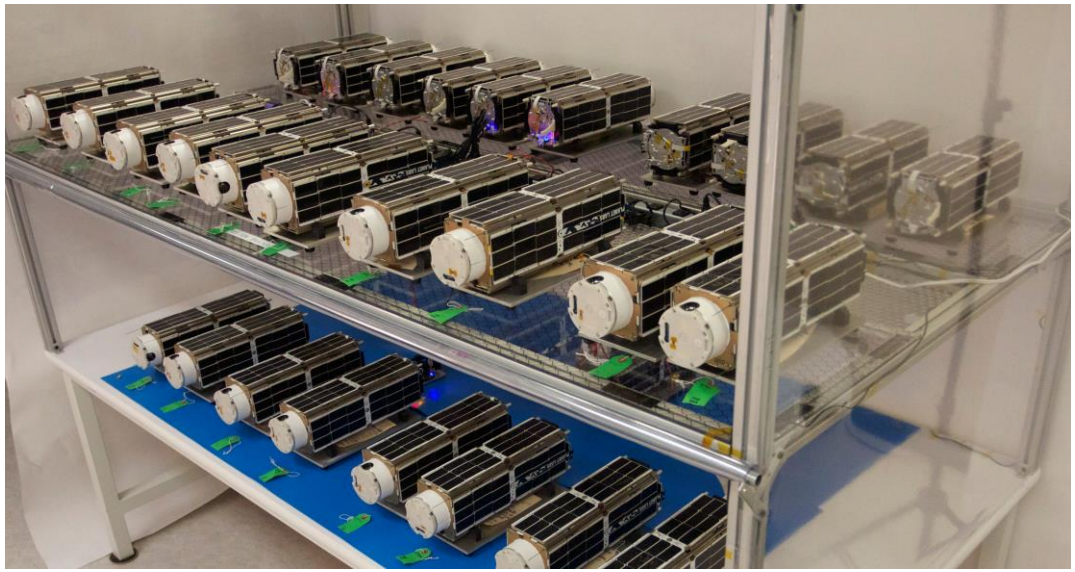


Figure 7: Planet Labs CubeSat Constellation

References

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Special thanks

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