Increasing Production Efficiency through Automation with Evolving BCT XB1 CubeSat Architectures

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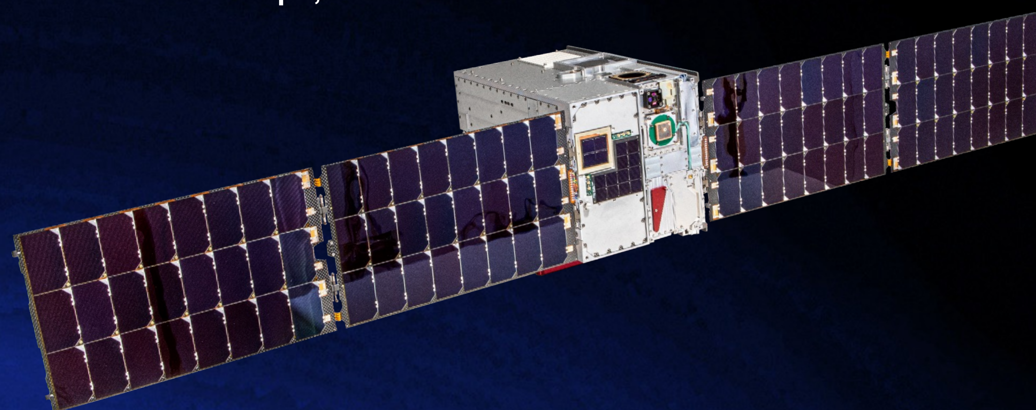
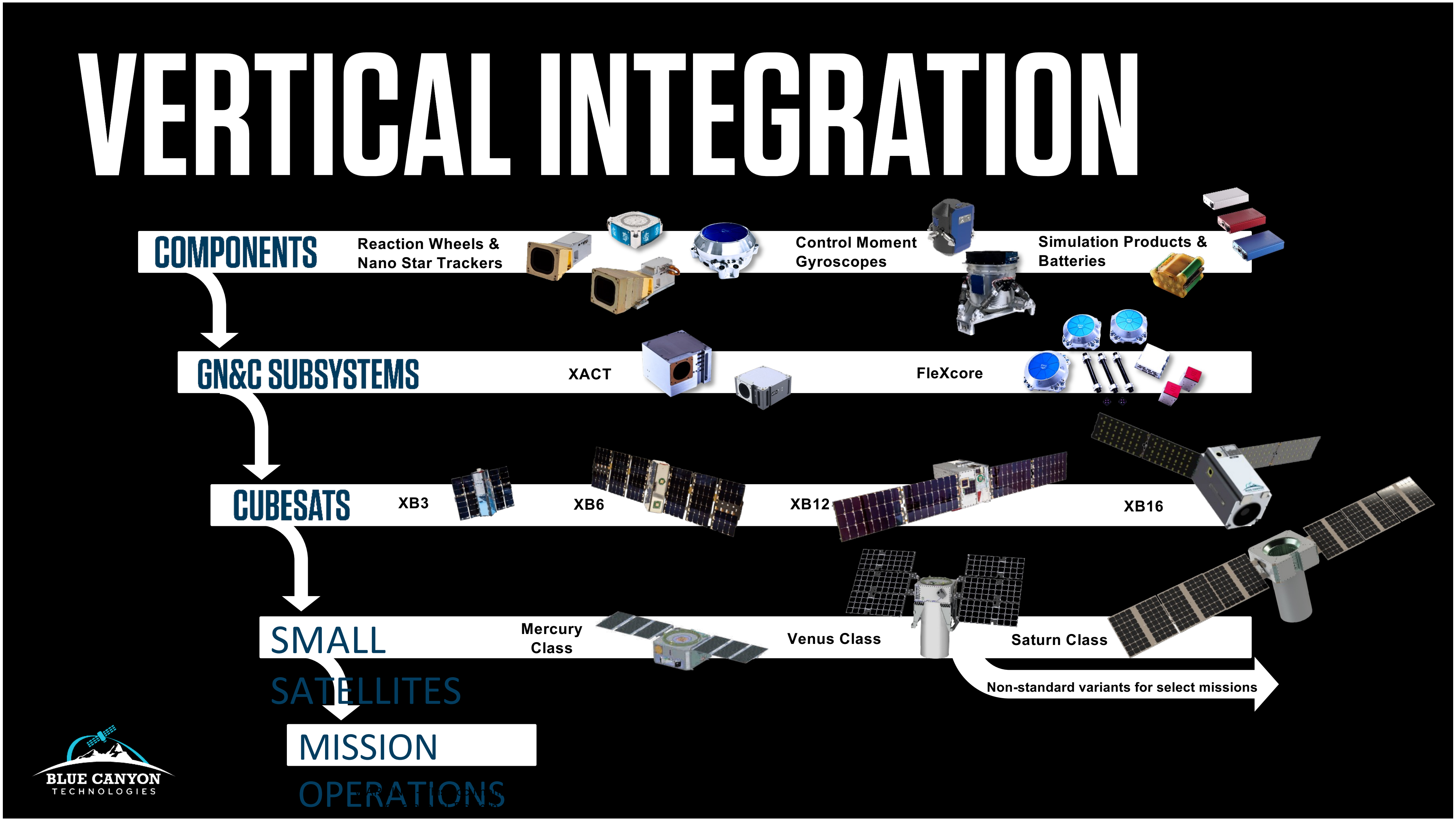
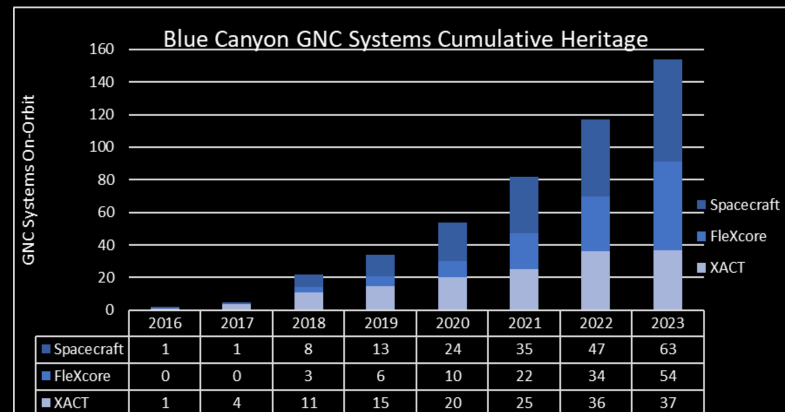


BLUE CANYON TECHNOLOGIES

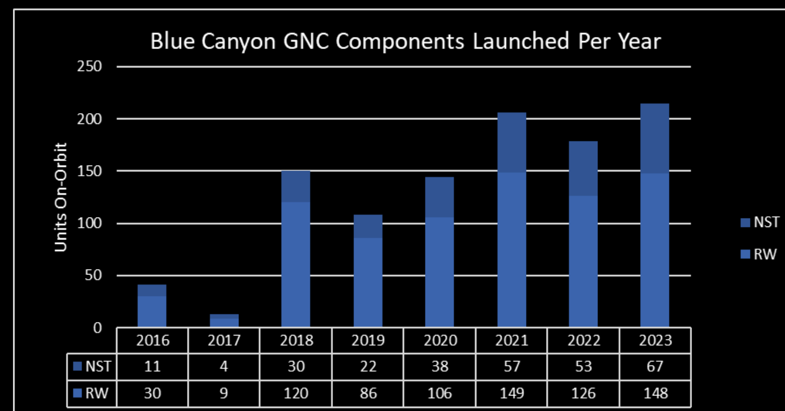

VERTICAL INTEGRATION
COMPONENTS
Reaction Wheels & Nano Star Trackers
Control Moment Gyroscopes
Simulation Products & Batteries
GN&C SUBSYSTEMS
XACT
FleXcore
CUBESATS
XB3
XB6
XB12
XB16
SMALL SATELLITES
Mercury Class
Venus Class
Saturn Class
Non-standard variants for select missions
MISSION OPERATIONS
BLUE CANYON TECHNOLOGIES

HERITAGE FROM PAST SEVEN YEARS

- Large number of systems delivered for flight but undergoing customer integration and/or awaiting launch
- 45+ BCT XB1 systems delivered on-orbit
- 150+ BCT GN&C systems have been deployed to orbit
  - BCT has delivered 750+ reaction wheels and 250+ star trackers separate from full GNC systems since 2016



	2016	2017	2018	2019	2020	2021	2022	2023
Spacecraft	1	1	8	13	24	35	47	63
FleXcore	0	0	3	6	10	22	34	54
XACT	1	4	11	15	20	25	36	37

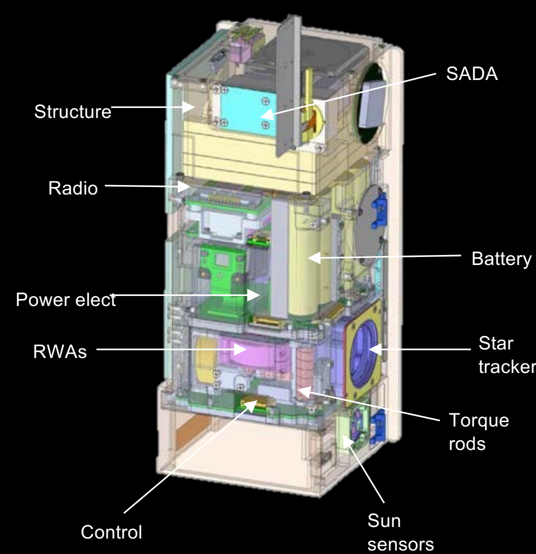


	2016	2017	2018	2019	2020	2021	2022	2023
NST	11	4	30	22	38	57	53	67
RW	30	9	120	86	106	149	126	148

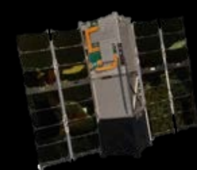
BLUE CANYON TECHNOLOGIES

PRIOR GENERATION XB1s

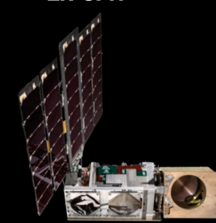
- Previous XB1 generations enabled numerous successful missions.
- To optimize available payload volume, XB1 avionics are densely packaged.
- High density packaging led to complex manufacturing of buses.
    - Rework on electronics boards requires disassembly of entire spacecraft



3U

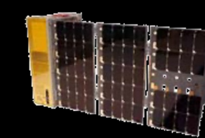


RAVAN (APL)
2x CAT



7x Tropics
(MIT-LL/NASA)

6U



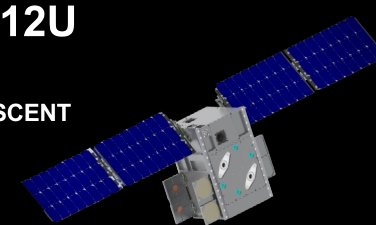
HaloSat
(Wallops)

CSIM (CU/LASP/NASA)

2x TEMPEST-D (CSU/JPL)
CIRIS (Ball)
CUBERRT (Ohio St.)

12U

ASCENT



BLUE CANYON TECHNOLOGIES

PRIOR GENERATION XB1 & TROPICS AI&T

- Challenging build for consistent manufacturing with quality.
- Elected to build the buses in pairs due to testability of 2 buses simultaneously. Any less was inefficient but any more was not manageable
- Software, onboard automation logic, and vehicle configuration values part of the same single Flight Software release.
  - Complicates constellation programs with multiple software builds and additional testing.
- Tests that took the most labor hours were not scripted or automated

BLUE CANYON TECHNOLOGIES

SPACECRAFT TEST METHODS

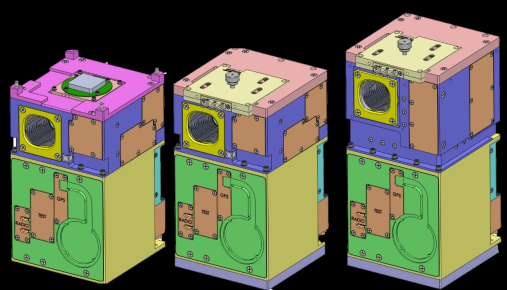
- BCT utilizes scripting and automation as much as possible to create repeatable and consistent test suites that apply across multiple spacecraft within a constellation, and across all BCT spacecraft programs
  - Scripting and automation allows for:
    - One test conductor to do more work in less time
    - Less human error and more consistency

- Only major functional tests were scripted fully for the TROPICS spacecraft test campaign, constituting approximately 20-30% of test time

BLUE CANYON TECHNOLOGIES

CURRENT GENERATION XB1 OVERVIEW

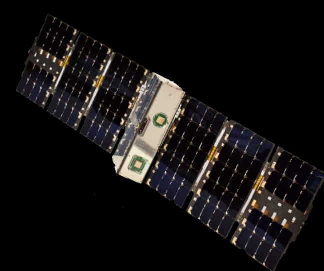
- Current generation XB1 designed for modularity.
  - Enhances production workflow for parallel operations, reducing dependencies.
  - Design allows for access to XB1 components even when integrated to space vehicle.
  - Modules can be swapped in and out of builds easily when required
- Internal Manufacturing Execution System requires fewer touch points for work order deployment, streamlining production floor.
- Flight software now separated from automation logic and vehicle configurable values.
- Repeated tests across vehicles reduced to single-run, with automated checks on other vehicles in constellation.
- Improvements in current generation reduce rework touch time by a large margin on.
  - Board reworks and replacements can be done without disassembly



Example Programs*

3x CLICK (MIT-SSL/NASA)
4x Starling (NASA)
18x Tomorrow.io

2x PREFIRE (NASA)
3x EZIE (APL/NASA)



AMS (MIT-LL)
SPARCS (ASU/NASA)
ARCSTONE (NASA)
VISORS (NASA/Ga Tech/Multiple)
Link XVI (ViaSat)

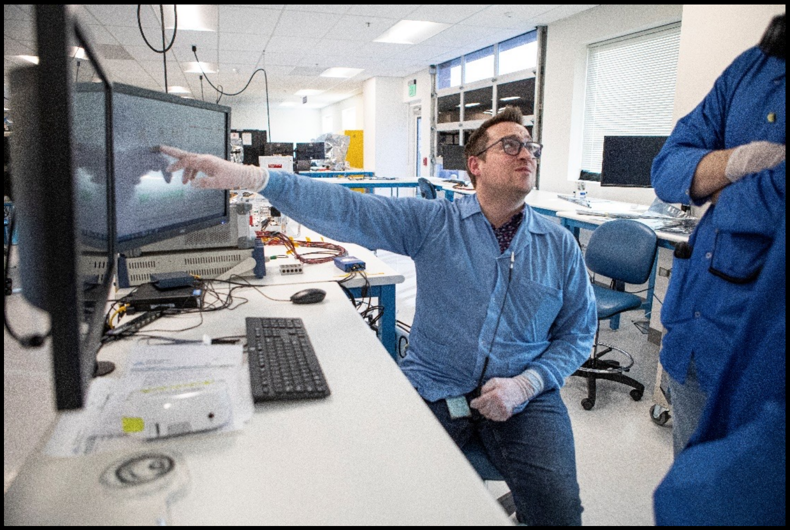
*Many more not shown

BLUE CANYON TECHNOLOGIES

AUTOMATION THROUGH AI&T

- Test campaign continues to use scripting and automation to create consistency and allow test conductor to more work at once

- Major functional tests are still automated, and additional tests are now scripted and with repetitive activities are also automated
    - Percentage of automation: ~60%
    - Increased automation in testing allows test conductor to operate more spacecraft at once, pulling in test timeline



BLUE CANYON TECHNOLOGIES

OPERATIONAL IMPROVEMENTS WITH AUTOMATION

- Science data gap detection
  - Payload Service / Automation
  - CFDP
- Parallel data processing (Real-time vs. Stored TLM)
- Dynamic return-to-cruise
- Autonomous Mission Resume (AMR)
- Automated ground scheduling / constellation deconfliction (Contact plan generation service)
- Bus commissioning improvements

BLUE CANYON
TECHNOLOGIES

THANK YOU