Autonomous Systems Validation (SysVal) environment for advancing Mission Operations

Kelsey Doerksen, Karl Fischer
Space System Engineering, Planet
35th Annual Small Satellite Conference
Monte Fitz Roy, Patagonia – March 19, 2018
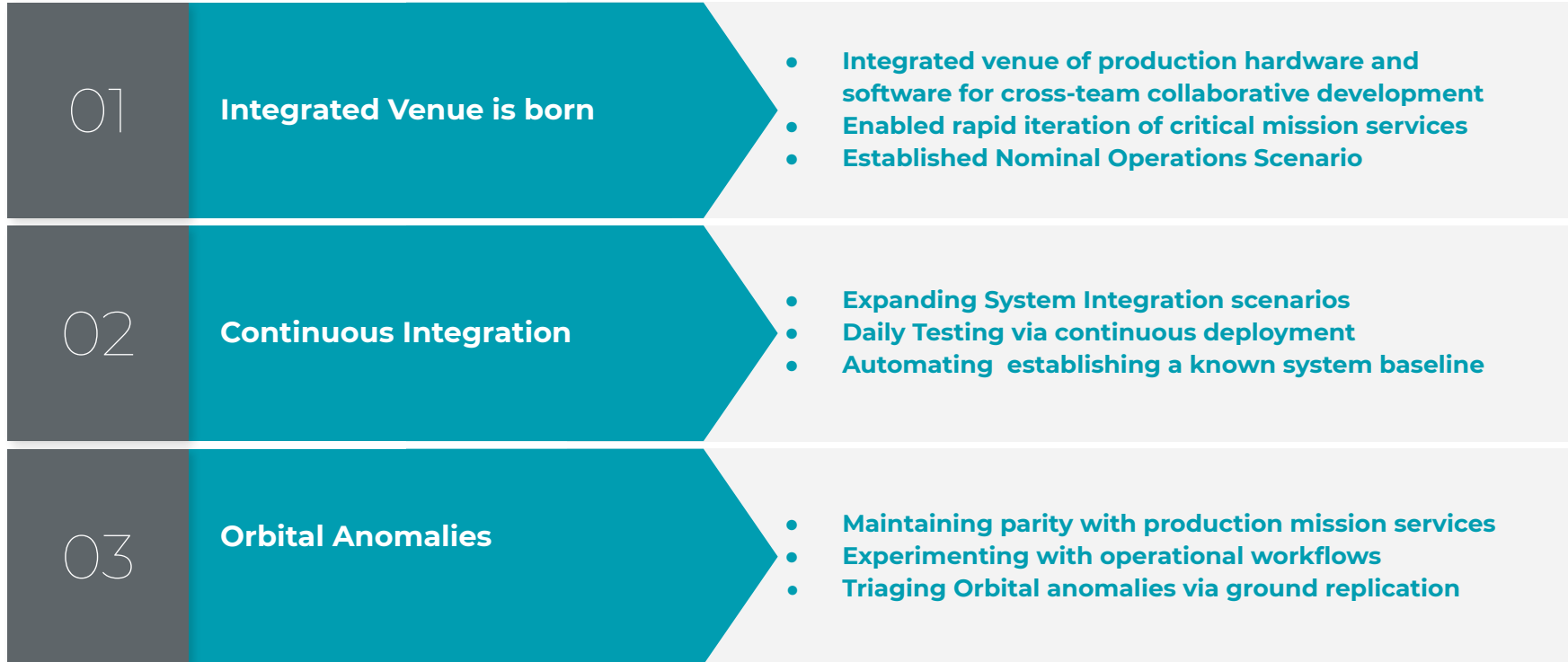
Approach to System Validation

- Originally designed as a venue for development work, over time it has organically **evolved into a tool to validate Satellite Operations workflows and processes**

- Utilizing one-to-one parity of infrastructure, **enables interactions with System Validation as you would interact with an Orbit Satellite**

- SysVal is driving **rapid automation**, focusing on how operators interact, taking a holistic approach.

London Array Wind Farm, United Kingdom – April 17, 2016

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System Validation- History At a Glance
Facilitating Agile Aerospace at Planet

01 **Integrated Venue is born**
- Integrated venue of production hardware and software for cross-team collaborative development
- Enabled rapid iteration of critical mission services
- Established Nominal Operations Scenario

02 **Continuous Integration**
- Expanding System Integration scenarios
- Daily Testing via continuous deployment
- Automating establishing a known system baseline

03 **Orbital Anomalies**
- Maintaining parity with production mission services
- Experimenting with operational workflows
- Triaging Orbital anomalies via ground replication

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System Architecture

Linear Dunes, Namibia – March 27, 2016

System Architecture
Principles of SysVal

1. System **tests should be automated**,
2. **Continuous integration** and deployment of hardware and software changes,
3. System **tests do not need to cover everything**, but they **do need to be explicit** about what they cover,
4. "**Continuous Validation**",
5. **Parity with orbital hardware** and production mission services
6. Interact with System Validation **as you would interact with an on-orbit satellite**

Jeddah, Saudi Arabia
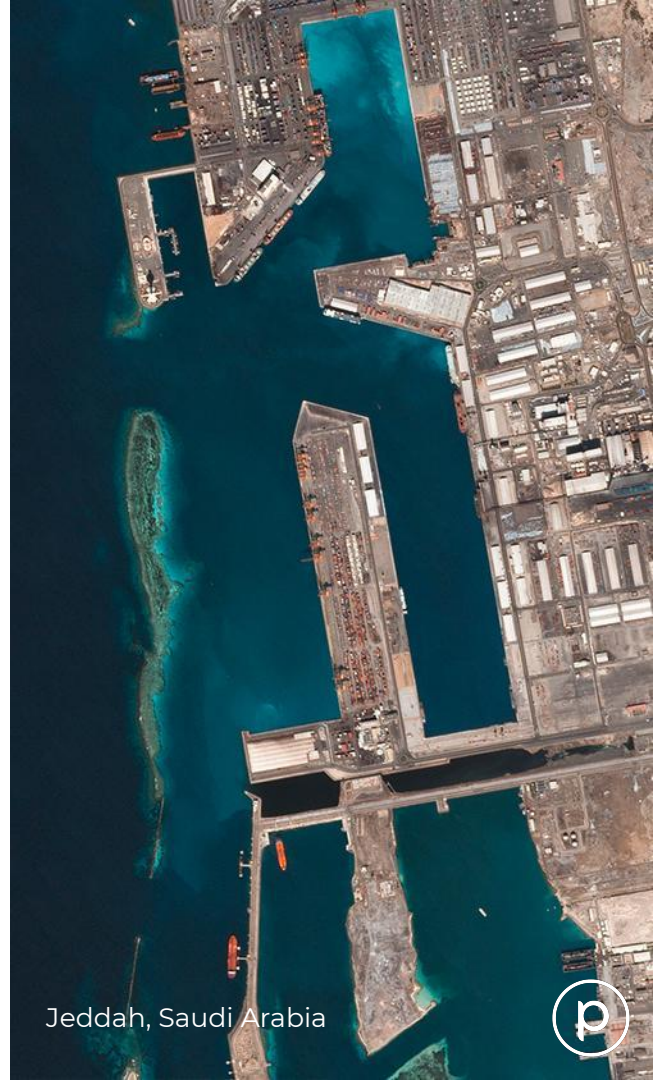
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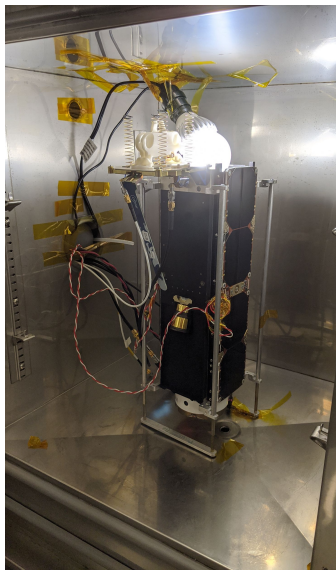# System Architecture
Components of SysVal

Figure 1: SysVal Hardware
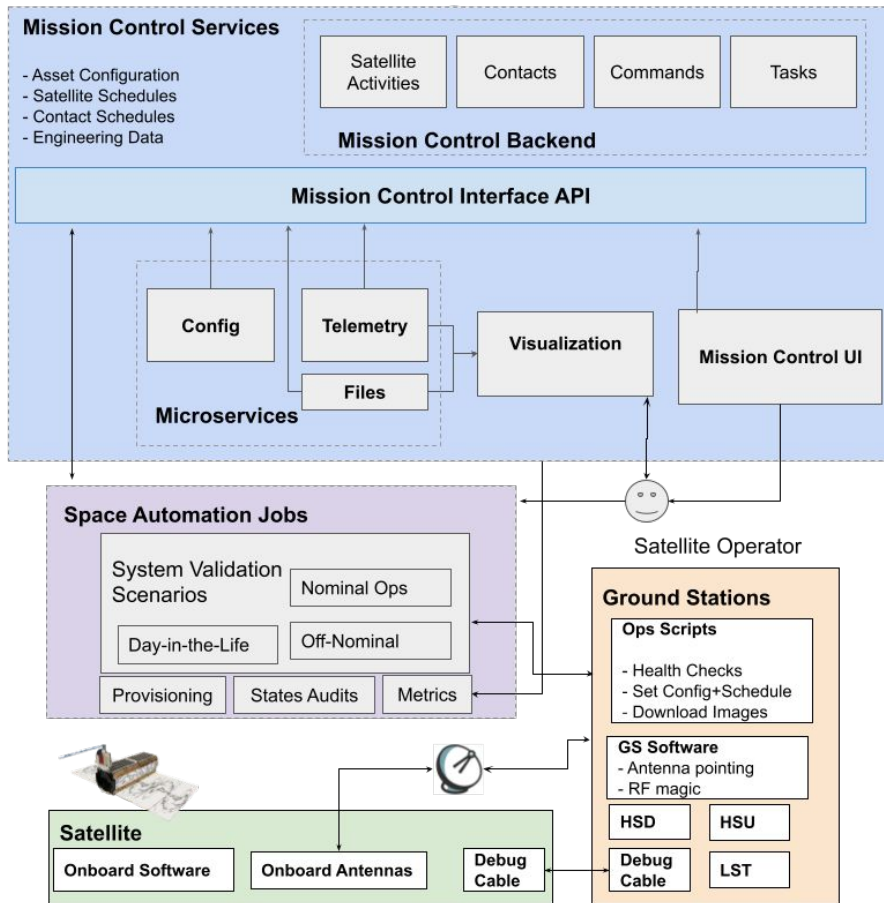
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Figure 2: SysVal System Architecture

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Use Cases

Great Barrier Reef, Australia – July 8, 2016

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Figure 3: Planet Dove Concept of Operations

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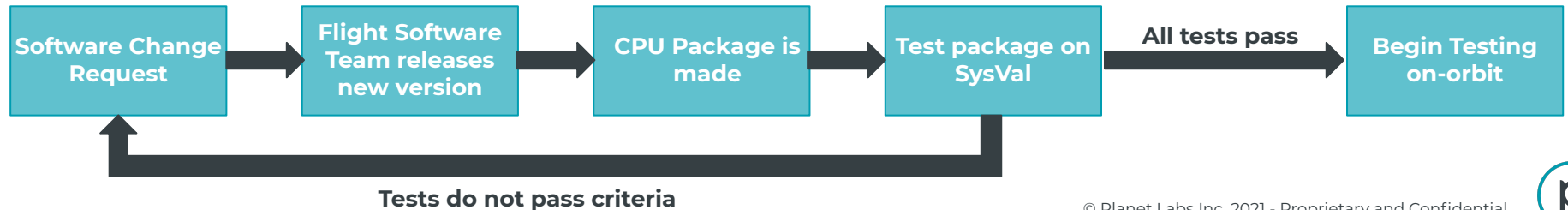
Anomaly Analysis and Software Development
SysVal Use Cases: Replicating Anomalies and Testing new software

Replicating Anomalies

- "**Bringing Space down to Earth**" by replicating on-orbit anomalies in a lab environment
- Enables operators to **circumvent testing limitations in space**:
  - No impact to satellite productivity
  - No restrictions on ground station availability
  - Removes spacecraft power constraints

Software Development

Figure 4: Sysval Software Development Workflow

```
Software Change  →  Flight Software  →  CPU Package is  →  Test package on  --All tests pass-->  Begin Testing
Request             Team releases       made               SysVal                                 on-orbit
                    new version
```

Tests do not pass criteria

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Automations

Linear Dunes, Namibia – March 27, 2016

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Maintaining Configuration of Distributed Structure:
Automations

- Simplified Integration of new Hardware:
  - "**Provisioning**" set Satellite to match an on-orbit "buddy" satellite
  - State updated thought same nominal operational pathways used on orbit
- Consistent **audits** provide at a knowledge of state system via integrated messaging
  - Satellite Software Configuration
  - Ground Station Configuration
- **SysVal Heartbeat** established with daily operational scenarios and log rotations
- Integrating production **alerting tools via metrics**

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
GS Audit 6am GS Provision 6:15am PST Sat Audit 9PST Sat Provision 12PST Daily Nom 2x 8PST/GMT	Sat Audit Sat Provision DNom	Sat Audit Sat Provision DNom	Sat Audit Sat Provision DNom	Sat Audit Sat Provision DNom	Sat Audit Sat Provision DNom	Sat Audit Sat Provision DNom

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Impact

\+

- Reduced latency from on-orbit anomaly identification to deployed solution.
- Mitigate Major service upgrades without impacting production (eg version 0 to version 1 Mission Control)
- Enable Tiger Team Efforts Validating Systems, gaining confidence before launches and commissioning campaigns

Shallow Seas, Bahamas – February 4, 2016

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Thank you for your attention!

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Lake Tuborg, Canada – May 30, 2015