Comprehensive Open-architecture Solution for Mission Operations Systems

Facilitated by

COsmos

Interstel Technologies

Facilitated by

XLR8UH
Company Team

Dr. Trevor Sorensen
CEO
• Aerospace Engineer
• 45 years experience in space field (NASA, DoD, commercial)
• Expert in mission operations
• Computer game designer

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• MA in Astronomy

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• Administration experience
• Project manager for research projects
• MA in Educational Psychology

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Marketing & Sales
UHM MBA Candidate

Lauren Kurashige
Legal
UHM JD/MBA Candidate

Founder

Founder
CEO's Experience
CEO’s Experience

Mission Operations

29.1 Mission Planning and Operations Development
29.2 Mission Execution
29.3 Mission Termination and Post-Mission Activities
29.4 Operations Process Improvement and Best Practices

Trevor C. Sorensen, University of Hawaii
with support from members of the AIAA Space Operations and Support Technical Committee*

It is possible to design and build the best possible spacecraft and even launch it into space, but it is useless unless there is a way for it to accomplish its mission. This is the role of mission operations. Contrary to a popular misconception, mission operations is not limited to what happens in the Mission Control Room or even the Mission Operations Center (MOC). That is really only the tip of the iceberg. Mission operations includes what happens on the spacecraft or launch vehicle, at ground stations, in engineering offices and science labs, to accomplish the goals of the mission, from design and development through mission execution. It is an integrated system of people, hardware, software, and activities that have to work together to ensure the successful execution of the mission. All organizations that fly space missions, from government agencies to industry and academia, perform mission operations activities. They nonetheless have different requirements for mission operations and often have their own philosophies and methodologies for developing and implementing mission operations. What is presented in this chapter are the methods that have worked for the author and have worked for others from all types of missions—manned, robotic, Earth orbit, deep space, small, large, single and multiple satellites.

Mission operations can be categorized into four basic functions: spacecraft or launch vehicle operations, payload operations, ground operations, and mission management. Mission operations also vary by the phase of the mission life cycle and are divided into two fundamentally different modes separated by the launch. Mission operations design, development, and testing occurs during the study (Phase A), design (Phases B and C), and the assembly, integration, and testing (Phase D) phases of the mission. Mission operations execution occurs during the flight phase (Phase E) and termination phase (Phase F).

The following definitions of the four basic mission operations functions are based on those by Kehr [2007]:

* The author would like to acknowledge the support of Jordan Kehr (DURS, retired), J. Jeffrey Davis, and Richard Cappello (Honeywell Technology Solutions, Inc.) and the following members of the AIAA Space Operations and Support Technical Committee: Frank Rodriguez (Space Station Processing), Patrick Klein (Naval Research Laboratory), David Lottula (Defense Advanced Research Projects Agency), and Jeffrey Shallow (NASA’s Kennedy Space Center).
CEO’s Experience

Space Mission

STAR FLEET I
The War Begins!

STAR FLEET II
Krillan Commander.

STAR LEGIONS

MINDCRAFT

Trevor C. Sorensen, University of Hawaii
AIAA Space Operations and Support Technical Committee

Although the payload is usually contained within the spacecraft bus, sometimes it might be separate, such as a separate probe or impactor vehicle.

Table 29.0, Fig. 29.0, Eq. 29.0
PROBLEM ?
Problem

Too many satellites... and lots more coming!
Problem

How do we efficiently monitor & control hordes of satellites?
Problem

Ops systems for multiple satellites are TOO COMPLICATED...
...and hard to adapt to new missions!
Problem

A good COTS solution is missing!
Voice of the Customers

“Adaptability is a definite problem for every mission I have worked on.”

Paul Douglas, NOAA Satellite Operations Facility

“System needs flexibility and configurability.”

Chris Jones, Iridium Operations Director

“Need to integrate everything into one system/tool that shows the status of everything in the system including spacecraft, ground stations, etc..”

Dave LaVallee, Project Leader, Applied Physics Laboratory

“COTS don't quite do what we need; they are not flexible.”

Chris Jones, Iridium Operations Director

“At Space X we could not find a COTS solution for our mission operations and had to develop our own.”

Dr. Marco Villa, former Director of Mission Operations, SpaceX
Problem

Is there a solution?

After all, it’s only ROCKET SCIENCE!

“It’s time we face reality, my friends... We’re not exactly rocket scientists.”
Yes, there is a solution - it’s…..

Developed by real rocket scientists (engineers)!
The **only** operations software toolkit that is comprehensive with nodal architecture
COSMOS Mission Ops Functions (Tools)

- Mission planning & scheduling (MPST)
- R/T command & control (MOST)
- Ground segment C&C (GSCT)
- System executive management (CEO)
- Flight dynamics (FDT)
- Data system management (DMT)
- Test bed & simulators (TBCT)
- Analysis tools
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## Competition

<table>
<thead>
<tr>
<th>Company</th>
<th>Product</th>
<th>Nationality</th>
<th>Cost</th>
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<tbody>
<tr>
<td>L3</td>
<td>InControl</td>
<td>US</td>
<td>$$$</td>
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<tr>
<td>Orbit Logic</td>
<td>Orbit Logic</td>
<td>US</td>
<td>$$$</td>
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<tr>
<td>GMV</td>
<td>HiFly</td>
<td>European</td>
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<td>Harris</td>
<td>OS/COMET</td>
<td>US</td>
<td>$$$</td>
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<tr>
<td>ESA</td>
<td>SCOS-2000</td>
<td>European</td>
<td>$$$</td>
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<tr>
<td>Johannes Klug</td>
<td>Hummingbird</td>
<td>European</td>
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<td>OHB</td>
<td>Ramses</td>
<td>European</td>
<td>$$$</td>
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<tr>
<td>Kratos</td>
<td>Kratos C2</td>
<td>US</td>
<td>$$$</td>
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<tr>
<td>Braxton</td>
<td>ACE Premier</td>
<td>US</td>
<td>$$$</td>
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<tr>
<td><strong>Interstel Tech.</strong></td>
<td><strong>COSMOS</strong></td>
<td><strong>US</strong></td>
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</table>
COSMOS Mission Ops Functions (Tools)
- Mission planning & scheduling
- R/T command & control
- Ground segment C&C
- System executive management
- Flight dynamics
- Data system management
- Test bed & simulators
- Analysis tools
How do we efficiently monitor & control hordes of satellites?

Users want ease of use and overall executive tool.
Ops systems for multiple satellites are TOO COMPLICATED…
…and hard to adapt to new missions!

Customers want something easily adaptable
How Do We Compare?

Desirable Features

- Open Source
- Plug and Play
- Remote Virtual Ops
- Scalable
- Error Handling
- Automation
How Do We Compare?

Desirable Features

- COSMOS v2
- COSMOS V1
- Hummingbird
- Kratos C2
- InControl
- ACE Premier
- OS/COMET
- HiPy
- Ramzes
- Orbit Logic
- SCOS-2000
Market

Satellites + UASs + Ground Stations

$24 B
Ground Equipment, Flight Software, Ground Software, Services, Ops

2020 Estimate

$2.4 B
Addressable Market

27
**Revenue Models**

**Freemium Model**
- FREE!
- + $
- License Product to Reseller

**Gov. Contracts** (annual licensing)
- Mission Ops
- Data on demand

**Commercial** (annual licensing)
- Portable Ground Stations
- Embedded in avionics

**Expansion Areas**

**Service**
- Mission Ops
- Data on demand

**Hardware**
- Portable Ground Stations
- Embedded in avionics
Go to Market Strategy

**Get**
- Seek strategic partnerships
- Win contracts to develop COSMOS & gain customers
- Get customers to try COSMOS demos
- Freemium Model

**Keep**
- Develop COSMOS community for developers/users
- Product improvement and new features

**Grow**
- Targeted collaborations
- Provide ops services
- Tiered product offerings
## Development Plan

### To COSMOS v2.0 Launch

<table>
<thead>
<tr>
<th>Milestones</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
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<tbody>
<tr>
<td>COSMOS Development</td>
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<tr>
<td>MOST Development</td>
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<td>OTB/Simulators Development</td>
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<td>CEO Development</td>
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<td>Other Tools</td>
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<td>Business Development</td>
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<td>Obtain VC Funding</td>
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<td>Commercial Operations</td>
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**First flight use**
Financial Projection

Revenue

- Reseller Sales
- Remote Sensing Sales
- Ground Stations
- License sales
- Large Commercial
- Government Contracts

SELL!
Financial Projection

Net Profit

Investment Needed
Version 1.0 - $50,000
Version 2.0 - $1 million
is expanding!

MAHALO!