

CubeSat Operations with Spaceflight Networks



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CubeSat Developers Workshop

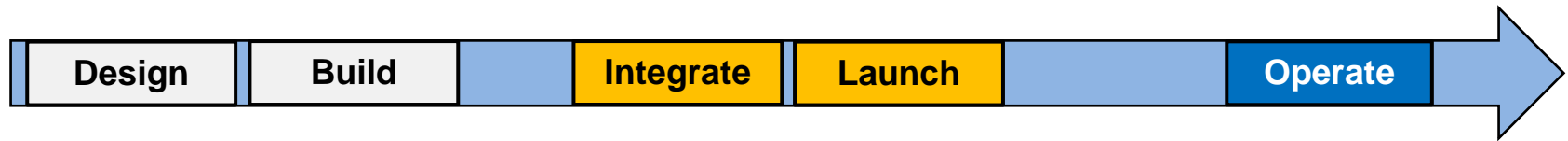
Spaceflight Industries Introduction



Systems

Services

Networks



- Formerly Andrews Space
- Founded in 1999
- Satellites and components

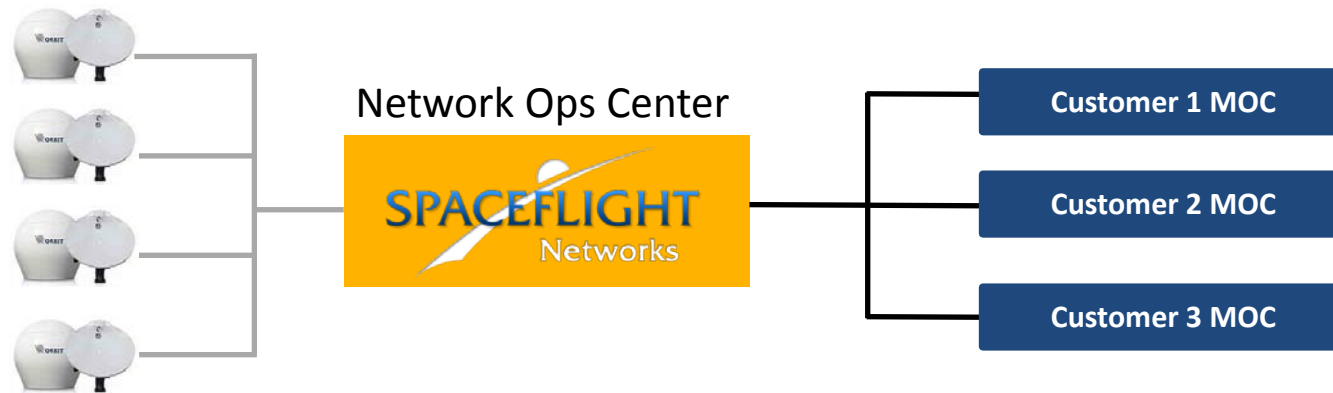
- Founded in 2010
- 115+ satellites on contract to launch

- Created in 2014
- Communication services



Spaceflight Networks Overview

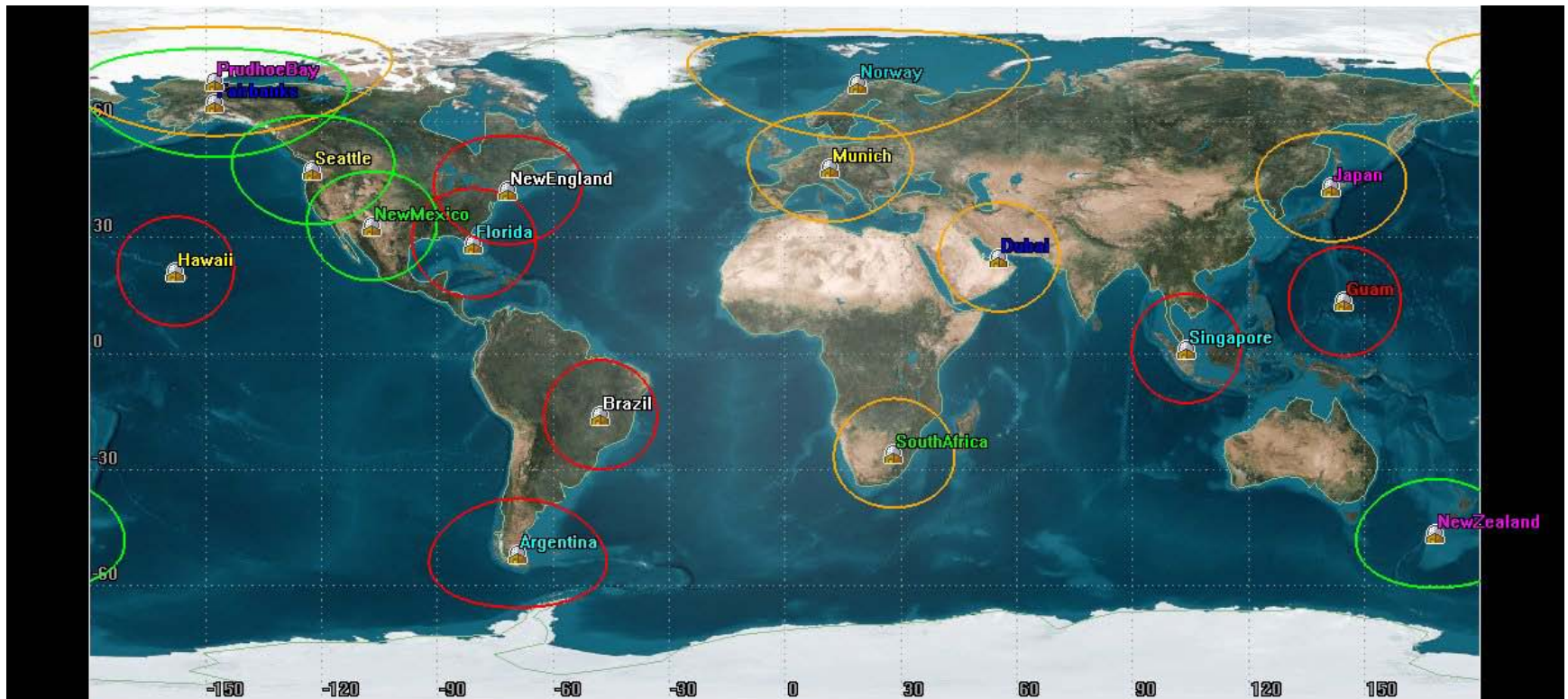
- Satellite communications services targeted towards the small satellite market
 - UHF uplink and downlink
 - S-band uplink paired with X-band downlink



- Commercial list pricing
 - **\$1.95/minute** UHF, **\$19.95/minute** S/X
 - Bulk discounts & bundling with launch available

Planned Ground Station Locations

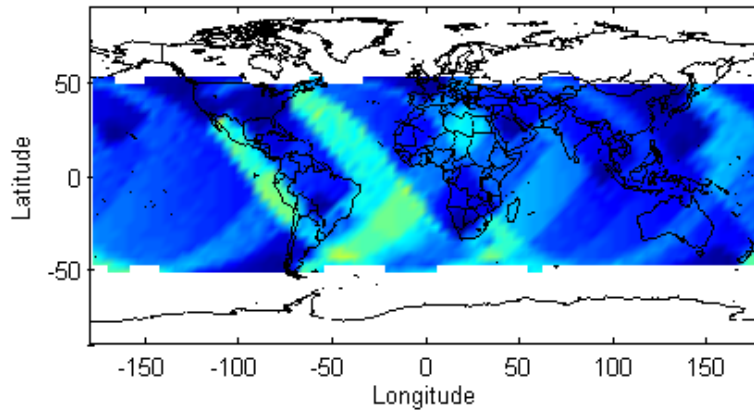
- Mix of Spaceflight-owned stations and third party stations.
- All stations will be presented to the user with a single & simple user interface.



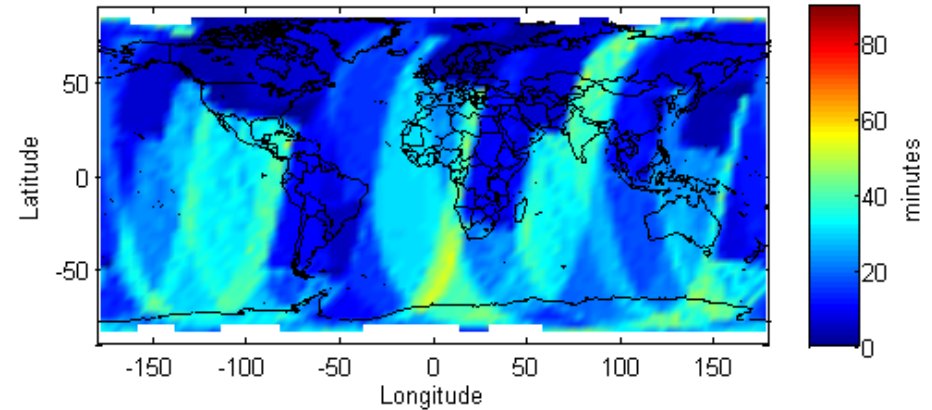
Network Designed to Minimize Data Latency

Average time from data collection to downlink opportunity:

51.6° LEO:



Sun Synchronous LEO



Data latency under 20 minutes is typical

Network Architecture (1)

- **No non-recurring setup fees.** Spaceflight will provide a list of recommended, compatible-out-of-the-box spacecraft radios.
- Software-defined radios where applicable
 - Have a custom implementation? We'll run your code.
- Encapsulation-agnostic as much as possible
- Secure connections between ground station and customer

Network Architecture (2)

- UHF antennas
 - 401-402 MHz Rx. 19 dBi gain.
 - 437 MHz Rx. 16 dBi gain.
 - 450 MHz Tx.
- S/X antennas
 - 2200-2300 MHz Rx. ≥ 12.8 dB/K
 - 8000-8500 MHz Rx. ≥ 25.4 dB/K
 - 2020-2120 MHz Tx
- Data rates
 - Up to 100 Mbps initially (X-band)
 - Expanding to support up to 300 Mbps
 - Dependent on link budget



UHF antenna @ Seattle

Compatible Radio List

- Simple user setup
 1. Choose & purchase a supported spacecraft radio
 2. Purchase a SFN data plan
- Initial spacecraft radio list:
 - CubeSat TT&C:
 - BitBeam BBUHF
 - CubeSat S/X band:
 - BitBeam BBSDR
 - Syrlinks EWC27
 - Tethers SWIFT radio
 - Microsatellite S/X band:
 - Same CubeSat S/X
 - Syrlinks EWC28
- Have others? Please inquire with us about supporting them!

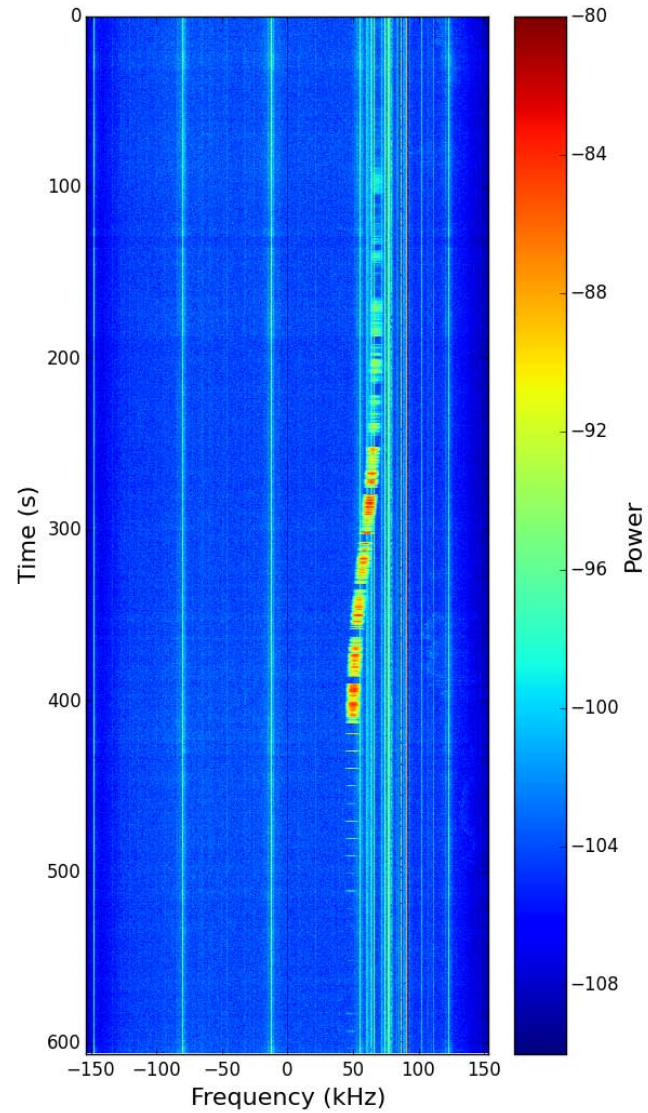
Concept of Operations

- Strive to provide a *simple* user interface to customers
 1. Sign in
 2. Choose your TLE/Satellite from the public list (CelesTrak), or upload your own
 3. From a list of available contact passes, choose which to utilize
 4. Real-time interface for send/received data provided during the pass
 5. Pay per minute
- Web-interface & APIs
- Antenna telemetry available & post-pass reports will be provided

2015 status

- 3 sites operational Q3 2015
 - Seattle, WA. UHF only. Currently operational.
 - Fairbanks, AK. UHF & S/X
 - Southland, New Zealand. UHF & S/X
- Spaceflight Networks beta
 - **FREE** UHF receive-only services from these stations
 - Beta user interface to be released this summer
 - Sign up to be a beta user today! <https://beta.spaceflightnetworks.com/>

Seattle Tracking Sample



Summary & Questions

- Spaceflight Networks is available to the CubeSat community
- **FREE** UHF Rx services operational this summer.
<https://beta.spaceflightnetworks.com>
- Paired with Spaceflight's Launch Services, one-stop shop for satellite operations

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Spaceflight is hiring!

**Job descriptions online and
at our booth**