FORMOSAT-7/COSMIC-2 Status Update

May 3rd, 2017

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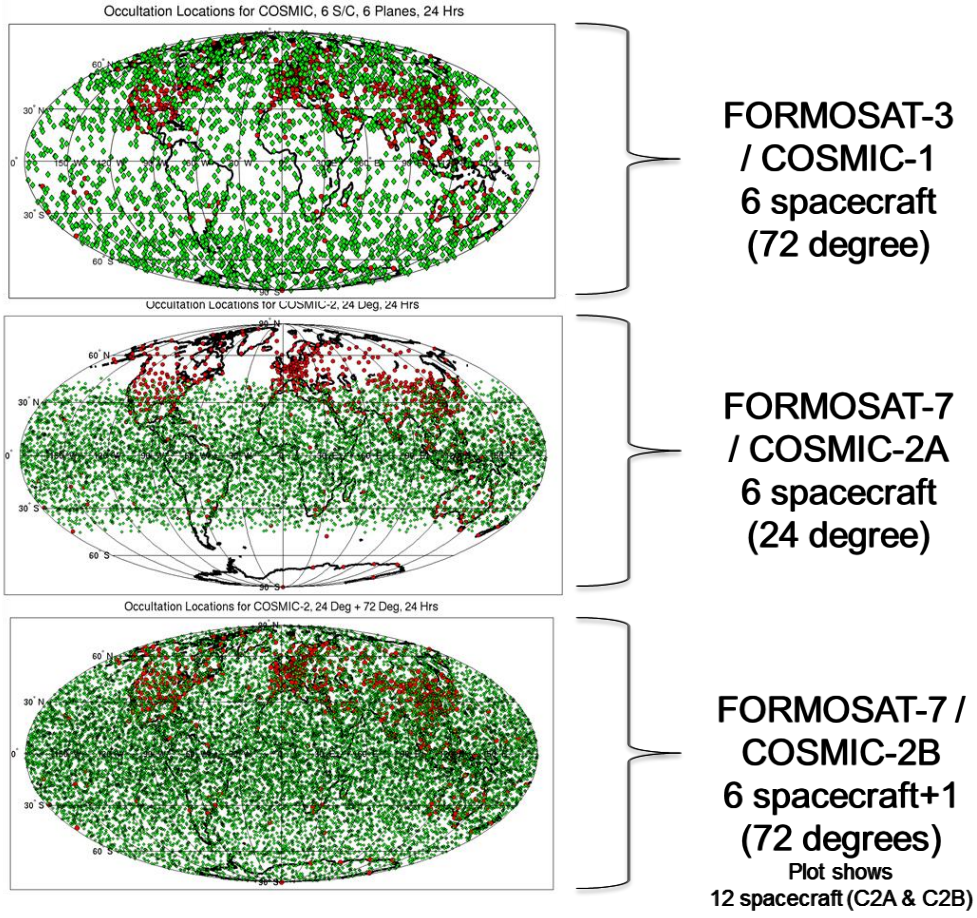
COSMIC-2 Overview

- COSMIC-2 is a follow on of the successful COSMIC-1 mission launched in 2006
- COSMIC-2 is a 12 satellite constellation that will provide operational and research users with the next-generation Global Navigational Satellite System Radio Occultation (GNSS-RO) data
- Radio Occultation data is collected by measuring the changes in a radio signal as it is refracted in the atmosphere, allowing measurements of the physical properties (temperature and moisture) of the atmosphere to be taken



Key Organizational Responsibilities

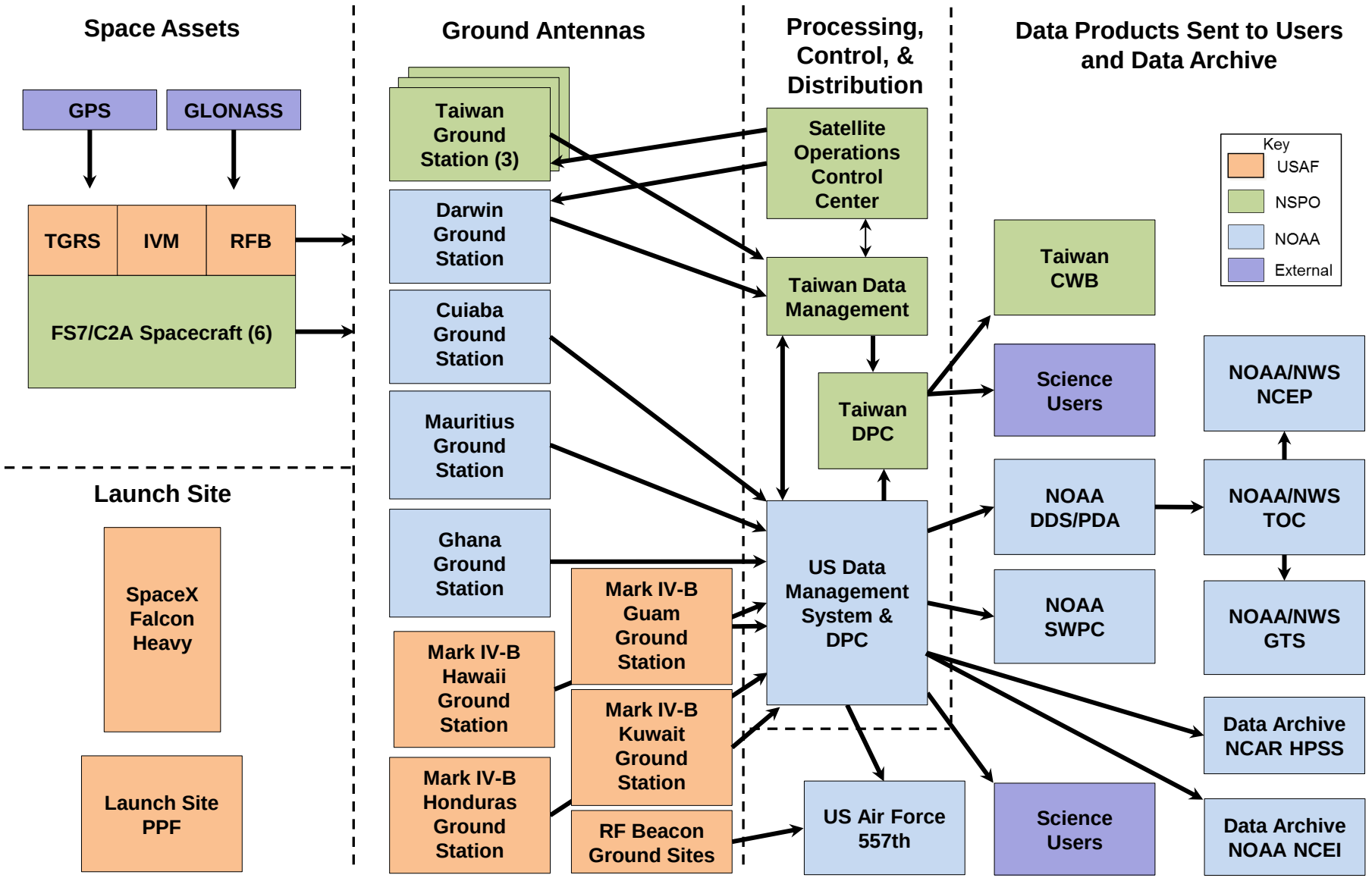
- NOAA Responsibilities:
  - Instruments via USAF (C2A)
  - Instrument (TGRS) via NASA (C2B)
  - Launch Service (via USAF C2A)
  - US and International Ground Stations
  - US Data Management System and Data Processing Center via UCAR
  - Data Distribution to Users
  - Data Archival via UCAR
  - Model Updates; Data V&V
  - Project Management

- NSPO Responsibilities:
  - Spacecraft Bus (SSTL-UK)
  - Spacecraft and Instrument Integration
  - Spacecraft System/Environmental Testing
  - Launch Site Integration and Ops
  - Satellite Operations & Control Center and Taiwan Data Management System
  - Taiwan Ground Stations
  - Taiwan Data Processing Center with CWB/NCU
  - Mission Operations
  - Scientific Instruments (set 2)
  - Project Management

- USAF SMC/AD-LE Responsibilities:
  - C2A Launch via SpaceX
  - Verify SC Compliance to LV ICD
  - Verify SC Compliance to Range Safety (91-710)
  - Assess all Spacecraft with respect to “do no harm” for the STP-2 stack
  - Launch Site Payload Processing Facility

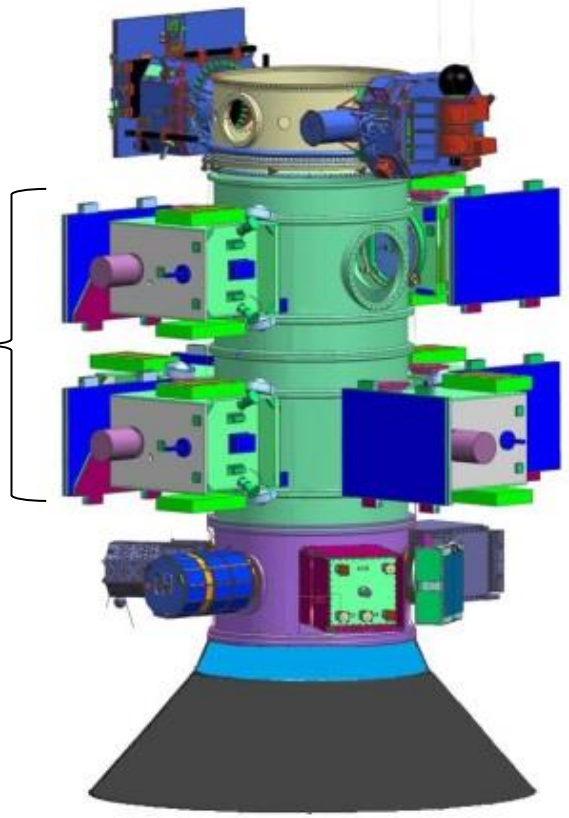
- USAF SMC/RS Responsibilities:
  - Instruments for C2A
    - TriG GNSS Radio Occultation System (TGRS)
    - Ion Velocity Meter (IVM)
    - RF Beacon(RFB) & Ground Stations
  - Mark IV-B Ground Stations
    - Hawaii - Honduras
    - Guam - Kuwait

System Elements



STP-2 Mission Overview

- COSMIC-2 is launching as part of the Space Test Program 2 Mission (STP-2)
- Integrated Payload Stack (IPS)
  - Six COSMIC-2 Spacecraft
  - Demonstration and Science Experiment (DSX)
  - Six Auxiliary Payloads (APLs)
  - Dispensers
  - Eight PPODs with Twelve Cubesats for LEO



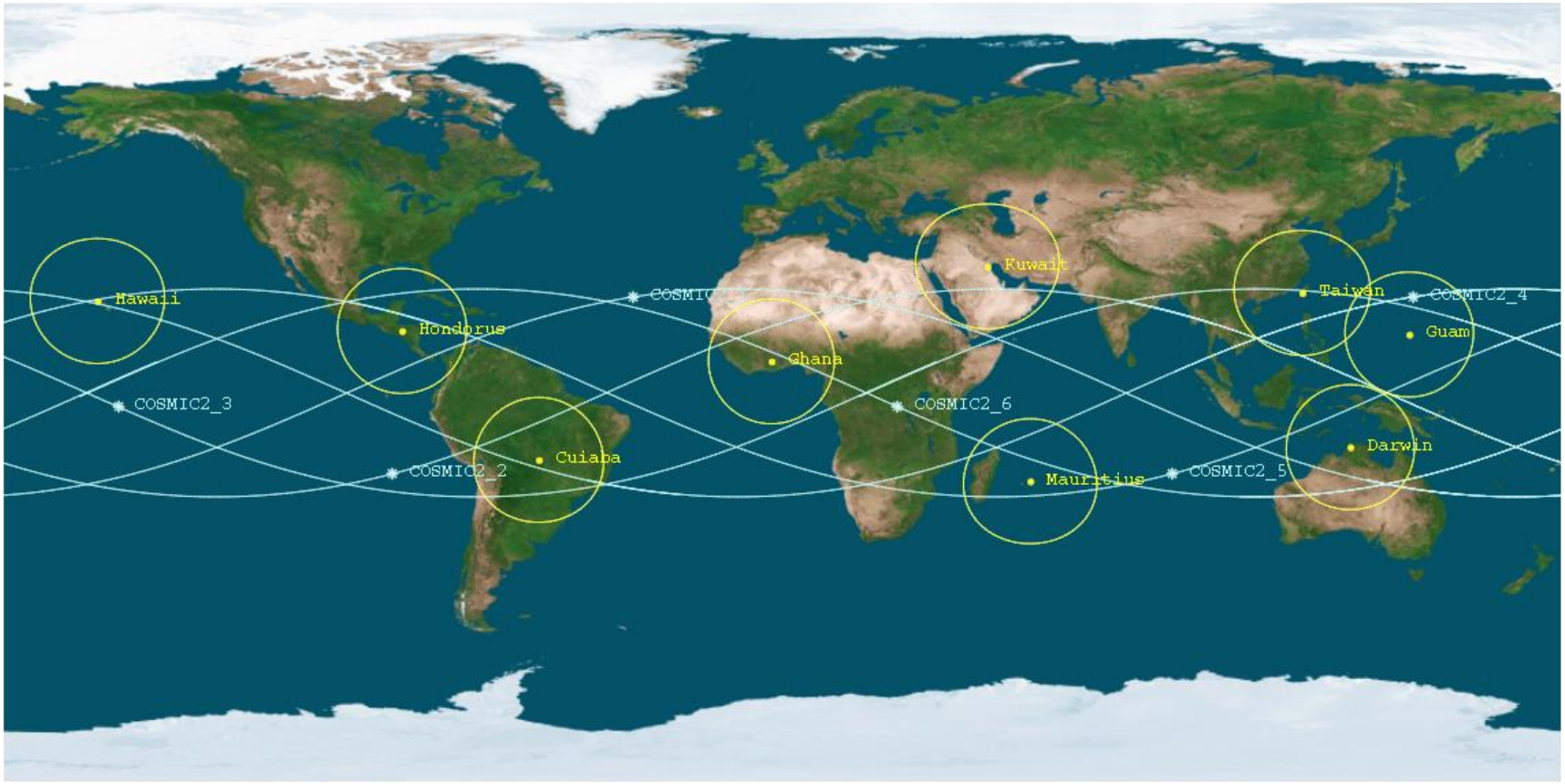
Concept of Falcon Heavy from Launch Comlex-39A CCAFS

Ground Segment/Antenna Sites

Summary of Ground Antennas

Site	Owner	Agreements	Development Status	Available for System Testing	Needed for Launch
Taiwan	NSPO	MOA	Operational	Ready	Yes
Darwin	BoM	MOA Signed	Commanding Operational, Back-end in Dev.	May 2017	Yes
Cuiaba	INPE	MOA Signed	Regression testing nearly complete, fully operational mid-May	May 2017	No
Hawaii	USAF	Letter of Commitment	Modifications Complete	April 2017	No
Honduras	USAF	Letter of Commitment	Modifications Complete	April 2017	No
Guam	USAF	Letter of Commitment	Modifications Complete	April 2017	No
Kuwait	USAF	Letter of Commitment	Modifications Complete	April 2017	No
Mauritius	NSC/KSAT	NOAA/NSC/KSAT Program Implementation Plan	Development In-Process	June 2017	No
Ghana	Atlas	NOAA Contract Awarded to Atlas Space Operations	Development In-Process	June 2017	No

Ground Station Architecture (C2A)



Ground Segment/Data Processing Center

Recent Events, Accomplishments & Status

- US Data Processing Center Status
  - Successfully Completed Data Processing Center (DPC) Readiness Review
    - UCAR is ready to support launch and post launch mission operations
- Completed Day In The Life (DITL) Testing
  - Pre-positioned simulated spacecraft data at each ground antenna site
  - Had each ground antenna site send data to the DPC at the appropriate time in the daily contact schedule
  - The data was processed at the DPC and distributed to users for evaluation
  - Results: The test was completed successfully

Summary

- Satellite Environmental Testing has been Completed
  - Requirement verifications/closure in-work
- Ground Antenna Architecture Complete for C2A
  - Requirement verifications/closure in-work
- US DMS/DPC is ready to support launch/mission operations
- Preparing for Spacecraft Pre-Ship Review in Taiwan (October 2017)
- Working with Air Force and SpaceX on Launch Date
- Team is now focusing Mission Operations Planning

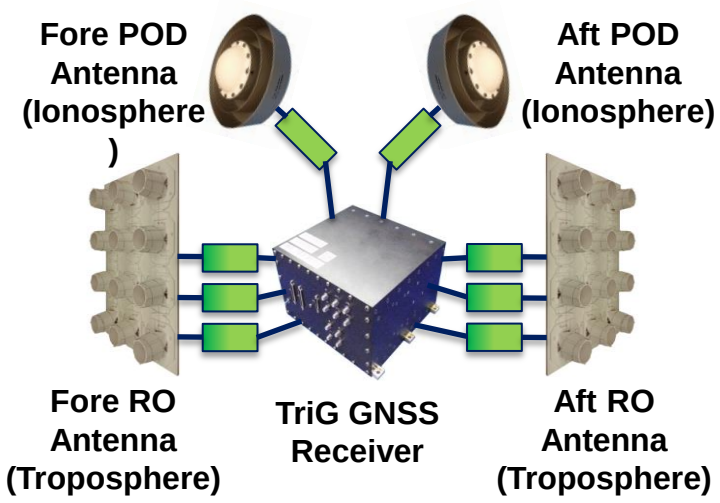
Looking forward to launch and transition to mission operations in less than a year!!!

BACK-UP

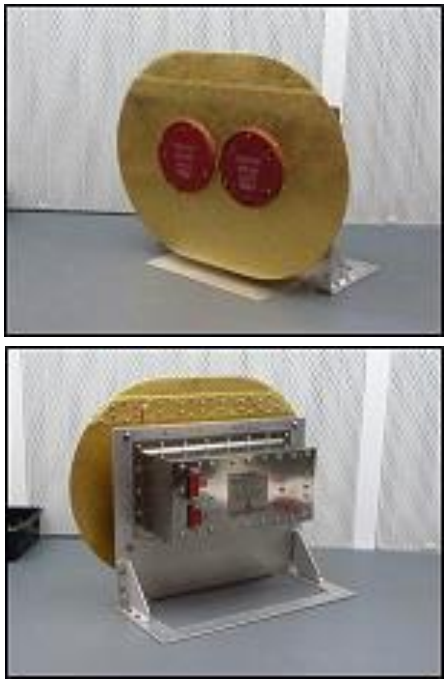
COSMIC-2A Spacecraft

Formosat-7 / COSMIC-2A Instruments

- Each Spacecraft has Three Science Instruments:
  - Mission Payload
    - Tri-Band Global Navigation Satellite System (GNSS) Receiver System (TGRS)
  - Science Payloads
    - Ion Velocity Meter (IVM)
    - RF Beacon (RFB)



TGRS



IVM

RFB

COSMIC-2 System Level Testing Performed at NSPO

FM3 Integration

FM4 Vibration Test

FM2 Preparation for Thermal Vacuum Testing

Propellant Tank Leak Test on FM 6

COSMIC-2 Acronyms

BoM	**Australia Bureau of Meteorology**
C-2	**COSMIC 2**
C2A	**COSMIC-2A**
C2B	**COSMIC-2B**
DITL	**Day-in-the-Life**
DMS	**Data Management System**
DPC	**Data Processing Center**
ESPA	**Evolved Expendable Launch Vehicle Secondary Payload Adaptor**
GNSS-RO	**Global Navigation Satellite System Radio Occultation**
I&T	**Integration & Test**
IPS	**Integrated Payload Stack**
IVM	**Ion Velocity Meter**
LV	**Launch Vehicle**
NOAA	**National Oceanic & Atmospheric Administration**
NSPO	**National Space Organization**
POD	**Precise Orbit Determination**
RF	**Radio Frequency**
RFB	**RF Beacon**
RO	**Radio Occultation**
SMC	**Space and Missile Systems Center**
SSTL	**Surrey Satellite Technology Ltd.**
STP-2	**Space Test Program 2**
TGRS	**TriG GNSS-RO Receiver System**
UCAR	**University Corporation for Atmospheric Research**
USAF	**United States Air Force**