# Dryden Flight Research Center
# DFRC
# Western Aeronautical Test Range
# WATR


**September 13, 2012**

# DFRC Status

- Status
  - DFRC ISS Systems Overview
  - Communication Equipment Replacement Update
    - Rockwell Collins 721S
    - DICES VoIP Stations
  - COMM3 Repair Update
  - COMM3 Upgrade ACU to TCS M-1 controller from MILA
  - Telemetry Upgrades
    - C-Band Telemetry Upgrades
    - Mobile Systems Upgrades
  - DFRC Space Operations Support

- Retained personnel proficiency and staffing levels for C-band, S-band and U/VHF operations

# DFRC ISS Systems Overview

## ISS V1 Support System

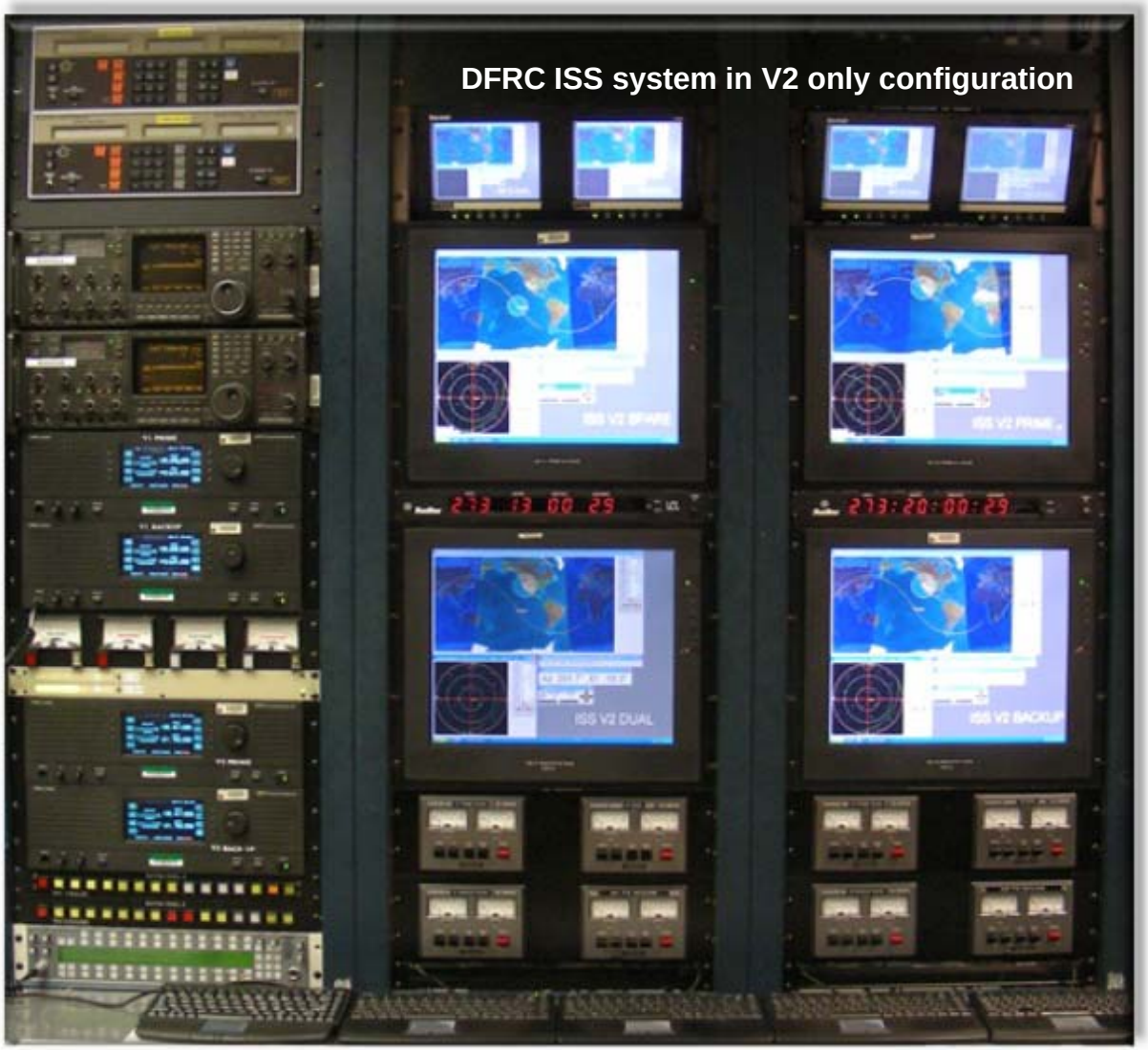
- ISS V1 Prime Quad Yagi System Top Left Display
- ISS V1 Back up Quad Yagi System Bottom Left Display
- ISS V1 Dual Yagi Bottom Right Display
- Spare V1 Tracking PC, Top Right Display

DFRC ISS system in V1 only configuration

# DFRC ISS Systems Overview

## ISS V2 Support System

- ISS V2 Prime Quad Yagi System Top Right Display
- ISS V2 Back up Quad Yagi System Bottom Right Display
- ISS V2 Dual Yagi Bottom Left Display
- Spare V2 Tracking PC, Top Left Display

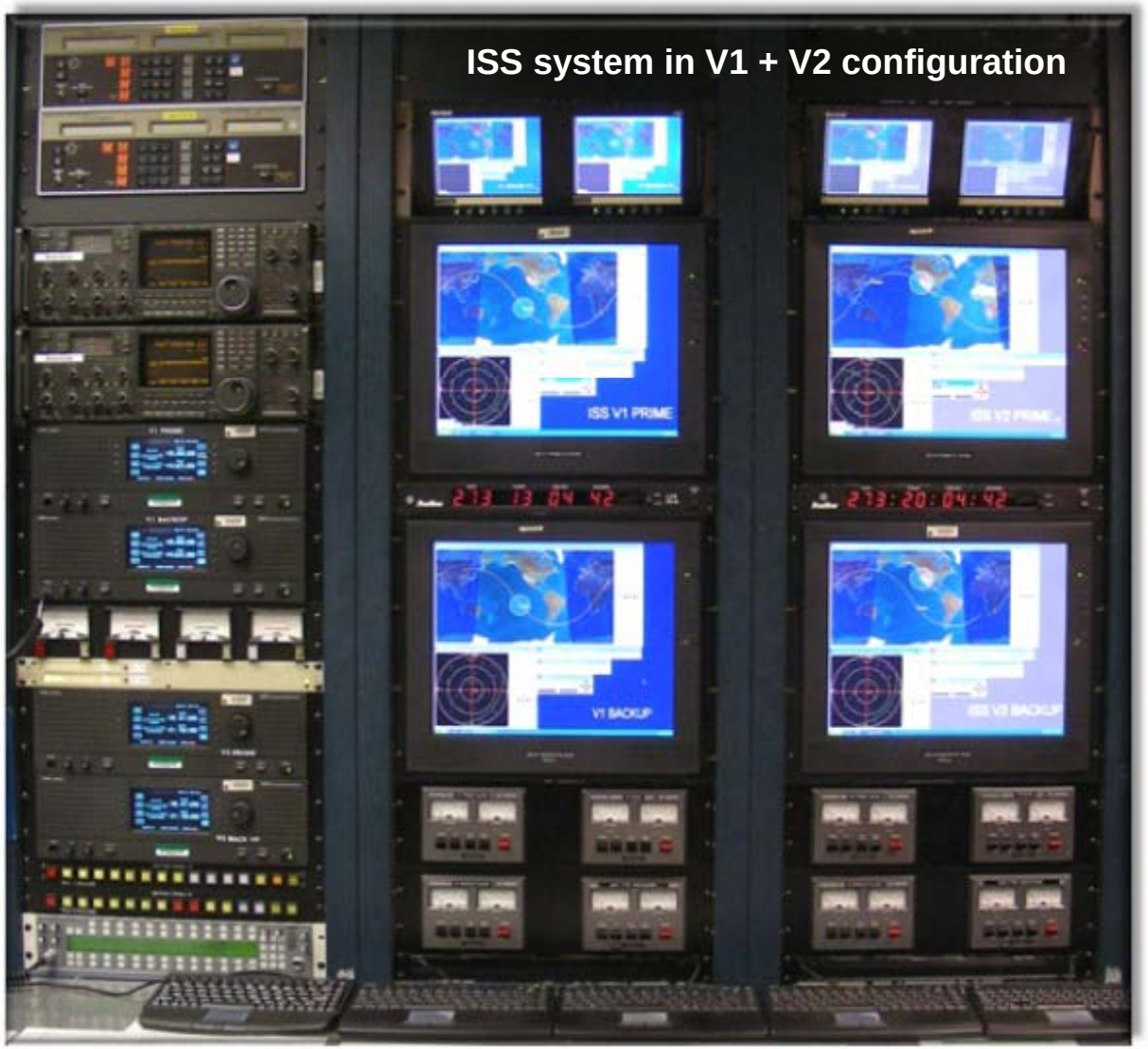



DFRC ISS system in V2 only configuration

# DFRC ISS Systems Overview

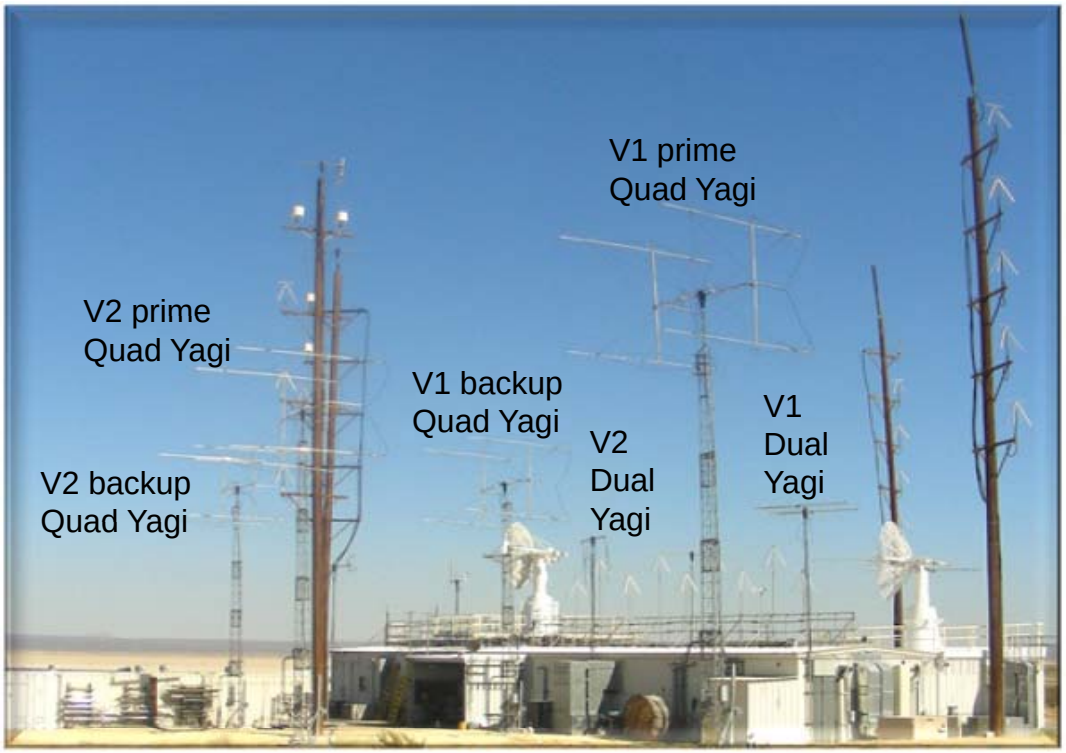
## ISS V1 + V2 system
### Contingency Configuration

- V1 equipment displayed on left large screens
- V1 Dual Yagi & Spare PC – displayed on top left small screens
- V2 equipment displayed on right large screens
- V2 Dual Yagi & Spare PC – displayed on top right small screens
- No open DRs or CCRs on the VHF ISS support system
- Four certified operations personnel



# DFRC ISS Systems Overview

## ISS Support Antenna Systems




- **V1:**
  - **Two Quad Yagi Antennas**
  - **One Dual Yagi Antenna**
- **V2:**
  - **Two Quad Yagi Antennas**
  - **One Dual Yagi Antenna**

**Quick Connect Antenna Patching**

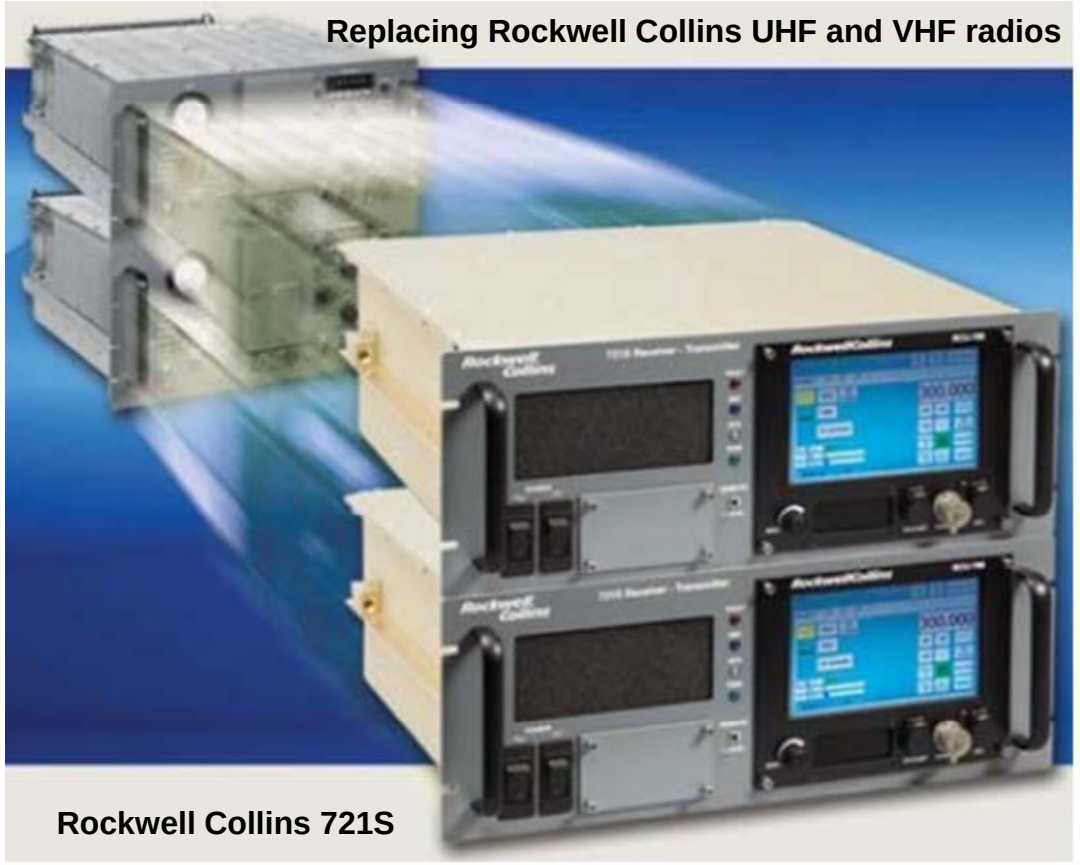

DFRC Ground Voice Communications Transceiver Replacement Update

# Communication Equipment Replacement

**DFRC Radio Communications Equipment Replacement**

**Currently 2 on Order Delivery Date 11/20/12**

**Plan is for multi-year replacement schedule**



# Communication Equipment Replacement

## Rockwell Collins Model 721S

- **Rockwell Collins GRC 171 & 211 Transceiver support vendors can no longer obtain all the parts necessary to repair modules**
  - **Dryden AM Transceivers will be replaced with Rockwell Collins model 721S VHF/UHF radios**
  - **The 721S adds FM capability and expands the frequency range of a single radio to 100 - 500 MHz**
  - **The 721S is a plug for plug replacement for the GRC 171 and the GRC 211**
  - **The 721S is on GSA price schedule**
  - **Transceiver inventory will be replaced in phases - funding dependent**

+

**GRC-211: 116 – 152 MHz**

**The Rockwell Collins model 721S will replace both the UHF GRC 171 & VHF GRC 211 .**

**GRC-171: 225 – 400 MHz**

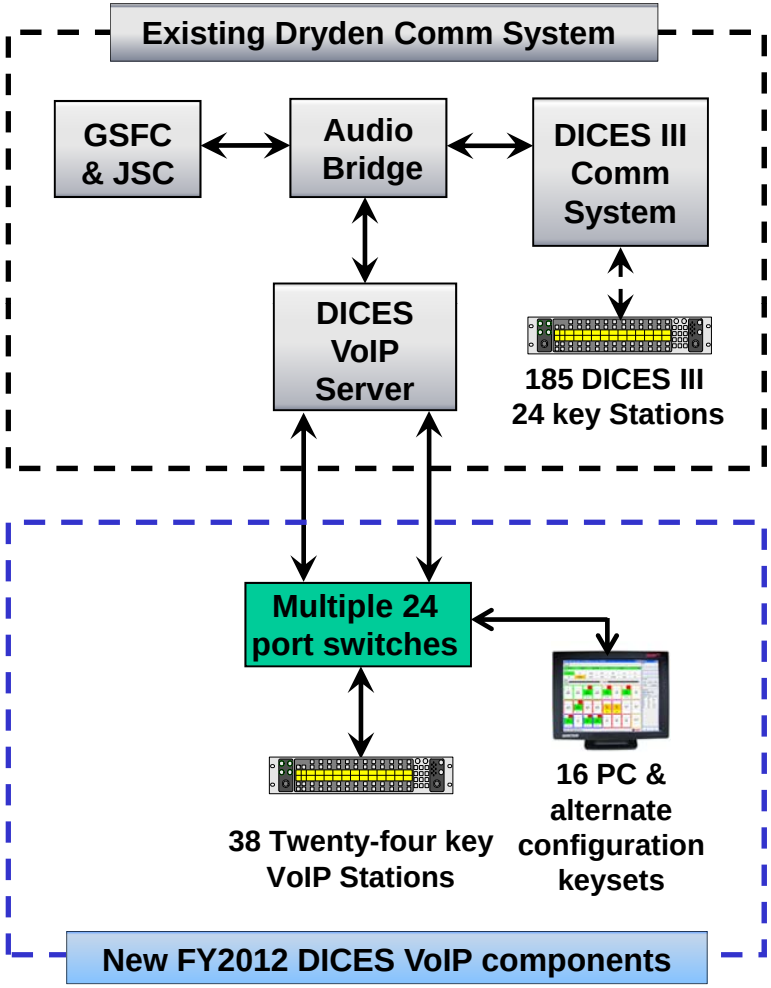
**721S: 100 – 500 MHz**

# Communication Equipment Replacement

# Communication Equipment Replacement

## DFRC Ground Communications VoIP End Station Deployment

- DICES III voice communications system vendor can no longer obtain all the components required for repair of some DICES III equipment
- DFRC will be adding additional VoIP end stations to work with existing VoIP node
- New VoIP end stations will allow existing DICES III equipment to be re-utilized as spares to prolong system life
- DICES VoIP end stations will be identical to existing 24 key DICES III end stations

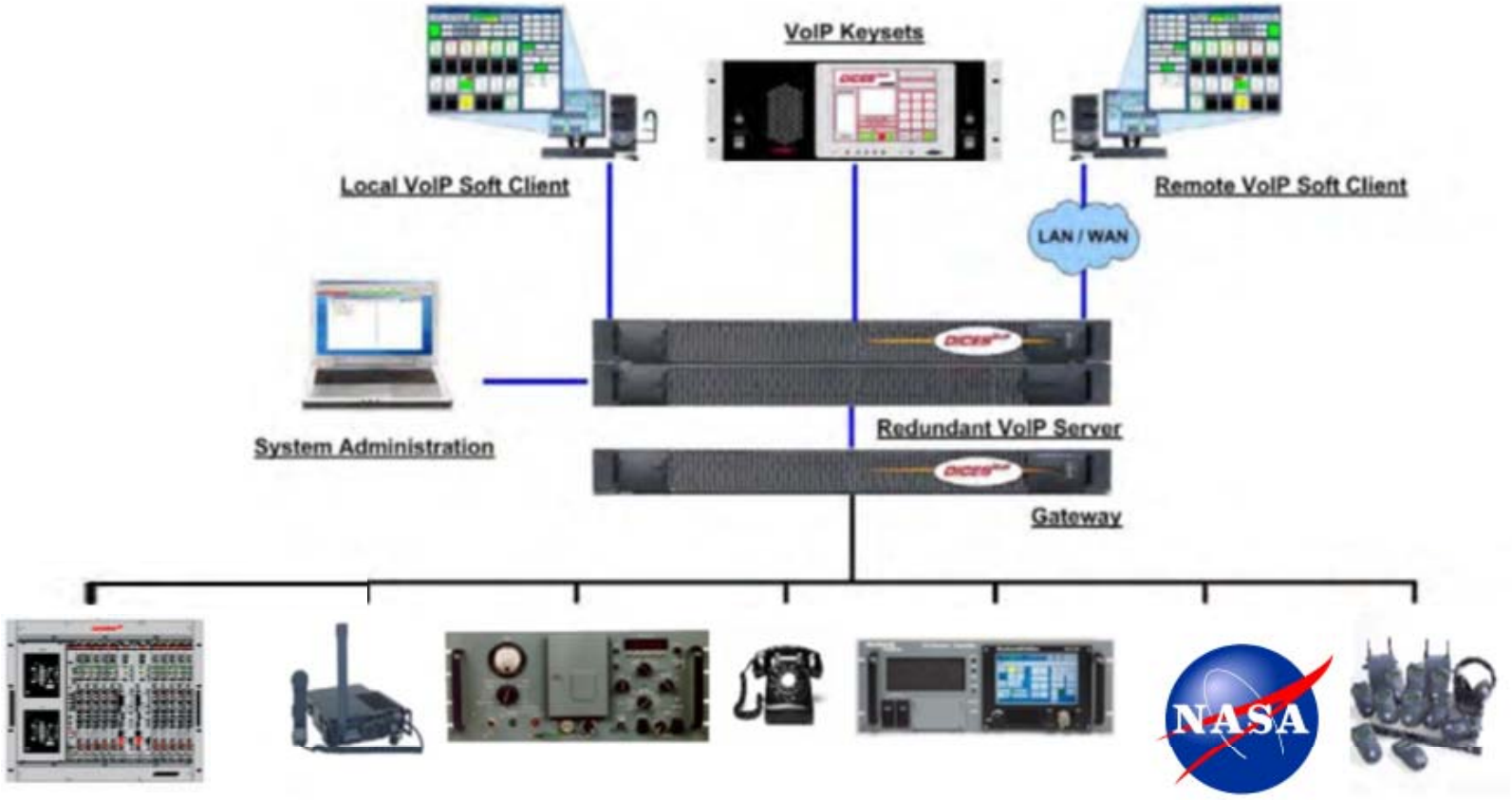


# Communication Equipment Replacement

## DFRC Ground Communications VoIP End Station Deployment

- DICES VoIP Stations currently on order, manufacturer delivery date mid-December 2012
- 38 - 2 RU VoIP Stations
- 2 - 3 RU VoIP Stations
- 2 - 4 RU VoIP Stations
- 2 - 5 RU VoIP Stations
- 10 - Soft Clients

# Communication Equipment Replacement




DICES III COMM System

URC200 UHF/VHF AM/FM

GRC 171/211 UHF/VHF AM

LAND LINES

GRC 721S UHF/VHF AM/FM

Other NASA Sites

Remote Comm Systems

# DFRC COMM3 Repair

**Dryden COMM3 Repair**

# DFRC COMM3 Repair

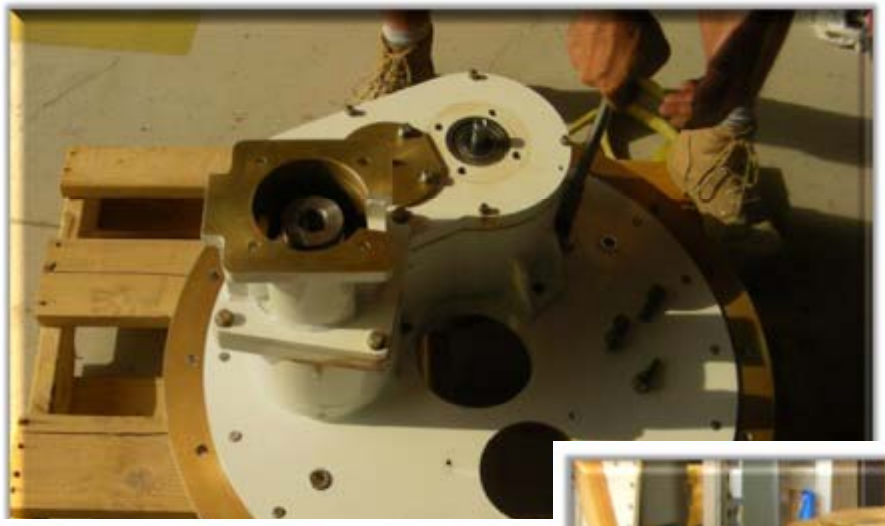
- COMM3, six meter directional antenna was taken down for maintenance in June 2012
  - Gearbox assembly issues have been addressed
  - Return to service TBD based on funds for MILA M-1 antenna controller integration (NTE ~$40K)
  - COMM1 & COMM2 (both 3 meter directional) available for support
  - COMM1 = 225 to 800 MHz (12 – 18 dB gain)
  - COMM2 = 225 to 500 MHz (12 – 16 dB gain)
  - COMM3 = 225 to 800 MHz (15 – 21 dB gain)

# DFRC COMM3 Repair



**COMM3 Reflector and Pedestal were removed and relocated to WATR Warehouse for evaluation and repair.**

# DFRC COMM3 Repair




**COMM3 was disassembled, 14 bearings, raceways, and several seals were replaced**

# Dryden COMM3 M-1 Antenna Control Unit




**EMP ACU-21 Upgrade to TCS M-1 Antenna Control Unit scheduled for FY2013**

# Communication Equipment Replacement

# DFRC Telemetry Upgrades

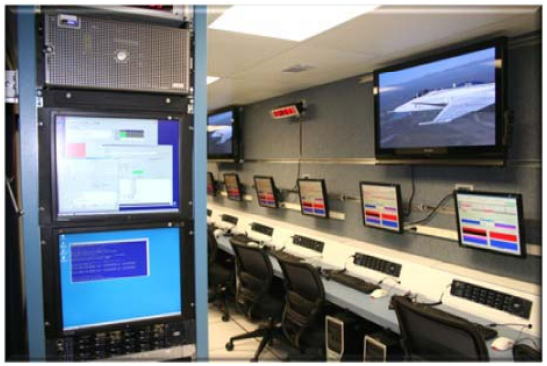
- **C-Band (4400 – 5250 MHz) Telemetry Upgrade**
  - **Dryden will upgrade one 7 meter TM system for new C-Band telemetry band to test feasibility. DFRC will expand to other TM systems after successful testing of L-, S-, and C-Band performance**
  - **Incorporating conical scan tracking feed for C-Band**
  - **Upgrading antenna controller for feed gain control**
  - **Replacing RF switch to accommodate new band**
  - **Upgrading receiver tuners for new band**
    **(down convert to P-Band 300 – 1150 MHz)**
  - **Incorporating test inject and upgrading pedestal to transport C-Band test signal to test inject**
  - **Upgrading Bore Sight tower for C-Band with new broad band antennas and fiber optic transport of RF signals**

# DFRC Telemetry Upgrades

- **Mobile Telemetry Systems Upgrades**
  - DFRC upgraded one 30 foot Mobile Operations Facility (MOF) to increase system availability by making it easier to transport and faster to set up. This system (MOF1) has similar support characteristics as the fixed TM systems at DFRC.

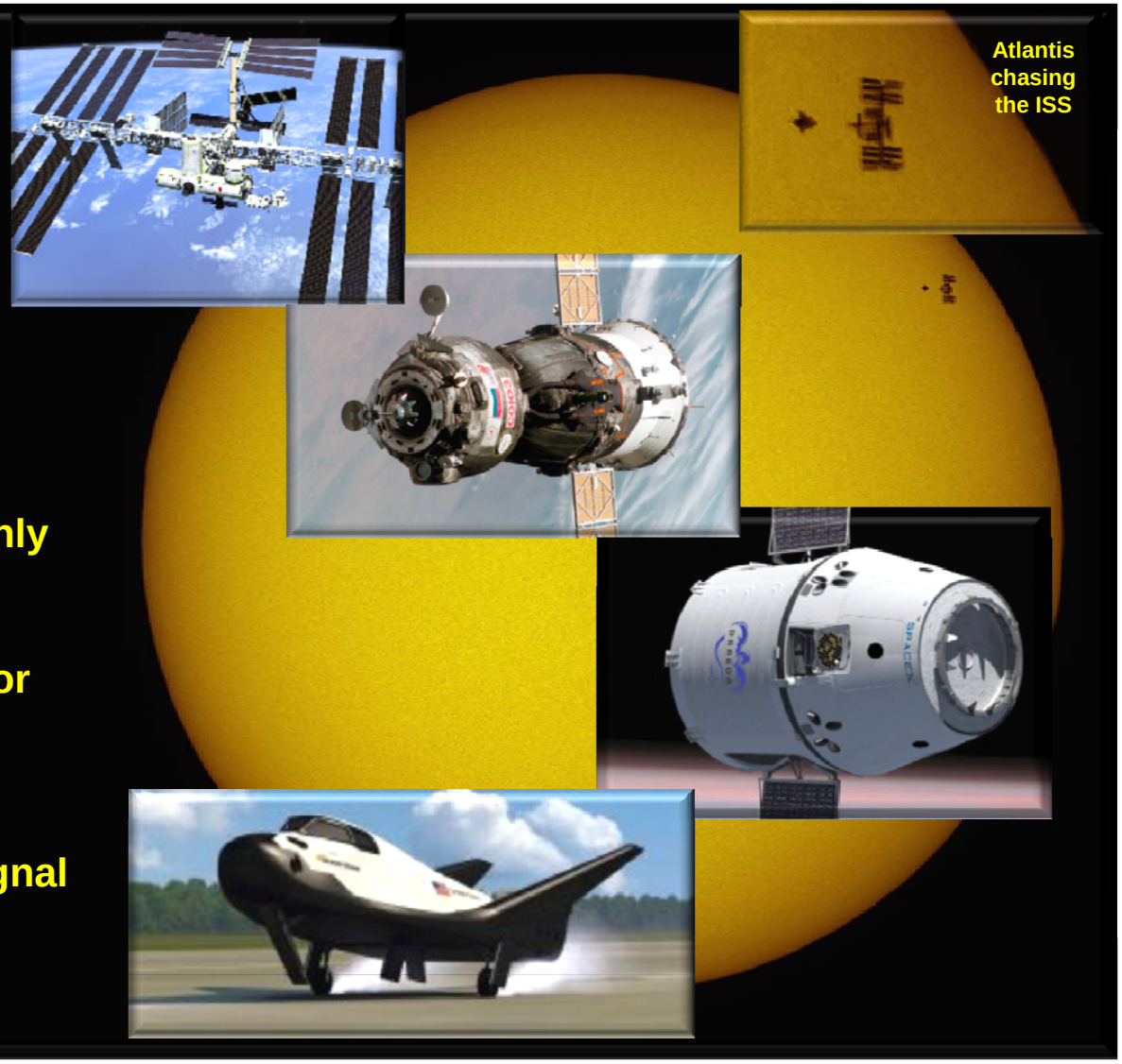
  - DFRC upgraded MOF2 to support unique customer support requirements.
  - DFRC acquired MOF3, waiting for a customer to request capabilities (same pedestal as MOF2, not trailer mounted).

  - DFRC upgraded MOF5 (53 foot trailer used for CEV PA-1 activities at WSMR) to support Dream Chaser as Mobile Mission Control Center for SNC. In conjunction with MOF1, these systems will be used to support tow testing of the Dream Chaser Engineering Test Article (ETA) at DFRC in November 2012.



# DFRC Space Operations Support

- 1 ISS V1 Proficiency Pass
- 1 ISS V1 Simulation Pass
- 2 ISS V2 Support
  - Soyuz 30
  - Soyuz 31
- 1 C-Band Radar tracking only for ISS proficiency pass
- 2 C-Band tracking passes for SpaceX Dragon spacecraft rendezvous to ISS
- SSSR – CUCU Spectrum signal strength testing for SpaceX
- Dreamchaser landing tests





# Questions?



# Appendix

# Dryden Systems Overview

# Dryden WATR Operational Systems

Mobile Systems

Telemetry & Radar

Communications systems

HD TV Vans

Long Range Optics

# Dryden Systems Overview

## Fixed Telemetry Systems

- Two 7 meter (ATF 1 & 2) and one 3.7 meter (ATF 3) L-, S-, and C-Band telemetry and TV downlink and L- & S-Band uplink with a redundant 100 Watt transmitter
  - ATF 1 & 2 G/T= 17 dB @ 2250 MHz
  - ATF 3 G/T= 9.8 dB @ 2250 MHz


## Radar

- Two 4.9 meter C-Band RIR 716 Radars
  - Capable of tracking LEO vehicles from horizon to horizon. S/N ratio is dependent on vehicle cross section and other variables

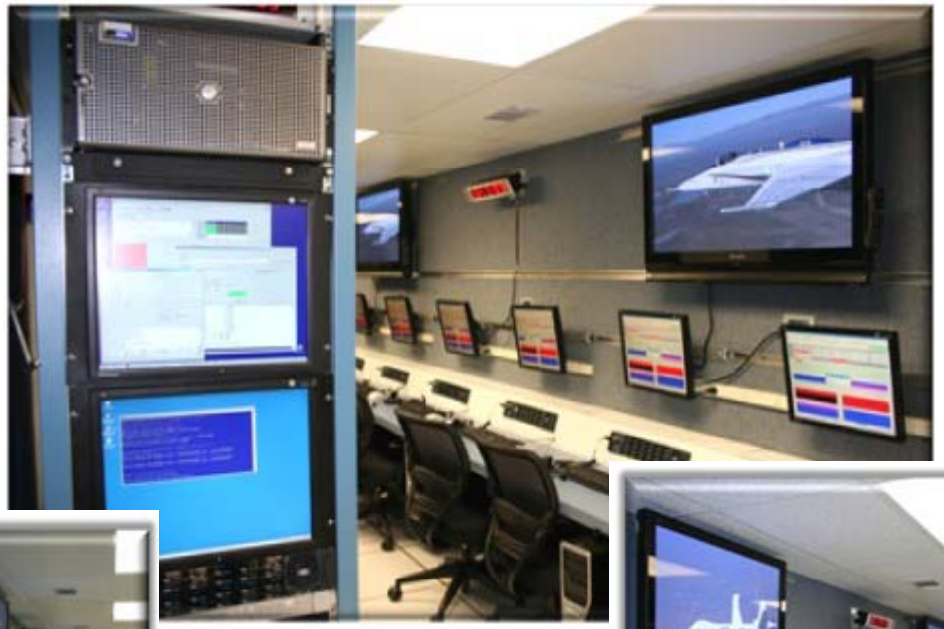
# Dryden Systems Overview

## Mobile Telemetry Systems

- MOF1 is a 30 foot trailer
  - Equipped with a 6-ft telemetry antenna with L-, S-, & C-Band telemetry and TV downlink, L- & S-Band uplink with a redundant 100 Watt transmitter
    - G/T=1.9 dB at 2250 MHZ
  - Three point electro-mechanical lift for deploying antenna system
  - 2 UHF/VHF radios
  - 12 channel voice intercom system

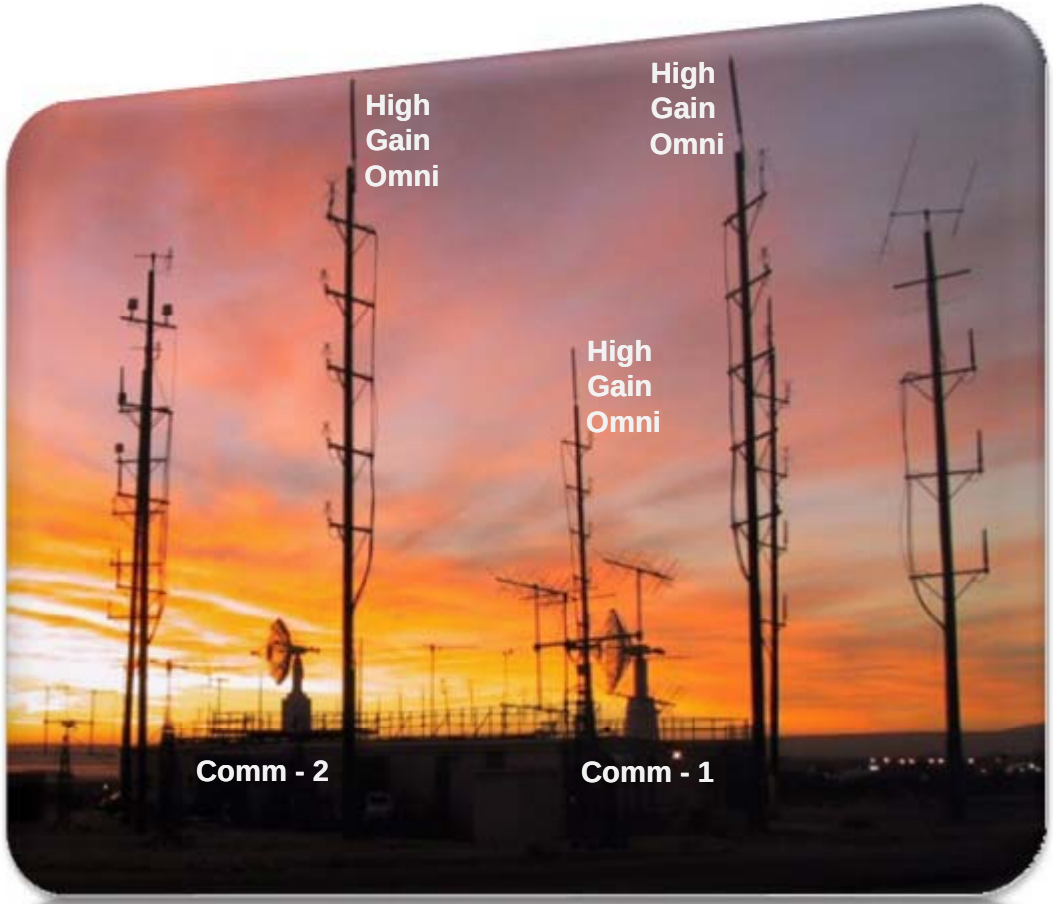
# Dryden Systems Overview

- MOF5
  - 53 foot trailer
  - Equipped with 14 research stations
  - Full PCM decom capability
  - Up to 6 PCM streams
  - Multi-channel video distribution system
  - Multi-channel voice intercom system



## Voice Communications Facility

- Three UHF Directional Antennas (Comm 1, 2 & 3) 10 to 22 dB gain frequency dependent.
- Three 7 dB gain UHF High Gain Omni antennas
- Two 10 dB gain VHF Directional Antennas
- Redundant Voice Communications system



# DFRC ISS Systems Overview

## ISS V1 Support System

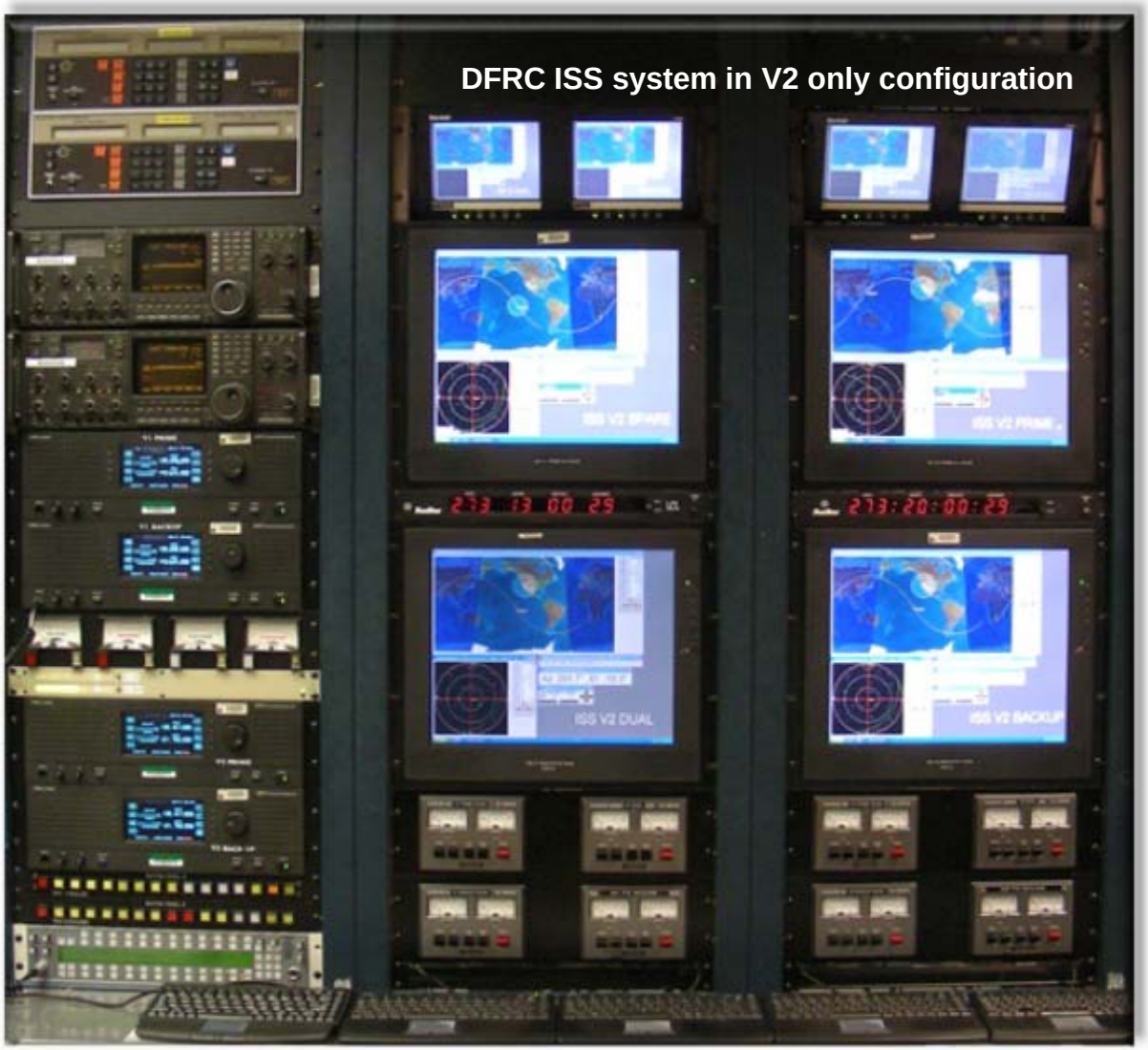
- ISS V1 Prime Quad Yagi System Top Left
- ISS V1 Back up Quad Yagi System Bottom Right
- ISS V1 Dual Yagi Bottom Right
- Spare V1 Tracking PC, Top Right

DFRC ISS system in V1 only configuration

# DFRC ISS Systems Overview

## ISS V2 Support System

- ISS V2 Prime Quad Yagi System Top Right
- ISS V2 Back up Quad Yagi System Bottom Right
- ISS V2 Dual Yagi Bottom Left
- Spare V2 Tracking PC, Top Left




DFRC ISS system in V2 only configuration

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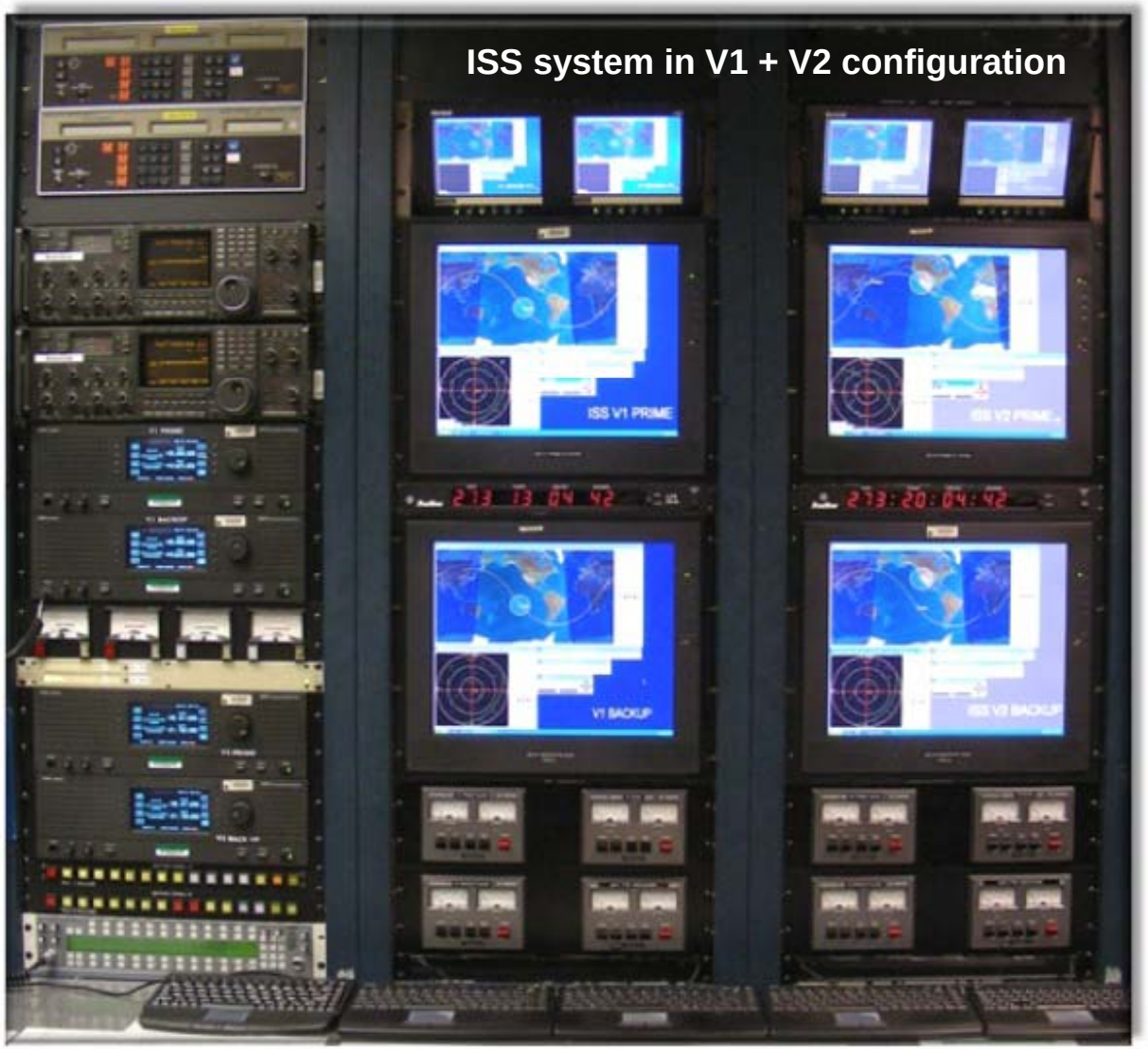
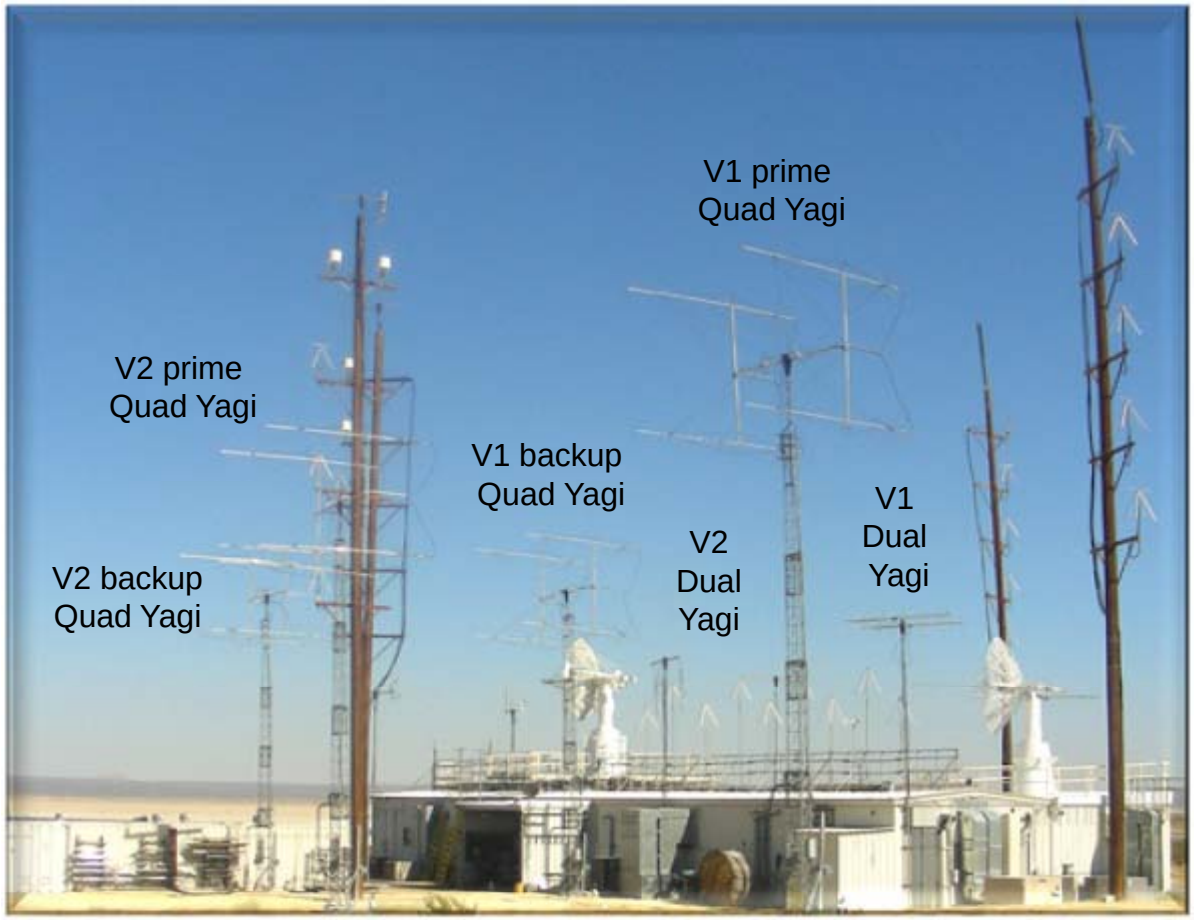


# Dryden ISS Systems Overview

## ISS Support Antenna Systems

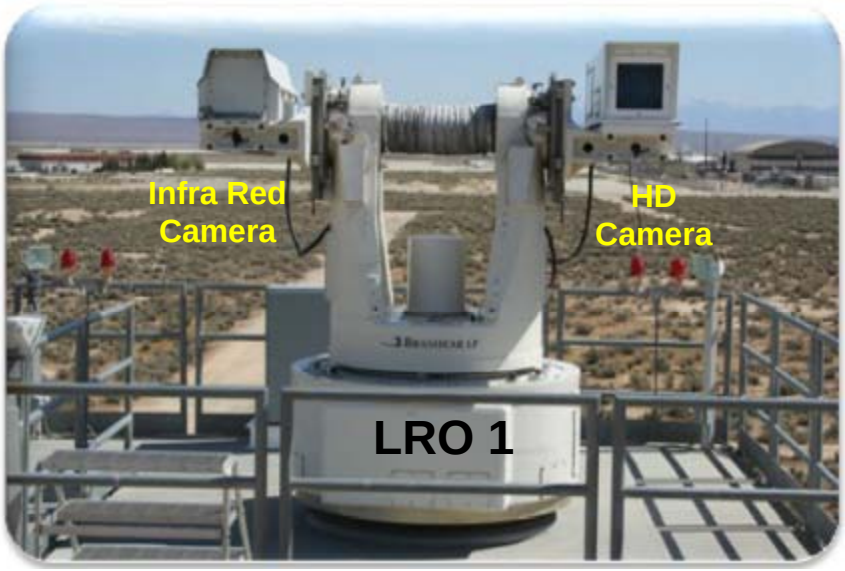
- **V1:**
  - **Two Quad Yagi Antennas**
  - **One Dual Yagi Antenna**
- **V2:**
  - **Two Quad Yagi antennas**
  - **One Dual Yagi antenna**



# Dryden Systems Overview

## Video Support

- Long Range Optics
  - HD 720p camera with 13.5 – 2300mm lens tracking to 100 nautical miles
  - 480i Infrared camera with 15x lens tracking to 40 nautical miles




# Dryden Systems Overview

## Video Support - continued

- TV 1 Mobile Video
  - HD 720p Camera with 27 – 1760 mm lens



- **TV 2 Mobile Video**
  - **HD 720p Camera with 15.2 – 260 mm lens**
  - **HD transmit capability**

# Dryden Systems Overview

## Video Support - continued

- ATF 1 & 2 camera
  - 520 NTSC with 2200 mm lens
- ATF 3 camera
  - 520 NTSC with 503 mm lens
- FRCC (Radar 34) camera
  - 520 NTSC with 3050 mm lens
- FDRC (Radar 38) camera
  - 520 NTSC with 3050 mm lens

## Dryden Mission Control Centers & Data Processing

- The WATR has two Mission Control Centers to support research and test missions
  - MCC1 - 27 Data display stations
  - MCC2 - 17 Data display stations
- The Mission Control Center provides real-time mission operations for test conductors, research engineers, range safety, and project personnel
  - Monitoring data for flight safety
  - Data analysis for in-flight test point clearance

MCC1

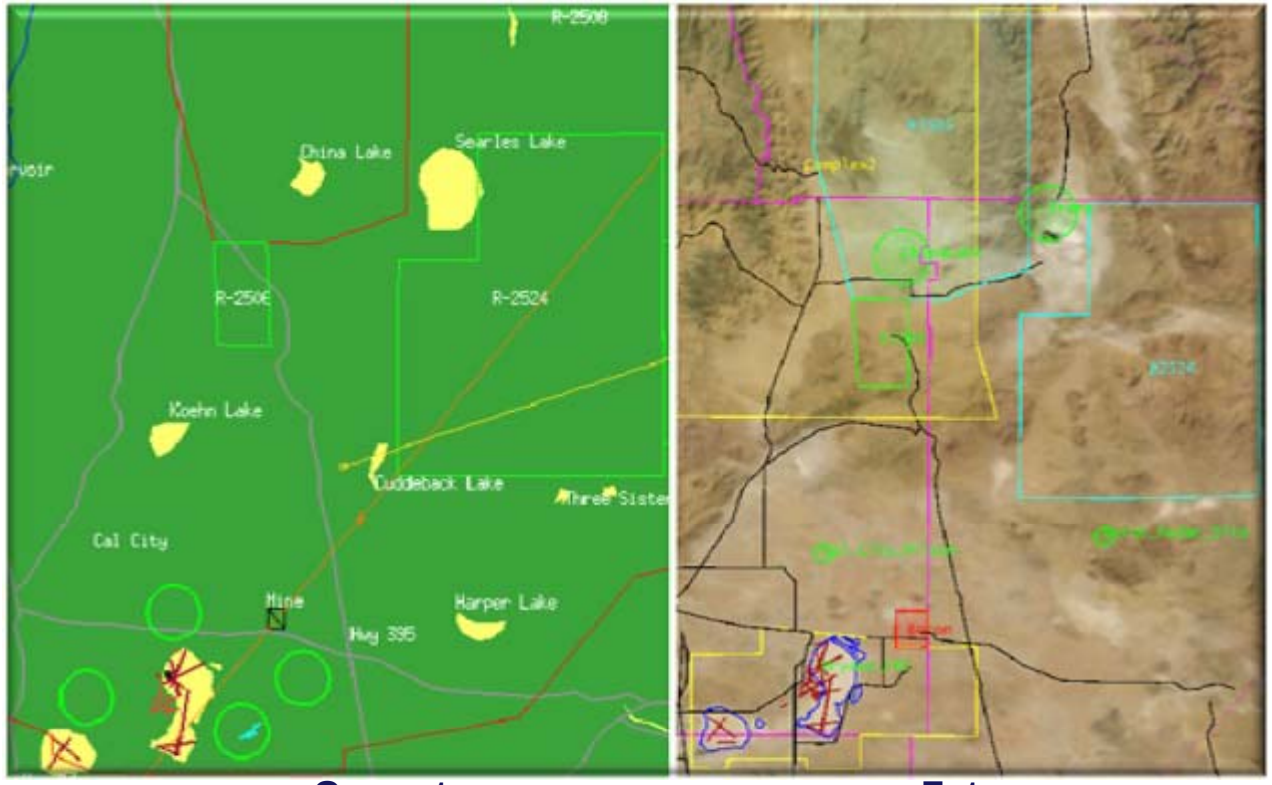
MCC2

# Dryden Systems Overview

## Range Safety

- Flight critical & time-space positioning information (TSPI) data
- Vehicle location and predicted debris impact points displayed on data monitors
- GRIM 2D display system in process of being replaced by PAM3D TSPI data display

**Global Real-Time Information Map (GRIM) Display**



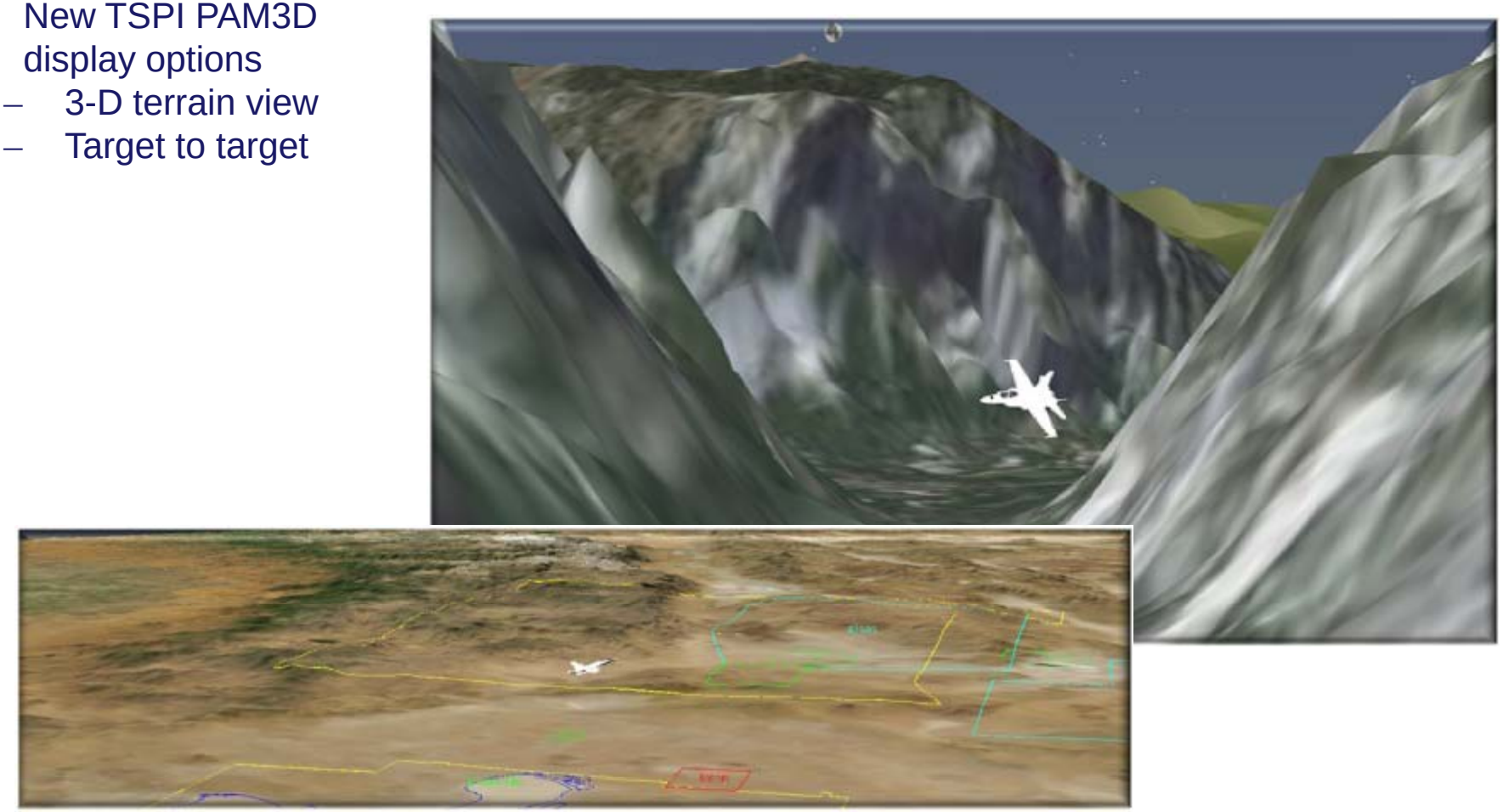

Current

Future

**Positional Awareness Map (PAM3D) Display**

## Range Safety continued

- New TSPI PAM3D display options
  - 3-D terrain view
  - Target to target



## Range Safety continued

- 20 KW (EIRP) Enhanced Flight Termination System (EFTS) for unpiloted vehicles
- Existing 4 transmitter System is in process of being replaced by a 6 transmitter array

Flight Termination System

# Programs Supported by Dryden

# DFRC Planned Comm System Configuration

(2017)