DARPA/USAF/USN J-UCAS
X-45A
System Demonstration Program

Gary B. Cosentino
Aeronautics Mission Directorate

DoD, Boeing, and NASA Partnerships

UCAV Program

DARPA

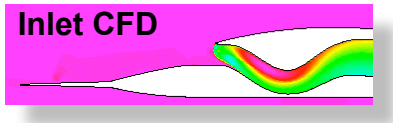
U.S. AIR FORCE

BOEING®

Dryden Flight Research Center
Flight Test Expertise and Support
Unique Facilities and Airspace

Air Force Flight Test Center
Airfield and Airspace Management
Flight Test Infrastructure

Inlet CFD



Wind Tunnel Tests

Ames Research Center
Computational Fluid Dynamics

Langley Research Center
Transonic Wind Tunnel Testing

Roles & Responsibilities – Program Wide

DARPA/Program Office

- **Government oversight/insight and approval authority**
- **SEIT IPT Lead**
- **Flight Test IPT Lead**
- **On-Site Rep – Gary Cosentino (Government Flight Representative)**

Boeing

- **Responsible Test Organization (RTO) for UCAV-ATD Flight Test Program, Per 845 OTA: MDA972-99-9-0003**
  - System Integration & Test : "The contractor shall provide a disciplined, controlled process for system integration/test and demonstration flight tests".
  - Owns the Flight vehicles and ground stations
  - Ultimately responsible for System Safety, Flight Safety, and Airworthiness
- **System Test Director**
- **Test Ops and Planning**
- **Site manager**

Roles and Responsibilities - NASA DFRC

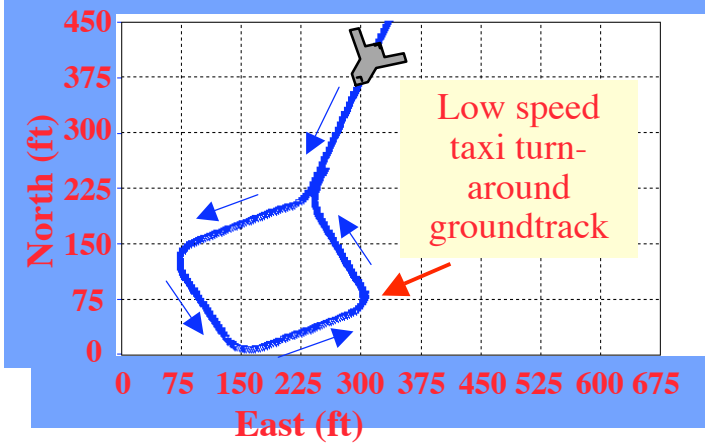
- **NASA Project Manager**
- **Range and Ground Safety**
  - Range and Ground Safety Plans and Hazard Analyses
  - FTS Hardware (GFE), Design and Testing Reviews & Analyses
  - Operating and Support Hazards and Analyses, Procedures Review
- **Flight Test Support and Infrastructure**
  - Provide Hangar, Ground Station, and Office Space
  - Integrate Range Assets (Radars, Telemetry, Control Rooms)
  - Coordinate Assets and Flight Test Support with AFFTC
  - Chase Aircraft and In-Flight Photography
  - Ground Photography
  - Meteorology
- **Technical and Engineering Tasks**
  - Autonomous Ground Operations Software, Auto Taxi Control Laws
  - Contingency Management for Autonomous Vehicles (Ground Ops)
  - Assist with Air Data Calibrations and Parameter Identification

DFRC Engineering Contributions

Autonomous Ground Taxi Control Development:

GPRA Milestone:
Demonstrate robust taxi capability with contingency planning for an autonomous vehicle (UCAV)

→ **Demonstrated October 24, 2001**



Structural Dynamics Testing and Analysis:

Ground Vibration Testing:
Utilized three 50 lb. shakers for excitation input and 176 accelerometers to measure aircraft response

Other Flight Test Support:

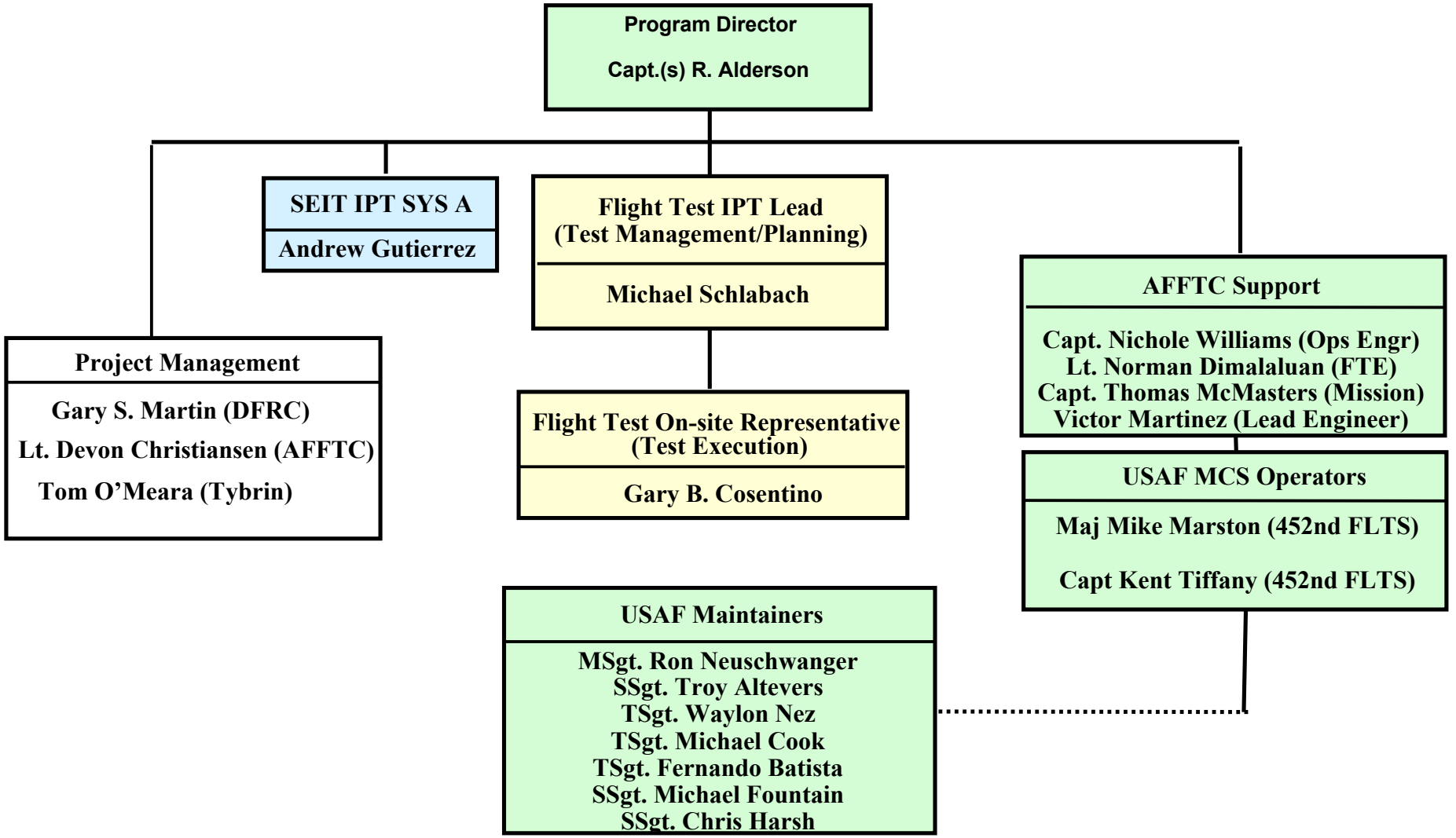
Range Facilities, Telemetry Data, Tracking Radars
Communications and Control
Support Equipment and Infrastructure
Lakebed Runways

Roles and Responsibilities - Air Force Flight Test Center

- **AFFTC UCAV Deputy Project Manager**

- **452nd FLTS**
  - » Currently providing 7 maintainers (2 crew chiefs and 3 weapons loaders)
  - » 2 UAV Operators; 1 Mission Planner w/weapons drop experience
  - » 1 Operations engineer, 1 Flight Test Engineer
  - – JON established between DFRC and 452nd for flight test support
- **System Safety Support from "day one"**
  - – AFFTC Safety/System Safety Office
  - – AFFTC Safety Review, Participation & Guidance in generation of: System Safety Program Plan, Mishap Plan, System Safety Working Group, Hazard Analysis, Flight Safety.
- **Spectrum Management Office support for concurrent radiation from "Trundy" Tower between Global Hawk and UCAV programs**
- **Propulsion support in Hush House**
- **Airfield management and air traffic control services**

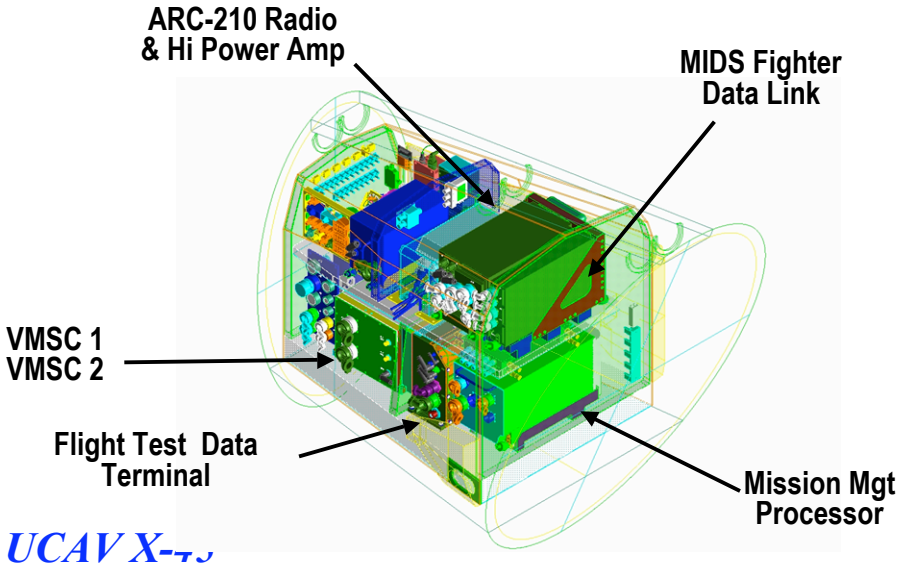
System Test Organization - Government (X-45A)



T-33 J-UCAS Surrogate Aircraft

Overview:

- Aircraft Nose Bay contains the UDS Flight Control and Communications Avionics Pallet
- UDS Pallet integrated with T-33 Autopilot; T-33 Controlled by the MCS operator during "up and away" flight (T-33 pilot cued for taxi ops)
- Flight Characteristics of T-33 Similar to X-45A, 0.7 Mach at 35,000 ft



Surrogate Serves as Significant Risk Reduction Resource:

- Guidance And Navigation (up & away)
- Contingency Management
- Mission Planning verification
- Comm Link and coverage testing
- Software checkout
- Team training and proficiency
- Range safety mission assessment

Test Site Layout

Vehicles in Test Bay 6

TOSC and Annex

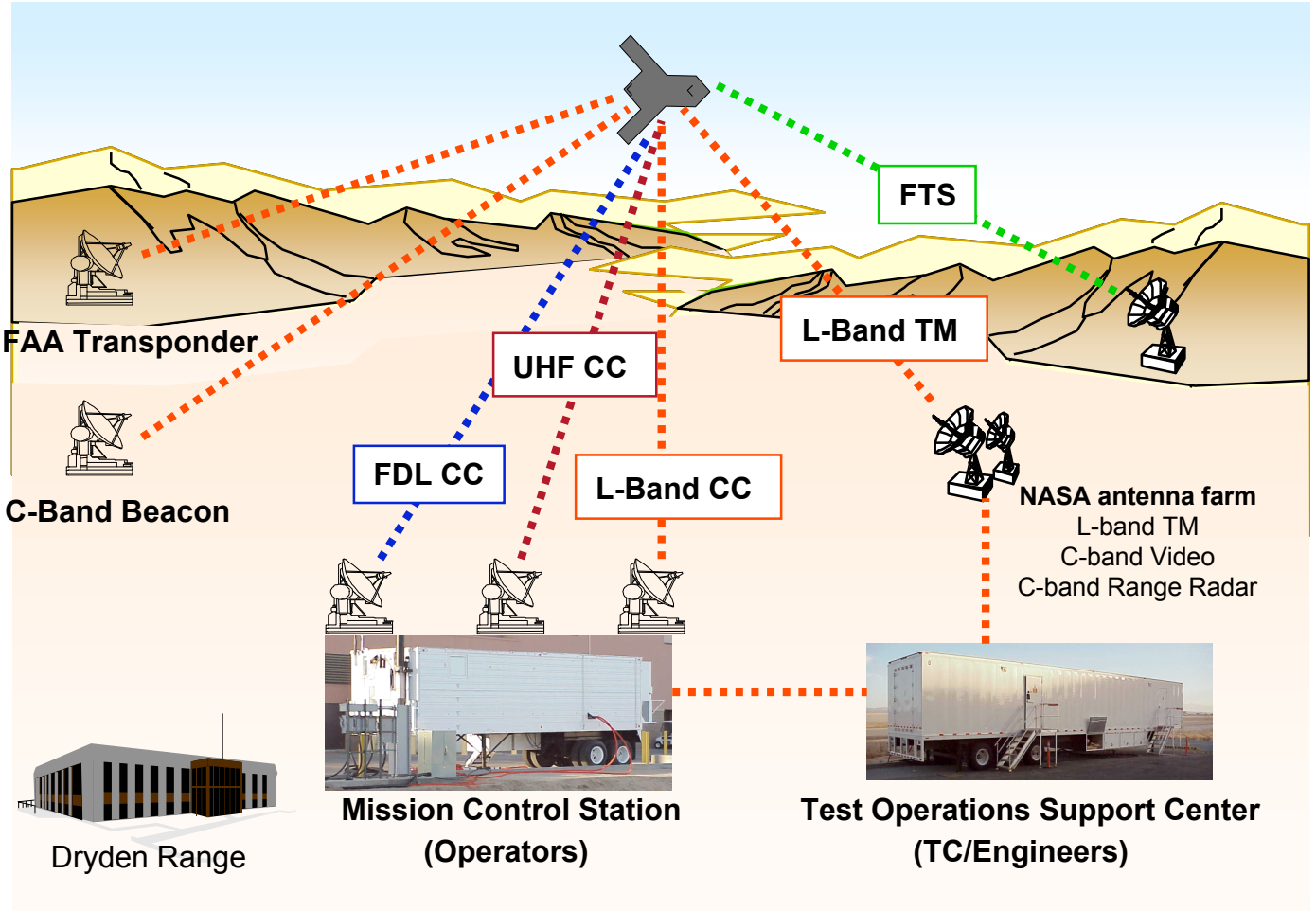
Interdependence of Range Assets

Program assets:

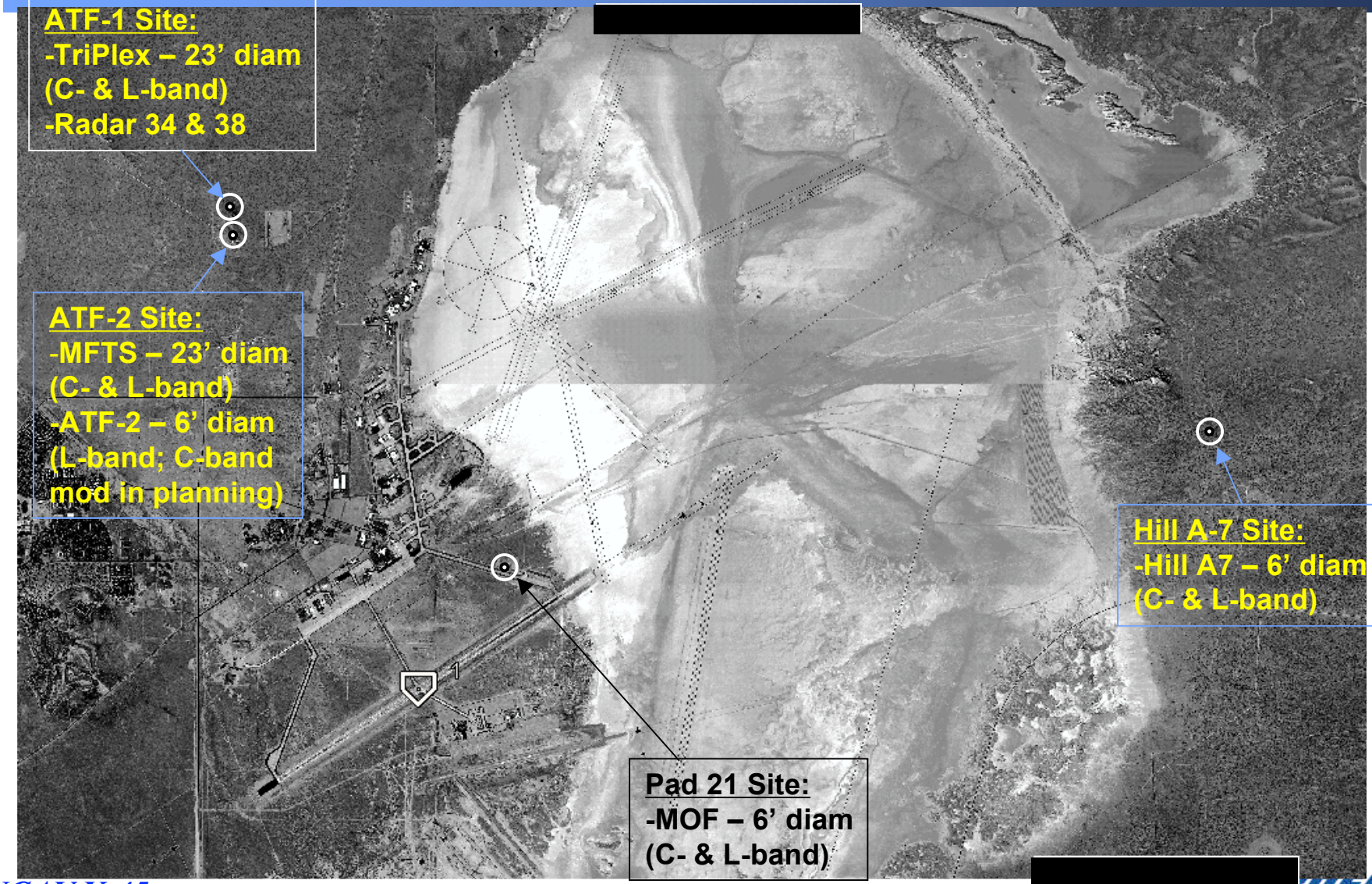
- X-45A vehicles
- T-33 Surrogate
- UMCS
- TOSC
- TM & C2 antennas

Range assets:

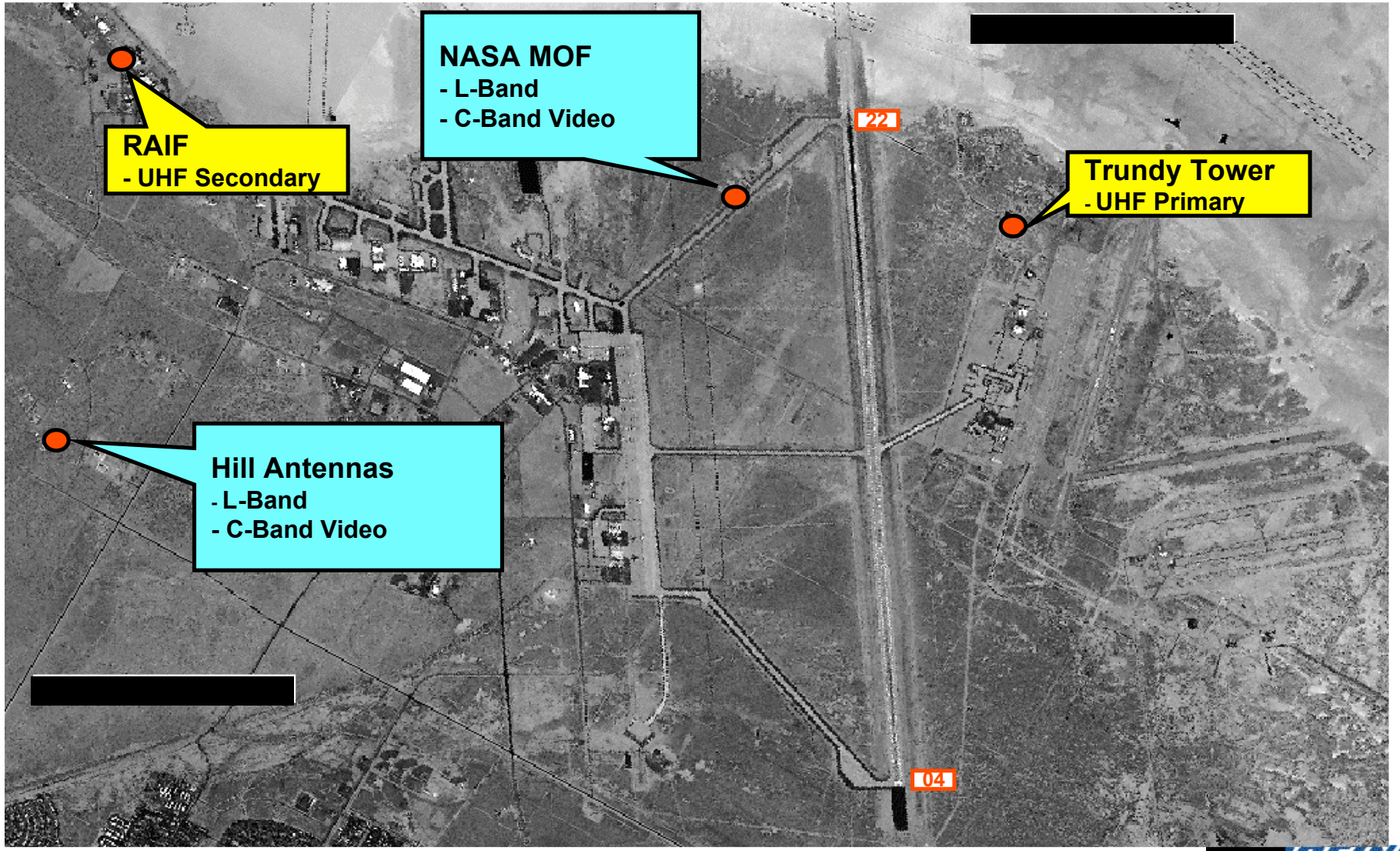
- Remote antennas and communication sites
- NASA/DFRC Mission Control Centers
- NASA/DFRC Mobile Operations Facility
- Flight Termination Hardware (ground & airborne systems)
- C-Band Tracking Radars & Optics



Dish Locations



Command and Control/TM Antenna Locations at AFFTC



X-45A Inert GPS-Guided Bomb Demo

18 April 2004

X-45A AV-1 & AV-2 Multi-Vehicle Ops Demo

1August 2004

Questions?