High Frequency Global Communications System

The Future High Frequency Global Communications System: Current Developments and Concepts

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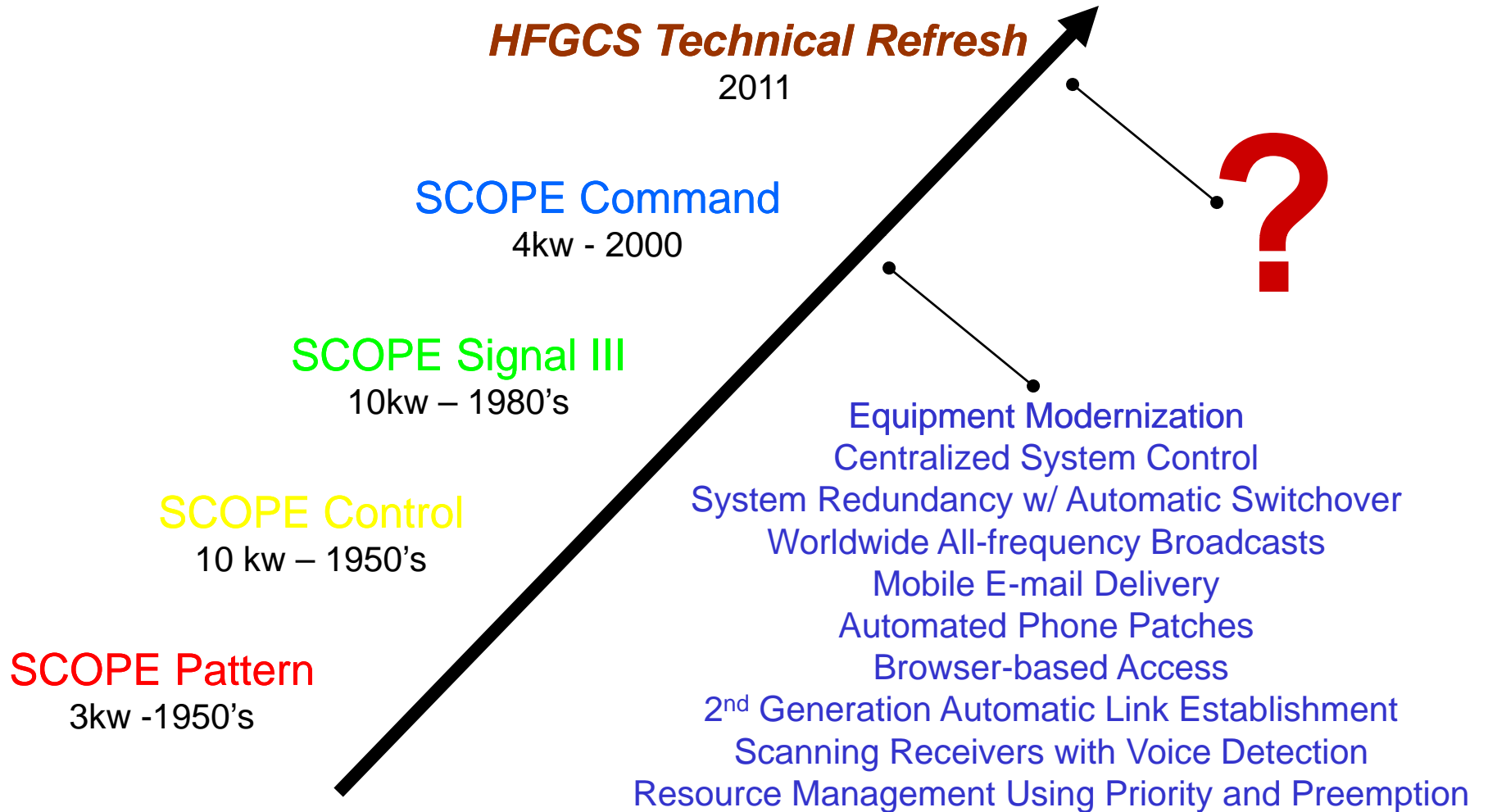**email: robert.adkinson@tinker.af.mil**

Integrity - Service - Excellence

Overview

System Evolution/History

System Features

Technical Refresh Vision

Current/Ongoing Modification Projects

Non-System Developments - Involved
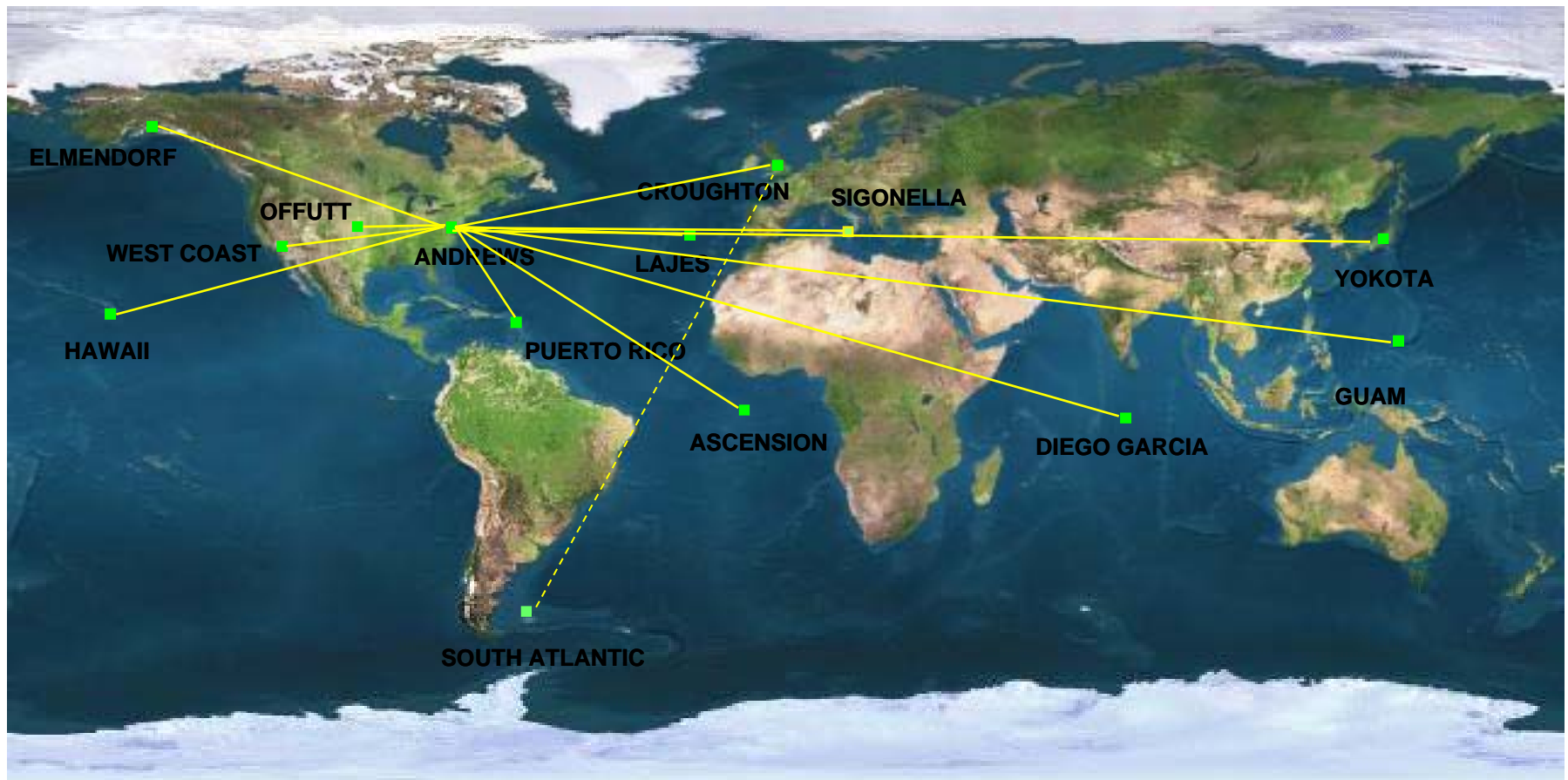
Non-System Developments - Not Involved

Summary

USAF HF Network Evolution

HFGCS Technical Refresh
2011

SCOPE Command
4kw - 2000

SCOPE Signal III
10kw – 1980's

SCOPE Control
10 kw – 1950's

SCOPE Pattern
3kw -1950's

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Equipment Modernization
Centralized System Control
System Redundancy w/ Automatic Switchover
Worldwide All-frequency Broadcasts
Mobile E-mail Delivery
Automated Phone Patches
Browser-based Access
2nd Generation Automatic Link Establishment
Scanning Receivers with Voice Detection
Resource Management Using Priority and Preemption

HFGCS Configuration

HFGCS Mission

- **United States Air Force worldwide fixed station, high power, high frequency radio system – 13 worldwide locations**
- **Provides:**
    - **Primary command and control for mobility air forces – voice and data**
    - **Presidential and executive DOD support**
    - **National Command Authority dissemination of Emergency War Orders through Emergency Action Messages – Single Integrated Operational Plan**
    - **Spanish speaking network between US, Southern and Central American Air Forces**
    - **Global Humanitarian/NATO Mission support**
    - **High Frequency Secure Email to the AWACS Fleet**

Current HFGCS Projects

- **Any Console/Any Station (ACAS)**
- **Link 11 Proof of Concept at Elmendorf Station**
- **Network Control Station - West (NCS-W)**
  - **Survivable Control**
  - **Remote Console Capability**
- **Full IP Network Control and Audio**
- **Fully Digital HF**
  - **Data**
  - **Voice**
- **Replace Keflavic coverage**
- **Planned Middle-east Station**
- **Planned Australian Station**
- **Right-sizing Discussions with Navy**

Any Console / Any Station

- **This is a current capability, but not yet fielded at all stations.**

- **Allows an operator sitting at any console to connect with and control any specific station in the system.**

- **Long lines to station must be connected to the same NCS to which the console is connected.**

- **Allows reduced operations, within human limits, to operate multiple stations from single consoles.**

Link 11 Proof of Concept

- Link 11 is a tactical data link protocol (TADL)
- Used for communicating tactical info (orders and data) to en-route aircraft.
- Link 11 is specific to HF
  - ISB channels not authorized for this station
- Link 16 is specific to UHF/Satcom
- NATO Improved Link 11 (NILE) is not planned.
  - Commonly called Link 22
  - Uses the Link 16 Message set
- Elmendorf AFB installation supports a unique mission – no plans to install Link 11 throughout system.

Network Control Station - West

- **Survivable System Control**
  - Stations can be operated locally at station sites
  - Can be operated from either NCS
  - Can be operated from remote consoles connected to either NCS
- **Remote Console Capability**
  - Consoles at NCS-West will be connected to NCS-East for system processing/control
  - Consoles at NCS-East will be connected to NCS-East for system processing/control
  - Consoles at any location can be connected via long-lines for system processing/control

Full IP Network Control and Audio

- **First step toward Technical Refresh goal**
- **Phased approach**
  - **Move system control from long-line T-1 links over to IP via network routers**
  - **Replace long-line audio trunks for HF E-mail communication with Audio over IP**
  - **Replace NCS-to-Station telephone trunks with Telephony over IP**
- **In development – has not been applied to system yet**
- **Will be limited to existing system architecture.**

Fully Digital HF

- **New project in the planning stage**
  - Second step toward Tech Refresh
  - Expected to allow expansion of services
  - Will allow HF networking (HF links as subnet)
- **Data**
  - HFGCS currently provided data services, but not IP-based
  - Implement over-the-air IP technologies
  - Must be standards-based for interoperability
- **Voice**
  - Analog capability must remain for time being
  - Mixed Excitation Linear Prediction (MELP) or similar digital voice technology
  - Must be standards-based for interoperability

Replace Keflavik Coverage

- **Install transmit and receive sites on oil rigs?**

- **Depend on Navy ships for coverage?**

- **Install new station somewhre in Maine?**

- **Collaborate with Canada for use of an east coast site?**

- **Dedicate log periodics at Andrews and Croughton?**

Back Burner Projects

- **Additional station in Middle-east**
  - **Currently in host nation agreement negotiation phase**
- **Additional station in Australia**
  - **Planned, but not an active project**
- **Ongoing discussions for interoperability and support issues with US Navy**
  - **Some stations located on Navy sites**
 - **Shared HF facilities and interoperating networks**
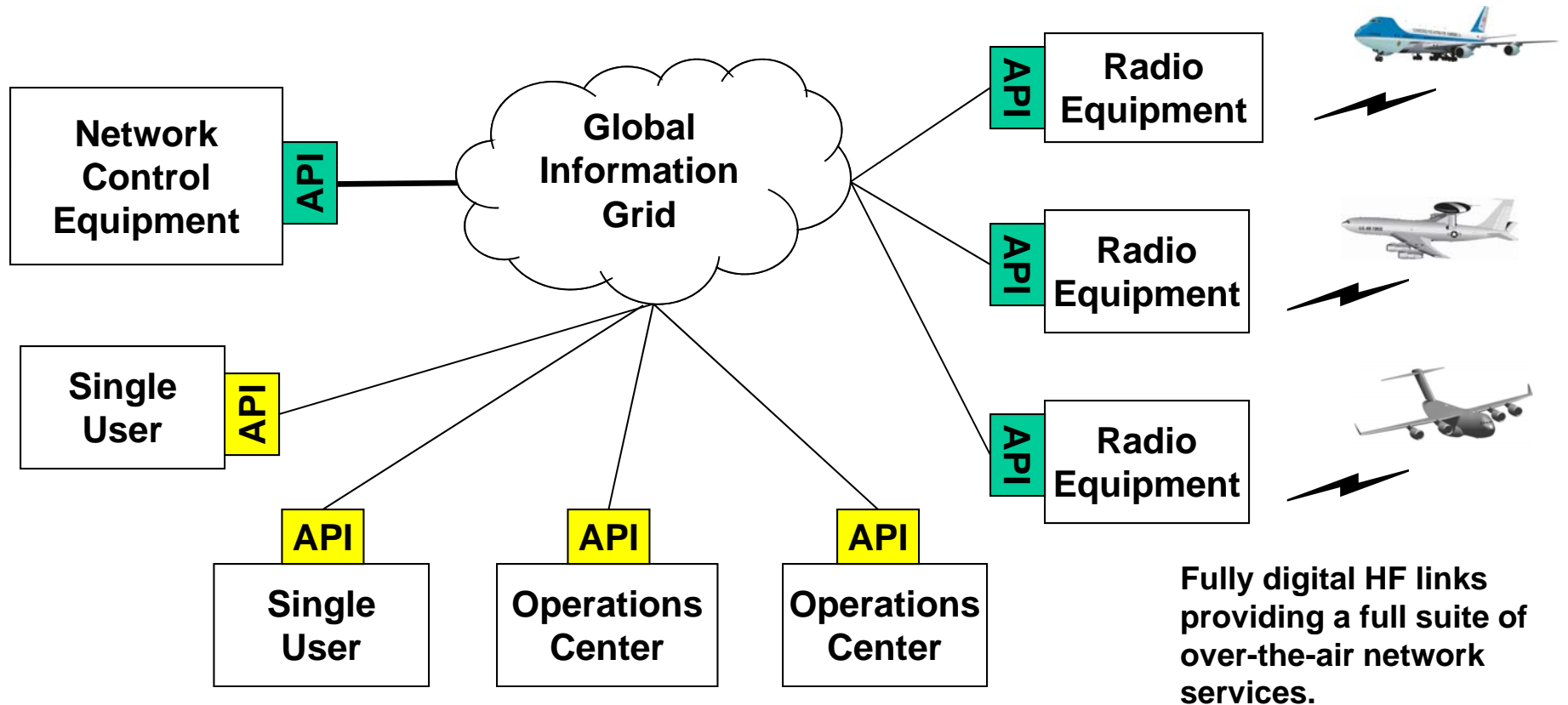
Current Architecture

- ## All station equipment located at "lights out" sites
  - Multiple radio levels, multiple antennas, etc
  - Separate control and analog audio paths from Network Control Station over dedicated long lines
- ## System access and control routes through NCS via proprietary software

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Technical Refresh Goal
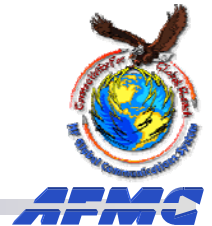
Future Vision:
Utilize Open System Control and Communication Technologies to allow modular evolution of system modifications.

Network Control Equipment — API — Global Information Grid

Single User — API

API — Single User

API — Operations Center

API — Operations Center

API — Radio Equipment

API — Radio Equipment

API — Radio Equipment

Fully digital HF links providing a full suite of over-the-air network services.

Green = HFGCS Gov't Owned Interfaces   Yellow = Other Gov't Owned Interfaces

Standards-Based Approach

- **Customer/mission evolution driven**
- **Will continue to support/interface with legacy equipment**
- **Open System equipment/applications for additions/changes in technologies**
- **Interoperable with other DoD and Allied systems**
- **HFGCS SPO has responsibility for:**
  - **MIL-STD-188-110B (will begin revision)**
  - **MIL-STD-188-141B (will begin revision)**
  - **MIL-STD-187-721 (expect cancellation)**
- **HFGCS is representing US interests in NATO Beyond Line of Site Communications Working Group**
- **Radio Information Transfer Technical Working Group being organized by the Army's Systems Engineering, Architecture, and Integration Center**

HFGCS Technical Refresh

- **Incorporate New Technologies**
  - Upgrade system for control and traffic handling
  - Additional services over HF (…maintaining backwards compatibility)
- **Possible Architecture Changes**
  - Replace proprietary control software with off-the-shelf
  - Distributed system control
  - Increase density of receiver sites
  - Network nodes vs. fixed stations
  - Utilize Near Vertical Incidence Skywave (NVIS)
  - Collaborative efforts with Allies
- **Possible Services Changes**
  - Frequency hopping protocols
  - Independent sideband for greater throughput
  - Ground linking with other radio networks (VHF, UHF) over IP
  - Automation of communications services upon user request/access
- **IPv6**
- **Joint Tactical Radio System (JTRS) integration**
- **Interoperable waveforms and collaboration with Allies/NATO**
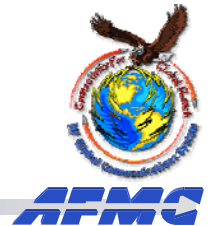- **Utilize an incremental approach smartly, as opportunities arise**

Outside Projects
With HFGCS Involvement

- **Information Operations Battle Lab HIGH WIRE**
- **Joint Airborne Network Services Suite**
- **NATO Standards**

High Wire

- **Extending the RIPRNET concept.**
- **High Wire is an AFIOB initiative which demonstrates the military value of integrating airborne radio systems, land mobile radio systems, and data networks with Voice over Internet Protocol (VoIP) technology.**
- **An in-flight near miss started this effort. It was found there was no positive control of aircraft.**
- **Originally focused on 55th Wing (Offutt) flying assets and VHF communication. UHF and HFGCS are additional players.**
- **Concept is to link an airborne LAN with a ground-based LAN via VoIP.**
- **Demo scheduled for 13-17 Nov 06.**
- **Selected Objectives:**
  - **Comprehend and minimize the security risks introduced by implementation of the Radio over IP and VoIP systems.**
  - **Determine ability to integrate a Motorola 4x Radio System into an IP-switched base network.**
  - **Determine ability to integrate a Supervisor of Flying (SOF) tower linked to URC 200, PRC 177 and GRC 171 radios into an IP-switched base network.**
- **The HFGCS Global Coverage is viewed as what makes this effort worth while, although not included in the original objectives.**
- **Equipment control will not be included in this demonstration.**
- **Expected to be followed by an AFIOB IP over HF demo.**

JANSS

- Hanscom AFB/MITRE effort
- Navy SPAWARS involvement
- Mobile network issues being addressed
- IP over HF software interface in development
- HFGCS BLOS capability again seen as important
- Potentially useful to HFGCS migration

From the **Joint Airborne Network Services Suite** Functional Description Document:

Across the DoD, efforts are underway to extend Internet Protocol (IP)-based networking services (e.g., chat, email, web browsing) to tactical assets. Future airborne mission applications are being developed assuming IP-based communications links to the aircraft will exist. Future communications system programs will develop and implement solutions for communications links that will provide IP-based networking capabilities.

The JANSS defines an integrated set of common functions to be performed, along with preferred protocols, standards and configurations. These functions may be realized through the use of many different system solutions, on any tactical asset (aircraft, ship, vehicle) and ground entry point (GEP) to enable the formation of heterogeneous inter-networks to be created with any combination of platforms and communication link capabilities. The JANSS will be modular, in order to adapt, expand, or enhance its functionality, as needed, to support particular platform's needs. Finally, the JANSS will be defined in increments enabling a clear migration of capabilities.

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NATO

- **HFGCS has responsibility for fielding technical questions during the US ratification process.**

- **STANAG 5066 E1A1 is undergoing US ratification**
  - **Comment period has closed**
  - **Status of US responding to NATO is unknown**

- **HFGCS represents US interests in BLOS COMM Ad Hoc Working Group**
  - **NATO actively working interoperability issues**
  - **US involvement is critical**

Known HF Radio Projects Without HFGCS Involvement

- **No direct HFGCS involvement, but we are watching other developments in the HF arena, looking for best practices.**
  - **Customs Over The Horizon Enforcement Network**
  - **G-RAP**
  - **JTRS**
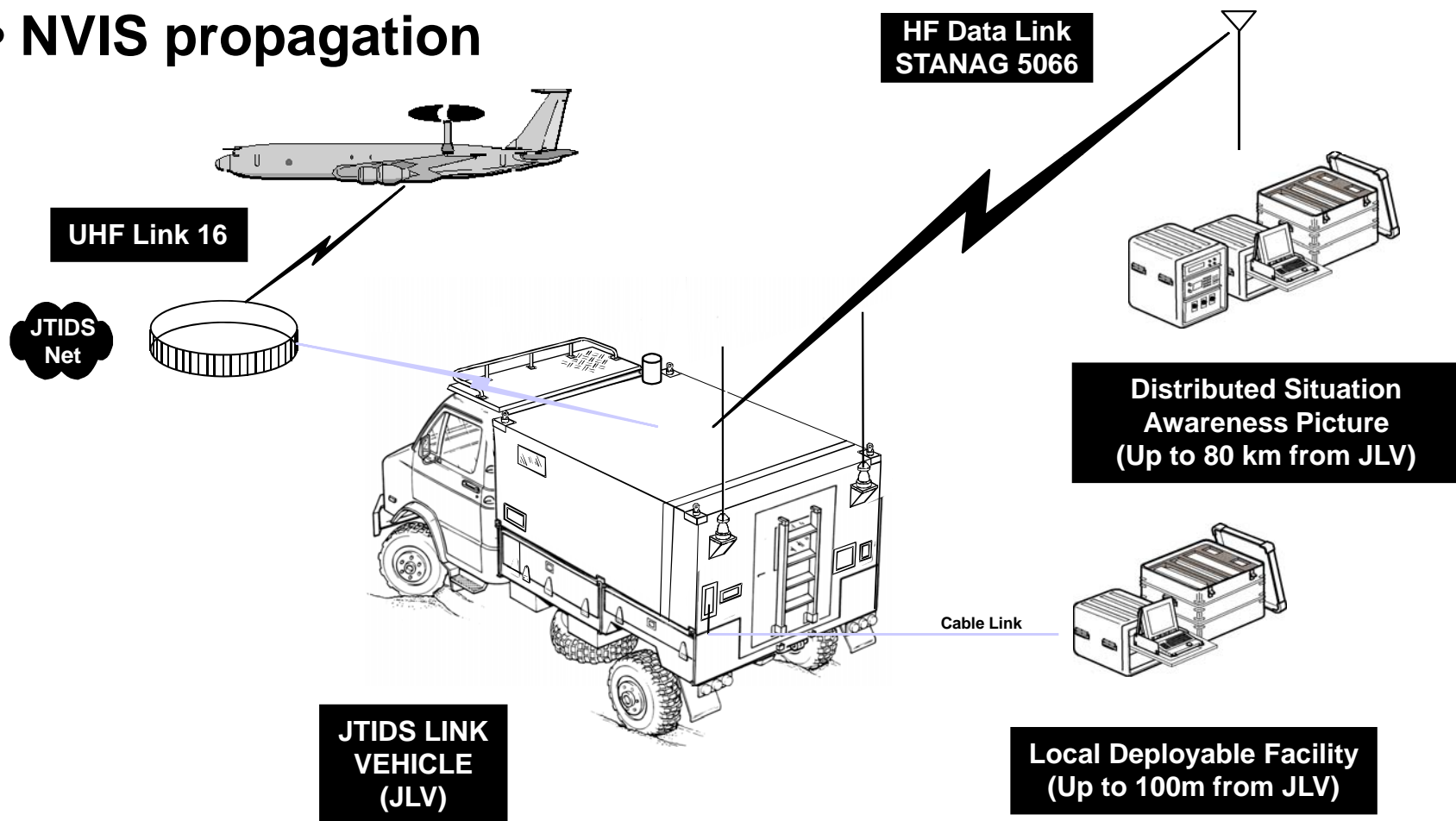- **Opportunities for standards-based interoperability**

COTHEN

- **Toured the US Customs Service HF system.**
- **Single-site, single-antenna, lower power, stations**
- **System site locations are more dense**
  - **Designed to communicate within first skip range**
- **Provide services to ground mobile and man-pack customers**
- **Noted several integration possibilities**
  - **Uses real-time signal strength to select best station to respond to a call.**
  - **Methods built-in to prevent stepping on a station not heard**
  - **Remote Command and Control package can be set up anywhere there are two PSTN lines available**

Ground-based
Received Air Picture (G-RAP)

- **Rockwell-Collins UK initiative**
- **Utilizes HF E-Mail for HF link**
- **NVIS propagation**

HF Data Link STANAG 5066

UHF Link 16

JTIDS Net

Distributed Situation Awareness Picture (Up to 80 km from JLV)

Cable Link

JTIDS LINK VEHICLE (JLV)

Local Deployable Facility (Up to 100m from JLV)

Joint Tactical Radio System

- **HFGCS only peripherally involved**
- **Have attended teleconferences, but no opportunity for input.**
- **JTRS not currently working on an HF waveform.**

SUMMARY

- **Current state of HFGCS**
- **System modification projects**
- **Tech Refresh vision**
- **Outside projects in HF arena**

Discussion/Questions?