

# **Experience With Expanding Air Force Satellite Control Interoperability**

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# Background

- **US govt goal to achieve interoperability among satellite control networks**
  - **Air Force Satellite Control Network (AFSCN), NASA, NOAA**
  - **Effort since 2001 to define, develop, and test standards**
    - **Interagency and commercial adoption of open, CCSDS and TCP/IP-based standards in progress**
  - **Demo'd AF use of NASA and NOAA ground stations in past**
- **Recent AF efforts focused use of commercial networks**
  - **Received funding designated to explore feasibility of augmenting AFSCN with commercial TT&C providers**
  - **Two commercial contracts awarded**
    - **Universal Space Network and Honeywell DataLynx**
    - **Develop and check out SGLS and USB at existing ground sites**
    - **Perform operational passes for designated satellites**
  - **Other supporting efforts**
    - **Enhance COTS equipment to support new standards**
    - **Provide facility and ops support within R&D satellite operations centers at Schriever AFB (CERES) and Kirtland AFB (RSC)**
    - **Prepare feasibility report (with 50 SW)**

# Outline

- **Configuration, results, future directions for:**
  - DataLynx
  - Universal Space Network
- **Government observations**



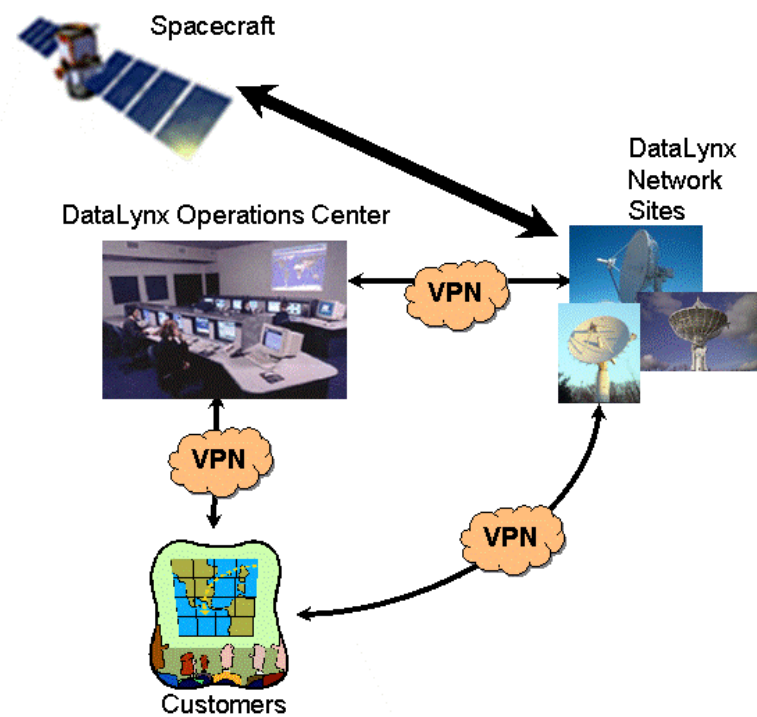
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## Expanding Interoperability between the AFSCN and Commercial Networks

**Honeywell**

# DataLynx Network

- Provides a single point of interface for a globally distributed network
- Provides full range of TT&C services for:
  - Launch and early orbit
  - Routine mission operations
  - Contingency operations
- Part of the NASA Ground Network
  - First to receive NASA Security Certification
  - 40 passes a day with Polar network
- Conducts ground network architectural trade studies
- Proven interoperability with NASA, NOAA, ESA, CSA, CNES, JAXA, and DLR
- In the process of demonstrating AFSCN interoperability



# Project Tasks

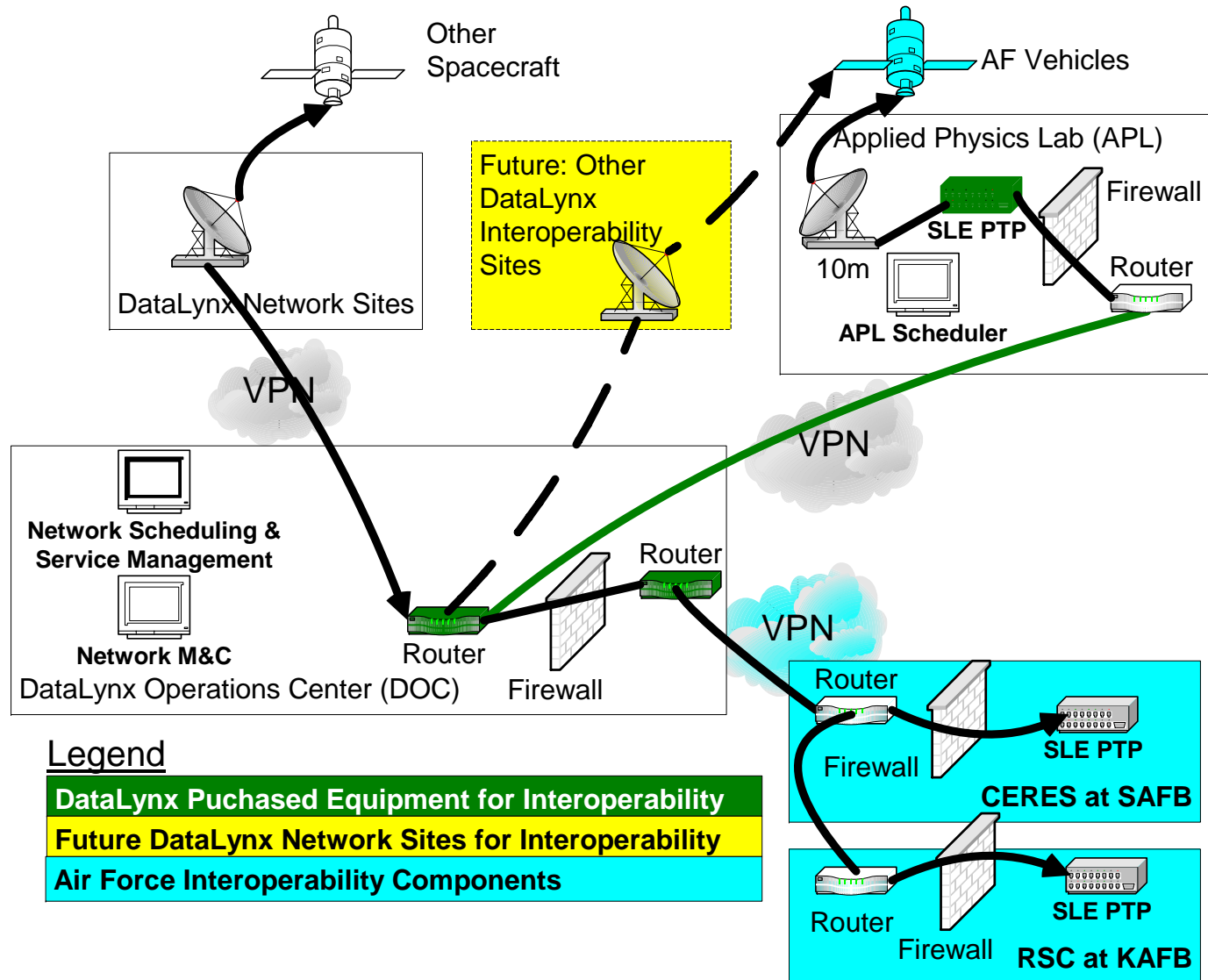
## Completed

- Procure and test T1 link between DOC and APL (DataLynx)
- Install and train on SLE scheduling system (DataLynx)
- Procure, configure, install SLE front ends (joint DataLynx/Govt)
- Procure T1 link between DOC and CERES (Govt)
- Document security and submit for DAA approval (Govt)

## Future

- Obtain AF approval to connect (Govt)
- Perform test passes (joint)
- Perform operational passes (joint)

# DataLynx Network Configuration



# Results to Date

- Contact Activities
  - Completed successful ground loopback tests with command echo and BERT
  - Completed passive receive contact with DSCS III
  - Awaiting government approval for live checkout passes
- Lessons Learned
  - PTP products delivered and worked as specified
  - Long lead times needed for government actions
  - Security and connectivity approvals can be long pole
  - Configuring DataLynx and APL for AF satellite contact parameters was straightforward

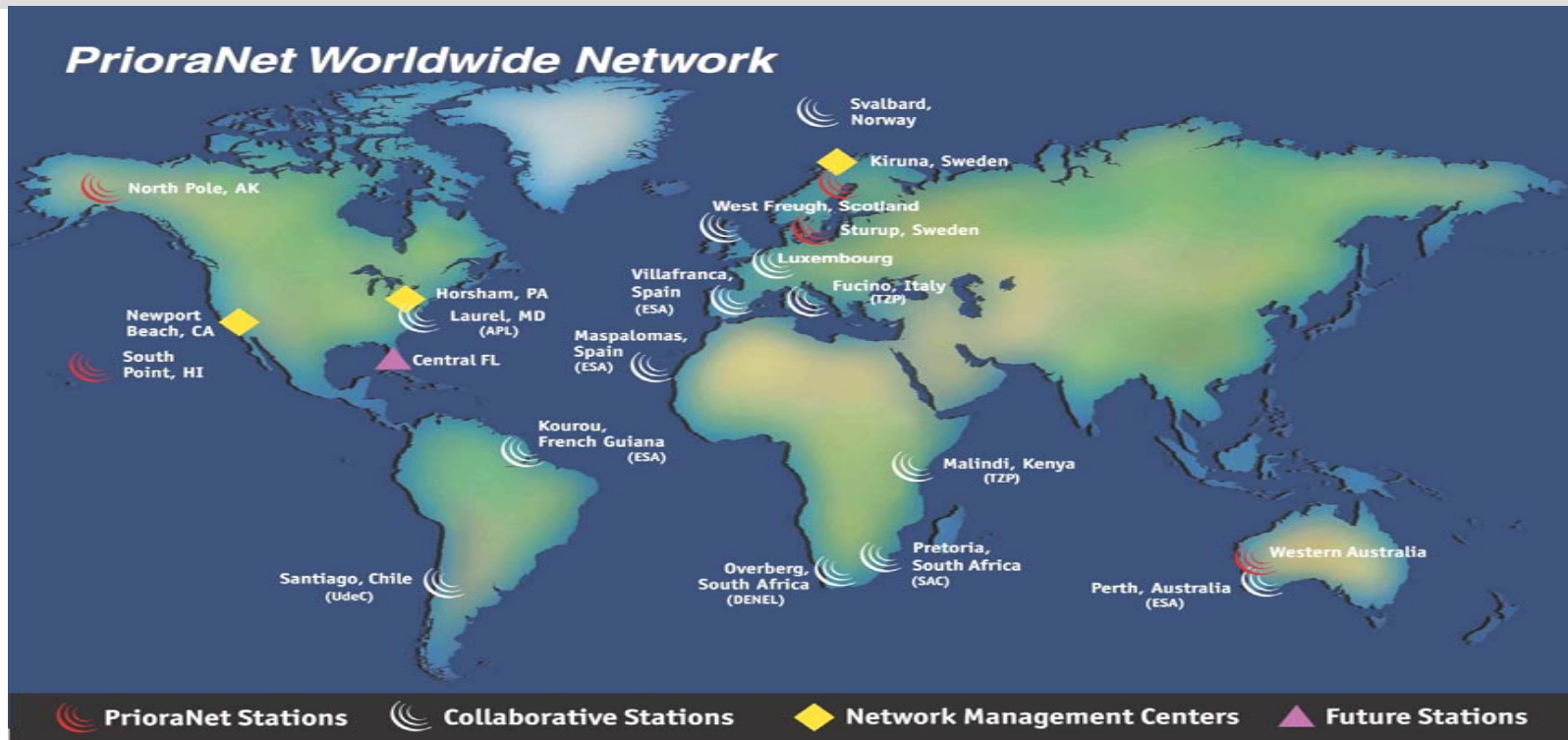


# What's Next

- Short Term
  - Resolve any technical issues in the APL Engineering Phase
  - Enter into the DataLynx APL Operational Phase and take 200 operational passes
- Long Term
  - Extend the interoperability to foreign DataLynx network sites (e.g. West Freugh, Scotland)
    - Address concerns regarding foreign technology release and military use of foreign systems

***Provide a cost effective, standards-based capability to augment the AFSCN for non-sensitive mission support.***

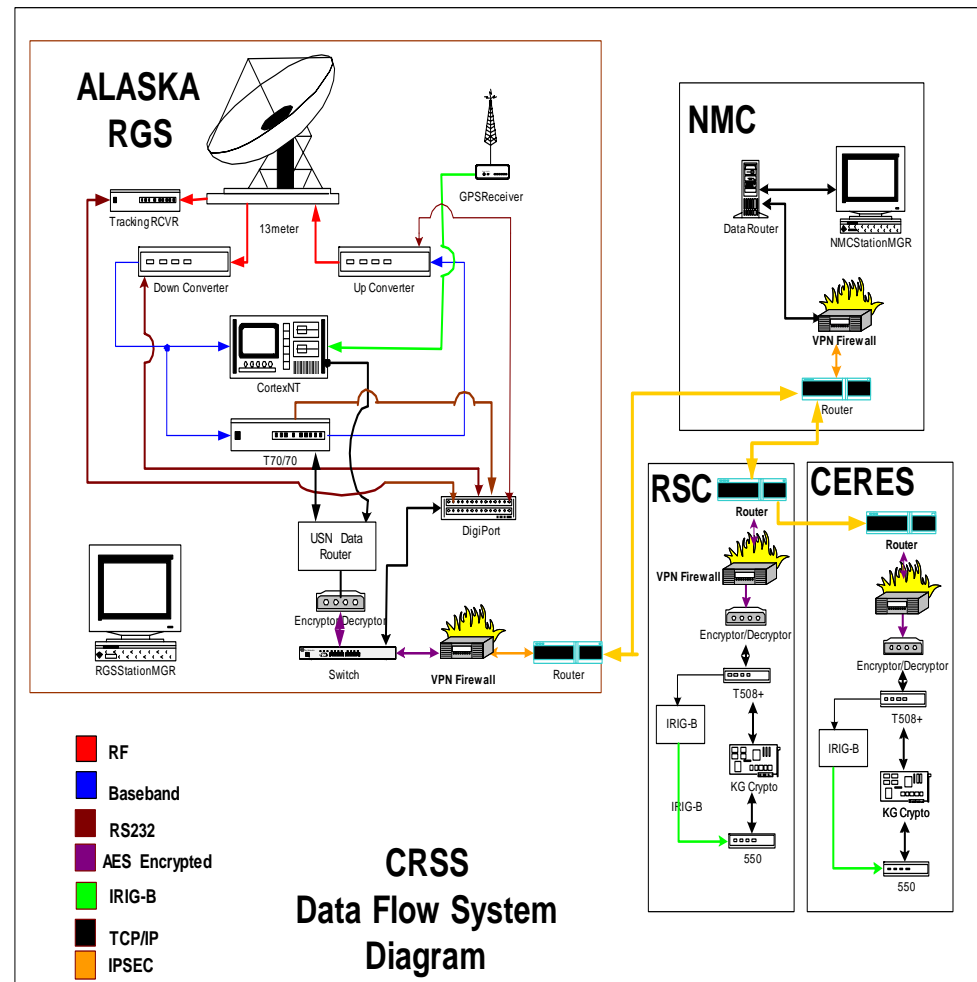
# Universal Space Network (USN)



- USN Owned And Collaborative Stations
- Multiple Bands/Formats: Universal S Band, SGLS, X Band, Ku Band
- Supports Commercial Satellite Launch, Early Orbit, And State Of Health
- Augments NASA Ground Network
- Provides X Band Downlink For DoD And NASA Spacecraft
- Demonstrates New Ground System Compatibility With Existing Spacecraft
- **Demonstrating Feasibility Of Augmenting The Air Force Satellite Control Network**

# USN CRSS Configuration

- **USN Invested By Adding A SGLS Capability To Its Alaska Station**
  - SGLS 500w Amplifier
  - S-band Up Converter
  - S-band Down Converter
  - RT Logic T70/70
  - Cortex NT
- **USN Network Is IP Based**
- **Connectivity Between AF SOCs and USN Network Management Center Is Via IP Over Dedicated T1 Links**
  - Circuits Protected Via VPNs
  - SOC-To-Spacecraft Communications Encrypted
  - DAA Certified



# CRSS CY2005 Goals

- **Integrate And Test RSC With USN Alaska Ground Station**
- **Integrate And Test CERES With USN Alaska Ground Station**
- **Conduct Developmental Passes For:**
  - **Commanding (Including Time Critical)**
  - **Telemetry (Including Time-Data Correlation)**
  - **Ranging**
- **Conduct Operational Passes To Certify Operational Suitability**
  - **TSX-5**                              -- **POAM**
  - **DSCS II**                              -- **GPS**
  - **DSCS III**
- **Refine The Scheduling Interface Between The SOC And USN Network Management Center**

# CRSS Results Summary

VEHICLE	RSC Passes	CERES Passes	Time Critical Cmd	Ranging Accuracy	Ops Qualified
TSX-5	28 / 31*	0	NA	Variable	Yes*
POAM	27 / 30	0	NA	NA	Yes
DSCS II	0	22 / 27	NA	NA	Yes
DSCS III	0	42 / 45	4 / 4	Good Std Deviation; High Bias?	Yes
Total passes	55 / 61	64 / 72	4 / 4		
Success Rate*	90%	89%	100%		

\*Success = met all TT&C ops qual criteria, except did not satisfy TDC for TSX-5

**Results Demonstrated Commercial Network Can Meet Technical Requirements To Support DoD Spacecraft**

# CRSS Results Assessment

- **Failed Supports Due To:**
  - Ranging Receiver Unable To Hold Lock
  - Network Socket Connection Problems
  - Definitive Hardware Failure
  - Control Center Inability To Command
  - Operator Error
- **Lessons Learned**
  - **Time-Data Correlation:** difficult to achieve AFSCN unique function with COTS equipment not designed for this
  - **Lack of public standards for AFSCN complicates integration of equipment from different vendors**
  - **Air Force approval to test satellites was difficult to obtain, even for “Test And Check Out” satellites (had to drop GPS)**
  - **Scheduling interface needs an operational environment to fully test**
  - **AFSCN ranging difficult to accomplish at same time as commanding**

# Way Ahead

- **Beginning CRSS Phase 3**
  - **Installing Standards-Based Comm Front End At Alaska Ground Station**
    - **Expected To Resolve TDC Issues**
  - **Implementing first USB Commanding Capability for AF**
    - **Potential Wideband Gapfiller Support**
  - **Conducting 200 Operational Passes From Alaska Ground Station To Assess Performance Of New Configuration**
- **Addressing Foreign Siting Concerns Thru OSD Space Policy**
  - **Received Government Of Australia Approval To Support Missile Defense Agency NFIRE Spacecraft**
  - **Obtaining Government Of Australia Approval To Support DoD's Wideband Gap Filler Program With Both SGLS And USB**
  - **Obtaining Government Of Sweden Approval To Support The Space Based Space Surveillance Spacecraft And Other DoD Missions**
- **Working Operational Security And DAA Accreditation Issues**
  - **Supporting SMC/SN Efforts To Obtain DAA Accreditation For Interface Between USN Network And Air Force Satellite Operations Centers**

**USN Goal: Provide A Proven Capability To Support Designated AFSCN Missions--Augment AFSCN Capabilities Or Capacity As Needed**

# Government Observations

- **Commercial networks (when augmented for SGLS) can successfully support non-sensitive AFSCN missions**
  - Some technical features (not needed by most missions) remain to be addressed by new standards
- **Equipment vendors are willing and able to incorporate new standards into COTS equipment**
  - More complete assessment of COTS products is underway
- **Commercial augmentation lowers cost by sharing use of existing commercial sites, equipment, comm, NOC, etc.**
- **Future direction requires agreements among stakeholders to resolve issues**
  - Security and policy approvals for use of commercial systems to support DoD missions are controversial and time consuming
    - Foreign sites have additional issues
  - Potential role of NASA and NOAA networks
  - Time frame for implementing interoperability



# Acknowledgements

- **Satellite Control Network Contract (SCNC) Interoperability Team**
- **Space and Missile Systems Center (SMC)/SNAI**
- **The Aerospace Corporation**
- **Global Science & Technology (GST)**
- **SMC Det 12**
  - **R&D Support Complex (RSC)**
  - **Space Test and Engineering Contract (STEC) operations**
  - **Center for Research Support (CERES)**
  - **CERES Engineering, Development & Sustainment (EDS) contract**
- **Avtec**
- **RT Logic**
- **Johns Hopkins University/Applied Physics Laboratory (JHU/APL)**