

TacSat-4: Military Utility in a Small Communication Satellite

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The overall classification of this brief is
UNCLASSIFIED

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202-767-0528



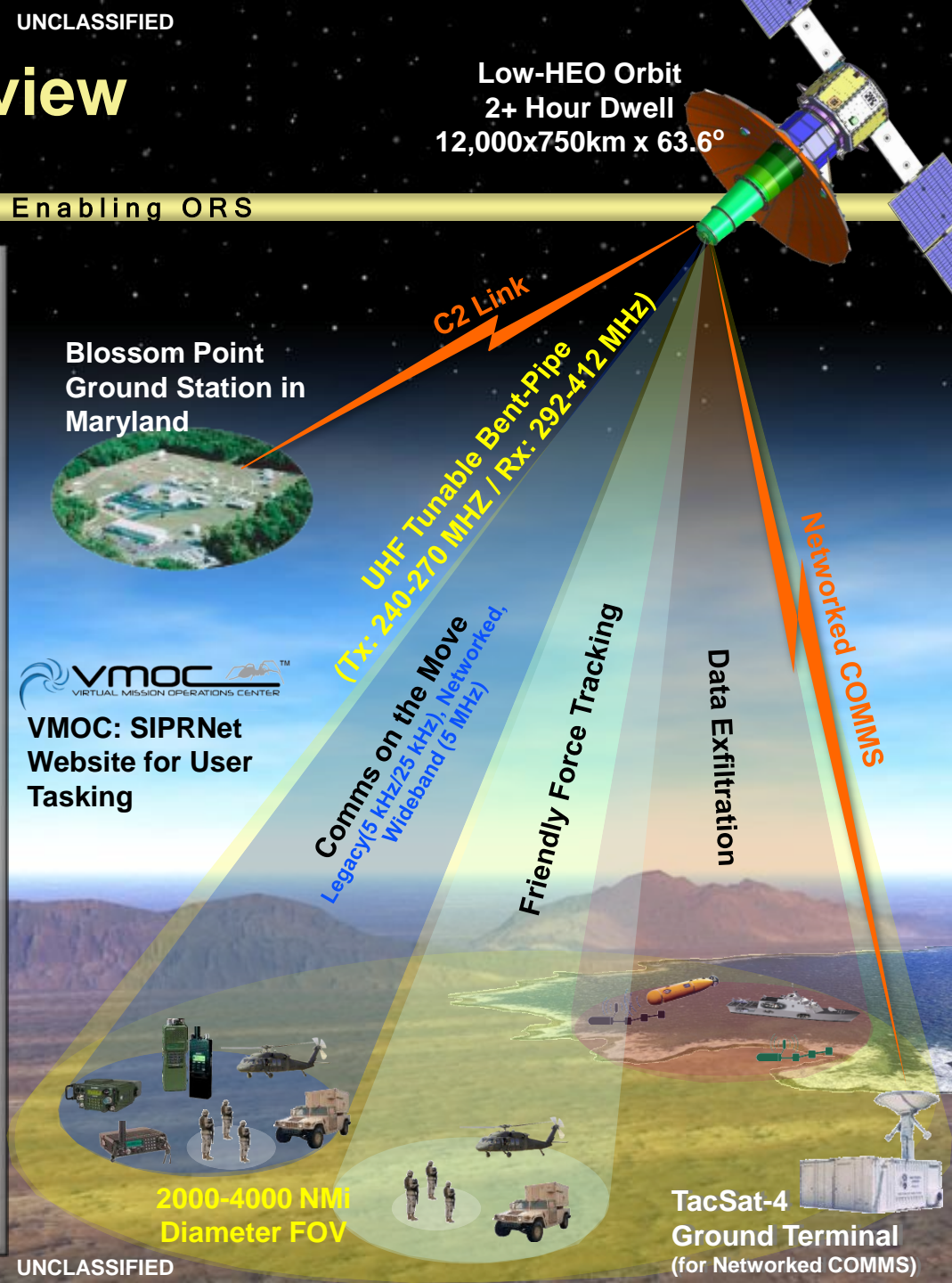
Naval Center for Space Technology
 Naval Research Laboratory
 Washington, DC

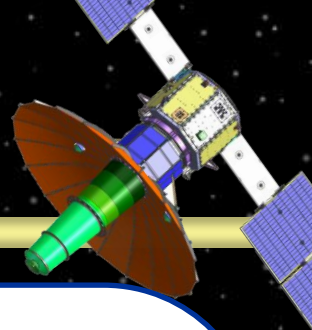
TacSat-4 Mission Overview

Low-HEO Orbit
2+ Hour Dwell
12,000x750km x 63.6°

TacSat-4: Providing Communications and Enabling ORS

- TacSat-4 mission's is to advance technologies & augment SATCOM
- New technologies used:
 - Thermal systems, bus standards, highly automated ground C2, VMOC mission planning, antenna, new battery, new launch vehicle configuration
- Capability can augments national SATCOM with up to 5 Legacy UHF channels...
 - Near global access (but not continuous) including Arctic circle
- Year-1: Military Utility Assessment & Experimentation





TacSat-4 Mission Operational & S&T Objectives

TacSat-4: Providing Communications and Enabling ORS

• Operational Objectives

- Augment UHF SATCOM, including COTM, Data-X, & FFT
- Focus on underserved Users, who are priority or equipment limited, and underserved areas
 - Augment GEO coverage to include the northern latitudes
- Provide JMUA and system info for follow-on acquisition options

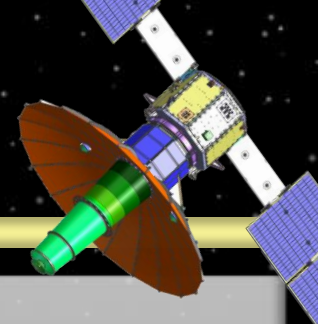
• UHF SATCOM Mission was Selected by General and Admiral Vote

- 1 vote from Army, Navy, Air Force, Marines, and STRATCOM
- Mission designed Jointly for 9 months in prep. for selection

• S&T Objectives & ORS Enablers

- New, long-dwell orbit for small satellite class
- New launch and range capability to reach this long dwell orbit
 - Minotaur-IV+ and Kodiak
- Achieve useful payload performance in small-sat class
- Demo highly automated C2
- Increase automation of mission planning including increased user access to tasking
 - Enable dynamic tasking without increased work load
- Advance spacecraft bus standards
- Multiple technologies to enable this capability in a small sat
 - 12 foot antenna, thermal pipes, Lithium Ion battery, etc...
- Advance radiation models

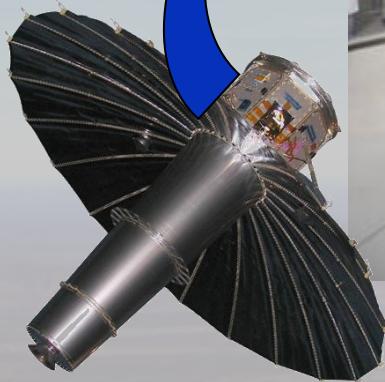
TacSat-4 – Spacecraft Components



TacSat-4: Providing Communications and Enabling ORS



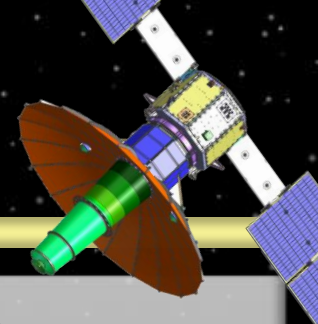
Spacecraft Bus Prototype for ORS Standards



TacSat-4 "COMMx" Payload
10 Channels of UHF



Launch Vehicle and Kodiak Launch Site



TacSat-4: Providing Communications and Enabling ORS



Launched:
27 Sept 2011



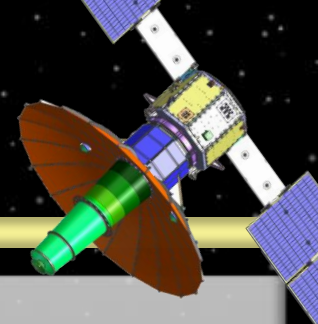
Minotaur IV+ Rocket



Kodiak Launch Complex



Users Equipment



TacSat-4: Providing Communications and Enabling ORS



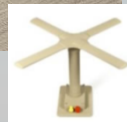
Airborne ARC-210 & ARC-231



AV-2040



AV-2091



AV-2090



USS WASP (LHD-1)



PRC-117 f/g



PSC-5



PRC-152

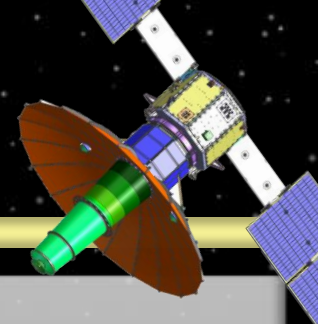


PRC-148 MBTR

And other SATCOM radios, as tested.



User Experimentation (1 of 2) for Official Utility Evaluations



TacSat-4: Providing Communications and Enabling ORS

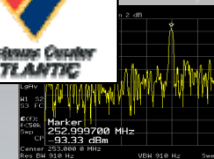
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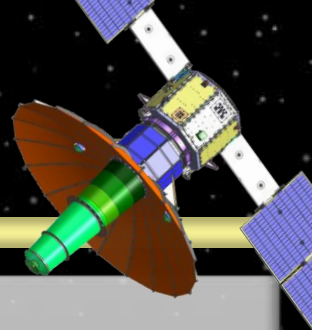
- **SPAWAR System Center**
 - JITC Compliance Testing (Complete)
 - MIL-STD-188-181 verification – BERT & C/No
- **Army SMDC Battle Lab & Future Warfare Center**
 - Focus on Communications-On-The-Move (COTM) and VMOC Mission Planning Systems
 - Modeling and simulation for constellations
 - Testing & report completed
- **ORS FFT Testing**
 - Completed evaluation of spacecraft FFT capabilities
- **Navy's Trident Warrior 2012**
 - Navy Ship, Sub, and Marines participating
- **International Participation by UK & Canada**
 - via TTRDP Project & Trident Warrior 2012



COMMS-on-the-Move testing in mountainous areas (Pikes Peak)



User Experimentation (2 of 2) for Internal Community Evaluations



TacSat-4: Providing Communications and Enabling ORS

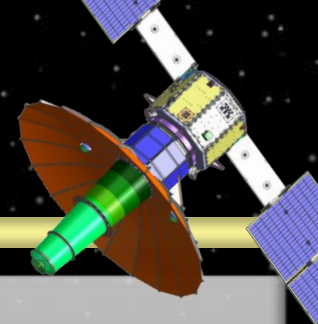
- **US Coast Guard**
 - Ship and, to a lesser extent, helicopter use especially at high latitudes
 - Voice (including out-to-area) & low-rate data

- **US Training Use by Multiple Services**



1/6/12 USCG Cutter Healy
breaks ice around the
Russian-flagged tanker
Renda 250 miles south of
Nome.





Trident Warrior 2012

TacSat-4: Providing Communications and Enabling ORS



Marines at
MCTSSA &
Hawaii



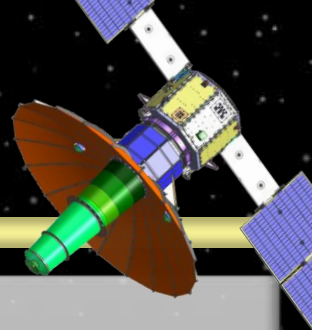
USS ESSEX (LHD-2)



USS OLYMPIA
(SSN 717)



End Users Results: Summary Performance



TacSat-4: Providing Communications and Enabling ORS

- **Supports SATCOM for All SATCOM Radios and SATCOM Antennas Tested**
 - SPAWAR Testing Confirmed TacSat-4 is JITC Compliant, per MIL-STD-188-181, for Standard SATCOM Equipment & Options
 - Satellite transponder is tunable over UHF band

- **Downlink – Data comparable to current SATCOM capability, Voice stronger by x2+**
 - However is not reliable with NON-SATCOM antennas like whip & baton antennas

- **Uplink – x4+ stronger than today's systems, can receive low power radio transmissions**
 - Can extend battery life



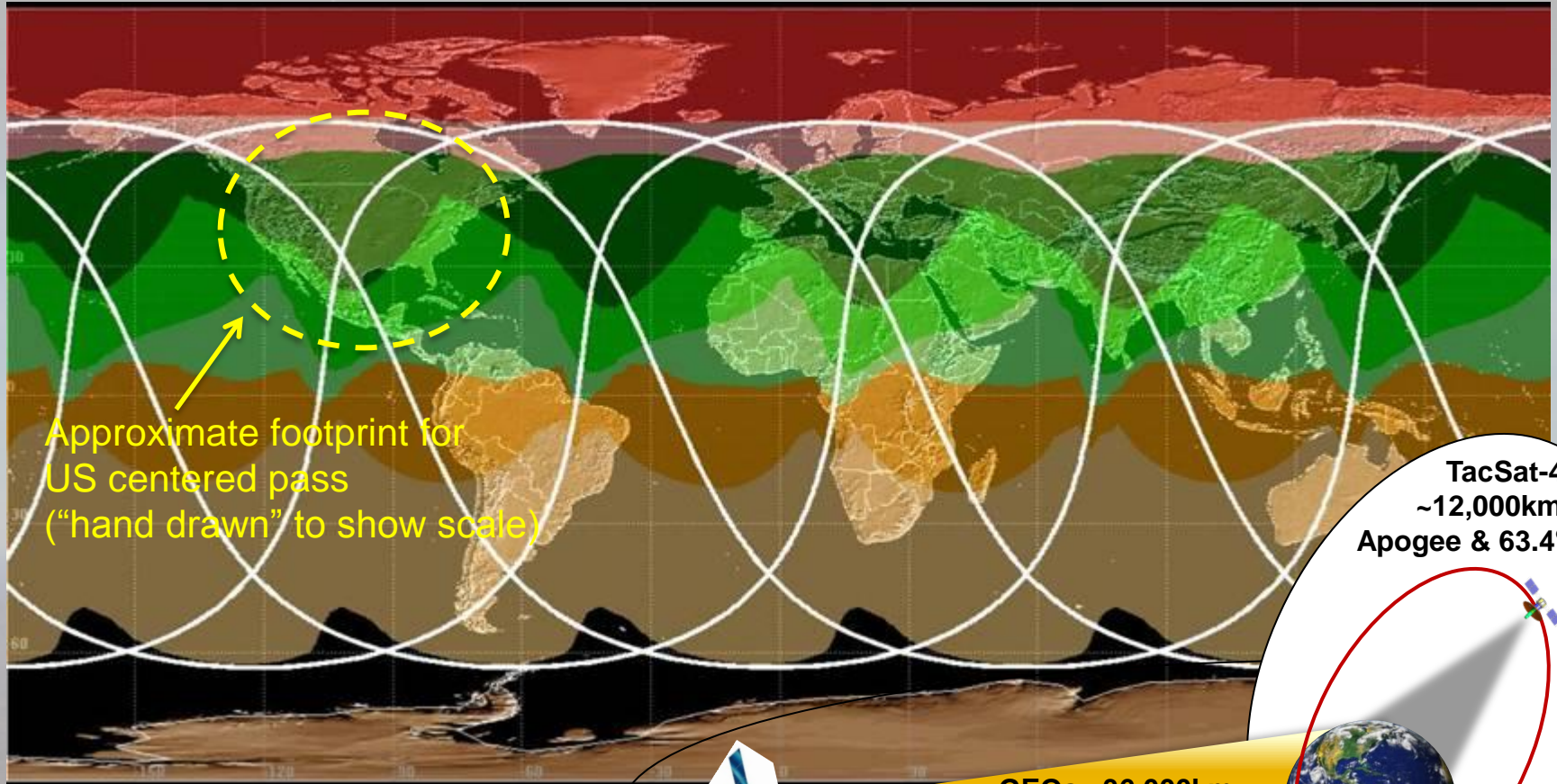
TacSat-4 Orbit and Global Coverage



TacSat-4: Providing Communications and Enabling ORS

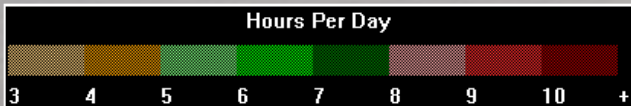
Maximum Hours per Day for a Given Location

A Given Location Typically Sees 3 Passes per Day Averaging 2 hours each Pass

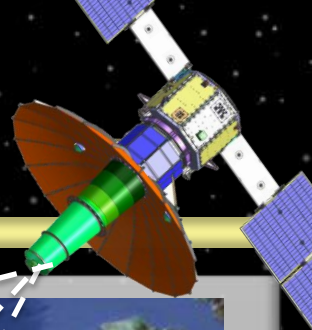


Approximate footprint for US centered pass ("hand drawn" to show scale)

TacSat-4
~12,000km Apogee & 63.4° inc.

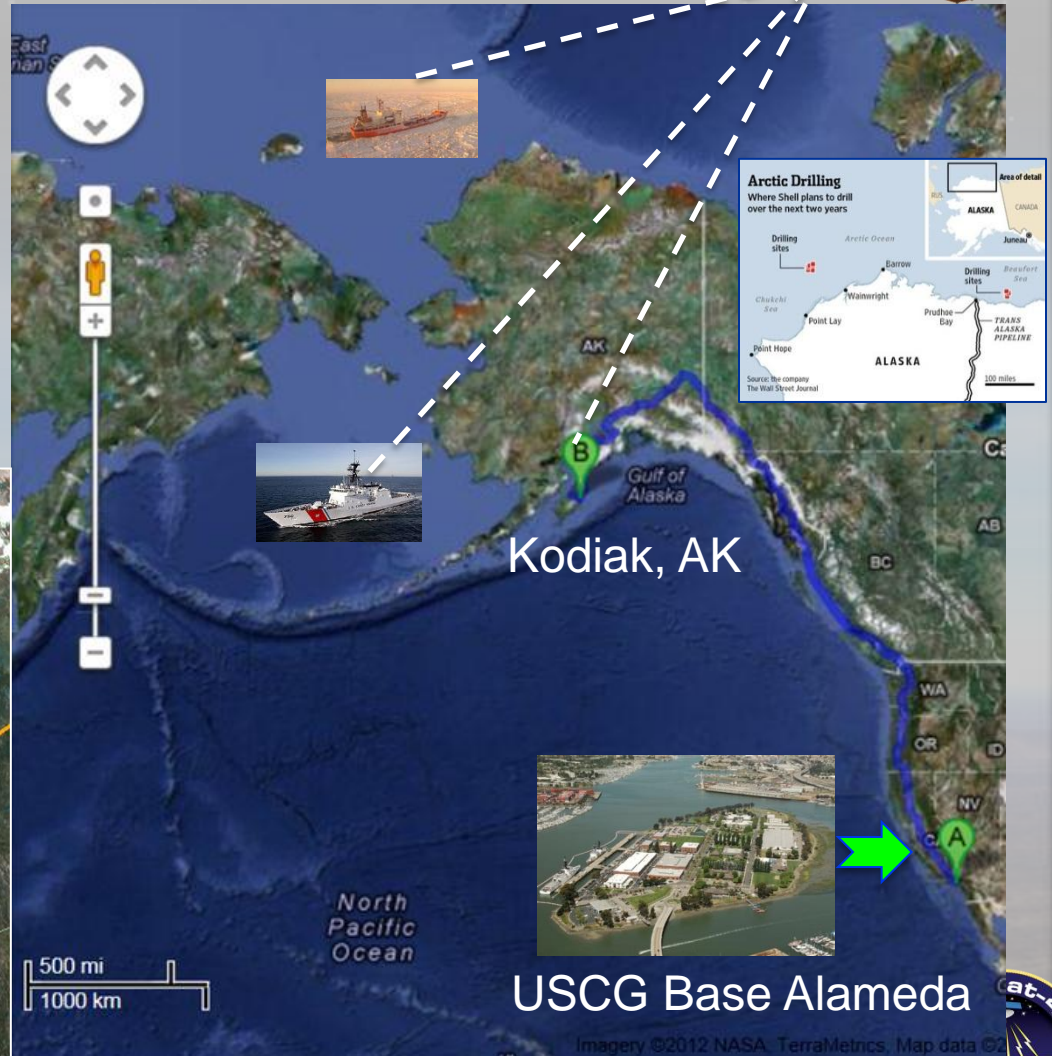
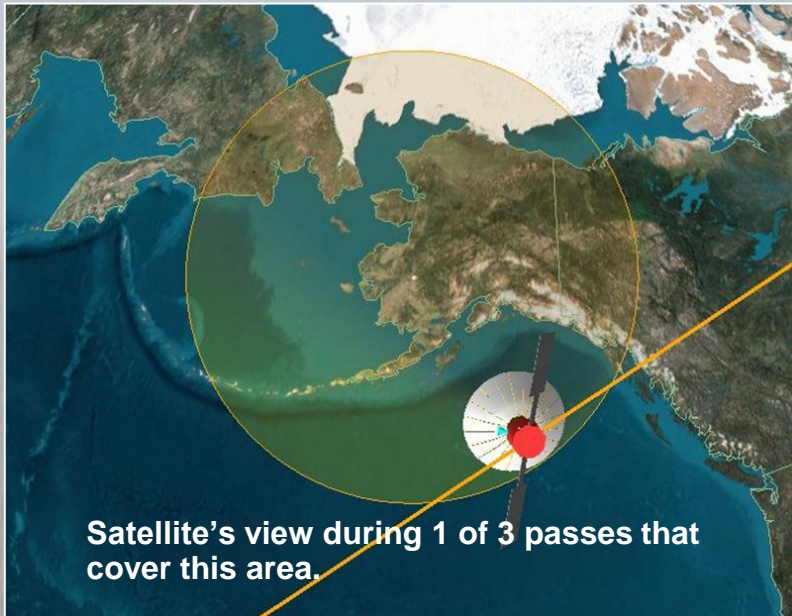


Example: USCG Use in Alaska Area

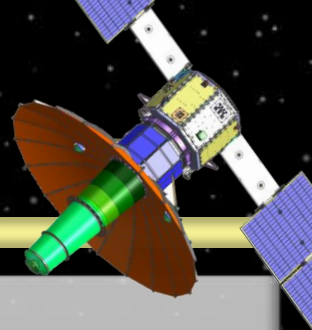


TacSat-4: Providing Communications and Enabling ORS

- Area: Alaskan coastal water, Aleutians, Bearing Straits, Arctic Ocean
- Voice & Data
- Includes networked COMMS from out-of-area locations like Alameda



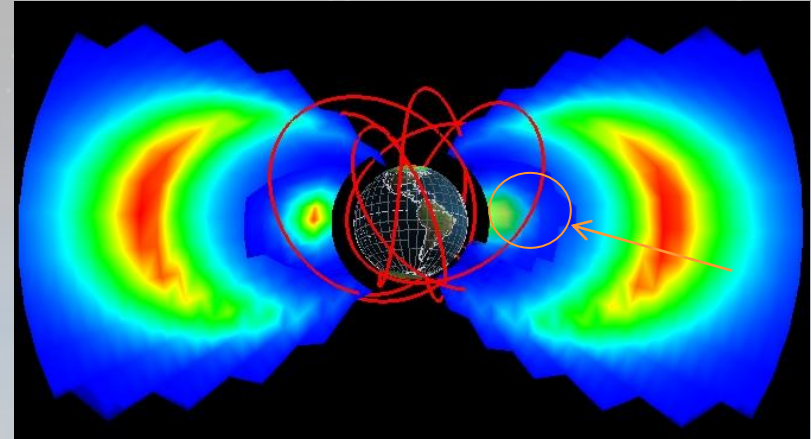
Scientific Radiation & Solar Cell Data



TacSat-4: Providing Communications and Enabling ORS

- **Protons are Order of Magnitude Higher than Predicted, although maybe a long transient cycle (TBD)**
 - TacSat-4 measurements confirmed proton flux is direction dependent
 - Protons mainly affect solar cells.
 - TacSat-4 is providing unique solar cell information.

- **Electrons Order of Magnitude Lower than Predicted**
 - Positively affects electronics total dose (reduces expected total dose)

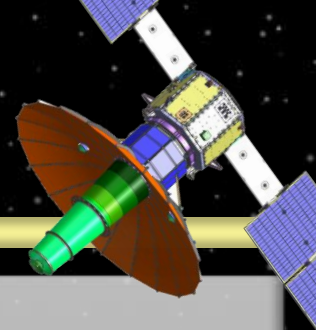


Monitoring the environment with Air Force's CEASE and Solar Cell Experiments

Tacsat-4 is providing new data to AP/AE8 & AP/AE9 radiation models used nationally.



Future – 2013 & Onward



TacSat-4: Providing Communications and Enabling ORS

- **Satellite Status**

- Estimated 2 years of life remaining
- ≤ 5 legacy channels, 3MHz or 5MHz collect channels, X-band downlink
- Frequency related: ITU filing is complete for TacSat-4 & constellation of 6 satellites for 40 years

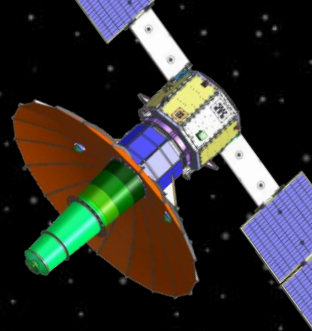
- **Funding Status**

- Navy S&T is funding Command and Control in FY13 to make available for User experimentation and potential User transition planning for FY14 and FY15
 - Available for Users to add funding for experimentation and use

- **Related Study for Future Systems**

- Polar UHF Military Augmentation System (PUMAS) study looked at future utility of “TacSat-4 Like” systems
- Final brief given to ORS & Navy for future acquisition decisions





Thanks for Your Attention!

