



Harmonization of USG Satellite Ground Systems

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Introduction

- GSAW 2006 concluded with a presentation by N. Peccia of ESA on “harmonization” of European ground systems
- Peccia concluded his presentation with the challenge “It would be nice to see such a process [of harmonization] at the USA level”
- This presentation summarizes progress toward harmonization of US government (USG) ground systems

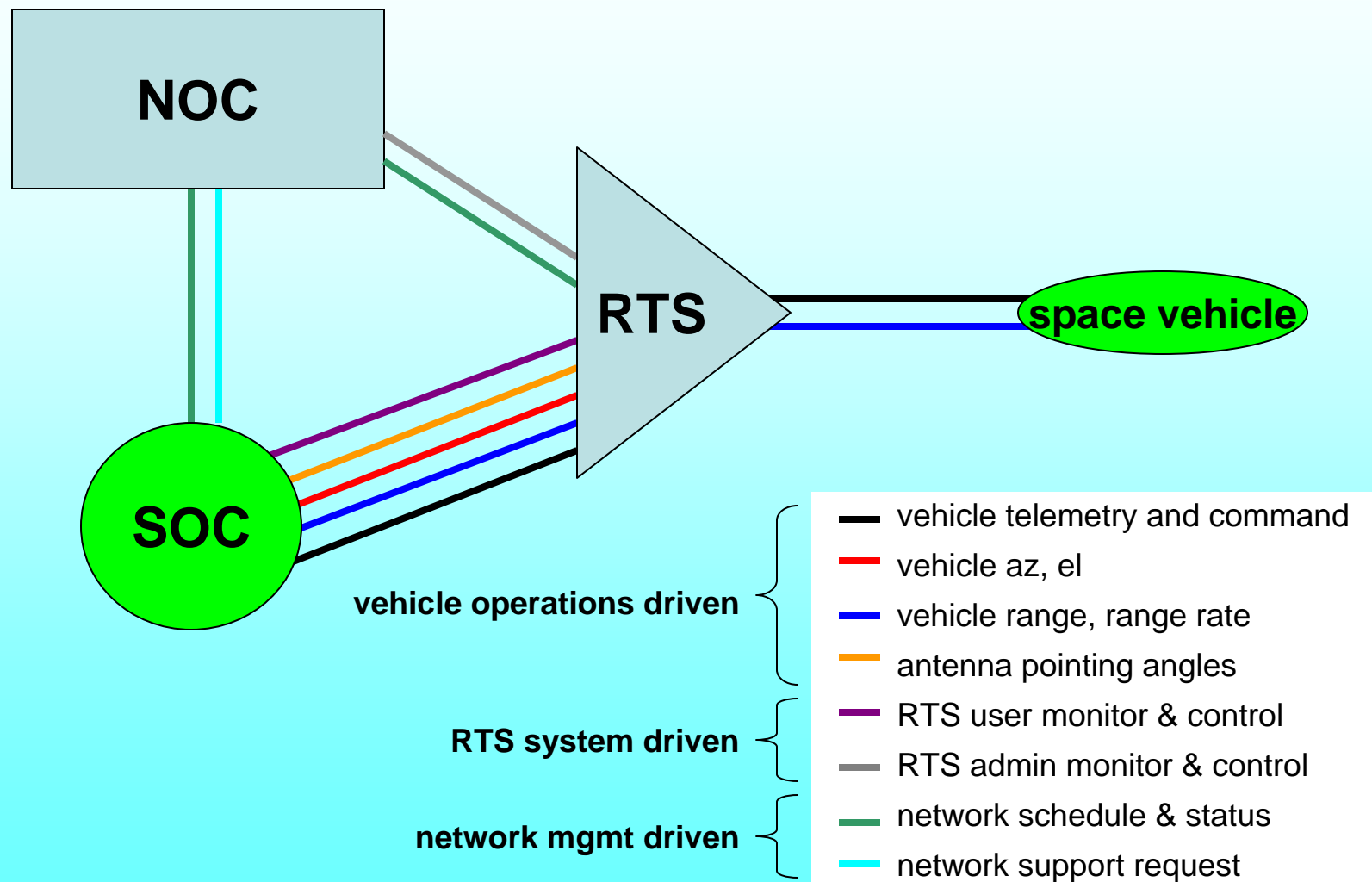
USG General-Purpose Ground Networks

- **Air Force Satellite Control Network**
 - 8 remote sites worldwide
 - 1800 MHz (L-band) uplink, 2000 MHz (S-band) downlink
- **Naval Satellite Control Network**
 - 3 remote sites in California, Maine, Guam
 - L-band uplink, S-band downlink
- **NASA Deep Space Network**
 - 3 remote sites in California, Spain, Australia
 - 24m, 34m, 70m apertures
- **NASA Ground Network**
 - 7 remote sites worldwide
 - S-band uplink and downlink, X-band downlink
- **NASA Space Network (TDRSS)**
 - 2 remote sites at White Sands and Guam
- **NOAA Ground Network**
 - 3 remote sites at Fairbanks, Wallops, and Point Barrow
 - L-band uplink (DMSP/GOES), S-band uplink (POES/GOES), S-band downlink, X-band downlink

SatOps Transition Plan

- NASA, NOAA, DoD co-signatory to *Satellite Operations Architecture Transition Plan, November 2000*
- reduce total USG cost by eliminating perceived ground network excess redundancy (without risk to reliability)
- evolve toward single, general purpose, interoperable S-band network for state-of-health, launch, early-orbit, anomaly resolution

Interoperable Interfaces



Impediments to Interoperability

- **Interface Impediment**: lack of common interface definition for operational functions common across networks
 - resolved by adopting common interface or middleware (relatively easy)
- **Operations Impediment**: operational functions not common across networks
 - resolved by adopting common capabilities (relatively hard)

DoD Operations Impediments

- DoD missions employ link-layer encryption on uplink and downlink
- manifestations in AFSCN and NSCN
 - ternary uplink (L-band FSK)
 - artifact of 1960s-era 3-symbol crypto systems
 - telemetry time-tagging at SOC
 - time/data correlation requirement
 - command bit streams
 - time-critical commanding requirement
 - command echoes from RTS
 - mainly for verification of comm to RTS
- also: SOC control of RTS pointing angles

SMC Interoperability Project

- initiated by SMC/SCNG (AFSCN acquisition agency) to address AFSCN interoperability requirements arising from SatOps Transition Plan
- multi-year, multi-phase, progressive approach
- executed under Satellite Control Network Contract, in partnership with NOAA OSO
- project approach
 - develop, test, and adopt open, IP-based standards for AFSCN operations at interoperable interfaces
 - incorporate new standards into AFSCN systems acquisition projects such as RTS upgrade
- AFSCN interoperability accompanies evolution to IP-based packet-switched network from current circuit-switched ops

Telemetry and Command Interface Standardization

- CCSDS SLE (www.ccsds.org) provides an interagency standard for telemetry and command ground operations
 - NASA networks are moving toward adoption of SLE
- Interoperability project developed Adaptations and Conversions of SLE for DoD operations, being accredited as ANSI standards (*see presentation by J. Pietras*)
- SLE-based standards being coordinated with NASA and NOAA

Scheduling and Management Interface Standardization

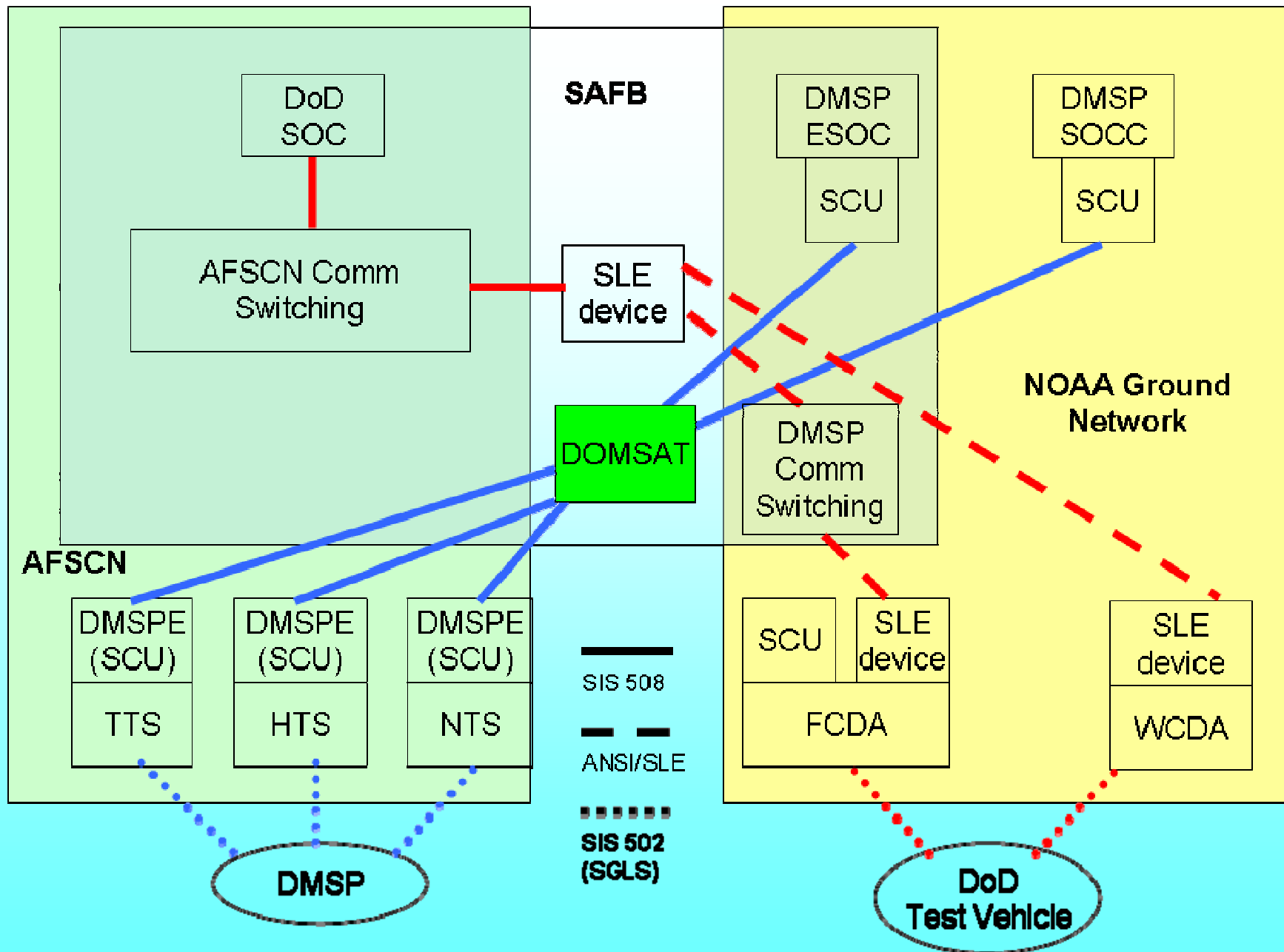
- scheduling
 - emerging CCSDS Service Management standard will likely support DoD operations
- RTS monitor
 - emerging CCSDS Track Data Message standard will likely support DoD operations
 - an XML-based AFSCN standard will be adopted for monitor functions not suitable for an interagency standard
- RTS control
 - an XML-based AFSCN standard will be adopted for control functions not suitable for an interagency standard

Air Force – NOAA Collaboration

- NOAA Wallops CDA station hosted prototype SLE devices and provided test pass support
- Air Force SMC developed prototype SLE devices and conducted data analysis
- a final demonstration is planned which will employ the NOAA Fairbanks CDA, the first time an operational AF SOC has run supports through a civil agency RTS

Interconnectivity Demonstration

- utilize SLE-based interfaces for telemetry and commanding, and prototype SLE SM interfaces
- provide SLE leave-behind at Fairbanks and Wallops
- utilize existing AFSCN-Fairbanks connectivity for DMSP network
- utilize dedicated T1 for Wallops connectivity
- temporary demonstration of access to NOAA CDA stations from AFSCN network switching infrastructure



Interface Coordination

- USG interagency (NASA/NOAA/AFSCN) non-binding MoU on telemetry and command ground standards agreement in work
- AFSCN seeking observer status to CCSDS

Conclusions

- operational impediments to USG ground control network interoperability have been overcome
- SLE/IP-based open standards are being adopted by AFSCN at its interoperable interfaces
- AFSCN systems are being upgraded to support USB operations
- a final interoperability accreditation demonstration is under way between AFSCN and NOAA
- harmonization of USG networks facilitated by agreement on interfaces, anticipated to be based largely on CCSDS SLE – technical issues largely resolved
- Policy and programmatic issues remain