

Air Force Satellite Control Network Interoperability



**Ground System
Architectures Workshop
March 2003**

Presented by:
Carl Sunshine, Aerospace
Lance Williams, Northrop Grumman
In support of SMC/CW



Goals for Use of Standards

- **Reduce risk, cost, and time for upgrades**
 - Use proven, efficient, standards-based solutions
 - Share development costs of COTS equipment and services over wider user base
- **Enhance Interoperability**
 - Move toward Integrated Satellite Control Network with DoD, NASA, NOAA, commercial
 - Increase sharing to broaden access and/or reduce total costs



Project Overview

- Formerly called “Standards & Protocols”
- Managed by SMC/CW as part of AF Satellite Control Network modernization program
- Multi-phase study and demo project started in 2001
 - Phase 1: Standards assessments and lab tests
 - Phase 2: Field tests with AF R&D assets
 - Phase 3: Field tests with commercial and civil agency ground stations
- Will feed back into SCNC Architecture development



Key Interfaces

• 1. RTS-SOC

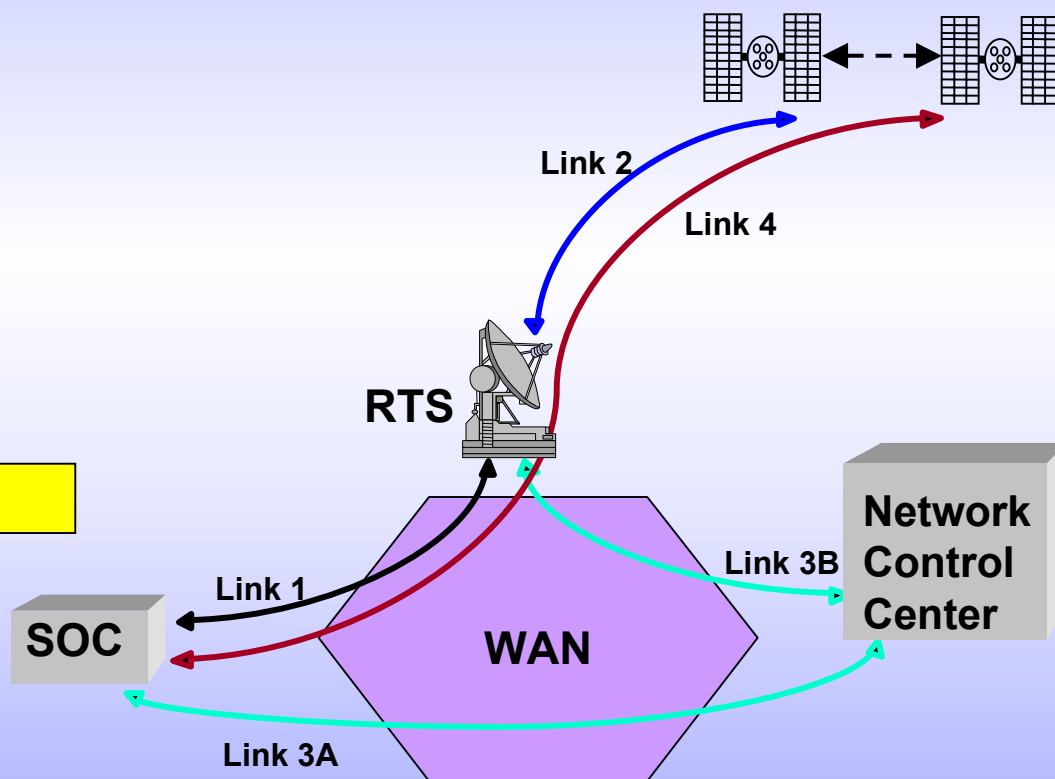
- A. “WAN hop” for Space Vehicle commands and telemetry
- B. RTS Control and Status

• 2. Space-Ground Link: “Space hop” for Space Vehicle commands, telem

• 3. Status and Scheduling

- A. SOC-NCC
- B. RTS-NCC

• 4. Space Vehicle-SOC (end-to-end) Commands, status, data





Space Link Extension

- **Extension to the widely-adopted CCSDS space link standard**
 - Extends link from RTS to SOC
- **Telemetry services (RAF) presume framed telemetry**
 - Not directly applicable to bitstream telemetry
- **Block commanding services (CLTU)**
- **Service Management (SM) services**
 - Configuration definition, scheduling, status



Space Link Extension, Continued



- **Expected to become a civil, foreign and commercial standard**
 - **Adopted for ESA missions, NASA DSN; others considering**
 - **Portions implemented in COTS TT&C equipment**
 - **SM implementation just beginning**

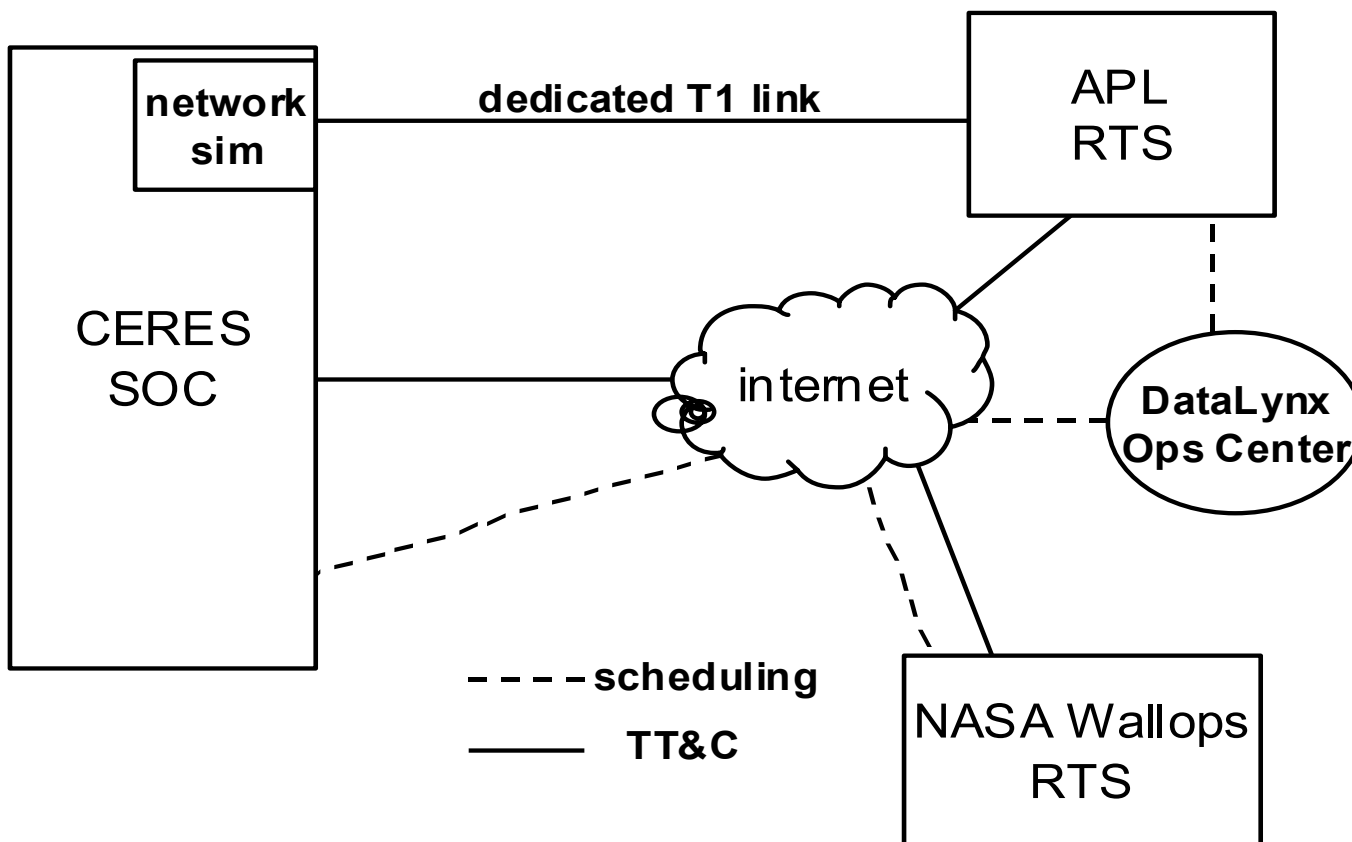


Test Bed Objectives

- **Test DoD satellite control using Internet based protocol standards over WAN**
 - ✓ **Assess alternate protocol options (UDP, TCP, SLE)**
 - ✓ **Transmit encrypted serial bitstream telemetry and commands**
 - ✓ **Accuracy, error rate**
 - ✓ **Delay and delay variation**
 - ✓ **Assess inclusion of COTS IP security software**
 - **Assess utility of SLE Management Services**
 - **Provide RTS status and tracking data**
- **Demo support for both SGLS and USB contacts from same ground station**

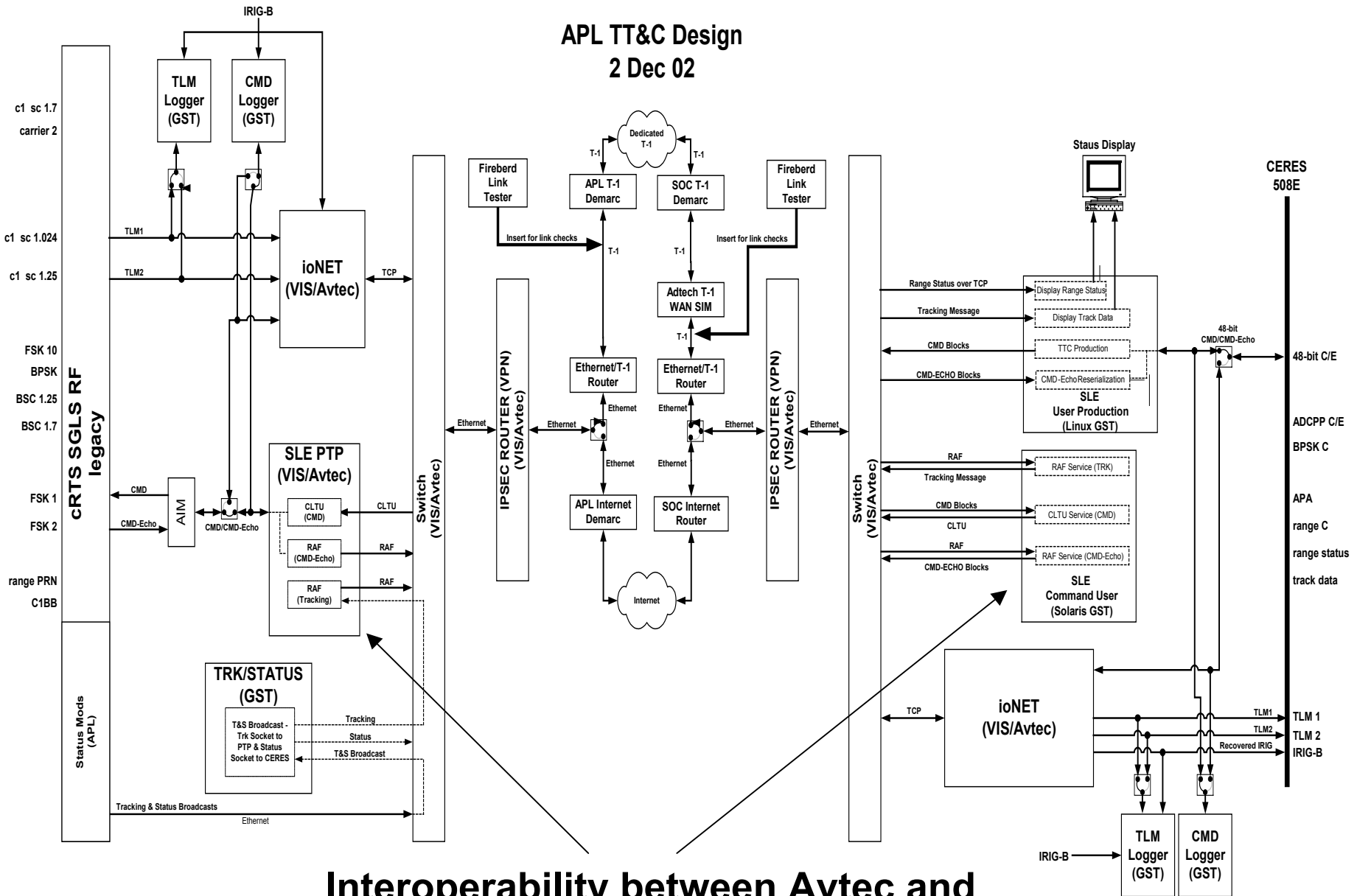


Phase 3 Communications



APL TT&C Design

2 Dec 02



Interoperability between Avtec and JPL/GST implementations



SLE and AFSCN Telemetry 1

- **Hardware design choice: Specialized mux**
 - Specialized for bit stream & IRIG time handling
 - AFSCN functional analogue: WANIU
 - Hardware issues: No standard for achieving precise time/data correlation
- **SLE design choice: omit SLE**
 - SLE issues: Not implemented by hardware vendor



SLE and AFSCN Telemetry 2

- **Hardware design choice: COTS PC, serial card**
 - AFSCN functional analogue: WANIU
 - Hardware issues: Time/data correlation precision limited by COTS hardware and OS
- **SLE design choice: enhanced RAF (unframed)**
 - SLE issues: No standard for unframed telemetry



SLE and AFSCN Commands



- **Hardware design choice: COTS IP mux at RTS; PC with serial card at SOC**
- **SLE design choice: CLTU**
 - **SLE issues: No direct support for bit stream commands**
 - **Compatibility of implementations proven**



SLE and AFSCN Echoes

- **Hardware design choice: same as for Commands**
- **SLE design choice: Return All Frames**
 - **SLE issues: No CCSDS standard for command echoes**



SLE and Track Data

- **Hardware design choice: same as for Commands**
- **SLE design choice: RAF**
 - **SLE issues: Track data transfer service still under development by CCSDS**



SLE and AFSCN Scheduling

- **Hardware design choice: x86 Workstation**
- **SLE design choice: Service Request version of SLE SM. Messages sent in XML format via email**
 - **SLE issues: Still being standardized**

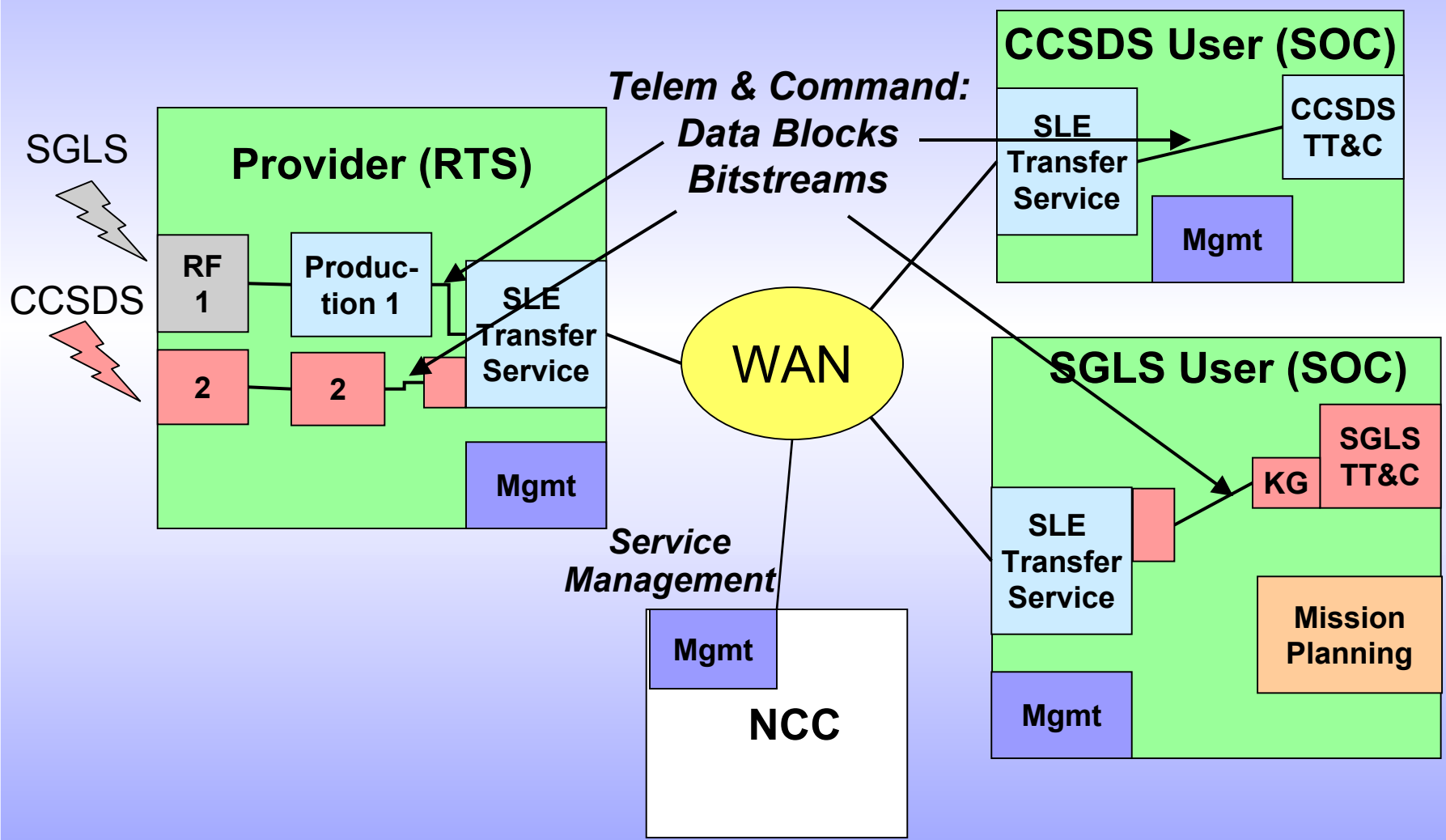


SLE and RTS Status

- **Hardware design choice: x86 Workstation**
- **SLE design choice: None (direct TCP socket).
Customized message in XML format**
 - **SLE issues: Not defined yet, but will be integrated into Service Management functions**



DoD-NASA Interoperability Concept





Acknowledgements

- **Global Science and Technology for SLE adaptations, network test-bed, and analysis**
- **Jet Propulsion Lab for SLE software**
- **Veridian Information Systems for net integ.**
- **AVTEC for network front ends**
- **AF Center for REsearch Support for test SOC**
- **Applied Physics Lab & NASA Wallops for RTS**
- **NASA CSOC (LM) for Wallops equipment**

Email contacts: carl.sunshine@aero.org, lance.williams@afscn.com