

Progress in Creation of National Standards for US Government Agency Space Vehicle Command and Telemetry Ground Operations

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**GSAW 2006
Manhattan Beach, CA
28 March 2006**

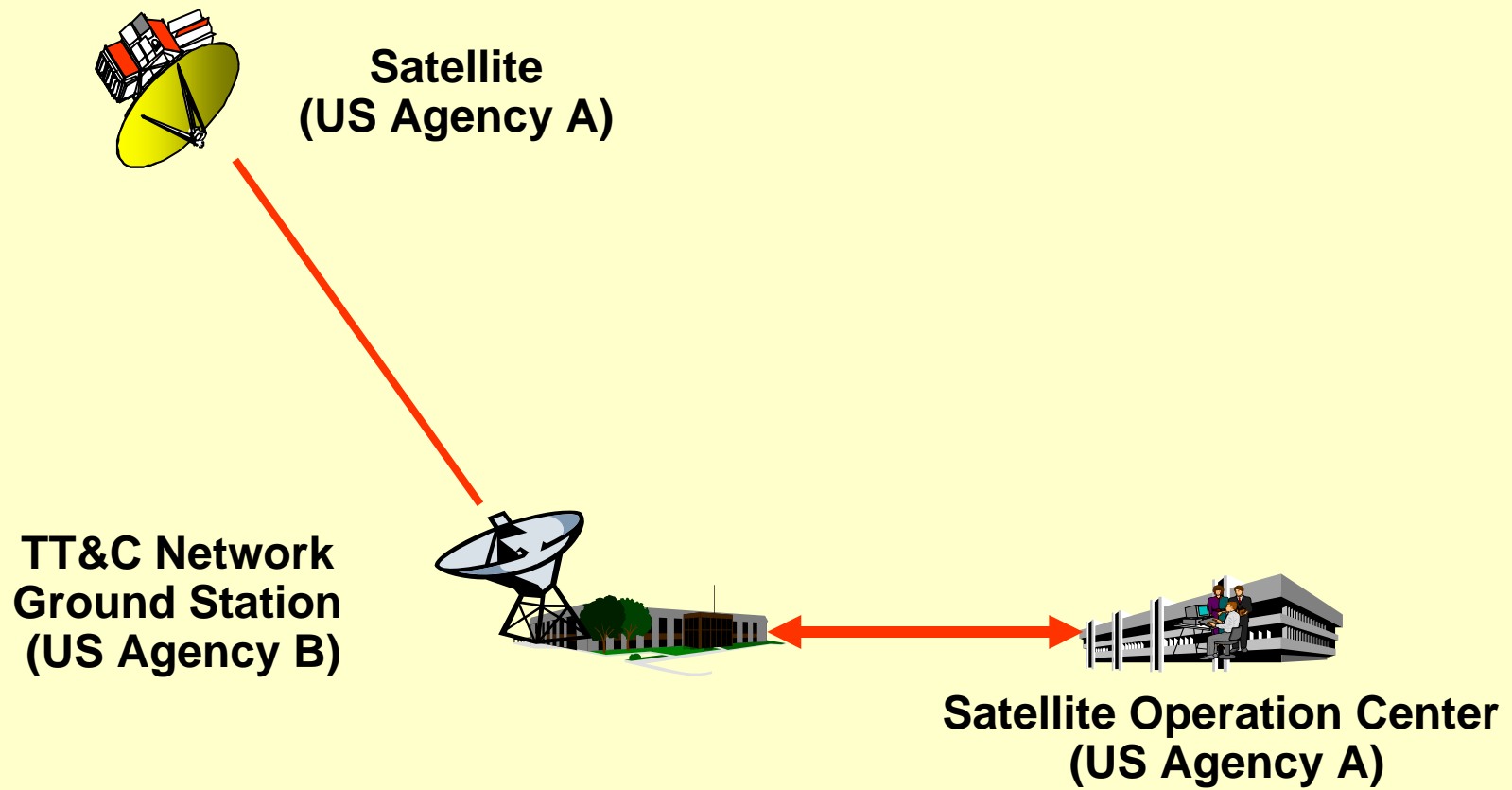
Topics

- **Background**
- **Approach to achieving interoperability**
- **SLE adaptation/conversion prototype testing to-date**
- **AIAA Satellite Control Network Data Transfer Committee**
- **Approach to standardization of SLE enhancements**
- **Status of current (draft) standards**
- **Possible additional ANSI standards**
- **Related activities**
- **Acknowledgements**

Background

- **NASA, NOAA, and DoD signed “Satellite Operations Architecture Transition Plan” (Nov 2000) to evolve ground control networks to share resources**
- **SMC/SN (AFSCN acquisition agency) has sponsored the *Interoperability Project* to meet interoperability requirement on AFSCN**
 - **Telemetry and command functions**
 - **Scheduling functions**
- **Concurrent upgrades to AFSCN ground systems are under way which will provide TCP/IP capability**

Background (concluded)



Approach to Achieving Interoperability

- **Adopt TCP/IP-based open standards for telemetry/command and scheduling functions**
- **Build on existing CCSDS Space Link Extension (SLE) standards**
 - SLE developed for international civil space community
 - SLE operates over TCP/IP
- **Extend SLE services through *adaptations* and *conversions* of SLE for legacy DoD, NASA, and NOAA space data types**
 - Unframed, time-correlated telemetry
 - Command streams
 - Ternary commanding
 - Command echo

Approach to Achieving Interoperability (concluded)

- **Propose SLE adaptations and conversions to ANSI for standardization**
 - **CCSDS standardization inappropriate for legacy data formats used by DoD, NASA, and NOAA**
- **ANSI SLE adaptations and conversions will provide a prescription for NASA and NOAA ground systems to support DoD operations**
- **AFSCN ground system implementation of standard SLE services and ANSI adaptations and conversions will support NASA and NOAA operations**

SLE Adaptation/Conversion Prototype Testing To-Date

- **Prototype implementations developed by:**
 - Avtec Systems
 - GST
 - RTLogic!
- **Ground network hosts of prototype SLE implementations**
 - DataLynx/Johns Hopkins University Applied Physics Laboratory
 - NASA/Wallops
 - NOAA Wallops CDA station
 - Universal Space Network/Alaska
- **AFSCN R&D SOCs hosting prototype SLE implementations**
 - CERES
 - RSC

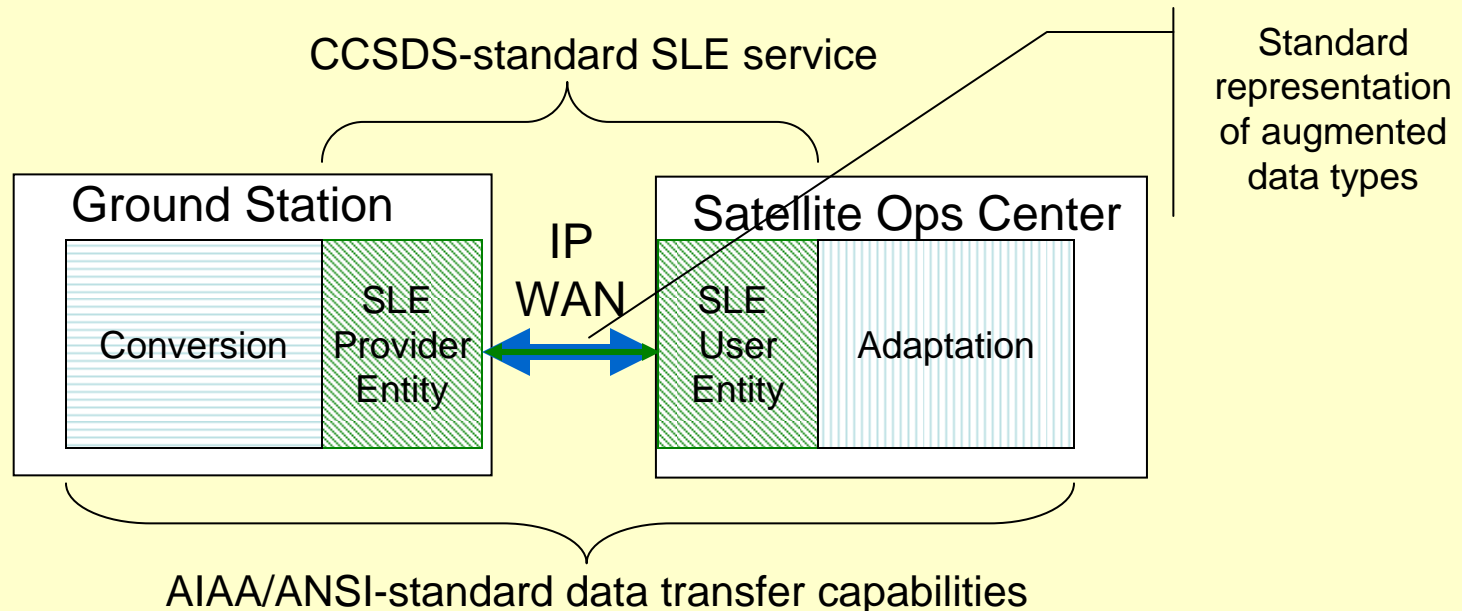
AIAA Satellite Control Network Data Transfer Committee

- **Formed in the Spring of 2005 under the auspices of AIAA**
- **Purpose**
 - **Development of standards for interoperable data transfer services for US civil, military, and commercial ground control systems**
 - **Adoption as ANSI standards**
- **Scope**
 - **6 cross-support data flows among US Government agencies and commercial TT&C service providers:**
 - **2 Ternary-formatted command flows**
 - **Echo of ternary command data**
 - **Binary-formatted command flow**
 - **Echo of binary command data**
 - **Time-correlated binary telemetry**

AIAA Satellite Control Network Data Transfer Committee Membership

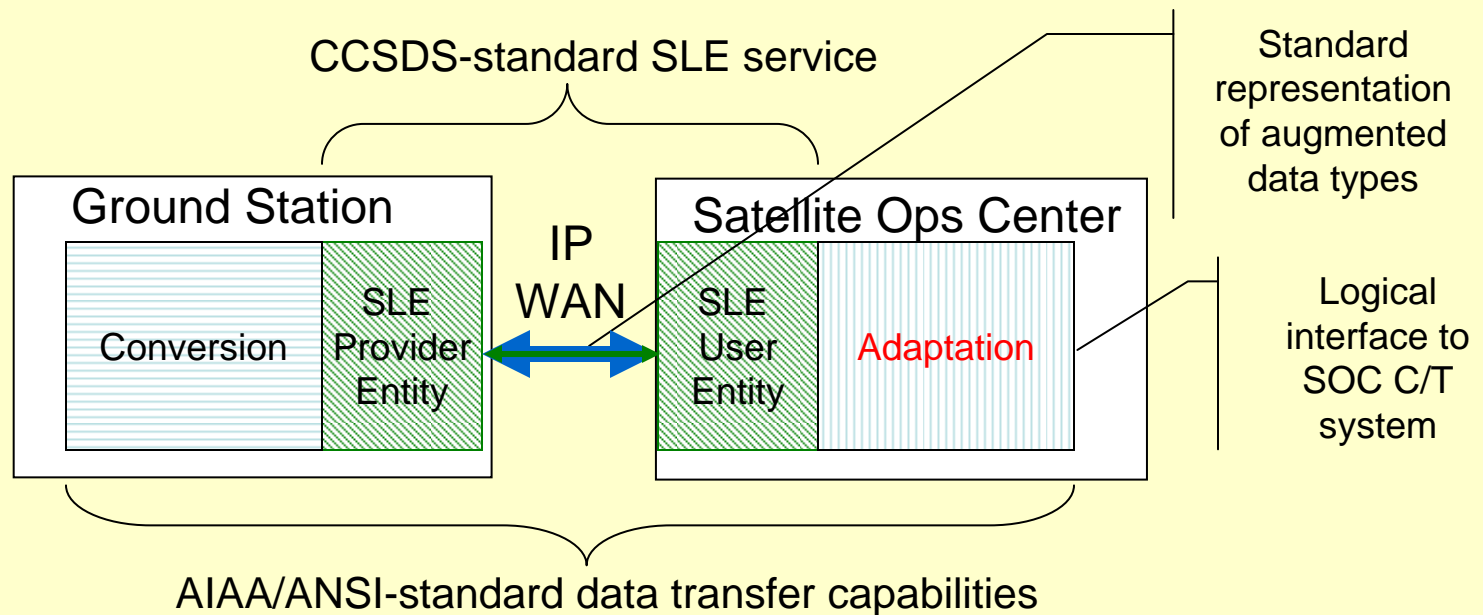
- **User Community**
 - SMC/SN (representing DoD)
 - NASA JPL (representing NASA)
 - Harris Corporation (representing NOAA)
 - Honeywell DataLynx (commercial)
 - Universal Space Networks (commercial)
- **Vendor Community**
 - Avtec Systems
 - L3 Communications
 - RTLogic!
- **General Interest and Support**
 - Aerospace Corporation
 - Global Science and Technology
 - Scitor Corporation
- **Non-Voting Members**
 - Northrop Grumman Corporation (AF SCNC; secretariat)
 - AIAA (liaison)

Approach to Standardization of SLE Transfer Service Enhancements (1 of 8)



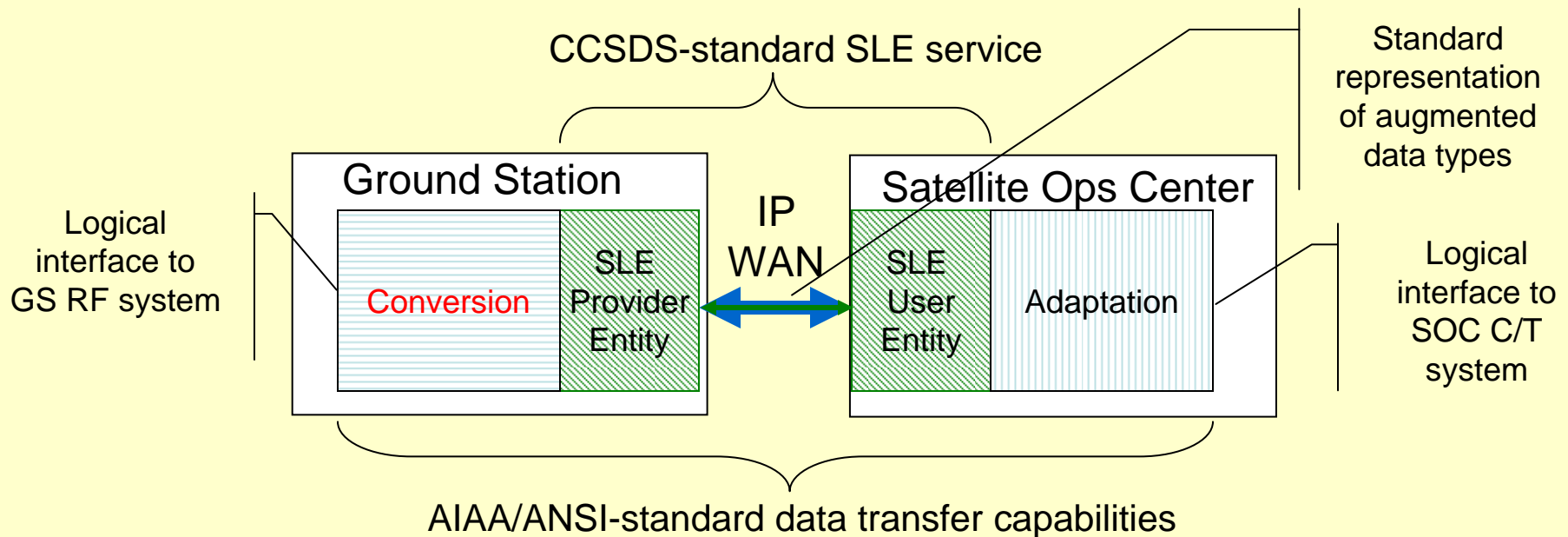
- **Standard representation of augmented data types defined across SLE service interface**
- **Adaptation and conversion functions encapsulate CCSDS-standard SLE services**
 - **SLE service operations are not altered**

Approach to Standardization of SLE Transfer Service Enhancements (2 of 8)



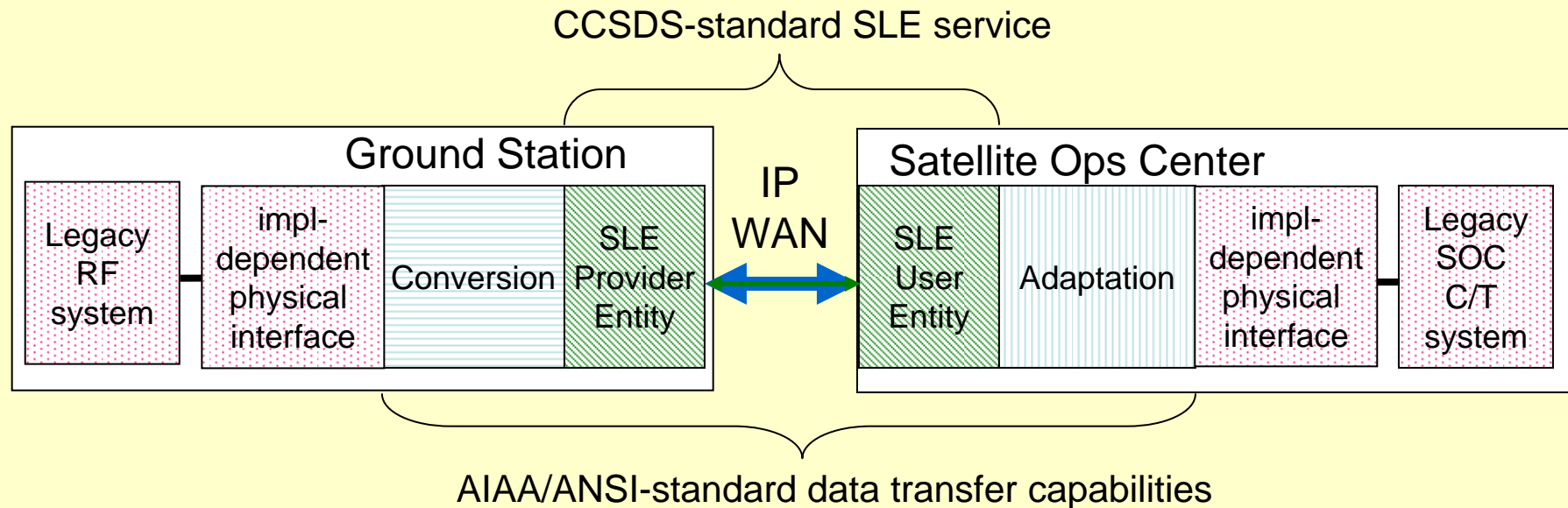
- ***Adaptation*** transforms data between standard representation over SLE service and logical interface to SOC command/telemetry systems

Approach to Standardization of SLE Transfer Service Enhancements (3 of 8)



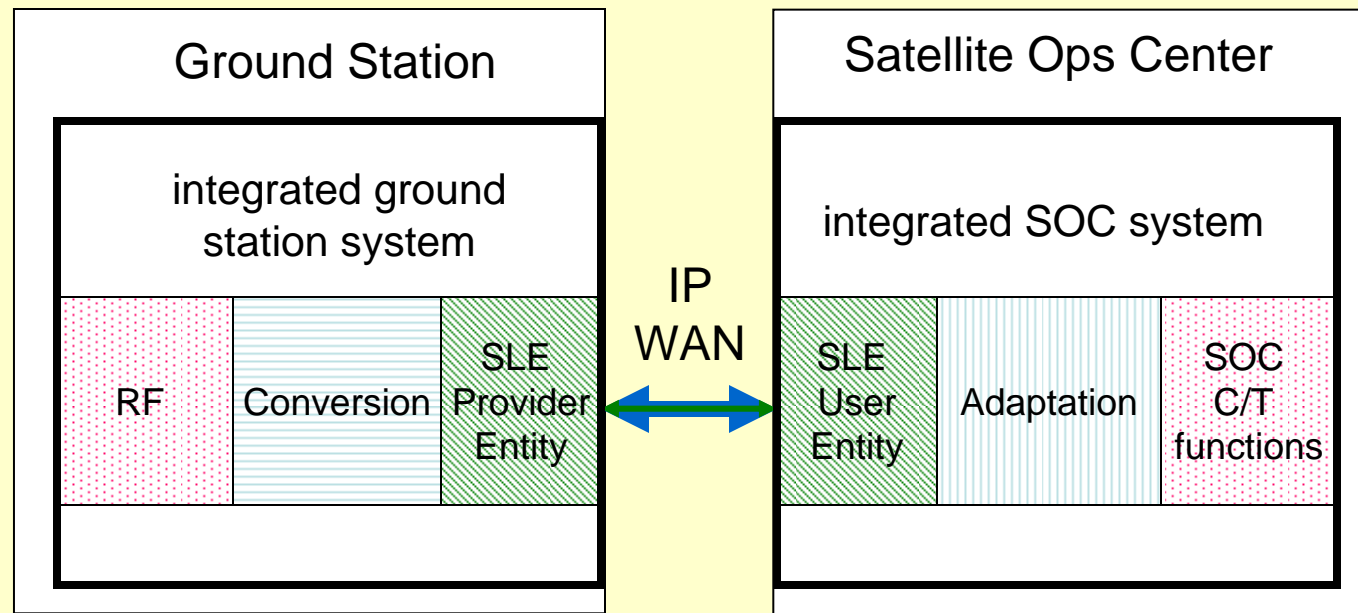
- ***Conversion*** transforms data between standard representation over SLE service and logical interface to ground station RF systems

Approach to Standardization of SLE Transfer Service Enhancements (4 of 8)



- **Physical interfaces with legacy systems** are outside the scope of the AIAA/ANSI standards

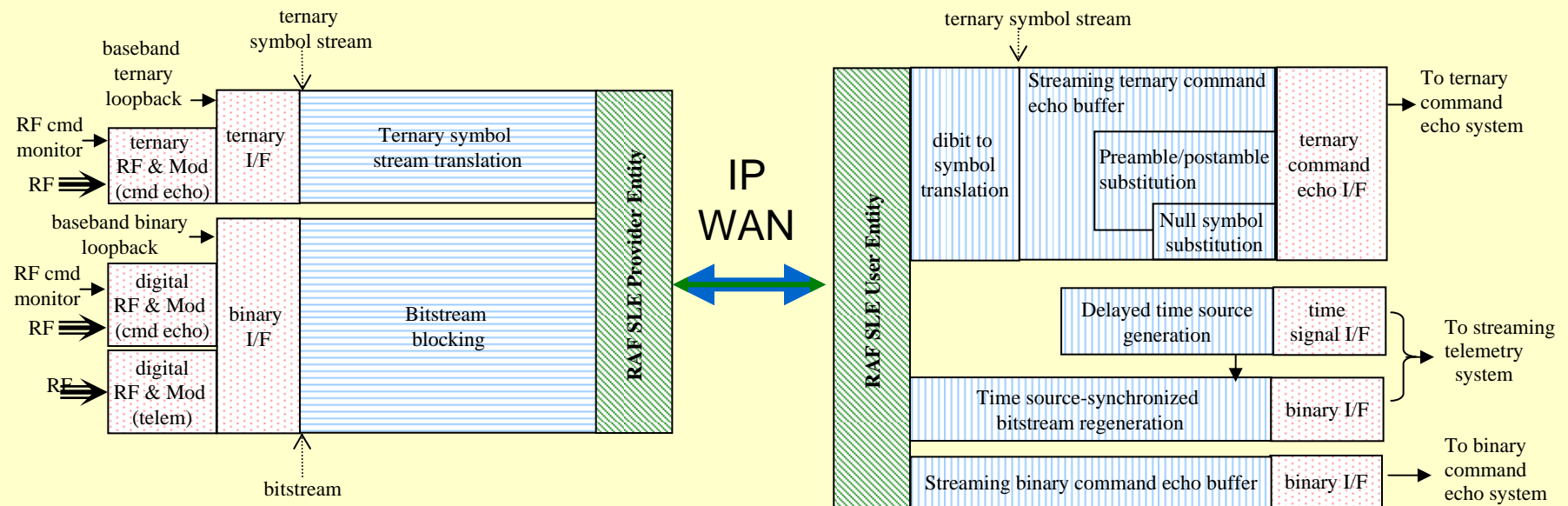
Approach to Standardization of SLE Transfer Service Enhancements (5 of 8)



- **For new system procurements, CCSDS and AIAA/ANSI standard-compliant functions can be embedded into integrated systems**

Approach to Standardization of SLE Transfer Service Enhancements (6 of 8)

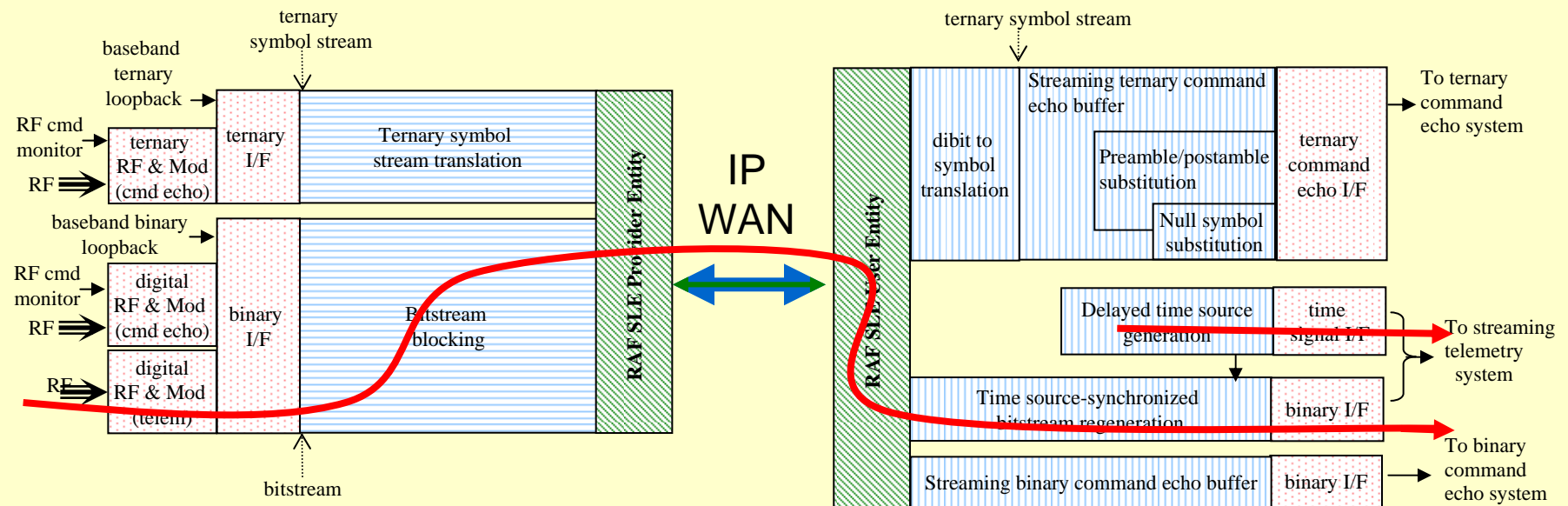
Conversions and Adaptations for RAF SLE Transfer Service



- **The adaptations and conversions are decomposed into smaller functional objects that can be combined to support the required data flows**

Approach to Standardization of SLE Transfer Service Enhancements (7 of 8)

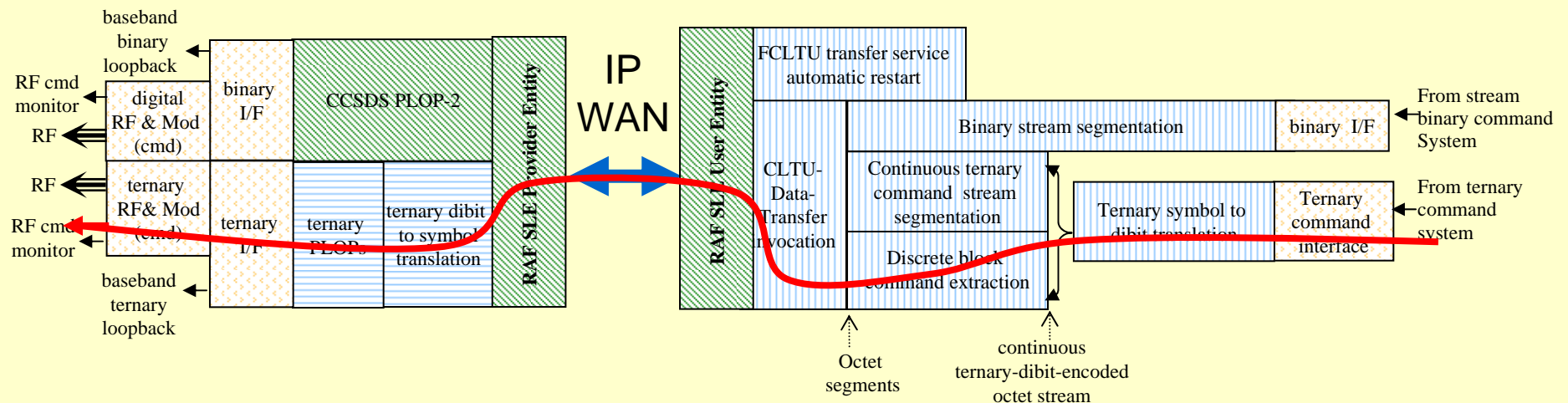
Conversions and Adaptations for RAF SLE Transfer Service



- **Specific flow types are supported by different combinations of the functional objects**
 - Time-correlated telemetry illustrated

Approach to Standardization of SLE Transfer Service Enhancements (8 of 8)

Conversions and Adaptations for FCLTU SLE Transfer Service



- **Discrete ternary command flow** illustrated through FCLTU adaptations and conversions

Status of Current (Draft) Standards

- **Two draft standards in progress**
 - *Adaptations and Conversions of CCSDS Space Link Extension Forward Communication Link Transfer Unit Service*
 - Specifies functions for SV commanding
 - *Adaptations and Conversions of CCSDS Space Link Extension Return All Frames Transfer Service*
 - Specifies functions for unframed telemetry and command echo
- **Independent levels of participation by USG agencies**
 - Development of ANSI standards
 - Adoption of ANSI standards
 - Commitment to share resources using the ANSI standards
- **Separate coordination activity among SMC/SN, NASA, and NOAA for mutual cross-support**

Possible Future AIAA/ANSI Standards

- **Discrete binary command echo**
- **Tracking data**
- **Ground station service status monitoring**
- **Ground station service control**

Related Activities – Scheduling Interoperability

- **SMC Interoperability Project is also addressing scheduling and network management interfaces**
- **Plan is to evolve AFSCN interfaces toward conformance with the emerging CCSDS SLE Service Management standard**

Acknowledgements

- **SMC/SN has provided funding for:**
 - Technical development of the AIAA/ANSI standards
 - Documentation of the AIAA/ANSI standards
 - This presentation to GSAW
- **Lance Williams (SCNC/Northrop Grumman) has been a key enabler of this ANSI standardization process**
- **Brian Safigan (Avtec Systems) provided key contributions to the augmentation specifications of SLE for AFSCN operations**
- **The members of the Satellite Control Network Data Transfer Committee (previously identified)**