ARCHITECTURE STUDY FOR FUTURE AIR FORCE SATELLITE CONTROL NETWORK

-PRELIMINARY INVESTIGATION-

GSAW
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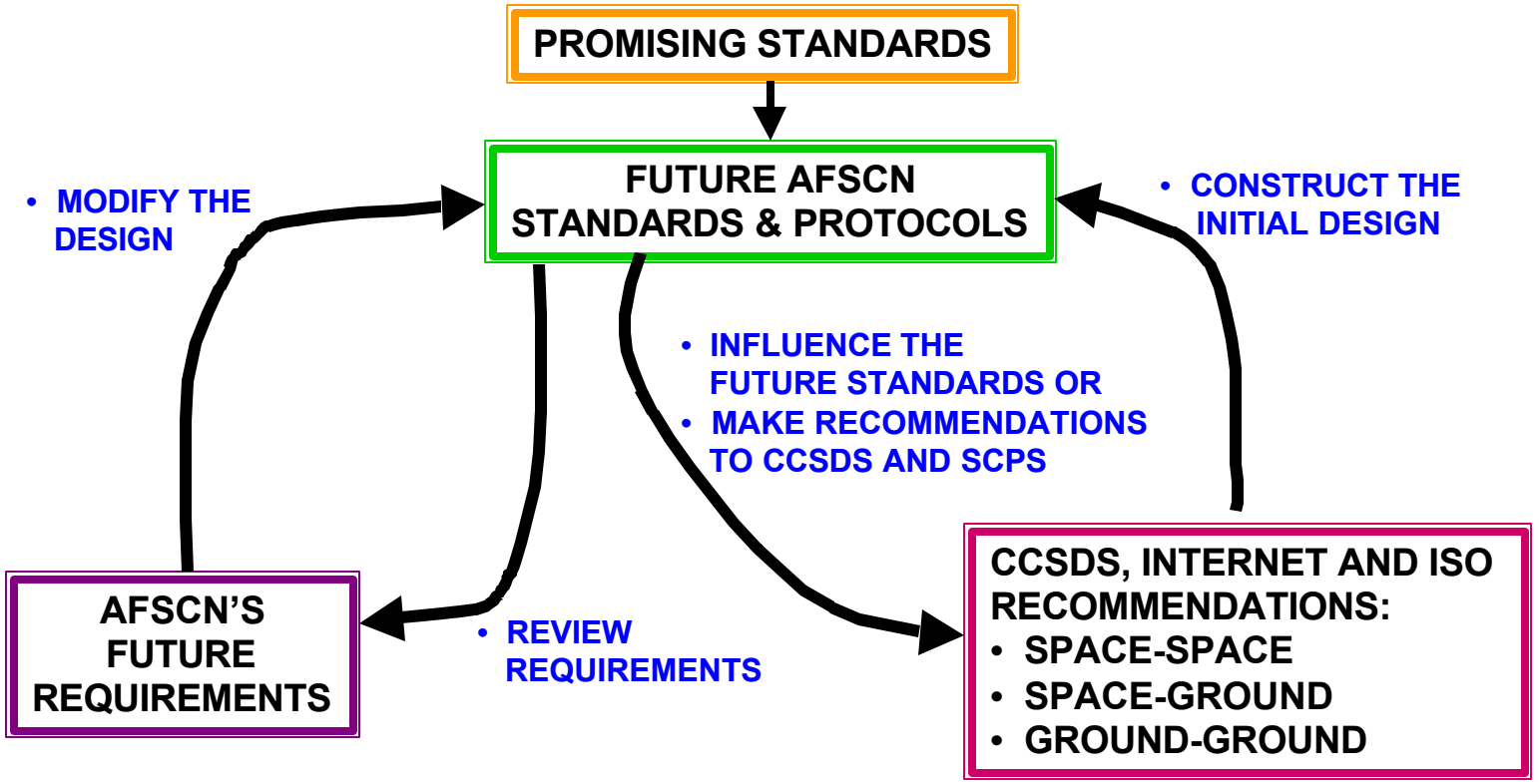
AFSCN STANDARDS AND PROTOCOLS GOALS

- **OBJECTIVES:**
  - **ENHANCE INTEROPERABILITY WITH OTHER SATELLITE CONTROL SYSTEMS**
  - **SUPPORT GREATER USE OF COTS EQUIPMENT AND SERVICES**
- **ADD ASTRODYNAMIC STANDARDS TO ORBIT ANALYSIS AREA**
- **ADD STANDARD WAN INTERFACE TO NEW RTS (AND SOC)**
- **ADD USB AND CCSDS SPACE-TO-GROUND LINK TO RTS**
- **ADD STANDARD SCHEDULING AND NET STATUS INTERFACES**

BACKGROUND

- STANDARDS AND PROTOCOLS TASK IDENTIFIED AS KEY ELEMENT OF AFSCN EVOLUTION
- INITIAL STUDY WORK TO SURVEY CURRENT INDUSTRY AND OTHER GOV'T PRACTICES AND ASSESS/ANALYZE
- DEMONSTRATION AND TEST EFFORTS WHERE NEEDED TO RESOLVE ISSUES/UNCERTAINTIES
- ACQUISITION/DEVELOPMENT OF NEEDED SOFTWARE/HARDWARE AND INTEGRATION INTO NEW RTS AND OTHER AFSCN ELEMENTS

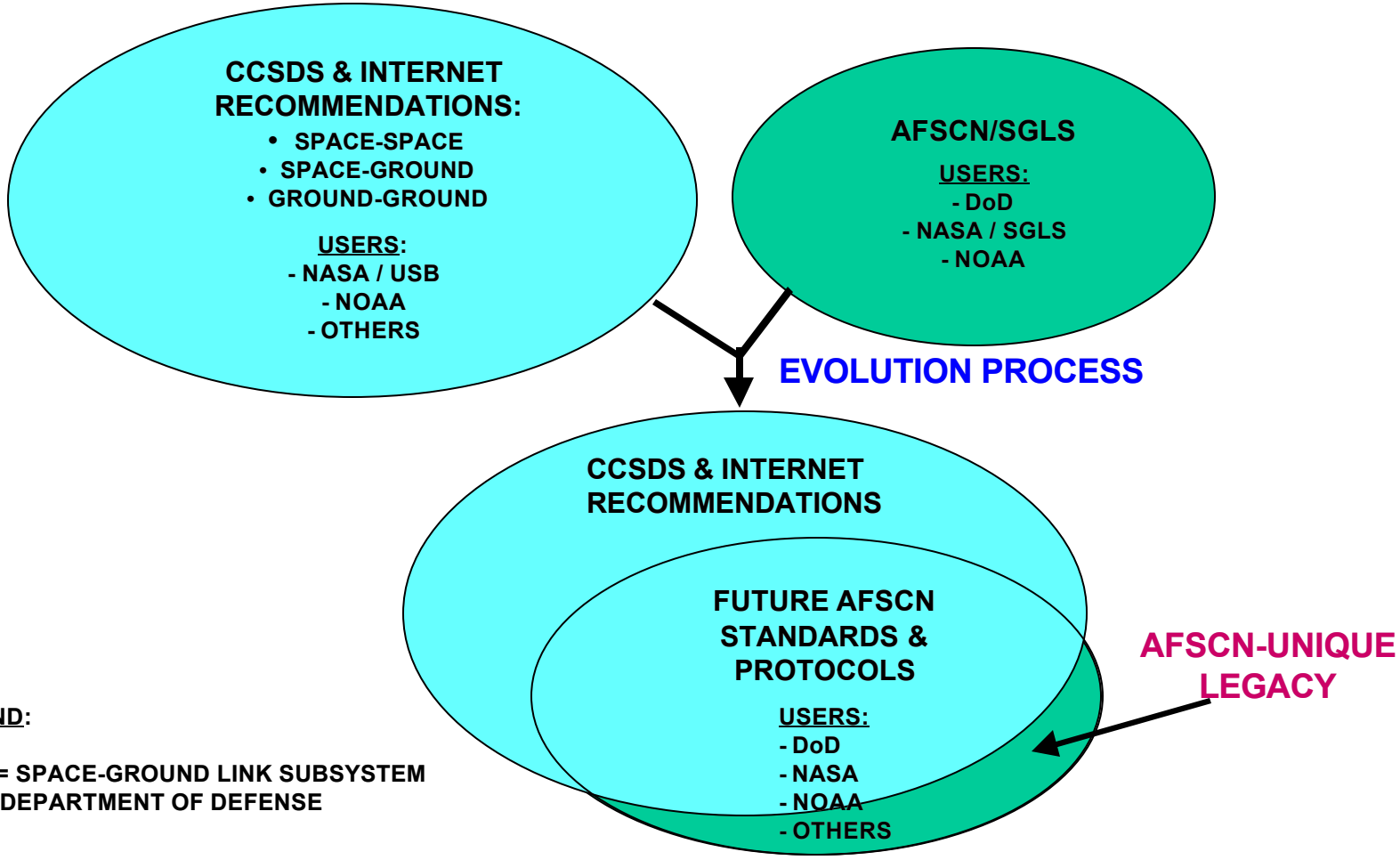
STUDY METHODOLOGY



LEGEND:

AFSCN = AIR FORCE SATELLITE CONTROL NETWORK
CCSDS = CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEM
SCPS = SPACE COMMUNICATIONS PROTOCOL STANDARDS
ISO = INTERNATIONAL STANDARDS ORGANIZATION

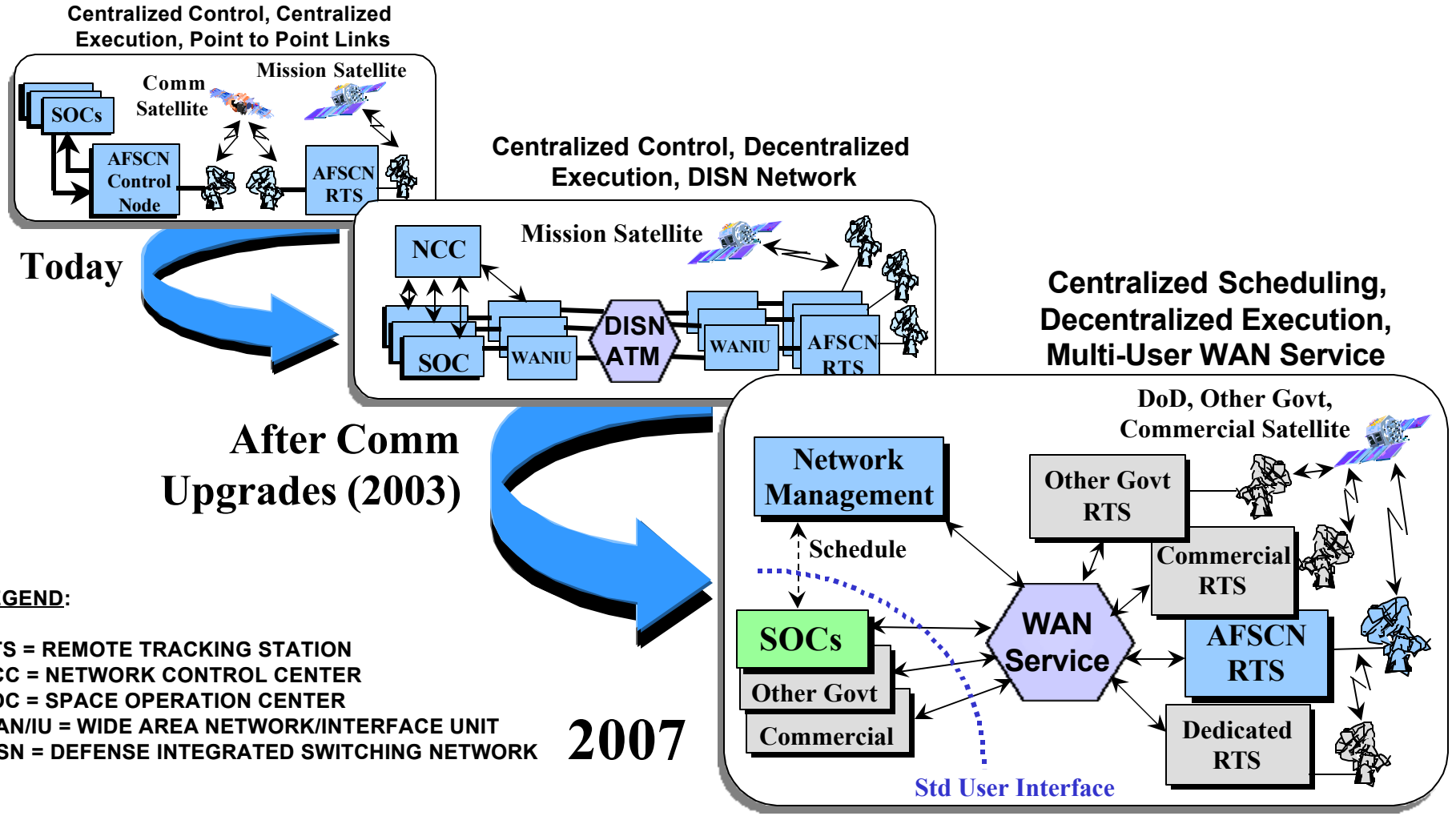
EVOLUTION VISION



LEGEND:

SGLS = SPACE-GROUND LINK SUBSYSTEM
DoD = DEPARTMENT OF DEFENSE

AFSCN ARCHITECTURE EVOLUTION



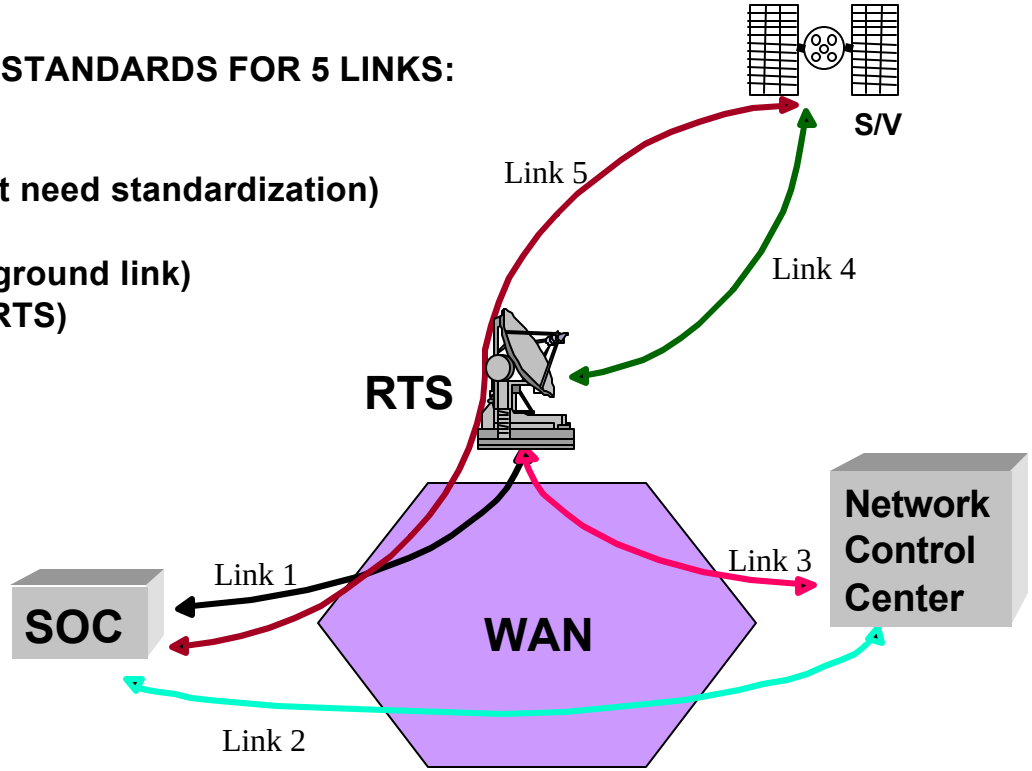
LEGEND:

RTS = REMOTE TRACKING STATION
NCC = NETWORK CONTROL CENTER
SOC = SPACE OPERATION CENTER
WAN/IU = WIDE AREA NETWORK/INTERFACE UNIT
DISN = DEFENSE INTEGRATED SWITCHING NETWORK

KEY INTERFACES

DETERMINE PROTOCOL AND STANDARDS FOR 5 LINKS:

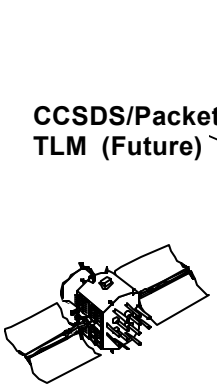
- **LINK 1: RTS-SOC**
- **LINK 2: SOC-NCC (does not need standardization)**
- **LINK 3: RTS-NCC**
- **LINK 4: S/V-RTS (space to ground link)**
- **LINK 5: S/V-SOC (through RTS)**



LEGEND:

S/V = SPACE VEHICLE
NCC = NETWORK CONTROL CENTER

PROPOSED ARCHITECTURE FOR TELEMETRY NETWORK

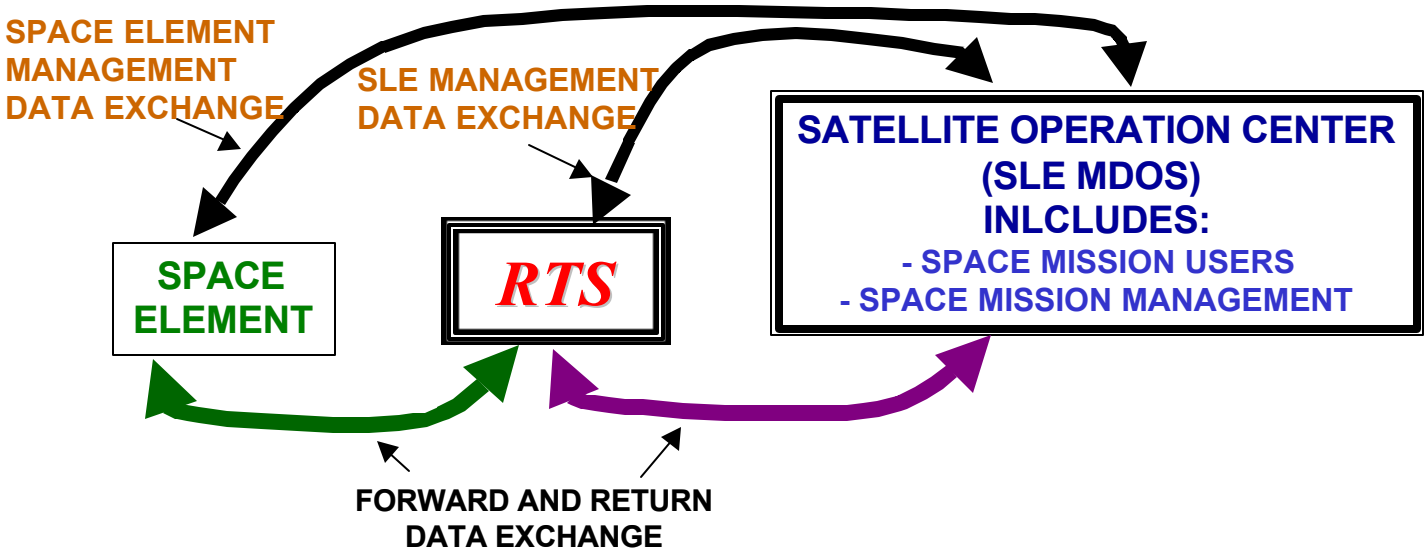


SPACE LINK EXTENSION (SLE)

SERVICES PROVIDED BY SLE

- SLE PROVIDES THE FOLLOWING SERVICES:
  - MANAGEMENT SERVICES:
    - SCHEDULING
    - MONITORING
  - CONTROLLING SLE TRANSFER SERVICES

SPACE MISSION DATA EXCHANGE MODEL



SPACE LINK EXTENSION (SLE)
APPLICATIONS TO AFSCN

- **INVESTIGATE USE OF SLE PROTOCOLS FOR FUTURE AFSCN APPLICATIONS:**
  - **MANAGEMENT SERVICES (STILL BEING DEFINED):**
    - **SOC-NCC LINK (E.G., SCHEDULING)**
    - **SOC-RTS LINK (E.G., POINTING ANGLES, PASS SETUP)**
  - **DATA TRANSFER**
    - **PROVIDE TIME TAGGING FOR TELEMETRY DATA**
    - **PROVIDE TIMED RELEASE OF COMMANDS FROM RTS**

SOME RESULTS TO DATE

- PRELIMINARY INVESTIGATION ON USE OF CCSDS STANDARDS BETWEEN SOC AND RTS
  - Bit Error Rate used as primary evaluation criterion
  - For commanding, may need double tail in Telecommand to avoid retransmission
  - For telemetry across WAN, may need retransmission, which complicates real-time delivery
- CONTINUE INVESTIGATION OF SCPS AND SLE FOR USE IN FUTURE NATIONAL SATELLITE CONTROL NETWORK
  - Planning tests of security, timeliness, data quality over standard WAN services

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  - **TOM TAM: SCPS PROTOCOLS**
  - **DONALD LANZINGER: NETWORKING PERFORMANCE ISSUES AND SECURITY**
  - **YOGI KRIKORIAN: WIDE AREA NETWORK INTERFACE AND CCSDS PROTOCOLS**

DESCRIPTION OF THE 5 LINKS

INTERFACE		DESCRIPTION
1. RTS-SOC	1.a From RTS to SOC	· S/V command echo data message or S/V telemetry data · Status and test report messages and Retransmit request message · Measured spacecraft angular position messages and Ranging data
	1.b From SOC to RTS	· Configuration messages for pretest, readiness test and performance test · ARTS equipment setting messages and Antenna pointing message
2. SOC-NCC	2.a From SOC to NCC	· Contact request and S/V orbital data · Network status
	2.b From NCC to SOC	· Contact Schedule · Network Status
3. RTS-NCC	3.a From RTS to NCC	· Status and test report messages and Test response messages · Maintenance request
	3.b From NCC to RTS	· Contact schedule and Maintenance schedule · Reconfiguration directives and Orbital information
4. S/V-RTS	4.a From RTS to S/V	· Command startup messages (acquisition and Lock-on) · Ranging signals and Other uplink Data
	4.b From S/V to RTC	· Command verification and S/V status and SOH · Ranging signal return and Other telemetry data or data
5. S/V-SOC (via RTS)	5.a From SOC to S/V	· Command sequences and command uploads · Other Uplink data
	5.b From S/V to SOC	· Telemetry · Other data

Legends:

ARTS = Automated RTS

SOH = State of Health