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CCSDS Application Profiles for the Mars Environment

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Agenda

- Abstract
- Introduction to CCSDS Layered Protocol Model
- Need for Application Profiles at Mars
- Application Profile Development Process
- Key Application Profile Considerations
- End-to-End Mars Application Profiles
  - Forward Link (Earth to Mars)
  - Return Link (Mars to Earth)

Abstract

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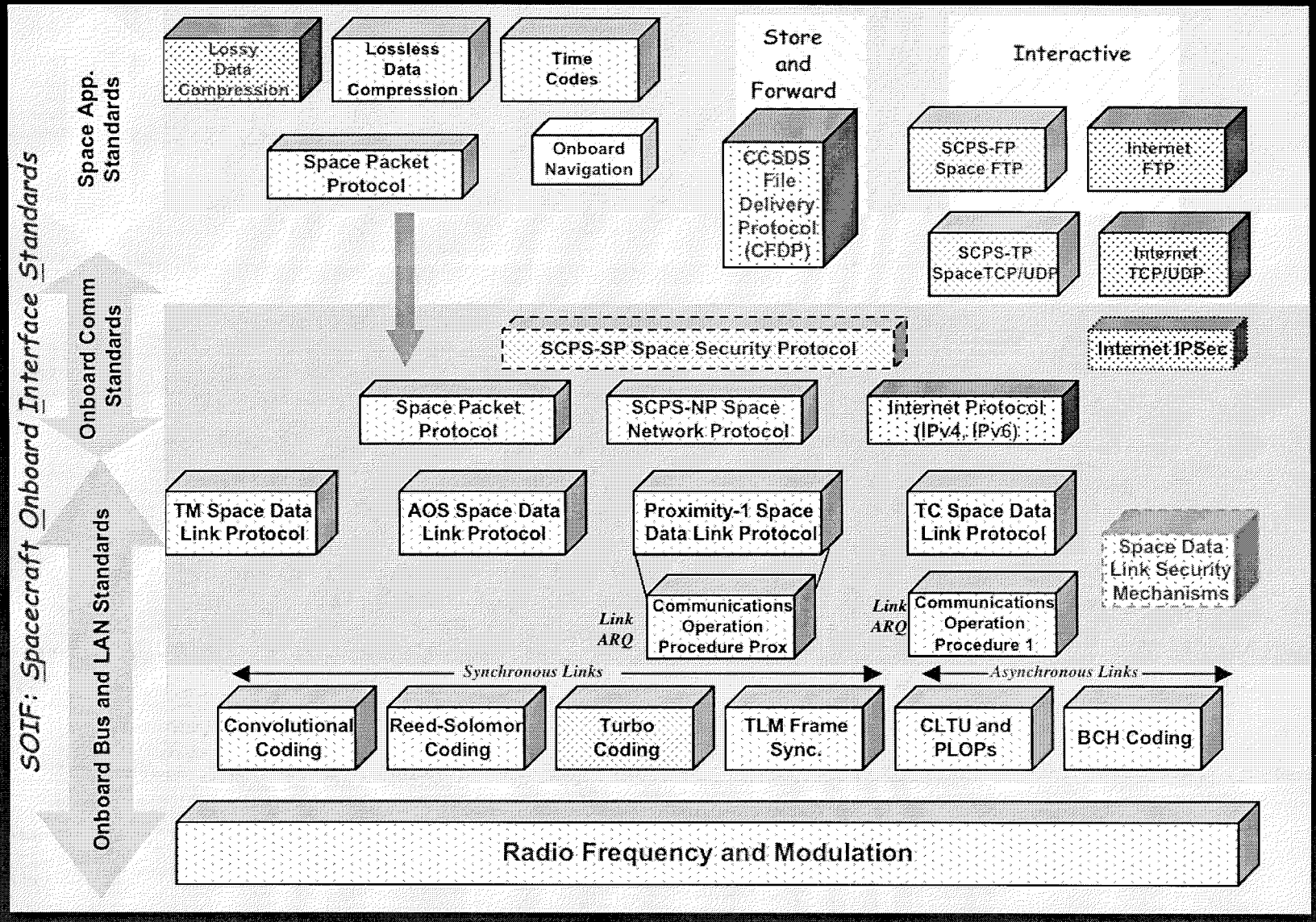
An application profile addresses the five layers of the CCSDS protocol stack applicable to space missions: physical, data link, network, transport, and application. The first step in establishing an application profile for a mission environment is to define which protocols and space application standards are to be used by the asset classes (e.g., orbiters, landers, probes) defined within the enterprise. Once this list of standards has been established, the individual options within the standards need to be evaluated in order that a specific subset of these options can be chosen. The application profiles consisting of a list of specific options within an approved list of communication protocols and applications defines the project's or program's communications policy for that specific environment. The advantage to this approach is that these profiles define categories of options applicable to specific mission asset classes so that individual missions need not reinvent the wheel when implementing CCSDS standards for communication protocols and applications.

Application profiles for the Mars environment will consist of a coherent list of options within the CCSDS layered protocol stack for international Mars projects organized by asset class. The goal of these profiles is to enhance interoperability and cross support amongst the diverse set of missions, represented by these asset classes at Mars.

This paper will discuss considerations for the application profiles for current and future missions at Mars. These missions belong to the following three asset classes: groups of small probes, medium to large size rovers and landers, and orbiters.

Networked CCSDS Space/Ground Communications Protocol Stack



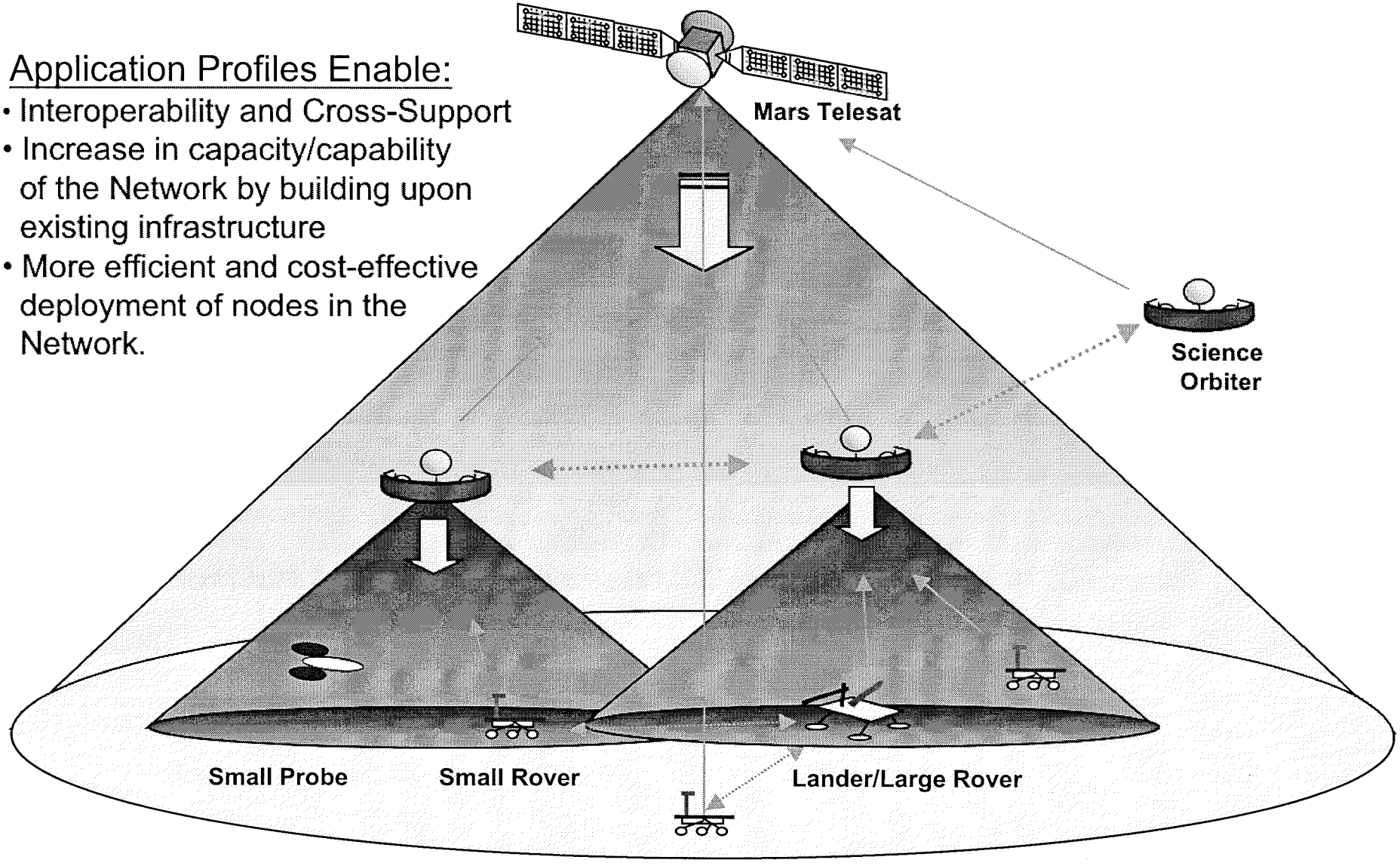
CCSDS Recommendation | Draft CCSDS Recommendation | CCSDS Report | Internet RFC

Application Profiles for the Mars Environment

Goal is ubiquitous communication in the Mars Environment

Application Profiles Enable:

- Interoperability and Cross-Support
- Increase in capacity/capability of the Network by building upon existing infrastructure
- More efficient and cost-effective deployment of nodes in the Network.



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Application Profile Development/Deployment Process

- Define which protocols and space application standards are to be assigned to the asset classes within the enterprise
- Within this defined list of standards/applications, evaluate and choose specific options within the standard for deployment.
- Implement the application profile throughout the mission set within the enterprise to enhance interoperability and cross-support

Key End-to-End Application Profile Considerations

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(associated with forward/return links)

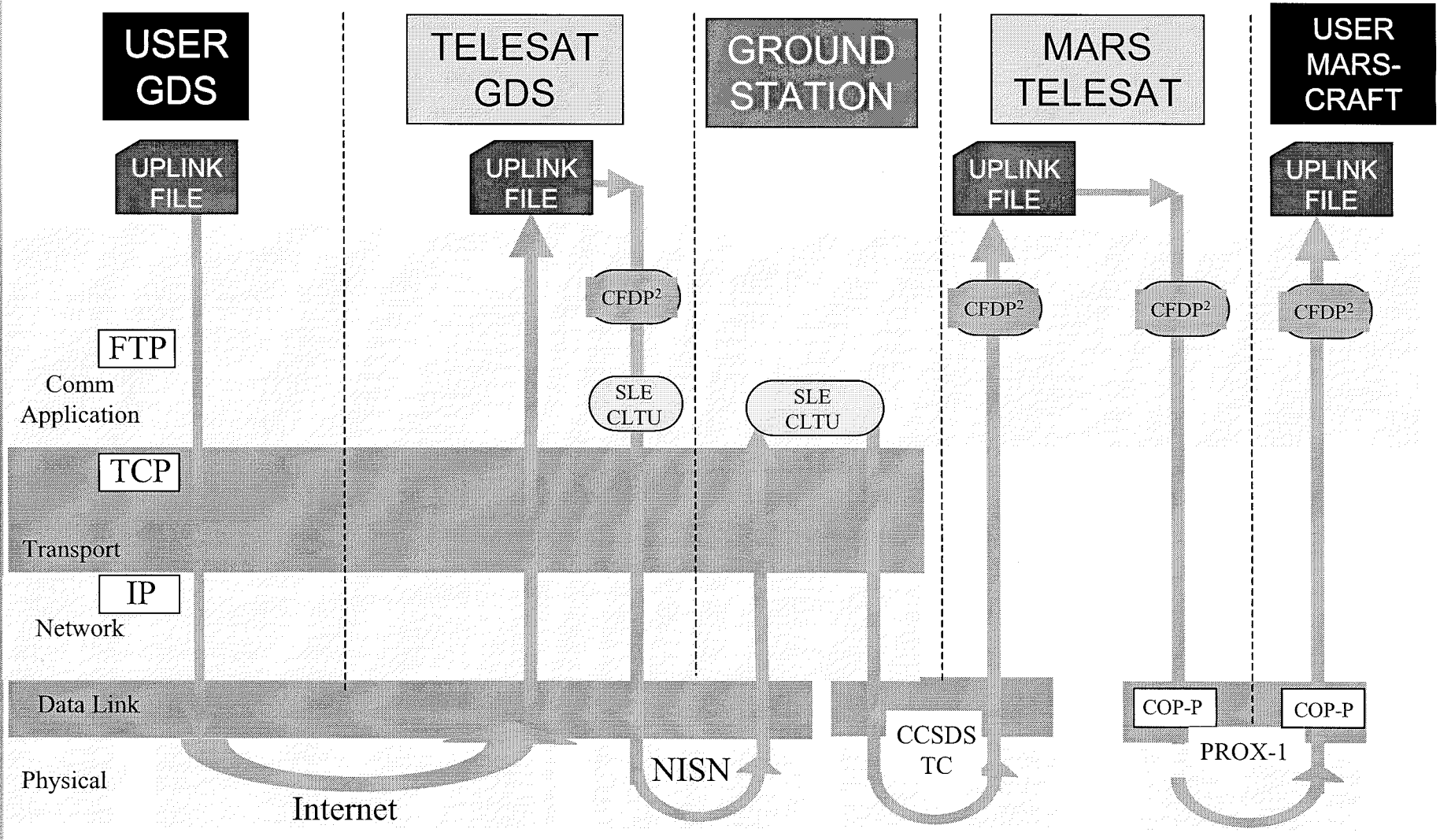
- Custody Transfer[1]
- End-to-End Data Accountability
- Data Delivery Robustness
  - Reliable vs Best Efforts
- Data Prioritization
- Data Quality, Quantity, Continuity, Latency

[1]*The receiving node accepts responsibility for the file by acknowledging successful receipt of it to the sender.*

General Application Profile Considerations

Drivers	RF & Coding	Link Layer	Network/Transport/Application
Testing at Earth	Regulatory limits		Connectivity
Round Trip Delays /Use of ARQ	Non-use of ARQ requires lower FER	Go-back N desirable with short delays	Selective Repeat desirable with long delays
Security	Spread Spectrum, Encryption	Authentication, Encryption	Access to Space (Router Issue), store & forward, file encryption
Emergency Modes	Omni vs pointing, Coding vs Uncoded	ARQ vs best efforts or none	
Missions: Power/ Energy/Duration limited	X-band .5 m HGA + 12 dB UHF on shared platform	Two 4.2 m HGA + Multiple Access phased array	1 m HGA + 12 dB UHF on shared platform
Relay data rates	Ability to transmit/receive & decode	Ability to do ARQ	Ability to do Select Repeat and prioritize data for return
Operational Issues: Routing, Prioritization, Demand Access	Demand access signaled over physical layer	Simple routing and prioritization	Move to more sophisticated protocols as network grows
Simultaneous multiple links?	CDMA/FDMA/ TDMA	Simultaneous ARQ sessions	Greater data management & control issues

Mars Forward Link Protocol Stack



Mars Return Link Protocol Stack