

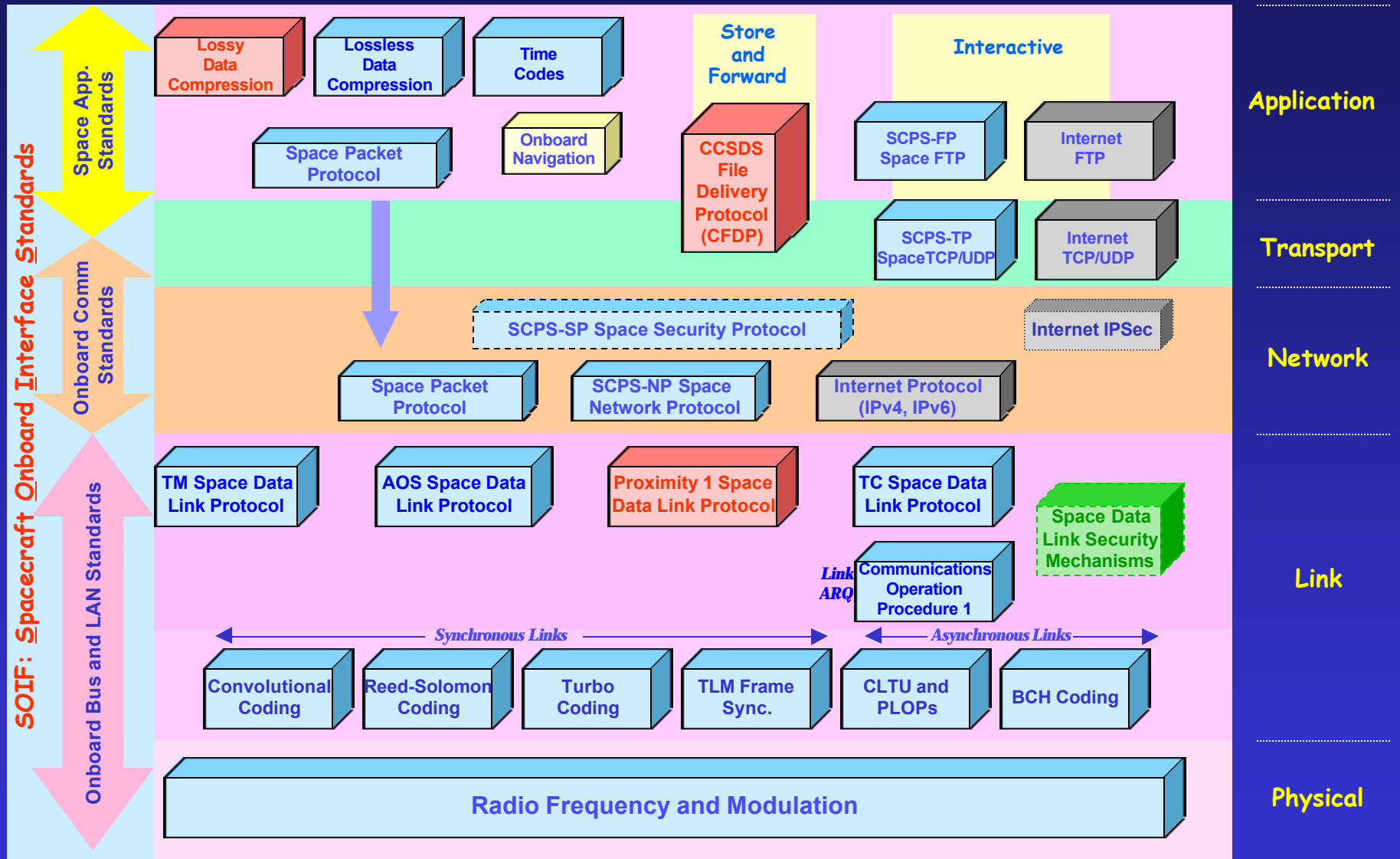


# CCSDS Standard Space Data Link Capabilities

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# Networked CCSDS Space/Ground Communications Protocol Stack



CCSDS Recommendation
  Draft CCSDS Recommendation
  CCSDS Report
  Internet RFC



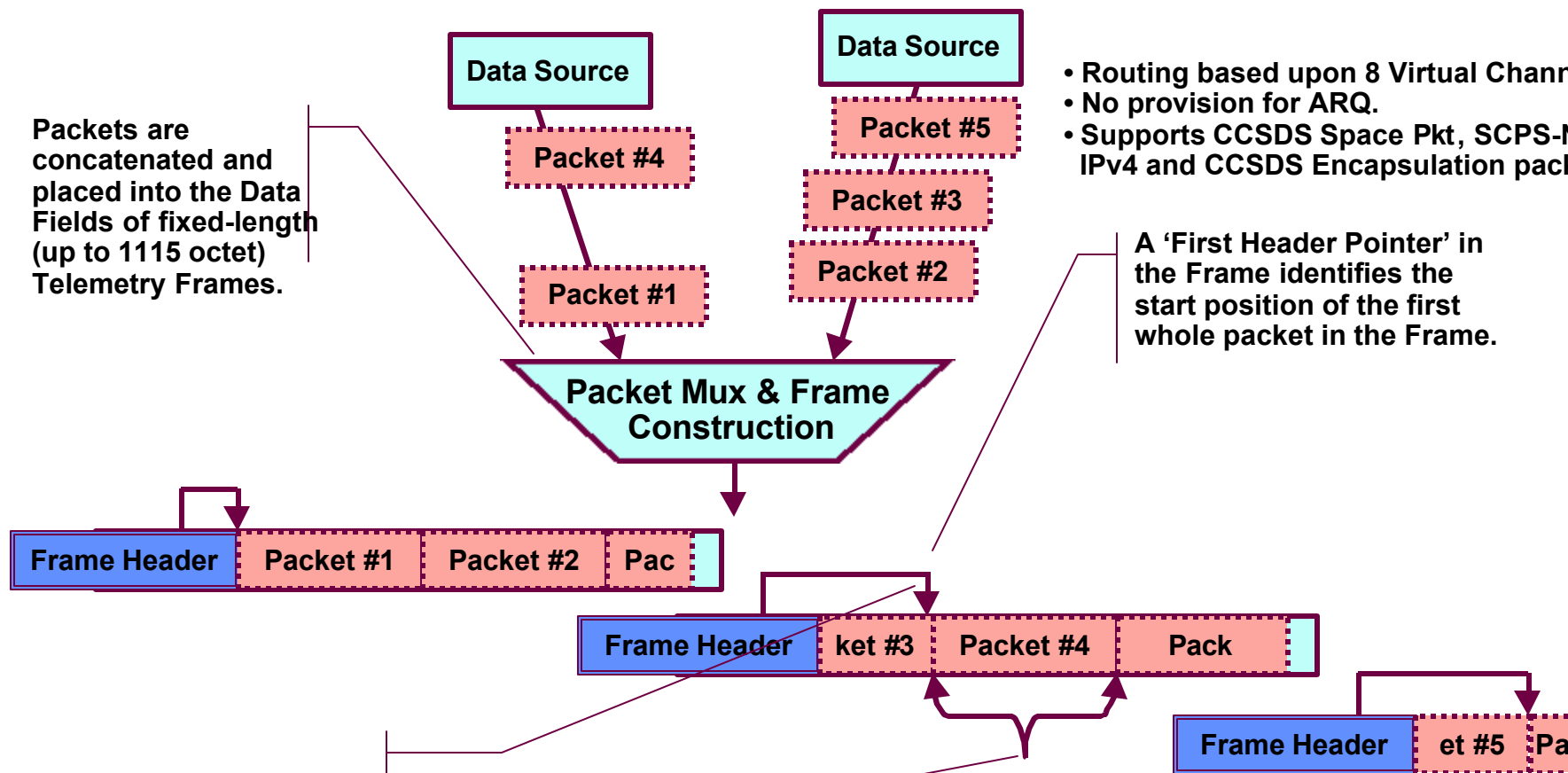
# TM Space Data Link



Packets are concatenated and placed into the Data Fields of fixed-length Telemetry Frames.

- Routing based upon 8 Virtual Channels.
- No provision for ARQ.
- Supports CCSDS Space Pkt, SCPS-NP, IPv4 and CCSDS Encapsulation packets.

A 'First Header Pointer' in the Frame identifies the start position of the first whole packet in the Frame.



...and the packet length information in each packet...

...are used to extract Packets from Frames.

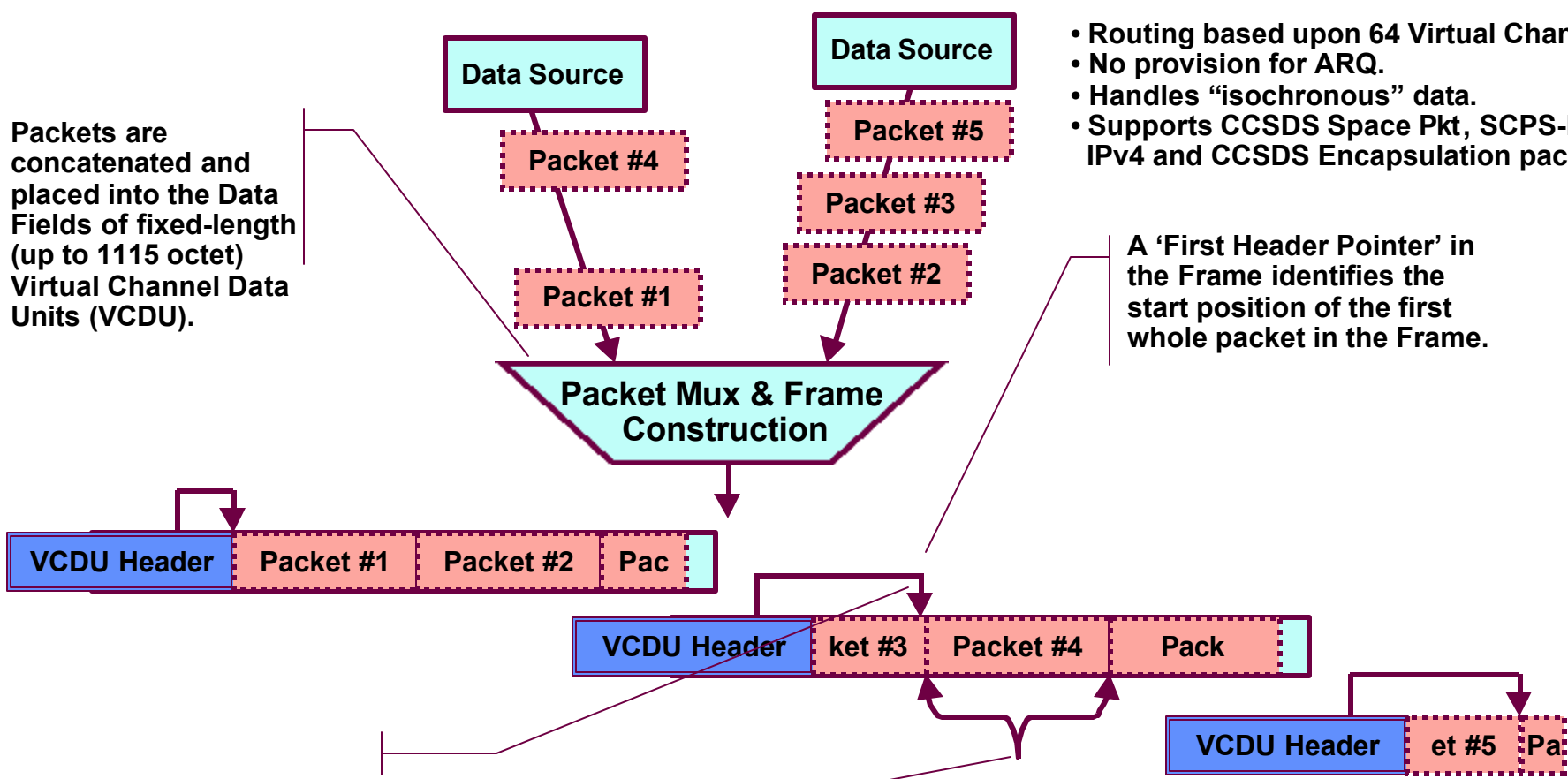


# AOS Space Data Link



- Routing based upon 64 Virtual Channels.
- No provision for ARQ.
- Handles “isochronous” data.
- Supports CCSDS Space Pkt, SCPS-NP, IPv4 and CCSDS Encapsulation packets.

Packets are concatenated and placed into the Data Fields of fixed-length Virtual Channel Data Units (VCDU).



A 'First Header Pointer' in the Frame identifies the start position of the first whole packet in the Frame.

...and the packet length information in each packet...  
 ...are used to extract Packets from VCDUs.

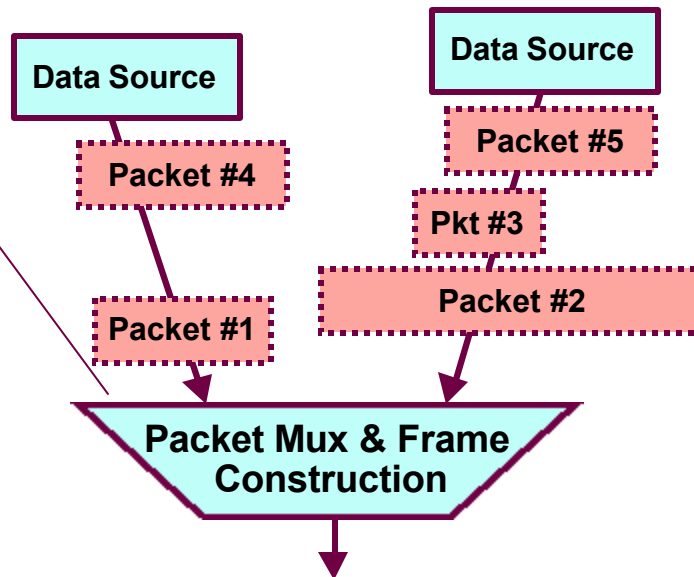


# TC Space Data Link Protocol



## at Sending End:

Packets are placed into the Data Fields of variable-length (up to 1024 octets) Telecommand Frames



- Routing based upon 64 Virtual Channels.
- ARQ Provided by COP-1 Protocol.
- Supports CCSDS Space Pkt, SCPS-NP, IPv4 and CCSDS Encapsulation packets.

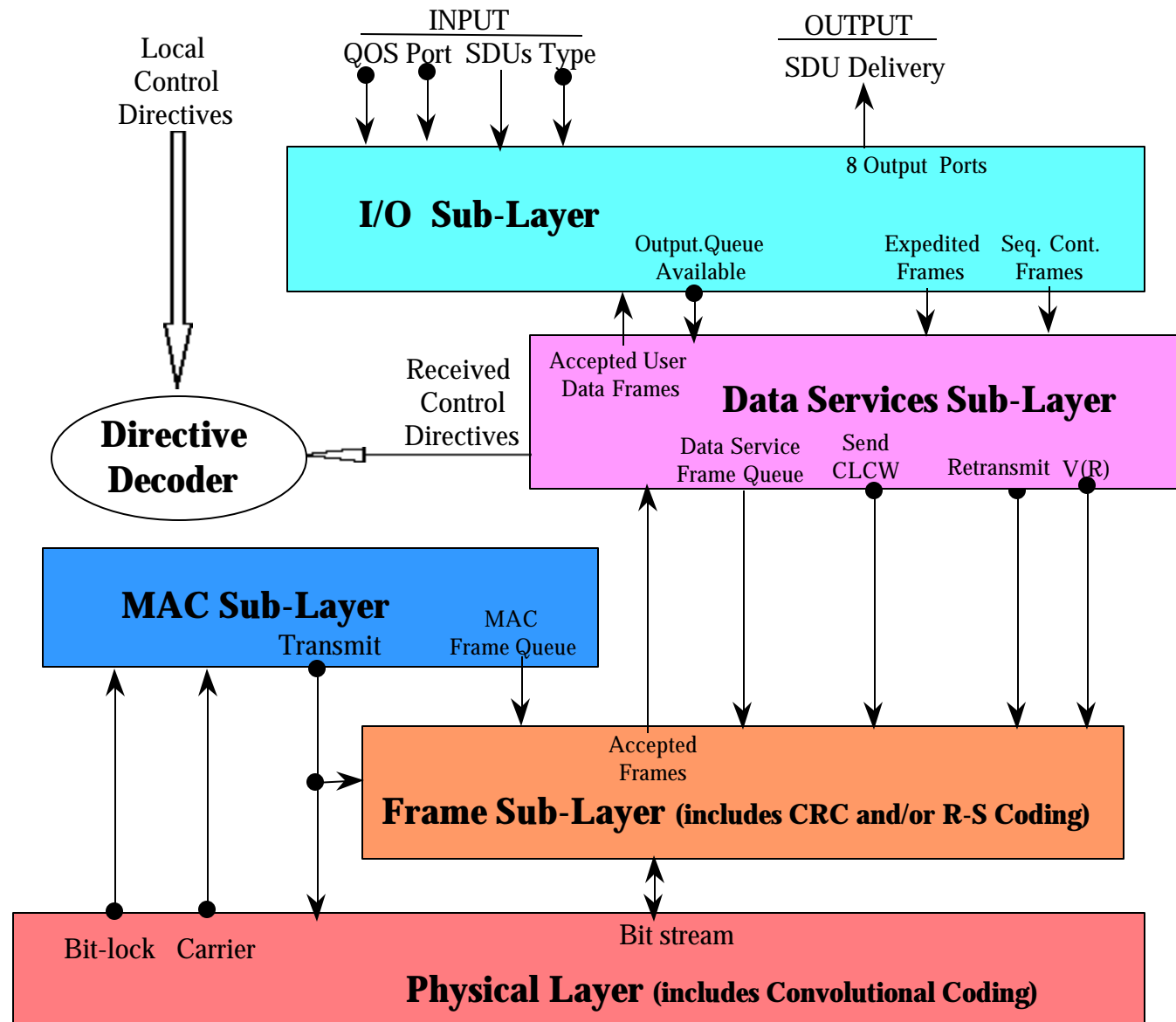


## at Receiving End:

The packet length information in each packet is used to extract Packets from Frames.



# Proximity-1 Layered Model





# Proximity-1 Layered Model Description



	Sender Functionality	Receiver Functionality
I/O SUBLAYER	Accepts user data for transfer provided routing info:QOS, port ID, etc; Makes frames	Receives frames; extracts packets; Rebuilds packets from segments;Routes data via ports
DATA SERVICES SUBLAYER	Frame Operations Procedure (FOP-P);	Frame Acceptance and Rejection Mechanism (FARM-P); Accepts/verifies control directives
MAC SUBLAYER	Controls transmitter state For link establishment, maintenance, termination	Controls receiver state For link establishment, maintenance, termination
FRAME SUBLAYER	Determines order of frames;Makes CLTUs	Decodes, verifies, validates, routes frames to higher layers
PHYSICAL LAYER	Provides the physical characteristics of the link frequency, modulation, convolutional coding, data rates, Doppler	



## Command Operation Procedures (COP-1 and COP-P) <sup>1</sup>



- COP-1 (and COP-Proximity) operate on the principle of sequential frame acceptance and retransmission with frame sequence numbering.
- The FOP initiates the transmission of TC Frames whose sequence numbers are arranged in upcounting sequential order.
- The FARM only accepts frames if their sequence numbers match the expected upcounting order.
- As soon as an error occurs, the FARM rejects all subsequent frames whose sequence numbers do not match the expected order.
- The FOP monitors the CLCW to determine if frames are being rejected, and if so backs up and retransmits the series of frames, beginning with the frame whose sequence number matches the number which the FARM is expecting.”

<sup>1</sup> ***Telecommand Summary of Concepts and Service, CCSDS 200.0-G-6, Green Book, January 1987.***



# Synchronization/Coding Techniques



<i>Functions</i>	<b>TM Synchronization and Channel Coding</b>	<b>TC Synchronization and Channel Coding</b>	<b>Priority-1 Synchronization and Channel Coding</b>
<b>Error Correction</b>	<ul style="list-style-type: none"> <li>Convolutional Codes *</li> <li>Turbo Codes*</li> <li>Reed Solomon Codes *</li> </ul>	<ul style="list-style-type: none"> <li>BCH Code *</li> </ul>	<ul style="list-style-type: none"> <li>Convolutional Code *</li> <li>Reed Solomon Code *</li> </ul>
<b>Error Detection/ Frame Violation</b>	<ul style="list-style-type: none"> <li>Reed Solomon Codes *</li> <li>Frame Error Control Field *</li> </ul>	<ul style="list-style-type: none"> <li>BCH Code</li> <li>Frame Error Control Field *</li> </ul>	<ul style="list-style-type: none"> <li>Reed Solomon Code *</li> <li>Attached Cyclic Redundancy Code *</li> </ul>
<b>Pseudo Randomization</b>	<ul style="list-style-type: none"> <li>Cyclic TM Random Sequence *</li> </ul>	<ul style="list-style-type: none"> <li>Cyclic TC Random Sequence *</li> </ul>	<ul style="list-style-type: none"> <li>Manchester Coding supplies this function</li> </ul>
<b>Frame Synchronization</b>	<ul style="list-style-type: none"> <li>32-bit Attached Sync Marker</li> </ul>	<ul style="list-style-type: none"> <li>16-bit Start Sequence</li> </ul>	<ul style="list-style-type: none"> <li>24 (var.) or 3-Bit (fixed) Attached Sync Marker</li> </ul>

\* denotes optional function