
Command & Service Module
Communications
APOLLO
NASA

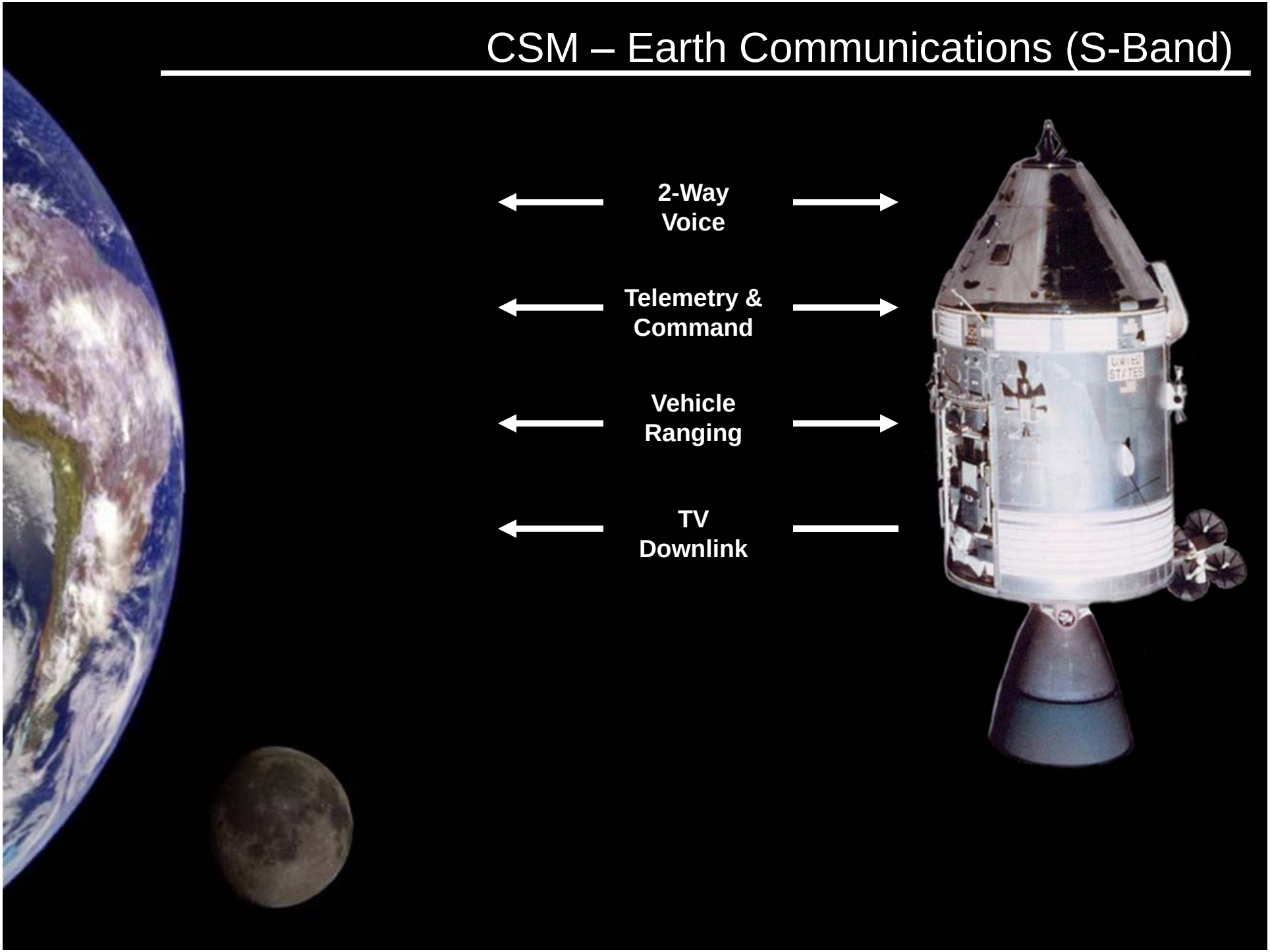
Objectives

1. Define System Capabilities
2. Describe the S-Band & VHF Systems
3. Discuss Communications during:
    1. Pre-Launch
    2. Ascent
    3. In-Flight
    4. Entry
- Closing Remarks

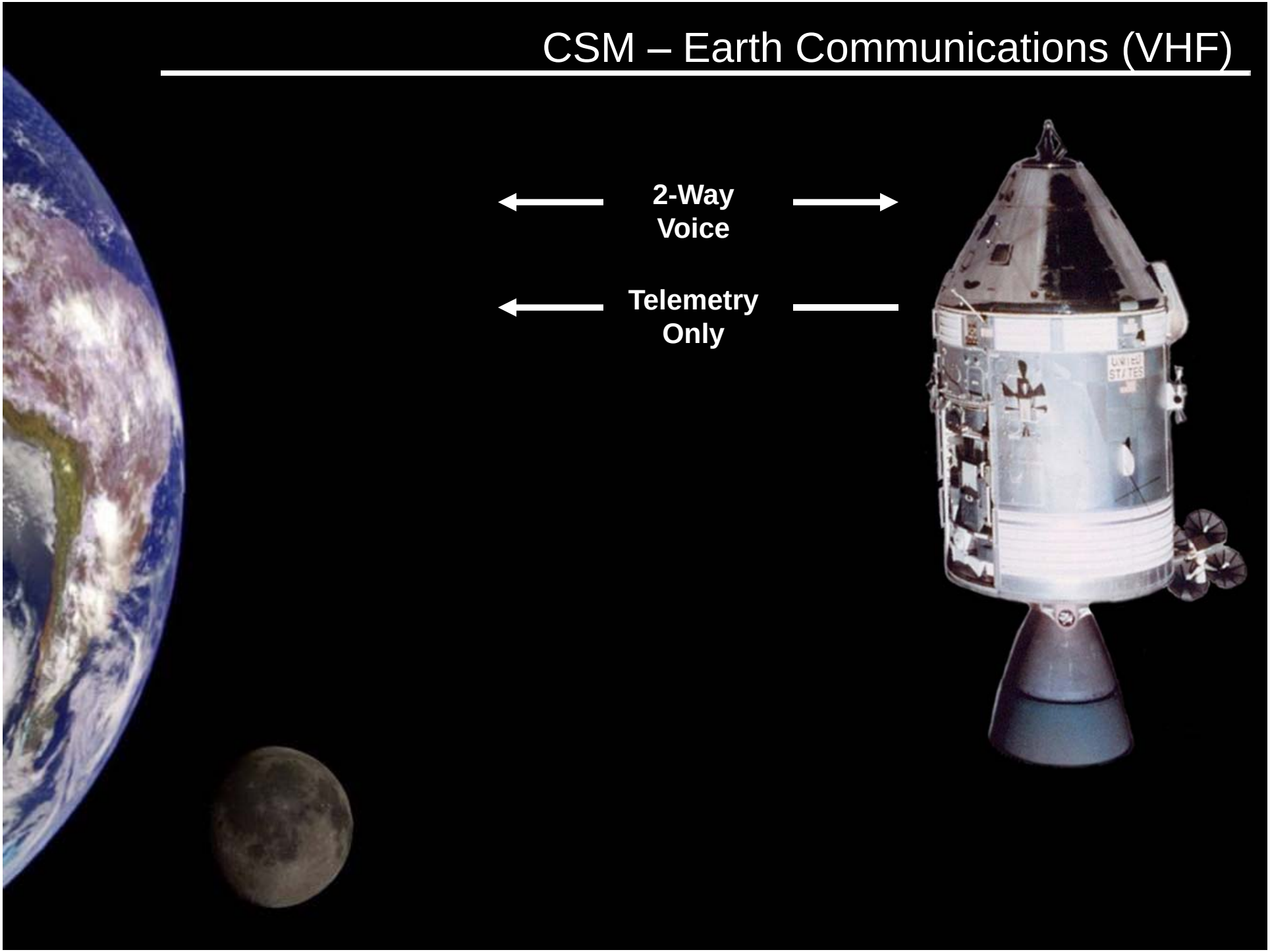
Capabilities

- Communication System Capabilities
  - CSM-Earth
    - 2-way Voice & Data (S-Band & VHF)
    - Television Downlink
    - Precise Vehicle Tracking
  - CSM-Lunar Module (LM)
    - 2-way Voice & Data
    - VHF only
  - CSM-Extra Vehicular (EV) Members
    - Voice capability with EV members
    - VHF only

CSM – Earth Communications (S-Band)



CSM – Earth Communications (VHF)

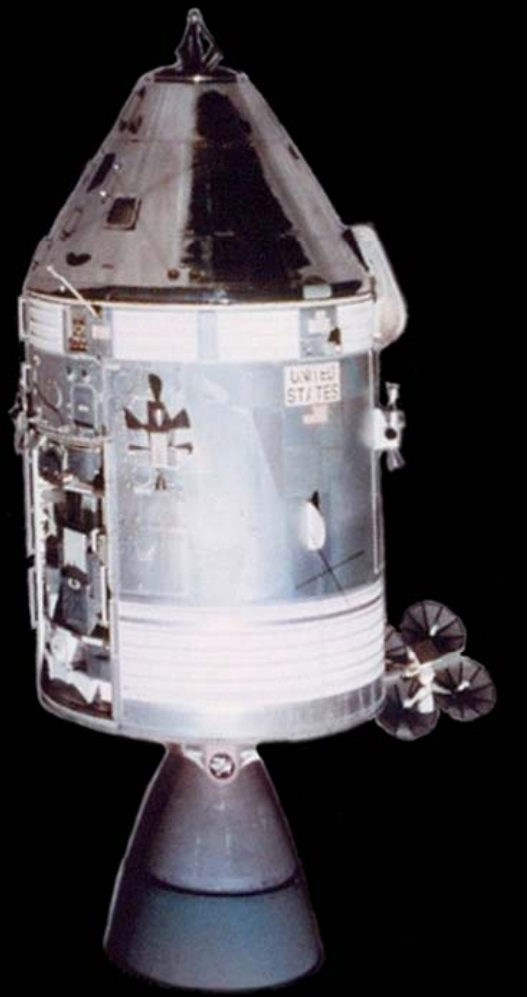


CSM – LM Communications (VHF)

2-Way Voice

Telemetry Only

LM Ranging



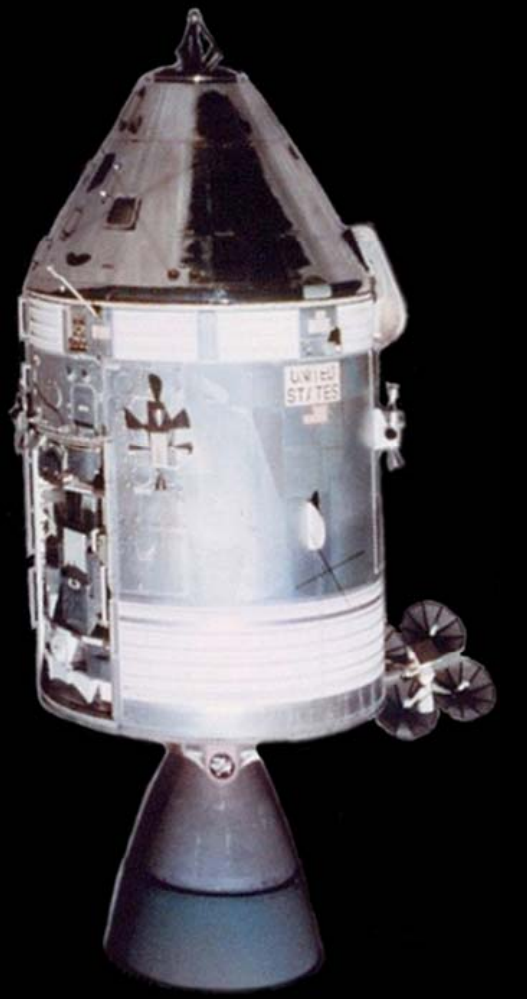
CSM - EV Crewman Communications (VHF)

2-Way Voice

EV Crew Telemetry

2-Way Voice

EV Crew Telemetry



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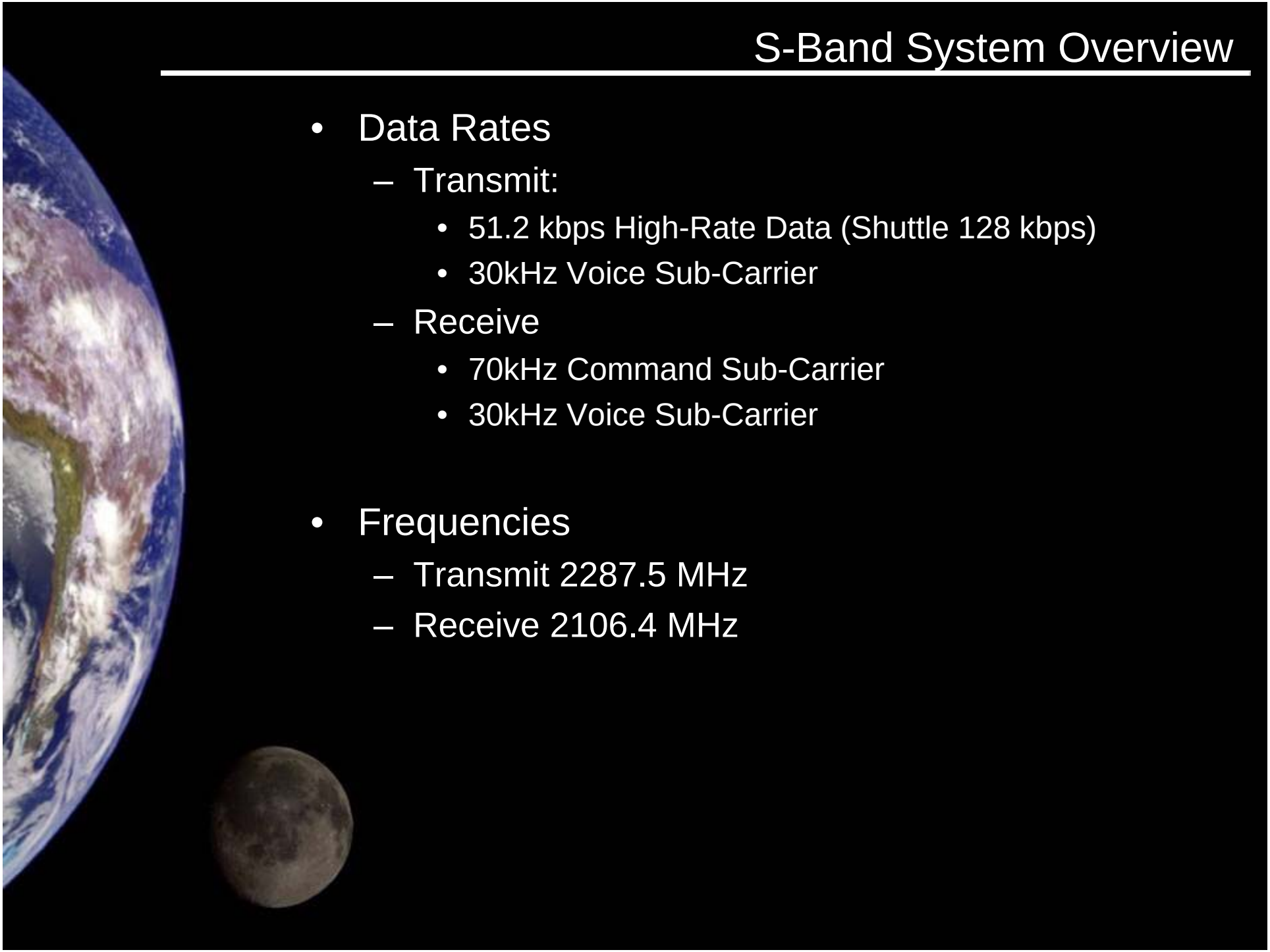
S-Band Communications

- S-Band System Overview
  - Data Rates
  - Operating Frequencies
- Major System Components
  - Pre-Modulation Processor
  - Unified S-Band Electronics
  - S-Band Power Amplifier
  - S-Band Antennas

S-Band System Overview

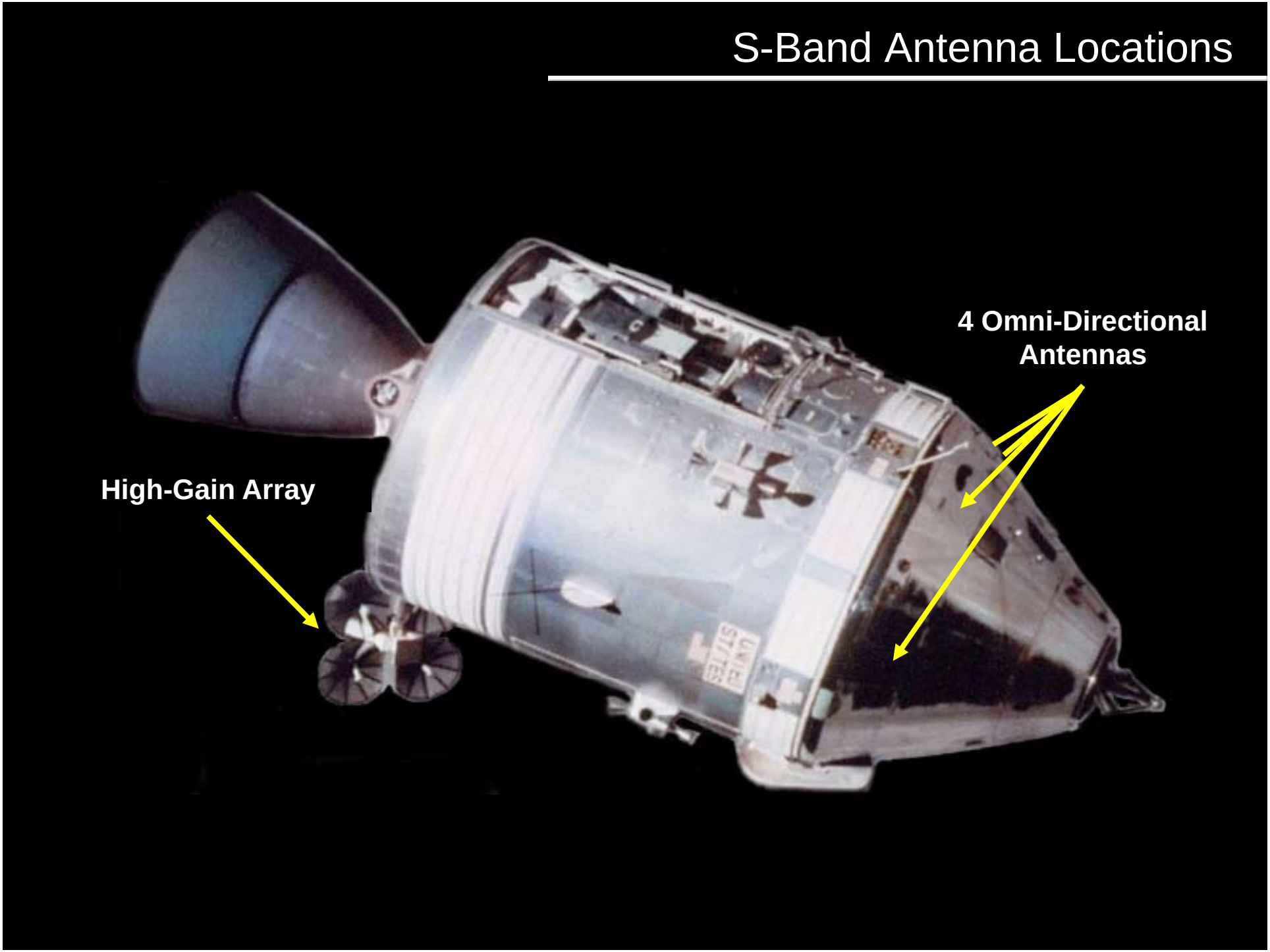


- Data Rates
  - Transmit:
    - 51.2 kbps High-Rate Data (Shuttle 128 kbps)
    - 30kHz Voice Sub-Carrier
  - Receive
    - 70kHz Command Sub-Carrier
    - 30kHz Voice Sub-Carrier
- Frequencies
  - Transmit 2287.5 MHz
  - Receive 2106.4 MHz

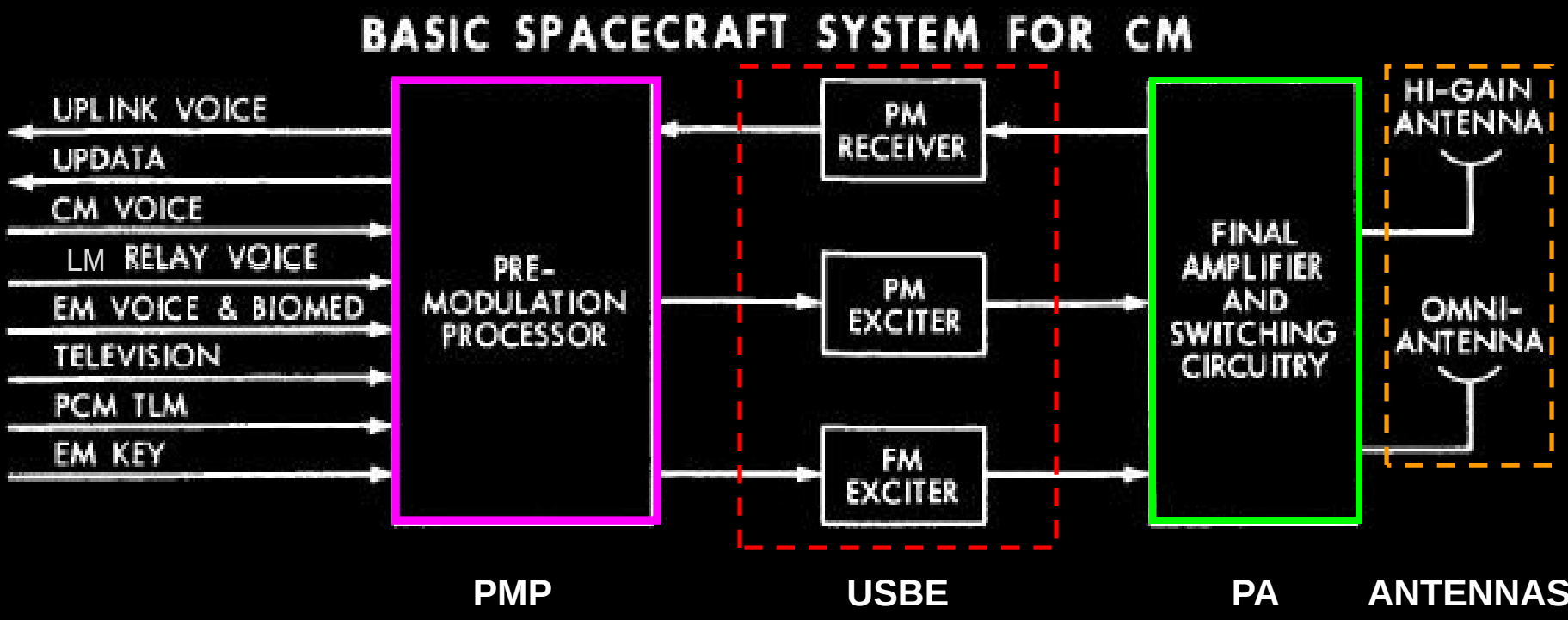
Major S-Band Components

- Pre-Modulation Processor (PMP)
  - "Brains" of the Comm. System
- Unified S-Band Equipment (USBE)
  - Transmitter & Receiver
- S-Band Power Amplifier (PA)
  - High, Low, and Bypass modes
- S-Band Antennas
  - 1 Deployable High Gain Array
  - 4 Omni-Directional's, mounted 90° apart

S-Band Antenna Locations



S-Band System Block Diagram



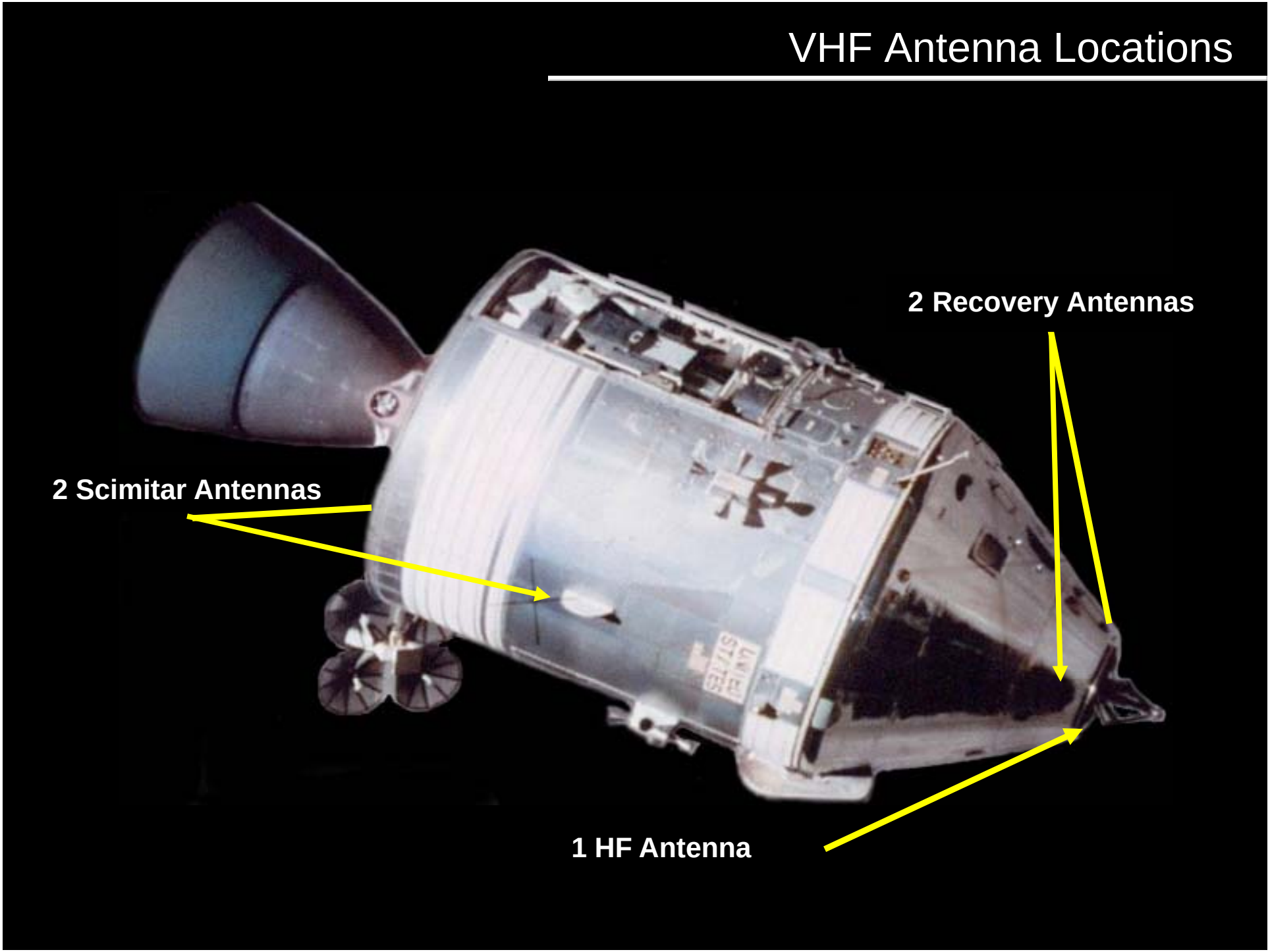
VHF System Overview

- What did it provide?
  - Data and Voice capabilities with Ground Stations, LM, and EV Members
  - Max reliable range of 1500 nautical miles
- Data Rates
  - 51.2kbps to Ground Sites
  - 1.6kbps to/from LM and EV crewman
- Frequencies
  - Transmit 296.8Mhz, Receive 259.7Mhz
  - Simplex & Duplex Modes

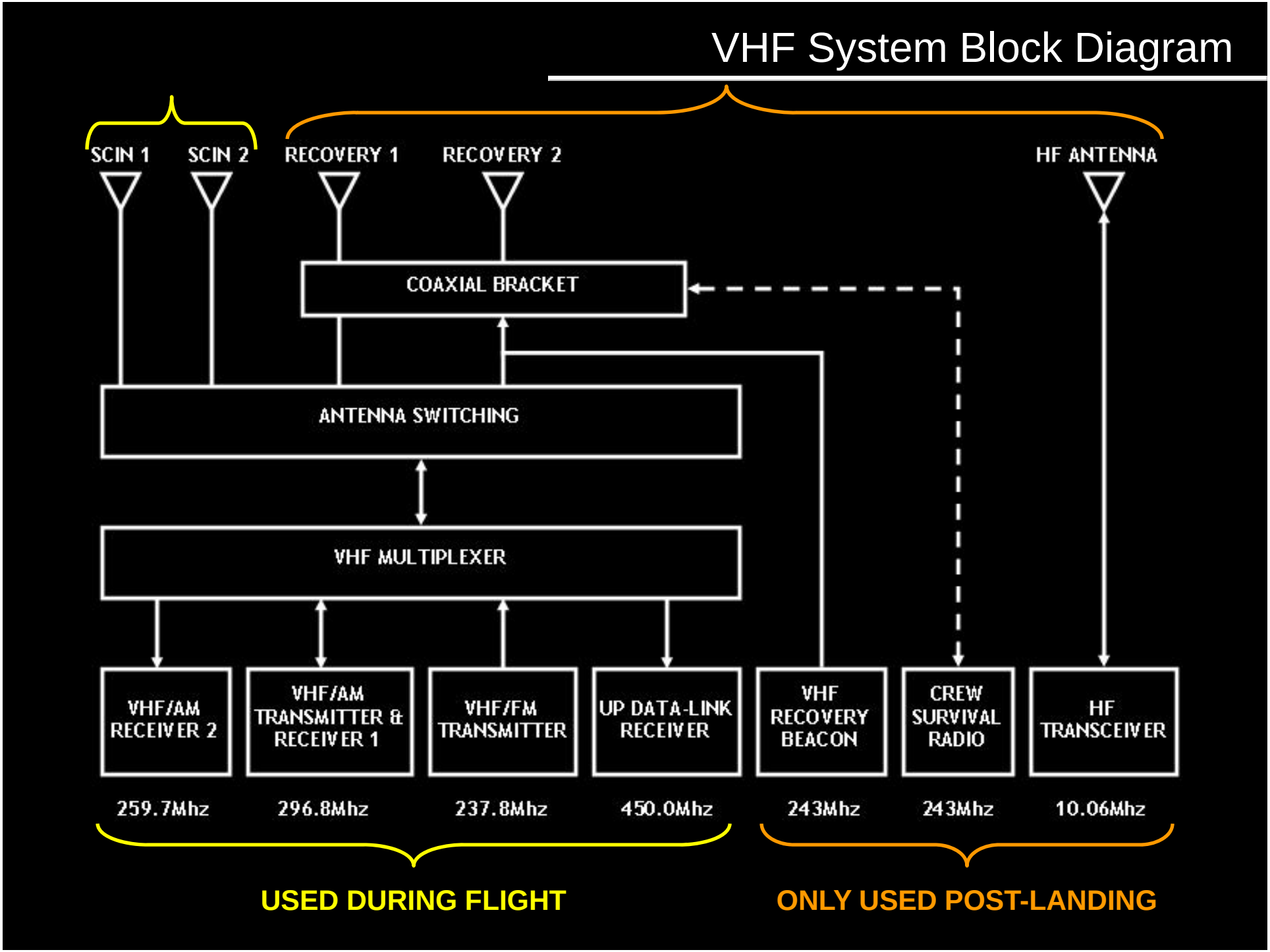
Major VHF Components

- VHF Transmitters & Receivers
  - Provided AM and FM capability
- VHF Multiplexer
  - Allowed up to 6 VHF transmitters or receivers to utilize the same antenna simultaneously
- VHF Antennas
  - 2 “Scimitar” Antennas, mounted 180° apart
  - 2 Deployable Recovery Antennas
  - 1 Deployable HF Antenna (Block I Only)

VHF Antenna Locations



VHF System Block Diagram



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Pre-Launch Communications

- Launch Umbilical
  - Provided 2-way voice, telemetry, and television from the launch pad

- Merritt Island Ground Station
  - Manned Space Flight Network (MSFN) Station
  - Provided 2-way voice, telemetry, command and ranging capabilities

Ascent Communications

- Ground Sites (MSFN Sites)
  - Ground Sites around the world that provided S-Band, VHF, Command, and Ranging capabilities
- Apollo Ships
  - Converted WWII Oil Tankers and Liberty Ships that provided S-Band, VHF, and Ranging
- ARIA
  - Converted planes that provided limited MSFN capabilities such as S-Band and VHF communications

In-Flight Communications

- Ground Sites (MSFN Sites)
  - VHF and S-Band capabilities with the CSM, LM, and Saturn IVB/IU

- Deep Space Network (DSN)
  - S-Band voice, telemetry, television, and ranging
  - Madrid, Goldstone, Canberra

Entry Communications

- Ground Sites (MSFN Sites)
  - When “in view” ground sites would attempt communications during reentry.
  - Negated mostly by plasma effects
- Recovery Ships
  - Used VHF and HF systems to find CM recovery beacon
  - Swimmer plugged into CM for communication link with crew
- ARIA
  - Four minute “Black Out Period” negated some of ARIA’s effectiveness

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Closing Remarks

- Overall, CSM communication system was rated highly by flight controllers and crew
- No major issues encountered during flight
- System was mostly autonomous for both crew and flight controllers
- Communications didn’t use satellite links like TDRS system Shuttle & ISS use today
- For more information on Apollo Comm. Systems, please visit the Apollo Wiki