Command & Service Module Communications
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)

- 2-Way Voice
- Telemetry & Command
- Vehicle Ranging
- TV Downlink
CSM – Earth Communications (VHF)

2-Way Voice

Telemetry Only
CSM – LM Communications (VHF)

2-Way Voice

Telemetry Only

LM Ranging
CSM - EV Crewman Communications (VHF)
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
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

- 4 Omni-Directional Antennas
- High-Gain Array
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

- 2 Recovery Antennas
- 2 Scimitar Antennas
- 1 HF Antenna
VHF System Block Diagram

USED DURING FLIGHT
- SCIN 1
- SCIN 2
- RECOVERY 1
- RECOVERY 2
- COAXIAL BRACKET
- ANTENNA SWITCHING
- VHF MULTIPLEXER
- VHF/AM RECEIVER 2
  - 259.7MHz
- VHF/AM TRANSMITTER & RECEIVER 1
  - 296.8MHz
- VHF/FM TRANSMITTER
  - 237.8MHz
- UP DATA-LINK RECEIVER
  - 450.0MHz

ONLY USED POST-LANDING
- VHF RECOVERY BEACON
  - 243MHz
- CREW SURVIVAL RADIO
  - 243MHz
- HF TRANSCEIVER
  - 10.06MHz
Objectives

• Define System Capabilities
• Describe the S-Band & VHF Systems
• Discuss Communications during:
  – Pre-Launch
  – Ascent
  – In-Flight
  – Entry
• Closing Remarks
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
• 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
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
• 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