TONE COMMAND SYSTEM

Telecommand system: allows instruction and/or data
to be sent to the spacecraft.

Commands may be

Relay commands

Data commands

Delayed commands

Command system design considerations

Orbit influence on link design, ground coverage

Need for delayed commands, data commands

Length of command message

Component choices

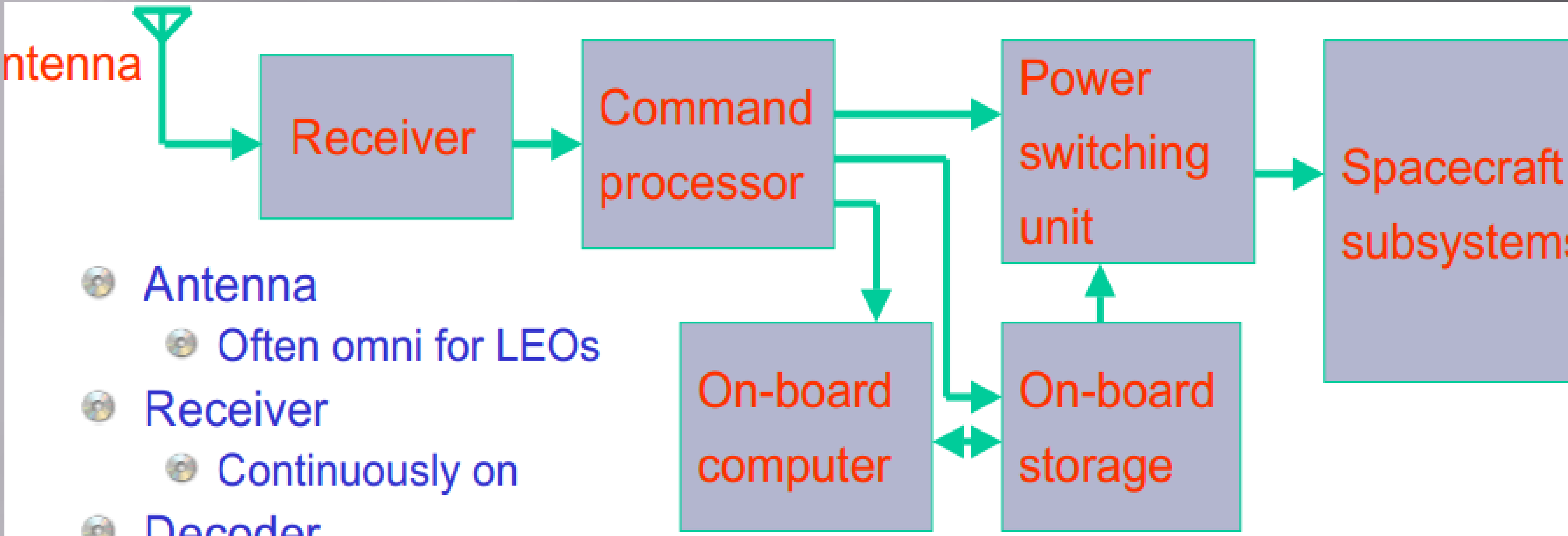
Radiation does, soft errors, latchup, shielding

Redundancy

Autonomy

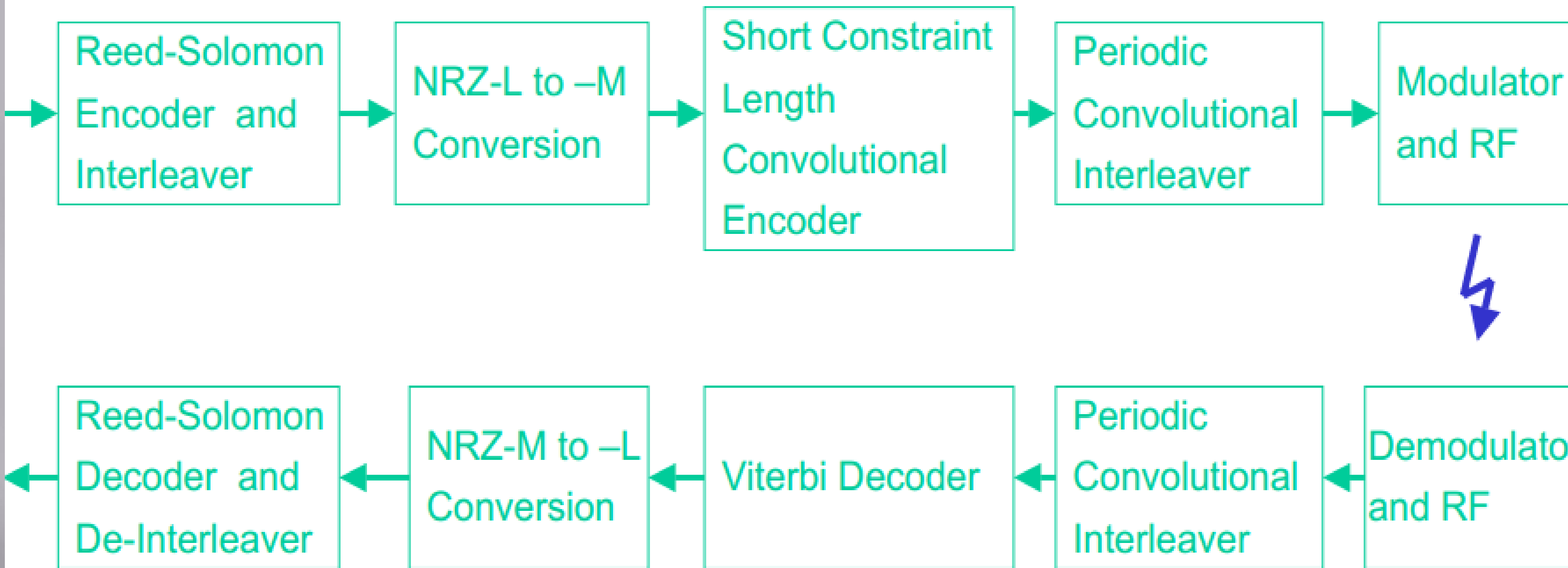
Environmental considerations

- The command unit features:
- • Command format defined by Goddard Space Flight Center
- – 7-bit error detection code
- – Uniquely defined command decoder address
- • Three command codes
- • 250-b/s, phase shift keyed modulation on 16-kHz subcarrier
- • Simultaneous DSN commanding and ranging
- • Command override of every automatic function
- The uplink signal, which can contain command and ranging data simultaneously
- on the same carrier, is routed to both onboard command receivers. The receivers
- cannot be commanded off (that is, they are “active redundant”), and once phase
- locked onto the carrier, they provide command data to each digital command
- unit/decoder, each of which is also active redundant. The command units
- independently switch their inputs between receivers every 320 ms until a signal
- is detected. Upon detection, switching is terminated and phase locking,
- demodulation, bit synchronization, and decoding are performed. The command
- units can be operated in either a clear text or encrypted/secure mode, the latter
- precluding unauthorized access to the spacecraft. The command decrypter can be
- reset to the clear text mode by an automatic timer, a power-on reset, or an
- automatic function provided in the event of loss of earth lock. Every command is



- Antenna
  - Often omni for LEOs
- Receiver
  - Continuously on
- Decoder
  - Validation of command
  - Validation of spacecraft address
  - Decryption
  - Recovery of clock and data
- Command processor
  - Command interpretation and validation
  - Interface to on-board units for proper actions
- Power switching
  - Interface circuitry between command logic and spacecraft subsystems

- Coding system



- Benefits of channel coding
  - Higher overall data throughput at the same overall quality (bit error rate)
  - Lower overall bit error rate using the same energy per information bit
  - Amenable to data compression, adaptive telemetry, and anomaly exclusion

- **Command** and **Data** modes refer to the two modes in which a computer modem may operate. These modes are defined in the Hayes command set, which is the de facto standard for all modems. These modes exist because there is only one channel of communication between the modem and the computer, which must carry both the computer's commands to the modem, as well as the data that the modem is enlisted to transmit to the remote party over the telephone line.
- When a modem is in **command mode**, any characters sent to it are interpreted as commands for the modem to execute, per the Hayes command set. A command is preceded by the letters 'AT', which stand for 'Attention'. For example, if a modem receives 'ATDT5551212' while in the command mode, it interprets that as an instruction to dial the numbers 5551212 on the telephone, using touch-tone dialing. While in command mode, the modem may send responses back to the computer indicating the outcome of the command. For example, the modem may respond with the word "BUSY" in response to the ATDT command, if it hears a busy signal after dialing and is configured to listen for busy signals.