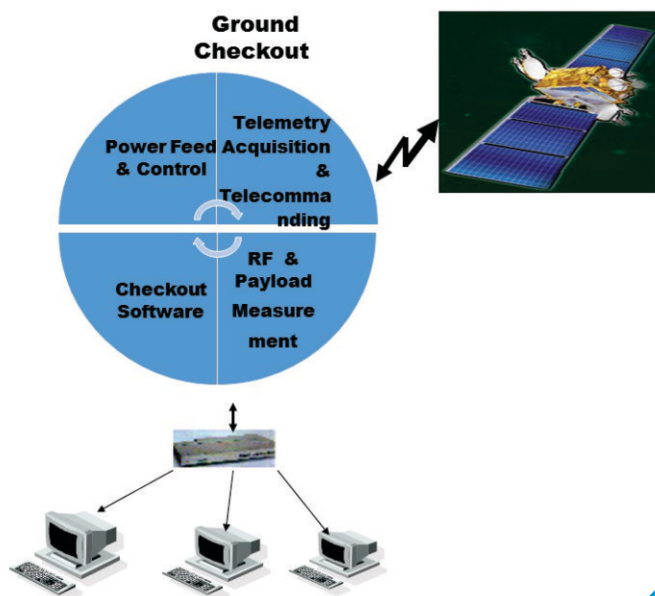


INTRODUCTION

Ground checkout System is used for conducting the exhaustive tests at integrated spacecraft level to evaluate and qualify the functional performance of all subsystems onboard and ascertain the spacecraft is flight worthy. Telecommanding & Telemetry reception plays a vital role during integrated satellite testing and therefore a reliable Checkout System is required.

To accurately predict and deliver high quality of service, checkout designers increasingly turn towards computer models of their systems to simulate real-time operating conditions and gain insights into usability and requirements prior to final product sign-off.

CCSDS format of telemetry and telecommanding is implemented in ISRO Satellites. **CCSDS Telecommand and Telemetry Simulator** is a software module developed to test and evaluate the functional performance of Telecommanding & Telemetry Acquisition in Checkout.



GOALS

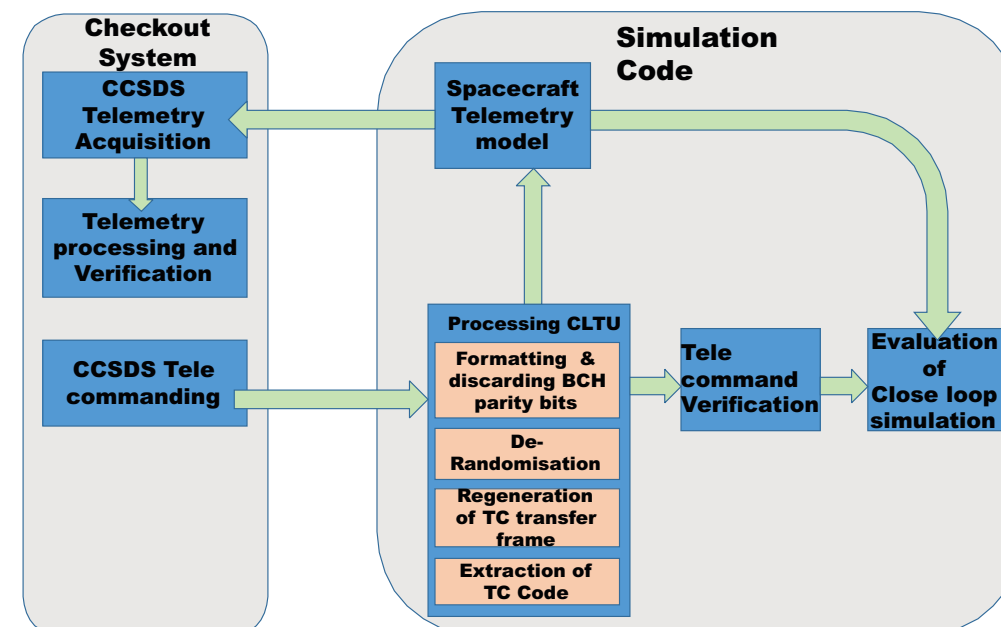
1. Utilize telemetry simulation to assess the competency of Checkout Telemetry Acquisition Unit
2. Ensure error free telemetry reception and onboard telecommanding
3. Evaluate the use of simulation to verify the close loop commanding
4. To determine the impact of the simulation model on the overall time required for the test and evaluation of Ground Checkout Telecommand & Telemetry reception System

METHODS

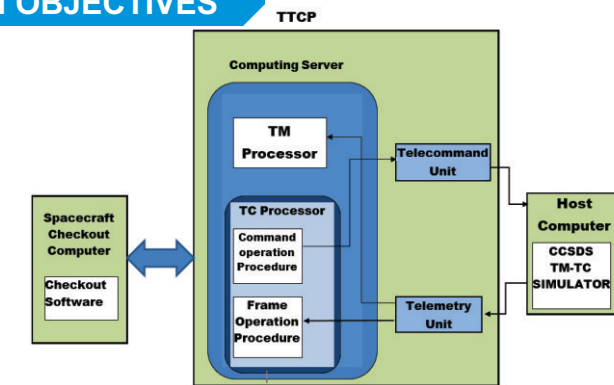
Telemetry (TM) and Telecommand (TC) links to the spacecraft are controlled from Checkout using TTC Processor (TTCP). Software in Spacecraft Checkout Computer (SCC) facilitates acquisition of real time telemetry, processing & analysis of the data in real-time and generation of telecommands.

The simulator generates spacecraft onboard data patterns of programmable data rate and frame length. It packetizes the data according to CCSDS Standards. The Simulated telemetry acquired through TTCP is validated by Checkout Software residing in Spacecraft Checkout Computer.

The telecommands sent from SCC are received in Simulator module for extraction of command code from CLTU (Command Link Transfer Unit). The command code obtained is compared with the transmitted code for verification & validation. Frame Accept & Reject Mechanism for close loop testing is implemented in simulator module.



SESSION OBJECTIVES



The objectives of these simulation sessions include identification of flaws in Checkout Telecommanding and Telemetry reception System before the establishment of Telemetry & Telecommand links with spacecraft.

CRITICAL ACTION

- Validate the telecommands transmitted from Spacecraft Checkout
- Analyze the received telemetry data and provide assurance of data quality
- Identify the cause for Automatic repeat request during close loop commanding.

CONCLUSION

The primary advantages of simulator is that it is able to provide users with practical feedback when designing real time applications as in the case of satellite telemetry acquisition & telecommanding. TM-TC Simulator allows to determine the correctness and efficiency of design before the checkout system is deployed for integrated satellite testing.

FUTURE WORK

Implementation of advanced concepts in satellite technology imply major departure from today's basic paradigm of onboard telemetry and telecommanding format. Checkout has to upgrade the telecommanding and telemetry acquisition system to support new formats. Evidently TM-TC Simulator has to be augmented to test and evaluate the updations in Checkout System.

REFERENCES

- CCSDS BLUE BOOK 232.0-B-1 (TC Space Data Link Protocol)
- CCSDS BLUE BOOK 231.0-B-1 (TC Synchronization And Channel Coding)
- CCSDS 202.1-B-1 (Command Operation Procedure)
- CCSDS 132.0-B-1 ((TM Space Data Link Protocol)