Event Number	Event Details
	Initiate AD Service (with CLCW check) Directive, BC_Out_Flag = Ready
E27	Receive Directive From Management Function Initiate AD Service (with Set V(R) Directive), BC_Out_Flag = Ready
E29	Receive Directive From Management Function Terminate AD Service Directive

N(R) = Frame Sequence Number in CLCW
NN(R) =Next expected frame sequence number
V(S) =Transfer frame sequence Number

2.4. ByPass CLTU Generation:

This block directly transmits the command to TC Hardware bypassing all the processing related to CLTU generation.

2.5. Log & Display:

This block deals with the logging and display of commands. Logging of commands will be done along with CLTU and the commands issued from host computer. Time reference is also logged for each command. Display will show the transmission status, date and time and the command code in GUI for quick reference.

2.6. TC Echo:

TC Echo block is used to dump either CLTUs or Transfer frame based on the request by clients. During Spacecraft IST, there is a requirement to provide command to different agencies involved during testing. To meet this requirement provision is provided to support 8clients.

3. Testing the Telecommand interface

Testing is the process of evaluating a system or its components with the intent to find whether the product satisfies the specified requirements or not. Testing is executing a system in order to identify any gaps, errors or missing requirements in contrary to actual requirement, Before communicating with the spacecraft thorough testing is carried out to clear the interface.The software was subjected to a third party team. Various test cases were generated which includes testing of variable length commands, continuous commanding, verification of frame transmission to multiple clients, abrupt disconnection of clients, abrupt closure of application, abrupt network failures etc . Interface testing of TTCP was also carried out with onboard computer. A proper plan was worked out to clear BD,BC and AD frame execution onboard. A gist of plan is as follows:

- Configure the host system for BD frames
- Initiate commanding to onboard decoder and verify the reception
- Configure onboard for AD frames by sending BC commands
- Unlock the onboard receiver through BC directives
- Synchronize onboard and ground by setting frame sequence number directive
- Configure the host system for AD frames
- Initiate commanding to onboard decoder and verify the reception

Thus, exhaustive testing was carried out to ensure satisfactory results before deploying it to various satellite projects .

4. CONCLUSION

The successful implementation of CCSDS based Telecommand Processing and management software for in-house developed TTCP has resulted in significant cost reduction for checkout operations. Costly procured TTC Processor Units for both CCSDS Telecommanding and Telemetry reception , were in use prior to the deployment
of indigenous unit in Checkout. In addition , the cost for
Annual Maintenance of the procured units is significantly high. Having the TTCP units, designed and developed in-house, the required expertise and resources are readily available for future requirements and maintenance. In future, the software will be upgraded for commanding in both CCSDS and Non-CCSDS based projects. Moreover, various possibilities of deploying it for ground stations can also be explored.

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