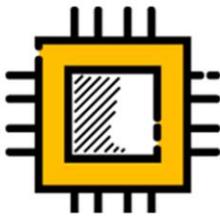


AEROSPACE IP CO-DEVELOPMENT



CHIPMONK

BACKGROUND

Chipmonk's Client is an established leader in the satellite launch vehicle and aerospace electronics industry. The project required refurbishing their existing product line to align with updated specifications released by CCSDS.org for space communication protocol.

Chipmonk's team had developed in-depth knowledge and expertise on aerospace technology working with clients in the industry and were able to demonstrate this value by engaging with the client in the early stages of project planning.

SCOPE

One of the major components of the refurbished system was a COP-1 compliant telecommand/telemetry space link between ground and field. The Client had previously used an IP vendor, but the vendor had no plans on updating its offering. Also, products by other vendors in the market were not updated with the latest requirements from the ESA board. The solution was to build a custom IP.

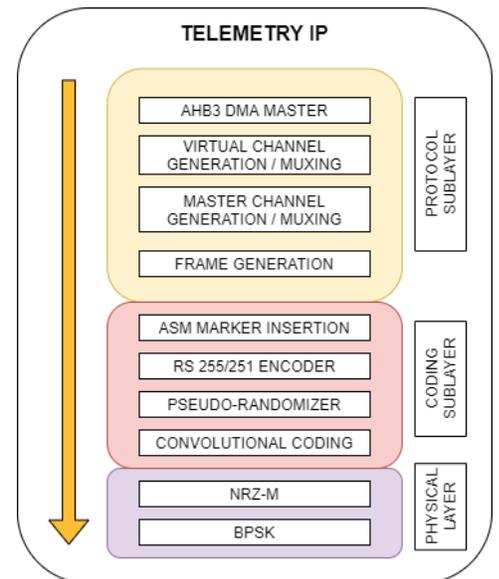
Chipmonk was tasked with the collaborative development of a Telecommand/Telemetry IP that is COP-1 compliant and could be easily integrated into the Client's satellite launch and communication system product line.

IP SPECIFICATIONS

TELEMETRY ENCODER IP

Architecture, RTL Design and Verification of a Telemetry Encoder IP with the below capabilities:

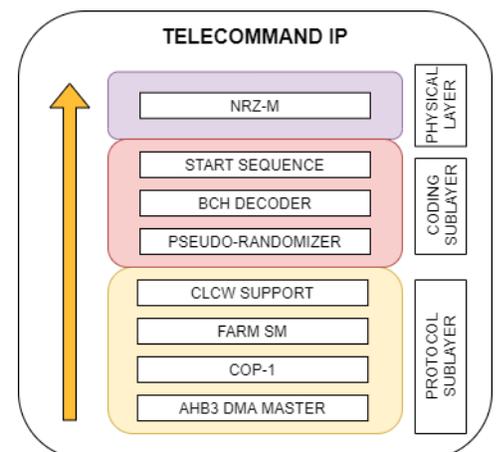
- Packet Telemetry (TM) capabilities
- Data Link: Protocol Sub-Layer
 - AMBA AHB3 Master DMA Interface
 - Master and Virtual Channel Frame Service
 - Master and Virtual Channel Generation, Multiplexing (6:1)
 - All Frame types supported (FHEC, FECF)
 - DMA Support
- Data Link: Synchronization and Channel Coding Sub-Layer
 - Attached Synchronization Marker
 - Reed-Solomon 255/251 Encoder (E=16)
 - Pseudo-Randomizer
 - Convolutional coding with puncturing
- Physical Layer
 - NRZ-M Modulation
 - Sub-Carrier Modulation (BPSK)



TELECOMMAND DECODER IP

Architecture, Design and Verification of a Telemetry Decoder IP with the below capabilities:

- Packet Telecommand (TC) capabilities
- Data Link: Protocol Sub-Layer
 - AMBA AHB3 Master DMA Interface
 - Communication Operating Procedure-1 (COP-1) compliance
 - Frame Acceptance and Reporting Mechanism (FARM)
 - Control Link Control Word (CLCW) support
- Data Link: Synchronization and Channel Coding Sub-Layer
 - Pseudo-DeRandomization
 - BCH Codeblock Decoding
 - Start Sequence Search and Lock
- Physical Layer
 - NRZ-M Demodulation



RESOURCES

As part of a collaborative effort, the team that developed the IP was a mix of staff from the Client company and Chipmonk.

	CLIENT	CHIPMONK
Management	1 x System Architect	1 x Project Manager
Design	1 x FPGA Designer	2 x ASIC Design Engineer
Verification	-	4 x ASIC Verification Engineer
Software	1 x Embedded SW Engineer	1 x Embedded SW Engineer
Prototype	2 x Lab Technician	1 x FPGA Emulation Engineer

The toolsets and technology used were:

- Simulation - Mentor Graphics QuestaSim
- Modelling – MATLAB/Simulink
- Platform – Xilinx Virtex 5QV (Space-Grade family)
- Synthesis/PnR – Xilinx Vivado Design Suite
- Software – Python, C

TECHNOLOGY STACK



**Consultative Committee for Space
Data Systems**



European Space Agency



AMBA AHB3



JTAG

TIMELINE

The initial engagement between the Client and Chipmonk began in May 2018. The project planning, design, verification and prototyping of the IP with a team of 12 engineers took 8 months. An additional 2 months was required with a subset of the team to assist with customer evaluations and system integration.

RESULT

The Client was the first in industry to have an ground and field space link that followed the latest standards proposed by the CCSDS and ESA board. The retrofit of launch vehicles that were deployed was a project that was green-lighted by the Client's customers as a direct result of this capability. Furthermore, the Client was able to firmly establish itself as the leader in aerospace and launch vehicle electronics.

The engagement was a success with all IP deliverables being fully functional. Performance targets were met as well. The collaborative development was kept confidential due to the secretive nature of the Aerospace industry and various security and Canada Controlled Goods compliance required of organizations that do R&D in this field.