

A Common Physical and Control Interface for ISAM Operations

Jack Martin, Sripad Sahu and Yaseen Zaidi

jack-martin@spacecode.co.uk, sripad.sahu@inphys.com, yaseen.zaidi@cranfield.ac.uk

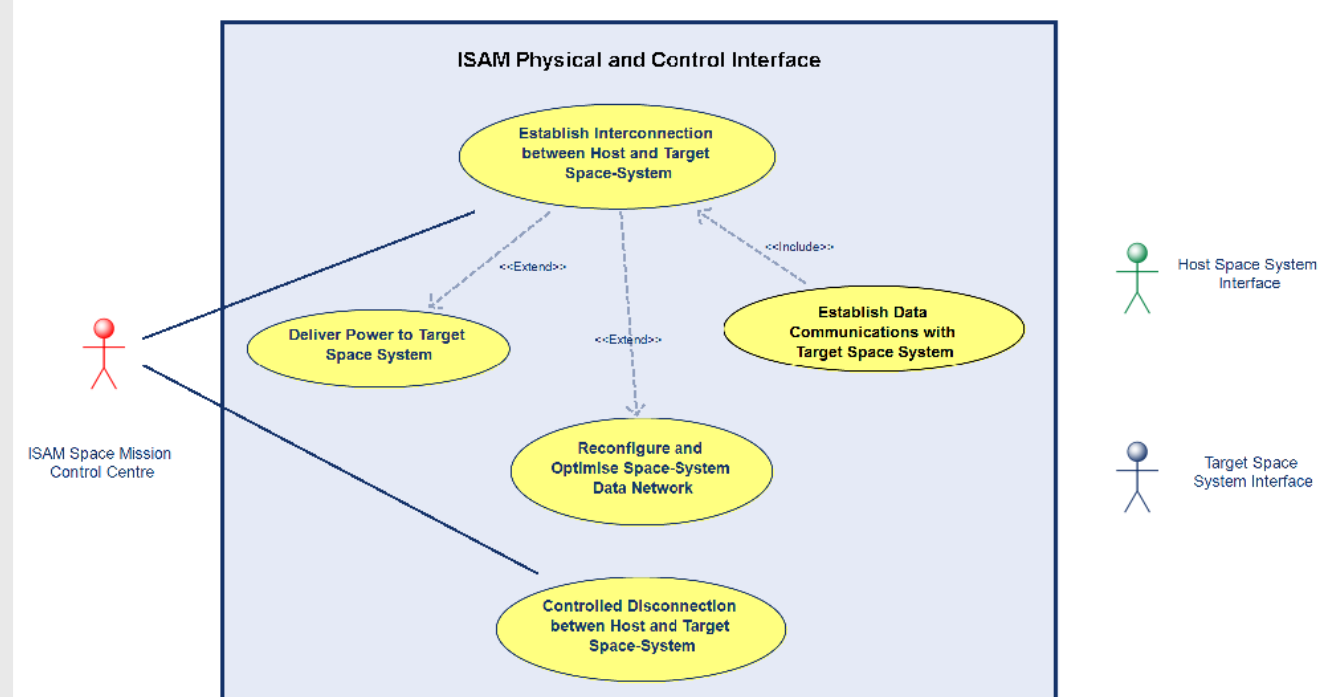
The Common Physical and Control Interface (CPCI) is a standardised, open-source solution to enhance interoperability in In-Orbit Servicing, Assembly, and Manufacturing (ISAM) operations. The absence of a universal interface in current space systems increases integration complexity, costs, and inefficiencies. CPCI leverages IEEE 802.3 Power over Ethernet (PoE) to enable simultaneous power and data exchange, providing a scalable and modular plug-and-play solution for future space missions.

Introduction

- Existing In-Orbit Servicing, Assembly, and Manufacturing (ISAM) missions lack a common physical and control interface, resulting in high integration costs and limited modularity for servicing, docking, and reconfigurable systems.
- Current space systems require a unified method to handle power distribution and real-time communication efficiently, reducing the complexity of integrating various subsystems and spacecraft.
- The Common Physical and Control Interface (CPCI) utilises IEEE 802.3 Power over Ethernet (PoE) to enable simultaneous power and data transmission, providing a plug-and-play solution for space systems.
- CPCI is designed to support modular spacecraft, enable autonomous docking, and enhance satellite servicing, making it a key enabler for future deep-space missions and commercial space stations.

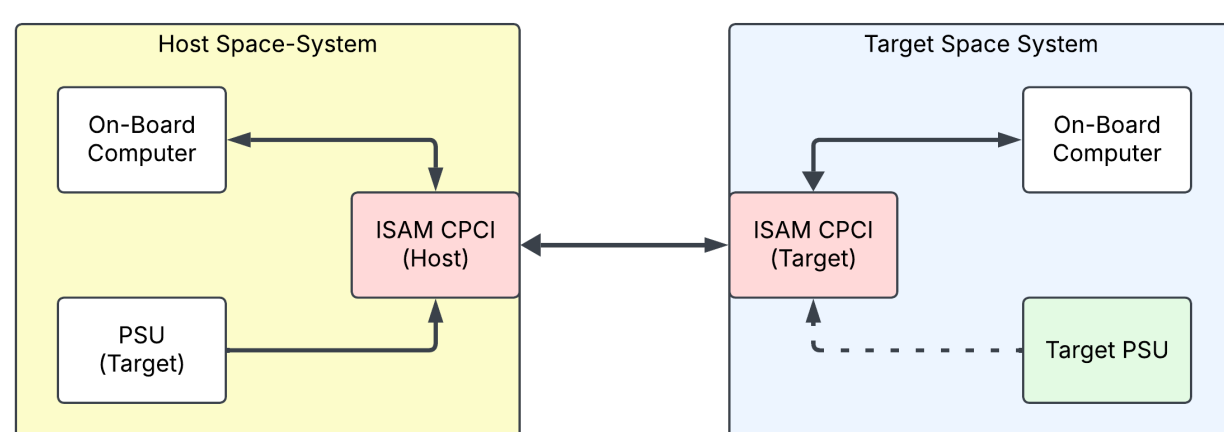
Use Case Diagram

To better understand and derive the use cases (scenarios) in which a common ISAM physical and control interface would be utilised, use case diagrams have been generated. From these use case diagrams, further behavioural diagrams could be derived to verify the user requirements.



System Design

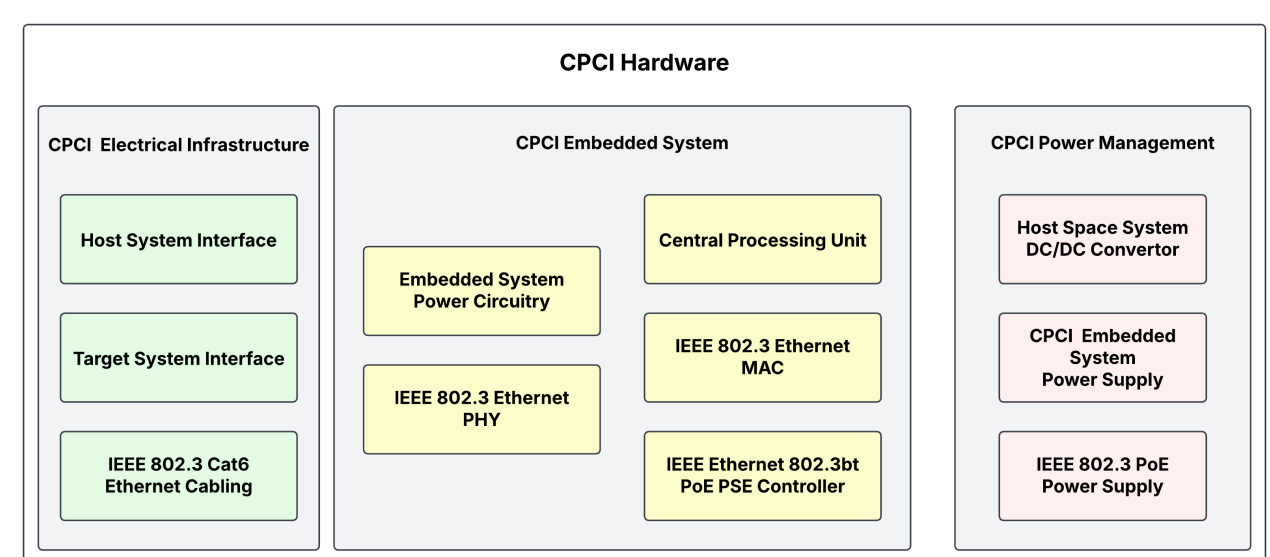
The top-level simplified architecture that depicts the Systems of Systems (SoS) for an ISAM space mission, inhibiting the CPCI, is as shown in the figure below.



It shows the expected interfaces that the CPCI will require to integrate with to satisfy the identified use cases shown in the use case diagram.

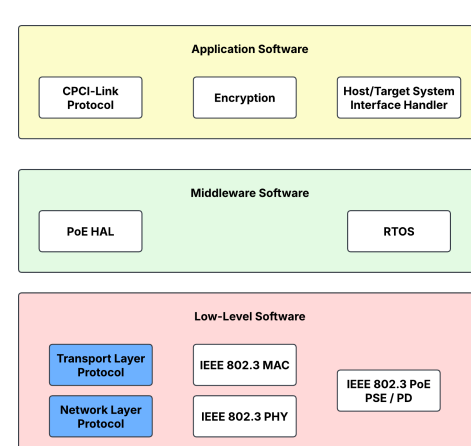
Hardware Architecture

From the identified system functionalities and subsequently solution technology during the study, the CPCI proposal hardware architecture is shown in the following figure. The proposed hardware can be categorised into three main areas: electrical infrastructure, embedded system and power management.



Software Architecture

The software architecture shows the currently understood CPCI embedded software stack, consisting of application, middleware and low-level software layers. The boxes coloured in blue would be the components within the software stack for optional functionality, as described



Conclusion and References

The CPCI for ISAM operations project has laid the groundwork for improving modularity and interoperability in ISAM. The concept of operation and proposed system design, including hardware and software architectures. A concept demonstrator system using IEEE 802.3 technology provided valuable insights, contributing to a technology roadmap for future development.

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