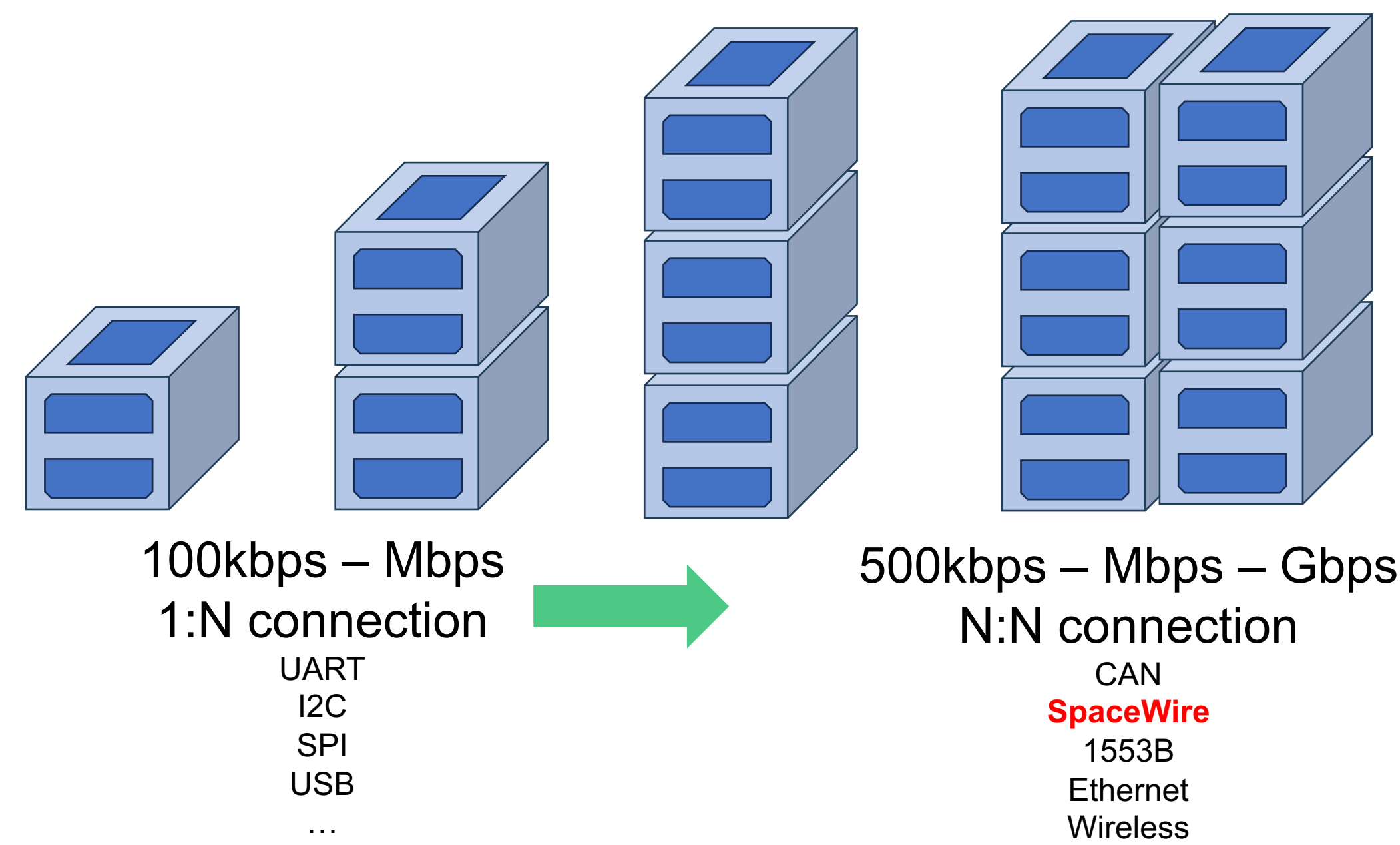


Examination of the Application Support Layer of CCSDS SOIS using SpaceWire Communication Stack and Low-code User Application

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I. Background

Complex on-board communications

As smallsats grow in large size, the on-board communication applications have become more complex, and SpaceWire, one of the standard buses, has been identified as a candidate for consideration. Since the introduction of new communication stacks increases application development costs, a standard interface for communication applications with multiple communication software stacks is required.

II. Step Examinations

1. Define the entire communication software stack structure for spacecraft from CCSDS SOIS. --- (Fig1.)
2. The use case of this research is the application interface of telemetry and telecommand services for spacecraft.
3. SIB2Generator is a low-code tool for generating the application's source code. --- (Fig3.)
4. CCSDS Space Packet is used as the data format for the SMCP application. --- (Fig 4.)
5. We propose that the implementation interfaces of the SOIS application support layer between the low-code application and the onboard subnetwork communication middleware. --- (Fig5.)
6. We develop an end-to-end communication check program using SpaceWire middleware and confirm the proposed interface. --- (Fig6.)

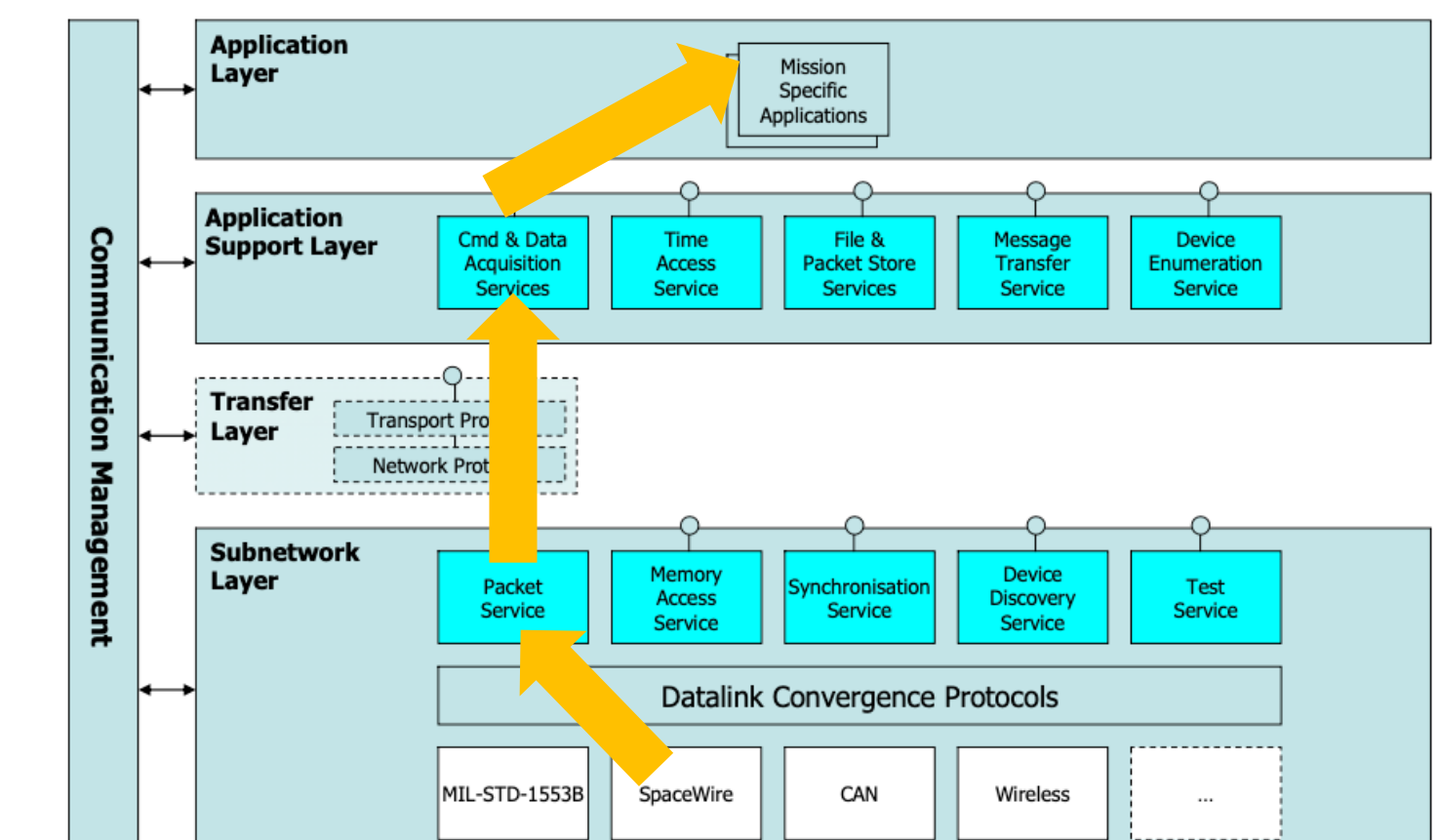


Fig1. Structure of CCSDS SOIS and Our use-case service.

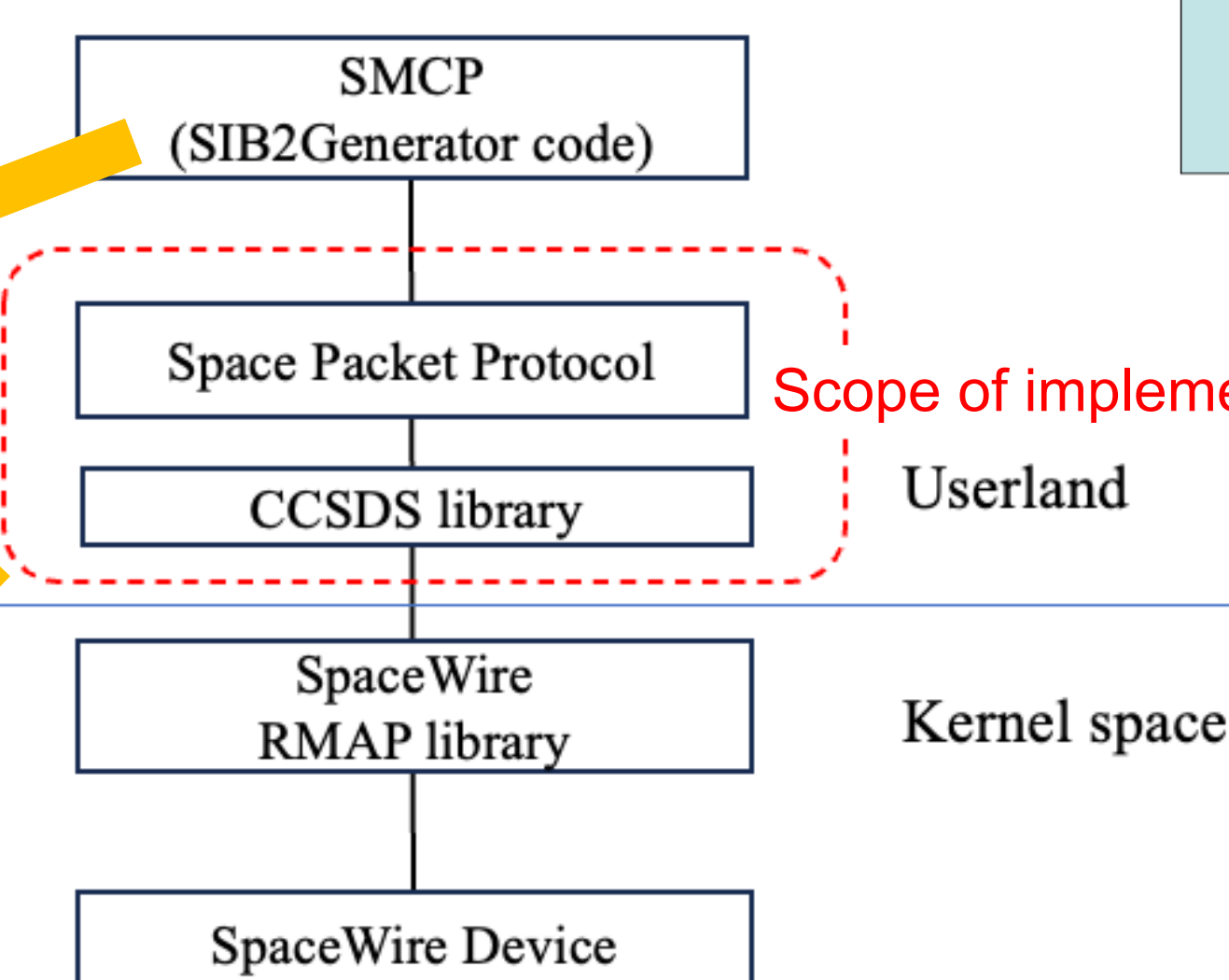


Fig2. The software stack structure of our proposed onboard communication application.

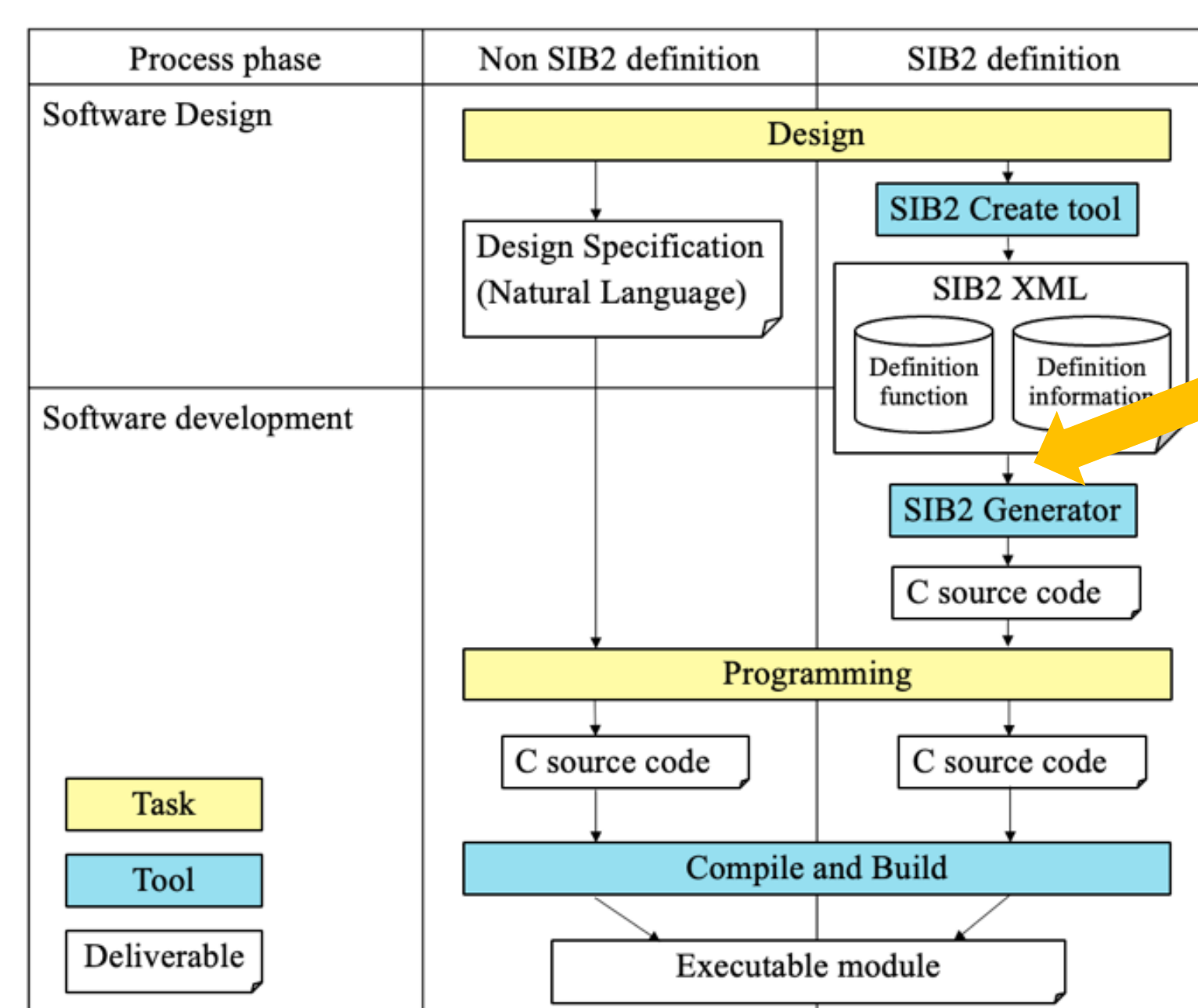


Fig3. Generated Telemetry and Telecommand Application by SIB2Generator(low-code tool).

SIB2 (Spacecraft Information Base Version 2) is a spacecraft telemetry command database designed based on MDA, which enables the automatic generation of telemetry command applications based on the database.
<https://c-soda.isas.jaxa.jp/index.html.en>

Proposed the Application support layer and implementation of the Application support layer for SpaceWire

1. Parse SMCP Telecommand message header
2. Send user data to the Application (function call to ACTION, GET, SET Telecommand)
3. Send to RMAP Reply packet

IV. Feature Works

- Examination of other Application Services (memory, time service)
- Test simulation environments for spacecraft digital twin.
- Measurement, log tracing and visualization by test simulation.

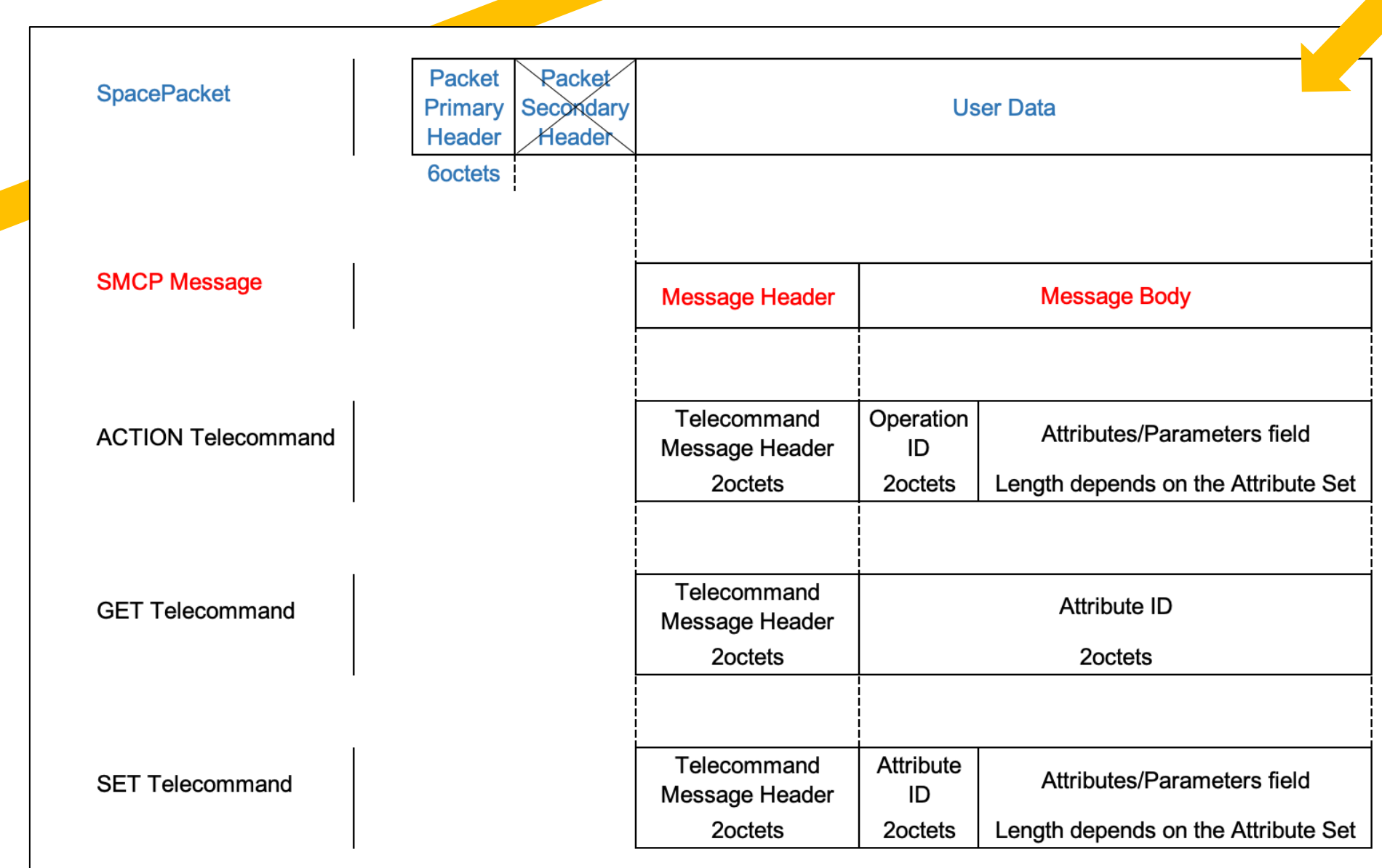


Fig4. Relationship between CCSDS SpacePacket and SMCP Message(SIB2 Application Protocol)

SMCP(Spacecraft Monitor and Control Protocol) is a protocol which is providing basic reading from, writing to and action from functional objects.

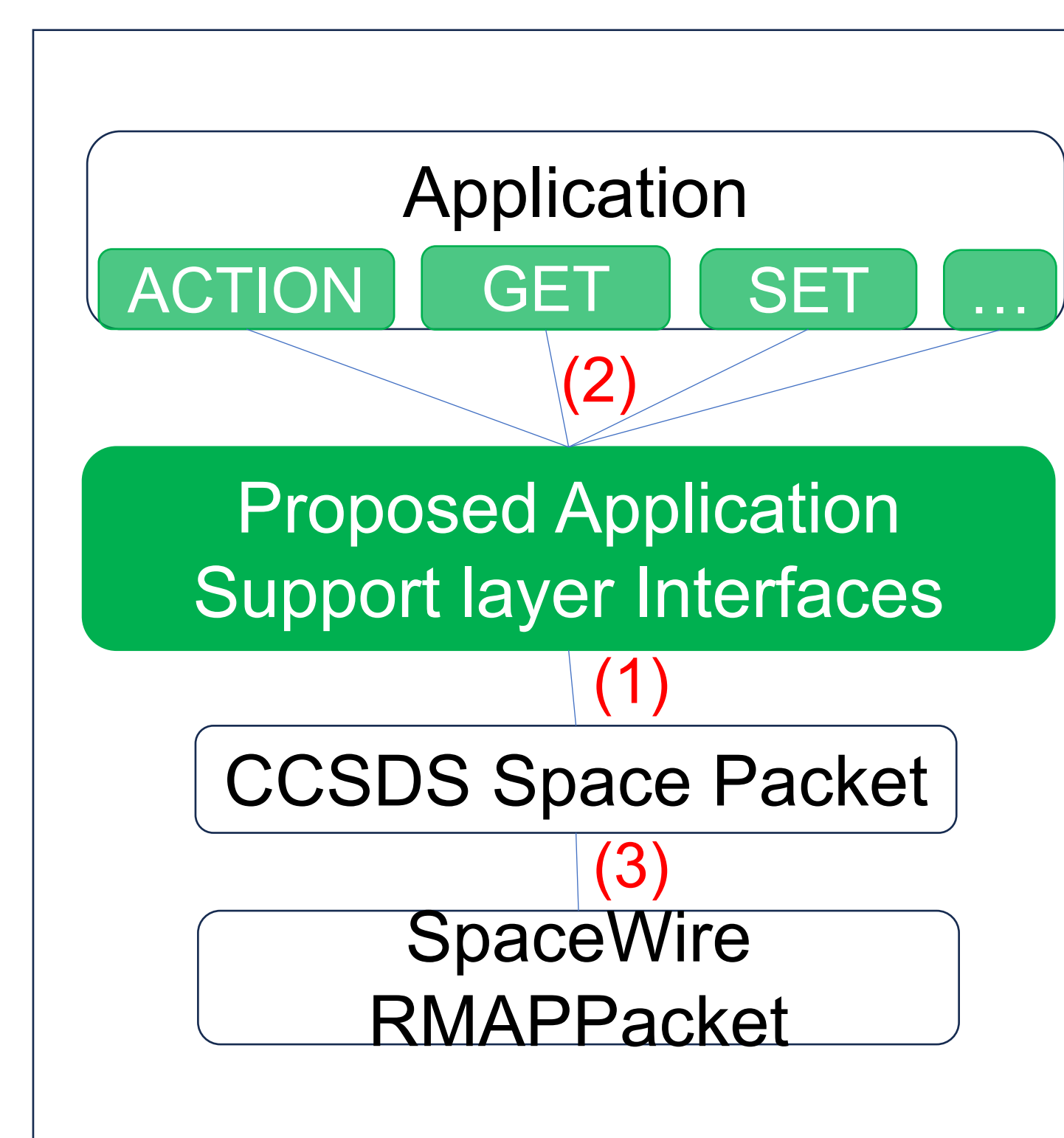


Fig5. Proposed interfaces for the application support layer

III. Result

- We defined the application support layer as an upper layer interface to the CCSDS SpacePacket and studied the implementation interface for telemetry command applications.
- A low-cost implementation interface for the application support layer was developed using a low-code application with the SpaceWire RMAP library and SIB2Generator.
- Confirmation of communication with the application using SpacePi and PC Simulator to implement the use case.

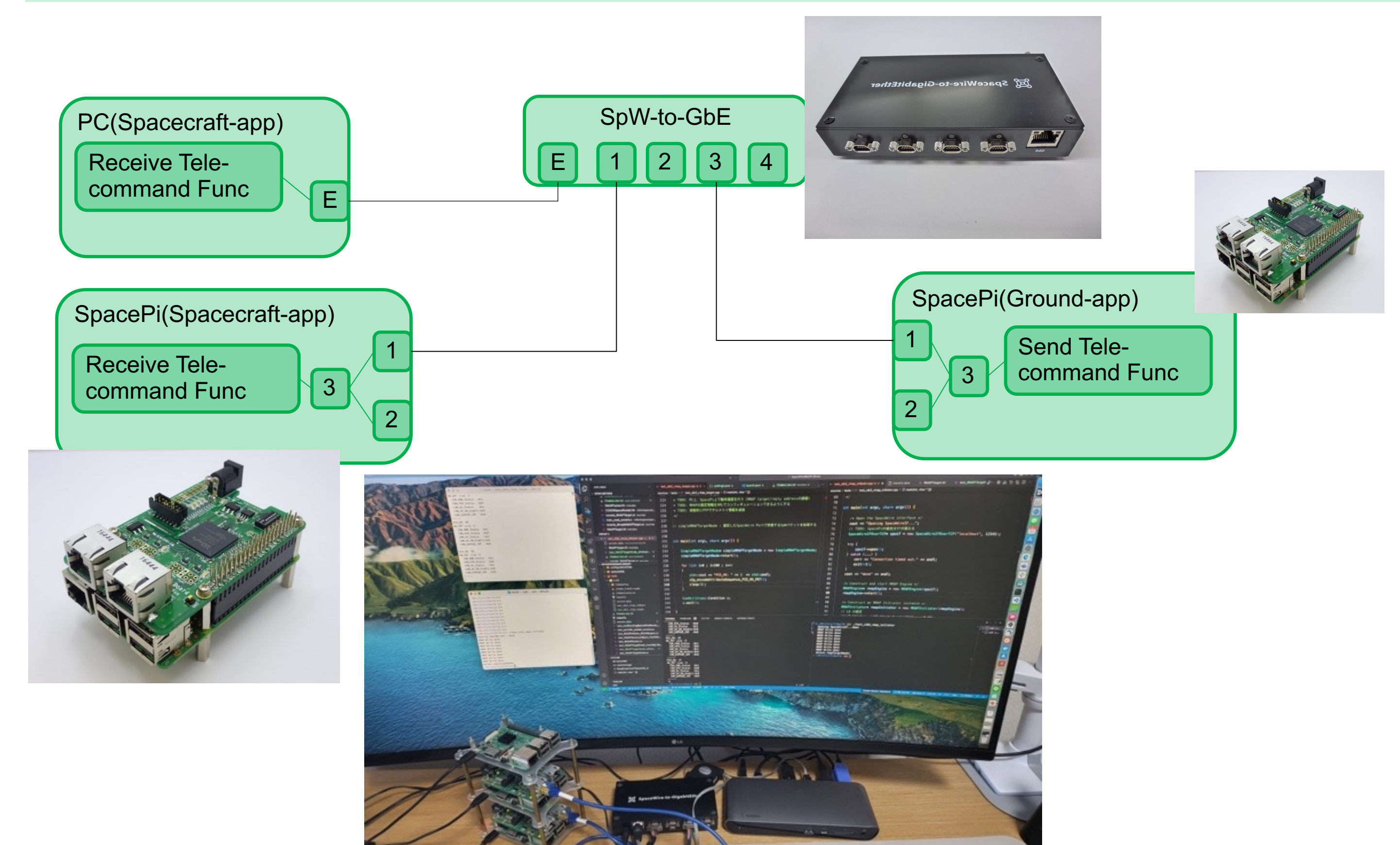


Fig6. Test environments - SpacePi (Raspberry Pi with SpaceWire HAT) and PC Simulator

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