Developing a Versatile Plug-and-Play Software Solution for CubeSat Bus Systems: Insights from Expert Interviews

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BIRDS Open Source Webinar #21

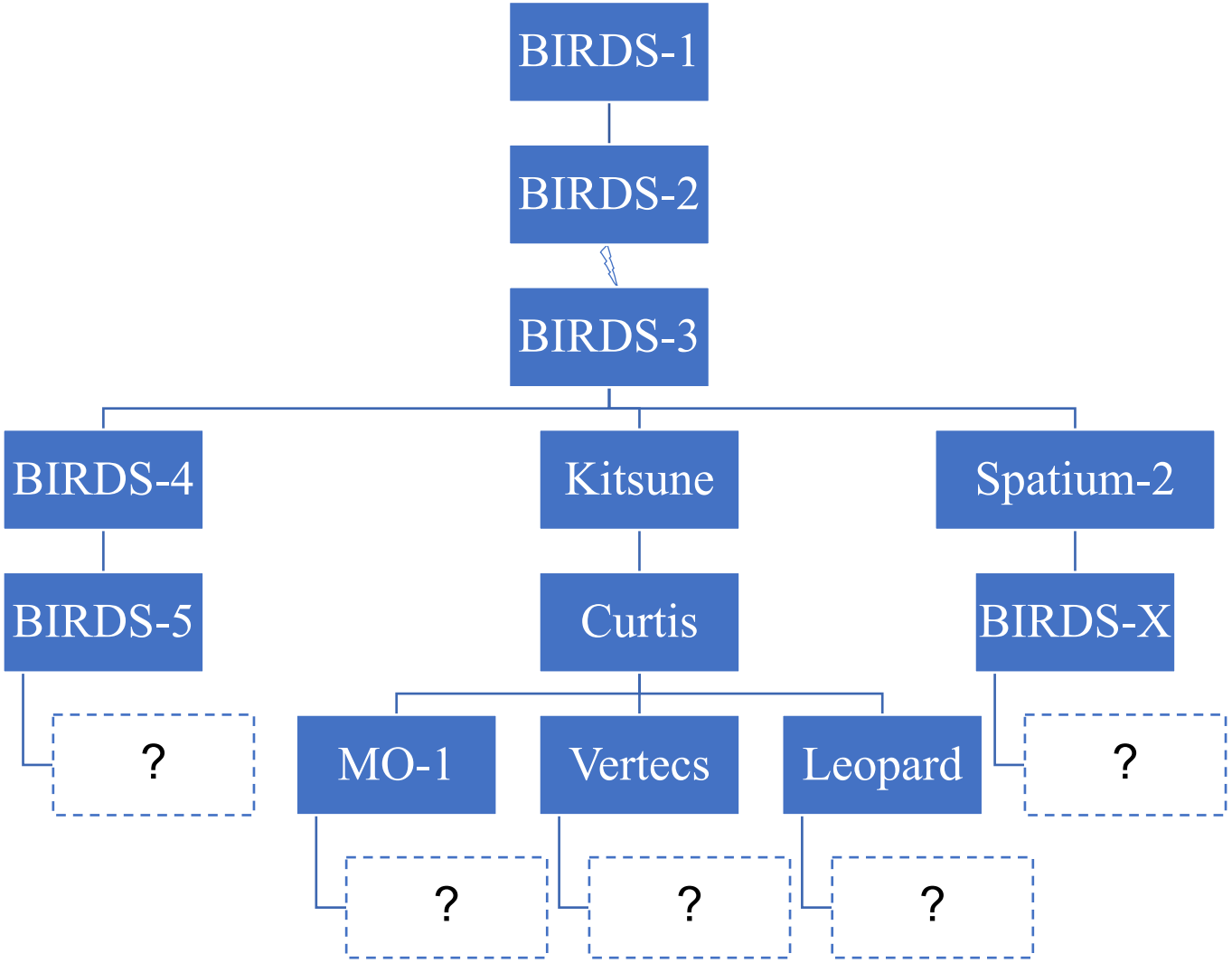
Outline

- Background
- Current Challenge
- Research methodology
- Summary of proposed outcomes
- Short term improvements
- Insights from interviews
- Questionnaire

Background

- BIRDS started in 2015
- Main goal: provide hands-on training in satellite engineering, project management, and cross-cultural teamwork to students from non-space-faring nations through the development of CubeSats in order to gain practical experience and contribute to global capacity building in space technology.

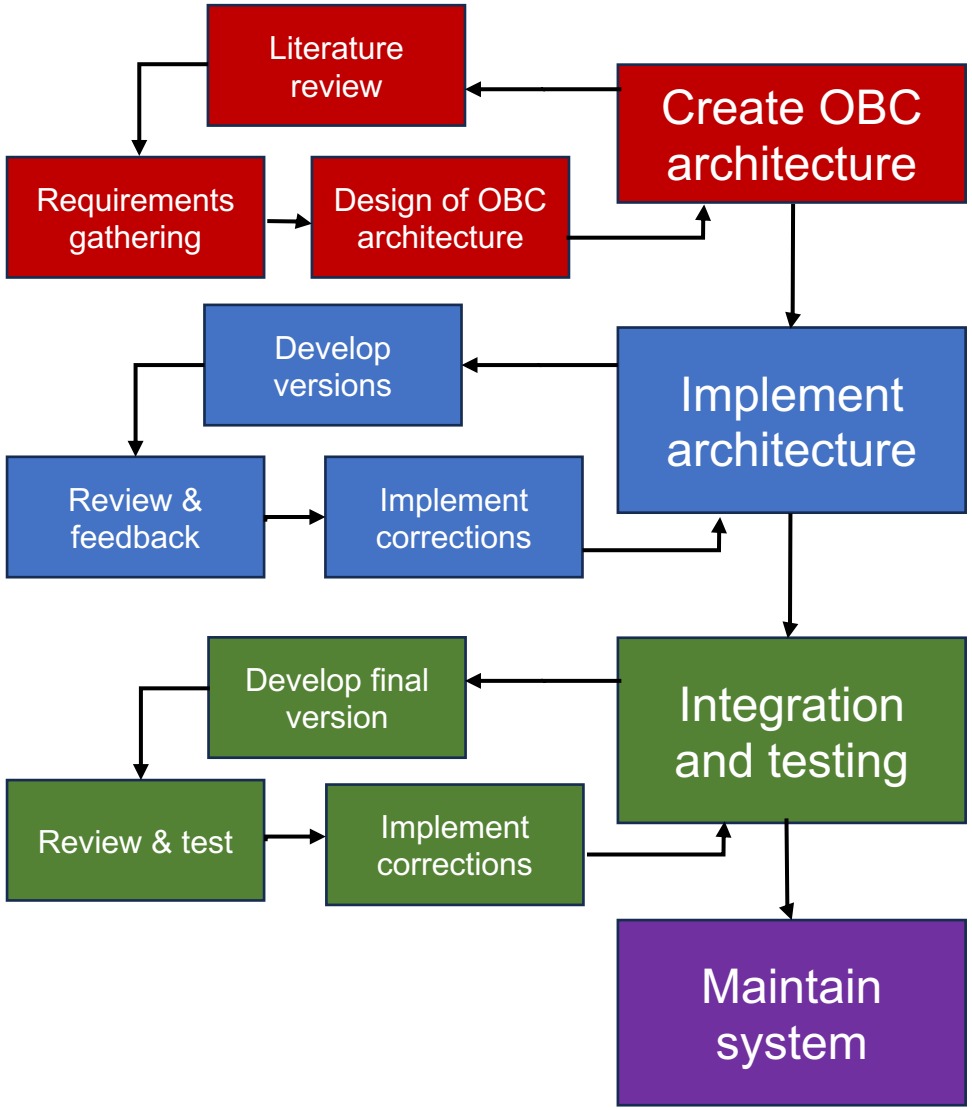
Current Challenge



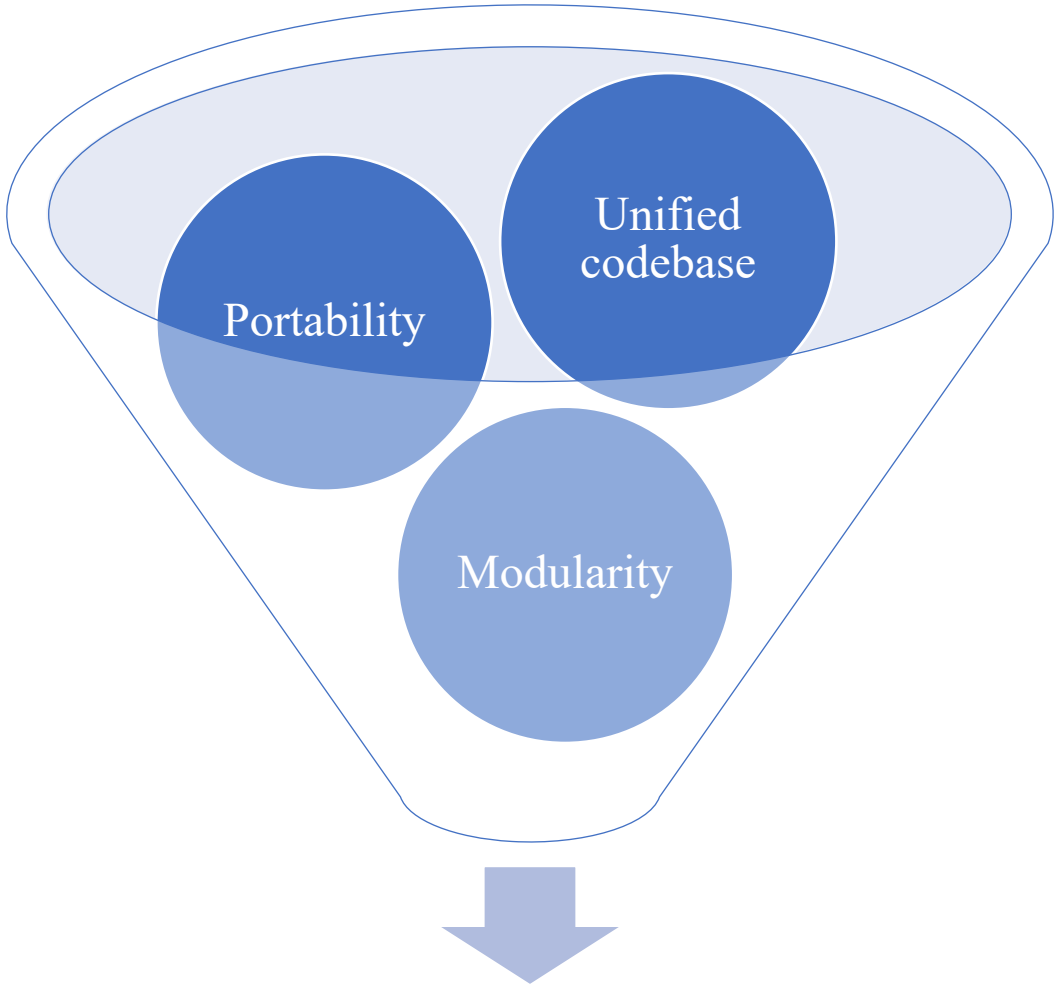
Research methodology

The approach that will be used to conduct the research:

- qualitative analysis of user and contributor feedback through interviews, survey,
- iterative development of a more structured codebase, and,
- quantitative measurements of user engagement within the BIRDS Open Source repository.



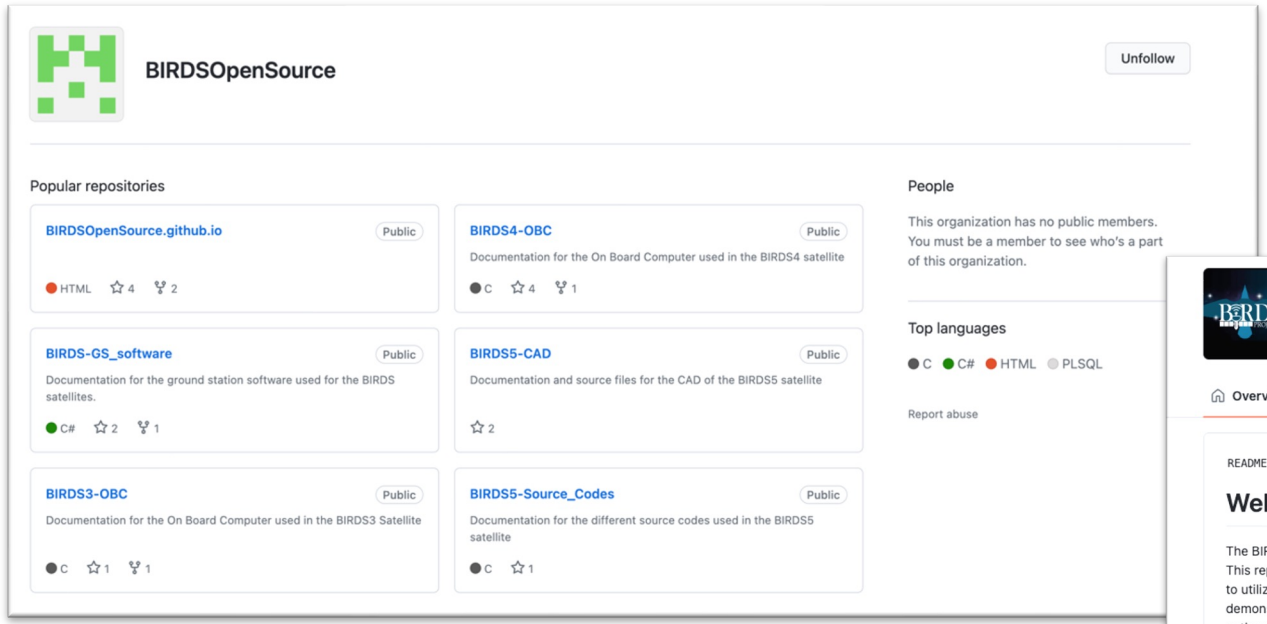
Proposed outcomes

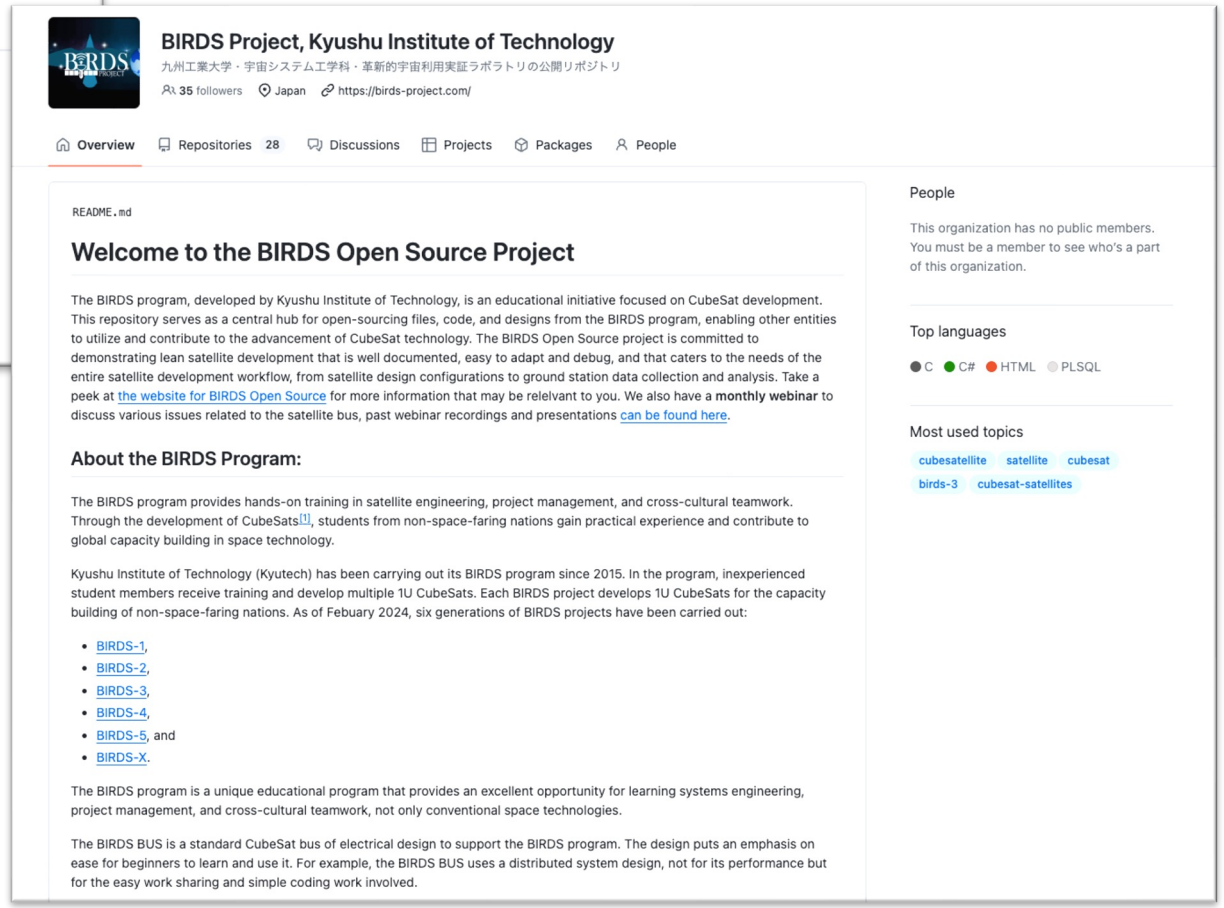


Facilitating open-source contribution

- **Mitigating replication challenges**

Short term improvements





Insights from interviews

Strategies for maintaining compatibility and interoperability

Satellite Name	Main OBC MCU	Prog. Lang.	Interfaces	Size	Missions
Birds-1	H8	C	-	5*1U	-
Birds-2	H8	C	SPI,UART	3*1U	5
Birds-3	PIC18	C	-	3*1U	4
Birds-4	PIC18	C	-	3*1U	-
Kitsune	PIC18	C	SPI,UART,CSI-2	6U	4
Spatium-2	RPi	C	USB2.0,UART,I2C,SPI	1U	1
Birds-5	PIC18	C	-	2*1U, 2U	5
Curtis	PIC18	C	UART	-	-
Birds-X	PIC18	C	-	2U	4
MO-1	PIC18	C	UART	1U	1
Vertecs	PIC18	C	SPI, UART	6U	1
Leopard	PIC18	C	SPI,UART	3U	6

✅ Firmware update

✅ Use of standardized communication protocols

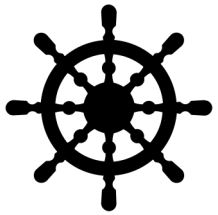
✅ Thorough compatibility testing

✅ Leveraging vendor expertise

Challenges encountered during the development of heritage cubesat software

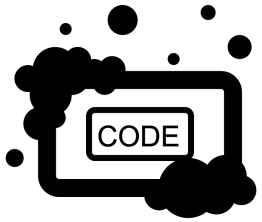
> “I learned the satellite operational flow from a flowchart on the white board and hearing members talking about it … Because I didn’t understand the H8 code **an important function was not implemented in BIRDS-3** and that was my fault.
>
> - BIRDS-3 OBC Member

code review



version control

issue tracking
(functionality checks)



clear design before
implementation

Modularity in cubesat software design

CONS

- ❌ Dependency management
- ❌ Testing and debugging
- ❌ Performance overhead

PROS

- ✅ Adaptability to hardware changes
- ✅ Reusable
- ✅ Scalable

Future directions and potential applications

Your Opinions

- Survey for research
  - https://forms.gle/3CWqpsWyNKLrUfKP6 (IN JAPANESE)
  - https://forms.gle/QfeANnToBuAHhwpb6 (IN ENGLISH)

- Opinions/ Observations on GitHub updates
  - https://github.com/BIRDSOpenSource

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END