



# SpaceWire Protocol Analyzer on Space Cube<sup>®</sup>

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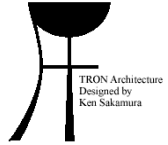
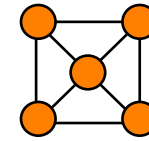
*SpaceWire User's Group, Japan*

Steve Parkes, and Stuart Mills

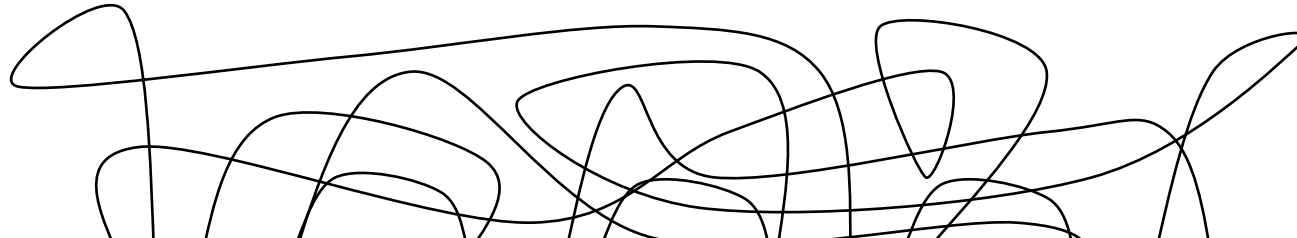
*Univ. of Dundee/Star-DundeeLtd.*



# Introduction



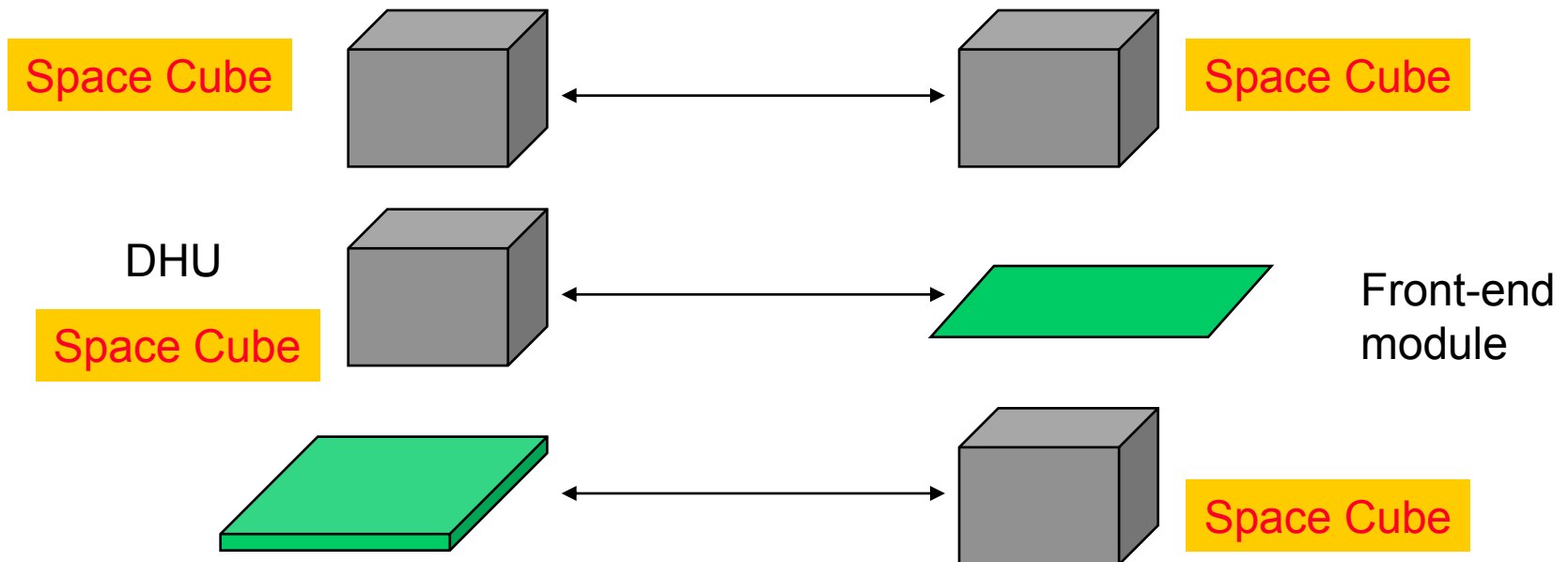
- System development in large and geographically spread community
  - (ex) Joint project like **Bepi-Colombo/MMO**
  - **Modular system**
    - **share developments**
  - **A reference in the development process**

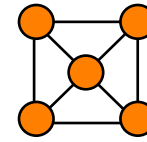


Simple and well defined interconnection  
System emulation

## □ Ground test system

- DHU emulation
  - DHU software development, Front-end module test
- Front-end emulation
  - Test DHU, System integration test





## □ Protocol tester

- USB brick (from Star Dundee)
- **Space Cube**<sup>®</sup> (from SHIMAFUJI)
  - CUBA (Space Cube Analysis Software)
  - NTSpace (Japan) - University of Dundee (UK)

**Space Cube is a stand-alone computer.**

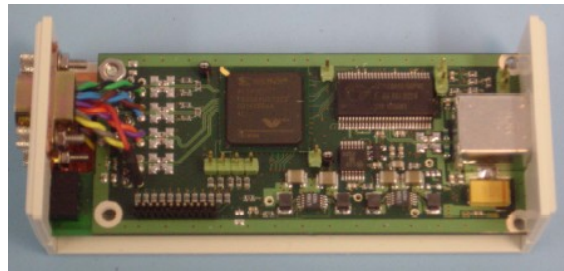
In case we need several **embedded** testers in a system, a stand alone one is preferable.

- ❑ The same RMAP protocol analyzer software runs on both USB brick and Space Cube®

Common API is established

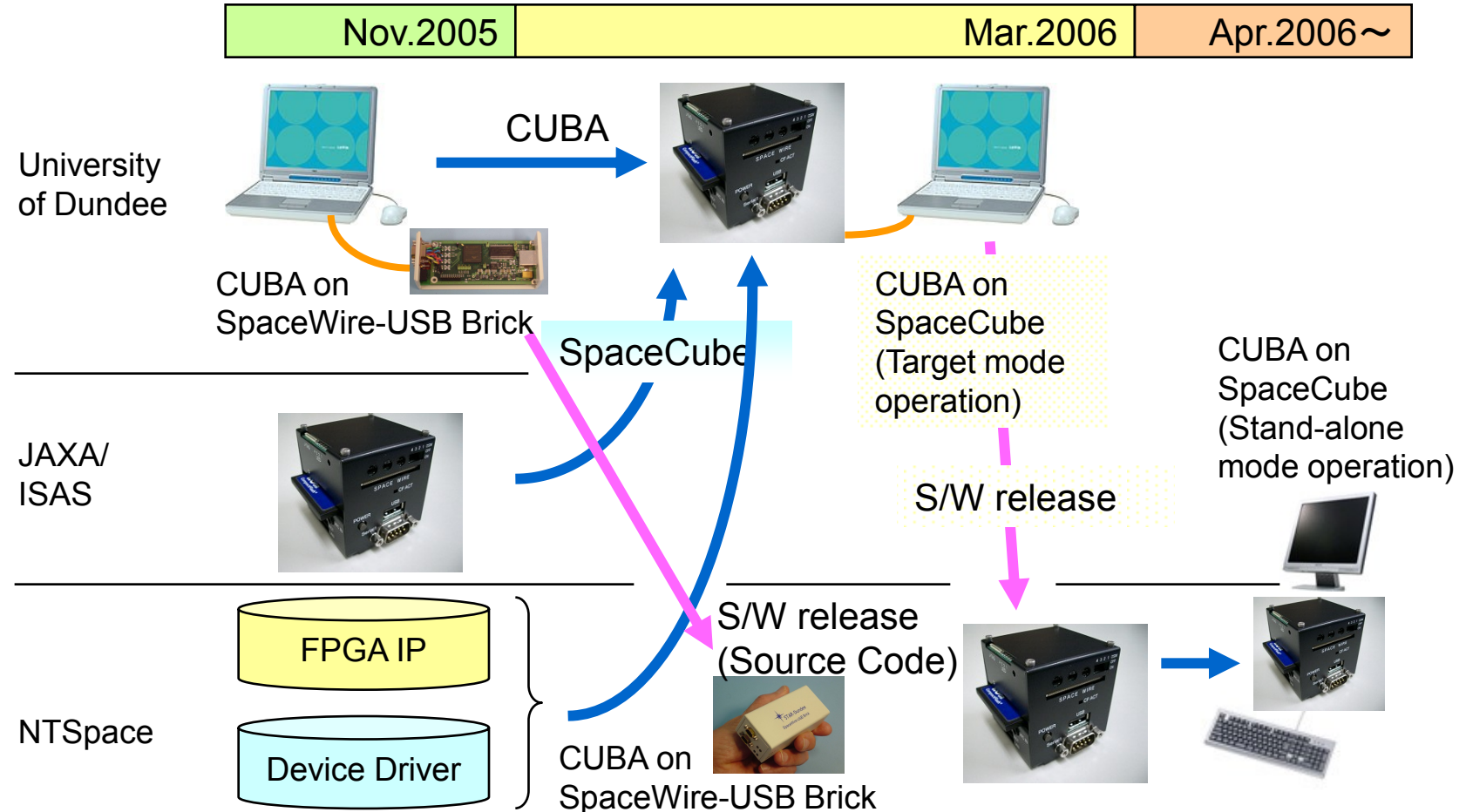


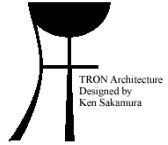
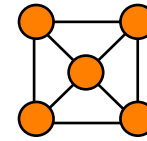
USB brick



SpaceCube®

## Development History





## ❑ Heritage of STAR-Dundee PETRI software

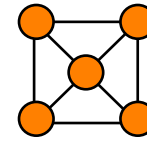
- Aimed at testing user equipment
- Send commands, receive response
- Commands defined in text file
- When to receive defined in the text file
- Run from command line
- Responses put in text file

## ❑ Four operation mode

- SpaceWire Interactive Mode
- SpaceWire Command Stream Mode
- RMAP Interactive Mode
- RMAP Command Stream Mode



# SpaceWire CUBA Software



## □ Specify Mode

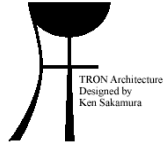
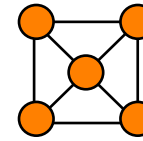
```
C:\ DOS Prompt - "SpaceWire CUBA Software.exe"

C:\Program Files\STAR-Dundee\SpaceWire USB>"SpaceWire CUBA Software.exe"

      SpaceWire CUBA Software Version 1.10
      Space Technology Centre
      Copyright (c) University of Dundee
      (S. Mills, S. Parkes)
      Using SpaceWire USB Driver version 2.32

Only one SpaceWire device detected, a SpaceWire USB Brick.
Using this device.
Please select whether an interactive (i) or stream (s) mode is to be used: i
Please select whether SpaceWire (s) or RMAP (r) commands are to be sent: s
```





## □ SpaceWire Interactive Mode

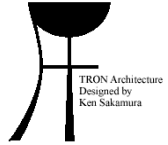
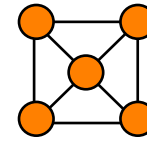
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SpaceWire CUBA Software Version 1.10
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Copyright (c) University of Dundee
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Using SpaceWire USB Driver version 2.32

Only one SpaceWire device detected, a SpaceWire USB Brick.
Using this device.
Please select whether an interactive (i) or stream (s) mode is to be used: i
Please select whether SpaceWire (s) or RMAP (r) commands are to be sent: s

Enter the bytes to be sent, "base=" followed by a base type to change the default
t or "x" to exit:
3 ff fe fd fc fb fa
Command successfully sent. Waiting for replies. Press any key to stop.
Received packet: ff fe fd fc fb fa EOP
Waiting for replies. Press any key to stop.

Enter the bytes to be sent, "base=" followed by a base type to change the default
t or "x" to exit:
```



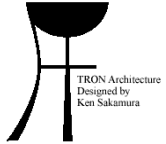
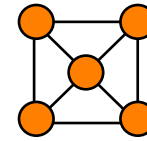
## □ SpaceWire Command Stream Mode

```
C:\Program Files\STAR-Dundee\SpaceWire USB>"SpaceWire CUBA Software.exe"

          SpaceWire CUBA Software Version 1.10
          Space Technology Centre
          Copyright (c) University of Dundee
          (S. Mills, S. Parkes)
          Using SpaceWire USB Driver version 2.32

Only one SpaceWire device detected, a SpaceWire USB Brick.
Using this device.
Please select whether an interactive (i) or stream (s) mode is to be used: s
Please select whether SpaceWire (s) or RMAP (r) commands are to be sent: s
Please enter the path to a file containing the commands to be executed:
SC_Input.txt
Please enter the path to a file to store the output (or space to ignore output)
SC_Output.txt
Command list file successfully processed.
The command list was successfully executed.

C:\Program Files\STAR-Dundee\SpaceWire USB>
```



## □ SpaceWire Command Stream Mode

– Example Input:

```
/* Send 2 packets */
```

```
S N:2 D:1 11 22 33 44 55 66 77 88 99 aa bb cc dd ee ff;
```

```
/* Change the input base to decimal */
```

```
B 10;
```

```
/* Receive 2 packets */
```

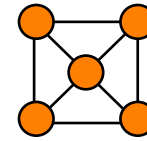
```
R N:2 L:16;
```

– Example Output:

```
/* Base = Hexadecimal */
```

```
F 11 22 33 44 55 66 77 88 99 aa bb cc dd ee ff EOP
```

```
F 11 22 33 44 55 66 77 88 99 aa bb cc dd ee ff EOP
```



## □ RMAP Interactive Mode

```
c:\> DOS Prompt - "SpaceWire CUBA Software.exe"

Please specify the type of RMAP command to perform:
  (r) Read
  (w) Write
  (m) Read/modify/write
  (b) Change the default base
  (f) Delete all fixed fields
  (x) Exit
Enter command type: r

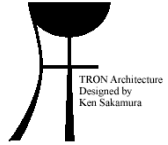
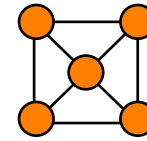
Destination Address: 0 fe
Increment Address: no
Destination Key: 20
Source Address: fe
Transaction Identifier: 0
Extended Read/Write Address: 0
Read/Write Address: 21
Data length: 4
Header CRC (e):
Command successfully sent, waiting for reply. Press any key to stop.

Read response
-----
Source address: fe
Incrementing addresses is not enabled.
Status = success
Destination address: fe
Transaction identifier: 0
Header CRC: f2
Data: 80 0 0 0
Data CRC: 31

Please specify the type of RMAP command to perform:
  (r) Read
  (w) Write
  (m) Read/modify/write
  (b) Change the default base
  (f) Delete all fixed fields
  (x) Exit
Enter command type:
```



# SpaceWire CUBA Software



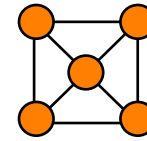
## □ RMAP Command Stream Mode

```
C:\ DOS Prompt
C:\Program Files\STAR-Dundee\SpaceWire USB>"SpaceWire CUBA Software.exe"

          SpaceWire CUBA Software Version 1.10
          Space Technology Centre
          Copyright (c) University of Dundee
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          Using SpaceWire USB Driver version 2.32

Only one SpaceWire device detected, a SpaceWire USB Brick.
Using this device.
Please select whether an interactive (i) or stream (s) mode is to be used: s
Please select whether SpaceWire (s) or RMAP (r) commands are to be sent: r
Please enter the path to a file containing the commands to be executed:
RC_Input.txt
Please enter the path to a file to store the output (or space to ignore output)
RC_Output.txt
Command list file successfully processed.
The command list was successfully executed.

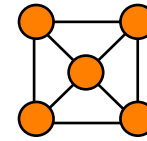
C:\Program Files\STAR-Dundee\SpaceWire USB>
```



## □ RMAP Command Stream Mode

– Example Input:

```
/* Send a read command to address 0x106 */  
CommandType: r;  
DestinationAddress: 0 FE;  
SourceAddress: FE;  
IncrementTarget: F;  
DestinationKey: 20;  
TransactionIdentifier: 0;  
ReadWriteAddress: 106;  
ExtendedReadWriteAddress: 0;  
DataLength: 4;
```



## □ RMAP Command Stream Mode

– Example Output:

Read response

-----

Source address: 376

Incrementing addresses is not enabled.

Status = success

Destination address: 376

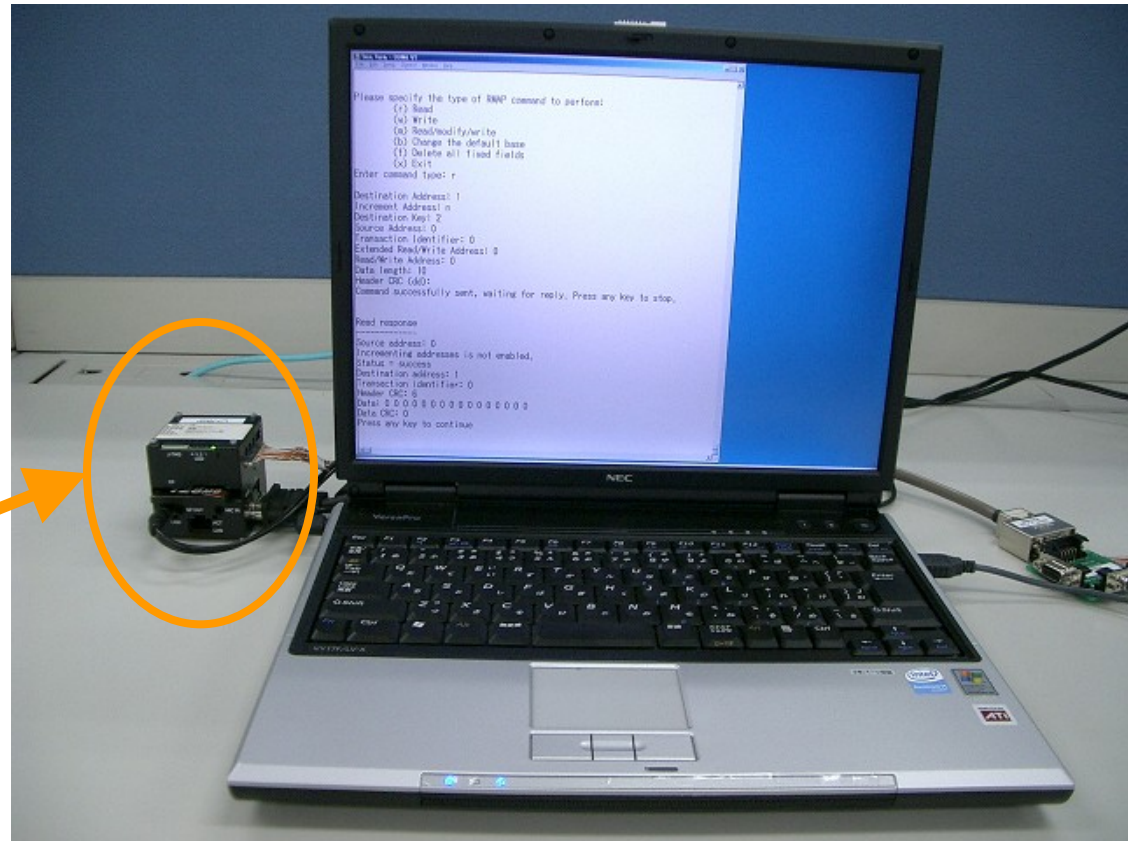
Transaction identifier: 0

Header CRC: 362

Data: 0 0 0 0

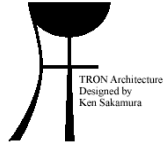
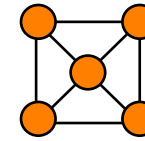
Data CRC: 0

## ❑ SpaceWire CUBA Software on Space Cube

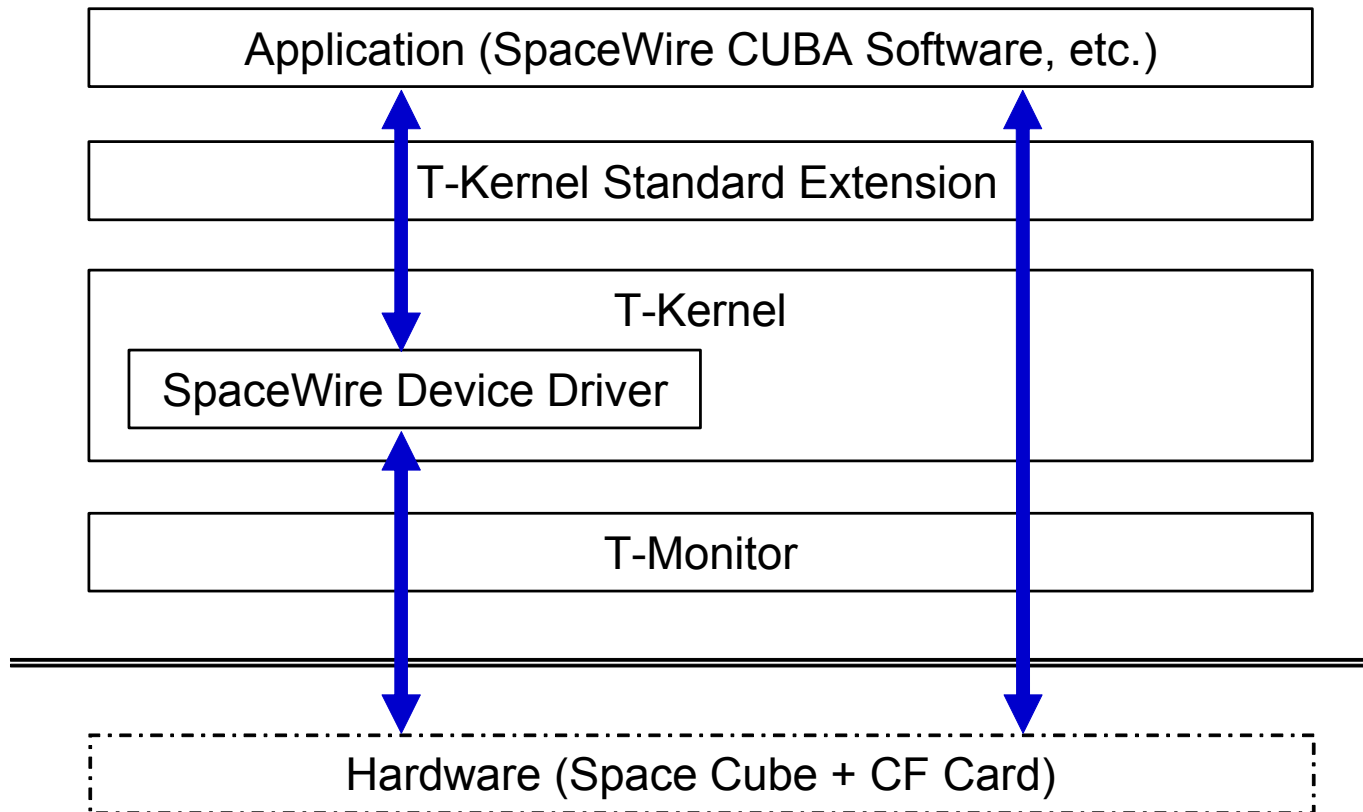


Space Cube





## □ Common API on T-Kernel and Windows





# Summary



- ❑ **Joint collaboration among European and Japanese SpaceWire community**
  - Used as a **reference** in a development process.
    - (ex) Joint project like Bepi-Colombo/MMO
  - Reflects various point of view of members participated in the development project.
    - Detail understanding of SpaceWire and RMAP specification including off-nominal state has clarified.
    - The concerns have already reflected on the latest RMAP specification
    - Community members have already enjoyed the benefit of SpaceWire CUBA Software in a sense.
- ❑ **SpaceWire CUBA Software is distributed from STAR-Dundee, Ltd. for SpaceWire user community without any restriction.**