Roadmap for Space Application (for Science Mission) in JAXA

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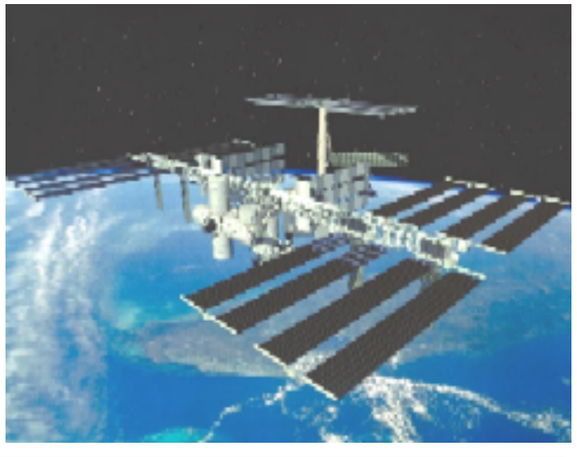
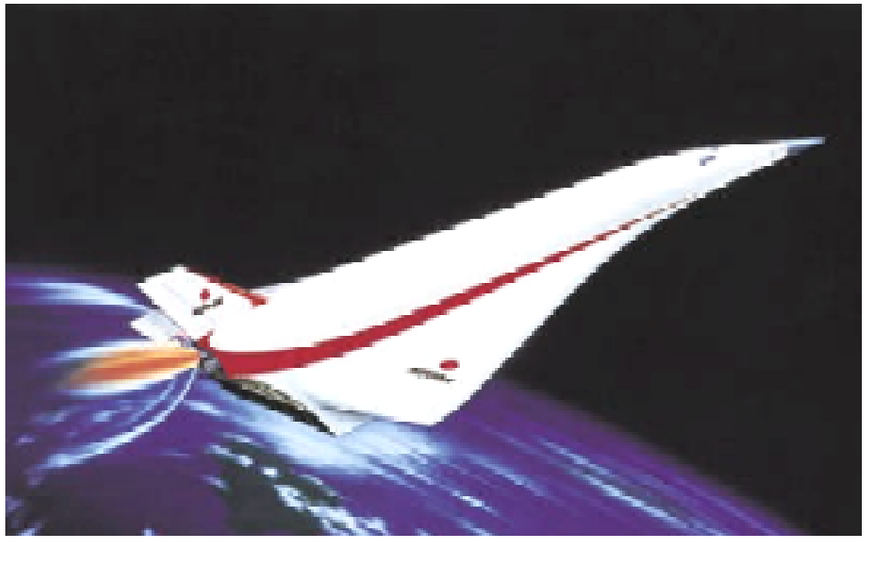
Japan Aerospace Exploration Agency



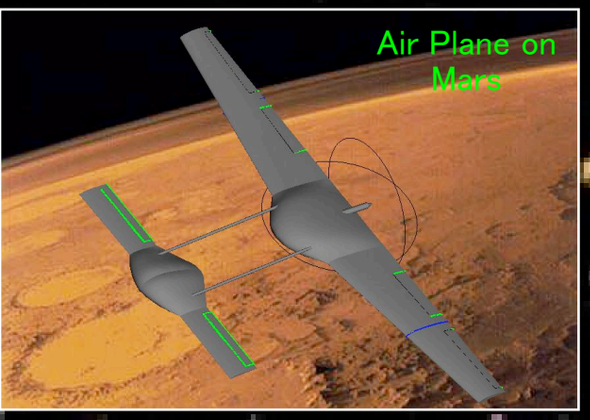


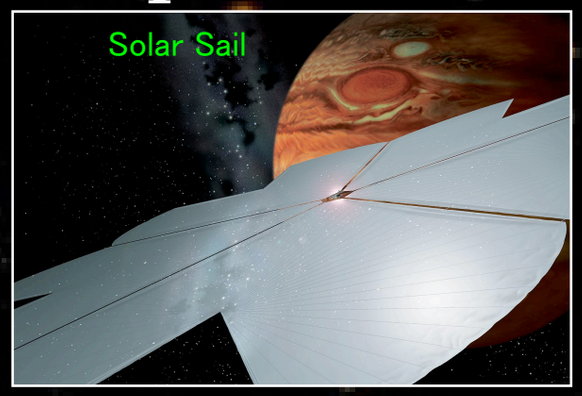
Space Wire UG in Japan (as of Oct. 2005)

FAM Science

Observation of the Universe and Exploration of the Solar System in 2025

the next-generation interplanetary navigation technology

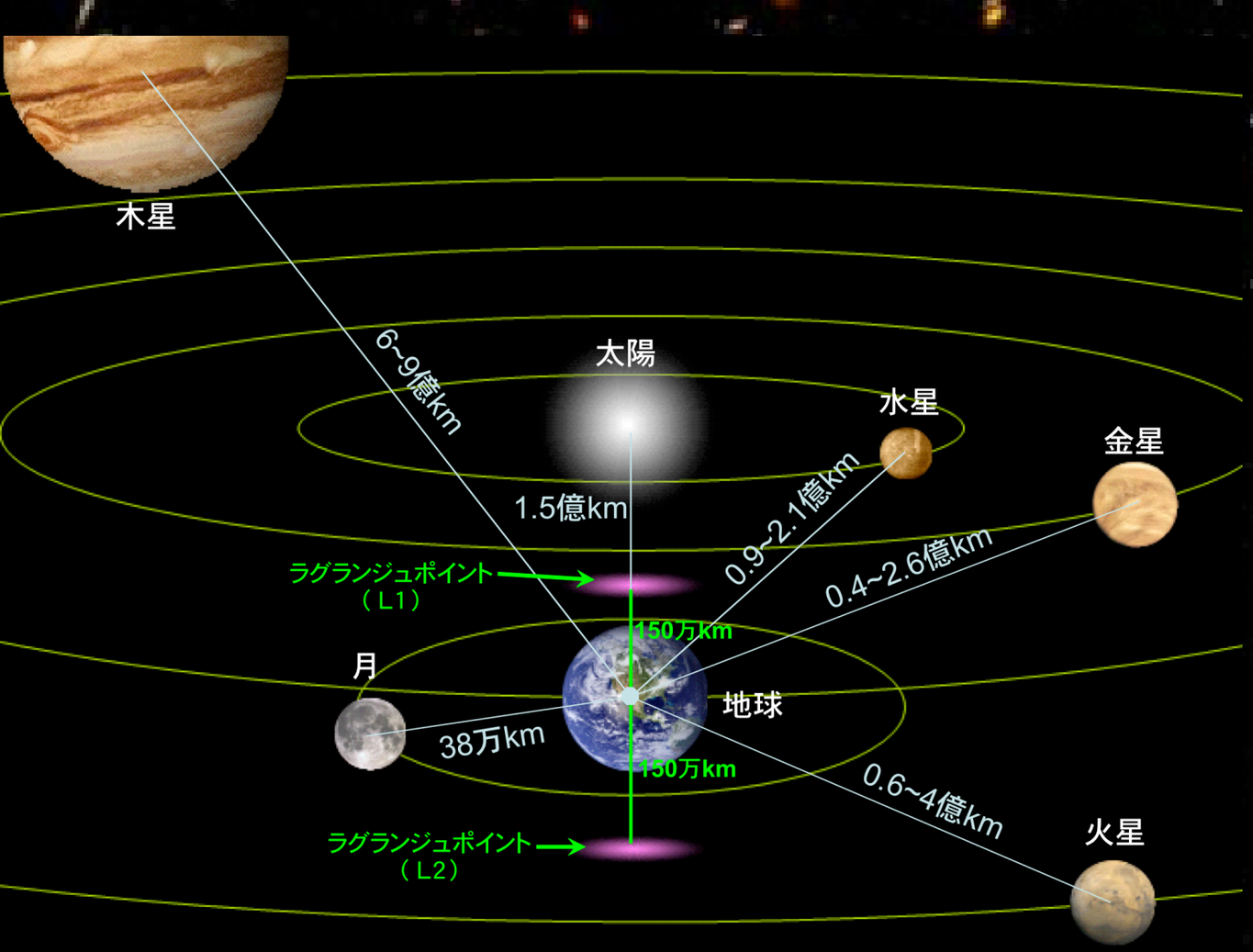




Observing to the edge of the universe

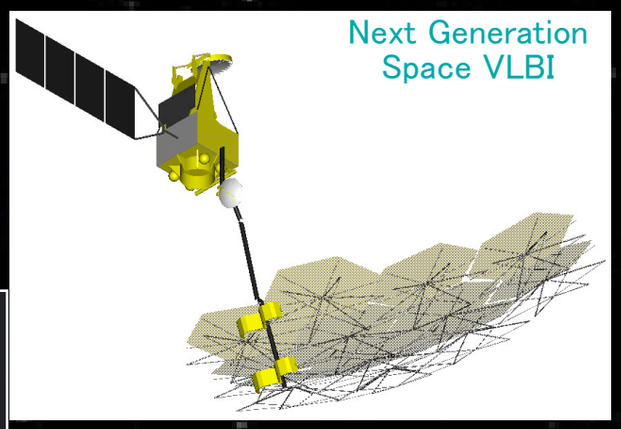
First Galaxy and First Black hole
Direct evidence of the signature of life
Exploration of Dark Energy

Reaching the entire solar system



Large Infrared Telescope to study the origin of the universe and the life

Space Observatories based on Formation Flight Technology around L2



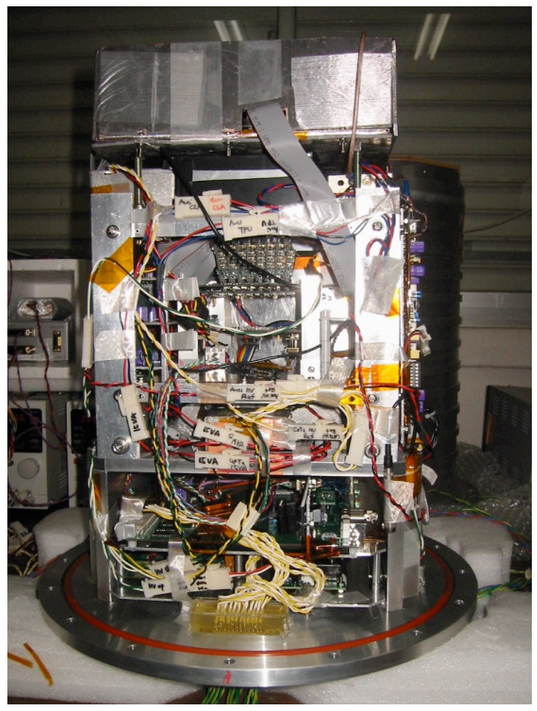
Headache!

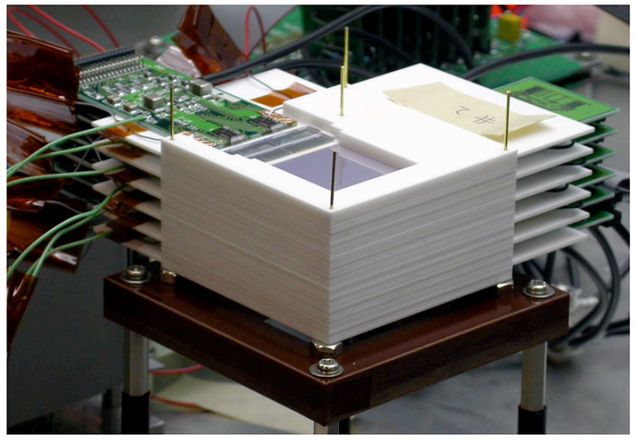
based on the experiences of making AstroE2 and others

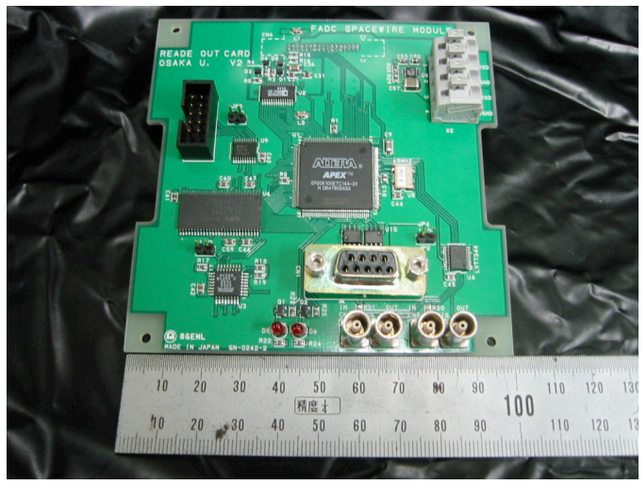
- Hand crafted to specific missions
- Different culture among different missions or even in one mission
  (sometimes spoken-technical-language is different : Beautiful Mis-understading due to a lack of common understanding)
- Complex interface between different companies : Takes time : Difficult to locate hidden troubles
- High cost just for interface testing

First Trial (2003)

We have tested "Space Wire" to know whether it matches our requirement for the use in "real" application in science



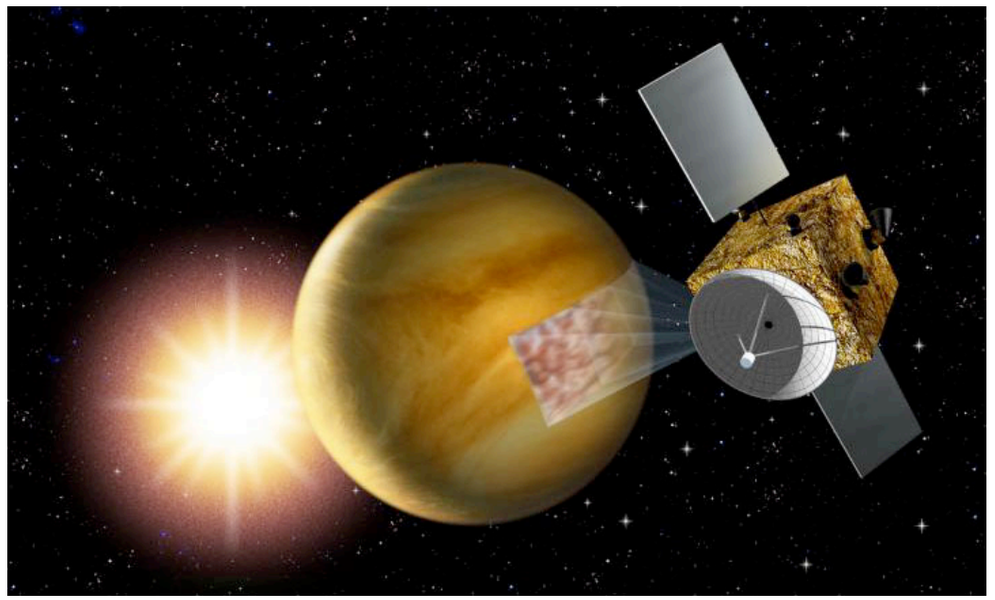




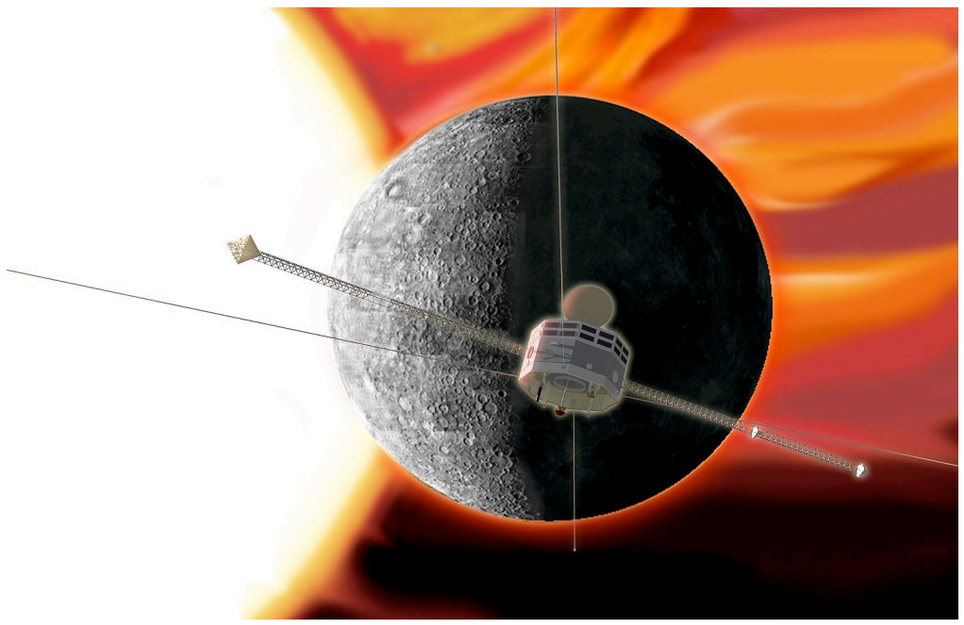
Planet-C/Bepi-MMO/NeXT

Now we have decided to adopt Space Wire for a series of future missions.

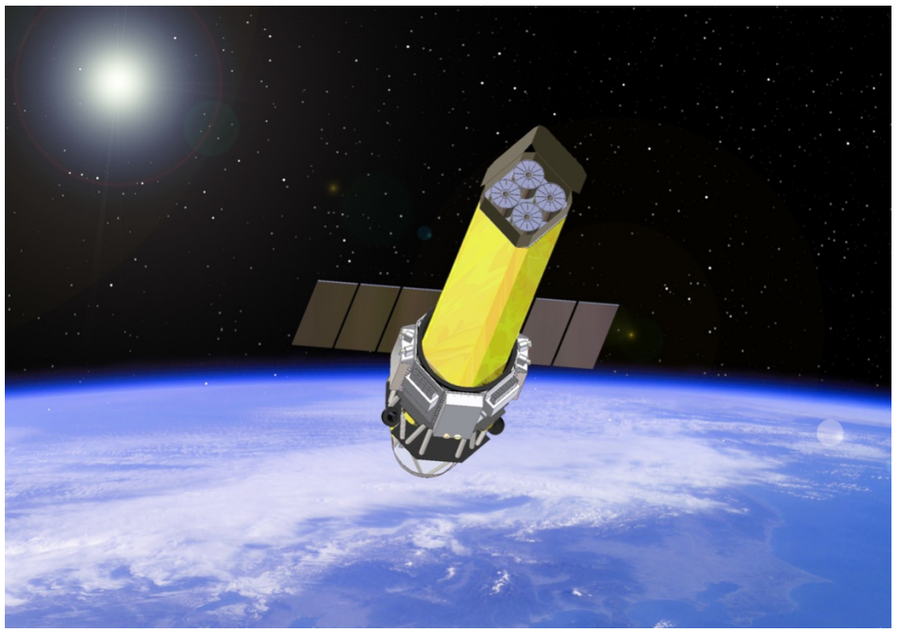
- Venus Climate Orbiter



Bepi Colombo Japanese MMO (2012)



X-ray Mission - NeXT - (proposed for 2011)



Concept

Space Wire

Exisiting Interface

Scientific Payloads

Data Hadling Unit
for Common system

bridge

Computer
for
Payload

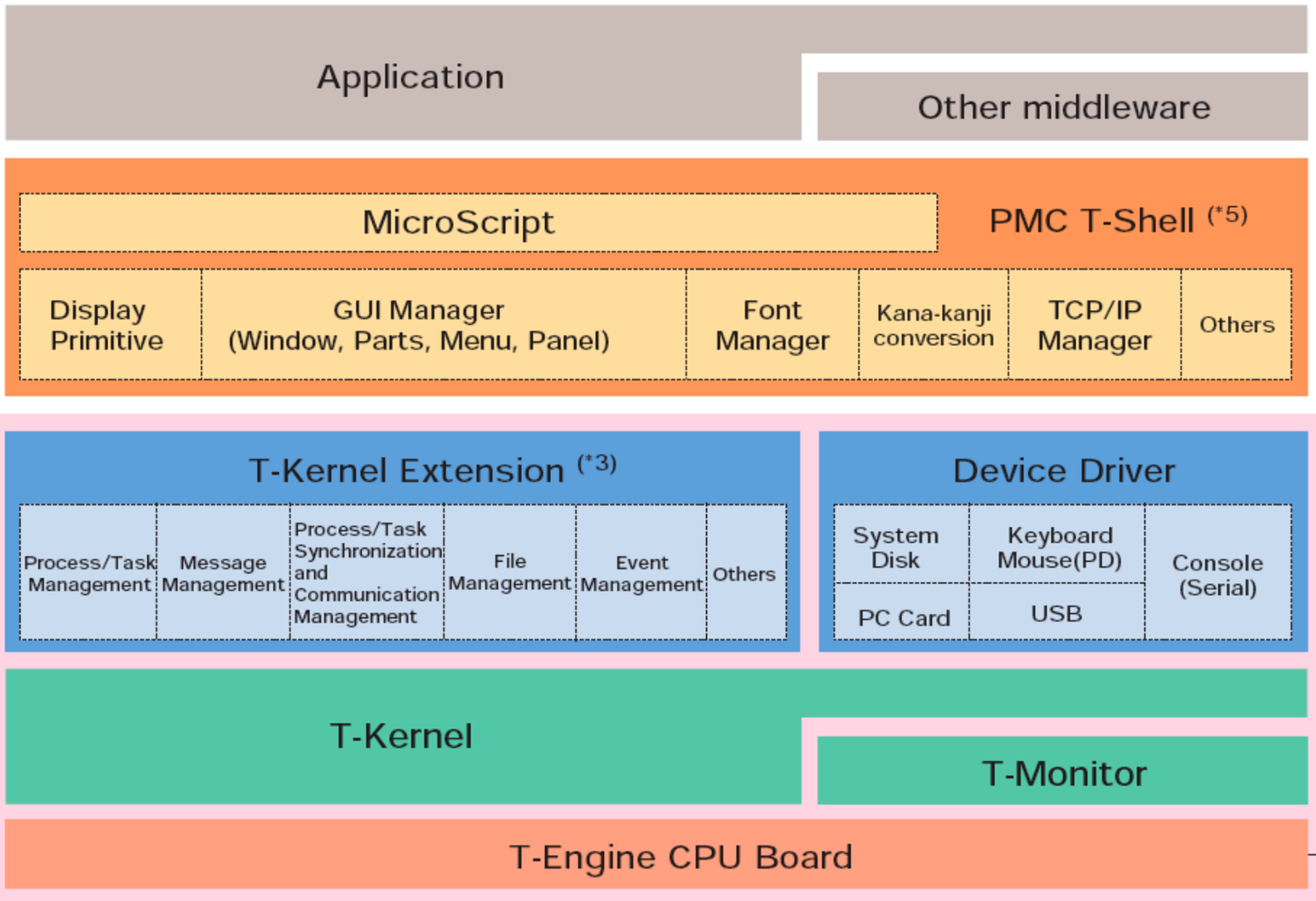
Computer
for
Payload

Computer
for
Payload

Computer
for
Payload

One more “Key Tech”

ITRON: Real Time OS >60 % share
For embedded system world wide
car, cellular phone
CTV tuner
HD recorder



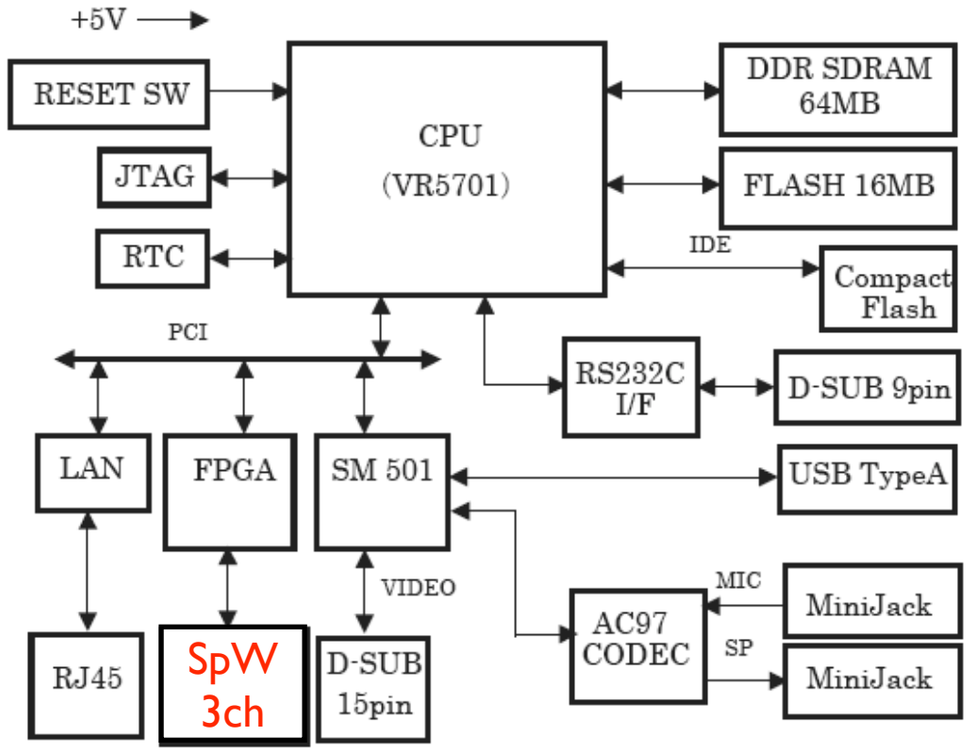
(*3) Some T-Engine Development Kit products do not include the T-Kernel Extension.
(*4) Some T-Engine Development Kit products do not include a touch panel LCD.
(*5) Available separately as the PMC T-Shell Development Kit

Space Cube®

SpaceWire based computer developed by ISAS/ JAXA & Shimafuji.

We are working on the standard SpW test system which allows us to skip interface testing of onboard equipments
: Send SpW commands
: Access by using RMAP
: can be used as a standard EGSE

Block Diagram



Specification

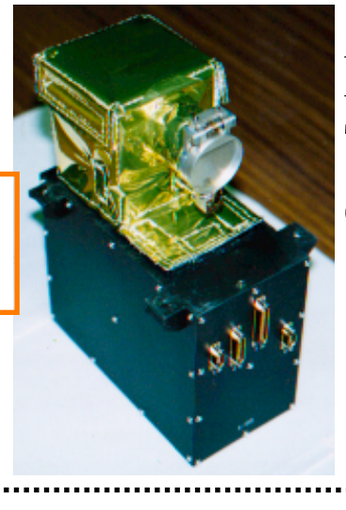
CPU	VR5701 200MHz／250MHz／300MHz
FlashROM	16M Byte
DRAM	DDR SDRAM 64M Byte
INPUT/ OUTPUT	IEEE1355 (SpaceWire), RTC, CF (True IDE), XGA (1024×768), USB1.1, LAN (100BASE), Audio (Stereo) RS232C, JTAG I/F (Debug)
POWER	+5V
SIZE	52mmx52mmx55mm

Concept (2)

DHU/MDP simulator
(SpaceCube)

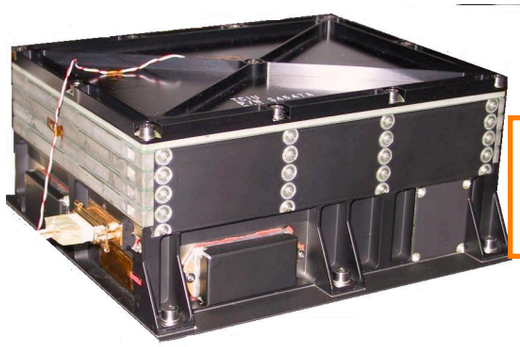
SpW I/F ⟷ SpW I/F

Sensor-A



Development
Test (Com/TLM)
Calibration …

DHU/MDP



SpW I/F

SpW I/F

Emulate for Sensor-A
(SpaceCube)

SpW I/F

Emulate for Sensor-B
(SpaceCube)

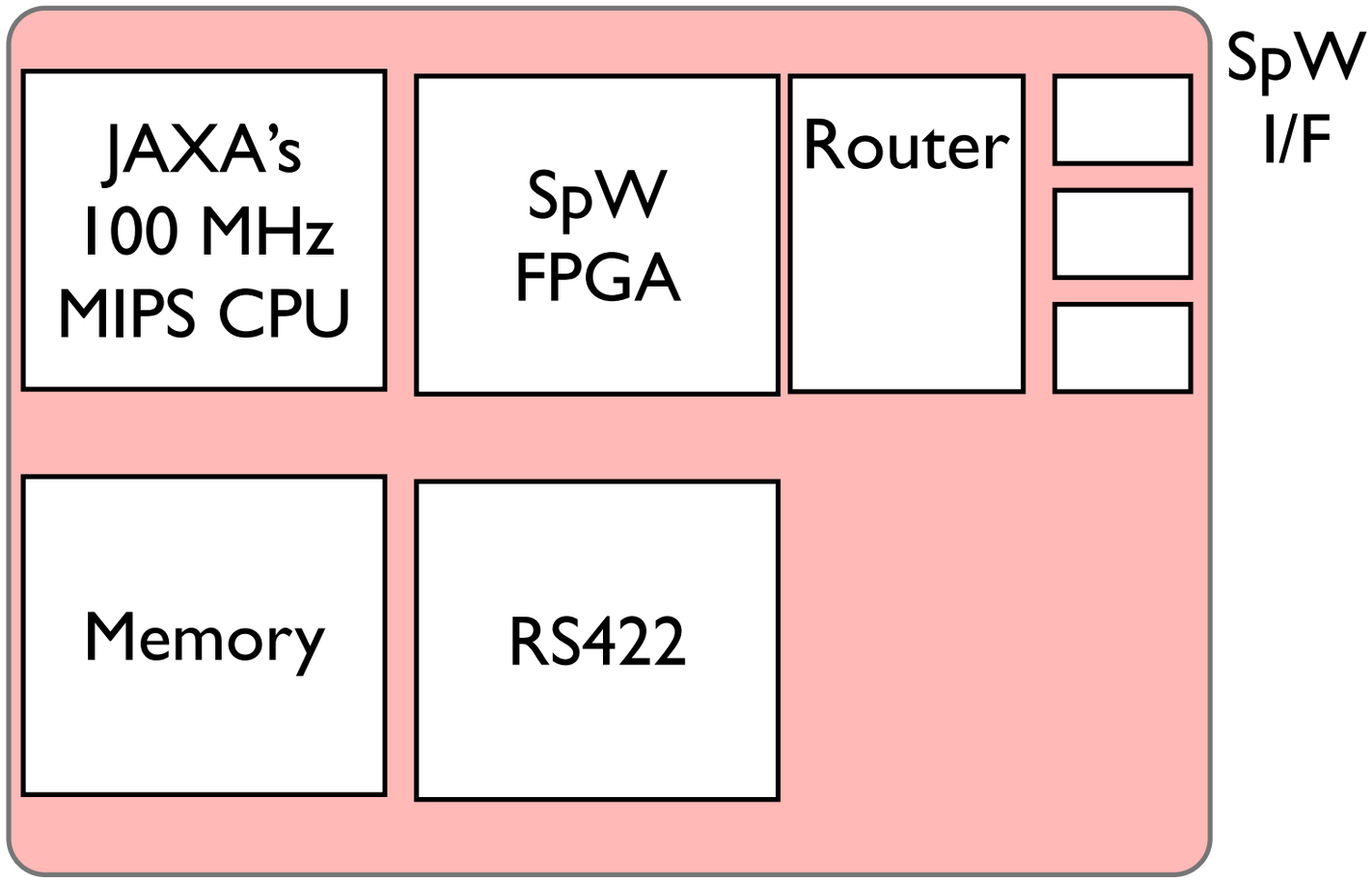
SpW I/F

Emulate for Sensor-C
(SpaceCube)

Development software
Testing for DHU

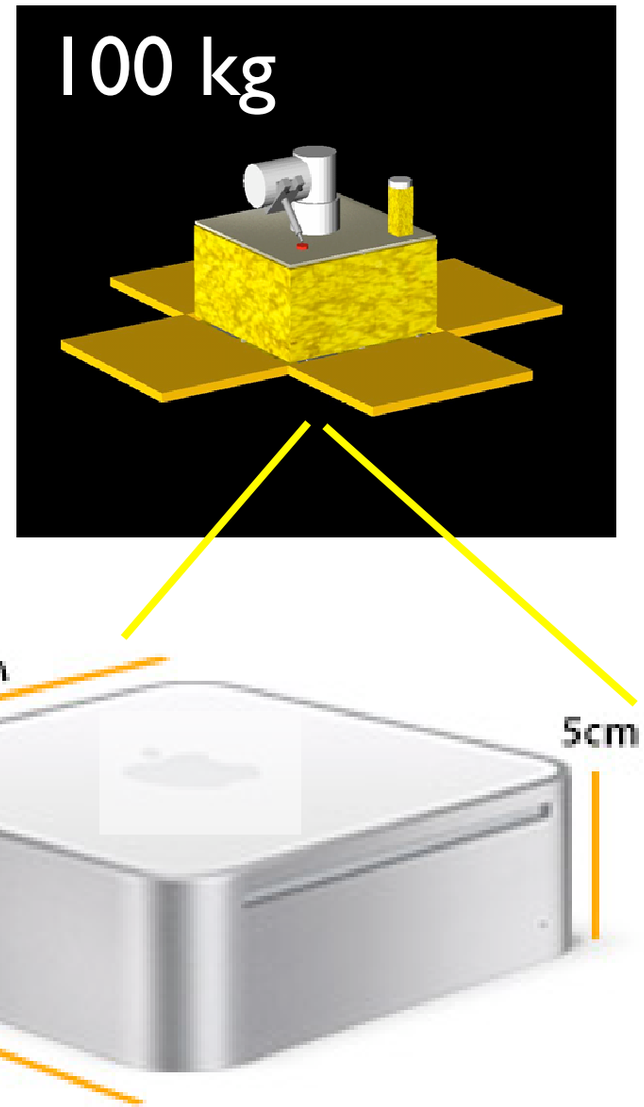
Space Cube II

First Prototype for DHU (Data Handling Unit) for Space



Objective: to establish
"Reference Architecture" for
science missions

propose small mission
for technical verification

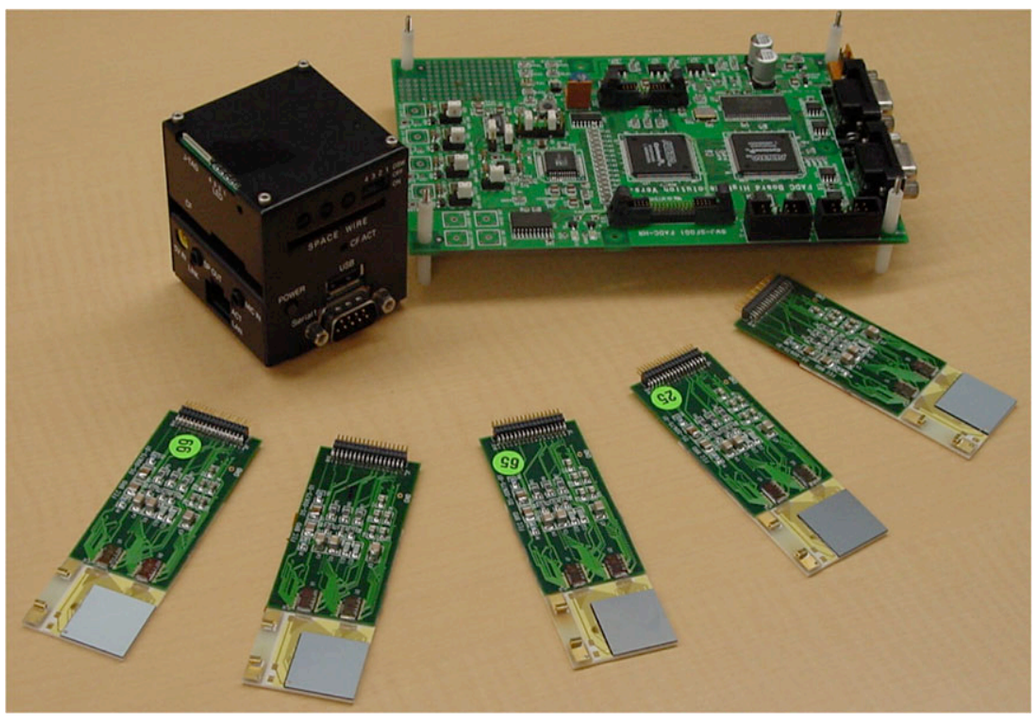


Industrial Application

Space Wire is very attractive

1. High Speed
2. Simple Interface
(can be implemented in FPGA)
3. RMAP makes hardware simple

gamma-ray module
for medical/inspection system
(ISAS/JAXA, MHI, ACRORAD)



NEC/NEC-Toshiba/ISAS-JAXA

Summary

- We have recognized that
  - Space Wire is a way to go (RMAP is useful)
  - Real Time OS is important
    - The concept of T-Engine is what we like
- Need more discussion to establish the concept of future satellite architecture in JAPAN