Multi Interface I/O Extension Card of T-Engine Platform for the Study of SpaceWire Protocol

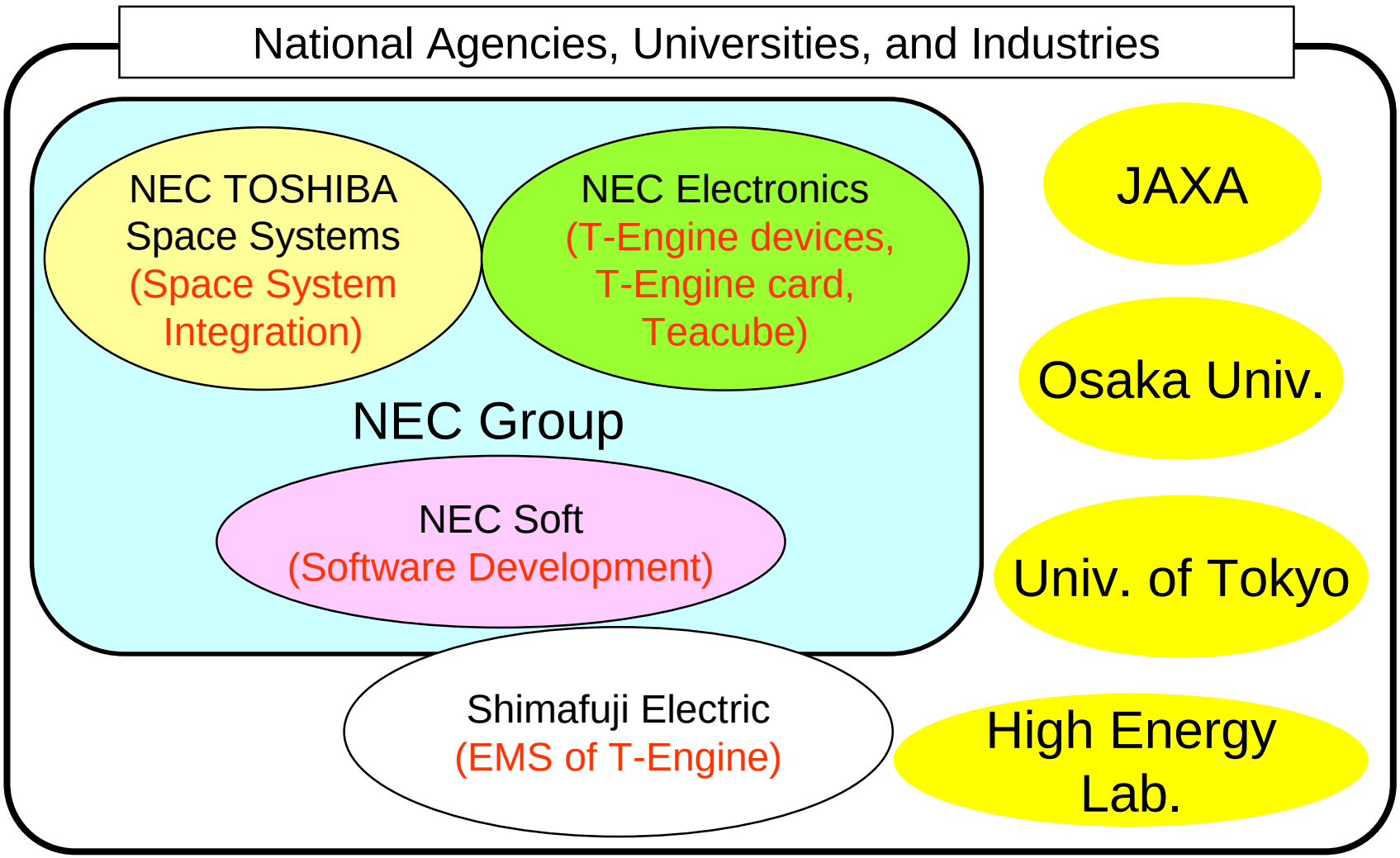
Hiroki Hihara

NEC TOSHIBA Space Systems, Ltd.

The Objective of SpaceWire Extension for T-Engine

- **Large capacity and high quality mission data transmission by high speed serial bus**
  - Standard high speed backbone data bus using IEEE-1355（SpaceWire）
  - Router function for other standard interfaces as CAN, IEEE-1394, etc.
  - Flexible connection and/or selection of various sensors and cameras by Plug'n Play function
- **Exploiting system LSI technology**
  - "Satellite system on a Chip (SoC)" with large scale system LSI technology
  - Small size, light weight, and low cost satellite bus with straight forward technology evolution (without any quality de-grade)
- **Standardized real-time processing platform**
  - TRON and T-Engine technology for real-time processing platform.
  - Meta-level integration of various sub-systems using object-oriented design
    ⇒ Operation scheme and sensor integration are the same over various satellite mission
  - Flexible inter-component connection with standardized bus interface

Development Framework
- wide range collaboration



■T-Engine

Standard T-Engine

micro T-Engine

Prof. Sakamura

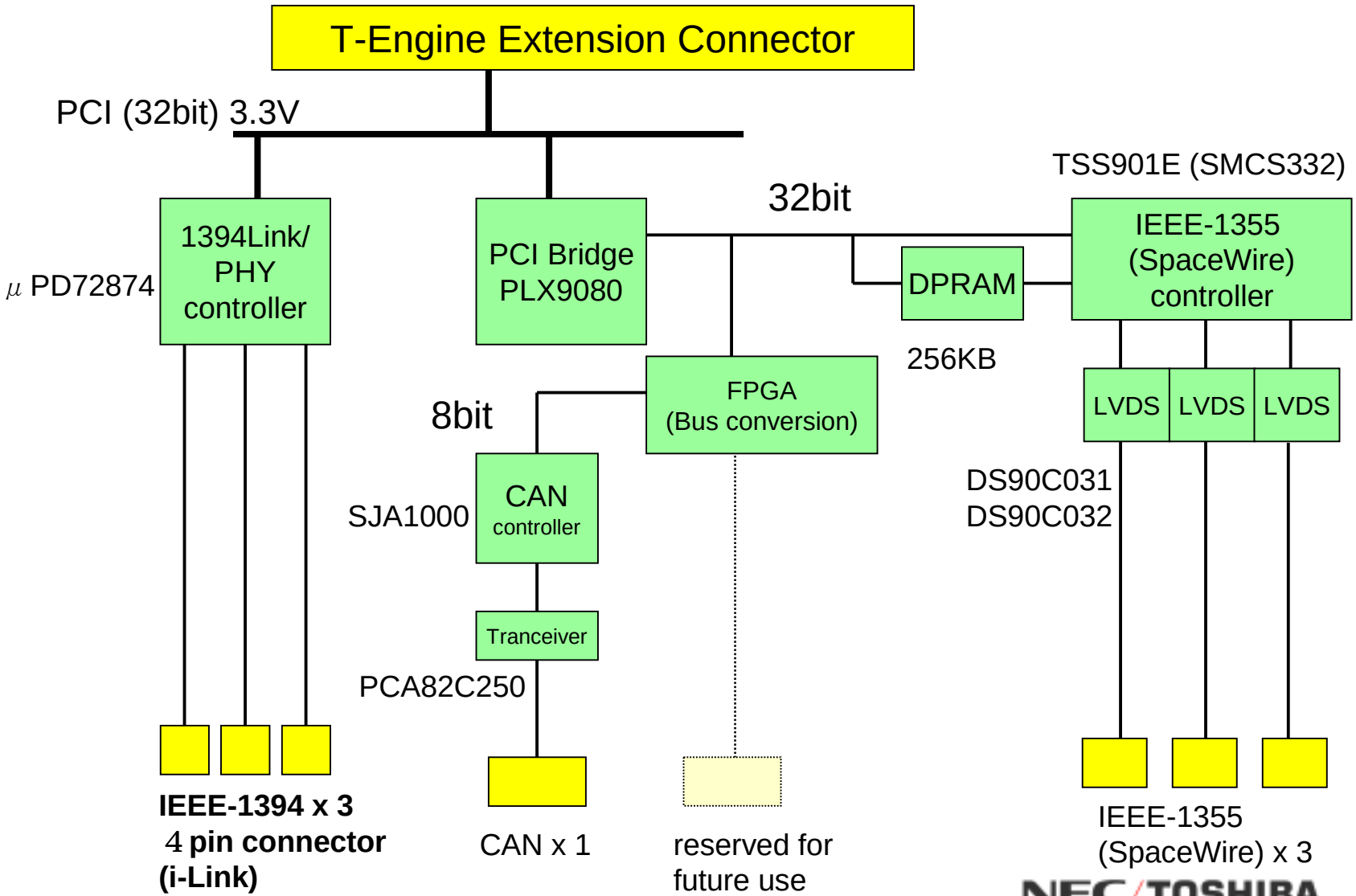
nano T-Engine

SpaceTRON (STRON) Extension Card (development code name)

- Evaluation Circuit Card Assembly (CCA) for T-Engine
  - Bus connection interface: T-Engine extension connector (140pins)
  - Applicable standard T-Engine: Connector Key Type 0404
    - T-Engine with PCI-bus interface
      - NEC VR5500 micro processor (64bit RISC) 800 MIPS
      - TOSHIBA TX4956 (64bit RISC) 400 MIPS with low power consumption
      - ARM and SH series might be applicable.
  - Board size: 150 x 75mm (T-Engine extension specification compatible)
  - SpaceWire interface (3-port) with wired connectors

I/F	Controller	I/F connector #1	Transmissin speed	Remark
PCI (Rev 2.1)		140pin		32bit / 33MHz
IEEE-1394	NEC：μPD72874	4pin x 3	Max 400Mbps	IEEE-1394a
IEEE-1355	ATMEL：TSS901E	9pin x 3	Max 140Mbps	SpaceWire
CAN	Philips：SJA1000	D-sub 9pin x 1	Max 1Mbps	CAN 2.0B

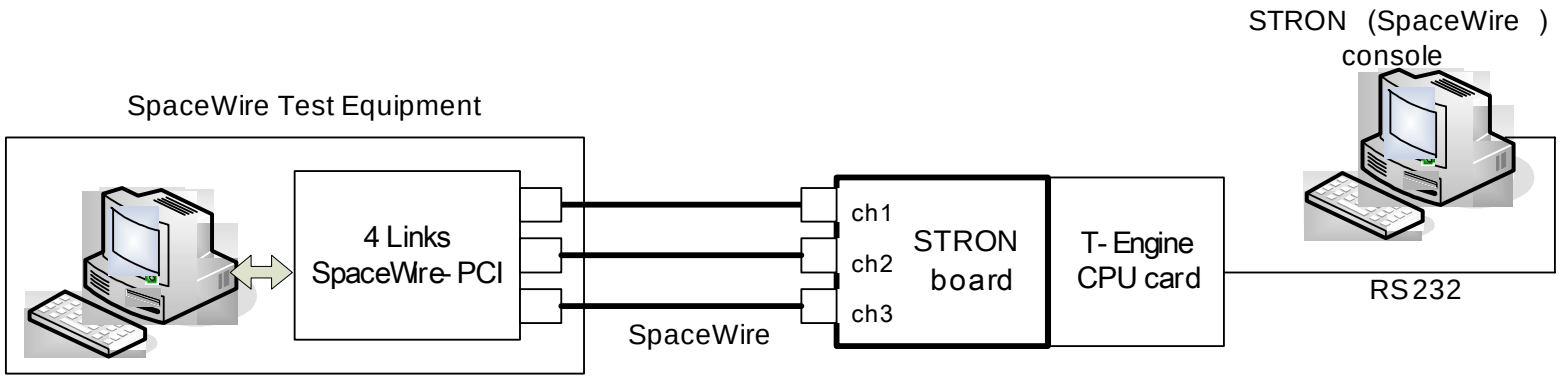
STRON board block diagram



STRON board outlook

- **Unified Architecture**
  - 2 circuit card assemblies for CPU module and various data bus interface with PCI-bus connection
    - SpaceWire x 3ch、IEEE-1394 x 3ch、CAN x 1ch、Extension I/F x 1ch
- **Open collaboration**
  - Developed by Industries with many advice from JAXA, Universities, and national laboratories.
  - Special thanks to 4Links Ltd. and CANON France for their advice.

■Compatible test using 4Links' SpaceWire-PCI

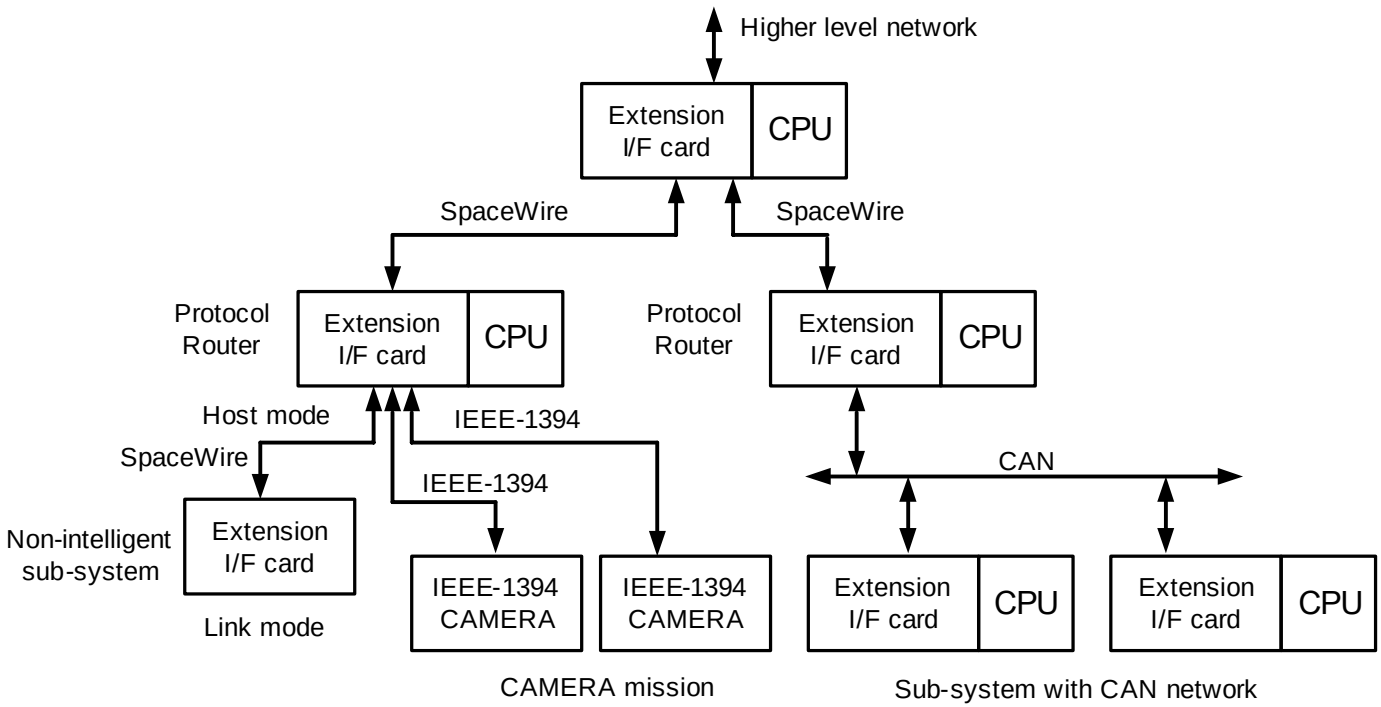


- Data Acquisition
- Data Transfer
- Data Transmission with parallel pass
- Continuous Data Transmission with sudden disconnection on some cables
- Control by Link operation

STRON board road map (1)

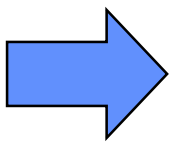
STRON board application

– Multi-protocol router for SpaceWire, CAN, FireWire, etc. using SpaceWire for back-bone.



STRON board road map (2)

- **STRON board application**
  - Re-usable middle-ware and device driver software
    - Software distribution system over T-Dist framework of T-Engine Forum
    - Low cost evaluation board kit for commercial industries and students
      - Wide range of opportunities to joining space activities
- **Monolithic STRON chip exploiting system LSI technology**
    - Future Plan



“Space nano T-Engine”

(ex) embedded interface for various sensors and actuators