The Designing Bus for Nuclear Safety Class Controller

Dongil Lee, Myeongkyun Lee and
Donghwa Yun (PONUTech)
Kwangki Ryoo (HNU)

CONTENTS

- Introduction
- The General Configuration of the EtherCAT
- Ethernet Fame with EtherCAT Data
- Controller
- Verification of performance
- Conclusion
- Reference

Introduction

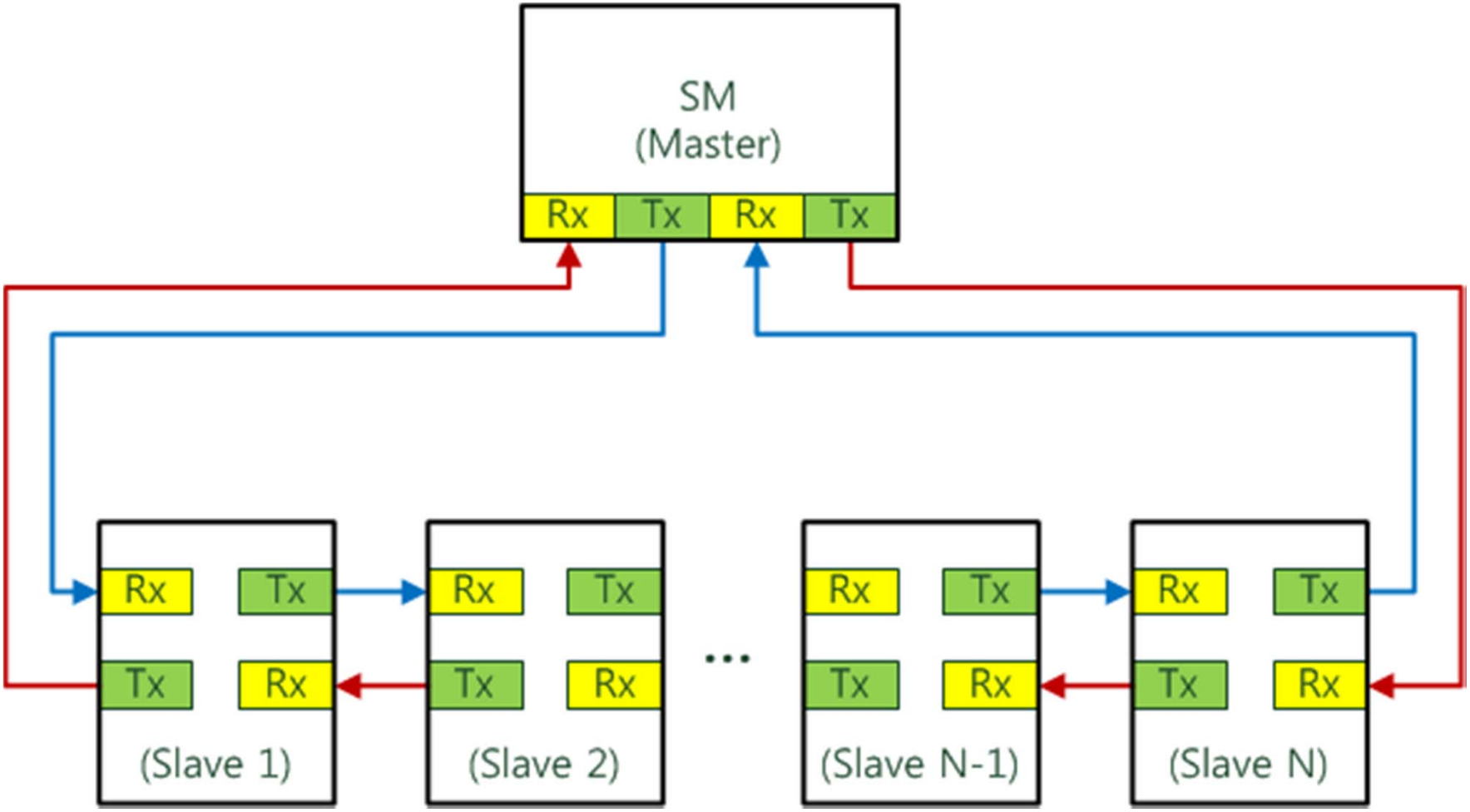
- Existing nuclear safety class controller typically used the Parallel Link. The increase of a small data communication in a result of increase in the number of I/O contacts demands to high-speed bus but it could not use some unstable problem that is switching noise, reference voltage unclear, magnetic coupling, FEXT-induced jitter and etc. in the parallel link.

- However to be shown to solve uses the E-Bus of EtherCAT widely used industrial site.

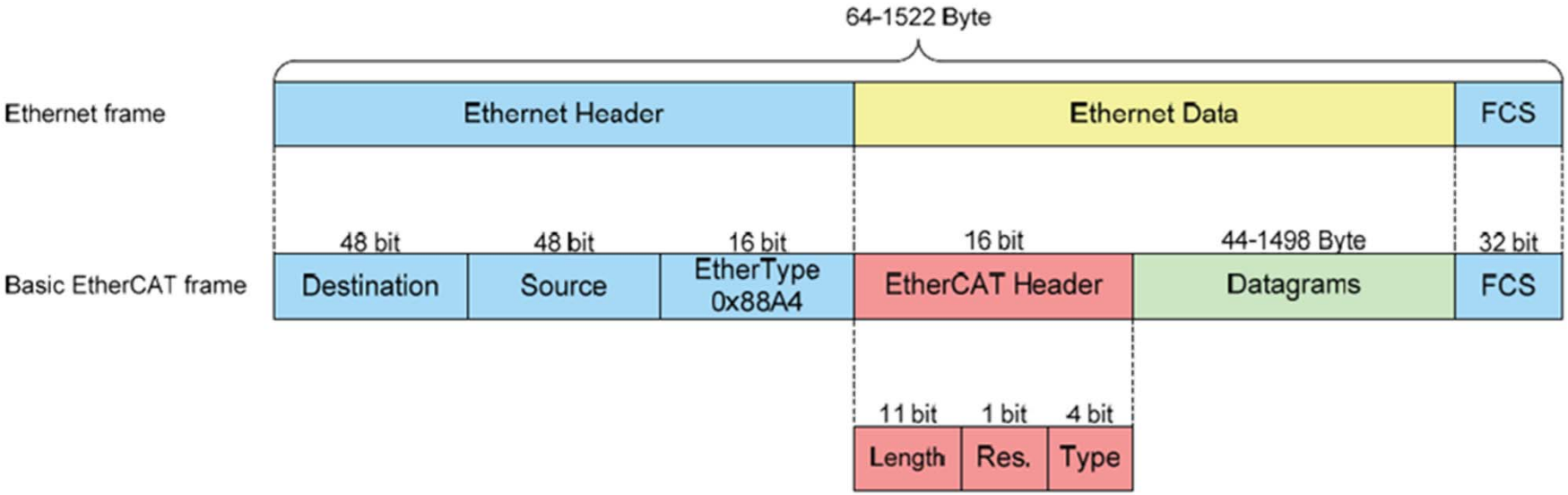
- The EtherCAT supports almost Line, tree or star topology.

- The On-the-fly processing way which can read and write data when the frame passes through in the network and the using the FMMU (Fieldbus Memory Management Unit) mapping in the 4GB (Giga Byte) space base on the hardware can process easily for a packet to each slave data.

The General Configuration of the EtherCAT



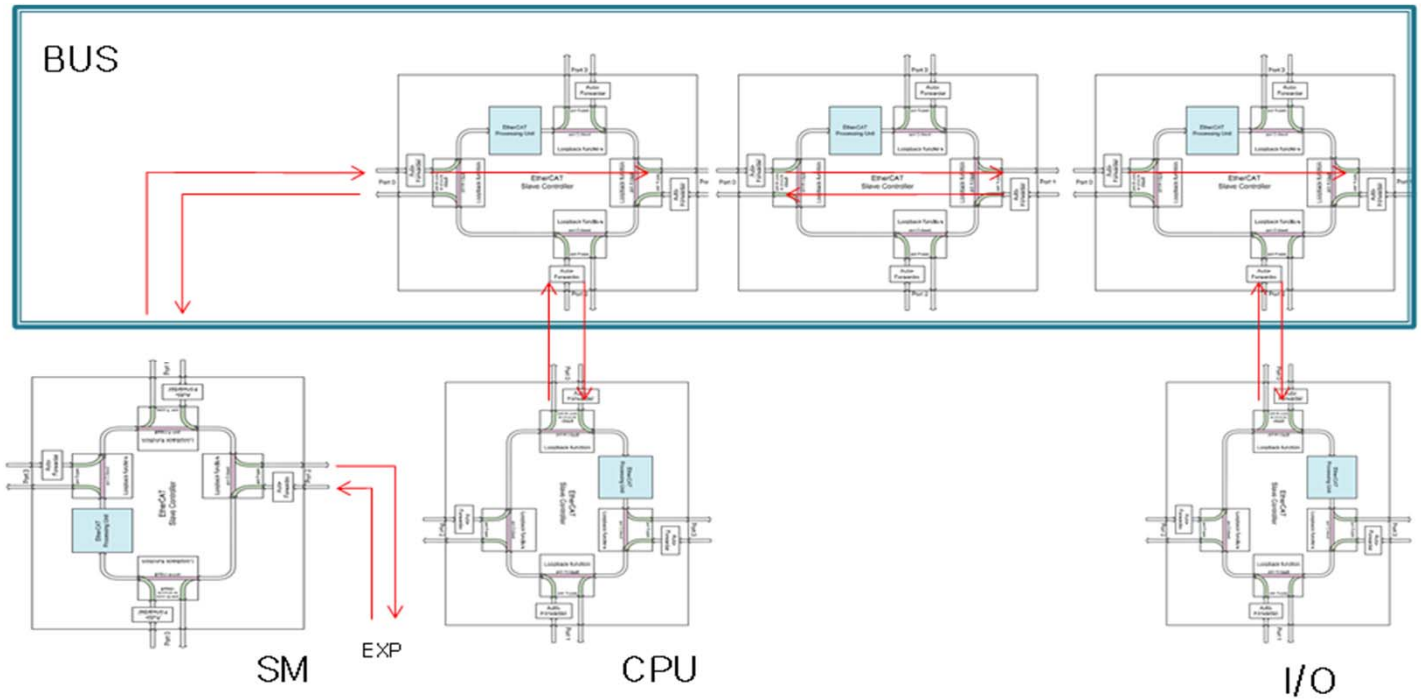
Ethernet Fame with EtherCAT Data



- EtherCAT Frame Header
  - Length
    - 11bit; Length of the EtherCAT datagrams (excl. FCS)
  - Reserved
    - 1bit
  - Type
    - 4bit; Protocol type. Only EtherCAT commands (Type = 0x1) are supported by EtherCAT Slave Controller(ESC)s.

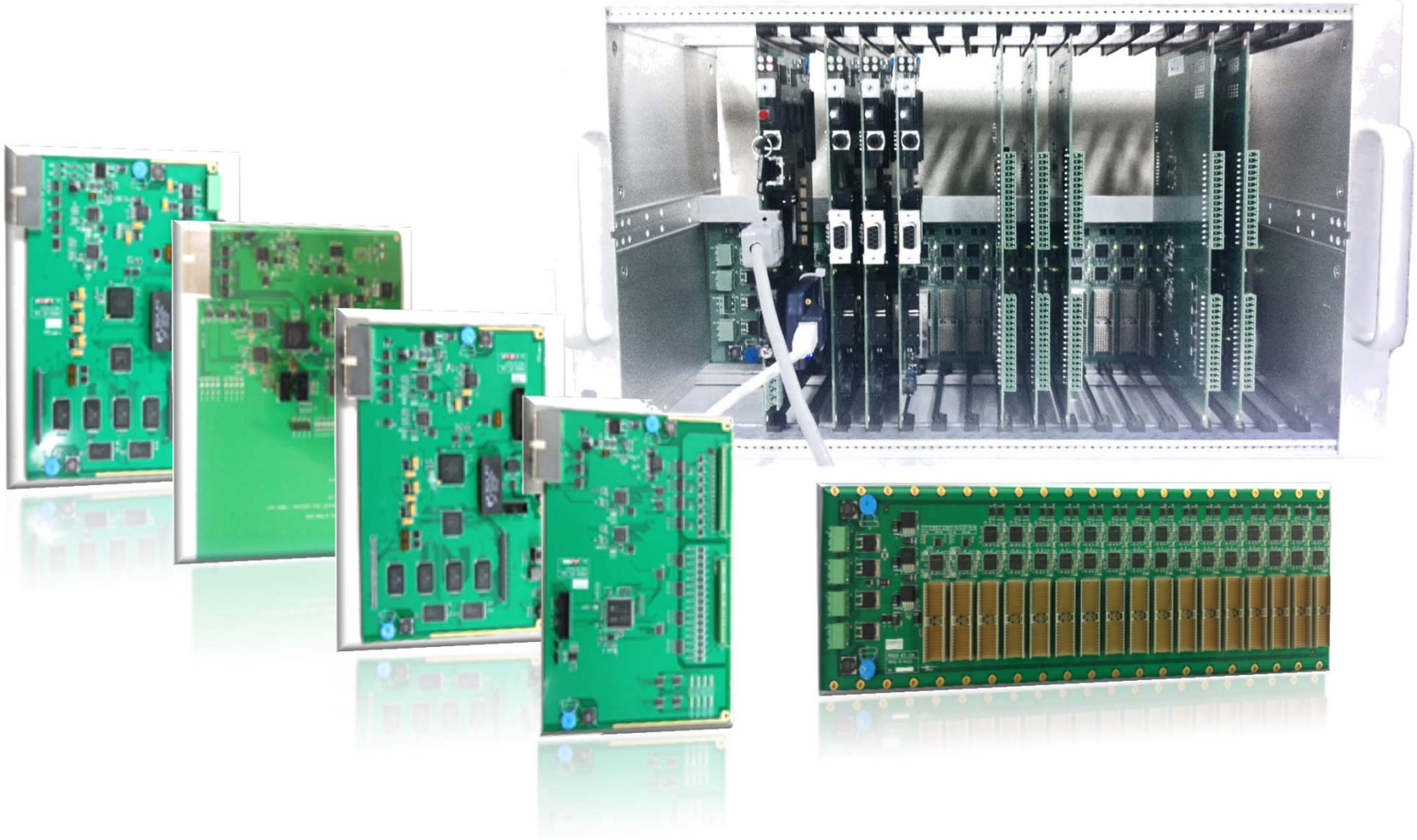
Controller

- Structure
  - In case of a EtherCAT Chip by ASIC, it has four (4) ports zero (0), one (1) ports are used as the default and auto-forward orders are zero (0) → three (3) → one (1) → two (2) port. In addition, each module shall install a chip in order to configure an “On-The-Fly” format a feature of EtherCAT and each slot shall setup a chip for Hot-Swap function in the backplane. And it shall implement a using three (3) of four (4) ports.



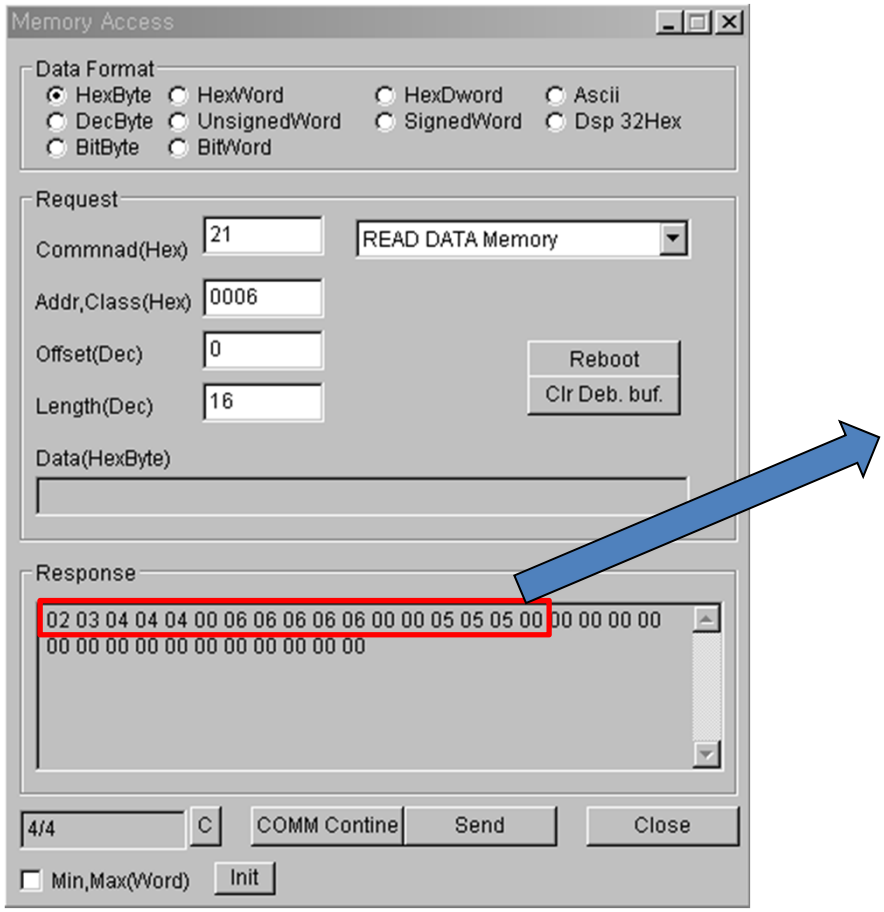
Controller

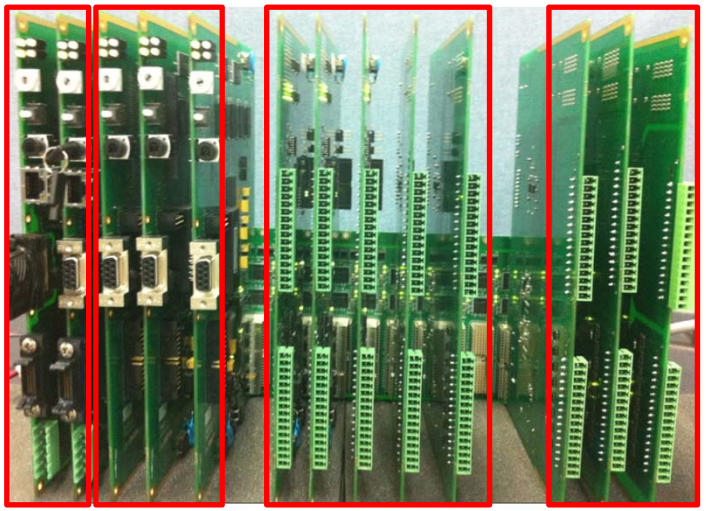
- Shape
  - The pin of backplane was saved and was possible designed to high speed data transaction because to design an E-bus using a LVDS line.



Verification of performance

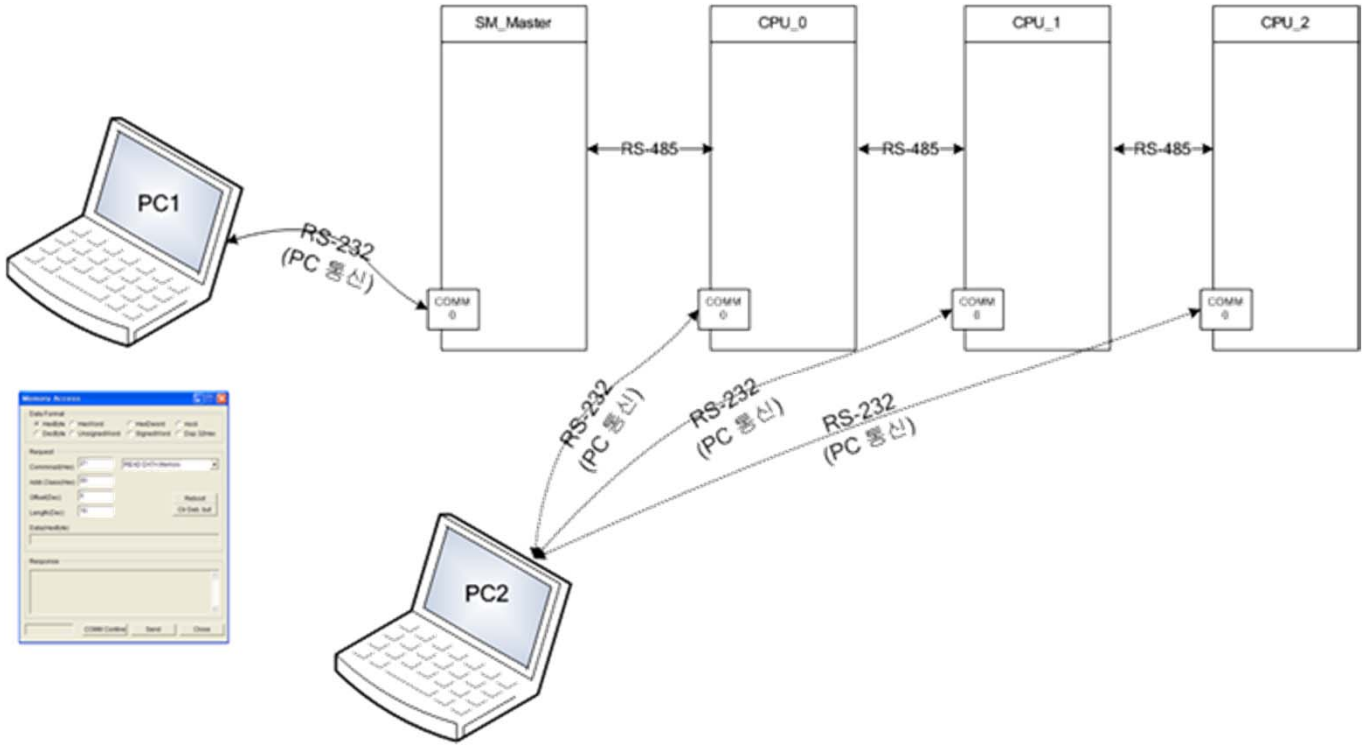
- Read information for each module after connected a computer through a RS-232.
- Information about the module, as shown in the following figure was confirmed by serial communication.





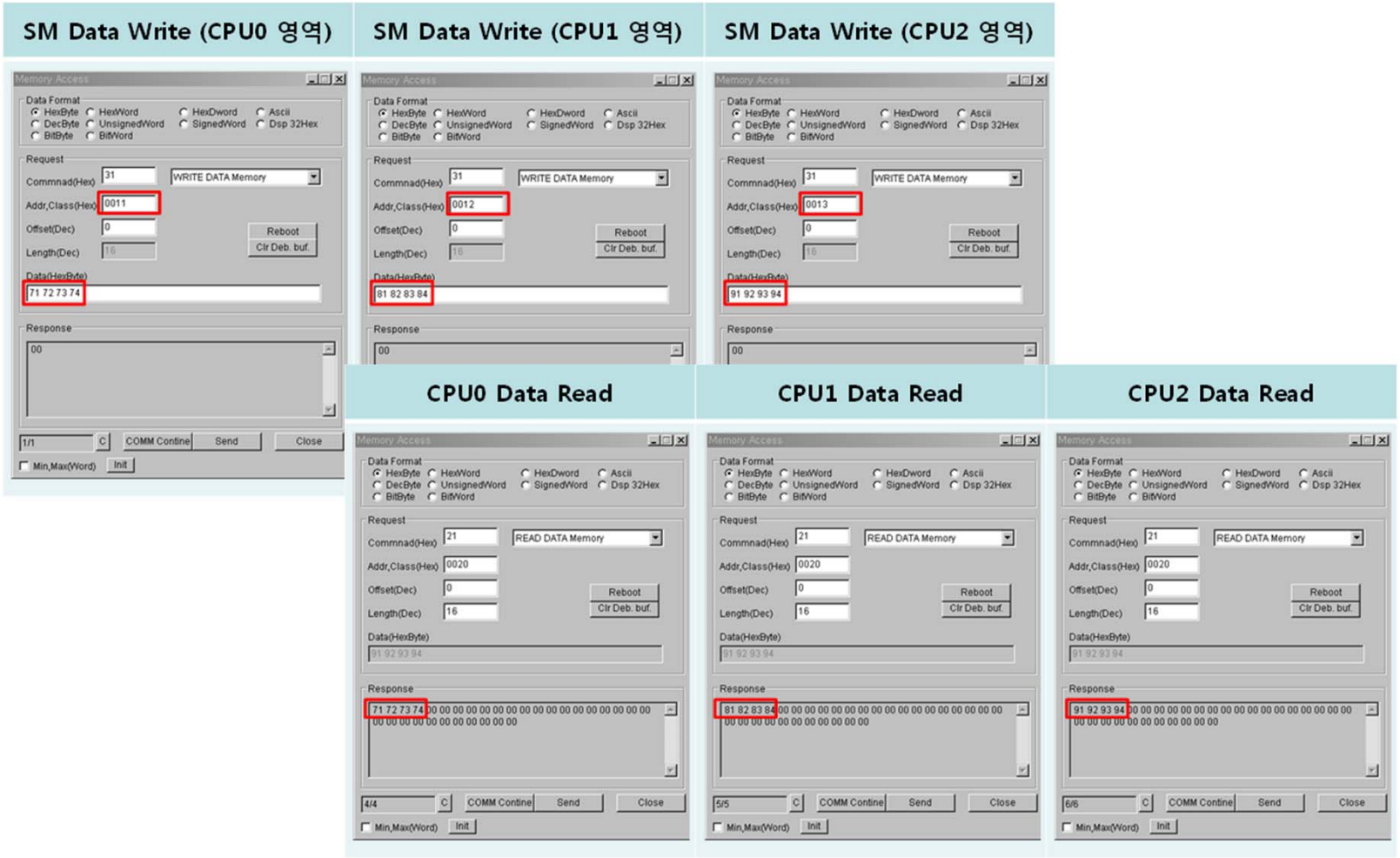
Verification of performance

- In order to confirm to performance of bus communication such as the figure is constructed. All CPU and SM (System Manager) module connected computers and then confirmed an operation to read and to write of a data in CPU.



Verification of performance

- Each CPU in the data transmission was a constant pattern SM normally received in the data could confirm that it has. Data can also be read normally the normal bus communication was confirmed.



Conclusion

- Data of the many contacts transmission was confirmed that there is no problem by means of using bus that a nuclear safety class controller was used by the E-bus of Widely used in EtherCAT of industrial communication network.

- The transmission of quantity will have many limitations because Commercial ASIC chips 8KByte Data transfer only. In the future a FPGA implementation of EtherCAT is required in order to transfer more DATA.

References

- [1] BECKHOFF, ET1100 Hardware Data Sheet v1.8, 2010

- [2] EtherCAT Technology Group, EtherCAT Communication Presentation, 2011

THANK YOU

PONU-Tech Co., Ltd.