

# Algorithm Configuration Functions of The FPGA-Based Safety I&C Platform NicSys8000N Designed for Developing Engineering Applications

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9th International Workshop on Application of FPGA in Nuclear Power Plants  
October 3-6, 2016, Lyon, France

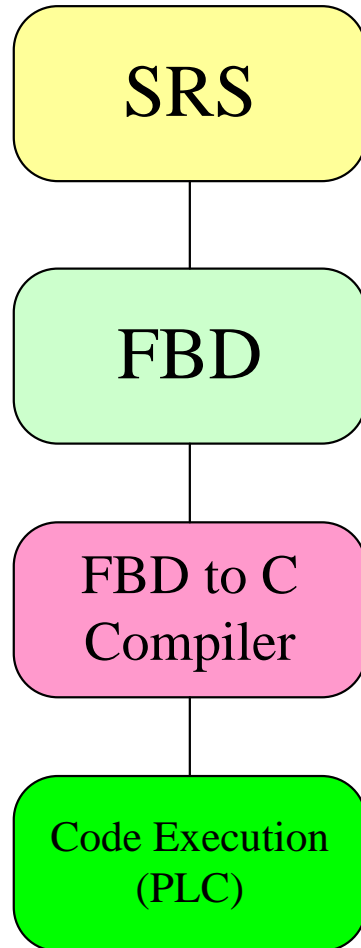


# Agenda

- Background
- FPGA-based safety I&C platform NicSys8000N
- Function Block library
- Executor
- Example of an engineering application



# Background



## PLC Execution process

- Software Requirements Specification
- FBD Design
- Convert FBD into PLC executable code
- Download executable code to PLC

## Disadvantages

- Cost of certification is very expensive
- Supply cycle of MCU and many other IC is relatively short



# Background



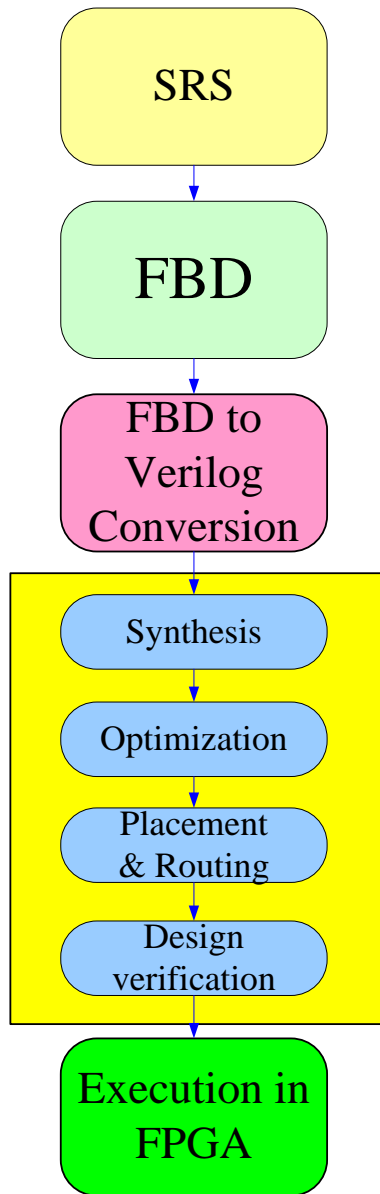
- Floating point arithmetic
- Video acceleration
- Server acceleration
- Signal processing

The performance of FPGA is excellent in the power consumption.

# Background

- Advantages of FPGA
  - Lower complexity
  - Independence between the various modules
  - Short response time
  - High reliability
- How to use FPGA to realize the algorithm configuration ?





## Generate a customized controller for each project

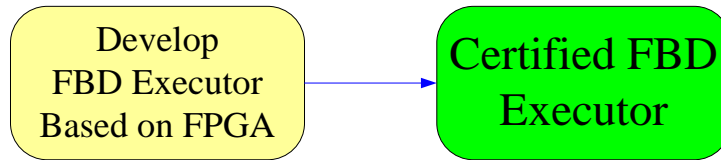
- Software Requirements Specification
- FBD Design
- Convert FBD into HDL file
- Synthesis, Optimization ,Placement& Routing, Design Verification
- Download

## Disadvantages

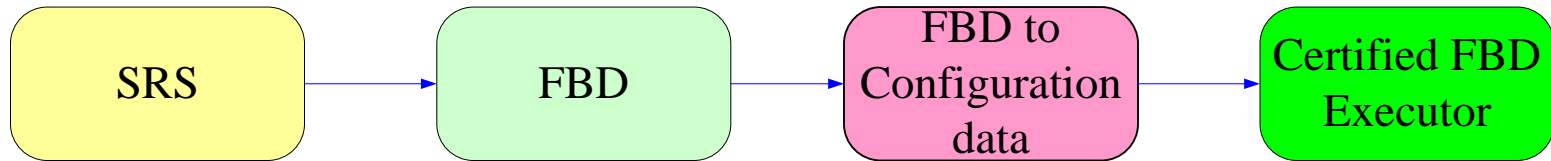
- The certification of the whole tool chains is very difficult.



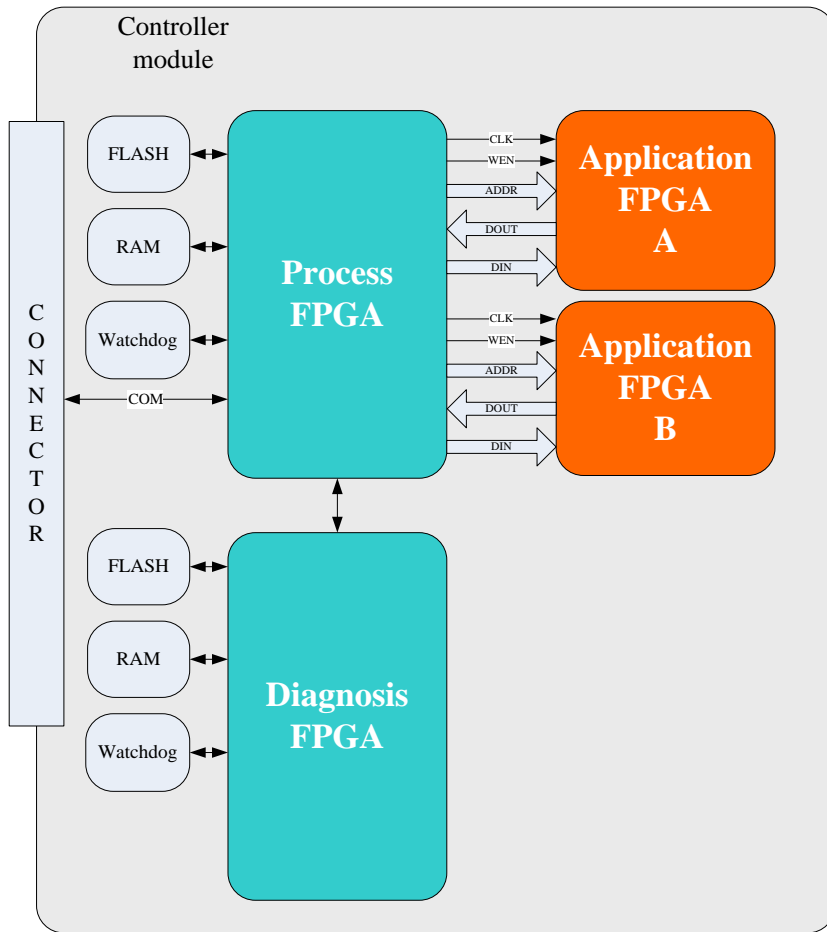
I )Development



II )Execution



# FPGA-based safety I&C platform NicSys8000N



- Four Flash-based FPGAs
- Process FPGA:
  - Communication
  - Memory interface
  - Data exchange
- Application FPGA:
  - Algorithm configuration
  - Function Block library
  - Executor
- Diagnosis FPGA
  - Power diagnosis
  - Communication diagnosis
  - State of process FPGA diagnosis



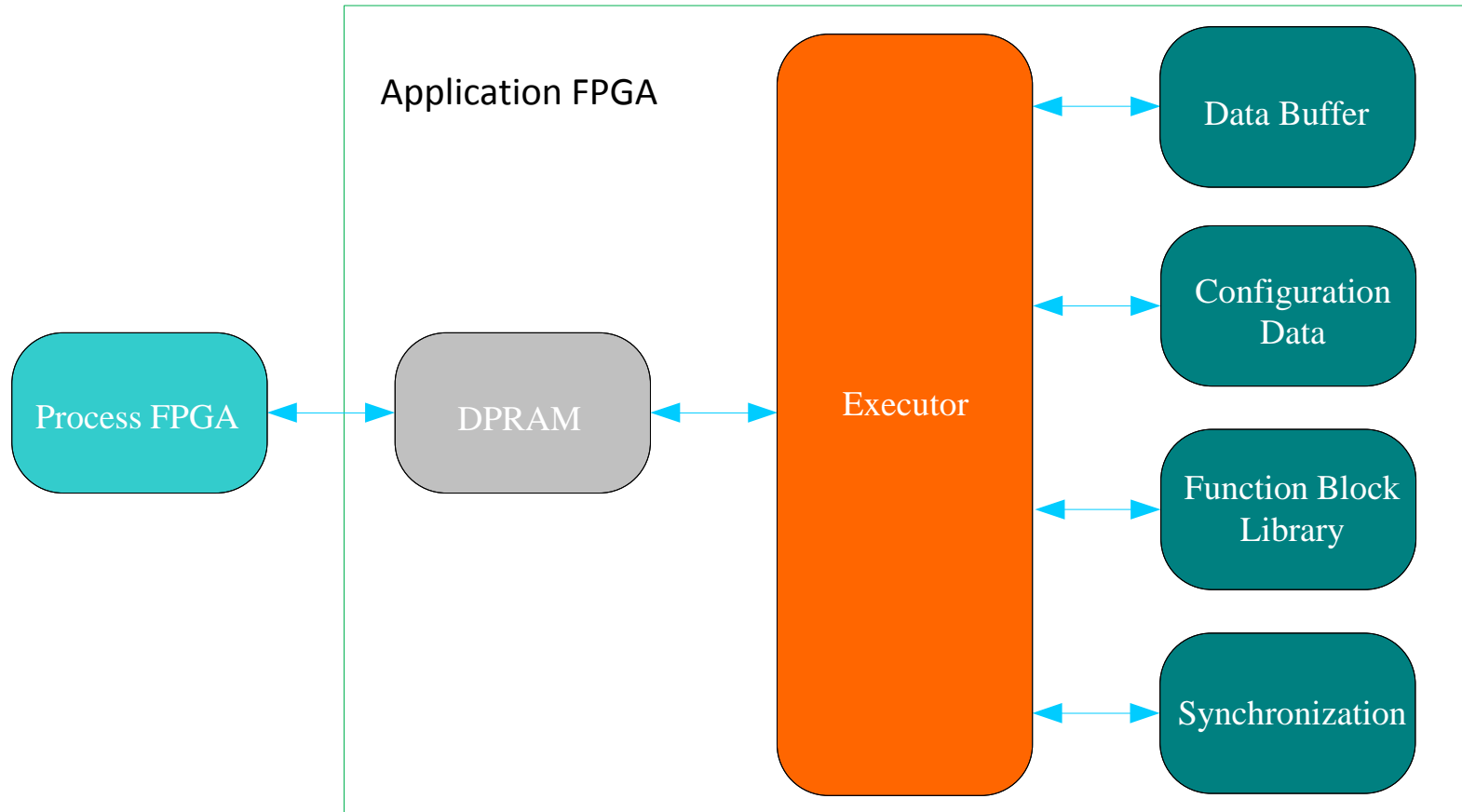
# FPGA-based safety I&C platform NicSys8000N

- Performance of Application FPGA

- Run 2500 function blocks, Including 2000 simple function blocks and 500 complex function blocks
- The execution time of each block is less than 0.1ms
- The overall operation of application FPGA is less than 7ms



# FPGA-based safety I&C platform NicSys8000N

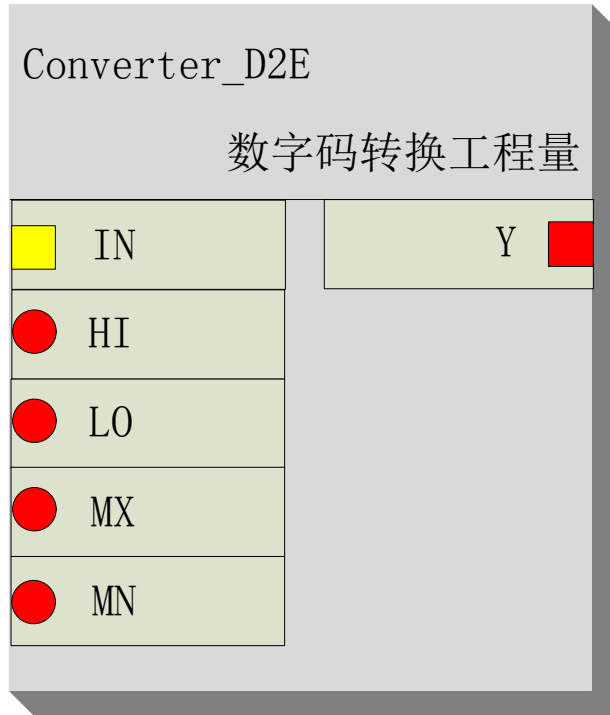


# Function block library

- Advantages of using the function block library
  - Reduce development and verification
  - Improve reliability
  - Reuse function block
  - Save FPGA resources



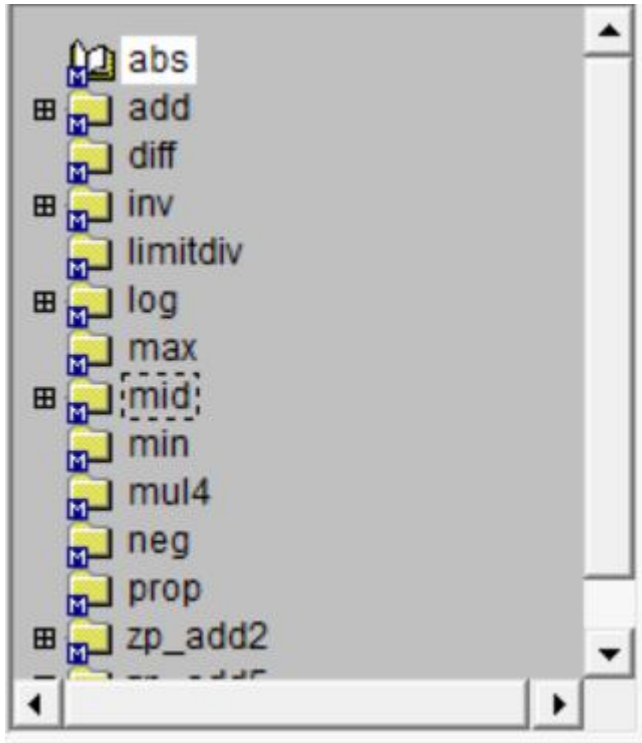
# Function block library



- Types of function block
  - Arithmetic block
  - Timers block
  - Logic block
  - Converter block
  - Compare block
  - Engineering block



# Function block library

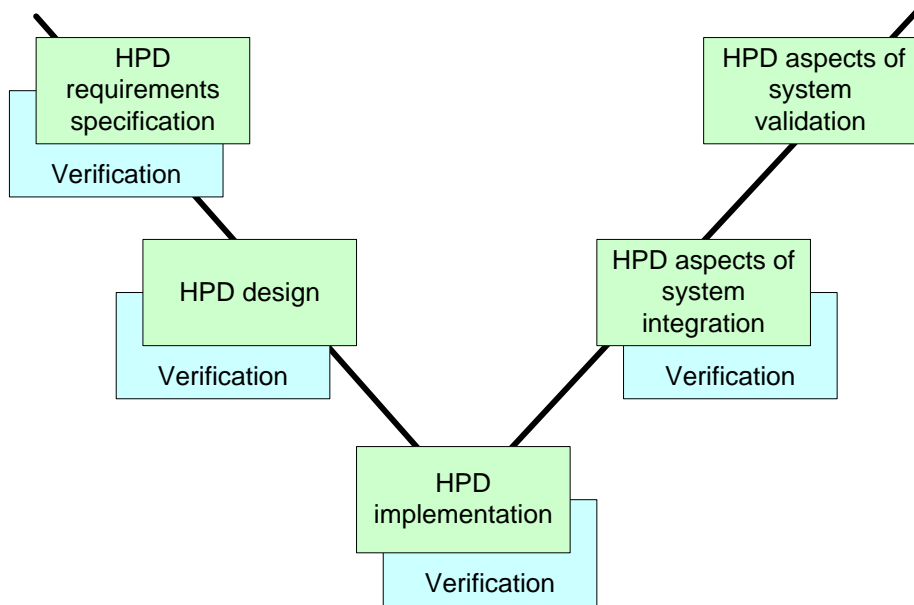


- Each function block is an independent HDL file
- Ease of management
- Function block can be independently verified
- Verified function block can be reused



# Function block library

If in some engineering application, the function block library of NicSys8000N does not have a specific function block, how should we do?



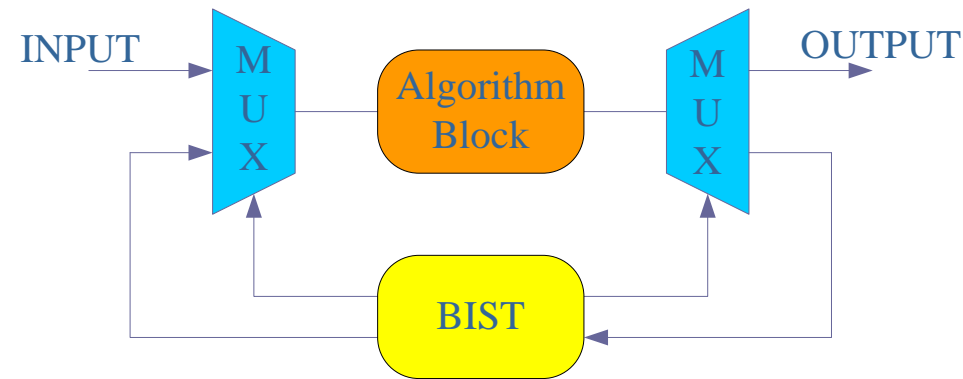
IEC 62566 Development life-cycle of HPD

- Reuse modules that have been verified
- Follow the IEC62566 standard to develop the new function block
- Complete the function block design, and fully verify the new function block
- Reduce time-to-market for new and improved products



# Function block library

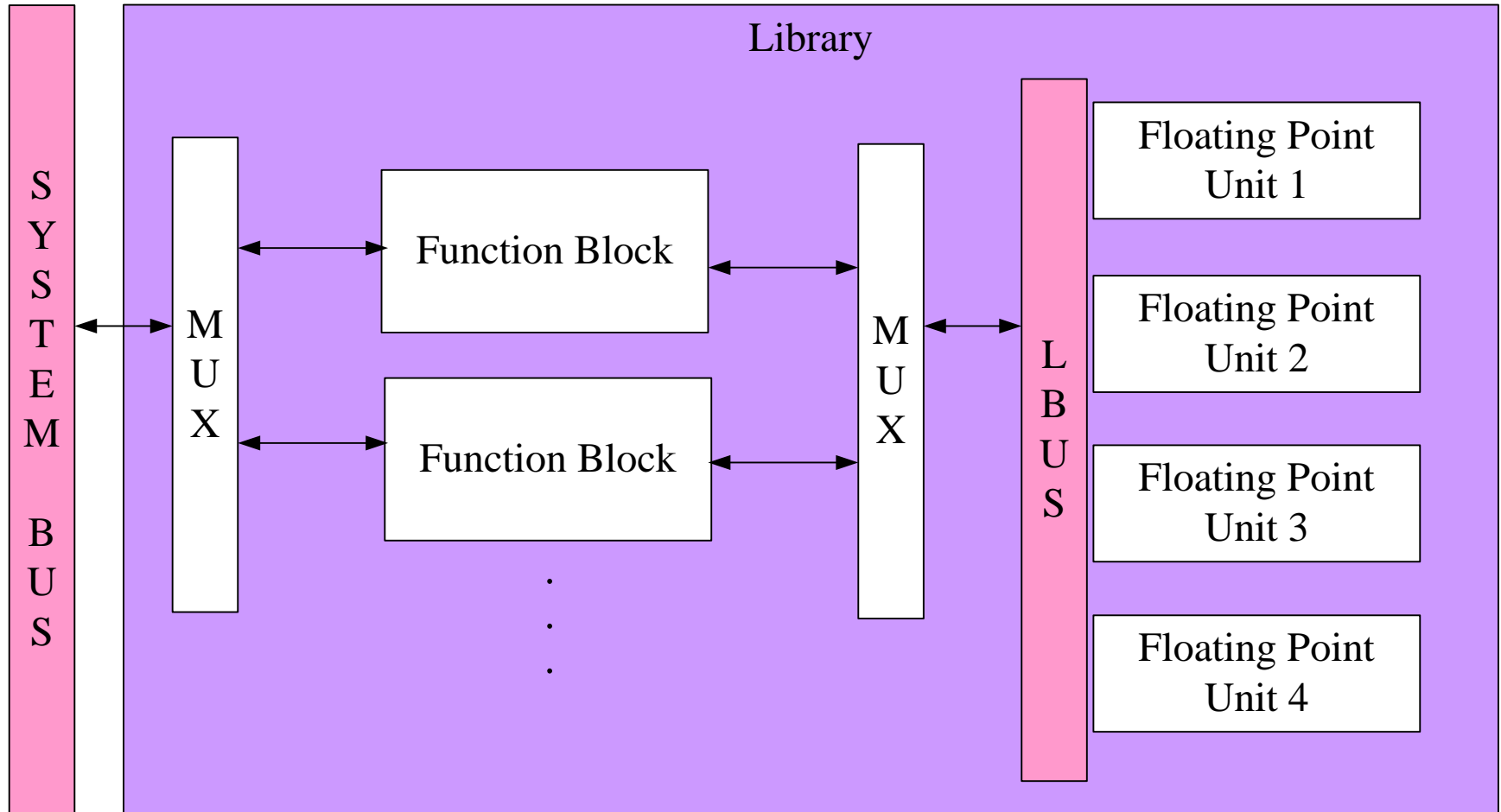
- NicSys8000N function block library has high reliability.



- The execution sequence of the function block
- The integrity of the algorithm configuration execution
- Function block has built-in self-test(BIST).



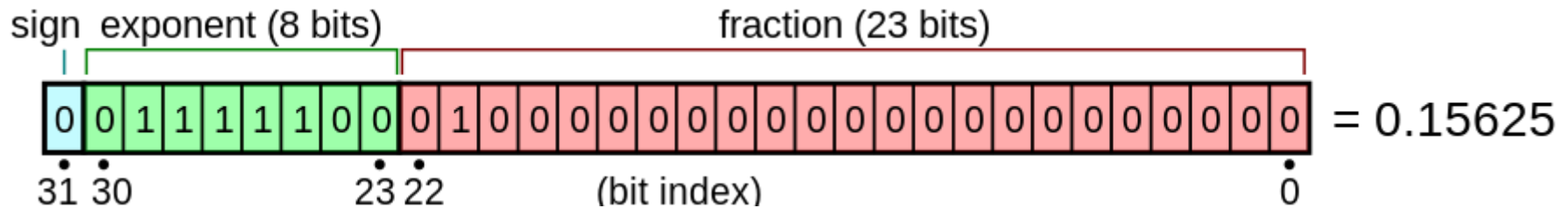
# Function block library





# Function block library

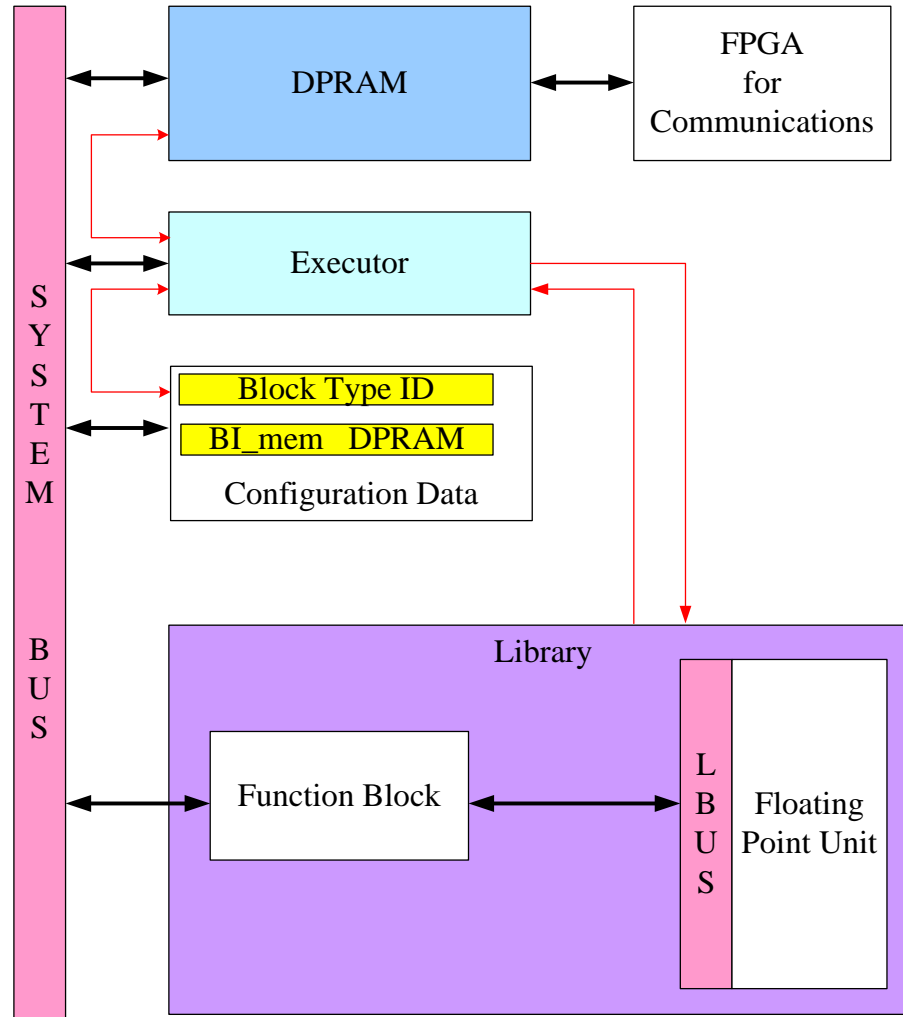
- Floating point format conforms to IEEE754 standard



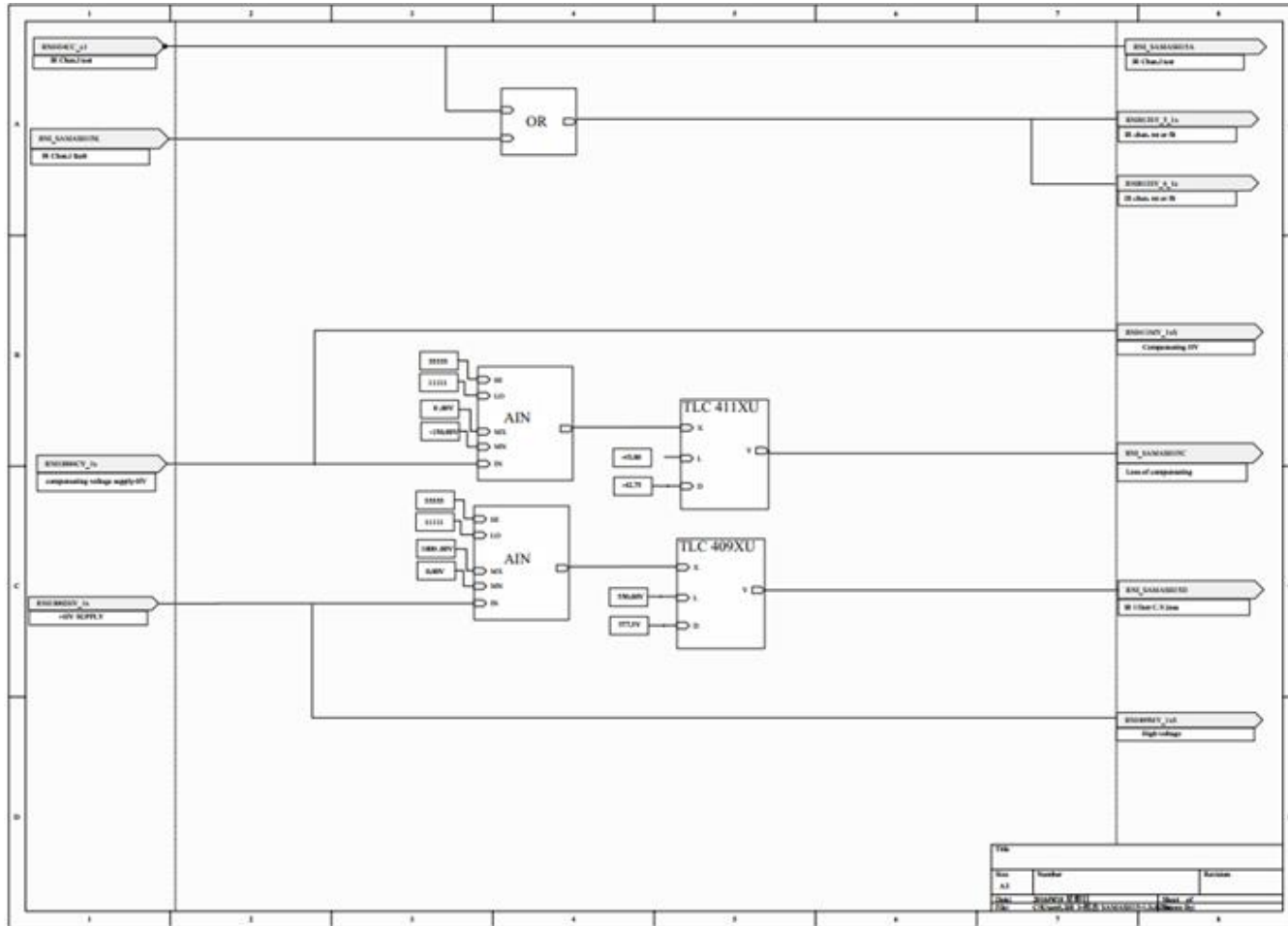
$$\text{value} = (-1)^{\text{sign}} \times \left( 1 + \sum_{i=1}^{23} b_{23-i} 2^{-i} \right) \times 2^{(e-127)}$$



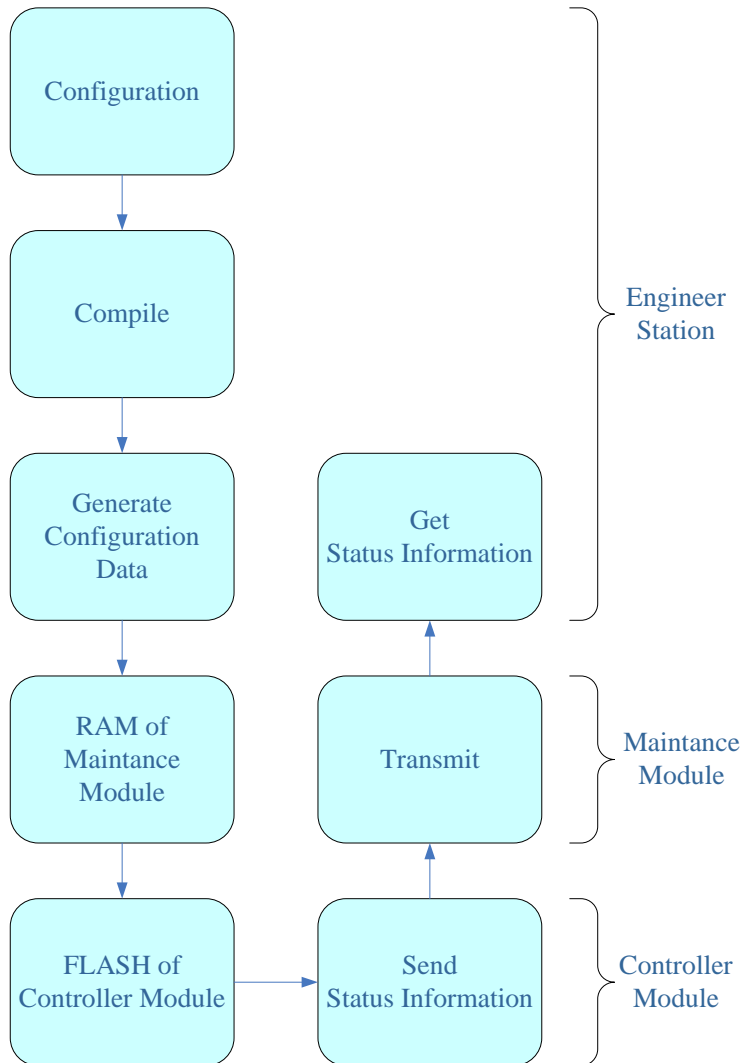
# Executor



# Example of an engineering application



# Example of an engineering application



- Generate FBD
- Compile
- Download
- Save to the Flash of Controller
- Check
- Send status information of Download



# Conclusion

The FPGA-based safety I&C platform NicSys8000N

- Realize complex algorithm configuration
- great speed and accuracy
- Short response time
- Easy to update
- High reliability



THANK YOU  
and  
QUESTION?

