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NEW FPGA DEVELOPMENT

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AGENDA

- MMC Development
- GPES Development
- Interfacing Development

MMC Development

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MMC Model Success

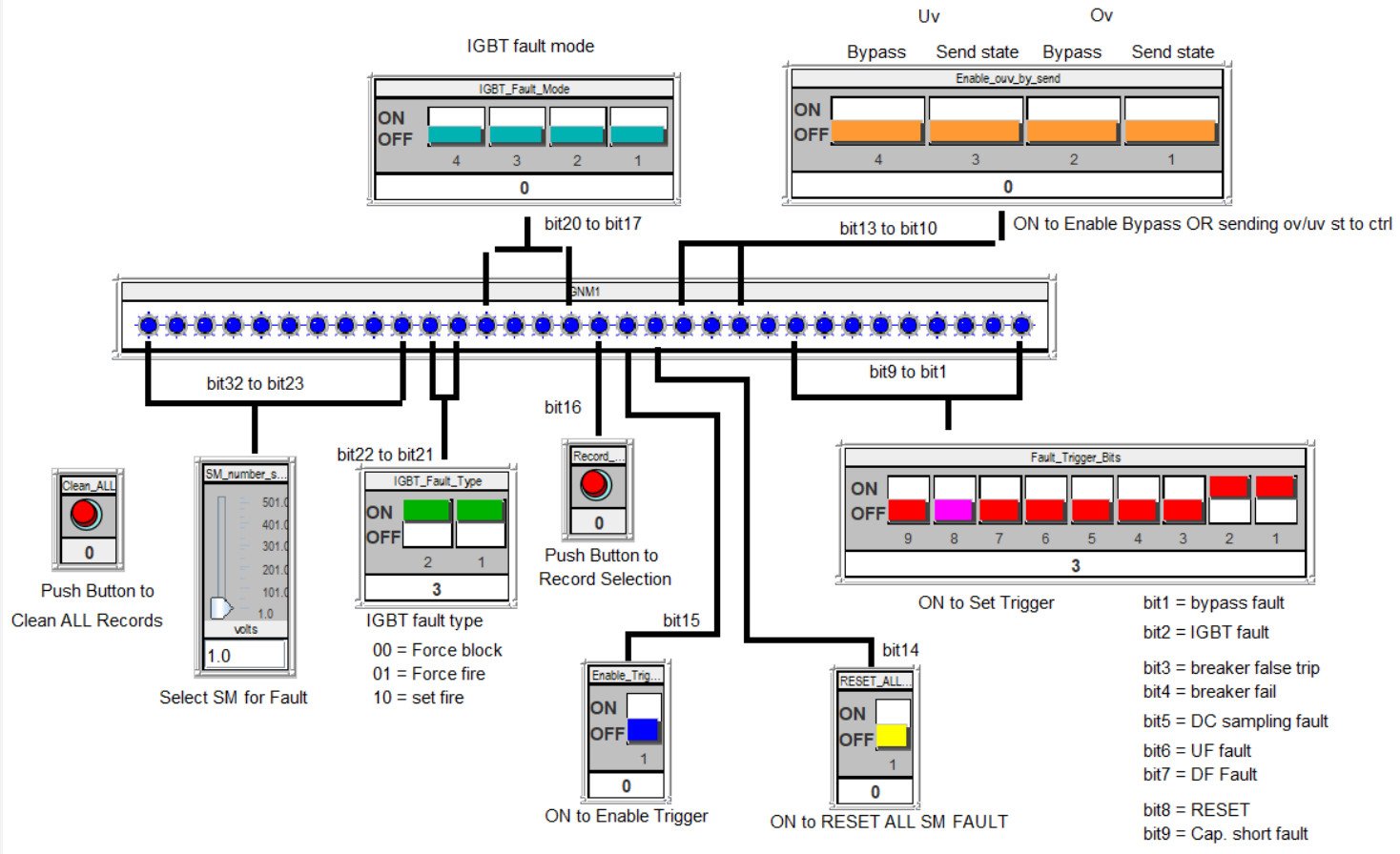
- ✓ Successfully involved in major HVDC projects all around the world, especially in China
- ✓ Model being improved and enhanced to satisfy different requirement from the real projects
- ✓ Being the first time, GMMX model is now used in the Kun-Liu-Long Project of CSG.

New Features of GMMX Model

- New faults: Bypass breaker fail and false trip fault, communication fault, DC sampling fault, etc.
- Trigger fault more flexibly
- Measuring IGBT switching frequency
- Monitoring all SM cap. Voltages, Firing Pulse Words, and SM state on User PC via UDP Ethernet
- HB and FB SM any location
- Support new Valve-to-Control protocol proposed by CSG

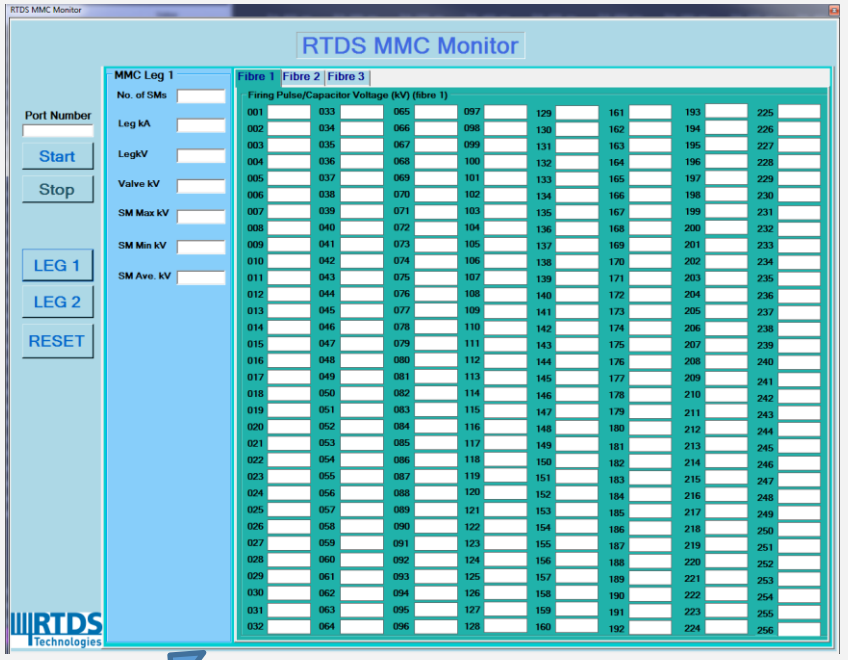
Faults and Triggering

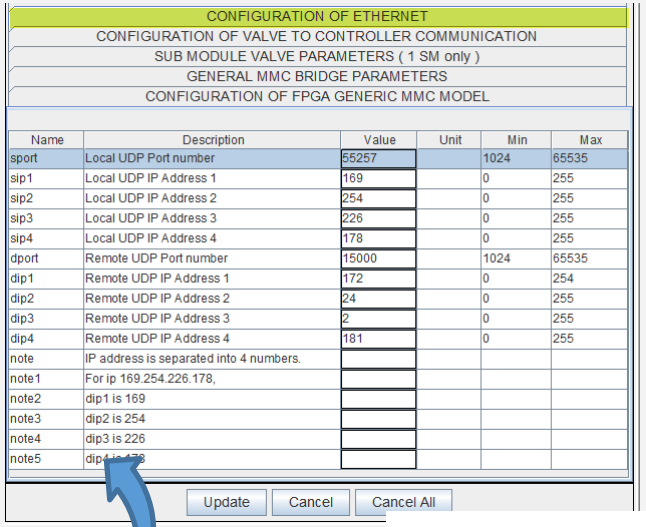
- Multiple faults on the same SM
- Trigger faults one SM after the other
- Trigger faults simultaneously for many SMs
- No need to re-compile the case

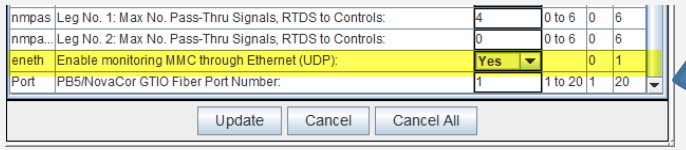


Monitoring MMC via Ethernet

- A Ethernet cable connected between PC and GTFPGA MMC unit
- SM voltage, firing pulse word, and state monitored





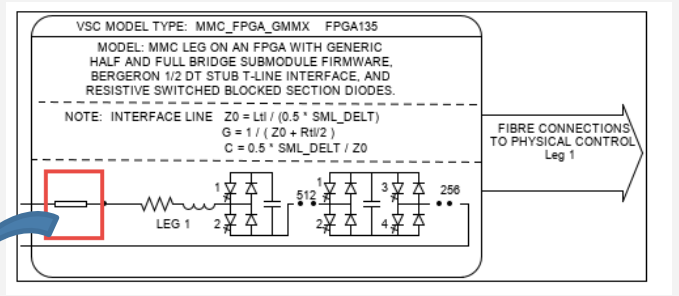


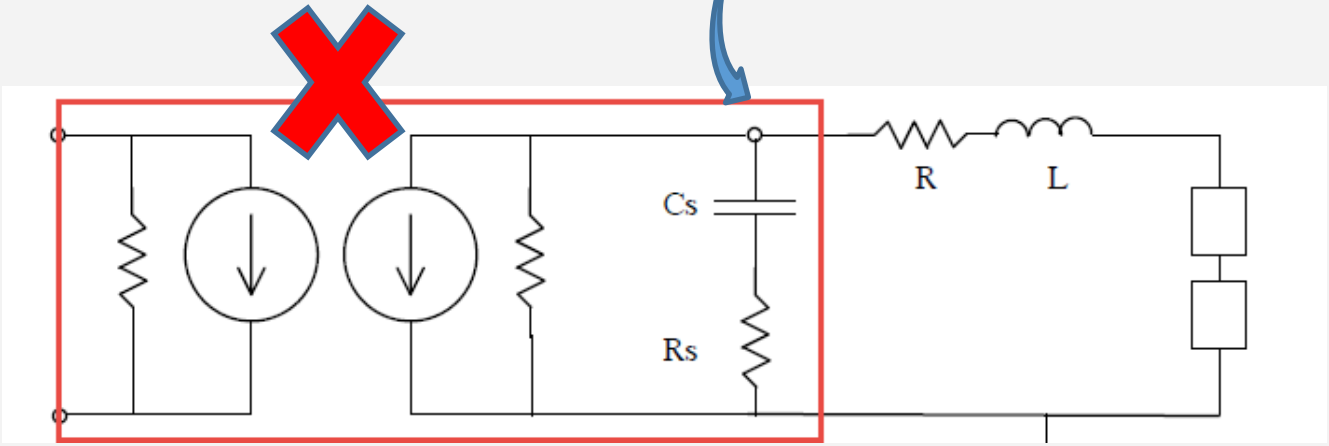
MMC Models in Substep

- ✓ U5 model and controller
- ✓ GMMX model and controller
- ✓ GMMX 6vlv model and controller
- ✓ GMT3 model (controller same as for GMMX)
- ✓ GMSD (serial double submodule) model (controller same as for GMMX)
- ✓ Upgraded MMC5 model supporting HB/FB mixed

New Development Next Step

- Like many other components in substep interface t-line eliminated
- More accuracy and flexibility





GPES Development

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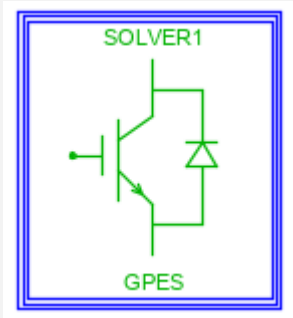
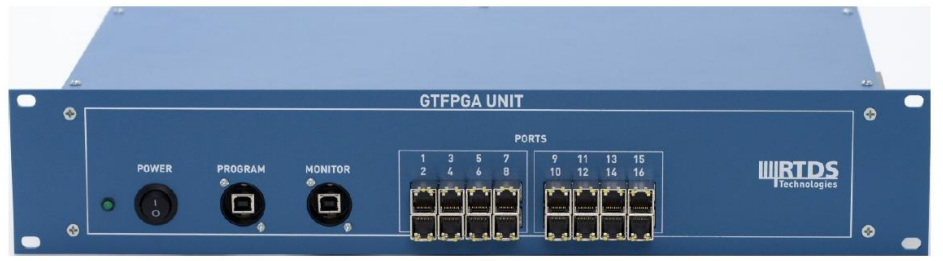
GPES Simulation Platform

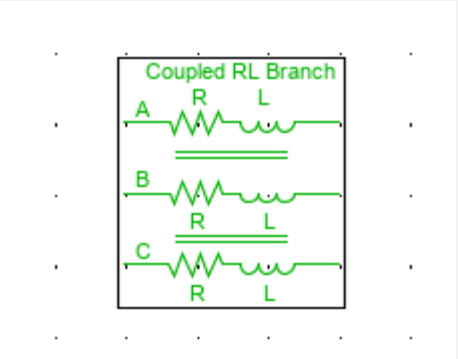
- A Generic Power Electronics Solver (GPES) on GTFPGA
- Uses powerful parallel processing power of FPGA
- Can model power circuits with arbitrary circuit configurations
- Larger network (128 nodes and 256 branches) and smaller time step (400+ ns), e.g., the dc breaker needs 110+ nodes and 200+ switches

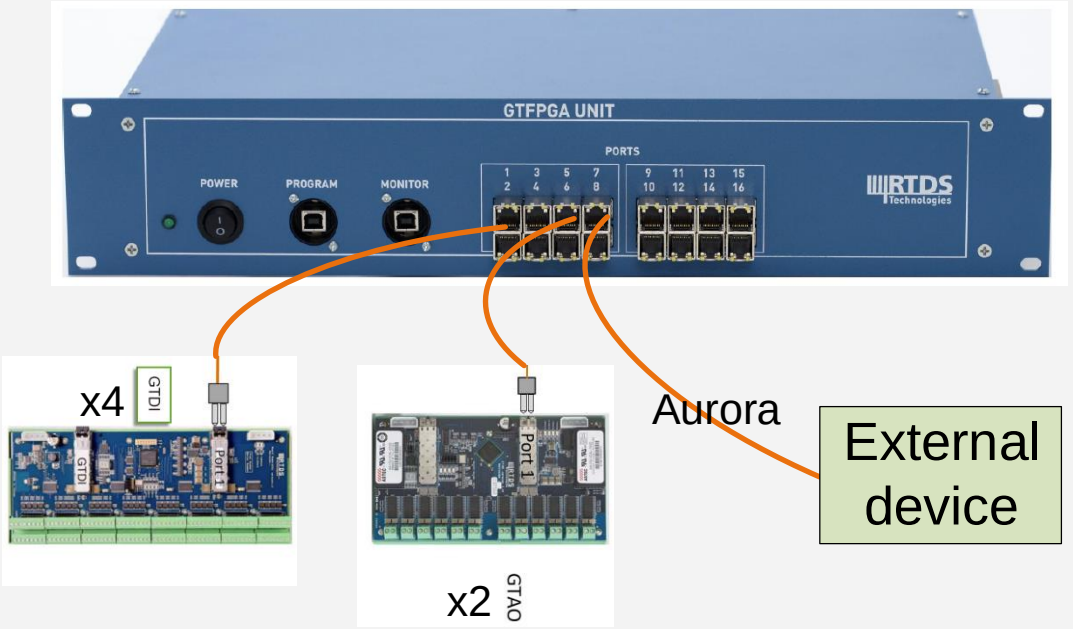




New Components

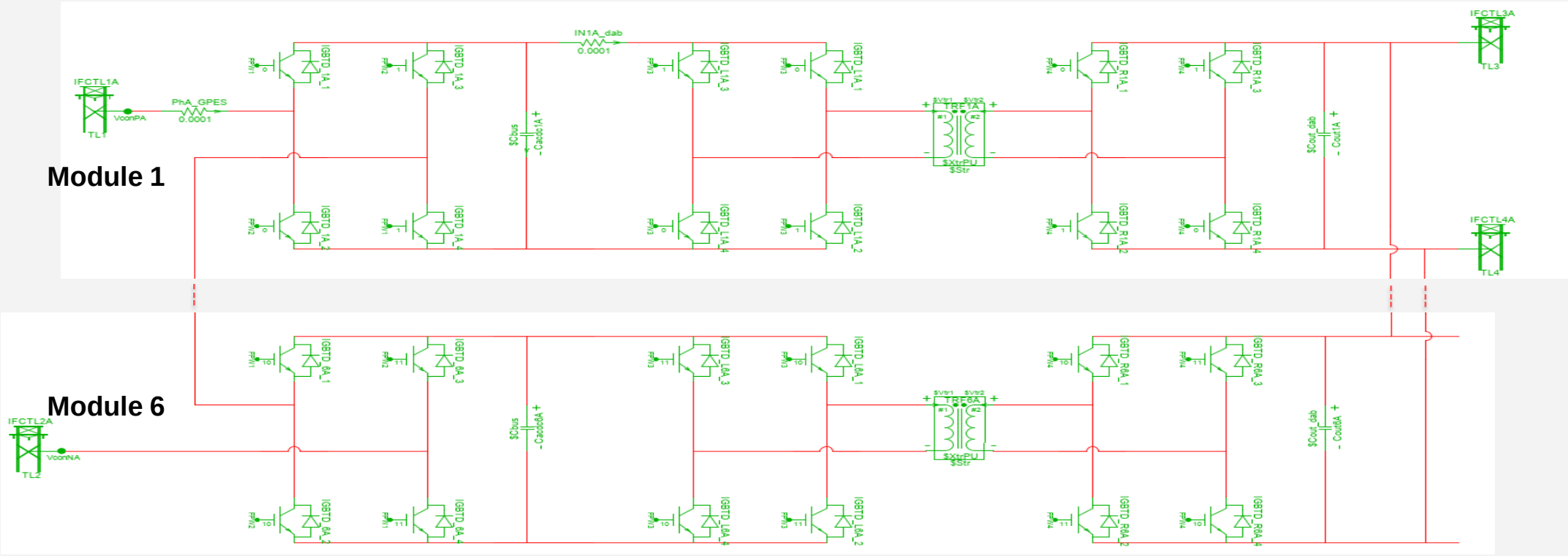
- Three-phase coupled RL component added
- 4 GTDI cards connected to Port 1-4 for firing 256 switches
- 2 GTAO cards connected to Port 5-6 for analogue output





GPES Example: DC-DC Transformer

- Up to 15 modules modelled in one GPES unit



Interfacing Development

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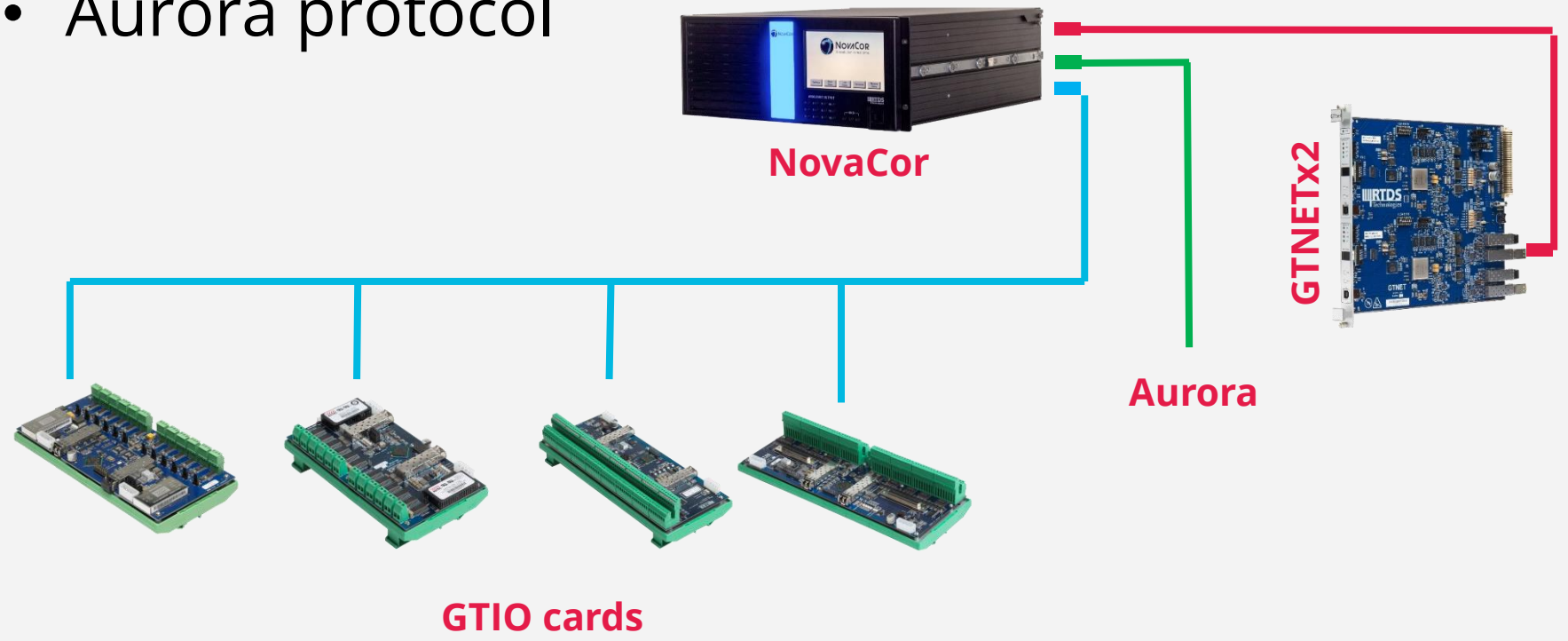
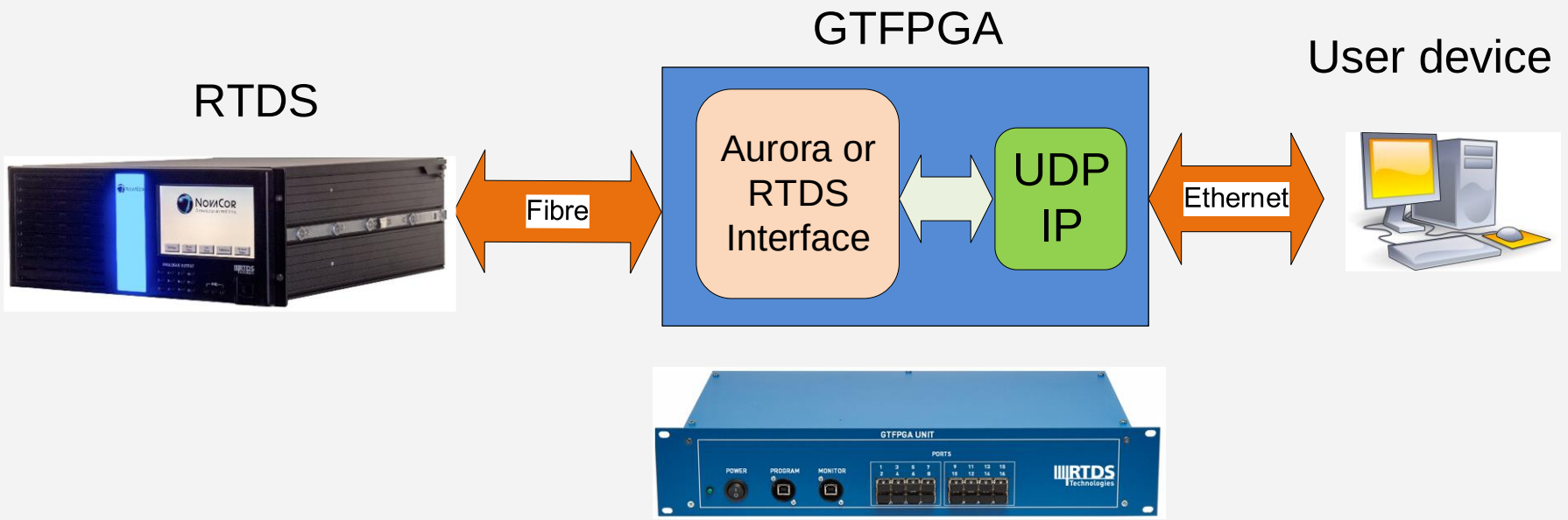
Interfacing to RTDS

- Convectional way: GTIO cards
- Network communication: GTNET cards, various protocols
- Aurora protocol



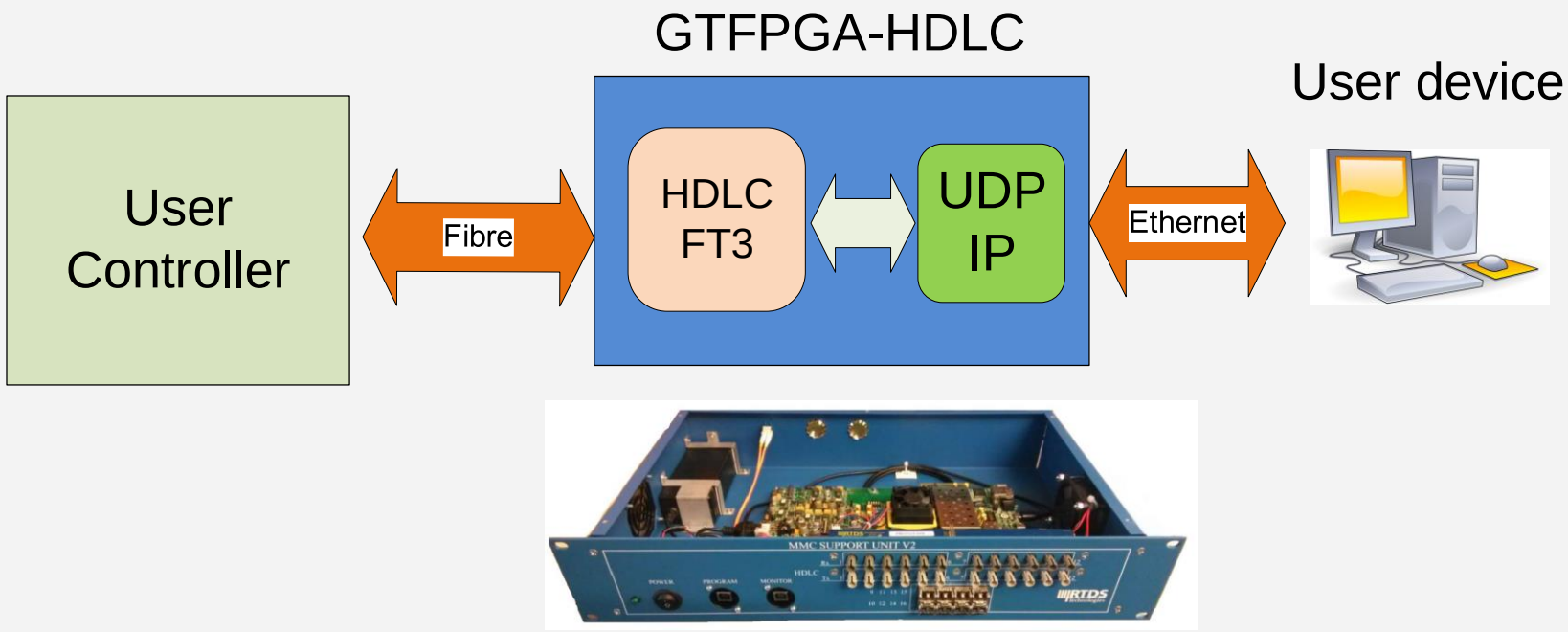
Interfacing via GTFPGA

- User device interface to RTDS through Ethernet (UDP)



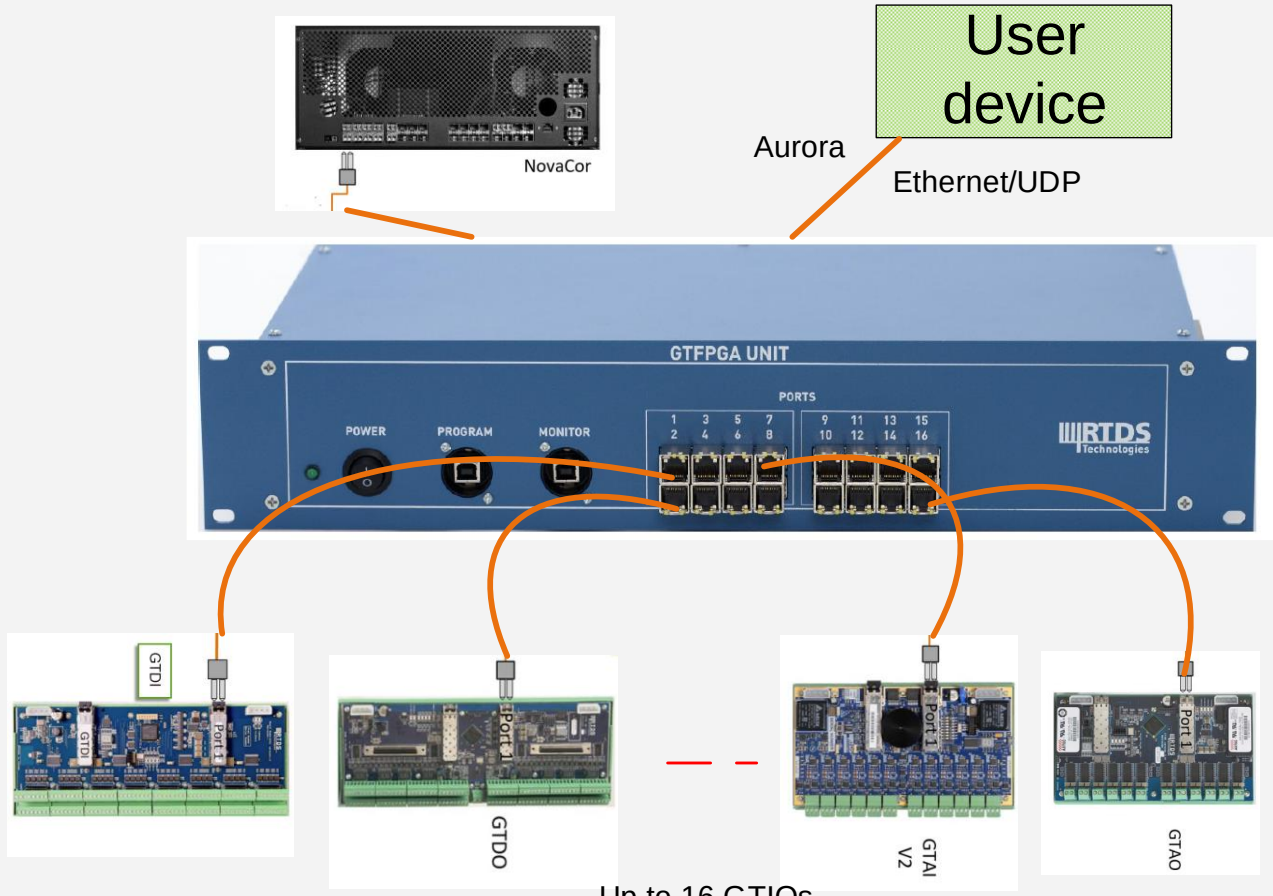
Interfacing via GTFPGA

- User device (UDP) interfacing to controller (FT3)



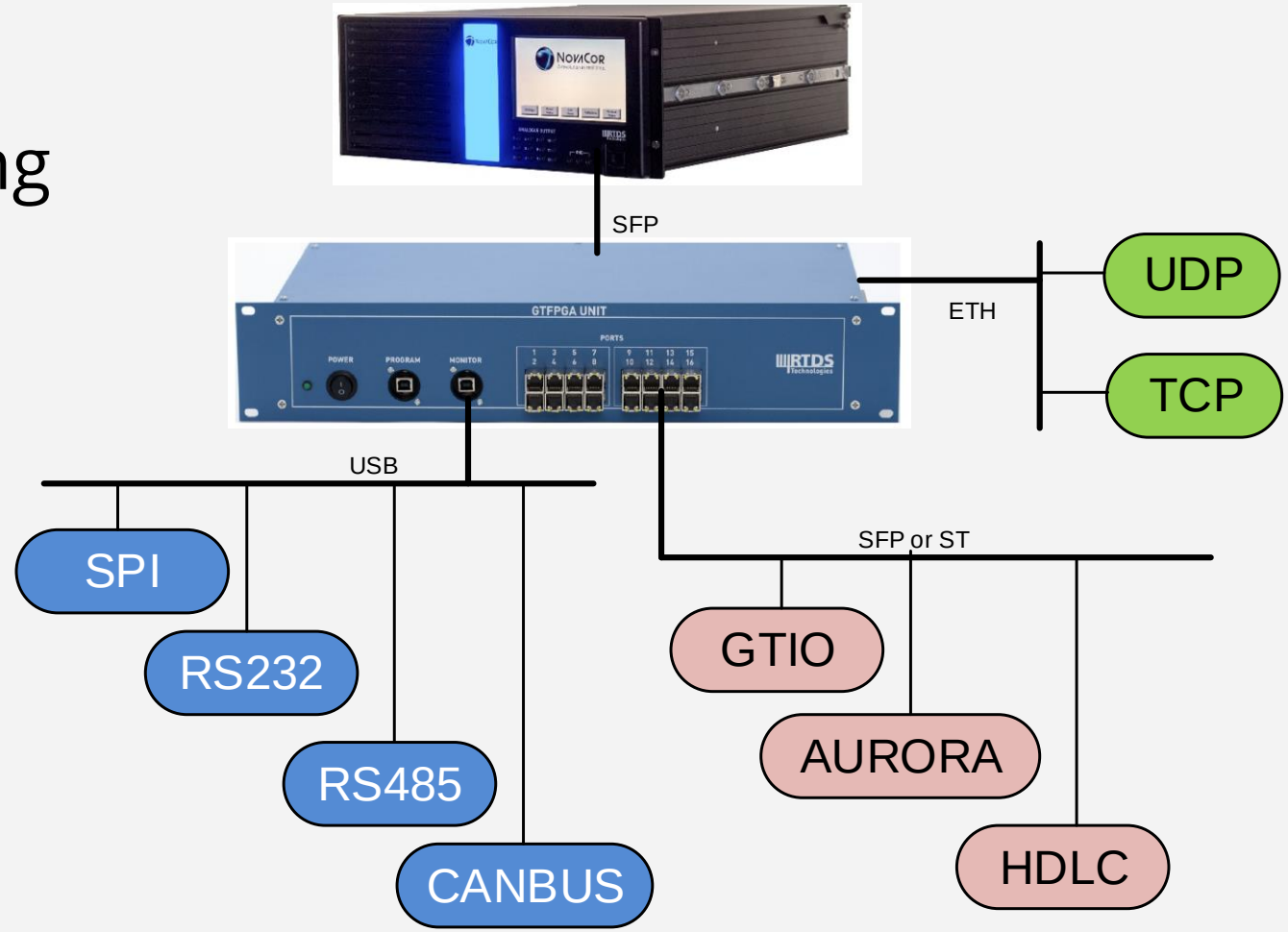
Interfacing via GTFPGA

- GTIO cards connected to RTDS or User Devices



Interfacing via GTFPGA

- More general
- Include many interfacing methods in a single GTFPGA



Any comment, new requests are welcome.

We are here to listen.

THANK YOU!
QUESTIONS?

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