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INTERNATIONAL PHD PROJECTS IN APPLIED NUCLEAR PHYSICS AND INNOVATIVE TECHNOLOGIES

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Gigabit Ethernet status and data transport on TRBv3

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Outline

1. Gigabit Ethernet in HADES
2. TrbNet
3. TRBv3
4. TrbNet-Over-GbE
5. Bi-Directional Ethernet
6. Summary

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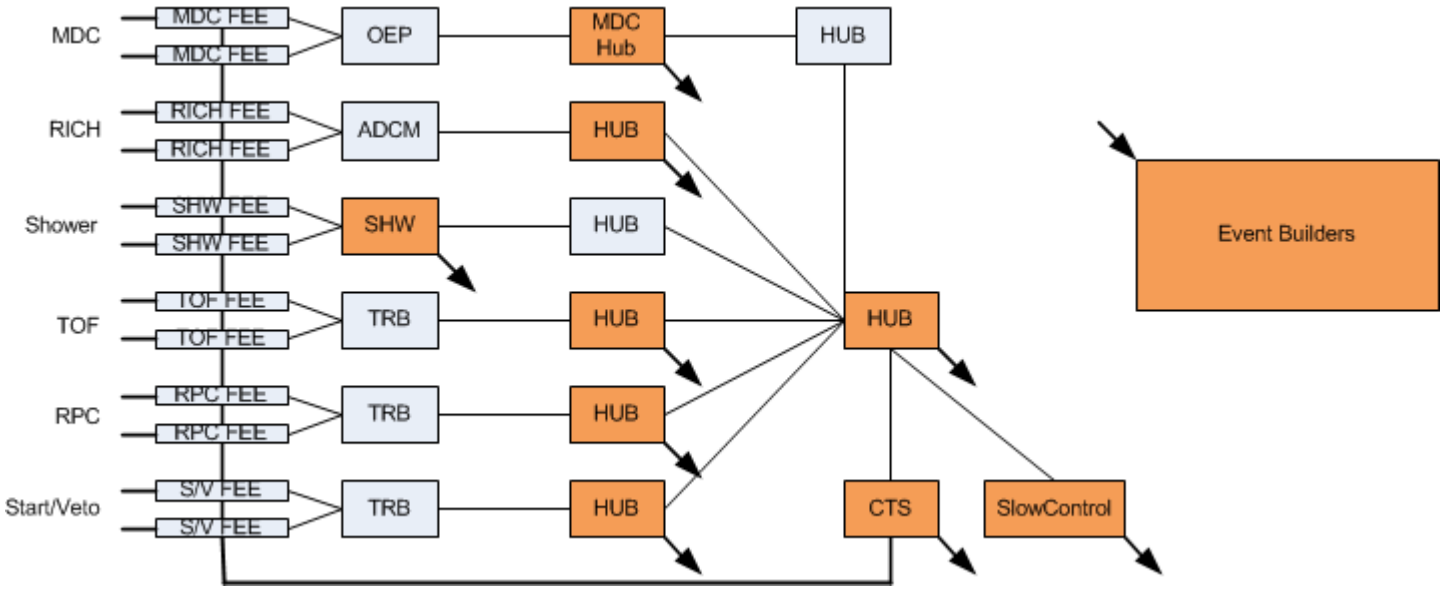
Gigabit Ethernet in HADES



- UDP over GbE used to send collected data to Event Builders
- Implemented on concentrator boards (HUBv2) and detector specific (Shower, MDC)

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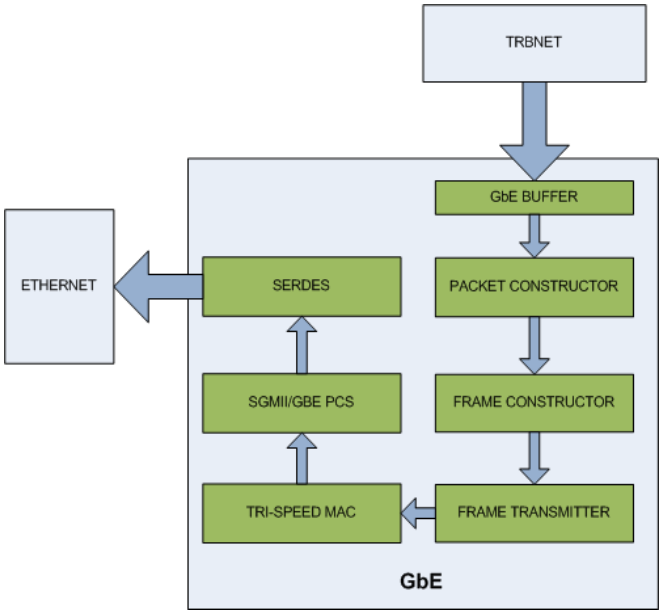
Gigabit Ethernet in HADES

- Layered structure
  - GbE Buffer – HADES specific interface and data buffer
  - Packet, Frame Constructors – UDP packets construction
  - Frame Transmitter, IPCores – Gigabit Ethernet, media access
- Implemented on Lattice ECP2M FPGAs
  - Uses 2 IPCores: Tri-Speed MAC and SGMII/GBE PCS
  - Platform independent upper layer
  - Ressource utilization for full entity:
    - 6k LUTs (6% for ECP2M100)
    - ~150kB RAM (26% for ECP2M100) (without GbE Buffer ~80kB)
- Performance
  - Full entity maximum throughput 50MBps
  - UDP construction only throughput 98MBps
  - For full entity, the speed can be augmented in trade of RAM consumption
  - No packet/frame loss or rejection due to corrupted construction



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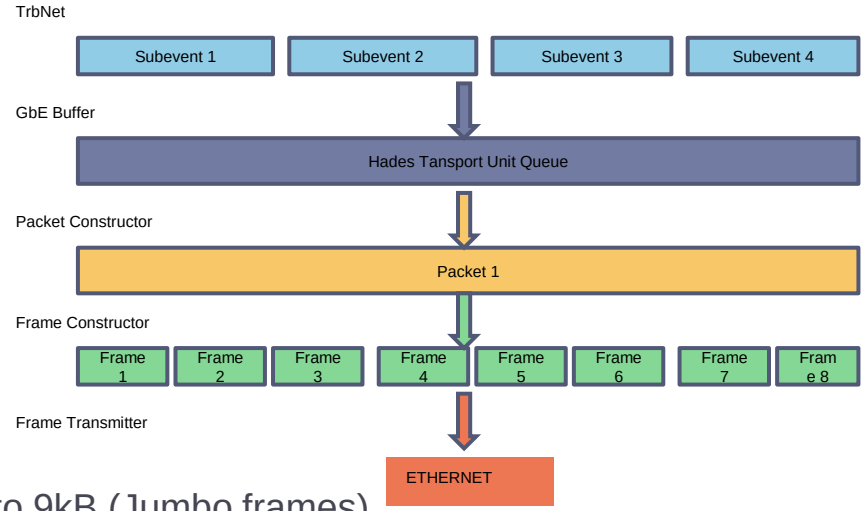
Gigabit Ethernet in HADES

- HADES specific interface (GbE Buffer)
  - Construction of Hades Transport Unit Queue
    - Queue consists of several subevents
    - Subevent can contain data from several endpoints
    - Uneven subevent size requires buffering
      - Drop in performance
  - Event builder selection mechanism



- UDP construction
  - Packet sizes up to 64kB
  - Packet fragmentation into Ethernet frames of up to 9kB (Jumbo frames)
  - Checksum calculation
  - No need for ARP in HADES case (only uplink)
  - All parameters are register-configurable

- Media access
  - Realized by IPCores
  - Autonegotiation
  - Link state control
  - Conversion to 8b/10b

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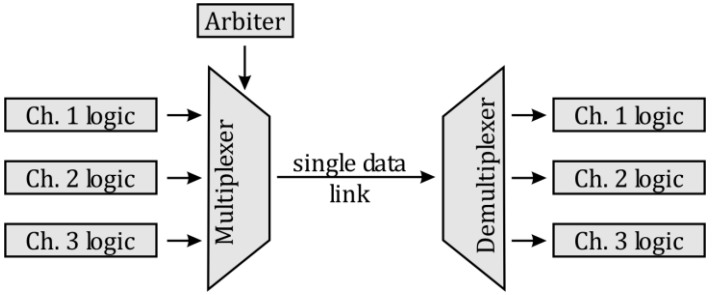
TrbNet

- 3 logical channels (priority):
  - LVL1 trigger
  - Data transport
  - Slow control
- Endpoint addressing scheme
  - Broadcasts
  - Unicasts
- Media independent
  - Optical links
  - LVDS lines
- Packet retransmisson
- Performance:
  - 75% of network bandwidth
    - for 2Gbps using 8b/10b encoding - data rate of 1.2 Gbps



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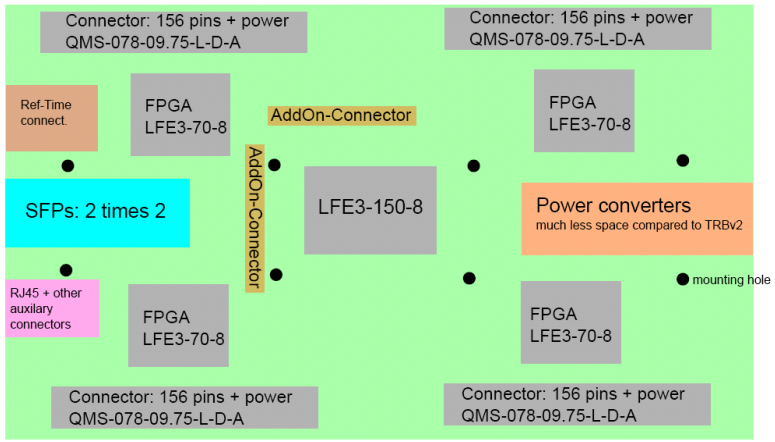
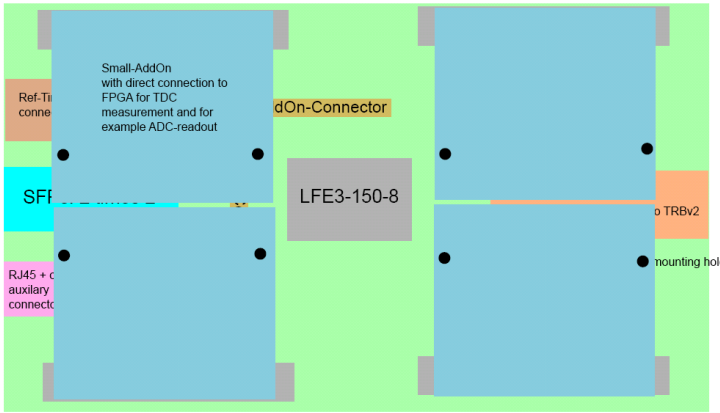
TRBv3

- Key features:
  - 5x Lattice ECP3 150
    - 4x for TDC or other purpouse
    - 1x main control
  - 8x 3.2 Gbps SFP
    - Multiple protocols
  - 4x 208 pin connectors
    - Input lines for TDC-in-FPGA
    - Connectors and power supply to small Addon Boards
  - 1x regular Addon connector
- No ETRAX!

TRBv3 layout proposal



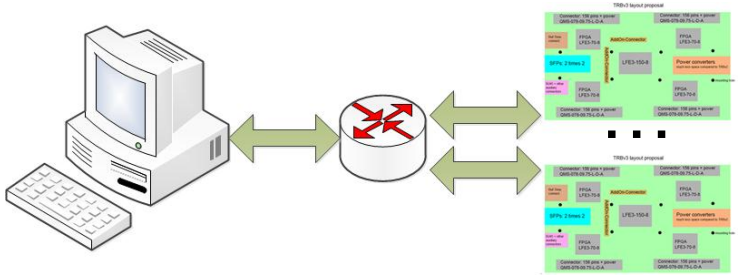
TRBv3 with small AddOns to cope with many applications.



TrbNet Over GbE

- Main idea:
  - No ETRAX on board
  - TrbNet endpoint on each FPGA

  - Control the board via Ethernet using TrbNet



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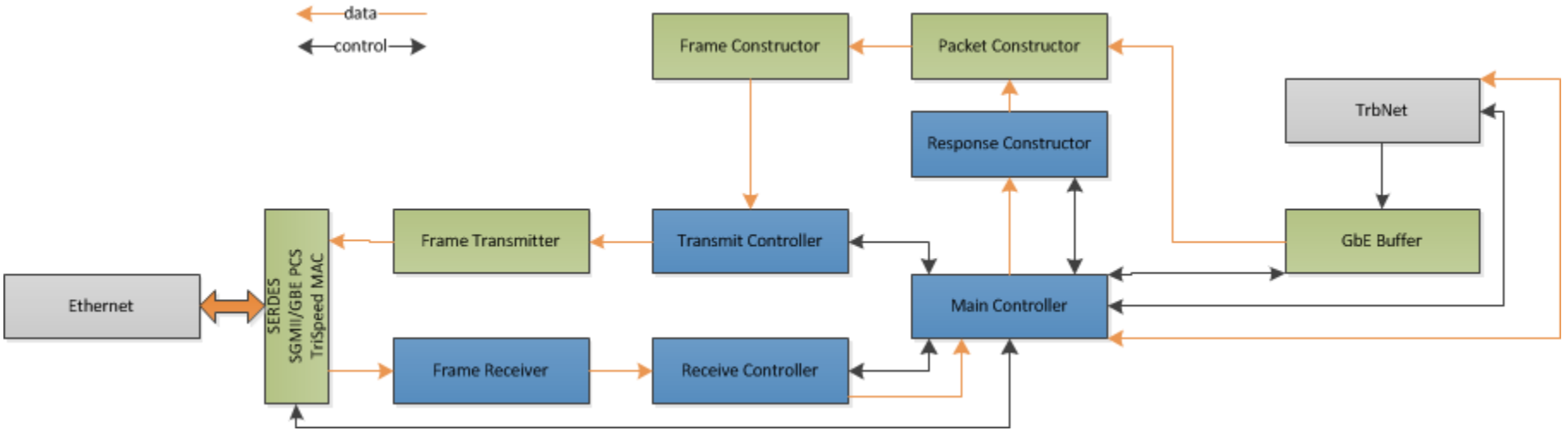
Bi-Directional Ethernet



- Reuse old components: packet/frame construction and transmission, TrbNet interface
- New elements: frame receiver, flow controllers, response constructor(s)
- Still pure VHDL logic (except media access)
- Without GbE Buffer – Full featured, full-speed, multiprotocol Ethernet endpoint

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Bi-Directional Ethernet

- Address assignment
  - Empty registers after reboot – no access from outside
  - Temperature sensor with unique ID on each board (not MAC address)

  - TRB DHCP
    - By default no address filtering on endpoints
    - Address mapping table on server

    1. Board sends request with its unique ID
    2. Server responds with broadcast message containing matching addresses
    3. One board accepts
       1. Saves the addresses
       2. Sets up filtering
    4. Others drop the message

- ARP needed for larger systems

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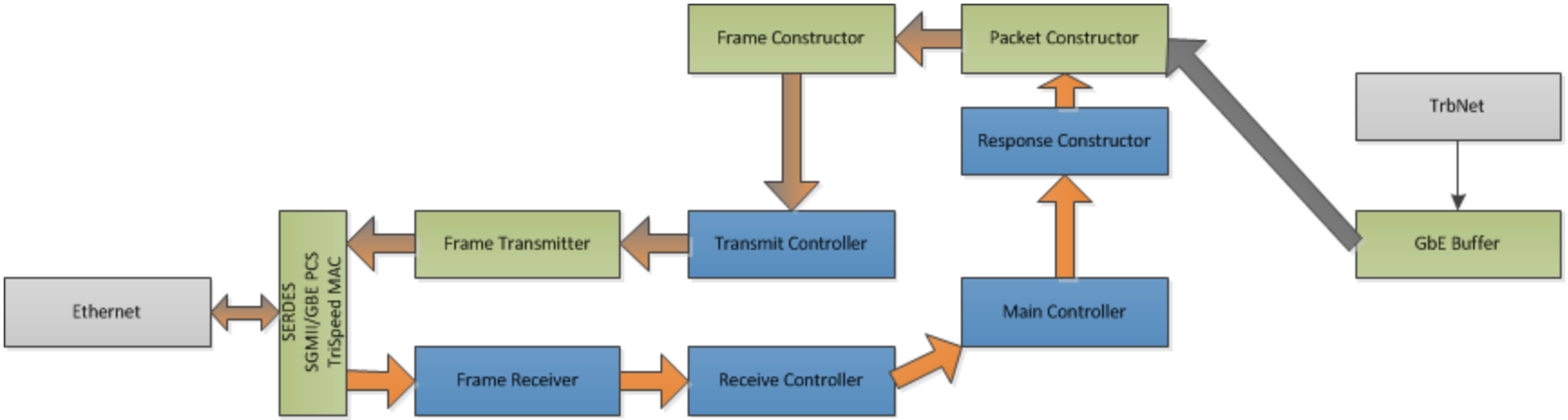
Bi-Directional Ethernet

- Status



- Done:
  - Test setup: injection of received frames into output stream
  - Most of the connection handling in two directions

- Still to develop:
  - Addressing mechanism
  - Higher level protocols implementations

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Summary

- UDP and Gigabit Ethernet implementation successfully used in HADES
- TRBv3 – new possibilities and new challenges
- TrbNet-Over-GbE – forces the development of Bi-Directional Ethernet implementation
- Project in development – first results are present

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