Long-Reach PHY Design Perspectives

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Long-Reach PHY Design Perspectives

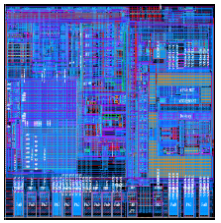
- Previously considered 15m PHY technical feasibility
  - Based on anticipated design changes, we estimated relative power, area, pin-count
- Industrial PHY is broader than Automotive PHY in scope
  - Process automation
  - Industrial automation
  - Building
  - Lighting
  - ….
- Cables, topology, power, disturbances, intrinsic safety, diagnostics

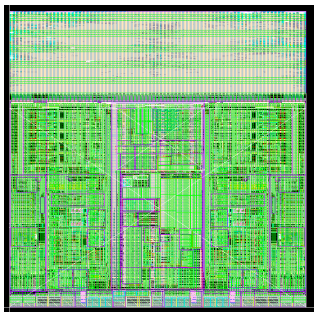
Long-Reach PHY Design Perspectives

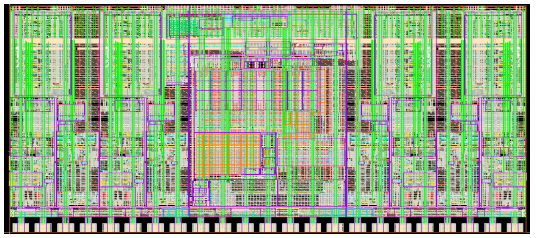
- A generic list of constraints
  - Our industrial focus is on long-haul point-point PHY's
    - 1000m trunk, 200m spur, 12 connectors
    - Echo-cancellation to 300m
    - Programmable swing
    - Fixed (and minimal) latency
  - Supply-disturbance / tolerance, noise immunity
  - Power constraint is important
    - Helps with powering, helps with intrinsic safety
  - Diagnostics
    - Tell me when performance may be degrading
  - Multiple configurations
    - PHY, PHY+MAC
  - Flexibility regarding power (don't preclude people from doing what they need for relevant applications)

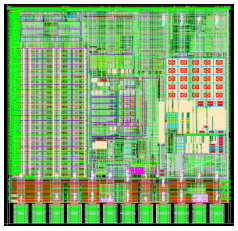
Long-Reach PHY Design Perspectives

- Relevant Technology Base
  - Consumer 100Base-TX
    - Separate TX/RX pairs (4 wire)
    - MLT3 coded signaling, +1,0,-1V
      - DSP and ADC/DAC'S
    - 4B/5B encoding, Point to point
  - Multiprotocol Industrial 100Base-TX
    - Same basic function as 100Base-TX, but for industrial environment
    - Deterministic (and minimized) latency
    - Diagnostics – broken cable, distance estimation, link quality estimate, register read access
  - "Industrialized" 10/100/1000 PHY
    - Bidirectional communication
    - Echo cancellation, NEXT/FEXT
    - New encoding and DSP schemes
  - Automotive 100Base-T1
    - Leveraged advanced and proven communication techniques
    - Multi-level, Echo cancellation, DSP, PSD-shaping for automotive emissions







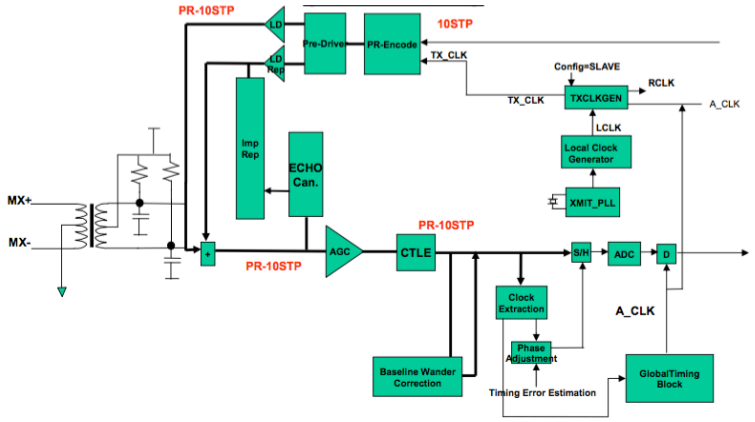


OmniPHY

Long-Reach PHY Design Perspectives

- Several technology options are possible
  - Our goal is to grasp the constraints and demonstrate feasibility, and report the results - not to find an optimum
  - Use a simple cable model based on equations presented

  - Developed a baseline from basic PHY
    - Hybrid
    - VM DAC, 4B3T
    - ADC, CTLE, DSP, Echo
    - DFE w/ Floating taps



  - Dedicate an ADC for real-time diagnostics
    - Monitor power supply and critical nodes/currents
    - Additionally allow read-out of DSP, CTLE, AGC settings

Long-Reach PHY Design Perspectives

- There are in fact many possible solutions, but that's for discussion later
  - A basic PHY architecture can suffice for feasibility
- Data-rate, insertion loss are very manageable
- A 2-port PHY can be area-optimized
- Estimated power dissipation <50mW
- Diagnostics and tuning options exist
- Need to refine cable models and impedances

10Mb/s SPE PHY Feasibility Summary

- We looked at the implementation aspects of Long-Reach 10Mb/s SPE PHY to establish technical feasibility
  - Captured a list of constraints that we'll refine down the road

We concluded that the Industrial 10Mb/s SPE is technically feasible