Downlinks and GBT

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Radiation Length of Electrical Links

- Up-links: AWG30 Cu-clad Al TwinAx: $X/X_0 = 0.076\%$
- Down-Links: AWG36 twisted pair: $X/X_0 = 0.0086\%$
  - all smeared over 1 cm at normal incident
- If each pixel module is served by one up and one down links
  - ⇨ down link contributes 10% of the radiation length
- one down link can serve 4 FE chips
  - Layer 1: reduce wire counts by a factor of 2
  - Layer 2: reduce wire counts by a factor of 2
  - Layer 3-5: each module contains 4 FE chips
- having one down link serving more than 4 FE chips will result in large loss of solid angle if one link is broken
- contribution of down links in radiation length and physical volume is insignificant in comparison to up links

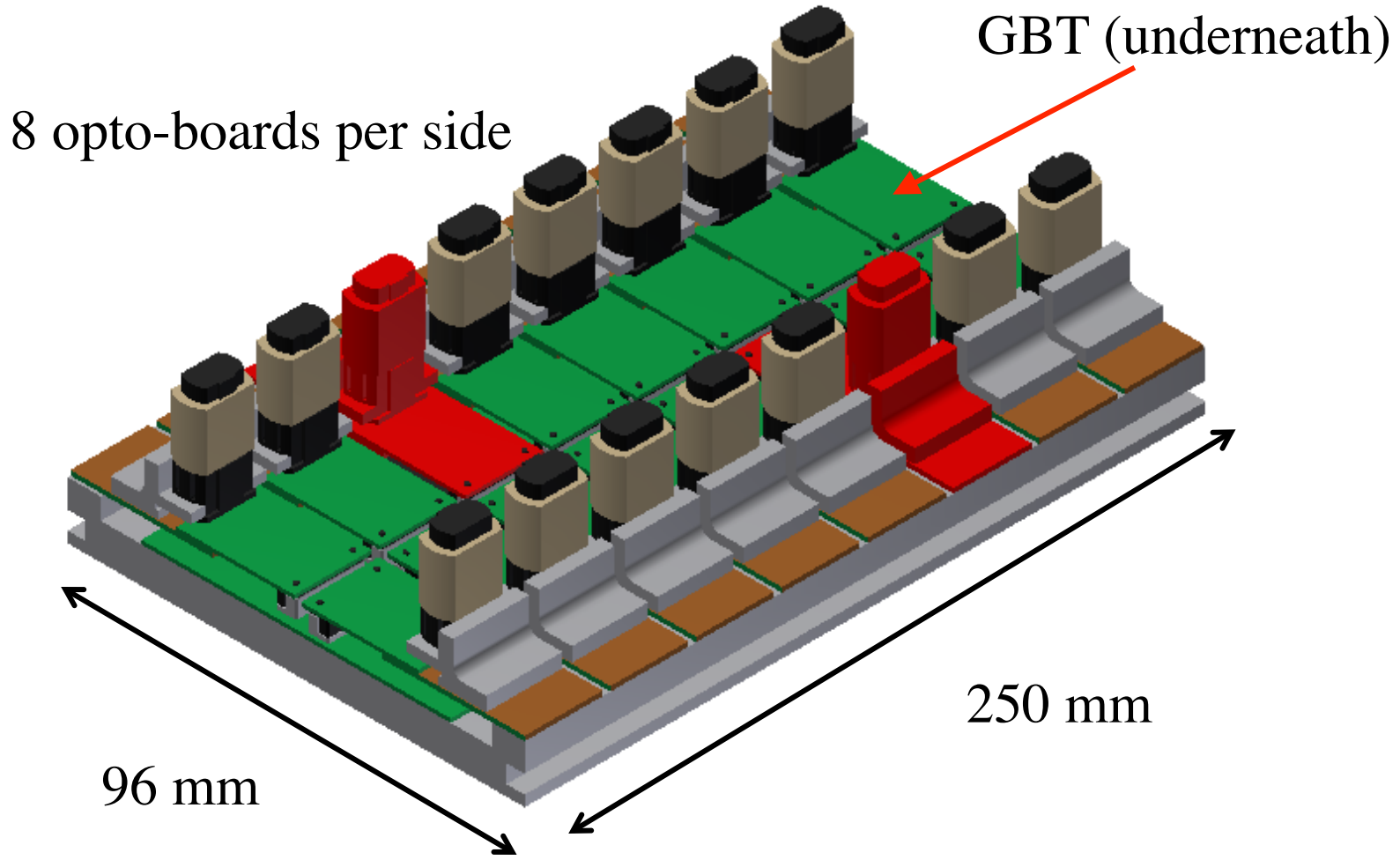
Opto-Box and GBT

- Basic assumptions:
  - up-links: use 12-channel VCSEL array operating at 5 Gb/s
  - down-links:
    - 12-channel receiver ASIC coupled to a 12-channel PIN array
    - one GBT de-serializes the 2.5 Gb/s signal from each channel in receiver ASIC to multiple 160 Mb/s streams for transmission to modules
  - one down-link opto-board for every seven up-link opto-boards

GBT at Opto-Box vs. EOS

- GBT will not survive the radiation at EOS for inner two layers
  - ⇨ put GBT at EOS for outer layers?
- If GBT at opto-box:
  - ✔ reliable delivery of control signals to VCSEL driver opto-boards
  - ✔ uniform opto-box design for all layers
  - ✘ several pairs of skinny wires to EOS
- If GBT at EOS:
  - ✘ send control signals from EOS to opto-boards
    - ⇨ more cables, connections, points of failures, messy
  - ✘ two opto-box designs
  - ✔ one bigger cables to EOS
  - ✘ failure at EOS will disable half of a stave

Opto-Box



Recommendation

- Put GBT on opto-box for simplicity, reliability, uniformity