Status of the Belle-II PXD Kapton Cable and Dock-Box-Board

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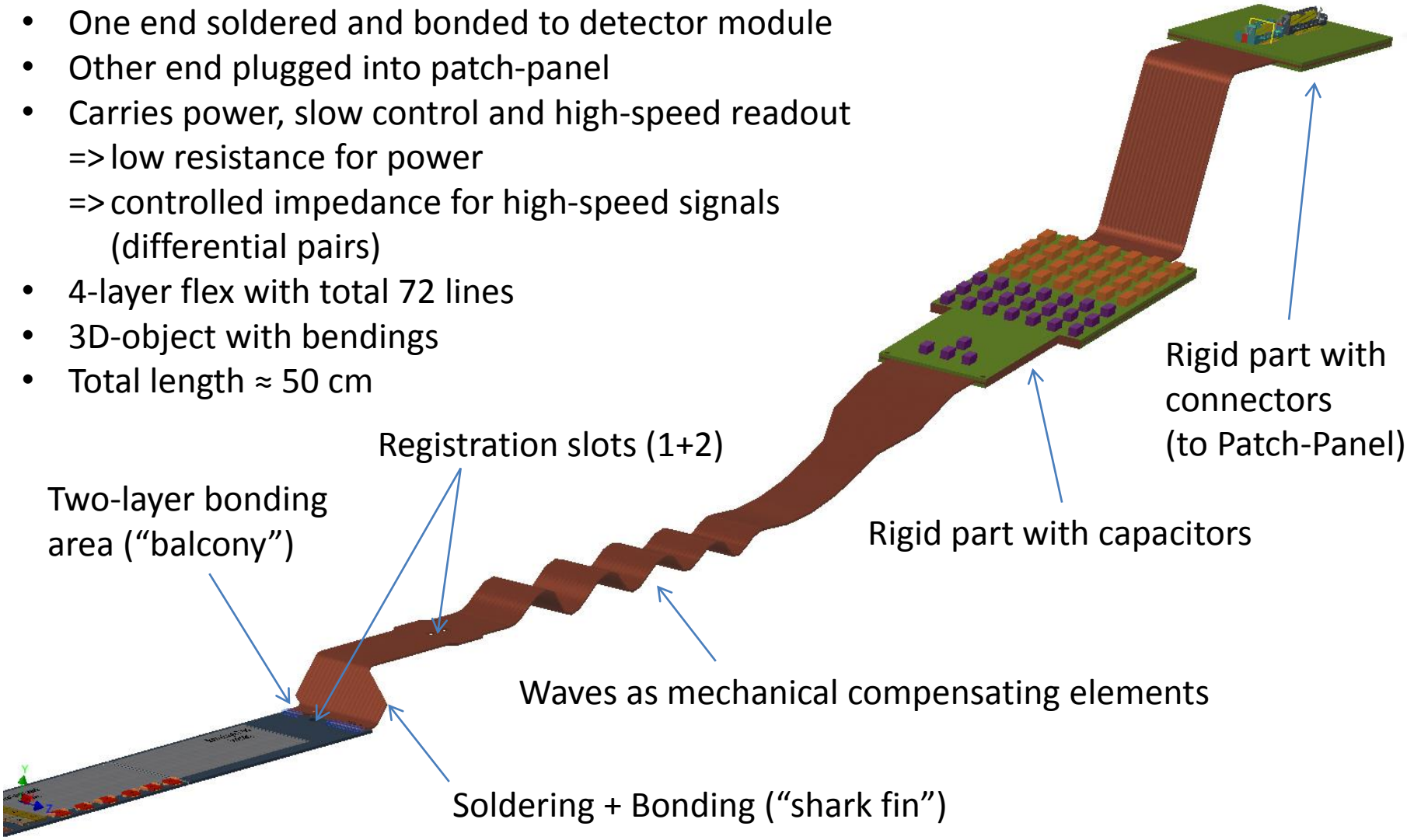
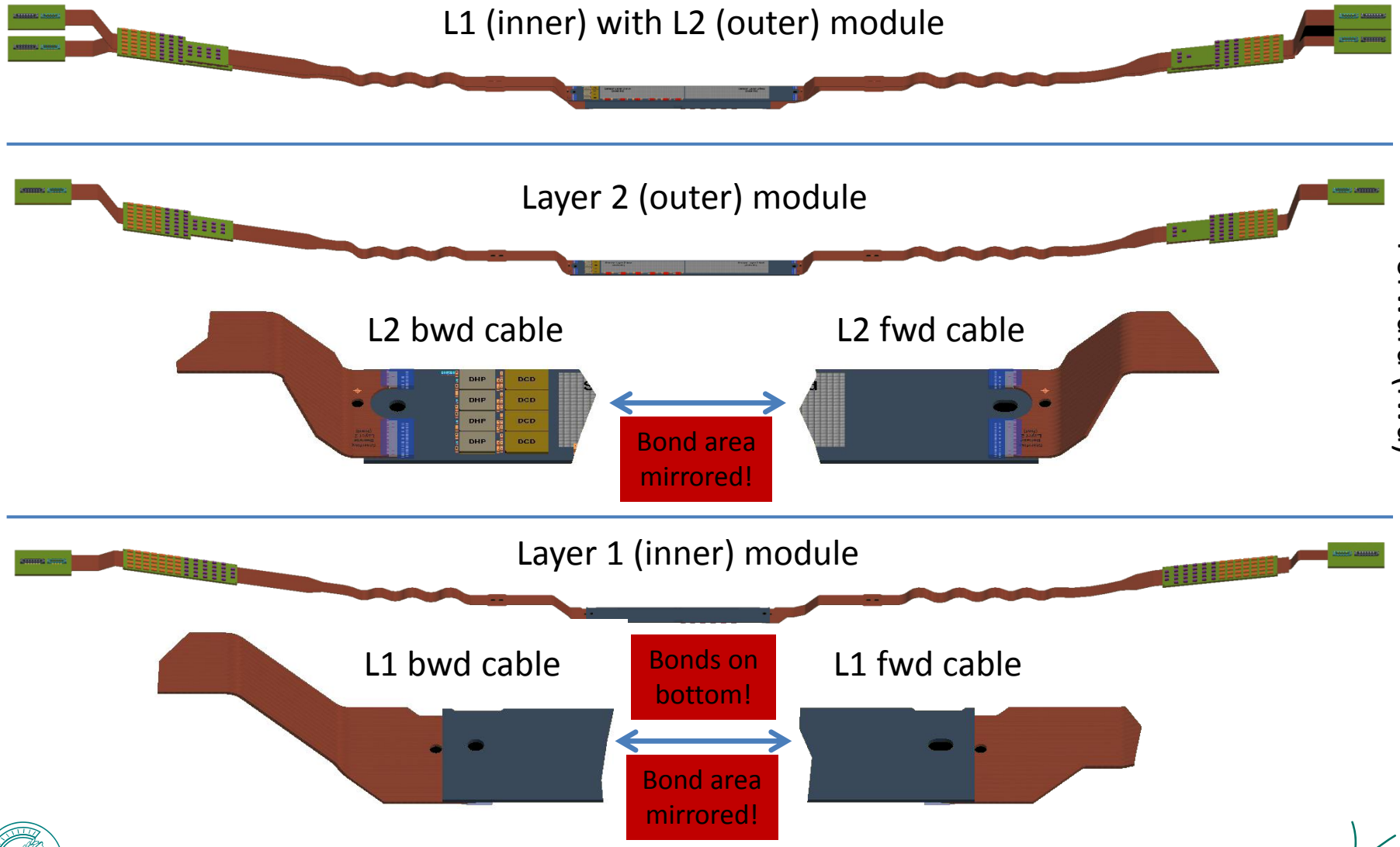
Kapton Cable on PXD

- One end soldered and bonded to detector module
- Other end plugged into patch-panel
- Carries power, slow control and high-speed readout
  => low resistance for power
  => controlled impedance for high-speed signals
  (differential pairs)
- 4-layer flex with total 72 lines
- 3D-object with bendings
- Total length ≈ 50 cm



4 Individual Variants



Cable Specifications

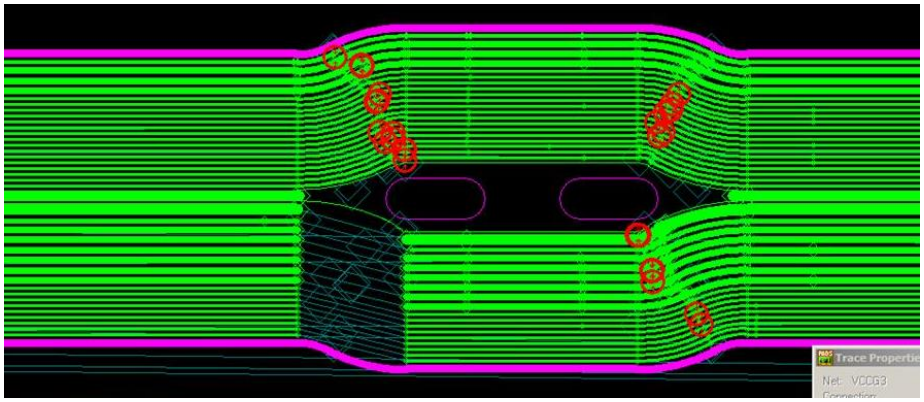
- 4 layers in flex area (Kapton)
- 6 or 8 (or more) layers in rigid part (FR4)
- Trace width and distance down to 100 µm
- Spacing between bond pads only 70 µm
- Trace distance to outline down to 210 µm (130 µm at “shark fin”)
- Via drill 0.2 mm, pad diameter 0.5 mm
- At PXD-side (“shark fin”): solder pads on bottom, two layers of bond pads on top (“balcony”)
- Mechanical precision at “shark fin” and registration slots ±30 µm => laser cutting instead of mechanical milling
- Impedance of differential pairs 100 Ohms ±10%
- Flex part: min. width = 10 mm, max. thickness = 0.4 mm, bending radius 2.5 mm
- Total length < 500 mm

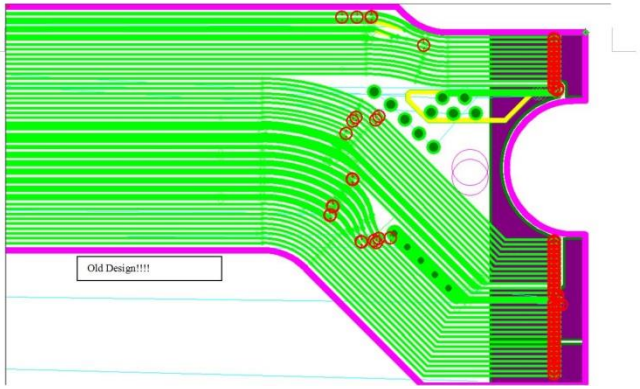
Work on the Kapton Cable at MPI

- Started in Oct 2012 based on a design done at the LMU in Altium Designer
- Data imported to PADS Layout with many issues (design- and tool-dependent)
- Much time invested in solving (removing) the issues to make the layout usable and editable.
- Changed strategy: Use straight traces instead of curves lines.
- Details (dimensions, placement) updated in close cooperation with the construction department.
- Document with specifications created in order to present to PCB manufacturer (Tayo, May 2013).

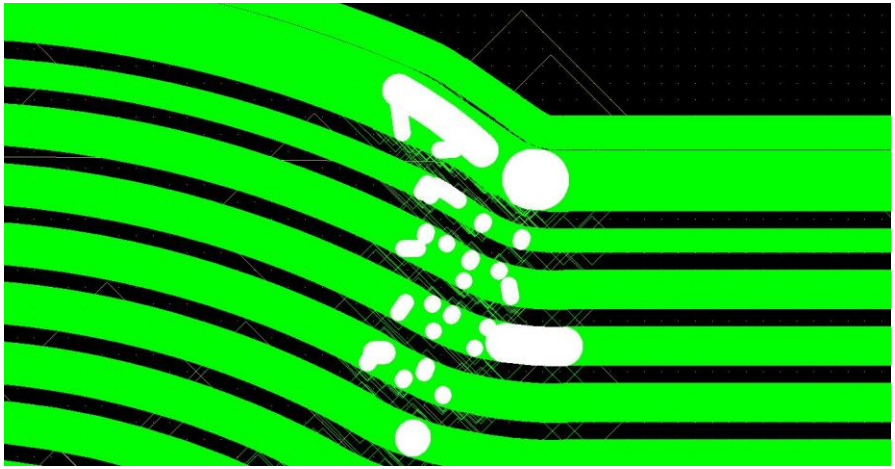
Issues after Import to PADS

Clearance errors at arcs: many DRC errors (red circles)

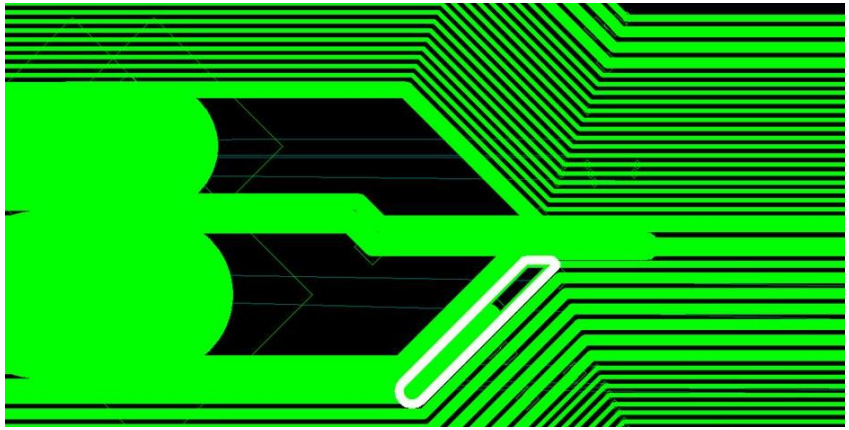




Traces consisting of many little elements:
=> no flexibility, online DRC impossible



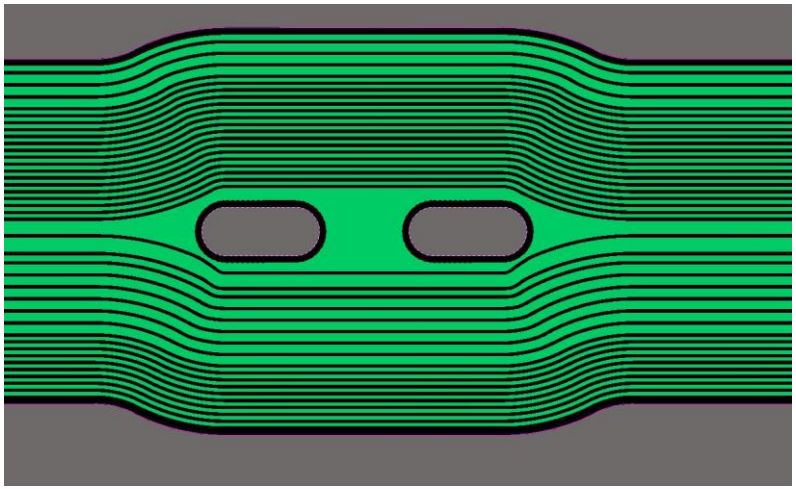
2D-line objects instead of copper
=> no electrical connection

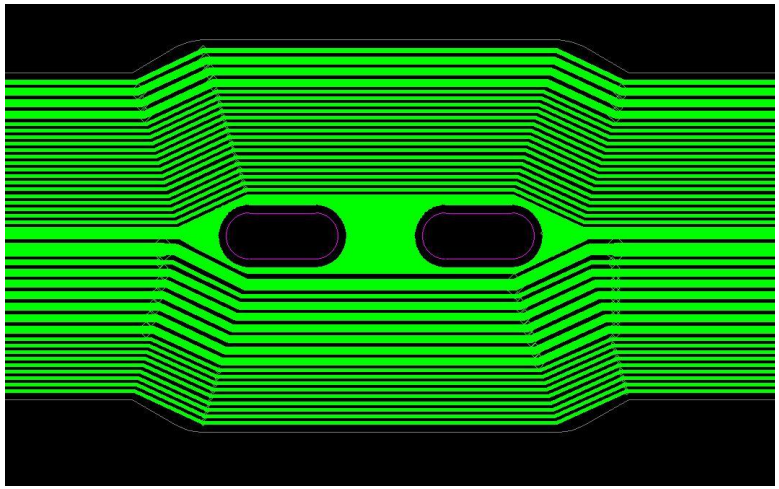


Examples of Modifications

Registration slots

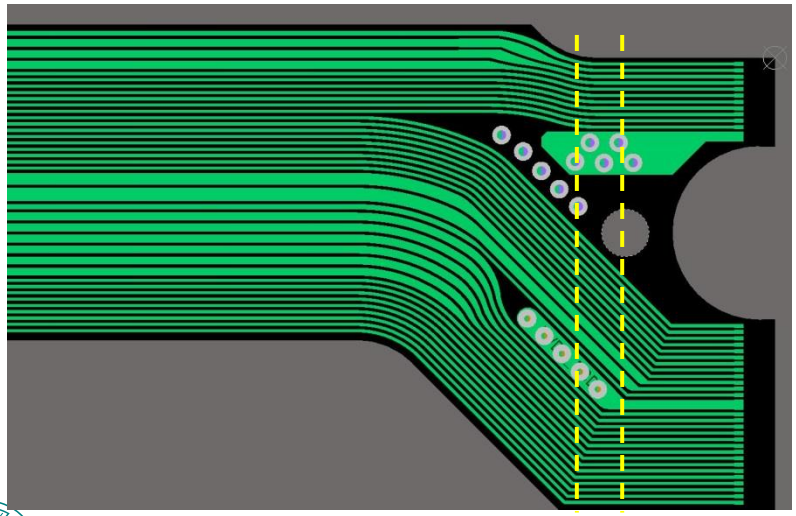
original

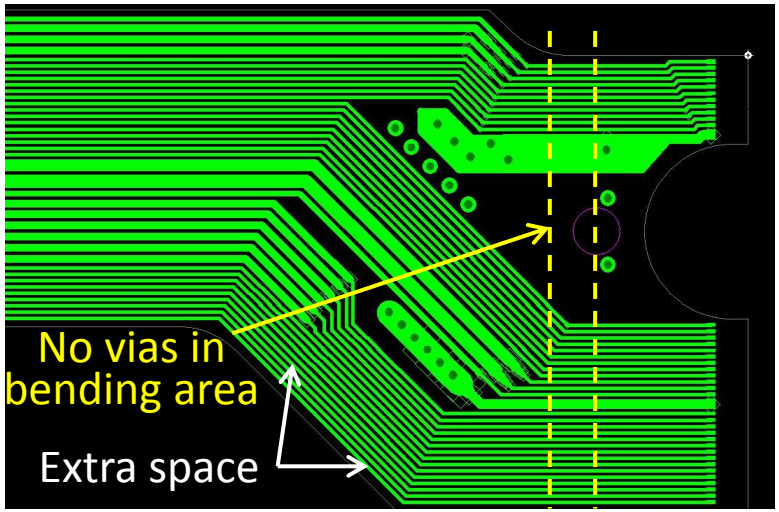




reworked

Bonding area “shark fin” (note the 3 mm of extra space)

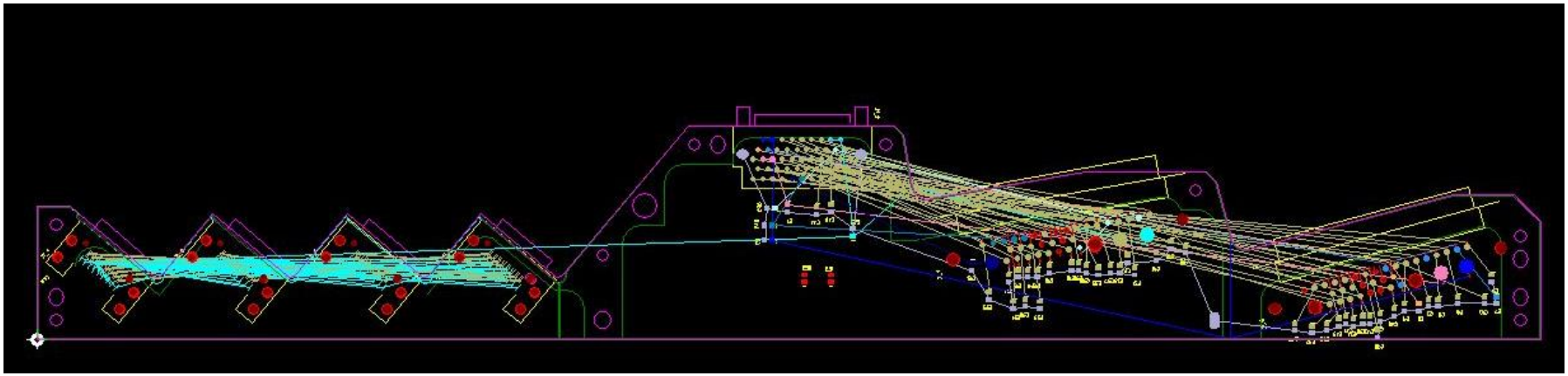




Next Steps

- Manufacture L2bwd prototype without capacitors at Tayo (not the final version!); layout probably ready in mid July 2013, i.e. cable expected in August (if all works smoothly)
- Perform measurements and simulations
- Insert the additional rigid part in the L2bwd; estimated amount of work 3 months
- Start work on L1fwd:
  - change side of “shark fin” from top to bottom
  - adapt geometry of flex part (incl. bending positions)
  - adapt rigid part with capacitors
- Layout of L1bwd and L2fwd:
  - mirror “shark fin”
  - adapt geometry and capacitor area

Dock-Box PCB



- Layout data imported from Altium Designer into PADS Layout
- Issue with definition of differential pairs.
- Estimated amount of work: ≈ 6 weeks
- At moment in competition with other projects

Summary

- Many issues concerning the Kapton layout solved.
- First prototype of Kapton cable expected in summer 2013.
- Much layout work required due to 4 individual types of Kapton cable.
- Dock-box board layout easier, estimated to be ready in 2013.

Any question?
Remarks?

Thanks for Your attention!