Polymer Multimode Waveguide Optical and Electronic PCB Manufacturing

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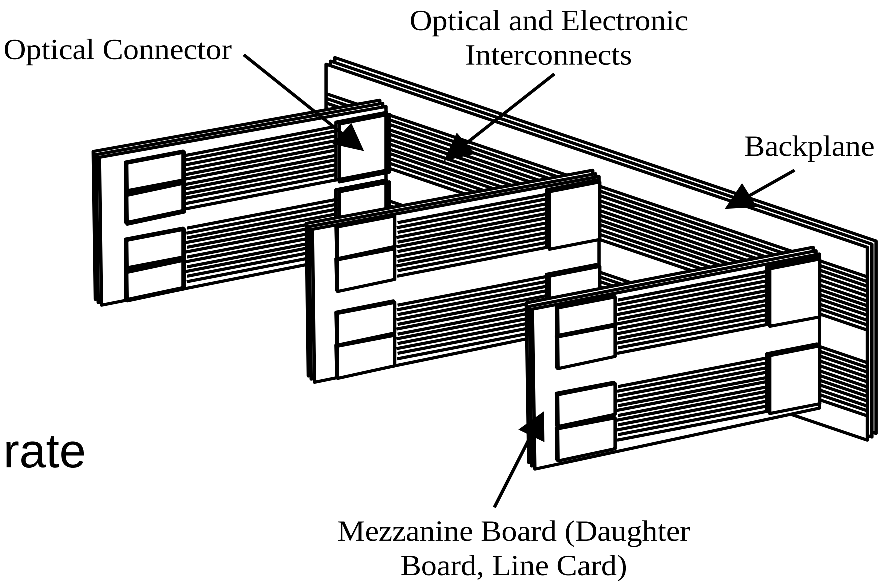
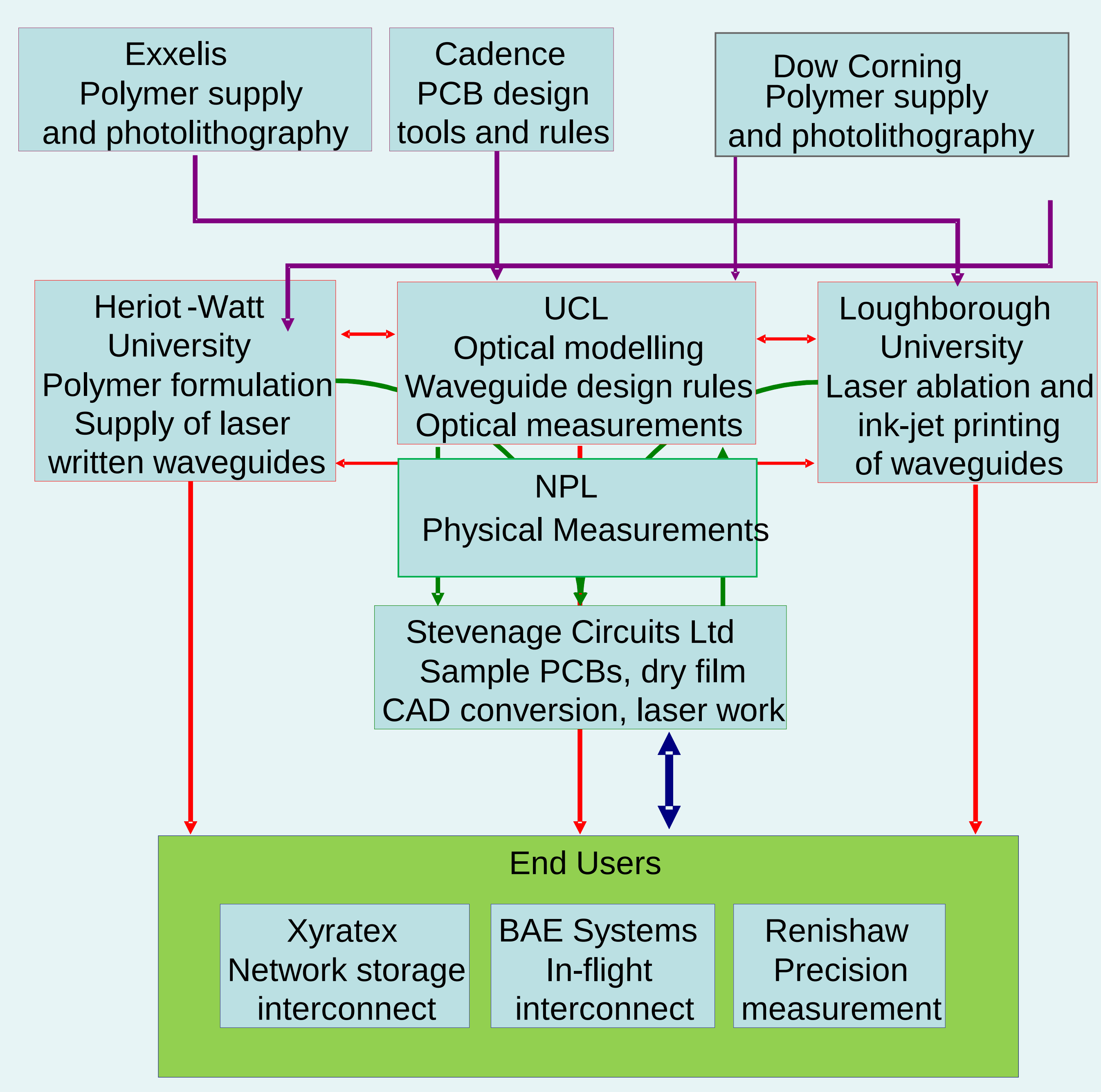
Copper Tracks versus Optical Waveguides for High Bit Rate Interconnects

- Copper Track
  - EMI Crosstalk
  - Loss
  - Impedance control to minimize back reflections, additional equalisation, costly board material

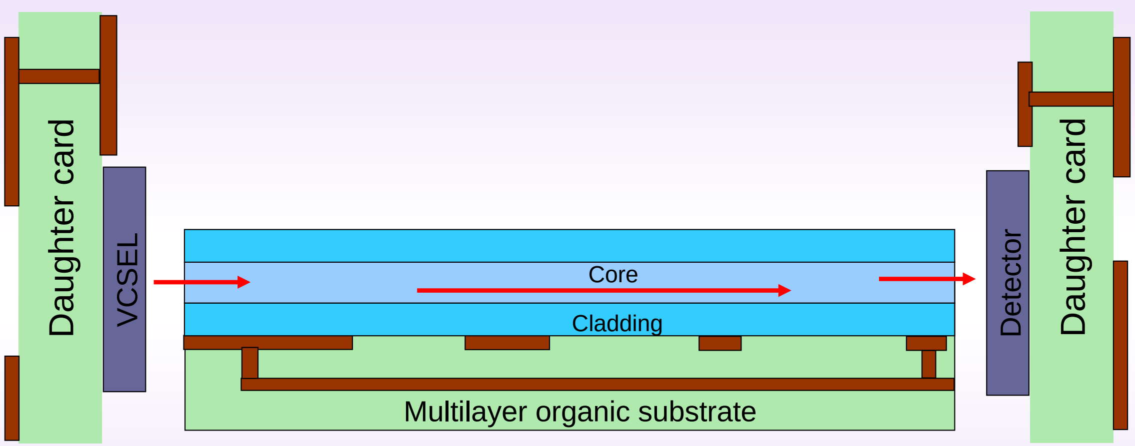
- Optical Waveguides
  - Low loss
  - Low cost
  - Low power consumption
  - Low crosstalk
  - Low clock skew
  - WDM gives higher aggregate bit rate
  - Cannot transmit electrical power




Exxelis
Polymer supply
and photolithography
Cadence
PCB design
tools and rules
Dow Corning
Polymer supply
and photolithography
Heriot -Watt
University
Polymer formulation
Supply of laser
written waveguides
UCL
Optical modelling
Waveguide design rules
Optical measurements
Loughborough
University
Laser ablation and
ink-jet printing
of waveguides
NPL
Physical Measurements
Stevenage Circuits Ltd
Sample PCBs, dry film
CAD conversion, laser work
End Users
Xyratex
Network storage
interconnect
BAE Systems
In-flight
interconnect
Renishaw
Precision
measurement

The IeMRC Optical Printed Circuit Board (OPCB) Project Final Aims

1. To investigate and compare several waveguide fabrication techniques, including Photolithography, Direct Laser Write, and Ink Jet Printing
2. To investigate and compare different polymers, including Polysiloxane and Acrylate/Methacrylate
3. To establish waveguide design rules and use with commercial PCB layout software to design a demonstrator
4. To investigate waveguides sidewall roughness by experiment and modelling



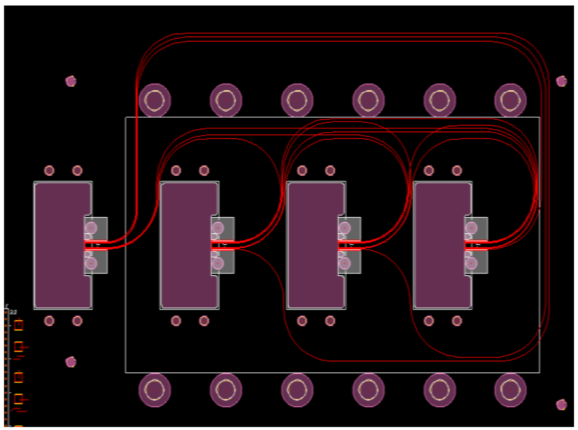
- Backplanes
  - Butt connection of “plug-in” daughter cards
  - In-plane interconnection
- Focus of OPCB project

Selected Achievements

- Heriot Watt's original acrylate/methacrylate formulation required a writing speed of ~75 µm/s at a power of ~100 µW. They formulated a new polymer which cures at a much faster writing speed of 100 mm/s at a reduced power of 8 mW
- Loughborough University have demonstrated the inkjet printing of polymer waveguide materials and fabricated trial polysiloxane waveguides using this technique.
- UCL characterised the waveguide wall roughness for the first time and derived a new theory to calculate the propagation loss due to sidewall scattering in press in IEEE Journal of Lightwave Technology.
- UCL made the first measurements of crosstalk between waveguides published in IEEE Transactions on Advanced Packaging.
- UCL established design rules for lowest loss for bend radius, crossing angles, waveguide spacing and used them with Cadence PCB layout tools to design a demonstrator backplane totally connecting 4 daughter cards which was fabricated and proved to work well – the first ever such demonstration

Optical PCB Backplane

Layout design



Fabricated PCB