

Photonics Research in New Zealand

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Photonics Research in New Zealand





- New Zealand research teams collaborate with research groups in Australia, Korea, USA, UK, Ireland, France and Germany.
- Progress and research successes in these areas have led to the development of two startup companies selling photonics equipment worldwide.

Southern Photonics

- A University of Auckland spin off company which manufactures test and measurement equipment for very high speed optical communications systems.



Institutions

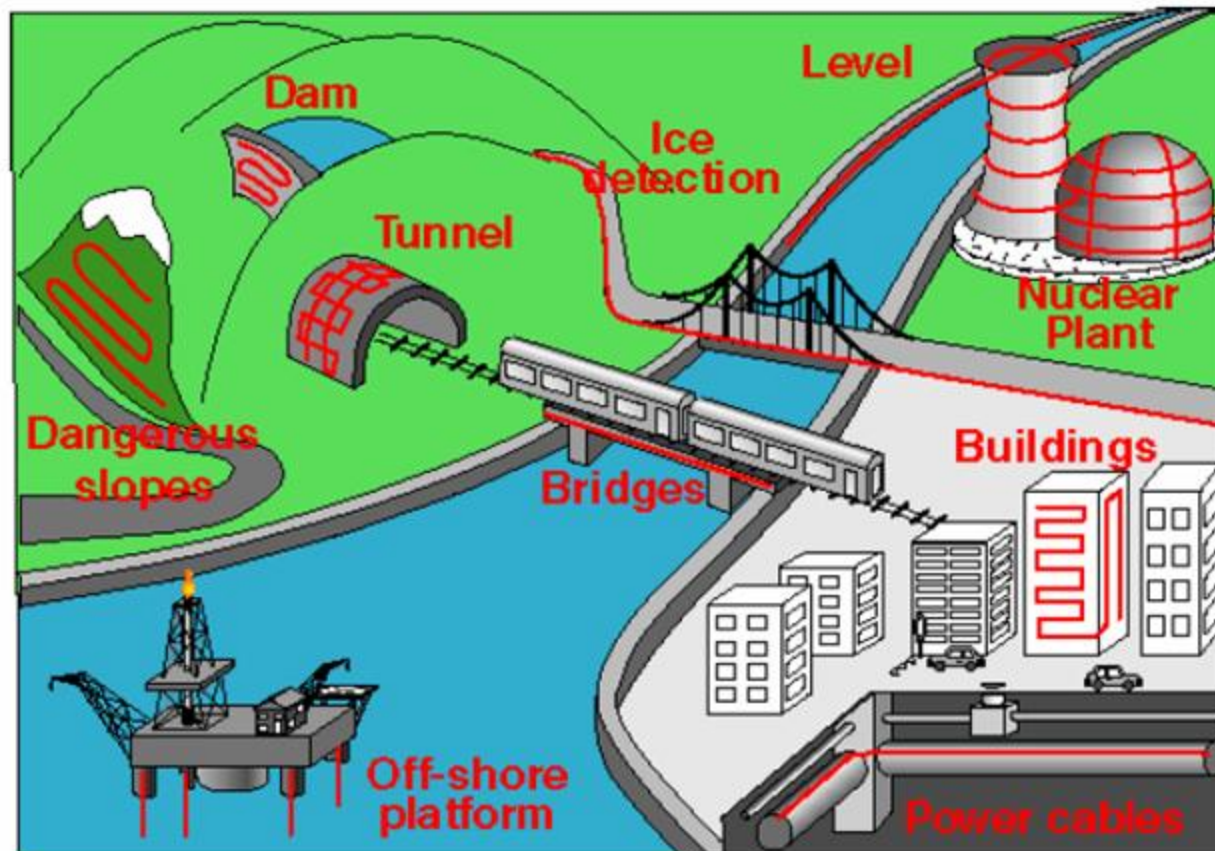
- Photonics and Laser Physics have been major research areas at Auckland and Otago Universities for three decades.
- University of Auckland
 - Optical communications research 
 - Nonlinear fibre optics research
 - Biophotonics research
 - Optical fibre sensors 
- University of Otago
 - Optical sensing technologies
 - Microresonator applications
- These Universities are currently bidding for funding to enable a Centre of Research Excellence in this area

Optical Fibre Sensors

- Funded by a government contract supporting collaborative research with Korea (IIOF Fund).
- Closely related technology to that used in telecommunications.
- Finding applications in structural health monitoring with interest from:
 - Power companies (Wind turbines).
 - Bridge builders and bridge monitoring authorities.
 - Transit authorities (Viaduct construction, highway monitoring)

Optical Fibre Sensor Network

- Safety surveillances for large structures.
- Prevention and early warning of disasters

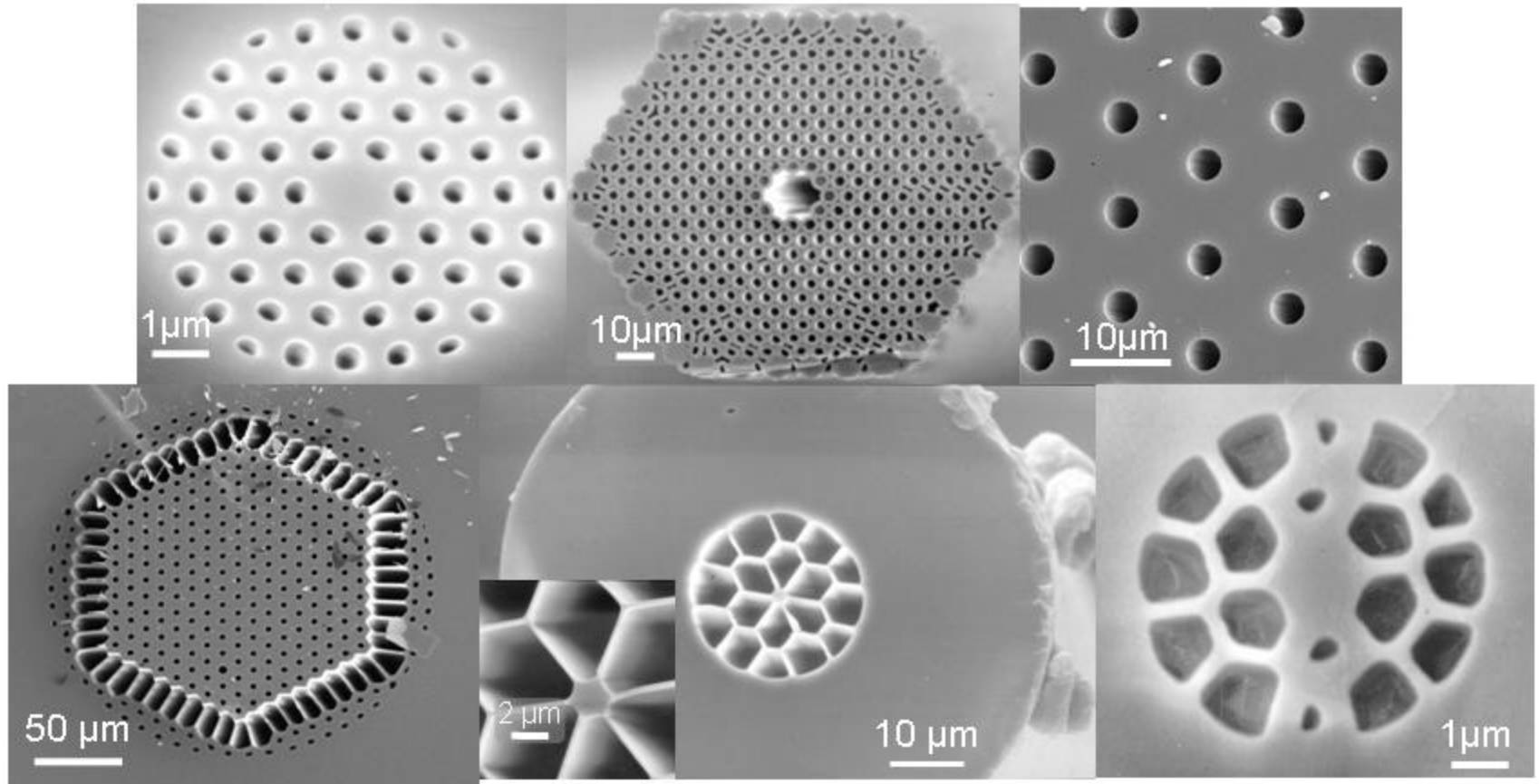


Optical Communications Research

- Key developments from the Auckland research group have included work on:
 - Optical pulse compression and conditioning
 - Optical switching (mechanical and optical)
 - Optical pulse amplification and analysis
 - Wavelength conversion (for WDM systems)
 - Plastic fibre applications (including FTTH)

Linkages

- The group at Auckland has active collaborations with a number of world leading research centres where custom optical fibres (holey fibres) are made.



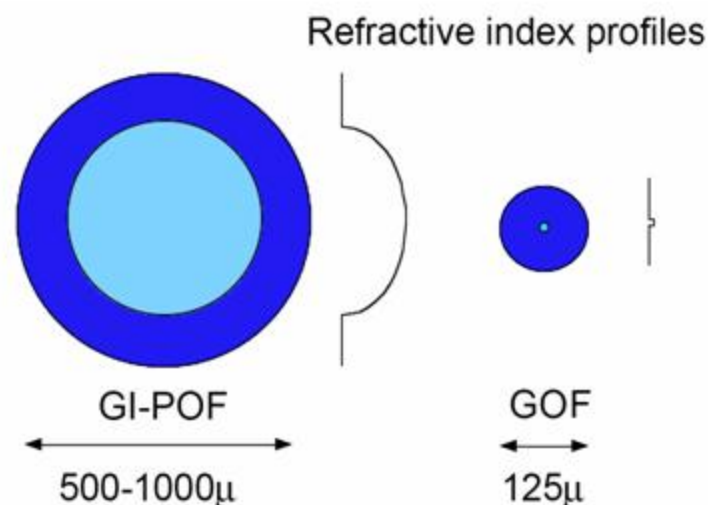
Optical Fibres

- Most of the fibres made for our use are single mode fibres which form the bulk of the world wide network used for optical communications.
- The holey fibres that we use are also single mode, but are able to perform specialised switching, frequency conversion and other functions.
- Recently we have been working closely with the Optical Fibre Technology Centre in Sydney on plastic optical fibres which also have an array of holes which run the length of the fibre.

Plastic Optical Fibres

- Plastic optics fibres have been used for many years for short, low cost communications links, but these links differ substantially from long haul links, as they use:

- Graded index multimode fibres
- LEDs instead of lasers
- Much fatter fibres

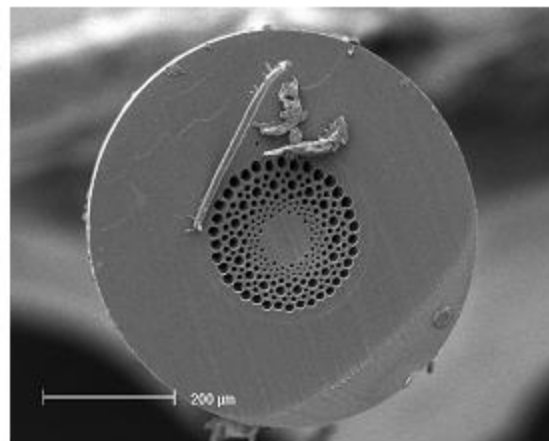


Plastic Optical Fibres

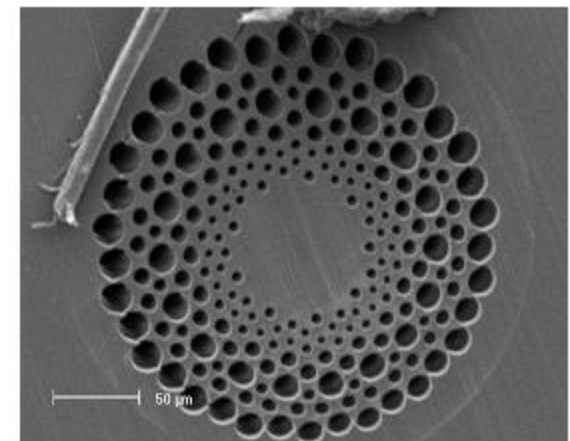
- Plastic optical fibres have been re-evaluated recently for use in Fibre To The Premises (FTTP) applications, they have:
 - Very low cost
 - Simple “Do It Yourself” installation with large diameter fibres
 - Use of visible light
 - Smaller “bend radius”
- The problem is that the cost of making the graded index profile is high.
- Our collaborators in Sydney have produced a “holey plastic fibre”. Here the graded index profile is made by the holes, a low cost plastic is used.

Plastic Optical Fibres

- The big problem with the holey plastic fibres is the difficulty of cleaving them (cutting them to produce a good optical surface on the end).
- We have developed a new method of cleaving.



*Graded Index
Microstructure Plastic
Optical Fibre
(GIMPOF)-developed
in Australia, cleaving
technology developed
in NZ*

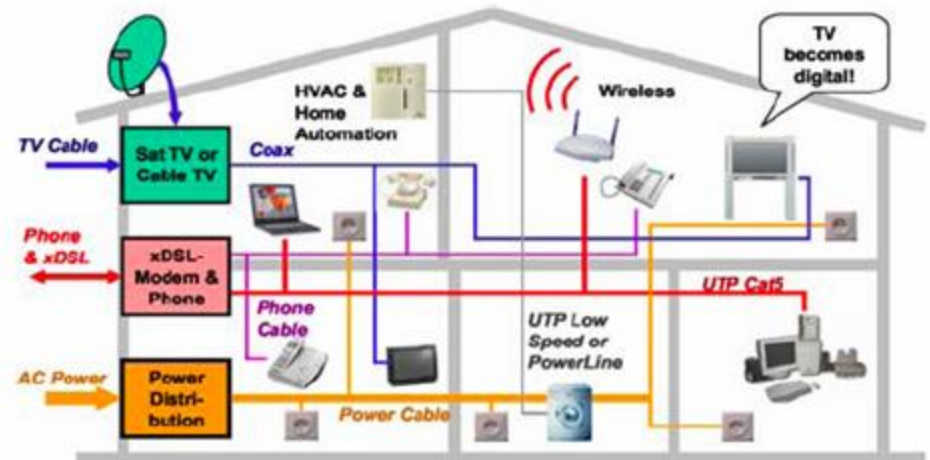


Plastic Optical Fibres

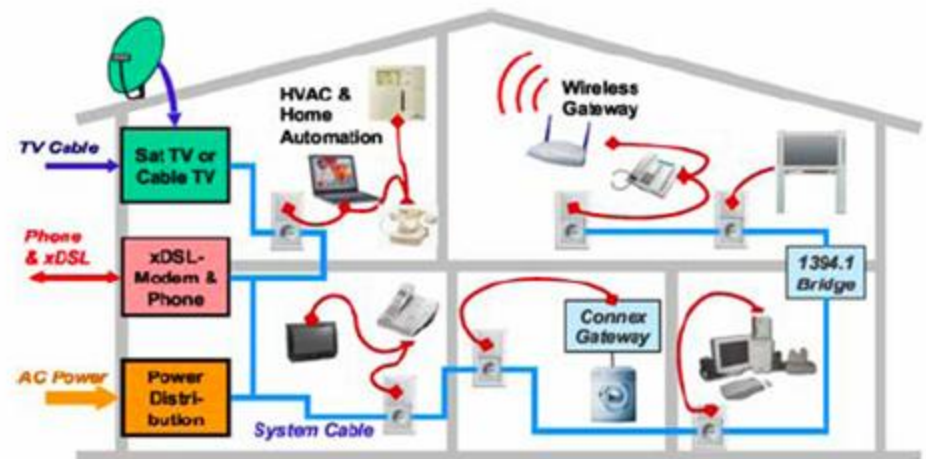
- Future plans in Korea and other advanced developed countries aim at 50-100Mb/s access for homes and offices.
- Once such an infrastructure is in place, plastic fibre technology could find application for low cost, high speed, home networks.
- We have shown that the fibres produced in Sydney have a remarkably high bandwidth, capable of transmitting 10Gb/s around the home.

Plastic Fibre Networks

- A plastic fibre network inside the home considerably simplifies networking.
- Current fibres can extend 50m at 10Gb/s data rates.



A Typical Home with Multiple Networks



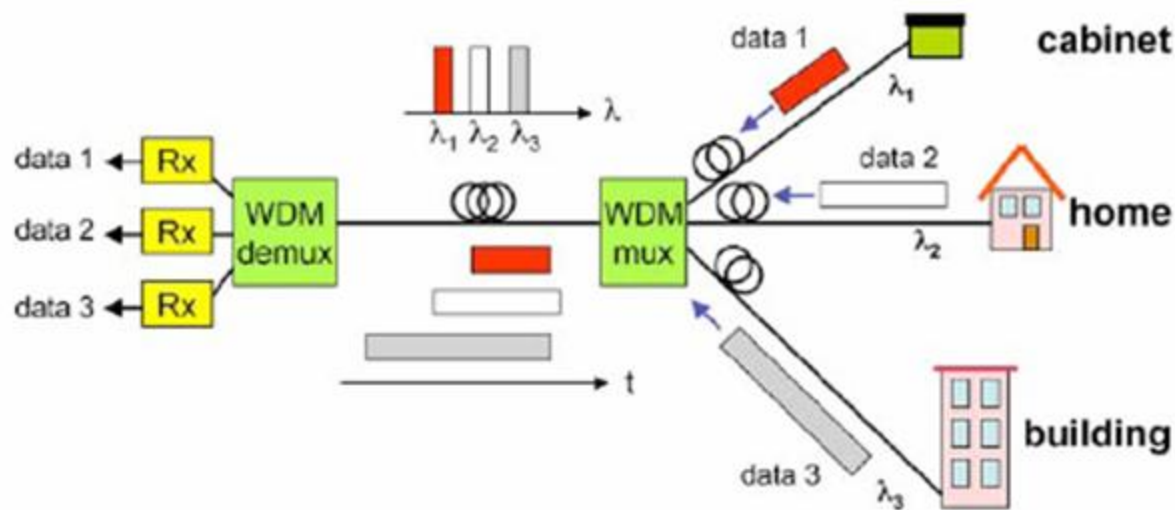
A Home with Ethernet / IEEE 1394 and POF

FTTP Research

- The Auckland group is also funded for a collaboration on Fibre To The Premises (FTTP) research with the Electronics and Telecommunications Research Institute (ETRI) in Daejeon.
- This research is cofunded by Telecom NZ and concerns:
 - Next generation WDM PON networks
 - Redundancy in metropolitan networks
 - Extension of the reach of the network

WDM PON networks

- This acronym describes a passive optical network (PON) based on the use of many wavelengths on the same fibre (called “wavelength division multiplexing” or WDM).

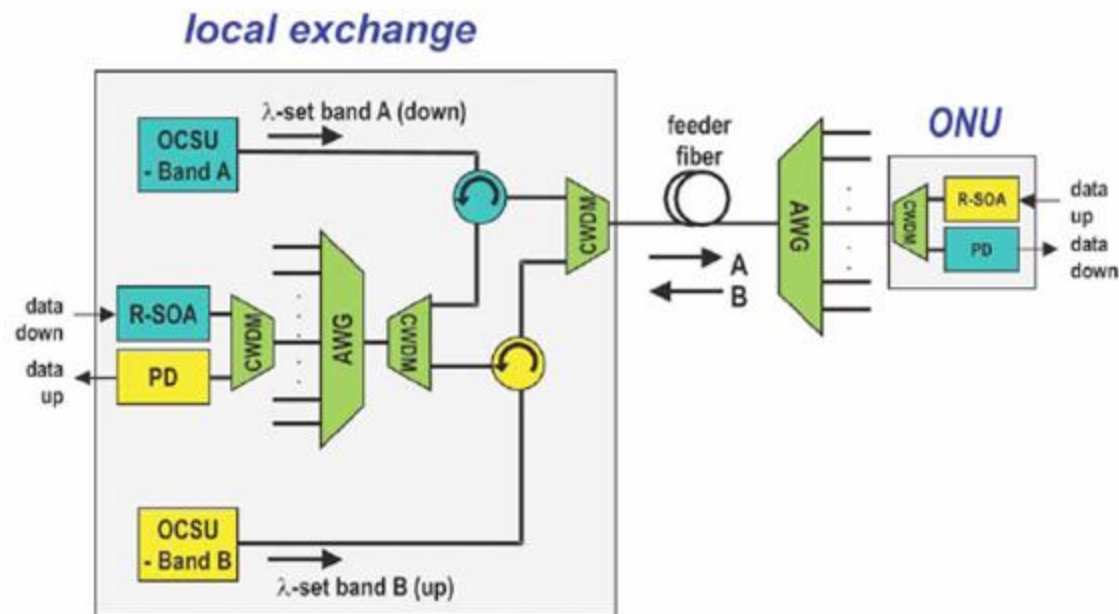


WDM PON Networks

- The key to deploying these very high speed networks is to reduce the cost of the equipment to be installed in each dwelling.
- A common method is to employ so called “reflective semiconductor optical amplifiers” or RSOAs
- These obviate the need for a customised laser at a different wavelength for each dwelling.

WDM PON systems

- The Optical Network Unit (ONU) is identical for each house and essentially reuses the light that was sent from the local exchange.
- This system could provide gigabit connectivity for each dwelling



Collaboration with ETRI

- ETRI has developed the required RSOA, and in Auckland we are developing software which simulates the device, enabling the performance to be predicted under different operating conditions.
- We plan to jointly set up a demonstration system for this technology with the help of a local developer who is building a PON system for two new housing developments in New Zealand.

Collaboration with Telecom NZ

- We are working with Telecom NZ to examine the economic feasibility of providing redundancy in planned FTTP systems to guard against large scale loss of service.
- There are a number of approaches involving ring network architectures, duplication of feeder and branch fibres etc, but deployment hinges on the costs.
- The results of this study are also of interest to our collaborators in ETRI.

Conclusions

- Optical communications research is of importance to broadband access providers, as well as to the academic community.
- A well trained workforce which understands the technologies is vital to their economic deployment.
- “Future proofing” of new networks is crucial to their long term economic viability .
- Our relationships with other Universities, Korean Research Institutes, and industry partners, have provided a great stimulus to the research.