

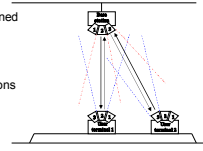
Introduction

- Increasing interest in **FTTH** (fibre to the home) and **PON** (passive optical networks)
 - Data rates of 100 Mbit/s and above
- ➔ **Home Access Network (HAN) (Optical wireless)**
- Duplex Gigabit/second data transmission
 - Cellular-approach-based green communications
 - Home and Office suitability (range, coverage)

Strategy and Modelling

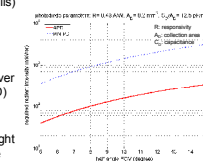
Strategy

- narrow field-of-view (FOV) line of sight links combined with transmitter/receiver angle diversity will offer
 - large modulation bandwidth
 - reduced ambient background noise level
 - high efficiency of power usage for communications
 - good coverage (overall)
- Cellular structure + MAC scheme → seamless communications and optimised transmit power
- Other advantages
 - Offers the potential for space division multiplexing capability (i.e. parallel Gbit/s links at different cells)



Transmit and Receive Modelling

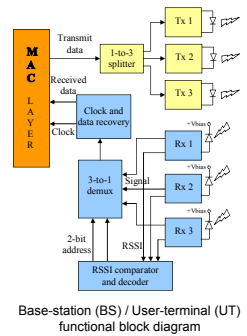
- FOV modelling shows substantially high radiant intensities required for a small change of FOV
- Avalanche Photodiode (APD) offers better receiver sensitivity compared to PIN-Photodiode (PIN-PD) → reduced Tx power
- Background light modelling showing ~3dB penalty between bright office lighting background and no-light scenarios → system is suitable for home/office use



System Elements

Demonstration 1 - OW system

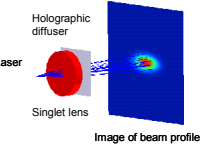
- Key features**
- Cellular system, 3 cells for each BS/UT
 - Hardware fast switching (handover) between cells (total delay < 500ns)
 - Bidirectional communications at 1.25 Gbit/s with bit-error-rate (BER) below 10⁻¹¹ (without FEC implementation)
 - Range up to 3.5m, coverage area of 45cm × 130cm (i.e. FOV of 9° × 25°)
 - Digital output data is retimed
 - Eye-safe compliance (class 1 transmitter)



Tx and Rx Design

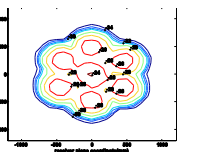
Transmitter

- Wavelength 825 nm
- Low ambient optical noise level
- Avoid commercial TV remote control
- Good silicon detector response
- 10-degree full-angle diffuser to achieve FOV and to meet eye-safe spec.
- Optical transmit power 25mW



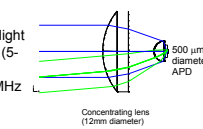
Base station coverage area

- Simulation for a 2-D coverage receiving plane, with BS consists of 7 cells
- 32dBm received power is required to achieve a 10-degree coverage (on 500µm diameter photodetector)

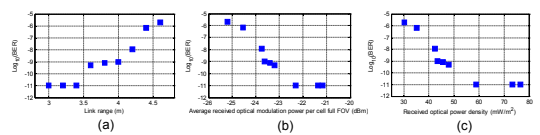
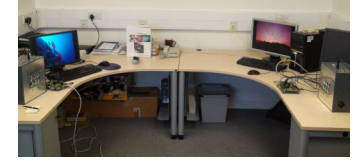
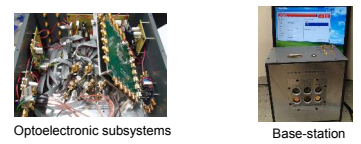


Receiver

- Optics
- Interference filter → minimize ambient light
- Lens system: offer a gain of factor 130 (5-degree half-angle)
- 0.2mm² APD, -35dBm sensitivity, 850MHz modulation bandwidth
- FOV of each receive cell is 10-degree



System & Performance



Conclusion

Demonstration 1 achievement: 1.25 Gbit/s error-free bi-directional cellular-system communications with limited coverage area
Demonstration 2 target: (i) wider coverage area, (ii) more compact design, (iii) reduced energy consumption

OMEGA project website <http://www.ict-omega.eu> Contact OMEGA info@ict-omega.eu