Long Reach WDM Access Networks and Other Access Researches in Taiwan

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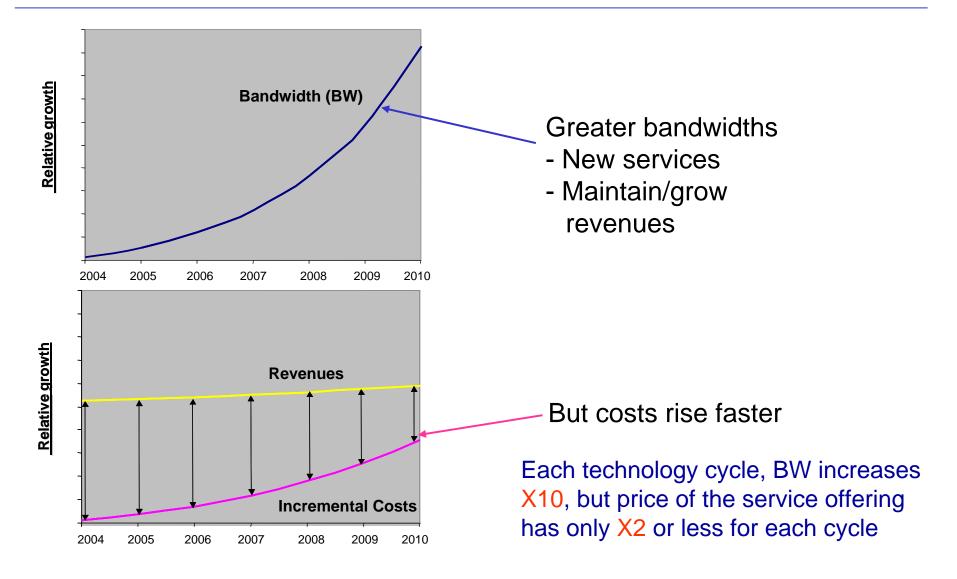


Outline

- Long reach WDM access networks – Challenges, architectures
- Fiber to the Antenna (FTTA) access networks
 - WiMAX FTTA system

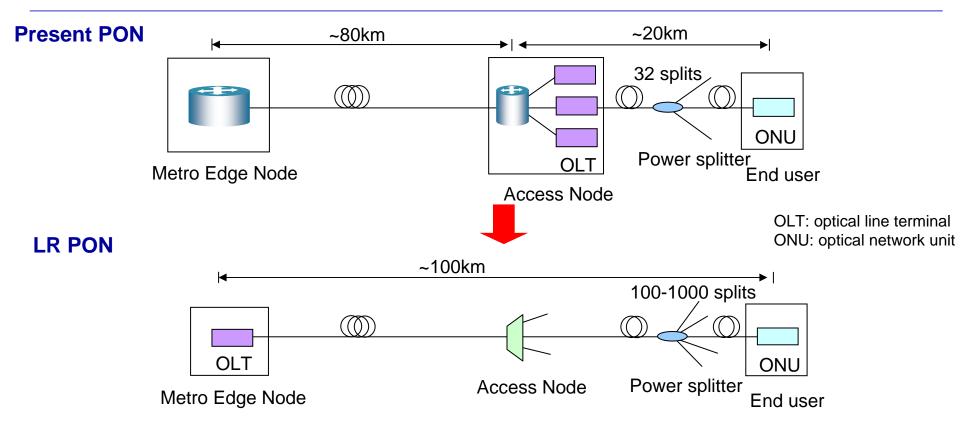


Bandwidth Growth – The Profit Margin Challenge



D. Payne and R. Davey, "The future of fibre access systems?," BT Technol. J., 20, 104-114, 2002

Long Reach Passive Optical Network (LR-PON)



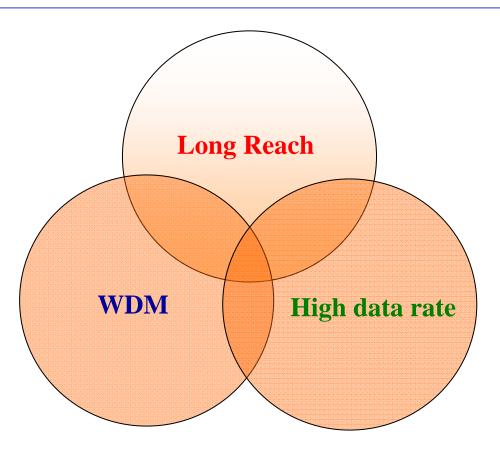
Since the underlying components (lasers, modulators, receivers etc.) cannot price decline a lot, only answer to reduce the cost is to reduce the number of interfaces, equipments and even network nodes

Long-reach (~100km) and high-split-ratio (100-1000) PON

- to integrate access and metro sections
- to reduce cost by simplifying network architecture
- wavelength division multiplexed (WDM) is usually considered



Features of LR Access



The LR access network will base on a new type of optically amplified, long reach (~100km) with high split-ratio (>100), high data rate, WDM PON



Challenges for LR PON

High power loss (e.g. 32 dB splitting loss for 1024 splits, ~30 dB fibre loss):

- Upstream, output power limited by ONU
- Stimulated Brillouin Scattering (SBS) limits launch optical power

Gain transient compensation for erbium-doped fiber amplifier (EDFA)

High speed Upstream Burst-mode Rx

Cost sensitive ONU (Tunable ONU/Reflective ONU):

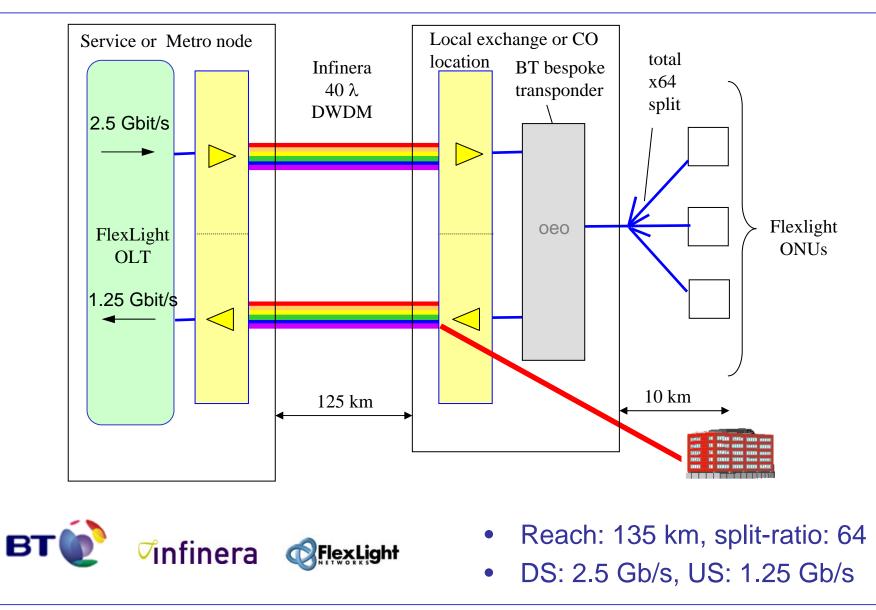
- Deployed at customer, should be low cost
- Wavelength stabilization (TEC, wavelength locker)

Long reach: fiber chromatic dispersion

10 Gb/s: External modulation or spectral efficient modulation formats

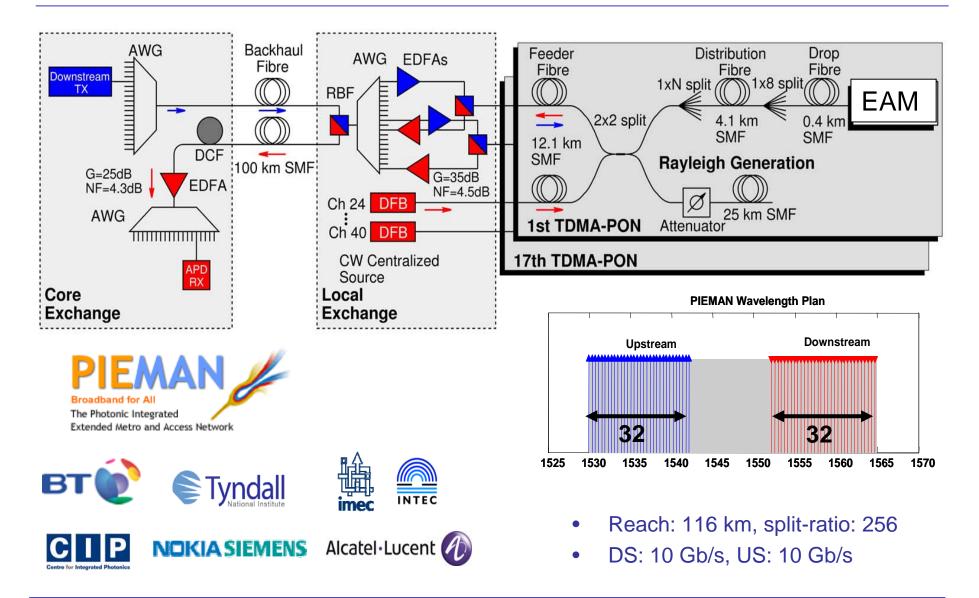


DWDM reach extension of GPON to 135 km



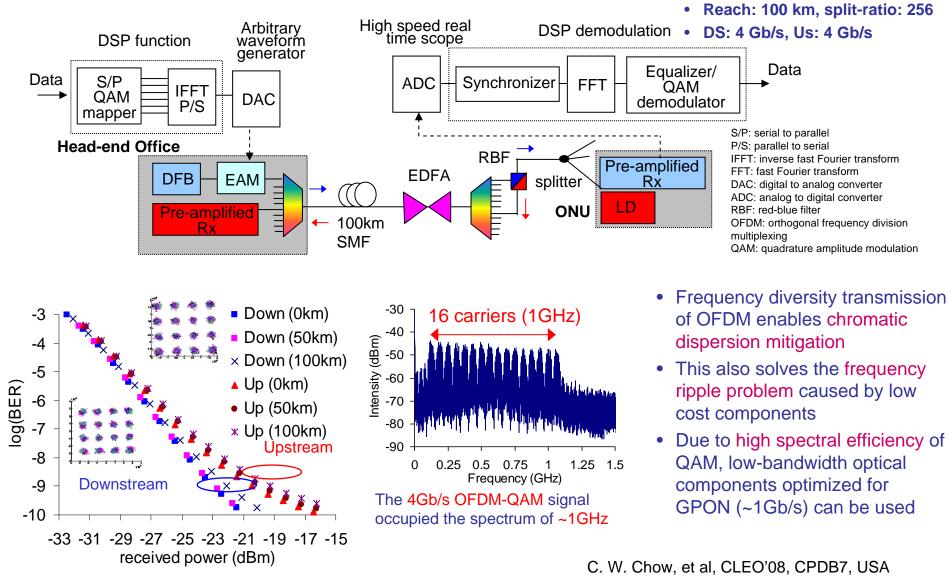
R.P. Davey et al, OFC 2005, Paper PDP35

10 Gb/s Carrier Distributed Long Reach PON with Colorless ONUs



P. D. Townsend, G. Talli, C. W. Chow, E. M. MacHale, C. Antony, R. Davey, T. De Ridder, X. Z. Qiu, P. Ossieur, et al, "Long Reach Passive Optical Networks," *LEOS Annual Meeting,* Invited Paper, ThW1, 2007

Experiment of LR-PON using OFDM-QAM





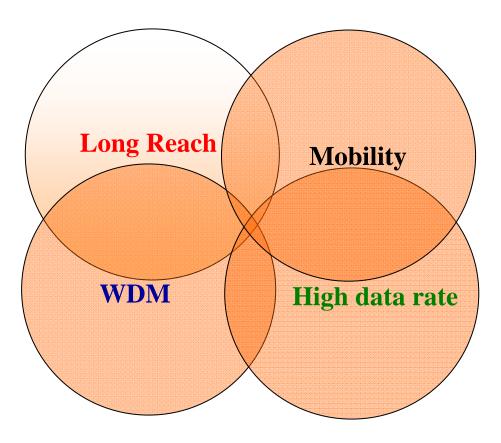




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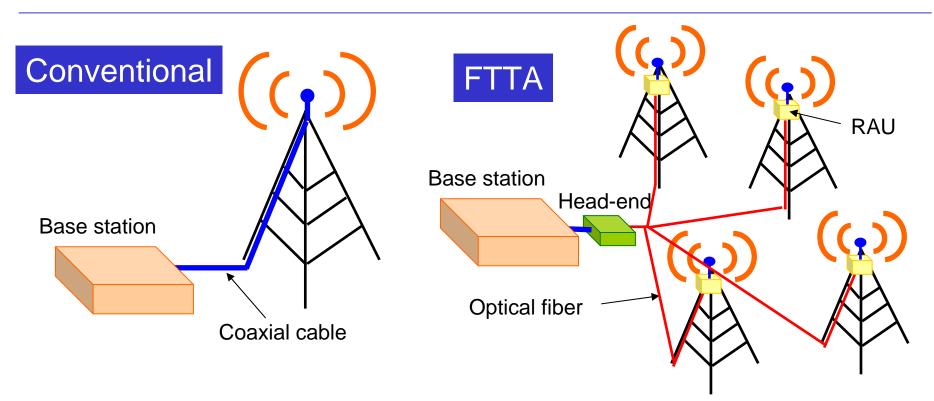
Features of Future Access



The LR access network will base on a new type of optically amplified, long reach (~100km) with high split-ratio (>100), high data rate, WDM PON



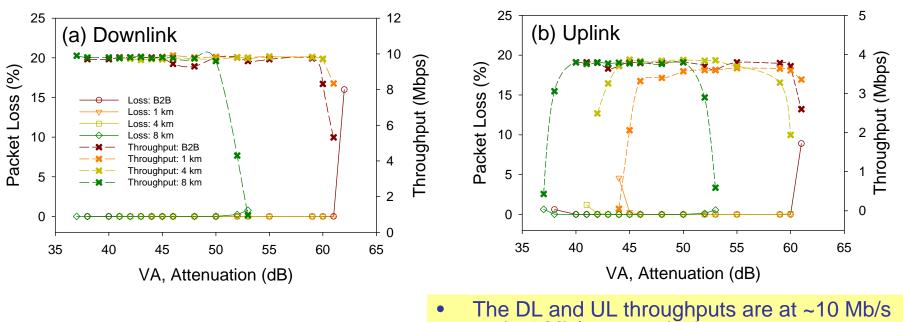
WiMAX FTTA Access Network



- WiMAX (Worldwide Interoperability for Microwave Access) for the last mile connection to provide flexible access services to end users
- FTTA can extend the RF signal distribution by using loss cost and low loss optical fibers
- Reduce base stations (BSs) by using head-end (HE) and low cost remote antenna units (RAUs)
- It is particular suitable in tunnels where distribution of wireless signal is restricted

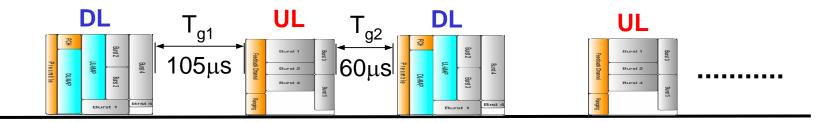


Preliminary Measurement Results



- The DL and UL throughputs are at ~10 Mb/s and ~4 Mb/s respectively
- WiMAX-over-fiber distance is limited to 8 km

Time Division Duplex (TDD) system limits the transmission distance







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Thank you