Optical technologies in future personal networks


Published in:
NIRICT kickoff event, 22 March 2007, Utrecht, The Netherlands

Published: 01/01/2007

Publisher’s PDF, also known as Version of Record (includes final page, issue and volume numbers)

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Optical Technologies in Future Personal Networks


Future Personal Networking

A Personal Network [1] requires a transparent and densely distributed infrastructure network to support

- High user mobility
- Heterogeneity of wireless networks and services
- High quality of service

Islands of Transparency in Optical Networks

- All-optical end-to-end connection has limited reach thus “Islands of Transparency” appear in the network
- An Island of Transparency has to be introduced in the Access domain → Fiber-to-the-X (FTTX)
- For Personal Networks, the X in FTTX stands for the PAN of a user → Fiber-to-the-PAN (FTTPAN) [2]

Fiber-To-The-PAN: Architecture

Radio over Fibre transmission

Digital baseband transmission

Optical Non-Transparent Interconnection

Local Island of Transparency

Optical Network Layering

Personal Area Network

Remote Island of Transparency

Personal Network (PN)

Radio Access Point (RAP)

remote private network

remote person

Fiber-To-The-PAN: Urban Indoor Scenario

Optical Transparent Interconnection

Personal Area Network

Home

Office

^1 – 20 km

Metro backbone

Remote Node (RN)

Intermediate Node (IN)

Cabinet Node (CN)

Central Office (CO)

Satellite dish

Radio-over-Fibre transmission

>1 – 5 kilometers

Spectral Amplitude Encoded Optical CDMA

- All-optical CDMA has a powerful and natural fit on FTTPAN
- Four clear advantages of Optical CDMA (OCDMA):
  - Cost-effective → frequency band sharing
  - Asynchronous → no central clock required
  - Soft capacity degradation → no hard user limit
  - Inherent security → information spread over large frequency band
- Spectral Amplitude Encoded OCDMA (SAE OCDMA) with integrated Mach-Zehnder based encoder/decoders (E/Ds):
  - Integratable → cost-effective node designs
  - Reciprocal → single design for transmitter and receiver
  - Periodic → fits a Wavelength Division Multiplexing (WDM) scheme
  - Spectral Shift Keying (SSK) → receiver bandwidth at data rate
- Patented tree E/D for increased cost-efficiency at Central Office

Conclusion and Outlook

- Optical fiber is expected to gradually replace the existing non-fiber based fixed access networks.
- We propose an FTTPAN architecture employing SAE OCDMA to transparently and cost-efficiently close the gap between mobile end-user and higher layer optical networks.

Acknowledgements

This research is carried out in the COBRA SWOOSHING project. The Netherlands Organization for Scientific Research (NWO) is gratefully acknowledged for funding through the NRC Photonics grant.

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