National Institute of Information and Communications Technology

ASEAN - NICT ICT Roundtable 2015

R&D Activities on Photonic Networks in Vietnam

Ngoc T. DANG, Bao Q. N. VO, and Lap H. LE

Posts and Telecommunications Institute of Technology (PTIT)

Vietnam

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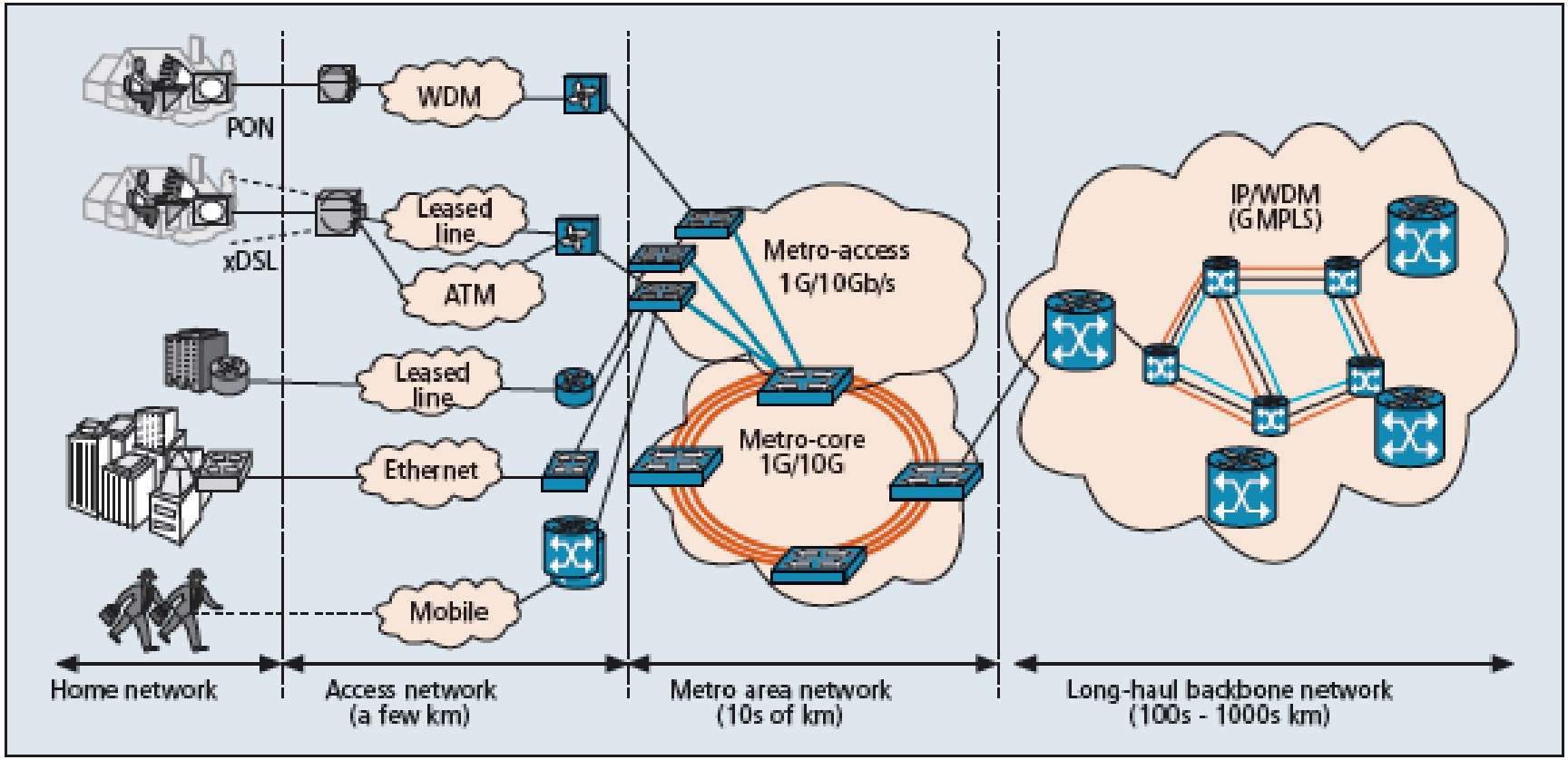
1. R&D on Photonic Networks in Vietnam

The end-to-end view of network segments: the access network, the metro network, and the long-haul backbone network



1. R&D on Photonic Networks in Vietnam

- Photonic Network Providers
  - Vietnam Posts and Telecommunications Group (VNPT)
  - Viettel
  - Hanoi Telecom
  - FPT Telecom
- Technologies
  - Backbone networks:
    - DWDM ring-based networks
    - IP (MPLS or SDH) over WDM
  - Metro Area Networks: Ethernet-based MAN
  - Access Networks: AON/PON-based FTTH networks

VNPT

Say it your way

Hanoi Telecom Corporation

FPT Telecom

1. R&D on Photonic Networks in Vietnam

- Photonic Network Research Groups in VN
  - School of Information and Communication Technology - Hanoi University of Science and Technology
    - Research areas:
      - Design and Optimization for Optical Networks
    - Major publications
      - On the Optimization of Survivable Mesh Long-Reach Hybrid WDM-TDM PONs
      - A Novel Topology Aggregation Approach for Shared Protection in Multi-domain Networks
      - Multi-domain optical networks: issues and challenges - Recent progress in dynamic routing for shared protection in multi-domain networks

1. R&D on Photonic Networks in Vietnam

- Photonic Network Research Groups in VN
  - School of Electronics and Telecommunications - Hanoi University of Science and Technology
    - Research areas:
      - Photonic Crystal Fiber: Design, Fabrication, and Applications
      - Nonlinear Effect in Photonic Devices
  - Faculty of Electrical and Electronics Engineering - Ho Chi Minh city University of Technology
    - Research areas:
      - Microwave photonics
      - Fiber optics sensors
      - Passive optical networks
      - Visible light communications

2. Introduction to PTIT - Vietnam

- Posts and Telecommunications Institute of Technology
  - A former member of Vietnam Posts and Telecommunications Group (VNPT)
  - A new member of Ministry of Information and Communications (MIC), Vietnam
  - A leading university focusing on Research and Education in the field of ICT in Vietnam
  - Integrating Research – Education/Training – Manufacturing & Trading in the field of ICT.

2. Introduction to PTIT - Vietnam

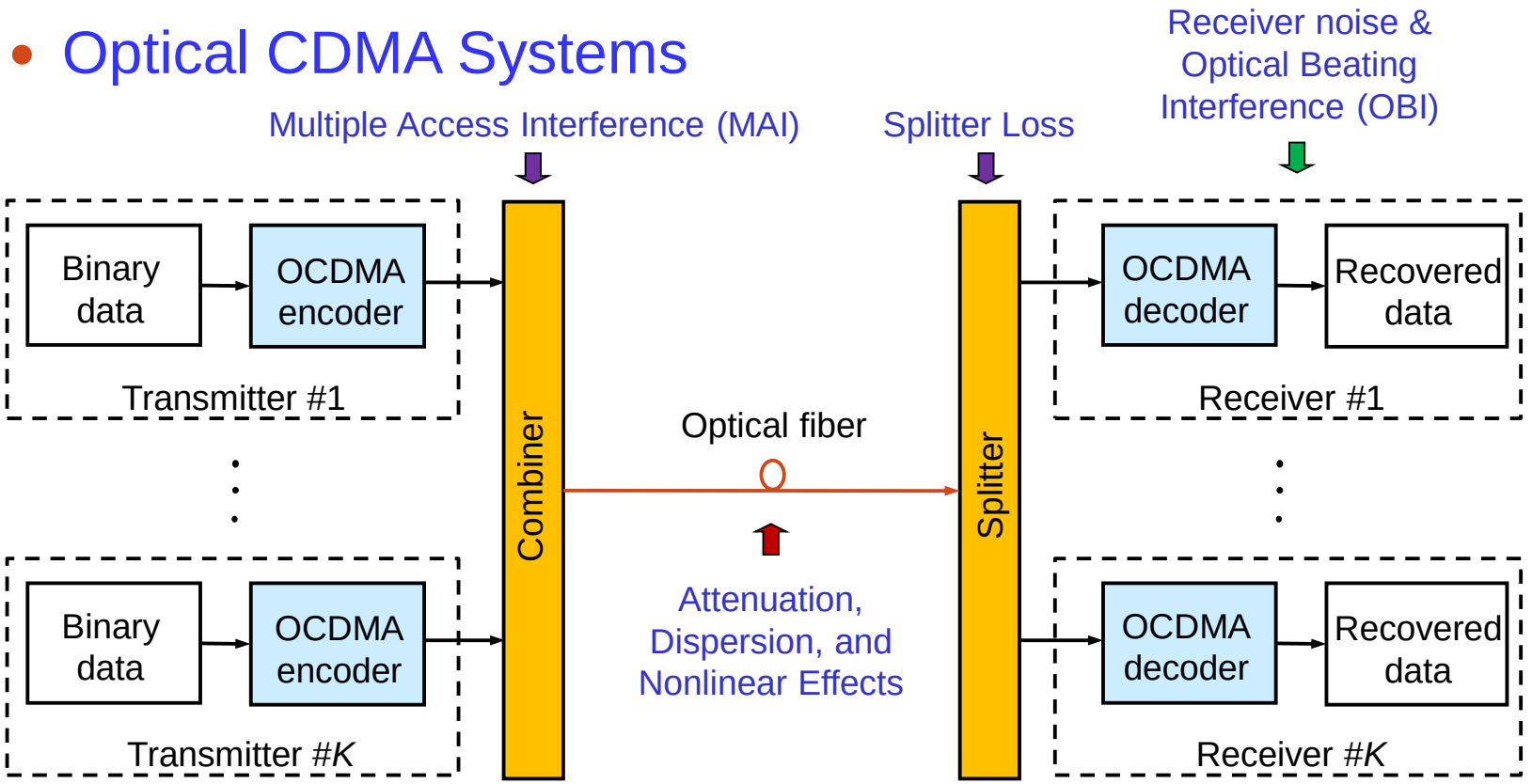
- Organization
  - Education
    - Faculty of Information Technology
    - Faculty of Telecommunications: Photonic Division
    - Faculty of Electronic Engineering
    - Faculty of Information Security
    - Faculty of Mutimedia Technology
    - …
  - Research
    - Research Institute of Posts and Telecommunications (RIPT)
    - Institute of Information and Communication Technology CDiT
    - Economics Institute of Posts and Telecommunications (ERIPT)
  - Training Centers
    - Posts and Telecommunications Training Center

3. R&D Activities

- Photonic Network Research Group at PTIT
  - Members and Research Topics
    - Assoc. Prof. Ngoc T. DANG (ngocdt@ptit.edu.vn)
      - System modeling, performance analysis and improvement methods for optical code-division multiple-access (OCDMA) systems; Free-space optical (FSO) communication systems; and Visible light communications.
      - Advanced optical technologies for 5G mobile networks
    - Dr. Nhan D. NGUYEN (nhannd@ptit.edu.vn)
      - Mode-locked laser; Advanced modulation schemes for optical communications; Optical soliton transmission techniques; Photonic signal processing.
    - Dr. Chau H. LE (lehaichau@gmail.com)
      - Optical system design and performance analysis; Optical networks architecture and control protocol; Advanced optical technologies and techniques for broadband access networks

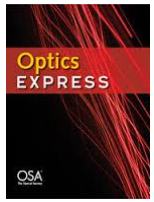
3. R&D Activities

- Optical CDMA Systems



- Objectives
  1. Performance evaluation of OCDMA systems under the effects of physical layer impairments
  2. Performance improvement methods for OCDMA systems

3. R&D Activities

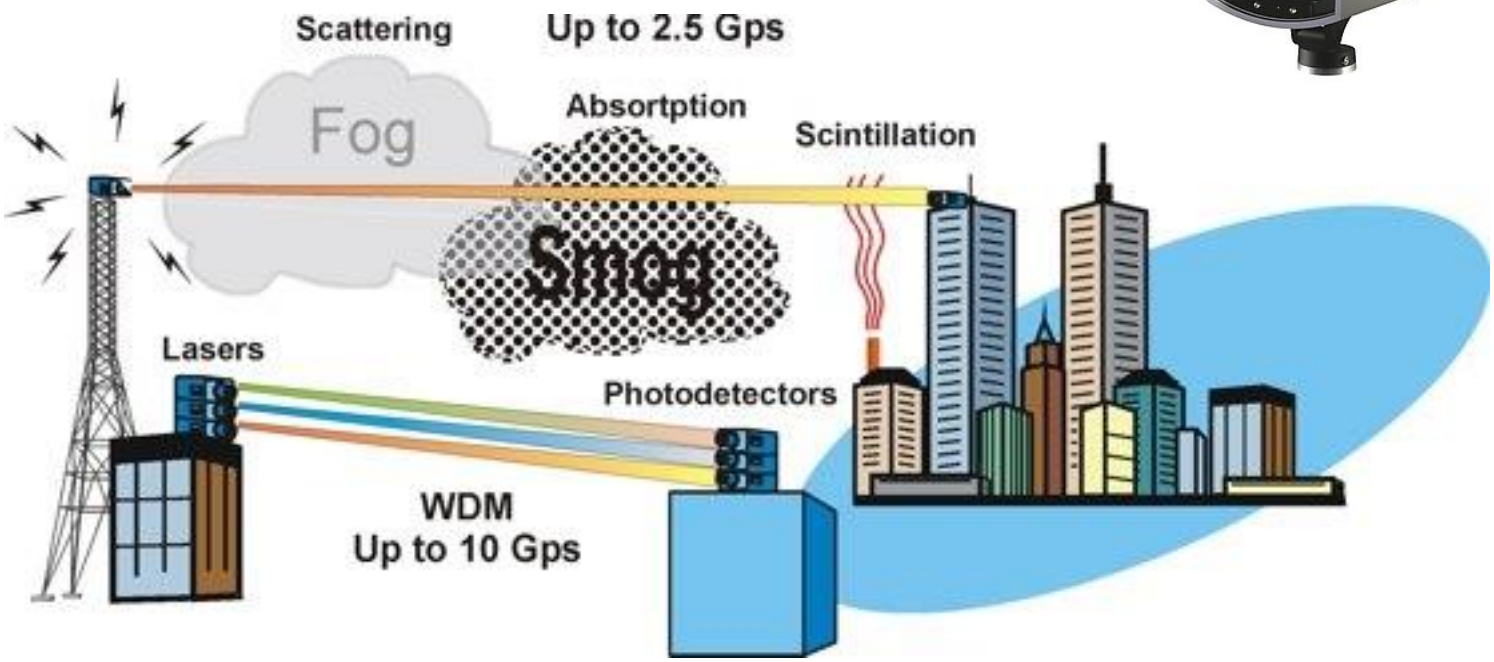


Optical CDMA Systems

- Performance Analysis of MW-OCDMA Systems under the Effects of ***Group Velocity Dispersion***
- Performance Analysis of MW-OCDMA Systems under the Effects of ***Four-Wave Mixing***
- Performance Improvement of MW-OCDMA Systems Using ***Optical Hard-Limiter***
- Performance Improvement of MW-OCDMA Systems Using ***Multi-Code Modulation***
- Performance Improvement of MW-OCDMA Systems Using ***Multi-Code Pulse-Position Modulation***

3. R&D Activities

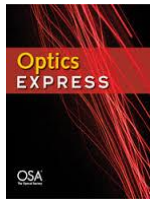
- Free-Space Optical Commun. Systems



(Source: http://althosbooks.com/opcodi.html)

- Objectives
  1. Performance analysis of FSO systems under the effects of physical layer impairments
  2. Performance improvement methods for FSO systems

3. R&D Activities



Free-Space Optical Commun. Systems

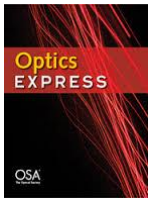
- Performance Analysis of FSO and FSO/CDMA Systems under the Effects of ***Pulse Broadening***
- Performance Improvement of FSO/CDMA Systems using ***Forward Error Correction***
- Performance Improvement of FSO and FSO/CDMA Systems using ***Advanced Modulation Schemes***
- Performance Improvement of FSO and FSO/CDMA Systems using ***Relay Transmission***

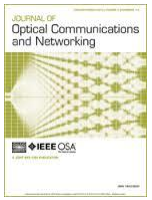
3. R&D Activities

Optical Soliton Trans. & Signal Processing

- Generation of Bound solitons in actively phase modulation mode-locked laser ring resonators
- Fast-processing statistical methods for measurement of BER in optical fiber communication systems
- Generation of high order multi-bound solitions and propagation in optical fibers

3. R&D Activities





Optical Netw. Design & Performance Analysis

- Impact of Electrical Grooming and Regeneration of Wavelength Paths in Creating Hierarchical Optical Path Networks
- Hybrid-Hierarchical Optical Path Network Design Algorithms Utilizing ILP Optimization
- Hierarchical Optical Path Network Design Algorithms Considering Waveband Add/Drop Ratio Constraint
- Performance evaluation of large-scale multi-stage hetero-granular optical cross-connects

Dr. Chau H. LE (in collaboration with the Nagoya University of Aizu, Japan)

4. International Collaboration

- Performance Evaluation and Improvement Methods for Relay-Assisted Free-space Optical Communication Systems
  - An on-going project funded by National Foundation for Science and Technology Development (NAFOSTED, Vietnam): grant no. 102.02-2013.02
  - Collaboration with Computer Communications Lab., Univ. of Aizu (JP)

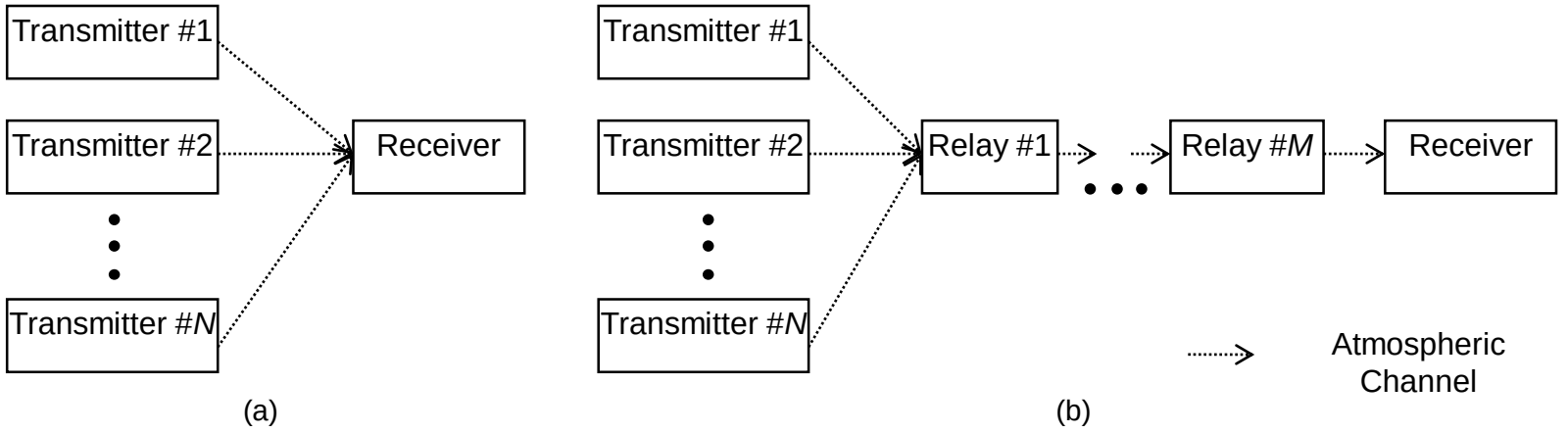
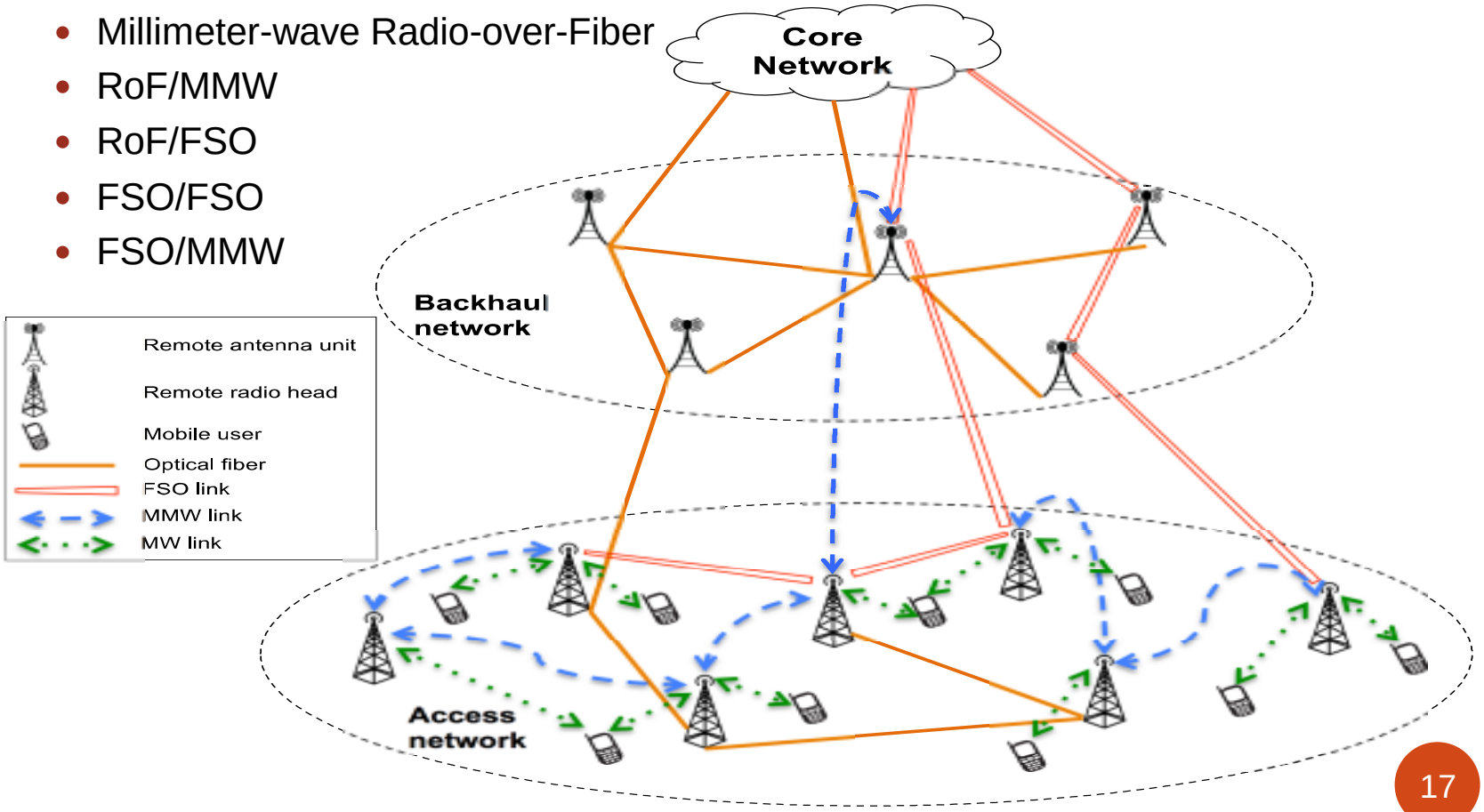


Figure 3. FSO access networks: (a) without relaying and (b) with relaying techniques

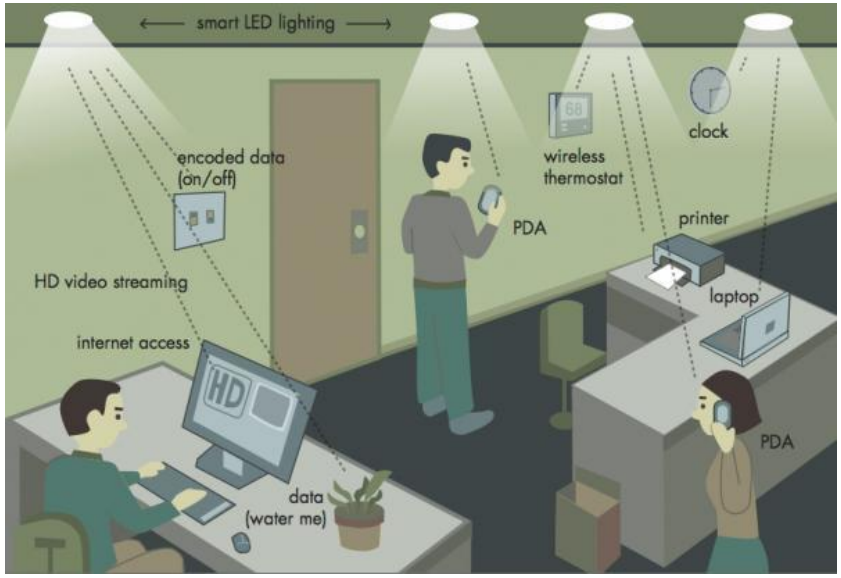
4. International Collaboration

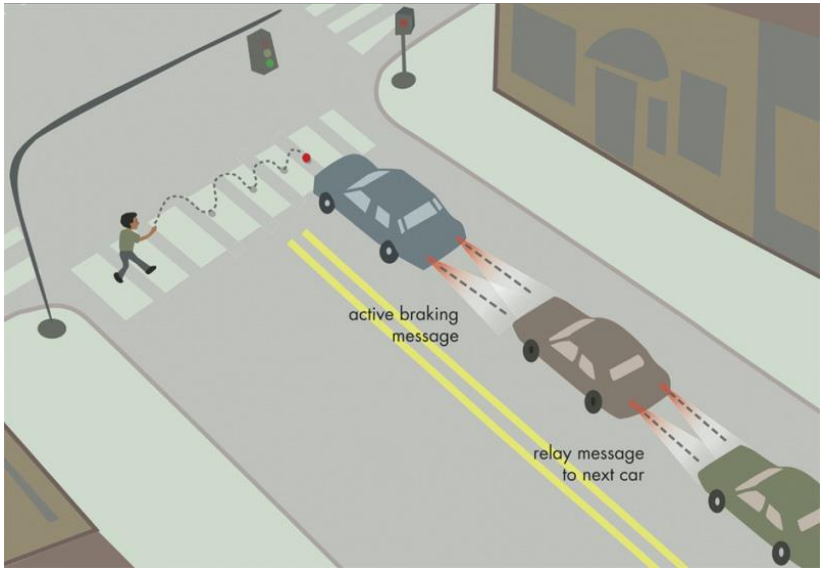
- Advanced Optical Technologies for 5G Backhaul Mobile Networks
  - Millimeter-wave Radio-over-Fiber
  - RoF/MMW
  - RoF/FSO
  - FSO/FSO
  - FSO/MMW



4. International Collaboration

- Visible Light Communications (VLC)
  - Performance improvement methods
  - Multiple access techniques for VLC
  - Cross-layer design and performance analysis
  - Applications of VLC





Source: http://www.eetimes.com/document.asp?doc_id=1256372

Conclusion

- Research on Photonic Networks in Vietnam
  - Mainly based on theoretical study and simulation
  - Lack of experiment systems
  - Research outcomes are academic publications
- Expected International Collaboration in Photonic Networks
  - Doing experiment
  - Standardization
  - Establishment of R&D platforms

Thank you for your attention!

Q & A

Major Publications

1. Hien T. T. Pham, Ngoc T. Dang, and Anh T. Pham, “Effects of Atmospheric Turbulence and Misalignment Fading on Performance of Serial Relaying M-ary PPM FSO Systems with Partially Coherent Gaussian Coherent Beam”, ***IET Communications***, Vol. 8, Issue 10, pp. 1762-1768, July 2014.
2. Ngoc T. Dang and Anh T. Pham, “Performance Improvement of FSO/CDMA Systems over Dispersive Turbulence Channel using Multi-wavelength PPM Signaling”, ***OSA Optics Express***, vol. 20, issue 24, pp. 26786-26797, Nov. 2012.
3. Ngoc T. Dang and Anh T. Pham, “Performance Analysis of 2-D OCDMA Systems using Novel Multi-Code Pulse-Position Modulation”, ***IET Communications***, vol. 6, issue 15, pp. 2425-2431, Oct. 2012.
4. Ngoc T. Dang and Anh T. Pham, “Reducing the Dispersion Effects in Multiwavelength Optical CDMA Systems by Using MCM Signaling,” ***IEEE/OSA Journal of Optical Communications and Networking***, vol. 2. no. 11, pp. 967-974 , Nov. 2010.
5. Ngoc T. Dang, Anh T. Pham, and Zixue Cheng, “Performance Analysis of Spectral Amplitude Encoding OCDM systems over the linear dispersive optical channel,” ***IEEE/OSA Journal of Optical Communications and Networking***, vol. 1, no. 6, pp. 521-529, Nov. 2009.