FG IMT-2020 Workshop and Demo Day: Technology Enablers for 5G

Technologies for future mobile transport networks

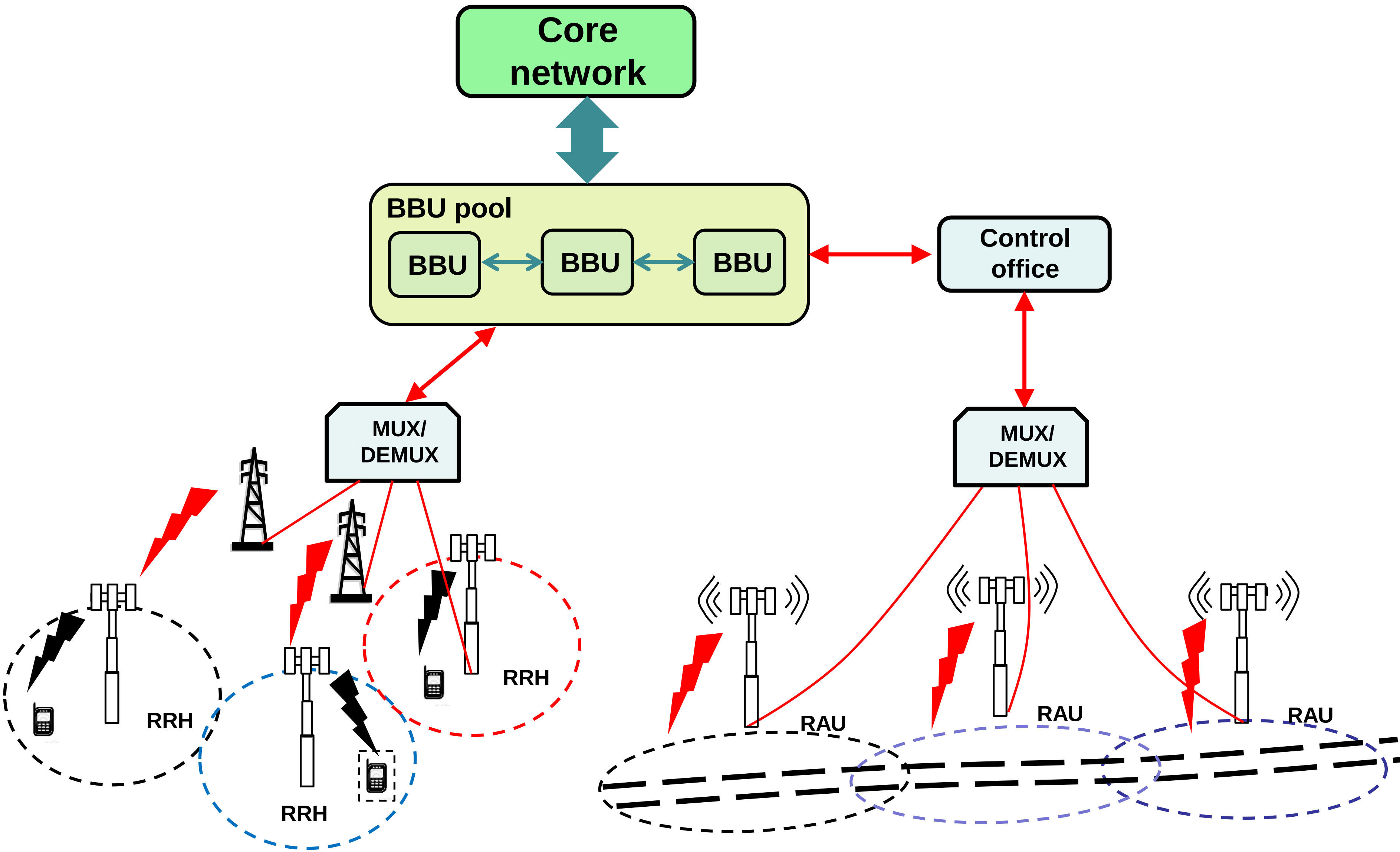
Pham Tien Dat[1], Atsushi Kanno[1], Naokatsu Yamamoto[1], and Tetsuya Kawanishi[1,2]

[1]National Institute of Information and Communications Technology, Japan
[2]Wasdea university, Tokyo, Japan

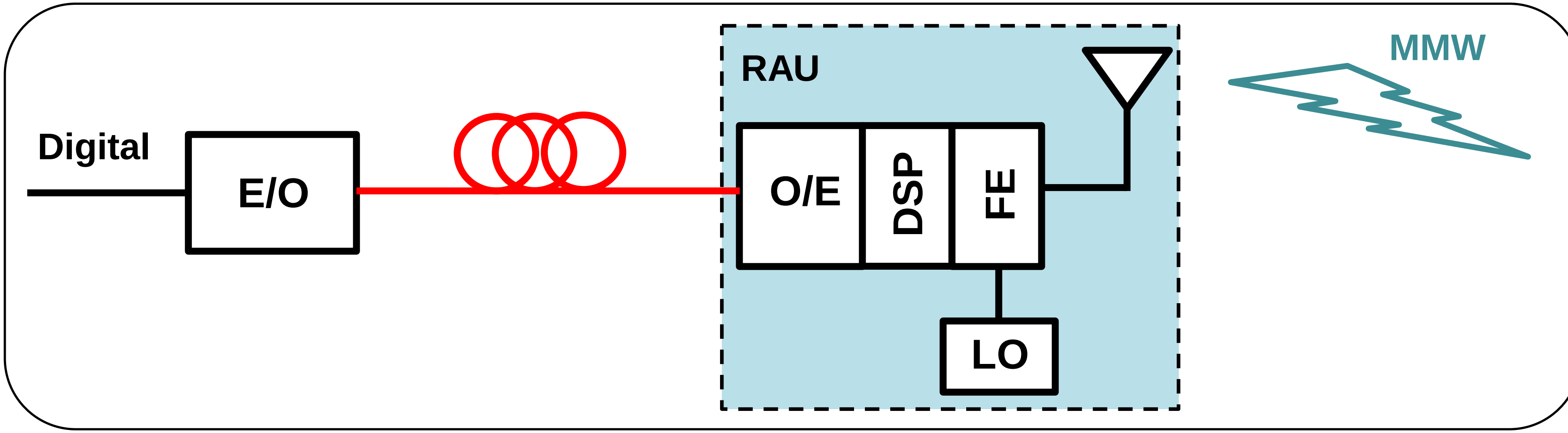
Outline

- Flexible fiber-wireless mobile fronthaul
  - Downlink system
  - Bidirectional transmission
- Seamless fiber-wireless for moving cells
- Multiple radios over fiber system
- Conclusion

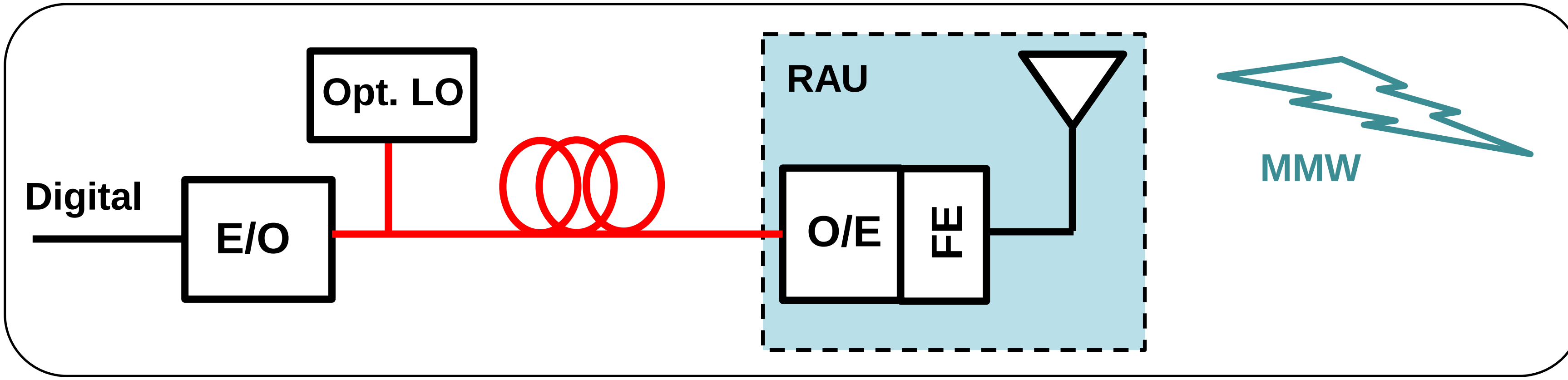
Flexible fiber-wireless transport systems



Fiber-wireless convergence

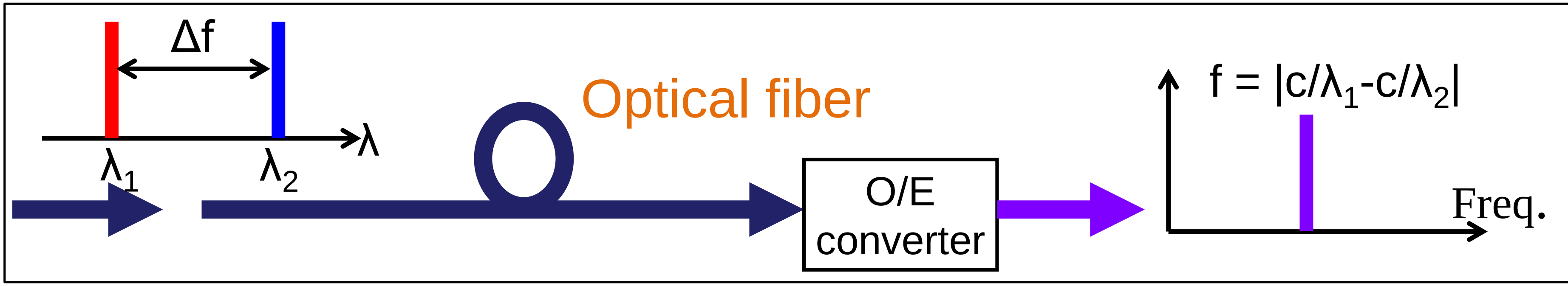


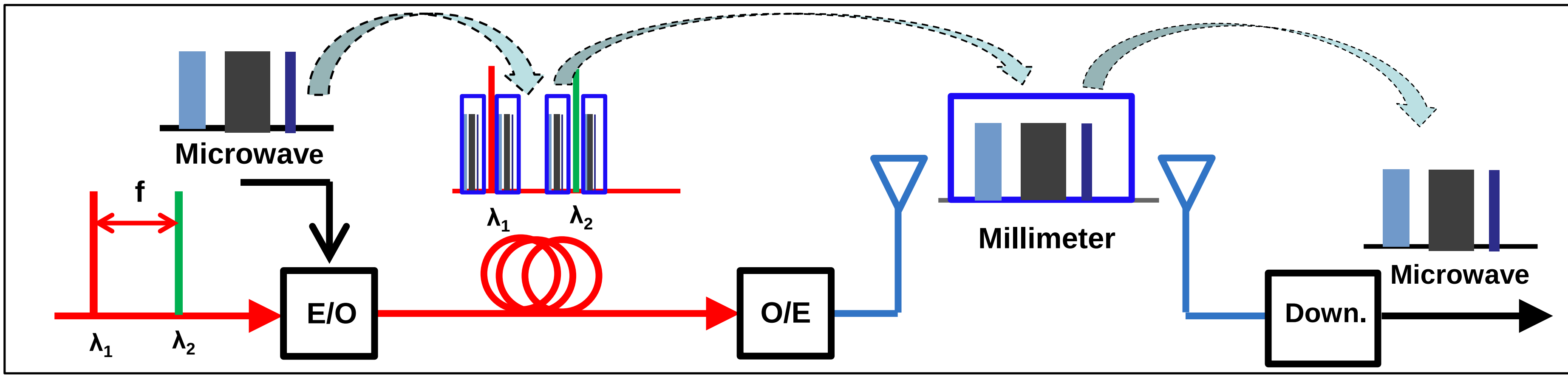
Conventional optical-MMW link: **Large latency, high power**

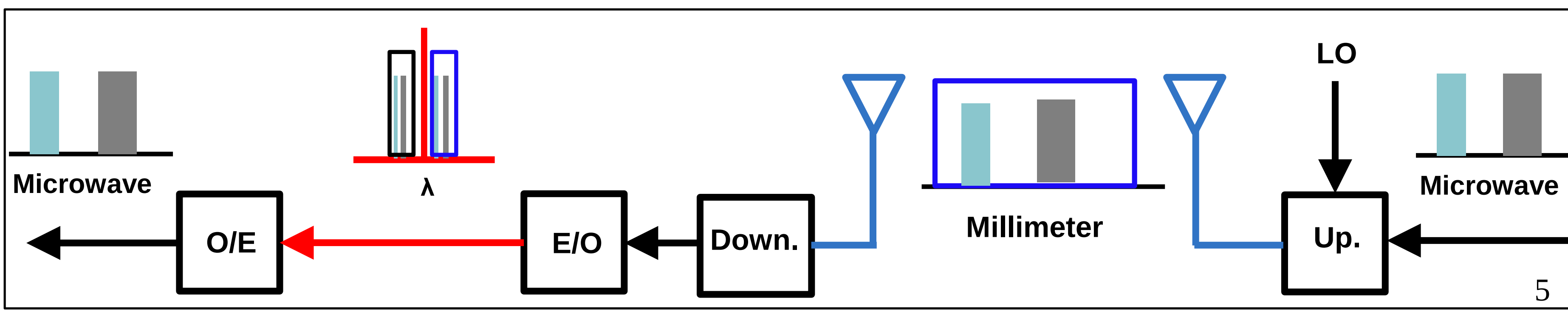


Seamless optical and MMW connection: **Low latency, low power**

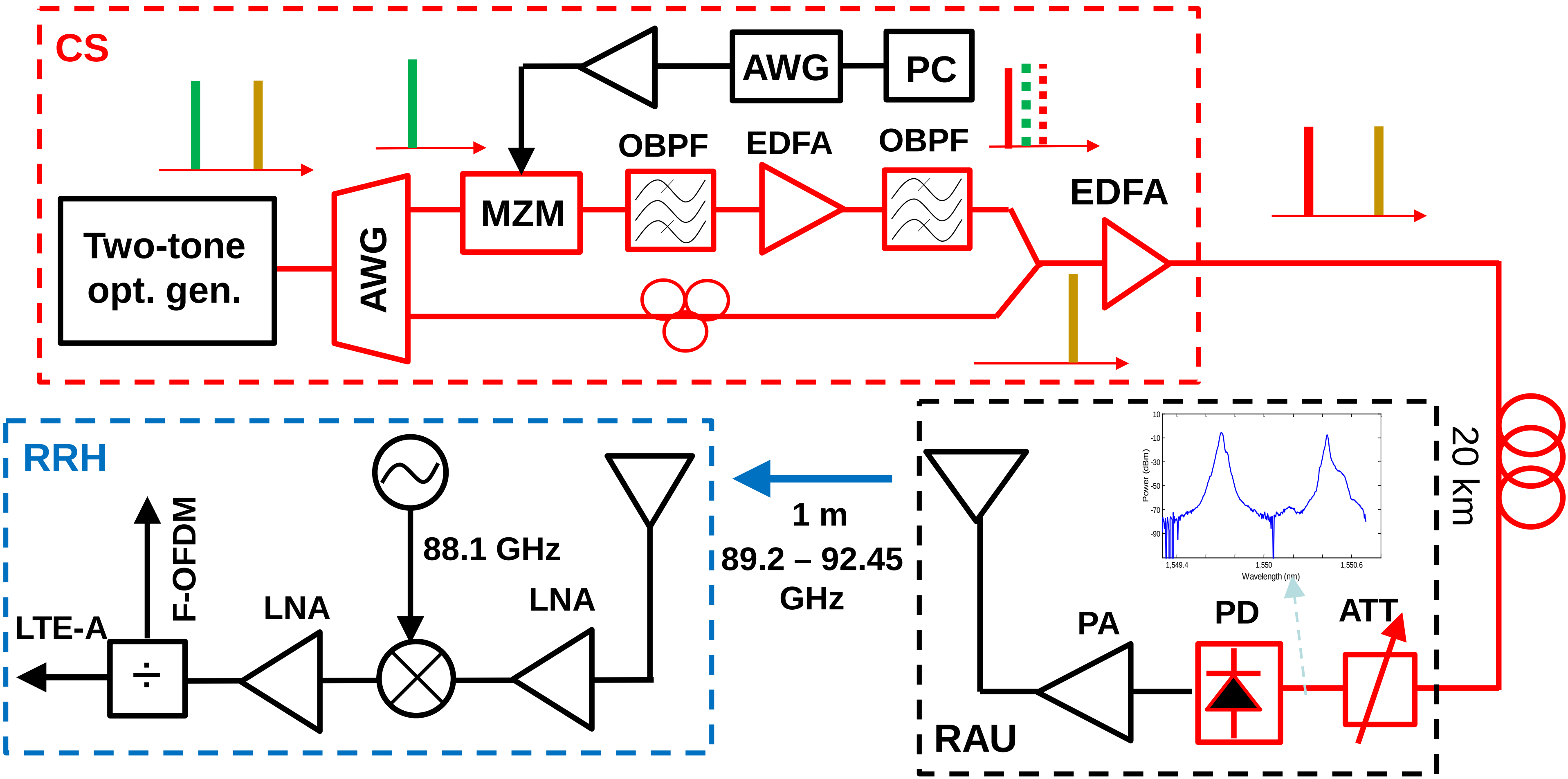
Operating principle







Downlink system: experimental setup



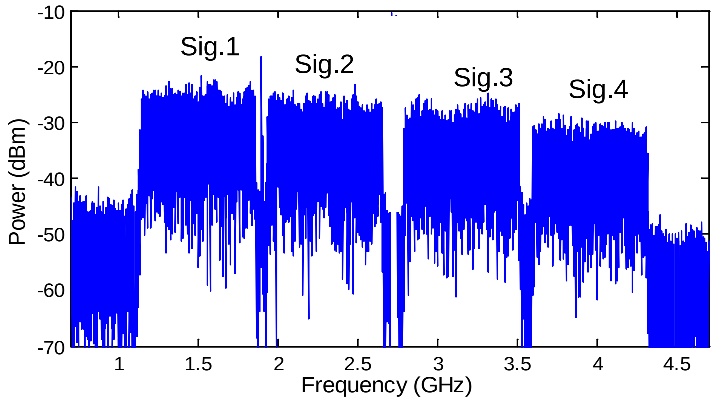
VSA: Vector Signal Analyser
LNA: Low Noise Amplifier
ATT: Attenuator
OBPF: Optical Band Pass Filter

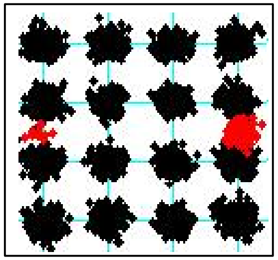
MZM: Mach-Zehnder Modulator
EDFA: Erbium-Doped Fiber Amplifier
VSG: Vector Signal Generator
PD: photo-detector

P. T. Dat et al., ECOC (2016)

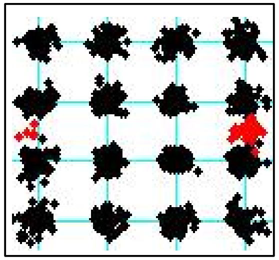
Downlink system: experimental results

P. T. Dat et al., ECOC (2016)

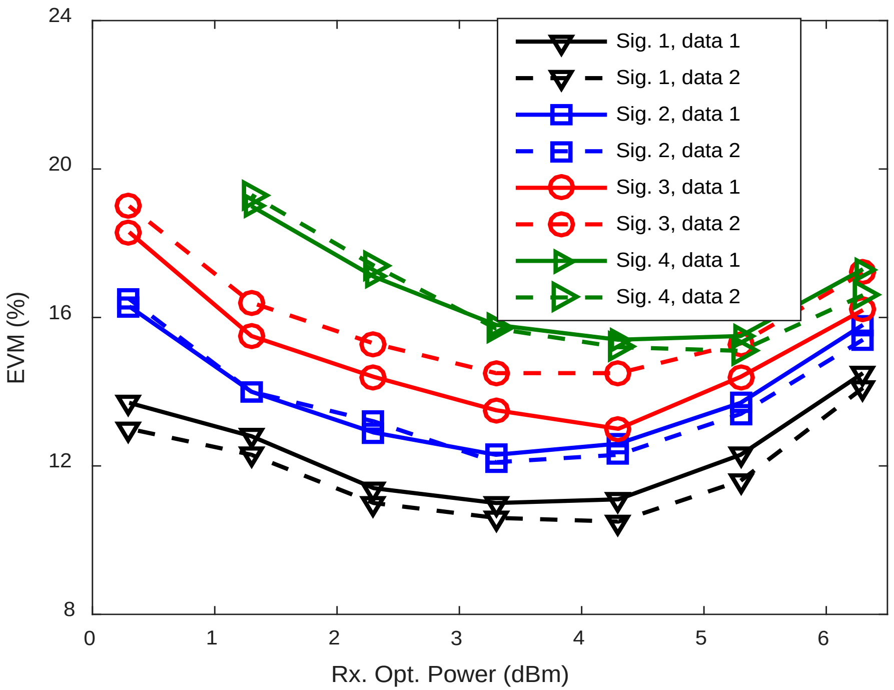




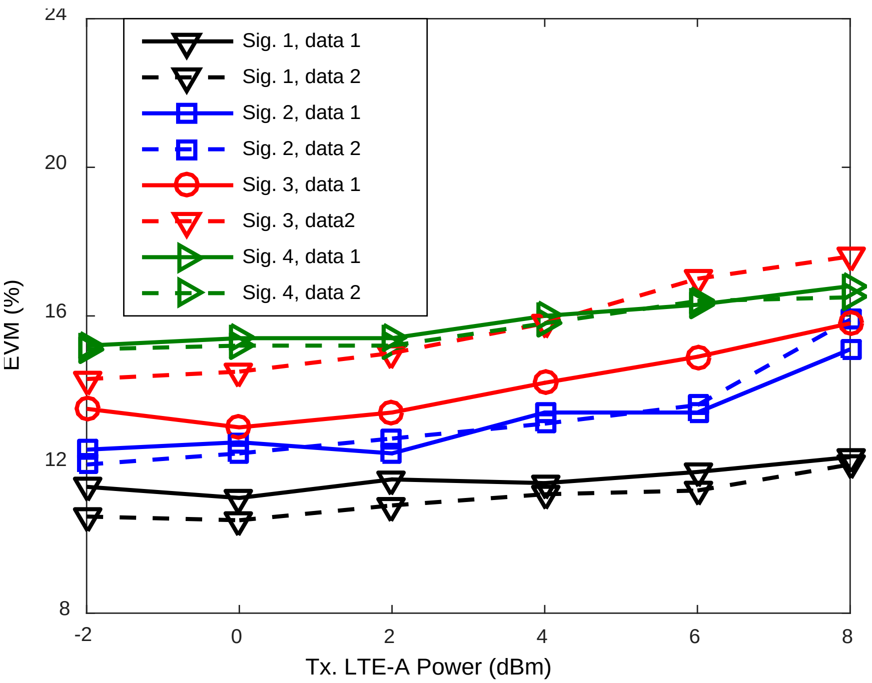
Data 1



Data 2

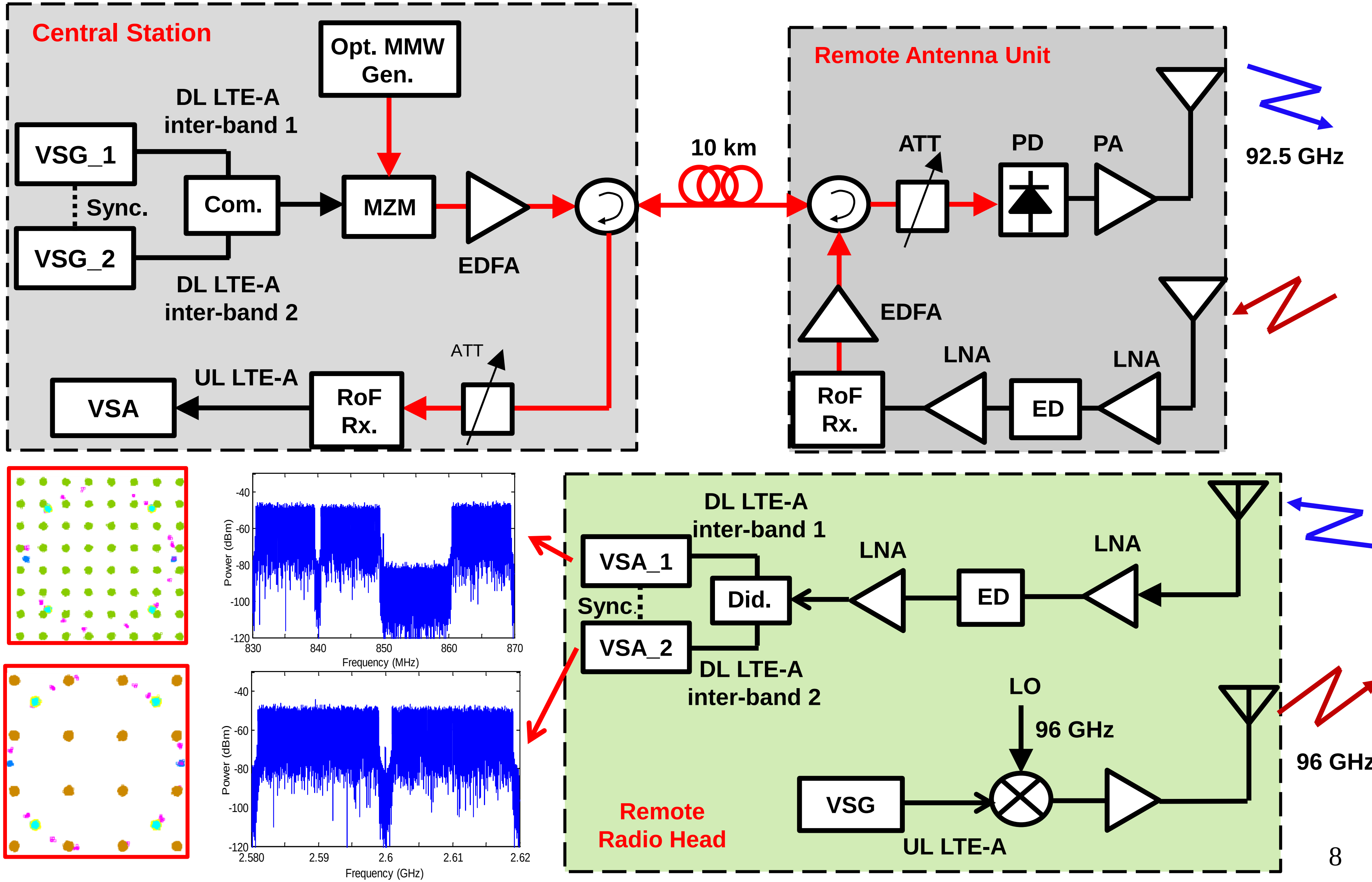


Performance versus received optical powers

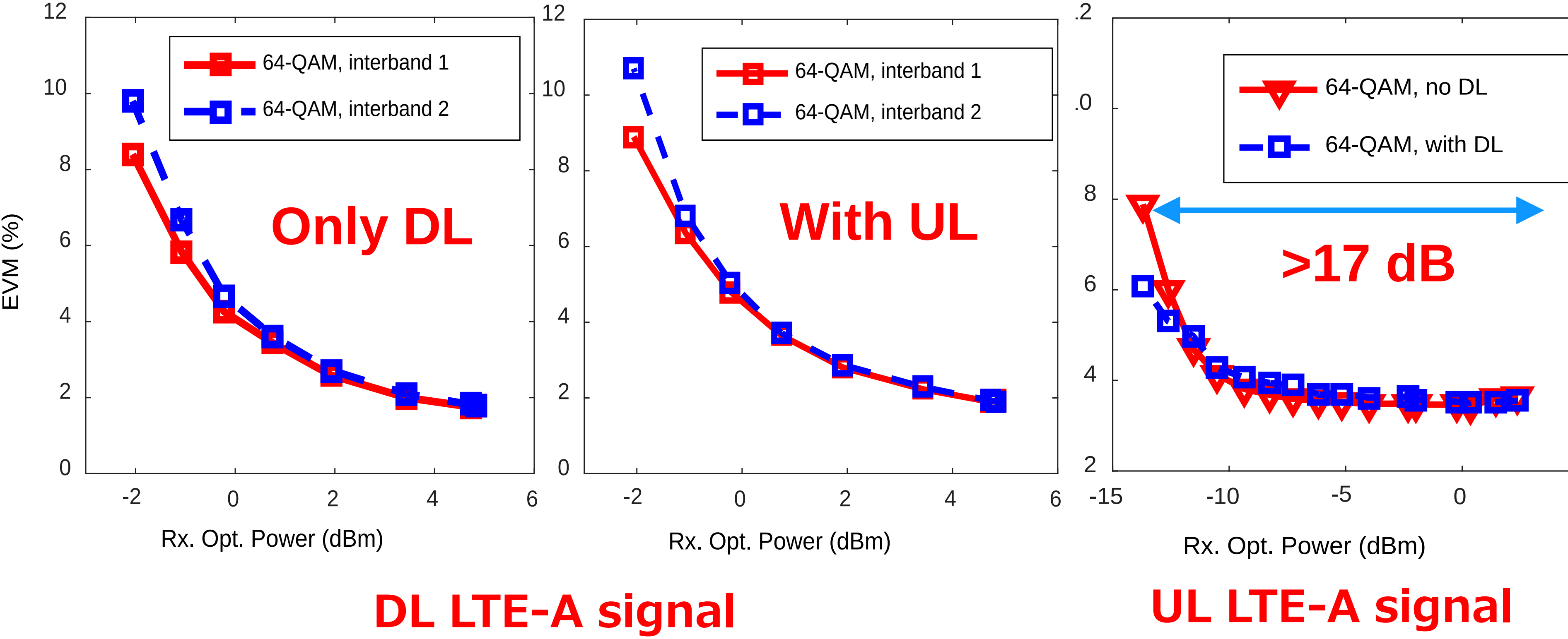


Performance versus LTE-A signal powers

Bidirectional system: experimental setup



Bidirectional: experimental results

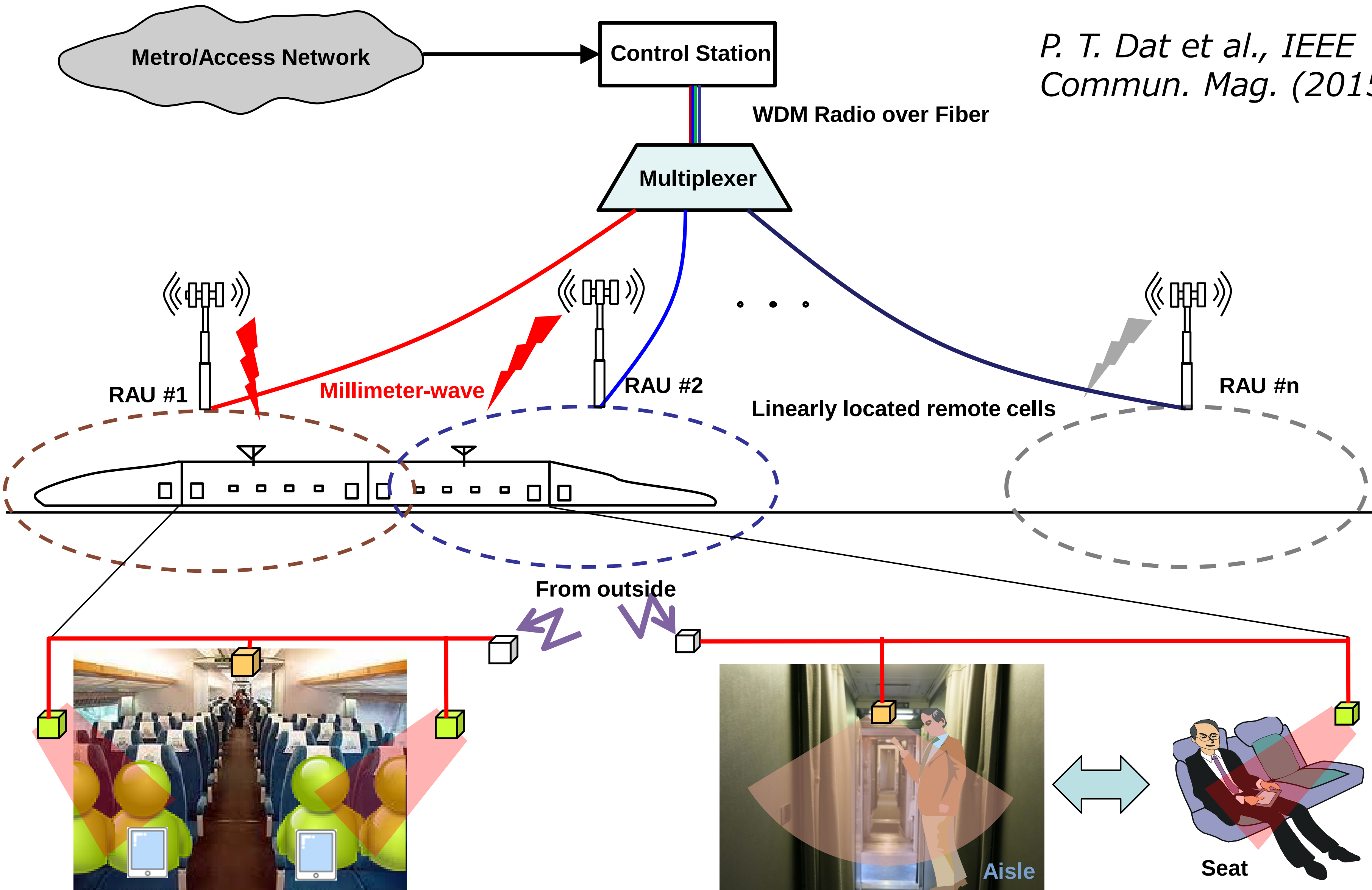


P. T. Dat et al., OFC (2015)

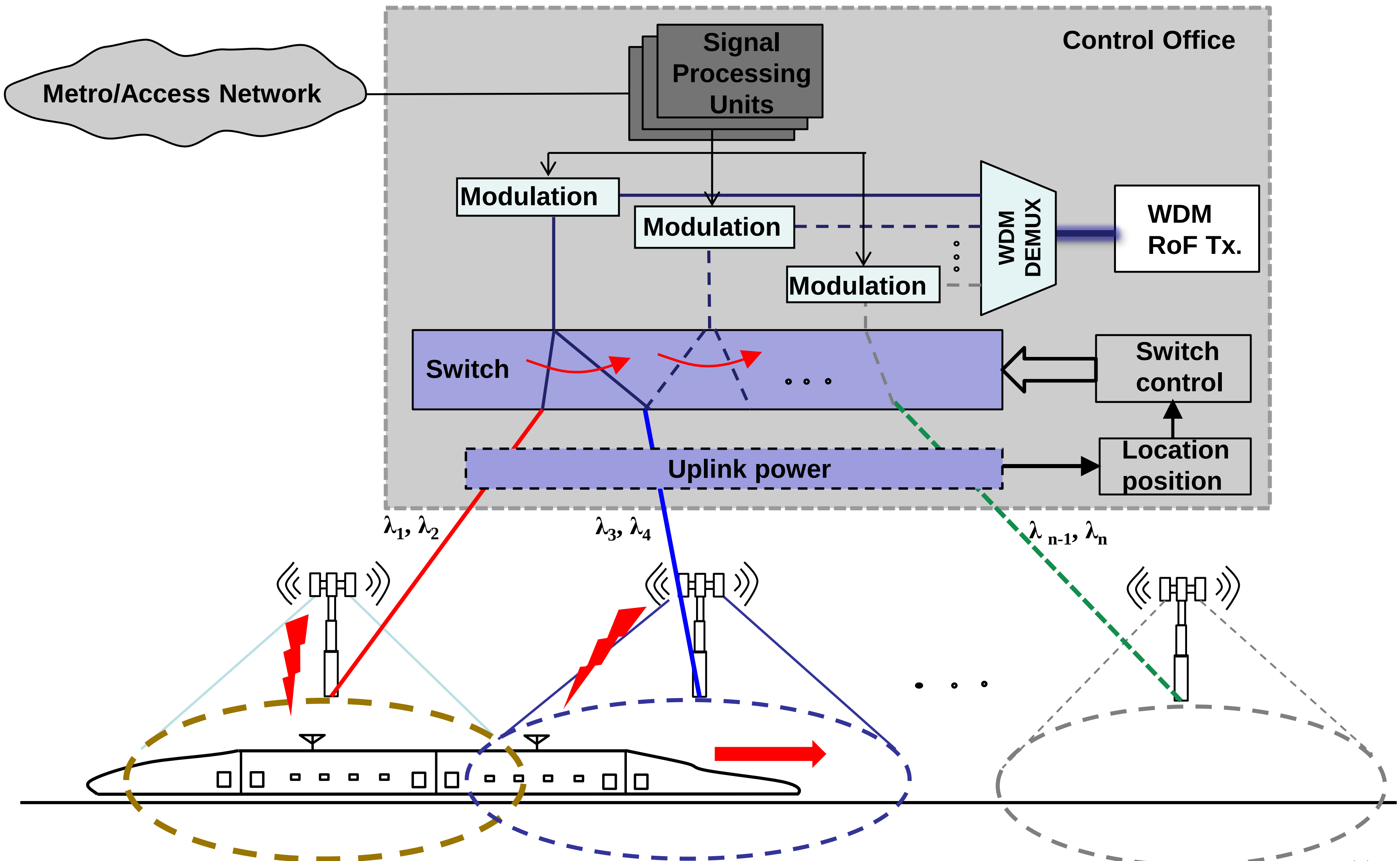
- **Successful bidirectional transmission for CA LTE-A signals**
- **Applicable for future 5G signal transmission (256-QAM with EVM < 3.5%)**
- **PONs can be applied for optical transport (ITU-T req. for PONs: 15 dB)**

Seamless fiber-wireless for moving cells

P. T. Dat et al., IEEE Commun. Mag. (2015)

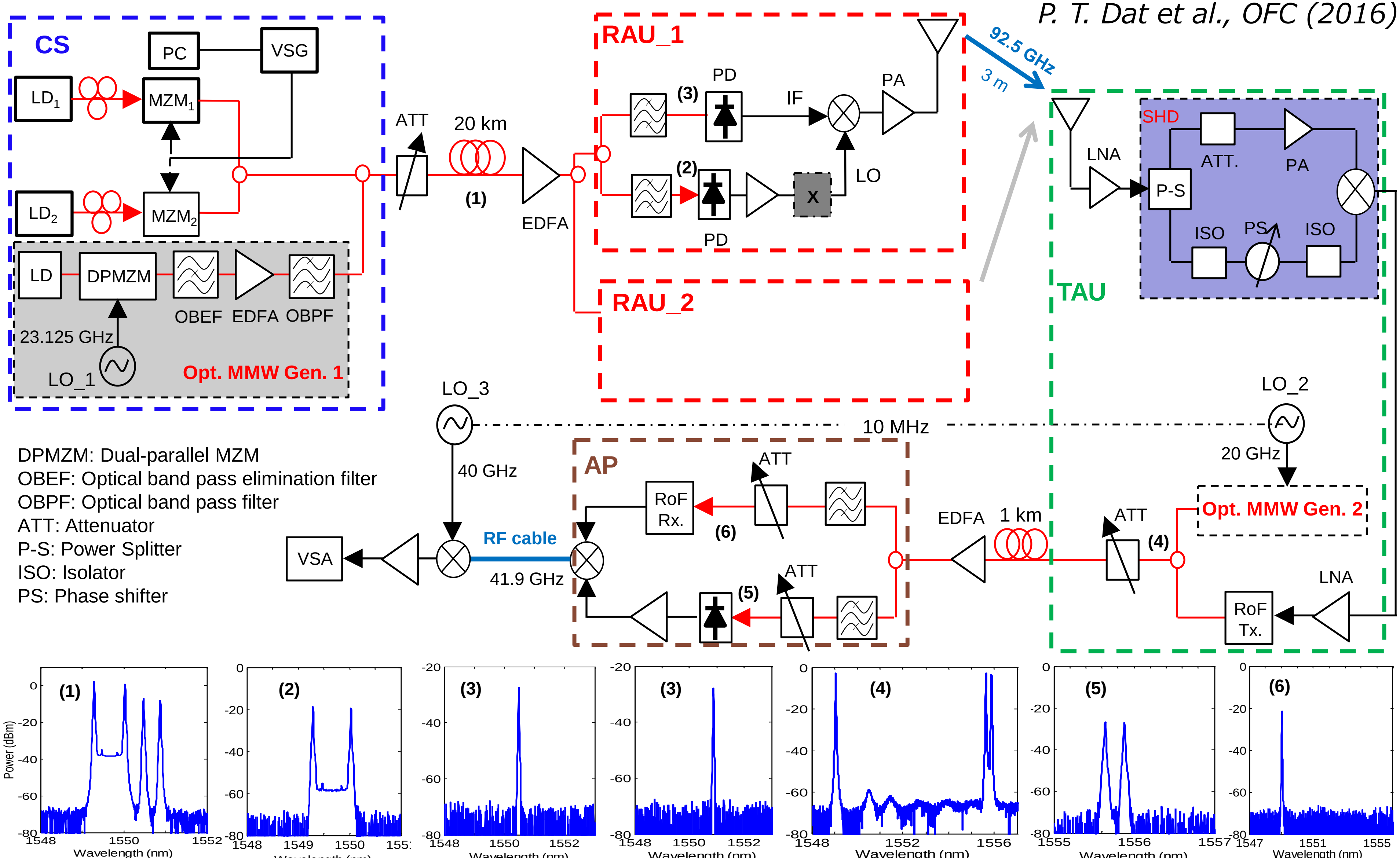


Network control and moving cells

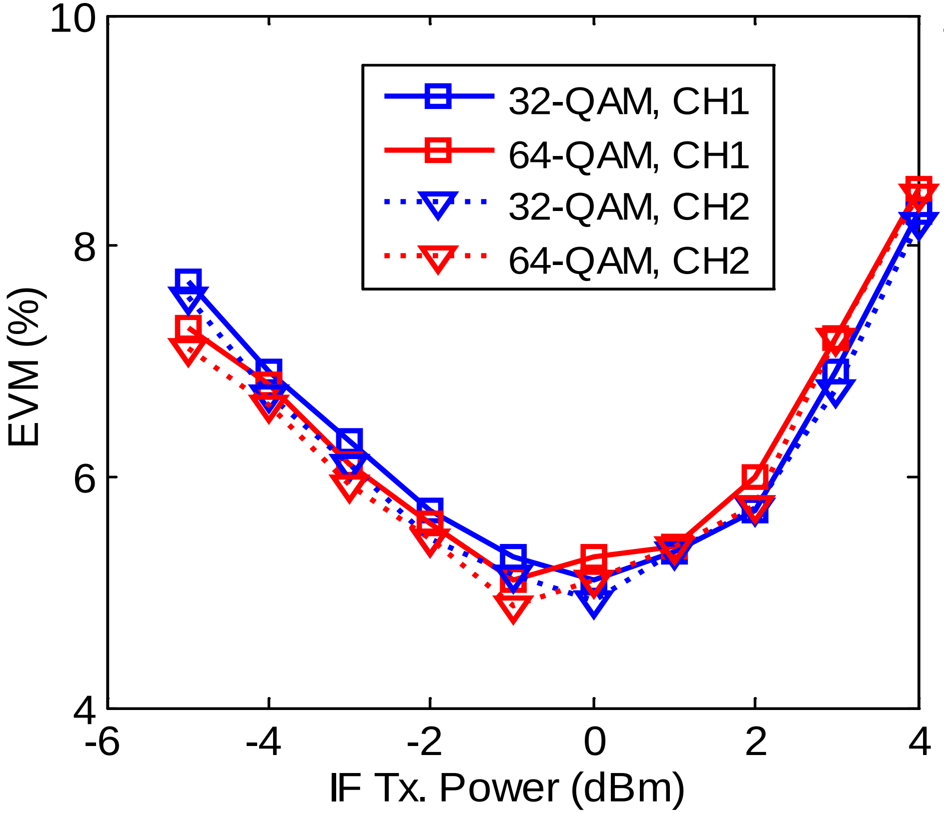


Proof-of-concept: experimental setup

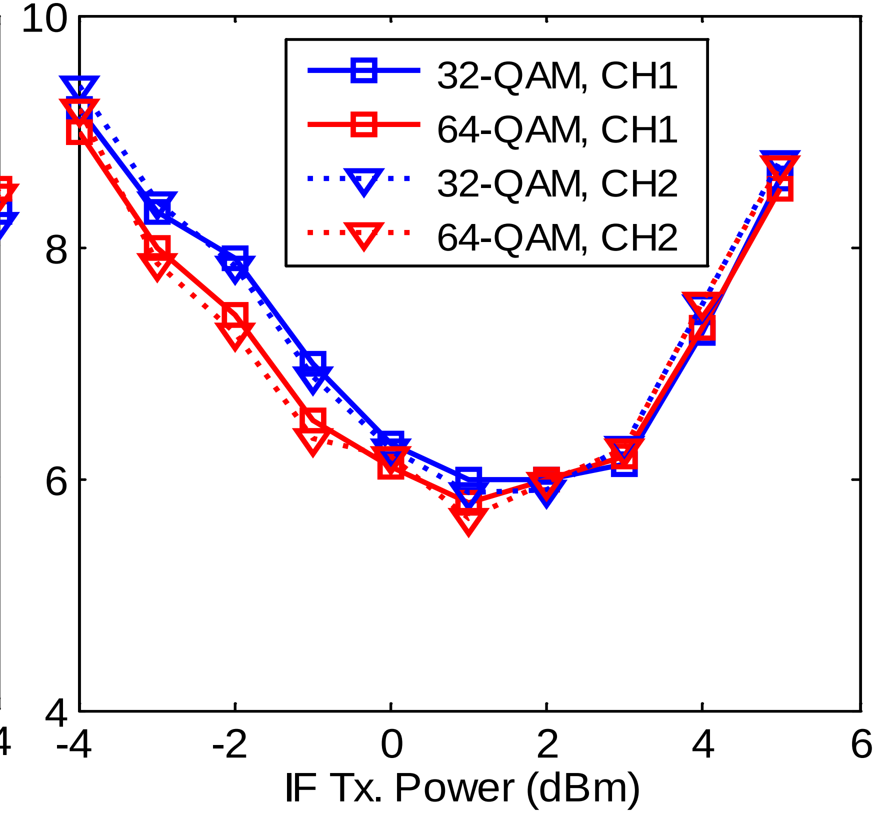
P. T. Dat et al., OFC (2016)



Proof-of-concept: experimental results



30-MHz OFDM signal



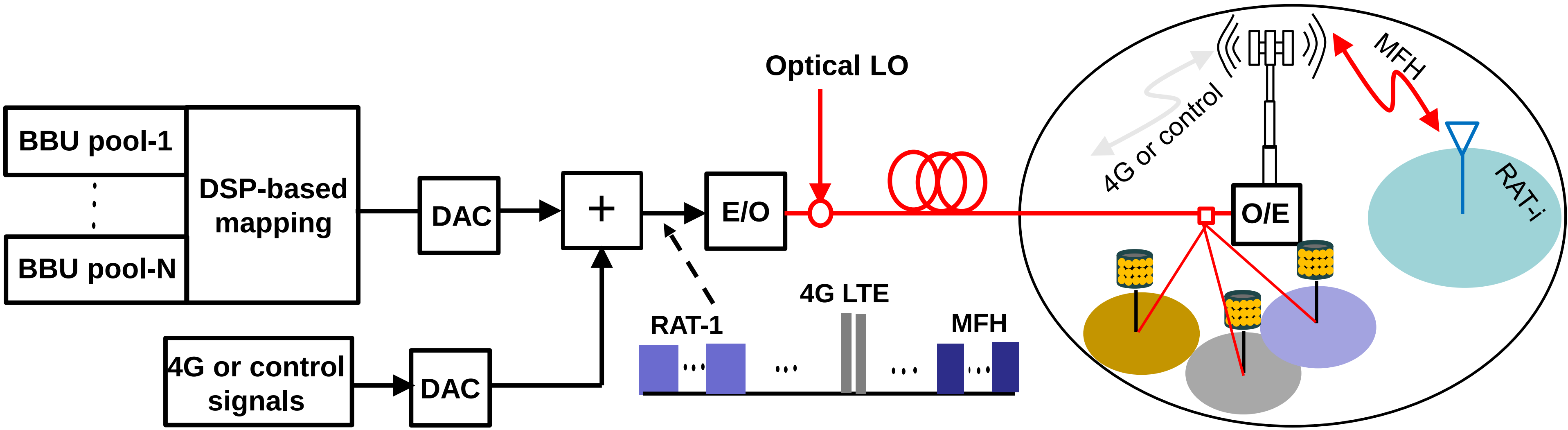
50-MHz OFDM signal

P. T. Dat et al., OFC (2016)

- **Good performance for both backhaul and over in-train networks**
- **High-spectral efficiency, low fiber-dispersion, cost effective system**

Multiple radios over fiber

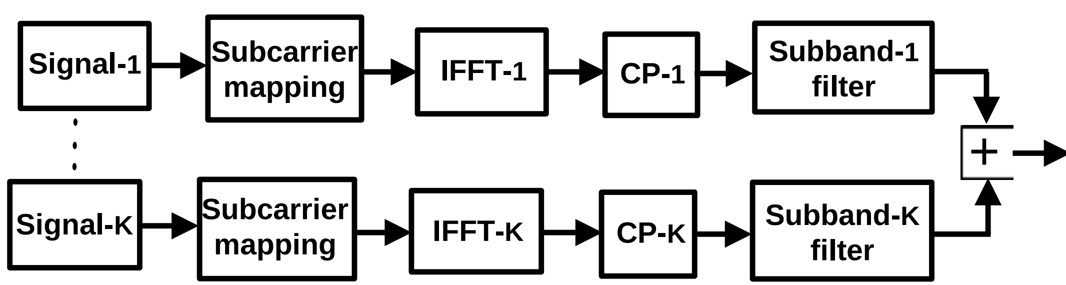
Multi-RATs over seamless fiber-wireless system



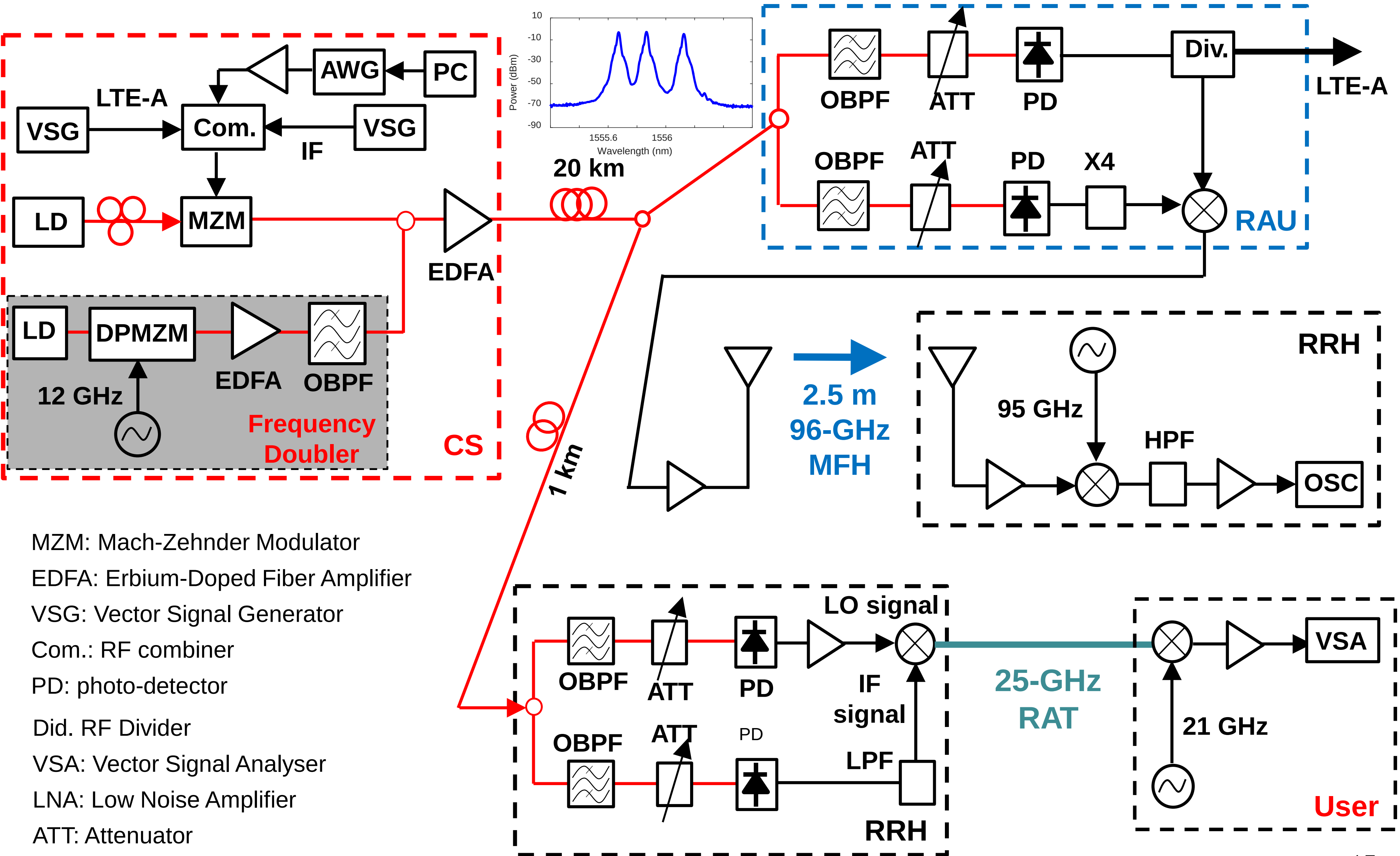
- CPRI for fronthauling: bit rate >> 100 Gb/s/cell.
- RoF: high-speed components, massive systems

Cooperation of optical and radio access networks

Data mapping using F-OFDM

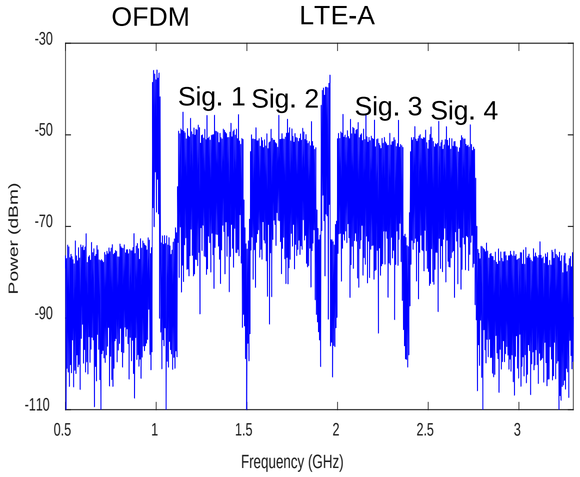


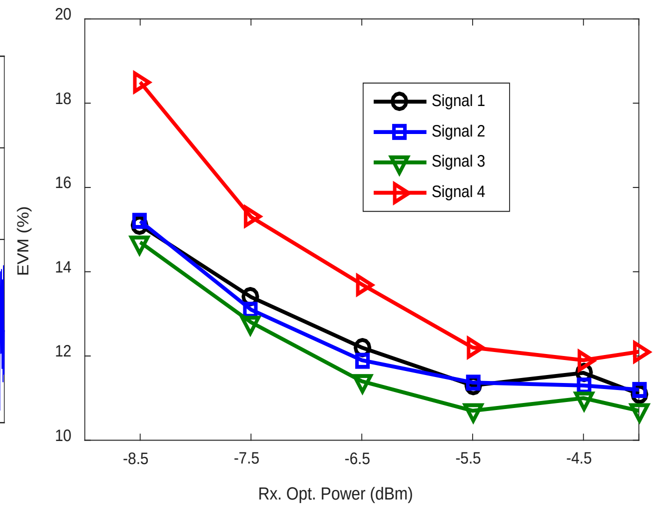
Multiple radios over fiber: experimental setup

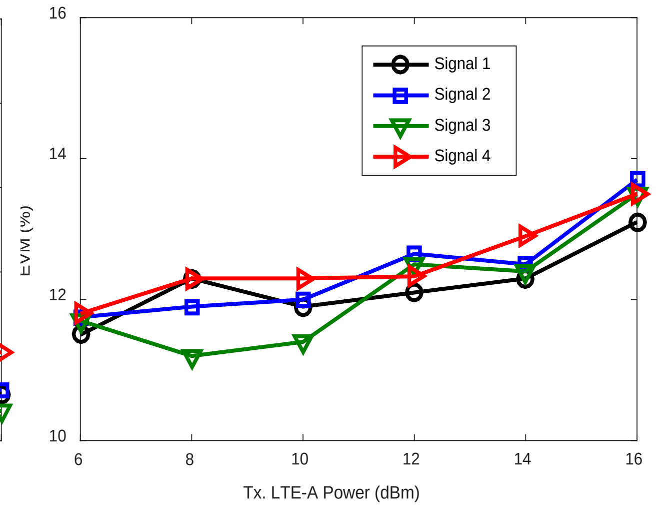


MZM: Mach-Zehnder Modulator
EDFA: Erbium-Doped Fiber Amplifier
VSG: Vector Signal Generator
Com.: RF combiner
PD: photo-detector
Did. RF Divider
VSA: Vector Signal Analyser
LNA: Low Noise Amplifier
ATT: Attenuator
(O)BPF: (Optical) Band Pass Filter

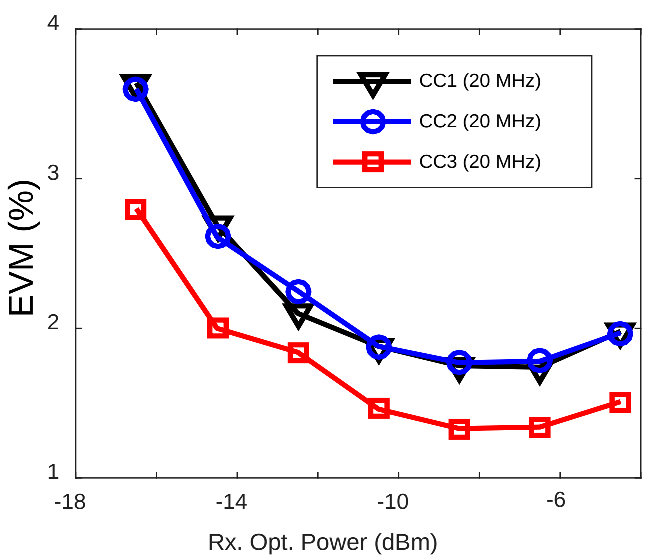
Multiple radios over fiber: experimental results



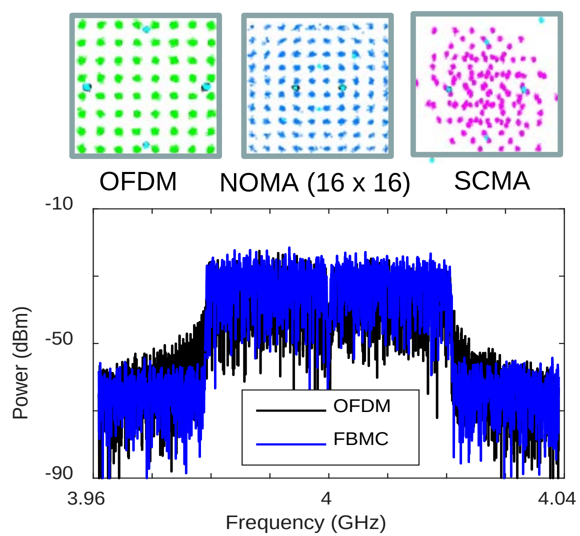


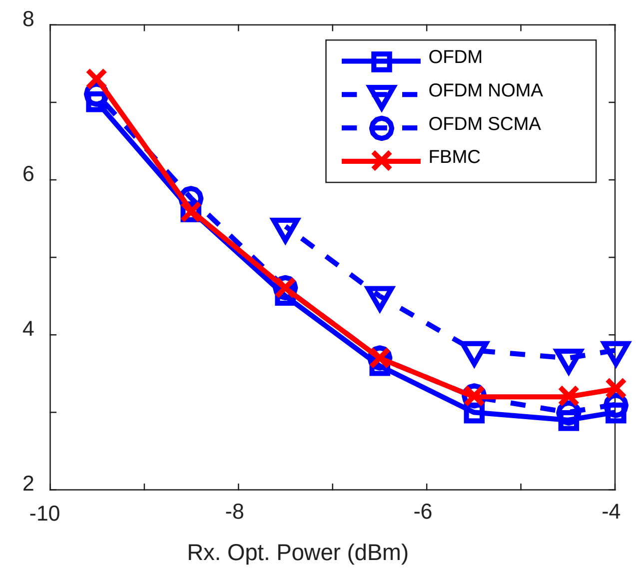


F-OFDM Signal



LTE-A Signal





New RAT signal (OFDM/FBMC)

Summary

- Seamless convergence of fiber-MMW would be a potential solution for future mobile fronthauling when fiber cable is not available.
- Convergence of WDM IFoF and linearly located distributed antenna systems is very promising for high-speed communication to high-speed trains.
- Co-design and cooperative fiber-radio access networks would be the key for future MMW and massive MIMO mobile signal, and multi-RAT transmission.

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Thank you

ptdat@nict.go.jp