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Submission Title: Application of RoF-Based Terahertz Fronthauling using Optical Sub-Harmonic IQ Mixer to Mobile/Wireless Access Systems

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Abstract: The aim of this contribution is to provide technologies to configure terahertz mobile/wireless access systems. The Radio over Fiber (RoF) based terahertz fronthauling which utilizes ultra high frequency responses of an optical sub-harmonic IQ mixer is proposed and discussed.

Purpose: Informing 802.15SG100G on coherent communication technologies for fixed point-to-point link

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Applications of RoF-Based Terahertz Fronthauling using Optical Sub- Harmonic IQ Mixer to Mobile/Wireless Access Systems

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Background

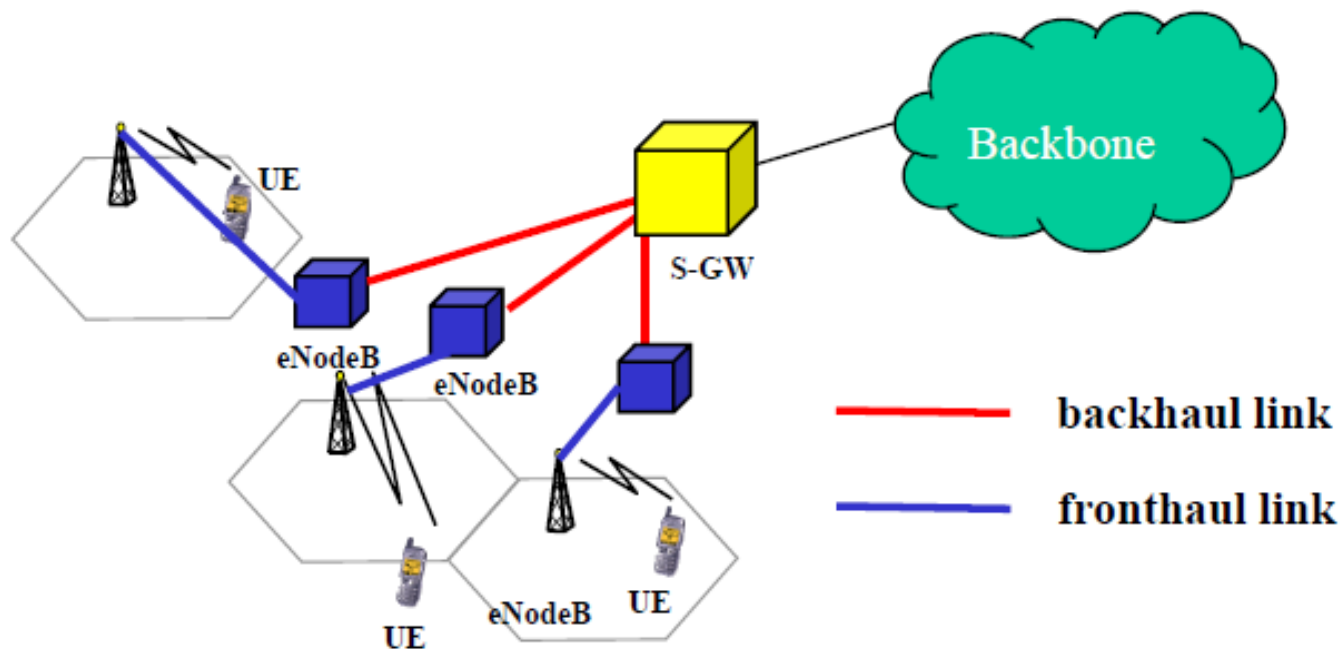
Draft PAR says:

1. Wireless switched point-to-point applications in data centers
2. Cellular wireless backhauling/fronthauling
3. Intra-device communication
4. Kiosk downloading.

At the last IEEE802.15 meeting, the requirements on wireless backhauling and fronthauling was presented [IEEE 802.15-13-0636-01-0thz]. The aim of this contribution is to provide technologies to configure those broadband mobile/wireless access systems. The Radio over Fiber (RoF) based terahertz fronthauling which utilizes ultra high frequency responses of an optical sub-harmonic IQ mixer is proposed and discussed.

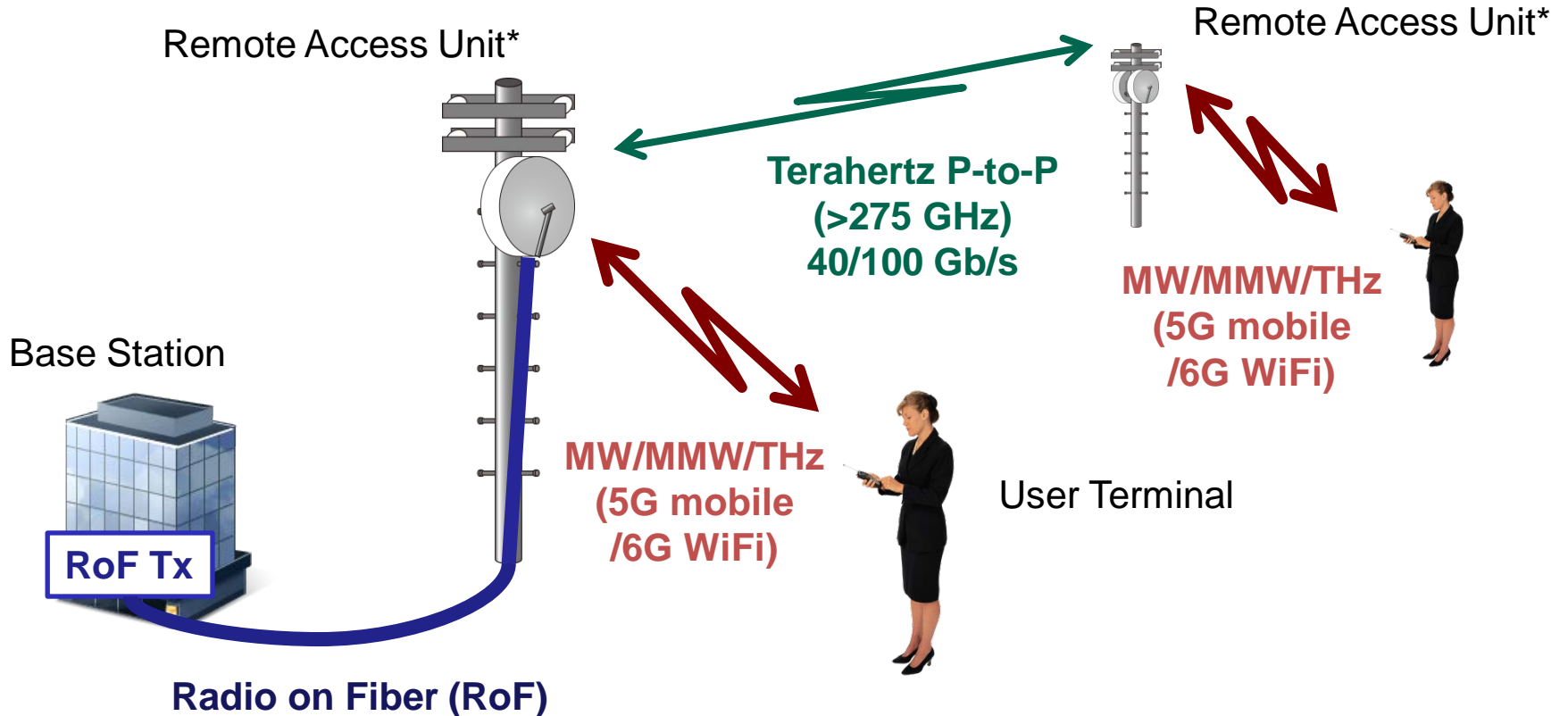
Definition of Fronthauling

The fronthaul link is the link between the base station and the remote radio head



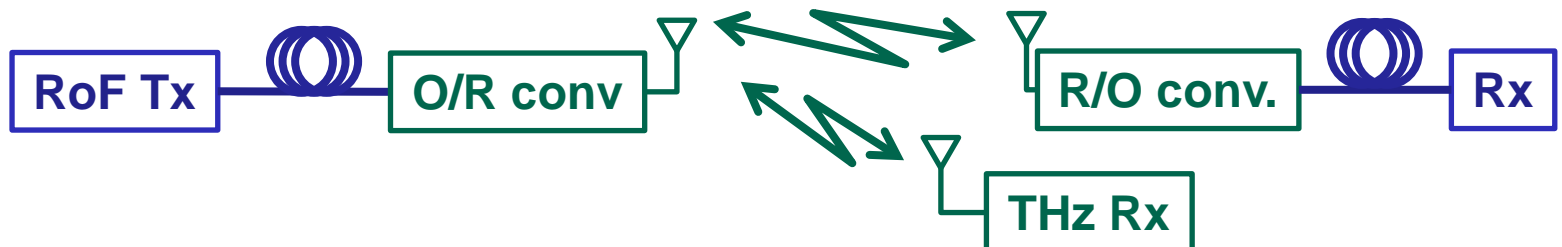
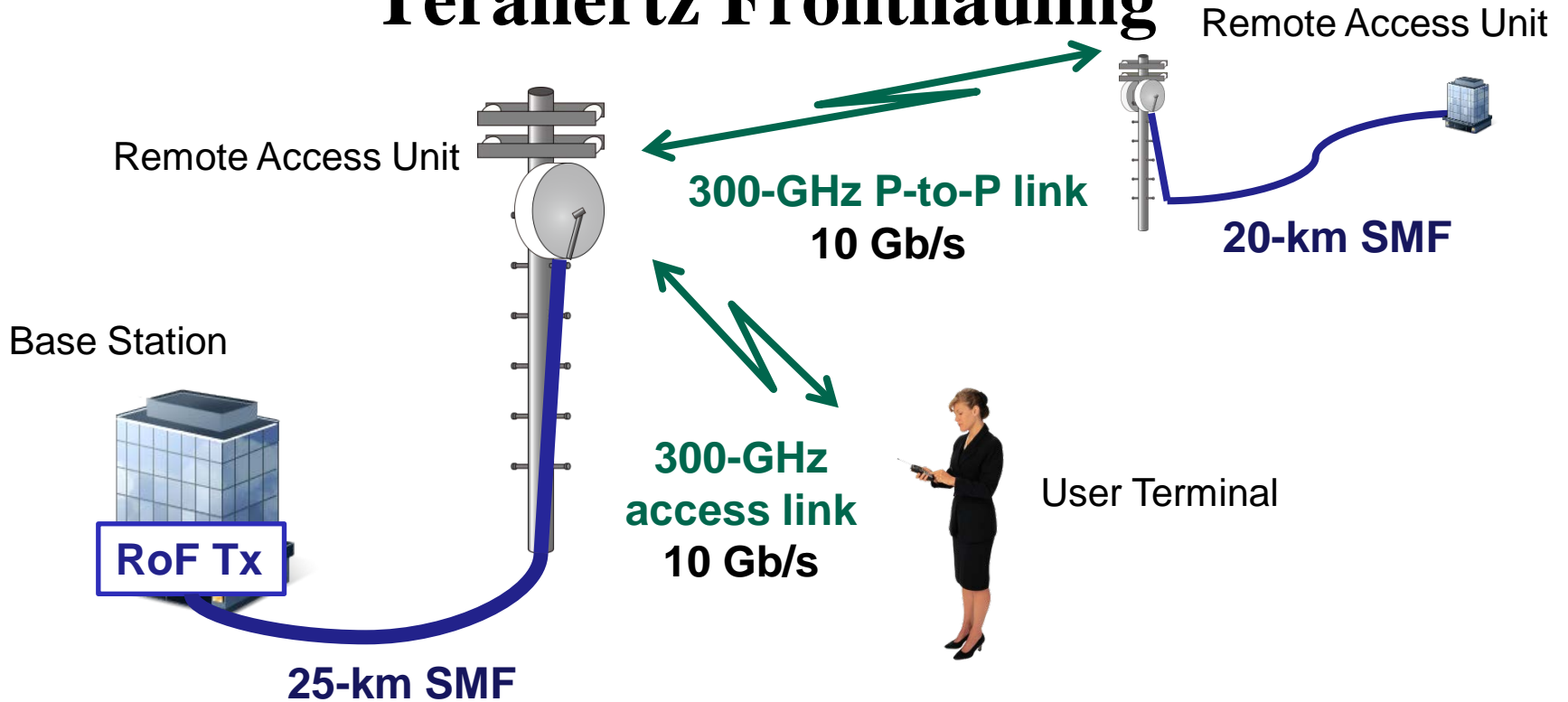
Reference: IEEE 802.15-13-0636-01-0thz

RoF-Based Terahertz Fronthauling for Mobile/Wireless Access Systems Applications

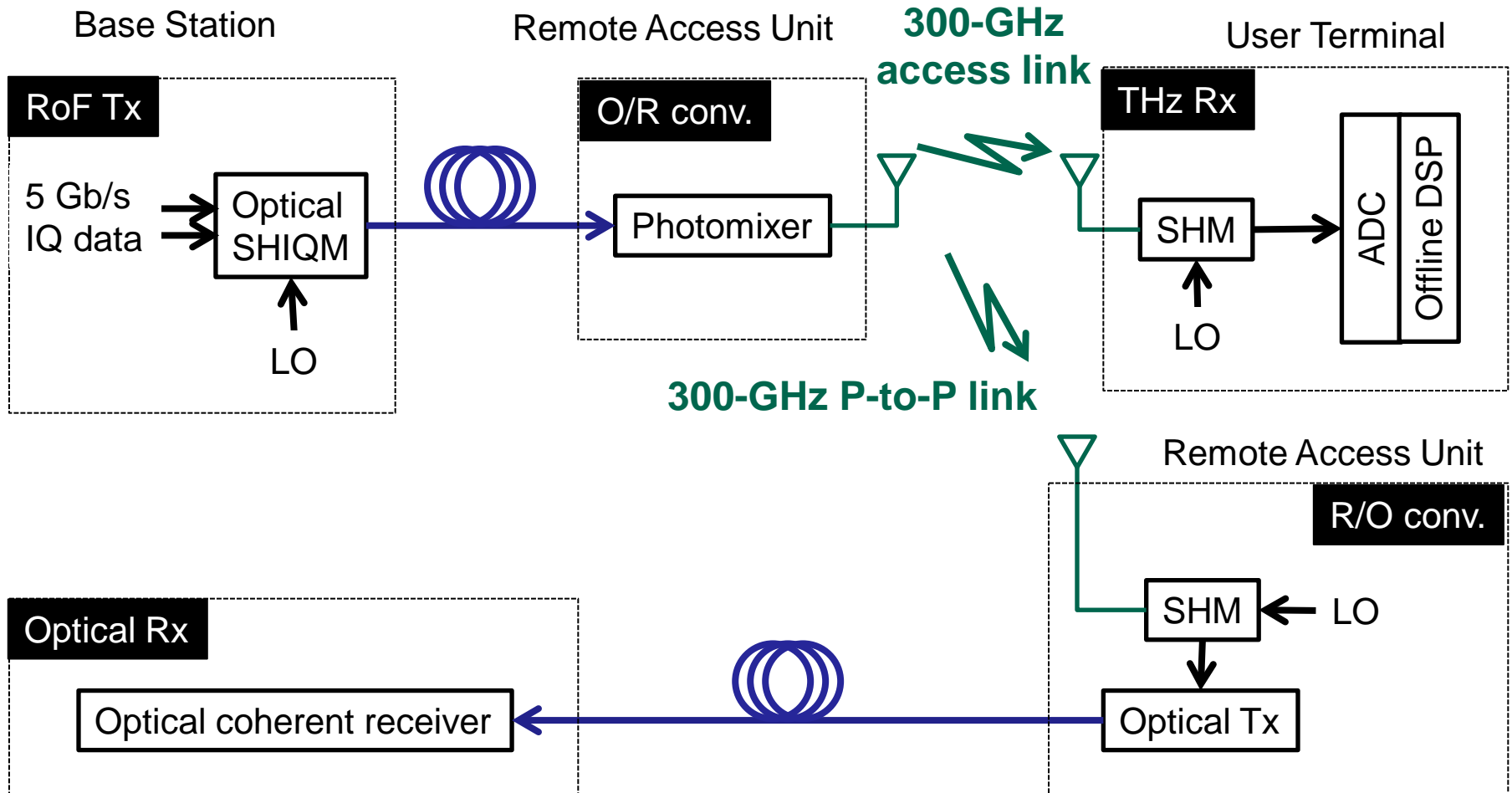


* Remote Access Unit (RAU): If fronthauling uses the CPRI (Common Public Radio Interface), RAU is indicated as Remote Radio Head (RRH).

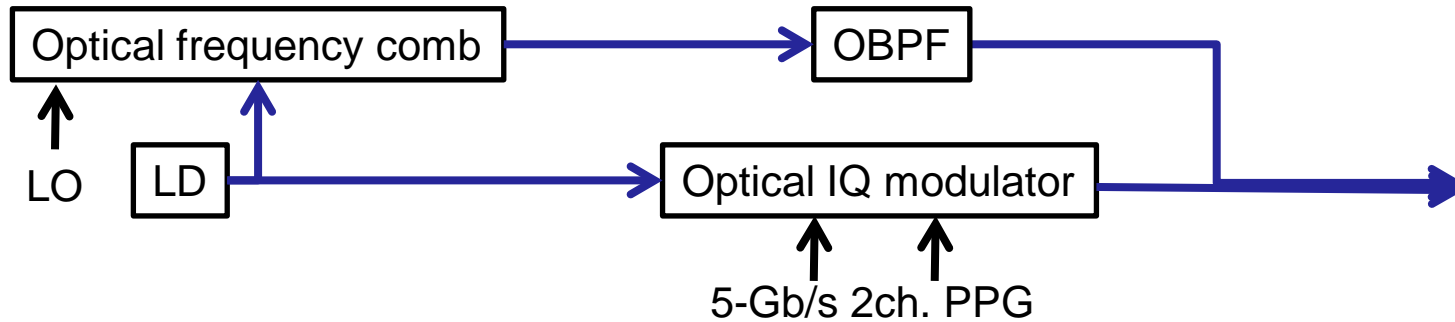
Performance Evaluation of RoF-Based Terahertz Fronthauling



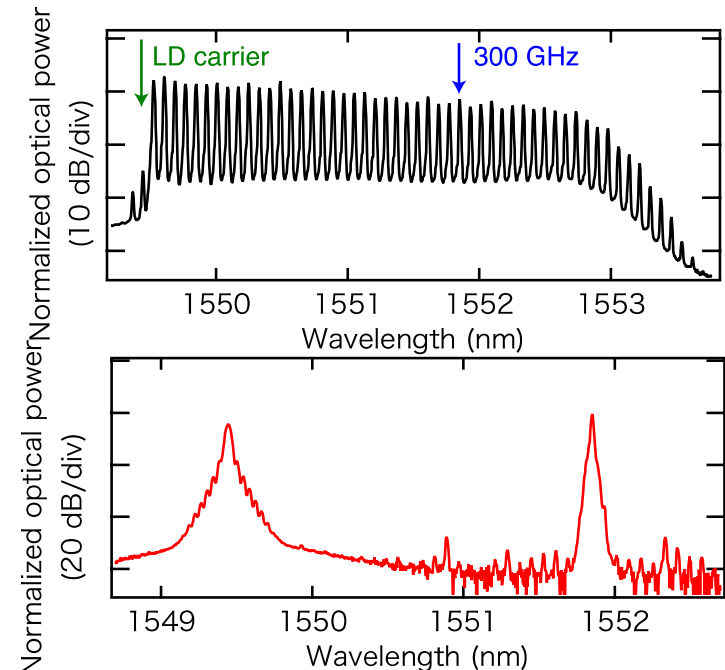
Block Diagram of Experimental Setup



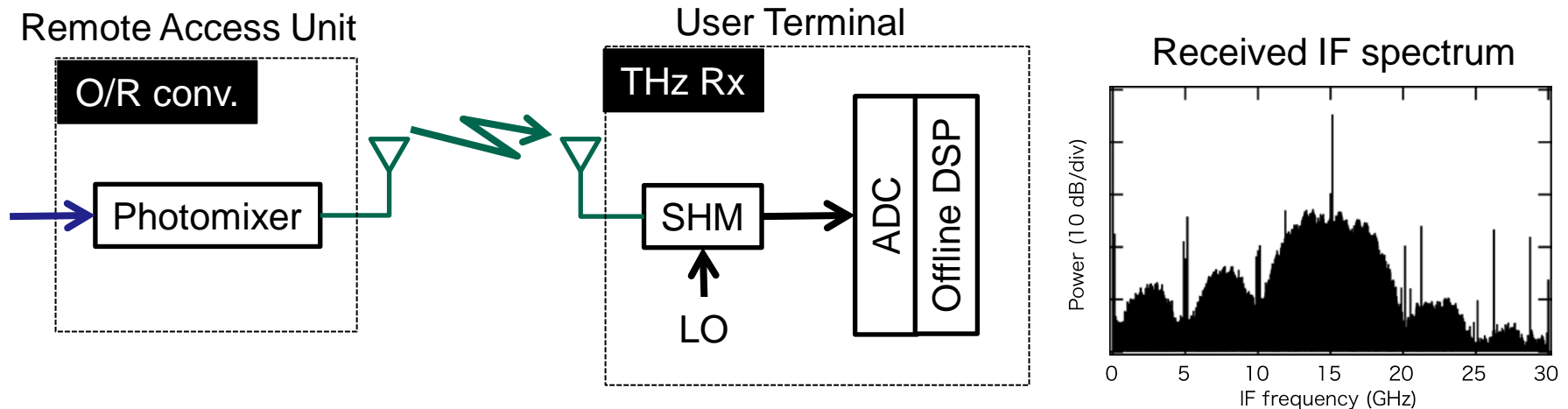
Configuration of Optical SHIQM at Base Station



1. Optical-modulation-based optical frequency comb signal is sliced to desired component by optical bandpass filter.
2. Optical IQ modulator generates QPSK baseband signal with 5 Gbaud.
3. Sliced optical component and optical baseband signal is combined by an optical coupler to form RoF signal.

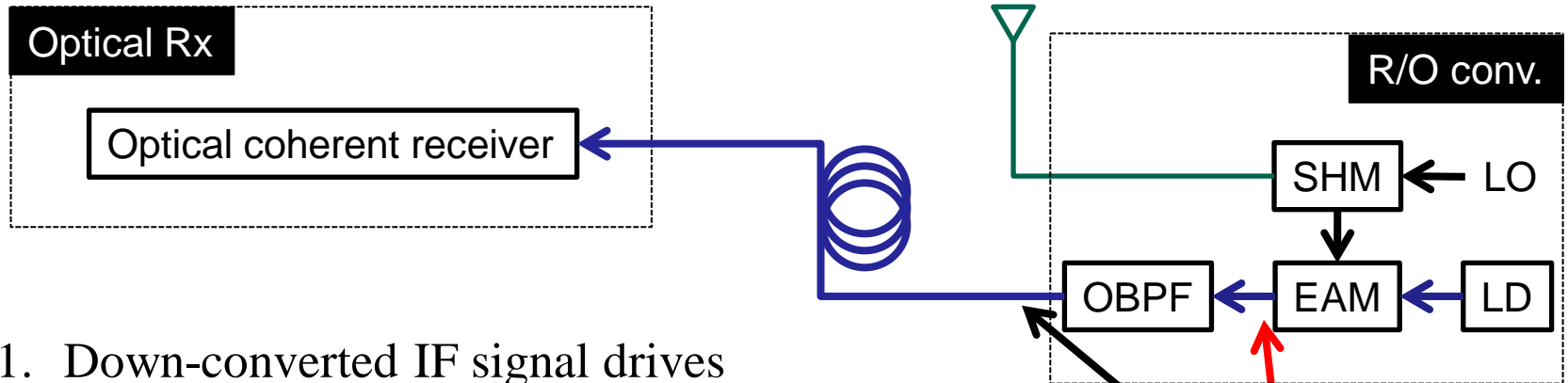


Terahertz Receiver

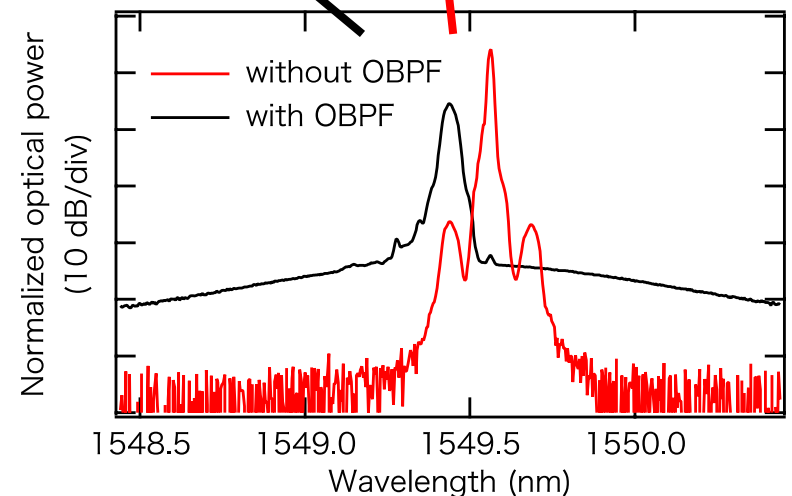


1. Photomixer (high-speed photodiode) irradiates 300-GHz QPSK radio signal.
2. Sub-harmonic mixer (SHM) converts IF signal from received radio signal.
3. Analog-to-digital converter (ADC) captures the IF signal.
4. Offline digital signal processing (DSP) demodulates the IF signal.

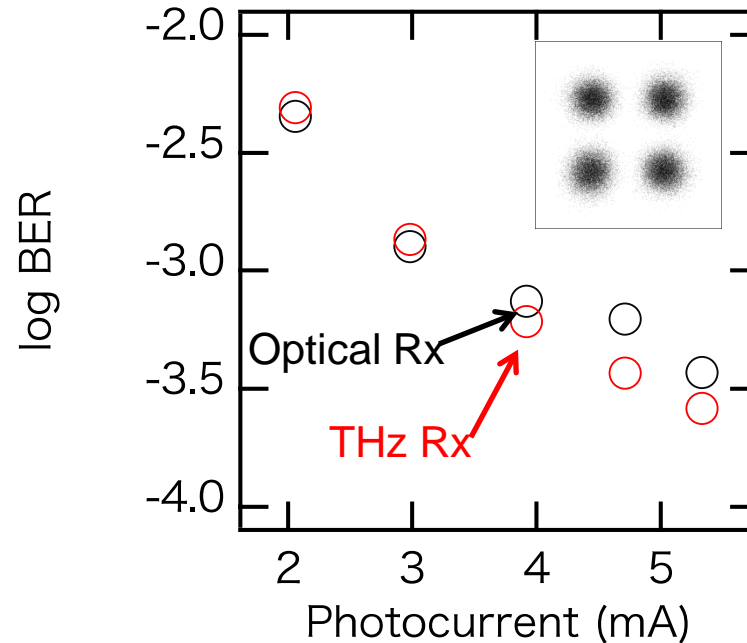
Configuration of R/O Converter



1. Down-converted IF signal drives an electro-absorption modulator (EAM).
2. Optical bandpass filter (OBPF) suppresses unnecessary carrier and modulated components.
3. Optical coherent receiver demodulates optical QPSK signal.



BER performance



- Obtained bit error rates (BERs) are within forward error correction limit of 2×10^{-3} .
- There is no significant penalty between optical Rx and THz Rx.

Summary and Discussion

- RoF-based terahertz fronthauling for broadband mobile/wireless access systems is proposed using an optical SHIQM.
- Although 10-Gb/s-class data transmission was achieved by 300-GHz, the carrier frequency can be easily increased by selecting optical band pass filter characteristics.
- Terahertz signal distribution to Remote Access Unit (RAU) through RoF feeder lines can be achieved without terahertz local oscillators and other RF components at RRH which reduce the complexity of RAU.
- It also help extending a distance between Base Station (BS) and RAU up to 100 km.
- All information contained in this presentation is meant to be included Technical Expectations Document [IEEE802.15-11-0745-12-0thz-thz-igtechnical-expectations-document-ted].

Acknowledgments: This research was conducted as part of the project entitled “Agile Deployment Capability of Highly Resilient Optical and Radio Seamless Communication Systems” program of the Commissioned Research of the National Institute of Information and Communications Technology (NICT).