# Towards super-heterodyne THz links pumped by photonic local oscillators

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***Abstract*— We present in this paper wireless data transmission experiments in a superheterodyne wireless system based on millimeterwave monolithic integrated circuits at a center frequency of 300 GHz, driven by photonic local oscillator (LO). Superheterodyne operation is attractive for compliance with the recent IEEE802.15.3d frequency standard. The super-heterodyne transmission with two channels is realized using an AWG and a photonic-based LO. The paper presents initial transmission experiments realized using two channels in the 300 GHz band.**

## I. INTRODUCTION

DRIVEN by the need of higher data rates, the interest for THz communication systems has been growing rapidly in the past years. Numerous groups have achieved good results in this field; for example, data rates of more than 100 Gbps have been reported using both all-electronic technologies [1], and photonics [2]. The reached data rates show that the terahertz range around 300 GHz is a viable solution, with the new IEEE 802.15.3d Standard [3].

## II. EXPERIMENTAL SETUP AND RESULTS

In the THOR Eu-Japan project, we are investigating the super-heterodyne architecture, were intermediate frequency signals (with several channels in E (71-76, 81-86 GHz) or V-band (60 GHz)) are transparently carried in 300 GHz band for future networks. Here, the 300 GHz system is composed of one transmitter/receiver based on integrated circuits packaged in split-block waveguide modules with a WR-3 output. The LO signal, around 8.3 GHz was produced by a photodiode using photomixing of an optically modulated carrier at 8.3 GHz.

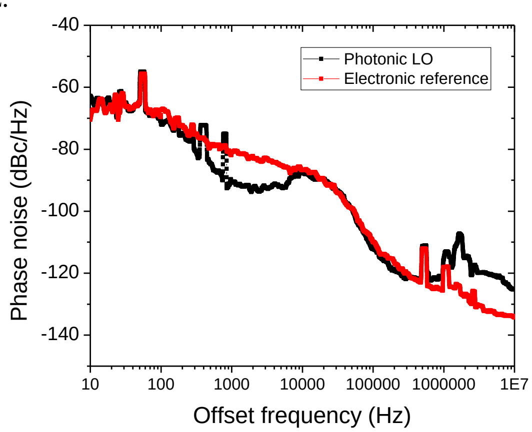
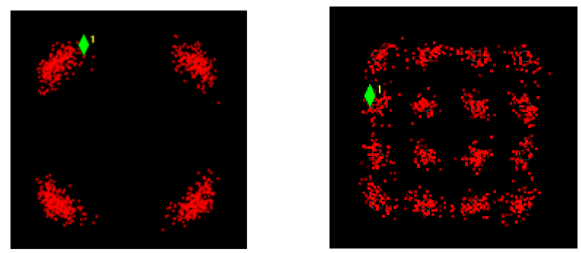



**Fig. 1.** Phase noise characteristics of the photonic-based LO and electronic reference.



2 Gbps, EVM = 11.27%    4 Gbps, EVM = 17.92%

**Fig. 2.** I/Q maps obtained for dual channel 1 GBaud QPSK and QAM-16.

First, we checked that the phase noise of the photonic-based LO was featuring a sufficient performance (Fig. 1). Then, using this LO to drive the up and down 300 GHz converters, a dual channel transmission was realized with 10 meters link distance (fig. 2). As can be seen, I/Q maps of both channels were successfully retrieved, with some noise affecting the constellations. Further measurements shown that even if phase noise was sufficient, carrier-to-noise issues were affecting the detection which are actually under investigation. In the future, we target to apply this concept to drive the up-down converters, not at 8.3 GHz but rather at higher frequencies (around 77 GHz). In that case, the photonics approach is of interest to avoid the phase noise multiplication factor usually affecting the multiplication chains used to generate the local oscillators in all-electronic systems.

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## REFERENCES

[1] H. Hamada, T. Fujimura, I. Abdo, K. Okada, H. Song, H. Sugiyama, H. Matsuzaki, and H. Nosaka, "300-GHz 100 Gbps InP-HEMT Wireless Transceiver Using a 300-GHz Fundamental Mixer," in 2018 IEEE/MTT-S International Microwave Symposium - IMS, June 2018, pp. 1480–1483.

[2] V. K. Chinni, P. Latzel, M. Zégaoui, C. Coinon, X. Wallart, E. Peytavit, J. F. Lampin, K. Engenhardt, P. Szriftgiser, M. Zaknoune, and G. Ducournau "Single-channel 100 Gbit/s transmission using III–V UTC-PDs for future IEEE 802.15.3d wireless links in the 300 GHz band," *Electronics Letters*, Bd. 54, pp. 638-640 (2018).

[3] IEEE Standard for High Data Rate Wireless Multi-Media Networks Amendment 2: 100 Gbps Wireless Switched Point-to-Point Physical Layer, IEEE-SA Standards Board Std.