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► To cite this version:

A Renau, C Maye, D Wrana, S Haussmann, I Kallfass, et al.. Full frequency duplex link over 645m in the 300 GHz band. Journée du Club Optique Micro-ondes (JCOM 2023), Jun 2023, Visio conference, France. hal-04160795

HAL Id: hal-04160795 https://hal.science/hal-04160795v1

Submitted on 12 Jul2023

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JCOM 2023 19 juin 2023 Online



Full frequency duplex link over 645m in the 300 GHz band

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Abstract—We present here a demonstration of THz transmission system enabling a full frequency duplex link in the 300 GHz band. This system is coupling a super-heterodyne architecture, E-band modems and duplexing system at 300 GHz.

Keywords — THz, wireless millimetre/sub-mm technologies.

I. INTRODUCTION

Terahertz (THz) transmissions systems are getting more and more attention for the 6th generation of cellular wireless communications that requires backhaul links with very high data-rate. Beyond the D-band (140-170 GHz) that is envisioned to start to be used within next 5 years, the 300 GHz will be the next step towards 100 Gbit/s backhauls. Many system approaches are considered ahead of these future backhauls, but almost all demonstrations rely on unidirectional links. We propose here the validation of a full duplex system and demonstrate a full-duplex link on a single antenna pair over 645 m.

II. LINK ARCHITECTURE AND PERFORMANCE

The link architecture is based on a super heterodyne approach which is able to up-convert traditional backhauling frequencies (< 100 GHz) up to the THz range and thus enabling channel aggregation. It was first demonstrated in [1], then it was shown that this approach enabled to meet the new IEEE 802.15.3d THz communication standard [2]. Targeting real implementation of THz backhauls in super heterodyne architecture, it is relevant to make the system compatible to a single antenna pair to simplify the alignment constraints for the expected outdoor use cases. This can be achieved with a duplexing system as shown in the figure 1. In this figure, a set of two up/converters are used to reach the 300 GHz band, where $f_{THz} = 3.f_{LO} + f_{IF}$, with $f_{LO} = 73.333$ GHz, and $f_{IF} = 74.6$ GHz or 84.6 GHz.

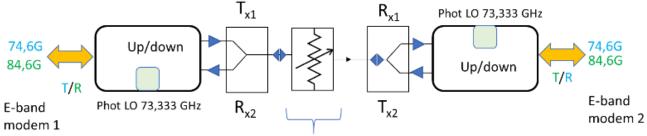


Figure 1: System architecture: two E-band modems with 10 GHz frequency spacing (74.6 and 84.6 GHz) are up/down converted into the 300 GHz band (295 and 305 GHz). The local oscillators are in this case achieved using a photomixing approach to avoid spurious tones in the LO signal at 73.333 GHz.



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III. BACK TO BACK PERFORMANCE

In order to estimate the link margin and the system is first testbed in back to back (B2B) case (ie with an attenuator between the T/R up/down converters, located at both ends. The modems in E-band are integrated with a monitoring system that enable to check the carrier to interference plus noise ratio (CINR), with a limit of 19 dB to be able to handle a QAM-32 signal. The channel bandwidth was here fixed by the E-band modem to 2.16 GHz, and the maximum net data-rate was 6.26 Gbit/s in each direction (total 12.52 Gbit/s). The data-rate was measured with the IPERF tool [3] dedicated for the testing of IP networks.

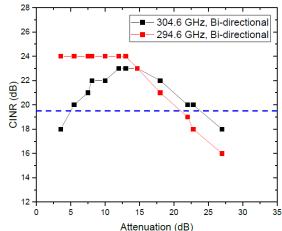


Figure 2 : Back to back test of the THz duplexed FSS system. For a QAM-32 operation, the system margin was evaluated to 21 dB.

The THz link was then successfully tested in an outdoor configuration with a pair of two Cassegrain antennas (62 dBi) over a 645 m distance, with a QAM-32 performance (12.52 Gbit/s).



Figure 3: Outdoor validation of the duplexed link over a 645 m distance.

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