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# Up to 100 Gbit/s short link using 300 GHz band Yagi-Uda antenna

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**Abstract**—We report on the use of a Yagi-Uda antenna on polymer substrate used for indoor 300 GHz data-link applications. The Yagi-Uda antenna-based data-link is validated for up to QAM-16 signals (100 Gbit/s).

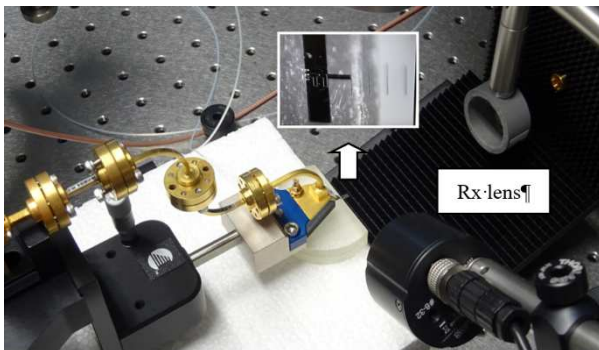
## I. INTRODUCTION

Driven by the data society, the need of high speed data is growing enormously over time. The use of new frequency resources offered by THz is one way to support this demand. We investigate here the use of a Yagi-Uda antenna for coherent communications up to 100 Gbit/s for indoor 300 GHz links.

## II. 300 GHz LINK

The Yagi-Uda antenna used in the THz link is fabricated on a cyclic olefin copolymer (COC) with 20 directors, lying on a 110- $\mu\text{m}$ -thick commercially available COC membrane [1]. The directivity achieved is higher than 15 dBi [1].

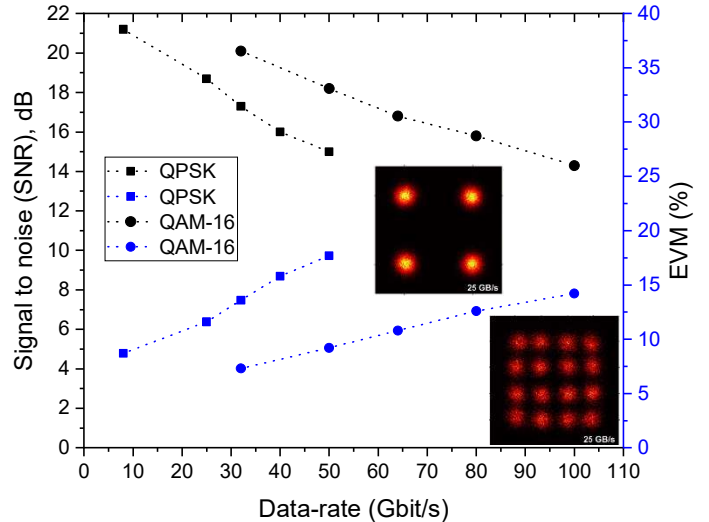
To enable the use of Yagi-Uda antenna in a THz link, a single laser-line is modulated using a I/Q Mach-Zehnder modulator (MZM). After combination of the modulated optical signal with a continuous wave laser, an erbium-doped fiber amplifier (EDFA) boosts the signal prior to injection in an untravelling carrier photodiode (UTC-PD) coupled to a 300 GHz CPW probe (Cascade Infinity type [2]). The UTC-PD is a very popular technique that enables optical to 300 GHz band modulated signal conversion among photonics-based techniques [3]. The signal is radiated in free-space by the Yagi-Uda antenna (figure 1). No external lenses to collimate the signal. The THz link is 0.2 m, and the receiver (associated with a 25 mm lens) is integrating a sub-harmonic mixer (GaAs) pumped by a multiplication chain and 30 dB IF amplifier. The IF signal is driving a real-time oscilloscope for I/Q mapping, signal to noise ratio (SNR) or error vector magnitude (EVM) calculation.



**Fig. 1.** Setup representation: Waveguide/CPW probe fed Yagi-Uda antenna and short THz link with Rx lens and horn antenna.

## III. RESULTS

The experiments and the data collections were performed for the antenna for different data rates and modulation schemes. The data analysis was done using a MATLAB based interface and analysis tool coupled to the wide bandwidth oscilloscope. The graphical analysis of the data displayed that the Signal to Noise ratio (SNR) calculated using the VSA software [4] is, as expected, degraded with the increase of the modulation bandwidth, highlighting a thermal-based limitation of the THz link. The same behavior is obtained for the  $\text{EVM}_{\text{rms}}$ . The highest data-rate tested was 100 Gbit/s, where a BER was found to be  $1.1 \times 10^{-2}$ , very close to noise floor of the detection system. However, the I/Q map (constellation) was still recoverable, as shown by the inset in the figure 2. To the best of author's knowledge, this is the first realization of a 100 Gbit/s link using a Yagi-Uda antenna in the 300 GHz band.



**Fig. 2.** BER performance of the Yagi-Uda based link at 300 GHz. QPSK and QAM-16 modulation format were tested, using up to 50/100 Gbit/s data-rates, respectively (see insets).

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