THz Transceiver development for High-speed Communication

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Transceiver at 300 GHz for more than 100 Gbps data rate

THz frequency ranges are most prominent spectrum to achieve high data rates communication. Historically, implementation of THz electronics is achieved by MMICs using III-IV semiconductor technologies, however, their applications are limited to space and defence sector. In last couple of decades, the enhanced performance of Silicon process, mainly SiGe-BiCMOS, helped to use highly integrable Si process in THz electronics as well. Recently, SiGe HBTs technologies, with f_T/f_{max} of value 350G/500G, are used to design transceivers above 200 GHz range. Additionally, IEEE 802.15.3d standard at 300 GHz band has been established. So, considering all the challenges and opportunities involved in THz electronics, we are developing THz Transceiver for High-speed Communication.

Beam-steerable transceivers with wide bandwidth are in high demand in radar, imaging and communication systems. There is a growing interest in pushing their operation frequencies toward the THz band, so that on chip phased array antenna configurations with narrow-beam response can be considered. However, the efficiency of a phased array depends on the performance of power amplifier or LNA as well as phase shifter. Considering our target of high speed communication, a sample architecture of THz transceiver, as shown in Fig. 1, is under progress.

- **Antenna** To steer the radiated energy, several slot antennas have been exploited to implement a phased array structure.
- **PA / LNA** Due to low current density near f_{max}, a single transistor amplifier stage can provide only a limited amount of output power. To overcome this limitation, several techniques such as cascode and cascade structures and power combining technique have been used.
- **Phase shifter** For future beam-forming experiments, both an active vector modulator phase shifter and a passive reflection type phase shifter have been studied.

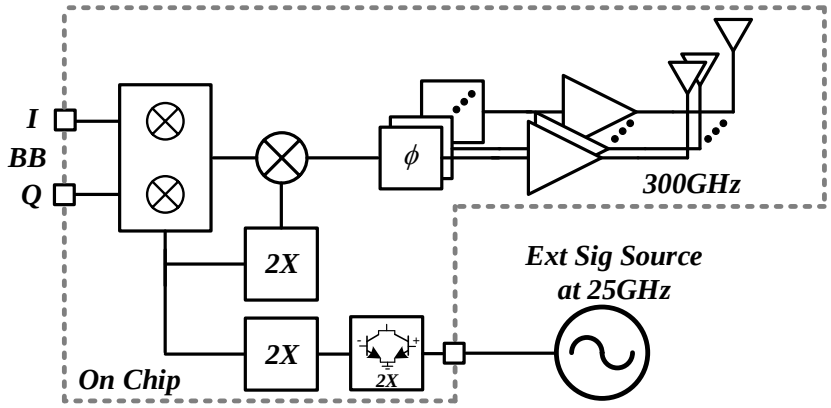

Fig. 1: Transceiver architecture at 300 GHz with on-chip antenna.

- **Up-/Down-converter** Different Gilbert cell mixers typologies at 100 and 300 GHz with 40 GHz bandwidth have been designed to up-convert I/Q baseband signals to the 300 GHz signal in transmitter and to down-convert the 300 GHz signal to I/Q baseband signal in receiver.
- **LO chain** PLL synthesizer are not practical in the THz transceiver. To overcome this limitation, frequency multiplier trees are commonly used. A frequency doubler has been designed by using push-push technique, in a cascade architecture, to generate 100 and 200 GHz LO signals.

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