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Multi_Gigabit wireless data transfer at 60 GHz

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The data transfer rate from highly granular tracking detectors are limited today by the available bandwidth in the readout links what prevents the detectors to be used for fast triggering.

MMwave technology is the next generation wireless technology that can provide multi-Gbps wireless connectivity for short distances between electronics [1]. Since the carrier frequency is higher (60 GHz), more data can be sent in a given period of time, by modulating the carriers amplitude, frequency or phase. The 60 GHz unlicensed frequency band is of particular interest for indoor point-to-point multi-gigabit due to its very low atmospheric attenuation and the large amount of spectral bandwidth (7-9 GHz). With such a bandwidth available and the optimum choice of modulation scheme, it would be possible to achieve a data rate in the 10' s of Gbps, and could therefore be a suitable method to solve the data transfer rate problem. Furthermore, due to its small wave lengths at carrier frequency of 60 GHz (5mm), it becomes possible to integrate the antenna on-chip or in-package.
The narrow beams of millimeter wave also allow for deployment of multiple independent links in close proximity. That makes the wireless modules very suitable to pass data between tracking layers.
The high speed links are low mass, low power, more secure and does not interfere with other wireless technologies for short distance data transfer.

In this context a multi-Gigabit wireless readout chip operating in the 60 GHz region is currently under development at the University of Heidelberg. The design is based on the well known superheterodyne transceiver architecture with approximately 3Gb/s throughput, x mW transmit power, 5 dB receiver noise figure (NF) and high gain omni-directional antennas. With such specifications, the link budget calculation shows that a range of few meters is possible. The targeted data rate for our first prototype is 3Gbps.

In this talk the key building blocks necessary to realize this architecture will be described.
Silicon-Germanium (SiGe) Heterojunction Bipolar Transistors (HBTs) BiCMOS is chosen as the technology to demonstrate the concept. In addition, we will also report on the current status of the design and performance obtained in simulation of our Millimeter Wave Chip development for a possible upgrade of the ATLAS Fast Tracker, in terms of area, estimated power consumption, data rate, and the emerging 3-D technology implementation scenarios that is particularly beneficial for 3-D wireless chip development.

[1] R. Brenner. "Multigigabit wireless transfer of trigger data through millimetre wave technology".
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