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Multi-Gigabit Wireless Data Transfer using the Millimeter Wave Band at 60 GHz

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Wireless techniques have developed extremely fast the last decade, and using them for data transfer in particle phyics detectors is not science fiction any more. In this paper we describe the status of the first prototype of the 60 GHz wireless Multi-Gigabit data transfer topology current under development at University of Heidelberg using IBM 130 nm SiGe HBT technology.
The wireless transceiver consist of a transmitter and receiver. The 60 GHz band is very suitable for high data rate and short distance applications as for example needed in the HEP experiments and other detector facilities.

Summary

Wireless techniques have developed extremely fast the last decade, and using them for data transfer in particle phyics detectors is not science fiction any more.
This is due to the tremendous advances in silicon technologies that have made it possible to build high performance transceivers operating in the millimetre band, where the 57-66 GHz band is situated. This license free 9 GHz band is very attractive in order to achieve high data transfer that has triggered the use in the HEP environment.
In addition to the high data rates that is possible using the 60 GHz spectrum, is the unique energy propagation charateristic of this band. It has a free space loss of 68 dB over a distance of 1m, a high penetration loss, that in our case is measured to be about -50dB for a fully equipped SCT (ATLAS) detector module, and an oxygen absorption of about 15 dB/Km. The last effect is of less importance for us, since a typical data transmission distance in HEP detectors is from a few cm to about a few meters where attenuation of about 0.1 dB are expected.
Also antennas operating at such high frequency are typical very directional, unlike the antennas operating at 2 or 5 GHz. Directivity is a measure of how well an antenna focuses its energy in an intended direction, thus operating at 60 GHz frequency results in a more focused antenna with a narrower beam width for a fixed antenna size, that minimizes the possibility of interference and the risk that the transmission be intercepted.
These features, the high path loss, high material penetration loss, narrow beamwidth, Line-Of-Sight (LOS), and operation in a cotrolled environment, makes the 60 GHz band optimal for short range operation. Also the use of high carrier frequency provides low form factor, which will reduce the material budget. This provides an extremely desirable frequency-reuse that can handle a large number of transceivers in a small area as required in the HEP detectors and other detector facilities.

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