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A multiple 10 Gbit Ethernet data transfer system for EIGER

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Eiger is a single-photon counting x-ray pixel detector developed at the Paul Scherrer Institute for energies up to 25 keV with a pixel size of 75×75 μm^2.
The Eiger detector is designed for synchroton applications and consists of several modules each having a total of 500 kpixels.
1.5 Mpixel and 2 Mpixel detectors (3 and 4 modules) are being integrated in several beamlines and a 9 Mpixel detector (18 modules) is currently under construction.

An Eiger module is subdivided into two half modules each having its independent but overall synchronized readout system consisting of a front-end board (FEB) and a back-end board (BEB). The maximum frame rate is 22 kHz independent of the detector size.
The data input stream is sorted in two FPGAs on the FEB. The data rate here goes up to 22 Gb/s. A rate correction is applied to
compensate for the counting loss at high count rates. Then the data stream is sent over eight 3.125 Gb/s highspeed transceivers to the BEB which receives and further processes the data.
On the BEB the stream is buffered in a DDR2 memory. This allows image summation to extend the dynamic range from 12 bit to 32 bit and also extends the limited external data rate
of the 10 Gbit/s Ethernet interface per half module. On a 9 Mpixel detector, with its 36 half modules, the maximum data rate reaches 45 GByte/s.
To reduce the network load on the servers side a round robin procedure is implemented by sending the stream to several servers. Here the challenge of keeping the images in one piece has been taken into account.
A second approach is online compression currently implemented to reduce the network load and to widen the Ethernet bottleneck.
The firmware layout as well as the presented and implemented functions will be presented in detail.

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