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Clock synchronization for a multidevice data acquisition system of a ground penetrating radar

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As part of the climate research, controlled environment facilities are deepening the knowledge of highly heterogeneous dynamic ecosystems centered around plants.
In the context of climate change, it becomes even more important to study the impact of climate conditions on crops under realistic conditions using large scale laboratories.
We develop a high resolution multi-channel ground penetrating radar (GPR) for a cylindrical lysimeter that is 1 m wide and 1.5 m tall. The GPR data is used to reconstruct a tomographic image of the soil and root system.
The GPR design, production and commissioning is performed by the Central Institute of Engineering, Electronics and Analytics - Electronic Systems (ZEA-2) of the Forschungszentrum Juelich in Germany.
The system is designed with 39 data acquisition (DAQ) units, one unit controls 64 radio frequency antennas and internally called the Baseboard (BAB), and a Master Module (MAM) used to concentrate the data and control the BABs.
Prerequisite for a precise tomogram is an accurate synchronization of all data acquisition components and low-jitter clocking.
Each BAB is equipped with the necessary clocking distribution, a Xilinx RFSoC providing the DAC and ADCs, and a separate antenna multiplexing FPGA.
The layout of the lysimeter is such that the MAM is connected to 13 BABs arranged in a ring on the lowest layer, and each of these is connected to two additional BABs surrounding higher layers of the lysimeter.
This combination of a star and chain topography provides a challenge for the clock synchronization and is discussed in this talk.
The analysis of the first verification data is shown and the DAQ roadmap is outlined.

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