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# Leveraging the Run 3 experience for the evolution of the ATLAS software-based readout towards HL-LHC

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The High-Luminosity Large Hadron Collider (HL-LHC), scheduled to start operating in 2029, aims to increase the instantaneous luminosity by a factor of 10 compared to the LHC. To match this increase, the ATLAS experiment has been implementing a major upgrade program divided into two phases. The first phase (Phase-I), completed in 2022, introduced new trigger and detector systems that have been used during the Run 3 data taking period which began in July 2022. These systems have been used in conjunction with the new Data Acquisition (DAQ) Readout system, based on a software application called Software Readout Driver (SW ROD). SW ROD receives and aggregates data from the front-end electronics via the Front-End Link eXchange (FELIX) system and passes aggregated data fragments to the High-Level Trigger (HLT) system. During Run 3, SW ROD operates in parallel with the legacy Readout System (ROS) at an input rate of 100 kHz. For the Phase-II, the legacy ROS will be completely replaced with a new system based on the next generation of FELIX and an evolution of the SW ROD application called Data Handler. Data Handler has the same functional requirements as SW ROD but must be able to operate at an input rate of 1 MHz. To facilitate this evolution the SW ROD has been implemented using plugin architecture.

This contribution presents the design and implementation of the SW ROD application for Run 3, along with the strategy for its evolution to the Phase-II Readout system. It discusses the lessons learned during Run 3 and describes the challenges that have been addressed to accomplish the demanding performance requirements of HL-LHC.

**Authors:**   TDAQ, ATLAS;  KOLOS, Serguei (University of California Irvine (US))

**Presenter:**   KOLOS, Serguei (University of California Irvine (US))

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