The ATLAS experiment at the Large Hadron Collider (LHC) stands at the cutting edge of scientific discoveries and distributed computing technologies. On the scientific front, the discovery of the Higgs boson leads to many new measurements of its properties, while opening the door to potential new discoveries in the search for dark matter. On the distributed computing front, ATLAS computing resources are distributed worldwide at hundreds of computing sites, while thousands of physicists analyze the data. The volume of processed data has grown beyond the exabyte scale, requiring more than a billion hours of computing cycles per year. The PanDA (Production and Distributed Analysis) system was developed to meet such scale and complexity of distributed computing for the ATLAS experiment. PanDA is the first exascale workload management system in High Energy Physics, already operating at a scale of million computing jobs per day, and processing over an exabyte of data per year since 2013. Grid resources, cloud resources, HTC and HPC resources are seamlessly integrated by PanDA. The success of PanDA in ATLAS is leading to widespread adoption and testing by other experiments. We will describe the design and implementation of PanDA, present data on the performance of PanDA at the LHC, and discuss plans for future evolution of the system to meet new challenges of scale, heterogeneity and increasing user base.

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