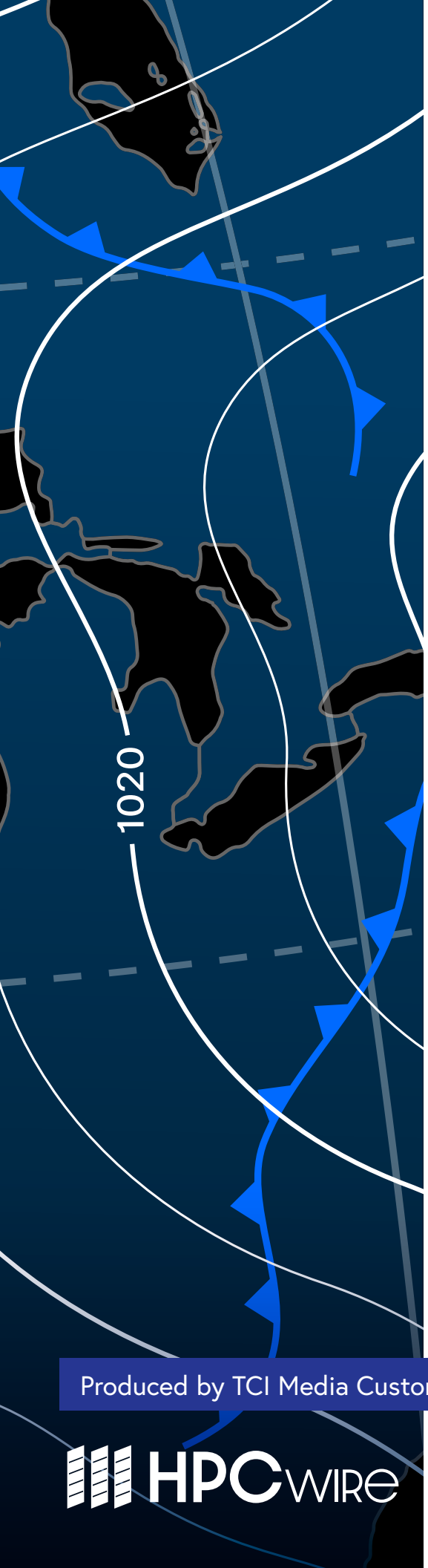

HPC IN A GLOBAL WEATHER ENVIRONMENT

CoreHive WCOSS White Paper

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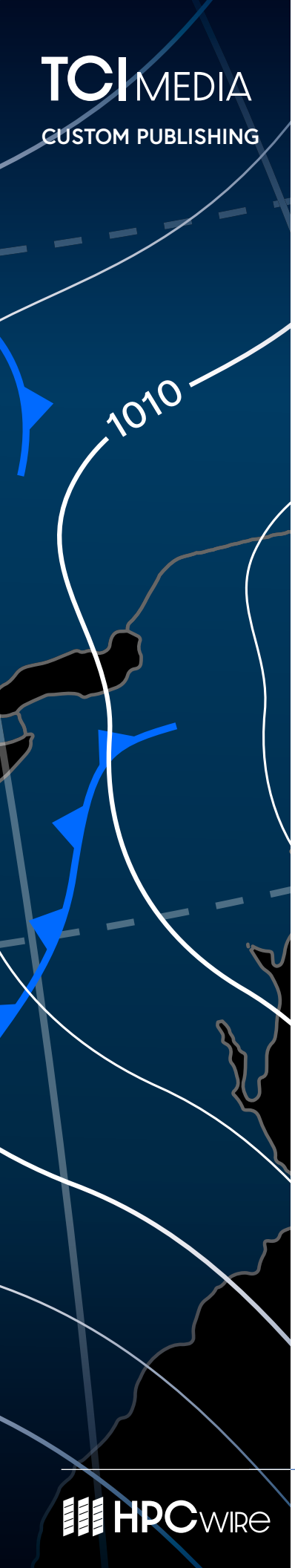
Executive Summary

The National Oceanic and Atmospheric Administration (NOAA) relies on supercomputers to produce detailed forecasts and warnings. CoreHive Computing partnered with IBM, as a small business, on a 10-year contract to upgrade the NOAA Weather and Climate Operational Supercomputing System (WCOSS). The successful integration of IBM, Dell and Cray systems achieved a computational speed of 8.4 petaflops, enabling NOAA to handle larger data volumes and process higher resolution models that produce more accurate weather forecasts.



Modeling the Earth's climate is a compute challenge as important as it is complex. Weather predictions have global social and economic impact, affecting everyone from farmers and vacationers to FEMA and the US military. Knowing what the next few hours or days will bring can be a matter of life and death, whether the risk is wildfires, floods, hurricanes, or tornadoes.

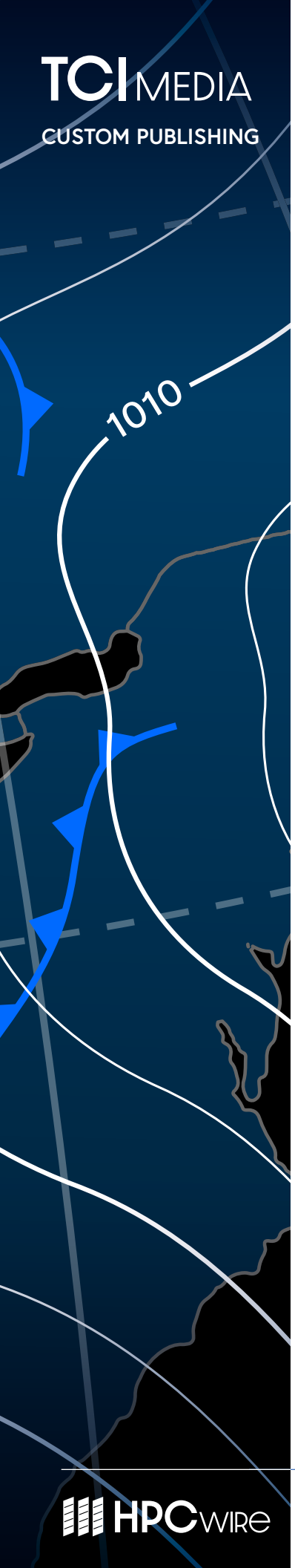
The National Weather Service (NWS), an agency in the National Oceanic and Atmospheric Administration (NOAA), has been using supercomputers for decades to produce forecasts, watches, and warnings, as well as provide data for public and international use. The NOAA's Weather and Climate Operational Supercomputing System (WCOSS) is always among the most powerful systems of its kind in the world.

In the 1950s, meteorologists had hundreds of data points to work with to make their predictions. Today those numbers are well into the hundreds of millions, streaming in every second from satellites, weather balloons, buoys, and other sensors. Constantly processing and analyzing such massive amounts of data makes climate modeling a perfect application for high-performance computing (HPC) systems and software.

In 2012, CoreHive Computing was selected as a major subcontractor to IBM on a 10-year, $500 million contract to upgrade WCOSS computing capacity, storage space, and interconnect speed. The project had two key performance requirements. The first was extremely high accuracy, with benchmark numerical results reproducing to five decimal places. High reliability was also crucial, since weather modeling HPC systems have to produce data and forecasts continuously. The WCOSS contract included a system availability requirement of 99 percent, operational use time requirements of 99.9 percent, and development use time requirements of 99 percent, accompanied by very high monthly penalties for non-performance.

CoreHive Computing, founded in 2003, is a technology consulting and solution provider that provides integrated, solutions-based technology services for public and private clients. The company specializes in HPC petascale deployments for U.S. clients, and had supported a previous National Centers for Environmental Prediction (NCEP) contract for IBM pSeries systems. "CoreHive has a proven record of supporting mission critical systems and have the skilled personnel to meet the stringent reliability and availability requirements for the WCOSS systems," said Mike Parkes, WCOSS Project Manager.

As a major subcontractor to IBM, CoreHive helped deploy HPC hardware, software, SA services, Application Analyst services, and Project Management services under the WCOSS contract. IBM provided two state-of-the-art data centers in Reston, Virginia and Orlando, Florida. Each center had identical hardware setups: one IBM Dell x86-based system and one Cray XC40 water-cooled supercomputer, as well as small test systems. The WCOSS systems were specifically designed to meet the specific benchmarks and growth targets provided by NOAA, with balanced compute and storage components.



By the conclusion of the contract in 2022, CoreHive and IBM successfully delivered four HPC system implementations that exceeded performance and acceptance testing requirements. The upgrade added 1.4 petaflops of computing speed—the ability to process 1.4 quadrillion calculations per second—at each data center. The result was a total operational speed of 8.4 petaflops, more than 10,000 times faster than the average desktop computer, putting the system among the 30 fastest in the world. The upgrade also added 60 percent more storage capacity.

One of the most difficult parts of the contract proved to be integrating the IBM and Cray systems. According to NOAA requirements, reading and writing data between all systems and storage had to be seamless for all users. Since the different hardware designs ran on different kinds of Linux operating systems, this proved to be a significant challenge. In the end, IBM and CoreHive used Spectrum Scale to enable compute jobs to be run from either system to either storage. "It had never been done before, getting an IBM supercomputer with IBM storage to fully integrate with a Cray system and DDN storage," said CoreHive Project Manager Joe Devine. "It was a bleeding edge integration in every sense of the term."

With their increased computing speed and capacity, the upgraded systems positioned NOAA to collect and process even more data to meet the growing needs of the weather industry, emergency management partners, and the public. More precise forecasts of extreme events a week or more in advance helps the agency deliver critical support services to local communities, and will lead to greater innovation, efficiency, and accuracy across the entire weather enterprise.

"CoreHive was an integral part of the team that designed, installed and supported the WCOSS systems," says Mike Parkes. "The systems met stringent SLAs and had positive reviews from the customer."

The end results of the WCOSS contract demonstrate CoreHive's success in delivering and supporting a world-class HPC system. The experience gained on the WCOSS contract positions them as one the most highly skilled small businesses capable of supporting such projects going forward.