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QiO* Foresight Optima DC+™ Boosts Data Center Server Sustainability

QiO's Foresight Optima DC+™ optimizes the power consumption of Intel® Xeon® Scalable processor-based data center servers.

Data centers utilize a large amount of energy to power the thousands of servers, networking equipment, storage and cooling systems required to deliver data services. According to the International Energy Agency[1], data centers consume around 3% of the world's electricity and produce around 2% of total greenhouse gas (GHG) emissions. Although this is a large amount of energy consumption (equivalent to 200TWh), the Data Center industry has done a compelling job of managing its growing energy consumption requirements in the face of accelerating demand.

Energy consumption in the Data Center world has been flat, growing at just 1.1 percent over the last ten years despite rocketing growth in internet traffic, and data center workloads.1 This success masks carbon emissions and energy management challenges that still facing the industry. Data centers are expected to continue to grow and will need to find new sources of energy savings to maintain or improve their power consumption requirements. In addition, energy is still a huge cost for a data center and saving money can be a competitive advantage.

There is still a lot that data centers can do to be net-zero compliant. Alternative energy can play a role, but because these sources are variable – solar and wind can be unavailable at certain times of the day – they don't meet the data center's energy demand profile.

Intel® Network Builders ecosystem participant QiO Technologies believes that the first rule for improving sustainability is to make more efficient use of the systems in place. The company believes that data holds the key to doing more with less, and artificial intelligence (AI) delivers the insights needed to navigate to net-zero. These beliefs are enshrined in QiO's Foresight Optima™ application, which includes cutting-edge scheduling and optimization algorithms based on reinforcement learning AI techniques to drive energy efficiency and decarbonization.

Optimizing Data Center Energy Efficiency

QiO Technologies is a leading industrial IoT AI software products company delivering the Foresight Sustainability Suite of solutions (Foresight Optima™, Foresight Maintenance® and Foresight Service®) to support energy intensive and asset heavy industries, reduce energy consumption, increase energy savings, reduce carbon emissions, monitor asset health, reduce unplanned downtime, enhance asset circularity, and automate ESG reporting.

QiO's Foresight Optima™ has been enhanced as Foresight Optima DC™ to continuously monitor and control Data Center HVAC and cooling systems to reduce energy costs, water usage and improve overall power usage effectiveness (PUE). In addition to Foresight Optima DC™, QiO has developed Foresight Optima DC+™ in collaboration with Intel for Data Center server optimization.

Offered as software as a service (SaaS), Foresight Optima DC+™ is being implemented at a number of data centers and has been shown to deliver up to 52% power with idle and up to 24% with a representative load on a given CPU, without any degradation of quality of service (QoS).[2] Foresight Optima DC+™ supports all relevant energy standards including Energy Star, EPC, ISO 50001, TCFD and EU Directive 2014/95.

Collecting Energy Data and Easy Reporting

Foresight Optima DC+™ features real-time emissions tracking for servers, storage devices and network systems. Data collected at the device level (i.e., server level) is then aggregated across the entire data center. As seen in Figure 2, the baseboard management controller (BMC) collects data from the data center servers using primarily collectD, SNMP, IPMI or its own in-band agent.

That data is then passed to a centrally located Foresight Optima DC+™ instance. The service uses virtualized Foresight Optima DC+™ that can then be deployed in an edge server (or in the cloud), as seen in Figure 2.

The data collected comes from server usage monitoring and shared resource monitoring. Foresight Optima DC+™ has a flexible application architecture that is interoperable across information technology systems, operational technology systems and cloud, and supports a wide range of application programming interfaces (APIs) allowing it to connect to existing servers, storage devices, network systems, cooling equipment and other systems. In a shared data center or co-location center, Foresight Optima DC+™ can share data on energy usage by customer with detailed reporting on energy utilization by network, storage, server and cooling/power systems.

That information includes overall energy consumption, carbon emissions and energy costs. It can be viewed by data center technical and business management, as well as by customers and provides accurate energy information to be used for carbon commitment reporting. Foresight Optima DC+™ comes with automatically created ESG report templates to make reporting easy.

Understanding and Optimizing CPU Power Levels

For each CPU core in the data center, Foresight Optima DC+™ plots an Energy Efficiency Index™ (EEI) based on telemetry data from past processes to determine which is the most energy efficient process and why. The EEI then becomes a standard metric for comparison across different machines in different locations and can be used to establish best practices.

Data used to develop the EEI metric also trains Foresight Optima DC+™, which is then deployed to identify strategies for reducing energy consumption. Foresight Optima DC+™ includes a reinforcement learning AI model that can perceive and interpret its environment to learn through trial and error, training itself to come up with a solution to optimize power consumption.

Foresight Optima DC+™ will search for the most efficient way to operate the servers. With a full understanding of the performance needs, it can recommend adjustments to sleep / power states of that processor to reduce the energy consumption during times the CPU is idle or could deliver the required performance using less energy.
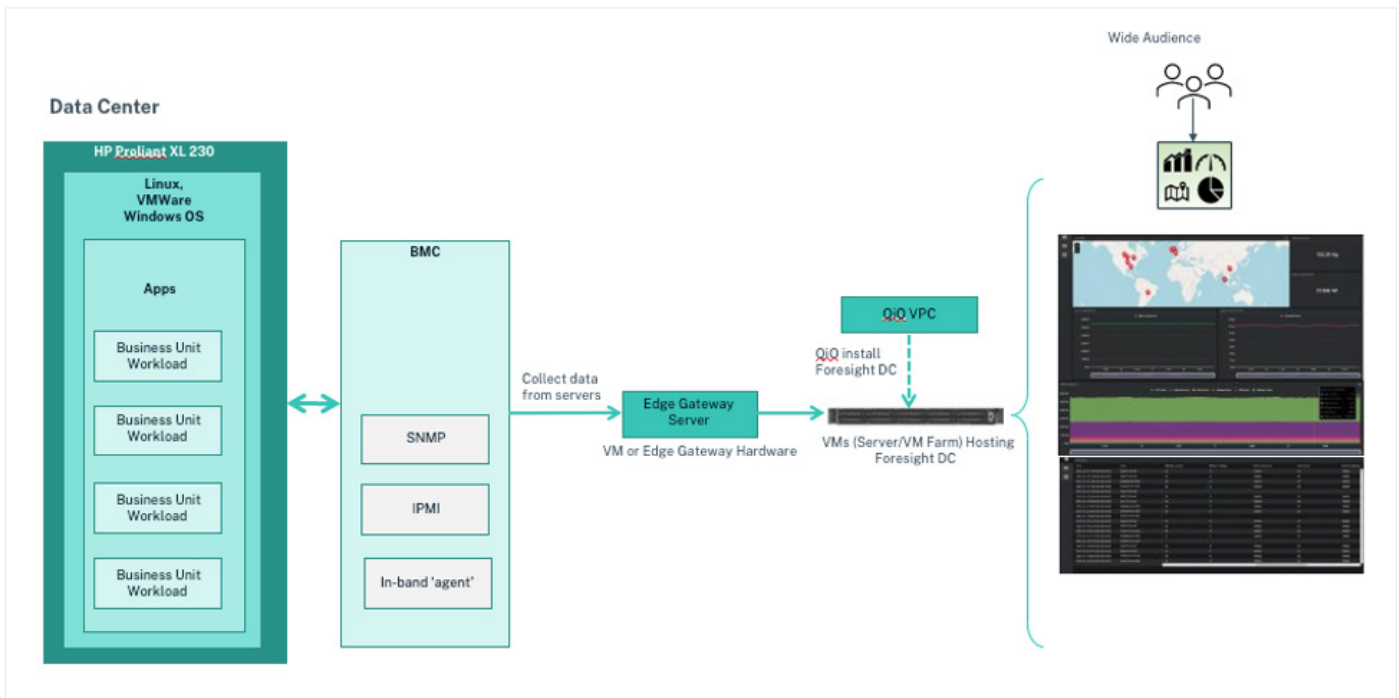

Figure 2. Block diagram of Foresight Optima DC+™ software elements. Courtesy of QiO Technologies.

Servers with 2nd generation Intel® Xeon® Scalable processors or later are able to configure the CPU power consumption by changing the voltage levels or by changing the sleep mode status. CPU p-states represent the different voltage-frequency control states of an Intel architecture CPU that can be adjusted based on workload. These are all active processor states that can be used to manage power consumption.

CPU c-states represent active states or a range of sleep states. During an idle time for a server, Foresight Optima DC+™ can adjust the c-states to reduce the clock signal, reduce the voltage or even completely shut down the CPU. Foresight Optima DC+ ™ accomplishes this in a closed loop manner. The adjustments are predictive and not reactive thus driving the efficiencies without impacting the quality of service.

Conclusion

Data center operators have done a great job of minimizing energy consumption in the past decade even as their workload volumes have grown dramatically. But they will have a hard time continuing that trend as the demand for data continues to grow. Even so, it is critical that they minimize their impact on the environment and the impact on their energy budget.

As shown in the test results above, QiO's Foresight Optima DC+™ is a game changing technology for data centers that reduces energy consumption at the server level. This unique technology provides an effective way to reduce energy consumption of a data center resulting in a reduction in demand for cooling and overall facility power requirement without considerable CAPEX outlay.

QiO Foresight Optima DC+™ collects and reports data on server energy consumption then adjusts CPU p-states and c-states to reduce power consumption during idle times –in a way that reacts to increases in demand without sacrificing quality of service. This game changing technology is one of the most effective ways to dramatically reduce overall energy consumption of the Data Center. It leads to overall reduction in cooling requirements thus reducing not only the energy requirements, but also significantly reducing the capex investment for building a data center.

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