Intel Factory

CASE STUDY

Intel® IoT Gateway
Internet of Things

Improving Chiller Health

Intel and IBM Show the Value of Real-Time Edge Connectivity in Applications of Predictive Maintenance and Quality

Fabricating the most powerful chips on the planet is a serious industry. At Intel factories, the whole process hinges on a sophisticated utilities system managed in the Central Utilities Building. From electricity to ultra-pure water cooling to compressed air and atmosphere conditioning, if the utilities break down it could spell disaster for the hypersensitive equipment of the factory.

Keeping the enormous factory cool falls to the job of a very sophisticated network of cooling systems: chillers, cooling towers, fans, and heat exchange systems. The network for cooling equipment—responsible for cooling water used for driving the entire plant—are massive machines that run continually and work together to deliver adequate cooling.

Addressing Energy Conservation

Intel’s factories are known not only for their sophisticated facilities, but also for their approach to supporting the environment. Energy-saving efforts undertaken over the last five years currently save 30 million kilowatt-hours. "We are challenged to continuously improve our energy consumption. A poorly running chiller consumes more energy. If we can save just a few percentage points of energy, and understand what makes certain chillers less efficient, we can make the whole plant more efficient," says Glen Kilcup, energy conservation engineer at one Intel factory.

Taking a chiller offline for a full reconditioning is a tall order, but necessary; these are half-million-dollar pieces of equipment, installed over weeks in an intricate plant setup. Industry average for a chiller rebuild costs $50,000 and the plant rebuilds some of the chillers in the fleet every year to keep them running reliably and efficiently. Unplanned downtime can put strain on systems that may be due for reconditioning. Running a plant this interconnected is one thing; running one efficiently is another.

"You can't take your eye off the ball for a moment. If we don't keep these systems running at optimal levels, we risk plant shutdowns," says Kilcup.
Improving Chiller Health

Intel turned to its own Internet of Things Group to look for answers. Data from sensors on all of the equipment in the central utilities building is captured on a robust closed network completely isolated from the outside world. The network of 22 chillers runs on traditional automated PLC-based controls. It can be turned on and off based on plant requirements or to perform maintenance. Data is transferred via PLCs to industry-standard real-time monitoring systems. These systems come preconfigured with essential information. The end goal is to leverage the available data and predict asset failures and/or recommend prescriptive actions before the problem occurs.

Assessing Chiller Data

IBM and Intel partnered to examine a chiller. Leveraging the data archives from a representative chiller, a team of data scientists led an effort to differentiate between what makes a chiller run efficiently, and what leads to problems. Forecasting chiller efficiency can help the team save energy and take steps to improve overall chiller health.

Rob Risany, worldwide innovation executive for IBM’s analytics solutions observes, “Imagine going to the doctor and having that doctor not know what was important to look for when diagnosing an illness. That’s what operators at the Intel factory deal with every day when it comes to chiller health. We set out to find the key issues which would tell us when a chiller was going to perform poorly, so that the operators could make changes to drive efficiency.”

The analytics in IBM’s PMQ platform found a high correlation between motor power consumption, heat buildup, and evaporator/condenser pressures. More importantly, it discovered that the current values showing on the monitoring equipment weren’t as important as their relationship to the historical moving averages of key values. Says Risany, “This is a fluid system where previous states directly impact the current state.”

Time of chiller runs is a major factor in chiller efficiency. Just as starting and stopping your car is bad for your engine, short runs of a chiller degrade performance. But eventually, overrunning the system degrades performance. It turns out that running a chiller for 20 hours will generate the best cumulative chiller efficiency.

About the PMQ Alliance

Intel is a member of the IBM PMQ Alliance.

IBM is investing significantly in the industrial Internet—from data gathering and systems integration to analytics and visualization to work order management and systems intervention. We recognize that the opportunity is much bigger than a set of enabling technologies.

True innovation requires a symbiotic view of the relationship between data, hardware, and services. We are committed to an open view of how clients will solve problems in this next phase of connected computing.

The PMQ Alliance is a manifestation of that commitment. It brings leading hardware, services and data partners together to cross-cut industry knowledge and expertise. As the largest supporter of open-source systems, IBM is creating an ecosystem where new ideas can flourish, and new businesses can emerge.

IBM’s PMQ Alliance provides flexible options for creating and extending your value proposition with IBM technology. Best of all, it can facilitate interconnections with other PMQ Alliance partners who may have value to broaden or deepen solution vision. Working closely with a special focus on client objectives, the PMQ Alliance supports flexible options for creating and marketing PMQ-based solutions.
So armed with insights from modeling, and the factors to watch for, Intel's IoT team now had specific items to filter in the real-time data pull with the gateway. The Intel IoT Gateway solution publishes the chiller sensor data from the MODBUS architecture and transforms that data from register-based values to a clearly understood JSON* message structure, delivered over MQTT*, the high-speed messaging protocol. IBM’s IoT Foundation* receives the messages; IBM PMQ fetches these messages; and a real-time modeling services assesses current state, displays a real-time dashboard of critical values, and archives the messages for future model improvement. The model specified a 5-minute poll at the edge to limit network impact and published the 11 variables needed by IBM PMQ to predict chiller performance and alert operators to upcoming risks.

**Conclusion**

The first stages of deployment are focused on providing new levels of insights to the managers of the utilities building. By accessing information and relationships they've never seen before, the team will be able to tune chiller settings to optimize energy efficiency.

Says Kilcup, looking at a view of the key measures the integrated Intel and IBM system provides to his team, "It's like you've created a giant flashlight and are shining a light on things we've never seen before."

The work is far from over. As described, a single chiller lives in a larger network of chillers. And the network of chillers is in a complex integrated facility, which includes power conditioning, water management, air circulation, and heat exchangers. Once the chiller system is in place for a while, extending the system to deal with all of these variables will be the next challenge for the Intel and IBM PMQ team.

**For More Information**

Learn more at intel.com/iotgateways and ibm.com/analytics.

Find out about IBM PMQ at ibm.biz/BdR6C9.