COMPUTING AT THE EDGE: FROM MERELY SMART TO TRULY INTELLIGENT BUILDING AUTOMATION

Around the turn of the 21st century, developers started deploying building automation systems (BAS) to tie together discrete building systems such as lighting, surveillance, HVAC, and fire alarms. Although these new structures were called "smart" buildings, they aren't smart at all; despite sharing a management interface, they lack the predictive capability and intercommunication skills of truly intelligent systems. Equipping buildings with NXP edge-computing technology, such as our Layerscape® processors for edge-computing nodes our and EdgeScale management software, can transform these networks into intelligent systems for increased occupant savings and convenience.

HVAC: FROM SMART TO TRULY INTELLIGENT

Turning a system into a fully optimized and automated BAS involves interlaced predictive and motion-based technologies that analyze the day-to-day movements within a building for the most savings and energy efficiency possible. Take an HVAC system, for example. The HVAC system is one of the biggest operating expenses for a building, so operators of older systems typically turn the heater down at night in the winter and the air conditioner up at night in the summer. A basic modern BAS sidesteps manual changes, identifies the time of day and changes the settings daily. Slightly smarter systems recognize days of the week and use the low-cost settings during weekend days. Even smarter systems know the days of the year and can extend these settings to holidays.

Tying HVAC units to other systems yields even greater savings. For example, networked office lighting systems with motion detectors could send information to the HVAC system so that it would only run at its normal setpoint when the building is occupied. The flaw in this configuration is that it wouldn't distinguish between a nighttime janitor or security guard and an office full of workers. It may also take a while to get an HVAC system to steady state: dampers must be adjusted, fans started, and heaters fired up. A building called The Edge in The Netherlands is cleverer and bypasses these problems by reading license plates of cars entering its parking lot, associates these plates with employees, and starts the HVAC system for those employees' work areas as soon as they drive on site. A similar system could use facial recognition from the surveillance system to perform the same task. Tenants and guests with privacy concerns may accept disclosing their comings and goings to a building's manager, but prohibit others to monitor such traffic.

The Edge Building, Amsterdam photo © Ronald Tilleman

An even smarter building would learn if a certain employee regularly comes in earlier than his peers and adjust the temperature accordingly. It could decide he's an outlier and maintain the overnight setpoint, or it could recognize him as a bellwether and start adjusting the temperature building-wide in preparation for the arrival of others. These uber-intelligent systems could include weather forecasts and, for cities with time-of-day or load-based billing, future electricity prices for another layer of efficiency. The system would adjust temperature in the morning based on these forecasts, *planning instead of reacting* to circumstances.

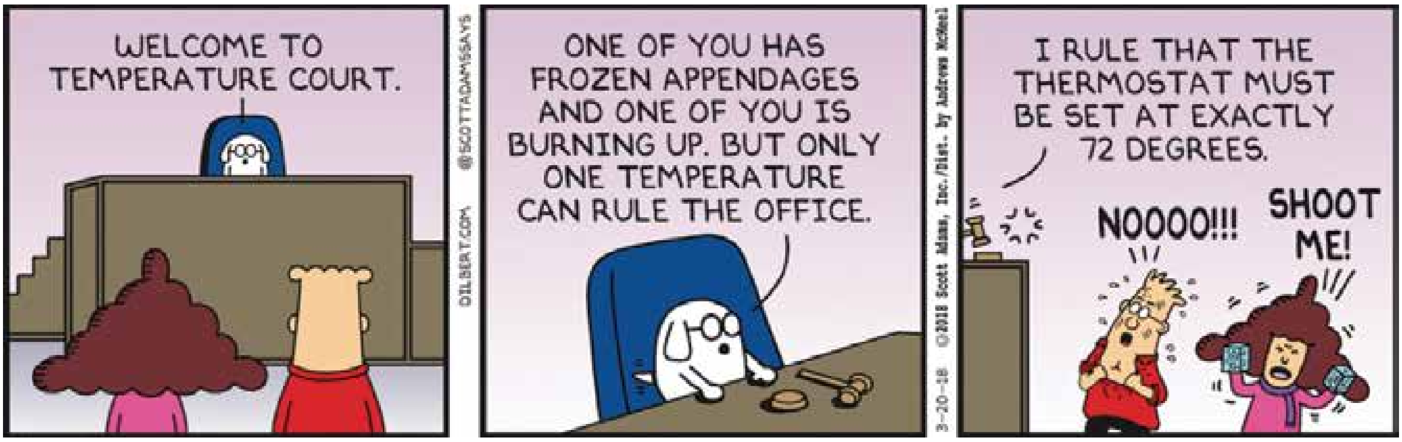
Machine learning is also helpful in optimizing HVAC systems in other ways. HVAC systems contain so much equipment and the conditions of each building are unique owing to their individual architecture and occupancy patterns. System and building sensors generate reams of data that can be analyzed to predict equipment behavior so the system can use these predictions to spy anomalies indicative of impending problems or control the system to achieve the desired set points at minimal cost.

FIRE ALERT SYSTEMS

An optimized fire alarm system is another example of multiple building systems linking via edge computing for better results. Most of these systems are simple: heat or smoke triggers an alarm, possibly sprinklers, when a fire has begun. A smarter approach could predict fires before they happen. A surveillance system could be programmed to recognize the face of an arsonist. If the system detects the offender's presence, it could alert guards to monitor that person until he or she leaves the building. The same security cameras could also detect overheating coffee pots and water heaters before a fire starts. Electric or gas meters also may detect anomalous energy usage, indicating trouble with these items.

AN EDGE NODE ABOVE

Though accessing data for facial and license plate recognition requires an outside link, most necessary computations for an intelligent BAS are done best on an edge-computing node where all information from the building systems is available, kept private and insusceptible to WAN outages. Even analyzing those reams of system and building center data is accomplished best on an edge system to help maintain privacy and to avoid transmitting a large amount of data for offsite analysis.



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A BAS operator can use the cloud for the management console and for handling data drawn from multiple sites. Models based on behavior patterns observed at multiple buildings and cloud macro data, such as weather, road closures, and watermain breaks, could in some cases be stronger than those based on a single building. In general, a hybrid approach that combines edge and cloud resources will work best. System developers will decide how to divide functions between on-premise edge resources and those based in the cloud.

NXP'S ROLE

This edge-computing era gives BAS managers the opportunity to get away from 10-year-old beige boxes and choose a system that is low-cost, compact, remotely managed, highly secure, and communications savvy, yet powerful enough for analysis.
Based on the de facto Arm standard, the 64-bit NXP Layerscape processor family spans single-core to 16-core processors. The LS1028A processor is an excellent choice for human-machine interfaces and system control. Designed for building automation and other industrial functions, it integrates two CPUs, an Ethernet switch, time-sensitive networking (TSN) capability, and a graphics processing unit (GPU), as well as standard I/O such as USB and PCIe for connecting to Bluetooth®, ZigBee®, 802.11, and other wireless modules. The LX2160A processor has 16 CPUs built in for high-performance analysis and networking. OEMs can rely on these processors; as part of the NXP 15-year Product Longevity Program, these processors are qualified for operating at industrial temperatures and designed to remain in service for 10 years.

SECURE PROCESSING FOR SECURE SYSTEMS

The LS1028A processor also comes with integrated NXP trust architecture, the heart of which is a hardware root of trust. This architecture helps enable a host of security capabilities such as secure boot, secure software installation and updates, rollback protection, secure hardware deployment and decommissioning, and runtime integrity checking. Securing building automation systems from malicious hackers is essential for the safety and security of offices, warehouses, factories, and their occupants.

EDGE-COMPATIBLE SOFTWARE

System software is a cinch for edge computing, too. For edge nodes performing analysis and controlling human-machine interfaces, their rich enablement ecosystem includes standard Linux® distributions like Ubuntu and Debian that support Layerscape processors. Developers can install application binaries from standard distributions or roll their own distribution, drawing from individual components of an NXP software development kit (SDK). For edge nodes that also perform control functions, the OpenIL project is a community-build industrial Linux distribution that supports the Layerscape family and offers real-time capability. It encompasses networking stacks (including TSN support), web servers (e.g., for configuration management), and tools and utilities common to Linux distributions. The OpenIL project supports the Ubuntu user environment, SELinux security enhancements, and the Buildroot project for OEMs to tailor their firmware.

NXP also collaborates with major cloud computing companies on their edge-computing efforts. These companies provide IoT SDKs and frameworks for endpoints and edge nodes, accelerating an OEM's time-to-market and facilitating the hybrid edge and cloud systems that will come to dominate building automation. They also help manage applications running on edge nodes. Complementing these companies' software, NXP offers the EdgeScale software suite to help developers leverage these frameworks for endpoints and edge nodes. By incorporating software on equipment and in the cloud, it helps facilities managers provision and manage hardware. The EdgeScale suite also taps into the trust architecture within Layerscape processors to help these managers securely deploy, upgrade and add software, including single-application and container products.

CONCLUSION

Building automation is on the cusp of a technological revolution, thanks to edge computing. Edge computing will establish better links between siloed subsystems so they can learn, predict and support each other's' objectives, ultimately saving money, conserving energy and improving occupant safety.

NXP is at the forefront of edge computing developments with the optimal processor power and software solutions to safely and efficiently manage systems joined by edge computing. The EdgeScale software suite and Layerscape processor family provide the computational power and secure system management abilities operators need for building automation and beyond.

Document Number: EDGECOMPAUTOWPA4 REV 0
Date of Release: July 2018