

# SMARTER BUILDINGS & HOMES

## WITH THE INTERNET OF THINGS

**IoT solutions based on open platforms give property owners and building managers a higher level of command and fine control compared to today's closed and proprietary building management systems.**

### **IoT Advances Building Automation to Enable Smarter Buildings**

A smart building is an intelligent space that optimizes efficiency, comfort, safety for people, and asset performance within the building.

According to Navigant Research\*, building management systems (BMSs) work to balance the performance of multiple building automation systems (BASs) to enable central control and achieve higher levels of efficiency. For example, coordinating occupancy data with temperature, humidity, and ventilation can not only save energy, but also maintain comfort in a way that optimizing each system separately could not.

### **New Age of Building Automation**

By 2020, it is expected that more than 50 billion devices will be connected to the cloud and each other<sup>1</sup> in what is commonly called the Internet of Things (IoT). This technological revolution is likely to have a tremendous impact on the smart building and home industry because of the possibility to greatly lower the cost and effort to instrument buildings with sensors, and to take advantage of powerful cloud-based data analytics.

# USER-FRIENDLY BUILDINGS

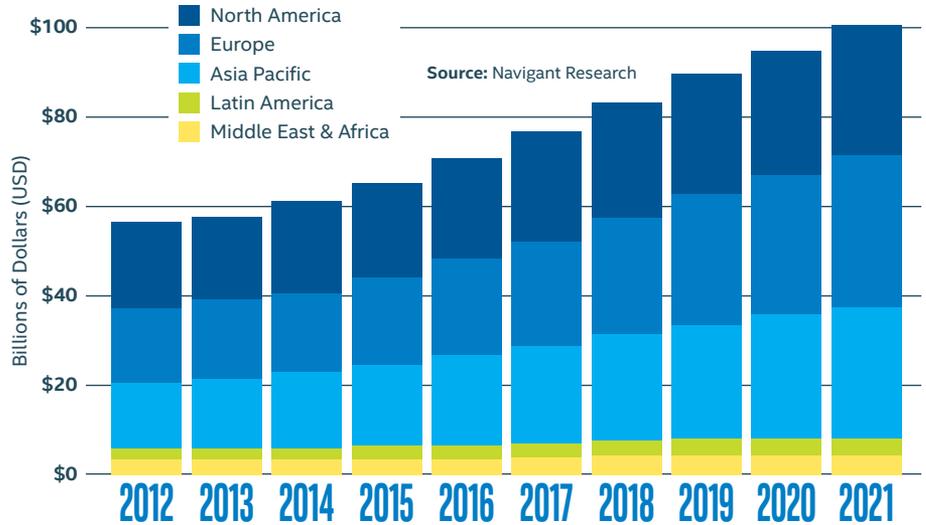


Figure 1. Commercial Building Automation Revenue by Region, 2012-2021

According to Navigant Research, “The market landscape continues to evolve as trends such as corporate awareness of the IoT and demand for data-driven decision support tools facilitate the global adoption of building energy management systems (BEMSs)? Quantifying this expanding market, a recent study by Navigant Research forecasts revenues for global commercial building automation systems (BASs) will grow from \$58 billion in 2013 to \$101 billion in 2021<sup>3</sup>, as shown in Figure 1. The forecast comprehends the energy efficiency requirements of new and retrofit commercial building construction.

### Open Platforms For Smart Buildings

The IBcon Conference is featuring building management solutions based on open platforms and IoT technologies that provide property owners and building managers a higher level of command and fine control compared to today’s closed and proprietary BASs. This is because the broad ecosystem of suppliers can integrate their innovative and cost-effective solutions on open platforms used to augment incumbent BASs (brownfield) or fully manage new buildings (greenfield).

Before this can become a reality, solution providers must recognize and tackle the complexity of IoT solutions to ensure secure and reliable deployments. Along these lines, Intel defined five IoT principles to help guide system manufacturers and systems integrators who are developing IoT-based BAS infrastructure:

**Edge-to-Cloud Services:** Services are delivered across the enterprise and globe, with time-critical services provided locally by edge devices (e.g., IoT gateways) to reduce latency.

**Mobility:** Building managers can visualize operational data from anywhere on the planet and with any mobile device.

**Data Analytics:** Building data is analyzed to generate useful insights, such as how to reduce energy consumption and better satisfy occupant needs.

**Security & Manageability:** Building systems and sensors/actuators connect to the cloud in a secure and manageable fashion.

**Collective Relevance:** Buildings have the ability to anticipate and respond to occupant needs in a meaningful way.

## Demos Featuring Five IoT Principles For Smart Buildings

### Daikin Applied\* Uses Energy Analytics to Increase Occupant Comfort and Predict HVAC Failure

Over the last decade, commercial heating, ventilation, and air conditioning (HVAC) units have been generating more and more data, but much of it has been under utilized or not accessible by building owners. Now this data is being put to work as Daikin Applied\*, the leading Global HVAC supplier, launched Intelligent Equipment\*, which uses big data analytics to make HVAC equipment more intelligent through the use of Intel® technology. The system provides users with financial summaries of their energy savings and equipment payback; measures and automatically adjusts for building comfort based on building occupant preferences; and gives users direct access to power usage and CO<sub>2</sub> emissions data, providing a more accurate view of the carbon footprint.

With the Intel® IoT Gateway, Daikin's Intelligent Equipment is able to seamlessly connect HVAC units to the cloud and securely aggregate, filter, analyze, and present data in an actionable way. This allows building owners/managers to improve the performance of their buildings and identify HVAC issues before they happen. At the maintenance level, the solution will predict faults such as fan, compressor, or motor failures, and will alert users when filters need to be changed based on usage instead of time. At the operations level, the system can sync with weather forecasts to adjust in advance for changing climate conditions.

Daikin's Intelligent Equipment embraces all five IoT principles, with data analytics and security being top of mind. Coming to market in the era of



**Figure 2.** Rebel\* Rooftop HVAC Unit from Daikin Applied\*

“hackers” and security breaches, Daikin and Intel engineered a solution with a robust security architecture that utilizes McAfee and Wind River\* technology assets and delivers a wide range of services driven by energy analytics.

#### Demo Ingredients

- **Intel IoT Gateway** collects, filters, and forwards data from HVAC units for analysis by cloud-based data analytics.
- **Daikin Intelligent Equipment Control Solution** provides real-time data streams for benchmarking performance and monitoring system operation.
- **Daikin Customer Dashboard** helps building and tenant managers keep occupants comfortable.
- **Wind River Linux\*** operating system ensures robust performance.
- **McAfee Embedded Control** security software protects systems in the field.

#### KMC Controls\* Modernizes Building Controls with Open BMS Solution

Although the flexibility offered by open BMS solutions is highly desirable, most property owners have too much invested in existing systems to simply abandon them. When “rip and replace” is not an option, it is possible to use IoT technologies to instrument buildings with utility meters, people counters, and other sensors.

This was the approach taken by Gisèle-Lalonde Secondary School in Orléans, Ontario, Canada, who, with the help of KMC Controls\*, augmented its existing building automation systems (BASs) with inexpensive utility meters and an IoT gateway. Their goals were to reduce energy consumption and improve student performance by:

- Creating a safer, more comfortable, and highly productive learning environment for students
- Metering water and natural gas
- Benchmarking kilowatt hour (kWh) per student
- Actively measuring and managing carbon dioxide levels
- Tracking building occupancy in real time

The existing BASs, which use proprietary communication protocols, send messages that are now captured, integrated, and sent to a cloud data center via 3G by a KMC Commander IoT Controller / Gateway. Data on the



**Figure 3.** Smart Phone User Interface from KMC Controls\*

health and performance of the building is then aggregated and analyzed in the cloud, and made available to building administrators via mobile applications and to building occupants via educational dashboards displayed on kiosks within the school.

The KMC Controls solution adheres to the five IoT principles, but most notably, mobility and edge-to-cloud services. From Android\* or Apple\*-based tablets, end users can access easy-to-understand visual analysis of an entire portfolio of buildings or



individual systems, as shown in Figure 3. The solution also ties edge-sensing and control systems to secure, cloud-based analytic services that can be used across the enterprise.

#### Demo Ingredients

- **KMC Commander\*** running on a **Dell\*-manufactured Intel IoT Gateway** collects sensor data and controls a variety of actuators in a demonstration of multiple building system components.
- **Mobile reporting software** provides views on mobile devices to building managers, owners, and occupants.
- **KMC Commander\* Dashboard** allows the user to interact with building system components.
- **Wind River Linux** operating system runs on the gateway.



Figure 4. Devices in the Yanzi Kit\*

#### Yanzi\* Provides Easy-to-Install Solutions to Make Buildings Smart

Yanzi\* kit provides a set of sensors, gateways to cloud services, mobile applications, and facility management of buildings. Figure 4 shows Yanzi Things - including the gateways, plugs, LEDs, cameras, and motion and climate sensors – that automatically connect to a smart phone through the Yanzi Cloud. The Things, cloud, and app are tightly integrated, giving the user a rich and powerful experience.

Easy to set up and use, the solution allows systems integrators and building managers to connect to Things instantly. The automatic provisioning of sensors provides automatic discovery, configuration, and setup of security keys. Yanzi is a world-class software platform backed by Intel Security software and the Intel IoT Gateway, which helps secure hardware, operating systems, applications, and data in flight or at rest. The solution has been deployed by Coor Service Management\* for facilities management and Tyréns\* for smart building: watch the video at [www.coor.com/News--Press/Local-news/2014/Internet-of-Things-IoT](http://www.coor.com/News--Press/Local-news/2014/Internet-of-Things-IoT).

Yanzi Things can perform such services as:

- Monitor wastebasket fill-levels
- Monitor refill needs of printers/copy machines
- Monitor video projector usage
- Monitor energy usage
- Provide video surveillance
- Monitor building security
- Help optimize space in conference rooms and workdesks

The Yanzi kit is aligned to all five IoT principles, with an emphasis on collective relevance and mobility. The system proactively saves energy, as in turning off conference room lights when motion sensors indicate the room is empty, thereby exemplifying collective relevance. End users can access data on an assortment of smart phones or a web browser, which provides a high degree of mobility.

#### Demo Ingredients

- **Intel IoT Gateway** collects, filters, and forwards data from Yanzi Things to cloud-based data analytics.
- **Yanzi** connects Things automatically and instantly.
- **Yanzi application** is the user interface, and it runs on a smart phone or PC.
- **Yanzi Cirrus Open Cloud API** assists Enterprise integration.

### Intel and Solution Family Connect Legacy Building Sensors to the IoT

Overhauling existing building infrastructure is usually not a cost-effective approach, so adding sensors to retrofit equipment through instrumentation is a more feasible alternative. Demonstrating this approach, Intel and Solution Family use an ECS IoT gateway with wiring interfaces to connect to legacy commercial off-the-shelf (COTS) sensors (e.g., temperature, pressure, air flow, current, etc.) that are already installed in buildings, as shown in Figure 5. The Solution Family application platform has two main components: an engine that implements data collection, communications, and rules, and a tool that empowers users through a drag and drop environment used to design, commission, and maintain any type of application. In the demo, the platform encodes the data into a Haystack compatible format. Haystack is an open source initiative to streamline working with data from the IoT devices.



Figure 5. Gateway Connects to Legacy Building Sensors



Figure 6. Switch Automation\* User Interface

#### Demo Ingredients

- **ECS Gateway** based on the **Intel IoT Gateway** connects to legacy building sensors.
- **Solution Family application platform** is designed to support an application's entire lifecycle from prototype and commissioning to long term maintenance.

#### Switch Automation\* Offers an Entirely New Approach to Managing Buildings and Sustainability

Switch Automation's cloud-based platform connects to devices and sub-systems in buildings for controlling and monitoring operations and sustainability performance. The solution collects building information (Figure 6) from a wide variety of disparate systems already in place and posts that information to the Cloud. It is also possible to integrate other sustainability information such as transportation energy use, paper consumption, waste generation, and more. Key features include:

- Portfolio command and control
- Single repository, single console
- Visibility into data and costs
- Spectacular time saving
- Supplier and service provider decoupling

## IoT Gateways in Building Management Systems

Until recently, the lack of a cost-effective solution to connect the unconnected things to the Internet has kept systems integrators from being able to deliver affordable smart BMSs to market. As a result, most small-medium building owners and operators do not have automated access to data in their buildings, which makes it very

difficult to realize energy savings, lower maintenance costs, and improve overall building performance.

A less expensive alternative is to instrument a building using IoT technologies, including low-cost sensors, on-premises gateways, distributed control, and cloud analytics. Instrumentation involves installing an independent collection of actuators and sensors (e.g.,

temperature, light) throughout a building to collect more information on the building's operation, such as utility usage. These sensors and gateways can augment existing BMS sensors for improved monitoring.

A key building block for instrumentation is an IoT gateway based on an Intel® Quark™ SoC or Intel® Atom™ processor, and several are on display in the Intel Booth at IBcon:



Eurotech\* ReliaGATE 15-10



Elitegroup Computer Systems\* GWS-QX



HCL\* Wireless Home Security Gateway



AAEON\* AIOT-QG-3D



Dell IoT Gateway

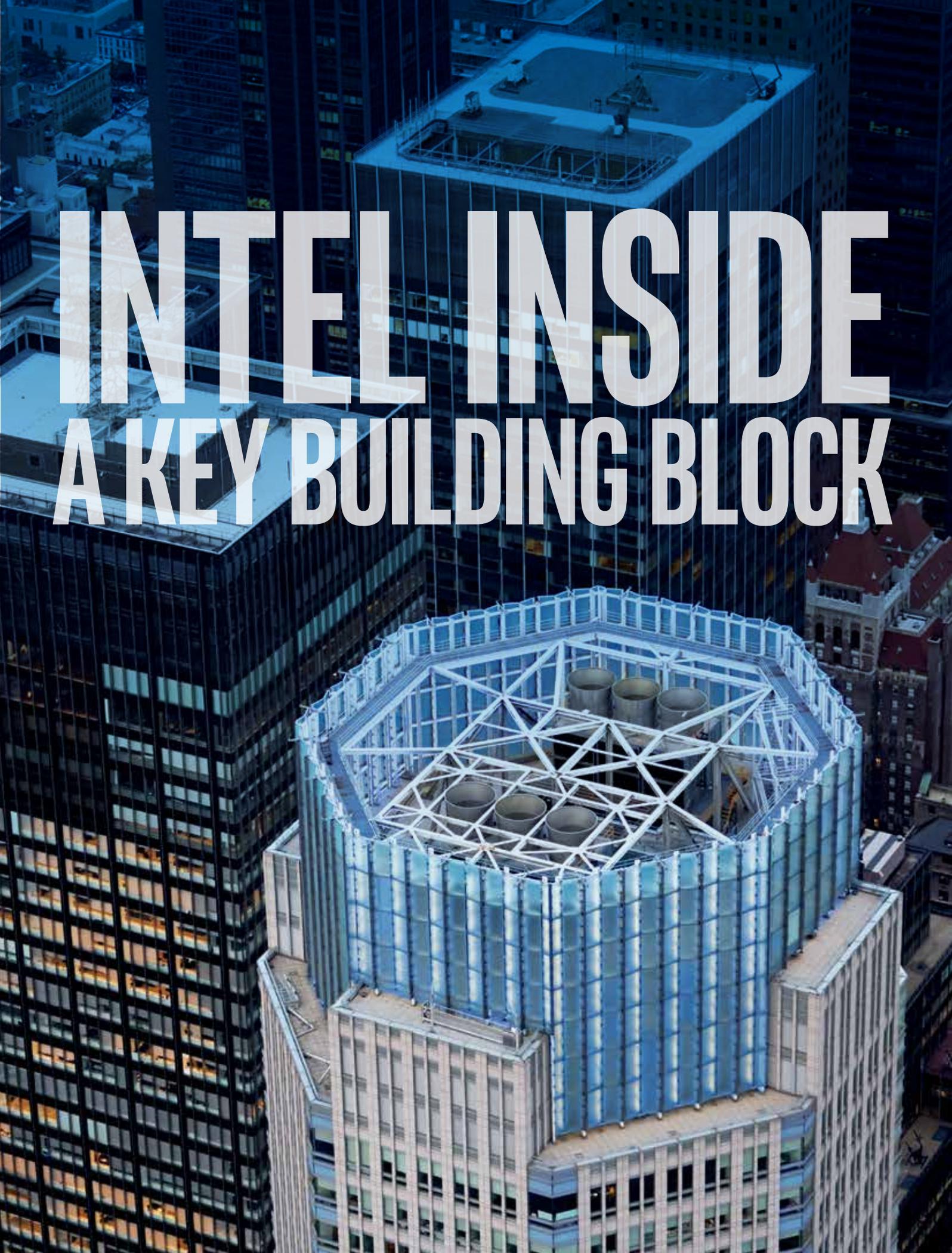
**Eurotech\* ReliaGATE 15-10** is a flexible Multi-Service Gateway serving a broad range of applications and specifically designed for M2M and IoT solutions with software qualified for the Intel IoT Gateway. Provided with an open-standard Yocto\* Linux operating system and enabled with Eurotech's Everyware\* Software Framework (ESF) for hardware abstraction and Java\* programming, the ReliaGATE 15-10 simplifies the creation of applications using Java on an Eclipse\* IDE.

**Elitegroup Computer Systems GWS-QX \*** (ECS) is an intelligent gateway host that is part of a smart energy framework that allows meeting owners to pre-configure conference rooms, such as switching on the projector and a room lighting scheme (e.g., conference, presentation, or video mode) when sensors detect arriving meeting attendees.

**HCL\* Wireless Home Security Gateway** detects fire and intrusion alarms from wireless sensors (e.g., smoke, CO<sub>2</sub>, motion, and contact); performs event-triggered video and image recording; and sends notifications by email and MMS. End-users can access and control the system via a secured, web-browser-based user interface running on PCs and mobile phones.

**AAEON\* AIOT-X1000** gateway platform is designed to seamlessly connect building and industrial devices to an IoT-ready system. Supporting a variety of communications protocols, the gateway connects edge devices to the cloud in nearly any application, including building automation, manufacturing, transportation, and energy applications.

**Dell IoT Gateways** are a solid foundation for an IoT edge solution that conserves valuable network bandwidth by relaying only meaningful data back to the cloud. Small in size and powered by a dual-core Intel® Celeron® processor, it is capable of driving a wide range of IoT applications.



# INTEL INSIDE

## A KEY BUILDING BLOCK

### Systems Integrators For Smart Building Solutions

Intel has a strong ecosystem supporting its edge to cloud IoT Platform architecture. This ecosystem includes system integrators ready to apply Intel and other industry-leading solutions to buildings. The breadth of these system integrators provides building owners and managers options for using IoT technologies to augment existing infrastructure or bring new solutions to solve the top challenges whether it is operating cost through improved energy and utility management, or increased tenant satisfaction through a more responsive environment to occupants needs. Here are a few of the systems integrators embracing Intel® IoT platform and its application in a smart building:

Accenture provides comprehensive solutions that span the end-to-end IoT value flow and combine proven hardware and software technologies

and assets with world-class business transformation and execution capabilities.

**Booz Allen Hamilton's\*** Systems Development and Integration professionals have a deep understanding of their clients' missions, process improvement requirements, and business process management objectives.

**Capgemini's\*** service integration expertise enables their clients to exploit best-of-breed solutions to gain the next level of productivity and quality.

**HCL Technologies** systems integration services revolve around enterprise architecture methodologies, application-centricity, and a vendor neutral approach, with a view to build a robust, business-aligned, and IT-optimized environment.

**IBM\* Global Technology Services** helps its clients assess, plan, and design a more consolidated, flexible, and resilient IT environment.

**NTT DATA\*** helps align solutions to an organization's unique vision and goals in a way that makes innovation simple, manageable, and adaptable.

**TCS\*** global experience and expertise enables them to transform their clients' enterprise into one streamlined and optimally-functional entity.

### Intel Building Blocks Deliver On The Five IoT Principles For Smart Buildings

Moving forward, the IoT will drive nearly every building system to have built-in, secure, interconnected intelligence. Similarly, the supporting network and cloud infrastructure will be enhanced to better protect data, manage devices, and perform data analytics. To deliver on a generic IoT vision, which can also be applied to building management, Intel developed a framework (Figure 7) to enable end-to-end solutions that join together a wide variety of systems. Central to the

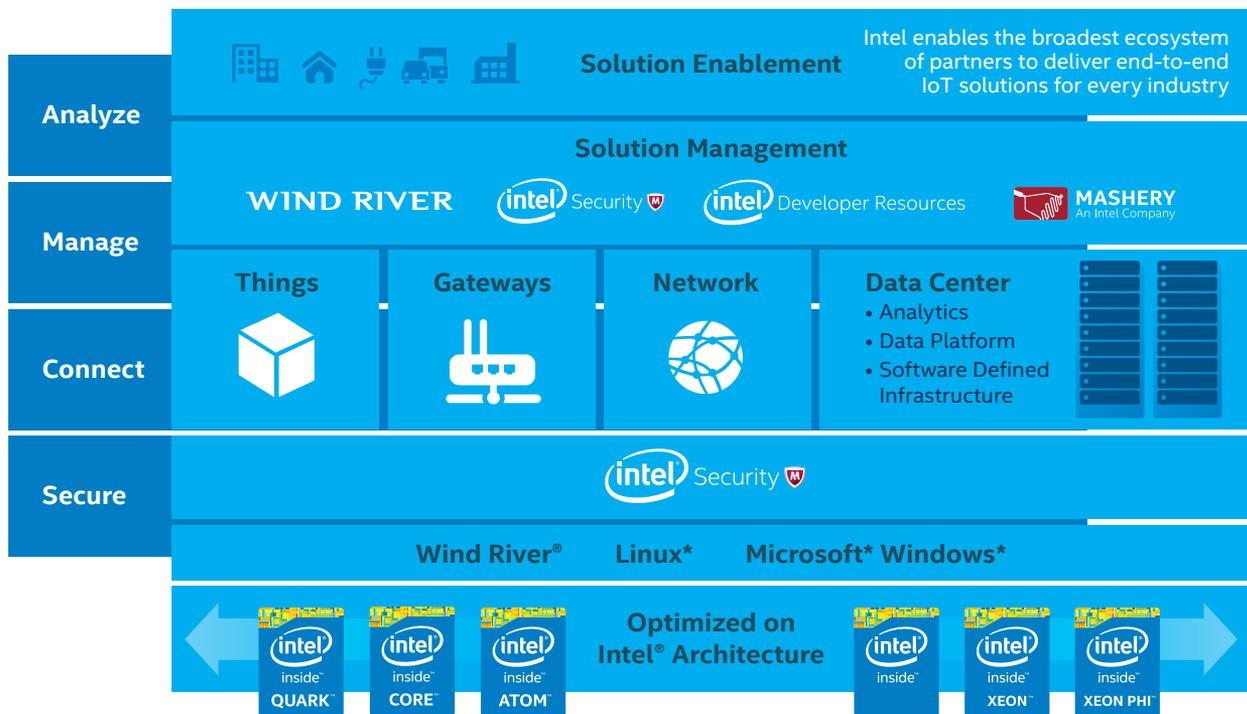


Figure 7. Intel Building Blocks to Satisfy the Five IoT Principles for Smart Buildings

framework are 'things,' gateways, and network and data center infrastructure, for which Intel provides an array of building blocks, including:

## Devices and Gateways

### Complete IoT Gateways

- **Intel® IoT Gateway** enables seamless and secure data flow between edge devices and the cloud.

### Processors

- **Intel® Quark™ processor X1000** is a family of low-power, system-on-chips (SoCs) featuring a 32-bit, single-core, single-thread Intel® architecture-compatible CPU.
- **Intel® Atom™ processor E3800 product family** features enhanced media and graphics performance, error correcting code, industrial temperature range, built-in security, and integrated image signal processing.
- **Intel® Core™ processor family** delivers exceptional CPU and media performance, along with enhanced security and I/O flexibility.
- **Intel® Xeon® processors** are designed for compute-intensive applications that demand the highest available performance, combining multi-core performance, hardware-based manageability, security, virtualization, and power management.

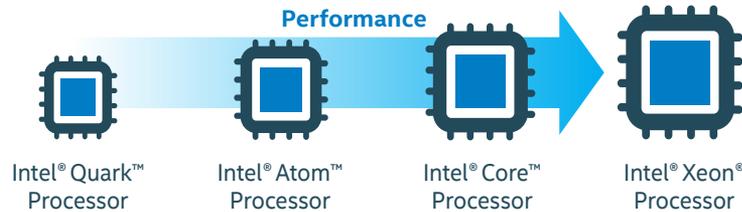


Figure 8. Intel Provides Unique Performance Scalability with Four Processor Families

### Software

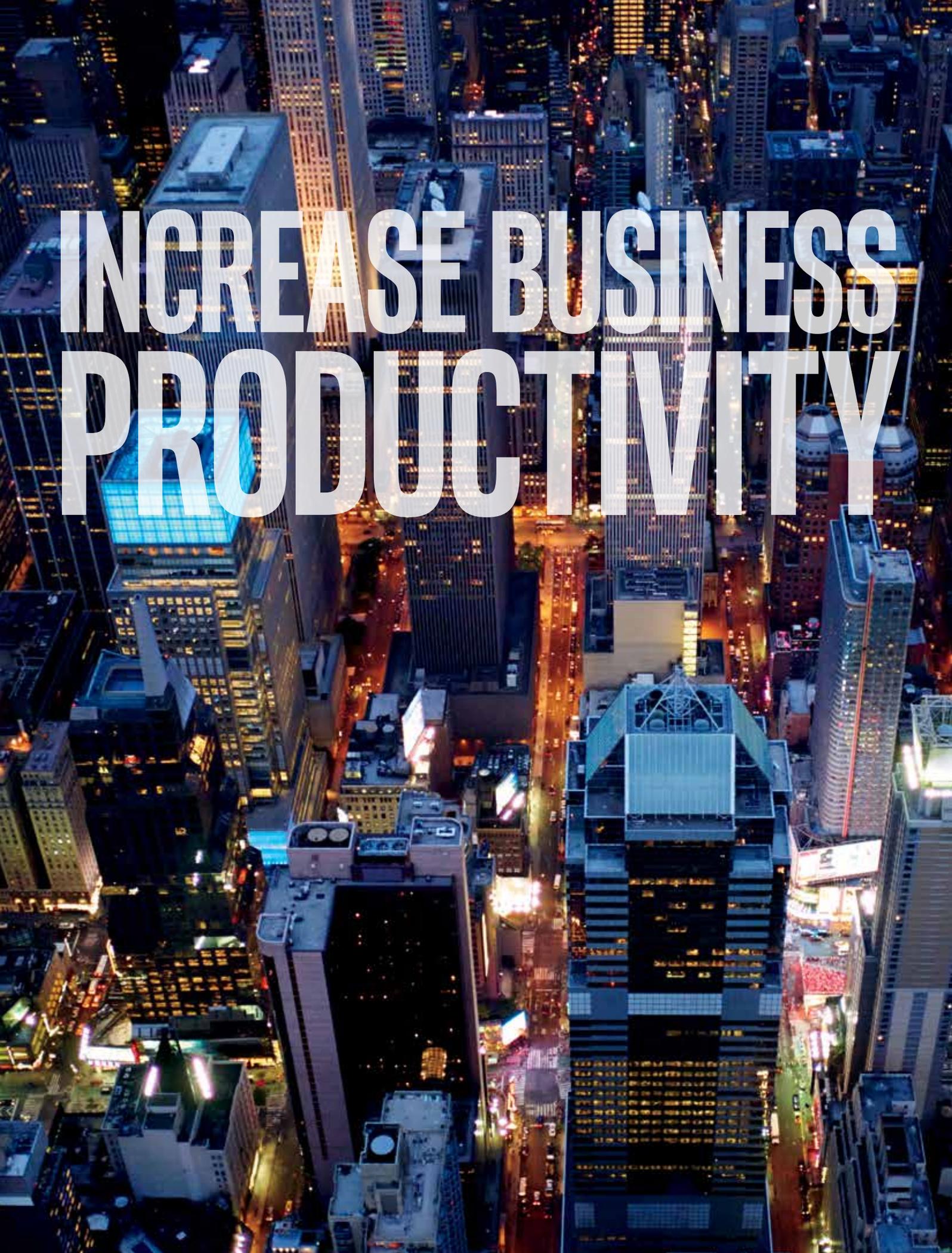
- **Wind River\* VxWorks\*** is the world's leading commercial real-time operating system (RTOS) and has been serving the needs of embedded systems of all shapes and sizes for more than 30 years.
- **Wind River Linux\*** is the leading commercial embedded Linux platform and the first to bring the advantages of open source without the risks to companies in all industries.
- **Wind River Edge Management System** is a cloud-based IoT platform that enables IoT devices to securely connect to a centralized console, providing device management and solution extensibility.

### Network and Cloud Infrastructure

- **Carrier Grade Profile for Wind River Linux** is the first product to meet the registration requirements of the Linux Foundation's Carrier Grade Linux 5.0 specification built for a Yocto Project Compatible product.
- **Intel® Datacenter Manager (Intel® DCM)** provides critical management capabilities for today's data centers. With the Intel DCM portfolio, IT and facility managers have the tools to improve manageability, increase availability, and reduce costs across key parameters, such as energy usage, monitoring, security, automation, and cloud.

### Securing Data and Devices

- **McAfee Embedded Control** maintains the integrity of devices, gateways, and servers by allowing only authorized code to run and only authorized changes to be made. It automatically creates a dynamic whitelist of the "authorized code" on the system. Once the whitelist is created and enabled, the system is locked down to the known good baseline and no program or code outside the authorized set can run.
- **McAfee ePolicy Orchestrator (ePO)** is the most advanced, extensible, and scalable centralized security management software in the industry. This open platform unifies security management to dramatically reduce the cost and complexity of security and compliance administration.
- **McAfee Endpoint Encryption** is the cornerstone of data protection since it encrypts data throughout the IoT environment, including devices, gateways, network files and folders, removable media, and USB portable storage devices.

An aerial night view of a city, likely New York City, showing a dense grid of skyscrapers and buildings. The scene is illuminated by the warm yellow and orange lights of the city at night, with some buildings featuring blue and white lighting. The text "INCREASE BUSINESS PRODUCTIVITY" is overlaid in large, white, bold, sans-serif capital letters across the center of the image.

**INCREASE BUSINESS  
PRODUCTIVITY**



## Service Management

Today, a large part of the interoperability, scale, and control for IoT can be achieved through API management. Standards-based design patterns for Web APIs, API management, and a RESTful architecture provide tremendous value in simplifying the task of interoperability across heterogeneous systems handling vast amounts of data. Since APIs have become ubiquitous, IoT deployments spanning a wide range of market segments can benefit from this proven architecture.

APIs lower the barrier to entry for connectedness and enable secure communication from things to applications located just about anywhere – in any cloud, data center, or accessible from API-enabled devices.

Intel's solutions and services offerings can be mixed and matched to suit specific IoT deployment and usage models.

- **Intel® Mashery™ API Management**

is a complete SaaS-based API Management solution deployed in any way: in the cloud, on-premises or hybrid.

Manage Partners

- *Onboard, engage and empower your internal and external developers.*

Manage APIs as Products

- *Create products tailored to specific user segments – without any coding.*

Manage Traffic

- *Manage traffic in the cloud, on-premises, or both.*

Run Reports and Analytics

- *Gain insight across partners, products, and traffic.*

## Building Solutions Based On Open IoT Platforms

The world is undergoing a dramatic transformation, rapidly transitioning from isolated systems to ubiquitous Internet-enabled 'things' capable of generating data that can be analyzed to extract valuable information. Commonly referred to as the Internet of Things (IoT), this new reality will enrich everyday life, increase business productivity, improve government efficiency, and the list goes on.

Intel is working with a large community of solution providers to develop open IoT solutions for the smart building industry. The solutions generate actionable information by running analytic software and services on data that moves between devices and the cloud in a manner that is always secure, manageable, and user-friendly.

Intel® products and technologies are helping make this a reality by providing fundamental building blocks for a robust ecosystem that is developing end-to-end IoT solutions. These solutions can be readily applied to develop smarter, more user-friendly buildings and homes that take advantage of IoT technologies.

Smarter Buildings & Homes  
with the Internet of Things (IoT)



For more information about Intel® solutions for the IoT visit  
[www.intel.com/content/www/us/en/internet-of-things/smart-buildings.html](http://www.intel.com/content/www/us/en/internet-of-things/smart-buildings.html).

<sup>1</sup> IDC\*forecast.

<sup>2</sup> Source, Navigant Research, Building Energy Management Systems, [www.navigantresearch.com/research/building-energy-management-systems](http://www.navigantresearch.com/research/building-energy-management-systems).

<sup>3</sup> Source "Building Automation Systems Revenue to Reach \$100.8 Billion in 2021," Energy Manager Today, Nov 26, 2013, [www.energymanagertoday.com/building-automation-systems-revenue-to-reach-100-8-billion-in-2021-097143](http://www.energymanagertoday.com/building-automation-systems-revenue-to-reach-100-8-billion-in-2021-097143).

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