

Telecom Service Providers Create New Revenue Source with Cloud-based IoT Platform for Smart Homes

Yoga Systems* uses an Intel-based intelligent gateway to deliver a home automation system that service providers (Telco, Cable, Broadband, Security) can turn into profit.



The Internet of Things
creates new opportunities
in home and building
automation.

Executive Summary

Service providers are facing difficult times brought on by falling average revenue per user (ARPU) and the exponential rise in data traffic, which requires increased network infrastructure investment. An indication of the severity is European ARPU, which fell by 5.9 percent (on average) per year from 2009 to 2013¹. As a result, service providers are looking for new ways to generate revenue in order to boost the bottom line.

Providing such an opportunity, innovative smart home technology from Yoga Systems* is enabling solutions that are affordable and user friendly for the masses, and complement a service provider's core communications and networking offerings.

Proven in large-scale deployments, Yoga Smart Home* is an intelligent smart home platform that connects to nearly anything: wired and wireless security detectors, cameras, thermostats, smart plugs, lights, entertainment systems, locks, and appliances. Yoga Smart Home lets end users manage these items from anywhere, with any device possessing an Internet connection. Yoga is a revolutionary operating system for the home, thus redefining the term "homepage".

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It is a perfect smart home solution for the Do-It-Yourself (DIY) consumer and professional installation market, including major features like:

- Cloud-based applications and services
- Scalable architecture
- Full end-to-end data security
- Accessible from any device - mobile, tablet, computer
- Location aware through smart phone app
- Available as white label for service providers

End users have simple control over lights, room temperature, and much more from their mobile phone (Figure 1), computer, or television – from wherever they happen to be. With an initial investment starting from around €200 and a monthly subscription fee of about €10-15, end users enjoy a simple installation process and a fully-automated, scalable future-proof, smart-grid-ready system.²

This solution blueprint describes how this smart home solution delivers energy savings, security, and comfort in homes, as well as smart building automation for commercial office buildings, base stations, and all types

of buildings. The solution employs Intel technologies designed to enhance the connectivity, manageability, and security of home devices. Telecom service providers Elion* in Estonia and Sonera* in Finland currently offer Yoga Smart Home to their customers. TeliaSonera* is launching this product in all seven Nordic and Baltic countries.

Key Business Objectives

Offer compelling home automation services that generate incremental revenue from existing customers, *increase subscriber stickiness through additional bundled features*, and are synergistic with existing standard communications and networking services.

Business Challenges

Home automation products focused on reducing energy consumption have been around for years. Current platforms have expanded beyond energy efficiency to include safety and comfort features, but they are not particularly user friendly, nor do they give end users much control. Generally, smart home systems are unsecure; require extensive programming skills to get the most out of systems; and need



Figure 1. System Accessible from Anywhere

an installation technician to configure them. A typical homeowner would struggle with connecting wireless components by carrying out a painful and time-consuming pairing process. The systems are passive and always require users to take action. This level of complication creates significant barriers for the mass adoption of home automation solutions.

Solution Benefits

The Yoga Smart Home platform and devices comprise an integrated IoT solution that delivers the following advantages:

- **Ease of Use by Geofencing:** Yoga Smart Home is location aware, meaning it *anticipates and executes* actions based on where family members are. When the last member leaves home, security and utilities can be managed with one touch, giving peace of mind and saving money. And when the first family member returns home, Yoga Smart Home prepares for his/her arrival - for example, by switching on the light if it is dark and opening the front gate when he/she reaches the driveway, as shown in Figure 2.



Figure 2. Interactive Yoga Smart Home* Features

- **Energy Savings:** By integrating energy and heating management through the use of smart plugs, thermostats, and meters, Yoga Smart Home manages a home's internal temperature and energy usage. Innovative technology combines real-time weather data with home location information and end user behavior patterns (heating and cooling) to generate significant cost savings.
- **End-to-End Data Security:** Communication between home devices, the Yoga central unit, the cloud, and the Yoga Smart Home app is protected using a minimum of 128-bit SSL encryption — the same encryption banks use when processing financial transactions. This ensures that all communication within the home and across the Internet is 100 percent private and secure.
- **Self-Installable Wireless Components:** Yoga Smart Home uses devices that are small, wireless, and extremely easy to install, including smart plugs, motion and smoke detectors, and relays. If needed, end users can also have professionally-wired components installed as well. Yoga supports most of the available automation protocols.

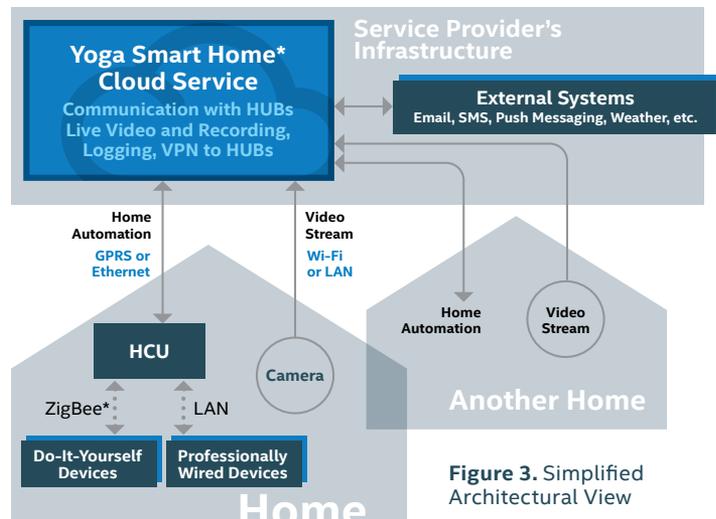


Figure 3. Simplified Architectural View

Solution Overview

Yoga Smart Home is an intelligent smart home platform that connects to wireless and wired security detectors, cameras, thermostats, smart plugs, lights, entertainment systems, locks, and appliances. Wireless devices are easily installed out-of-box, whereas wired devices may need the help of an electrician to install and connect power and Ethernet lines. Once the devices are in place and switched on, they will appear on the Yoga Smart Home app, which runs on mobile phones, tablets, and computers.

Key Components

The simplified architectural view of Yoga Smart Home in Figure 3 shows the customer premises equipment and cloud-based service provider infrastructure. The solution also scales to service multiple homes from the same app. In the home, the home central unit (HCU) is an Intel®-based gateway that connects to wireless and wired home devices, and provides the secured high availability expected by service providers. Cameras may also be added using the end user's Wi-Fi or LAN connection. The cloud-based service provider infrastructure

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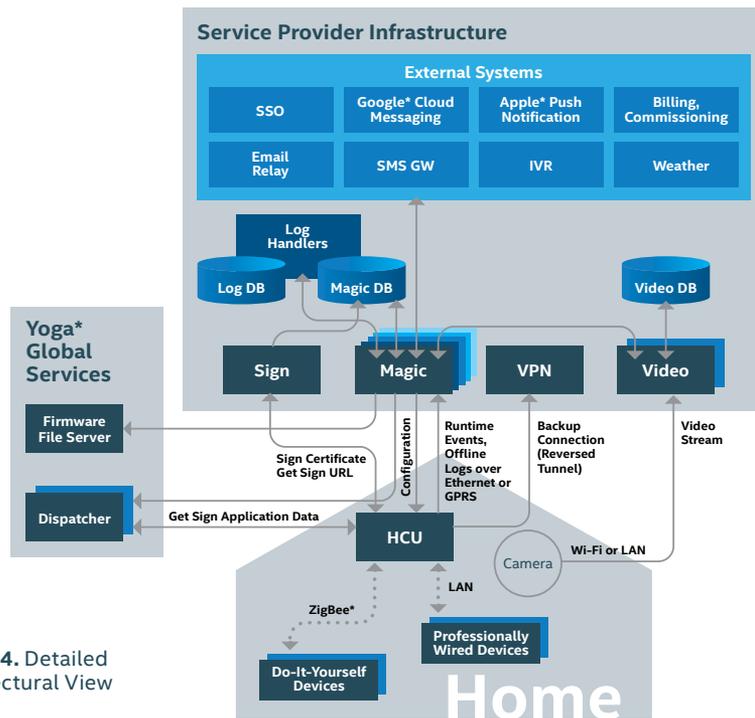


Figure 4. Detailed Architectural View

communicates with the HCU and provides a number of services, such as live video recording and sending weather updates.

The detailed architectural view in Figure 4 expands upon the service provider infrastructure and shows Yoga global services, which include software update delivery. The end user's HCU connects to a cloud server, called Magic, to receive configuration information and to send updates about all the events happening in the home. Magic logs these events and presents them to the user over an attractive and easy-to-comprehend user interface.

The HCU only stores configuration data it receives from the cloud, so if the HCU is replaced, the same configuration can be loaded on the new system. This avoids having to configure a new system from scratch, thus saving service providers and end users substantial time.

Solution Capabilities

Yoga Smart Home is an intelligent system that learns a family's behavior and adapts itself to their preferences. If they like to have a night-light on all the time, it will stay on. If they are worried about their electric bill, the system will ensure electricity is not being wasted. The system is also proactive when it has to be. It activates home security when the last person leaves and notifies the appropriate people automatically. The following describes other system capabilities.

1. **Service Activation:** After a customer buys the HCU, there are two possibilities for service activation:
 - After the customer signs an agreement with a telecom operator, service is activated by the operator's billing, which uses the Yoga Smart Home to activate service.
 - The customer goes to a smart home web portal (URL provided to customer while purchasing devices) to activate the service, which is charged by a third party billing system (e.g., PayPal*).

2. **End-to-End Data Security:** Security mechanisms implemented on devices, the HCU, and cloud servers protect the home and end-user data from hackers.
3. **Location Awareness (i.e., Geofencing):** Yoga Smart Home allows end users to control their homes based on whether family members are at home or away, as shown in Figure 5. Homes may be secured upon departure or disarmed upon arrival according to automatic settings or after confirmation via a push message. Multiple geofences allow additional rules to be carried out when arriving or leaving other areas.



Figure 5. Proactive Alerts Using Location Awareness

4. **Multiple Personalized Views:** Since family members have different interests (e.g., energy savings, video surveillance, security, and comfort), Yoga Smart Home supports personalized graphical views on the dashboard, so all users have their own dashboard which only they can modify and see.
5. **Security Alerts:** Burglar, fire, and panic sensors can immediately alert multiple users wherever they are via their mobile phones.

- 6. Video Surveillance:** Live video recordings can be programmed manually or started when an event occurs in the home. Video streaming is encrypted.
- 7. Energy Metering and Statistics:** Electricity, water, and gas energy consumption can be measured and monitored in real time, even at the device level. Historical views help end users identify usage patterns.
- 8. Device Controlling and Monitoring:** Smart plugs and smart relays can switch devices on/off and measure their energy consumption. In addition to manual remote control, devices can be switched on/off automatically using user-defined automation rules.
- 9. Temperature Monitoring:** Room temperature is logged via the temperature sensors included in door magnets, and motion and smoke detectors or other devices which have the capability to measure temperature.
- 10. Flexible Automation Rules:** End user selected actions can be taken based on conditional rules, such as “WHEN this THEN that”. Multiple conditions can be defined with AND (all conditions met) or OR (one condition met) logic rules.
- 11. Multiple Notification Options**
Notification can be sent to multiple people by email, SMS, or push notifications (Figure 6) regarding alarms or when the system is armed or disarmed.
- 12. Customizable Graphical Views** End users can take pictures of their rooms and drag their devices onto them using the flexible graphical view.
- 13. Multiple Language Support**
The system supports multiple languages. The default language is English, but other languages can be added as needed.



Figure 6. Notification Via Tablet

Technology

Sensors and Actuators

Yoga Smart Home can manage nearly anything that has an Internet connection, including wired and wireless security sensors, cameras, thermostats, smart plugs, lights, and entertainment systems. End users can choose from an assortment of DIY sensors and actuators, including:

- Smart Plug
- Motion Detector
- Door/Window Detector
- Smoke Detector
- Energy Meter Interface (Electric, Gas, Water)
- Keyfob Remote Control (Built-in Authentication)
- Smart Relay
- Surveillance Camera
- Sonos* Wireless Hi-Fi Speakers
- Philips* HUE LED lights

These devices have been validated to ensure their compatibility and interoperability with Yoga Smart Home.

In addition to DIY, there is an extensive range of devices for professionally wired installations to create a fully intelligent office building. In full installation, building managers can control access, security, lighting, ventilation, heating, cooling, curtains, media devices, etc.

User Interface Devices

End users can access their Yoga Smart Home graphical interface with a variety of PCs, tablets, and mobile phones.

Home Central Unit (HCU)

The most important device in the Yoga Smart Home system is the home central unit (HCU). There are many different types of HCUs to choose from. The most secured HCUs are Yoga Tiny* and Yoga PRO1*, which are based on the Intel® IoT Gateway using the Intel® Quark™ SoC X1000 series with special security features. The gateway delivers secure, energy-efficient computing in a small form factor, making it ideal for service providers who want to enter the smart home market segment with a solution that connects to existing routers in Plug and Play fashion.

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For service providers looking to integrate the Yoga Smart Home system into their existing triple play gateways that provide Internet, voice, and video, the Intel® Puma™ 6 Family of home gateway silicon with an Intel® Atom™ processor delivers the quality of service needed to provide a reliable, cost-effective, carrier-grade gateway. Built-in hardware virtualization with Intel® Virtualization Technology (Intel® VT) and local storage makes it easy for service providers to architect the Yoga Smart Home system in its own virtual partition. Because Yoga is added through a virtual machine (VM), it can be dropped in on the fly and isolated from other services running on the box. If a problem occurs, it is only necessary to restart that VM and not the entire



Figure 7. Yoga Tiny* Home Central Unit (HCU)

gateway. Best of all, there is no need to validate the VM against the entire stack or recertify the device. Depending on an operator's subscribers and installed user base, service providers can deploy either an Intel Quark or Intel Atom processor-based gateway, or a combination of both, with a Yoga solution that is software consistent across Intel® architecture devices.

The HCU is the brain of the home - it knows the status of home and its devices, and from the cloud side, it has the ability to receive additional information and to send back home logs. The HCUs use different channels

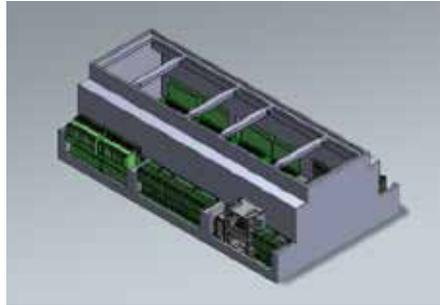


Figure 8. Yoga PRO1* Home Central Unit (HCU)

to communicate with wireless and professionally wired devices via in-built or external communication channels.

Pictured in Figure 7, the Yoga Tiny HCU monitors the status of the house, controls its devices across a local area network, ZigBee*, or Bluetooth* network, and communicates with the service provider's cloud. Home devices can be relatively unintelligent, mostly responsible for receiving commands from the HCU and reporting their status, thus keeping device costs down.

The HCU does not require an additional Ethernet port since it can function as a two-port Ethernet switch, allowing it to share an existing LAN cable going to an already installed set-top-box, Internet router, or similar.

Should the Internet connection be lost, the HCU will continue to control the home as usual, except without remote capabilities, like displaying the real-time graphical view or allowing changes to the configuration.

Yoga PRO1, shown in Figure 8, acts the same way as Yoga Tiny, but is meant for professionally wired installations like high-end smart homes, large commercial office buildings, and other industrial buildings. Yoga PRO1 features all the same security features as Yoga Tiny and has direct onboard inputs, outputs, and automation bus interfaces that are needed for professional and industrial installations.

Security

Of critical importance is ensuring the smart home environment is secure. Yoga Systems does this by implementing a set of security technologies provided by the Intel IoT Gateway, including those shown in Figure 9.

- **Anti-Malware:** Application whitelisting software – a key capability in McAfee* Embedded Control* – allows only authorized code to run on the smart home system. Once a whitelist is created and enabled, the system is locked down to the known good baseline; no program or code outside the authorized set can run, and no unauthorized changes can be made. The approach is a secure and reliable alternative to the traditional antivirus solutions that continually scan for malicious code and work to remove it from the system.

<p>Anti-Malware</p>	<p>Resiliency</p>	<p>Data Protection</p>
<ul style="list-style-type: none"> • Application Whitelisting 	<ul style="list-style-type: none"> • Secure Boot • Hardened OS 	<ul style="list-style-type: none"> • Encryption • Virtual Private Network

Figure 9. Security Technologies

- **Resiliency:** This aspect of security maintains system integrity by protecting underlying software components, such as the boot loader and the operating system. As such, the following mechanisms help prevent malicious software from getting control of a system before it is booted and other security mechanisms are running. Secure boot establishes a root-of-trust (RoT) that ensures only cryptographically verified, authenticated software is allowed to run during the boot process. The hardened operating system (OS) classifies files as executable, read-only, etc.; thus rogue software, which has not been identified by the OS, will not be allowed to execute.
- **Data Security:** Encryption algorithms, such as the 128-bit SSL encryption used by Yoga Smart Home, protect data as it travels to and from the cloud. Virtual private networks further protect data by requiring a private key in order to read the data.

Cloud

The cloud is the most important part of the Yoga Smart Home, providing scalable and redundant service. The cloud takes care of storing home configurations and logs, serving the user interface, communicating with external systems (e.g., weather, email, SMS, and push messages), managing user permissions, and keeping a constant eye on each home system's health.

Yoga Building Automation System Software

Yoga Systems home software performs the automation, control, and monitoring functions previously described. In addition, analytics software in the cloud recognizes family member behavior patterns and makes decisions that are in line with their

lifestyle preferences. With its advanced alarm management and extensive data gathering, end users can remotely control and monitor appliances, like lights, load controllers etc., from their mobile devices. Real-time monitoring with video surveillance can also trigger an alert when cameras detect motion. The software is designed to deliver very high levels of stability, reliability, and scalability, making it suitable for telecom service provider deployments.

IoT Tenets

The Yoga Systems smart home system is designed to provide security and interoperability from edge to cloud in keeping with five key tenets defined by Intel:

- **World-class security** as the foundation
 - The solution implements robust hardware and software-level protection that secures data between the home, the cloud, and end user mobile devices.
- **Automated discovery and provisioning of edge devices** to ease deployment
 - Yoga Systems and its partners ensure select wireless sensors and actuators are Plug and Play.
- **Data normalization** through protocol abstraction to improve interoperability
 - Yoga Systems software performs protocol translation (e.g., ZigBee, Ethernet, Wi-Fi, GPRS) without end user intervention.
- **Broad analytics infrastructure** from edge to cloud to realize customer value
 - Yoga Systems software running on home systems and cloud servers analyzes energy usage patterns to make recommendations and show data in easy-to-understand graphical views. The solution is location aware through geofencing and engages users proactively when needed.

- **Infrastructure** to monetize hardware, software, and data management from edge to cloud
 - Yoga Smart Home is an end-to-end, IoT-based solution capable of providing value-added services to end users as well as providing the operations and billing infrastructure needed to support profitable business models.

Smart home systems based on IoT solutions from Yoga Systems and Intel are helping telecom service providers create a new source of revenue. The intuitive and easy-to-use system offers end users a way to curb their energy costs and keep their homes secure, along with providing a wide range of useful information.

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Summary

Smart home systems based on IoT solutions from Yoga Systems and Intel are helping telecom service providers create a new source of revenue. The intuitive and easy-to-use system offers end users a way to curb their energy costs and keep their homes secure, along with providing a wide range of useful information. Taking advantage of IoT technologies from Intel, Yoga Systems developed a secure smart home system that service providers can feel comfortable offering to a mass market.

Resources

[Intel® Internet of Things Solutions Alliance](#)

Members of the Intel® Internet of Things Solutions Alliance provide the hardware, software, firmware, tools, and systems integration that developers need to take a leading role in IoT.

[Intel® IoT Gateway Development Kits](#)

Intel® IoT Gateway development kits enable solution providers to quickly develop, prototype, and deploy intelligent gateways. Available for purchase from several vendors, the kits also maintain interoperability between new intelligent infrastructure and legacy systems, including sensors and data center servers.

For more information about Yoga Systems* solutions for building automation, visit www.yogasystems.com.

For more information about Intel® solutions for smart buildings, visit www.intel.com/iot.



Yoga Systems is a member of the [Intel® Internet of Things Solutions Alliance](#). From modular components to market-ready systems, Intel and the 250+ global member companies of the Alliance provide scalable, interoperable solutions that accelerate deployment of intelligent devices and end-to-end analytics. Close collaboration with Intel and each other enables Alliance members to innovate with the latest technologies, helping developers deliver first-in-market solutions.

¹ Mark Giles, "Market Consolidation Aims to Address Rising Investment Costs for European Operators," May 6, 2014, MobileWorldLive web site, <http://www.mobileworldlive.com/market-consolidation-aims-address-rising-investment-costs-european-operators>.

² Source: www.events.cleantech.com/amsterdam/sites/default/files/CTForumAmsterdam_Yoga_Systems_Executive_Summary.pdf.

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