**Simplifying the Design of Cloud-Connected Intelligent Vending Machines**

Integrated IoT building blocks enable a future-proofed design that also reduces development time, complexity, and the risk associated with investment.

**Design Challenges**

Today, most vending machines are just capable of collecting money, providing change, and dispensing products. This limited functionality is largely due to machine architectures based on low-end microcontrollers that lack the compute power and ease of reprogramming needed to implement new services, like loyalty programs and marketing campaigns, which vending operators, brands, and consumers are now demanding.

In trying to keep vending machine cost low, designers often focus on their particular component and fail to take a system level approach, which may actually result in a higher cost system. For instance, if boards monitoring stock levels, cash, and temperature are not designed to communicate with each other, they could duplicate functionality, like each having their own SIM card for telemetry. An alternative approach is to combine all vending machine functions onto a single Intel® architecture processor-based board, which can actually be less expensive than all the boards it replaces. This approach also makes new feature integration easier, which is an important factor when making investment decisions that consider the suitability of machine designs into the future.

For vending machine developers, designing in the necessary technologies is challenging, but is a task made easier by the Intel® IoT Retail Gateway Reference Design for Intelligent Vending, which is an industry-specific version of the Intel® IoT Gateway. This Intel® IoT Gateway provides a recipe that can help developers define the best architecture solution. There are, of course, other approaches to meet specific platform requirements; and ultimately, Intel and Intel architecture offer complete flexibility at multiple levels: operating system, hardware, and software.

For more details, visit [www.intel.com/retailsolutions](http://www.intel.com/retailsolutions).

Building upon the Intel® Reference Design for Intelligent Vending, the gateway integrates validated building blocks that facilitate the integration of numerous compute workloads, such as vending machine control (VMC), touch screen integration, telemetry and platform connectivity, software manageability, transaction management, sensorization, security, and digital signage. Intel provides the base components that allow vending machine manufacturers to focus on innovation, reduce development time and investment risk by adopting proven compute modules, and differentiate themselves by moving to a powerful PC-based computing platform.
Solution Overview

The Intel IoT Retail Gateway Reference Design for Intelligent Vending provides a solution for re-architecting traditional vending machines into highly-capable, Internet-connected machines that can offer engaging consumer experiences, drive business transformation, support new transaction models, and reduce operating costs. Figure 1 shows the key building blocks, which include:

i) Intel IoT Gateway
ii) Vending machine I/O (VMI) board
iii) Vending machine API

i) Intel® IoT Gateway

The Intel IoT Gateway offers companies a key building block to enable the connectivity of both legacy and next generation intelligent infrastructure to the IoT. It integrates technologies and protocols for networking, embedded control, enterprise-grade security, and easy manageability on which application-specific software can run.

Intel IoT Gateways enable:

- Connectivity up to the cloud and enterprises
- Connectivity down to sensors and existing controllers embedded in the vending machine
- Pre-process filtering of selected data for delivery
- Local decision making, enabling easy connectivity to legacy systems
- A hardware root of trust, data encryption, and software lockdown for security
- Local computing for in-device analytics

In the case of the Intel IoT Retail Gateway Reference Design for Intelligent Vending, the computing platform is based on the Intel® Atom™ processor E3815, which is a system-on-chip (SoC) that delivers high I/O connectivity such as HDMI* output for digital advertising, LVDS for low cost touch screen, USB 2.0/3.0 ports for receipt printing, camera and sensor integration for consumer interactivity, etc., and RJ45 Ethernet socket for wired connectivity. There is also a mini PCI Express* slot that can be used by 3G modules to provide cellular connectivity.

This compute board is based on the Intel® Reference Design for Digital Signage (EL-10), which vending machine manufacturers can make or buy as shown in Table 1.

Very often a key challenge for machine developers is to establish a platform that meets the latest standards without having to establish an in-house software development department. To this end, Intel, through the Intel IoT Gateway, has made available an off-the-shelf, fully-validated, deployment-ready stack, resulting in significant benefits including reduced development time and engineering investment, and therefore, lower overall investment risk.
ii) Vending Machine I/O Board

Today’s vending machines use a wide range of bus protocols (e.g., CAN, ccTalk, Protocol A, MDB, USB) to communicate between the vending machine controller (VMC) and machine peripherals, such as control mechanics and note readers. With the Intel IoT Retail Gateway Reference Design for Intelligent Vending, the VMC functionality moves to the Intel Atom processor E3815-based board, which communicates with machine peripherals via a vending machine I/O board, detailed in Figure 2.

The I/O board, which is described in detail in the Intel Reference Design for Intelligent Vending, is a low-cost design that handles protocol conversion and provides a high-level of I/O flexibility. Vending equipment manufacturers can incorporate the board functionality in several ways:

1. Purchase vending machine I/O board from an OEM or ODM (See Table 1).
2. Request an OEM or ODM to build a customized version of the board.
3. Build a board themselves using schematics and layout files available from Intel.
4. Integrate the function onto an Intel® processor-based computing board using schematics and BOM from Intel, providing a path to an “all-in-one” board solution.

With this platform, vending machine manufacturers can shorten their time to market; and since most of the engineering work is already done, they can focus on market differentiation and business models that can generate additional revenue streams.

![Figure 2. Vending Machine I/O Board.](image-url)
iii) Vending Machine API

The remaining challenge in designing cloud-connected intelligent vending machines is vending platform control. This can be achieved by using the Vending Machine API, which is described in detail at Intel Reference Design for Intelligent Vending. This API provides a level of abstraction that allows vending machine manufacturers to concentrate on high level applications, like the user interface.

The API provides a consistent programming interface regardless of the underlying hardware. This means the same application may be used across a fleet of disparate machines. The API also handles deliberate deviations from vending specifications such as the MDB protocol by vending peripherals. These deviations are specified in an easy-to-use text file, and the API compensates for these during run time.

In Conclusion

The Intel IoT Retail Gateway Reference Design for Intelligent Vending...

- Provides an “all-in-one” architecture for vending, which eases software management as well as provides a future-proofed compute platform.
- Decreases the risk associated with design investments, as the technologies are tried and tested.
- Reduces engineering time through VMI design work available in the Intel IoT Retail Gateway Reference Design for Intelligent Vending, which is also supported by an established supply chain.
- Eliminates the complexities of vending protocols by integrating a vending machine API.
- Delivers an integrated, pre-validated, and flexible retail vending solution, including foundational hardware, software, and security building blocks to speed up solution development and deployment.
- Specifies a proven recipe for building scalable solutions with standards-based interfaces and ensuring secure communications between vending machines and the cloud.
- Enables business innovation on proven technologies that provide the computing power, connectivity, security, manageability, and ease of reprogramming needed to support advanced services.
- Facilitates the implementation of new revenue generating functions, such as digital advertising or product recognition, without requiring additional platform investment.