Target Customers
Retailers wanting to generate customer insights to improve the in-store shopping experience.

Introduction
In the future, the winners in retail will be those who invested in building personalized consumer experiences based on a deep understanding of each shopper as an individual. With a global retail Internet of Things market projected to reach $35.5 billion by 2025 (Markets and Markets, March 2020), growing numbers of retailers are turning to responsive solutions that efficiently harness their data to gain a competitive edge. The Smart Retail Solution (SRS) supports the creation of standardized, scalable, and flexible solutions for retailers to uncover new business insights in real time. SRS combines retail hardware and sensors with a mix of software to integrate data from islands of technologies across stores, creating instant, automated feedback for retailers to act on. Celadon in Container (CIC), Intel's open source Android* platform, is a key software component of SRS. It incorporates critical containerization technologies that allow retailers to run Android applications at high densities, leading to consolidated operations and reduced costs for a variety of use cases. This solution brief provides details around Celadon in Container market deployments as part of the Smart Retail Solution.

Celadon in Container and Smart Retail Solution can play a role in enhancing smart retail experiences for both retailers and consumers.
Use Case
Inventory Management & Product Placement

CiC analyzes data collected by the SRS gateway to identify issues like misplaced items and fast moving products. The data is then connected to a retailers inventory management system to generate alerts based on product insights and availability. The analysis of this data can also provide hints as to how products can be co-located in the store to enhance the shopping experience for customers.

Use Case
Customized Advertisements

The SRS gateway has multiple physical interfaces to the sensor arrays that capture information and drive high resolution images and video to digital advertising displays in the store. CiC is the software component that captures video data, completes pre-processing when possible, sends it to the cloud, and retrieves customer information like age, gender, or expression - all in real time. The application running in CiC then chooses a customized, store specific advertisement to project onto the nearest digital display.

Smart Retail and Data Analytics

Ensuring customers can easily find products they want in stores and identifying ways to better understand customer preferences will be key to any retailer’s success. Celadon in Container and the Smart Retail Solution can play a role in enhancing smart retail experiences for retailers and consumers alike.

Smart Retail Solution Components

SRS is a complete solution that can consist of an Intel® RFID Sensor Platform (Intel® RSP), an Intel architecture gateway, and a Cloud, all working together to automate operations for retailers. Informed by multiple integrated data streams, the solution combines inventory totals and coordinates with real-time consumer data to instantly display customized advertisements. Figure 1 below describes the major building blocks of SRS and how they interact:

- **Intel® RSP, a USB camera or other sensor input:** Intel RSP is a multi-sensor product that enables data ingestion from numerous sources in the retail location. The sensor features an integrated radio-frequency identification (RFID) reader and antenna, designed to work in dense retail environments. This component could also be a USB camera or other sensor input collecting visual data in the retail store.

- **Intel architecture gateway or similar edge device:** Typically, an Intel® Xeon® processor with i5 or i7 Cores. The gateway configures and controls SRS sensors and connects to the cloud. This component could also be viewed as an independent edge device.

- **Cloud:** Provides sheer compute power to perform real time analytics on ingested visual and raw sensor data. Typically an Intel® Xeon® server.

![Figure 1: Smart Retail Solution](image-url)
Celadon in Container for Smart Retail Solution

The SRS gateway is the key component that collects information and passes it to the cloud for processing. The gateway has multiple physical interfaces to the sensor arrays, along with low-cost end-nodes that drive high resolution video and images to digital advertising displays in the store. The gateway also includes CiC, which uses Linux* as a host operating system. CiC interacts with local devices from the gateway and enables connections to the cloud to offload data processing. In addition, when containerized over Docker*, CiC allows displays to interface directly with the gateway, reducing smart retail costs by minimizing the number of devices required for operations.

Figure 2 depicts an existing solution without Celadon; it needs an additional Android device to run the content application and drive the display. The solution uses a typical x86-based gateway running Ubuntu* or Rancher* as the host operating system. The gateway interacts with specified Android devices through a WiFi gateway. The Android device runs an instance of Android with a custom application and interfaces with one HDMI display.

In contrast, Figure 3 uses CiC, which consolidates operations by enabling retailers to run Android in a Docker container directly on the gateway. In this deployment, the application managing the digital display content sits on the gateway, eliminating the need for the additional Android device. Retailers will be glad to know the Android application remains mostly unchanged, and a similar logic can be employed on the sensor side to reduce costs of intermediate devices. In addition, the consolidated solution also optimizes end-to-end latencies by eliminating intermediate delays due to additional interfaces in the existing solution.
Conclusion – Key Solution Benefits

CiC with the Smart Retail Solution helps retailers build a foundation for a variety of retail use cases, including real-time customized advertisements and enhanced inventory management. Using CiC, retailers can expect to:

- **Accelerate deployment.** CiC helps speed time to market by reducing the effort needed to deploy. Also, CiC provides a robust way to switch or upgrade software, firmware, and workloads on digital displays and consoles.

- **Reduce costs.** CiC consolidates operations by enabling retailers to run Android in a container directly on the gateway, eliminating the need for additional devices.

- **Maintain reliable operations:** CiC provides a ready-to-use, end-to-end solution based on continuously supported Intel technology.

- **Avoid missed sales.** Retailers can more accurately quantify inventory, and avoid lost sales due to unstocked or misplaced items.

- **Enhance experiences.** Efficient analytics drive greater understanding of customer preferences based on in-store behaviors, thereby allowing retailers the capability to provide personalized marketing.

About Project Celadon

Project Celadon is an Android open source platform for Intel® architecture. It provides flexibility for developers to create and customize advanced applications on the latest Android releases, which helps accelerate product development time. Leveraging Intel hardware acceleration, Project Celadon improves efficiency and allows for reliable scalability across a variety of use cases, including smart retail, cloud gaming, smart classrooms, and more.

Learn More

For more information about Project Celadon, visit [https://01.org/projectceladon](https://01.org/projectceladon)

Intel, the Intel logo, and Xeon are trademarks of Intel Corporation in the U.S. and/or other countries.

*Other names and brands may be claimed as the property of others.

© 2020 Intel Corporation