



# The connected retail store

A guide to how the IoT helps retailers improve operational efficiency and customer experience

White paper | April 2020



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# Introduction

Digitization, the Internet of Things (IoT), and the availability of an abundance of data are opening up new possibilities for the retail industry. Retailers are currently evaluating models of how they can use these technologies to reconcile their two strongest drivers: rising consumer expectations regarding service and store experiences; and the need for higher efficiency and cost reduction.

Based on discussions with retail customers, we share insights in this white paper into how they leverage IoT technology to overcome this challenge. First, we take a look at the current dynamics within the industry and discuss why now is the right time for retailers to invest in IoT. Next, we describe some monitoring use cases for the food retail industry. We also shed light on some more complex value-adding and cross-domain examples, such as building and energy use cases. We then provide an overview of the core technical capabilities a retail IoT solution should cover. And to conclude, the final chapter introduces the Bosch IoT Suite, the Bosch Group's platform for IoT solutions.

“Retailers can cut total working hours by more than 20 percent by using existing technologies to systematically optimize and simplify routine daily processes.”

[Oliver Wyman](#)

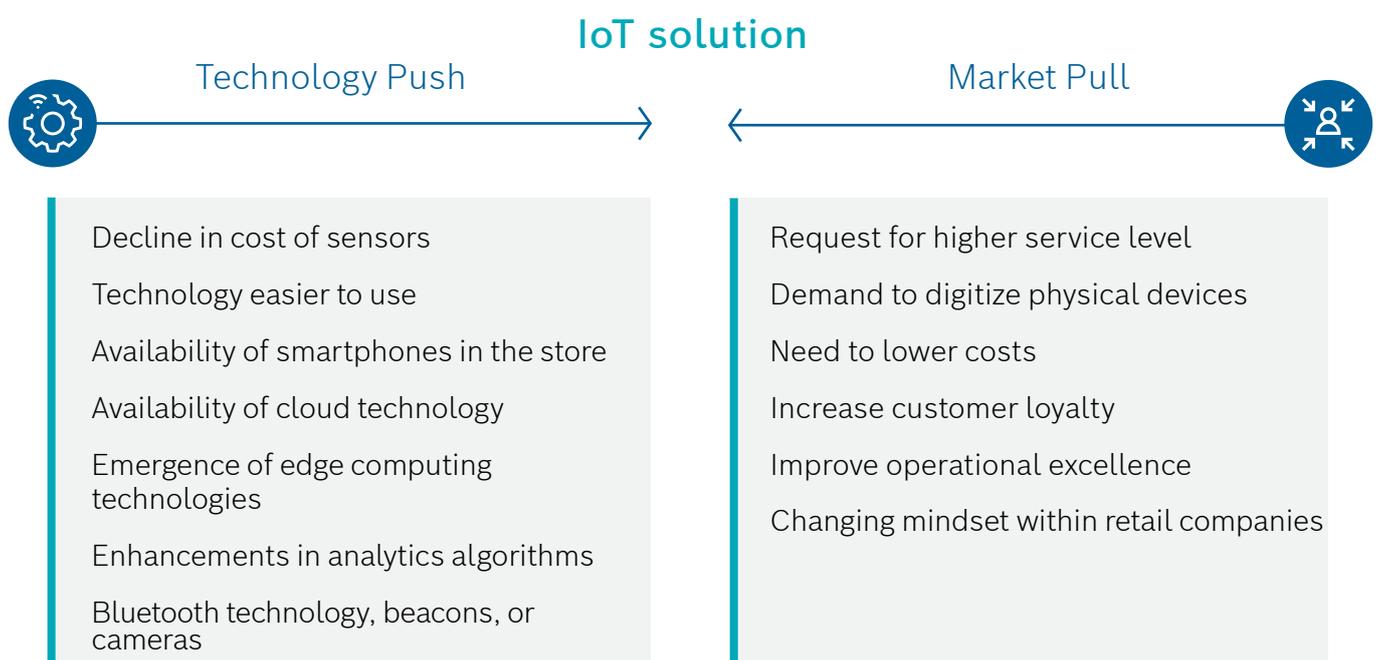
# Digitization trends within the retail industry

Over the past few years, digitization has become a strongly prominent and dynamic topic within the retail industry. This trend will continue over the coming years across all segments, from fashion to food, drugstores, and DIY.

“The growing relevance of topics like IoT and artificial intelligence presents new opportunities and prospects to retail for shaping a digitization strategy.”

[EHI Retail Institute](#)

This dynamic development has its origins in two innovation drivers that are working in favor of digitization. Firstly, the maturity level attained by certain technologies generates a technology push that provides the basis for higher efficiency and innovative business models. Secondly, there is an increasing market pull that has its origin in latent, unsatisfied customer needs and the need within the industry to reduce costs.



## Technology push



Take a look at [Bosch's Parking Lot Sensor and the Cross Domain Development Kit](#)

- The high demands of digitization have brought about an extensive use of sensors. The past five years have seen a tremendous **decline in the cost of sensors**. At the same time, sensor technology has been continuously improving, so that retailers today have powerful low-cost sensors at their disposal.
- Over the past few years, the **technology has also been getting easier to use**. This means that even users who do not have a programming background can handle the technology.
- The availability of **smartphones** in the store allows staff to maintain devices based on notifications they receive. This releases them from time-intensive regular manual inspections.
- The availability of **cloud technology** permits a far more flexible and more modular use of new technologies than in the past.
- While cloud technology is beneficial in many cases, there are certain kinds of store data that retailers want to process locally. With the emergence of **edge computing technologies**, retailers can process data locally within a certain store and only send the KPIs to the cloud for storage. Particularly when it comes to real-time notifications, quick decisions on the device level are necessary, and latency needs to be eliminated.
- The past few years have brought about many enhancements in **analytics algorithms**. These improvements make it possible to handle even huge amounts of data and derive improvement measures from it.
- When it comes to shoppers' behavior, online retailers have a big advantage over brick-and-mortar retailers: they know a lot about their customers' preferences due to cookies. In order to build up this knowledge as well, today's offline retailers can use **Bluetooth technology, beacons, or cameras** to learn about their customer's journey through the store.

## Market pull

- Not only due to competition from online retailers, but also in keeping with the prevailing *zeitgeist*, customers have come to expect a **higher level of service**. Technology is needed to cover this demand.
- In general, there is a **high demand to digitize physical devices** on the store floor. Retailers want to be able to read the status of their devices in order to optimize, for instance, energy consumption and device functionalities, and to improve their customers' experience.
- The retail industry has traditionally had a **need to lower costs**. Automation of manual processes on the store floor and beyond reduces manual efforts and frees up time for a higher service level.
- Store managers are investing in ways of increasing their **customers' loyalty** and evaluating models to increase their customers' comfort.
- Customers often experience the processes within retail stores as inefficient. In order to change this, retailers are investing in **operational excellence**.
- The **mindset within retail companies** is changing. Retailers are assessing digital use cases and business models in order to keep track with market demand.



[IoT Starter Package](#)

# The connected store – use cases

In this chapter, we will describe some use cases within the food retail industry in more detail. Some of them have been implemented on the basis of our customers' requirements, others are currently in the development or evaluation phase and give an outlook to what else is feasible. The focus on the food segment is based on the fact that this area appears to have the strongest impediments to a satisfying shopping experience.

“The shopping event in which customers most frequently experience shopping killers is the weekly food shop. Obstacles here include long waiting lines at cashiers and reverse vending machines, unfriendly staff, and a lack of parking lots.”

[EHI Retail Institute](#)



## In-store equipment monitoring

- The monitoring of store floor equipment is an easy-to-implement use case for retailers, offering both a high impact on customer satisfaction and on cost savings. For reverse vending machines, cooling devices, shopping carts, baking stations, recycling containers, or any other device, automated monitoring takes over time-consuming manual tasks and frees up valuable time of store personnel, resulting in a higher level of service. Predictive notification of malfunctions (or notification before a pre-defined configuration is reached) ensures that staff can intervene proactively before customers become irritated.
- When considering the automated monitoring of cooling devices, the advantages are even more manifold. Whenever a pre-defined temperature is not kept, a real-time notification allows store personnel to react quickly to avoid food wastage. In addition, the long-term documentation of the temperature inside cooling devices can be used for later legal reference.
- In the case of smaller devices, such as those used for mobile data collection, the question frequently arises as to where the devices were last left. Being able to roughly identify their location saves staff the time spent in searching around for them and making unnecessary treks around the store.



[How to find IoT use cases  
for the retail domain](#)



## Parking lot management

- A lack of parking spots is one of the most annoying shopping killers in the weekly food shopping experience. In the worst case, it can cost a branch outlet up to 20 percent of its sales on a given day. This can be prevented by monitoring the parking spaces belonging to stores.
- To avoid inconveniencing customers, an automatic notification can be sent to the store manager to open up more cashiers and service desks when the parking lot is full.
- In addition, customers can be encouraged to postpone their shopping to a later point in time. In this case, customers can access the predicted filling status of a car park for their desired shopping time via an app. When the app displays that the car park will probably be full, the customer is offered a discount coupon to shop at a later point in time.
- Technology also allows corrective action to be taken against cars that are parked over a longer period of time and that seem not to belong to customers in the store.
- Retailers are increasingly offering charging stations for electric vehicles in their parking lots. In cases where charging is offered free of charge for a certain amount of time, fees can automatically be levied once the time limit has been exceeded. Alternatively, the charging process can be stopped. In the event of a vehicle using the charging station for much longer than allowed, a notification can be sent to store personnel.



Our customers estimate that a lack of parking spots on the weekend can cost a branch outlet up to 20 percent of its sales on a given day

“Overfull parking lots are a misery. Searching for eternity for a free space, maneuvering around small parking lots with confusing layouts – that sucks all the joy out of the shopping experience before you even get to a store.”

[EHI Retail Institute](#)



## Energy optimization

- From building technology such as heating, ventilation, and air conditioning (HVAC), to lighting, through to advertising displays and car parks: automatic monitoring of energy consumption is a big lever on cost savings. The energy consumption of in-store devices can be monitored continuously and assessed on a regular basis in order to adjust consumption in the long term. In case of a defect, the visualization of the position of the defective device within the building can ensure quick response. To guarantee a holistic picture of the energy needs and the costs involved, external systems such as weather data and pricing information about electricity can also be taken into account so as to optimize energy consumption.
- Adjusting lighting to changing daylight conditions reduces energy consumption enormously. In addition, the daily automated switch of various installations to night mode needs to be controlled. If there is an alert that some parts of the store have not been switched to power-saving mode, corrective action can be taken.
- In the case of malfunction, remote monitoring reduces on-site support and maintenance work. Technicians and facility managers can be automatically alerted to resolve the problem, having received the information from the device in advance as to which component is defective and needs to be replaced.
- In the domain of energy management, peaks in energy consumption can be monitored to save costs. It makes sense to introduce “block” signals to prevent flexible devices such as ovens or fans from being switched on when their operation would cause a load peak. The peak load can be calculated by means of the constant monitoring of the devices and of current overall power consumption.
- The data can be viewed collectively across specialist divisions and departments. This allows buildings to be clustered into units in order to identify regional or country-specific differences and identify optimization opportunities.
- The availability of photovoltaics opens up new avenues for retailers to either reduce costs in their stores or to build up new business models. Firstly, the amount of energy that is generated by retail stores via photovoltaics can be measured and visualized, as well as the amount of energy consumed.

- In addition, access to energy market information provides the means to decide how the energy that is produced by a retail store is used: whether it is used within the store itself, or fed into the market, depends on the market price the retailer would receive or pay for provided or purchased energy. Power-hungry technologies such as charging stations for electric vehicles, in particular, increase the retailers' energy demand. Strong consumers such as these increase the need for retailers to know when to consume and when to sell energy.



### Building management and security

- Beyond such use cases, which aim to optimize energy consumption, the movement patterns and paths that customers use within a store provide valuable insights into how to optimize store layout and the positioning of goods. This people tracking allows retailers not only to evaluate customer paths, but also to assess the spots where they linger for a longer period. In addition, on the basis of customers' movement patterns, the order of license holders in the store can be optimized.
- Intelligent infrared-based queue management increases customer satisfaction and avoids purchase interruptions. By measuring line length, waiting time, and service time, the check-out process can be improved and conversion increased.
- In addition, a permanent functional monitoring of individual fire detectors or areas generates an alarm in the event of failure. Malfunctions can be repaired timely by an alerted person or maintenance firm.

## More about digitization for administrative buildings



[A commercial building where everything is connected](#)



## In-store customer experience

- Store Design greatly impacts how customers discover products, whether it's the item they wanted to buy or a complementary item they also chose to purchase. In a brick-and-mortar environment, stores haven't enjoyed many metrics to gauge whether certain department arrangements are more conducive to sales of particular items or product categories. Video-based In-Store Analytics allows brands to visualize shopper behavior throughout a store's footprint, showing which areas receive heavy traffic and strong engagement, and which could be better utilized or positioned. At department level, retailers can analyze the flow of customers to understand where most people are entering the space, which product groups they discover first and how they then navigate across different product displays, allowing retailers to identify opportunities to drive cross-selling.

“Among Gen Z shoppers, 65 percent said they liked the in-store experience for trialing products.”

[A.T. Kearney, Future Consumer Report](#)

- As e-Commerce continues to expand, successful brands are shifting their physical merchandising strategies to keep pace. Savvy stores have embraced omnichannel showrooming concepts that don't target purchases directly, but still enable retailers to turn shoppers into product fans. Computers, premium sound systems, eyewear and wellness products are a few purchases that reveal their full feature set in-store. Video-based In-Store Analytics allow to collect customer engagement metrics down to a product group level to measure which product presentation methods are driving product interaction. With this new data brands can take advantage of highly effective A/B testing to ensure they keep delighting shoppers. Regular tweaks will result in a customer journey that's fresh and interesting, and ensures your retail space is being used most effectively to maintain engagement with your target shoppers.
- Product marketing can be an important lever to increase sales performance. Product engagement metrics enable brands to better target and measure promotions and marketing efforts and ensure marketing invest is applied in the most targeted manner. Video-based In-Store Analytics metrics allow a precise measurement of product engagement levels and engaged-to-sales conversion to identify, whether a certain product group requires an awareness campaign (low product engagement) or rather a promotional trigger (high product engagement but low sales conversion). Post-campaign, these metrics also help to understand whether the marketing invest effectively helped increase engagement and/ or conversion rates.



## In-store customer service

- Workforce management remains a challenge for many retailers. Overstaffing is costly, but understaffing means you're likely to miss your conversion marks. Revenue data isn't sufficient for staff scheduling because it doesn't measure lost opportunities. Instead, traffic data for staff scheduling will measure the total potential of customers coming through the store's door. To create a solid plan, traffic data should be predicted into the future including possible effects of weather, promotions and other factors. Aside from scheduling, traffic data also allows retailers to compute useful metrics, such as conversion rate, that help evaluate past staff deployment. Cloud-based traffic counting systems fed by intelligent video cameras can achieve and maintain a traffic counting accuracy at 95 percent, calibrated to every individual entrance scenario and automatically monitoring data accuracy over time, to ensure staffing predictions can rely on stable, accurate traffic data.

“Stores lose a colossal \$37.7 billion in sales each year due to wait times. Almost half (48 percent) of shoppers said waits of more than five minutes were too long, prompting them to either purchase the item elsewhere or abandon the transaction entirely.”

[Ayden, “New Study: Long Lines Cost U.S. Retailers \\$37.7 Billion,” May 1, 2018](#)

- Physical stores are increasingly used to support retailers' omnichannel strategies. Ensuring services such as BOPIS (Buy Online, Pick-up In Store) meet customer service expectations – and that they generate repeat store business and enhance customer loyalty – requires a frictionless visit. Video-based In-store traffic data analytics show retailers how the service execution is actually happening in the physical locations. They create clean data set of all customer paths that moved through the checkout process, thereby excluding irrelevant paths of persons crossing through the wait area on their way to product displays, but not really standing in line. Based on this data-set, wait times and line lengths at the cash wrap can be computed, providing the brand with insight into whether the BOPIS station is moving customers through quickly enough and delivering on that fast transaction promise. It's also possible to see if shoppers are abandoning the line due to lengthy delays, walking away and leaving their planned purchases behind. In addition, retailers can identify appropriate opportunities to pursue upsells and help happy customers explore nearby products without adding friction to their journey.

# Technical features of an IoT retail solution

The challenge in connecting and digitizing retail stores lies in the sum of different existing systems, which need either to be replaced at substantial cost or else integrated into an IoT platform. The latter always comes with integration efforts. However, this kind of platform support for already installed appliances is absolutely necessary when it comes to building a connected retail store. Below we take a closer look at the technical core capabilities an IoT platform should have.

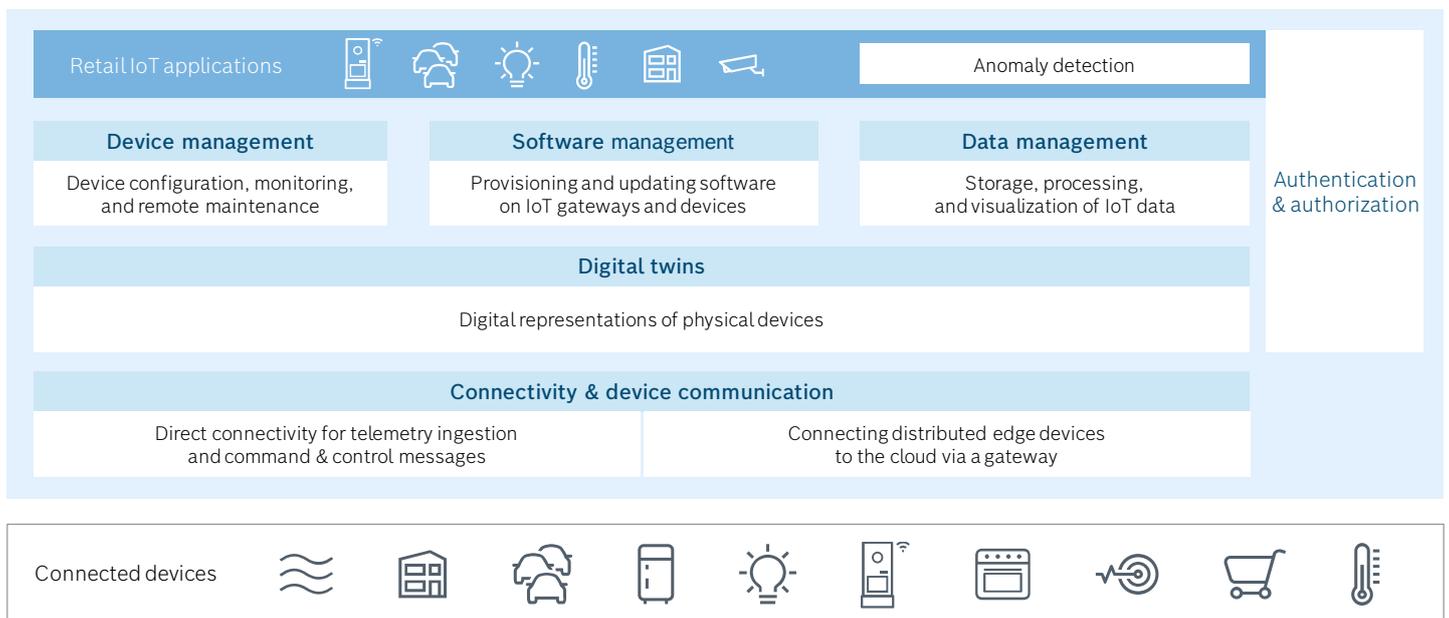
Within retail stores, there are many different technologies and legacy systems in operation, and their replacement cycles are generally long. This means what retailers really need are connectivity services. For the different types of data and use cases, a retail IoT solution should offer these kinds of connectivity:

**Direct connectivity via cloud:** In this case, installations such as lighting systems can be directly connected to cloud applications via various protocols and APIs. IoT applications retrieve telemetry data from devices (device-to-cloud communication) either with or without guaranteed delivery and send command and control messages to devices (cloud-to-device communication). Direct connectivity to the cloud can be beneficial for large amounts of data that are to be sent to the cloud, and for reporting purposes.

**Indirect connectivity via gateways:** Non-IP-capable devices, such as temperature or occupancy sensors, call for a connection to a gateway to communicate with applications. These gateways are not only capable of speaking to the device using field protocols such as ModBus or wirelessMbus, they also map this data toward a remote cloud application using IP-based communication. Similar to the direct connectivity scenario, the gateway provides two-way communication between the devices and the cloud to support both telemetry and command and control use cases.

A gateway edge computing approach can also be beneficial for IP-capable devices as well as for local third party applications. This kind of approach is used primarily to avoid latency, especially for real-time notifications, to ensure data privacy, and for security reasons. In this case, the use of a gateway is not motivated by technology, but more by project needs.

In addition to connecting in-store devices, an IoT platform also needs to interact with other 3rd **party services** (such as SAP, facility management, and more). Standardized web interfaces and the streamlining of different data streams must therefore be catered for. Incoming data is converted into standardized norms during this process so that it can be processed by the application at a later point in time. Once the streamlining process is properly implemented it can be recycled for new devices as a de-facto standard.



© Bosch.IO

In order to provide a digital representation of the device, a so-called **digital twin** or device shadow service is needed. This not only allows retailers to have an online view of the store itself, but also to manage decentralized use cases, such as a comparison between different store locations. Digital twins of device applications allow retailers to store and update the data, properties, and relationships of these assets, and to be notified of all relevant changes. The digital twins of devices, sensors, and other web-enabled things are subsequently able to interact with one another. Users can also enrich their digital twins with further capabilities based on the information or functionality provided by additional systems.



[A guide to successful IoT device life-cycle management](#)

In order to configure devices and set up rules based on generated data, retailers need rich **device management** functionalities in an IoT solution. It should support multiple device management protocols and various classes of gateways and devices in order to manage all equipment on the store floor. A prominent example of the need for configuration is security cameras:

retailers need to define which zones they want to have monitored, and at the same time they need to be able to flexibly adjust this zone. To this end, they must be able to control the cameras remotely and avoid manual effort. Other equipment such as reverse vending machines can even be configured across all markets, which again reduces costs and the efforts involved in manual interventions.

During our discussions with retail customers, we often hear that the diverse landscape brings about time-consuming monitoring efforts for retailers. In order to consolidate the reporting views of third-party systems on the store floor, a retail IoT solution should offer a dashboard that **visualizes all device data** in one single board.

“Bringing together the 5-6 dashboards of each device manufacturer will generate real business value.”

Insight from an interview with a store manager

Retail stores run a large number of devices from various device manufacturers and therefore need a powerful tool for **software updates**. This allows retailers to fix errors and add new functionalities. Updates need to be distributed locally to store floor devices, but the rollout and the versioning of such updates have to be managed centrally. To enable remote updates for widely distributed devices, the tool should include a powerful software and campaign management system to support large-scale rollouts.



[How to generate added value from IoT data. 12 tips for successful IoT data management](#)

In order to learn from the data generated by their devices, retailers should opt for IoT solutions that include **data management and analytics** functionalities. These should collect, process, and store IoT data for further analysis. IoT data management provides the basis for optimizing devices and functions and developing new services and solutions. In addition, it should be able to analyze field data and address recurring analytics.

# Bosch IoT Suite: the IoT platform for retail solutions

Bosch has traditionally been a “things” company. Over the past few years, we have been transforming ourselves into an Internet of Things company, enabling connectivity for all Bosch devices as well as for non-Bosch devices. During this digital transformation phase within our company, we have also consulted numerous customers on their digital journey and implemented their IoT projects together with them.



[How traditional companies master digital transformation](#)

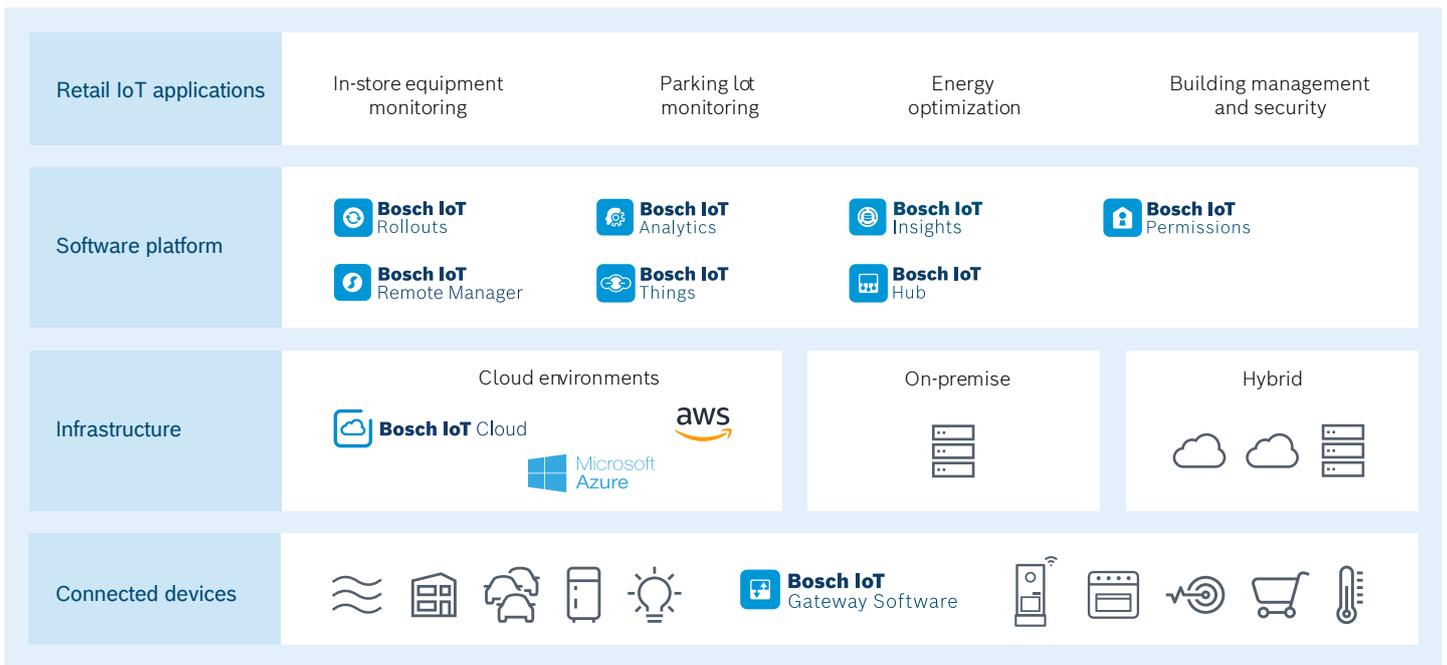
The Bosch IoT Suite is the Bosch software platform for IoT solutions. Currently, the Bosch IoT Suite connects more than 10 million sensors, devices, and machines with their users and enterprise systems. It incorporates Bosch’s domain know-how and is therefore the perfect match for retail IoT applications. Its functionalities cover:

- Reliable connectivity and management of devices, sensors, and gateways
- Secure access management
- Digital representations of physical devices
- Execution of firmware update and software rollout processes
- Management and analysis of IoT data



[More than 10 million sensors, devices, and machines are connected via the Bosch IoT Suite](#)

The Bosch IoT Suite consists of several cloud services that run on various cloud environments such as the Bosch IoT Cloud and Microsoft Azure. Moreover, the Bosch IoT Suite’s device management service is suitable for on-premises installation. In addition to the backend services, the Bosch IoT Suite also includes the Bosch IoT Gateway Software, which enables and supports edge computing use cases for the IoT.



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The Bosch IoT Suite is built on open source. For our customers, this means that they can monitor the evolution of new features and the progress being made with any bugs that arise. They can also download early releases to test them out in their own environment before they are implemented in the Bosch IoT Suite. For companies engaged in open source, this means they no longer have to rely on a single vendor and are no longer dependent on proprietary third-party platforms or lone players. Instead, they are organically supported by the participants of the open source community. As a result, companies can create a solid foundation and a stable future for their business.



For more information on In-store Analytics, visit [boschsecurity.com/instoreanalytics](https://www.boschsecurity.com/instoreanalytics)

In-Store Analytics is built around Bosch FLEXIDOME IP panoramic cameras with on-board Intelligent Video Analytics. Intelligent Video Analytics is highly accurate and enables the cameras to create position data of shoppers' movements which later allows to map In-Store Analytics metrics down to an individual fixture or product display. The cameras send this data to the cloud, where advanced algorithms filter the shopper position data according to individual store environments and relevant behavior patterns. For instance, reliable queue metrics are achieved by removing customers browsing nearqueue displays from the concerned data set. In a final step, the data is intuitively presented through customized web interfaces. Here, users can flexibly query the entire data set since installation for an area in any store at any point in time. This is also true for new metrics and capabilities, introduced to all customers over time. The actual video streams never leave the retailer's premise, thus maintaining shopper's privacy.



Get started with Bosch IoT Suite

# Conclusion

“I want to deliver the best-in-class shopping experience to my customers, powered by new technologies.”

Insight from an interview with a store manager

The retail industry, and particularly the food segment, is currently experiencing a strong and dynamic shift towards digitization, focusing on process optimization, cost optimization, and greater customer satisfaction. As a crucial tool, the IoT helps implement use cases to achieve these goals.

The Bosch IoT Suite enables retailers to exploit the full potential that the IoT offers them: building a connected store, releasing staff from manual tasks, and offering customers an efficient and emotionally positive shopping experience.

## More insights

-  How to master complexity in IoT deployments with device management? Download our [white paper](#) on successful IoT device life-cycle management
-  How does edge computing complement the cloud in IoT? Get our edge computing [guide](#)
-  How to generate added value from your IoT data? Here are [12 tips](#) for successful IoT data management

# Bosch in the Internet of Things

Bosch.IO GmbH combines the full set of consulting and implementation skills to deliver IoT and digital projects, focusing on the retail, energy, building, industry, consumer goods, agriculture, and mobility sectors. Bosch.IO has 900 experts on board, including consultants, coaches, cloud software developers, digital marketers, UX and business model designers, solution architects, and project managers. Based in Germany, Bulgaria, Spain, Japan, China, Singapore, and the USA, they team up interdisciplinary to serve customers around the world. Drawing on a broad base of industry knowledge and a deep well of software expertise, this Bosch company has proven its merits in more than 250 IoT projects.



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