

How Confidential Computing Delivers A Personalised Shopping Experience

Aggregation* Decentralized Data and Intel® SGX

Authors Executive summary

Dr. Farhaan Mohideen

IoT Product Strategy, Intel Corporation

Paul O'Neill

Director, Confidential Computing,
Strategic Business Development,
Intel Corporation

Nukri Basharuli

Chief Executive Officer, Aggregation

Alex Manilov

Chief Product Officer, Aggregation

Fabian Schaefer

Director of Analytics and Data
Management, Magnit

Customers and, more importantly, loyal customers are a retailer's biggest asset. But while it is crucial to attract new customers, retaining existing and past customers is ultimately more important for long-term retailer profitability¹. So, it is vital that customers know their preferred retailer understands them and their preferences, and can provide them with a personalised shopping experience.

Placing advertisements in print and online is one of the most successful marketing tactics retailers can use to attract customers to try new products, as well as marketing existing products with new offers. However, unless these ads are highly relevant to the customer and are not repeated too many times, this approach is not only frustrating to the customer but can also impact brand loyalty.²

It is therefore critical that ads are targeted to the right audience and at the right frequency to truly have beneficial results. This paper discusses the ability to quickly identify target audiences to drive new campaigns and how a multi-faceted view of the customer helps to achieve maximum relevance. Data is at the heart of the solution and in this paper we will discuss the ability to share data across multiple partners, without comprising data security.³

Improving the retail customer experience

Retailers are seeing a significant shift in customer behaviour and expectations. Customers are increasingly gravitating towards retailers that can offer a personalised and consistent experience across all channels of interaction with the products and services they love to buy⁴. Enabling these interactions has also meant that retailers have needed to make fundamental changes to every aspect of their businesses. This impact is profound and is bringing about changes at the front of store, back of store, and in engagements with service partners.

The customer journey is far from straight forward. No longer are customers discovering and purchasing products from the same channel in which they started their journey. As the permutations for discovery, purchase and delivery increase, retailers have come to realise that they need a flexible infrastructure, one that is digitally connected both in-store and online to keep up with their customers.

Digital enablement brings new opportunities to engage directly with customers in both of these areas. Retailers have realised that when they have a customer

Table of Contents

| | |
|---|---|
| Executive summary..... | 1 |
| Improving the retail customer experience..... | 1 |
| An era of personalised advertising..... | 2 |
| Using data in advertising..... | 2 |
| The role of Confidential Computing..... | 4 |
| Deployment at Magnit..... | 6 |
| Conclusion..... | 6 |

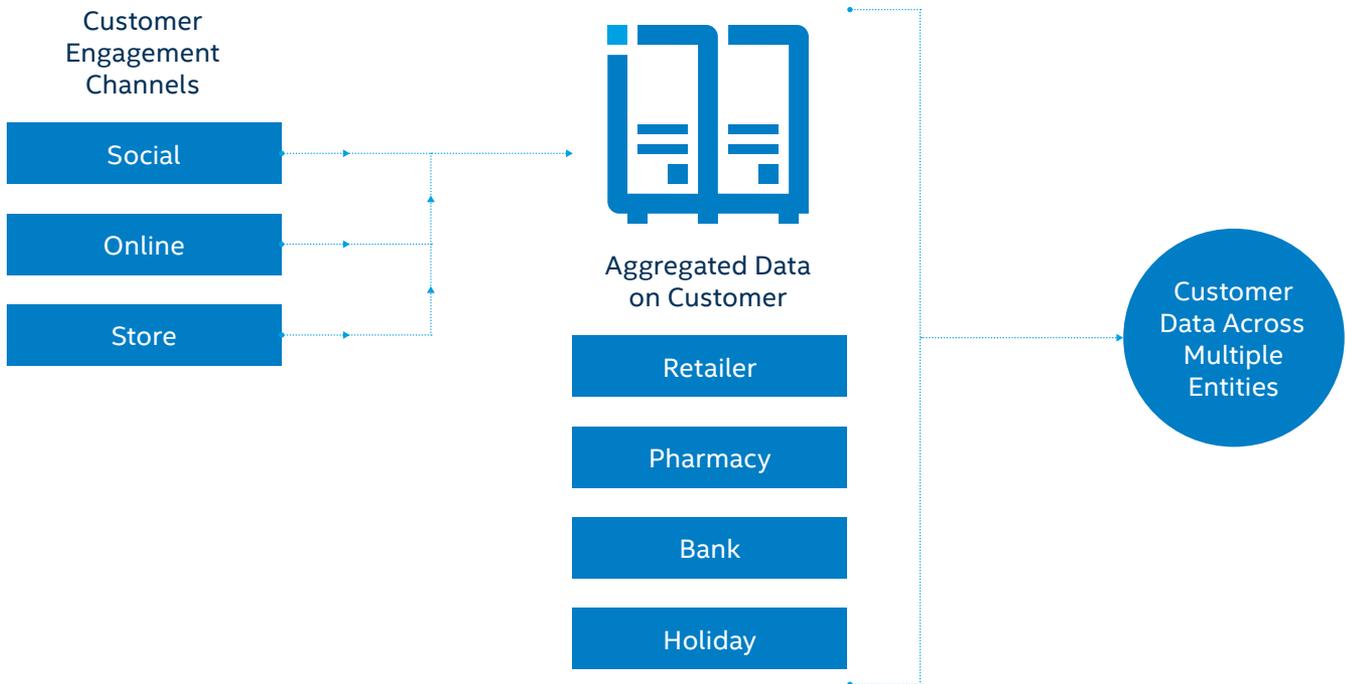


Figure 1. Customer profile across many entities

engaged in their store – irrespective of the channel – it is paramount to increase the time spent at the store by showing hyper personalised content to them. More digital engagements bring more understanding of each customer's preferences, buying habits and important life milestones.

The digitisation and the connected nature of stores generates lots of data that, when used appropriately, can generate significant benefits to the retailers and their customers. This data can then be used to increase brand value and to run campaigns that reach a significantly higher proportion of targeted customers. These will be customers who not only find those campaigns relevant, but could potentially convert to a sale.

An era of personalised advertising

Advertisement campaigns are not cheap and billions of dollars are spent by large brands to generate awareness and promote their products to customers. The goal of advertisers is to target the right customers at the right time and in the right place. Done right, advertising continues to be an effective mechanism to target existing customers as well as attracting new ones.

Once segmented channel data is available, it gives enough information to advertisers on where they should place advertisements and where they should focus their efforts to achieve the best ROI for their brands. In the digital age, advertisements go beyond simply promoting products. They can also be used to provide personalised offers and discount coupons. This can lead to targeted incentives for customers in a specific location or new ways of enticing customers to come over to a nearby store.

When advertising is pushed to segmented customers, it is also easy to know how many times an advertisement has been repeated and thereby control repetition. Using purchase information from the retailer, it is also possible to start excluding a customer from the original segment so that an advertisement is no longer shown to them.

The effectiveness of advertising comes from the focused customer data generated by retailers. The value of this data is further enhanced when customer data is gathered across all channels rather than limited to a single channel. This can then be further augmented by taking customer data from multiple retailers and service providers, which can provide a multi-faceted view of the customer, helping to increase the relevance of an advertisement to an individual customer. Figure 1 (above) shows the various entities that a customer can be engaging with to derive a more 'holistic' view of engagement. Data from these multiple entities can provide a fuller understanding of a customer's needs and preferences.

Using data in advertising

The ability to gather different perspectives of a customer across many retailers and other entities provides a more holistic view of that customer. This would normally be across a consortium of retailers and entities who have joint or common goals.

Traditionally, the creation of a target audience is a long and multi-stage process. Typically, the advertising agency sends out some parameters to the retailers and other participating consortium entities. These parameters are then analysed against the available data and catalogues that are in the system, and the audience is refined based on the required

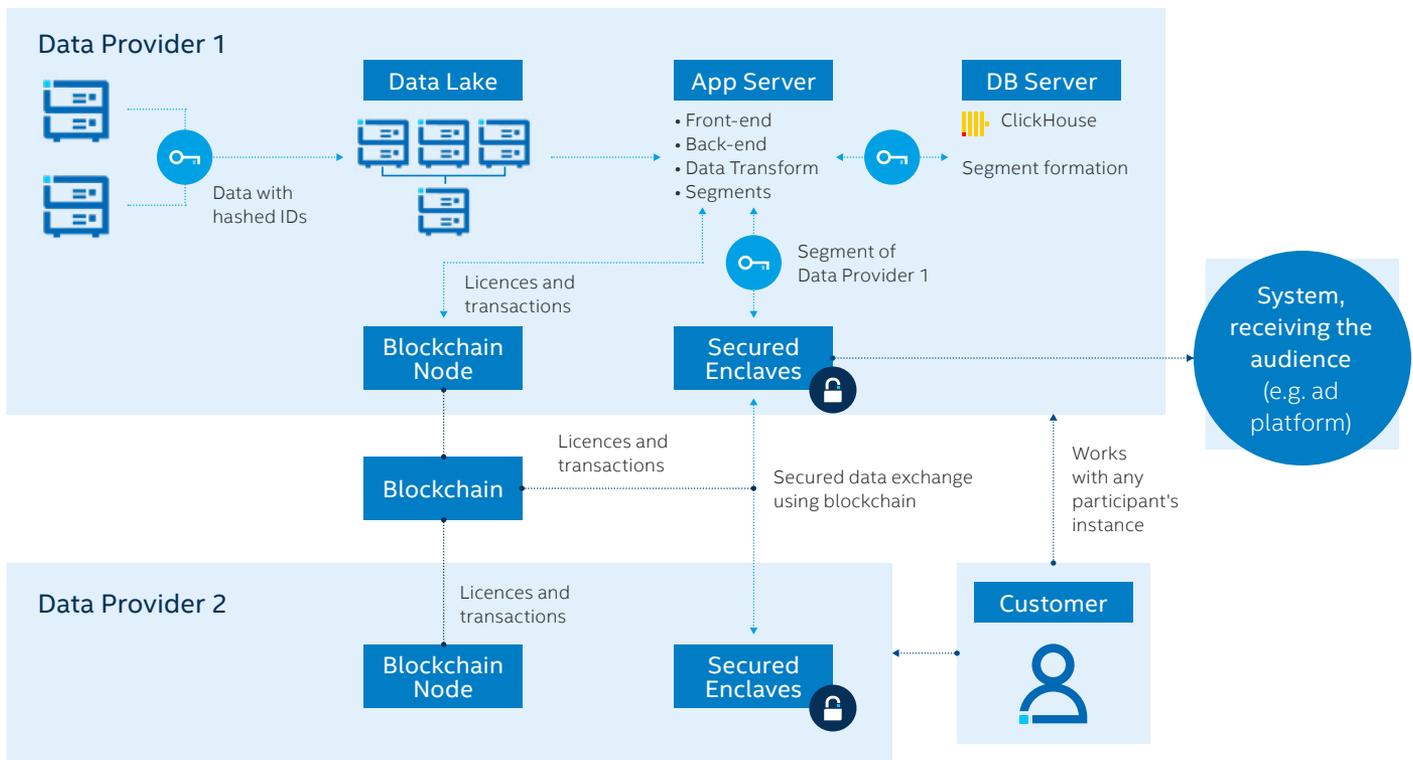


Figure 2. Decentralized Data Management Platform Architecture

campaign goals and the size of the resulting samples. The preparation of the audience for a campaign can take the retailer about a week to complete.

A Decentralised Customer Data Platform

Aggregation came up with a platform that not only reduces the time to identify the campaign audience but to also do this in a secure manner⁵. The Decentralized Customer Data Platform (CDP) does not require each of the consortium members to share their customer data amongst themselves or share it directly with the advertising agency.

The system has been designed as an open network, with the ability to connect other partners to their audience and to all kinds of services that would make marketing management truly integrated and data driven. The platform architecture shown in Figure 2 (above), provides for completely decentralised data processing across multiple data providers.

The solution is installed in the retailer's IT landscape (in the cloud or on premise) and all operations are performed with signed scripts, without transferring any data externally. Data from all channels from the retailer (Example: Data Provider 1, Figure 2) is securely³ populated in the Data Lake and segmentation is kicked off.

The solution has been implemented using blockchain technology and all operations on the Aggregation platform are governed by smart contracts. These smart contracts are used to define the rules and policies imposed when working with data from one or more data providers.

When a second data provider's information (see the Data Provider 2 example in Figure 2) is also combined to create a more comprehensive combined segment, the data is first executed independently by each provider. The resulting data is encrypted and sent to a secure enclave. For security purposes, the data in the enclave is only accessible by a special script signed by each of the data providers. This script is loaded in the enclave and performs its operations to generate the combined segmented data. This, in turn, produces a set of encrypted customer IDs that can now be used by advertising platforms.

The smart contract policies also provide a definition of the revenue share from monetising the advertisements. The use of smart contracts and secure enclaves enables the creation of combined segmentation from multiple data providers without their full disclosure to the partner or third parties.

Improved campaign performance reporting

The platform provides the end-to-end reporting on campaign performance. This particularly looks at online to offline conversion, i.e. the influence of ads on product sales across all channels. A typical marketing funnel usually includes a variety of communication channels: from broadcast communications at the stage of awareness formation to advertising on the retailer's inventory – in store or online – to complete a purchase.

Implementing online to offline analytics requires the amalgamation of data of several participants. The platform correlates the impressions received from advertisers with

How Confidential Computing Delivers A Personalised Shopping Experience

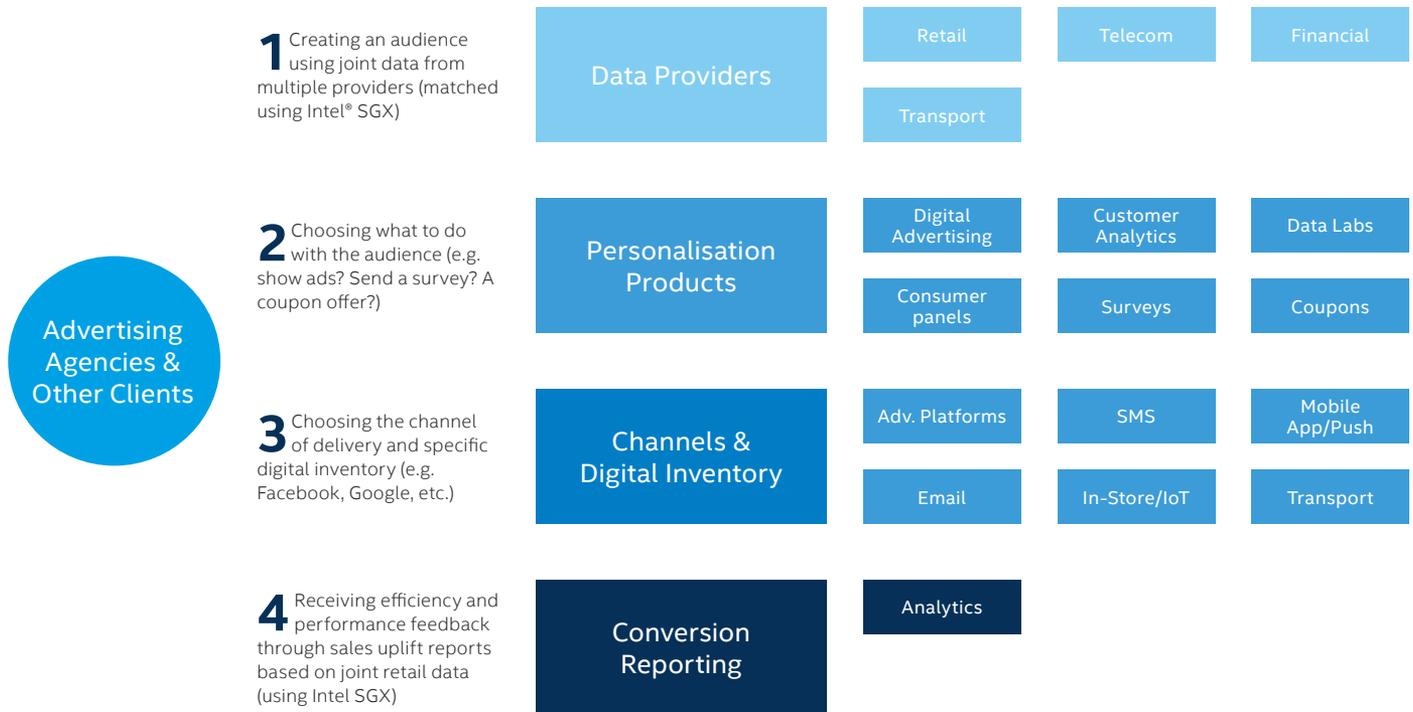


Figure 3. Main participants and marketing process through the CDP

that of the retailer’s POS data to determine the conversion, as well as the effectiveness against loyal customers.

Unless the data is shared by the advertising platform, it is impossible to build a complete end-to-end report. Traditionally, advertising platforms have been hesitant to share their data. The Aggregation solution uses secure enclaves to help participants, including the advertisers, to upload data that is only accessible by a signed script and used to generate the analytics report. This gives a complete view of the effectiveness of the campaign.

The role of Confidential Computing

In today’s data centric world, data is normally encrypted ‘at rest’, ‘in storage’ and ‘in transit’. But there is demand for the protection of data ‘in use’ to ensure that data is always protected. Enterprises and organisations that are working with sensitive data, such as Personally Identifiable Information (PII), financial data, or patient health information, need to mitigate threats that target the confidentiality and integrity of either the application or the data in system memory. The sovereignty of customer data should always be protected, so that it is not subject to attacks from external or internal threats.

Confidential Computing protects data in use by performing computation in a hardware-based Trusted Execution Environment. These secure³ and isolated environments help prevent unauthorised access or modification of applications and data while they are in use. This increases the security level of enterprises that manage and compute sensitive data.

In a world where we are constantly storing, consuming, and sharing sensitive data – from credit card data and medical records to firewall configurations and geolocation data – protecting that data in all its states is more critical than ever. Cryptography is now routinely deployed to provide data confidentiality (stopping unauthorised viewing) and data integrity (preventing or detecting unauthorised changes). While techniques to protect data in transit and at rest are now commonly deployed, the third state – protecting data in use – is the new frontier.

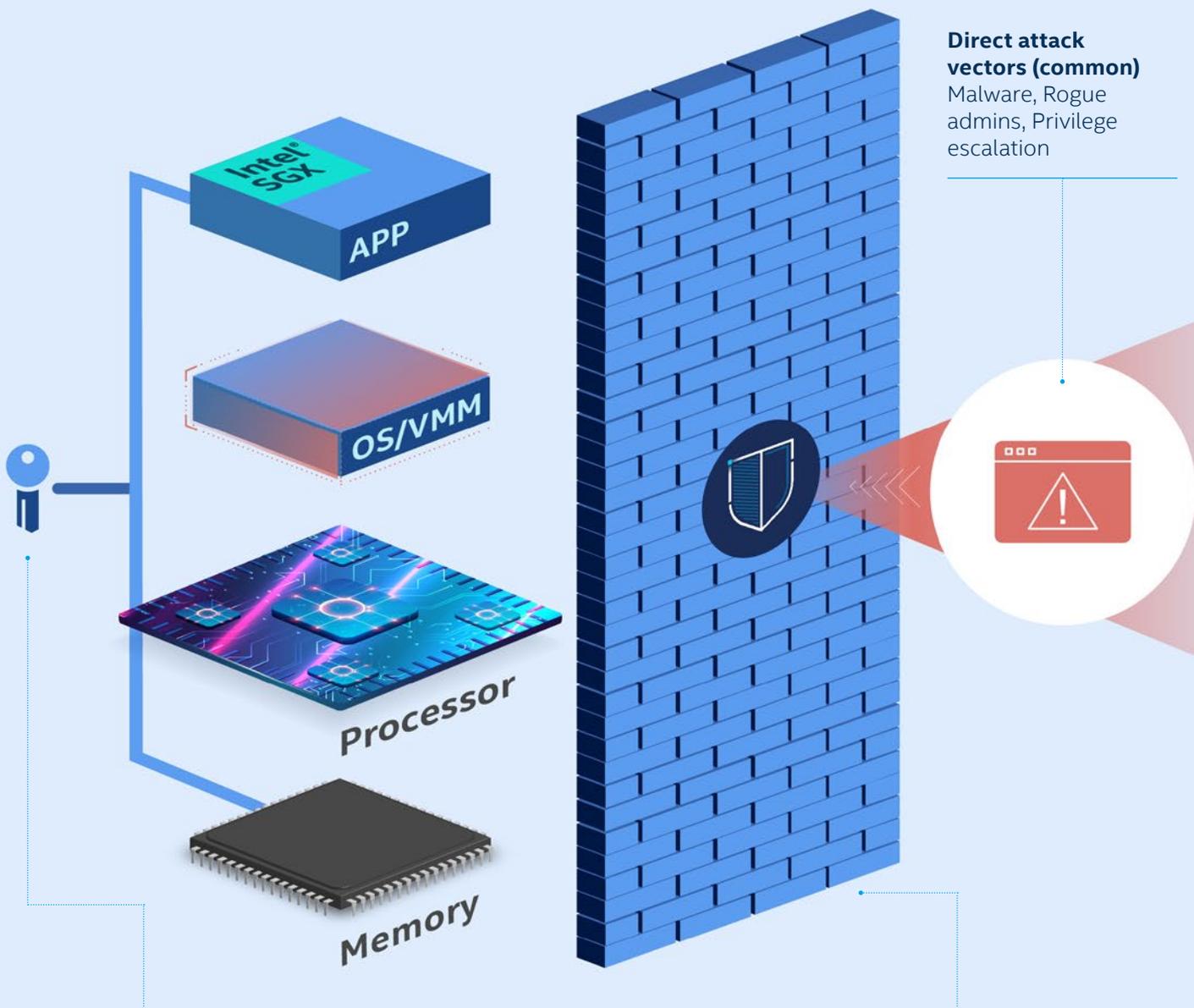
Intel® Software Guard Extensions

Intel® Software Guard Extensions (Intel® SGX) is one of the technologies enabling Confidential Computing today. The technology enables new cloud use cases such as Multi Party Computation, Privacy Preserving Machine Learning and many others spread across industries that are dealing with privacy of data on a daily basis. It is the most tested, researched and deployed hardware-based Trusted Execution Environment on the market.⁶

Intel SGX offers hardware-based memory encryption that isolates specific application code and data in memory. Intel SGX allows user-level code to allocate private regions of memory, called enclaves, which are designed to be protected from processes running at higher privilege levels. Only Intel SGX offers such a granular level of control and protection.⁷

The solution provided by Aggregation implements Confidential Computing with Intel SGX to protect retail data while it is being processed.

Figure 4. Intel® SGX – A hardware-based security solution



Direct attack vectors (common)
Malware, Rogue admins, Privilege escalation

With Intel® SGX, the app talks directly to the encrypted enclave on the processor, providing additional protection from potential threats targeting the OS/VMMs

Intel® SGX helps isolate data in use from the OS/VMMs that are targeted by direct attacks

Deployment at Magnit

Magnit is one of Russia's largest retailers with over 20,000 stores. It implemented the Aggregation solution along with another data provider, an online payment processing operator that gave a combined customer base of 70 million. The combination of the two partners allowed the retailer to expand its advertising audience – for example, buyers of children's goods offline and online. It also enabled it to implement more complex advertising scenarios, such as advertising coffee beans to the owners of coffee machines.

The campaign preparation time was reduced from one week to just 10 minutes, with a significant increase in the accuracy of the audience selection. With the use of reporting on the effectiveness of the campaign, it became possible to validate the audience and campaign parameters during campaigns. This acceleration of the process allowed Magnit to increase the number of commercial campaigns by an order of magnitude. According to the results of the first quarter of use, just over 200 advertising campaigns were carried out.

After a successful start, Magnit's own marketing team also began to use the platform to target and measure the effectiveness of their campaigns. Magnit's digital ads are now only targeted to relevant audiences. For example, promotions for baby products are shown only to customers with children, while information about the opening of a new store is shown only to those who live in the same neighbourhood. This allows the retailer to save on impressions and achieve greater coverage of the target audience.

Future Direction

Magnit is considering incorporating IoT sensors into the platform to capture product availability on shelves and customer choice within the store, as well as including digital

signage as a stand-alone advertising space. The audience of the retailer's stores is 12-15 million people every day, which makes it comparable to the largest television channels. In general, the platform's services establish direct (and seamless) interaction between the retailer and the brand, delivering all types of communications.

Conclusion

Retailers understand the needs of modern shoppers and are making fundamental changes to be flexible and to provide the best service to their customers. Personalised advertisements, offers and discounts make the customer feel special and, when done properly, they can deliver a significant business advantage to retailers.

Aggregation has implemented a solution that many in the advertising field would have considered impossible. The strategy of building the solution as a decentralised platform has paved the way to use Confidential Computing to securely³ manipulate data from various partners. The ability to increase the efficiency of identifying the target audience and launching campaigns has a direct correlation to the retailer's bottom-line. The ability to do this with high accuracy and speed will be a differentiator and of high strategic importance to retailers. The clever use of blockchain technology – and the definition of the rules of execution with smart contracts – makes it possible to track every transaction accurately without sharing third-party data.

Learn More

You may find the following resources useful:

- [Intel SGX Enables Magnit to Create a Trusted Computing Environment](https://www.forbes.com/sites/larrymyler/2016/06/08/acquiring-new-customers-is-important-but-retaining-them-accelerates-profitable-growth)
- [Intel® Software Guard Extensions \(Intel® SGX\)](https://www.researchgate.net/publication/232643232_Impact_of_Repetitive_and_Contextual_Advertisements_on_Consumer_Behavior_An_Exploratory_Study)
- [Confidential Computing Consortium](https://www.intel.com/content/www/us/en/security/confidential-computing.html)
- [Retail Technology by Intel®](https://www.intel.co.uk/content/www/uk/en/architecture-and-technology/software-guard-extensions.html)

1 <https://www.forbes.com/sites/larrymyler/2016/06/08/acquiring-new-customers-is-important-but-retaining-them-accelerates-profitable-growth>

2 https://www.researchgate.net/publication/232643232_Impact_of_Repetitive_and_Contextual_Advertisements_on_Consumer_Behavior_An_Exploratory_Study

3 No product or component can be absolutely secure.

4 <https://www.infosys.com/newsroom/press-releases/documents/genome-research-report.pdf>

5 <https://www.intel.com/content/www/us/en/security/confidential-computing.html>

6 <https://www.intel.com/content/www/us/en/security/confidential-computing.html>

7 <https://www.intel.co.uk/content/www/uk/en/architecture-and-technology/software-guard-extensions.html>



AGGREGION

