CUJOAI

THE DEVICE INTELLIGENCE REPORT 2023

LATEST TRENDS AND GROWING EXPECTATIONS
FOR CONNECTED EXPERIENCES

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INTRODUCTION

The rising use of privacy-enhancing technologies, while beneficial for users, is obfuscating devices and posing notable challenges for network service providers (NSPs). While these providers can still identify and manage devices on their networks using existing techniques, they face difficulties in achieving direct engagement with consumers and optimizing their services.

Despite being able to maintain operations and identify maintenance needs, their capabilities are limited in terms of automation, enhancement, and optimization. Therefore, there is a pressing need for sophisticated, reliable, and innovative methods of device identification that can facilitate better consumer engagement and improve performance.

By addressing the complexities introduced by privacy-enhancing technologies, such as hidden hostnames, randomized MAC addresses, reduced user agents, Private Relay and VPN use, and other obfuscation techniques, CUJO AI Explorer empowers the telecommunications industry with a robust framework for device identification. This comprehensive solution not only maintains user privacy but also ensures seamless network operations, allowing service providers to deliver a high-quality experience to their customers.

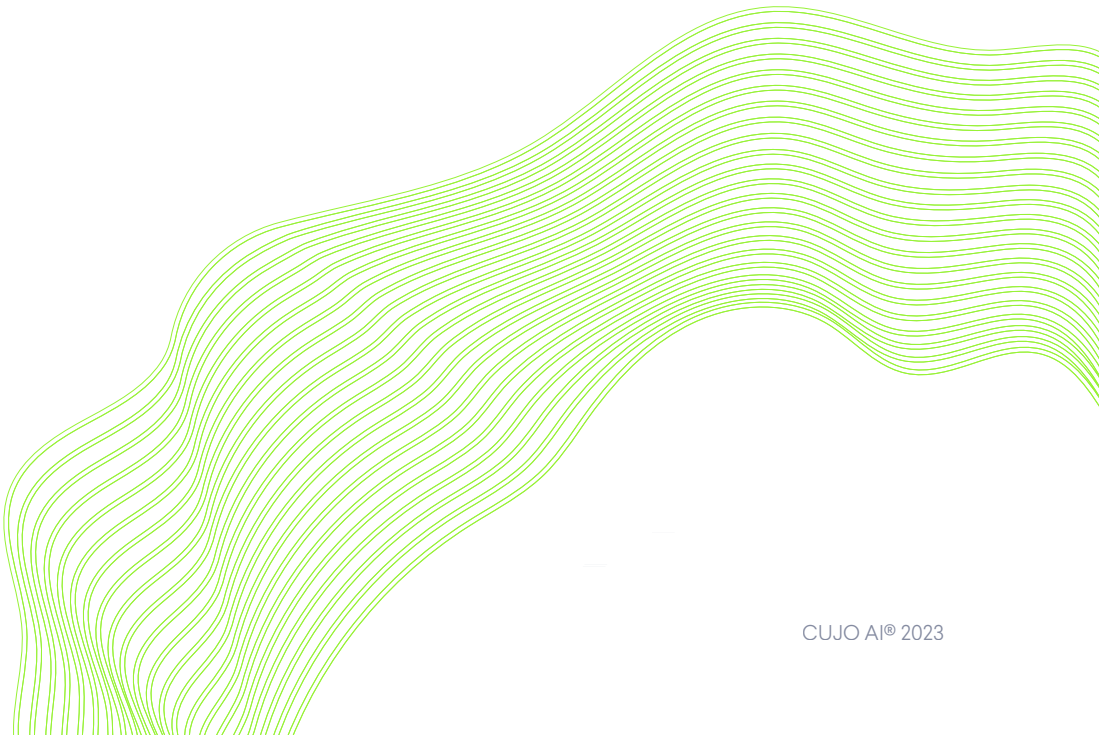
In 2023, **90% of new attended devices**, including smartphones and computers, issued randomized MAC addresses, obfuscating key data points that many network service providers use to identify devices. Currently, randomized MAC addresses are used by devices **on over 95% of home networks**. Devices also use a different randomized MAC address for every SSID on networks with multiple Wi-Fi SSIDs.

Our estimates show that other data points for device identification are also being obfuscated: around 50% of attended devices provide reduced user agent data, while 30% hide their hostname, in addition to around 15% of devices that connect via virtual private networks (VPNs) and 10% that are already using Apple's Private Relay.

As the leading device identity provider for network service providers, CUJO AI has successfully identified more than 2 billion devices. Our device identification algorithms analyze connection metadata to identify and classify device types and models. We use device identification to enhance the protection of certain device types from cybersecurity threats targeting them.

Furthermore, we supply device identities and contextual information (e.g., 4K streaming capability) to network service providers seeking to help them monitor, evaluate, and improve their service quality. CUJO AI Explorer currently assists network service providers to ensure that parental controls, Wi-Fi experience improvements and other services are delivered to hundreds of millions of devices every day.

This comprehensive report spans the period from April 1, 2022, to April 1, 2023, and is based on device identification data gathered by CUJO AI Explorer. Brought to you by CUJO AI Labs, this third annual report showcases the transformative potential of artificial intelligence in the telecommunications industry. The report offers extensive data about device popularity and notable brands, enabling network service providers to leverage device intelligence data from their networks for unparalleled insights and informed, data-driven decision-making.



INTRODUCTION

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LEADING BRANDS: DOMINANT PLAYERS IN THE CONNECTED DEVICE MARKET

During the last year[1], consumers connected more than 22,570 uniquely identified device models to home networks monitored and protected by CUJO AI. The entire connected device landscape is vast and changing, with minor brands and niche devices emerging every month. Nevertheless, consumers continue to buy and use most devices from the 5 leading brands: Apple, Samsung, Amazon, Google, and LG. It is also notable that among these brands only Amazon has a more diverse roster of popular devices types.

The top 5 connected device brands and their most popular device types

Apple	1. Smartphones 2. Tablets 3. Smartwatches
Samsung	1. Smartphones 2. TVs 3. Tablets 4. Smartwatches
Amazon	1. Voice control devices 2. Streaming video devices 3. Tablets 4. E-readers
Google	1. Voice control devices 2. Smartphones
LG	1. Smartphones 2. TVs 3. Tablets

[1] *Here and everywhere else in the report 'last year' means the period covered by this report (between 1 April 2022 and 1 April 2023).*

Consumer trust in **Apple** is unsurprising, as the company has a very strong and interoperable ecosystem, with a focus on a seamless user experience. Our previous reports noted how popular the iPhones and Apple Watches were, when compared to their competition.

Samsung is in a strong second position with a similar portfolio of the most popular connected devices, with a notable addition of smart TV devices. The company has a very diverse device offering and has recently expanded its foothold in the kitchen appliance category.

Amazon has the most unique device portfolio, which includes its Echo and Kindle device lines. Note that Ring, which is a consumer favorite among dozens of connected camera brands, is treated as a separate brand in this report.

> We also see that consumers are choosing more Sony devices, which means that we might see the brand in the top 5 soon.

While smartphones, personal computers, tablets, smart TVs, and voice control devices continue to make up the majority of all connected devices, hundreds of brands are focusing on smaller IoT niches, as we discuss in the section on the connected device landscape (page 12).

Since our data suggests that consumers chose these brands when buying connected devices, we wanted to get a deeper understanding of whether some consumers actually preferred one to the other.

Examining Brand Loyalty: Consumer Commitment to the Leading Connected Device Manufacturers

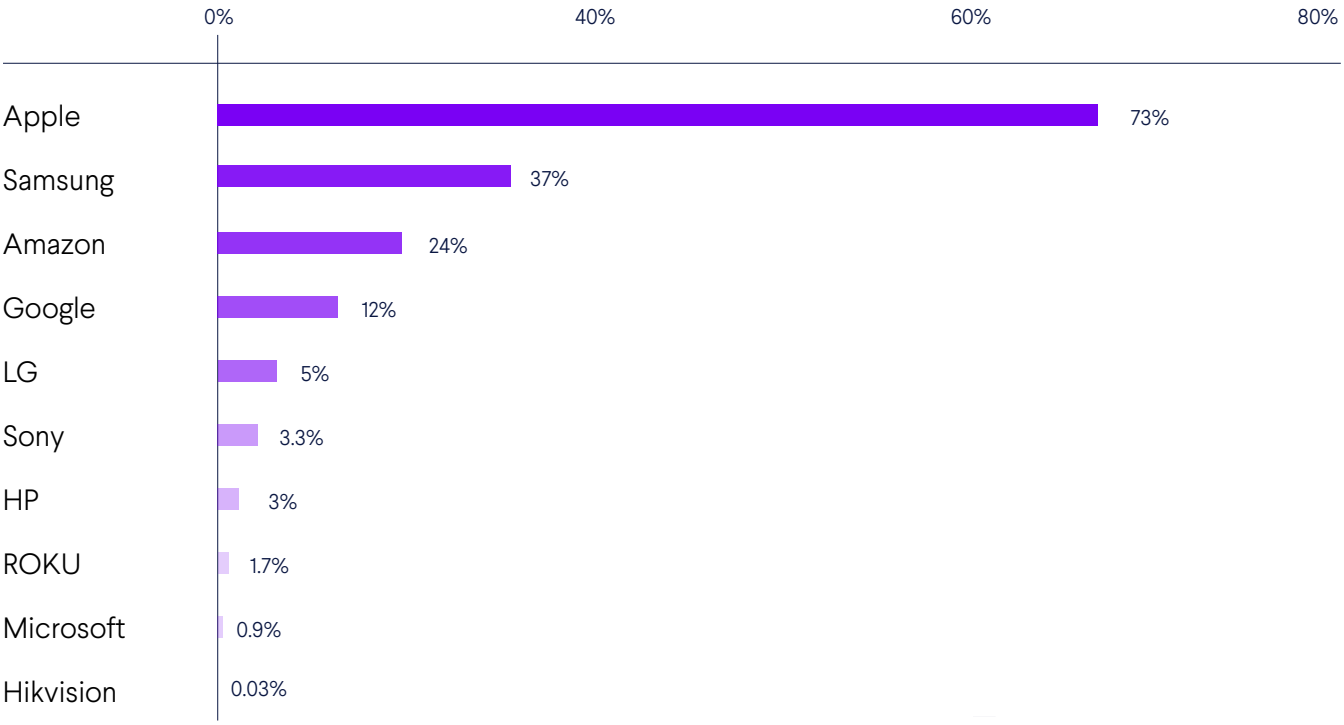
Brand loyalty goes beyond buying the same phone brand for everyone in the household. True brand trust involves using a diverse range of devices and appliances from a single manufacturer. This year, we looked at how many households used two or more different device types from every brand.

Our findings revealed that consumers used a variety of devices from only the very most popular brands: 73% of households had two or more different device types from Apple, showing how strong the brand's device ecosystem is.

Almost two times fewer, 37% of homes, had at least two different types of Samsung devices, and we expect this number to grow as Samsung continues its focus on smart appliances.

How Many Homes Have Two or More Different Device Types

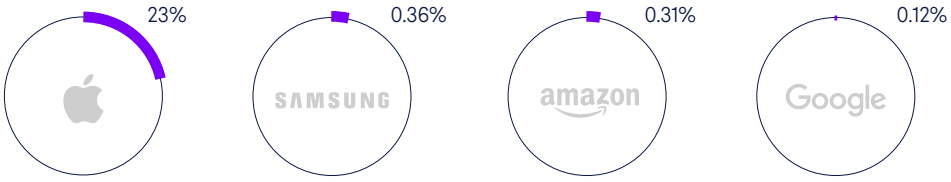
From Each of the Top 10 Most Popular Brands



Some consumer homes were essentially committed to a single brand: we discovered that 25% of households owned five or more different device types from a single brand. Here, Apple emerged as the unrivaled leader, with 23% of homes possessing five or more different types of Apple devices.. In contrast, Samsung and Amazon were as prevalent in just 0.36% and 0.31% of households, respectively. This data shows that some consumers would likely be more receptive to a product bundle only if it included their preferred brand and type of device.

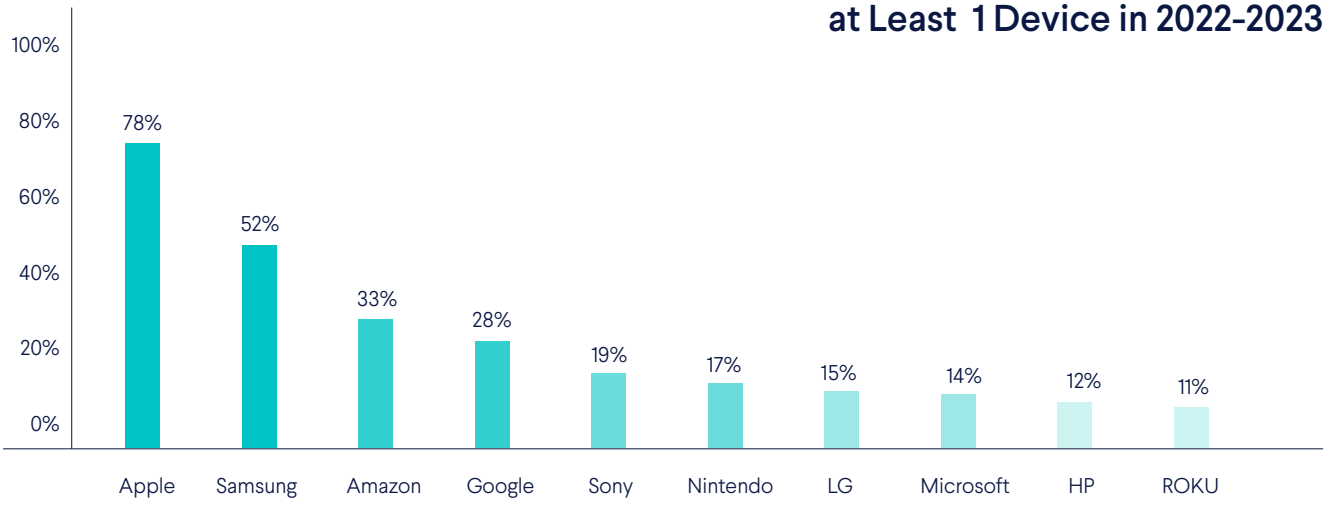
How Many Homes Have Five or More Different Device Types

From Each of the Top 4 Most Popular Brands



Furthermore, we investigated the percentage of homes that connected at least one device from the top 10 brands last year. Apple dominated with a 78% presence, followed by Samsung in more than half (52%), and Amazon devices in almost a third (33%) of the homes. It is notable that consumers connected more devices from Sony and Nintendo than LG.

How Many Homes Connected at Least 1 Device in 2022-2023



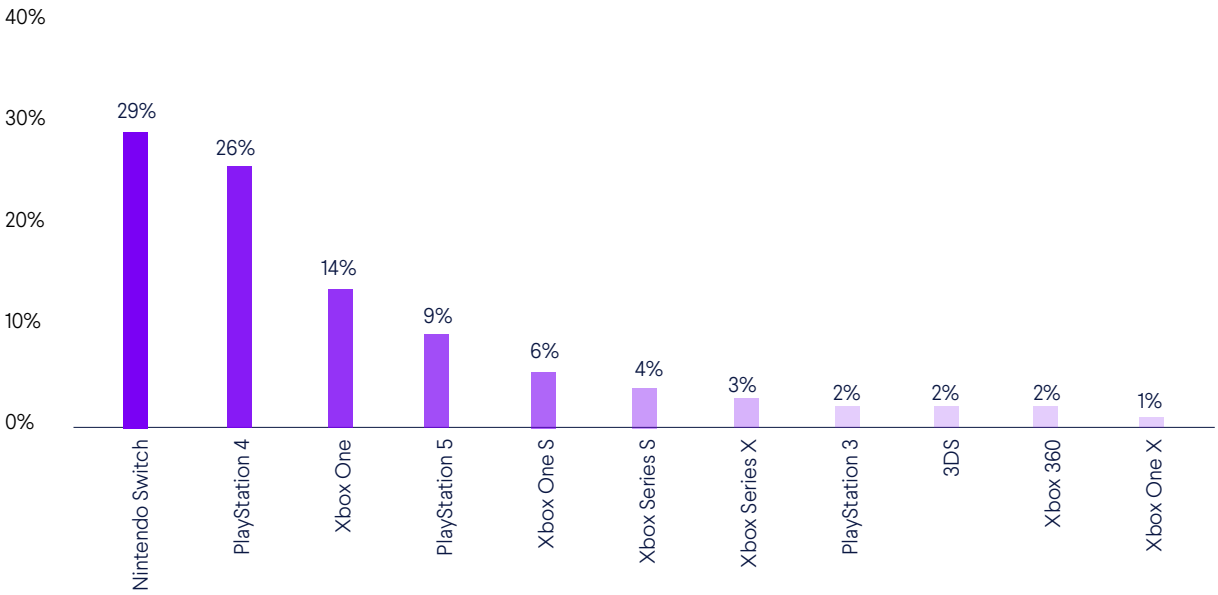
These findings show the commitment and trust that consumers place in leading connected device manufacturers. If we look at the connected device landscape as going beyond individual purchases, we see consumers embracing diverse device types from a handful of brands and creating connected ecosystems that enhance their daily lives.

As brands continue to innovate and expand their product offerings, maintaining and fostering connectivity for each device will be paramount for network service providers. Brand loyalty and adoption data can provide a solid basis for developing new products, device bundles, and personalized services to those end-users who are most likely to need and want them.

Console Wars and Brand Loyalty

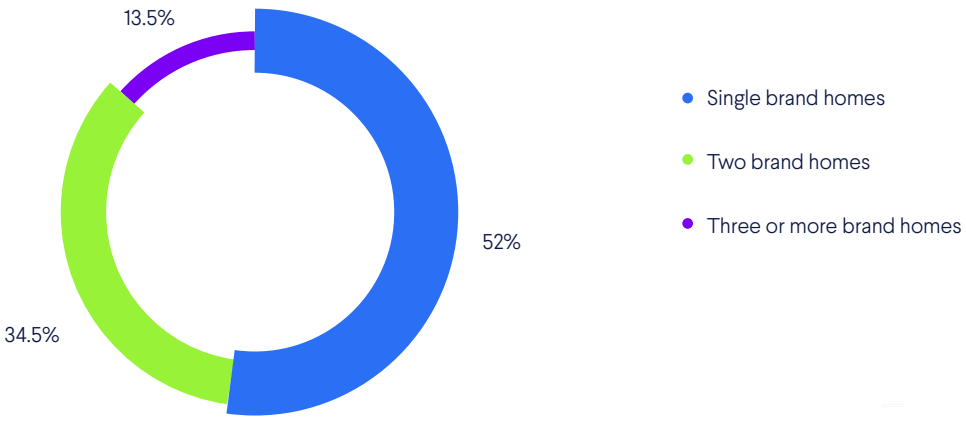
Almost 51% of home networks have at least a single gaming console, and Nintendo Switch is the most popular console with close to 29% of the market.

The Most Popular Gaming Consoles



To examine how loyalty played in the gaming space, we investigated the number of households that were loyal to a single brand and discovered that **48% of gaming households use gaming consoles from two or more brands**. A smaller segment, 13.5%, have consoles from three or more brands.

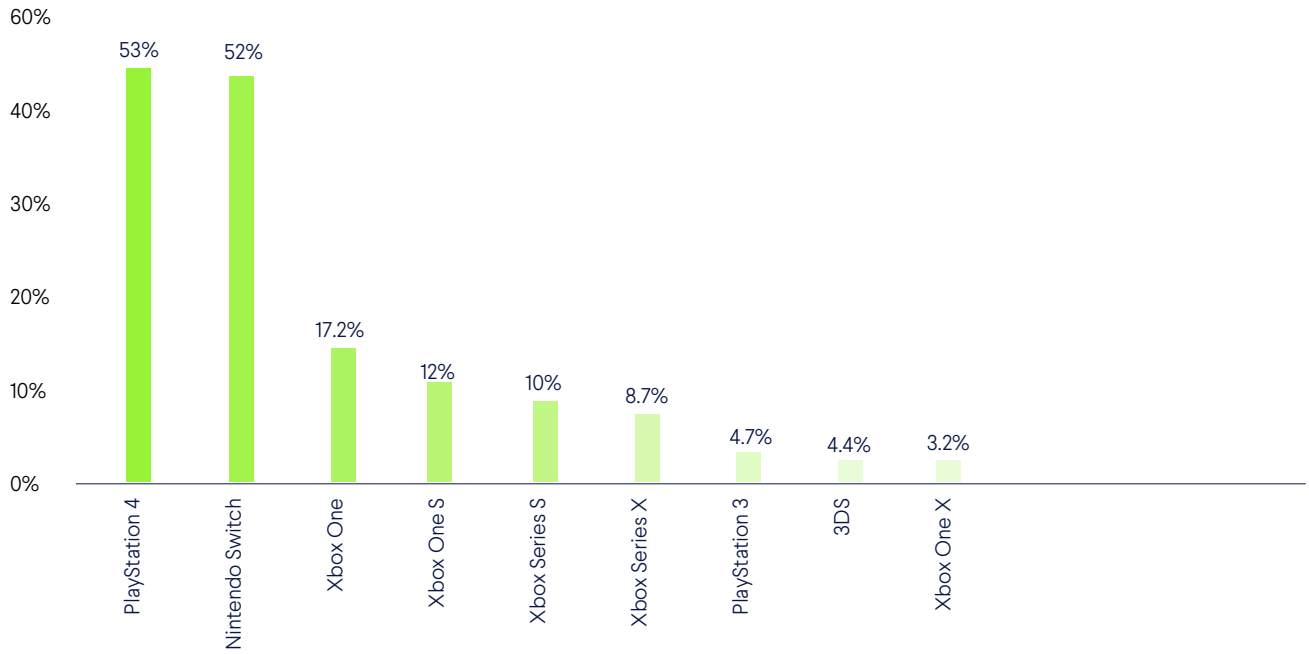
Gaming Console Brand Loyality



This data shows how CUJO AI Explorer can be used to analyze a customer segment and identify business opportunities: knowing which homes use a gaming console can help a network service provider decide which end-users are most likely to respond to a product bundle that offers a gaming console. For example, would offering a PlayStation 5 with a service upgrade entice gaming households that owned Xbox or Nintendo consoles?

To answer this question, we examined the 2022-2023 data on PlayStation 5 purchases and observed that most buyers upgraded from a PlayStation 4. Interestingly, over half of these new PlayStation 5 owners also had a Nintendo Switch. Additionally, a considerable percentage of households had Xbox consoles, indicating a trend of multi-brand ownership in the gaming community, and highlighting the diverse gaming preferences and interests of consumers. Gamers are thus likely to respond to device offers from other brands, as well as services that would allow them to access a wider range of games, features, and exclusive titles.

New PlayStation 5 Owners Also Used



The gaming console market continues to have a healthy competition among manufacturers, but we clearly see that brand loyalty and the notion of 'console wars' only takes it so far: many gaming households are open to exploring other platforms. Seeing how more than half of all homes are playing games, network service providers need to focus their efforts and provide the best connected experiences for these latency-sensitive and bandwidth-intensive use cases.

> Thanks to AI-driven device intelligence, network service providers can unlock and access the data that gives them a much better view of how and why their networks are being used on a per-device level. Seeing how trends develop in the connected device market, service providers can offer personalized, relevant product and service offers to their end-users.

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THE CONNECTED DEVICE LANDSCAPE

THE CONNECTED DEVICE LANDSCAPE

CUJO AI Explorer gives network service providers a clear view of what types, brands, and models of devices their end-users use. This data allows providers to gain insights about how trending connectivity use cases might impact their service quality, as well as discover new opportunities for value-added services, in addition to proactive network maintenance that suits the capabilities and needs of their devices.

The past year witnessed a surge in popularity for several device categories, indicating the evolving consumer preferences and the increasing integration of technology into various aspects of everyday life.

Among the standout categories, kitchen appliances showed remarkable growth, nearly **doubling in popularity** on a year-over-year basis. Additionally, baby monitors, pet devices, energy management devices, and connected cars also experienced over 30% growth in popularity during the same period.

Device Categories That Gained The Most Traction in 2022-2023

The Matter IoT Standard

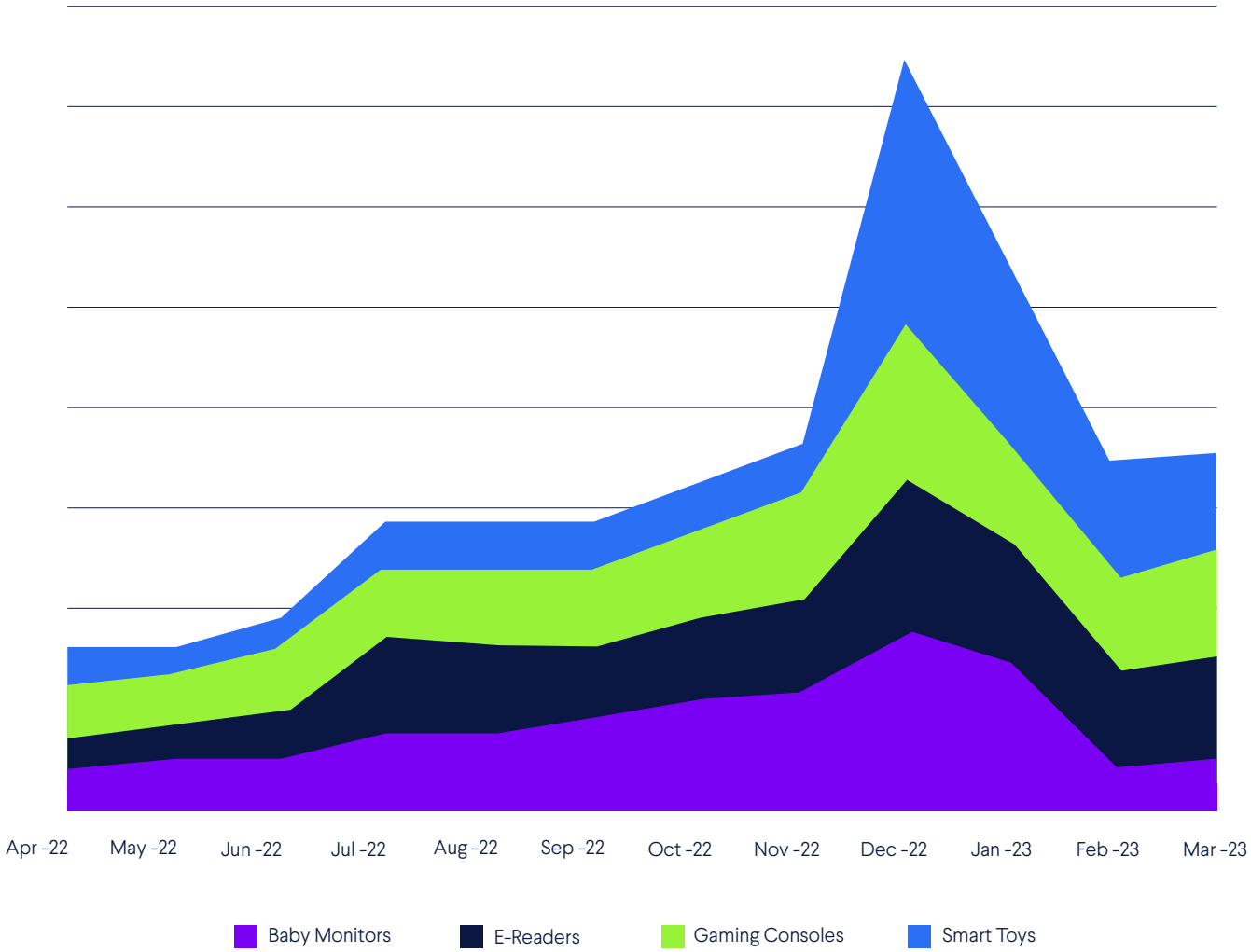
Matter, the open-source IoT standard, currently has very low adoption, but 79.91% of homes that do use Matter devices connect more than one Matter-compatible device.

The growth of these device categories reflects the increasing integration of technology into various aspects of daily life. As consumers seek convenience and efficiency, their expectations for connected experiences also evolve with every new feature and functionality. The trends we observe every year indicate a continued demand for smart and connected solutions across multiple sectors.

During the holiday season, which spans from late November to the end of December, consumers connected significantly more new devices. According to our data, new device connections increased 19% in November and 25% in December. Several device categories witnessed significant boosts during the holiday season, notably baby monitors, e-readers, smart toys, and gaming consoles.

As we've noted in previous device intelligence reports, the holiday season is the best indicator of the prevailing device trends in the market, as consumers seek out the best deals on devices that enhance their convenience, entertainment, and personal well-being. Some categories of devices continue to show strong surges every year, which can give network service providers valuable insight into what types of use cases they need to prepare for before, during and after the holiday season.

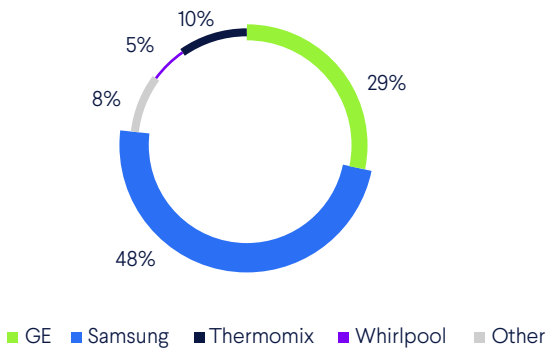
The Holiday Season Boost



Kitchen Appliances: The Most Rapidly Growing Category of IoT Devices

Last year, kitchen appliances became the fastest-growing IoT device category. To gain deeper insights into this booming sector, we conducted an analysis of the most notable brands within the IoT kitchen appliances market. Our findings reveal that Samsung has overtaken GE for the leading position.

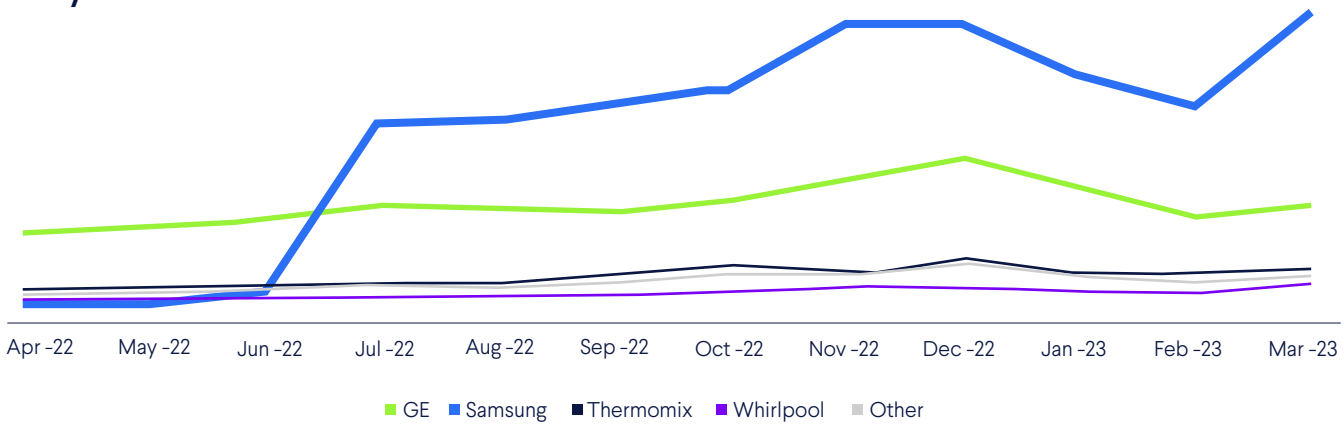
New Kitchen Appliances Connected Last Year



This year's data shows how Samsung's pivot towards more connected appliances has allowed them to grab almost half of the connected kitchen appliance market. Samsung's ascendancy in the kitchen appliances IoT market is marked by their extensive product portfolio, which includes smart refrigerators, ovens, dishwashers, and other essential kitchen devices. Their newest appliances are equipped with advanced connectivity features.

As a result, the 95% increase in this device category is mostly attributable to Samsung (and to a lesser extent GE).

New Kitchen Appliances Connected Every Month



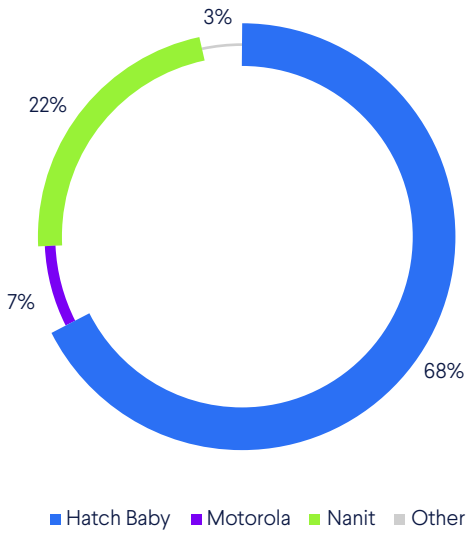
Since the IoT device sector is known for major security issues, network service providers should pay close attention to the connectivity patterns of these devices and offer their end-users cybersecurity solutions such as CUJO AI Sentry, that provides robust AI-driven protection to all devices on the home network.

Baby Monitors: Significant Growth Driven by Key Brands and Holiday Season Demand

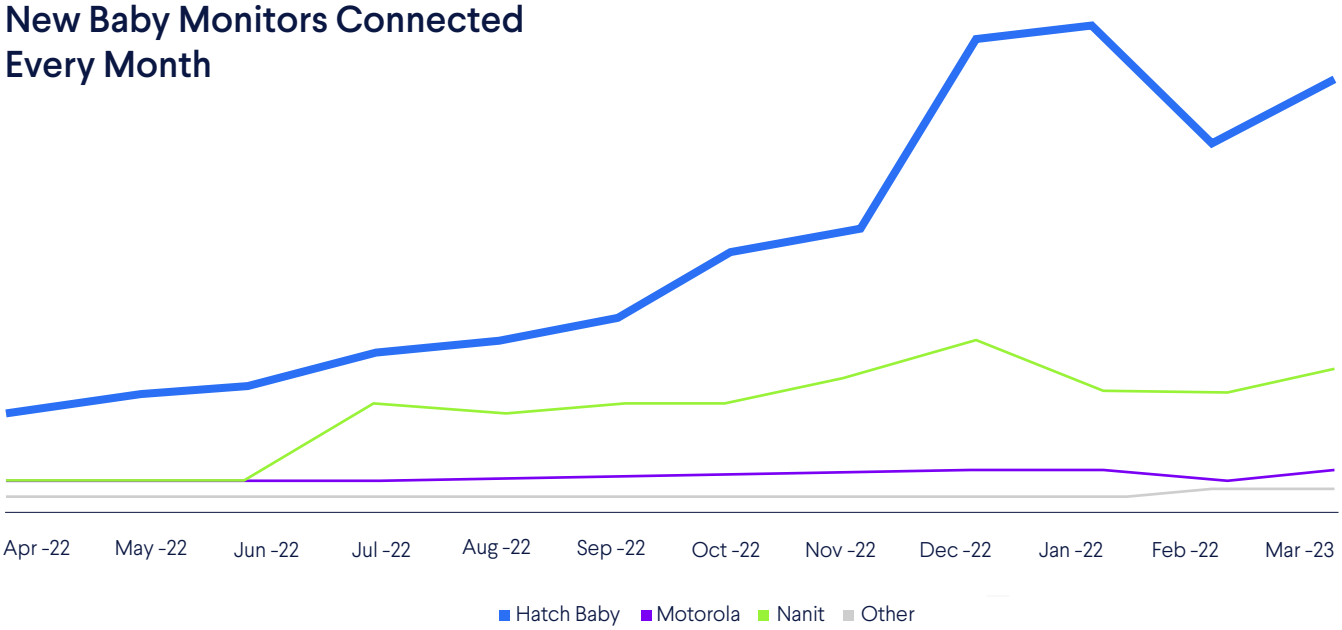
50% growth in a single year is a significant change in the baby monitor category.

Our data shows that two brands are responsible for the change: Hatch Baby and Nanit. Motorola also grew by almost 60% but has a much smaller device population. Baby monitors continue to be some of the most popular devices during the holiday season.

New Baby Monitors Connected Last Year



New Baby Monitors Connected Every Month



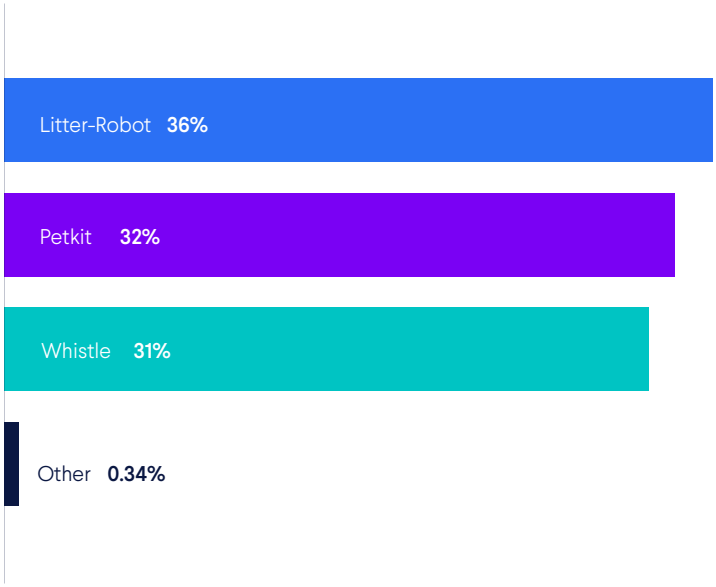
A New Product Propels the Connected Pet Device Category

Pet devices, although a niche market, have been gaining popularity in recent years, as people increasingly turn to technology to assist with pet care. These devices range from smart feeders and water dispensers to health monitors and GPS trackers.

The connected pet device market is heavily dominated by a few brands. The top three brands account for over 99% of all connected pet devices, underscoring the nascent state of this market. This year, the release of Litter-robot 4 was the main growth factor in the category.

As pet owners seek more efficient and convenient ways to care for their furry friends, it's likely that we'll continue to see new releases and innovations in this niche market.

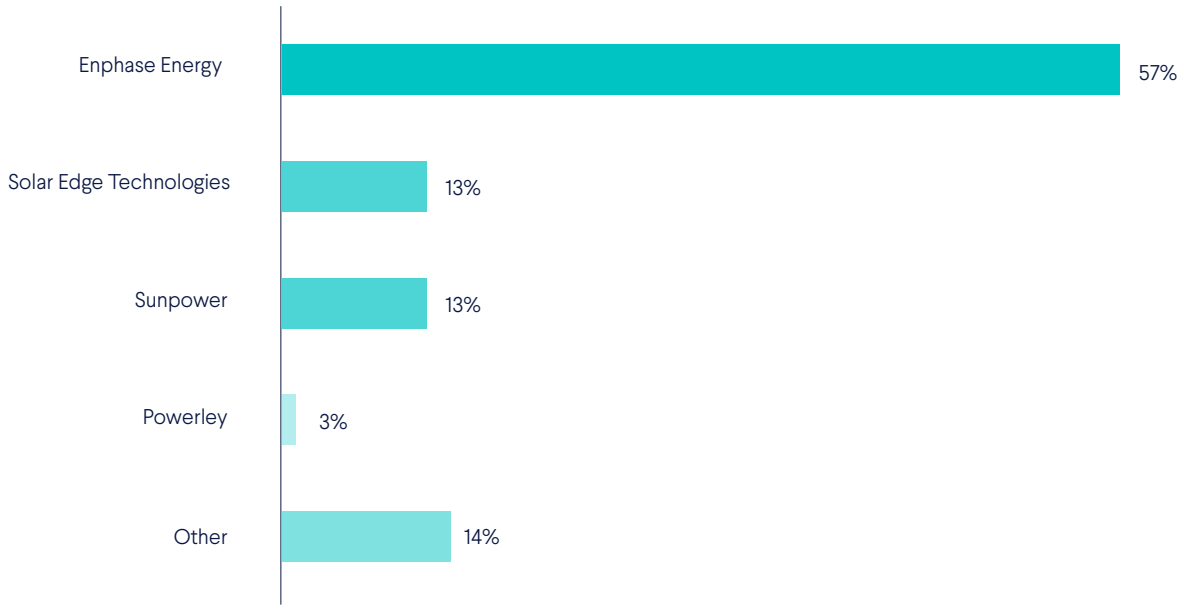
Pet Devices Connected Last Year



Energy Management Devices Continue to Gain Steam

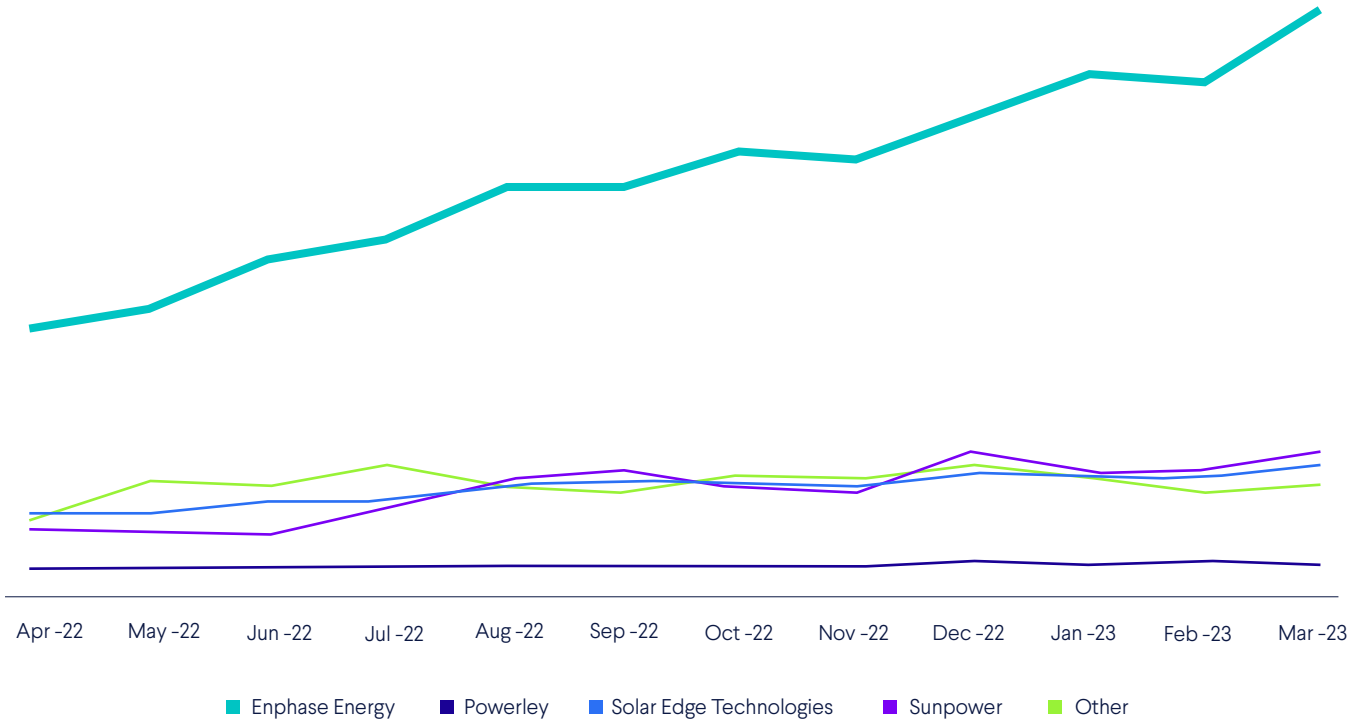
The energy management sector has been experiencing steady growth, as evidenced by the findings in the previous year's report. One dominant player in this category is Enphase, which has grown to a substantial 56% market share. Enphase has achieved remarkable progress, nearly doubling its average monthly connected device numbers over the course of the year.

Energy Management Devices Connected Last Year



SunPower, a key player in the energy management category, experienced impressive growth of over 100% within the past year, overtaking SolarEdge which grew by around 50%. While Tesla, Powerley, and EcoFlow have fewer devices in use, they have shown strong growth in this category as well.

Energy Management Devices Connected Every Month



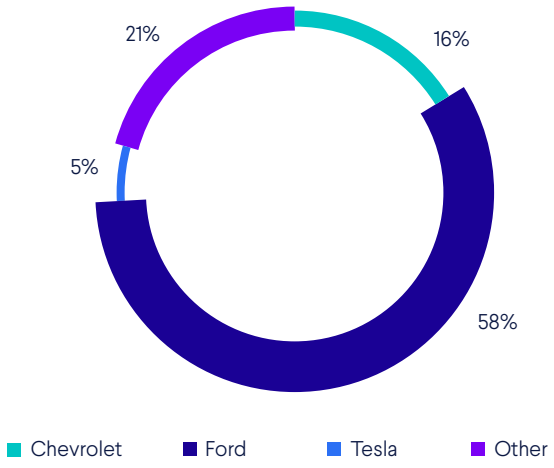
As more consumers produce solar energy and seek out other energy-saving solutions, network service providers have an opportunity to offer connectivity plans suited for remote panels and create partnerships and product offerings with energy management manufacturers.

> The continued growth of this device category clearly shows that there is an opportunity to offer end-users ways to effectively monitor and control their energy usage, ultimately leading to reduced environmental impact and lower energy bills.

Connected Cars Growing in Number

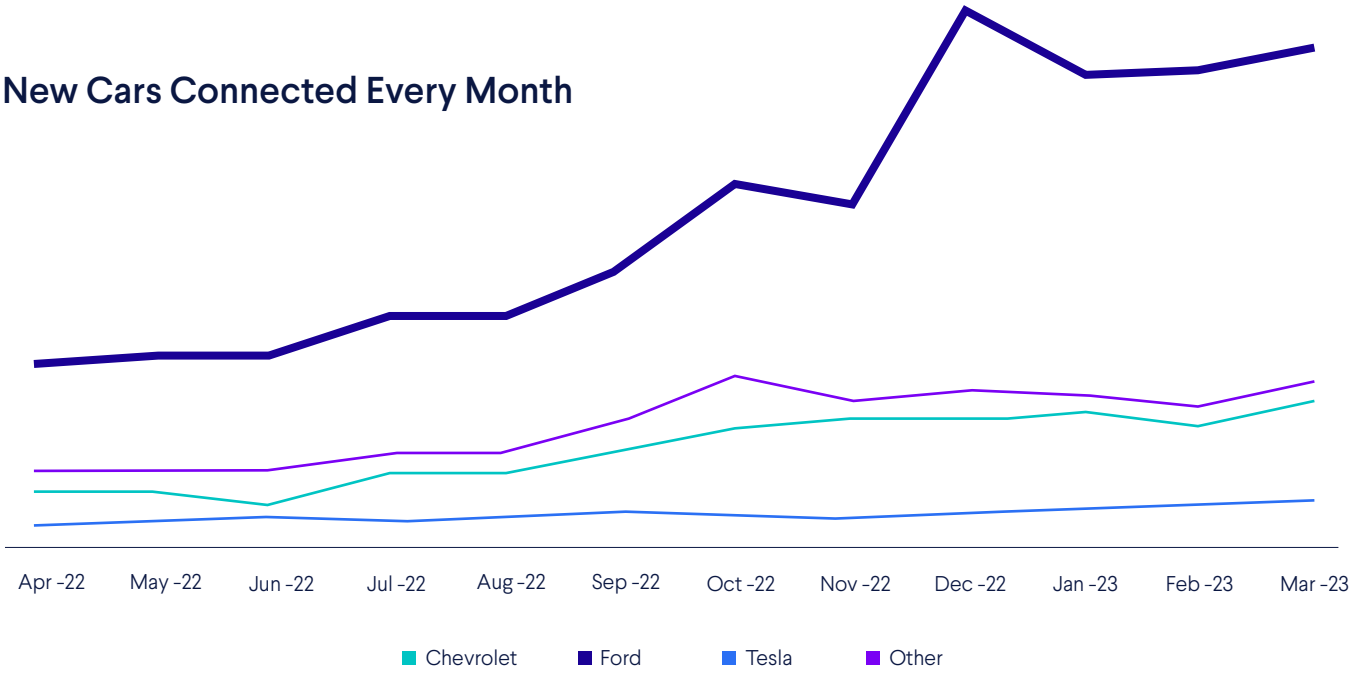
The connected car market has witnessed significant expansion, with Ford emerging as the frontrunner in terms of the sheer number of new connected vehicles throughout the year. Chevrolet and Tesla have also shown sustained growth in this category. As consumers increasingly seek out more technology in their vehicles, the demand for connected car features is likely to continue growing, with more brands entering the market and new innovations emerging.

New Cars Connected Last Year



Connected vehicles are a steadily growing device category that is opening new partnership opportunities where network service providers can offer connectivity solutions to car manufacturers for over-the-air updates and other services.

New Cars Connected Every Month

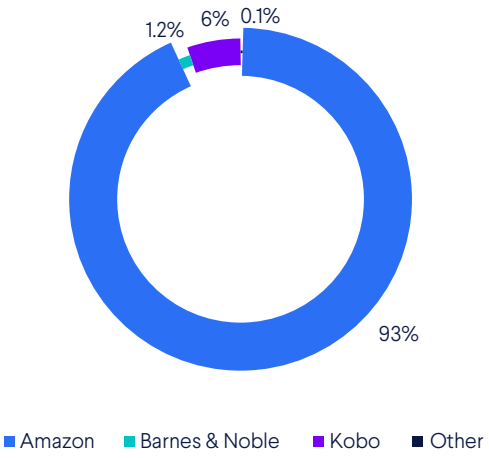


Since both established manufacturers and new players in the industry are recognizing the importance of connectivity and are incorporating it into their vehicle offerings, the competitive connected car market offers good opportunities where partnerships with network service providers canbecome a differentiating factor.

The E-Reader Market Is Dominated by One Key Player

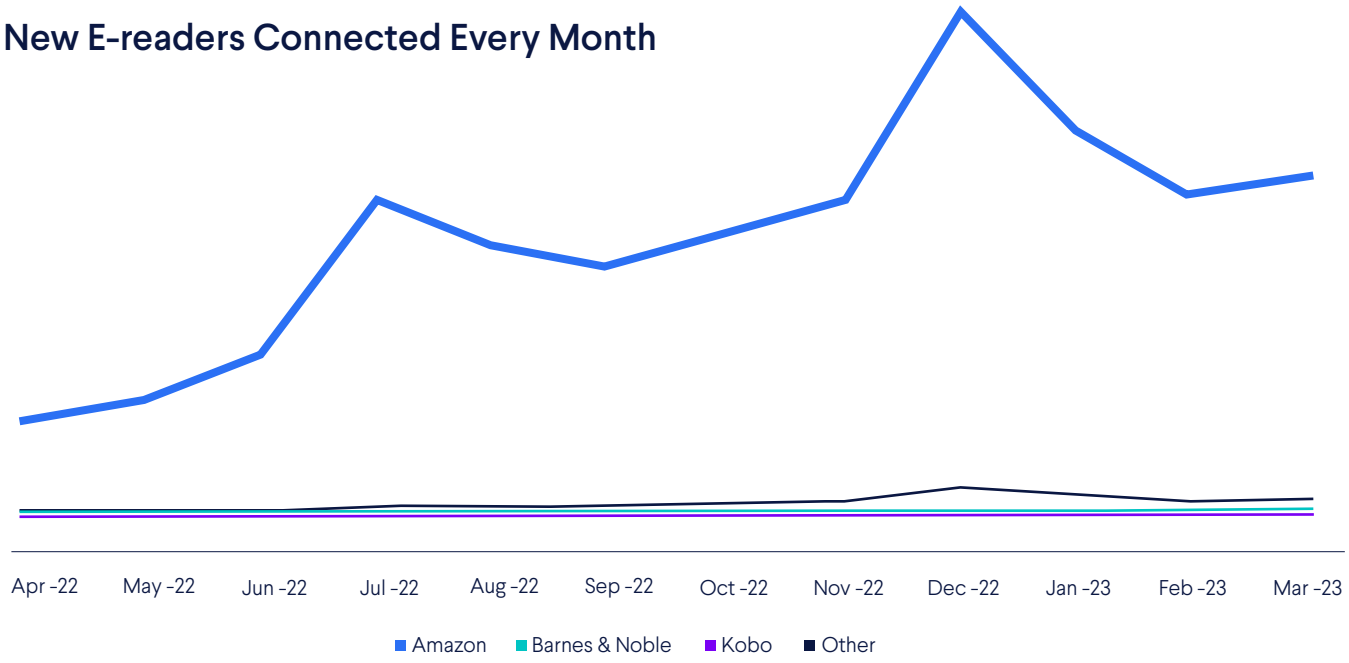
Amazon's Kindle devices continue to dominate the e-reader market, with a substantial lead over their closest competitor, Kobo. While other brands offer e-reader devices as well, Amazon's Kindle remains the top choice for most consumers.

New E-readers Connected Last Year



The popularity of both brands experienced a significant surge during the holiday season, with a notable increase in new devices connected. Additionally, the Kindle experienced considerable growth during the summer months, indicating that e-readers remain a popular device category throughout the year.

New E-readers Connected Every Month



The seasonal trends in e-reader popularity are also an opportunity to offer them as product bundles for new subscribers at the best time.

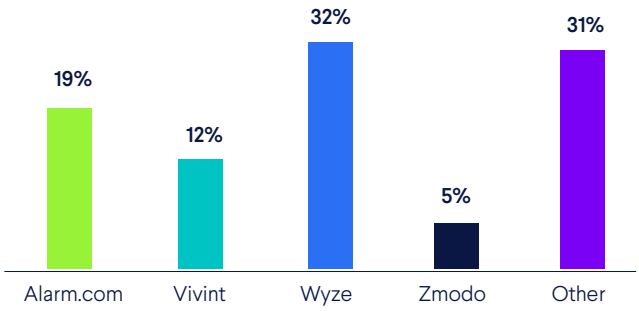
Smart Home Automation – A Diverse and Growing IoT Category

Smart home automation is a rather broad category of smart home devices, which includes dozens of brands. However, several key players are emerging as leaders in this space. Wyze, a relatively new player in the market, has experienced particularly strong growth and has been a major contributor to the overall growth of the category. In addition, established brands like Alarm.com and Vivint continue to grow rapidly, further driving expansion in the smart home automation market.

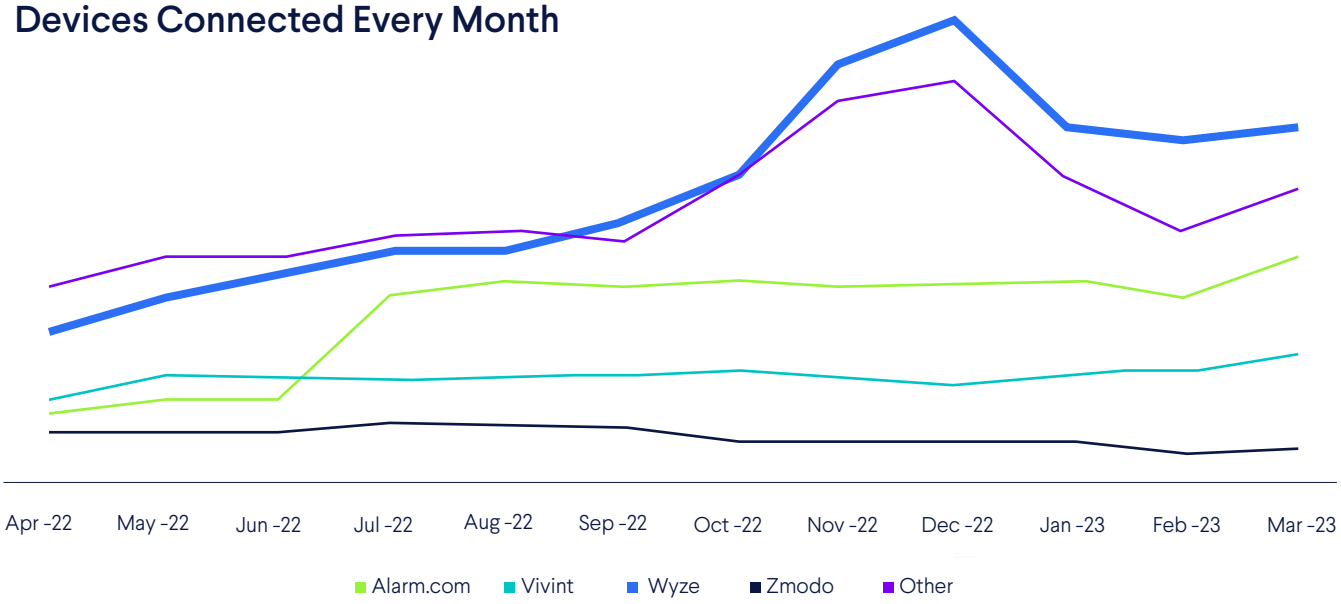
Some consumer homes are truly smart, with connected controls and automation for lighting and security systems, temperature regulation, entertainment systems, and more. These devices have a low threshold for the connected experience, and network service providers can optimize their connectivity, for example, by helping to move them to lower frequency wireless bands.

With the rapid pace of technological innovation in the smart home market, there is a significant opportunity for both established players and new entrants to capture market share and drive growth in the smart home automation category.

New Smart Home Automation Devices Connected Last Year



New Smart Home Automation Devices Connected Every Month



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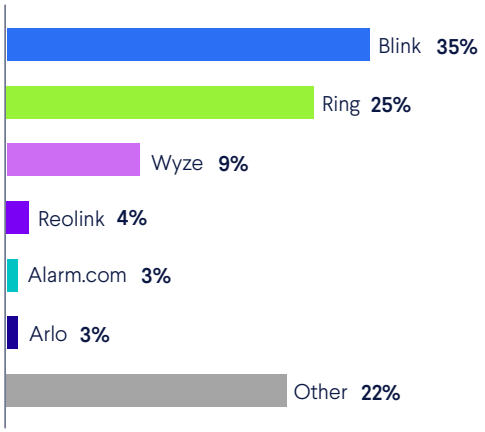
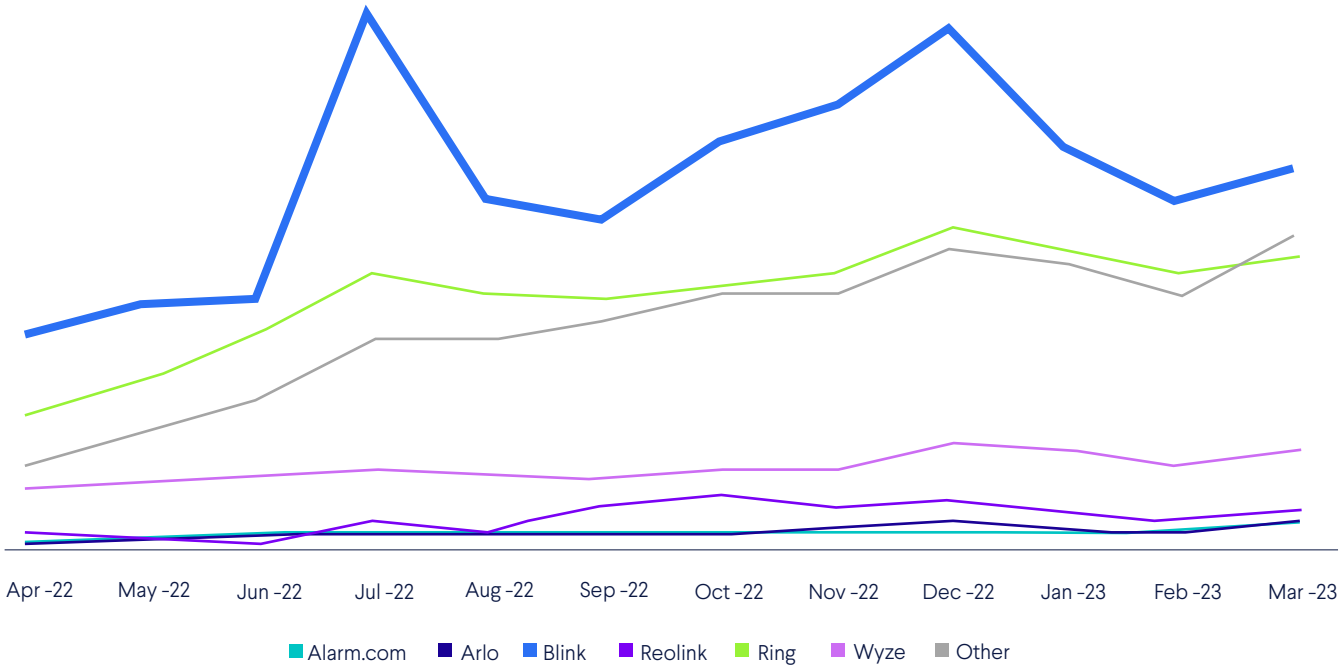
Connected Camera Market Sees Emerging Leaders

Cameras are some of the most problematic connected devices in terms of security. It is a popular category with a very diverse ecosystem, consisting of dozens of brands. Our data shows that Blink and Ring hold around 60% of the market. Wyze, a relative newcomer, holds a strong third position.

New Cameras Connected Last Year



New Cameras Connected Every Month

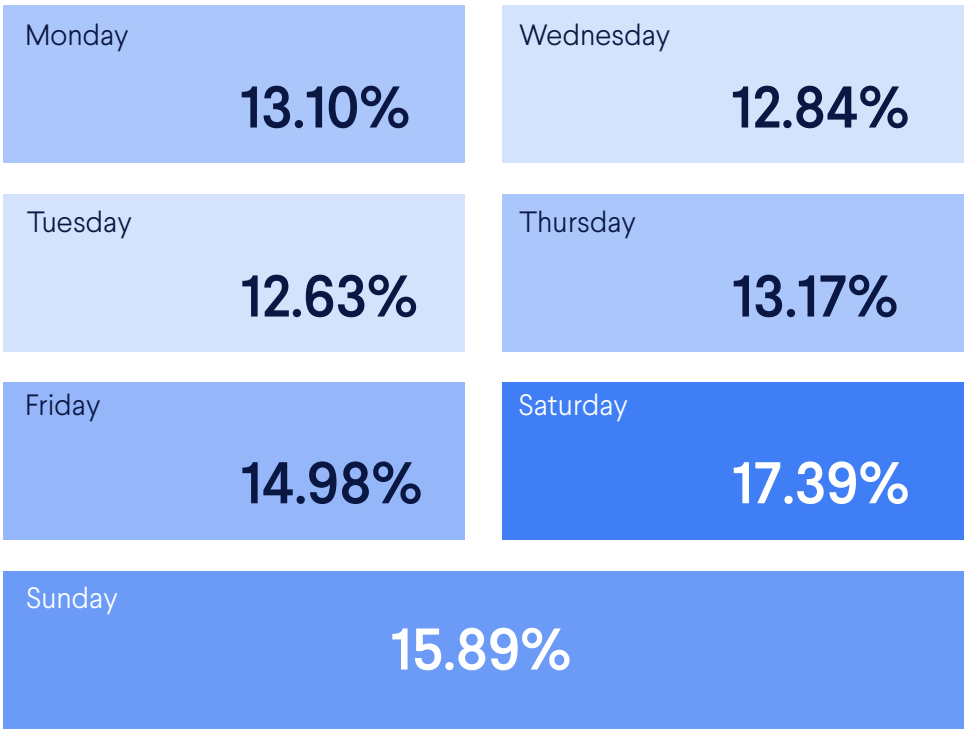


As most connected cameras address consumer security concerns, network service providers have an opportunity to offer these end-users in certain localities additional security measures, such as 5G connectivity for their security devices, as well as other security devices, such as smart alarms or smoke detectors.

When Are New Devices Connected?

Our data analysis of connected devices revealed interesting insights into which days of the week have the highest device connectivity.

Saturday proved to be the most popular day for new device connectivity, with 17.39% of all devices being connected on that day. Sunday followed closely behind, with 15.89% of devices being connected. In contrast, Tuesday had the lowest device connectivity with only 12.63% of devices being connected, followed by Wednesday with 12.84%.



> Half of the newly acquired devices are set up during weekends.

Overall, our findings suggest that weekends play a significant role in driving device connectivity, as people have more time to set up and explore new devices. The weekend is therefore a crucial time when end-users experience connectivity issues with those new devices and might need more guidance or help with trouble-shooting, which might directly impact the workloads of network service providers' customer care agents.

CONCLUSION

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CONCLUSION

The connected device landscape continues to evolve and grow, challenging network service providers to offer the best-connected experience for every single device. With a growing number of IoT devices, 51% of homes using low-latency gaming devices in addition to high-bandwidth smart TVs, remote work, and video conferencing, those who provide the best, personalized connected experiences will gain a major advantage in developing and offering new products to the market.

Device identification and contextual data about device capabilities is crucial to transforming the telecommunications businesses and surmounting the challenges posed by growing consumer expectations and technological advances.

To meet these growing demands and deliver personalized connected experiences, it is crucial for network service providers to have a deep understanding of device identification and contextual data about device capabilities. This information plays a pivotal role in transforming telecommunications businesses, enabling them to overcome the challenges posed by consumer expectations and technological advancements.

By harnessing precise device intelligence, service providers can make data-driven decisions and seize new business opportunities based on valuable insights into the unique characteristics and requirements of each device connected to their networks.

Our existing customers already use precise data about their networks to find new business opportunities, optimize costs, improve customer care, and develop products in a data-driven, personalized way.

Precise device intelligence can give network service providers a much-needed source of truth to base their decisions on:

Security and threat detection: Identifying devices is essential for ensuring network security and detecting potential cybersecurity threats. By accurately identifying devices, telecoms can monitor and analyze network traffic to identify and stop suspicious activities, potential malware infections, or unauthorized access attempts.

Quality of service: Telecoms strive to provide a high-quality experience to their customers while efficiently managing network resources. Device identification enables them to offer tailored services and support specific device capabilities, for example, 4K streaming or latency-sensitive use cases. Thanks to device intelligence, network service providers can speed up troubleshooting and enhance their understanding of the quality of service for every device.

Network planning and optimization: Accurate device identification data helps telecoms make informed decisions regarding network planning and optimization. By understanding the types and number of devices connected to their networks, they can plan network capacity, deploy infrastructure, and optimize network performance based on the specific requirements and usage patterns of different devices.

Personalized services: Device identification allows telecoms to offer personalized services and recommendations to their customers. By understanding the devices and their usage patterns, they can provide customized offers, recommendations, partnerships, and value-added services tailored to individual customers' needs and preferences.

Brand engagement: Thanks to device intelligence, network service providers can improve the customer experience by enhancing their native application with easier access to meaningful information about the status and service quality for devices connected to their networks, parental and network management controls, as well as relevant notifications, diagnostics, and self-care tools.

Precise device intelligence also enables network service providers to drive innovation and stay ahead of the competition in an ever-evolving market. By utilizing contextual data about devices, providers can proactively identify emerging trends, anticipate customer demands, and develop cutting-edge solutions that address the needs of their subscribers. This strategic use of device intelligence enables providers to future-proof their services and stay at the forefront of technological advancements, ensuring long-term success and growth.

About CUJO AI Explorer

CUJO AI Explorer is a stand-alone device intelligence solution for network service providers, which uses machine learning to identify device types, manufacturers, models, OS versions, and hardware capabilities. The largest network service providers in the world use Explorer to future-proof and optimize their core services and networks.

Explorer is able to identify more than 50,000 device models by analyzing connectivity metadata. It is a proven and versatile solution that has already identified more than 2 billion consumer devices on the largest telecommunications networks in the world and has enabled leading network service providers to shore up their operations and gain previously untapped insights about their networks and end-users.

About CUJO AI Labs

CUJO AI Labs is an advanced research department of CUJO AI specializing in IoT threat research and NSP customer cybersecurity. Labs researchers use the largest scale real-world device behavior database of over 2 billion anonymized consumer devices to empower advanced machine learning technologies that protect tens of millions of households around the globe. Every year, CUJO AI Labs publishes in-depth data-based reports, such as this one, on the IoT ecosystem and cybersecurity.

About CUJO AI

CUJO AI provides advanced multilayered cybersecurity and device intelligence as a product for Internet Service Providers, which allow them to protect end users' devices and home networks.

Major mobile and broadband providers partner with CUJO AI to offer security as a value-added service to their clients.

As the only platform of its type deployed to in tens of millions of homes and covering almost 2 billion connected devices, CUJO AI offers advanced AI algorithms to help its clients uncover previously unavailable insights and raise the bar on customer experience & retention with new value propositions and superior operational services.

Fully compliant with all privacy regulations, CUJO AI services are trusted by the largest broadband operators worldwide, including Comcast, Charter Communications, TELUS, Sky Italia, Rogers, Cox, Shaw, and Videotron.

More information: connect@cujo.com

Media inquiries: press@cujo.com

cujo.com