

MARKET RESEARCH NOTE

How the Bluetooth® Electronic Shelf Label Standard Will Impact the Smart Retail Market



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Andrew Zignani
Sr. Research Director

As senior research director for ABI Research’s Strategic Technologies team, Andrew conducts research into the rapidly changing wireless connectivity market, with an emphasis on market forecasts and qualitative insight covering Bluetooth technology, Wi-Fi, 802.15.4, near-field communications (NFC), HaLow, WiGig, and other emerging wireless standards and protocols. Andrew also writes reports on the technological evolution and long-term prospects for wireless connectivity technologies, particularly as they increasingly target new verticals across the Internet of Things (IoT).

Introduction

Electronic shelf labels (ESLs) have been on the market for over two decades, evolving from basic LCD displays with limited pricing and product information towards higher quality, multi-functional IoT platforms capable of enabling several customer-facing and back-end operational benefits simultaneously. Despite the enormous potential addressable market of tens of billions of labels across retail, warehouse, healthcare, and many other environments, electronic shelf labels have thus far been unable to reach their true market potential. Reasons for this limited penetration include hardware costs, inconsistent ROI, and limited awareness and education on the benefits of deployment.

Arguably, the biggest factor in this limited penetration has been the fragmented nature of the ESL market, which is comprised of a wide range of incompatible solutions and the lack of a unifying ESL standard. Many retailers have therefore been hesitant to adopt ESL solutions due to resulting concerns over vendor lock-in and no multi-vendor interoperability. This has limited their desire to deploy ESLs across all their stores and deploy additional smart retail use cases over time.

In the last few years, awareness of the benefits of ESL adoption has rapidly accelerated, with leading ESL vendors reporting record unit and revenue growth, large-scale deployments across multiple verticals, new entrants to the market, and growing penetration across regions traditionally hesitant to adopt these solutions. Demanded by retailers looking to digitize their retail operations, the recent arrival of the Bluetooth® Electronic Shelf Label standard has the potential to accelerate this market further. With a Bluetooth standard, new vendors can enter the market to streamline deployments, reduce the risks of vendor lock-in, and help to create an interoperable Bluetooth based ESL ecosystem that can address many of the challenges faced by retail and other environments.

What Are Electronic Shelf Labels?

ESLs are wireless, battery-powered e-paper displays that provide relevant information to the person reading them. This can include pricing information, product details, inventory and stock-levels, offers and promotions, and other contextual information and features. ESLs can provide an enhanced customer experience while delivering greater operational efficiencies for the business.

ESL Use Cases

As Figure 1 shows, ESLs can be applied across multiple verticals, including retail, warehouse and logistics, smart buildings, hospitality, and healthcare, among others.

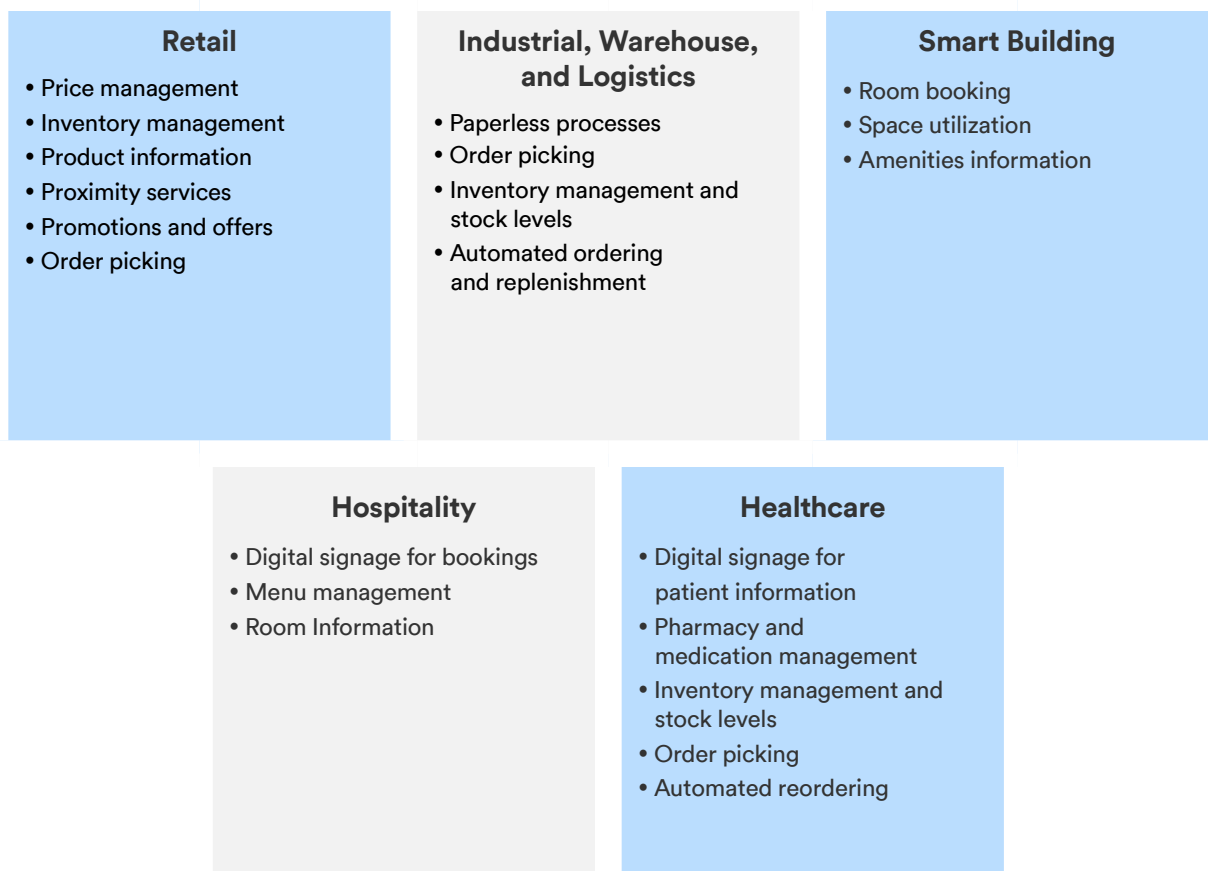


Figure 1: Electronic Shelf Label Use Cases by Vertical

ESLs can enable several use cases, including automated pricing, order picking, condition monitoring, proximity services, and product, occupancy, and asset information. However, it is the retail market which has dominated ESL deployments to date, and ABI Research expects this will continue to be the largest opportunity for ESLs for the foreseeable future.

Smart Retail Market Drivers

As Figure 2 demonstrates, brick-and-mortar retailers are facing a number of growing pressures.

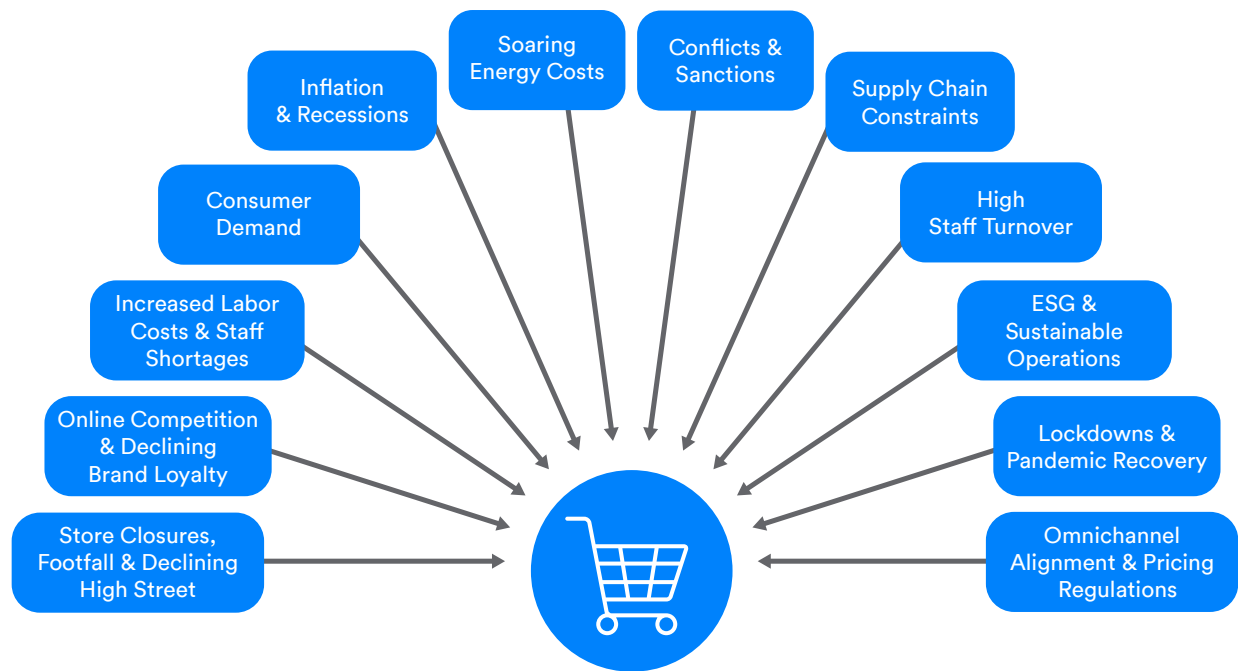


Figure 2: Growing Pressures on the Retail Market

As a result of these pressures, retailers are increasingly looking towards smart retail Internet of Things (IoT) technologies to help them deliver operational efficiencies, increase conversion, and encourage customers to return to stores.

Growing pressures on the retail market can be broadly grouped into three key areas:

Competitive Market Pricing

- High inflation, increasing customer expectations on omnichannel pricing alignment, and the emergence of different fulfillment methods (in-store pick up, local delivery, etc.) all require more frequent pricing changes, increasing the demand for consistent and automated pricing to enable better customer experiences and improved conversion.



Increased Customer Expectations

- Customers are demanding better in-store experiences that leverage digital technologies. This includes tailored recommendations, personalized promotions, AR/VR decision making, streamlined checkout, and additional product information to help to ensure better customer experiences, increase loyalty, and improve store traffic.
- There is a growing need for retailers to gather insights into customer behavior to provide improved shopping experiences, personalized marketing, and to increase conversion rates in store.

Process/Resource Expense

- Smart retail technologies can help to enable better planning and real-time stock updates for in-demand items by ensuring shelves are replenished, prices can be adjusted dynamically, inventory is optimized, and waste is reduced.
- High labor costs are accelerating the need for automation and optimizing in-store processes such as changing prices, order picking, checkout, and replenishment.
- High staff turnover can be reduced by eliminating tedious manual tasks, improving job satisfaction, and shifting staff resources to more impactful areas of the business, such as improving the customer experience.
- The climate crisis, consumer pressures, and emerging regulations are all pushing retailers to increasingly adopt more sustainable practices both in-store and across the supply chain. Efforts to reduce waste, source locally, enable in-store fulfillment, encourage responsible and sustainable consumption, and support greater supply chain transparency will become vital differentiators for retailers over the next decade.

Benefits of ESL

Electronic shelf labels (ESL) have the potential to address several of these pressures and become a fundamental component of the future of retail store digitization. The benefits of ESL include:

Pricing Optimization

- **Real-Time Automated Pricing** - ESLs can help enable more accurate pricing via automatic updates. Estimates are that five-to-ten percent of paper label prices are errors due to slow updates or misplaced labels. By automating this process, these errors can be reduced, meaning customer satisfaction is improved at checkout, less staff time is wasted, and conversion is increased. This is particularly acute during high inflation, supply chain interruption, or seasonal environments where price changes happen on a regular basis.
- **Omnichannel Alignment** - ESLs can increase omnichannel pricing alignment, ensure greater in-store conversion, and reduce *showrooming* and customers purchasing elsewhere after visiting the store. This can help increase customer loyalty.
- **Dynamic Pricing** - ESLs can enable more dynamic pricing, allowing retailers to be more proactive in price matching their competition, easily create limited time or quantity offers, boost sales in traditionally slower periods, and better manage inventory via stock and demand-based pricing.
- **Support for Regulatory Changes** - In certain countries, new pricing regulations mean retailers must show the basic price alongside the item price, requiring an update of all labels nationwide. ESLs can better support changes such as these alongside countries supporting multiple or adopting new currencies, such as the Euro.

Enhanced Customer Experiences

- **Product Information** - ESLs can provide additional product and stock information, product reviews, multiple currency pricing, and allergen and nutritional information to help conversion. These can also be combined with NFC and QR codes to link to additional information online.
- **In-Store Navigation and Proximity Marketing** - When combined with Bluetooth® proximity services and mobile devices, or LED equipped labels, ESLs can help guide customers to the next item in their basket, provide tailored proximity-based promotional offers or upsell recommendations, and provide price checks versus the competition.
- **Analytics** - When combined with Bluetooth® technology or sensors, ESLs can help monitor traffic around certain products or in-store locations, allowing retailers to better optimize their store and product layout based on heatmapping and other metrics.

Process/Resource Optimization

- **Optimized Order Picking and Replenishment** - ESLs equipped with LEDs can light up to enable staff to more efficiently pick online orders, accelerate replenishment, facilitate returns, and reduce mistakes, improving customer and worker satisfaction.
- **Improved Inventory Management** - ESLs can enable retailers to accurately track inventory levels in real time, ensuring faster replenishment and better control of pricing and inventory availability for customers. Out-of-stock, in-store labels can provide online stock availability and links to the website via NFC or QR codes to complete the order or offer a discount when back in stock to ensure conversion. Promotions on overstocked items can also help reduce waste and minimize losses on seasonal items.
- **Enhanced Staff Resources and Job Satisfaction** - ESLs can enable retail employees to focus their attention on more vital areas of the business, such as customer support, and reduce time spent on monotonous tasks, such as replacing paper labels. This can enable better customer experiences and enable employees to better optimize their work efforts while allowing retailers to improve job satisfaction and reduce staff turnover. ESLs can help reduce food or perishable item wastage via dynamic pricing or expiry date alerts to help clear stock. ESLs can also provide additional sustainability information (e.g., recycling, carbon footprint, energy rating, and sourcing information) to enable better supply-chain transparency and foster more responsible purchasing.

Market Demand for ESL Standardization

788
MILLION

total electronic shelf
labels installed globally
by the end of 2022

Data Source: ABI Research, 2023

There are tens of billions of paper labels globally that could be replaced with electronic shelf labels (ESL), representing an enormous addressable market. However, by the end of 2022, ABI Research estimates that the installed base of ESLs reached 788 million units. This means that the ESL market has barely scratched the surface of its true market potential. One of the major reasons for this has been ESL market fragmentation.

The ESL market is made up of a number of different competing end-to-end solutions, often use-case specific, proprietary, and vertically integrated. This has made it difficult for retailers to invest in and scale up these use cases

as they do not want to lock themselves to a single, specific technology supplier at this early stage of market maturity. Therefore, many retailers are partnering with multiple ESL vendors and diversifying their supply of ESLs to ensure they are not trapped into a single vendor.

At the same time, some retailers have held back in adopting ESL and retail IoT technologies for fear of a technology becoming obsolete or the promise of something better in the future. The need to deploy multiple infrastructures, concerns over interoperability, security and privacy concerns, the need to support a long-term retail strategy, and a lack of education or complexity in deployment or maintenance are further barriers.

One technology that has delivered a standards-based approach to the ESL and smart retail market is Bluetooth®.

With many ESL vendors reporting record revenue over the last few years, ESL is clearly poised to become a fundamental component of future retail store digitization, enabling better customer engagement and experiences, local fulfillment, greater store automation, more efficient operations, and more frictionless checkout experiences. However, as successful large-scale smart retail deployments increasingly rely on interoperability, information gathering, and sharing across many different use cases, retailers will need to avoid siloed solutions that are incapable of working effectively with each other and will increasingly look towards open and modular platforms enabled by open standards. This will enable ESLs to become just one part of a wider smart retail wireless network that is able to aggregate and analyze data from several different use cases and devices to generate more intelligent insights and services. To achieve this and to accelerate this market further,

large retailers demanded the standardization of ESL technology to better deliver simple-to-deploy, low-cost, low-power, interoperable, highly secure, and future-proof ESL solutions that are available from multiple vendors and capable of delivering on multiple use cases. One technology that has delivered a standards-based approach to the ESL and smart retail market is Bluetooth® technology.

The Bluetooth® Electronic Shelf Label Standard

In early 2023, the Bluetooth Special Interest Group (SIG) announced the release of the new wireless standard for the ESL market. The intention was to create a scalable, low-power, secure ESL standard that can enable the ESL market to reach its full potential. The Bluetooth® ESL standard leverages key new feature enhancements introduced in Bluetooth® Core Specification Version 5.4, including Periodic Advertising with Responses (PAwR) and Encrypted Advertising Data, to deliver secure and scalable ESL deployments required by the ESL market.

Most importantly, the Bluetooth SIG also released ESL Profile and Service specifications. These were developed by the ESL Working Group, consisting of leading ESL vendors and enabling technology suppliers, and will standardize the process for message transmission between access points and ESLs. These initiatives, demanded by many retailers looking to deploy ESL technology, will enable standardized, interoperable ESL products that use Bluetooth® technology to be created, removing a fundamental obstacle to adoption which has plagued the industry to date.

Benefits of the Bluetooth® ESL standard

The arrival of the Bluetooth® ESL standard has the potential to bring a number of benefits, including:

- **Increased Interoperability** - One of the major benefits of adopting the Bluetooth® ESL standard is that it gives retailers the flexibility and choice to buy products and solutions from one vendor knowing that they will work with those from another. This allows them to tailor the solution to their specific needs and gives them the ability to choose their preferred supplier without losing out on potential innovations from other vendors.
- **Flexibility and Reduced Vendor Lock-In** - Retailers who adopt solutions based on the Bluetooth® ESL standard can switch to a different vendor if their current solution provider falls behind on their promises or starts to lag behind the competition, avoiding the need to commit to a single-vendor ecosystem or deploy an entirely new infrastructure. Furthermore, as retailers increasingly deploy other smart retail technologies – including wireless sensors, lighting controls, and beacon infrastructure – this can minimize friction in enabling an interconnected smart retail ecosystem and offer greater flexibility in

choosing complementary product offerings that can provide additional benefits and ROI beyond a single use case. Retailers will also have greater flexibility to choose their optimal ESL and infrastructure providers rather than being limited to vendors who are compatible with a specific proprietary solution.

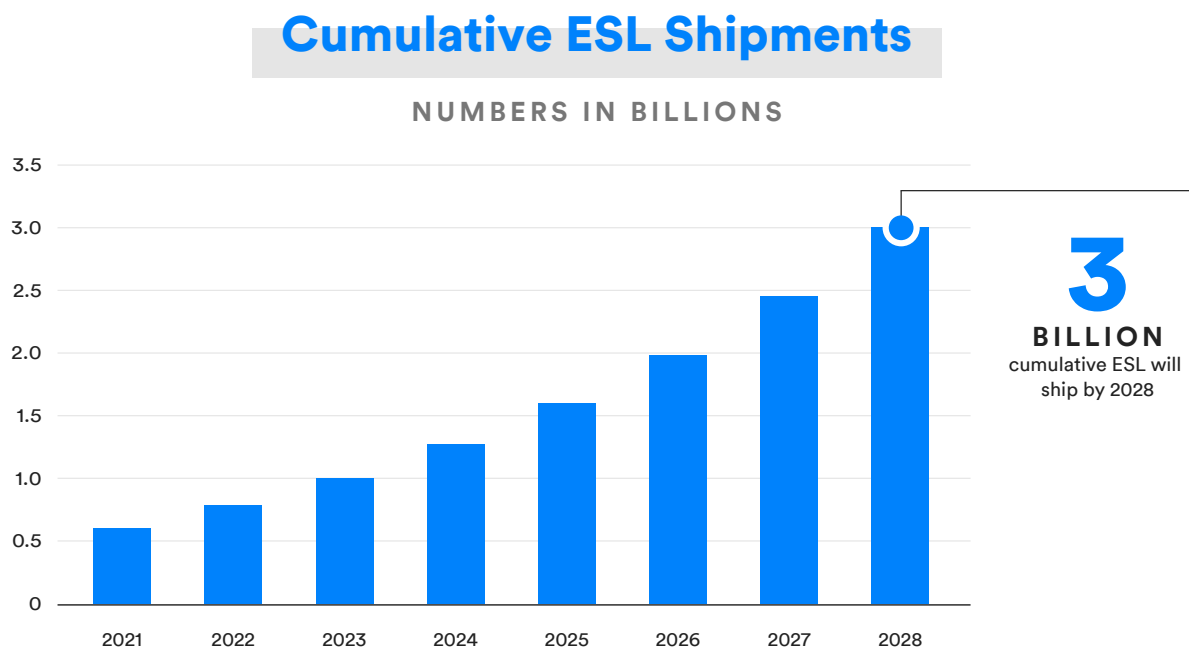
- **Economies of Scale** - Retailers can also benefit from the enormous economies of scale that Bluetooth® technology can rely on. The Bluetooth® ESL standard is likely to enable a much wider number of Bluetooth chipset and ESL solution providers to address the market, while Bluetooth chipset solutions and reference designs specifically addressing the requirements of the ESL market are likely to emerge. This will enable greater product choice, increased competition, a larger supply of products and wireless chipsets, global availability, a reduced burden of entry, faster time to market, and collaboration from a wide number of players across the value chain.
- **Innovation and Competition** - While the ESL landscape has been dominated by proprietary solutions, the availability of the Bluetooth® ESL standard will help solution providers enter the market. This democratization and increased competition within the ESL market could lead to much faster innovation via new features and product differentiation, reductions in cost via additional competition, increased awareness in the overall ESL market, and greater adoption within different regions.
- **Long-Term Product Evolution** - Various industry stakeholders across the smart retail value chain will continue to work together within the Bluetooth® ESL Working Group to identify the primary requirements of the industry and help develop strong collaborative solutions. This will also lead to increased competition and will give retailers flexibility to choose which suppliers best fit their specific requirements. Underlying standards will also help shift the focus towards value-added features rather than core functionality, spurring additional innovation, all the while guaranteeing interoperability.
- **Future-proofing** - For retailers, there has been some hesitation in deploying solutions due to the promise of something better in the future. By leveraging standards-based solutions, such as Bluetooth® technology, vendors have more visibility on the technology roadmap, including performance and features that can be upgraded over time as various innovators contribute to the publicly available specifications. Future-proof standards-based infrastructures will lay the foundation for additional retail problems to be solved and for new services to be created over time, unlocking further value and ROI.



- **High Scalability** - Though the current ESL market is dominated by proprietary technologies, the market is seeing strong growth and existing solution providers offer very compelling ESL product portfolios. However, serving the addressable market of tens of billions of shelf labels globally is unlikely to be achieved if retailer choices are tied to the product portfolios of a few proprietary vendors. Retailers across the globe could be at the mercy of a single supplier's proprietary technology and the fortunes of a single company. Any disruptions faced in their supply chain could negatively impact planned rollouts. In contrast, by standardizing ESLs using Bluetooth® technology, retailers can benefit from the huge number of Bluetooth vendors, chipset suppliers, software developers, system integrators, and other industry players that continue to grow and evolve.
- **Streamlined Deployment** - Most enterprise Wi-Fi access points already include embedded standards-based IoT technologies, such as Bluetooth® technology. Therefore, deploying ESLs with Bluetooth® technology as the wireless networking technology will require minimal additional investment into dedicated ESL infrastructure, reducing the cost and complexity of deployment. This contrasts with proprietary technologies which have traditionally required a discrete network of transceivers in addition to the wireless AP to deploy the ESL network (though some have partnered directly with AP vendors).
- **Multi-Use Infrastructure** - By leveraging Bluetooth® technology, not only can the infrastructure be used to enable ESLs, but the same infrastructure can accommodate multiple additional Bluetooth® use cases, including wireless sensor networks, beacons and proximity services, asset and personnel tracking, POS connectivity, and lighting and building controls, among many others. This can drastically increase the value of a smart retail deployment's ROI while minimizing the cost and complexity of managing multiple use cases.

ESL Market Forecasts

There are tens of billions of labels globally that have the potential to be replaced with electronic shelf labels, representing an enormous addressable market. As Chart 1 shows, by the end of 2022, the installed base of ESLs reached nearly 800 million units.



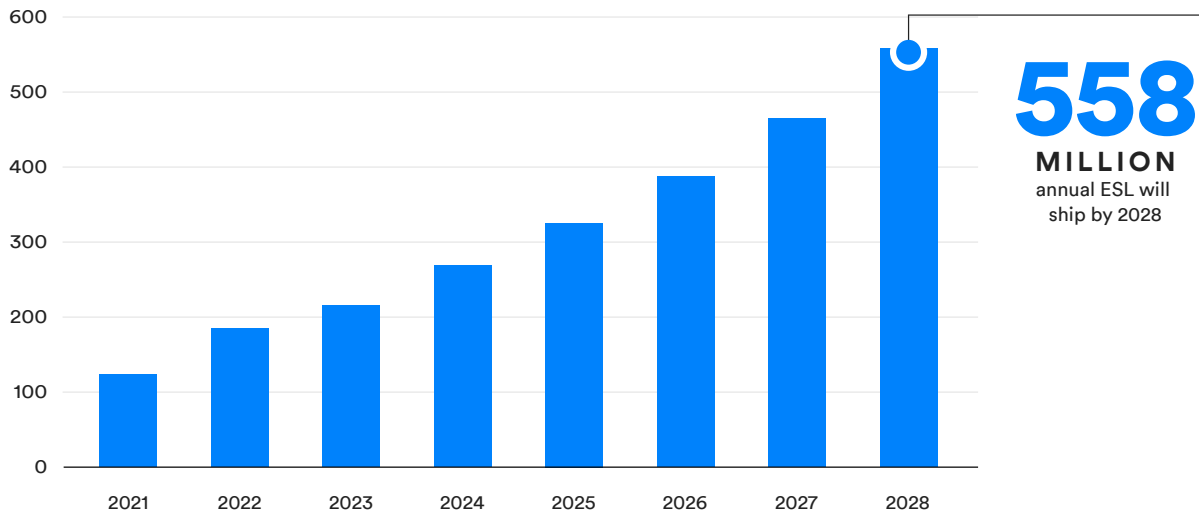
Data Source: ABI Research

Chart 1: Cumulative ESL Shipments, 2021 to 2028

The last 24 months have seen a rapid acceleration of ESL deployments and strong (often record) unit and revenue growth from leading ESL vendors. As Chart 2 shows, ABI Research estimates that nearly 185 million ESLs were shipped to the market in 2022, growing considerably from 124 million units in 2021. This year, the market is expected to grow to over 215 million units.

Annual ESL Shipments

NUMBERS IN MILLIONS



Data Source: ABI Research

Chart 2: Annual ESL Shipments, 2021 to 2028

By 2028, ABI Research forecasts that ESL shipments will reach nearly 560 million annual shipments while cumulative shipments of ESLs will reach over three billion. This will be driven by deeper penetration in existing regions and organic growth in areas such as APAC, USA, UK, and other parts of Europe.

Opportunities for Bluetooth® Technology in the ESL Market

Several ESL vendors are already utilizing Bluetooth® technology. The availability of the Bluetooth® ESL standard is expected to significantly increase adoption in the coming years. This will come through existing Bluetooth® vendors adopting the ESL standard and alternative technology solution providers offering Bluetooth® ESL as part of their product portfolio, as well as new entrants to the market supporting the technology.



As Chart 3 shows, by 2028, ABI Research forecasts annual Bluetooth® ESL device shipments will reach 117 million units, growing from approximately 16 million in 2021. However, proprietary and alternative ESL technologies are also expected to grow during this period due to large market shares from leading vendors and continued acceleration of the ESL market.

Annual ESL Shipments by Technology

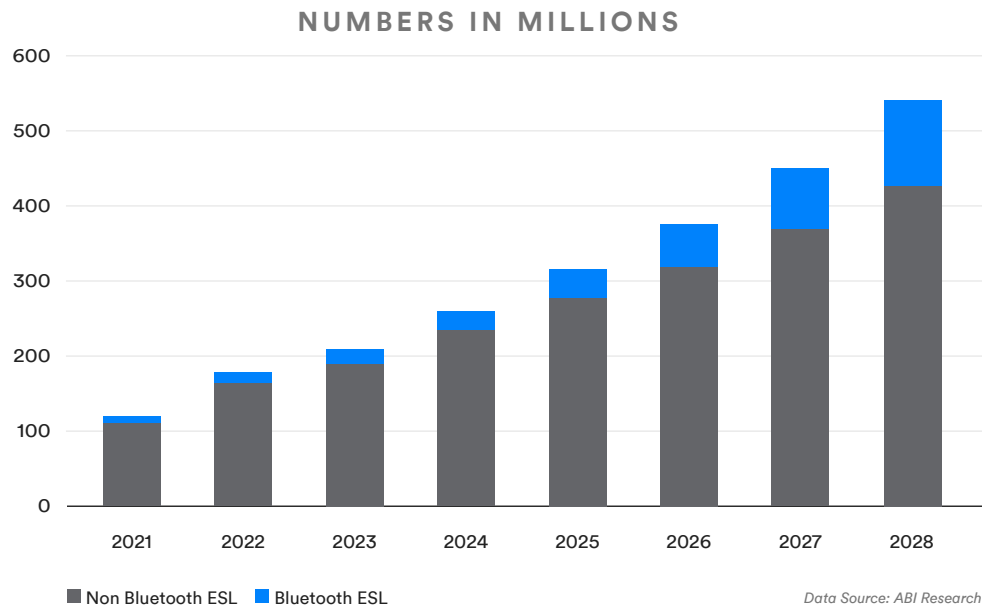


Chart 3: Annual ESL Shipments, 2021 to 2028

The Future of Bluetooth® ESL

The ESL market is on the verge of accelerated adoption across multiple regions. Numerous compounding pressures on retailers are incentivizing smart retail transformation and building on the growing awareness of retail IoT technologies. At the same time, customers are returning to stores with growing demands for better in-store experiences, omnichannel alignment, and new fulfillment methods. Meanwhile, the falling cost of ESLs, partnerships with infrastructure vendors, improvements in label quality, form factors, features, and battery life, and new entrants to the market spurring tech innovation and product choice have all helped the market to grow in recent years.

Despite these incentives, many large retailers had been hesitant to adopt ESL technologies due to the lack of an open ESL standard that can guarantee interoperability between multiple vendors. The lack of a dedicated ESL standard had meant that retailers were forced to choose from several proprietary product offerings and commit to their specific ecosystems. This is naturally a risky and difficult decision for many retailers, particularly as they develop wider or long-term smart retail strategies that transcend ESL deployments. As a result, many retailers decided not to adopt ESLs or have done so in a limited capacity via pilots and trials or only within certain areas. This ultimately slowed down the rollout of ESL solutions and the related efficiencies and enhanced experiences that they can enable, which, in an increasingly competitive retail landscape, has the potential to become more costly. Furthermore, by committing to a single vendor ecosystem, retailers may be missing out on innovations from the competition that could provide additional ROI across a wide range of consumer-facing and backend operational use cases. As a result, retailers are increasingly looking towards adopting standards-based solutions that can allow them to take advantage of a variety of smart retail use cases in a frictionless manner.

The Bluetooth® ESL standard will deliver an interoperable smart retail solution that can address both consumer facing and back-end operational challenges

The recent arrival of the Bluetooth® ESL standard has the potential to better address the needs and concerns of retailers and enable the ESL market to reach new heights. The Bluetooth® ESL standard can allow a much wider selection of retailers to adopt ESLs while helping to deliver on larger smart retail visions, digital transformation strategies, and operational efficiencies over time. While proprietary technologies from single vendors dominate existing deployments, the Bluetooth® ESL standard will help enable the next wave of adoption and deliver an interoperable smart retail solution that can address both consumer facing and back-end operational challenges as they arrive.

The Bluetooth® ESL standard can also help create a more open smart retail ecosystem capable of generating multiple ROIs. This will lead to increased competition, continued feature innovations and product differentiation, greater product choice, reduced risk, and improved interoperability.

The availability of the Bluetooth® ESL standard is therefore set to transform the smart retail space, allowing new solution providers and innovators to enter the market, alleviating retailer concerns, and helping create several new ESL and smart retail services and platforms which can help retailers better address pressures they are facing today and over the next decade.

Bluetooth Market Research Community

Join the Bluetooth Market Research Community to receive early access to market data highlighting the latest Bluetooth® technology trends and forecasts. You'll also have the chance to weigh in on what data is collected and shared to ensure you receive the research that's most valuable to you and your business.

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