Whitepaper

Why LTE connectivity is the answer for Smart POS and Vending

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Build a Smarter World

Introduction

Wireless connected payment devices have already been widely embraced across the globe with consumers preferring the convenience of card or mobile phone-enabled payments over handling cash. Since the pandemic, this has become even more apparent and cash is not only the favored payment method but now the default for most users. In 2020, global consumer preference to pay with cash fell to 15%. The move away from cash and increased trust in near-field communication (NFC) for payments, has seen connected terminals for in-store remote payments become part of everyone's daily lives and the global point of sale (POS) terminal market is growing even more rapidly because of this.

While wired or Wi-Fi enabled connections for point of sale payment devices are widely adopted, they add a layer of complexity for organisations because they require installation, setting up and connectivity contracts for each fixed location are required. This hampers businesses that need to move locations such as vending machines and causes delay in deployment at sites that are not already served by wired or Wi-Fi connections. It's far simpler and more flexible to turn to cellular connectivity and the popularity of this approach is growing rapidly.

Connectivity for POS and vending equipment is an already valuable market that still has large opportunities for growth. The market for cellular POS terminals is set to grow four-fold from US$20bn in 2020 to US$80bn in 2026[1] while the market for smart vending machines, which also rely on cellular connections, is forecast to grown from US$11bn in 2017 to US$30bn by 2024[2]. This expansion is underpinned by consumer habits but also by a new wave of fully-featured yet cost-effective payment terminals which utilise cellular connections to make the technology available to all types of users.

This extends from a one-person business which can simply buy a 3G-connected payment terminal for a one-time fixed fee to operators of fleets of vending machines who embed cellular-enabled payment technology into their stores. This connectivity can be used not only for secure payments but to manage stock, monitor vending machine performance and enable predictive maintenance. There are high- and low- end scenarios at play across multiple types of retailers and vending scenarios and cellular connections, dominated by LTE Cat M, are demonstrating their value in terms of flexibility, ease of deployment, global availability, security and cost efficiency.

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1 https://www.globenewswire.com/news-release/2020/03/15/2000694/0/en/Mobile-Point-of-Sale-Terminals-Market-revenue-to-cross-USD-80-Bn-by-2026-Global-Market-Insights-Inc.html
2 https://iotbusinessnews.com/2019/01/24/90887-intelligent-vending-machine-market-to-see-15-growth-to-hit-us30-billion-by-2024/

3

Get to the point (of sale)

Mobile point-of-sale (mPOS) is a flexible, low-cost method of expanding card acceptance in face-to-face environments by using hardware encryption technology to facilitate the use of untrusted devices across untrusted networks. In essence, mPOS describes the use of consumer-oriented mobile devices such as tablets and smartphones that function as a point-of-sale terminal to facilitate payment card transactions through a connection to a card-accepting reader. The transformative element is that this can be done by utilizing low-cost devices and therefore can make digital payments possible for some retailers and businesses for the first time.

Many transactions involving small – or micro – merchants are made away from physical retail stores and are completed using cash rather than credit or debit cards. This is an enormous opportunity for traditional bank acquirers and payment service providers (PSPs) to address with card-based acceptance solutions.

While the prize is substantial, there are two key challenges involved in addressing this market which are in conflict with each other. The merchants demand that payment services are provided at low cost because high payment charges are unsustainable while the payment enablement systems demand high security in order to prevent fraud on their systems. For many years traditional point-of-sale (POS) terminals have been rejected by micro-merchants because of their high cost, long term contractual commitments, restrictive user interfaces and the Payment Card Industry Data Security Standard (PCI DSS) compliance requirements. Even so, the move by the payments industry to adopt mPOS technology to either replace or complement traditional POS terminals is underway and opening up this substantial opportunity.

Global POS CAGR Forecast, 2020-2025E

NAM
+20%

Europe
+16%

KOREA
-2%

Japan
+4%

China
+16%

MEA
+18%

India
+38%

LATAM
+17%

RoW
+26%
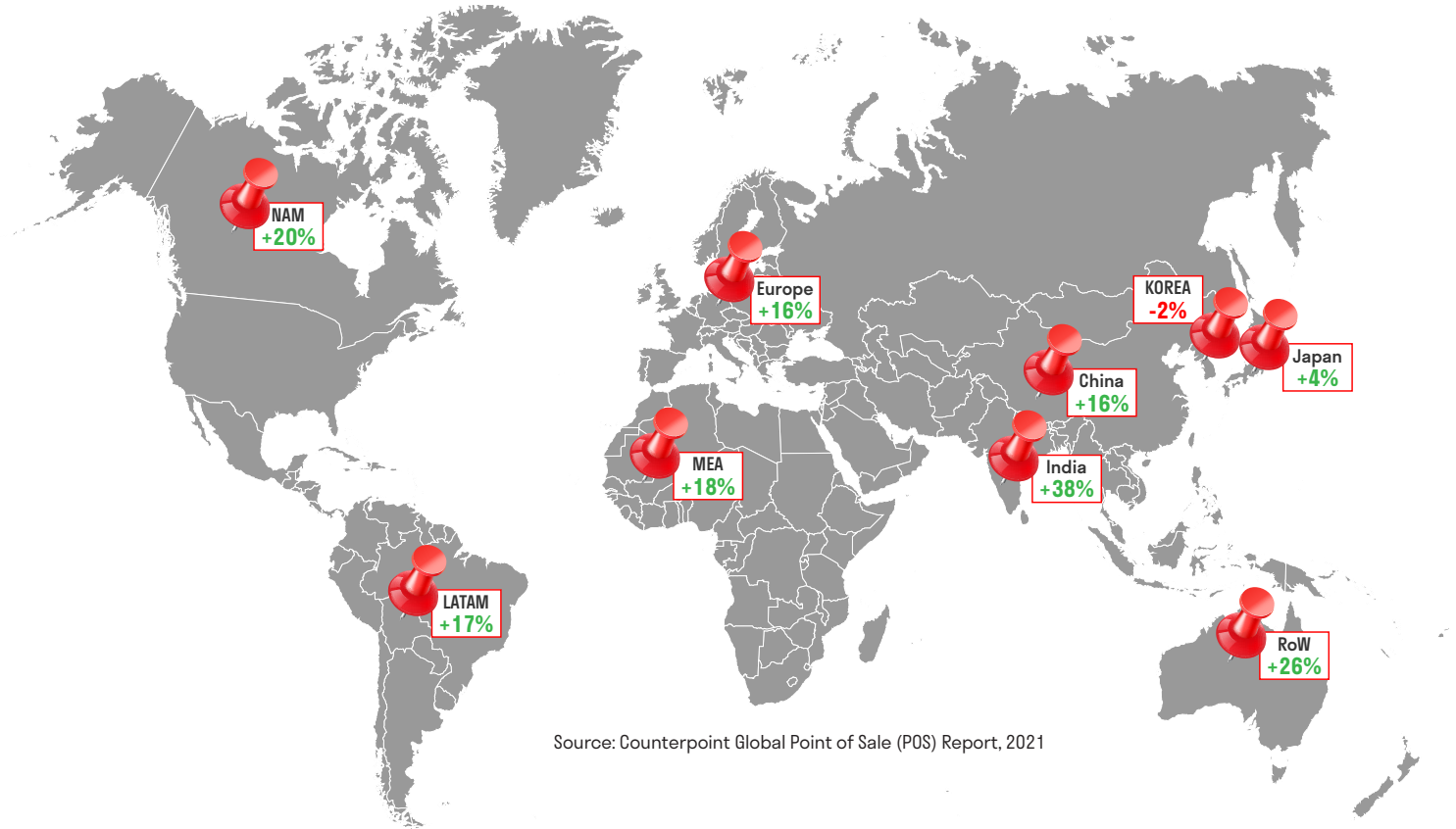
Source: Counterpoint Global Point of Sale (POS) Report, 2021

Global POS shipments to reach 270 million units by 2025. Rising consumer awareness on cashless transactions and favorable government policies to help in growing POS shipments.

India will be the fastest (+38%) growing POS market during the forecast period driven by digital transformation in retail market transactions.

4G Cat 1 is replacing traditional 2G/3G POS terminals in most cases. The decreasing ASP of 4G Cat 1 chipset and modules is helping POS vendors choose 4G Cat 1 technology

Retail is going to lead in POS applications. However, this segment witnessed decrease in POS shipments in 2020 due to COVID-19.

Chinese players dominate the global POS market, with 8 out of the top 10 companies being Chinese. Local manufacturing may have an adverse impact on Chinese players.

Figure 1: Global POS Growth Forecast 2020-2025

No longer an mPOS-sible dream

Research firm Berg Insight has reported that the mPOS terminal market is growing at about the same rate as the traditional POS terminal segment and there are now more than 70 vendors active in the global market today. The combination of increased acceptance of non-cash payments and growing adoption of NFC payments has transformed the POS payments landscape. The firm reports that the attach rate for NFC in the mPOS segment reached 69% in 2020 as NFC-ready mPOS terminal shipments reached 26.9 million units. It further predicts forecasts that global shipments of NFC-ready mPOS terminals will grow at a compound annual growth rate (CAGR) of 11.7% in the next five years to reach 46.7 million units by 2025[3]. The growth is driven by the increase in mPOS terminal shipments from 39.2 million units in 2020 to 50.3 million units in 2025, Berg Insight says.
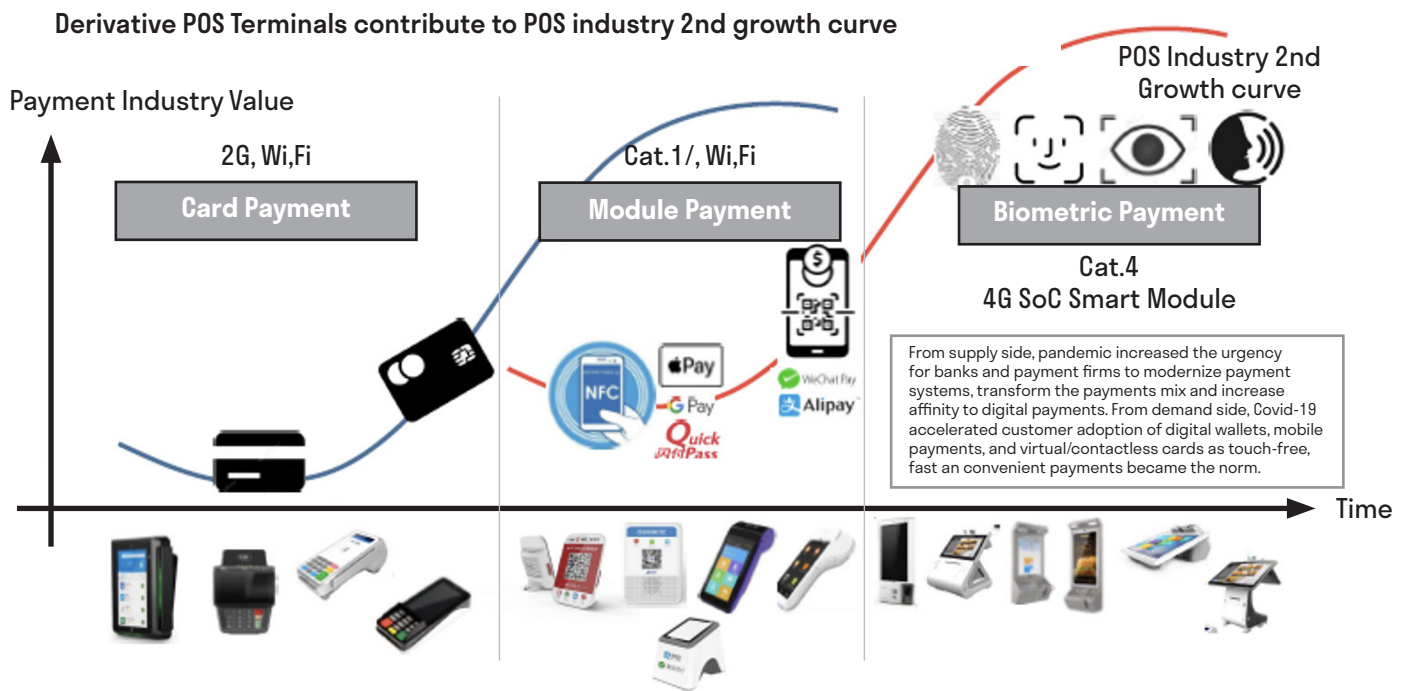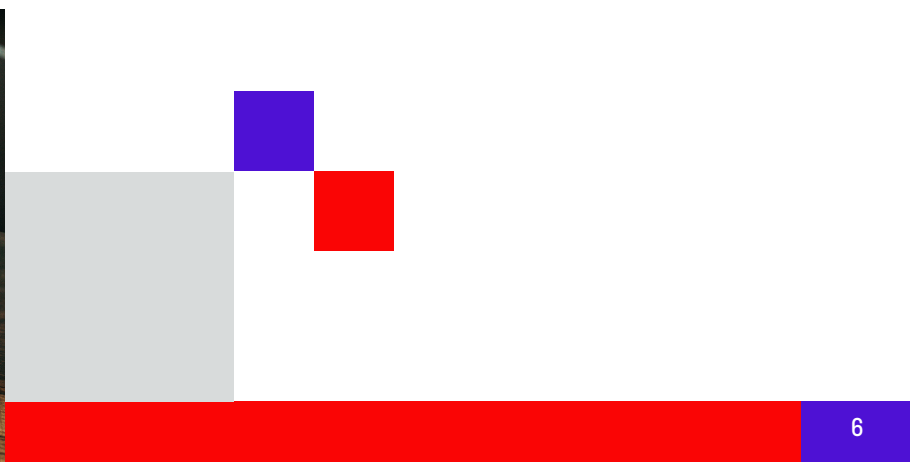
Derivative POS Terminals contribute to POS industry 2nd growth curve

Figure 1: Global POS Growth Forecast 2020-2025

3 https://www.berginsight.com/shipments-of-nfc-ready-pos-terminals-reached-672-million-in-2020

Cashless is the sweet spot in the vend diagram

Dumb vending machines that failed to properly release your favorite chocolate bar are a thing of the past and are increasingly offering more complex products but also gathering data on user choices and becoming more intelligent as they tailor offerings to the needs of demographics in the locations they are sites. Smart or intelligent vending machines utilize the connectivity enabled for payment to also manage the machine's business functions and this is helping to encourage significant growth in adoption of smart vending machines.

Research firm Technavio reports that the market for intelligent vending machines is set to grow by US$9.33bn during the period 2020-2024 at a compound annual growth rate of 22%[4]. Much of the growth (38%) for these advanced machines is expected to come from the North American market and the firm also foresees the beverage segment offering the maximum opportunity during the forecast period.

The increasing demand for cashless vending machines, partly due to the pandemic, is one of the main factors driving growth. The increase in smartphone adoption and payment using internet-enabled devices, debit cards and credit cards has fueled the growth of cashless payments worldwide. Alongside this, advances in artificial intelligence and automation are enabling cost-effective intelligent vending to be rolled out for a variety of use cases and market sectors.

The AI-enabled smart, autonomous store is at the most advanced end of the vending spectrum with sensorless payment systems based on computer vision, deep learning and multi-sensor fusion technology, it can accurately identify shopping behavior and commodity information as well as automatically complete payment after customers pass through the exit gate. This replaces mechanical and repetitive manual check-outs with AI algorithms that enable customers to avoid waiting in line. Other market developments include toys and blind box vending, in which consumers cannot see the product they are buying, but these are highly dependent on individual market tastes and it is not possible to draw global patterns or trends for predicted usage.

Further innovations, include shipping container-sized AI smart unmanned stores that can be deployed in various scenarios with flexible deployment methods. These movable AI-enabled intelligent unmanned stores can be flexibly implemented in various scenarios. They are suitable for different types of retailing and can be combined with different shelves and containers or spliced with other containers to create larger stores.

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4 https://www.businesswire.com/news/home/20210202005552/en/9.33-Billion-Growth-in-Global-Intelligent-Vending-Machine-Market-During-2020-2024-Featuring-Key-Vendors-Including-Azkoyen-SA-Compass-Group-USA-Inc.-and-Crane-Co.-Technavio

How ai is impacting the pos market

AI-enabled POS systems provide maximum flexibility while also providing precise monitoring for inventory tracking and order management. AI POS systems can also be easily integrated to assist with reporting and connect to accounting systems. These systems are able to handle the complex scheduling tasks that were previously time-consuming and overwhelming and precluded smaller organizations from utilizing mPOS. AI-enabled POS systems are easy and fast to use so employees can be more productive. This is important in the restaurant industry where servers can be freed up and increase their overall productivity. These POS systems rely on advanced technologies instead of human labor so they also eliminate human error and provide a consistent experience every time.

Self-ordering POS options like kiosks, vending machines and online ordering that use AI have been proven to shorten queues, reduce wait times and increase sales. AI-enabled POS systems can also provide unique insights on the changing habits and behavior of customers and even recommend which customers to re-engage with. For example, knowing a customer buys a beverage at a specific time most days means a vending machine operator can push an offer to them.

Connectivity adds detail to retail

Most vending machines and POS today run on 4G/LTE, Wi-Fi or wired ethernet connections. Some still run on 3G technology which is being discontinued in many regions, forcing operators to upgrade.

POS is being revolutionised by adoption of mPOS, which typically relies on 4G/LTE with some 3G deployments due to be replaced. The convenience of no wires and being able to take payments outdoors makes the case for LTE as the connectivity of choice for this market because the bandwidth is sufficient and the technology is secure enough to support charging and payment activities

Vending machines have traditionally relied on a vending machine controller (VMC) to manage systems including payment, refrigeration, lighting control and product handling. Machines have been low-footprint, low-power devices in the past and lacked sufficient power to support new services. However, vending platforms are changing, creating more powerful machines that can support new services and interfaces. The connectivity provided by LTE, Wi-Fi or wired methods has been sufficient but this is poised to change with the capacity that 5G brings.

5G connectivity is set to stimulate innovation in vending machine platforms. LTE was the first wireless connectivity that truly ushered in the era of mobile broadband to the vending industry. It enabled fast communications for vending machines but the autonomous stores of the future will use cloud-based software, AI and machine learning. The low latency capabilities of 5G and greater intelligence in smart vending machines will come together to enable richer, more in-depth experiences as we change how we shop and retailers refine how we are marketed to.

How Quectel helps

Quectel offers a comprehensive range of modules that are ideal for a wide variety of applications and can be integrated within mPOS devices and vending machines. These include, but are not limited to:

The Quectel **SC20** series of multi-mode LTE Cat 4 smart modules. These have a compact form factor of 40.5mm × 40.5mm × 2.8mm and offer five variants with built-in Android OS and five variants with built-in Yocto Linux OS. The SC20 is suited to both industrial and consumer applications requiring high data rates and high-speed internet access. The modules deliver data rates of up to 150Mbps downlink and 50Mbps uplink on LTE networks, and support wireless communication via IEEE 802.11a/b/g/n and Bluetooth 4.2 Low Energy. The SC20 is also backward-compatible with Edge and GSM/GPRS networks, ensuring connection even in remote areas without 3G or 4G coverage.
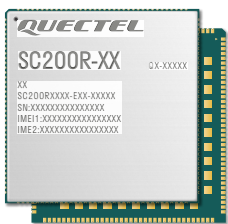
The **SC200R** shares its form factor with the SC20 and is a high-performance module that supports various multimedia functions, making it ideal for both industrial and consumer applications that require high data rates. The SC200R consists of five variants to meet various geographical demands and also offers GNSS and MIMO technology.

Multiple-input multiple-output (MIMO) technology allows the SC20 and SC200R to greatly minimize errors and optimize data speeds. Both series combine high-speed wireless connectivity with embedded multi-constellation and a high-sensitivity GNSS receiver for positioning. A wide range of supported interfaces allow the SC20 to serve IoT applications including portable navigation devices, POS, routers, data cards, automotive, smartphones, digital signage, security and industrial PDAs.

A wide range of supported interfaces (including LCM, camera, touch panel, MIC, SPK, UART, USB, I2C, SPI and more) allow the SC20 and SC200R to serve a wide range of IoT applications including edge computing, cloud servers, AI robots, smart POS, home gateways, wearables, PDAs and tablets, vending machines, delivery lockers, law enforcement equipment and in-car entertainment systems.
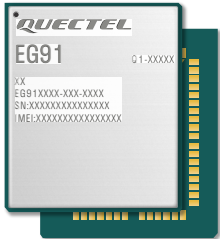
The Quectel **EG91** is a series of LTE Cat 1 IoT modules in an LGA package measuring 29.0mm × 25.0mm × 2.3mm, which meets the 3GPP Release 11 standard. The EG91 is pin-to-pin compatible with Quectel's UMTS/HSPA+ UG95 and UG96 modules, and LPWA BG95 and BG96 modules, enabling simple, flexible and scalable migration from 2G and 3G to 4G. The series consists of eight variants to meet various geographical demands.

The EG91 provides cost-effective LTE connectivity, delivering maximum downlink rates of 10Mbps and uplink rates of 5Mbps under LTE, is designed using space-efficient surface mounted technology, and features an embedded power management unit for ultra-low deep-sleep current consumption. The module is therefore ideal for size-constrained, low-power IoT applications which are not reliant on high-speed connectivity but do require the longevity and reliability of LTE networks.
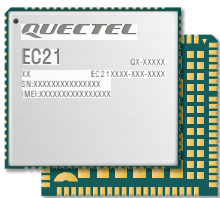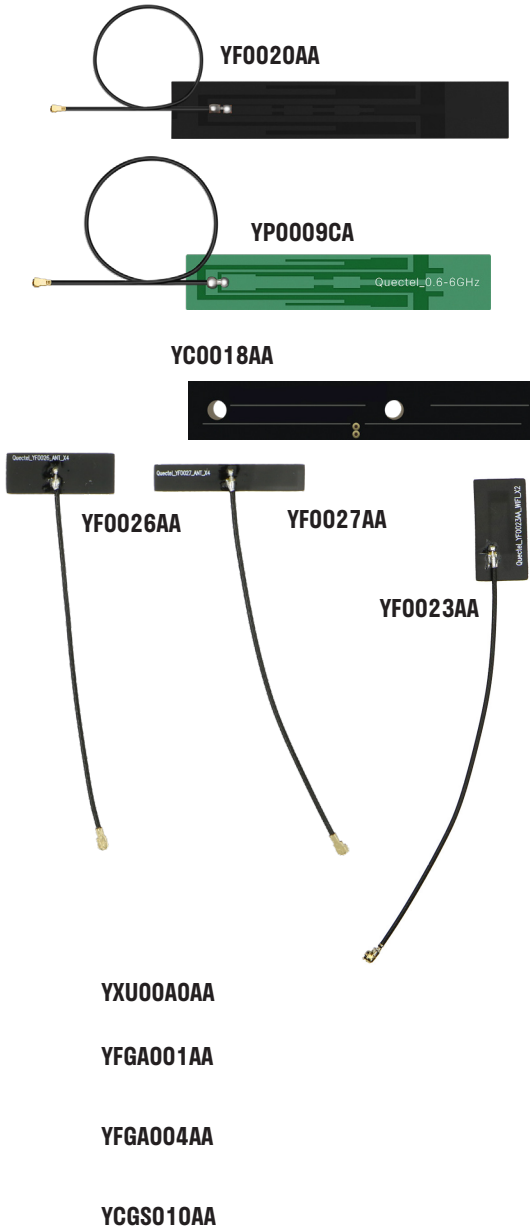
The Quectel **EC21** is a series of LTE Cat 1 IoT modules in an LCC form factor measuring 32.0mm x 29.0mm x 2.4mm, which meets the 3GPP Release 12 standard. The EC21 is compatible with Quectel's UMTS/HSPA+ UC200T modules and multi-mode LTE Standard EC25, EC20 R2.1, EG25-G and EG21-G modules. It is therefore backward-compatible with existing EDGE and GSM/GPRS networks, enabling easy migration between LTE and 2G or 3G. The series consists of ten variants to meet various geographical demands.

The EC21 also provides cost-effective, low-power LTE connectivity, delivering maximum downlink rates of 10Mbps and uplink rates of 5Mbps under LTE, and multiple-input multiple-output (MIMO) technology meets demands for data rate and link reliability. This makes the series ideal for IoT applications which are not reliant on high-speed connectivity but do require the longevity and reliability of LTE networks.

Finally, the Quectel **EG915U** is a series of LTE Cat 1 modules optimized for IoT applications. The modules deliver maximum downlink rates of 10Mbps and uplink rates of 5Mbps. Adopting a laser engraving process, the EG915U series features improved heat dissipation and durable label information which make it well-suited for automation requirements. In addition, modules are compatible with Quectel's multi-mode LTE standard EG912 and BG95 modules, which ensures easy migration from 2G to 4G networks to meet the needs of different industry applications.

YF0020AA

YP0009CA

Quectel_0.6-6GHz

YC0018AA

Quectel_YF0026_ANT_X4

YF0026AA

Quectel_YF0027_ANT_X4

YF0027AA

Quectel_YF0023AA_WIFI_X2

YF0023AA

YXU00A0AA

YFGA001AA

YFGA004AA

YCGS010AA

In addition to modules, POS devices also need antennas in order to ensure optimized connections. Typically, antennas rely on cellular, GNSS, Wi-Fi or Bluetooth connections to ensure uninterrupted coverage. For POS devices, antennas are usually embedded into the charger with nothing external that can be broken off.

In the 5G market, Quectel offers the **YF0020AA** flexible printed circuit (FPC) antenna. Operating at 600-6000MHZ frequency bands, this antenna measures 90.15 x 15.2 x 0.13mm and offers an IPEX IV connector. Alternatives include the Quectel **YP0009CA** and **YC0018AA** surface mount design (SMD) antenna.

In the Wi-Fi market, Quectel has a comprehensive portfolio of SMD and FPC antennas. The **YF0026AA** Wi-Fi 6E/BT FPC antenna operates in the 2400-2500MHz and 5150-5850MHz frequency bands, has dimensions of 28.9mm x 11mm and offers an IPEX MHF 1 connector. This peel and stick antenna has a cable length of 100mm. Quectel also offers the **YXU00A0AA** SMD FR4 antenna alongside additional FPC options, the **YF0027AA** and **YF0023AA** both of which feature cable plus connector.

For GNSS, which has applications for POS and vending devices that move locations often and require ubiquitous coverage, Quectel offers a complete range of FPC and ceramic chip SMD antennas. The **YFGA001AA** GNSS L1/L2/L5 and L6 FPC antenna works in the 1160-1270MHZ and 1560-1605MHz frequency bands and has dimensions of 74.56mm x 24.5mm x 0.13mm. This is a high-efficiency multi-band L1/L2/L5/L6 FPC antenna. Ground plane independent, it is designed for flexible mounting on the underside of any non-metallic housing with a cable and connector for easy installation. The Quectel range also includes the YAT001AA ceramic patch antenna, the **YFGA004AA** FPC antenna and the **YCGS010AA** ceramic chip SMD antenna.

For all antennas, Quectel provides comprehensive antenna design support that includes simulation, testing and manufacturing for custom antenna solutions to meet customers' specific application needs. **Find out more here**
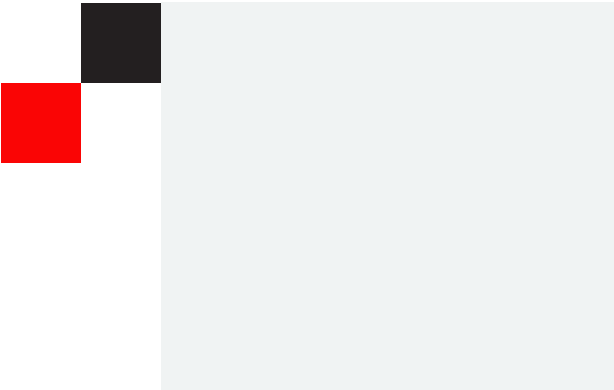
Conclusion

The pandemic has proved to be a stimulus for greater adoption of mPOS and vending as people want to eliminate contact with cash and minimise in-person interactions. However, even before the pandemic moves were well underway to utilize LTE connectivity to enable wireless, cost-effective mobile point-of-sale devices. Barriers to increased adoption are continuing to lower as mPOS devices become cheaper and service fees are more acceptable to even micro-businesses. This adoption curve will continue as we progress down the path to a cashless society and secure cellular connectivity is a fundamental foundation for mPOS payments.

In the vending market, great innovation is seeing a new generation of vending machines perform far more complex tasks and enable more effective marketing stock-keeping and operations. However, this is only the start. A new wave of unmanned shops, blind box vending, where consumers can't see the product they are buying, and multi-ingredient offerings are already coming to market. The systems these demand to ensure stock is not pilfered, shelves are stacked, quality is maintained and goods are paid for will be rely on AI, machine learning, cameras, sensors and tracking. The connectivity that interlinks all of these will play an essential role in making this complicated architecture work.

In both markets, LTE is the current best suited connectivity. It is secure, provides enough bandwidth and costs sufficiently little to make it appealing. In the future, 5G will arrive and that will have applications serving the rich demands of unmanned retailers but Quectel has LTE module options to suit most use cases from LTE Cat M1 to LTE Cat 4 smart modules.

To learn more about how Quectel's comprehensive range of modules, antennas and global IoT connectivity can power your business into new opportunities in mPOS and vending, visit www.quectel.com