Whitepaper

PERFECT WIRELESS EXPERIENCE

Building a Sustainable Future with IoT-enabled e-Transportation

Introduction

In recent years, reducing carbon dioxide (CO^2) emissions to achieve a net zero future has become a higher priority than ever before. Currently, global efforts to reduce emissions are still falling short of the goals outlined in the 2015 Paris Agreement. Despite this, many countries are revising their targets to meet even more stringent goals to prevent the worst effects of long-term climate change.

One of the biggest contributors to carbon pollution is the transportation sector, which is responsible for approximately 23% of energy-related CO^2 emissions. Without urgent action, this figure is likely to rise to 40% by 2030. By 2050, the sector as a whole is set to increase its emissions by 60%[1].

A promising solution to the issue of transport carbon-neutrality is the increasing availability and popularity of electric vehicles (EVs) and micro-mobility devices. By using electricity as fuel, these vehicles are ushering in an era of cleaner transportation. The impact will be particularly evident where these initiatives are matched with energy-grid decarbonization and a move towards renewable power.

Around the globe, many countries are starting to build out infrastructure to support this shift to clean transportation, in alignment with the goals specified in the 2021 United Nations Climate Change Conference (COP26)[2]. However, to maximize the impact of these initiatives, it is critical that e-transportation is supported by data-driven insights.

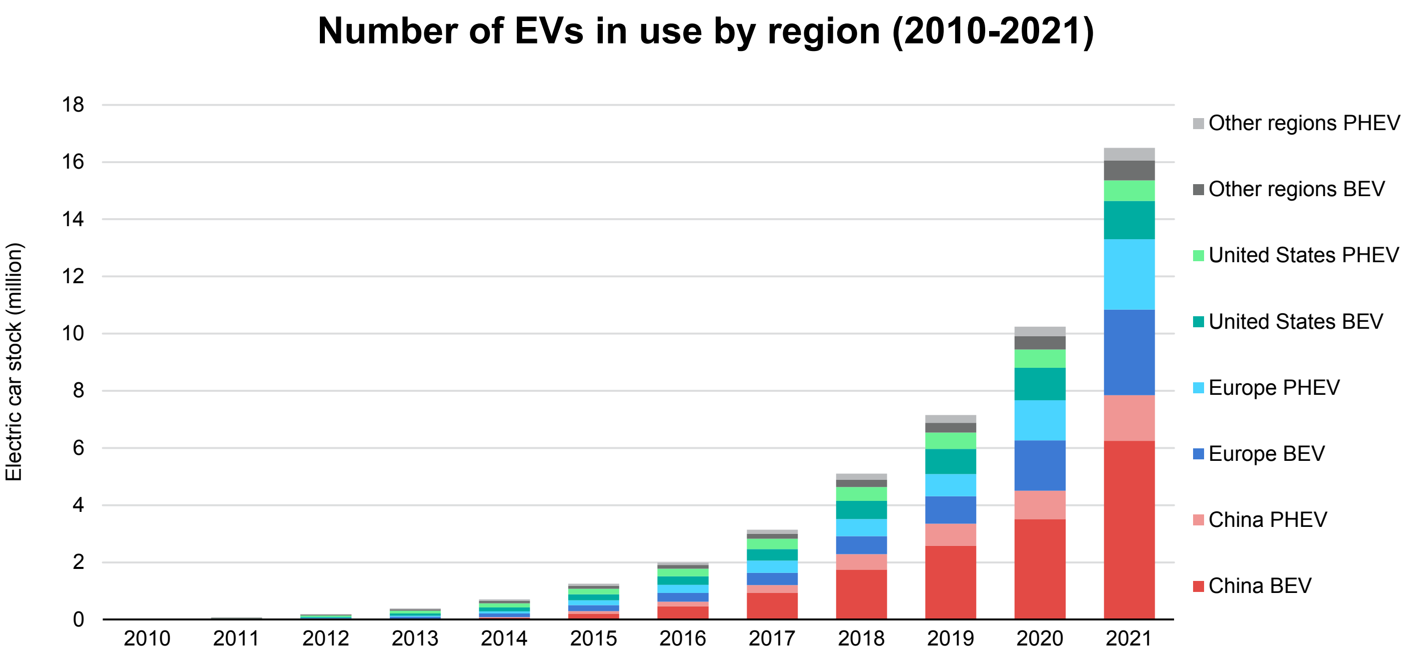
Combining e-transportation with dedicated Internet of Things (IoT) infrastructure allows smart cities and commuters to realize unparalleled efficiency gains. This should help us move towards a future where EVs and dedicated EV charging systems are the new normal, supporting climate sustainability.

Footnotes:
[1] Decarbonising Transport initiative
[2] Transport commitments and initiatives launched at the UN Climate Change Conference (COP26)

The Growing e-Transportation Market

As the global population continues to grow, the challenges faced by current transportation systems will intensify. City-based commuters, for example, face increasing traffic congestion and reduced safety as the number of cars on the road increases. These challenges highlight a clear need for improved infrastructure and alternative modes of transport. At the same time, the growth of traditional transport modes is unsustainable. According to current estimates, about 75% of new vehicle sales by 2030 would need to be EVs to meet sustainability targets[3].

In response to these challenges and increasing global demand, EV sales have increased steadily over the past three years, with the number of electric cars in use tripling in 2021, as shown below:



Notes: BEV = battery EV; PHEV = plug-in hybrid EV
(Source: International Energy Agency, May 2022)

Current estimates expect the sector to grow at a compound annual growth rate (CAGR) of 21.7% between 2022 and 2030, with established companies like Tesla and Volkswagen leading sales over this period[4]. By 2050, about 80% of global vehicle sales is expected to be electric.

Footnotes:
[3] Why the automotive future is electric
[4] Electric Vehicle Market by Component, Vehicle Type, Vehicle Class, Propulsion (BEV, PHEV, FCEV), Vehicle Drive Type (FWD, RWD, AWD), Vehicle Top Speed (<125 mph, >125 mph), Charging Point Type, Vehicle Connectivity, End Use, Region - Global Forecast 2030

To boost the adoption of EVs, many governments are incentivizing citizens to buy EVs through subsidies and increased investment into EV infrastructure, like charging stations. There has also been a drive to shift public transit systems in cities to electric systems. Examples of these initiatives include using fully electrified bus fleets or providing commuters with electricity-powered mobility options for short-distance travel within cities.

Micro-mobility Adoption

Another growing trend in the EV space is the use of micro-mobility devices, such as e-scooters, e-skateboards, and e-bikes. These devices offer commuters flexibility and affordability for short-range travel. Similar to electric cars, the micro-mobility market is expected to undergo steady growth over the next few years at a CAGR of 16%, increasing from US$3 billion to US$12 billion by 2027[5].

Adoption of micro-mobility devices should also greatly reduce transport-related CO^2 emissions, particularly where these devices replace traditional vehicles, like cars, as a mode of transport.

Footnote:
[5] How to maximize IoT to advance the micromobility market

Wireless IoT Connectivity: The driving force of the e-Transport Revolution

In all these cases, wireless connectivity and IoT capabilities are instrumental in making EVs a realistic solution for improved sustainability. Fibocom's wireless communication modules play a key role in these deployments, empowering users and owners to maximize these vehicles' sustainability benefits.

With the deployment of 5G, a wide array of new use cases becomes possible, leveraging three core 5G capabilities:

- eMBB (enhanced Mobile Broadband)
- uRLLC (ultra-Reliable Low Latency Communications)
- mMTC (massive Machine Type Communications)

Backed by 5G and IoT, e-transportation is finding new ways to manage and monitor EVs at both the individual level and as part of broader, citywide wireless networks. This means EV owners can improve their vehicles' performance and access the necessary data and services to ensure peak efficiency. For example, by using an app connected to the smart city network, car owners can find nearby charging stations and determine the best times and rates for charging their vehicle.

For areas where 5G is not yet available and scenarios where low latency is not mission-critical, using a 4G LTE network is the ideal and more cost-effective solution.

LTE provides reduced latency, scalable bandwidth capacity and backward compatibility with WCDMA (Wideband Code Division Multiplexing Access) and GSM (Global System for Mobile Communications). For example, via an LTE network, large-scale logistics management tracks the location of multiple EVs and manages their connection for optimal efficiency. This also increases security and ensures timely maintenance across the fleet, for example, by keeping track of battery charge and discharge rates. Meanwhile, private companies, like ride-sharing services, can use wireless connectivity to monitor the operational range of their vehicles to optimize how and where vehicles are used.

For users relying on both public transit and ride-sharing or rental systems, ubiquitous wireless connectivity paves the way for a smooth, seamless travel experience. The figure below outlines a potential e-transportation journey for a commuter living in a wireless, IoT-enabled smart city:

As the figure shows, the process of charging and payment can also be automated when supported by a broader wireless network, with vehicles operating as part of a machine-to-machine (M2M) economy. This in turn makes it easier for electricity providers to balance the load on a city-wide grid and incentivize or disincentivize charging at different times through lower or higher rates. Vehicle owners can also be incentivized to take part in “smart-charging” vehicle-to-grid (V2G) initiatives. With these initiatives, their vehicles essentially operate as energy-trading batteries that contribute to a more sustainable and greener city grid.

e-Transportation Scenarios and Applications

In this section, we'll explore specific e-transportation connectivity applications in greater detail, as well as the different types of electric vehicles at the forefront of the e-transportation revolution.

Public transport: The adoption of electric buses and taxis in public transport is growing, providing significant economic benefits, such as reduced fuel costs, especially in high-mileage use cases. Cities and counties are also cooperating with schools to electrify school buses, provide staff with EVs, and install EV infrastructure in school parking lots and administrative facilities.

With the support of wireless IoT connectivity, transportation network companies can optimize fleet operations remotely and accurately. Drivers are further empowered to track vehicle performance, map out journeys based on the best points and rates for charging, and tap into enhanced security options such as geo-fencing and vehicle immobilization.

In addition, performance-tracking and monitoring applications allow drivers to detect potential faults in real time and schedule preventative maintenance for optimal performance.

Micro-mobility vehicles: As part of “on-demand” city-wide transport schemes, micro-mobility devices offer users the benefits of access to EVs without having to purchase or maintain the devices themselves. In this way, these devices contribute to a diverse EV economy that reduces emissions and traffic congestion in cities, while also forming part of a larger, enmeshed e-transport system.

On a localized scale, micro-mobility vehicles such as e-bikes are gaining traction, particularly among commuters in cycle-friendly cities such as Paris, Beijing and San Francisco. Though primarily used for shorter trips around the city, high-end e-bikes are capable of ranges up to 100 km. Improvements in lithium battery technology, such as lithium-titanate, also mean that the range, charging time, and durability of these devices should improve massively in the coming years.

In some cities, e-bikes have also become a go-to option for ride-sharing services and public transport provision. Supported by existing cycling infrastructure and city-wide wireless connectivity, commuters can easily locate and use these services to reach their destination.

In addition to e-bikes, city-based commuters are seeing the advantages of smaller, lightweight vehicles, including e-scooters, Segways, and e-skateboards. These smaller devices are not only suitable for personal transport – ride-sharing companies also use them as a cheap, easy alternative for tourist and commuter travel.

For commuters who choose to buy their own devices, these vehicles are usually inexpensive and cost-effective to operate and maintain. Another advantage is that it is typically easy to transport micro-mobility devices on other public transit systems. This means that users commuting by train or bus, for example, can take their device on board with them, giving them greater freedom and flexibility of movement in their commute.

Battery Management Systems (BMS): For all the EVs discussed above, the core component that is essential to their performance is their battery system. Vehicle owners will naturally want to optimize these systems to enhance output, durability, and longevity. Many of these functions are regulated by a Battery Management System (BMS), which aims to improve battery health and prevent damage.

Using wireless connectivity and a suite of IoT sensors embedded in the vehicle itself, the BMS can access detailed telematics data to support its objective. In practice, this means monitoring battery temperature and power output, planning optimal charging schedules, and allowing users to personalize battery configurations. Vehicle owners can also log data on battery parameters and performance under different conditions remotely. This enables users to make comparisons that they can use to inform maintenance and fault management.

As edge computing and Artificial Intelligence (AI) become more prevalent, these data points can also be used to construct “digital twins” of EVs, improving safety and enabling real-time prognostics of battery and vehicle health.

EV infrastructure: One of the most important factors in the transition to e-transportation for cities around the world is investing in EV infrastructure, such as EV charging stations. Communications equipment maximizes the value of this infrastructure, allowing charge points to monitor usage, identify users, and easily facilitate payment.

These benefits extend to both individual users and operators or governments running these systems. For example, IoT-enabled charging stations can give operators insight into the demand for the service at different times and allow them to remotely monitor and manage charging station capacity and local grid loads.

Meanwhile, the vehicle owner can track the availability of charging points in real time with a smartphone app, book a slot while en route to the point, and pay for the service automatically once charging is complete.

As the above examples demonstrate, wide-scale adoption of e-transportation provides more than just a sustainability opportunity. It allows us to reimagine the future of public and private transportation and to develop safer, smarter, more interconnected systems.

Fibocom Wireless Communication Modules

Making this e-transportation future a reality requires fast, seamless, reliable connectivity. Fibocom's wireless modules are designed to meet these requirements and enable communications across a range of network scenarios. This includes the next-generation 5G and LTE modules that will support the smart cities and smart infrastructure of the future.

High-speed 5G Solutions

FG160 and FM160

- Air Interface: 5G, 4G, 3G
- 5G NR Sub-6 band compliant with 3GPP release 16
- High-data throughput for use with cellular terminals such as CPE, STB, IPC and ODU
- Supports multi-constellation GNSS receiver for high-performance positioning and navigation

FG360

- Air Interface: 5G, 4G, 3G
- Built-in quad-core and 2GHz ARM Cortex-A55 CPU
- Supports 5G SA and NSA network architectures
- High-speed performance designed for FWA, gateway, industrial monitoring, and augmented reality

Cost-effective 4G Solutions

FM101 and FG101

- Air Interface: 4G, 3G
- Supports more than 20 LTE frequency bands and 3 different communication modes (Cat 6, Cat 12, and Cat 13)
- Supports multi-constellation GNSS receiver (GPS/Galileo/ GLONASS/ BeiDou) for high-performance positioning and navigation
- High-speed connectivity for applications like FWA, smart cities, and C-V2X

NL668

- Air Interface: 4G, 3G
- High-value LTE Cat 4 module
- Worldwide LTE, WCDMA, and GSM coverage
- High-performance chipset platform with low latency and high reliability
- Professional reference design and timely technical support to help customers quickly complete product development.

L716

- Air Interface 4G, 3G
- LTE Cat 4 wireless communication module
- A maximum downlink rate of 150 Mbps and uplink rate of 50 Mbps
- Supports rich industry-standard interfaces and multiple internet protocols, meeting the diverse hardware and software demands of IoT products
- Seamless connectivity with high performance and low latency across a range of IoT applications

MC116

- Air Interface: 4G, 3G
- LTE Cat 1 module with a theoretical downlink peaking at 10 Mbps and an uplink of 5 Mbps
- Adopts LCC+LGA form factor
- A rich set of interfaces, including SIM 1.8V/3.0V, USB2.0, UART, and I2C
- Applications across a wide range of IoT scenarios, including asset tracking, smart payments, public security, and Internet-of-Vehicles connectivity

MC610

- Air Interface: 4G
- LTE Cat 1 bis module supporting VoLTE (Voice over LTE), Audio, Recording and SMS
- LCC+LGA form factor
- A rich set of interfaces, including USB, UART, SPI, and I2C
- Provides stable and secure connectivity for the low- and medium-rate IoT market
- Ideal for IoT scenarios such as smart payment, sharing economy, IIoT, asset tracking and telematics

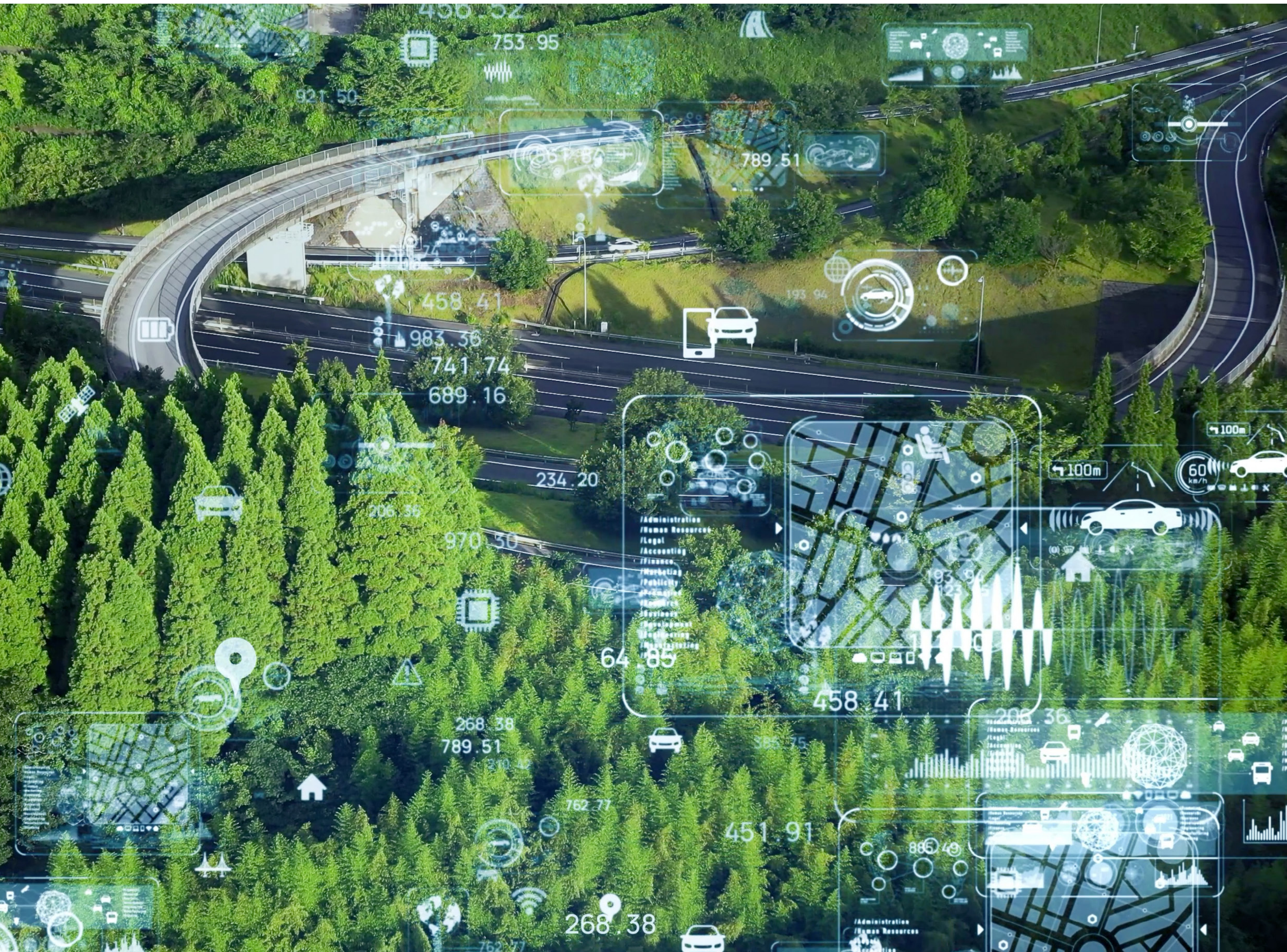
L610

- Air Interface: 4G
- LTE Cat 1 bis module with VoLTE (Voice over LTE), camera, LCD, keypad, and other functions
- Supports Open CPU as well as built-in Bluetooth and Wi-Fi Scan
- A rich set of interfaces, including USB, UART, SPI, I2C, and SDIO

Enabling Sustainable Transportation with Fibocom Connectivity

Increasingly, cities and countries across the globe are choosing to implement carbon-neutral transportation solutions in line with international agreements. At the same time, consumer demand for these solutions is growing, making e-transportation the next frontier of global sustainability.

Fibocom is dedicated to meeting this demand with diverse wireless communication modules suitable for a range of scenarios. Fibocom modules are already being used to enable a variety of e-transportation and Internet-of -Vehicles (IoV) solutions that enrich this new sector with the power of wireless connectivity. In collaboration with other global technology leaders, we aim to make the clean transport revolution a reality and to help usher in the new era of sustainable transportation.



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