TM Research & Development

3G Sunsetting and Its Impact on Mobility IoT Solutions

White paper

Executive Summary

The phasing-out of the third-generation (3G) cellular communication technology standard heralds a significant technological impact today. In fact, it has already begun affecting businesses and their customers globally.

This has particularly affected the many IoT devices that previously depended on 3G. They are now forced to return to a 2G network or upgrade to 4G LTE. Some will inadvertently require the newer 5G networks.

As with many other solution providers, TM R&D is facing a dilemma. The need to manage device connectivity at a lower bandwidth, for instance, using the 2G network versus upgrading its devices to become compatible with the newer networks, has unfortunately come at a cost.

In this whitepaper, we will assess the impact that 3G Sunsetting has on the Malaysian market, looking specifically at Mobility IoT solutions deployed by TM R&D.

Overall, significant performance degradation was observed where devices facing connectivity issues like speed, latency and coverage had increased twofold from 10% to 20%. This resulted in functional impairment.

These key challenges concerning 2G network coverage and its limited data transfer capabilities have proven that migration to a more sustainable Mobility IoT device on newer networks will guarantee better performance and user satisfaction in the long run.

Malaysia's 3G Sunsetting Landscape

As 5G technology continues to emerge globally, the retirement of legacy networks like 3G and 2G have been inevitable. They have made way for the current cellular towers' 5G spectrum allocations and space constraints.

In Malaysia, this has meant that customers with no access to the newer 4G or 5G networks have been forced to depend on older networks like 2G.

Because of this, various data-rich applications and device connectivity are constantly impacted by poor coverage and data transfer issues due to bandwidth limitations.

The question is, are Malaysians ready for the 3G Sunset tech? In particular, service providers and small and medium-sized enterprises (SMEs) have to fall back on 2G for their business needs – this is something they've had to consider.

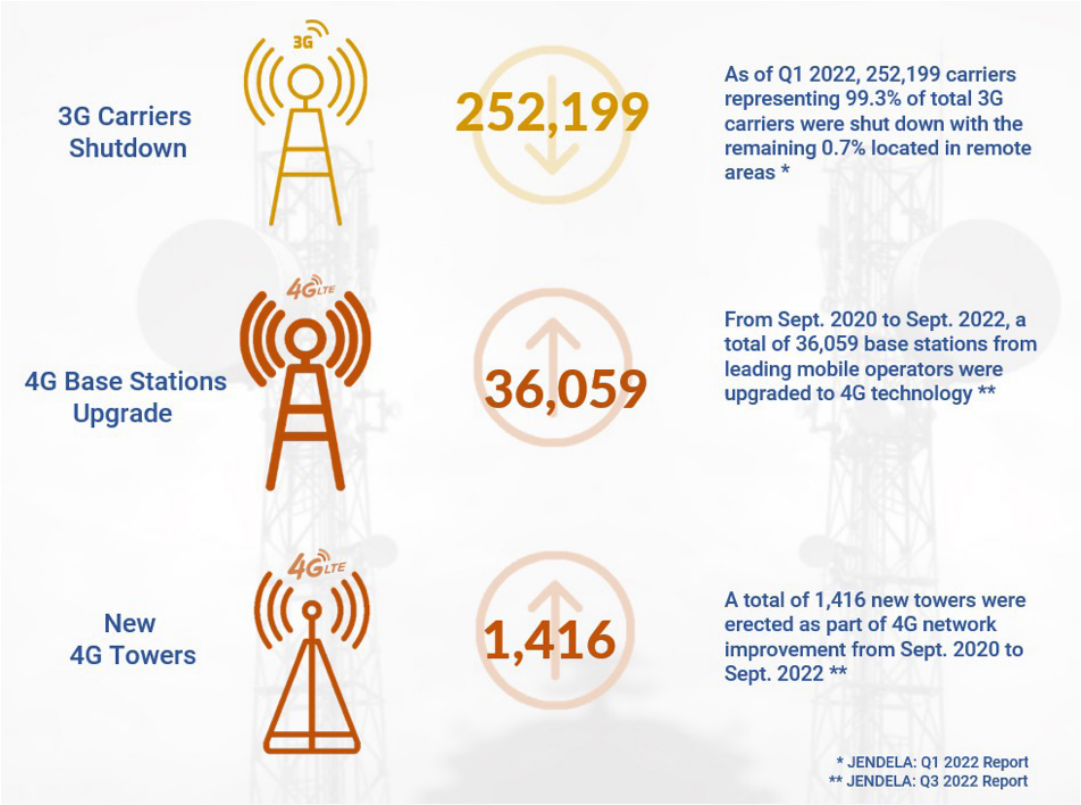
Are they ready to deal with latency and data delay issues when devices are forced to run on 2G services, capping at most 64 kbps?

As the rest of the country surges ahead, the government has supported replotting its unique approach to 5G through various efforts, including JENDELA.

MyJENDELA Initiatives

In December 2021, the Malaysian government began phasing out the country's 3G networks via its JENDELA initiatives. Newer network technology was brought in to replace the older ones with much effort.

The ultimate goal of this initiative was to reallocate spectrum usage and further improve the quality of service to enhance online experiences for the public. These included shutting down 3G carriers, upgrading 4G base stations, and setting up new 4G towers across Malaysia.



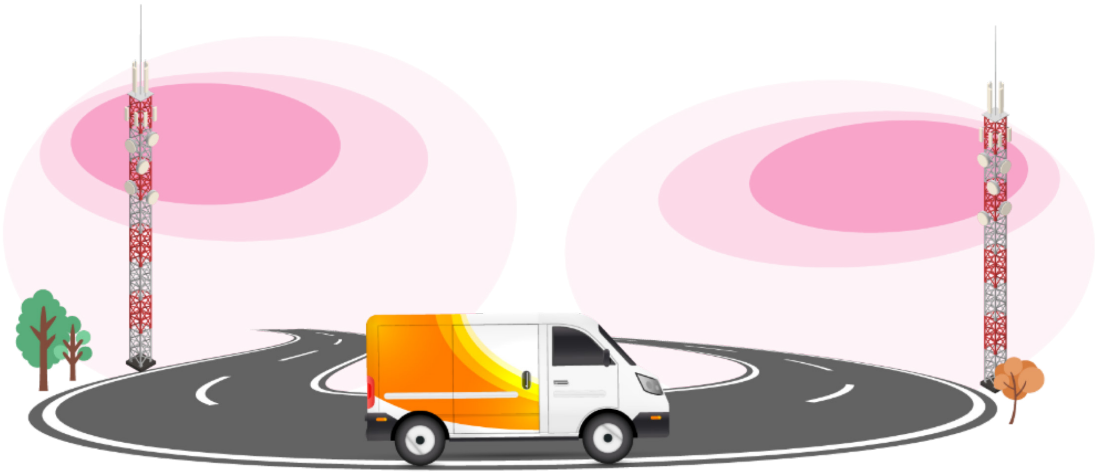
Mobility IoT Solution

In Smart City development plans, Smart Mobility is the core segment that serves intelligent transport and mobility networks for the public. Within this segment lies Mobility IoT applications, which enable data sensors to be installed on infrastructures and vehicles for higher efficiency.

These applications can be autonomous vehicles, fleet tracking, logistics monitoring and e-scooters, to name a few. For them to be implemented correctly and remain efficient, maintaining stable and continuous connectivity is a must. However, at the onset of 3G sunsetting, problems related to data rate, latency and congestion pose significant challenges to maintaining this requirement.

Critical Challenges in Fleet Tracking Solution

For Mobility IoT solutions such as a Fleet Tracking system, network performance issues occur from congestions due to 2G's limited bandwidth compared to 3G. As the nationwide 3G sunsetting began rolling out, there were network congestions contributed by ordinary mobile users falling back from 4G to 2G in non-4G accessible areas. The impact of network congestions on the Fleet Tracking functional performance was further compounded by the low data rate and high latency nature of the 2G network.



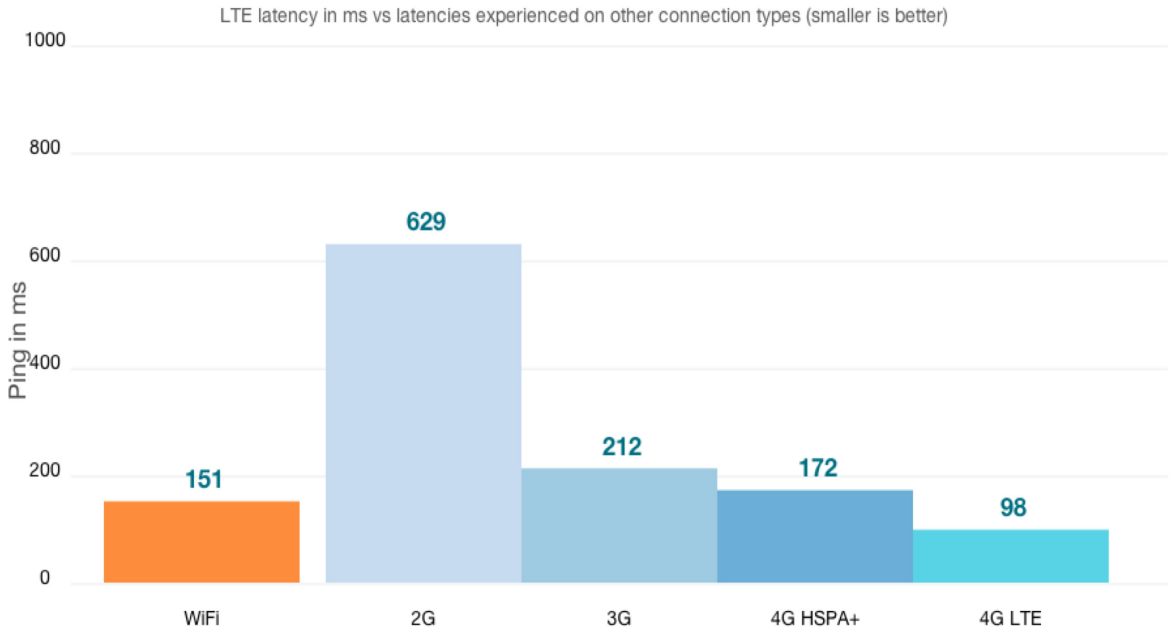
In the Fleet Tracking system that runs on 2G, vehicle tracking and live data issues have occurred during data transfer hand-over because of weaker 2G signals taking place between two cells. This performance drop has been dramatically accelerated by the vehicle's IoT sensors encountering "dead zones", where 2G coverage is unavailable. This has caused data transfer delays when the vehicle enters a new cell coverage. The 2G "dead zones" further affect each user's dashboard's live data and vehicle tracking information.

Data Rate

Low data rates impede the real-time data uploading to the server from IoT devices, especially devices that are on the move with frequent variations in throughput. IoT devices that produce real-time data on the web portal will need immediate updates at the click of a mouse. For example, tracking IoT devices will demonstrate correct locations if the information is uploaded in time.

Latency

IoT devices with latency sensitivity require Transmission Control Protocol (TCP) – protocol enabled to allow data integrity rather than User Datagram Protocol (UDP). TCP is a connection-oriented protocol, whereas UDP is a connectionless protocol. The main differences between TCP and UDP are speed and time taken to transmit data. TCP ensures data transmission is completed without any discrepancy but has a much higher overhead on IoT devices. UDP provides faster data delivery at the cost of missing data. Unfortunately, mobility solutions can't tolerate either of the two limitations.



*Latency comparison for different connectivity types (more minor is better) **

TCP versus UDP for Mobility IoT, which is better?

In Mobility IoT, data transfers between sensors and servers are commonly performed through two main methods – Transmission Control Protocol (TCP) and User Datagram Protocol (UDP).

Each has its advantages and drawbacks. While TCP has proven more reliable, it transfers data more slowly. Meanwhile, UDP is less reliable but works more quickly. This makes each protocol more suited to different types of data transfers.

Characteristic	TCP	UDP
Connection type	Requires connection acknowledgement before transmitting data payload	No connection is needed to transmit data payload
Data payload in sequence	Can send data in sequence order	Cannot send data in sequence
Data payload retransmission	Can resend data if packets fail	No data retransmit. Lost data cannot be retrieved
Delivery of data payload	Delivery of payload is guaranteed	Delivery of payload is not guaranteed
Data errors checking	Complete error checking to make sure all data arrives at the destination	No error checking of all data to make sure arrives at the destination
Speed	Slow but completely delivered	Fast but at risk of incomplete data delivery

For Fleet Tracking operations running on TCP and UDP protocols using 2G network, the performance is affected by data rate, latency and weak signals issues. These issues further deteriorate the Fleet Tracking functional performance within the 2G out-of-coverage or “dead zones” situations. First, network unavailability means no vehicle live tracking information is shown in the portal. It will also cause GPS tracking coordinates to ‘jump' from the last available network coverage to the newly available coverage area.

Secondly, the vehicle tracker and its buffer storage can potentially be complete if the out-of-coverage area is vast. When the fleet vehicle approaches a new cell coverage area, the buffered data can be uploaded to the server. Such situations result in reporting delays and inaccuracies. On top of that, the tracker's whole buffer storage and 2G's limited data transfer rate creates bottlenecks for vehicle data to reach the Fleet Tracking server on time.

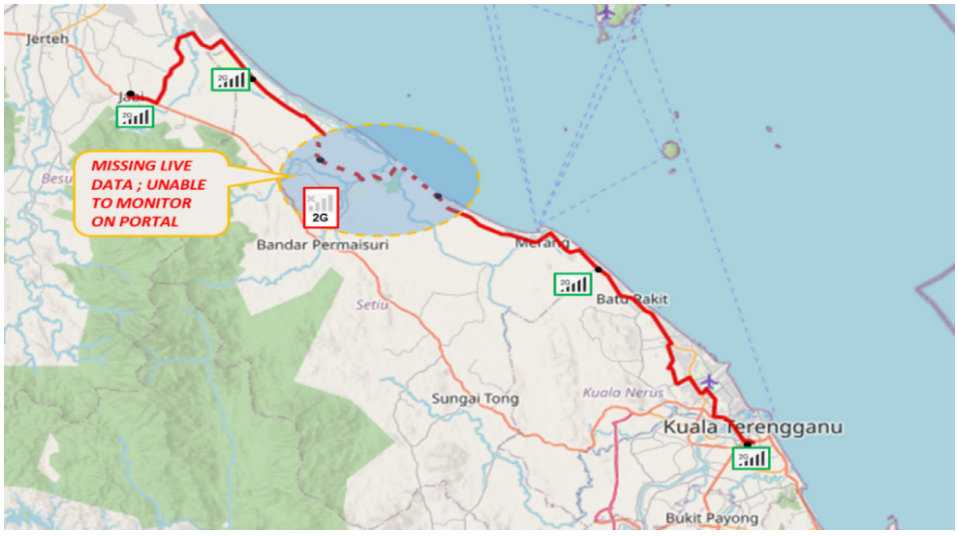
How did the Tracking Performance on 2G do?

An excellent way to demonstrate the tracking performance and its functionality can be seen in TM R&D's Mobility IoT solution, called CONVES.

A fleet vehicle was tracked from Jabi to Kuala Terengganu in East Coast of Peninsular Malaysia. With no 2G coverage in areas indicated by Location C and D, no live tracking data or vehicle diagnostics information was available in the Fleet Tracking server and portal.

Then, at Location E, the GPS tracking jumps were observed, and it took more time than expected to display updated vehicle information. This was due to limited data transfer capacity and a latency setback.

Eventually, the uploaded buffer data was finally synchronised at Location F, taking a full hour to complete the uploading transmission.

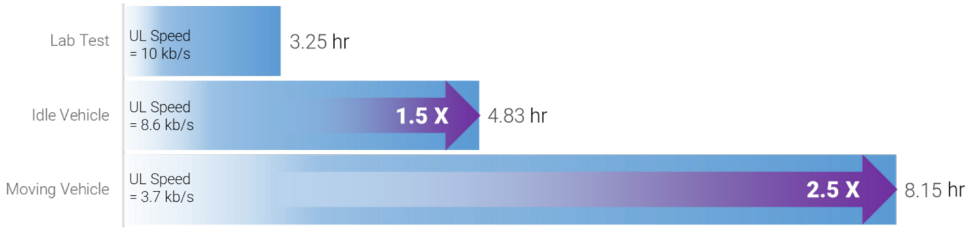


Location:	A	B	C	D	E	F
Tracking:	10:00 AM ; GPS	10:10 AM ; GPS	10:20 AM ; GPS	10:35 AM ; GPS	10:50 AM ; GPS	11:50 AM ; GPS
Portal info:	10:00 AM ; GPS	10:10 AM ; GPS	Showing Location B	Showing Location B	GPS 'jumps' : Location B, C & D	11:50 AM ; GPS
Synchronization:	In sync.	In sync.	No real-time data	No real-time data	Portal data delay	Data upload completed & in sync.

Fleet routing event from Jabi to Kuala Terengganu

2G Stress Test

To further discover the impact of 3G Sunsetting, laboratory 2G stress tests were conducted and compared with the actual on-the-road performance of fleet vehicles from Cyberjaya to the nearby KLIA airport. The two main parameters studied consisted of the time taken to upload tracking data from the vehicle tracking device to the server and the data upload speed on the 2G network.



2G stress test: Time taken to upload all tracking data to a server in different setups

In the controlled lab test, the maximum possible report logs (maximum buffer size) were recorded in the tracking device and were later uploaded to the Fleet Tracking system server. The data rate measured in the lab was 10kb/s, requiring 3.25 hours for upload completion. For comparison, the test was simulated in another two scenarios; one was performed inside a stationary vehicle, while the other was on a moving vehicle from Cyberjaya to KLIA.

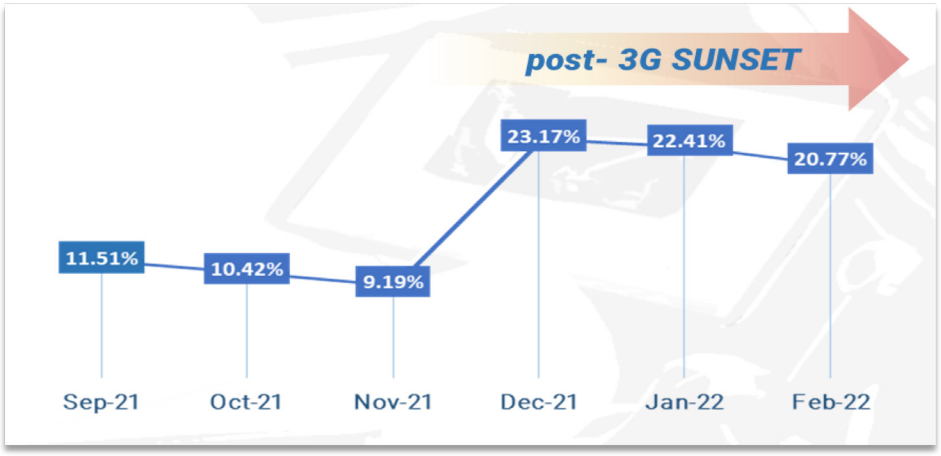
The result shows that the average upload rate in lab setup had reduced from 10 kb/s to 8.6 kb/s and 3.7 kb/s, respectively, for idle and moving vehicle setups. It took 1.5 times longer (4.83 hours) to flush complete buffer data from an inoperative vehicle and 2.5 times longer (8.15 hours) from a moving vehicle.

This delay in flushing the buffer data may cause old data to be overwritten before it can be uploaded to the portal, causing permanent missing data. In essence, substantial delays and bandwidth limitations are vital factors that limit the effectiveness and efficiency of Fleet Tracking mobility IoT solutions on 2G networks.

It is also worth noting that the nature in which mobility IoT solutions are deployed also impacts their functional operation. For instance, rather than having a direct connection to the 2G wireless cells, the tracking sensors used in this application are typically embedded inside moving vehicles. In this case, the lower speed and bandwidth of 2G are further compromised due to the vehicle body and compartment barriers that weaken the transmission signals to and from the 2G cells.

The impact of 3G Sunsetting in a nutshell

Based on the comparison of performance data of trackers connected to 3G and subsequently 2G after the 3G sunset, the nationwide 3G sunsetting activities in Dec 2021 triggered an instant drop in performance compared to November 2021. On average, about 20% of reported trackers observed connectivity issues after 3G sunset, as opposed to only 10% when running on 3G network. This represents double the performance degradation, epitomising the 3G sunsetting effect on Mobility IoT solutions.



Fleet Tracking connectivity performance issues from September 2021 to February 2022

The Way Forward

For IoT Mobility solutions like Fleet Tracking solutions that still leverage 2G connectivity, there are several options to consider when deciding whether current tracking sensors are still feasible.

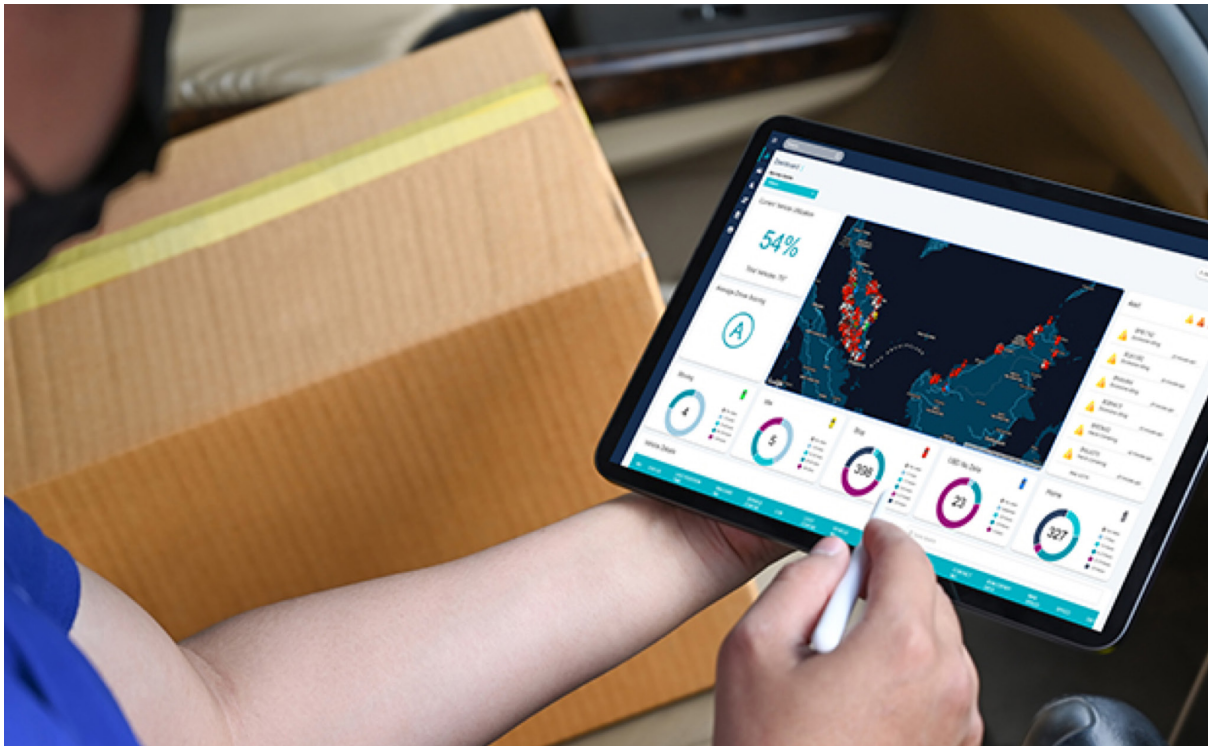
The first option of maintaining operation in 2G offers the lowest migration cost whereby existing tracking sensors can be tuned with optimised payload size and packet delivery algorithms to work in a 2G environment amidst slower data transfer and coverage issues. However, the significant drop in 2G system performance compared to 3G will undoubtedly affect overall users' satisfaction, as observed from double the performance degradation of trackers while running on 2G. Another factor to consider is whether there will be a 2G sunsetting exercise shortly. Judging from the current environment, this might take place sooner than expected.

The second option is to upgrade the tracking device sensors to be 4G compliant. With faster network performance, more comprehensive 4G coverage and an abundance of sensors available in the market, this option guarantees better mobility IoT system performance with the shortest migration time possible. The upgrading cost will increase development expenditure, but its viability can be justified by balancing better system performance and user satisfaction in the long run.

The third option is directly upgrading the tracking device to 5G, skipping the 4G ecosystem altogether. While this may seem a worthy option now that the 5G network has started to be widely available, notable issues make this option debatable. First and foremost, the 5G coverage has yet to reach a decent nationwide coverage, especially in rural areas. Coupled with the scarce availability of 5G-compliant tracking devices and the high price that comes with it, the idea of upgrading directly to 5G quickly loses its commercial viability due to the longer migration time needed and increased overall cost.

Based on the pros and cons of each option, the second one is determined to be the most viable solution among all three options considered. This route is taken by TM R&D's Fleet Tracking solution team that guarantees steadied mobility IoT performance, user satisfaction and long-term sustainability.

TM R&D's Mobility IoT solution - CONVES (Connected Vehicles), is a Fleet Tracking solution designed for logistics companies, transportation companies, municipal or enforcement authorities and enterprises with many fleet vehicles. Successfully deployed on 2000 vehicles throughout Malaysia, CONVES went through device network migration activities post-3G sunset, resulting in smoother operational continuity with less impact from network issues.



CONVES by TM R&D allows fleet operators to track and monitor their vehicles' real-time location and data, ensuring improved productivity, vehicle safety and compliance.

By operating on 4G trackers, the CONVES developers have succeeded in limiting performance issues due to 3G sunsetting. The optimisation works resulted in more excellent stability and reliability of the system, utilising better network coverage, higher data rate and lower latency environment. As a customer-first organisation, TM R&D is always committed to finding the best options to serve its customers in any potential technology sunsetting, now or in the future.

For more information on CONVES, **Click Here**

Creator of Smarter Ecosystems for a better Malaysia

Established in 2000, TM R&D is the innovation arm for TM Group focusing on creating smarter ecosystems to make business and life easier for a better Malaysia. TM R&D's solutions are clustered around four (4) pillars namely Intelligent Platforms, Data Brokerage, Connectivity/Tools and IR4.0/Digital Solutions.

Growing from strength to strength since 2016, TM R&D has won multiple global awards and generated more than 2,800 Intellectual Property Rights (IPRs) and 1,400 digital assets to-date.

TM R&D's innovations are all developed in-house and cut across multiple verticals such as Utilities, Retail, Agriculture, Healthcare and Education with safety and productivity as the top priority.

As TM R&D continues to expand beyond connectivity and into smarter digital ecosystems, its role in TM has become more prominent and exciting.

We are looking for remarkable people to join us. People who are courageous enough to push boundaries, curious enough to experiment with new technologies, and who have the determination to drive new ideas forward. A new opportunity awaits you here in TM R&D.

Be a part of our family at https://www.tmrnd.com.my/jobs/ or email recruit@tmrnd.com.my

For more information about TM R&D and its products and services, visit **www.tmrnd.com.my**