
# Simplifying Safety

The business case for running your ISA application on a cellular Network Access Device

Whitepaper

November 2023

# Executive summary

Already required for all new vehicle types as of July 2022, Intelligent Speed Assistance (ISA) technology will also become mandatory for all new cars sold from July 2024 in the EU.

One year on from the first wave of ISA procurement, some OEMs with smaller volumes in the EU still find themselves without a solution for their platforms. At the same time, some OEMs are currently implementing their ISA systems and are encountering issues with their original suppliers.

The challenge is especially pronounced for entry-level vehicle segments, whose existing hardware platforms may have architectural constraints and limited resources to support new ISA applications. As a result, OEMs find themselves faced with the need to integrate additional dedicated hardware onboard – bringing more costs and integration complexity.

TomTom and Rolling Wireless have teamed up to test a viable solution to the challenges faced by OEMs.

It involves deploying TomTom's Virtual Horizon software on Rolling Wireless' network access devices (NADs). NADs are already required onboard vehicles to enable cellular/GNSS connectivity for eCall. With this lightweight solution, car OEMs can satisfy ISA requirements without the need to invest in separate hardware.

In this paper, we describe how our first-of-its-kind solution provides a straightforward path to ISA compliance. We share details of our successful joint proof of concept (POC) exercise: demonstrating how an online system for ISA can be implemented on hardware already used by OEMs, allowing them to meet ISA and European New Car Assessment Programme (Euro NCAP) requirements at a fraction of the cost and effort.

## The building blocks of our ISA solution:

# NADs & Virtual Horizon Online

### Rolling Wireless' Network Access Devices

Rolling Wireless is the world's leading Tier 2 supplier of Network Access Devices (NADs) to the automotive industry.

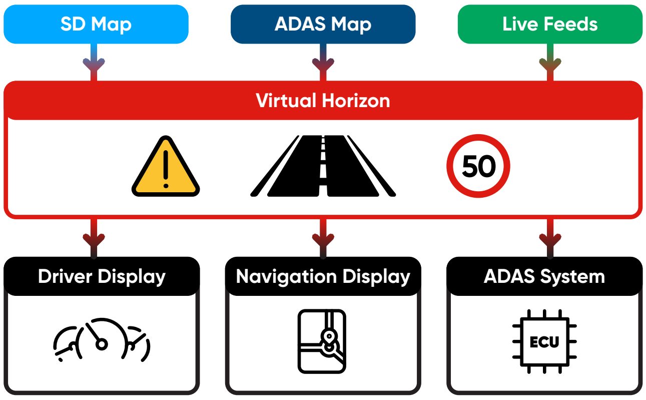
The company's 4G and 5G modules are engineered from the ground up to achieve the highest level of compliance with automotive-grade specifications. Equipped with an application processor that runs open-source embedded software, Rolling Wireless' NADs enable OEMs and Tier 1 suppliers to build a Linux-based Telematic Control Unit (TCU) using a single module.

Rolling Wireless NADs are optimized for TCU design flexibility, offering hardware and software compatibility between different generations of network standards.

### TomTom Virtual Horizon Online

TomTom Virtual Horizon is an electronic horizon solution, which provides a highly accurate model of the road ahead. It transmits data from TomTom's maps and live feeds to Advanced Driver Assistance Systems (ADAS), allowing vehicles to see beyond the range of on-board sensors.

This virtual view of the road becomes a powerful tool both to support ADAS systems and to provide the best experience to drivers.

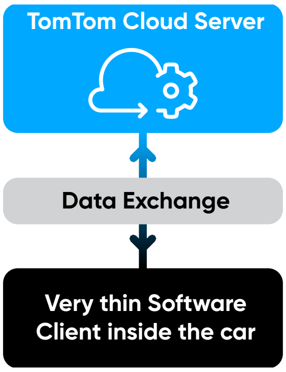



TomTom Virtual Horizon exposes data on the vehicle network and offers precise positioning and route prediction. It is designed to work offline, fully online or in a hybrid mode.

Virtual Horizon Online is TomTom's lightweight and fully online electronic horizon solution, designed to run on a small hardware footprint. It gives vehicles access to the ADAS map data required for ISA compliance, while requiring minimal onboard hardware and resources. Virtual Horizon Online is capable of map-matching the position of the vehicle and predicting its most probable path (MPP) on the cloud, returning only the minimum set of data needed by the vehicle to operate the ADAS function.

**Virtual Horizon Online offers two key advantages:**

- Low hardware footprint on the vehicle side.
- Always up-to-date map data thanks to the online delivery.




The diagram to the left offers a very simple view of how the solution works.

**Most of the "heavy lifting" is done on the TomTom Cloud Server, including:**

- Map data acquisition
- Map matching
- Vehicle horizon calculation

**This leaves only the following essential tasks to the client software running inside the car:**

**01**

Acquire the current car position.

**02**

Send the car position to the cloud server.

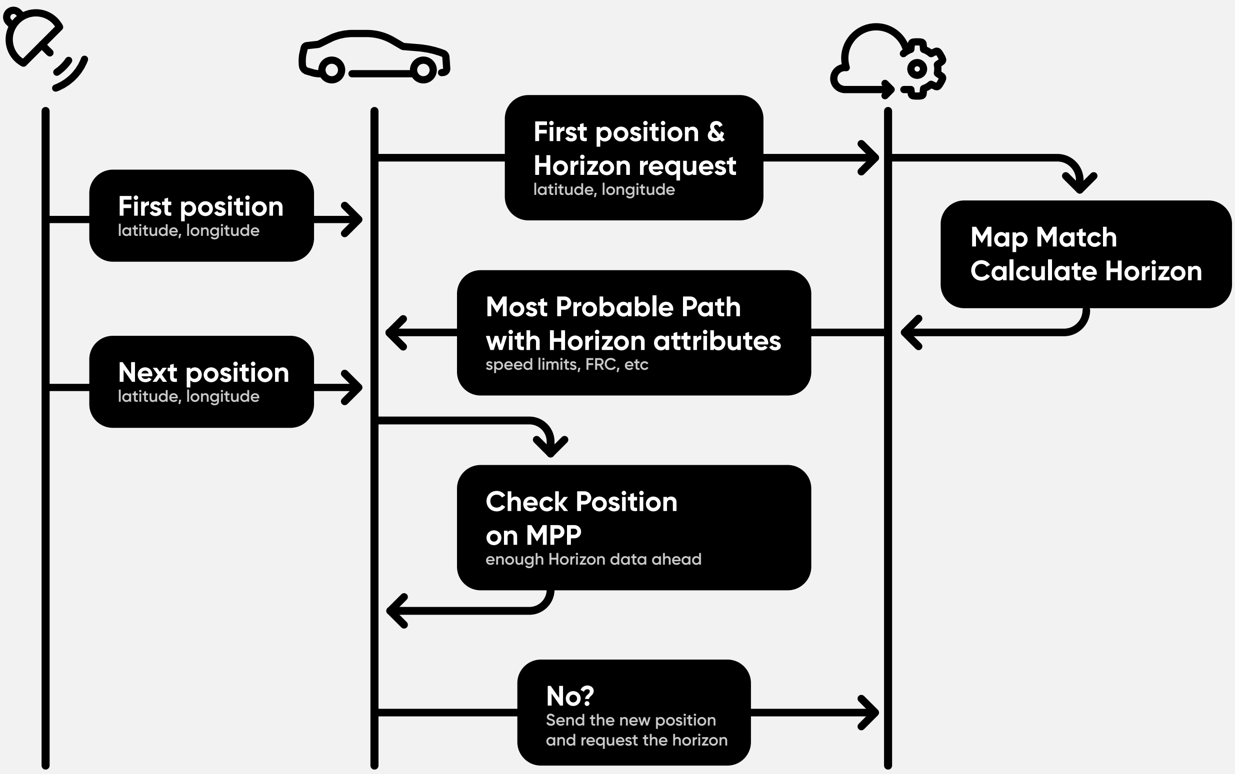
**03**

Receive horizon from the server.

**04**

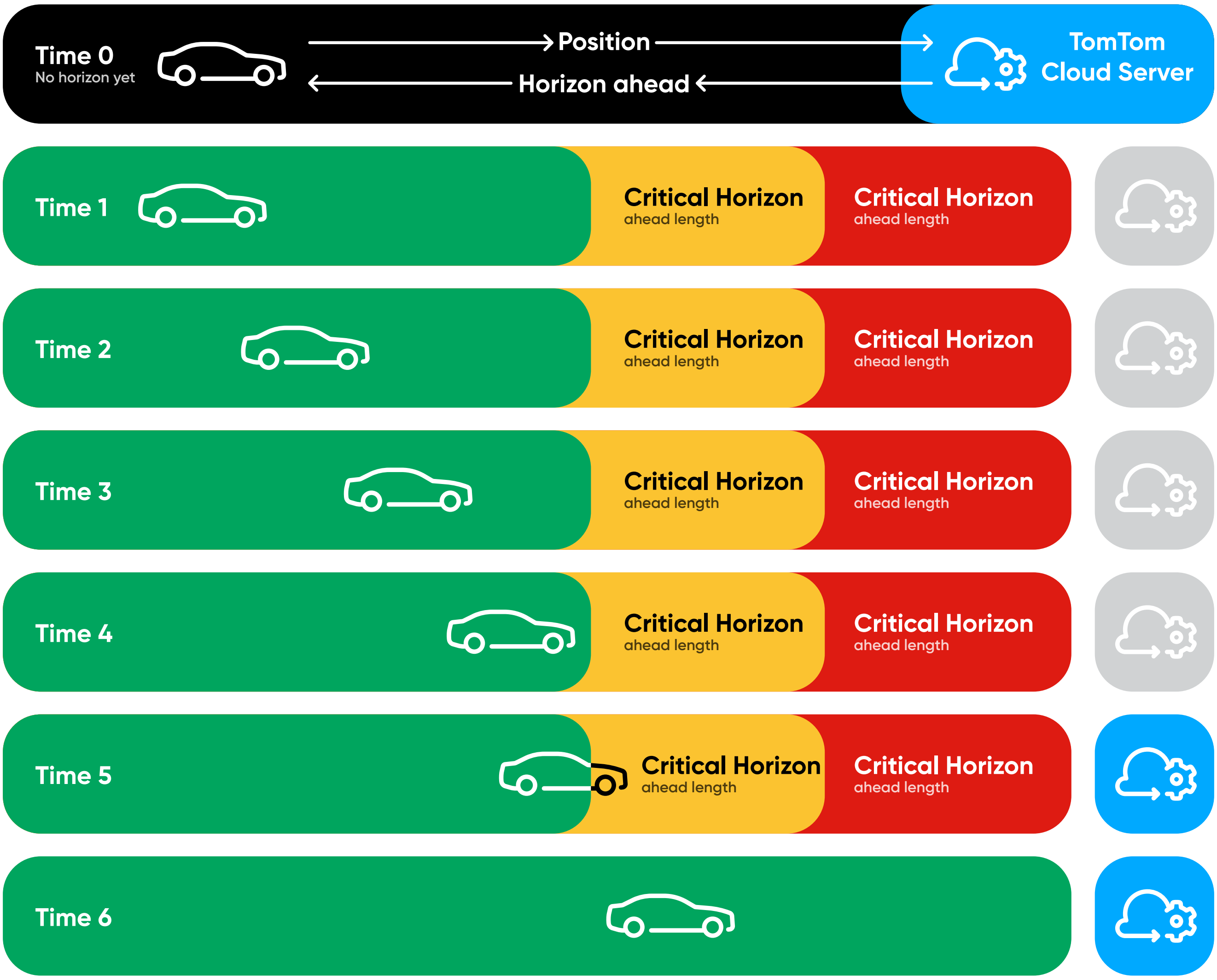
Execute the horizon-based business logic; e.g., speed assistance.

## In the diagram below, we take a closer look at how this is achieved.



At the very start of the process, we have no horizon data, and no map is stored on the client side. So, we send the current car position to the cloud and get the first horizon data back. The data received will correspond to the MPP – the path on which the client is the most likely to continue driving – there are heuristics in place to help us to anticipate the path ahead.

Once we have the horizon on the client side, we can estimate if we are still following it or not. On every position update from navigation satellites, we map match the new location onto the horizon data we have. This action is performed on the vehicle side, meaning no data transfer is involved for the map matching itself. Only if we have deviated from the predicted path ahead or are close to the end of transmitted data, the next portion of the horizon data is requested. This helps minimize data transmission.

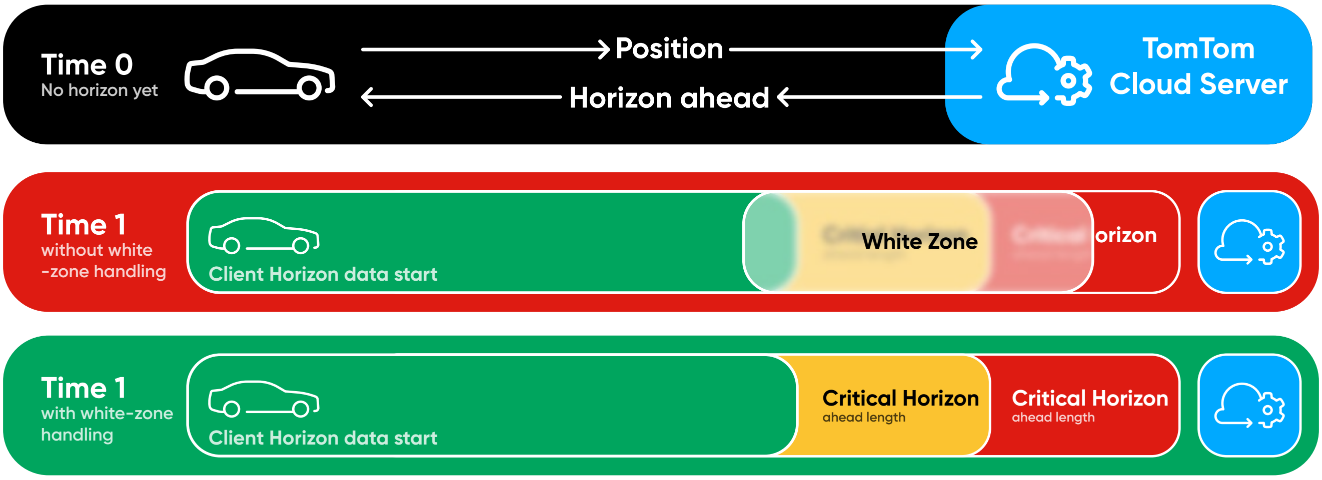


**Virtual Horizon Online can also handle connectivity gaps. There are two ways in which the software can prevent the absence of horizon data due to connectivity gaps:**

- Storing a portion of the horizon locally.
- Taking white zones (areas with zero or low connectivity) into account when requesting the horizon.

As shown in the diagrams above, we request the horizon data for a certain distance ahead of the vehicle. This helps to prevent horizon gaps while driving on a certain stretch of road. The distance covered by the horizon data is configurable, as is the threshold for when to request the next horizon stretch.

"White zones" refer to gaps in cellular coverage. Such data is available per country. When requesting the horizon, we make sure that it does not end up in a white zone. If we detect that the end of a horizon lies in a white zone, we deliver more data to make it through the white zone.



# The opportunity

ISA is expected to bring significant road safety gains through increased speed compliance.

Usually, depending on the selected ISA solution (onboard maps, map tile streaming or a full online map), as well as vehicle characteristics in terms of CPU capabilities and IVI system, ISA can be deployed on different electronic control unit (ECU) architectures.

Cars with complete infotainment systems typically come equipped with powerful hardware, capable of running the ISA application on top of the rest of its navigation stack. However, this type of hardware is not always available in entry-level cars, which tend to have more limited resources in terms of CPUs, memory, and IVI features. It means that entry-level models typically face a tougher road to ISA compliance – requiring carmakers to integrate additional hardware, at considerable cost and effort.

There could, however, be a creative solution to this challenge. Since April 2018, all new-model cars (including entry-level cars) and light vans in Europe are required by law to be equipped with eCall: an in-vehicle system for making free 112 emergency calls. eCall mainly uses Telematics Control Unit (TCU) and, more specifically, NAD connectivity capabilities to carry out cellular communications.

Thus, entry-level cars could leverage the already available NAD to carry out the ISA online service as well, since the NAD provides necessary interfaces such as cellular connectivity and GNSS (Global Navigation Satellite System) positioning. In addition, as most ISA solutions' footprint on memory and CPU are very low, NAD resources could be used to run ISA, freeing other ECUs to carry out other tasks.

# Our approach

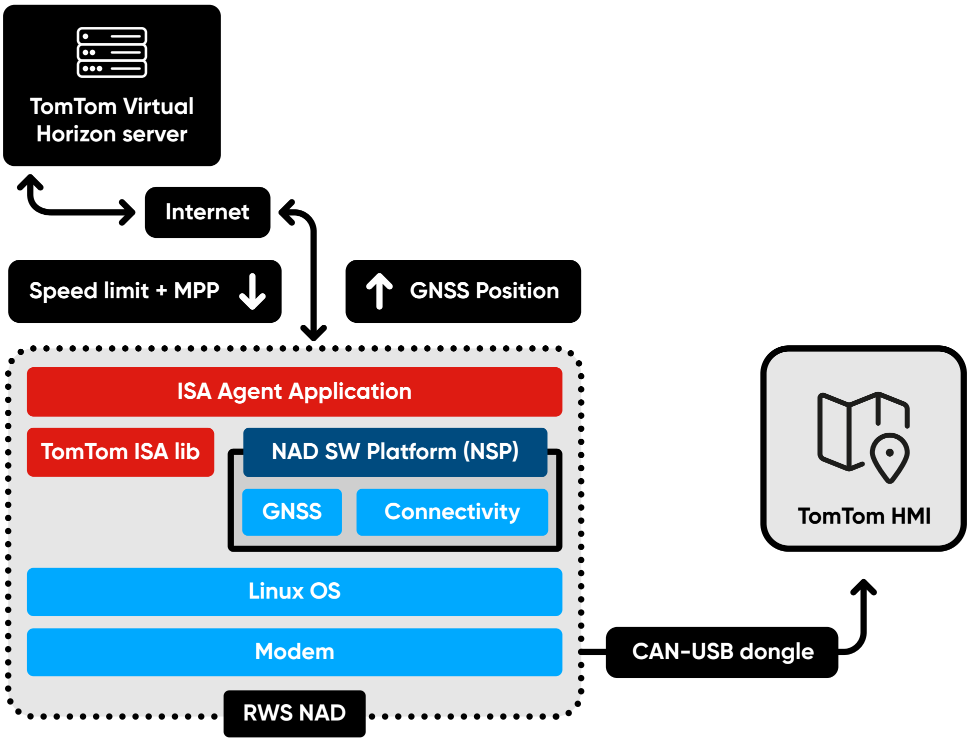
Together, TomTom and Rolling Wireless decided to embark on a POC to put this idea to the test.

The main objective is to demonstrate that a fully functional ISA application can be deployed by integrating Virtual Horizon Online on entry-level 4G (RL9xxx series) and 5G (RN9116) NADs with limited resources.

To the best of our knowledge, there have yet to be any deployments of an ISA application on an automotive connectivity module. This could explain why the automotive industry may be reluctant to use NADs to deploy such applications, due to a lack of technical information on integration feasibility and performance.

To fill this gap, this POC aims to provide the necessary background and proof points to corroborate that ISA can be well-integrated in vehicles NAD, with minimal impact on CPU/RAM. It also aims to demonstrate an easy and fast integration path of such a service for both car OEMs and Tier-1 suppliers.

# Here's how we did it




- TomTom's Virtual Horizon Online agent is integrated into the Rolling Wireless NAD.
- The NAD gets GNSS position information from its integrated GNSS engine, then sends vehicle position data to TomTom's cloud through HTTPS request.
- The online service is HTTPS-based.
  - The information is transmitted in JSON format. Security and certificate-based authentication are in place.
  - To exchange information with the online service, a client needs an API key.
- Online Map Matching and Online MPP determination is performed on the TomTom server.
- The TomTom server returns the speed limit values with the new horizon snapshot.
- The speed limit information is received by the NAD with the new horizon snapshot (MPP).
  - Some MPP data are saved on the NAD so that speed limit information is available even if there is no connection.
- The received data is then routed to the TomTom HMI to display the actual speed limit, as well as the MPP with associated speed limit values.

# The outcome

The POC successfully demonstrated that a fully functional ISA application can be deployed by integrating Virtual Horizon Online on 4G or 5G NAD using limited CPU and memory resources.

**CPU, RAM and data consumption measured during the POC were limited, in alignment with expected results:**

CPU consumption of Virtual Horizon Online (ISA agent) is very low:

- 5% (Total available NAD DMIPS ~2500 DMIPS): 250 DMIPS

RAM memory usage is very low and constant:

- 8MBytes (over 512MB)

Data consumption for VHO:

- 2.6KB per Km.
- With an average of 2,500Km per month, this yields ~6MB.
- This results in ~72MB per year.

# Conclusion and possible future improvements

The result achieved is an important proof point for the market and fills an important gap by demonstrating the deployment of an ISA solution on an automotive connectivity module.

This may offer the automotive industry a less complex and lower-cost alternative to achieving ISA compliance for entry-level vehicle platforms with limited resources in terms of CPU, memory and IVI features.

With the ISA POC correctly running on Rolling Wireless 4G and 5G entry level NADs, this POC could be easily ported to premium 5G NADs such as the RN93xx and RN94xx series where more processing capabilities could be offered for more advanced functionalities.

**The horizon data could be extended to include additional attributes and data streams, such as:**

- Traffic signs, curvature, gradient, weather-related speed limits and Point of Interests (POIs).
- Alerts about local traffic and road hazards.

**A richer electric horizon could support ADAS and driver warning applications beyond the scope of ISA; for example:**

- Warning the driver of local hazards on the road (in compliance with Euro NCAP requirements).
- Powertrain optimization and cruise control assisted driving capabilities.

**It could also be possible to further improve MPP capabilities by:**

- Integrating more advanced MPP heuristics that take into account the history of travel to increase accuracy of the MPP.
- Extending the MPP topology with sub-paths, in addition to the MPP and crossroads. This would further improve local horizon availability.

Finally, it would be possible to further improve white-zone handling by pre-fetching a wider range of data, including sub-paths, and using actual connectivity status in the car to minimize impact of connectivity gaps.

This successful deployment of an ISA solution on an automotive connectivity module addresses a crucial gap in the market and offers a promising, cost-effective option for achieving ISA compliance in entry-level vehicle platforms. As we look ahead, the expansion of horizon data to encompass additional attributes and data streams holds the potential to further enhance vehicle safety and connectivity – delivering better driving experiences for all.

## Contact us

Interested in learning more about the methods and results of this POC? Would you like to explore the possibility of deploying your ISA application on a cellular NAD?

**Please get in touch with us.**

tomtom

For more infomation visit
**TomTom.com**