



## Get ready for vehicle-to-everything communications and 5G

### Use case

Nokia is a strategic technology advisor to highway agencies and departments of transportation in preparing the highway's mission-critical communications networks for the future of mobility with vehicle-to-everything (V2X) communications and 5G. Nokia helps highway agencies to leverage existing cellular networks for V2X, enhancing road safety for travelers and roadside workers. The technology also improves traveler comfort and makes highway travel more fuel-efficient, meeting the changing connectivity demands of vehicles and modern travelers.

## Challenges

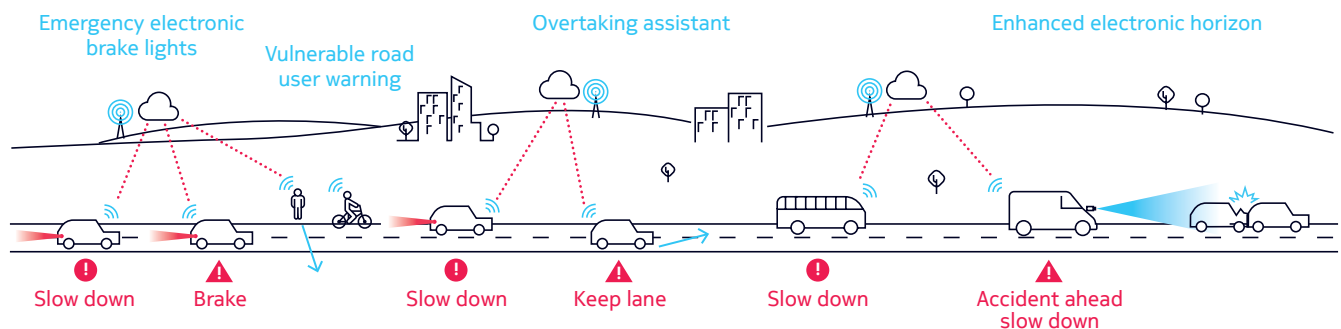
More than 1.25 million people die on the roads each year<sup>1</sup>, with 90 percent of cases being caused by human error<sup>2</sup>. Highway agencies and departments of transportation want to increase safety for travelers and roadside workers. Automated driving supported by V2X communications has the potential to save lives by preventing millions of traffic accidents. Connectivity with other vehicles and pedestrians, centralized cloud-based back-office systems, traffic control centers and roadside equipment will enable services such as hazard warnings, cooperative adaptive cruise control, platooning and more. Real-time communication helps vehicles deal with situations that neither the driver nor the vehicle's built-in sensors can identify, enabling safer and more predictive driving.

Safety-critical V2X use cases for highways demand a latency below 100 ms end-to-end; sometimes even 50 ms latency is required. Such low latencies are usually not supported by today's 3GPP-based cellular networks, e.g. LTE, and highway agencies do not hold licenses to operate cellular networks along their highways. An IEEE 802.11p-based radio technology, also referred to as Dedicated Short Range Communication (DSRC) or Intelligent Transport Systems (ITS)-G5, is seen as an alternative to V2X over cellular (C-V2X). But that requires building a costly new footprint of DSRC-infrastructure along the highways and adding another new dedicated DSRC-communication module in addition to existing cellular modems that are already embedded in many vehicles.

## How we help you

Nokia helps highway agencies and departments of transportation to partner with communications service providers to leverage existing cellular networks, such as LTE, for C-V2X. LTE is a globally deployed technology. When augmented with Multi-access Edge Computing (MEC) in a joint neutral host approach, it provides a viable and cost-effective solution that can accelerate the adoption of V2X communications. The Nokia MEC platform rapidly processes content at the very edge of the mobile network cloud. It can support several use cases with low latency and distributed functionalities, such as distributed analytics, predictive algorithms and distributed self-learning, with an inherent and consistent high level of security.

Figure 1. Enhancing road safety with vehicle-to-everything communications



1 Estimated road traffic related fatalities in 2013 of WHO

2 Estimation of McKinsey & Company

## How our approach changes the game

The Nokia mission-critical solution for V2X meets the demanding requirements of the highway and automotive industry by taking advantage of the economies of scale of the global telecommunications ecosystem:

- Robust end-to-end latency for safety-critical V2X use cases below 20 ms
- Enabling predictive driving based on a long-distance view beyond the range of in-vehicle sensors and direct vehicle-to-vehicle communication
- Greater network capacity to support multimedia services for traveler comfort in addition to safety-critical V2X use cases
- Improved network coverage through a neutral host approach by leveraging existing highway infrastructure, e.g. toll gantries, for mounting cellular antennas of communications service providers and existing communications networks of highway agencies for backhauling
- Building upon telecommunications standards to integrate V2X into existing cellular modems that are already embedded in many vehicles
- Alignment with the 5G technology roadmap including LTE-Advanced, LTE-Vehicular and others

## Why our approach is different

- Industry thought leader in enhancing cellular networks for V2X communications
- World-first demonstration of using a live LTE network with MEC for V2X communications
- Various V2X market trials across the globe with a partner ecosystem
- Market-leading position in LTE technology on the way to 5G
- V2X communications technology innovation with Nokia Bell Labs

## How you benefit

With the Nokia mission-critical portfolio, highway agencies and departments of transportation will benefit from a viable, cost-effective and future-ready solution for C-V2X:

- Lower cost in realizing V2X communications through the use of existing cellular networks in a neutral host model in partnership with communications service providers
- Future readiness of the V2X solution through the alignment with the 3GPP roadmap for the next generation of telecommunications networks on the way to 5G
- Increased road safety for travelers and roadworkers by enabling predictive driving based on long-distance information
- Enabling new, ultra-responsive services improving traveler comfort, such as situational information or augmented reality, with new revenue streams for highway agencies.



## Let us help you

With Nokia, you can realize V2X communications today by leveraging existing cellular technologies, supporting automated driving, increasing traveler comfort and improving the infotainment experience. Increase highway safety and traffic efficiency while optimizing infrastructure investments.

### About Nokia

We create the technology to connect the world. Powered by the research and innovation of Nokia Bell Labs, we serve communications service providers, governments, large enterprises and consumers, with the industry's most complete, end-to-end portfolio of products, services and licensing.

From the enabling infrastructure for 5G and the Internet of Things, to emerging applications in virtual reality and digital health, we are shaping the future of technology to transform the human experience.

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