NOKIA

The road to Automotive success starts with Network APIs

Programmable connectivity
with Nokia's Network as Code

Intelligent transportation and programmable networks

The automotive world is racing toward a smarter, more connected future defined by autonomy, electrification and immersive digital experiences. The pressure on the network has never been greater. Vehicles today must operate flawlessly in complex, congested environments, manage continuous over-the-air software updates, locate themselves accurately beyond GPS limitations, and provide seamless in-car entertainment - all while maintaining safety, reliability, and security. But the industry still faces major hurdles: inconsistent connectivity, unreliable location services in urban canyons and parking structures, and the inability to adapt network performance in real time.

Manufacturers are embracing advanced driver-assistance systems (ADAS), pursuing Level 4 autonomous driving, remote tele-driving, in-car entertainment, and enhancing their safety and roadside assistance systems. Advances in artificial intelligence (AI), next-generation vehicle-to-everything (V2X) communication systems, and advanced sensing technologies like LiDAR are being integrated into next-generation automotive hardware and software platforms.

A key ingredient in pulling all this together is access to programmable networks. The network can provide not only advanced connectivity that dynamically provides Quality of Demand (QoD where its required but important insights about on-board device status, vehicle location beyond the reach of

global navigation satellite systems like GPS, and V2X communications with adjacent vehicles, traffic management, EV charging infrastructure, and, even, pedestrians. Developers of automotive applications can leverage the power of 5G by using network APIs that integrate the functionality of the network directly into their software applications.

This is where Nokia's Network as Code (NaC) comes in. Network as Code empowers automotive developers to integrate the network directly into their applications through standardized, interoperable APIs. These APIs unlock access to capabilities like connectivity management, dynamic Quality on Demand, network-based location, reachability, and slicing all essential for delivering safe, immersive, and autonomous experiences at scale. With Network as Code, the network evolves from a passive transport layer into an active enabler of innovation across the connected vehicle ecosystem.
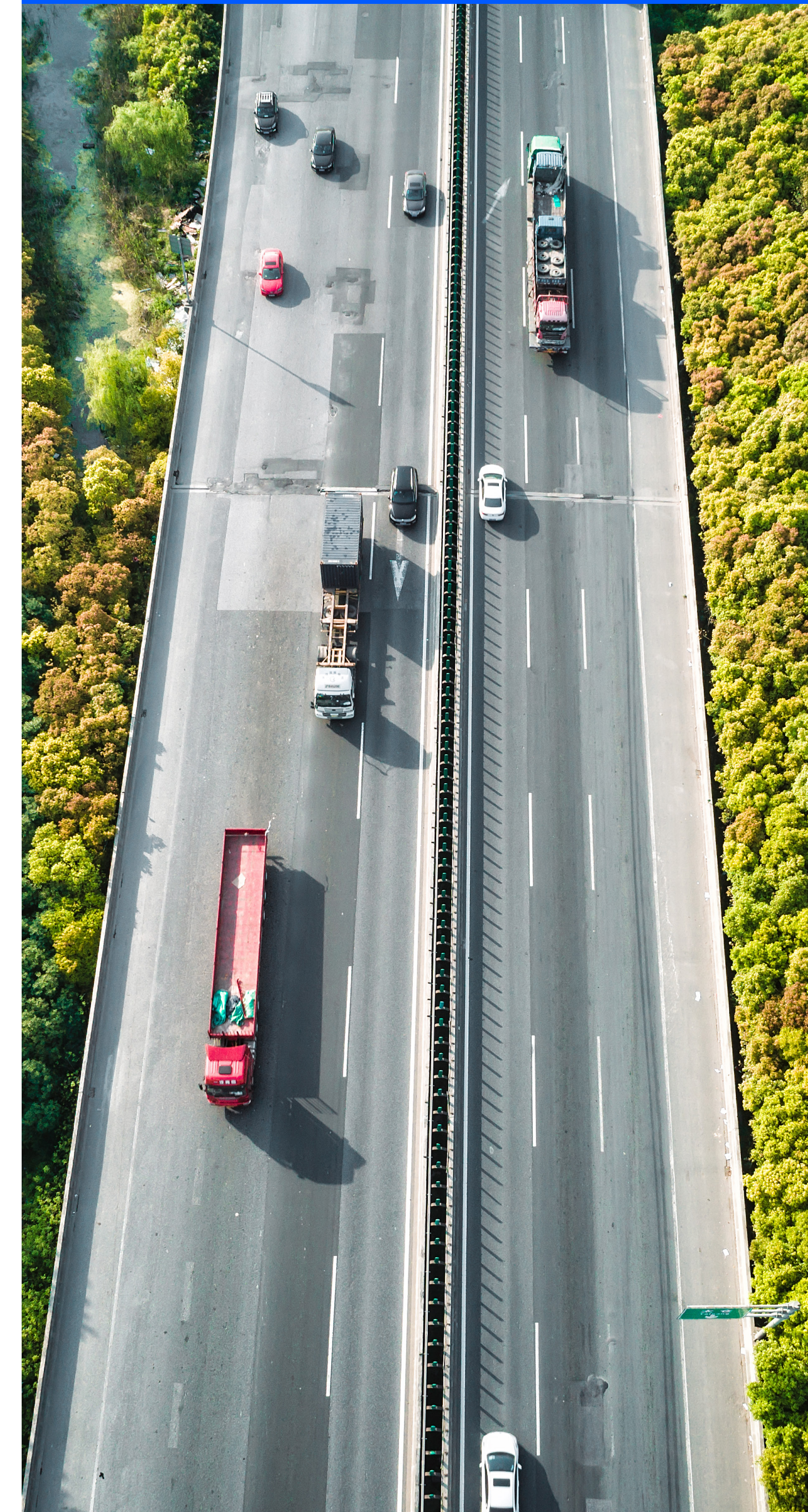
Demand growing for automotive-focused APIs

According to Statista, worldwide automotive IoT is expected to reach **U.S. $275 billion in 2025**. One of the more rapidly growing segments, automotive, is being driven by the need for connected vehicles, vehicle analytics and location-based services. Fortune **Business Insights** says the global market size was **$3.44 billion in 2023** and is projected to reach **$27.73 billion by 2032**.

As AI and data analytics are increasingly adopted into automotive applications, the network will have an important role to play. Automotive applications will vary in the kinds of services they receive from the network via API calls, whether it's Quality on Demand (QoD) or information about vehicle location, vehicle density, and reachability.

System integrators, independent software developers, and automotive OEM suppliers are already developing automotive applications that rely on network performance and data. They can supercharge their applications using APIs to integrate these services into navigation and autonomous driving systems, as well as into analytics platforms that track real-time information about the state of vehicles for OEMs, insurers and fleet owners. In addition to location data, information on vehicle acceleration, engine temperature, speed, and braking can be used for everything from predictive maintenance to usage-based insurance that incentivizes better driving behavior.

Automotive data will also feed into planning and policy processes, giving road and city administrators more information on where to allocate scarce taxpayer resources and develop infrastructure to better plan for urban development, roadworks and traffic management.
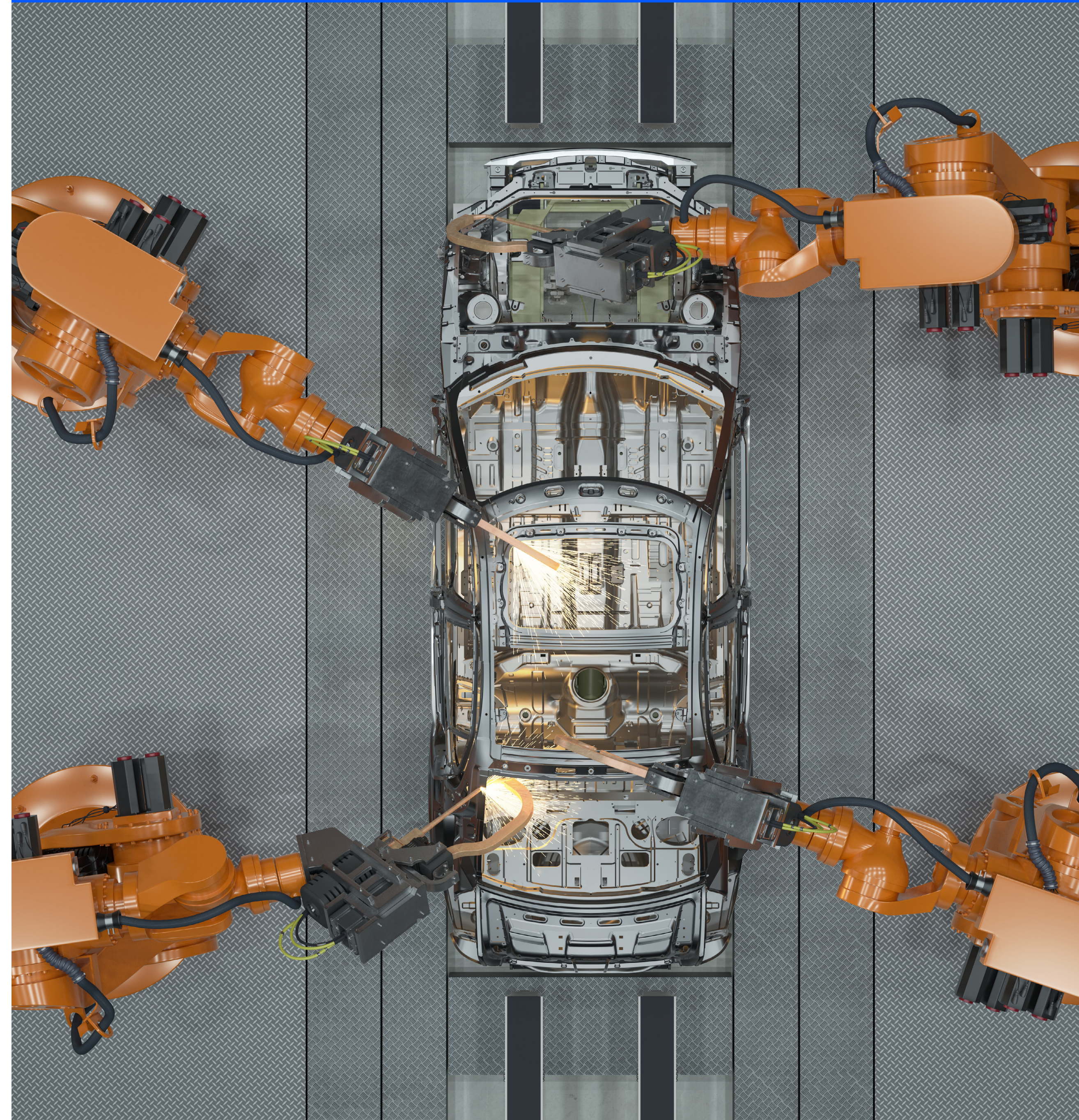
Challenges 1/2

Emerging automotive applications such as autonomous driving, teledriving, and in-car entertainment face significant technical challenges that demand more than traditional connectivity. While many vehicles now come equipped with smart systems, they often operate in isolation, lacking access to real-time network intelligence and contextual data. This creates limitations in both performance and safety.
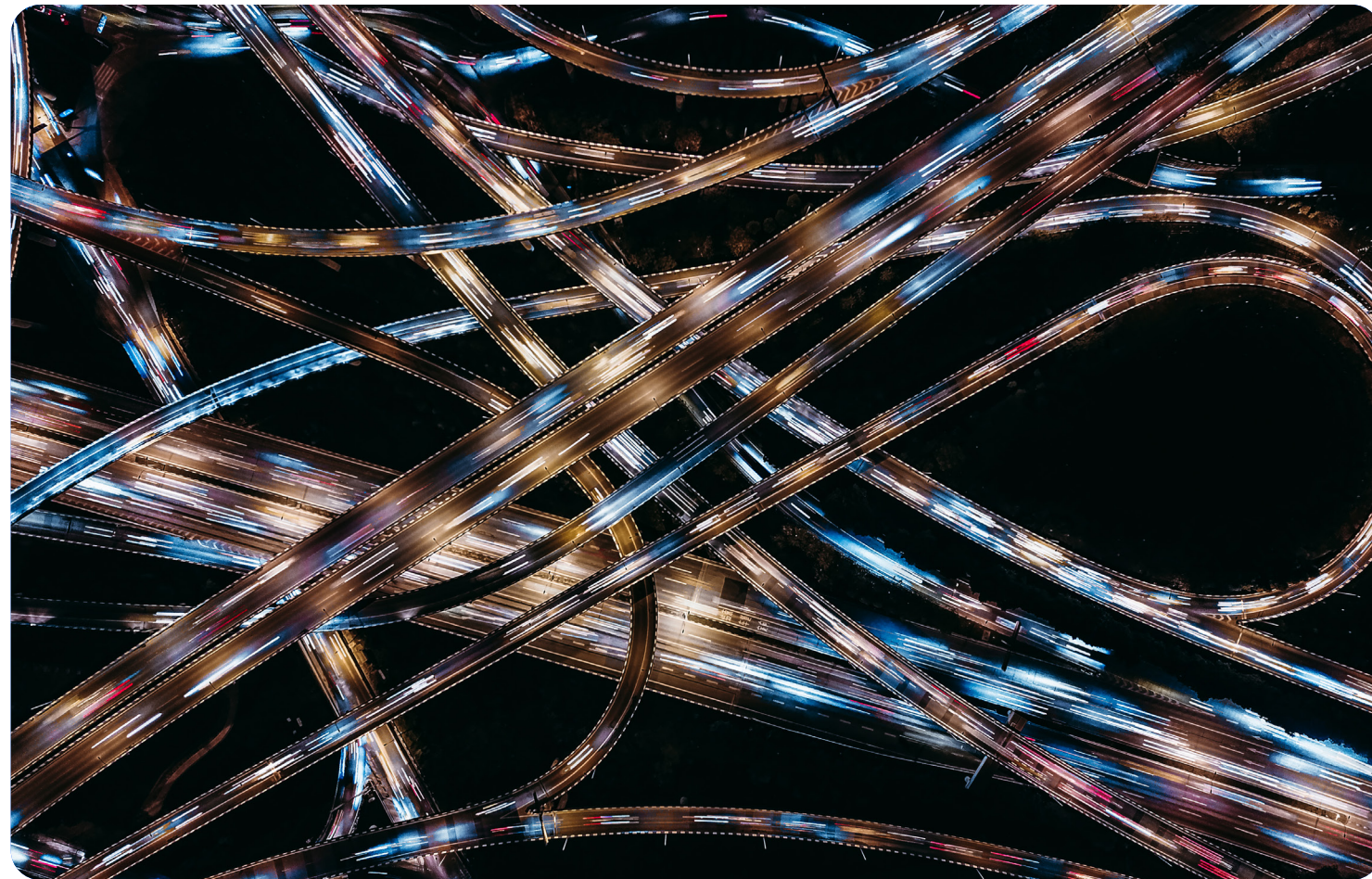
Ultra-reliable, low-latency connectivity

is essential for autonomous and teleoperated vehicles to navigate safely in dense traffic and complex urban environments. The need for uninterrupted command and control - especially during critical maneuvers or handovers between human and remote drivers - means the network must guarantee minimal latency and high reliability.

Over-the-air (OTA) software updates

are crucial for keeping vehicles secure, functional and compliant with evolving regulations. However, OTA delivery can be compromised by inconsistent network performance or insufficient bandwidth, leading to incomplete or delayed updates.

Reliable location data

is another major challenge. GNSS-based systems like GPS often fail in urban canyons, underground parking garages, and tunnels, where signal interference and multipath propagation degrade accuracy. For navigation, roadside assistance and geofencing, imprecise or unavailable location data can put vehicles and passengers at risk.

Challenges 2/2

In-car entertainment and contextual services

also suffer in areas with fluctuating bandwidth. Streaming video, real-time traffic updates, and location-based infotainment require stable and high-quality network conditions to ensure a seamless user experience.

Congestion and crowding

in urban environments can further impair network responsiveness. Without a way to understand population density, vehicles cannot optimize routes to avoid high-risk or slow-moving zones - impacting safety, efficiency, and passenger comfort.

Vehicle-to-Everything (V2X) communication gaps

hinder the ability of vehicles to interact effectively with other road users and infrastructure. Without robust, low-latency, and context-rich V2X integration, vehicles miss critical data from surrounding environments, increasing the risk of collisions and reducing the effectiveness of traffic management systems. V2X plays a pivotal role in enabling vehicles to receive real-time updates from traffic lights, pedestrian crossings, emergency vehicles, and road sensors. A lack of integration prevents vehicles from responding dynamically to hazards, congestion and sudden changes in driving conditions.

Data security and reliability

remain major concerns. Automotive applications that depend on remote commands, OTA updates, or teleoperation are vulnerable to spoofing, jamming, and cyberattacks if data is not encrypted, authenticated and validated. Vehicles without secure and reliable data channels may be at risk of unauthorized access or manipulation, leading to potentially dangerous scenarios involving vehicle control or data integrity failures.

Solutions

Nokia's Network as Code platform addresses these challenges by offering a suite of interoperable APIs that integrate advanced network capabilities directly into automotive applications.

Our platform offers five powerful network APIs for third-party application developers to build innovative automotive solutions:

Quality on Demand API

This API ensures ultra-reliable, low-latency connectivity by enabling dynamic allocation of 5G network resources such as ultra-reliable low-latency connectivity (URLLC) and enhanced mobile broadband (eMBB). Applications for autonomous driving and tele-driving benefit immensely from the ability to prioritize data paths that meet stringent latency and throughput requirements. Whether navigating a congested city street or performing a remote driving handover, this API provides the network responsiveness needed for mission-critical decisions.

Device Location API

The Device Location API delivers precise, low-latency location data by using network-based tracking, supplementing or replacing global navigation system (GNSS) signals. This is particularly valuable in GPS-impaired environments like urban canyons or underground garages. It ensures accurate navigation, supports geo-fencing rules, and improves safety for use cases such as parking assistance and emergency services.

Device Reachability API

This API tracks the real-time status and network availability of devices within the vehicle. It ensures that applications only initiate tasks - such as diagnostics, updates or teleoperation - when the vehicle's systems are accessible and online. This helps prevent failed communications or unintended operations.

Network-Aware Route Optimization API

With this API, navigation systems can select driving routes that will provide the required network quality of service based on current network performance data. Vehicles can avoid zones with poor signal coverage or degraded service, leading to smoother, more reliable journeys and improved in-car experiences for passengers relying on infotainment or cloud services.
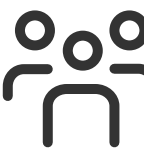
Population Density API

The Population Density API offers insight into real-time or historical human density in specific geographic areas. Connected vehicles can use this data to reroute away from areas of congestion, reduce safety risks in pedestrian-heavy zones, and optimize delivery or fleet efficiency. This API enhances situational awareness and allows for smarter mobility planning.

Device Status API

OTA updates, diagnostics and predictive maintenance workflows rely on accurate, up-to-date information about a vehicle's device readiness. The Device Status API ensures that such updates are only pushed when vehicles are prepared to receive them, minimizing update failures and improving operational integrity.

Benefits

V2X Integration via QoS and location APIs

By combining QoS on Demand and Device Location APIs, this solution enables seamless V2X communication. Vehicles can exchange data with infrastructure, nearby vehicles, and pedestrians, supporting features like cooperative lane merging, smart signal prioritization and hazard alerts. The result is a safer and more efficient driving ecosystem powered by real-time collaboration.

Scalability

For enterprises offering intelligent transportation services and support, highly scalable 5G networks offer seamless IoT connectivity with massive machine-type communications (mMTC) services, ensuring reliable coverage across vast and dynamic environments. 5G's ability to dynamically scale means that even in high-density environments where large volumes of connected devices are simultaneously transmitting their location data, it is possible to manage the surge of network traffic and prioritize the most critical data traffic.

Nokia's Network as Code platform, powered by Rapid, is a comprehensive, enterprise-grade solution designed to meet these challenges. It enables seamless network expansion, providing the flexibility to scale IoT infrastructure efficiently while optimizing for both performance and reliability. With this advanced platform, enterprises and developers can ensure optimal connectivity and performance as they manage growing networks of connected vehicles, even in complex, high-demand environments.

Secure Connectivity and Authentication APIs

To address data security and reliability, Nokia's NAC platform incorporates native 5G protections such as encryption, network slicing, and SIM-based authentication. When paired with the Device Reachability and Device Status APIs, these features enable robust endpoint validation and anomaly detection, helping safeguard the integrity of remote commands, updates and sensitive user data. These APIs unlock new capabilities that directly tackle today's biggest challenges in automotive innovation. By leveraging real-time network intelligence, automotive applications can become smarter, safer and more responsive - delivering not just performance improvements, but competitive advantage in a rapidly evolving mobility landscape.

Superior data integrity and cybersecurity

The security architecture of 5G offers enhanced protection for connected devices including 256-bit encryption, SIM-based authentication, identity concealment, and virtualization features like network slicing. This makes it a more resilient choice for vehicle communications than other networking technologies.

In terms of location data, unlike GPS, which can be jammed or falsified, 5G's cellular-based tracking utilizes multiple network infrastructure points to ensure accurate and reliable vehicle location verification. This robust system is nearly impossible to manipulate, providing a secure solution for critical vehicle applications. Additionally, the Device Reachability API provides real-time insights into the operational status of devices, helping detect unauthorized usage and optimize maintenance schedules. These features collectively enhance energy efficiency, anomaly detection and predictive maintenance strategies, making 5G a superior choice for securing, managing and optimizing connected vehicles.

Together, the Device Location and Device Status APIs offer a powerful, network-based solution for securing, managing and optimizing connected vehicles.

Building compelling automotive applications

Assuring that the network can meet the bandwidth and latency requirements of the application is crucial to the viability of automotive use cases. Nokia's automotive-focused APIs serve multiple purposes, from assuring network performance to providing contextual data. In the case of vehicle location, it is even possible to integrate network device location data algorithms and visual computing recognition used with cameras, RADAR and LiDAR. This can ensure precise location identification, even in complex settings. These solutions enhance situational awareness and navigation, enabling everything from traffic efficiency to management of fleet assets. Geofencing applications can dynamically alter no-go zones in real-time or alert drivers to roadside emergencies, roadworks, and rapidly evolving incidents.

Use Case: Enabling reliable Teledriving with Network as Code

Autonomous or remote driving services are being trialed in cities around the world. One such service is being offered by Elmo in Estonia. Elmo's teledriving service utilizes state-of-the-art technology, including advanced sensors, cameras, RADAR, and LiDAR systems. These components work together to ensure precise navigation and situational awareness, enabling the tele-driving service to operate smoothly in complex urban environments.

Elmo faced a critical challenge: ensuring consistent, real-time connectivity between the remotely driven vehicles and their operators, particularly in congested city environments. To address this, Elmo partnered with Nokia and Elisa to integrate Nokia's Network as Code with QoD (Quality on Demand) APIs. This solution allowed Elmo's system to request enhanced network performance dynamically - such as increased bandwidth and reduced latency - ensuring stable and responsive video and control links. This use case demonstrates how programmable networks can reliably support edge-critical services like teledriving, unlocking scalable opportunities for remote mobility solutions in urban settings.

Nokia Network as Code

The industry's leading network API platform designed for enterprise business-critical needs

ABI Research ranks Nokia overall leader and top innovator for telco API platforms

Nokia Network as Code is the industry's leading API platform that enables you to easily integrate specialized capabilities and rich insights from the network into your fleet and IoT management solutions.

Since launching the Network as Code platform in late 2023, Nokia's ecosystem of 50+ Network as Code partners covers leading global networks including BT, Orange, Telefonica, Vodafone and US Majors.

Nokia's commitment to widespread API adoption extends beyond network-side aggregation, and our ecosystem also includes hyperscalers like Google Cloud; Communications Platform as a Service (CPaaS) providers such as Infobip; large system integrators such as Global Logic and Wavemaker; vertical independent software vendors like Elmo; and the world's largest public API hub through Nokia's acquisition of Rapid.

Unified API access across global networks

You don't need to update your codebase for every region and service provider. Network as Code offers an expanded set of Network APIs with unified API access across all leading global networks, greatly simplifying development complexity.

Take advantage of extreme API performance and availability

Powered by best-in-class API hub technology from Rapid (now acquired by Nokia), Network as Code offers you guaranteed API performance and the highest API availability across the industry.

Our API technology has been reliably proven to execute in excess of 63 billion API transactions annually and is trusted by leading enterprises across the financial services, aviation, automotive, fleet, and telecommunications sectors.

You don't need to be a network expert

Designed 'developer-first' with a comprehensive developer portal, sandbox environment and GenAI-based code generation assistant, Network as Code makes it easy to embed network data, insights and specialized capabilities into your application without needing you to interpret complex telecom parameters and data sources.

Flexible billing and charging models to suit your business needs

Whether you're a startup or a global enterprise, you can scale your API usage effortlessly with our transparent pricing. Our pay-as-you-go model means you only pay for the API calls you actually make—ideal for keeping costs low during early development or small-scale deployments. And when your needs grow, you can upgrade to a tiered subscription with customizable packages that fit your exact requirements.

Get started with Nokia Network as Code

Quickly build ready-to-deploy use cases on our developer portal

- Comprehensive documentation, tutorials and sample code for every Network as Code API

- Google Gemini GenAI code generation assistant simplifies use case development for first-time adopters

- Full featured sandbox environment to help you test and evaluate use cases across every network

Accelerate development with prefabs from Nokia and our partners

- Fully customizable, consumer-grade UX

- Prefabs embedded with enterprise-class security

- Code and Ops freedom for extensive scalability

- Embeddable web components for third-party applications
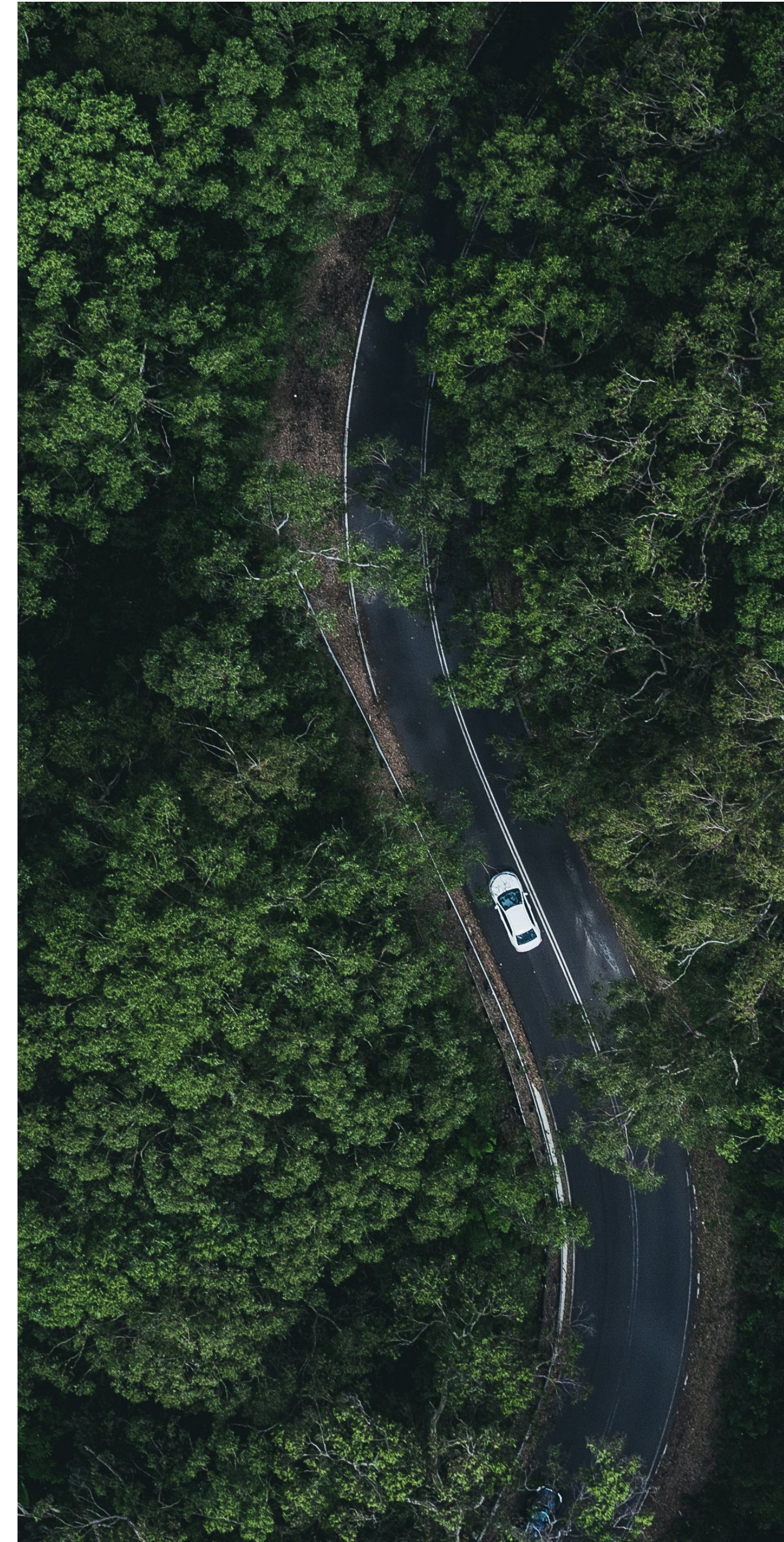
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About Nokia

At Nokia, we create technology that helps the world act together.

As a B2B technology innovation leader, we are pioneering networks that sense, think and act by leveraging our work across mobile, fixed and cloud networks. In addition, we create value with intellectual property and long-term research, led by the award-winning Nokia Bell Labs.

Service providers, enterprises and partners worldwide trust Nokia to deliver secure, reliable and sustainable networks today – and work with us to create the digital services and applications of the future.