

Creating The World's Largest Network of Connected Vehicles for Smart Cities



Veniam turns vehicles into mobile Wi-Fi hotspots and builds city-scale vehicular mesh networks that expands Internet access, connects transportation and collect terabytes of urban data

Sociedade de Transportes Colectivos do Porto (STCP) wanted to address the city's critical mobility and transportation challenges. To achieve this objective, the city of Porto needed to implement a platform to build and operate networks of connected vehicles and share urban data. Veniam developed and implemented its hardware, software and cloud components to solve Porto's key citywide mobility and transportation challenges. The V2V (vehicle-to-vehicle) mesh network solutions deployed by Veniam expand public Internet access and collect terabytes of urban data, to improve a variety of city operations and urban living conditions, making them resource efficient, climate and environmentally friendly.

Today, Veniam and the city of Porto have deployed the world largest network of connected vehicles – a true vehicular mesh network, by expanding the low-cost wireless coverage to 600+ connected vehicles, including taxis, waste collection trucks and a entire public bus fleet in Porto to enable private, public and municipal transportation operations to be more efficient.

Full-scale Commercial Deployment in Porto (Portugal)

- City-scale vehicular mesh network (Sept. 2014-today)
- 600+ vehicles, including entire public bus fleet, taxis and municipal service vehicles, connected with Veniam NetRider™ mesh networking devices
- 371,000+ unique Wi-Fi users
- 4,000,000+ Internet sessions
- 2.5 terabytes of internet traffic per month
- 1,3M hours of Internet traffic
- 70% of traffic offload from cellular to fixed network with 8 access points/km²

Overview

Vehicles offer a cost-effective way to expand wireless coverage in cities. Vehicles provide the opportunity to gather, share and store massive amounts of urban data to improve quality of life in cities. With their large batteries, vehicles are ideal Wi-Fi hotspots whose dedicated wireless spectrum allows them to connect to each other and the Internet. Using Veniam's turnkey solution, fleet operators can turn vehicles into mobile Wi-Fi hotspots that are capable of delivering Internet access to passengers while collecting terabytes of valuable data for diverse applications in connected transportation, industrial logistics and smart cities.

“From day one, our vision has been to bring mobility to Wi-Fi, connect every vehicle and offer affordable Internet access to as many people as possible” - João Barros, Founder and CEO of Veniam.

Porto Connected Transportation Objectives

- Extend the network at least to 3 different fleets of public or municipal transportation
- Design, develop, prototype and pilot an open-platform to enable privacy-aware access to the city data from third parties and/or internal systems of the public or municipal authorities
- Design, develop, prototype and pilot a fully distributed architecture and standardized mechanisms to enable a) data collection and transport in the city through standardized interfaces, b) seamless interoperability among heterogeneous networks, multiple wireless technologies and diverse vehicles from different fleets, and c) large-scale storage and data management in the Cloud
- Design, develop, prototype and pilot standardized interfaces to provide application developers with the means to simplify application development

Challenges

Porto faced two challenges. First, the city wanted to improve Internet access for its citizens. Second, Porto struggled with the problem of unconnected municipal services, leading to underperforming city operations, underutilization of key data, and inefficient use of critical city resources. Of the 28 million kilometers per year travelled by 413 service vehicles and 475 public vehicles, 25% of this travel is estimated to be unnecessary, leading to fuel waste, infrastructure over-use, and city pollution. Specific examples include:

- 1. Environment:** The largest city vehicle division (yearly budget of \$30M U.S.) found garbage collection trucks (yearly budget of \$18M U.S.) emptying containers that are less than full, leading excess fuel expenditure and labor expenses
- 2. Police:** Municipal police vehicles were found to be patrolling areas without known incidents
- 3. Transportation:** The economy reduced public transportation, with many buses often carrying less than 5 people



“Working with Veniam has allowed us to take a fresh look at our city-wide connected vehicle strategy. Thanks to the continuing work of the Veniam team we can see how our transport network is working as a whole, and develop innovative ways to improve it for Porto’s citizens” - Filipe Araújo, Porto's city councilor for innovation and environment

Solution

Porto used Veniam's solution to deploy a city-scale vehicular network that leverages its large commercial fleets and the existing fiber and Wi-Fi infrastructure. The vehicles include public buses and private taxis that provide passenger transportation, as well as delivery trucks, garbage collection vehicles and street cleaning units. To connect these vehicles, Veniam developed a multi-network On-Board Unit (OBU) equipped with Wi-Fi/DSRC/cellular interfaces, called NetRider. The NetRider turns vehicles into Wi-Fi hotspots that can deliver Internet access to passengers and mobile workers in and around the vehicles. Additionally, Veniam developed the NetRider Access Point (AP) to connect passing vehicles to the wired infrastructure of various network providers and, ultimately, to the Cloud.

By leveraging the capabilities of DSRC, NetRider OBUs and APs are able to form a wireless mesh network, bringing 10x improvement in reach and 100x improvement in urban-area coverage when compared to conventional Wi-Fi hotspots. A total of 55 Veniam APs have been deployed in Porto's downtown area, bringing the density to 8 APs per square kilometer. During a normal peak working hour, an average of 40 public transportation buses circulate in this area, enabling Veniam to extend the range of each APs via the multi-hop and vehicle-to-vehicle communication capabilities of its NetRider devices. This extended range, in turn, enables the possibility to offload 70% of the data generated in that area, with only 30% of the traffic transmitted via the more expensive cellular connection.

Veniam's approach and methodology also enable Porto to gather terabytes of urban data inexpensively from the city to the cloud. This data is generated by a myriad of sources, from in-vehicle sensors and cameras to the OBD2 (On-Board Diagnostics) interface, as well as external Wi-Fi/Bluetooth-enabled sensing units spread over the city. The city's over 400 municipal service vehicles affiliated with the garbage collection, police, and road and building maintenance departments are being used in the full-scale deployment. Once equipped with a NetRider unit, any vehicle can join the network, expanding wireless coverage while offering a solution for the storage and sharing of delay-tolerant data related to city operations. More importantly, Veniam provides Over-The-Air (OTA) updates, as we learn from past performance and improve the software in real-time remotely, allowing Veniam devices and network to continue to evolve even after deployment.

By providing secure access to the data gathered by a large variety of heterogeneous sources of information, Porto's current public/private institutions and fleets, Veniam's Application Programming Interfaces (APIs) will also offer the opportunity for third parties to build and deliver data rich services and cloud applications.

"Environmental sensors, noise sensors... In the end, what this project has given to the city is lots of data. We can understand where the city can save money, to invest in other projects. Waste management has a key role here." - Filipe Araújo, Porto's city councilor for innovation and environment

Porto Smart City Benefits

Veniam's deployment in Porto has already significantly expanded the spectrum of smart city operations and Wi-Fi coverage for citizens, including:

- Improvement of Porto's city both functionally and structurally, using information and communication technology as an infrastructure
- By connecting infrastructure to the Internet it increased life quality and save money
- The flow of traffic is treated as a holistic system that automatically takes all relevant factors into consideration in real time
- Energy and global carbon emissions savings used by the transport and traffic in the city
- Effectively formed a gigantic dynamic mesh network of constantly communicating vehicles, helping to reduce accident rates
- Aside from the obvious benefits of reducing road traffic incidents, the city's connected vehicles share mapping and traffic data, with the goal of improving the efficient flow of traffic throughout highly congested areas and reduced emissions
- Using sensors, data, such as garbage collection, environment insights, driving patterns, vehicle conditions, traffic conditions and accident alerts, are sent to the cloud and analyzed for the benefit of drivers and companies

Smart City Lessons Learned

- Smart cities demand careful planning and, at an early stage, it is essential that national and municipal governments, citizens and all other stakeholders agree on the smart city definition they aim to fulfill. A clear definition or strategy must address two key factors: the city's desired functions and purposes, with its functions referring to the appearance and operation of a city, and its purposes to the benefits promised by a smart city model.
- Smart Cities monitor and integrate conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, sea-ports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities and monitor security aspects while maximizing services to its citizens.
- A smart city is a city that is well performing in a forward-looking way in (economy, people, governance, mobility, environment, and living) built on the smart combination of endowments and activities of self-decisive, independent and aware citizens.
- Looking at its functions as well as its purposes, a smart city can perhaps be defined as a city that strategically utilizes many smart factors, such as Information and Communication Technology to increase the city's sustainable growth and strengthen city functions, while guaranteeing citizens' happiness and wellness.

For more information

To learn more about how Veniam and its customers are building Smart Cities, contact Veniam or visit us at veniam.com

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