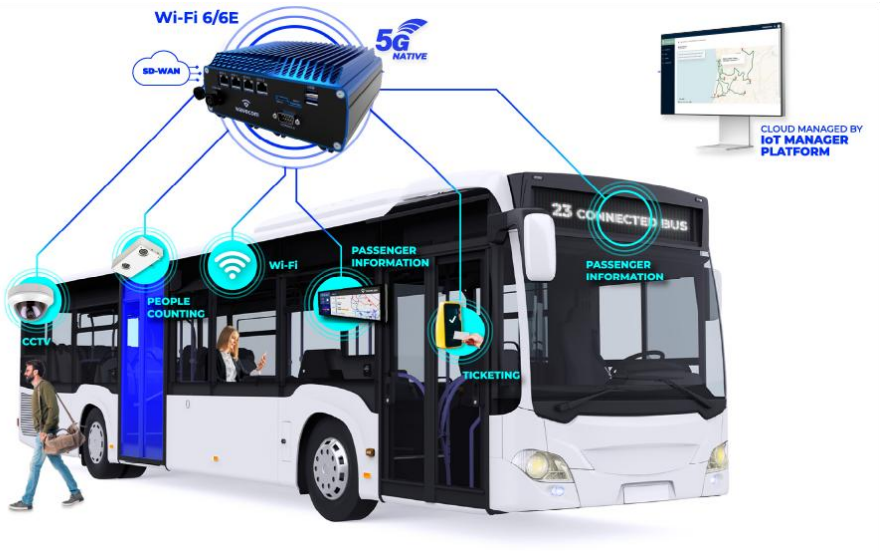
wavecom Technologies

White Paper

Connected Bus by Wavecom

Episode 1 – What Systems Integrators Can Expect



The public transport bus routes need to be more pleasant and convenient for the passengers by providing bus vehicles with **Connected Bus** solutions which offers a set of value-added features including Wi-Fi | onboard connectivity for passengers and systems, passenger counting, fleet management | CAD – AVL | GPS location service, Alerts and surveillance | CCTV and information | infotainment.

This White Paper is focused on **Systems Integrators**, as they are those who are close to Bus Operators, integrating and installing **Connected Bus** solutions in their bus fleets.

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Introduction

Mobility in Smart cities and villages have become a global trend, as a growing urban and sub-urban population increases the citizen demand for better mobility quality.

Cities and villages intend to diminish the number of personal cars on their streets, roads and roadways, by encouraging those citizens and visitors to use public transportation bus routes.

Figure 1 - Passengers travelling in a bus and accessing Wi-Fi services

The public transport bus routes need to be more pleasant and convenient for the passengers by modernizing bus fleet with low-and zero-emission vehicles and providing bus vehicles with **Connected Bus** solutions which offers a set of value-added features including Wi-Fi | onboard connectivity for passengers and systems, passenger counting, fleet management | CAD – AVL | GPS location service, Alerts and surveillance | CCTV and information | infotainment as depicted in Figure 1.

Thus, Bus Operators must improve their bus fleets, installing **Connected Bus** solutions with many benefits in their operation and profitability, due the growth in the number of passengers.

The **Systems Integrators** play an important role, as they are in the field and close to the Bus Operators, doing integration and installation of **Connected Bus** solutions in their bus fleets.

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Connected Bus Solution

The **Wavecom Technologies** **Connected Bus** solution has been developed with the specific needs of bus operators in mind, with the aim of significantly improving their business efficiency and profitability in a modular and evolving way.

Seamlessly, it enables integration with CCTV | surveillance video streaming and ticketing systems through APIs. The elementary **Connected Bus** solution's components comprise a **Wavecom** **modular Gateway** (5G Native) installed in each bus vehicle, which is cloud managed by our **IoT Manager/Multi-Tenant Platform** (5G WAN Manager | SD-WAN) as shown in Figure 2.

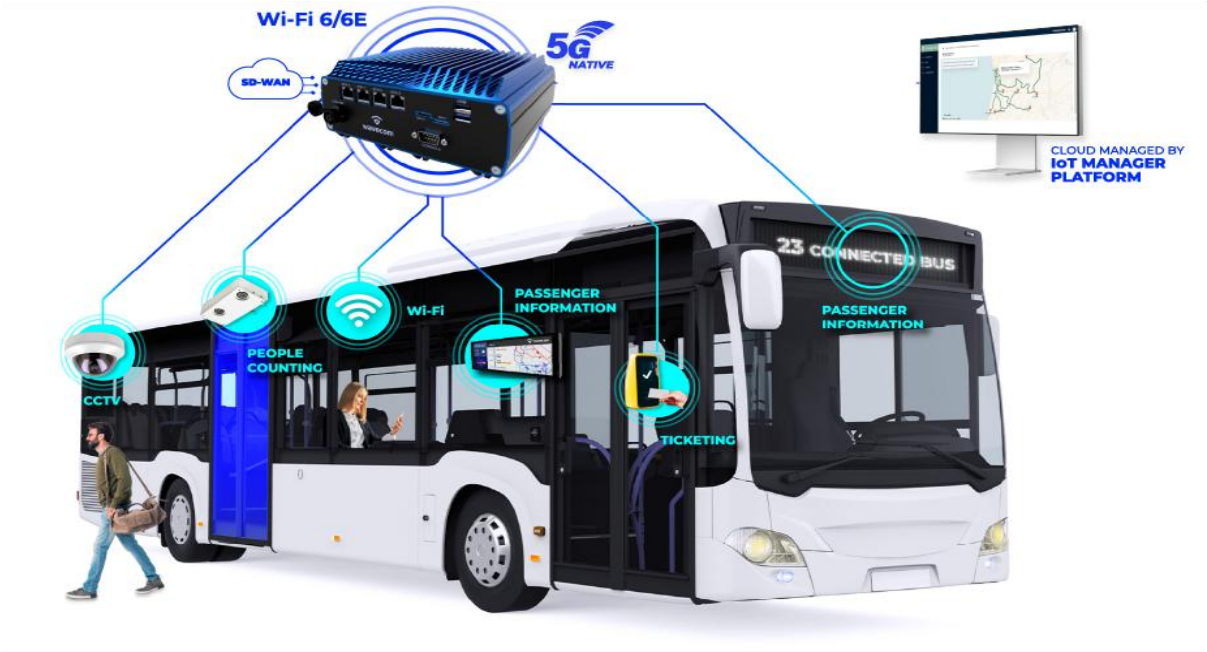

Figure 2 – **Diagram** | Connected Bus Architecture and functionalities

Bus onboard equipment refers to our single **modular Gateway** (5G Native) offering the following features:

- 2 x eSIM 5G modems, providing redundancy by using up to 7 SIM Card profiles
- 2 x separated Wi-Fi 6/6E Access Points
- 1 x integrated GPS
- Possibility of providing information in IoT Manager Platform or via API
- Network resources (OSPF, STP, DHCP Server/Client, NAT, DNS, Link Aggregation, VPN Server/Client, QoS, VLAN …)
- Ethernet and serial interfaces for local connectivity
- VPN over WWAN (5G) for centralized real-time monitoring and management
- Certified for automotive environment

The **Wavecom** **Modular Gateway** is a modular platform that offers a range of technologies, including 5G and Wi-Fi, with the ability to support multiple MNOs (Mobile Network Operators) simultaneously. This provides redundancy or capacity balancing and bandwidth complementarity. On the other hand, **Wavecom** **IoT Manager /Multi-Tenant Platform** (5G WAN Manager | SD-WAN) (Figure 3) is a central software responsible for monitoring and managing all **Modular Gateways** centrally in a Cloud.

It adheres to robust security standards, with comprehensive and active analysis conducted throughout the development and service operation.

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It is able of centralizing all provided functionalities such as:

- Wi-Fi User Access Control
- Network Access Control
- Gateways/Device management
- Real Time equipment's' monitoring
- Customizable Captive Portal
- Real Time Fleet Visibility with Route Optimization
- Ability to create CSAT (Customer Satisfaction Surveys)

In terms of security issues, tunnel protocols (SD-WAN), security policies and other mechanisms are used to prevent possible attacks to the network.

Figure 3 - IoT Manager /Multi-Tenant Platform

IoT Manager /Multi-Tenant Platform overseas:

- Implementation of centralized, multi-tenant and cloud-based architecture
- Graphical interface with indication of number of users, traffic per equipment or per bus and service
- Real-time monitoring of all available network interfaces, with average latency and throughput indicators
- Capacity to configure all the associated routers through a single control panel
- Definition of QoS policies per application
- Creation of security policies per equipment as well as general

Wi-Fi | Onboard Connectivity

The high performance of 5G provides reliable Wi-Fi onboard connectivity for passengers (e.g., high speed internet service) and onboard systems (e.g., video from each bus can be transmitted in real time in case of an emergency), enabling remote commissioning and monitoring, data traffic control in compliance with Captive Portals and GDPR norms.

Passenger Counting

It allows controlling the bus vehicle's occupancy, in real time and right from a remote Bus Operators' communications management platform.

Fleet Management | CAD – AVL

It allows Fleet Management/Tracking in real time using CAD – AVL (Computer-Aided Dispatch / Automatic Vehicle Location) that connects the bus vehicles seamlessly with Bus Operator's back-office scheduling and dispatching software. It can automatically collect vital data used by dispatchers such as:

- Schedule adherence status, breakdowns and emergencies.
- Central information of vehicle positioning and speed data (real-time and historic)
- GPS data feeds to 3rd-party systems via dedicated APIs
- Delay and incident alerts, along with other onboard data when relevant
- Passenger attendance per route/stops, with extensive reporting

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Alerts and Surveillance | CCTV

It offers advanced connectivity for onboard monitoring systems, such as CAN-BUS, IP devices, and cameras used by Surveillance | CCTV systems. The remote and real-time analysis of the events sent by each bus is carried out by the Bus Operator's communications management platform.

Ticketing

The Connected Bus solution provides secured connectivity interfaces (via API) to integrate with bus onboard ticketing devices and systems from 3rd-party.

Information | Infotainment

It allows the integration of connected passenger information systems, infotainment both onboard and at the bus station, public announcements and targeted messages and media-rich captive portals.

Integrating a Connected Bus Solution

Systems Integrators play an important role since they are in the field directly in touch with Bus Operators, which need **Connected Bus** solutions to incorporate in their fleets. We work closely with **Systems Integrators**, offering an adaptable **Connected Bus** solution (hardware and software) for their specific use cases.

We also support **Systems Integrators** throughout installation (Zero Touch Provisioning on the infrastructure and monitoring of all gateways' interfaces and devices) and after installation (fast failure detection and fast recovery).

This support includes a study of the **Systems Integrator**'s needs and guidance on the best design and planning to be implemented. During implementation, our engineers will support the **Systems Integrator** team to realize what was previously designed. At the same time, **Systems Integrators** will have direct contact with our specialists.

Conclusion

At the end of **Episode 1**, it is expected you as a **Systems Integrator** knows:

- how to support Bus Operators by improving the attractiveness of passengers to leave their own personal cars and choose the bus to travel daily, installing **Connected Bus** solutions with huge benefits in their operation and profitability.
- how to use our reliable and balanced **Connected Bus** solution, that answers you to cope with the Bus Operators needs to improve the comfort and security for their passengers.
- what are the overall key features of our **Connected Bus** that can be easily integrated and incorporated in a solution to be installed in a Bus Operator fleet.
- how to provide an adaptable **Connected Bus** solution (hardware and software) for your Bus Operators' customers specific use cases. and supports you during all project phases.
- we can support you during deployment and after installation. This support also includes a study of your needs and guidance on the best design and planning of a **Connected Bus** solution to be installed in a Bus Operators fleet.

The next White Paper, **Episode 2 - Zero Touch Provisioning**, will talk about what Zero Touch Provisioning is and its advantages during deployment and after installation **Connected Bus** solution in a fleet of a Bus Operator.

It's coming, so stay tuned!!!

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Acronyms

4G	Fourth Generation Mobile Network
5G	Fifth Generation Mobile Network
API	Application Programming Interface
CAD – AVL	Computer-Aided Dispatch / Automatic Vehicle Location
CAN-BUS	Controller Area Network - Bus
CCTV	Closed-Circuit TV
DHCP	Dynamic Host Configuration Protocol
IP	Internet Protocol
LTE	Long Term Evolution
NAT	Network Address Translation
OSPF	Open Shortest Path First Protocol
SD-WAN	Software Defined – Wide Area Network
STP	Spanning Tree Protocol
Wi-Fi	IEEE 802.11x Wireless Network
WWAN	Wireless Wide Area Network

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Contacts

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