NEXCOM
The Intelligent Systems

White Paper

Smart Buses Steer into Smart Cities with Vehicle Telematics

Smart bus services can alleviate concerns for bus service operation, urban mobility, and environmental sustainability in the course of urbanization.

Smart City is pushing the transformation of bus services across cities. The core thrust of the transformation is the concept of "Smart Bus" promising to elevate road safety, operational efficiency, and passenger satisfaction. For smart bus scenarios to unfold, what is needed is vehicle telematics data which can bring far-reaching changes in driver management, asset management, and passenger services. Additionally, barriers to the vehicle telematics adoption in terms of time, costs, and efforts must be considered to ensure successful, large-scale implementation on smart buses.

This article discusses how to deliver smart bus services for cost-sensitive bus carriers with compact vehicle terminals like NEXCOM's VTC 1020 and its variant of VTC 1020-PA powered by Intel® Atom™ processor x5-E3930. The article looks at what vehicle telematics data the VTC 1020s can extract and its extended applications with the integration of real-time communication in smart bus services. We then contemplate how the VTC 1020s can help improve driver-passenger communication with the support for multi-display passenger information and bus announcement system. To ensure successful system implementation, we address concerns, such as space limit, poor ventilation, and unstable vehicle power supply, and explain how NEXCOM VTCs and Intel® Atom™ processor together can mitigate system threats and deliver a high cost-performance value for bus carriers.

Smart Cities Need Smart Bus Services

Buses are outfitted with assorted systems for reasons ranging from fleet management, regulatory compliance to service enhancement, casting a glance of the dynamics of bus services. However, as the urban population is projected to increase to 7.4 billion, accounting for about 70 percent of the world's population, by 2050 according to the United Nations, a holistic review and meticulous planning become must for bus service delivery. Overlooked details in bus operation can become decisive factors in retaining and even increasing ridership, determine how ridership is weighed against operating expenses, and offer savings on such as fuel, insurance premium, and vehicle downtime.

In the meanwhile, the population and traffic created by cities can exacerbate problems of long travel time, unexpected delays, and road accidents, frustrating passengers and other road users and giving bus services a bad name. As to local governments, keeping cities live and thriving and achieving environmental sustainability at the same time is a difficult balance to strike. That is how NEXCOM's vehicle terminals come into play (Figure 1).

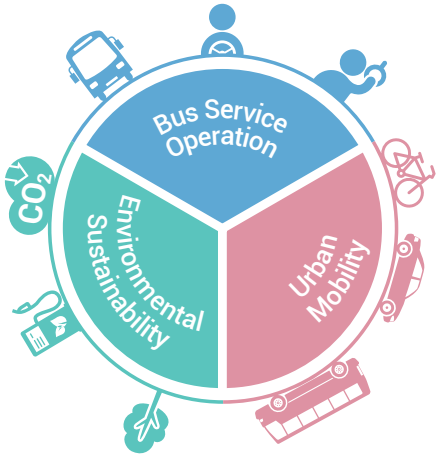

Figure 1. Smart bus services can alleviate concerns for bus service operation, urban mobility, and environmental sustainability in the course of urbanization.

The Elements of Smart Bus Services

A Treasure Trove of Vehicle Telematics Data

To address concerns about bus service operation, mobility in urban areas, and environmental sustainability, NEXCOM's VTC 1020 vehicle terminals are equipped

Smart buses are data treasure troves containing vehicle operation information, diagnostic messages, and transportation statistics.

with Intel Atom processor, data acquisition and sensing capabilities, and wireless communication technologies to support electronic logging, vehicle-to-infrastructure (V2I) communication, and passenger infotainment, aimed to push the makeover of bus services with vehicle telematics.

To advance bus service operation, the vehicle terminals have integrated multiple communication and sensing technologies to gather vehicle status and in-vehicle activities (Figure 2). The VTC 1020s can communicate with vehicle microcontrollers over a Control Area Network (CAN) with the optional support for the SAE J1939 standards. The VTC 1020s can collect not only vehicle operation information such as engine coolant temperature, mileage per hour, and fuel economy but also diagnostic messages about abnormal fuel injector voltage, oil filter replacement, and diagnostic trouble code (DTC) clearance.

Location information is generated by a combination of a GPS receiver with the dead-reckoning option and a G-sensor for motion detection to increase traceability and accuracy. In challenging urban environments a bus can be tracked by GPS when signal strength is strong and steady and by inertial measurements—based on bus speed, moving direction, and acceleration information—when GPS signals are interfered and blocked. Moreover, the location tracking and motion detection functions can offer 24/7 anti-theft protection. Details of how the VTC 1020s can alert dispatchers to a misplaced bus or emergencies after service hours are explained later.

Transportation statistics can be obtained by using the VTC 1020s in conjunction

Figure 2. Smart buses are data treasure troves containing vehicle operation information, diagnostic messages, and transportation statistics.

Wireless communications allow bus carriers to use vehicle telematics to their advantage for service improvements.

with passenger counters, door sensors, ticket machines, and other peripheral devices. Leveraging a rich I/O set on the VTC 1020s, bus carriers can compute the number of boarding/alighting passengers, the number of travel trips, and bus stop dwell time, among other values, required to evaluate transportation performance and the scope of fare evasion.

To make the most out of vehicle telematics data, various wireless connections are supported by the VTC 1020s. For instance, LTE networks enable bus locations and transport statistics to be shared in real time to provide live bus arrivals for bus bunching mitigation, active adjustment to bus frequency for passenger waiting time minimization, and direct voice communication for drivers and dispatchers in case of emergency (Figure 3). Wi-Fi connections present a cost-efficient alternative for uploading less time-sensitive data to backend servers after buses return back to bus depots. And the beacon technology, a variant of Bluetooth developed for the internet of things, is ideal for accurate proximity sensing and can be used to signal a traffic light to grant a high priority to an approaching bus—a practice which can prevent buses from being held up in traffic, increase bus travel time reliability, improve passenger satisfaction, and reduce fuel consumption and greenhouse gas emissions caused by idle buses.

Passenger Infotainment

More than an electronic logging device, the vehicle terminals can also provide passenger infotainment. Thanks to the dual-core architecture of Intel Atom processor x5-E3930, the VTC 1020s can present signage contents in front-end applications while processing vehicle telematics data in the background.

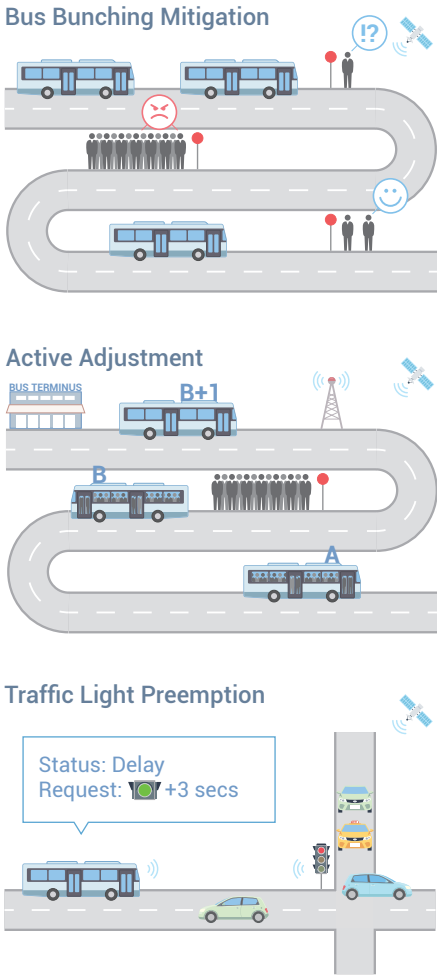

Figure 3. Wireless communications allow bus carriers to use vehicle telematics to their advantage for service improvements.

Combining the graphics engine integrated in the processor, the vehicle terminals can drive up to three displays simultaneously with the VTC 1020-PA, showing route information, Ultra 4K commercials, and location-based promotions inside and/or outside a bus. Moreover, extra system headroom is available for GPS-based bus stop announcement and passenger side speakers to facilitate driver-passenger interaction.

Navigate through the Harshness

All these features must be built on system reliability regardless of daunting installation environments. Taking advantage of the extended temperature support and high power efficiency of Intel Atom processor, the VTC 1020s can offer enhanced system

Vehicle telematics data also has various potential applications in terms of driver management and asset management.

durability even when confined in a small space with poor ventilation or under an ambient temperature which can potentially reach 70 degree Celsius in summer and drop to -40 degree Celsius in winter. The unstable vehicle power supply—transient voltage fluctuations and spikes induced by turning on ignition igniters or windshield wipers—is dealt with ignition on/off delay, 9V-to-36V DC support, and low battery voltage protection to avoid premature system failure. The system reliability is further ensured by the fanless design which can prevent dust and grease accumulation on major components of the VTC 1020s.

Put on Full Alert

There are more ways the VTC 1020s can help in bus services (Figure 4). In driver management, these vehicle terminals, incorporating iButton readers, can grant the access to buses to only authorized drivers in duty hours and combine vehicle status data to compile hours of service (HOS) logs. When drivers are on the road, driving behavior data about hard braking, harsh acceleration, and speeding can be recorded and/or streamed live to assure driving guidelines for safety and comfort are followed and to simplify the shift to usage-based insurance.

From the aspect of asset management, vehicle operation information and diagnostic messages allow dispatchers to keep track of health status of an entire bus fleet and implement predictive maintenance schedules, maximizing bus utilization and reducing risks of road accidents due to vehicle malfunctions. As to the physical security of buses, it is made possible to track buses even when igniters are switched

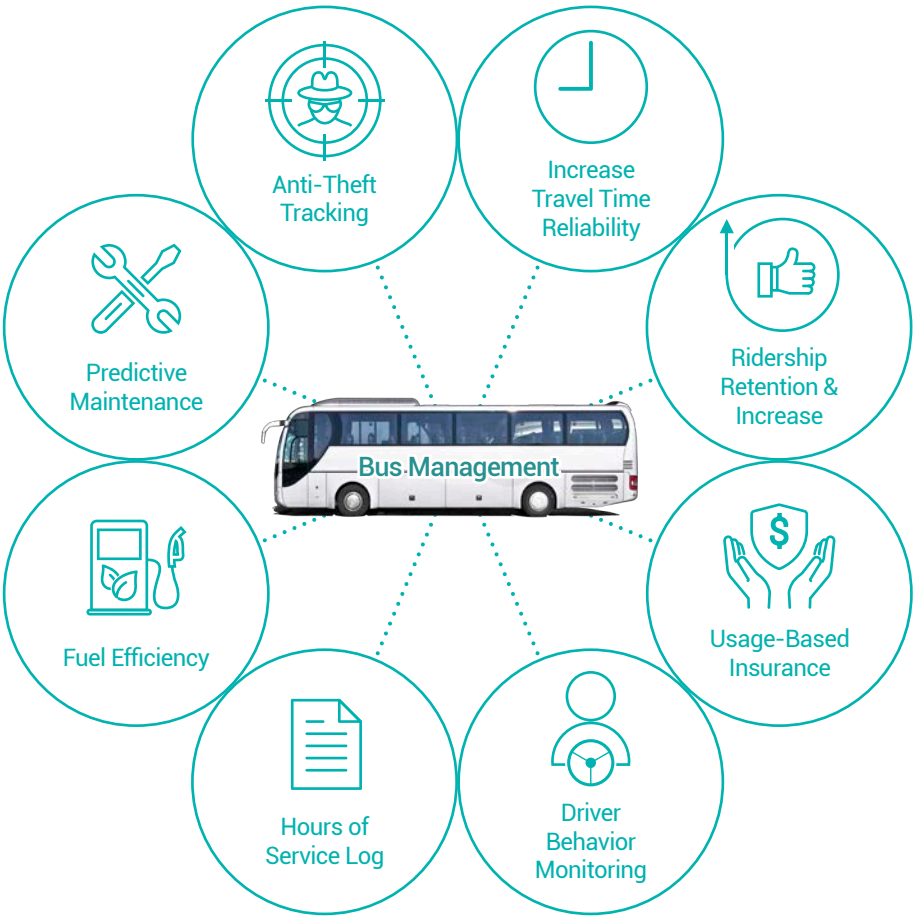

Figure 4. Vehicle telematics data also has various potential applications in terms of driver management and asset management.

NEXCOM vehicle terminals feature 24/7 anti-theft tracking to strengthen the physical security of buses.

off because of the aforementioned location tracking and motion detection functions. Designed to stay alert around the clock, these functions, when sensing unusual movement of a bus, can automatically text the GPS coordinators and tilt angles of the bus in question along with pre-edited contents to registered phone numbers (Figure 5). Following the steps on a utility GUI built in the VTC 1020s, bus carriers can set receivers to dispatchers, authorities, and even insurance companies based on the severity of the incident.

Conclusion

Information technology is reshaping the landscape of the transportation industry. Given the trends towards urbanization and the rise of megacities, bus carriers must renovate the ways the service is operated, sooner rather than later. To usher in the bus service reinvigoration, NEXCOM is propelling the proliferation of vehicle telematics with rugged mobile computing solutions to help bus carriers exploit data goldmines to confront challenges in daily bus operation and to drive continuous operational improvement.

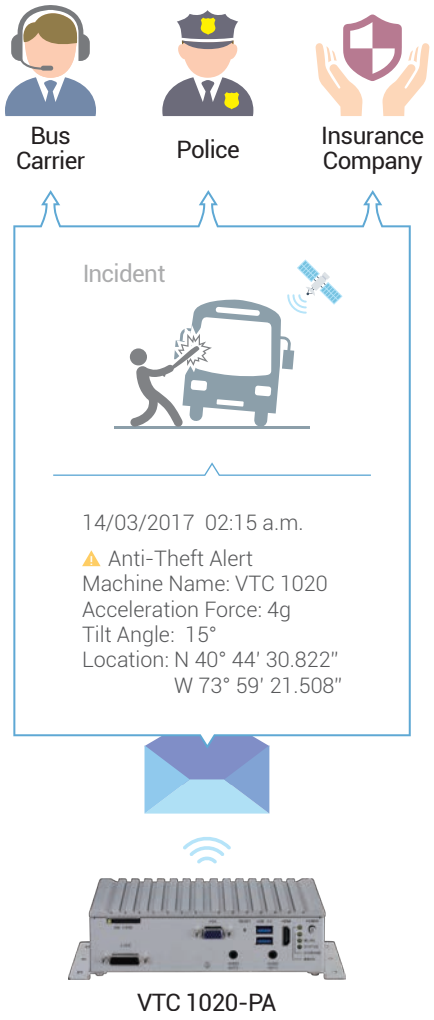

Figure 5. NEXCOM vehicle terminals feature 24/7 anti-theft tracking to strengthen the physical security of buses.

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