

Bluetooth Technology @WORK

The lowly city bus – aging, noisy and emitting noxious fumes – has been much maligned over the years. Visions of weary people trudging up dirty steps and collapsing into sagging seats are ingrained in our consciousness.

Those images are fading, though, thanks to a healthy dose of technology and a lot of ingenuity.

One company committed to bringing its fleet into the 21st century is Azienda Trasporti Milanesi (ATM) S.p.A., the public transportation company of Milano, Italy. ATM S.p.A.'s fleet, which consists of nearly 3,000 buses and other vehicles, serves about 600 million passengers per year.

The company has long pioneered vehicle maintenance, originally using serial-port computer data lines to download information from vehicles' onboard diagnostic units. That system was somewhat effective, giving technicians information about mechanical problems on individual buses. But it was not consistent or comprehensive enough to keep the vehicles running the way company executives wished.

Going the Wireless Route

Bluetooth technology takes an international ride when an Italian city's bus system pairs with a Swedish SIG member, making mass transit safer, comfortable and more efficient.



Technician Andrea Sgnaolin checks data from a public bus in Milano, Italy. He's using the Intellibus system with Bluetooth technology.

What's more, ATM S.p.A. executives wanted to find a more proactive methodology that would reduce vehicle breakdowns, improve management of bus logistics and provide a better overall experience for passengers.

Onboard Intelligence

In 2002, the company chose to implement Intellibus, an automated, "intelligent" bus analytics and monitoring system developed by digigroup Srl, a systems integrator based in Torino, Italy, and Centro Ricerche FIAT S.C.p.A. of Orbassano. A Bluetooth wireless technology module manufactured by connectBlue of Sweden is the key communications component of Intellibus.

The system uses Bluetooth technology to download diagnostic reports from buses in ATM S.p.A.'s maintenance depots. Intellibus also collects a variety of statistics on vehicle operations, facilitating the predictive diagnosis of efficiency losses in key systems such as engine cooling. ATM S.p.A. selected a Bluetooth enabled system largely because of the technology's affordability, technical feasibility and ruggedness, notes Claudio Cassarino, the company's chief information officer.

To make the system work, digigroup implemented a host of changes in both ATM S.p.A.'s bus fleet and its six depots. Each bus was outfitted with a proprietary logic control unit, known as a VIDAC. Early VIDACs were outfitted with an external Bluetooth wireless module affixed to the side that connected via serial communications links to the main vehicle control system, which collects data and controls the bus during operation. Later versions of the wireless module were integrated directly into VIDAC, underneath its casing.

Both controllers work the same way. They gather a host of information from the main vehicle systems and analyze the data to discover or predict potential failures. For example, high engine temperature might trigger an alarm and store the information in a VIDAC's memory, ready to be downloaded via the Bluetooth wireless module upon arriving at an Intellibus-equipped depot.

"It allows (maintenance technicians) to collect a tremendous amount of information, such as in subsystems like engine failure, temperature and pressure alarms, which are all monitored by the bus," explains Marco Rocco, technical manager with digigroup.



FAST FACTS | digigroup Srl | HQ: Torino, Italy

Business / Systems integrator for public transportation.

Technologies / Products center around the VIDAC system of vehicular equipment.

Systems / Include Intellibus (onboard telematics), FleetWare (fleet management) and EcoFleetWare (trash collection vehicles).

Customers / Include the public transport systems of Milano, Trento, Lazio, Napoli and Calabria, Italy.

Wireless Diagnostics

Hundreds of data sets can be sent from the vehicle to the depot: meter and pressure readings, time spent in different gears and in braking, temperatures during vehicle operation, time the doors spend open and closed, engine speed, oil and fuel levels, automatic gearshift failure, torque, air conditioning and more.

The onboard units transmit this data via wireless controllers at each of ATM S.p.A.'s six bus depots. A controller is essentially an industrial computer that manages the connection between the ground station and the vehicles. Each controller can operate different download/upload links; each link is comprised of two RS-232 Bluetooth enabled transceivers provided by connectBlue.

The first Bluetooth enabled transceiver is used as an inquiry device. Connected to a directional antenna, it scans the refueling area for vehicles with information that is ready for download. If such a vehicle is found, the transceiver adds the vehicle to the download queue.

The second wireless transceiver is a download device connected to an omnidirectional antenna. One at a time, the system contacts vehicles in the queue and downloads onboard information to the ground station.

Intellibus stores the diagnostic, alarm and operational information in a database, where it's analyzed using algorithms developed jointly by digigroup and ATM S.p.A. Each algorithm is devoted to a particular subsystem, such as engine cooling, battery performance or air conditioning.

The VIDAC controllers periodically require firmware updates. These also can be downloaded automatically to the vehicles during the short-range transmission phase. Once all downloads and updates are performed, the system removes the vehicle from the update queue.

Driven to Improve

ATM S.p.A.'s implementation of the Intellibus system has numerous benefits. Fewer vehicle breakdowns, for example, mean better passenger service.

"If we can prevent the stopping of a bus during service due to a failure by being proactive, it offers a great return on investment, both for the people using the bus and for the cost of the repair," explains Cassarino, who notes that catching an impending failure is less costly than fixing a broken bus in the street. What's more, maintenance is performed only when needed, in contrast with

"blind maintenance" performed at fixed intervals. That also saves money. And measuring metrics like fuel economy can translate into consistent savings.

"If we find that a driver isn't optimizing how he is driving, and we can change that, it saves fuel," Cassarino says.

In addition, statistical data gathered automatically from the entire fleet is invaluable in studying the behavior of a large number of vehicles. This in turn helps drive large-scale decisions affecting the fleet.

Mechanical and operational data helps keep vehicles running smoothly. But ATM S.p.A. collects other data as well. Besides increasing passenger comfort, data on how drivers drive can increase operational safety and efficiency. ATM S.p.A. is even considering cash bonuses for drivers with excellent driving profiles.

"We are trying to understand if the driver is braking too much or accelerating too quickly, or if he is using the gears properly," Cassarino says. "That way, we can create some best practices."

Roadmap for the Future

ATM S.p.A. is dedicated to remaining on the cutting edge of transportation and technology. That includes extending Intellibus throughout Milano and its surrounding 86 towns, while continuing to upgrade the buses, trams, trolleys and underground railway lines.

Radiobus, for example, is an on-call system that brings taxi-style convenience to traditional bus service. Radiobus should provide greater safety and reduced wait times to passengers traveling at night and in the wee hours of the morning.

The system will provide route tracking, guaranteed radio contact with the driver, GPS location-tracking, automated reservations and on-the-go route optimization. It will transmit route information to the driver through a real-time video interface.

Radiobus currently does not utilize Bluetooth wireless technology but may add it in the future, according to Cassarino.

And ATM S.p.A. has other plans. These include a gradual extension of its centralized traffic-light control program throughout the city to help control traffic and increase the speed of public transportation. €

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Keeping Up With Technology

ATM S.p.A. started its Intellibus project in 2002 using Bluetooth Core Specification Version 1.0. It then migrated to Version 2.0 + EDR (Enhanced Data Rate). As the technology evolved, so did firmware and management requirements. Intellibus had to be reprogrammed for compatibility among devices utilizing different core specs.

"The second generation of Bluetooth offers better performance in things like overall power and power adjustments," explains Marco Rocco, technical manager with digigroup, the project's systems integrator. "For example, we use low power in the inquiry phase, but on the load antenna, we use the maximum amount of power to communicate with buses when they arrive to park. But globally, it wasn't difficult to switch from the first to second generation."

Even so, it's been useful to upgrade to smaller, lower-cost devices that work seamlessly with Bluetooth v2.0 technology.

"It's an easy migration path, because it has the same form factor and can use the same mounting options, but with the latest chips," says Martin Engdahl, sales director for connectBlue, a Swedish provider of wireless solutions.

Compliance is another driver that prompted the upgrade. A European Union directive requires the reduction of harmful substances like lead-based solder and other toxic heavy metals in the production of electronics. All devices using older electronics must be upgraded to meet these standards.

But most importantly, Engdahl points out, newer technology comes with better functionality. For example, devices based on Bluetooth v2.0 technology can coexist with Wireless LANs, providing better interoperability and better access for various types of data transmission. These devices also boast faster connection times, more reliable connections and greater range. — K.D.S.



FAST FACTS | connectBlue | HQ: Malmö, Sweden

Business / Ready-to-use Bluetooth wireless devices and Wireless LAN (WLAN) products and modules, as well as custom-designed Bluetooth wireless solutions.

Products / Bluetooth technology enabled product starter kit; OEM modules; products in housings, repeaters and I/O modules; WLAN modules supporting both 802.11b and 802.11b/g standards.

Customers / Dozens, including Alfa Laval, Parker Hannifin, GE Medical, digigroup, Nestle, Leica, BMW and DaimlerChrysler.



FAST FACTS | ATM S.p.A. | HQ: Milano, Italy

600 million / Passengers transported yearly

1,075 square kilometers / Geographic area served

1,746 / Buses in fleet (traditional, Radiobus & trolley bus)

800 / Buses managed by Intellibus (goal is 1,600)

8,500+ / Employees

3 / Number of underground lines

93 / Number of road lines

20 / Number of tramlines

3 / Number of trolley-bus lines