Real-time bus-travel data uses mobile-device text messages

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A new information service that provides accurate estimates of bus-stop arrival times uses expertise in computer science, statistics, forecasting and marketing.

Several cities now have displays at bus stops and metro or railway stations with expected arrival or departure times, along with mobile services to help travellers find that information, for instance through text messages (see Figure 1). Information- and communication-technology developments—in particular global-positioning systems (GPS) and mobile-telecommunications networks—enabled the services.

Information on expected arrival and departure times is, in general, quite reliable for metro or train services but not for buses, which must share their journeys with other traffic. We have worked on transit-supervision systems (TSSs) based mostly on GPS. They have been deployed extensively and are applicable to a wide variety of vehicles, including buses, trams or trains. Initially, they assisted with overall transportation-system control. However, since they provide real-time information on vehicle location and speed, it became clear that such data could be made public. Forecasting applications were thus incorporated into the TSS to calculate expected arrival times at vehicle stops.

To effectively help travelers, we had to consider the difference in displaying information at a vehicle stop and receiving it by means of a mobile device. In the first situation, the user is at the stop and information on the expected arrival time is updated regularly and free of charge. However, if the user is not at the stop, he or she may rely on text messages to access updated information, but each message may incur a fee.

Current mobile services enable a user to request information by sending a text message to a central contact number and system. This central service point, the short-message service centre (SMSC), is managed with the involvement of all mobile companies. The SMSC interprets the text message and forwards it to the appropriate TSS forecasting system, which then queries the real-time database with information on vehicle location and speed. The answer is sent back to the SMSC and subsequently to the user's mobile device.[1]
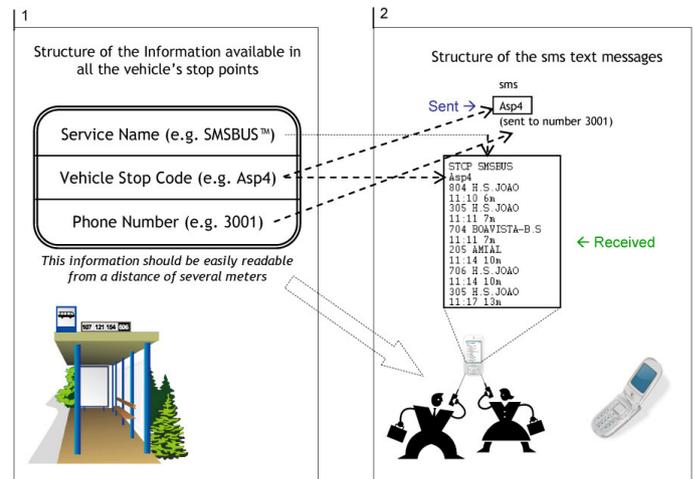

Figure 1. *Structure and user guidelines for displaying messages. sms: Short-message service.*

Existing TSS forecasting applications may try to have an expected average estimation error close to zero. Although this seems a good objective, it ensures that there is a 50% likelihood that half of the estimated arrival times will show that vehicles will take longer than they actually do. If travellers rely on such information, they may miss the vehicle. To provide useful real-time information estimates for bus-stop arrival times through text messages, we need to have an intelligent system to provide travellers with information that is accurate and as responsive as possible to changes in traffic conditions. It must also be conservative in that it does not provide quantitative estimates for buses approaching stops (which because of estimation errors may have departed) or for long-due buses, in which case it may be better to stick to planned times. And it must be safe by introducing an intentional small error indicating that the bus will arrive sooner than calculated by the system.[2]

SMSBUS, a service based on these ideas, has been used in the Porto metropolitan area (see Figure 2) since 2005. Extensive system and service testing have been undertaken. After field studies of prototypes reached an acceptable level of service, the system was publicized widely in buses, bus stops, cinema
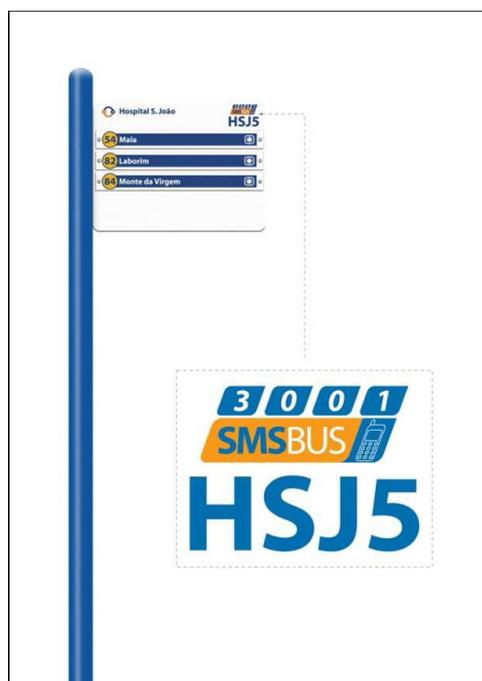
Figure 2. Example of bus-stop information for the SMSBUS service in Porto (Portugal).

and on the radio. In the initial month, the service was free of charge and its performance topped 40,000 messages a day. After an 0.20 Euro message payment was introduced, the rate of use dropped to an average of 4000 messages a day. Some incentives were used during the launch of the service, such as offering free season tickets to some customers. Every acceptable service complaint that reached the transport-company call centre resulted in crediting the customer. The service has been improved regularly since its launch and some key components have been patented.[3] SMSBUS has received awards from IV Forum Telecom and Deloitte Touche Tohmatsu.

The SMSBUS service was developed by Optimization and Transport Planning SA for the Society for Mass Transit Port SA, the metropolitan bus company of Porto. Researchers from the School of Engineering at the University of Porto were involved in the overall design, as well as prototype and statistical validation. We are now researching and developing more advanced Web and Smartphone services, taking into account user needs and transport companies' plans.

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