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What are Intelligent Transport Systems?

Why they are Significant for Public Transport Authorities and Operators.

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Autonomous cars are currently receiving a lot of hype. So are self-driving and electric buses. Media releases boldly state that the future of public transport has arrived. This all sounds exciting, but what's the reality? In this whitepaper, we look at what Intelligent Transport Systems are and what they do. We'll also show how they can help to deliver a better public transport future by reducing costs, improving public transport perceptions, and delivering substantial service improvements for passengers.

Public transport authorities are dealing with perceptions that services are slow, do not go where and when passengers want to go, and are environmentally unfriendly. They are doing their best within their budget constraints, and the general public's preference for private cars. But **delivering a quality public transport system** is as much about managing perceptions, as it is managing reality. Passenger perceptions are influenced by both the quality of service delivered, and how public transport information is presented. Intelligent Transport Systems (ITS) provide a way for transport authorities to break this nexus - addressing both improvements in service delivery, and public perceptions of performance. In this whitepaper, we look at how ITS can help deliver significantly better public transport services - offering quality, as well as value for money.

How is Public Transport Viewed Currently?

Around the world, public transport is recognised as a vital community service. It transports people to and from work, provides access for socially disadvantaged people and delivers a sustainable transport mode – freeing up road space for other uses. There are also secondary benefits that vary by city, depending on their priorities. These may include public transport having an emergency evacuation role or providing community access for aged persons and those with special needs.

To attract and retain passengers, the public transport offering needs to be made appealing, by providing regular, reliable services that are safe and clean.

These services need to be integrated across all transport modes and be easily accessible. Most public transport authorities attempt to deliver clean, safe, and regular services amongst congested road corridors at a low price - a big task, even in the best of circumstances. A task that even if completed relatively well, needs continual monitoring and management to gain visibility, and widespread acceptance by commuters.

The public's sometimes narrow view of public transport seldom thinks of how it is seamlessly connected with optimised routes, services, and drivers, or how it helps the government meet environmental targets. For example, using electric-powered vehicles can significantly contribute towards air quality improvements, and lowering carbon footprints.

However, thanks to a well-ingrained, decades old-car culture that still promotes the feeling of freedom, if people own a car, they still prefer to drive.

Common reasons given for driving are that public transport services don't go where they want to go, when they want, or that public transport is too unreliable, takes too long, or is too dirty - polluting the city with diesel fumes. Historically, some of this may have been true, but with zero-emission vehicles now available and the right planning, operations and tracking tools in your hands, it is possible to address many of these perception issues - both with the public, and funding bodies.

Implementing the right approach means it is possible to make public transport the preferred choice of transport for many journeys, as shown in Switzerland with their fully integrated bus, tram, and train networks. When coupled with zero-emission vehicles, the resulting public transport solution can have remarkable impacts on a city and country - lowering overall traffic levels, and increasing air quality, not to mention the quality of life.

By knowing about the tools available, you can plan how to best use them - delivering better services and enhancing public perceptions, while showing results in the bottom line.

Knowledge empowers decisions, and accurate data lets you move forward with confidence.

In the following sections, we discuss what these tools are, and some of the benefits you can gain by using the right tool to suit your public transport service. For transport authorities and operators, these important tools are collectively known as Intelligent Transport Systems, or ITS for short.

What are Intelligent Transport Systems – and Their Benefits?

ITS is nothing more than the use of computer systems to help deliver better public transport outcomes. This goes back to the 1980s when ITS solely focused on controlling traffic lights to move more traffic (including buses) through an intersection. With time and maturity, the range of ITS tools has expanded, and algorithms that automate operations have improved dramatically – which include several benefits for transport authorities, operators, and the travelling public.

Four of the key benefits of ITS for public transport are:

They help provide planning and delivery efficiencies.

They help monitor and manage service delivery against plans, particularly at times of disruption.

They inform your passengers in real-time about what is happening, which helps improve the passenger experience, and

They help increase ridership numbers.

For many transport organisations, ITS is now a vital part of their service delivery - touching on almost all aspects of what they do. Let us examine these four benefits in more detail.

Benefit One - Planning and Delivering Services

Planning tools are the start of the journey. Generally, public transportation occurs from people's homes, places of work, and leisure locations. By analysing data on current transport distributions, as well as future planned developments, ITS planning tools can be used to simulate scenarios to design inclusive, integrated networks.

Predicted future transport demands, when assessed with likely housing, retail, leisure, and commercial developments, enables the style of public transport to be assessed – such as conventional bus services, bus rapid transit systems, ferries, light rail networks, metro systems, or even new urban and interurban rail networks. ITS tools can be used to analyse and simulate different transport solutions using "what if" analysis, which helps ensure a balanced and sustainable transport network.

Following this high-level planning, ITS tools can use origin/destination data and turn that into viable routes - obtaining a balance between passenger coverage and route complexity. Now you can run services where people actually want to go, at the times they want to go there. The ITS system allows you to analyse and simulate the current situation - quickly allowing you to "re-boot" your network to meet changing demand on a more regular basis.

Demographic overlays can help identify population demands based on age, income, and car ownership. This can help with determining where stops are located, and potential future route extensions. Planning tools can quickly assess potential travel times to see if routes are within an acceptable walking distance for an average passenger. Community costs can be determined and used to compare plan options.

Fleet optimisation tools take those planned timetables and turn that into a daily plan for each vehicle ("Blocks") and driver ("Shifts"). When used appropriately, this tool can optimise the number of services required. Automated fleet optimisation tools can provide savings between 5-10% of your fleet.

That is money that can be freed up for other beneficial uses. When applied to drivers, these tools incorporate labour agreements and operator business rules, giving a plan that optimises labour costs, and is fair to all. Every operation has its own way of doing things. A good tool will let you configure your plan to your specific circumstances.

It will factor in variables such as where your depots are located, local enterprise bargaining agreements, and popular meal break stops. It will also allow for unique operational situations such as low bridges, or an inability to turn at key locations, which restrict the use of double-decker or articulated buses but allows standard buses or minibuses to be used.

Benefit Two - Monitoring Service Delivery

Having a plan is great, but our next ITS tool turns the plan into reality by managing actual services and people. **Day of operations** software (or dispatch software) helps deal with the chaos that can be a dispatch room. On the personnel side, it can deal with drivers being on leave or calling in sick at the last moment. Regarding fleets, this software considers all available and unavailable vehicles – for example, those undergoing maintenance, or if they are out of service. The result is a high level of service availability and drivers to deliver your bus, tram, or ferry operations. A secondary feature of this tool is that it manages vehicle maintenance - reducing waste, and minimising vehicle downtime. Ultimately, these savings flow back into lower costs and can be channelled into more services for passengers or reinvested back into the business.

If you contract your bus, ferry, and tram operations to commercial operators, then you will want to monitor that these services have been delivered, and how well they are run.

Ideally, you want to improve efficiencies and drive service quality through competition, and how you spend your money.

The ITS **Automatic Vehicle Location and Control** (AVLC) tool is what you need here. It fits a GPS tracker and touch display to every vehicle, telling the driver and the control room about each service. By allowing the control room to communicate to the driver, it gives the operator the ability to improve services whilst they are actually running.

Singapore's Land and Transport Authority use their AVLC to track every bus in the country (over 4,500 of them) across multiple routes and operators. This gives them a reliable, consistent way to monitor their contracted services, and helps keep Singapore moving.

A more advanced use of this tool is to control services on high-frequency "headway" routes. Headway management reduces service bunching - meaning passengers get the regular service they were promised. No more long waits followed by three services turning up at once. Transport for London uses this on all services where they run more than three buses per hour. One key metric they use to monitor services is Excess Waiting Time or (EWT).

This is a measure of the additional time an "average" passenger would have had to wait over the planned time. For example, if a service runs every five minutes, then, on average, a passenger should have to wait 2.5 minutes for a bus to arrive (some arrive earlier, some later, but the average is half the interval).

Therefore, if the actual interval at a stop is six minutes, one minute more than planned, then the excess waiting time is 30 seconds (3 – 2.5 minutes). If the actual interval was seven minutes, then the actual wait time would be one minute (3.5 – 2.5 minutes). In London, they link the EWT metric to operator payments, and use EWT to maintain and improve reliability across the network.

If you connect your bus tracking system to your traffic control system, then you can give priority to buses and trams at signalled intersections.

This means that late buses and trams can be assigned shorter red light and longer green light times along their routes, without any intervention by the driver. When vehicles spend less time waiting at red lights, these time savings add up over the trip, helping maintain on-time running. All of this happens automatically, without driver intervention. As the vehicle approaches a light, it sends a message to the traffic control system informing it of its impending arrival, and the way it wants to travel through the junction. The traffic control system can then determine how to respond, reducing the time lost queuing at the intersection. When this occurs, it greatly improves passenger experience and many of your passengers will start to feel that catching the bus or tram is a better option than using their own car.

The AVLC tool can also connect to **Automatic Passenger Counters** on buses, trams, and ferries so that you know how loaded each vehicle is, which enables the transport authority to prevent overcrowded services – whilst enhancing passenger safety.

Many cities follow Zurich's example and fit some or all of their vehicles with passenger counters. Passenger counters gained prominence with COVID-19 limiting capacity on individual services, because of social distancing requirements. Another onboard safety device is the **smart CCTV** system. CCTV systems have moved beyond mere recording and playback. Now, they are tools that can identify if people are wearing masks, are fighting, are too close to a platform edge, or are acting in a suicidal manner.

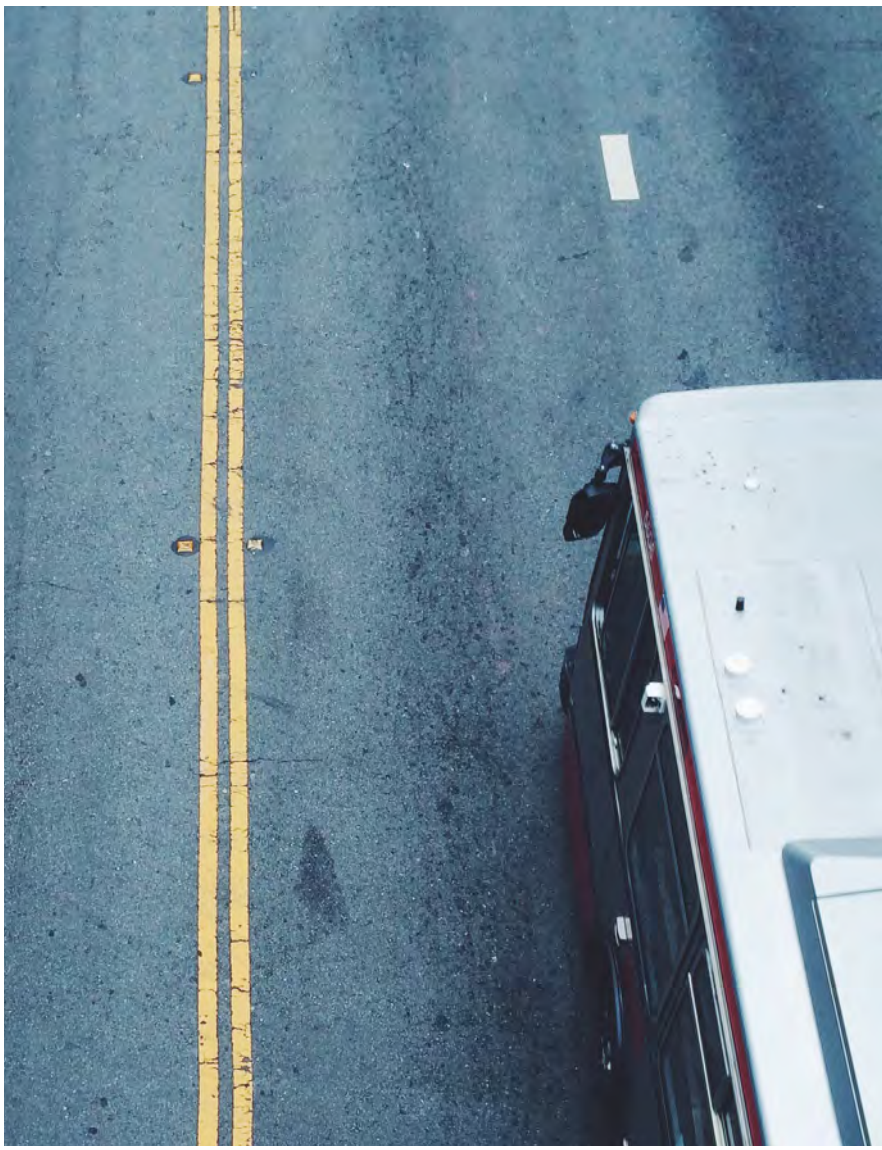
The capabilities of these systems are growing and show no signs of slowing down. Modern AVLC systems connect to the on-board CCTV and provide the control room with direct access to cameras in real-time, allowing them to quickly see the cause of an incident, and further improving safety. Linking the CCTV into the AVLC solution allows the service controller managing the vehicle to view, if necessary, the interior of the service and assess the situation directly.

Ticketing is our next tool. Highly visible to the public, this ITS tool can really open up your public transport network to more users. Modern systems support multiple payment options - cash sales, transport cards, credit cards, smartwatches, and mobile phones. They can be single-use, have value stored on the card, or be account-based.

The intention is to make it easy for people to use public transport - making it simple to interchange between services and transport modes (such as buses, trams, ferries, or rail), enabling a true multimodal network. These systems also speed up boarding times and provide a wealth of transport data such as origin-destination, time of travel, and passenger demographics. You can even feed this information into the planning tools to close the planning loop.

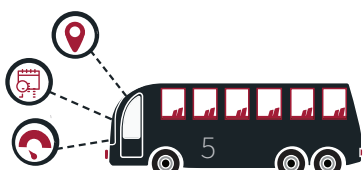
There is no doubt that electric buses have now come of age. Rolling out these zero-emission vehicles is now a straightforward economic decision, and directly addresses perceptions (and the facts) that fossil fuel powered buses and private vehicles are significant pollution emitters.

However, the introduction of electric vehicles needs to be carefully planned and executed. This requires re-analysis of the route network as the way of operating, the type of vehicle, and route types are linked.



Generally, there are routes that are suitable so that only full overnight charging is required at the depot, but there are also other routes where opportunity charging is required to maintain vehicle range. All of these factors need to be included in the planning process. ITS tools are necessary to make this analysis of different requirements and optimise electric vehicle deployment.

Electric vehicles themselves are full of ITS solutions and specialist computers.



They are already supported by current generation planning, day of operations, and AVLC tools. This was needed so that range limitations and specialty charging requirements for electric buses can be factored into plans for the routes they can run, layover or depot charging, and how long the vehicle can be used without recharging. Initially, bus fleets are likely to undergo a transition phase, with a mixture of older legacy diesel buses, newer hybrid buses and then newly introduced electric buses. As the fleet moves over to an all-electric one, ITS tools continue to provide the management and coordination necessary to ensure quality service delivery for the travelling public.

Demand Responsive services are not for everyone, but this ITS tool allows for smaller vehicles to complete the "last mile" of a trip between your regular stop and the home, other stops, or office. The last mile is that short trip that is just that little bit longer than the average person wants to walk. These services have no fixed route or timetable, relying on ITS to build one on the fly automatically - picking up passengers and dropping them off at agreed locations.

Often overlooked, there is even an ITS tool for **school bus** services that helps plan routes, tracks the buses and student locations - great for child safety.

Benefit Three - Passenger Information and Improved Experience

Probably one of the biggest ITS benefits is improving the passenger experience with real-time passenger information. This cuts to the heart of managing commuter perceptions. Passengers cannot see where the buses, trams or ferries are along the route, so an ITS system is a great visual tool that monitors every vehicle in real-time, predicting when they will arrive at each stop.

This availability of accurate, up to date and consistent information directly impacts the customer experience, providing reassurance and information. When your passengers are informed at every stage of their journey in real-time, they know what to expect in terms of service arrivals, departures, transfers, and potential delays. This information can be communicated at stops using audio-visual displays, internal and external vehicle displays, in-vehicle audio announcements, and websites/apps which can be viewed on a passenger's mobile device.

ITS systems can be integrated into your operations control system, and your vehicle on-board computers to ensure a consistent and accurate information flow across different systems and media.

The use of this tool reduces passengers' perceptions of waiting time, giving them other travel options if required, so they are not forced to wait. This demonstrates that you value their time. We see comprehensive passenger information systems in cities as diverse as Melbourne, Singapore, London, Zurich, and Johannesburg. Integrating journey planning systems with the real-time information, as well as details of upcoming events (e.g., major festivals or roadworks) and how they will impact the network provides additional information that contributes to the experience, and utilisation of the public transport network.

The fare collection process should be quick, seamless, transparent, and present minimal barriers to travel. Modern ITS fare management solutions can approach the convenience of simply stepping into the vehicle and alighting with the mundane financial transaction being almost invisible - with commuters using a 'tap and go' kind of ticketing system. No more digging around for correct change or waiting for the bus driver to perform cashier type duties.

An improved passenger experience then directly translates to the fourth benefit – increased ridership.

Benefit Four – Increased Ridership

Perhaps the most difficult benefit to quantify is the cause of increased ridership numbers. It is easy to monitor if ridership has increased, but why? It is seldom a single action that drives up ridership – it is usually the result of a combination of incremental improvements. A new electric bus may be an environmental winner, but unless it runs on time and goes to the right places, it will do little to change the public use of this service.

A holistic approach is needed, where the various parts are selected and are held together with the glue of ITS. Each component builds a little on its own, and each enhances the others.

Ridership is directly linked to the quality of the service being provided. A basic requirement is to provide services between places passengers want to go and when, which we have covered in the planning section. However, once the network is in place, the ridership can be built up gradually and maintained by the application of ITS solutions.

Transport authorities that have implemented ITS systems show greater reliability in their services, increased convenience for passengers buying tickets, and increased passenger engagement through better passenger information.

Overall, these services are simply more attractive to passengers and this has the effect of increasing ridership and ultimately increasing ticket revenue.

In Singapore, the restructuring of the bus network and the introduction of service quality-based metrics and control facilities has enhanced passenger satisfaction across the network.

The iBus ITS solution in London has enabled service delivery despite the challenge of increased traffic congestion. In Tshwane, South Africa, the A Re Yeng Bus Rapid Transit (BRT) system uses vehicle tracking, traffic signal priority, off bus ticketing and real-time passenger information to deliver an outstanding service to passengers in Pretoria.

Providing a transport experience which approaches, or even exceeds the ease of use of private cars, will directly generate ridership.

Conclusion

The ITS technology and components we have discussed here can be used both in isolation or combined to deliver greater synergies and efficiencies. Often, these tools can be integrated with non-ITS initiatives to deliver a radical change in mobility within a city.

For example, a BRT system, where dedicating roads and stations to buses lifts them out of the daily traffic gridlock. When BRT systems have efficient fare solutions which minimise or even eliminate fare payment delays, they deliver the ability to run fast, high-frequency services.

By monitoring the public transport services delivered and providing the tools to manage disruption and maintain services, public transport can be appreciated, and even advocated by the travelling public. Using the right ITS tools will help services run more efficiently with fast boarding, easy ticketing and real-time updates guiding passengers.

Intelligent Transport Systems are not science fiction wizardry. They are here and now, delivering real benefits and savings across the world. We see leading public transport authorities like Transport for London and the Singapore Land Transport Agency embracing ITS and making it a pivotal part to their overall public transport strategy. But there are also smaller cities that are embracing what ITS has to offer. They not only track all their vehicles and provide passengers with real-time upon arrivals, but also use the performance data to drive better service quality. These transport authorities are already trialling Artificial Intelligence and autonomous vehicles in their quest for better passenger service.

You may not want to go that far just yet, but by incorporating the right ITS technologies into your transport plans now, you will have the tools to reduce your costs, improve how public transport is perceived by your customers, and deliver tangible service improvements for your passengers.

Find out more about our ITS solutions at the Trapeze ITS Hub.

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