Downer
Relationships creating success

SMART CITIES

July 2017

House of Representatives
Standing Committee on Infrastructure, Transport & Cities

"Inquiry into the Australian Government's role in the development of cities, 2017"

A DAY IN THE LIFE OF A SMART CITY

Each day the commuter would be advised of the best travel route taking into accuont factors such as the weather, major events, or expected disruptions or delays.

If there are delays or disruptions they might take the option to drive to a station and then take public transport.

Use light rail.

Take the bus.

Or take the train.

Each journey would be informed by the best transport option and best route, including when to leave their house, how to get to a stop or station, how to pay for tickets and charges, where to park, where to shower and change, how to change platforms and the best exit from a station to get door-to-door each day.

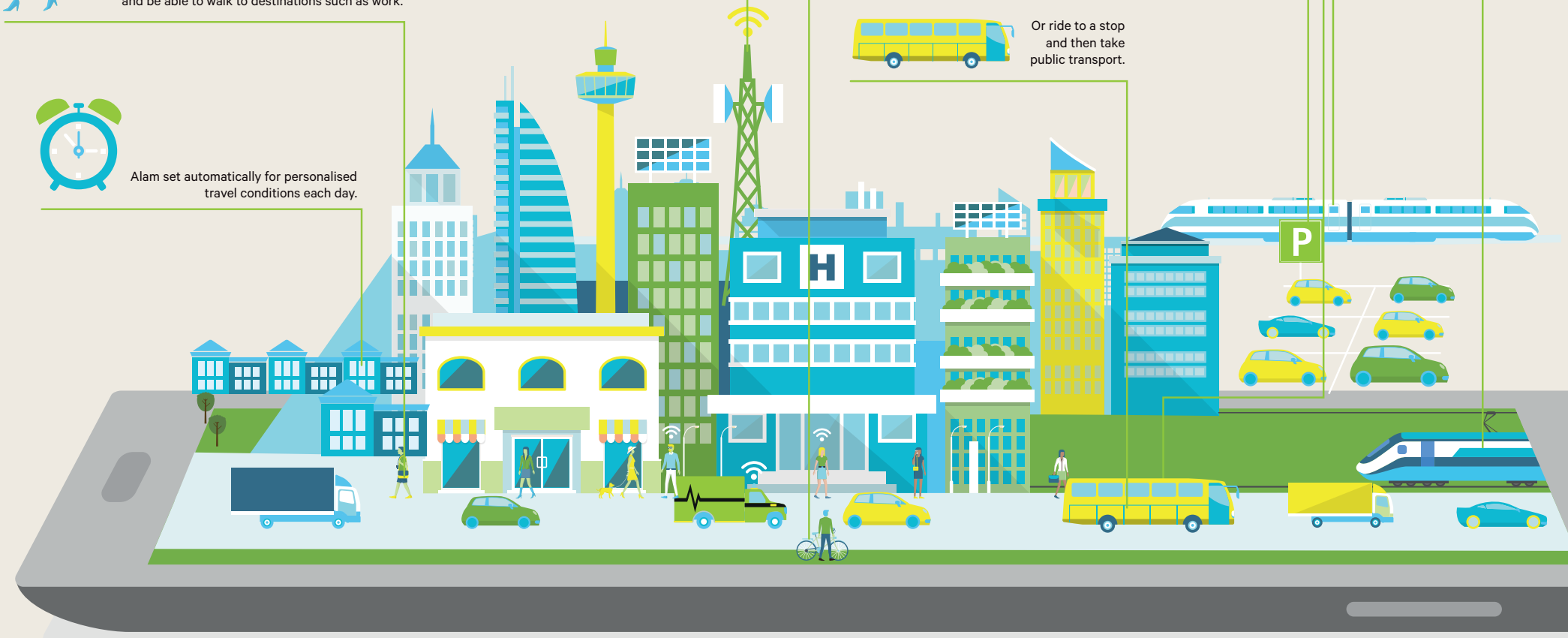
Some residents will regularly ride to work, or just on a specific day.

Car pooling might be a regular or specific option on a particular day.

Or ride to a stop and then take public transport.

Many residents will live close to their place of employment and be able to walk to destinations such as work.

Alam set automatically for personalised travel conditions each day.



SMART CITIES

A smart city is an efficient, liveable, economically, socially and environmentally sustainable city.

Smart cities leverage on technology to improve the quality of life for residents.

For cities to become smart, sustainable and more liveable they need to focus on key enablers such as e-Governance, waste management, water use, renewable, energy, mobility/public transport.

Liveability can be enhanced by encouraging high-quality and innovative energy efficient public transport, including integration between all transport modes and active mobility solutions.

More liveable cities will be smarter cities, allowing greater capacity, and actually improve quality of life for citizens.

Critical to achieving liveability will be smarter mobility that can be classified into three major areas: sustainable transport, connected transport, inclusive transport.

Living In a Smart City

The smart city will improve how we live, work and play.

One of the key measures of living in a smart city is the ease of mobility, especially how we commuting to work, or use the transport system for mobility.

Even with increased options for working from home, residents will make choices that suit their personal and professional needs without having to compromise their work arrangements to accommodate the limitations of the transport network.

While smart cities facilitate more people living closer to their work, improved transport improves quality of life for all residents, including those not using transport.

Another critical opportunity of the smart city is the increased sustainability and efficiency of services, especially utilities that are available to all members of the community. In smart cities utilities use patterns of data to better understand their systems and better align with new energy sources.

These changes don't just make cities operate better they can help improve people's lives by creating stronger and healthier communities.

MOVING AROUND IN A SMART CITY – PERSONALISED AND INTEGRATED TRAVEL

So how will citizens move around in a smart city.

A commuter's day begins not with an alarm set for their usual wake up time, but instead they will be woken at the time required for their best journey plan for that day.

Depending on where they live and work, the resident of a smart city will be woken up earlier if their usual route they drive to work is undergoing road works or facing expected delays from a incident on the road. They won't be tuning in to the traffic report, it will be tuning in to them, advising them of best they should travel that day.

If commuters need to allow extra time due to disruptions on their personalised route, then their alarm will automatically go off earlier to allow them more time.

Commuters may also be advised of an alternative route and/or mode of transport to get to work that day.

Ride a Bike to Work

A bicycle sharing option may be the best option for a commuter on a given day, as their personal exercise tracker identifies they missed their normal exercise routing and they need to increase their mobility. They would be advised of the nearest collection point and be able to reserve a bike our space once they leave the house.

Bicycle centres support riders by providing a secure storage facility, where their bike is put into bulk storage and they receive a token to retrieve it later, with showers and other amenities available on site. Locating these bicycle centres at transport hubs supports riders to 'park and ride' from suburban stations as well as ride into the city centre.

Detailed bike routes provide riders with a cycle plan for getting to work, taking the safest and most cycle friendly route, especially where designated bike paths may not be available, as well as profiles on the gradient and difficulty of the route to align fitness objectives and advise of the suitability for individual riders.

Share a Car to Work

A carpooling option from a neighbour, or sharing an autonomous vehicle may be made available to them. Carpooling applications link drivers and passengers in real-time, thus enabling dynamic carpooling. Drivers and passengers can find other people situated on the same route via a smartphone app and vice versa. Autonomous vehicles as they are introduced can stop and pick people up on route, through the use of real-time apps that match similar passenger routes.

Passengers can also directly debit his or her fare to an app, eliminating the achieved or difficult exchange of cash. However, with a congestion charge applying in the Smart City, the commuter may prioritise and encourage carpooling to off peak periods.

The driver (or autonomous car) would be advised of the best parking options aligned to their route and destination based on data from the parking sensors in the smart city's car parks. Autonomous cars may even leave the city centre to locate the best parking option outside of the congested CBD . The driver may have the option of reserving a spot based on their proximity and reliability.

Changes to the route commuters drive to work would be fed directly to their car, advising them of the best directions to get to the office. That route would then accommodate the expected additional traffic that day, and advise different people of variations to their routes to avoid congestion.

The traffic system would also be aware of the expected additional planned traffic and adjust the traffic lights accordingly to better manage projected traffic flows. Sensors along the road, and in the lights, would monitor the traffic network and make the necessary real time adjustments.

The road they travel on may be designated for specific configurations of transport modes, with better combinations aligned together rather than all roads always being available to every mode of transport. For example, one road with a light rail operating on it, may combine best with bicycles and not passenger cars or light and/or heavy vehicles.

Tonnage limits may vary around peak and non-peak road usage, especially on multi-modal roads and these would be monitored by sensors built into the road.

Take Public Transport to Work

Alternatively, they may be advised that public transport is the best option available to them. The location of the nearest bus, light rail or train stop will be provided to their smart device, and they will be advised when to leave the house to make the next best available service.

An option might be for the commuter to drive to a station, knowing that there is parking available through a park and ride service that integrates parking fees and public transport fares. The system is smart enough to use pooled parking rather than reserved parking. This means the interconnected parking system knows if you are likely to use your reserved spot, or if it is free to be reallocated for casual use – thereby optimising parking availability.

To access the public transport system they will simply swipe their smart device at the stop or station and be charged a single fare that will be directly debited to their savings account. They won't need a transit card, they use an app on their smart phone that integrates trip planning, payment processing and provides traceability for ticket inspection. Integration into individual smart phones facilitates real-time transport planning to match public demand with supply.

Similarly, a tourist, intra-state or interstate traveller will simply download an app and be charged via their smart phone for accessing the public transport network.

Where practical, one mode of transport will align with another. For example, a one minute delay of a ferry on Sydney Harbour, may prevent a bus load of passengers waiting half an hour for the next service where there is no alternative mode of transport. These decisions are made based on the number of passengers arriving late, the number of passengers already on the bus, the impact to passenger's journey connections, and the impact on the network of introducing delays.

Commuters would be advised in real time of delays in the network and given options for other services of modes of transport to optimise the overall experience

They will be able to wait at smart bus shelter and train platforms, where people can interact with new technologies, and social media – using interactive apps to see on a map where their next bus, tram or train was, not just an ETA.

This allows passengers to make informed decisions on how to best arrive on time at their destination. For example they know they can wait 10 minutes for the bus, or opt to flag down the nearest autonomous vehicle. With this information passengers are better able to use multi-modal transport options, achieving the right balance between cost and the time for each trip.

Passengers won't need to know or consult timetables as they will have access to on demand services, with set regularity for peak, shoulder and off-peak times that are adjusted real time to match supply and demand. The announcement at the train station won't be for the delay to a specific service but simply when the next service arrives.

Access to the Smart City

The smart city will not just better serve the needs of the residents of the city but all those who access the essential services of the smart city, especially those outer suburbs. Electrification of rail lines from outer suburban or regional centres helps overcome the over-urbanisation and concentration of population in Australia's urban centres.

Upgrading more regional rail services from diesel engines has clear environmental benefits but also greatly improves the efficiency of the rail network and the rolling stock used by public transport operators.

Improved rail services not only improve access for regional communities to large smart cities, they allow more people to take advantage of the natural advantages of regional living and help develop regional smart cities.

New rail technologies not only make rail more competitive with road, they actually make rail more efficient than road. This not only improves road safety but it reduces the cost of road maintenance and improves the carbon footprint of transport systems.

New technology supporting Smarter Transport

Smart cities will also support electricity and renewable energy operated cars. "Plug-in" ready cities will facilitate the expansion of a Public Electric Vehicle (EV) infrastructure that ensures the safe, reliable, and efficient integration of EV charging loads with the power grid.

Additional investment in hydrogen refuelling stations to be incorporated as hydrogen fuel cell vehicles increase in usage over the coming years.

With additional commuters accessing the public transport network on the road, the signalling system would prioritise the city's trams and trains.

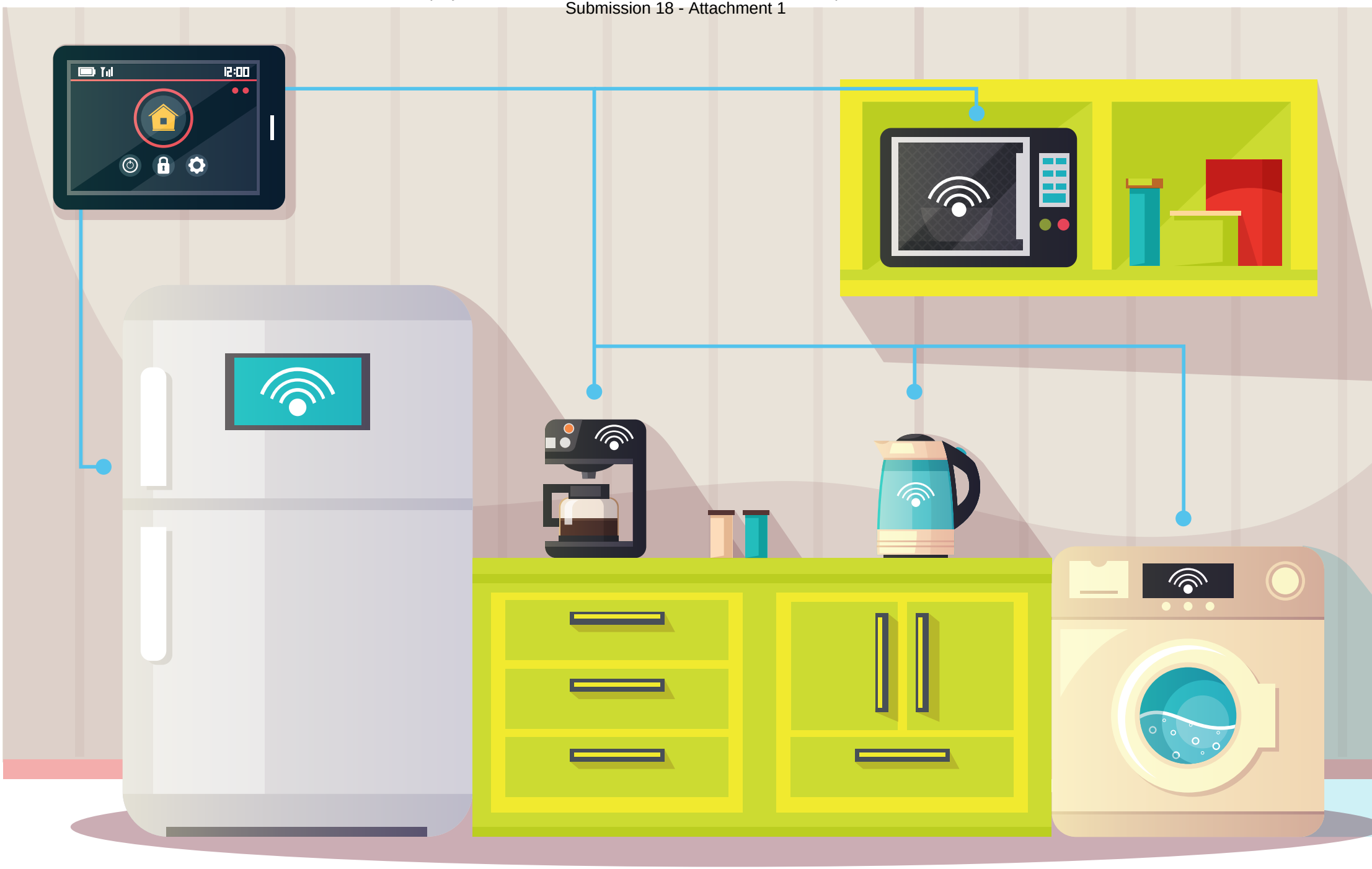
Sensors would monitor for bottlenecks or other disruptions and intelligently adjust the signals for traffic lights and level crossings. Autonomous vehicles use real time traffic information to adapt to the best routes that keeps traffic moving. Automated monitoring will better manage traffic flow across the network in real time.

With smart street lighting, at night LED lights will dim when there are no cars or people on the street. The inbuilt CCTV cameras monitor safety and traffic incidents using Artificial Intelligence.

Networked Building Management Systems (BMS), system will manage cooling, heating, and lighting use when areas are not being utilised, and accommodate utility companies demand side power management by widening temperature set points, during peak demand.

Advanced vehicle monitoring supports asset tracking and predictive maintenance by actively monitoring vehicle measures such as overheating, tire pressure, passenger loads.

Long term integrated and coordinated planning is the key to planning more sustainable cities. We need to look at infrastructure from a holistic perspective, looking at how we can leverage one piece of infrastructure to support others, plan for infrastructure to match population growth and ensure we leverage appropriate technologies.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AT HOME IN A SMART CITY

A smart city uses digital technologies or information and communication technologies (ICT) to enhance quality and performance of urban services, to reduce costs and resource consumption, and to engage more effectively and actively with its citizens.

When we arrive home in a smart city, our utilities and services are tailored to our personal requirements.

Energy in a Smart City

In the smart city large-scale renewables and large-scale battery technology will play a central role in keeping our electricity system stable, reducing prices, and reducing emissions.

The electricity to our houses will be generated predominantly from renewable sources, with large wind farms generating electricity that is stored in large batteries as baseload power to the grid.

The demand response program will save the resident utility costs, especially for charging their electric car after the trip home, for use that night and to be ready not just for the morning trip to work but for any eventuality during the night.

Consumers can better plan to use power in off peak times and power authorities engage in consumer elected load shedding in times of high demand.

Water in a Smart City

Our household water consumption will be improved through the use of smart meters that will ensure network optimization and sensors that will detect leakage and are linked to area response teams. This means repairs are actioned within hours rather than days, reducing waste.

Smart city pipeline monitoring solutions can deploy mobile pressure sensors, flow meters and acoustic sensors throughout the water network to detect leaks, stagnant water, or blockages thereby improving efficiency and health outcomes.

Optimising pressure and flow within pipelines and traps helps extend operational life of assets and active asset management can reduce the cost of unnecessary or overdue preventative and corrective maintenance.

Household gardens, parklands and recreational areas will only be watered if the weather report doesn't predict rain or if there hasn't been sufficient rainfall. Sensors will not only measure rainfall but the moisture content of the ground and the seasonal demands of the vegetation.

Evapotranspiration technology will calculate the wind, humidity, solar radiation and temperature to determine watering requirements.

The smart city resident didn't have their meter physically read by a utility employee or have to manually do it themselves. Smart meters reduce manual meter reading costs and keep more utility vehicles off the roads to reduce CO2.

Safety in a Smart City

All through the day and night, the smart city has been enhancing the safety of its citizens. Nearly all classifications of crime can be reduced through smart ICT in the form of lighting, video surveillance and data analysis and visibility.

Safety is a high profile benefit in smart infrastructure, with threats of terrorism often aimed at public infrastructure. Smart cities can make us safer.

There are enormous benefits in upgrading traditional sodium lights with LED lights. With simple sensors, we can brighten an area where there are people.

A small additional investment in cameras in the light poles gives us vision. Microphones in light poles picks up gun shots, calls for "Help" and then automate a call to emergency services, including live video footage so the operator can see the situation (avoiding false call outs). Police car in the vicinity would automatically alerted to a potential issue.

A record of the incident is also available. Video analytics even let security forces put out a description of a person of interest, allowing authorities to track people if needed. Technology that simultaneously watches all CCTV cameras in the city can be used to find these persons of interest.

A smart city resident will also sleep easier knowing that ICT based solution are vastly improving disaster planning and remediation. Disaster planning traverses the management of biosecurity outbreaks, crisis management, emergency response, and recovery.

In the past the challenge of maintaining essential services during these times included a huge effort in completing visual inspections of all assets, with access challenges in parts of a city most affected.

Deploying wireless cameras, temporary lighting and temporary signals enables agencies to manage safety, security and traffic flows. Similarly, journey time modelling and matrix boards to inform motorists of changes and monitor the impact of traffic movements due to relocation of business operations out of the centre, are valuable tools during these times.

Services in a Smart City

The goal of building a smart city is to improve quality of life by using technology to improve the efficiency of services and meet residents' needs. Smart Cities are not about technology for technology's sake, but rather improving services for people.

Meeting resident needs and having efficient services is great – but what we are really wanting is a city that is liveable. Cities and their citizens need and expect effective public services. Public services need to become smarter: more efficient, innovative and available to all.

The acronym XaaS (anything as a service) refers to any of an increasing number of services provided on-line: everything as a service or anything as a service.

The city becomes a service organization with citizens as the customers and the smart city providing high quality services to its citizens. Services delivered by smart cities should be easy to use, efficient, responsive, open and sustainable for the environment.

The provision of real-time information about urban environments is important for running different helpful applications and services.

At home the resident of the smart city will have access to high speed broadband for entertainment and commercial internet needs, this also networks then to a range of information systems that automatically push and pull a range of data services.

Smart city authorities and other contractors will continue to embrace sensor technologies in a wide array of infrastructure to report asset condition, asset effectiveness, and assess asset replacement/renewal. One example is the use of sensors on rubbish bins around municipalities to assess odour and rubbish levels. Through implementing and monitoring these sensors, Councils and other government agencies are better able to manage routine collection and asset condition – leading to improved amenity for all citizens.

Technologies such as autonomous vehicles reduce labour-cost and improve capacity of infrastructure, hence reducing the overall cost of infrastructure per unit of production. During the night and off peak periods, drones will conduct inspections of critical infrastructure such as roads and railway tracks, minimizing disruptions and risks associated with manual work.

The use of technology platforms by elected representatives rather that direct service delivery by the public sector will support the continued evolution of smart cities through increased standardisation helps realise the full potential of new technologies and big data analytics. This promotes greater accountability, transparency, efficiency, and purchasing power for the citizens of smart cities.

Smart City Infrastructure

Infrastructure in smart cities helps improve the efficiency, reliability, delivery and maintenance of infrastructure and essential services.

All assets of the city, especially fully integrated infrastructure, must be working and evolving as a sustainable ecosystem. Smart city infrastructure investment will reduce congestion, improve market access for goods and labour, and increase safety.

The asset recycling programs of governments across Australia have unlocked capital in their existing assets and used the proceeds of leasing arrangements to fund new investment in productive infrastructure. In addition these private sector investors are likely to increase capital investment in their operations to improve and grow their businesses.

Smart cities will also gain greater investment in critical infrastructure through greater collaboration across the tiers of government. More flexible combinations of grant funding, loans and equity investments. This will also include wider adoption and acceptance of user-pays and value-capture models.

The Business Council of Australia has put forward the following criteria to determine whether an asset is owned privately or by governments, and how that asset should be operated:

- Governments should sell infrastructure assets where the private sector already owns other like assets and provides other like services (this effectively demonstrates adequate policies are already in place to protect consumers).
- Private ownership should be preferred where appropriate arrangements can be established for the infrastructure service in any of these three ways:
  - There is a market price set by an effective and contestable market for the infrastructure service.
  - There is a regulated price that allows an adequate return on an efficient investment while also protecting the interests of consumers.
  - There is an implicit contract price that a government agrees with the owner of the
  - infrastructure on behalf of public users (includes community service obligations).

- Government ownership should only be preferred where it can be demonstrated that it is necessary for achieving the community's objectives with respect to infrastructure provision e.g. demand risk on some new greenfield projects.
  - These businesses should be sold once the project has matured.
  - Government owned infrastructure should outsource delivery and operations based on competitive long-term contracts.

Infrastructure funding and financing policies must complement effective infrastructure planning, prioritisation, delivery, maintenance and operation by the public and private sectors to form an effective infrastructure system overall.

The continued use of Public Private Partnerships ("PPPs") and other collaborations between public and private providers will facilitate the deployment of new technologies. More innovative approaches in service delivery will harness the potential of the technology and associated big data.

Government can reduce the cost and risk of the PPP process to bidders by reimbursing some bid costs and implementing a streamlined PPP model for smaller projects.

Smart cities will expose services to contestable supply, so that the best operator or provider delivers the services.

Operating and maintaining infrastructure in smart cities will increasingly be determined by capability as well as capacity.

Communities in smart cities receive community focussed government services that generate lower costs, higher performance, and greater responsiveness.

The IoT is increasingly being applied in buildings and in urban infrastructures such as transport and utilities in a way that challenges many of the assumptions about cities operate.

For governments traditional outsourcing criteria will need to adapt to the new challenges of the IoT and big data, to ensure the continued deployment and adoption of new technology and to capture the full potential of the data available in smart cities.

Franchising is another way elected representatives in smart cities can maintain infrastructure and assets in public hands but still transfer operational responsibility through a competitive process for the delivery of services for a defined period of time.

Franchising also provides substantial savings to government, which can be re-invested in infrastructure or improvements to service delivery, especially to meet the demographic challenges of an ageing population and to better support those with special needs.

Smart cities will capitalise on opportunities to enhance service quality, increase capital investment and improve cost efficiency across transport, utilities and other services.

These will support and facilitate the deployment and uptake of technology and data solutions that improve the liveability, productivity and sustainability of Australian smart cities.

SMART TECHNOLOGY CASE STUDY

Smart ICT will better connect people, data and things and from this new capabilities are already emerging.

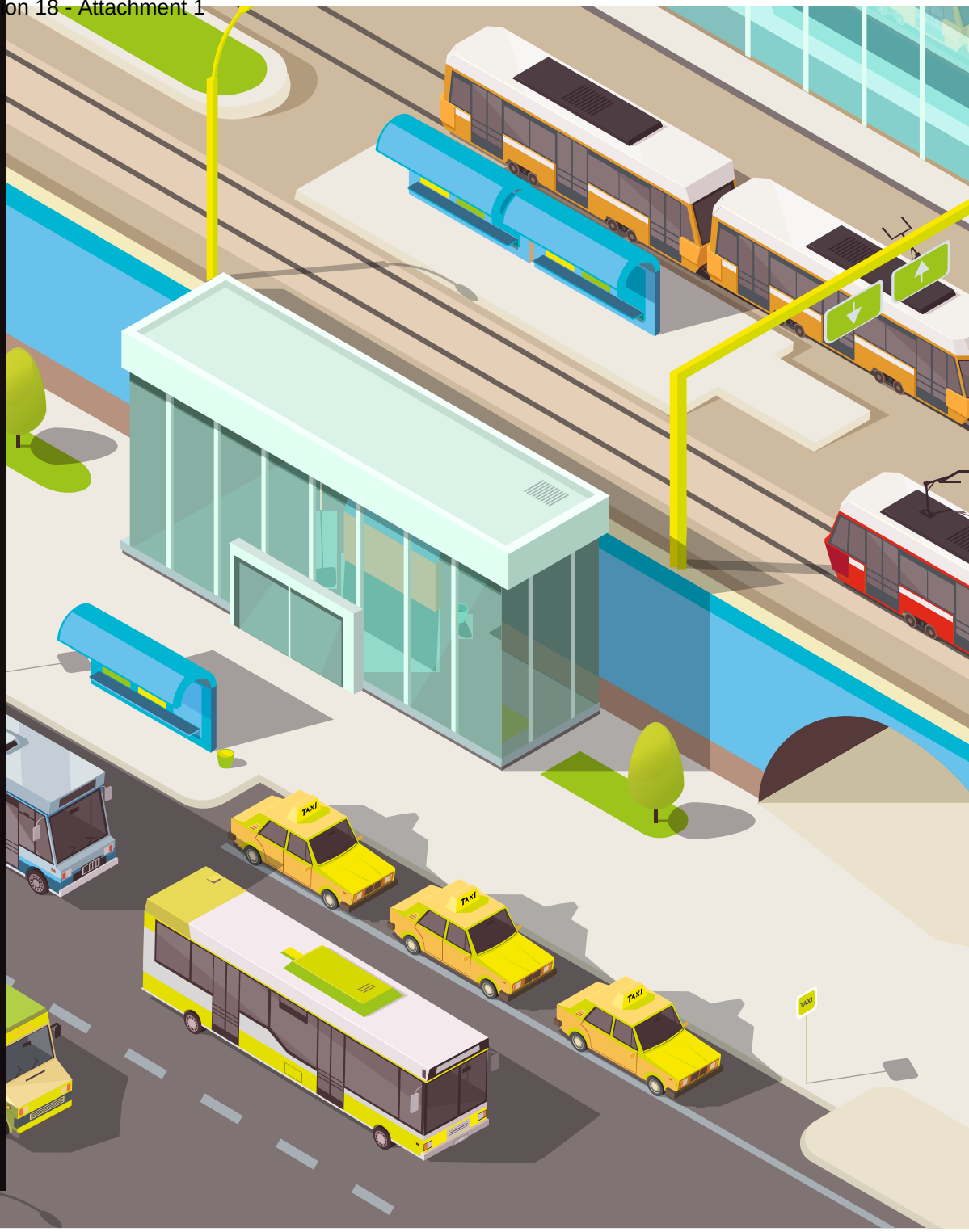
Street lighting is a current example of how smart ICT is enabling energy use reductions. Combining LED installation with central control systems can achieve energy savings in excess of 40%, provide improved and adaptive lighting and eliminate the mercury waste generated by traditional lamps.

Improved camera technology and data transfer capability, combined with improved lighting, can enhance safety and security in cities. High definition facial recognition will be one aspect of technology that will become increasingly important to security and enforcement agencies.

For public authorities, smart ICT can improve parking collection rates. Smart parking technology increased parking revenues by $50m annually in Barcelona, whilst reducing congestion (Cisco, IoE - Smart City Barcelona, January 2014).

Smart motorway technologies provide the capability to better manage congestion and increase capacity of existing motorways. Key applications include ramp metering, ITS, VSLS/VMS, and in-car journey management applications that help road users find the best route given prevailing traffic conditions. Combining these technologies with new car technologies such as driverless vehicles (also known as autonomous vehicles) increases capacity of existing networks and the ability to improve road safety and infrastructure efficiency.

Capability will evolve as we move from multiple standalone control systems towards networks of interacting elements with physical input and output.



Background on Downer

Downer is a leading provider of infrastructure and engineering services across transportation, utilities, communication, resource and property sectors. Downer is an ASX100 company with over 17,000 employees across Australia and New Zealand.

Our technical capability covers data transfer, data storage, field devices and managed services. We have a number of information technology partnerships that allow us to service the connected infrastructure environment and we are active participants in using Connect and Australia's IoT think-tank.

Current initiatives our teams are working on include:

- Geographic Information System (GIS) development and design, including 3D geospatial imagery;
- Development of 'connected' infrastructure, including a prototype connected bus shelter in collaboration with Auckland Transport, Solta, Alcatel Lucent, Samsung, Chorus and Designbrand;
- Smart/Managed motorway design and implementation;
- Intelligent Transport Systems;
- Multi-modal public transport ticketing systems;
- Design and management of datacentres;
- Infrastructure support for EV charging systems;
- Smart parking systems;
- Managed lighting networks.

Background on Keolis Downer

Keolis Downer is Australia's leading private provider of multi-modal public transport. It is the largest light rail operator in Australia, and one of the top five bus operators, providing transport services for more than 250 million passengers each year.

Keolis Downer joint venture (51/49) was formed in 2008. It currently provides operations and maintenance under franchise to two light rail networks, and urban and school bus networks in four different states. It also operates the integrated transport system in Newcastle, NSW, that includes buses, ferries and a light rail (in 2019).

As an innovative partner to transport authorities, we have developed digital solutions aimed at improving the passengers' experience, that integrate planning, booking and ticketing functionalities. We have also included digital solutions in our operations and maintenance processes to improve efficiency, quality of service and asset management. Keolis is the leading worldwide operator of driverless metros. Below are some of the many initiatives our team are currently working on:

- Connected vehicles: we are currently conducting autonomous shuttle trials in Lyon and Paris (France), Las Vegas (USA), and soon Melbourne with La Trobe University as first and last connectivity miles solutions integrated into a larger transport network
- Connected travellers: we are implementation our integrated digital app "Plan Book Ticket" in several cities in France. We also do research in partnership with an international digital think tank to understand how digitalisation impacts travellers and changes their expectations
- Connected employees: use of "smart glasses" to optimise maintenance in Boston (USA)
- Connected infrastructure: we use wireless networks, high definition cameras, GIS to improve maintenance and asset management in Australia and other operations around the world.
- By providing efficient and integrated transport solutions we connect people to places and contribute to the cities' overall liveability

Downer and Keolis Downer are excited about the design and planning of Smart Cities and are keen to see the increased understanding and adoption of the technologies currently available and emerging. Our ambition is to support governments in delivering their vision and helping the transition towards smarter cities.

CONCLUSION

Smart cities take static infrastructure and services, and make them smart, to empower people and improve their standard of living and quality of life.

Whilst the cost of building smart infrastructure can be more expensive to build, there is huge value to be gained through operational efficiency and improved customer outcomes. There are economic, social and environmental impacts.

Economic benefits include:

- Longer life cycle for our assets
- Cheaper to maintain infrastructure
- Flow on benefits to the broader economy, such as attracting investment, growing exports, providing platforms for other savings through the economy. i.e. reduced travel time for commercial vehicles.

Social benefits such as:

- Safer societies (less accidents, less crime)
- Infrastructure that is more reliable and when it is not, better information for our citizens
- Healthier – imagine having sensors embedded in the sewerage system that can help to monitor community health – even alerting households that may have an illness before they realise it.

And of course environmental benefits:

- Reduced impact on our environment through a reduction in greenhouse emissions
- Greener cities

So Smart Cities will better balance environmental, social, and economic objectives.

Recommendations:

1. Increased utilisation of technology in infrastructure and services for improved asset management.
2. Mobility as a service, with multi modal connectivity in transport allowing seamless and fully informed choice by commuters.
3. City infrastructure benefiting from renewable energy and facilitating continued uptake of electric vehicles.
4. Grow public transport infrastructure to support ongoing reduction of traditional car ownership models, with the change to mobility as a service models.

Smart Cities are not about technology for technology's sake, but rather improving services for people.

They are about meeting the needs of citizens in a city that is liveable and sustainable.

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