Transport and connectivity:
smarter infrastructure for
a smarter city

Connectivity outlook report 2020

bai communications
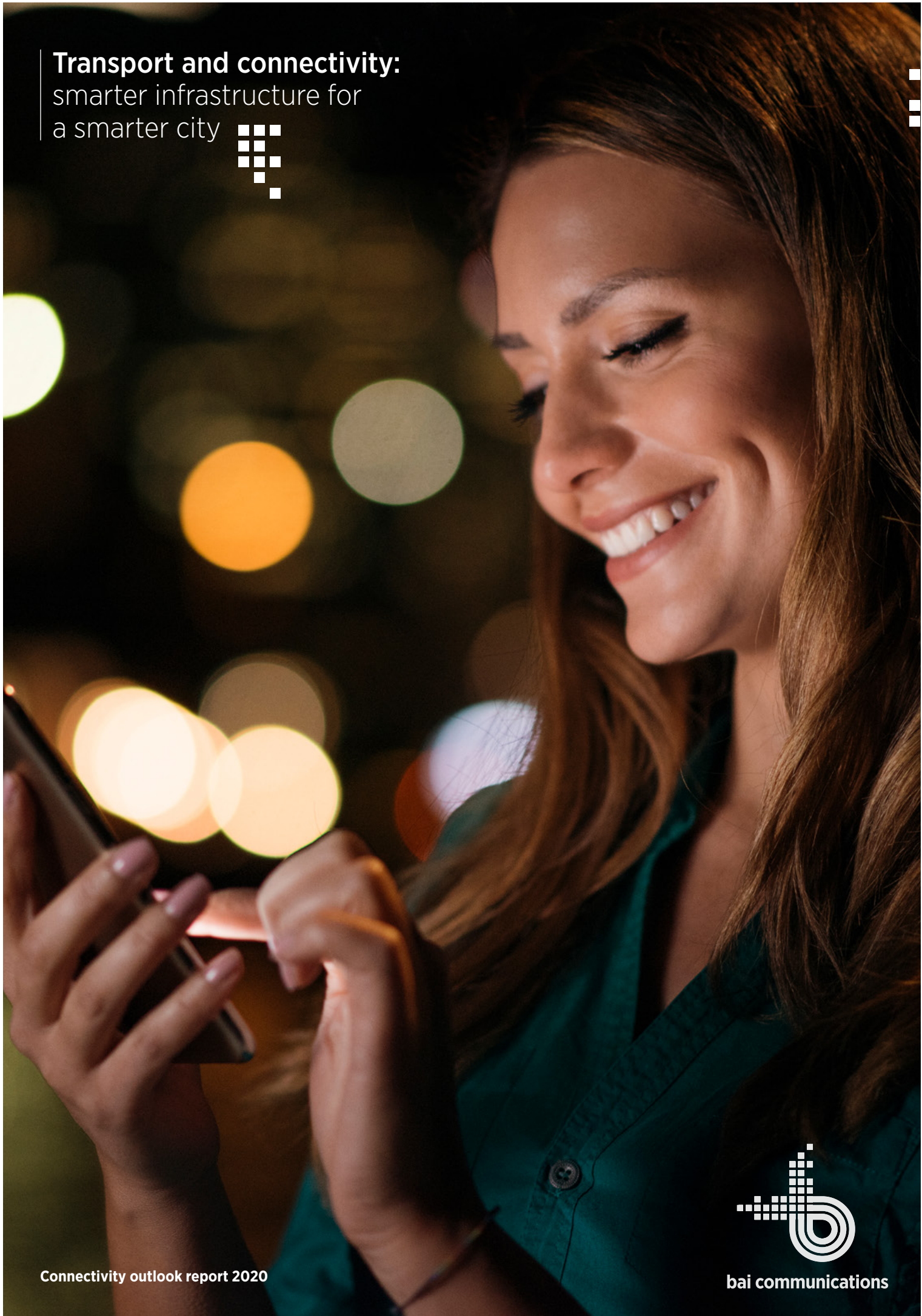
Smart infrastructure helps cities boost innovation, growth and wellbeing

Public transport operators are vital contributors to their city's prosperity and their citizens' wellbeing. Besides providing the infrastructure to help people get from point A to point B, transport operators are also responding to their users' need to remain connected during trips (especially important to commuters of longer journeys) and to the need of travelling in a safe environment, which has become even more relevant during the COVID-19 pandemic.

As commuters travel, improving the current communications infrastructure can have huge benefits from a safety point of view. More broadly, public transport users today expect to access reliable mobile networks to use their devices without interruption and to benefit from real-time data-backed services. In this context, frictionless connectivity is a must.

From a transport operator's perspective, deploying advanced network technologies – such as 5G wireless and Wi-Fi 6 – is critical. It enables the expected continuous connectivity for customers above and below ground as well as the smart city solutions to streamline operations and improve public safety, further enhancing the customer experience.

Fast, high-capacity mobile networks make it possible – and cost-effective – to implement services such as contactless ticketing, passenger tracking, environmental monitoring, platform management and live service updates.

Early in 2020, BAI Communications surveyed more than 2,400 rail users in five global cities: Hong Kong, London, New York City, Sydney and Toronto. Respondents were asked how they saw the state of transport, connectivity, and its role in the future of their city. Key findings are summarised below.

1. **Advanced network infrastructure is the key to a smart city**

- 91% of rail users would support government authorities investing in new and reliable wireless and fibre networks.

- 85% of rail users are interested in 5G (and 83% support their city investing in a 5G network).

- 93% of rail users would support transit systems that use connectivity to reduce commute times.

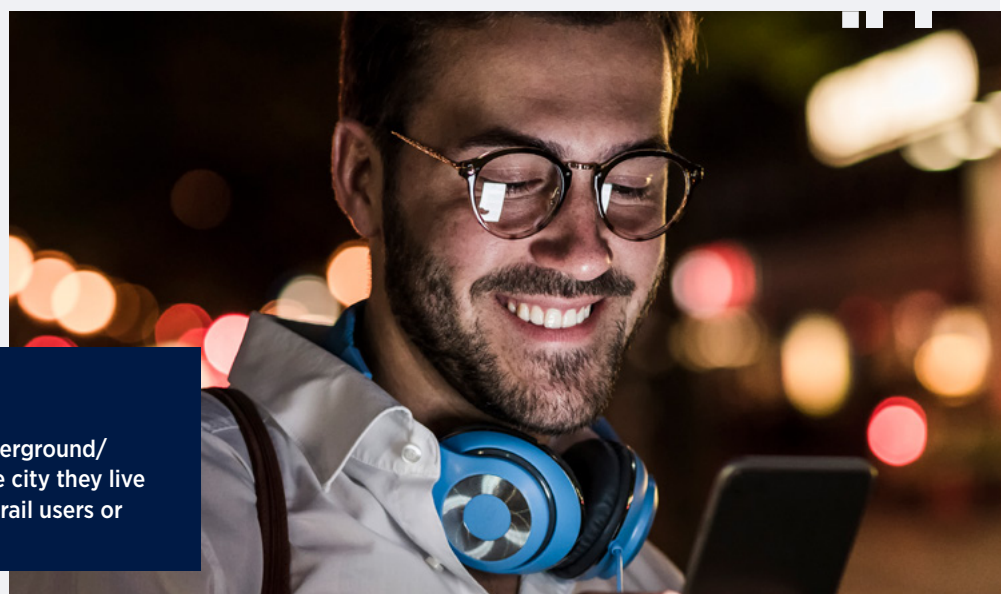2. **Data-driven services make transportation safer, smarter and more efficient**

- 95% of rail users would be more likely to use the rail network in their city if technology-driven solutions were implemented.

- 91% of rail users are at least somewhat comfortable with the idea of receiving tailored alerts about problems or delays on their normal route.

- 4 in 5 rail users (81%) are at least somewhat comfortable with their anonymised data being used to improve transport systems. It seems anxieties around data collection are receding, as people better understand the benefits on offer.

3. **Connectivity gives citizens control over their time, their work and their wellbeing**

- 4 in 5 workers (78%) would use public transport to get to meetings if they could reliably work on documents as they travel.

- 9 in 10 commuters (90%) would enjoy the journey more if rail networks evolved using connectivity, data and AI.

- 89% of rail users think their government should consider how networks and digital connectivity can be used to redesign public spaces to make them safer and more accessible.

These findings tell us that cities and their public transport systems should be evolving to meet current expectations and future needs alike. Opportunities include deploying 5G wireless infrastructure, implementing data-enabled personalised services and configuring public spaces with connectivity in mind.

Seizing these opportunities will position government, businesses and transit authorities to deliver numerous public and private benefits, with improved safety and security just the beginning. Additional benefits include creating new business opportunities, facilitating innovation, transforming public spaces and providing opportunities for citizens to improve their personal and professional wellbeing.

DEFINITION: Rail users
In our survey 'rail users' were defined as:
A respondent who has used the train/underground/subway or light rail (tram/streetcar) in the city they live in the past 3 months. All respondents are rail users or a subset of rail users.

A note on the COVID-19 pandemic

The research underpinning this survey was conducted early in 2020. We believe its findings offer valuable insights to transport operators and authorities grappling with the COVID-19 pandemic and its ongoing social and economic effects.

The pandemic's full impact on public transport – as on all sectors of the economy and the way we live – remains to be seen. However, we note that as economies continue to adjust, public transport will be as critical as ever. It will be a central point of focus and consideration for governments and citizens across all major cities as populations navigate the return to work and life as economic activity begins to stabilise. In this context, some of the evolutions of service delivery may include:

Responsiveness: Managing passenger and service flows will be critical to rebuilding public trust in transport systems. Beyond optimising services and safety, transport systems must also synchronise with their city's 'flow'. Populations will expect them to respond to public events and new work arrangements, extending peak usage times to avoid overcrowding and ensuring passengers can move freely and quickly from street to platform to train (and vice-versa) – with uninterrupted connectivity.

Flexibility and coordination: Public transit authorities and operators will also need greater operational flexibility and improved coordination between all transport modes, including traffic management and intermodal transfers.

Real-time communication: The ability to communicate with staff and commuters in real-time using different channels will be crucial. And the need for the fast and widespread rollout of existing, connected technologies such as wireless and contactless solutions for ticketing and information sharing will be greater than ever.

Improved data networks: Data is a requirement for all these functions, as it is for virtually every aspect of transport management, from maintenance and strategic planning to ticketing and on-platform operations. That is why we believe that maintaining and, where possible, upgrading data networks and other communications infrastructure should be a priority for transit authorities and operators.

Introduction

Public transport remains critical to cities and citizens. As economies adjust to the COVID-19 pandemic, they will rely on public transport to help citizens move to and from their jobs and other activities.

But in this environment, old challenges take on new urgency even as they are supplemented by new requirements – such as social distancing and reduced on-site workforces – stemming directly from the global health emergency.

In early 2020 we surveyed more than 2,400 commuters in the same five global cities as in 2019: Hong Kong, London, New York, Sydney and Toronto.

Our data shows that the benefits communications infrastructure enables, such as 4G and 5G wireless, personalised services and connected public spaces, are critical to innovation, opportunity and wellbeing. Key findings are:

- advanced network infrastructure is the key to smart cities;

- data-driven services make transport safer, smarter and more efficient;

- connectivity gives citizens control of their time, their work and their wellbeing.

1. Advanced network infrastructure is the key to a smart city

As cities evolve and become 'smarter', infrastructure is being built or retrofitted with Internet-connected sensors and devices to both private and public networks, creating rich data flows for optimising operations and planning. Critically, we found that citizens want government agencies and service operators to invest in smart infrastructure so they can remain connected to online services and to enable transport network improvements.

In rail networks, sensors can measure everything from train arrival times and rolling stock performance to air quality and passenger numbers. This data can be analysed for tactical use (operations and service delivery) as well as for strategic purposes (planning and development).

Citizens are tech-savvy and expect their cities to keep pace with new technologies such as AI and the internet of things. These technologies rely on advanced communications networks such as 5G and Wi-Fi 6 to deliver information when, where and how it is needed.

Citizens have some clear ideas about how this infrastructure can benefit them as well as the networks they travel on:

"I think generally 5G technology being pushed through the rail network is going to provide major economic advantages in the long term … A stable network where one can remain connected to services and advanced algorithms and data analysis can be used to improve safety."

— Study participant

Such comments show that people want high-quality, connected services and support investment in the technologies needed to deliver them. The data about technology adoption leads us to three conclusions:

- Citizens want local governments and other public-facing organisations to invest in smart infrastructure as they understand that it will enable improved service and safety.

- People believe that advanced technologies (such as 5G wireless, data analytics and the internet of things) could provide strong personal benefits.

- Workers want technology to reduce commute times through innovations such as personalised alerts, contactless ticketing systems and more efficient operations.

These conclusions suggest that the public is ready to embrace advanced network infrastructure as an imperative for social and economic benefit as well as personal wellbeing.

Citizens want governments to invest in smart infrastructure

91% of rail users would support government authority investment into new and reliable wireless and fibre networks, with nearly two in five (38%) full-time workers strongly supporting such investments.

Importantly for public transport authorities and operators, 91% agreed that all world-class cities should have seamless mobile/cellular coverage above and below ground. In comparison, 84% have increased or changed the way they use public transport due to advances in transport-related technology.

Governments have a social license today to invest in network infrastructure

I would support government authorities investing in new and reliable wireless and fibre networks

34% Strongly agree

57% Agree

8% Disagree

1% Strongly disagree
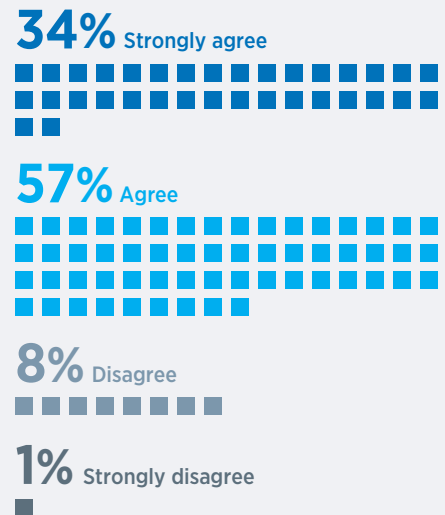
Theme: 5G

Demand for 5G wireless will continue to grow. As compatible devices enter the market and telecommunications providers roll out compatible networks, data-driven services are enhanced. Commuters will benefit from faster and more reliable connectivity, while transit authorities and operators will be able to host more concurrent connections, deploy more sensors, and improve data analytics. Rolling out data-driven services at scale will encourage the public to make more use of the transport network as it streamlines operations.

5G

The benefits of advanced technology are strongly desired

85% of rail users are interested in 5G, and 83% support their city investing in a 5G network. Yet only 64% believe their city is taking full advantage of the opportunities 5G presents. Only 56% believe their employer is doing the same.

Public understanding of 5G's benefits while commuting is growing. Streaming video and high-quality video calls were the top two, nominated by 56% and 42% of respondents respectively, with others such as uploading documents to the cloud (37%), performing more complex work tasks (32%) and the ability to connect more devices (32%) also scoring well.

Other responses indicated a similar hunger for the benefits technology could bring, such as personalised commute information (86%) and assistance for people with disability (85%).

5G networks a priority for commuters

	86% Total interested	**21%** Extremely interested	**33%** Very interested	**32%** Somewhat interested	**11%** Not interested	**3%** Don't know/ not sure
Tailored and personalised commute information						
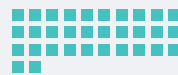
	85% Total interested	**25%** Extremely interested	**32%** Very interested	**29%** Somewhat interested	**10%** Not interested	**4%** Don't know/ not sure
Systems to inform and assist disabled people with accessibility						

	85% Total interested	**29%** Extremely interested	**32%** Very interested	**24%** Somewhat interested	**12%** Not interested	**3%** Don't know/ not sure
5G networks and connectivity						

> **Next-generation automation technology will continue to reduce the impact of human error and human limitations on railroad operations, improving safety and efficiency.**
> —Study participant

Workers want technology to reduce commute times

93% of rail users would support transit systems that use connectivity to minimise commute times. The areas of potential improvement are many; for example, some 84% of commuters have increased or changed their public transport use due to transport-related technology.

Solutions include real-time service information (49%), apps that make route planning easier (45%), contactless payment systems (39%), safety related systems (such as surveillance and communication, 32%) and apps that make bookings easier (30%).

"Commuters want reliable network coverage and capacity, including underground. In the long term, 5G mobile networks will offer greater capabilities and capacity."

— *Dean Bubley, industry analyst, futurist and consultant*

Transport-related technology would improve the customer experience

I would support transit systems that leverage digital commute times

31% Strongly agree

62% Agree

6% Disagree

1% Strongly disagree
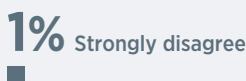
Year-on-year: connectivity is more important to rail users in 2020

Historical data shows that providing continuous connectivity throughout a person's journey is even more important in 2020 than it was in 2019, with 'high-speed internet' and 'no black spots' both nominated as factors that would make people pay more for using the rail network.

Would the following make you pay more for using the rail network?

High-speed internet throughout the journey was **36%**, up from **33%**

No black spots in cell/mobile service was **28%**, up from **21%**

2. Data-driven services make transport safer, smarter and more efficient

Few things cause more frustration than not knowing when a service will arrive or waiting for a train on an overcrowded platform, especially in times where social distancing is essential to the public's wellbeing. Effective traffic-flow management, alerts about arrival times, and other connectivity-dependent services can significantly improve commuters' daily experiences.

Most travellers use mobile devices during their journey, and they understand that they can receive personalised information and alerts among others, such as safety messages.

Passengers understand connectivity's benefits. They are willing for their data – once anonymised – to be used to enhance services and improve operations. The survey results show that:

- Technology improvements drive rail use, with respondents supporting investments in data-driven solutions for safety, data collection and real-time service information.

- Users want personalised services and they understand this will require providers to gather and analyse personal data, such as travel times and movements.

- Anxieties around data collection seem to be receding, as commuters increasingly desire data-driven services on offer and understand the benefits.

In short: commuters want connectivity and are happy for their data to be collected and used to drive service improvements. They understand the benefits and are eager to see them implemented.

Theme: Personalisation

Personalised services for transport users typically revolve around trip planning and optimisation. The ability to identify user public transport journeys allows for far more than alerts about early- or late-running trains. It creates opportunities to streamline intermodal transfers, assist passengers with special needs with access information, optimal seating locations based on destinations and occupancy levels, auto-generate alerts to specified contacts (e.g. alerting a spouse about a late-running train) and more.

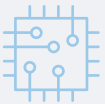> **Technology could improve my rail journey by allowing me to be a safe passenger ... I would like to know which carriages are more likely to have seats available ... it could prevent missing travel connections by providing more accurate real-time data.**
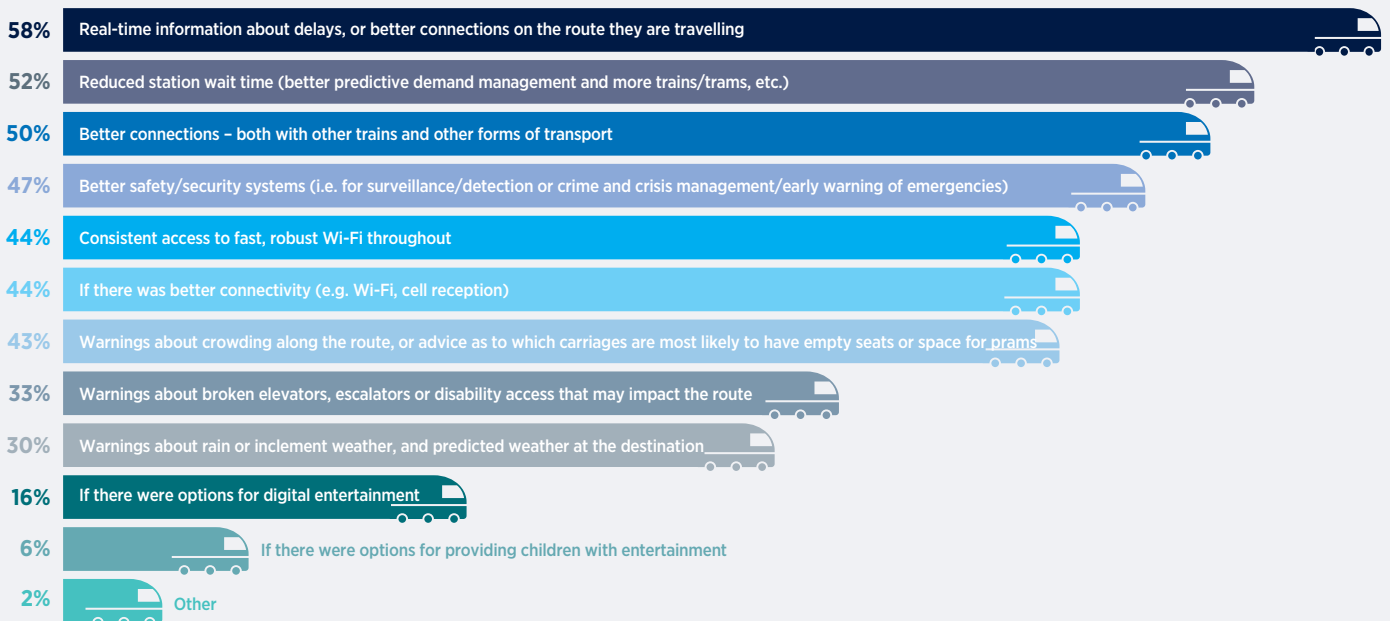>
> **—Study participant**

Technology drives rail use

95% of rail users would be more likely to use the rail network in their city if technology-driven solutions were implemented. Suggestions include real-time service information, reduced wait times, improved safety, improved connectivity and warnings about crowding or access problems. Most citizens have, and regularly use, smart or data-enabled devices; commuters are no different, with a substantial majority (91%) using mobile devices every day.

Yet just short of half (47%) of rail users use their devices on the way to work, and only a few (9%) rate the quality of reception on their rail network as excellent. With 98% of rail users expecting a rail network to do more than simply get them from A to B, there is an opportunity to improve transport uptake by investing in network quality.

The most desired improvements are real-time information about delays (58%), reduced station wait time (52%) and better connections with trains and other transport types (50%). Only 5% of commuters indicated that nothing would make them use the rail network more.

Rail users want real-time information

%	
58%	Real-time information about delays, or better connections on the route they are travelling
52%	Reduced station wait time (better predictive demand management and more trains/trams, etc.)
50%	Better connections – both with other trains and other forms of transport
47%	Better safety/security systems (i.e. for surveillance/detection or crime and crisis management/early warning of emergencies)
44%	Consistent access to fast, robust Wi-Fi throughout
44%	If there was better connectivity (e.g. Wi-Fi, cell reception)
43%	Warnings about crowding along the route, or advice as to which carriages are most likely to have empty seats or space for prams
33%	Warnings about broken elevators, escalators or disability access that may impact the route
30%	Warnings about rain or inclement weather, and predicted weather at the destination
16%	If there were options for digital entertainment
6%	If there were options for providing children with entertainment
2%	Other

95%

would be more likely to use the rail network in their city if technology-driven solutions were implemented

"Adding real-time information like 'present train car and nearest escalators and exits' on the railway app [would] allow commuters to leave the stations in the fastest and most convenient way.
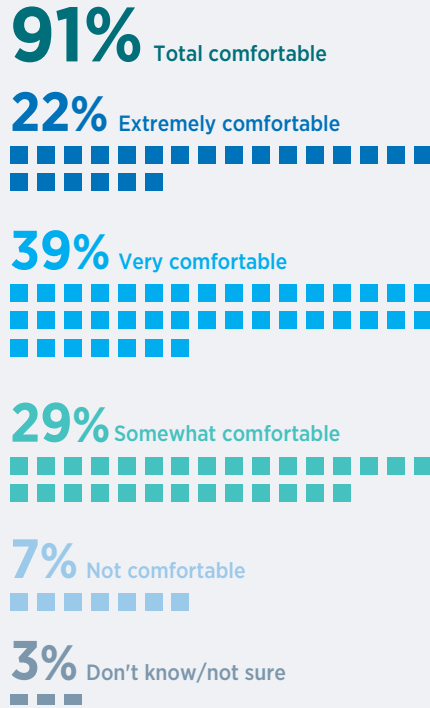
—Study participant

Users want personalised services

91% of rail users are at least somewhat comfortable with the idea of receiving tailored alerts about problems or delays on their normal route. The overriding desire is for journeys to be more time efficient: nearly three-quarters (72%) of commuters have lost time due to late-running, cancelled or faulty rail services.

Tellingly, nine in ten passengers (90%) believe they will benefit if rail networks 'evolved' using connectivity, data and AI to provide better services so they could enjoy their journey more. The expected benefits span both productivity (such as doing chores and other practical tasks and working on self-improvement courses) and personal wellbeing (such as staying connected with friends and family and arriving at their destinations relaxed and happy).

Users are comfortable with tailored alerts

Nine in ten rail users would be at least somewhat comfortable receiving tailored alerts of issues/delays in their normal route

91% Total comfortable

22% Extremely comfortable

39% Very comfortable

29% Somewhat comfortable

7% Not comfortable

3% Don't know/not sure

Year-on-year: real-time service information is more important to rail users in 2020

Historical data shows that providing real-time information to reduce waiting times, information about maintenance or hazards, and crowding control is more important in 2020 than it was in 2019.

Desire for specific safety features on rail networks has grown over the past year:

Real-time trip updates to reduce waiting times was **57%**, up from **54%**

Real-time information about station maintenance or potential hazards was **47%**, up from **46%**

Sensors that control crowding was **45%**, up from **44%**

90%

of passengers believe they will benefit if rail networks 'evolved' using connectivity, data and AI

Anxieties around data collection are receding

Four in five rail users (81%) are at least somewhat comfortable with their anonymised data being used to improve transport systems. Similarly, three-quarters of rail users (75%) are at least somewhat comfortable with their data being used to predict travel patterns to provide them with a personalised transport service.

And the understanding of how data can be used stretches beyond service reliability and reaches into safety and security, with three-quarters of rail users interested in facial-recognition and behaviour-monitoring systems.

4 in 5

rail users are at least somewhat comfortable with their anonymised data being used to improve transport systems

Rail users accept monitoring technologies

73% Total interested

Surveillance systems with facial recognition and behaviour-monitoring for crowds

20%	29%	25%	23%	4%
Extremely interested	Very interested	Somewhat interested	Not interested	Don't know/ not sure

70% Total interested

Autonomous vehicles

16%	26%	29%	24%	6%
Extremely interested	Very interested	Somewhat interested	Not interested	Don't know/ not sure

3. Connectivity gives citizens control over their time, their work and their wellbeing

Nobody wants to miss an opportunity to improve aspects of their career or their personal life. Travellers greatly benefit from being able to use their time effectively, whether that means working on an important professional or personal project or staying up to date with their interests. Many of these activities require connectivity.

But commuters want more than 'just' the ability to read their favourite news website, stream a podcast or schedule a meeting while they travel. They want what they have at home or in the office: fast, stable and secure connectivity, seamlessly delivered regardless of whether they are above or below ground, stationary or mobile. They want to use their time well, whether for work or personal purposes.

Such sentiments show that, while people want their journeys to be quick and time-efficient, they nevertheless expect to remain connected. The survey data shows three key observations:
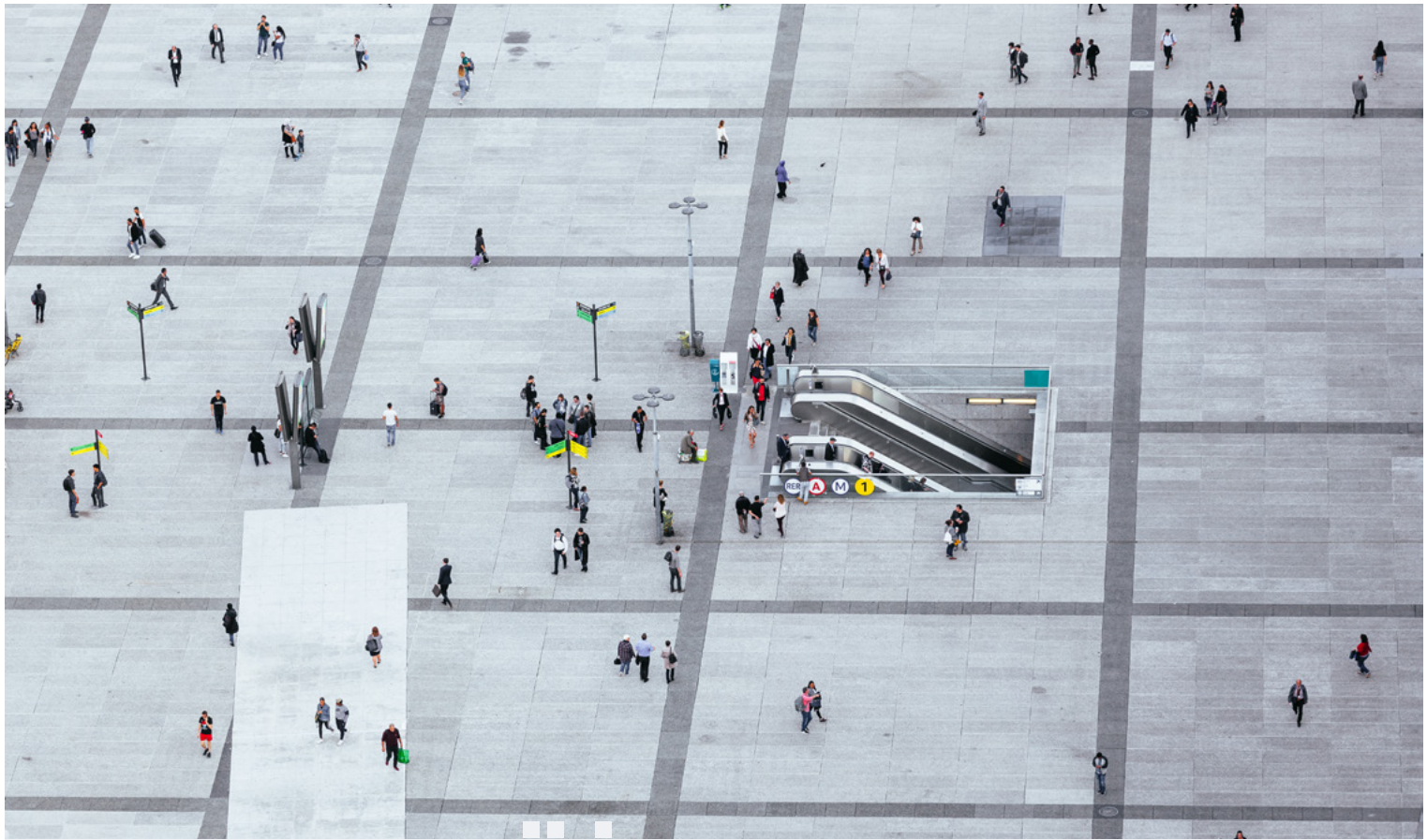
- Reliable connectivity can drive public transport usage, especially if it enables data-intensive work tasks such as video communications, or safety features for crowd monitoring.

- Connectivity, data and AI can help commuters enjoy their journey by enabling them to use their time effectively on activities that promote work-life balance and personal wellbeing.

- Network infrastructure has a role to play beyond subways and transit corridors, and citizens want their governments to embrace connectivity in public-space design.

These findings show that users are looking to service providers – such as transit authorities and governments – to implement these technologies at scale and enable improvements to their safety and their work and life productivity.

Theme: Public spaces

What does a public space designed to take advantage of connectivity look like? It might look like Amazon's walk-in, walk-out grocery stores. Or it might look like the 'station of the future'. Incorporating the internet of things and data-driven solutions into a public space's fabric is an opportunity to provide services such as smart ticketing, digital displays and lighting, asset monitoring, smart security systems, environmental management, virtual assistants, information kiosks and more.
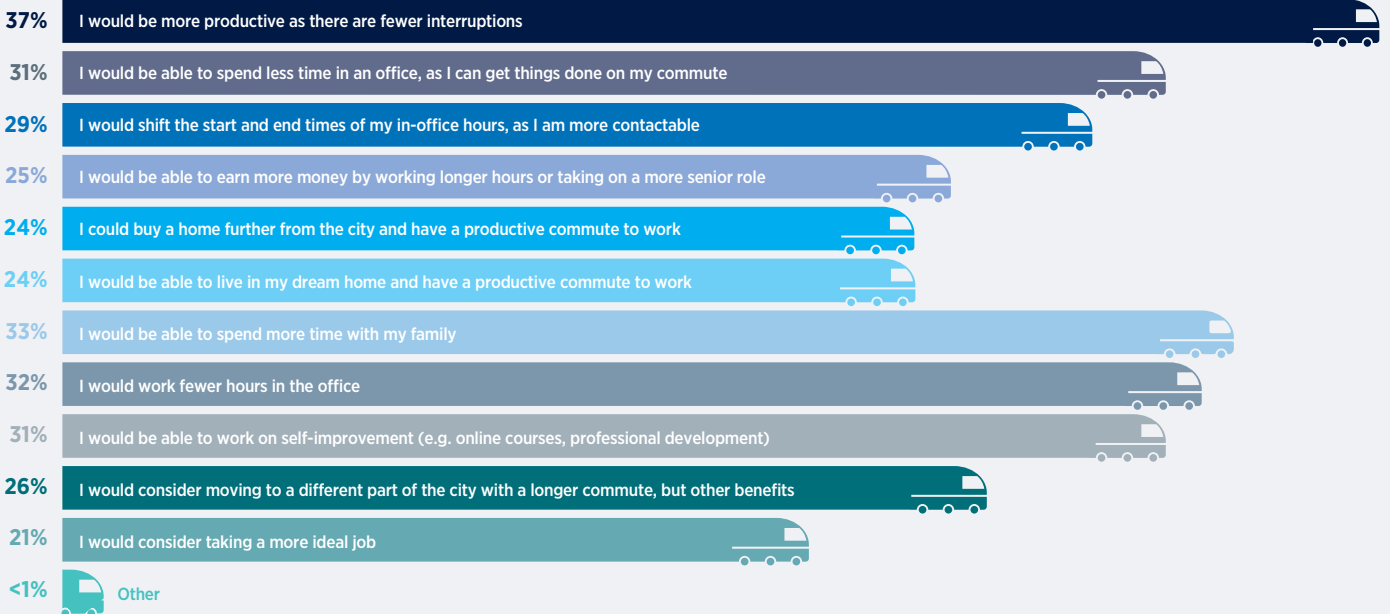
Reliable connectivity can drive public transport usage in the future

Four in five workers (78%) would use public transport to get to meetings if they could reliably work on documents as they travel; 75% if they could upload work to the cloud; and 70% if they could use video communications with their team.

Workers need (and may demand) the ability to manage the time they spend on public transport and to remain productive while doing so. 79% of rail users indicated their comfort with using Wi-Fi or mobile networks to do important tasks while travelling. Three-quarters (74%) of commuters believe that their productivity would increase if rail networks evolved to allow them to work effectively.

79%
of rail users indicated their comfort with using Wi-Fi or mobile networks to do important tasks while travelling

Connectivity's many benefits for rail commuters

%	Benefit
37%	I would be more productive as there are fewer interruptions
31%	I would be able to spend less time in an office, as I can get things done on my commute
29%	I would shift the start and end times of my in-office hours, as I am more contactable
25%	I would be able to earn more money by working longer hours or taking on a more senior role
24%	I could buy a home further from the city and have a productive commute to work
24%	I would be able to live in my dream home and have a productive commute to work
33%	I would be able to spend more time with my family
32%	I would work fewer hours in the office
31%	I would be able to work on self-improvement (e.g. online courses, professional development)
26%	I would consider moving to a different part of the city with a longer commute, but other benefits
21%	I would consider taking a more ideal job
<1%	Other

> "Better connectivity would give me the ability to get more done both for my employment and personal life ... Productivity would increase and allow me more free time at home ... It would increase my productivity and personal happiness.
>
> —Study participant

Connectivity, data and AI can help commuters enjoy their journey

Nine in ten commuters would enjoy the journey more if rail networks evolved using connectivity, data and AI. Work-life balance benefits employers as well as employees. As the global workforce becomes increasingly mobile and distributed, transport systems must facilitate these changes.

As we have seen, commuters understand where these benefits originate. 70% think 5G networks will positively impact their ability to stay connected with friends and family. 86% identified benefits from an evolved rail network that allowed them to work effectively on their commute. These benefits included better work-life balance and improved personal wellbeing.

9 in 10

commuters would benefit if rail networks evolved using connectivity, data and AI

Commuters believe they will benefit from evolved networks with connectivity, data and AI

47%	I would be able to arrive at my destination relaxed and happy
42%	I would enjoy some 'me time', free from the distractions of family or chores
33%	I would be able to keep more connected to my friends and family in a meaningful way
36%	I would get some chores done while travelling (e.g. paying bills, online shopping)
34%	I would do practical tasks I enjoy, but rarely find time to do (e.g. holiday planning)
33%	I would spend time researching or on my hobbies
24%	I would work on self-improvement courses
23%	I would be able to further my education (e.g. online study/distance learning)
1%	Other

**Network infrastructure has a role beyond subways and transit corridors**

89% of rail users think their government should consider how networks and digital connectivity can be used to redesign public spaces to make them safer and more accessible. Further, 80% are comfortable with their data being anonymised and used to aid city planners and transport authorities in the design of new roads or bike paths.

The public is ready for technology to play a more significant role in their lives. Connectivity infrastructure should not only extend above ground to provide seamless connectivity, it should also redefine how citizens interact with their city – with government, businesses, services and their fellow citizens. For example, 73% of rail users would use an app alerting them to environmental conditions along their journey (such as temperature, pollution or poor air quality).

Connectivity and public spaces

I think the government should consider how networks and digital connectivity can be used to redesign public spaces to make them safer and more accessible

29% Strongly agree

60% Agree

9% Disagree

2% Strongly disagree
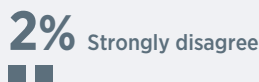
Year-on-year: commuters want connectivity to improve their wellbeing

Historical data shows that most work and wellbeing benefits of connectivity have increased in rank from 2019 to 2020, with only 'buy a home further from the city' and 'spend more time with my family' decreasing (by 1% each). Notably, 'work on self-improvement' jumped from 25% to 31%.

Increased flexibility would be a benefit of continuous connectivity:

I would be able to work on self-improvement (e.g. online courses, professional development) was **31%**, up from **25%**

I would be able to earn more money by working longer hours or taking on a more senior role was **25%**, up from **20%**

I would be able to live in my dream home and have a productive commute to work was **24%**, up from **22%**

89%

of rail users think their government should consider how connectivity can be used to redesign public spaces

Smart infrastructure helps cities boost innovation, growth and wellbeing

With the advent of mobile, Internet-connected devices, we have all become more and more reliant on the ability to access information at any time and from virtually any location. However, the continuous evolution and improvement of this access requires investments in key technologies, such as 5G wireless and Wi-Fi 6 infrastructure, to provide the connectivity needed for new and existing services.

73%
of rail users would use an app alerting them to environmental conditions along their journey

Importantly, we have benefited from data-driven services delivered directly to our smartphones, tablets, fitness trackers and other devices. These have become integrated into our daily lives, so public transport providers have an opportunity to transition into the 'digital mainstream' and provide advanced network technologies and services such as personalised updates and spaces designed to take advantage of connectivity.

In the 2019 *Continuous connectivity report*, we identified three likely benefits such connectivity could bring: re-shaping the workforce, re-shaping public transport and re-shaping the city.

In each case, we have seen many of the expected benefits emerge. Public transport operators have continued integrating data-driven services into their systems. Similarly, architects and infrastructure providers alike have begun including data networks, and the services they enable, into their designs.

This year's report has highlighted three developments that extend last year's concepts. Network infrastructure upgrades such as the 5G wireless rollout, data-driven services such as personalisation, and the application of connectivity in new areas such as public space design are further steps along the same continuum.

Transport operators should consider them as priorities for investment and development, as they will deliver the capabilities needed to improve operations, deliver better services, and provide a compelling customer experience.

"Becoming more resilient in the face of economic and public health disruptions is important moving forward … allowing riders to social distance, reserve a seat, offering contactless payment, and providing in-app wellness checks can all play a role."

— Susan Shaheen, Institute of Transportation Studies, UC Berkeley
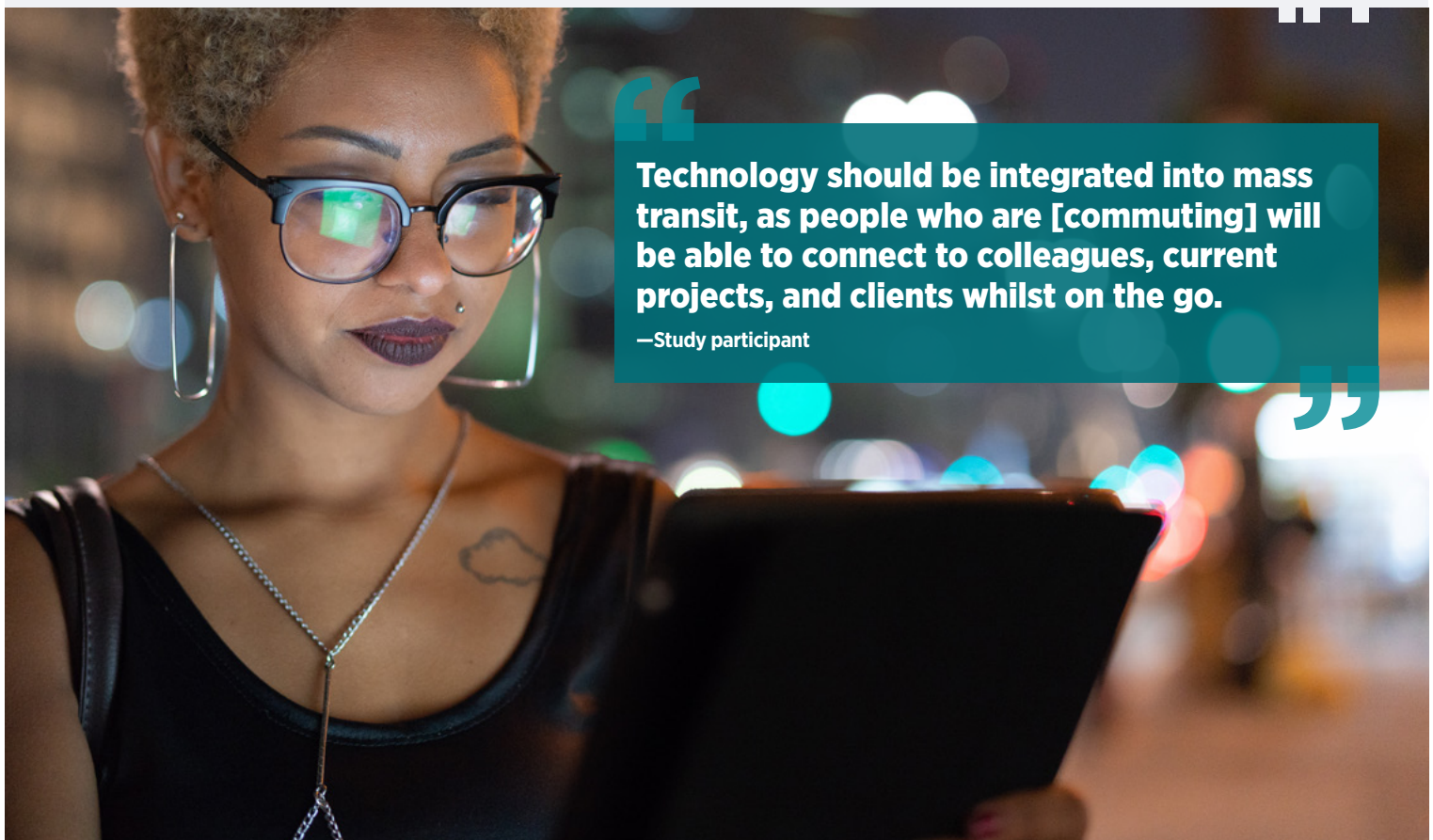
> **Technology should be integrated into mass transit, as people who are [commuting] will be able to connect to colleagues, current projects, and clients whilst on the go.**
>
> **—Study participant**

New technologies and new interactions will create new opportunities

Dean Bubley is a technology industry analyst, futurist, speaker and consultant. He specialises in wireless, telecommunications and the internet of things. Dean is recognised as one of the world's leading analysts covering 5G, telco business models and regulation, the future of voice and video and the emergence of technologies such as blockchain and AI. BAI Communications invited him to examine and comment on the findings.

Dean Bubley

Transport passengers benefit from wireless coverage both directly (on their own devices) and indirectly (via the transit company's internal apps and services). When it comes to working while travelling on public transport, many factors come into play. These include having sufficient space and seating, wireless connectivity, power supplies and adequate levels of personal safety.

Passengers on trains and metros will want to interact with the transit system operator in real-time in a variety of ways. Good wireless network coverage will allow them to use dedicated smartphone apps and notifications, SMS messages, phone calls, social media chat and proximity services.

In response to the COVID-19 pandemic, transit operators will need to deploy new systems to protect staff and customers. These include digital signage, thermal cameras for spotting individuals with fevers, automated disinfecting robots and mechanisms to enforce social distancing. They will require rapid deployment and flexibility, favouring wireless, rather than wired, connectivity.

Advanced network infrastructure is the key to a smart city

Today, few cities directly invest in mobile infrastructure, except for public safety. But city authorities and public transport operators have a huge indirect impact in areas such as planning authorisations, giving them a crucial voice.

Transport systems need good connectivity both for internal operational systems and for passengers. In some cases, these may share the same infrastructure, while in others there will be separate network domains.

Commuters want reliable network coverage and capacity, including underground. In the long term, 5G mobile networks will offer greater capabilities and capacity. Most applications work perfectly well on 4G networks; however, in the future 5G-only applications may also hold strong appeal.

Data-driven services make transport safer, smarter and more efficient

The survey findings show that many transport users desire personalised notifications and alerts. Transport operators can deliver these directly, or via third-party apps, if relevant data is exposed via APIs.

A key challenge for transport network operators will be providing fine-grained location data that is usable with mobile apps and devices. Innovation will be needed, especially as GPS signals do not work underground.

The trade-offs between utility and privacy are complex but critical to gaining user trust and acceptance. Transport authorities should be transparent, making their data collection and use policies clear to all users.

Connectivity gives citizens control over their time, their work and their wellbeing

Better connectivity for mobile knowledge workers could improve productivity or reduce working hours – or both. But this assumes adequate space, security and power outlets are available in-carriage.

Public transport operators also need good connectivity for their applications, as well as for travellers' mobile devices and preferred mobile network provider. A mix of cellular and Wi-Fi is optimal – with a clear path to supporting next-generation 5G mobile and Wi-Fi 6 technologies.

Thus, enhanced connectivity is part of a package of improvements rail networks can offer commuters to improve their wellbeing and productivity. Conversely, poor network coverage can be stressful – and can also reflect badly on mobile network operators and service providers.

Real-time, reliable and resilient: the future of public transport

Susan Shaheen is an internationally recognised expert in mobility and the sharing economy. She co-directs the Transportation Sustainability Research Center (TSRC) of the Institute of Transportation Studies at the University of California (UC), Berkeley. BAI Communications invited her to examine and comment on the findings.

Rail users want more reliable, efficient, and safer journeys. Providing real-time information about public transit delays can help to increase transit ridership in the post COVID-19 world, as travel time and travel costs are important determinants in public transit use. Providing more reliable service and efficiencies through wireless data applications could help to alleviate the stress associated with wait times and in-vehicle travel time.

Testing real-time information and technology impacts on rail use is an important step in light of the survey findings that indicate a desire for more information-based services, such as traveller information, apps and tailored alerts.

Advanced network infrastructure is the key to a smart city

In recent years, economic, environmental, and political forces have quickly given rise to 'smart cities'. Communities pursuing smart city initiatives can be mapped across four different categories, reflecting a range of problems and strategies to facilitate innovation:

- technology-oriented communities or regions driven by technological innovation;
- economic revival cities or regions reinventing their economics;
- growth cities or regions expanding economically and spatially; and
- small and rural communities investing in placemaking and workforce development.

Each category calls for an array of strategies that can transform transportation services and operations. In creating a smart city, authorities need to better understand community concerns and identify potential strategies. Then, they should explore and create institutional capabilities that leverage the public and private sectors, implement pilot projects with the communities they will serve, and evaluate outcomes.

Data-driven services make transport safer, smarter and more efficient

Seamless routing, booking, and payment can help to provide public transit users with a customised experience. These services might include contactless payment, seat reservations to ensure social distancing, information on the presence of virus clusters by route and in-app wellness checks. These types of applications could help to make public transit more resilient in the current pandemic and a future health crisis.

Perceived safety today has a lot to do with trust in public transit. Technology can aid in this by providing critical information to public transit riders regarding crowd control, virus cluster status, seamless payment and booking and more.

Restoring public trust in transit ridership is particularly important due to COVID-19 recovery efforts. Personalised services could assist in providing key information to travellers to increase their comfort and perceived safety with public transit.

Connectivity gives citizens control over their time, their work and their wellbeing

At the moment, wellbeing is strongly linked to public health and providing for one's household in light of the economic recession in many parts of the world.

As a result, we have seen a big shift to telework, which has impacted the demand for public transport due to virus transmission concerns. Many commuters accept the use of CCTV cameras, facial recognition and crowd behaviour monitoring to enhance public transit safety, according to the survey results.

Becoming more resilient in light of economic and public health disruptions is important moving forward. This includes developing more context-sensitive strategies that reflect community input and virus transmission concerns. Measures such as allowing riders to social distance, reserve a seat, offering contactless payment and providing in-app wellness checks could all play a role.

Susan Shaheen

Methodology

This report is based on findings from a survey of 2,483 rail users aged 18+ in Hong Kong (n=497), London (n=498), New York City (n=492), Sydney (n=498) and Toronto (n=498). 'Rail users' were respondents who had used their city's rail system in the last three months. All respondents were 'rail users' or a subset of rail users. Note that throughout the report the terms 'respondent', 'rail user' and 'user' are used interchangeably, and all refer to this group.

'Commuters' were respondents who used public transport between work or study in the last three months and who worked or studied full- or part-time.

The survey was conducted online among members of a permission-based panel, during 17–25 April 2020. After interviewing, data was weighted to the latest population estimates and rebased to provide an equal sample of people in each city.

The research was commissioned by BAI Communications and conducted by Lonergan Research in accordance with the ISO 20252 standard.