Digital Mobility

Uniting the Solutions for Tomorrow's Transit Needs

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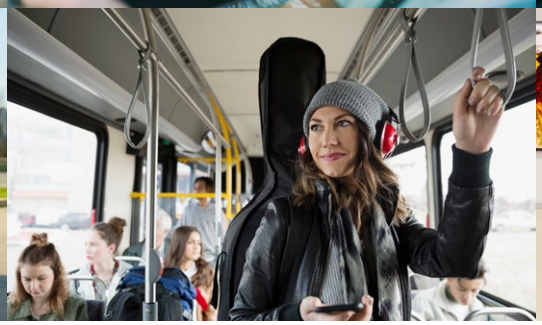



INTRODUCTION

The challenge of urban mobility — how people travel within their home city or region — has never been more complex or unpredictable.

In cities throughout the world, growing populations seek out the most affordable, efficient, and comfortable solutions for their mobility needs. Commuting to work; picking up children from school; arriving at a doctor's appointment; traveling to the airport; visiting a museum or concert hall; getting home safely after a night out with friends. Each city's transportation ecosystem includes a combination of public transit options, private vehicles, and modes of active travel like biking and walking; in recent years, a growing number of private mobility service providers (MSPs) like ridesharing, bike-sharing, and electric scooters have emerged to capitalize on the growing demand for end-to-end mobility.[1]

With billions of urban residents traveling across the world's cities each day, passenger flows are determined according to supply, demand, pricing, and service considerations. But while in a vacuum, travelers seek to choose the transit option that best suits their needs and priorities, thoughtful coordination is required to maintain efficiency and shape the environmental and social impacts of the transportation network at a local, regional, national, and even global level.

In an environment defined by increasing congestion and dangerous emissions, end-users, transit coordinators, and local politicians are beginning to align on their goals. Each stakeholder would prefer a transportation system with less traffic; predictable, stress-free travel; accessible mobility for all and reduced emissions. But while the goals are easily identifiable, the means of achieving them are not. The world's major transportation systems are currently fragmented and siloed, limiting the ability of city leaders to make the large-scale changes needed to move the needle on congestion and emissions. Ultimately, managing congestion and reducing congestion will require coordinated behavior change for users across the network – creating the need for tools that cities can use to systematically manage user behavior and keep the network running smoothly.

This whitepaper will define the concept of digital mobility, a comprehensive transportation strategy that offers long-term solutions for the challenges of population growth, carbon emissions, and urbanization. Beyond exploring the diverse applications of digital mobility, the whitepaper will offer actionable steps for operators, planners, leaders, and end-users to work towards a more sustainable and equitable transit future.

[1] https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-future-of-micromobility-ridership-and-revenue-after-a-crisis

THE NEED FOR DIGITAL MOBILITY

While each local transportation network faces a unique set of challenges and circumstances, a few global factors give rise to the need for digital mobility in every city, state, and region:

Congestion: If current trends in mobility continue, the world's cities will face a dramatic increase in traffic and congestion. Passenger transport is expected to increase nearly three-fold between 2015 and 2050, from 44 trillion to 122 trillion passenger kilometers.[2] Growth in private vehicle use is expected to continue in the immediate aftermath of COVID-19, and private vehicles will remain the long-term preferred mode of personal travel worldwide. In particular, single-occupancy vehicles are driving increases in traffic and congestion, while drivers idling for parking in city centers can contribute up to 30% of traffic. Beyond passenger travel, the steady increase in global freight will also contribute to congestion: based on current demand levels, global freight demand will triple between 2015 and 2050 as a result of the massive increase in e-commerce spending.

Emissions: Increased carbon emissions have direct impacts on rising sea levels, global health outcomes, and social inequality. According to the International Energy Association's Tracking Transport 2020, "transportation is responsible for 24% of direct CO2 emissions from fuel combustion." The vast majority of these emissions (more than 70%) come from road transportation (passenger and freight), compared to just 11% from aviation. Without ambitious government intervention supported by a shift to digital mobility, emissions are projected to double by 2050 as a result of increased demand for cars and aviation in developing countries.

Urbanization: According to research from the United Nations, the global population is expected to boom in the coming decades, soaring to 9.7 billion by 2050.[3] This growth will largely be concentrated in urban centers. A recent report from the International Institute for Environment and Development predicts that urban populations will grow by 1.56 billion over the next two decades.[4] Of this growth, 83% is expected to take place in Asia and Sub-Saharan Africa. This increase in population, together with the growing adoption of active travel modes, presents safety challenges for cities seeking to protect vulnerable road users at busy intersections and along congested roadways.

[2] https://www.itf-oecd.org/transport-demand-set-triple-sector-faces-potential-disruptions

[3] https://www.un.org/development/desa/en/news/population/world-population-prospects-2019.html

[4] https://www.iied.org/urbanising-world

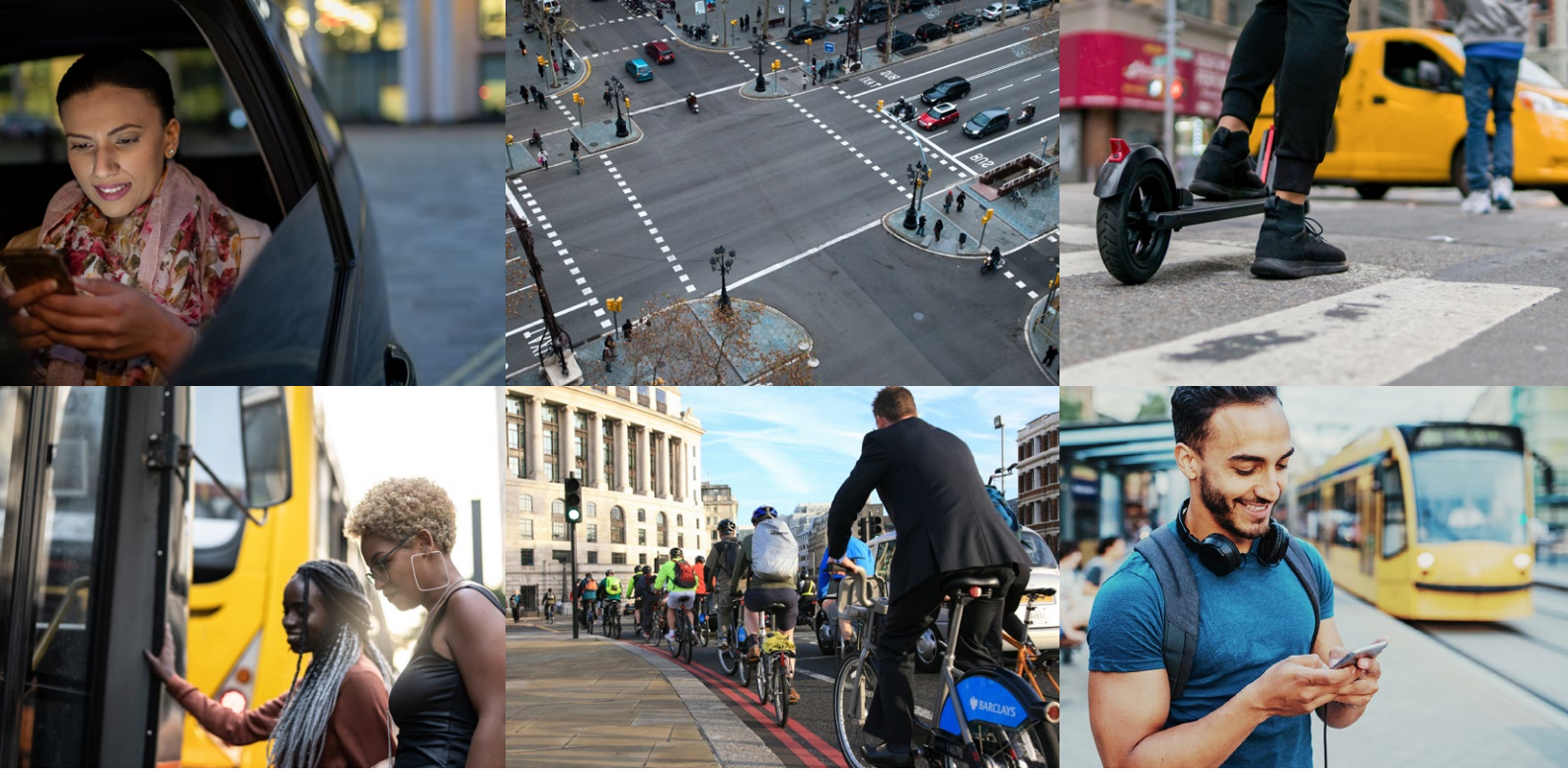
Covid-19: Traffic jams can add minutes and hours to a worker's daily commute, and the unprecedented surge in personal car use resulting from the COVID-19 pandemic indicates that these delays will only grow in the coming years. As many offices shift to hybrid working models, commute times will become less predictable while traffic will not see any noticeable decrease.

Growth and limitations: While the world's population is expected to grow substantially, the world's physical resources are finite: we cannot build more land or natural resources to accommodate a massive increase in global citizens. This challenge is particularly relevant in transportation, as history has shown that road users will increase to meet new capacity. A 10% increase in road capacity yields a 6-10% increase in vehicle miles traveled over a long-term period.[5] While autonomous vehicles and the shared economy have the potential to both disrupt and optimize our use of limited resources, cities will need to take a thoughtful and proactive approach to ensure progress.

Many transportation authorities have adopted digital technologies and innovative strategies to address these issues by making public transit more attractive, including mobile ticketing and real-time passenger information, as well as tools to manage demand like congestion pricing. However, these technologies in silos are not enough to tackle the monumental challenges facing transportation and our world today. To address the impacts of urbanization and reverse climate change, we must embrace digital mobility.

TODAY, DIGITAL MOBILITY IS THE DIGITALIZATION AND INTEGRATION OF MOBILITY MANAGEMENT AND OPERATIONS SYSTEMS TO ACHIEVE POLICY GOALS AND AN OPTIMIZED NETWORK FOR SMOOTHER, FASTER AND MORE SUSTAINABLE TRANSPORT.

[5] https://travelcalculator.ncst.ucdavis.edu/about.html



WHAT DOES DIGITAL MOBILITY ENTAIL?

The definition of digital mobility includes concepts like operating systems, mobility management, and optimized networks. But what do these mean exactly, and what pieces are involved in the comprehensive idea of digital mobility?

Digital mobility is centered around the idea of harmonizing disparate systems across the mobility network to enable collaborative and holistic decision-making between local, regional, national and even international stakeholders. These disparate systems are not just a city's various public transit services; digital mobility includes everything from ridesharing to traffic and intersection management. With one transportation network comprising multiple modes, we expect users to tie together these different options throughout their journeys. We should manage these systems in the same way that users experience them: as coordinated entities.

By integrating every mode of transportation in a given area, digital mobility offers each service provider, stakeholder and end user with a common operating picture across the entire transit ecosystem. This real-time information supports data-driven decision-making and efficient network management. With these tools, systems are able to react quickly: when an accident on a major roadway creates delays for a popular bus route, digital mobility enables coordinators to efficiently clear the incident using the best routes to avoid traffic; notify travelers of the disruption; and advise frequent bus users to instead use an alternative train route.

Digital mobility also facilitates a shift from reactive to proactive thinking. If city leaders anticipate a day with poor air quality, they can proactively use dynamic pricing to make road use and parking less appealing. This nudges travelers to public transit options, who may be incentivized further with discounted rates. Meanwhile, smart intersections help to make active journeys safe for those who chose to bike or walk.

The benefits of digital mobility can be applied to both present operations and future challenges. With comprehensive digital mobility, data flows in from a variety of sources to indicate real-time demand across the network: ticketing systems on public trains and buses; electronic toll collection systems across large highways; cameras and sensors at urban intersections. Using

this information, transit planners and operators can employ flexible incentives to mitigate congestion and rebalance traffic flows. If heavy road use is leading to traffic jams and increased emissions, transit authorities can increase road user charges accordingly, persuading commuters to consider more affordable options like public transit and active travel.

As cities accumulate data, they can use the aggregate datasets to inform long-term planning. The applications for transportation data range from tiny details to sweeping initiatives. Understanding traffic flows can allow transit operators to more effectively schedule bus routes or add additional cars to subway lines during peak hours. On a larger scale, identifying areas with outsize demand for private car use could indicate the need for a new public transit route.

Digital mobility operates under the pretense that a more efficient mobility network will be beneficial to all service providers; in particular, digital mobility empowers leaders with new tools to effect direct change in their networks. However, the most important stakeholder in digital mobility will always be the end user. The principles of digital mobility place the end user at the center, delivering consistent service enhancements and price adjustments to make all journeys shorter and more environmentally friendly.

Data-Driven Decision-Making Across Harmonized Systems

STRATEGY	PRE-TACTICAL	TACTICAL
Planning: Before Journey	Operations: Day of Journey	Operations: During Journey
• Historical data and predictive analytics inform investments, planning and decisions.	• Transit operators plan mitigations for predicted disruptions such as large events, construction, or weather. • Certain modes of transit are prioritized based on typical periods of congestion.	• Behavioral nudges shape traveler behavior to balance demand and reduce disruption. • Real-time system management includes incident response, modal coordination, etc.

While digital mobility strives towards optimization, the ideal solution will be different for each city and its residents. Digital mobility is policy-enabled: policy inputs can shape the transportation network's planning and operations according to the preferences of the city. In some cases, this may mean increasing the cost of road use to limit carbon emissions; in other cases, a commitment to equity may lead to increased public transit investments in specific regions or neighborhoods. Digital mobility platforms are versatile, establishing the foundation for cities to effect specific changes according to their goals.

STAKEHOLDERS AND USE CASES

When deployed across a city or region, digital mobility has a profound impact on all stakeholders in the transit ecosystem:

Planners/Operators: Transportation planners are often limited in their abilities to implement proactive strategies due to data silos. Digital mobility unifies all transportation data in a single system of systems, enabling planners to study and understand how a change in one mode will lead to reactions across other modes. Eliminating silos provides a breakthrough for planners that cannot be overstated; with a new set of tools and incentives, they can more effectively chart public transit schedules, allocate investments, and implement pricing strategies to balance traveler flows.

Service Providers: In an optimized transportation ecosystem, all service providers benefit from the halo effect of improved customer satisfaction, reduced congestion, and the predictability of reliable supply and demand. Digital mobility prioritizes efficiency over any individual mode of transit; balancing traffic flows ensures that all mobility providers will benefit from a stable customer base. Additionally, digital mobility helps service providers to reduce many of the headaches that are traditionally associated with facilitating transportation in a major city. Whether it's unpredictable (a traffic accident) or known well in advance (a major concert or sporting event), digital mobility gives operators useful tools to react in real-time and keep the network moving smoothly.

End Users: The end user is at the center of digital mobility. As planners, operators and service providers embrace data-driven decision-making, the end user benefits from consistent, incremental improvements to the transportation ecosystem. Services are more efficient; travelers are always informed of the fastest and most affordable route to their destination; emissions are reduced; and equity as achieved through data-backed policies and initiatives. When properly designed and implemented, digital mobility benefits all end users, regardless of who they are, where they live, or how much money they earn.

City Coordinators: City coordinators: Like planners and operators, city coordinators benefit tremendously from a mobility ecosystem with no silos. The role of the city coordinator requires cross-departmental cooperation, and digital mobility makes it easy to implement new initiatives across public transit, traffic management, and smart intersections. Digital mobility enables city coordinators to move from theory to action, employing smart solutions to encourage more active travel or public transit use. The ability of these tools to respond in real-time ensures that coordinators can leverage behavioral nudges as a powerful solution for reducing congestion and emissions.

While transportation optimization is the core benefit of digital mobility, the comprehensive strategy also manifests across a variety of use cases:

Digital Mobility Use Cases

Mobility-as-a-Service (MaaS)/Mobility On Demand (MOD): MaaS/MOD is a holistic vision for the future of mobility, through which travelers can move seamlessly across public, private and shared modes of transportation. Digital mobility provides the essential technology systems to enable these concepts, connecting previously siloed infrastructures and delivering the data-backed insights necessary to support multi-modal transportation. This holistic approach also applies to journey pricing, allowing users to understand the cost of a trip from door to door, including road usage, parking, micromobility and transit. Policymakers can incentivize environmentally-friendly transit modes, with dynamic price changes for parking and road use helping to regulate demand.

Freight Management: According to the International Transport Forum, global trade-related freight transport is responsible for approximately 30% of transport-related CO2 emissions. Digital mobility reduces congestion on roadways by incentivizing passengers to choose other modes of transit over private vehicles; this makes it easier for freight vehicles to reach their destination and limits emissions that result from frequent traffic jams. Freight management efforts are integrated directly into broader active management systems, ensuring that deliveries are organized at times that are most efficient and least disruptive to other modes of transit within a city.

Smart Intersection Management: To manage traffic flows, transit planners and operators must make adjustments on a route-by-route and intersection-by-intersection basis. Digital mobility enables operators to implement smart intersection management, which can both rebalance traffic flows and also prioritize active travel modes. Intersection management is a vital solution for public safety, as sensors and cameras can be used to ensure safe passage for pedestrians as they enter and exit the intersection. Signal priority can also be used to facilitate faster journeys for buses and even delivery vehicles during pre-arranged windows.

Holistic Congestion Management: In today's siloed transportation environments, congestion is addressed on a mode-by-mode basis. With digital mobility, planners and operators can take a comprehensive approach, identifying capacity in other systems and incentivizing travelers to choose less-congested routes and modes. By zooming out on the transportation ecosystem, transit authorities are able to more easily influence traffic flows and prevent congestion before it occurs. Congestion management isn't limited to individual cities; the same tools can be used by stakeholders throughout a larger region to manage congestion in a coordinated manner. Traffic doesn't end neatly along city limits — it requires oversight across larger areas.

WHILE DIGITAL MOBILITY STRIVES TOWARDS OPTIMIZATION, THE IDEAL SOLUTION WILL BE DIFFERENT FOR EACH CITY AND ITS RESIDENTS. DIGITAL MOBILITY IS POLICY-ENABLED: POLICY INPUTS CAN SHAPE THE TRANSPORTATION NETWORK'S PLANNING AND OPERATIONS ACCORDING TO THE PREFERENCES OF THE CITY.

THE PATH FORWARD

What are the next steps forward for cities willing to pursue digital mobility? The path forward is feasible, but it requires a combination of technical, political and social initiatives to reach its full potential.

Technical: Digital mobility is attainable today. The technologies and innovations needed to make it a possibility can all be achieved through a combination of infrastructure upgrades and Software-as-a-Service (SaaS) solutions. A unified, account-based system for payments and ticketing can deliver the back-end technology to ensure interoperability among transit systems. While the industry's leading digital mobility and MaaS solutions are backwards-compatible with a large portion of legacy equipment, piecemeal upgrades may be required on specific modes to ensure that data can be collected and that new strategies can be rolled out instantly using cloud-based software.

The piecemeal approach offers additional benefits. Rather than requiring wholesale replacement of existing systems, a targeted approach makes digital mobility more affordable and accessible for budget-minded cities. These interoperable multi-purpose technologies also make it possible for multiple agencies within a region to share solutions, rather than requiring substantial investments from each individual organization.

Political: While transit providers can facilitate the technical upgrades needed for digital mobility, a concerted effort is required on the part of local policymakers to encourage coordinated mobility management. New procurements policies that favor multi-purpose that reduce the lifetime cost of mobility systems. Cross network and public-private cooperation will not take place in a vacuum; government influence and intervention are needed to place all transportation providers on a level playing field and promote holistic management. Politicians must advocate on behalf of a new transportation strategy to their constituents, taking responsibility for the outcome: by investing publicly in the success of digital mobility, policymakers will reap the rewards as end users appreciate the system's benefits and efficiencies.

Social: Many of the most exciting innovations taking place in transport today center around the use of mobile devices contactless payments. However, these technology upgrades must be matched with parallel solutions for the unbanked and the tech-averse. Digital mobility must consider the needs of all people, providing equitable service and access to those in low-income neighborhoods and those with disabilities. Another key social component of digital mobility is data protection: with user data forming the backbone of planning and operations, transit leaders must ensure the security and anonymity of personally-identifiable information.

BY INTEGRATING EVERY MODE OF TRANSPORTATION IN A GIVEN AREA, DIGITAL MOBILITY OFFERS EACH SERVICE PROVIDER, STAKEHOLDER AND END USER WITH A COMMON OPERATING PICTURE ACROSS THE ENTIRE TRANSIT ECOSYSTEM. THIS REAL-TIME INFORMATION SUPPORTS DATA-DRIVEN DECISION-MAKING AND EFFICIENT NETWORK MANAGEMENT.

CONCLUSION

In conclusion, in every area of the world, cities face an increasingly complex challenge in providing residents with safe, efficient, accessible, reliable mobility. Through improved operations and reduced costs, digital mobility delivers a win for the cities, transportation agencies, and end users. In the long term, an efficient, interoperable transit system helps to improve outcomes and drive key policy objectives for the city across everything from healthcare to education to social services. Digital mobility offers a clear pathway to long-term stability, and it is available now to any city or region willing to invest in the next generation of transport solutions.

TO LEARN MORE

Audrey is a Strategy Manager at Cubic Transportation Systems. Audrey has over six years of transit industry experience across strategy, business development and project management. As a New York City native and a transplant to Washington DC, Audrey is passionate about bringing innovation to cities to provide more reliable and accessible mobility options to travellers. She is committed to a future mobility network that is more sustainable, equitable and reliable.

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CUBIC – A LEADER IN INTELLIGENT TRAVEL SOLUTIONS

At Cubic, we believe our identity is intrinsically linked with our customers, and the people our customers serve. How they get from one place to the next – how that impacts their lives, their fellow travelers and their cities – and how it feels along the way.

That's why we're passionate about developing transportation solutions that improve the way we move throughout cities. Innovation is in our culture, and our history speaks for itself. In our 45-year history, we've delivered public transport fare collection systems to over 450 operators, including 20 regional back office systems, and traffic and transportation management systems for major cities and regions on four continents.

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