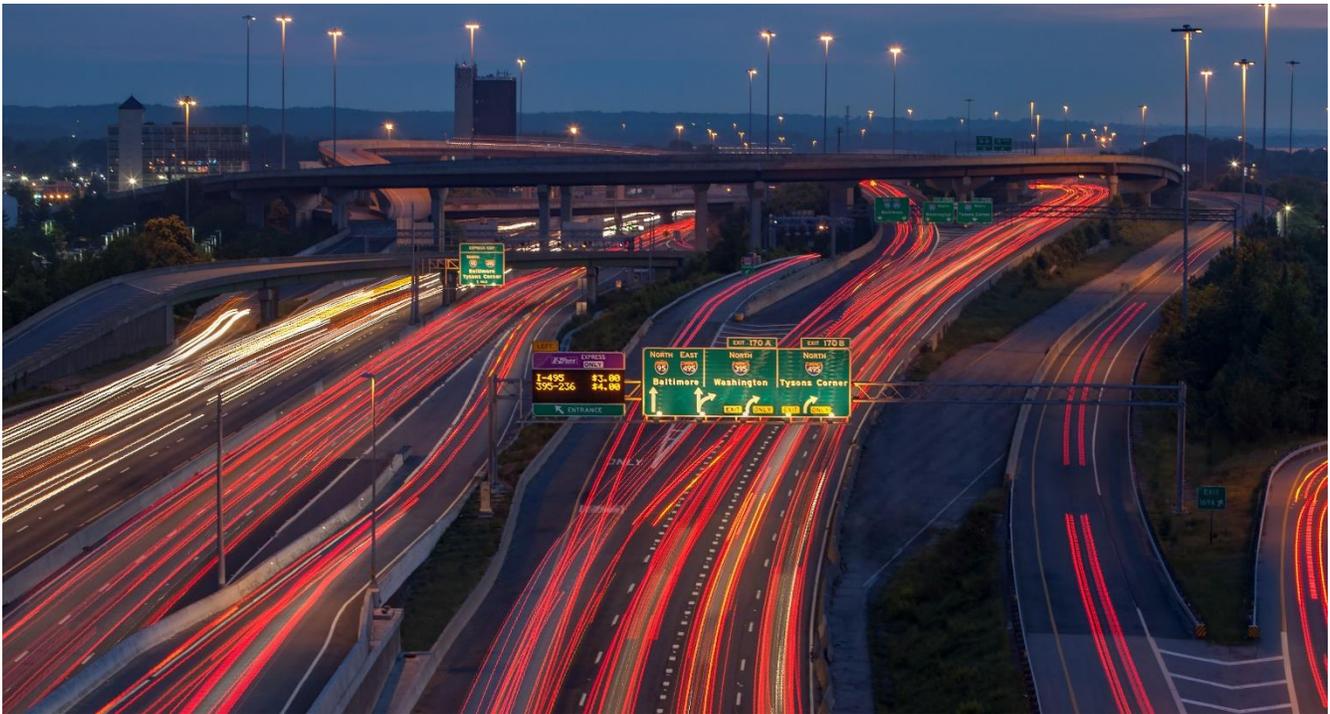




IRF White Paper: Future of Road Pricing in North America



January 2020



IRF expresses its gratitude to the **Parsons Corporation** for underwriting this White Paper

INTRODUCTION

Charging for the use of roads is not a new practice – dating as far back at the 7th century BCE – but its recent rate of expansion has been staggering. By some estimates, the combined road market for road pricing services (aggregating electronic road tolling, congestion pricing and road usage charging) — is expected to grow from 200 million accounts in 2015 to more than 540 million by 2025. The drivers of this trend are multiple and include the need to fund infrastructure investment and upkeep, tax road users for the “externalities” they generate (e.g. lost productivity due to congestion), charge foreign vehicles using the national road system, and brace for the continuous decline in fuel taxes.

The technologies supporting road pricing services currently co-exist as separate ecosystems, frequently guided by a range of economic and regulatory considerations. The growing appeal of road pricing, particularly in emerging economies, is encouraging agencies to look at an even wider spectrum of technological responses ranging from integration with mobile payment for private users, to combined services aimed at the fleet operator market.

Lastly, the emergence of autonomous and shared mobility presents challenges for road pricing service providers. Economics dictate that a considerable portion of autonomous mobility will start out as shared trips, whilst simultaneously generating more traffic from “empty rides”. These dramatic trends will likely reshape the road pricing market as we know it, in ways that are not yet fully understood.

To take a measure of these trends and understand their wide-ranging implications for the North American market, the International Road Federation (IRF) convened senior specialists to join a Global Leadership Seminar held on November 19, 2019 as part of the 2nd IRF Global R2T Conference.



The seminar’s goals were to:

- Align understanding on current & future policy developments driving road pricing
- Address the technological & business outlook for road pricing
- Achieve consensus on how long-term mobility trends will likely impact the road pricing market
- Outline opportunities to bridge knowledge gaps through educational resources

The findings presented hereunder reflect the range of views expressed during the seminar and may not be attributed to one person or organization in particular.

ABOUT THE IRF

The International Road Federation is a global not-for-profit organization, headquartered in Washington, DC since 1948 and supported by regional operations throughout the world. The IRF serves a network of public and private sector members in more than 70 countries by providing world-class knowledge resources, advocacy services, and continuing education programs which together offer a global marketplace for best practices and industry solutions. For more information about IRF activities and member services, please visit www.irf.global.

EXECUTIVE SUMMARY & RECOMMENDATIONS

1. Charging road users for access to transportation infrastructure is an age-old concept that is currently experiencing a renaissance thanks to pressing funding concerns (arising from fuel tax revenue loss) and the concurrent emergence of a wider range of technology options. However, the underlying principles of fairness, contributing to road quality, internalizing external costs, and revenue creation remain some of the cornerstones of current and future road pricing schemes.
2. In the United States, Federal, state and local jurisdictions continue to rely on fuel taxes to fund upkeep and new road construction investments. A combination of greater fuel efficiency in the vehicle fleet and higher road projects costs observed in the last two decades has had a significant and detrimental impact on the investment capacity of these jurisdictions. Many now recognize the need to address this challenge through fixes which frequently include road pricing as a major policy alternative.
3. Hurdles to introducing road pricing include the cost & complexity of administering these programs (relative to the relatively ease of managing today's vehicle and fuel taxes), data protection concerns, enforcement of payment, as well as questions related to interoperability with other systems.
4. Where tolling programs already exist, these have prepared road users to the idea of paying for the upkeep of a high-quality network (and in the case of managed lanes, being able to make a trade-off between journey time and cost), while providing operators with the capabilities to administer wide-scale systems.
5. At the urban level, lack of space to grow road capacity in the face of increasing travel demand and declining public budgets have created a compelling case to consider pricing systems for access to Central Business Districts. The argument for congestion charging is typically built over a number of years with the assent of the business community and a range of incentives and investments designed to reduce reliance on private transport while increasing the attractiveness of public transport and "last mile" options.
6. Whether at the urban or interurban level, road pricing programs frequently affect the travel patterns of hundreds of thousands, and can bring about important societal benefits that extend well beyond the funding equation. But these programs also provide mobility actors with the opportunity to take advantage of the dynamic data now available to them via new data points such as vehicle health and driving data, which can provide value outside of traditional charging services, such as in the realm of road safety, telematics-based insurance, fleet management, or congestion analysis.
7. The societal pressures we know today – increased population and economic activity around geographic hubs – will all worsen over the next decade, placing additional stress on transportation infrastructure and increasing commuting times, absent demand management policies. The need to charge according to a growing number of parameters (such as location, destination and number of occupants) will thus become even more appealing to policy-makers. For drivers, journey time will no longer be the only variable, since frequent trade-offs will need to be made between time and cost, possibly embedded within the vehicle's navigation system. Increasingly, road pricing applications will expand across jurisdictions and reciprocal arrangements may progressively make way to unified pricing systems working off a harmonized technological platform.

FROM A SLOW MARCH TO A SPRINT

Charging road users for access to transportation infrastructure is an age-old concept that is currently experiencing a renaissance thanks to pressing funding concerns (arising among others from fuel tax revenue loss) and the concurrent emergence of a wider range of technological means available to policy makers.

In a growing number of countries, a portion of road users are already confronted with one or more forms of payment mechanism. The most traditional method takes the form of a barrier that is lifted by the processing of the payment. Free flow (or Open Road) tolling covers situations in which the payment is registered automatically, typically through radio technology (DSRC or RFID), in which a receiver attached to the gantry reads the radio signal as the vehicle passes, or through the use of Automatic Number Plate Reading (ANPR) cameras which match license plates with existing accounts. With satellite-based road pricing, a device located inside the vehicle is armed with GNSS signal capable of locating the device and calculating the charge based on distance driven and time of day. For the purpose of this paper, these charging mechanisms will collectively be designated as “road pricing”.

The arguments in favor of road pricing generally revolve around four key principles:

- **“Fairness”**: only users of the asset are confronted with the costs, whilst tax payers bear less or no cost for funding, maintaining, and operating the road infrastructure. Road pricing also provides a mechanism to ensure international users pay for their usage and damage of road infrastructure.
- **“Road Quality”**: road charges guarantee the capital necessary for maintenance, leading to better roads, frequently enshrined in road quality covenants in the case of road concessions. Toll motorways have also proven to be safer than other roads as they can give operators detailed information about usage as well as create an incentive for maintenance and improvements.
- **“Internalization of External Costs”**: road pricing offers a mechanism to price externalities, including congestion and harmful emissions. Dynamic road charges can also be utilized to mitigate these externalities, e.g. by creating incentives to travel (or not travel) at certain hours of the day.
- **“Revenue Creation”**. Pay as you drive charges generate revenue for governments. In an era of increasing fuel efficiency and electrification, road pricing can compensate for reduced fuel tax revenues, securing sufficient funds to maintain and improve the road network. Public funds can thus be directed to other expenditures.

Countries and cities around the world are embracing road pricing at a rate not previously seen before. In 2015, approximately 50 countries had at least one significant RUC scheme in place, a figure which will rise to 60 by 2025. Individual trajectories and the associated technology choices however remain predominantly driven by local and regional considerations. For example, Europe is seeing a growing number of schemes for Heavy Goods Vehicles (HGV) reflecting the policy priorities of countries that are heavily impacted by transit traffic. Other regions have tended to focus on all-vehicle tolling schemes (see figure 1).

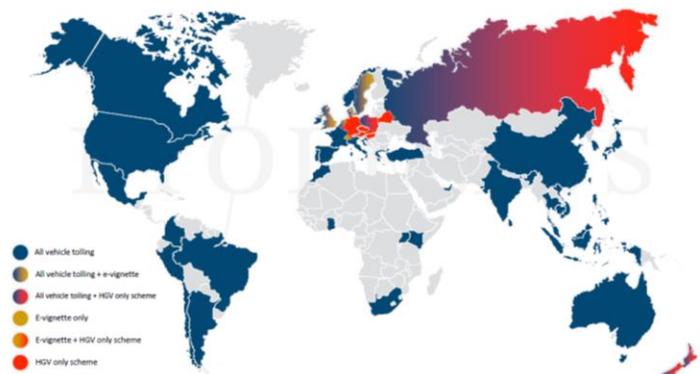


Fig 1: Tolling schemes in place in 2018

Source: Ptolemus Consulting Group

The technological landscape supporting pricing applications can be broadly grouped into three main protocols: RFID, DSRC and GNSS, frequently in tandem with ANPR-based enforcement. Areas currently operating infrared schemes (Malaysia, Indonesia and India, in particular) are all moving away from the technology and will begin adopting national RFID or DSRC protocols within the next 2-3 years. This is driven partially by a desire to add new functionalities such as stolen vehicle tracking and traffic enforcement.

This landscape is expected to further complexify within the next decade with the wider adoption of light vehicle charging spurred by growing motorization rates throughout the developing world and the modernization of the fleet in developed economies, combining with a highly competitive market that is driving road pricing implementation costs down even further. GNSS and Smartphone technology, combined with mobile wallets, will also play a larger role in road user charging as mobile payments become mainstream, and the demand for location-based services (such as geo-fencing and routing) continues to grow.

On present trends, the global road pricing market is expected to grow from 200 million accounts in 2015 to 540 million by 2025, creating opportunities for a wider range of market actors such as fuel card issuers, mobility service platforms, and the OEM market with in-vehicle payment capabilities conceived as part of the grander vision of the connected car.

“Countries and cities are embracing RUC at a rate not previously seen before”

A PRESSING NEED TO ADDRESS THE FUNDING SHORTFALL

In the United States, Federal, state and local jurisdictions continue to rely on fuel taxes to fund upkeep and new road construction investments. A combination of greater fuel efficiency in the vehicle fleet and higher road projects costs observed in the last two decades has had a significant and detrimental impact on the investment capacity of many jurisdictions (see figure 2). In the United States where the Federal Gas Tax has remained unchanged at 18.3c/gallon since 1993, 20 States have resorted to increasing the State Gas Tax in the last 5 years and 26 have introduced annual fees on Electric Vehicles to make up for the shortfall in tax income. However, the accumulated loss will never be fully recovered, and these increases – frequently unpopular with the electorate – will not fix a structural trend (see Figure 2).

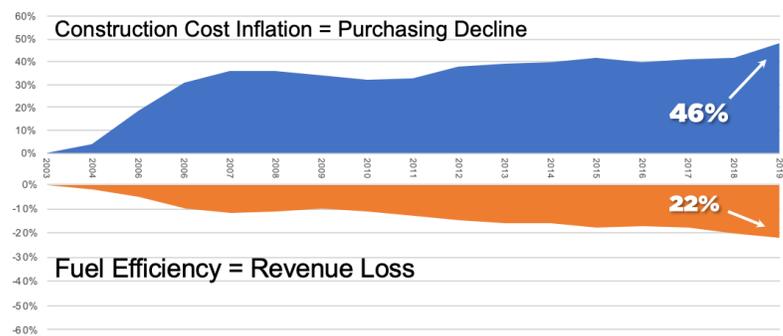


Fig 2: Utah Revenue Loss, 2003-2019
Source: Utah DOT

Public policies need to recognize the complexities of road pricing and the associated challenges with the messaging to stakeholders.

The case of the state of Utah is particularly rich in insights. Utah's RUC system is a voluntary program that alternative fuel (electric and hybrid) vehicle owners may opt into at the time of their annual registration renewal, instead of paying a flat fee. While the program only concerns up to 50,000 motorists at the time of its launch (January 2020), it is expected to provide a key policy signal to the wider electorate if the State expands this idea to the entire fleet of private vehicles. In doing so, Utah's legislators wished to ensure the program was designed from the start to be interoperable with existing road toll accounts and to give space for the future introduction of value-added services and changes to the technological ecosystem arising from connected vehicles.

Utah's RUC Program in a Nutshell

- Participants sign up with third-party account manager who collects and reports miles driven, via embedded telematics or in-vehicle technology provided by the account manager.
- Participants place a credit card on file and set up a pre-paid wallet from which mileage fees are deducted periodically.
- Payment of the per-mile fee stops once the accumulated total for the year is equal to the annual flat fee.
- The account manager provides a phone app for submission of an odometer capture photo at enrollment and a yearly photo to make sure that mileage corresponds to actual odometer readings.
- People with privacy concerns may opt for short-term data retention or pay the flat fee.

“Utah's RUC program goes beyond the substitution of gas tax revenue”

Road pricing momentum is evident across the United States where, in addition to Utah, more than 10 states or regional corridors have or are designing pilot projects. In the short term, these pilots create opportunities to:

- Involve the public and key stakeholders in the design of a road pricing policy and system
- Help policy-makers discover sources of concern and find fixes at the policy and/or system levels
- Assess technology, including its ability to integrate with existing tolling schemes
- Use results to refine policy recommendations to the legislature and design parameters for a live system

Hurdles to introducing road pricing include the cost & complexity of administering these programs (relative to the relatively ease of managing today's vehicle and fuel taxes), data protection concerns, enforcement of payment, as well as questions related to interoperability.

Currently, 35 US states have one or more facility-based tolling operations in place managed by a variety of actors (state DOT, dedicated tolling agency, concession, etc.) and representing US\$ 18 billion in revenues.

In many ways, this existing ecosystem of road tolls in those 35 states has prepared road users to the idea of paying for the upkeep of a high-quality network (and in the case of managed lanes, being able to make a trade-off between journey time and cost), while providing operators with the capabilities to administer wide-scale systems, including:

- Managing a significant number of customer accounts
- Processing regular & consistent high volume, low value transactions
- Maximizing revenue capture & distributing of revenues across several entities
- Managing the logistics of a large number of in-vehicle devices

Washington DC's Managed Lanes

The Capital Beltway High Occupancy Toll (HOT) Lanes project (officially known as the 495 Express Lanes) is a public-private partnership between VDOT and Capital Beltway Express, LLC (a joint venture of Fluor and Transurban) that opened in November 2012 with 14 miles of two new lanes in each direction and dedicated ramps connecting I-95 with the Capital Beltway to create a seamless HOV network. Dynamic tolls manage demand to keep the lanes moving above 45-55mph during peak times – journey predictability is thus ensured. Roadside equipment monitors traffic density on both managed and general-purpose lanes, and toll prices are updated as often as every 10 minutes to adjust to changes in real-time traffic conditions. The resulting toll prices are displayed on variable message signs in advance of every Express Lanes entry point. Customers are thus able to make an informed trade off between their time and spending decision.



THE GROWING APPEAL OF CONGESTION CHARGING

Lack of space to grow road capacity in the face of increasing travel demand and declining public budgets have created a compelling case for cities around the world to consider pricing systems for access to their Central Business Districts.

Singapore and London are among the pioneers who have introduced an access charge for motorists, although each followed a specific trajectory. Singapore's Electronic Road Pricing is currently a DSRC-based program in transition to a GNSS system that offers variable rates to enter the city based on the observed level of road congestion (measured by flow rate). If expressway speed falls below 45 km/h, the access rates are dynamically increased. By contrast, the London scheme uses ANPR technology at camera sites along the boundary route and within the zone and charges a flat rate to motorists.

Policy makers in both cities recognize road pricing on its own cannot deliver the full range of results unless it is accompanied with a range of incentives and investments designed to reduce reliance on private transport and increase the attractiveness of public transport as well as "last mile" options. As a case in point, London has set a target of 80% of all trips to be made by cycling, walking and public transport in 2041 (against 63% today), the key element of London's Transport Strategy. Singapore's imminent migration to GNSS-based charging will also provide an opportunity to deliver value-added services including real time information on traffic conditions and integration with off-street parking fees.

The argument for congestion charging is typically built up over a number of years with the assent of the business community and other key stakeholders. In London, the case for congestion charging was built up throughout the 1990's, prior to the formation of TfL. TfL implemented the scheme and undertook research to assess whether the objectives were met:

- The total number of vehicles entering the zone reduced by 60,000 per day
- Traffic circulating in the zone fell by 15% during weekday charging hours
- Congestion in the zone fell by around 30% (although congestion levels have recently increased in part as a result of London's policy to reallocate road space to more sustainable modes of transport).
- The charge also underpinned an 11% shift from car use to public transport, walking and cycling

Since adopting the Congestion Charge in 2003, London has taken further steps on Road User Charging with the aim of improving Air Quality within the city centre. Most significantly, London introduced the Ultra Low Emissions Zone (ULEZ), which corresponds with the Congestion Charge area, in 2019. ULEZ issues an additional charge to motorists if their vehicles do not meet emissions standards. Its short period of operation has already significantly reduced the number of polluting vehicles within the zone. Since April 2019, traffic volumes in central London have fallen by up to 9%.

“We had to be clear about the narrative of the London Congestion Charge”

At the vanguard of a wider trend in North America, The City of New York has endeavored to fast-track a new Central Business District Tolling Program expected to raise US\$1.5 Billion in revenue annually to fund transit. The program which at cruising speed will rely on 150 toll points for entry and exit was approved by the New York State Legislature in April 2019, awarded in October 2019, and is scheduled to be operational in April 2021. In order to meet this ambitious timeline, two key decisions were made early on the project: 1/ adopt parallel delivery tracks addressing tolling policies (such as tariffs, exemptions, etc.) and project delivery and 2/ make use of the existing E-ZPass Tolling Back Office (which already serves millions of user accounts in the wider NY area).

It is too early to predict the outcome of New York's CBD Tolling Program, though a number of key success factors can be drawn from efforts undertaken elsewhere:

- Champion: who will provide political leadership for the process?
- Challenge: a problem related to congestion which people can agree is in need of a solution
- Solution: a realistic solution or set of solutions
- Money: a large enough funding mechanism to justify the behavioral change
- Story: a compelling story that gains political support and considers a wider range of social issues



LEVERAGING THE WHOLE TRANSPORT SYSTEM BENEFITS OF ROAD PRICING

Whatever their area of application, road pricing programs frequently affect the travel patterns of hundreds of thousands and can bring about important societal benefits that extend well beyond the funding equation.

In the case of London, achieving safer roads closely embedded in the core objectives of the Congestion Charging program. While the number of reported personal injury road traffic accidents has consistently reduced over the last 20 years across the whole of London, this was further reduced within the zone by the introduction of congestion charging. In the first three years of the scheme between 40 and 70 additional collisions were avoided each year, notionally attributable to the traffic changes brought about by congestion charging. Nonetheless, in 2017, over 30,000 people were injured in road collisions, of which 131 were killed and 3,750 seriously injured. Casualty reduction retains a central focus for TfL through its vision zero approach, aiming for zero deaths & serious injuries by 2041.

Introduced in 1978, New Zealand's Road Usage charging system (applicable to all diesel powertrains and vehicles above 3.5t) provides an inspiring example of a collaborative approach which has yielded a range of societal benefits, including measurable contributions to the country's road safety strategy. The program allows for charge collection by commercial vendors – any service provider can join in provided it adheres to the national standards and code of practice jointly established by the public and private sector and passes the government certification process. This mechanism provides high confidence that standards are robust but not so prescriptive that they will inhibit innovation. This market-friendly approach has led to the development of innovative services by commercial vendors delivering significant downstream benefits to vehicle fleet managers, for instance through the provision of instant feedback on driving patterns through a visual display.

“New Zealand's charging program has evolved into a partnership based on shared outcomes”

Vendors now have the opportunity to take advantage of the dynamic data that is available to them through tolling applications. New data points such as vehicle health, and driver and driving data, can provide value outside of traditional road charging service provision, such as in the realm of telematics-based insurance, fleet management, or congestion analysis to name a few (see figure 3).

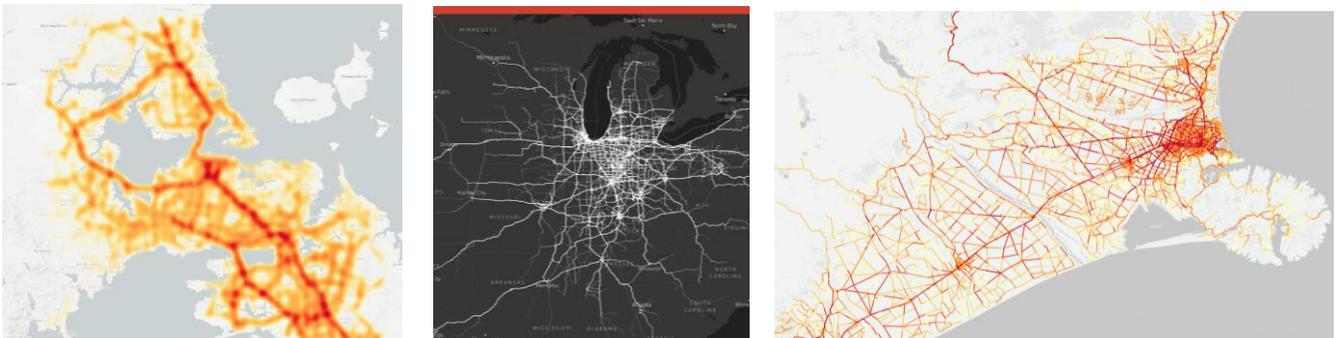


Fig 3: Congestion hotspots, real-time freight fluidity indicators and dynamic route risks are just some of the downstream benefits of regulatory telematics.

Source: EROAD

CONCLUSION: PREPARING FOR CONVERGENCE

The future of road pricing may well take the form “ubiquitous Road User Charging (RUC)” with a single system covering congestion charging, electronic tolling, and other charging mechanisms.

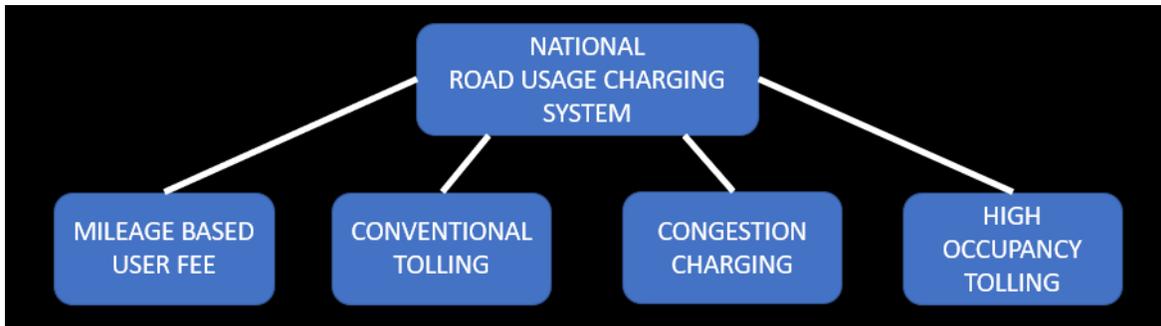


Fig 4: Ubiquitous RUC
Source: EMOVIS

Current societal pressures - increased population and economic activity around geographic hubs – will not subside, placing additional stress on transportation infrastructure and increasing commuting times, absent demand management policies, and concomitant public transportation improvements. The hybridization of the vehicle fleet will quicken, placing the fuel tax system of revenue in an ever-increasing precarious position. And the need to charge according to a growing number of parameters (such as location, time of day, distance travelled and number of occupants) will become even more appealing to policy-makers. For drivers, journey time will no longer be the only variable, since frequent trade-offs will need to be made between time and cost, possibly embedded within the vehicle’s navigation system. In the longer run, it is expected that existing pricing applications will expand across jurisdictions and reciprocal arrangements will progressively make way to unified RUC systems working off the same technological platform.

Meanwhile, the vehicle automation landscape is evolving at a fast pace with the introduction of advanced LiDAR technology and driving processors. When Level 5 automation becomes widespread, it could initially result in worsening congestion (through zero occupancy vehicles on the move) and fare splitting challenges (in the case of shared vehicles). Road pricing policies, particularly congestion charging programs that seek to manage demand, will thus increasingly need to address new use cases that are difficult to predict.

“It is easier to predict where the tolling industry will be in 30 years than 5 years from now.”

APPENDIX – SEMINAR AGENDA

- 12:00** **Meet & Greet**
- 12:20** **Introduction by Chair**
Steve Morello, Partner, D’Artagnan Consulting
- 12:30** *Key technology trends: an overview*
Marissa Burkett, Consultant, Ptolemus Consulting Group
- 13:00** *Whole transport system benefits of modernizing road pricing technologies*
Nina Elter, Senior Vice President, Global Market Development, EROAD
- 13:30** *Utah’s tolling delivery partnership model*
Nathan Lee, Director, Technology & Innovation, Utah DOT
- 14:00** *Are Managed Lanes the future?*
Lev Pinelis, Director of Innovation, Transurban
- 14:30** **Coffee break**
- 14:45** *How are North American cities taking on congestion charging?*
Jo Averkamp, Vice President Systems and Solutions, Parsons Corporation
- 15:15** *The next decade of urban congestion charging for Singapore*
Kian-Keong Chin, Chief Engineer, Singapore LTA
- 15:45** *Congestion charging in London – leading the way on sustainable transport and safety*
Ben Johnson, Senior Delivery Planning Manager, Transport for London
- 16:15** *RUC and Congestion Charging: Converging Strategies?*
Charlie Mitchell, Senior Program Manager, Emovis USA
- 16:45** **Concluding remarks by Chair**
Steve Morello, Partner, D’Artagnan Consulting