Taking a toll

In the second and final part of his investigation into the future of tolling technology, Josef Czako of Moving Forward Consulting asks a variety of stakeholders what they see as the priorities going forward. RFID and free-flow tolling loom large…

ITS *International* asked major stakeholders such as policymakers, users, operators, integrators and concessionaires involved in planning and implementing tolling, charging and pricing schemes in various parts of the world for their views on the present and future situation for tolling and charging.

In particular we wanted to know what future developments can be expected – and what their drivers will be. Also, what are the pros and cons of the various technologies serving tolling, charging or pricing, and which combinations of them might be required? The answers from our panel of talking heads were intriguing…

Malika Seddi, international vice president of IBTTA and director of international affairs at ASFA, France

"From the point of view of concessions and users, tolls or the 'user pays' principle are efficient tools to enhance sustainable mobility, and road infrastructure is a key pillar to boost our economy. Governments are responsible for providing a reliable road network that guarantees safe and efficient mobility for passengers and goods. From that perspective, France has financed, developed and equipped its motorway network of approx. 9,170km by resorting to the 'toll concession model', hence structuring the country with high levels of service and safety without recourse to public budgets. The concessionaires collect the tolls based on the 'user pays' principle which makes all users - French and foreign - contribute to the financing, instead of taxpayers. The new European legislative dispositions for concessionaires, fixed by the 2014/23/EU Directive and transposed into French law by Order 2016-65, admit the opportunity of implementing more flexibility in the use of the concessionary tool in future. Thus,

concessionaires suggest the use of the assets of the toll concession model by unfolding new services to increase the efficiency of road infrastructure, and also for investments into the future mobility ecosystem. Examples of this include reserved lanes for collective use (e.g. buses, taxis, shared vehicles); penetrating multimodal exchange points between public transport and road transport; fostering the deployment of electric and autonomous vehicles; supporting the European C-ITS initiative as part

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>
> *Malika Seddi*
> *ASFA & IBTTA*

of the way towards cooperative, connected and automated mobility; envisioning the transformation of toll collection into fully free-flow mode without gates, without the need for stopping; and moving forward overall modernization. European cities are increasing in size and the population is concentrated in urban and peri-urban areas. Also, time spent commuting, congestion, air pollution and noise are all increasing in our cities. Fostered by digitalisation, new mobility needs are emerging with new services: better co-modality with public transport, shared services like car-pooling or car-sharing, electromobility or autonomous vehicles. Tolls, road user charging or mobility pricing schemes may be similarly applied as well to foster and manage mobility in cities. It is also useful to recall the principles that have made the 'French-style' concession model successful to answer the double call for more sustainable mobility, thanks to clear earmarks on transportation improvements and to support the economic restart." **ITS**

Jack Opiola, CEO, Mobility Plus, US

"I see that today not only the market but technologies themselves are in transition. DSRC and RFID tags – toll tags – supported by video image capture, are the norm. Between these two choices, more expensive DSRC tags with read-write capabilities and batteries are losing market share to less expensive and durable RFID tags that now cost $1 and below. However, I see video image capture being the long-term winner and replacing tag technology. There are more research dollars and brain power being spent on video image capture software, equipment, and AI processing to fully automate the process. In addition, these advances are reducing the cost of investment and operations more so than any other technologies being considered. While video image capture is looked at today as the supportive technology to toll tags, GNSS, smartphones and telematics tolling options, I think it will emerge as the sole

> **Video image capture...will emerge as the sole technology necessary for tolling including vehicle classification, vehicle/traffic counts, surveillance, and other ITS considerations over the next five to 10 years**
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> *Mobility Plus*

technology necessary for tolling including vehicle classification, vehicle/traffic counts, surveillance, and other ITS considerations over the next five to 10 years. Road usage charging, environmental charging (low-emission or zero-emission zones), central business district charging - also referred to as congestion charging - have been looked at since Singapore, London and Stockholm as cordon or area charging. Unfortunately, the edge effects created by an area or cordon require great attention and create inequities in their adoption with DSRC, RFID and video image capture technologies. GNSS - whether it be a user-based insurance (UBI) dongle, or a smartphone app using the internal GNSS chip and internal 4G/5G modem, or telematics embedded in cars that also use GNSS, 4G/5G modem or Internet of Things communications - will greatly enhance these charging schemes in the future. GNSS technology will allow not only ring-fenced vehicle crossings, but dwell time in a zone or distance/mileage used on the road network or selected roads/bridges/tunnels in the network. Video capture may continue to support these schemes for part or all of the enforcement purposes." **ITS**

Road infrastructure is a key pillar to boost national economies

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John Davis, regional director, Aecom, Ireland

"Road pricing will be used to achieve multiple inter-linked objectives, namely: lowering emissions, road infrastructure financing, demand management and replacing fuel taxes. Some operators favour ANPR because of lower capital expenditure (capex) costs (i.e. no need for OBU distribution) whilst others look at 'whole life cycle' costs, (i.e. what technology yields the lowest transaction cost). DSRC and RFID are proven to yield the most efficient transaction cost but larger schemes require significant upfront infrastructure costs, impacting on the capex versus operating expenses balance. The best approach for determining technology choice is to perform a SWOT analysis comparing technologies against policy requirements. HGV RUC schemes utilise an OBU combining DSRC and GPS/GNSS, whilst ANPR is used for enforcement. It is not yet

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> *John Davis*
> *Aecom*

cost-efficient to extend GPS/GNSS to cover cars so this will be the domain of DSRC and RFID for quite a time. ANPR will continue to integrate machine vision techniques to yield higher accuracy. All technologies have their place and will continue to achieve a reasonable market share in the short term.

Road infrastructure planning now requires the integration of cooperative, connected and automated mobility (CCAM) digital infra-structure with civil infrastructure. In Europe, the C-ROADS initiative has seen the trialling of C-ITS Day 1 services. I foresee European stakeholders starting to trial Day 2 services including road pricing. This will provide the evidence for policymakers to start using road pricing as an enabler for achieving multiple transport objectives. This will happen quite rapidly. The evolution of interoperable ETC technologies took 35 years from initial trialling to widespread deployment. C-ITS technologies are already being deployed therefore I foresee a scenario over the coming decade whereby road pricing schemes transition to using CCAM technologies. This can be managed efficiently if schemes are planned in a modular, flexible fashion." **ITS**

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Zoltan Varga, CEO, National Toll Payment Services & Csaba Nagy-Amigo, technical director ITS, ARH Adaptive Recognition, Hungary

"One of our flagship projects as a technology provider is the Hungarian nationwide Tolling Project, serving more than 6,900 km of national highways and roads. It includes all light and commercial vehicles. To serve a variety of different clients, various technologies have been implemented: GNSS is used for distance-based electronic tolling of commercial vehicles above 3.5 tonnes, and e-Vignette/e-Sticker is used for time-based tariffs for light vehicles and buses. ANPR is utilised in both schemes for vehicle detection and enforcement. The operational cost for the Hungarian nationwide tolling system amounts to about only 9% of the total toll revenue. ARH's enforcement technology is supporting both post-paid (pay-as-you-drive) and pre-paid (purchase a ticket for a route, a specific county or a time frame in advance) toll payments. Our aim was not to require any road-intrusive sensors or devices to be installed. Following the purely video, radar and laser-based vehicle detection solutions, the vehicle identification is based on ANPR cameras. Thus, nearly 100% vehicle detection rates can be achieved, regardless of traffic conditions to secure the enforcement efficiency for the operator. Our task is to provide our customers with new technologies in an appropriate manner as we are convinced that a new technology results in lower cost, better efficiency – and does not result in increased risk. Considering this, a tolling system works best when invisible: road users do not have to slow down or even stop at gates, and monitoring and enforcement are performed at cruising speed in free-flow mode. This means that it is more likely that users will accept toll charges since the toll operator additionally offers better quality of roads, new road extensions and a convenient mode of payment." **ITS**

The 'French-style' concession model has been successful, says Malika Seddi

Manuel Haertlé, senior product manager, Feig Electronic, Germany

"We experience RFID technology being heavily used worldwide in transportation, for payment of tickets in public transport, electronic toll collection or parking. Since it is based on radio communication, RFID works also in poor weather conditions like fog, snow, ice or heavy rain. It is easy to use, offers high transaction (and thus revenue) security, can be easily installed in the vehicle windshield, headlight, or embedded into the licence plate. RFID does not require any battery and offers secure and interference-robust application being based on the international standard ISO/IEC 18000-63 including also cryptographic authentication. This means privacy is ensured since only authorised stakeholders will receive access while offering the proper authentication key. RFID is an ideal platform - not only for toll collection, but also for congestion

> **We see RFID as a partner technology for ANPR, in combination offering the highest efficiency and best enforcement results**

Manuel Haertlé
Feig Electronic

charging, parking and traffic management or road safety applications. RFID offers low investment and operational cost since sticker tags and readers can be purchased at attractive costs. Apart from transport and mobility, RFID serves many other applications; vast synergies therefore exist to virtually combine any application. Sustainable mobility needs to also reflect future challenges and disruptions: growth of demand, urbanisation, the urgent need to reduce congestion and the negative impact of transport to the environment, shared mobility, automated driving, electrification or digitalisation. This will require significant investment in assets, infrastructure and technology, followed by operational associated cost. Thus, policymakers and operators have to ensure sustainable financing, including contributions from users (pay-per-use). For this, a widespread and efficient payment technology platform is needed - as offered by RFID. We see RFID as a partner technology for ANPR, in combination offering the highest efficiency and best enforcement results. Since RFID is vehicle related, this is of advantage for tolling and charging compared to smartphones." **ITS**

Benoit Lempkowicz, public affairs manager, Satellic, Belgium

"We see that the 'pay-for-use-only' model is clearly becoming the norm in many aspects of modern life: rental-by-the-minute for bicycles, e-bikes and e-bcooters, or car insurance by the kilometre, to pay only for the service actually used. Therefore, the Viapass kilometre charging system for trucks in Belgium, delivered and operated by Satellic, is in line with this new way of thinking. In addition to paying only for every kilometre driven, paying for external costs like emissions, infrastructure damage or the zone where driving takes place is more acceptable in the societal mindset. As a consequence, users must be 100% sure that they pay only the price for their actual use of the highway - and in return, the toll chargers must be 100% sure that they get the tolls they are allowed to collect from users. Satellic implemented the very first fully EETS-compliant tolling system in Europe - in Germany. Toll plazas, toll gantries or special

> 66 **Smart use of technology could create a 'bring your own device' solution, like a smartphone or an advanced OEM on-board computer, together with tolling apps** 99
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> **Benoit Lempkowicz**
> *Satellic*

tolling lanes are a thing of the past, while smart, satellite-based, interoperable and free-flow road user charging is a forward-looking technology allowing easy implementation in any country or region. Under the supervision of Viapass, the Belgian joint venture between T-Systems and Strabag has deployed an innovative and modern kilometre charging

system for heavy good vehicles. The OBU from Satellic uses satellite positioning technology (GNSS) together with mobile communication (GSM) and dedicated short range communication (DSRC). Commercial operations were launched in April 2016. Today, more than 600,000 active OBUs have been installed, and around 140,000 heavy goods vehicles which are subject to tolls use the Belgium road network every day. For the future of tolling in Europe, we see extensions to include other types of vehicles and new pricing models for innovative traffic management which consider the time of day, location or current traffic volume. This would address issues of sustainable mobility, financing, pollution and multimodality. Future and smart use of technology could also create a 'bring your own device' solution, like a smartphone or an advanced OEM on-board computer, together with tolling apps to bring easier accessibility and acceptance." **ITS**

Roman Podprugin, head of sales, ISBC, Russia

"Having experience as a system integrator for various toll projects in Russia and CIS countries, we see that convenience for the payment of tolls is important: no queues, simplicity, fast online recharging, and operational and technical support in case of questions or difficulties. We promote RFID technology for the following reasons of convenience:
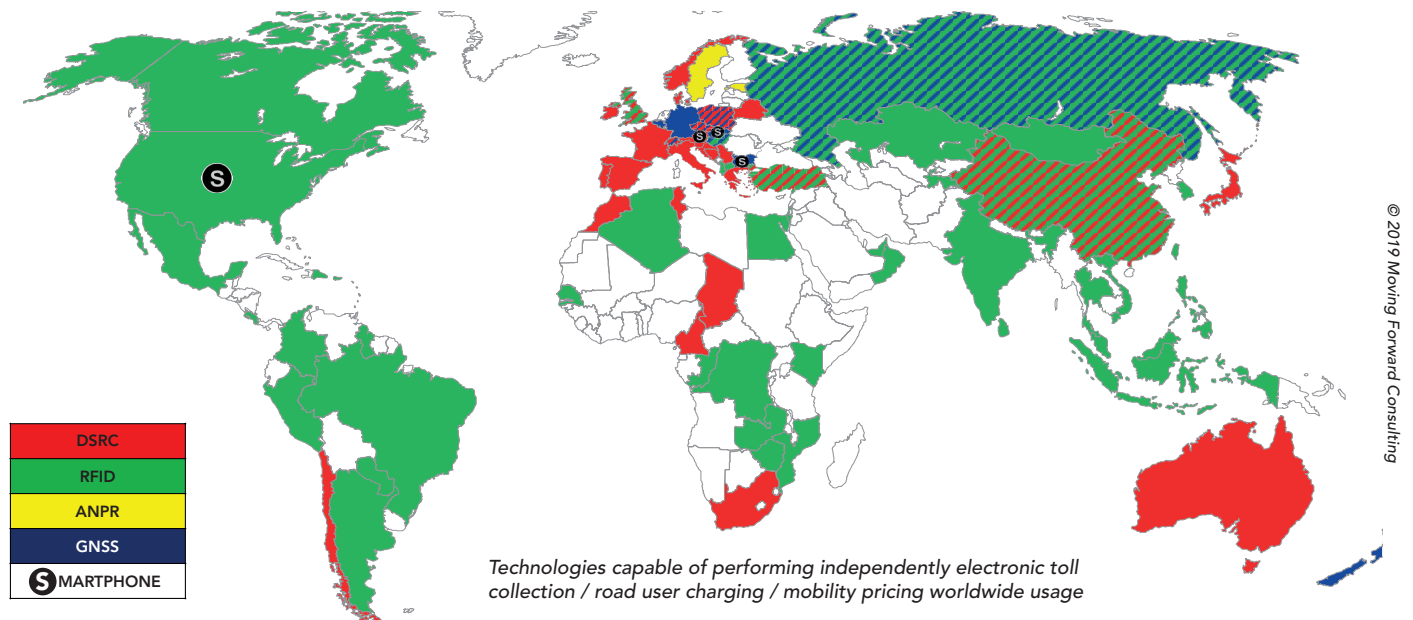- Reading of RFID tags is possible at normal driving speed, there is no need to reduce speed at the RFID-tag reading points
- It offers high security against copying and fraud from the account balance of the RFID tag since it provides cryptographic protection with THE AES 128 bit

- Good convenience of replenishing the account balance of the RFID tag when supported by the back office
- RFID allows more attractive prices and subscriptions for payment since other tariffs to pay - such as by credit card – are usually more expensive

In Russia, the possibility to introduce electronic toll collection (ETC) systems requires a political decision followed by legislation. Thus, good information on the potential and advantages of ETC is required. For integrators, it is necessary to understand the intricacies of the toll road market, to be able to connect the customers with the appropriate technology, based also on their

experience in building suitable IT software solutions using billing technologies including online payment. Operators need to include into planning of infrastructure provisions for roadside equipment required for ETC, with the ability to control the installation and commissioning processes.

For users, easy access for the payment of tolls via a modern sales network is essential. This also includes spending little time to fulfil formalities to open or manage the account in order to buy an RFID tag. Also, good instructions need to be provided on how to install a tag in the vehicle. In addition, the market needs a solution for car windshields using thermal glass or heating grids in order not to obstruct RFID communication." **ITS**

🟥	DSRC
🟩	RFID
🟨	ANPR
🟦	GNSS
Ⓢ	SMARTPHONE

Technologies capable of performing independently electronic toll collection / road user charging / mobility pricing worldwide usage

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Suresh Kakarla, CEO, TollPlus, US

"Road usage charging (RUC) systems need to respect the individual's right to privacy while securing the data for revenue collection to maintain fairness (no under/overcharging). One of the biggest challenges facing RUC implementation is convincing the public that any data collected on their road usage will be protected and that the users are not being actively monitored while travelling. Thus, it is critical to maintain the security of RUC systems to protect personal data and trip information in designing and managing data security according to legal requirements and best practices. It implies taking specific data security measures based on the Payment Card Industry (PCI) standards for online financial-grade transactions, including authentication and authorisation for data access, notification of data modification, data masking, encryption and storage, data transmittal, ISO requirements for network security, and data storage and data destruction. Access to data must be restricted to authorised personnel. Security measures include:

- Physical security: access to the data centre should be restricted through biometric authentication and 24/7 video surveillance

- Electronic security: system information should be protected to ensure the security of stored and processed data, including a dedicated firewall to restrict access to mission-critical data, web applications developed using secure programming standards, critical components of the physical architecture deployed in a high-availability cluster
- Communication channels: security by Virtual Private Network (VPN) for operations to secure data traffic by providing confidentiality, integrity, authenticity and anti-replay

- Compliance: security that is fully compliant with PCI-DSS (Data Security Standards) using secure coding principles based on PCI-DSS guidelines

The exhaustivity and integrity of data needs to be respected across the full RUC applicative chain. This means that no data must be lost or modified, even if there is a server crash, memory failure or any other technical incident. In order to achieve this, all system databases have to be redundant in order to never lose any data if a hardware issue occurs." **ITS**

Drivers may increasingly demand more convenient modes of payment

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