



Ministry of Sea, Transport and Infrastructure

**Study on the development of
electronic toll collection system in the Republic of Croatia**

Terms of Reference

1. Introduction

The Government of the Republic of Croatia initiated an overall process of modernisation and restructuring of the road sector, as outlined in the Letter of Sector Policy of the Ministry of Sea, Transport and Infrastructure in March 2017. Within this process it was deemed necessary to transform in the medium-term the existing toll system for the use of the state-managed motorway networks into a fully-automated system that will permit electronic toll collection without the use of physical obstacles, ensure greater traffic safety and flow in an acceptable and non-discriminating way for all users of motorways that are paying toll, ensure optimum costs and toll revenue for the motorway network managers and be interoperable with future EETS service.

A preliminary analysis was made in 2016 in the Study "Restructuring of the motorway network in Croatia" that was ordered by the Ministry of the Sea, Transport and Infrastructure and financed by the European Bank for Reconstruction and Development (EBRD) to survey the existing conditions with the help of international consultants and to consider the potentials for improvement and development of the electronic road tolling.

Currently the largest part of the Hrvatske Autoceste d.o.o. (HAC) and Autocesta Rijeka-Zagreb d.d. (ARZ) networks is charged via a closed-toll system with the possibility of payment by cash, bank cards and low-speed DSRC electronic payment (ENC); each payment mode's share is approximately one-third of total revenue. Within the trunk of the HAC/ARZ networks connecting Zagreb to Split, Osijek, Rijeka and key international borders, tolling is proportional to the distance travelled and depends on the vehicle type and (for heavy vehicles) number of axles. (A few specific plazas, e.g. Krk island, apply open "point" charging.) The Government intends to maintain the basic principle of charging related to distance for all vehicle categories and is therefore considering technological options that would satisfy this criterion, while at the same time aiming to (i) limit traffic congestion, which can be acute especially during the tourist season, (ii) introduce tariffs encouraging the use of vehicles with reduced CO₂ emission, (iii) decrease the number of staff on direct toll collection, and (iv) ensure enforcement of toll payment and minimization of toll evasion.

The EBRD Consultant's preliminary analysis indicated that free-flow "dedicated short-range communications" (DSRC) as well as "global navigation satellite systems" (GNSS) are the basic technological options for automated charging in proportion to the distance travelled. For the same reason, vignette options are not being examined. The Consultant also suggested that, prior to the implementation of the improved, fully-automated toll system, enhanced automation should be sought within the existing system, through targeted improvements that will take into account requirements for (a) timely transition to the future system and (b) avoidance of unreasonable investment in equipment that would be rendered obsolete by the future system.

To be able to choose the optimum solution it is necessary to examine the benefits and possible drawbacks of the candidate systems and to make financial analyses of all costs and benefits, including the transition from the current system to the future one, as well as fulfilment of the aforementioned principles of (i) limiting congestion; (ii) fair and environmentally-sensitive charging that will not compromise current level of revenue per vehicle-kilometre; (iii) optimization of cost and in particular its labour component; (iv) ease of use and proper enforcement. The suggestions for extension and rehabilitation of the existing electronic toll

collection system and the introduction of automated vending machines from the Study "Restructuring of motorway network in Croatia" require further studying and a detail analysis from the aspect of overall costs, time frame for implementation and final solution. Finally, national and international interoperability requirements will be examined; the solution chosen should be expandable to other networks including the currently conceded Zagreb-Macelj (AZM) and Bina Istra networks, either after the end of the concession periods or – should such a decision be made – earlier.

2. Objectives

The aim of the study is to conduct a thorough analysis of applicability of the currently available technological solutions of electronic charging supported by Directive 2004/52/EC (on the interoperability of electronic toll systems in the Community); Decision 2009/750/EC (on the definition of services of the European electronic toll and its technical elements) and relevant national legislation and rules; and to recommend a future option for the selection of suitable technologies that HAC and ARZ or their successors as per institutional restructuring (hereinafter: motorway managers) will implement on their respective networks.

The study should examine and compare objectively the benefits and drawbacks of individual technologies, and it will be implemented in two stages. In the first stage the feasibility of application of DSRC, GNSS and other technological possibilities fulfilling the basic principles will be analysed and a strategic selection of the final solution for the electronic toll collection will be proposed, while in the second stage a detailed analysis of requests for the chosen final solution will be made.

In addition to examination of technologies and their comparison a particular focus shall be put on the possibility of surveillance and control.

A number of criteria shall be considered in examination and comparison of different solutions:

Traffic and toll aspects:

- Traffic specificity (seasonal load of the road network and the share of individual vehicle categories),
- Expandability to new motorway sections and structures in the toll charging system and the modifications in vehicle categories and thus the associated total costs,
- Toll collection for a particular vehicle category proportional to travelled distance,
- Charging different toll tariffs depending on vehicle CO₂ emission,
- Efficiency and the cost of surveillance,
- Risk of collecting toll fee from the motorway user,
- Enforcement and minimization of toll evasion / leakage, including fraud, diversion to other roads, user non-compliance,
- Possible congestions (especially during the tourist season),

Technological and legal aspects:

- Dependability (exposure) to resources that are not under control of operators,
- Disposal of source code,

- Standard protocols and standard interfaces,
- Reliability,
- Real-time data processing,
- Modularity, flexibility and scalability to upgrade,
- Ability to process estimated increased number of vehicle transactions a per year (entrance-exit transactions),
- End-user oriented system of sale and additional payment (web and mobile applications),
- Climate configuration diversity (snow covered sections, gale force wind, high temperature in summer),
- Complexity of installation and total costs for operators and final users,
- A minimum 10-year functioning of the system system operation with ensured spare parts and maintenance support,
- The simplicity of the use of the system by all parties (operators, users incl. international ones and the providers of EETS),
- Protection of personal information,

Other unspecified:

- All other relevant criteria:
- Number of employees on direct toll collection operations,
- Administrative costs.

The Study will be a reference document based on which the Ministry of Sea, Transport and Infrastructure (hereinafter: the Ministry) will recommend a new toll charging system to the Government of the Republic of Croatia that shall be implemented around or before 2020.

3. Scope of the services

Consultant will prepare the Study in two main stages:

- In the first stage the feasibility analysis of possible toll technologies application will be conducted taking into account all the criteria mentioned in the previous section, as well as the time frame and financial costs, and accordingly a strategic choice of technology of electronic toll system will be proposed,
- In the second stage a detailed analysis of requests for the chosen electronic toll technology will be done, as well as of the timeframe and financial plan for the project implementation.

3.1. First stage: Analysis of technological and policy options for the fully-automated toll system and development of proposals for strategic decision

In this stage the Consultant will prepare a proposal for the choice of technological solution of electronic toll system with an emphasis on the following tasks:

(a) Detailed definition of candidate technological options

- DSRS, GNSS and any other technological options fulfilling the principles identified in chapters 1 & 2 of this scope will be defined in detail, including:
 - On-board unit (OBU) requirements
 - Roadside and central control and data storage equipment requirements (gantry or other)
 - Software requirements
 - Data storage requirements
 - Supported means of payment for private and corporate users
 - European and international experience from usage of option
 - Vending or renting facilities for tourists, transit traffic and other relatively infrequent users
 - Usability of current system's elements / transition issues
- Sub-options shall be examined where meaningful, including:
 - „Passive“ vs. „active“ GNSS
 - Alternative satellite systems (GPS, GALILEO, GLONASS)
 - „Thin client“ vs. „thick client“ OBUs
 - Hybrid OBUs
 - Alternative methods of automatic vehicle identification (e.g. automatic number-plate recognition)
 - Alternative methods of automatic vehicle classification
 - Combination with traffic violation enforcement

(b) Simulation on the networks and definition of policy inputs

- Dimensioning for implementation in the current HAC / ARZ networks
- Expanded dimensioning for coverage of the totality of Croatia's motorways, including hitherto uncharged sections and AZM / Bina Istra
- Simulation of all aspects of implementation for each option (and any sub-option) on the current and expanded networks, including:
 - Alternative charging scenarios: (i) at currently-applied base-charge, seasonality and discount levels; (ii) differentiation of charging as per environmental parameters (EURO engine category and any other suitable criteria); (iii) variant base-charge, seasonality and discount levels
 - Transition from current system to future system
 - Enforcement provisions; and revenue loss scenarios depending on fraud and evasion levels, depending on such provisions
 - Scenarios of OBU distribution / charging
- Existing financial and operational data and analysis will be used (EBRD Consultant, Working Group 4, World Bank, MSTI Financial Advisor, National Traffic Model as available) – data collection will be limited to specific needs corresponding to gaps identified by the Consultant in the Inception Report subject to Client's approval and Bank's no-objection.

(c) Multi-criteria analysis of options (and any sub-options) and draft strategy proposal

Elements to be covered in the analysis include, as a minimum (and may be enhanced by additional factors that the MSTI, road managers and/or consultant may deem necessary):

- Capital expenditures – including indicatively construction, equipment (central, field, OBU), software and one-off licensing, periodic maintenance / renewal in a 15-year horizon, removal of previous installations as necessary
- Operating expenditures – including indicatively toll collection/supervision, toll enforcement, back office, sales, routine maintenance / repairs (incl. also software), periodic licensing, communication (telecoms etc.) – with staffing impacts analysed separately
- Impact of guarantee period – breakdown of lifecycle maintenance costs between contractor and operator
- Revenues – in accordance with scenarios defined in (b) above
- Impacts on traffic load (congestion)
- Impacts on transition from current system: issues and costs for road managers / operators, users (esp. subscribers) – including estimation of reasonable required expenditures on the current system, taking into account the timescales for optimization of HAC/ARZ networks' operation as defined in the Letter of Sector Policy and other MSTI policies
- Comparison to perpetuation of current system
- Legal and administrative impact (changes in the legal and institutional framework)
- Operational organisation of activities in the period of transition from the current model to the new electronic toll system and after the new electronic toll system has been fully implemented.

Based on the above multi-criteria analysis, a draft strategy proposal for a fully-automated toll system will be developed, including an indicative time frame for its gradual introduction and for replacement of the current one.

All these suggestions shall be complied with good international and national experience, practices and relevant regulations.

The strategic proposal should demonstrate in a manner satisfactory to MSTI and the Bank the elements (including identification risks and mitigation measures) for addressing all basic principles identified in sections 1 and 2 above, namely distance-based charging, limitation of congestion, linkage of charges to environmental costs, reduction of staffing and minimization of toll leakage.

The Ministry (MSTI) will make the decision on the strategy taking into account the Consultant's draft proposal.

3.2. Development of detailed implementation plan for introducing the selected system – Advanced preliminary study

Based on the information obtained in the earlier stage and the final strategic decision, the Consultant shall carry out a detailed plan for the introduction of the selected solutions for the chosen fully-automated tolling system through the following tasks:

- Propose and describe the general architecture of the toll collection system from which it is clear what main components (hardware and software) are necessary so that the tolling system could function as a whole,
- Identify technological, staffing, financial and policy elements (a “roadmap”) in appropriate details so as to facilitate the MSTI in tendering the proposed system in accordance with the MSTI’s planned implementation timeline
- Develop details of the system to the level of advanced preliminary study, including drawings, draft operation and maintenance concept, human resources matters, legal/institutional and policy issues, financial (cost-revenue) estimates and extended write-up to be used in the bidding documents..

The elements that should be specified in more detail include:

- (a) Technological elements (indicative list, to be adapted to the solution chosen for development)
 - road infrastructure and/or infrastructure of existing toll plazas:
 - electric power supply,
 - telecommunication infrastructure and capacities,
 - lane control units ,
 - recognition of vehicle approaching ,
 - classification of vehicles,
 - identification of vehicles,
 - recording license plates,
 - system of technical security / surveillance of lanes on the existing (transit) plazas
 - physical safety of equipment and ancillary structures,
 - infrastructure of plazas for registration of users i.e. sale and rental and return of OBU (in the event that the chosen solution involves the need for such facilities),
 - central infrastructure:
 - hardware support (server and network / communication facilities),
 - software support (server software support),
 - basic functions and tasks of the transactions processing system,
 - ERP system (basic user interface, reporting, the concept of access control and security requirements),
 - CRM system (a basic overview of functionality of user web sites and applications; SMS services for payment, check account

- balances and informing users; mobile user applications; unbundled access for partners to sell and support; specify security requirements),
 - system of electronic / card payment (non-cash transaction processing),
 - state the requirements for redundancy of critical system elements,
 - state the requirements for the procedure of generating back-up copies and data recovery,
 - state the requirements for the type of transaction data that are stored and the duration of their storage,
 - system for central control and monitoring of all elements of the toll system that integrates control of all parts of the toll system, (Detailed review of inventory-components and spare parts system, monitoring the operation of each part in real time, diagnostics and alerts on failures, planning and management of preventive and corrective maintenance, automatic control of physical and system security, reporting),
- mobile control units:
 - state the requirements for the type and quantity of equipment that will be used for the control and prevention of fraud in toll,
 - state the estimated number of staff that will be employed in the control and prevention of toll evasion.
- Specify as appropriate and specify requirements for other necessary elements of the electronic toll system,
- Propose requirements for a way of developing, design, planning and implementation of the electronic toll system, in which the transition from the existing to the new toll system shall be integrated,
- Propose requirements for expandability of the system in terms of ease of change of sections and toll policy,
- Propose requirements for an open-system components of the electronic toll system to achieve future interoperability with the new, currently unforeseen information systems,
- Propose basic requirements for project management (requirements relating to the preparation of the management plan, the timeline of the project, planning meetings, periodic reporting, key personnel for project management, documentation, quality management and risk management),
- Propose requirements for the method of system delivery (plan of delivery, delivery management, delivery of the test system at several selected locations in order to test the correctness of operation and to evaluate performance)
- Propose requirements for spare parts and consumables,

- Propose requirements for maintenance service and improvements outside warranty period, the possibility of software and hardware upgrade in line with the Public Procurement Act,
- Propose guidelines and documentation for implementation of public tender for designer and contractor of the toll system,
- Supervision of work of the Designer and Contractor,
- Propose requirements for maintenance service and improvements in the trial period and warranty period,

(b) Staff-related requirements

- Detailed staff dimensioning and basic job descriptions,
- Propose requirements for staff (re)training for operation, routine and intervention maintenance.

(c) Financial elements

- Investment and operating costs, based on the itemization of 3.1 (c) above.

(d) Policy elements

- Detailing of legal / administrative changes including write-ups to be used in legislative text as may be necessary.

The Consultant shall take into account all requirements and proposals of the Ministry and motorway operator.

4. Time schedule, reporting requirements and budget

The anticipated duration of the TA consultancy is 9 months from the contract signing date.

The Consultant should prepare and submit reports covering the commencement of activities and individual tasks described above.

The table below provides only indicative dates for the submission of final reports for each stage, but the motorway operators need to check them previously, provide their assessment and comments and ensure that the changes in individual reports have been entered before submitting their final versions.

Deliverables – Stage I	Week from the start	
The Inception Report will be the output from the first stage, part (a) as defined in section 3.1 above. It will contain a summary of the existing situation (based	3 rd week	

on the EBRD Consultant's report, this ToR's introduction and Consultant's own observation), an identification of candidate technological options and sub-options, as well as an identification of any data gaps.		
The Interim Report will be the output from the first stage, part (b) as defined in section 3.1 above. It will contain identification of scenarios (technological options, charging scenarios and any variants as required) for the multi-criteria analysis.	7 th week	
Draft strategy proposal – output from the first stage, part (c) as defined in 3.1 above.	13 th week	
Total Stage 1	13th week	
Deliverables – Stage II	Week from the MSTI's strategy decision	
Roadmap with technological, staffing, policy and financial elements, as detailed in Section 3.2	4 th week	
Advanced preliminary design as detailed in Section 3.2 – draft submission	14 th week	
Final submission of the advanced preliminary design, including drawings and detailed write-ups on HR, legal/policy and financial elements, in line with section 3.2 and including also proposals on:	23 rd week	
(a) The basic requirements for project management (requirements about development of the management plan, a timeline of the project, planning meetings, periodic reporting, key personnel for project management, documentation, quality management and risk management)		
(b) Requirements for the method of system delivery (development of a plan of delivery, delivery management, delivery of test systems in several selected locations in order to test the proper functioning and to evaluate performance)		
(c) Instructions for the implementation of public tenders for the selection of the designer and contractor of the system		

(d) Supervision over the designer's and contractor's work	total of 50 weeks (accounted as 8 hours per week per expert)	
Total Stage 2 (without supervision)	23 weeks	
Overall	36 weeks	

All deliverables that are listed in the table must cover all elements described in the section Scope of services. All reports will be prepared in Croatian and English, and available in print and in the form of relevant electronic documents, as agreed with the Ministry.

5. Requirements for qualifications of key experts in the Consultant's team

Consultant (a company or joint venture made of several companies), must demonstrate experience in implementing similar tasks.

The Consultant's working team should include experts who cover all the skills and relevant experience needed to perform the described tasks.

Working team should possess the following qualifications, experience and skills:

Project references

Details of relevant project experience, in performing feasibility studies and cost benefit analysis in the transport (motorway/highway) segment, in the previous 5 years, at least:

- Three projects demonstrating knowledge and experience in design and implementation, and/or operation of intelligent transport systems in several EU countries, which meet the following specifications:
 - at least one of the contract is connected with design and implementation and/or operation of free-flow toll system (DSRC and/or GNSS technology),
 - implementation of toll system has to be on the national road network, whose length is at least 600 km,
 - at least one system containing 9 or more toll plazas with at least 50 million transactions a year,
 - one of the plazas should have an AADT of at least 40,000 vehicles per day,
 - at least one of the contract is connected with design and implementation and/or operation of toll system, whose CAPEX was at least 50,0 mil. EUR and OPEX was at least 18,0 mil. EUR.

(Preferential advantage: experience with projects in more countries, more projects concerning toll systems, experience with both technologies, etc.)

- The reference value of each project must be at least 50 000 EUR, while at least one value of the project shall amount to 150 000 EUR.
- Senior Transport Planner (Team Leader)
 - a minimum of 10 years' experience in transport planning in developed and emerging economies, motorway/highway tolling experience is required, with a

- minimum of 5 years' international experience and a minimum of 5 years' local field experience
 - Education: University degree in Traffic Engineering or a relevant, directly related discipline, or equivalent
- Senior Transport Economist
 - preferably 10 years' experience in transport economics and advisory in developed and emerging economics, experience in economic analysis and feasibility studies in motorway/highway infrastructure is required, while understanding of tolling and of local environment and local field experience is an advantage, but a minimum of 5 years required
 - Education: University degree in Economics or a relevant, directly related discipline, or equivalent
- Senior Transport or Systems Engineer
 - preferably 10 years' experience in transport engineering in developed and emerging economies, motorway/highway operational experience is required, while understanding of tolling and of local environment and local field experience is an advantage, but a minimum of 5 years required
 - Education: University degree in Electrical Engineering, Traffic Engineering or a relevant, directly related discipline, or equivalent
- Senior Infrastructure Finance Expert
 - preferably 10 years' experience in transport financial advisory in developed and emerging economies, experience in financial analysis, cost estimates and feasibility studies in motorway/highway infrastructure is required, while understanding of local environment and local field experience is an advantage, but a minimum of 5 years required
 - Education: University degree in Economics or a relevant, directly related discipline, or equivalent
- Senior Legal Advisor
 - preferably 10 years' experience in legal / institutional affairs in Croatia, EU and domestic transport legal experience is required, while understanding of local environment and local field experience is an advantage, but a minimum of 5 years required.
 - Education: University degree in Law or a relevant, directly related discipline, or equivalent
- Senior IT Expert
 - preferably 10 years' of experience in IT advisory in developed and emerging economies, experience in analysis of the transport IT systems is required, while understanding of local environment and local field experience is an advantage
 - Education: University degree in Electrical Engineering / IT or a relevant, directly related discipline, or equivalent
- HR Expert (10y); local experience is required
- Marketing Expert (10y); local experience is desirable

- Civil Works Advisor (10y) with experience in construction project management / bidding documents; local experience is desirable