Electronic Fee Collection Systems

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Toll

- **Toll** – a charge for the usage of the road infrastructure subject to the charge
- **Classifications**
  - Charge events: Discrete (Open / Closed) / Continuous (TDP)
  - Charging: Manual (non-free flow) / Automatic (free-flow)
  - Objective: RoI / O&M budget / Tax / Traffic regulations
  - Geo-characteristics: Urban / Inter-urban areas (congestion pricing / tolling)
  - Technology: DSRC / Tachograph / GNSS / CN
  - Legal nature: Levy / Tax
- **User Charge**

Discrete vs. Continuous

- **Discrete**
  - Road-side infrastructure
  - Might be considered unfair
  - Effects on spatial planning
- **Continuous**
  - Fairer
  - Need for the RSE is reduced significantly

Charge Object

- **An object, usage of has been subject to a charge**
- **Charge object** type:
  - Cordon (oslo, Trondheim, Bergen)
  - Area (London)
  - Section (tunnels, bridges, city rings, etc.)

Objectives

- Taxation
- Funding for the operation and maintenance or building new parts of the infrastructure
- Polution reduction
- Traffic regulation

Implementation of an EFC system

- Role of stakeholders
- Public awareness (campaigns, questionnaires)
  - Swings & round-abouts
- Political will and support
- Implementation usually has to be done within 4 years
  - Feasibility study
  - CBA
  - Requirements specifications
  - Tender
  - Evaluation
  - Implementation
  - Operation

EFC system architecture

- **Road-side**
  - Tolling (DSRC only)
    - Fixed gantries
  - Enforcement
    - Fixed / Mobile / Portable / Manual (Handheld)
  - Other (LAC / CCC)
- **Back-office**
  - Tolling
  - Enforcement
  - Operation & Maintenance
- **OBE**

Roles

- **Toll Charger**
  - Tolling system operator
  - Enforcement operator
  - Scheme owner
- **Service Provider**
- **User**

Stakeholders

- Public authorities
- Suppliers
- Manufacturers
- Providers
- Users
- Users associations
- Politicians

Generic EFC system

- Tolling Sub-system
- Enforcement Sub-system
- Operation&Maintenance Sub-system
- User

Tolling sub-system

- Processes covered:
  - Charge objects definitions
  - Tariffs definitions
  - Charge records collection
  - Charge calculation
  - Payment & clearing
- Payment means types:
  - OBU (DSRC / GNSS-CN)
  - Non-OBU (mobile / cash / card / etc)

Enforcement sub-system I.

- Important to distinguish between:
  - Compliance checking
  - Enforcement
- Processes covered:
  - Check of users‘ compliancy
  - Collection and storage of the evidence
  - Penalties processing
- Enforcement strategy
  - Combination of system enforcement means
  - Public awareness

Enforcement sub-system II.

- System must be able to provide court-proof evidence
- System must be able to detect anomalies, which may indicate an offence or offences committed by the user
  - Swapped OBU
  - No OBU
  - Incorrect declaration of the attribute used in the tariff identification process
- All information collected shall be kept for the penalties management process and potential hearings at the court

Operation & Maintenance Sub-system

- Processes covered
  - Regular maintenance of the back-office & road-side facilities
    - Support levels
  - Customer service
  - Performance monitoring & reporting
- Some of the processes might be outsourced

Operators

- Tolling sub-system
  - Supplier / Scheme owner
- Enforcement Subsystem
  - Public authority (Customs)
  - Legal processes are usually not within the responsibility of the private company
- Maintenance & Operation sub-system
  - Supplier / Scheme owner
  - Third party

Technologies used in the EFC systems

- **Technologies used for the purpose of charging**
  - DSRC
  - GNSS-CN
  - Tachograph
  - Cameras (ANPR)
  - Combination of the above
- **Technologies used for the purpose of the enforcement**
  - Laser detectors & scanners (vehicle class detections)
  - Overview & ANPR Cameras (LPN recognition)
  - DSRC

Performance

- **KPI** - Key Performance Indicators
- Dependent on what is the subject of the tender during the introduction process:
  - Service (DBMo DBMFO=PPP)
  - Equipment (DB or DBM)
- In case the system is owned by the publiv authority, the KPIs should cover the performance of individual sub-systems as well:
  - KPIs for the RSE
  - KPIs for the BO
  - KPIs for the OBU
- False positives / Missed detections rate

DSRC-based EFC system

- Roads divided into segments (usually stretch between crossings)
- Open / Closed
- Road-side equipment (RSE) for both tolling and enforcement installed on the roads subject to charge
- Road-side equipment (tolling):
  - DSRC beacons
  - Road-side unit (controller)
  - Cabinet
- Charge to pay is calculated as a sum of lengths of segments vehicle has driven through (based on the detection)
- Cheap OBUs, expensive RSE

DSRC-based EFC system – DSRC transaction

- Using CEN DSRC 5,8 GHz
- DSRC transactions:
  - Communication between the OBE installed in the vehicle and the DSRC beacon installed on the gantry
  - OBU wakes up when the vehicle has entered the communication zone of the beacon
  - Beacon Service Table & Vehicle Service Table
  - Access Credentials along with the request
  - Authenticators along with the response
  - OBU HMI
  - Closure

GNSS-based EFC system

- Location information is collected from the satellite navigation system (majority of the systems use GPS)
- OBU turns on when the vehicle has entered the geographic area, which contains the road infrastructure subject to the charge
  - Thin / Thick client
- Road-side equipment installed on selected roads, depending on the purpose:
  - Localisation augmentation
  - Compliance Checking
- Charge is calculated as a sum of lengths of segments identified during the matching process

GNSS-based EFC system

- Possible use of additional sources of information (e.g. Tachograph)
- OBU might have a DSRC modul interated as well (e.g. due to compliance checking or localisation augmentation)
- Comparing to the DSRC system:
  - The autonomous OBU is more complex than the tag
  - Flexibility of road network to cover (additions)
  - No need for such amount of RSE
  - Larger emphasis on the enforcement (or compliance checking)

OBU

- Thin or Thick client (mostly applicable to autonomous systems) and Tags (DSRC)
- Considered as a „payment means“
- Off-board account for the majority of the system in the EU
- OBU collected by the user during the registration & personalisation process
- HMI is present on most OBUs
- Each OBU has unique ID
- OBU is linked to the vehicle (i.e. Vehicle licence plate number)

Congestion Charging

- Urban environment – different traffic characteristics than in the inter-urban environment
- Same technologies used as for the regular tolling (or the combinations)
- Usual objective is to reduce the pollution and traffic
- Peak time and off-peak time tariffs
- An alternative option for travelling is usually offered when congestion charging is introduced

Eurovignette Directive (1999/62/EC)

- toll' means payment of a specified amount for a vehicle travelling the distance between two points on the infrastructures referred to in Article 7(2); the amount shall be based on the distance travelled and the type of the vehicle;
- 'user charge' means payment of a specified amount conferring the right for a vehicle to use for a given period the infrastructures referred to in Article 7(2);
- Possibility of imposing tolls / user charges on motorways, higher class roads, bridges, tunnels
- Tolls and user charges may not be imposed at the same time for the use of single section of the road
- Tolls and charges shall not discriminate
- Setting up limits for the tolls and user charges

Interoperability

- Ability of two or more independent EFC systems operate in cooperation / conjunction
  - An OBU of one system could be used in other systems as well
- Foundations of the interoperability of the European EFC systems laid down in the EC „Interoperability Directive“ 2004/52/EC via definition of the EETS service (European Electronic Toll Service):
  - Definition of EETS
  - List of technologies to be used in the future EFC systems implementations
  - Schemes out of the scope
- EU-funded projects: CESARE, PISTA, MEDIA, MOVE-IT

Interoperability Directive (2004/52/EC) I.

- Lays down the condition necessary to ensure the interoperability of electronic road toll systems in the Community.
- Considers all types of road fees and entire Community road network (urban, inter-urban, motorways, major, minor roads, tunnels, bridges and ferries)
- Possibility of imposing tolls / user charges on motorways, higher class roads, bridges, tunnels
- Interoperability shall be achieved via introduction of European Electronic Toll Service
  - As complementary to the national electronic toll services
- Defines a set of technologies to be used 2007 onwards:
  - DSRC
  - GNSS & CN

Interoperability Directive (2004/52/EC) II.

- Provides for the usage of an On-Board Unit (OBU) through all the electronic toll systems in the MS (based on previously listed technologies)
- GNSS-based technology is of a preference
- Possible migration of the DSRC-based systems
  - Study on possible migration to toll systems using satellite positioning and mobile communications technologies by systems using other technologies launched in 2009
  - Outcome – technically feasible, but expensive
- Possibility of usage of OBU for other services – i.e. single contract with the Provider of the EETS service
- OBU / Contract shall entitle the user to use the whole network of road infrastructure

Interoperability Directive (2004/52/EC) III.

- EETS shall be independent of the fundamental decisions taken by the MS (vehicle types, purpose, etc.)
- EETS service shall be provided irrespective of the place of registration of the vehicle or nationality of the parties to the contract (i.e. road user can register the contract with any provider)
- The work of the standardisation bodies shall be used as much as possible (i.e. provide for the standards applicable to the electronic toll systems)

Standardisation bodies – CEN/TC 278

- http://www.itsstandards.eu
- European standardisation body
  - Established in 1991
  - 33 national MS (NSBs)
  - Over 300 nominated experts
- CEN/TC 278 deals with the ITS
  - 16 Working Groups: WG1 – Electronic Fee Collection
- Responsible for managing the preparation of standards within the field of Intelligent Transport Systems
- Cooperation with ETSI, ISO and potentially other standardisation bodies

EFC-relevant standards

- EN 14906 Electronic fee collection -- Application interface definition for dedicated short-range communication
- EN 15509 Road transport and traffic telematics. Electronic fee collection. Interoperability application profile for DSRC
- TS 17575 Electronic fee collection -- Application interface definition for autonomous systems
- 17573 Electronic fee collection -- Systems architecture for vehicle-related tolling
- Basic types:
  - Technical specifications
  - Technical standards (profile standards – relevant for the interoperability)
  - Technical reports

Standardisation bodies – ISO

- http://www.iso.org/iso
- International Standardisation Organisation
- ISO TC 204 deals with the ITS:
  - 18 Working Groups: WG 05 – “Fee and toll collection”

EETS Decision (2009/750/EC) I.

- Defines EETS – roughly speaking, a service allowing a user to use only one OBU for all EFC systems in EU
- Sets out the necessary technical specifications and requirements, and contractual rules relating to EETS provision
- Defines the roles and their obligations and rights
  - EETS Provider
  - Toll Charger
  - EETS User
- Contains definitions (e.g.):
  - EETS domain / EETS domain statement
  - Suitability for use
  - Interoperability constituent
- Defines relationships between the roles

EETS Decision (2009/750/EC) II.

- Defines the evaluation phases towards the equipment of the EETS Provider (i.e. EETS OBU) whether it complies with the requirements of the Toll Charger
  - Conformity to specifications
  - Suitability for Use

EETS – Toll Charger

- Toll Charger - means a public or private organisation which levies tolls for the circulation of vehicles in an EETS domain (e.g. RSD or MD)
  - Shall accept on a non-discriminatory basis any EETS Provider
  - Shall maintain EETS domain statement
  - The toll charged to EETS users shall not exceed the corresponding national / local toll
  - Shall accept any EETS OBU of any EETS Provider with whom the TC has a contractual relationship and which has been evaluated for its conformity and suitability
  - Shall provide for the “degraded mode of service”

EETS – EETS Provider

- EETS Provider - means a legal entity fulfilling the requirements of Article 3 and registered in a Member State where it is established, which grants access to EETS to an EETS User
  - Shall conclude contracts covering all EETS domains
  - Shall inform EETS users of his EETS domain coverage
  - Shall provide EETS users with EETS OBUs (within contract)
  - Shall provide customer services and support to the EETS User
  - Shall collaborate with the Toll Charger in the enforcement efforts

EETS – EETS User

- EETS User- means a (natural or legal) person who subscribes a contract with an EETS Provider in order to have access to EETS
  - May subscribe to the EETS service through any EETS Provider
  - Shall ensure that all user and vehicle data provided to the EETS Provider is correct
  - Shall operate the EETS OBU according to the EETS Provider's instructions
  - Shall pay for the usage of the service to the EETS Provider

EETS - history

- European Electronic Toll Service
- April 2004: Directive 2004/52/EC: Directive provides for the Setting-up of a European Electronic Toll Service (EETS) – this document enables the EETS
- October 2009: Decision 2009/750/EC of the Commission on the definition of the EETS and its technical elements (approved by Member States in the Toll Committee) – this document defines the EETS
- October 2012: EETS to be available for vehicles exceeding 3,5 tonnes and coaches (Obligation of Member States according to Art 3 (4) Directive 2004/52/EC – Interoperability Directive)

REETS – Regional EETS

- EU co-funded project (http://www.reets.eu)
- Member states involved: Poland, Denmark, Austria, Italy
- Aim is in fact to provide for the proof of concept of EETS as a service not only from the technical perspective:
  - Analysis phase
    - Contractual framework
    - Certification
    - KPI
    - Back-office interface
    - Interoperability management
  - Deployment phase
    - Info platform
    - Monitoring Testing / Implementation

Díky za pozornost

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