Electronic Toll Collection:
Project Management and Implementation

Presented by
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Introducing Mott MacDonald and ETC

- Mott MacDonald is a private engineering consultancy employing over 8000 people worldwide
- 2005 Turnover: €750M (US$920M)
- Key ETC experience:
  - Engineer for Dartford River Crossing ETC Upgrade (2002)
  - Automatic Number Plate Recognition systems architect for TfL Western Extension Zone
  - Government advisor for several ETC projects e.g. France, Greece, Poland, Thailand, Hong Kong, Brazil
What is Electronic Toll Collection (ETC)?

- Toll Collection – is the means for an Administrator to advertise charges for the use of road infrastructure.
- Electronic Toll Collection – is the means by which an Operator can automate the Toll Collection process.
- The Operator is appointed to remit toll revenue to the Administrator.
- ETC can be applied within a zone and/or to a set of road segments.
ETC: Determining the Key Success Factors (KSFs)

- Timetable for the introduction of the service
- Area of coverage
- Vehicle classification
- Revenue collection
- Enforcement
- System performance

The achievement of each KSF will determine the success of the ETC system
KSF: ETC Launch timetable

- Launch of the ETC service must coincide with revisions to any existing toll service.
- ETC Operator must agree with the Administrator how to minimise revenue loss during launch of the ETC service.
- The Operator may be required to compensate the Administrator for loss of revenue.
KSF: ETC Area of coverage

- Geographical area:
  - Zone-based
  - Road segment-based

- Diversion routes away from the ETC area
  - Local effects
  - National/Regional effects
KSF: Vehicle classification

• Applicable vehicle classes and exemptions must be considered e.g.
  - Motorcycles
  - Passenger vans
  - Heavy Goods Vehicles
  - Emergency/security vehicles

• Applicable criteria
  - Gross Vehicle Weight
  - Number of vehicle axles

• Applicable local and EU legislation

• Acknowledgment of environmental impacts in setting vehicle classification
KSF: Revenue collection

Accurate and timely revenue collection depends on a number of factors:

- **Accuracy of charging systems**
  - Security of funds transfer to ETC Operator

- **Integrity of Central Back-office facilities**

- **Integrity of Enforcement systems**
  - Accurate detection and reporting of ETC violators
  - Legislation allowing the pursuit of offenders through civil and criminal action
KSF: Enforcement

- Parallel but independent system monitoring the accuracy of the ETC system
- Deployment of fixed and mobile enforcement equipment to detect violators
- Flexibility of solution to address temporary enforcement requirements
- Sufficient coverage to detect:
  - Diversion vehicles
  - Violating vehicles
- Accurate reporting of violation records for penalty charges
KSF: ETC System performance

- The Administrator will appoint an Operator to design and operate the ETC system.
- The Operator will be responsible for achieving the KSFs to pre-agreed levels on behalf of the Administrator.
- The Administrator may penalise the Operator for failing to achieve stated levels of performance.
ETC Technology

- The choice of ETC technology is important however:

  - The delivery of the ETC service and achievement of KSFs is independent of the ETC technology
What are the benefits of ETC?

- **Administrator:**
  - Clear revenue stream to justify/repay expenditure in infrastructure
  - Demand mechanism to control/reduce congestion
  - Establishment of vehicle database for enforcement and Value-added services

- **User:**
  - Clear price structure for use of infrastructure
  - ‘User pays’
  - Reduced congestion

- **Society:**
  - Improved efficiency of road infrastructure
  - Reduced environmental impact from fewer stationary vehicles
  - Availability of funds to support public transport initiatives
Issues and pitfalls for ETC

- **Revenue**
  - What is the expected revenue stream, who carries the risk?

- **Enforcement**
  - Are systems in place to detect offenders and recover unpaid charges

- **Diversion**
  - Good planning is required to reduce/eliminate potential diversion routes

- **System expansion**
  - Planning prior to implementation will reduce/eliminate unnecessary roadside infrastructure

- **Interoperability**
Interoperability – a big issue for ETC

- The EFC Directive (2004/52/CE) was adopted by the European Parliament in 2004
- The Directive will lead to the creation of the European Electronic Toll Service (EETS)
- EETS Timetable:
  - Stage 1: Service definition 1 July 2007
  - Stage 2: HGV and Coaches mid-2009
  - Stage 3: All vehicles mid-2011
The Principle of the EETS model
EETS principles

• One contract, one on-board unit per vehicle

• Available on whole tolled network, however:
  - “The Directive will not interfere with the pricing policies of European Member States, but the systems implemented under the Directive should be able to interface with any charging policy decided at national levels”

• Same quality of service expected in all countries

• Interoperability Manager role should be identified and filled as soon as possible to identify and resolve issues
The future of ETC

• EETS will become a reality within 5-10 years

• Priority should be given to the identification and appointment of the Interoperability Manager

• Operators should design and plan value-added services now e.g.
  - Emergency call (E-call)
  - Breakdown call (B-call)
  - Real-time traffic information
  - Fleet and location-based services
In summary

• Plan well
• Agree on risk profile between the Administrator and the Operator
• The Operator must ensure that all Key Success Factors are achieved
• Ensure that the ETC launch timetable is achieved

Thank-you
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About the author

Terry O’Neill is a Chartered Engineer with 15 years’ experience of project and engineering management (multi-disciplinary). He has key experience of the development of toll systems for the Slovak Republic, London, USA and Hong Kong.

Now the Head of Transportation Telematics and Controls on behalf of Mott MacDonald, Terry is responsible for the business and strategic management of all Transportation Communications projects with emphasis on providing state-of-the-art technological solutions to clients worldwide with particular emphasis on toll systems.

1 Abstract

The purpose of this paper is to provide an introduction to the project management and implementation of Electronic Toll systems. The early definition and resolution of key factors can contribute greatly to the success of an Electronic Toll Collection system. If implemented well the ETC system will contribute a low-risk revenue stream to the Administrator. However the key factors for each ETC implementation will vary and key success factors must be managed through the lifetime of the project, from system definition through to operation and revenue collection.

2 Why is Electronic Toll Collection (ETC) important?

Toll collection is a mechanism by which a road user and the Operator agree a basic commercial contract. The Operator states a charge for use of his road network, and the road user agrees to pay.

The concept of toll collection for use of transport infrastructure is not new.

The use of turnpike tolls for new roads and bridges has been commonplace since the Middle Ages. Many manual systems survive to this day. However ETC systems have been in operation since 1987 in Europe.

The purpose of ETC is to provide automation to the process of toll collection in order to minimise cost and maximise efficiency in the remittance of ETC funds by the Operator to the Administrator.

Since then ETC systems have been deployed throughout the world. But what distinguishes a successful system from a less successful deployment?

3 How can ETC be implemented successfully?

Every deployment of an ETC system has differing Key Success Factors (KSFs). However the following list is representative of the KSFs to be found on most schemes:
• Launch timetable for ETC service
• Area of coverage
• Vehicle classification
• Revenue collection
• Enforcement
• System performance

Each of these factors is dealt with in detail below.

Where the Operator fails to achieve any or all of the KSFs he may be subject to financial penalties.

3.1 Launch timetable for ETC service

The timetable for the launch of the ETC service must be agreed well in advance between the Administrator and the Operator. In cases where there is an existing toll service the Operator must ensure that there is no loss of continuity in revenue collection between the existing service and the new ETC service.

3.2 Coverage of ETC system

One of the first issues to consider is the geographical area that will be subject to the ETC service.

There are in general two classifications of geographical area for ETC:

• Zone-based schemes and
• Road segment-based schemes

A zone-based scheme will typically be an urban environment or a specific element of infrastructure (e.g. bridge, tunnel).

Road segment-based schemes will typically be specified road infrastructure, perhaps constructed by a road operator. Such schemes may be implemented on an urban, a regional or a national basis.

During the planning phase consideration must be given to diversion effects around the ETC area, where users intentionally avoid paying ETC charges through the use of alternative non-ETC routes. This was a key concern prior to launching the London congestion charging scheme and several traffic schemes were put in place to counter this.

Where a national scheme is being proposed, diversion may take two forms:

• Diversion of traffic on to local roads outside the ETC area, causing excessive delays and negative environmental effects, or
• Diversion of traffic outside national boundaries, leading to high traffic volumes on key sections of road infrastructure, which may be unpriced.
During the design phase careful consideration must be given to the area of coverage proposed for the ETC and the roadside infrastructure that will be required to minimise diversion effects.

### 3.3 Vehicle classification

The Administrator must decide which classes of vehicles will be subject to ETC tolls, and which will be exempt. This should be identified as part of any existing or planned legislation.

Currently in Slovakia all vehicles of Gross Vehicle Weight of 3.5t and above are eligible for the payment of a Vignette charge. However this system provides no distinction between occasional users and frequent users; all pay the same charge.

It is now widely recognised that the size and weight of a vehicle have direct impact on the road infrastructure and therefore heavier vehicles should incur a larger charge to reflect this. A well-designed ETC system allows the application of variable tolls and also allows that users only pay for their direct usage, regardless of whether they are occasional or frequent users.

### 3.4 Revenue Collection

Of no less importance is the collection of ETC revenue.

Although the Administrator can predict expected revenue levels, the responsibility for the collection of revenue and the identification of toll violators will be left to the party responsible for the design and implementation of the ETC system, known here as the Operator.

All ETC systems, irrespective of coverage, require three principal sub-systems in order to function efficiently:

- Charging
- Enforcement
- Central services

The Charging sub-system consists of components to record the charges incurred by the road user against an agreed and published tariff, and to inform the operator to allow recovery of these costs. This may include vehicle-mounted equipment as well as roadside equipment.

The Enforcement sub-system detects those users who are not complying with the relevant charge regime. The Operator reports non-compliant users to the Administrator.

The Central services sub-system collates road use charging data for billing and recovery purposes.

### 3.5 Enforcement

The Operator must report on a regular basis to the Administrator with records of ETC violators. This may include:

- Vehicles within the ETC area with defective or missing on-board ETC equipment
- Vehicles within the ETC area with incorrect vehicle classification

The Administrator may choose to make user of mobile units to carry out enforcement duties in real-time.
The Operator must provide full photographic information and evidential records to the Administrator such that the violator can be either stopped whilst en-route, or subsequently through the use of civil and criminal courts.

### 3.6 System performance

For most toll schemes the Administrator will ‘out-source’ the implementation and operation of the ETC system to an Operator. In such instances the Administrator expects that the Operator is much more experienced in the design and implementation of ETC systems.

The Administrator will lay down performance criteria for the Operator that can be monitored in a transparent manner by an independent third party (e.g. the Engineer to the Contract).

This transparency is important because modern international contract conditions assume that the Engineer can monitor the project on behalf of the Administrator.

Key performance criteria for the Administrator and Engineer to monitor will include:

- Launch of the ETC system to an agreed timetable
- Transfer of ETC funds to the Administrator by the Operator
- Accuracy of charging data produced
- Ability of the Operator to detect and report violators

The Administrator and Operator will agree the level of performance expected against each of the criteria during the operation of the ETC system, with appropriate penalties for failure to achieve the agreed performance levels.

The Administrator generally will not seek a solution from the Operator that is based on a particular technology solution. Rather the Operator will be required to demonstrate optimal achievement against key performance criteria regardless of the technology deployed as part of the ETC system.

### 4.0 What are the benefits to be gained from ETC implementation?

Benefits to the user and the Administrator are distinctly different as may be described below:

**Administrator:**

- A clear revenue flow that provides justification for his investment in infrastructure
- A demand mechanism to control and reduce congestion through time-shifting of peak demand
- Establishment of an accurate database of road users for enforcement and also for subsequent provision of value-added services

**User:**

- A clear price structure for use of the road infrastructure on a per usage basis
- Reduced congestion in key areas (e.g. urban areas, bridges etc) leading to improved journey times
Consideration should also be given to the wider benefits available from the implementation of ETC. These may be summarised as follows:

- **Improved efficiency of road infrastructure**
  As the Administrator is able to monitor usage demand benefits can be derived from improved efficiency of road infrastructure, particularly at key ‘bottlenecks’.

  The availability of such demand information may in turn allow the Administrator to provide real-time travel information to road users. These were key drivers for the Hong Kong Transport Department when considering urban charging in 2000.

- **Reduced environmental impact**
  Environmental benefits can be gained from reduced congestion, thereby reducing the presence of Carbon Monoxide (CO) and Nitrous Oxide (NO) produced by stationary or slow-moving vehicles. This was a stated policy objective of Transport for London (TfL) when introducing the London congestion charging scheme.

- **Use of ETC funds to support public transport**
  Where agreement can be reached between the road Administrator and local government, funds raised through ETC may be used in part to support public transport services, thereby providing viable travel alternatives. Again this was supported by TfL before and during the launch of the London congestion charging scheme.

5.0 **ETC Issues to consider**

In order to design, implement and maintain a successful ETC system, consideration must be given to the following issues:

- **Revenue stream**
  The Administrator and Operator must agree on the expected level of toll revenue, and further what level of return can be expected by the Administrator.

  Equally the Administrator and Operator must be able to agree the expected level of return to both Administrator and Operator to avoid conflicts during operation.

- **Enforcement**
  A legal framework must exist to allow the deployment of an ETC system, and more importantly the legal framework must provide powers to the Administrator to recover non-payment of ETC charges from Users. In addition the Administrator must receive full support from the relevant government entities in the recovery of ETC charges, either through the civil or criminal justice system.

- **Diversion/System expansion**
  Consideration must be given to counter-acting diversion effects and also possible future expansion of an ETC system.

  These issues must be identified and addressed at the planning stage for an ETC system. With any technical solution that is proposed for ETC a certain amount of roadside infrastructure will be required. Every effort should be made to avoid designing roadside infrastructure that may become obsolete following an expansion of the ETC system.

- **Privacy**
The Operator must demonstrate visibly that the privacy of road users will be protected. This will require clear policies on the recording and retention of vehicle and user information, and how such information will be used for enforcement purposes.

- **Interoperability**

  The EFC Directive (2004/52/CE) was adopted by the European Parliament in April 2004, and is due for ratification by national parliaments.

  The Directive will lead to the creation of the European Electronic Toll Service (EETS). The Directive describes a regulatory framework for the deployment of EETS in three stages:

  - **First stage**: definition of the service for 1 July 2007
  - **Second stage**: HGV and Long Distance Coaches, planned for mid-2009
  - **Third stage**: all vehicles, planned for mid-2011

  The Directive will not interfere with the pricing policies of European Member States, but the systems implemented under the Directive should be able to interface with any charging policy decided at national levels.

6.0 **Summary**

The successful deployment of an ETC system will depend upon the following:

- Clear timetable for introduction of the ETC service
- Clear definition of the area to be covered by the ETC system
- Unambiguous system of vehicle classification
- Clarification of responsibilities for the collection of revenue
- Clear definition of the performance criteria for the ETC system

The Administrator and Operator can work closely together to achieve a satisfactory outcome for both government and road user.