



## Why is technology important for the implementation of road user charging?

Governments should define objectives and design the charging scheme and then consider the appropriate technology. However, some technologies are not mature enough to implement in the very near future. Technology also plays an important role in the implementation process because of the need to reduce capital and operating costs. Technology also affects the implementation process via acceptability. Road user charging means that the presence of vehicles in a certain charging area will have to be tracked. Storage of these tracking data may cause privacy and civil liberties concerns which might affect the implementation process.

Key challenges for technology include reliability, cost of implementation and of operation. Well-designed technology can provide greater flexibility in choices, e.g. by enabling more complex charging schemes and overcoming equity concerns by permitting varying charges and exemptions for different types of user. A range of options exist, and technologies have evolved over time.

## What is currently known about road user charging technology?

The traditional cash based toll collection systems combine charging and payment into one event. For electronic charging methods, we need to differentiate between charging and payment. The charging and payment processes are strongly linked to the enforcement process, regardless of the choice of charging technology.

It has been argued that the three electronic technolo-

gies described in the table on the next page are not competitors, but should be regarded as complementary: DSRC to permit vehicles to be identified and localised for enforcement purposes, GNSS/CN for distance based measurements, and ANPR to identify occasional users and to capture image-based evidence sufficiently reliably to be acceptable in court.

## Payment

Several options and payment channels exist for the transfer of funds between the user of electronic charging and the scheme operator. The case studies give more details.

## Enforcement

A charging system cannot exist without enforcement. An enforcement strategy needs to be based on three fundamental objectives:

- ensuring that charging policies and payment rules are followed by all road users,
- informing and raising awareness of scheme requirements to deter non-payment and
- ensuring that the fees are paid.

## Costs

Operating costs of existing systems vary between 4% and 48% of the revenues. The Swiss system with 4% is the cheapest system, the London Congestion Charge with 48% the most expensive. Differences in cost to revenue ratios between existing systems depend on factors like the level of charges, traffic volumes, constraints leading to high collection costs and technology used.

CHARGING	CHARGING CONCEPT	ADVANTAGE	DISADVANTAGE
Manual toll collection	Point based	Highly reliable and accepted	Creates congestion around toll collection areas Space consuming
Paper Licences	Point or area based	Simple and cheap	Limited number of classes Difficult distribution, purchase arrangements and enforcement
Electronic , automatic Number Plate Recognition (ANPR)	Point or area based	Most mature	Requirement for street furniture High costs
Dedicated Short Range Communication (DSRC)	Point or area based	Can be used with a variety of charging concepts	Requirement for street furniture
Global Navigation Satellite Systems (GNSS)	Distance or time- based, entire network	Most sophisticated Street furniture required only for enforcement	Operational problems with 'urban canyons' and parallel and close highways. High costs of on-board-units

### What further research is needed?

Further research is needed to enhance the accuracy of position systems required for distance-based road charging systems. ANPR works well but does not recognise all vehicles. Improvement of Optical Character Recognition is necessary to enhance the performance of ANPR. And last but not least, research is needed to decrease the investment and operational costs of distance-based road charging systems.

### What can we conclude at present?

Dedicated Short Range Communication (DSRC) and Automatic Number Plate Recognition (ANPR) are mature technologies for charging road use. The following Dos and Don'ts should help to increase the likelihood of a successful road user charging implementation.

#### DOs

Policy objectives should drive technology: the technology is only the enabler of the policy, not the drive

Define the system requirements first and then choose the technology

Treat charging and payment as separate events

- Charging relies on capturing evidence of a vehicle's presence at a specific location at a specific time. It is strongly linked to the enforcement system
- Payment concerns transferring funds from the user of an electronic charging scheme to the scheme operator. Several methods of payment can be used, and drivers may pre-pay or post-pay

Consider using a DSRC or straightforward ANPR system if distance-based charging is not essential to achieve the scheme's objectives

Keep costs down to provide sufficient revenues to finance other elements of the integrated transport strategy

#### DON'Ts

Do not automatically opt for GPS based systems if the policy is zonal based charging.

Do not delay implementation by waiting for the perfect solution

Do not start with too complex solutions. Start simple and expand later

Do not underestimate the importance of investment and operational costs. They are critical in the choice between different technologies

