µDeclarations, charge cards & enforcement

Agenda

- The enforcement scenario
- µPayments / µdeclarations and enforcement
- Confidential µfee messages (depreciated)
- µdeclarations via a charge card
- Charge cards and interoperability

The goal is to show the use of a smart card with micro-declarations in order to:

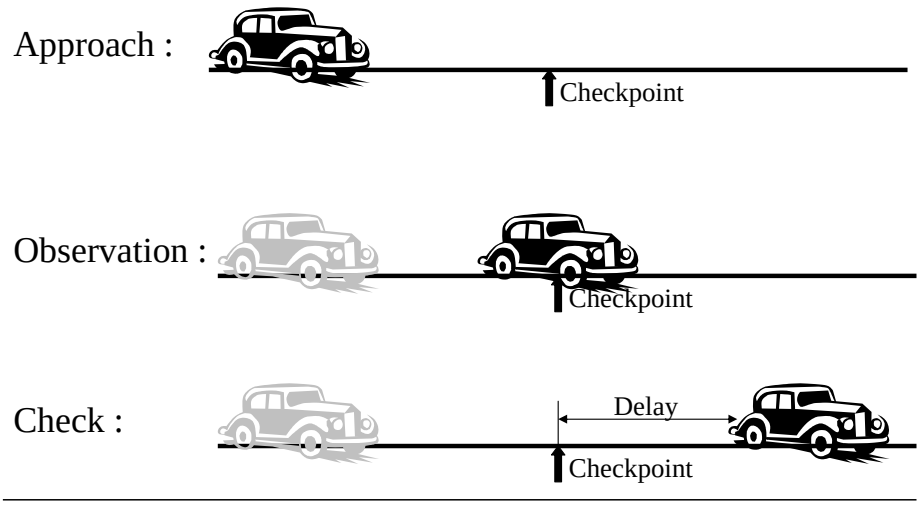
- protect the privacy of drivers and

- to minimize the network capacity required

With µPayments / µdeclarations payments or declarations are done in small amounts, i.e. e.g. for every kilometer of for every few kilometers.

With micro declarations the driver /vehicle only declares how much he is obliged to pay. The actual payment will occur later, e.g. upon receiving an invoice (or tax notice) based on his declarations.

The enforcement scenario



For every of the following scenario's 3 phases are distingquished:

1. The period before a vehicle passes a check-point
2. The observation of the vehicle at a check point
3. The moment at which the data obtain by the observation has been check at which it can be determined whether or not the µPayments / µdeclarations before the checkpoint were correct.

If the delay is short enough the vehicle can be stopped if the declaration or payment was incorrect.

Note that the last µPayments / µdeclarations before an arbitrary and unexpected checkpoint were correct, one also gains confidence that all other µPayments / µdeclarations were correct.

µFee messages to centre (1)

Approach :

Checkpoint

- µPayment or µdeclaration to a centre containing at least :
  - Vehicle identification
  - Location (and time) of endpoint micro fee trajectory
  - µFee
- The check point is unexpected !

In this case all µPayments / µdeclarations are send by the vehicle to an operating centre.

It should be note that the approach of a check-point should be unexpected.

If not fraud will be easy, the vehicle will only send correct µPayments / µdeclarations if it expects an check point and if may try to send false one if that not the case.

However, not that the operating centre can perform some consistency checks:

1. The trajectories for successive µPayments / µdeclarations shall be connected,
2. if the time is send too, the speed shall be within reasonable limits, and
3. The µfee shall correspond to the location (road) and, possibly, the time.

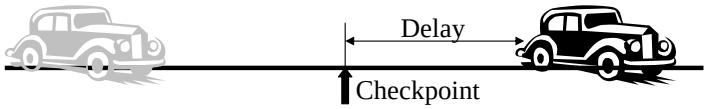
µFee messages to centre (2)

Observation :

- Unexpected observation and registration of:
  - Vehicle identification (e.g. video)
  - Checkpoint location
  - Observation time
- No communication with the vehicle required

µFee messages to centre (3)

Check :



- Central comparison of µfee and observation :
  - If a match than okay
  - If not apply enforcement measures
- If small delay => the vehicle can be stopped
  (requires on-line communication with centre)

At the operation centre it canbe checked whether or not a µPayments / µdeclarations has been received on a trajectory just before the checkpoint.

If so and if this µPayments / µdeclarations was okay, it is okay.

If not, or if the µPayments / µdeclarations was not okay, than enforcement measures should be applied.

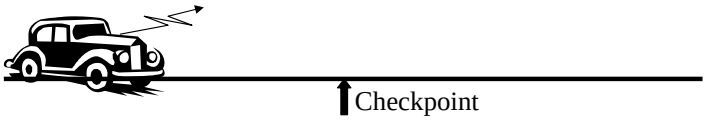
µFee messages to centre (4)

- Advantages:
  - Simple enforcement procedures
  - No short range communication with vehicle required
- Disadvantages:
  - Communication load (lots of µfee messages)
  - Privacy (the centre can monitor mobility patterns)

Because the detailed information in the µPayments / µdeclarations the operating centre can determine the mobility pattern of the vehicle and, therefore of the regular driver.

Confidential µFee messages (1)

Approach :



- µpayments or µdeclarations to a centre with:
  - Fee
  - Hash code over location (and time) information
  - Location and time info is retained, not sent
- The check point is unexpected

In this case the trajectory information is not send to the operation centre but registered in an administration to be kept by the owner / driver.

Confidential µFee messages (2)

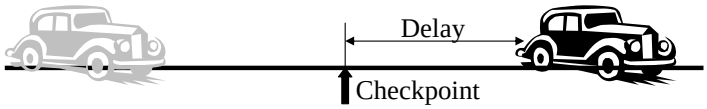
Observation :

- Unexpected observation and registration of:
  - Vehicle identification (e.g. video)
  - Checkpoint location and observation time
  - Last µfee message(s) sent to the centre
- Communication with the vehicle required

In order to be able to check whether or not the last µPayments / µdeclarations were correct, the observer must now obtain the details of these µPayments / µdeclarations from the vehicle (as only the µfee and a hash code has been send to the centre).

Confidential µFee messages (3)

Check :



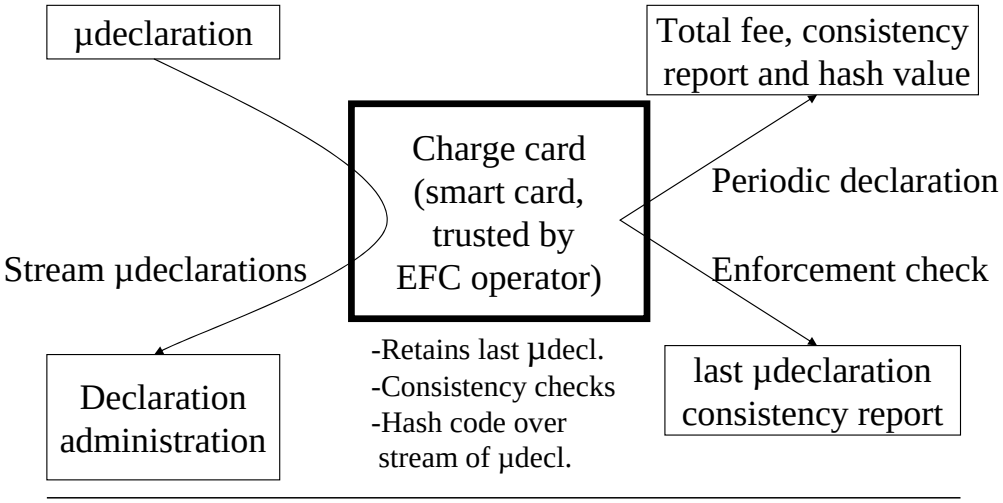
- Comparison of µfee and observation :
  - Calculate hash code over messages received at checkpoint
  - If within a reasonable timeframe µfee message(s) with the same hash code has been received then OK
  - If not apply enforcement measures
- If small delay => the vehicle can be stopped

In this case the operating centre must have received a µPayments / µdeclarations with the same hash code as can be calculated form the data obtained from the vehicle at the check-point.

Confidential μFee messages(4)

- Advantages:
  - Privacy
    (the centre can monitor mobility patterns)
- Disadvantages:
  - Communication load (lots of messages)
  - Requires short range communication with vehicle

An in vehicle charge card



In this case all µdeclarations are passed via a smart card which acts as a remote agent (trusted device) of the operating centre.

The smart card calculate totals, performs consistency checks(see the slide ‘µfee messages to a centre (1)’ before) and stores the last µdeclaration.

In this case no µPayments / µdeclarations are send to an operating centre but only a periodic, say monthly declaration.

The µdeclarations registered in an administration to be kept by the owner / driver.

Note that smart card also calculates an hash code over all the µdeclarations for each declaration period. This hash code can also be re-calculated over the µdeclarations registered in the owners/drives administration. It therefore be detected wheter or not the information in this administration has been changed.

Vehicle with charge card (1)

Approach : 

Checkpoint

- µdeclarations to the smart card:
  - Declaration with fee, location and time information
  - Card retains totals and last 2 µdeclarations
  - Card performs consistency checks, calculate totals
- The check point is unexpected, if not:
  - Plausible declaration while approaching
  - Possible false declarations if not

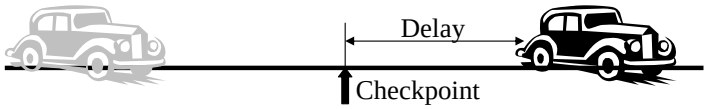
Vehicle with charge card (2)

Observation :

- Unexpected observation and registration of:
  - Vehicle identification (e.g. video)
  - Checkpoint location and observation time
  - Last µdeclarations passed to the smart card
- Communication with the vehicle required

Vehicle with charge card (3)

Check :

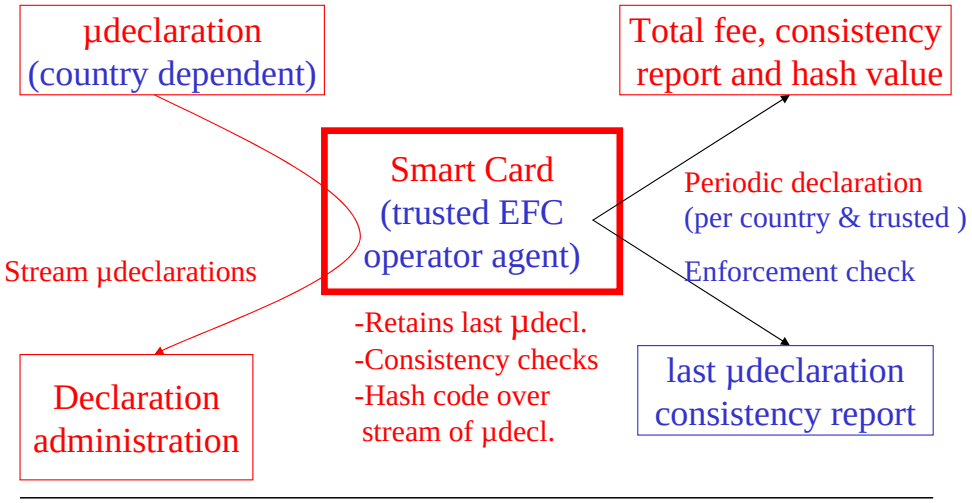


- Local check of last µdeclaration :
  - OK if for a reasonable trajectory with correct fee
  - If not apply enforcement measures
- If small delay => the vehicle can be stopped

Vehicle with charge card (4)

- Advantages:
  - Privacy (mobility patterns can not be monitored)
  - Much less communication capacity required
- Disadvantages:
  - Requires short range communication with vehicle
  - Extra administration burden for vehicle owner

Charge card & interoperability (1)



Charge card & interoperability (2)

Approach :

- ‘Red’ vehicle in a ‘blue’ country
- µdeclarations to the smart card:
  - Also conform local (blue) rules

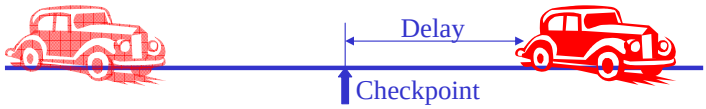
Charge card & interoperability (3)

Observation :

- Unexpected observation and registration of:
  - Vehicle identification (e.g. video)
  - Checkpoint location and observation time
  - Last µdeclarations passed to the smart card
- Interoperable communication required

Charge card & interoperability (4)

Check :



- Local check of last µdeclaration :
  - OK if on a reasonable trajectory with correct fee
  - If not apply enforcement measures (via home country?)
- If small delay => the vehicle can be stopped
- EFC operator host country should be trusted