# ELECTRONIC TAX COLLECTION FROM HEAVY VEHICLES

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## ABSTRACT

The road stress and wear caused by heavy vehicles entails costs far in excess of the amounts collected through fuel taxes. Information about heavy vehicle traffic makes the road authorites better equipped to manage such traffic and to estimate maintenance needs and road durability. Incorporating vehicle counting and classification into an advanced electronic fee collection scheme for heavy vehicles would enable the road authorities to obtain the information needed for improved road stress evaluations.
An electronic reading is a relatively simple first step in electronic billing. Adding time and place would be a logical next step which, however, increases the complexity level as it calls for more sensors and increased differentiation. This step can be implemented through central data processing. The third step in electronic billing and the most advanced is to have digital maps and processing inside the vehicle. All steps have in common the return of the data obtained over the telephone network or by other means. How big a step to take is not only a matter of technical capability and cost, but also a matter of privacy concerns, existing systems, implementation policies and incentives.

## 1. HEAVY VEHICLES

Heavy vehicles cause stress and wear on the roads representing costs far in excess of the amounts collected through fuel taxes. Our estimates conclude that heavy vehicles are responsible for 99% of structural road damage [3]. To prevent greater damage, axle weight limitations are applied and enforced. Monitoring equipment is set up to count and classify the traffic, generating figures for among other things traffic analyses and trends. Road carrying capacity is systematically measured with falling weight deflectometers. A network of electronic frost depth sensors are installed at strategic locations for road network coverage, providing data about the sub-base road conditions at various depths, for frost-thawing analyses. Currently under development is a real-time frost depth forecast model for thaw-induced axle load limitation management [2]. Furthermore, notifications are broadcast about axle weight limitations, an email sent to major truck companies and notices put on traffic information systems. Because of this road stress and wear, special charges are widely levied on heavy vehicles, often in the form of distance charges. Driven distances are measured and stored by digital tachographs which are the devices used to deliver reliable metering, already installed in all newly imported vehicles. Digital tachographs are calibrated and certified by authorised garages prior to use. For tax collection purposes, manual readings of the digital tachographs are imposed twice a year with corresponding effort and earning losses for the truck companies.

Distance taxes are levied on heavy vehicles with total weight exceeding 10 tonnes. The allowable total weight is often higher than the actual weight, particularly on a return trip if a truck is not moving goods round trip. Weight levies could be evened if the charge was based on the actual load, measured with load sensors which can be found in many heavy vehicles today, rather than the maximum allowable total weight.

The road authorities would like to know the actual road burden at any given time, in particular the stress from heavy vehicles on roads with weak or weakened carrying capacity. If it is possible to get good information on heavy vehicle traffic, the road authorites would be better equipped to manage the heavy vehicle traffic, estimate maintenance costs and road durability [3].

## 2. ELECTRONIC TAX COLLECTION

Technically it is a relatively easy task to establish a road use taxation scheme with electronic billing but there are many obstructions, technical, economic, administrative and social which must be overcome prior to such establishment.

Logically it would be convenient to introduce such an electronic taxation scheme first for heavy vehicles, as this vehicle group is already taxed according to mileage in addition to fuel taxes. Two approaches seem indicated for relatively simple implementation in the near future. One, to modify a digital tachograph with an additional module to transfer date and mileage data already collected by the digital tachograph to the revenue office. The other, to enable fleet management firms, with vehicles participating in reliable fleet management, to deliver vehicle mileage data for the tax levies, given adequate quality control [3].

Such a scheme results in minimal economic and administrative overhead, reduces stops for manual readings and provides an incentive to the truck companies to spend less time on red tape.

Some road-use taxation schemes propose to take this further and require the addition of location to collected data [1]. The primary reason is to enable location-based, or location and time-based, price differentiation. This request adds substantial complexity to the scheme. Before implementation, careful reasoning should be given to the matter, considering and reconsidering. Today we have only relatively simple vehicle mileage reading. Adding location means adding new equipment to the vehicle fleet for locationing and integrating it with the vehicle mileage readings from the certified digital tachograph.

### 2.1. Embedding new equipment

Adding new on-board equipment in today‘s heavy vehicles requires expert knowledge. It is an intervention, a foreign object, which can only work adequately if it is installed perfectly. Heavy vehicles have an electrical main switch which digital tachographs and localising equipment frequently bypass. This is to ensure power to the devices, also when the switch is off.

For locationing purposes the on-board unit needs a global navigation satellite systems (GNSS) receiver, preferably an in-built receiver to cut the cost of installation but without losing its receiving sensitivity. The same applies for a communications antenna. This scenario is, nevertheless, fairly unrealistic. To ensure a good satellite connection, an exterior GNSS-receiver is often needed as well as an external communications antenna. This may involve expensive installation. Recent developments in GNSS-receiver sensitivity mitigates this somewhat and the GSM-network range and coverage is expanding. However, external components increase fault risks as they are understandably more vulnerable in relation to wear and tear [3].

This being said, standardisation would help the development considerably. Pre-installed standard plug-ins for power, pulse count and ingeniously designed placements for on-

board equipment, antennas and receivers by truck/car manufacturers would minimise installation costs. Installation of such equipment would then be a straightforward task, with the main investment being the on-board equipment and communications services. In the near future the price for such on-board equipment/devices will not be insurmountable given the quantities needed.

Technical problems are constantly being solved, making a road-use taxation scheme an attractive solution to counteract reductive income from fuel taxes.

As a pulse count connection requires expert installation, there is considerable interest in basing mileage solely on the GNSS-signal [1]. Our experience is that it can be used for mileage approximation but does not replace vehicle mileage derived from a pulse counter. If the GNSS-signal is lost, this affects the mileage, time and location. For general taxation purposes, mileage must be undisputed. Having both the mileage derived from a pulse counter and from a GNSS-receiver, one would certainly complement the other, making a road-use taxation scheme more reliable and accurate [3].

### 2.2. Digital maps and internal processing

If you add digital maps and internal processing to an on-board unit with a GNSS-receiver for location, a pulse counter for derived mileage and a communications device, you have a setting with enormous potential functionality.

For taxation purposes it is possible to have time and localised tax differentiation. For the road authority it is possible to count and classify actual vehicle trips and mileage on roads and road sections and so forth. The on-board unit thus becomes an integrated counter and a classifier representing actual road stress and traffic patterns. With on-board processing this can be done as anonymously as wanted without curtailing personal rights, as there is no need for vehicle tracking, only periodic summary reports to the responsible authority [3].

### 2.3. Stepwise implementation

How big a step to take and how to proceed, is not only a matter of technical capability and cost, but also a matter of privacy concerns, existing systems, implementation policies and incentives. Costly installation and equipment can today be justified for transcontinental heavy transport fleets involving complex transborder pricing schemes but in a lesser degree for localised transport. Other reasons may include traffic management in cities or purely an interest for localised price differentiation as it opens up a variety of possibilities [1].

An electronic road-use taxation scheme should, from an ideological viewpoint, begin where an established revenue system is not available or where there is a need to expand or modify an existing one. This may apply for an existing heavy-vehicle mileage taxation scheme or a scheme for taxation of alternative fuel vehicles, which are generally not subject to a road taxation scheme today. The optimal solution would be to make a transition to a new scheme more attractive by providing incentives for the change. One should not forget that in the transition period both schemes must be able to coexist. This is one of the complications involved when changing from a fuel-based taxation scheme to a road-use taxation scheme [1]. It isn‘t feasible to have two systems running at the same time, with no effective control measures in place.

## 3. CONCLUSION

Electronic fee collection from heavy vehicles is technically feasible with minimal embedding and economic obstacles. Expanding such a scheme to cover other vehicles could be justified for alternative-fuel vehicles which are mostly exempt from road-use taxes today. Changing the general tax scheme from fuel-based to mileage-based should preferably be associated with car manufacture embedding standardisation and modifications for cost reduction to ensure real revenue earnings from the new scheme.
Adding location to the electronic fee collection opens up a variety of possibilities and of complications as well. Including electronic maps and internal processing can mitigate privacy concerns and help road authorities to obtain actual data on road burden and traffic.

## REFERENCES


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