Implementation of noise-related track access charges

Annex to

“UIC Status report and background information on noise-related track access charges”

Author: Peter Hübner, dipl. Ing ETH, CH-8706 Feldmeilen; e-mail: peter.huebner@bluewin.ch in close collaboration with the UIC-CER-EIM-working group noise

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0. Executive summary

Railway noise reduction is on the political agenda.The Commission's Communication on railway noise, published in July 2008 as part of the Greening Transport package, recognizes that the most efficient way to reduce railway noise consists in retrofitting the existing freight fleet to low noise technology using composite brake shoes instead of cast iron shoes. The Commission wishes to stimulate the retrofitting process by introducing noise related track access charges (NRTAC), first on a voluntary basis, then through a mandatory regulation. The noise related component of the track access charge will first be a bonus for low noise trains or vehicles, later on it can be complemented by a malus for noisy trains or vehicles.

This requires braking technology that is available, safe and economical. Status of these developments is documented in several UIC documents, for example the UIC Status Report 'Noise Reduction In Rail Freight (2008); it is regularly updated in UIC's newsletter 'Focus' (Feb. 2009). All information is available at UICs homepage. http://www.uic.org/spip.php?article1718.

In 2007 UIC published a report concerning NRTAC (http://www.uic.org/spip.php?article1721)**.** The report sets out the prerequisites for NRTAC and shows the complexity of the introduction of NRTAC. The introduction of NRTAC will need new processes and, perhaps, new technical means for tracking single wagons and to record of tracking history on the various networks. This paper forms an annex to this report and was elaborated jointly by CER, UIC and EIM; it will provide an overview on the various implementation possibilities for introducing NRTAC, and the related technical and financial consequences. It is also intended to provide input to the study which DG TREN has commissioned to a consulting group to carry out and to produce results by autumn 2009.

This annex starts with an overview of the two existing implementations of NRTAC (in Switzerland and the Netherlands) as well as of existing pilot applications to monitor existing noise in the Netherlands. It then provides a description and evaluation of tools and processes which might be used for the purpose of NRTAC. The investigated solutions include an overview on the existing international data exchange between the railways, an evaluation of the use of costumer consignment note data, an analysis of the various wagon register data in use, an evaluation of the wagon tracking technologies including RFID-technologies, GPS-technology and video technology. Special emphasis was laid on an evaluation whether to use the technology offered in the framework of the TAF TSI. It then examines the cost considerations and gives an overview of the costs related to the rolling stock itself (retrofitting costs, design and homologation costs, operational costs) and the transaction costs (investments costs and costs caused by the data collecting and billing process).

The report concludes that, for a fast implementation of NRTAC, the availability of LL-blocks will be a prerequisite. The total costs of retrofitting, even with LL blocks if homologated, are high and cannot be afforded by the rail sector itself. Then national solutions and implementation of the needed processes on these systems have to be introduced as a further precondition for implementation of NRTAC. As needed information cannot be exchanged between RUs and IMs by existing systems, self declaration of kilometers run by low noise vehicles on "lines sections subject to NRTAC" as implemented in Switzerland and the Netherlands could be a quick solution. At a later stage, the automated tracking could be supported by deployment of TAF TSI, but this will need national implementation and significant adaptations of company internal business processes and IT.

The implementation of NRTAC will be a complex undertaking where measuring and billing systems (especially if self declaration was not be accepted) as well as financial flows will have to be organized and safeguarded. Special care has to be taken that NRTAC will also in reality form an incentive for retrofitting. Depending on the technique used, the transaction costs could reach the or even exceed magnitude of the retrofitting cost.

In this context, the other scenarios in DG TREN's Impact Assessment, in particular the use of direct subsidies for retrofitting instead of, or to complement NRTAC, should not be excluded.

1. Introduction

1.1. Background

Railway noise reduction is on the political agenda. The most efficient way to reduce railway noise is to retrofit the existing freight fleet with low noise technology using composite brake shoes instead of cast iron shoes, supposing such a technology is available, safe and economical. The EC's communication on railway noise, published in July 2008, recognizes this fact in pointing out that the priority measure to reduce noise is the retrofitting to low noise technology of the existing European railway freight fleets. To stimulate the retrofitting process, The Commission suggests the introduction of NRTAC in a first period on a voluntary basis to be followed by a mandatory regulation in few years. The noise related component of the track access charge will first be a bonus for low noise trains or vehicles but could be completed later on by a malus for noisy trains or vehicles.

In 2007 UIC published its ***'UIC Status report and background information on NRTAC'***, a report describing the rail freight system in detail, especially the involved parties, the rail freight and rail freight wagon businesses and the contractual relations between them. The report then also gives an overview of the existing typical track access charging system as well as the existing two applications of NRTAC in the Netherlands and in Switzerland. It then sets out the prerequisites for NRTAC such as the need for interoperability, harmonized approaches, etc. and highlights the complexity of an introduction of NRTAC, but it did not cover concrete implementation scenarios or issues.

The focus of this annex is the implementation of NRTAC. However, the conclusions of the main report remain valid: that direct public funding of retrofitting should also be considered as it is likely to involve much lower transaction costs.

1.2 How to raise NRTAC

NRTAC can be implemented in principle for whole trains or for single wagons. In evaluating the two possibilities 'Wagon based charging' versus 'Train based charging' it is important to consider the fact that one single low noise (retrofitted) wagon within a complete train only causes a minor noise reduction. A large percentage of silent wagons, retrofitted or new, within a train is a precondition for a significant noise reduction. Therefore a train based charging could have a bigger impact on noise reduction as it not only stipulates the retrofitting of wagon, but also forms an incentive to compose trains with a high percentage of retrofitted and silent wagons. However in practice this solution faces major problems: First, the wagon owner's cannot influence train composition and hence noise and whether there will be a bonus for a train. In consequence the funding of the retrofitting of these wagons cannot be taken for granted. Second, the RU has, within single wagon transport, only very limited influence on the train composition and in consequence its noise emission and any bonus.

As the aim of the NRTAC is focused on stimulating the retrofitting of wagons, a wagon based pricing system therefore seems the right instrument. Therefore the train based charging has only in theory a bigger leverage effect on noise than wagon based charging as it would form a larger incentive to compose silent trains: practical train composition will however in most cases not allow this.

To raise NRTAC on a wagon basis, there is a need to record the mileage run by the wagon on each network or part of network submitted to NRTAC, this recording should follow standards of bookkeeping rules[1]. As a consequence, normal billing processes have to be introduced. In the track access charging process without NRTAC the planned or driven train-kilometres are mainly used to calculate the track access charges, for this process the instruments and billing processes are well known and introduced. To raise a noise related component of track access charge at a single wagon level, there is a need to allocate the wagon kilometres of each wagon to the various parts of the infrastructure networks used; for this purpose there are currently no

[1] The records should be transparent and reproducible also after a certain time, as other financial data.

systems known or introduced. In practise, this means that, prior to the introduction of NRTAC, for all networks, calculation routines and tools to record and store the kilometres driven by wagons on the network or part of the network subject to NRTAC, will have to be developed and introduced. In addition, if the bonus of NRTAC should go to the wagon owner, this will cause billing process between parties[2] which have no contractual relationship in the normal transport process.

In designing an NRTAC system, one deciding factor has to be kept in the focus: in order for NRTAC to form an incentive for retrofitting, the noise bonus should be higher than the costs incurred by wagon owners, including the retrofitting costs, transaction costs and any negative impact the use of K- or LL-blocks will have on the life cycle costs of wagons.

1.3 Intention of this report

As stated above, the introduction of NRTAC will need new processes and –perhaps- new technical means for the tracking of single wagons and the recording of the tracking history on the various networks. This annex to the UIC report[3] intends to provide a technical overview of the various implementation possibilities for introducing NRTAC, and the technical and financial consequences. It will give an overview on the already existing systems and processes as well as an investigation from a technical point of view, of possible future solutions. The most beneficial possibilities will have to be investigated in more detail in a later phase.

[2] Infrastructure manager and wagon owner
[3] UIC Status report and background information on noise related track access charges

2. Existing processes and applications to raise (noise related) track access charges

NRTAC have been implemented in Switzerland (since ~2002) and in the Netherlands (since July 2008). In addition the Netherlands are testing a tracking technology for wagons and the possibility to use noise monitoring stations. These applications are described in the following paragraphs.

2.1 Swiss scheme - self declaration

In order to support the Swiss noise abatement programme[4] Swiss legislation on railway noise abatement[5] stipulates that all (including foreign) railway vehicles which meet the new noise standards will be accorded preferential treatment when calculating the marginal contribution. Since ~2002 the infrastructure manager has awarded a bonus of CHF 0.01 per axle kilometre travelled by vehicles which are not fitted with cast iron brake blocks[6].

Practical implementation is based on a system of audited self-assessment. The railway undertaking (RU) must submit a detailed application[7] for the noise bonus to the Federal Office of Transport (FOT). Following confirmation of entitlement by the FOT, the RU may submit an application for a refund to the respective infrastructure manager. Although this reduces the income of the infrastructure manager, the taxpayer meets all the costs of infrastructure which are not covered by revenue, including revenue lost because of the noise bonus. Whether and how the RUs have to pass on the bonus to the wagon owners is not specified in the legislation.

In practice, the RUs give the FOT a list of kilometres travelled per vehicle as obtained from the wagon management system. Scope for audit by the FOT is de facto very restricted and is limited to plausibility checks. The method is considered as feasible for claiming the bonus for homogenous trains crossing Switzerland. The sole criterion for the refund is the type of brakes. For example, eight-axle low-platform wagons with disc brakes obtain an attractive refund due to their high number of axles. The refund is less attractive for mixed trains (with wagon load traffic) because the outlay to apply for the refund for a single wagon is approximately the same as the amount of the refund itself. The method is also too complicated to use on mixed trains in domestic Swiss traffic. In Switzerland, the entire process is facilitated because both the RUs and the infrastructure managers use the same software and the same databases for wagon data; the Cargo Information System (CIS).

2.2 Dutch scheme - self declaration

The Netherlands introduced a noise related bonus as part of their performance scheme on 1st July 2008. This has been made possible through a very specific interpretation of article 11 of directive 2001/14 on performance schemes. The use of silent rolling stock is considered as an improvement of performance of the railway network that should be rewarded by a bonus. Benefiting from the bonus are vehicles (both passenger and freight) which have been retrofitted with low noise technology; new rolling stock using low noise technique is excluded from the bonus, being just TSI-compliant. Thus the bonus could in principal concern 4 types of passenger wagons (owned by incumbent railway undertaking NS) and all old freight wagons.

The level of bonus was fixed at €0,04/wagon-km. The total possible bonus a vehicle can earn was limited to € 4.800/vehicle for passenger coaches (based on a maximum mileage of 120.000 km over 2 years) and for freight wagons to € 2400/wagon (based on a maximum total mileage of 60.000 km and a maximum mileage of 25.000 km/year over 3 years)**.** After complaints by freight railway undertakings advocating that such differences between passenger and freight wagons were discriminatory, the Dutch Railway authority asked for a revision of the bonus scheme. Consequently the maximum amount of bonus for freight wagons was set at the same level as

[4] The program consists in retrofitting all Swiss Rolling stock, in construction of noise screens according ot a cost-benefit ratio and to install noise insulation window in cases where the other noise reduction means are not successful enough.
[5] Article 5.2 of the Federal Act on Railway Noise Abatement of 24 March 2000
[6] The noise bonus was a political decision taken by the parliament to encourage especially foreign wagon owners to retrofit their rolling stock. Retrofitting of Swiss rolling stock is paid by the confederation as part of the Swiss noise abatement program taking in account that it is more efficient to retrofit rolling stock than to invest in noise screens (which are as well paid by the state). Swiss owned rolling benefits as well from the noise bonus to cover higher operational costs.
[7] Stating the type of vehicle, actual sound levels and distance travelled (proportion of axle kilometres of that category of train),

for passenger wagons in the 2009 draft scheme. The maximum amount of bonus is now € 4.800 (maximum mileage of 120.000 km during 2 years) for both passenger and freight wagons.

In the absence of any solution to track and trace individual wagons and information on their noise performances (see chapter 2.3), the bonus can currently only be granted following self-declaration by the railway undertakings. For this purpose, the RUs have to use the already existing and mandatory report for dangerous goods. This provides, per registered wagon, the number of km run in the Netherlands as well as the specification of the journeys with date, train number and number of km. ProRail may perform random checks on wagon conversions and specified km. The bonus is applied to the railway undertakings only. For the wagon owner economic principles and the pressure from the railway undertaking are thought to be strong enough to stimulate retrofitting. By March 2009, two passenger-operators had accepted the bonus system; while freight operators still state that the level of the bonus is not high enough to form an incentive.

2.3 The Dutch pilot RFID[8] application in the innovation program

In the framework of the Innovation program, equipment to record the number of kilometers run by individual wagons was tested on 200 wagons. To use the system for the entire network at a later stage, extra investments would be needed.

System architecture

The noise related track access charge component is to be charged according to the wagon-km driven on Dutch railway infrastructure. To measure the wagon-km the pre-existing Quo Vadis and Gotcha systems were used. Quo Vadis measures the weight in motion (WIM), while Gotcha performs a wheel defect detection (WDD) of trains. It consists of 40 monitoring stations installed on the Dutch infrastructure. The train weight measurement and its data are currently used to calculate the driven ton-km of each train and to bill the track access charges for weight to the railway undertakings accordingly. The 40 stations allow capture of over 95 % of trains. The backbone of the system consists of 8-16 fibre optic sensors, mounted on the rail, a measurement cabinet for local processing on site, an optional tag reader and a central server computer for compiling all measured data. For data safety, data is stored in a redundant system as well. The system is able to recognize trains using two methods:

- comparing the time of measuring of the weight of an axle using a Quo Vadis measurement unit with the time that a train has run in the same track segment; or

- by reading RFID tags which are fixed on the trains or vehicles. If RFID is in use, the vehicles number can be determined, if appropriate information is available on the local database.

On the vehicles, the only equipment needed is the RFID-tag, which is permanently magnetic and does not need any electric power. The WAGON TSI (§ 4.2.5.2) in force specifies the type of RFID-tags to be used without making the setting of tags on wagons mandatory. A database giving relation between tag number and vehicle number is needed to allow the correct identification of the vehicles. Extending the use of the system to the entire network would require additional investment. The cost of each station is about € 100.000, of which € 5000 are dedicated to the tag-reader; they were paid by ProRail. The costs of RFID - tags, between 20 and 40 €, were paid by RUs. In the innovation programme, 200 wagons have been equipped with this kind of tags. The database to register all freight vehicles is not yet built but a feasibility study showed that it should not be difficult to do.

Possible use of the Quo Vadis System for noise monitoring

From 2011 the data obtained by the Quo Vadis system could be used to determine also the driven km of retrofitted low noise rolling stock. A prerequisite will be an update of the software in use as well as installation of tag-readers at all stations and on both sides of the tracks. This is considered to be feasible.

[8] Radio frequent identification (RFID) technologies, see also chapter 3.7

Cost/Bonus charging

The noise bonus will be handled together with the track access charges. ProRail will be compensated for the additional costs of a noise bonus by the government; the amount will of the order of € 15 Mio for a three-year period. The goal is to stimulate the retrofitting of wagons carrying 50 % of the freight-km in the Netherlands. Thus priority is given to trains running in the Netherlands and shuttle trains.

2.4 Dutch application of noise monitoring stations[9]

Five noise monitoring stations have been installed in the Netherlands in the framework of the innovation programme. They consist of a stand-alone computer, two microphones and two accelerometers, a weather station and a data-transmission system.

These stations use the existing Quo Vadis and Gotcha systems explained in the last chapter for train identification and power facilities.

For each passing train, noise monitoring stations are able to measure the noise level by the following components:

- Noise: A weighted sound exposure level (SEL) + octave spectrum 63 Hz – 8 kHz and
- Vibration Exposure Level of the rail (analogous to SEL, vertical vibrations of rail foot) + octave spectrum 31,5 Hz – 8 kHz. (to be clarified)

Because the noise level depends on track quality, the wind direction and speed, correction factors are used to minimise these influences. Data are transmitted every night to a central database, which can be accessed through an internet application. After finalization of the innovation program in 2007 it was decided to continue the work of 1 fixed and 1 mobile noise monitoring station. They work on a regular basis and their measurements are as accurate as manned measurements. They are used to measure the noise of complete trains. At the moment tests are being performed to check how close the microphone should be placed to the track to be able to distinguish between noisy and silent freight wagons with high accuracy. This is still under investigation and is one of the reasons why the current Dutch NRTAC scheme is only based on declarations by the RU.

In addition it has to be pointed out that measuring operational noise as a basis for NRTAC will raise the fundamental question whether it is correct to use operational noise emission data and not homologation or equipment based noise emission data.

2.5 Dutch pilot application of measuring noise by measuring the quality of the wheels.

Another measuring method to distinguish between noisy and silent freight wagons is by measuring the quality of the wheels. Because vibrations are the basis of noise and rough wheels produce these vibrations, the roughness of the wheels can be used as a surrogate measure for the noise of wheels. The current (Gotcha) system is not able to measure the rail vibrations in the frequency spectrum that is causing the noise. Therefore, tests are being planned with an update of the system using different vibration sensors. This method will use direct noise measurements, because the installation and maintenance of these vibration sensors will be cheaper. ProRail considers this a very promising innovation. However the concluding remark to the chapter before remains valid: It is questionable to measure operational noise as basis for noise related track access charges as long as the environmental impacts of the competing transport modes is not measured also in operation. The possible differentiation in order to give an bonus.pro wagon could be used in the future. Consequently noise measuring has explicitly not been required by the European Commission in its communication on railway noise abatement measures of 2008.

[9] Further details see:http://www.dbvision.nl/publicaties/2007/S5.1_Edwin_Verheijen.pdf and http://www.noiseinnovationprogramme.eu/data/files/algemeen/32%20-%20Van%20den%20Brink%20-%20Noise%20Monitoring%20Stations.pdf

3 Possible tools and/or processes to raise NRTAC

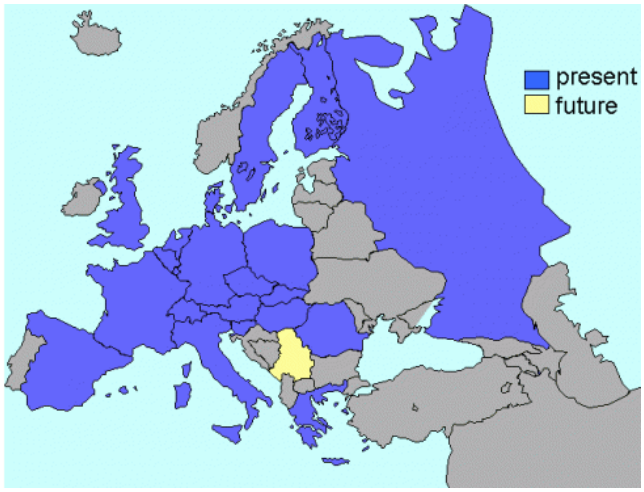
To raise NRTAC, 2 elements of data are needed: The first element is whether wagons are equipped with low noise technology (braking) equipment and, depending on the used charging scheme- whether they are new wagons using K- or disk brakes or older rolling stock which has been retrofitted to composite brake shoes. The second element to know is the mileage of the wagon on the network or part of the network subject to NRTAC. To know this second element, either information from the transport messages or tracking systems implemented on the wagons and infrastructure could be used, with connected software to analyze this data. This chapter gives an overview on the existing data exchange between RUs and analyzes the possibilities to use the customer consignment note or wagon register data; an overview on the known tracking and tracing systems as well as an analysis of the possible use of the TAF TSI[10] will conclude this chapter.

3.1 Existing common data exchange between RU's:

Several systems are currently already in use to exchange transport messages between the RU especially dedicated to international traffic.

3.1.1 HERMES System

Already in 1978 six railways (BR, DB, FS, SBB, SNCB and SNCF) launched under the auspices of the UIC (International Union of Railways), the HERMES project to provide a high quality data communications network across railway boundaries to allow a wide range of structured exchanges of information between otherwise incompatible IT platforms serving passenger and freight business. HERMES was continuously developed and adapted to new technology, most recently in 2007, linking in 2009 the railways of 20 countries showed in the map. HERMES is in principle a RU based system for advanced and real-time information on the operation of trains.



In practice there has to be a distinction between the HERMES Network and HERMES applications and messages: The HERMES telecom network is managed by an autonomous group (HITRAIL[11]), whose shareholders are exclusively RUs and IMs. The HERMES telecom network is used by all the actors of the railway sector (Freight operators, Passengers operators and IM). This network links all Europe; it is totally independent from UIC. In order to use it, IMs and RUs have to pay subscriptions. The HERMES applications and messages are UIC property and are only developed by UIC members using UIC leaflets handled today by the 'Group of Network Users', under the trusteeship of the Freight IT Study Group. The important application in use by the members is "application 30" called "pre-announcement".

However there are some country-specific applications allowing data exchange to IM-based systems (i.e. ARTIS in Austria and CIS in Switzerland). Data quality in HERMES varies depending the RU's equipment and technology and sometimes only rudimentary data is available. However clear improvements are being made.

Information concerning wagon number and braking equipment are transmitted using HERMES. Data transmitted using HERMES system may be more extensive than those used on national systems as these national data systems will depend in extent and quality on national requirement resulting in some data inconsistency between the several systems in use. For example,

[10] Technical Specifications for Interoperability for Telematic Applications for Freight

[11] For details see: http://www.hitrail.com/?q=hermes-network

the information on braking equipment transmitted with Hermes is in accordance with UIC leaflet 404-2, while for national requirements a lower standard may be sufficient, e.g. for Austria only a very rough classification of the braking equipment is needed.

3.1.2 Information exchange in the RAILDATA group[12]

RAILDATA is a special group of the International Union of Railways (UIC), whose objectives are the development, operation and maintenance of international freight information systems on behalf of its members and other users with maximum synergy and lowest costs. There are presently two applications in production:

- ORFEUS - consignment note CIM[13] data exchange
- ISR (International Service Reliability) - wagon status reporting

ORFEUS is a central international information exchange system to ensure exchange of CIM consignment notes data as well as the CUV[14] wagon notes data between the co-operating RU)s, making the collection of consignment or wagon note data at borders superfluous. The data are delivered by the forwarding RU to ORFEUS and from there distributed to other RUs involved in the transport. The main goal of the system is to improve speed and reliability of international freight rail transport and to allow significant cost savings. ORFEUS is in real time and daily production. The ORFEUS members use the consignment data for incoming traffic procedures. The following railway companies take part in the production now: SNCB/B-Cargo (Belgium), CFL (Luxembourg), Green Cargo (Sweden), Rail Cargo Austria (Austria), Railion Scandinavia (Denmark), Railion Deutschland (Germany), Railion Nederland (Netherlands), SBB Cargo (Switzerland), SNCF Fret (France), Trenitalia Cargo (Italy).

International Service Reliability (ISR) is a common tool of the European freight RUs for concentration and exchange of information about the international movements of freight wagons through a central platform. It makes it possible to track both loaded and empty freight wagons and consignments across a significant part of Europe. Besides information about actual status and position of the wagons, it also enables to see wagon status history or freight traffic flows as well as the estimated time of arrival based on past traffic statistics. Information prepared by ISR enables both visible customer service improvements and significant cost savings. Most RUs reports to ISR the following basic set of event types: Shipment order (consignment note), Departure from shipping station, Arrival at intermediate station (typically marshalling yard), Departure from intermediate station, Border crossing (planned and real) and Arrival at destination station. The information about shipment order comes from the ORFEUS system and is internally forwarded to ISR which establishes a linkage between production and commercial information. A huge number of wagon events is reported: i. e. during November 2008 total about 7.2 million wagon events were reported by the 15 ISR members with current applications and information. The following railway companies take part in the reporting of various sets of events:

- Reporting all types of events: B-Cargo, SNCF Fret, Railion Germany, FS Trenitalia, CFL, Green Cargo
- Reporting all types of events except shipment orders: CD Cargo, MAV Cargo, ZSSK Cargo
- Reporting all types of events, except planned border crossing: Railion Netherlands, SBB Cargo, Rail Cargo Austria)
- Slovenian railway (SZ) reports all types of events except shipment order and planned border crossing and RENFE reports planned border crossing only.

[12] For details see http://www.raildata.cz/default.htm
[13] CIM: Contract of International Carriage of Goods by Rail
[14] CUV: Contracts of Use of Vehicles in International Rail Traffic

3.1.3 Conclusion on existing data exchange

Between most European railway freight undertakings, data exchange supported by powerful data networks and systems is already in use. This data exchange is dedicated to improve international traffic, to reduce costs and to improve transport information between the various actors. Data exchange emphasises train movement, but it includes also data concerning the wagons and its equipment. However data exchange is focussed on the business needs of freight transport. The information needed to raise NRTAC is not available from this but might be added with reasonable and feasible efforts. All the RU's have to take part if the systems are to be useful.

3.2 Customer consignment note data

Using customer consignment note (CCN) data for noise related purposes has to take into account that some confidentiality questions will have to be solved as detailed knowledge on wagons and journeys could form a competitive advantage to third parties. CCN data do not contain data on the brake equipment of the wagons, thus it is not possible to distinguish between quite and noisy wagons. CCN data does contain information on the wagons number and trains used. Further, the CCN does not include any data on the type of wagon or actual distance driven on the infrastructure, since these pieces of information are irrelevant for the customer. Hence, the two most important attributes for NRTAC (brake type and kilometers driven) are not included in the consignment note data and would have to be added from other databases.

On a European level, CCN data could be interesting using the information on the wagon numbers in a train, if access to a wagon data base with well maintained information about the braking equipment is available.

In principle using this data is similar to a self declaration of low noise vehicles. However, since the two basic attributes for NRTAC are not included in the CCN data world, it would make a lot more sense to combine them directly - as proposed in chapter 3.5 - instead of adding them to a database, in which they offer no additional value.

3.3 Wagon register and wagon movement data

3.3.1 General remarks, regulation within directive 2008/57/EC of 17 June 2008 (TSI)

In the framework of the revision of the railway interoperability directive, the EC enacted in July 2008 legislation concerning registration of railways rolling stock: For safety reasons Member States are required to assign an identification code to each vehicle (locomotives and wagons) placed in service and to enter the vehicles in a National Vehicle Register (NVR). The registers have to be open to consultation by all Member States and by certain Community economic players. The registers should be consistent regarding data format and should therefore be covered by common operational and technical specifications. In order to facilitate the placing in service of vehicles and reduce administrative burdens, a procedure for authorization of vehicle types should be added and a European register of authorized types of vehicles should be set up and maintained by the European Railway Agency (ERA). This European wagon register shall include the technical characteristics of each type of vehicle, as defined in the relevant TSIs. It can be assumed, that the needed information to distinguish between silent and noisy rolling stock will be within the technical characteristics according to § 4.8.2 of the Noise TSI to-day in force and can be included with reasonable efforts.

3.3.2 Wagon register and wagon moving data in existence

There is a large number of existing wagon registers whose care is currently the responsibility of various stakeholders, i.e. wagon keepers, RUs or railway authorities. Detailed descriptions of some national applications are in the annex and the current status of these examples can be summarized as follows:

In Austria the infrastructure manager ÖBB Infrastruktur Betriebs AG takes care of the wagon register data in a system currently called ARTIS. Within this system all freight wagons running on ÖBB's network have to be included. The wagon related information within ARTIS includes its braking equipment and whether wagons are noisy or silent. The data is stored for 3 months.

In France, the French Railway Safety Authority is responsible to register wagons and to maintain the French National Vehicle Register. In the database, all mandatory fields according to the EC Decision 2007/756 are included, but this includes none about types of brakes. Currently SNCF (as probably most other RUs) has no automatic software allowing the calculation of kilometres run by wagons in its trains in other countries than France. In RAILDATA, there are ongoing discussions to add the necessary complements to the ISR application enabling it to perform the calculation of kilometres run by wagons, but no decision has been taken yet.

In Germany the National Vehicle Register is administrated by the Federal Railway Authority. In addition to general information such as wagon owner, wagon keeper and vehicle number, the NVR lists detailed technical data of freight wagons including attributes for type of brake and brake pad. The wagon owners deliver the information to the NVR administration in electronic form on a data carrier (CD/DVD). Without registration operation of a vehicle in Germany is not allowed. Information on the NVR is in normal cases not available on the infrastructure managers' systems.

In Great Britain wagon data is recorded in a Rolling Stock Library (RSL). RSL has fields for data such as identification number, status (operational/non-operational), expiry of the registration, route availability, maximum speed, weight, dimensions etc. RSL also provides data (e.g. on unit formations) to the system Paladin (**P**erformance **A**nd **L**oading **A**nalysis **D**atabase of **IN**formation), which is a centralized storage of historic train movements (actual and planned), vehicle formations plus loading, and delay details, but it is unclear whether the full consist of freight trains is provided as a routine operation. The GB system could easily be modified to capture mileage data by type of vehicle (noisy or silent).

In Switzerland all train operating companies have to transmit electronically all operational data necessary for operation before departure of the trains into the cargo information system of the Swiss railway infrastructure (CIS Infra). These data include among general technical data especially the brake equipment of the wagons. Technical wagon data are stored in addition within a data base of CIS Infra to be used for further transport with this wagon. On request this data base may contain additional technical information from the RUs and/or owners of wagon.

3.3.3 Summary on Wagon registers and wagon movement data

Wagon register data as it is stored for example in the National Vehicle Registers will form the most important source of information to gather the status of wagon equipment. Obstacles to a fast European wide implementation are the current lack of relevant information on braking equipment in many databases as well as the great variety of data ownership and in the responsibility for data management. Harmonization of the data fields concerning the noise question, (specifying the braking equipment) is a precondition for simple implementation and collection of the data content in question. Wagon movement data is not available in a harmonized way and tracking and tracing equipment might be needed to allow automated processes.

An instrument for NRTAC can be created by combining the NVR information about the retrofitting status of the wagons with the information about the mileage run by the wagons. This data can be provided the RUs. Under the already existing General Contract for the Use of Wagons (GCU), which has been joined by about 600 IMs and RUs Europe-wide, the RUs are obliged to inform the wagon owners upon request about the mileage run by their wagons. For the purpose of NRTAC the wagon owners would have to aggregate the annual mileage of their wagons over the relevant RUs and networks, combine it with the retrofitting status according to the NVR and report the data set to the entity administrating the NRTAC. This approach to NRTAC, the NVR+GCU-mileage model, would provide a short-term and cost effective solution with the possibility for Europe-wide expansion.

3.4 Wagon tracking technologies

3.4.1 Radio frequent identification technologies (RFID) technologies

In chapter 2.3 the Dutch experience in the use of RFID is outlined using the example of the Quo Vadis system to calculate the kilometres of a specific wagon. After a tag is placed on the wagon the 40 Quo Vadis units are able to measure (when combined with the train measurement system) the number of wagon-km of a specific (i.e. retrofitted) wagon on the Dutch railway system. To get high accuracy there have to be placed measurement units on both sides of the track. This implies extra investment. Until a decision is made on this subject, the self-billing method based on the format for dangerous goods transport is used (see chapter 2.2).

The costs of RFID-system will strongly depend on the availability of a system to build on. The costs for the tags on the wagons are according to the Dutch experience of between 20 and 40 € per wagon. The costs of a tag-reader are reported to be some 5000 €/reader. In the German project 'leiser Rhein' the costs for a simple pilot application equipping ~5000 wagons and 8 sections along the Rhine railway lines have been estimated at € 200'000 - € 450'000. To estimate total European investment, one could use the following data: Infrastructure: 75'000 km of railway in TEN-T[15] with a pair of readers every ~30 km would cost ~25-30 Mio €; but depending on the required accurateness of the recording, the total investment could also be much higher[16]. The investments the wagons could be estimated at ~7.5-15 Mio € if the tags would be fixed i.e. only to the 370'000[17] heavily used wagons of the total European fleet of some 600'000 wagons. Not included in these investment costs and difficult to estimate are the costs to develop and maintain the needed software to calculate the mileage of wagons and store these results for billing in accordance with bookkeeping rules in a safe matter, this software probably will have to be developed for each network in a specific own version. It is worth mentioning that RFID-based systems will be used for billing between economically independent market actors. The billing has to be valid and conflict free in order to meet commercial as well as fiscal standards.

3.4.2 Global Positioning Systems (GPS)

In principle there are 2 detection systems Galileo and GPS in existence both being regarded in technical application as compatible. A GPS-based vehicle tracking system consists of two main parts: At the vehicle there is a telematic unit, using the GPS to detect the position of the vehicle, in addition there is a modem necessary to transmit the information (which car has used which route and when); the modem is responsible for the requirements of electric current of the telematic unit. Energy can be saved by, for example, having only weekly data communication; this way DB Schenker Rail has some 14,000 wagons equipped with such systems in operation functioning 6-7 years without battery changes. On the infrastructure, a portal/ centre is necessary for data collection and for the customizer specified processing. These data can be made accessible over the internet.

For GPS systems vehicle tracking forms only a small part of its possible functional range: using sensor systems data such as temperature, air humidity, running performance, maintenance data could be collected for maintenance control. Also loading and other conditions could be made available centrally, also for each vehicle. Given the needed functionality for vehicle tracking and tracing, GPS is considered as too expensive. In the German Project "leiser Rhein" the costs for a GPS system have been estimated to be about 200.000 €/month (5000 wagons, 8 sections in the network to be tracked). The costs of the telematics unit are some 800-1200€/piece, depending strongly on the number of units purchased. In the German project even the telematic provider considered GPS as too expensive as a RFID system could represent a more economic solution, offering just the needed functionality. In addition GPS telematic units have the high risk

[15] Without High speed lines

[16] In general RFID will require the installation of readers at all relevant network junctions on both sides of the track in order to ensure a high level of reading precision especially in dense networks. DB estimates for the German network the required number of reading stations to 8.000, causing with 2 readers per station @ 5.000 € total investments for Germany of 80 Mio €.Therefore, the required investment for RFID-based systems is very likely to be significantly higher.

[17] 370'000 Wagons: Number assumed by the commission in its communication on rail noise abatement

of being stolen. On a European scale, to fit telematic units (for 800 € each) to the heavily used part of the existing fleet (~370'000 Wagons) would cost of about 300 Mio €, at least doubling the investment cost of retrofitting using LL-blocks. In addition, there would be according to the estimates in the German Project operating cost in a order of magnitude of 15 Millions € / month. As in the case of RFID in these investment costs and difficult to estimate are not included the costs to develop and maintain the needed software to calculate the mileage of the wagons and store these results for billing in accordance with bookkeeping rules in a safe matter.

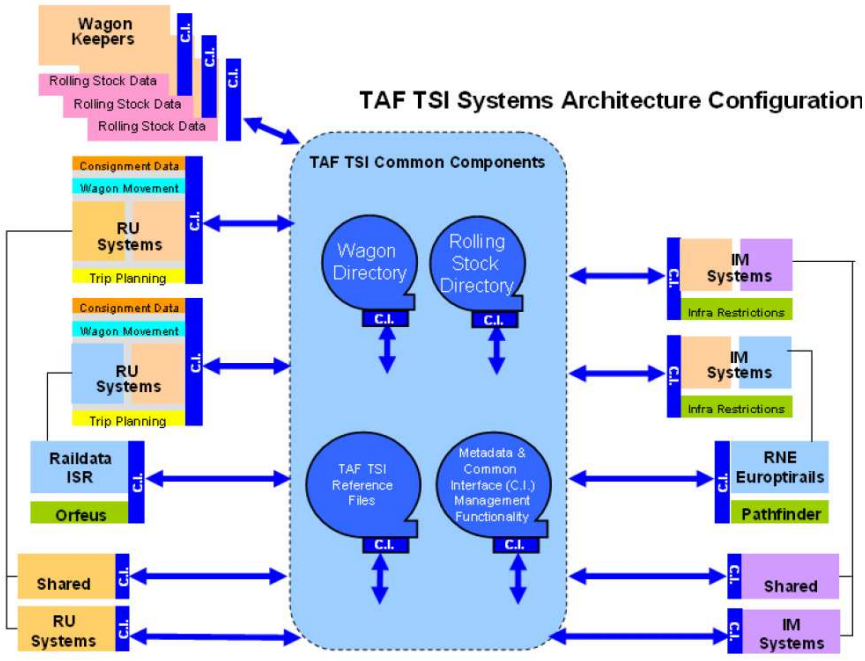
3.4.3 Video technologies

Video is another available technique to recognize wagons. The wagon identification is based upon a camera which is fixed on a pole next to the track. The camera identifies the 12-digit-wagon number, which is printed on all wagons. The system produces single photo shots. The generated photos are free of distortions. The system generates files with the number of the wagon, the location and the time of passing. Currently there is no information on the maximum speed of the wagons for this technology or on the consequence of bad visibility for reliability.

For any kind of identification, an interface to a database with the wagon information would be needed and also another interface to the train run information to identify train number and train path. This system is technically available but not used by any IM within Europe. Reliable information on costs is currently not available but costs are estimated to be significantly higher than for RFID technology (chapter 3.4.1) giving similar results, so no further investigations have been carried out.

3.4.4 Use of the 'Technical Specifications for Interoperability for Telematic Applications for Freight' (TAF TSI)

TAF TSI is a regulation aimed at improving the interoperability of international rail freight transport in Europe by improving the communication between RUs and between RUs and IMs. Both parties will have to use this new platform for an operative communication based on the exchange of data in a predefined format. The messages transferred using a common interface deal mainly with the operation of the trains, preparing the train paths and following their real operation. Some of these predefined messages are mandatory while other messages are optional. Independent of the type of messages, concerning the path request processes the communication between RU and IM always has a clear short-time focus. In this regard any considerations or planning with a long-term character are not in the focus of TAF TSI. The backbones of TAF TSI are the common components which rely on existing IT-systems and data in use or generated by the RUs and/or the IMs. The general TAF TSI Systems Architecture is shown in this graph.

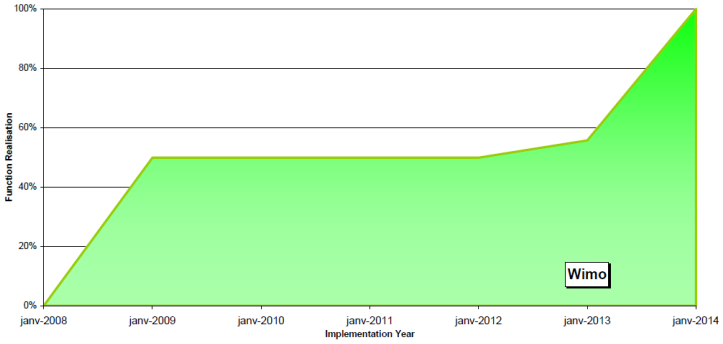


The TAF TSI regulation is designed set clear standards on messages to be exchanged between RU's and IM's by defining common

reference files and codification schemes to uniquely and unambiguously identify entities, objects and locations. TAF TSI is not designed for charging schemes for the use of infrastructure. According to annex II (§ 2.5) of directive 2001/16/EC and now 2008/57/EC, the TAF sub-system should cover in future also applications for freight services, including information systems (real-time monitoring of freight and trains), marshalling and allocation systems, reservation, payment and invoicing systems .TAF TSI regulation does not deal with the collection of any data to be used, all data have to be generated using other decentralized procedures or tools. TAF TSI is a regulation and not 'hardware', as it does not provide solutions or processes but enables the various stakeholders to profit from data exchanged via the common interface and to be used in their procedures. Concerning NRTAC, the charging processes with TAF TSI will have to be developed and implemented by the various RUs and IMs, according to processes defined by the NRTAC system.

Deployment and implementation of TAF TSI

TAF TSI applications and common components will be introduced according to the strategic European deployment plan for the years 2008-2014. For the purpose of NRTAC, probably the so-called WIMO modules (including the wagon movement function) will be the critical one (see graph at the right). It will only be fully introduced in 2013/14. Currently the deployment plans for TAF TSI do not contain all the needed data and processes to raise NRTAC.



Suitability of TAF TSI for NRTAC:

The implementation of noise related access charges is only possible if there is a method of collecting data regarding the noise classes of trains or wagons. Within the "Green Package" DG TREN has named "TAF TSI" as a possible technical solution to collect and exchange the required data between IMs and RUs for NRTAC neglecting the fact that data collection is not part of TAF TSI. An evaluation of the applicability of "TAF TSI" for the implementation of noise related access charges has to be based upon a fundamental analysis of "TAF TSI".

At first sight things seem simple: it is seemingly enough to add a field to a base of data. But in terms of a noise related access charge the identification of the noise character of each wagon and the identification of each train path used by these wagons would have to be covered by existing TAF TSI functions to fulfil the requirements of such an access charge system. For this purpose the optional train composition message which is exchanged between RU and IM seems to be the most relevant type of message. This message contains information on the unique identification number of all wagons used within a relevant train. However currently this message cannot yet contain any information on the used braking system, on the noise level of any wagon or complete train as, in the database relating to the wagon, this information is not yet implemented[18]. Therefore the use of train composition messages for NRTAC is only possible if major adaptations to the TAF TSI guidelines and full implementation of the TAF TSI Common Interface and the databases behind them are also implemented. Also the train composition message has to be defined as mandatory for all RUs and all RUs have to be capable to deliver this type of message including additional noise related data.

Even if these requirements can be fulfilled, this will only allow a gathering of information on the status of noise reduction of a single wagon but not on the mileage driven on a network by a wagon or train. The main problem with data gathering for NRTAC is the fact that the rolling stock operational database only provides kilometers since last overhaul; TSI TAF does not describe how this information is recorded in the rolling stock database. Furthermore, kilometers or the kilometers run on a dedicated network cannot be found in any message. It would therefore

[18] The relevant TSI Wagon CR has in its scope only new, upgraded or renewed freight wagons placed in service after entering the wagon TSI into force.

be necessary to complete the TSI TAF messages by a distance calculation module[19], either by implementing a new kilometer reference file, or by completing existing messages (Train running forecast, Train running information, Path details). This module should be able to deliver the kilometers run by the wagon on every dedicated network. A solution for this problem in the TAF TSI world has not been identified so far. It would have to be implemented in addition to the adjustments necessary to adopt train composition message after implementation of today's TAF TSI provisions.

To cover the aforementioned new aspects additional functionalities have to be developed and integrated within the TAF TSI Regulation. This process will require time and significant sums of money. Additionally the processes of production for RUs and billing for IMs would be confronted with significant changes and new requirements. For example, a number of IMs in Europe bill the kilometric performance based upon the timetable while others bill on the basis of operated kilometres. Any train path kilometre registered in a TAF TSI system will cause incompatibility with the existing billing systems of some IMs.

In conclusion, the use of TAF TSI faces two major problems: the existing legal and technical framework for TAF TSI does not contain any type of message which would allow the operation of a NRTAC. Finalization of the TAF TSI framework also cannot be expected before 2014. The adaptation of TAF TSI would need a revised TSI, causing substantial additional costs and needing 1-3 additional years. In addition there will be the need to increase the bonus to finance the retrofitting of wagons with LL-blocks significantly to include these implementation costs.

3.5 Conclusions on future possible tools and processes to raise NRTAC

National Vehicle Register data will in any case form the most important source of information on the wagon which has to be gathered as one basic component to raise NRTAC.However this information has to be integrated in all the various existing databases and supplemented if needed with recent information (wagon data including braking equipment); further the data must be regularly updated either by the RU, the wagon owner, infrastructure manager, a railway organization or a railway agency. Currently the owner of the relevant data differs all over Europe. Minimum requirement will be to introduce the needed characteristics to raise noise-related components of track access charges as a mandatory component of the train/wagon data acquisition and their mandatory passing on according to the international TSI, including an appropriate marking of the wagons. The starting point for such a procedure has to be an internationally coordinated definition of low-noise wagons.

The mileage of the vehicle on a specific network has to be gathered from other sources to enable the infrastructure manager to raise NRTAC. Even if every infrastructure manager has this information at his disposal it cannot be neglected, that at a European level there will be some 25 ways to come to a solution. Generally speaking the infrastructure manager will have the information about trains (but not always about wagons), and RUs and IMs will need in any case information about wagons for safety reasons, and this information has to be combined.

For automated tracing and tracking of the vehicles for instance RFID could form a possible solution, at least on a national scale. In the past, general deployment of such equipment was discussed and checked, but could not even been decided positively when companies were still integrated; the splitting between IMs and RUs will make introduction of such a system even more complex.

At the other hand, combining the existing data of the NVR and from the General Contract of Wagon Use offers a simple, manageable solution with clear cost advantage over the introduction of expensive, sophisticated systems for NRTAC. In addition, this solution can be implemented Europe-wide and in a relatively short term. However this data will have to be combined with the mileage data of the wagons driven on the various networks.

[19] Such a module will have to be specified, developed and implemented outside the TAF TSI, as the TAF TSI is about Data exchange and reference data.

4 Cost estimates and considerations

4.1 Introduction

In this chapter, considerations on costs are taken, at least as far as cost estimates are available. The first section is dedicated to the technical costs on the vehicle side, such as the retrofitting costs and the operational costs of composite brake shoes. The next section deals with the transaction costs of raising NRTAC, such as the technical costs to equip infrastructure and vehicles with recording devices and further the administrative costs for the tracking and billing processes within the involved entities.

4.2 Technical cost

4.2.1 General remarks

Currently, in general, there is only limited knowledge and practical experience of using K- blocks available on questions concerning wheel wear, equivalent conicity and the related economical impacts. Knowledge and practical experience of using LL-blocks is even more limited. Considerations on life-cycle cost and the administrative processes can be based on this limited information only. Practical experience in retrofitting using K-blocks and the related costs are available in Switzerland, where till spring 2009 some 5000 wagons have been retrofitted, financed in the framework of the Swiss noise abatement program. Further some data concerning the costs to design the retrofitting-engineering and the related homologation processes can also been gathered from the Swiss experience. In addition there is also information available from several wagon-test-series with LL-blocks in the Netherlands

4.2.2 Rolling stock: Cost of Retrofitting

Currently only K-blocks are homologated and available for retrofitting[20]. These brake blocks are used for all new[21] vehicles, as they are necessary to fulfil the requirements of TSI Noise. Costs for the retrofitting of wagons using K-blocks depend on the type of wagon and lie in a range between 3,000 and 10,000 Euro per wagon. The costs to retrofit the total fleet of 600'000 wagons used on the European network with K-blocks have been estimated by UIC to be some ~2 Billion €[22]. However not all existing wagons can be retrofitted as there are some technical restrictions.

Due to the high cost of retrofitting using K-blocks, a cheaper alternative had to be found and this led to the development of LL-blocks. However, the development of LL-blocks had to be rescheduled and is unlikely to be finalized before the end of 2012 taking into account the recent problem of equivalent conicity[23]. After an extended testing period, LL-brakes are therefore expected to be available at the earliest in 2012/2013. The cost of organic LL-blocks will be comparable with K-blocks (28 - 33 €/block), while the costs of sintered LL-blocks will be 56-68 €/block[24]. LL-blocks should not cause by their design the additional need for adaption of braking equipment, and this should reduce their overall costs. However it has to be confirmed whether this will be avoidable. The cost for retrofitting using LL-blocks are estimated from some 100 up

[20] Homologation is valid in general for wheels of diameter> or = 920 mm and axle load of 22.5 t. Homologated is C 810; Jurid 816M is homologated for the configuration 2Bgu; the configuration 2Bgu received from SNCF to date only a limited homologation. For wheels < 920 mm currently no solution is available causing several derogations by Member States. For wagons using the configuration 2Bg, only one supplier is available with the resulting lack of competition.

[21] K-blocks have to be used in new ordered vehicles, new vehicles based on existing orders may still use cast iron block.

[22] Currently (Spring 2009) greater experience on retrofitting cost using k-blocks is only available in Switzerland: Retrofitting costs in Switzerland are in a range of 7500€ (2 axle wagons) – 11'000€ (4axle wagons). In these costs is included that on 16% of the fleet the wheel sets had to be changed as well. The whole retrofitting program covers ~10'000 wagons and some 70 wagon types. Retrofitting of Swiss rolling stock is paid by the confederation as part of the Swiss noise abatement program taking in account that is more efficient to retrofit rolling stock than to invest in noise screens (which are also paid by the state). Swiss owned rolling stock benefits as well from the noise bonus to cover higher operational costs.

[23] Equivalent conicity describes the complex phenomena, that the wear on the wheel may have a great influence on the geometrical form of the running surface of the wheel thus having a negative impact on the running quality of the wheels on the rail, due to these bad geometrical conditions. As soon as this running quality results in an unstable running of the wheelset or the bogie as a whole, safety aspects are touched and the wheels have to be reprofiled to comply with the geometrical demands.

[24] For comparison: Cost of cast iron brake shoes is around 5-6 €/block.

to 4200 €/wagon plus the cost for the blocks of ~600 €/wagon[25]; retrofitting with LL-blocks of the ~370'000[26] heavily used wagons (out of the total fleet of 600'000 wagons used on the European network), including the cost for the blocks, will cost about 650 Mio. €[27].

4.2.3 Rolling stock: Design costs for retrofitting & wagon homologation, organizational costs for retrofitting process.

To allow retrofitting of a wagon type, engineering design work and a successive homologation to the retrofitted wagon type is needed. Swiss experience with up to now some 30 different wagon types showed that the engineering design is quite demanding and also complicated, as even wagons of the same type may have different braking gears, also often the (usually old) wagon may in practice be different from its type drawings. The braking performance of the wagon with new types of braking shoes has therefore to undergo intensive and costly testing, including launching tests also called slip tests. Swiss experience shows engineering design and homologation costs of on average additional ~1600€/wagon; these costs are relatively high due to the high number of ~30 different wagon types and the low number of wagons per wagon type (sometimes only 30 wagons/type). Per wagon type these costs can sum up to several 100'000 €. Swiss experience is based on retrofitting using K-blocks; it is unknown how far this testing and the related costs might be reduced as retrofitting using LL-blocks will need less adaption to the braking equipment. A study should be undertaken to define families of types in order to reduce the number of required slip tests.

In addition organizational costs to set up the whole retrofitting process have to be taken in account. These costs consist of:

- logistic costs (i.e. setting up the needed stock of the various types of brake shoes);
- commercial costs (i.e. bringing the wagons to the workshops if retrofitting is not done in normal maintenance cycles, though such abnormal programming should normally be avoided);
- administrative costs for the organization of the retrofitting (i.e. setting up a schedule to withdraw the wagons for the retrofitting).

4.2.4 Rolling stock: Operating costs

K and LL-blocks also cause additional operating costs – costs for maintenance of brake blocks and wheel sets. For wagons with K-blocks a lot of knowledge has been gained during the recent years: currently K-blocks still have disadvantages regarding life cycle costs (LCC) in comparison with cast iron blocks, leaving a substantial need for further improvement. Lifecycle costs of LL-blocks are hardly known due to the lack of experience in their use.

Composite blocks cause damages to the wheels affecting the equivalent conicity and in consequence causing a wear and safety problem and a higher LCC results from this problem. LCC depend strongly on the limit value for the equivalent conicity that still needs to be set. For the data in the figure the assumption is made that wheelsets are reprofiled when the limit value for the equivalent conicity of 0.4[28] is exceeded. Especially the wagons with sinter LL-block qualities suffer from high equivalent conicity causing extra maintenance costs for the wheelsets. In these

[25] When retrofitting SS-wagons using organic LL-blocks thermally stable wheels in accordance with UIC Leaflet 510 and a kink valve should be used, causing in some 20 % of the fleet replacement of these elements and additional retrofitting costs in a magnitude of up to ~4200€/wagon; total cost including the cost of the blocks are some ~5000 €.

[26] This number is used in DG TREN's IMPACT ASSESSMENT STUDY ON RAIL NOISE ABATEMENT MEASURES ADDRESSING THE EXISTING FLEETS of December 10, 2007

[27] Cost estimated as follows: 300'000 wagons with 1000€/wagon; 70'000 wagons with 5000€/wagon

[28] In combination with nominal track geometries UIC 60 1435 mm 1/40. Latest UIC statement is that a limit value of 0.23 should be used for practical applications when the exact track quality is unknown. This LCC estimate could therefore only be realized if brake block shape is optimized in order to reduce the equivalent conicity and/or if the limit value for the equivalent conicity will be increased.

pilot projects the organic LL-blocks show to be less sensitive to this aspect and extra maintenance costs are much lower – more or less comparable to organic K-blocks or even lower.

Results from the Dutch Whispering Train projects with LL-blocks give some insights in the influence of LL-blocks on LCC. The figure shows a forecast of the additional LCC due to the use of different LL-block types depending on the remaining life span of the wagon. Costs for retrofitting are included. Those costs are based on data from four distinct pilot projects with different types of wagons and different types of LL-blocks mainly running within the Netherlands, generalised for a 4-axled wagon that runs 60.000 km per year.

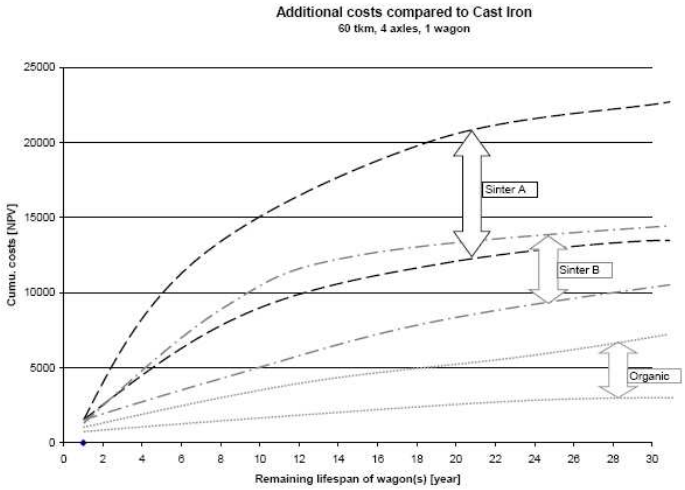


Figure: Influence of LL-blocks on LCC. [Source The Whispering Train Programme - Life Cycle Cost calculation – Intermediate Report – Lloyd's Register]

It has to be expected that there will be a mixture of brakes within the whole freight wagon fleet. Therefore the complete cost for retrofitting will be for a mixture of the costs of K-blocks and LL-blocks. As the LL-blocks have a clear cost advantage there should be a focus on this technology. Due to practical and technical restriction it will not be possible to retrofit all existing wagons using LL-blocks.

4.3 Transaction costs

4.3.1 General consideration

A NRTAC system presupposes continuous recording of noisy and quiet wagons, a process of billing these wagons and some additional support processes. Any cost assessment is mainly driven by the methods of data collecting and processing. In general these methods can be broken down into two groups. Both groups cause different kind of costs and affect different parties: The infrastructure managers, railway undertakings, wagon owners or even governmental parties. These processes and costs are described below.

a) Application of theoretical noise criteria

In contrast to actual measurement of noise, the application of theoretical noise criteria, such as the design characteristics of the wagons, gives an adequate indication of the anticipated noise emissions of freight wagons and is quite easily understood by the wagon operator.

An important condition for the introduction of a noise component to track access charges, on the basis of theoretical noise emissions, is the knowledge of the individual wagon numbers in a train and the attributes such as the type of brakes, required for the calculation. There are in principle several possibilities for collecting this information:

- **Self Declaration**
- **Customer Conseignment Note (CCN)**

- **National Vehicle Register (NVR)**
- **TAF TSI**
- **RFID**
- **GPS**
- **Video**

b) Measuring the real noise emission

Here it is the actual noise emission which is measured. There are 2 ways of measuring noise: directly measuring noise with a microphone (see chapter 2.4.) or indirect by measuring the wheel quality (see chapter 2.5). The results of direct measurement are influenced by maintenance-related conditions such as condition of track (whose effect can be eliminated) and extraneous noise (wind, ambient noise). Therefore they are less suited to simple controls of traffic movements of *re-equipped* vehicles. The indirect method is influenced by maintenance-related conditions such as condition of track. This can be eliminated, so in the Netherlands this is regarded as promising method.

The costs of a system measuring the real noise emission are not usually taken into account as the competing transport modes do not use any real emission data on noise in any charging processes. Furthermore real noise-measurement is explicitly not required by the Communication of the European Commission on rail noise abatement measures.

4.3.2 Costs of installations

The costs of the various options of needed infrastructure are covered within Chapter 3 as far as they are available; they are here reported to allow a better overview, all for 370,000 wagons:

RFID technology:

Fixed installations Tag-readers: ~30 Mio €; Rolling stock Tag: ~20 Mio. **Total: ~50 Mio €.** As noted in chapter 3.4.1 the required investment for the installation of RFID tag readers could be significantly higher taking into account areas with dense networks. Minor direct operational costs are caused by cleaning and maintaining tag readers. Not included: costs to develop and maintain the needed software to calculate the mileage of the wagons and store these results for billing according to standards of bookkeeping rules.

GPS technology:

Fixed installation: none; Rolling stock Telematic unit: **about 300 Mio. €** plus operational cost in the magnitude of some **Millions € / month**. Not included the costs to develop and maintain the needed software to calculate the mileage of the wagons and store these results for billing according to standards of bookkeeping rules.

Video technology:

This technology is estimated to be more costly than RFID-technology without additional benefit, but has higher risks for bad recording of wagon data due to i.e. climatic conditions or visibility of wagon data (contamination). No further analysis was therefore made.

Use of TAF TSI:

It was impossible to determine the costs to adopt TAF TSI without a full functional Requirements Definition. A functional requirement study will have to be done including the underlying applications systems used to implement it prior to determining the costs. However, the costs will be enormous.

4.3.3 Costs caused in the process of data collecting and billing

The process of data collecting and billing the NRTAC will be rather complicated and involve all market participants. In consequence the transaction costs will affect all these involved entities. In elaborating this annex report it was not feasible to make in depth a study on these costs,

which may also vary from country to country. In order to produce some cost data in this important field, the working group asked DB colleagues to make some evaluations based on German knowledge and experience of operating some 7000 freight trains with over 100'000 wagons per day which are presented below. DB's market share of freight tonne km in Europe is ~25%.

Implementation of NRTAC will cause additional transaction costs for all market participants. These costs are caused within the following processes:

- Process of Data Collection
- Process of Billing
- Process of Administration (Charges, Contracts)

Transaction costs will arise for any type of NRTAC and will affect wagon owners, Railway Undertakings and Infrastructure Managers. Moreover there can be additional transaction costs within the governmental organisations. These costs are not part of the calculations within this paper. Anyway each type of NRTAC recording system shows differences regarding the type and amount of costs. The following table shows for any type of NRTAC system which market participant is affected by costs within the various processes.

Recording system	Data Collecting			Billing			Administration		
Self Declaration		RU			RU	IM	WO	RU	IM
Customer C.N.		RU	IM		RU	IM	WO	RU	IM
NVR + GCU	WO	RU		WO		IM			IM
TAF TSI		RU	IM		RU	IM	WO	RU	IM
GPS		RU			RU	IM	WO	RU	IM
Video			IM		RU	IM	WO	RU	IM
RFID		RU	IM		RU	IM	WO	RU	IM

WO = Wagon owner, RU = Railway Undertaking, IM = Infrastructure Manager

Any estimation of transaction costs is very difficult as systems are not yet completely specified and cost will differ within Europe as there are big differences in organisational structures, IT systems and cost structures. In the estimates made by DB AG the most important cost drivers for each type of NRTAC have been specified and an assessment of their costs was done. It showed that main cost drivers are the huge number of datasets which change daily and the resulting complain management.

In a further step these cumulated costs have been distributed to the wagon km of DB AG thus giving an estimate of the total costs involved for Germany. This may be used as an example for the European scale, where for the different countries also different cost sets will have to be used.
The following table summarizes DB AG's assessment of the needed steps and the involved parties in the various processes as a function of the different recording systems:

Method/ Process	self declaration	CCN	NVR/GCU	TFA TSI	GPS	Video	RFID
Process of Data Collecting							
Recording status of brakes/wagons	RU	RU	WO	WO, RU	WO, RU	WO, RU	WO, RU
Recording of wagon distances run	RU		RU				
Analysis of CCN and wagon distance run		RU					
Analysis of GPS recording of wagon distance run					RU		
Transmission of CCN and brake information to IM		RU					
Implementation of information in TAF relevant databases				RU			
Transmission of Data to IM	RU		WO	RU	RU	RU	RU
Analysis of Video information and linking to train run and braking system information						IM	
Analysis of RFID information and linking to train run and braking system information							IM
Data Storage of all Video information						IM	
Data Storage of all RFID Information							IM
Data Storage	WO, RU	RU, IM	WO, RU		RU		
Process of Billing							
Implementation of data within billing systems	IM	IM	IM		IM	IM	IM
Implementation of received TAF data within billing systems				IM			
Plausibility Checks	IM		IM				
Calculation of Charges	IM	IM	IM	IM	IM	IM	IM
Billing and Data Storage	IM	IM	IM	IM	IM	IM	IM
Complaint management	IM, RU	IM, RU	IM, RU, WO	IM, RU	IM, RU	IM, RU	IM, RU
Process of Administration (Charges, Contracts)							
Calculation of Bonus/Malus	IM	IM	IM	IM	IM	IM	IM
Negotiation of amount with regulator/state/DG TREN	IM	IM	IM	IM	IM	IM	IM
Contractual Relationship for transfer of bonus to wagon owner	RU, WO	RU, WO		RU, WO	RU, WO	RU, WO	RU, WO
Costs							
Estimate €Cts per Wagonkm	0.2	Not quantified	0.2	1.8-2.0	1.5-2.0	1.5-2.0	1.5-2.0
Estimate for Germany Mio € per year	~12	Not quantified	~12	100-120	90-120	90-120	90-120

4.4. Some conclusion on the costs

The introduction of noise related track access charges will have a considerable impact of costs. Costs are for one part caused by the installation and maintenance of any recording system and in the other part by the operating of the recording and billing system needed to raise NRTAC. All these cost will have to be added to the costs for retrofitting the freight vehicle fleet to low noise technology. The magnitude of implementation costs are –depending on the chosen solution- for the installation and maintenance between zero (self declaration) and ~300 Mio € (GPS-Technology) and for the operating the system only for Germany between 12 Mio €/y and up to over 100 Mio €/y. These costs have to be put in relation to the retrofitting costs of ~650 Mio €. While the retrofitting costs have the benefit of direct noise reduction it has to be pointed to the fact, that the implementation costs of NRTAC have no direct impact or benefit regarding the envisaged noise reduction. In order to really have an incentive for retrofitting other models than NRTAC with a more direct cost flow to the wagon owner should also be considered.

5. Elements to be considered for a noise bonus to form an incentive for retrofitting

5.1 NRTAC in the Railway freight business processes

The rail freight business is subject to strong intermodal and intramodal competition. If the noise related components of track access charges are to form an incentive for retrofitting, their introduction should not neglect this. It means that the NRTAC must be transparent, predictable and reliable and they should not harm the competiveness of the rail freight market; therefore NRTAC should not result in a rise of costs of the rail freight sector; thus it has to be a bonus and its costs must be recovered from sources outside the rail system.

To be predicable, reliable and calculable, the NRTAC system has to be simple and be applied everywhere, anytime and, to the extent possible, at the same level. The reason for this demand is that when calculating wagon rentals, it is not feasible to predict when and where in Europe the wagon in question will be used. If there is a great variation in NRTAC throughout Europe, the wagon owner will not be in the position to calculate the possible noise bonus his wagon will earn and this will reduce his incentive to retrofit it. Even when calculating a transport across Europe, it will not be clear, in the offer stage, which route the wagon will take and at which time. Therefore there is a clear need to have an European wide, harmonized approach at an equal level for NRTAC to enable the freight operator to take into account the noise bonus in his offer and in his contracts with the wagon owner. In addition, Swiss and Dutch experiences to date show that the implementation of NRTAC on only a single network which is small in relation to the whole transport network does not give an adequate incentive to retrofit rolling stock - in neither country retrofitting occurred due to the use of NRTAC.

Summarizing these perspectives, a variation of the NRTAC on dedicated lines or in distinguishing between day and night time of traffic should not be considered for the same reason.

5.2 Level of noise bonus

According to the European Commission “greening package” adopted in July 2008, one of the main objectives of NRTAC is to stimulate the fast introduction of low noise technology in the railway freight traffic without introducing any discrimination. It therefore will be decisive on which level the noise related component of the track access charges will be set. If the level is too low, it will not form an adequate incentive to encourage wagon owners to retrofit its existing freight fleet. Apart from numerous points to be criticized some interesting basic assumptions are given in the final report of DG TRENS’s ‘IMPACT ASSESSMENT STUDY ON RAIL NOISE ABATEMENT MEASURES ADDRESSING THE EXISTING FLEETS of December 10, 2007. In this study, it is stated that in a general form, the total incentives should be equal to the costs of retrofitting + added maintenance costs + added administrative costs + incentive margin. In other words, the bonus should be the total added costs + incentive margin. Assumptions will have to be made about the number of km driven by a wagon each year and the number of years the bonus will be given. After that the bonus can be determined.

The authors of the study mentioned above estimate the needed bonus to form an effective incentive to be in a range of 3-9 €cts/wagon-km.

Looking at the basic data in the impact assessment study one has to take into account that the data is based on K-blocks and that the author’s estimation of the LCC of K-blocks appears rather positive, although this cannot be confirmed. Looking at LL-blocks, the lower LCC can also not been confirmed, but the total retrofitting costs are lower than using K-blocks. If LCC turns out to be higher, the bonus needed to form an incentive must be even higher than estimated in the Impact Assessment Study. Looking at the ‘normal’ track access charges in use in Europe which are in average 2.5 - ~4 €/train-km, a bonus of ~10 €cts/wagon-km will, in a train of ~20-30 wagons, reach the magnitude of the total existing access charge. Currently in use are noise bonus of 4 €cts/wagon-km in the Netherlands and of ~2 €cts/wagon-km in Switzerland, but in both countries no incentive effect could be observed till date.

In any case the bonus has to reflect the total costs involved in the retrofitting including additional operational costs and an incentive. In total the wagon owner should have a fair chance to recover all his costs in relation to the retrofitting.

5.3 Application rules

NRTAC can be introduced for a limited period or permanently. In the Netherlands the bonus is limited to a maximum sum of 4800 € and only applicable for a limited period or a limited mileage. In Switzerland on the other hand, there is no time or cost limitation for the application of the NRTAC, only its level will be adapted from time to time. A model without cost or time limitation may give a wagon owner greater incentive to retrofit as he will receive a higher return on his investment in retrofitting each wagon and he may use the bonus for already retrofitted vehicles to finance the retrofitting of additional vehicles. The same could be valid, if a noise related bonus were applied as well to retrofitted or new low noise wagons. However, such an open-end system may not be acceptable for a government. As the retrofitting process is limited to the existing fleet, a limitation of a bonus mechanism to a fixed time period (i.e. until the existing fleet is retrofitted) seems justified. But this period needs to be long enough to provide adequate incentives to invest, a period of at least 7-10 years would be required.

There would be a delay in retrofitting caused by the need to have at least 2 suppliers able to deliver safe and economical LL blocks This could take some time as industry will have to invest to be able to produce the needed huge quantities of brake blocks; in addition the maintenance cycle of wagons (6 years) has to be complied with to avoid specific stops of the wagons at the workshops. All this means there could be very long delays in retrofitting.

5.4 Bonus or Malus

A noise related component of track access charges may form a bonus, a malus or a combination of both. However to support the Commission's objectives this component should form a bonus for a period of at least the first seven – ten years of a retrofitting program. A prerequisite will be the availability of LL blocks in large quantities. Such a procedure will also take in account that, according to Directive 2001/14 (Art 7.5), the combined effects of the bonus and malus cannot provide the IM with an increase in revenue except to the extent that competing modes of transport are submitted to such charges.

Once the retrofitting program is ongoing, a combined bonus/malus system could be used for further stimulation of retrofitting. However, a malus should not be introduced until the following conditions are met:

- most of the fleet is retrofitted[29]
- no increase in LCC shall result from using composite brake shoes (to avoid a potential modal shift from rail to road)
- also in the road sector similar malus systems are introduced

[29] In this case a noise-related TAC is no longer justified because the aim of retrofitting the existing fleet has been reached

6. Overview and recommendations

6.1 Overview on the investigated solutions

Tool/Process	Effectiveness	Reliability	Complexity	Costs
Self declaration	In use in NL and CH. System works to refund bonus, no retrofitting due to bonus to date.	Sample checks have to be and can be done (Swiss and Dutch experience).	RU interested in getting bonus.	Only administrative costs, monerate transaction costs.
Customer consignment note (CCN) data	Existing CCN data has no relation to wagon brake equipment and kilometres driven. Could only in principal form link between train nr and wagon nr	Falsification not probable; reliable data.	New processes to be developed. Easier to combine relevant attributes directly	High transaction costs.
Wagon register data (NVR) + GCU-mileage	Existing wagon register contains needed information concerning noise. GCU-mileage to be gathered by wagon owners	Wagon register data is an official database.	Mileage of wagons per network has to be gathered by wagon owners from RUs. Processes to be standardized	Only administrative costs, moderate transaction costs
TAF TSI	Forms regulation which improves trans-European data exchange. Neither charging nor noise issues foreseen.	Reliable, when in place. Will be based on existing (national) processes.	Basic system (without NRTAC-components) in development and deployment. Change in objectives will have to be brought in the process of releases.	Very high: Adaption of existing TAF TSI needed, implementation seems to be costly and time consuming. High transaction costs
GPS	Effective, will record every movement of wagons. Aggregation of information needed.	Technically reliable, high risk of damages and theft of equipment.	Needed processes could be developed outside of existing charging systems.	Very high installation and transaction costs
Video	Effective, will monitor passing by of every wagon.	Technical in principle reliable, but wagon numbers, may not be readable due to dust and dirt..	Needed processes could be developed outside of existing charging systems.	Very high installation and transaction costs
RFID	Effective, will monitor passing by of every wagon equipped with a tag.	Technical reliability depending on the measurement equipment up to 95 %. Risk of non readable tags due to dust and dirt. High demand of harmonization for an European application.	High need of an European-wide coordinated implementation. Needed processes could be developed outside of existing charging systems.	Moderate installation costs, high transaction costs.

6.2 Recommendations for the first 5 years

Based on the knowledge gained with this annex report, the following elements will have to be considered for the implementation of NRTAC:

1) Focus efforts on rapid homologation of LL-blocks.

Noise reduction of rail freight traffic by retrofitting the existing freight wagon fleet will only take place if an economically bearable technical solution is available which allows safe operation. In this context, focus must be on fast homologation of LL-blocks, taking into account the needed clarifications and improvements concerning wheel wear and the related problem of equivalent conicity. Collaboration between block suppliers, UIC and the railways involved in the research should be stimulated. It has to be highlighted that the availability of LL-blocks is a precondition for any action of legislation in this field of NRTAC. Unfortunately a timescale for this action cannot be guaranteed.

2) European harmonization

A precondition for NRTAC to form an adequate incentive for retrofitting will be the harmonized introduction in the main parts of the network in question. Harmonisation is needed for the level of bonus, the processes to raise the NRTAC as well as the date to come in force of this incentive. The rules for this charging system should be developed at an early stage to allow the member states and the railway sector to develop the systems in time. The goal should be to have a common position and regulation in place within these first five years. It has also to be considered that different political choices of Member States or their financial situation may affect the level of funding and the financial support with the result to generate market distortions, with some operators being penalised or benefitting too much. In this perspective, any kind of incentive should be managed at European level using European funds to guarantee an equal distribution.

3) National solutions. Investigations undertaken for this report resulted in only the (national) wagon register data offering solutions to raise NRTAC in the near future. However this data has to be combined with the mileage of the wagons in the various networks. In consequence there will be a need to develop for each infrastructure network the processes to deviate from the available train- and wagon-path data the needed input to calculate the noise related components of the track access charges. Common backbones (e.g. HERMES-system and DATARAIL/ISR) could and should be used to transmit information between the railways. To start at a national level is also in line both with current developments (NL, CH: systems in place, D: pilot will be introduced relatively shortly) as well as with the intention of the Commission to stimulate voluntary introduction of NRTAC at a national level. The need for a later harmonization on an European level should not be neglected within the national solutions.

4) Bonus in the beginning. At least in the starting period (~7 years) the noise related component of the track access charge should be a bonus, as only this will provide an incentive for retrofitting in the competitive environment of the (railway) freight market. The bonus-only system should remain in force until the very large majority of the European wagon fleet is retrofitted. The level of the bonus should be chosen high enough to really form an incentive. However precondition for any action will be the availability of LL-blocks in the needed (high) quantities.

5**) Self declaration.** Current investigations showed that no automatic wagon tracking systems will be available without considerable to very high investment cost and considerable time to implement. Therefore self declaration of the use of low noise vehicles by the wagon owner (as applied in the NL and CH) should be used in the starting period. The authorities/entities responsible to charge or refund the noise related components of track access charges could use some random or plausibility proofs for checking the claimed low noise mileages. However it might cause some problems to enlarge these procedures to a European scale, but these problems are considered to be solvable. Moreover, the incentive system should be based on direct relationship between the financer and the beneficiary to avoid the IMs extra-costs. An agency/authority, in force of its institutional role, can reduce the potential conflict situations between actors resulting in a better management of the system.

6.3 Recommendation for beyond 5 years

Use of TAF TSI

According to the SEDP roadmap, the TAF TSI is expected to be fully implemented in 2014. This might in principle allow the processing of the national systems introduced in the starting period in a more efficient way, but only after the accomplishment of significant changes to the TAF TSI regulation and in particular the company internal business processes and IT. It is not guaranteed that these changes could be done in the foreseen time period until 2014. In addition to that the transition to use the instruments of TAF TSI will not only be faster and may be more accurate, but may also be more costly. Before upgrading a simpler system to this sophisticated application, it should be questioned whether the noise related component of track access charges will only be used for the limited time period of retrofitting; this would make sense as the idea of NRTAC is to form an incentive for retrofitting.

Change from bonus to combined bonus/malus system

Once the retrofitting program is launched (~after 7 years) and the vast majority of the existing wagon fleet is retrofitted, a change from the bonus system to a system including malus could be considered. However it could be questionable whether there will be a need at all to continue with noise related components of track access charges after ~2018(?), when the majority of wagons will be retrofitted except as a means of increasing the incentive to retrofit or spreading out the payments over a longer period. It is a fact that no great differences in the noise performance exist between vehicles using composite brake blocks or disk brakes; it is therefore at least questionable whether the efforts will be worth to operate a rather complicated charging system for these small variations.

7 Final remark and conclusions

The analysis done in elaborating this report showed that there is no easy way to implement NRTAC as an incentive to stimulate the retrofitting on the older freight rolling stock. The implementation of NRTAC remains a very complex undertaking where complicated measuring and billing systems as well as financial flows will have to be organized. Considering the final aim of the Commission and the complexity of creating a NRTACs, the direct funding of the retrofitting seems to be a more practical and faster solution, in addition guaranteeing that all financial resources are directed the technical retrofitting and not to administrative processes.

In this context the politic would be well advised to reconsider the situation and put emphasis on the other scenarios in EU DG TREN's impact assessment[30] including the use of direct subsidies for retrofitting.

[30] IMPACT ASSESSMENT STUDY ON RAIL NOISE ABATEMENT MEASURES ADDRESSING THE EXISTING FLEETS (Dec. 2007)

ANNEXES

ANNEX A) UIC-CER-EIM Noise Expert group participating in the work on this report:

Company	Name	First name	e-mail
ATOC -UK	Wallace	Richard	richard.wallace@atoc.org
B-Cargo	Borghart	Rony	rony.borghart@b-rail.be
CER	Brinckman	Delphine	db@cer.be
CER	Lochman	Libor	libor.lochman@cer.be
CER	Drew	Jeremy	jeremy.drew@cer.be
DB AG	Bonati	Corinna	corinna.bonati@bahn.de
DB AG	Theis	Mario	mario.theis@bahn.de
EIM	Wolff	Dan	dan.wolff@eimrail.org
EIM	Eripret	Jérôme	jerome.eripret@eimrail.org
FS	Ferrari	Sandra	sandra.ferrari@skynet.be
Infrabel	Charch	Radoine	radoine.charh@infrabel.be
ÖBB	Wiesinger	Andreas	andreas.wiesinger@oebb.at
ÖBB Infra Betrieb AG	Wiederin	Stefan	stefan.wiederin@oebb.at
PKP-PLK	Wröbel	Jaroslav	j.wrobel@plk-sa.pl
ProRail	Gritter	Aldert	aldert.gritter@prorail.nl
RFF	Guerrero	Anne	anne.guerrero@rff.fr
RFI	La Paglia	Giampaolo	g.lapaglia@rfi.it
SNCB	Vanderstappen	Joris	joris.vanderstappen@nmbs.be
SNCF	Alibert	Bernard	bernard.alibert@sncf.fr
SNCF	Fragola	Fleur	fleur.fragola@sncf.fr
UIC	Hübner	Peter	peter.huebner@bluewin.ch

The TAF TSI deployment team contributed also to this report in evaluating the possible use of the TAF TSI

ANNEX B) National examples on Wagon register and wagon movement data

B 1) Austrian Rail Transport Information System (ARTIS)

The ÖBB Infrastruktur Betrieb AG charges the train trips on basis of actual data operated on its network, and not on planned data (in accordance with train path order), as it is current practice of other European infrastructure operators. To collect actual operated train and wagon data the system ARTIS is used; ARTIS is a decentralized system with over 50 computer locations and approx. 153 decentralized ARTIS stations. The data are electronically passed back and forth from the stations of origin by the points of identification to the terminal stations using in international traffic the HERMES system. The data are reported from the regional computers to a central server. Thus all freight wagons, operated on the ÖBB net are completely registered in ARTIS. Wagon-related information is kept stored in ARTIS for 3 months, allowing a wagon to be recognized by the system returning within this period from another railway network. Data queries are possible by all users concerning train history, wagon history, etc. In addition various special evaluations using defined queries (e.g. parking days of wagons) are possible.

ARTIS contains information for each passenger and freight train in a train data sheet the train-related data and in a wagon list the wagon-related data. Within ARTIS there is also train-related information available about the predominant braking equipment in a train using with dedicated rules the differentiation between disc brake, normal block brake and block brakes with composite brake shoes. Thus in ARTIS the necessary data regarding braking equipment of the wagons is completely included, so fulfilling one of the most important preconditions to charge in future noise-related components of track access charges based on constructional characteristics. However this data is only based on the information of planned operation and not on the realized train circuit.

B 2) France

For several years, the SNCF internal software NAW (“ Nouvel Acheminement Wagons”) has allowed it to calculate the kilometres run in France by the wagons included in its trains, whichever they belong to it or to other keepers, and so to inform the other keepers about such an information important for maintenance and safety.

Through an old UIC application named GOETHE, SNCF has received the number of kilometres run by its wagons included in the trains of B-Cargo, Trenitalia, Railion Deutschland and Railion Netherlands in their country. Of course, with the liberalisation, such information is not sufficient, as SNCF wagons during their stay in Germany for instance, may be included in trains of other RUs than Railion Deutschland.

Today SNCF (as probably a lot of other RUs) has no automatic software in order to calculate the kilometres run by wagons in its trains in other countries than France.

Discussions are in progress inside RAILDATA in order to add the necessary complements into the ISR application in order to perform the calculation of kilometres run by wagons, but no decision has yet been taken.

Today, as France is not yet concerned by NRTAC, there is of course no calculation about kilometres run by wagons on “silent” line sections. But in fact, such a calculation can be seen nearly as a “sub-product” of the calculation of kilometres for maintenance purposes (which is mandatory according the CR WAG TSI in force (§ 4.2.8.1.2).

In the rolling stock database MARGOT used before 31/03/2007 by SNCF in order to matriculate wagons (its own ones and the ones of other keepers registered through the SNCF RU), the necessary information about disk brake, cast iron brake blocks or K blocks existed. Since 1/04/2007, SNCF has no more the right of matriculating wagons and this task was transferred to the French NSA, the EPSF. To-day, as far as we are informed, the NVR updated by the EPSF

contains the mandatory fields according to the EC Decision 2007/756, but no more the ones about types of brakes.

B 3) Germany

In Germany the National Vehicle Register NVR is under administration of the Eisenbahnbundesamt (EBA). In addition to general information such as wagon owner, wagon keeper and vehicle number, the NVR lists detailed technical data of freight wagons including attributes for type of brake and brake pad. The wagon owners deliver the information to the NVR administration in electronic form on a data carrier (CD/DVD). Under certain conditions a manually compiled list is regarded as sufficient. Wagons newly put into operation (new and retrofitted) have to be registered in the NVR, as the operation of a vehicle is prohibited without registration. Therefore the retrofitting status of the wagon fleet registered in a state can be documented on the basis of the NVR. The NVR exists as an electronic database only. It has been designed to provide Europe-wide information about the vehicles placed into operation. For this purpose the European Railway Agency (ERA) has established an IT-System to transfer requests to the respective states' NVR's.

Information on the wagon data is not available in the systems of the infrastructure manager, as they are not allowed to ask for wagon information in the normal case. Also as there is no track related train movement information in the NVR, a system of charging based on passing noise 'hot spots' would neither be feasible within NVR nor within IM´s systems at this moment of time.

B 4) GB Wagon register data and recording of train movements

The GB system mandates wagon data to be recorded on a database (the Rolling Stock Library – or RSL). RSL has fields for data such as identification number, status (operational/non-operational) expiry of the registration, route availability, maximum speed, weight, dimensions etc. However, RSL is part of a large suite of IT systems which together are able to provide differing reports on operations. Some systems would automatically generate certain predefined reports whilst other reports could be generated due to the interface of systems.

Core to the system is TOPS (**T**otal **O**perations **P**rocessing **S**ystem), originally sourced from the USA, it has undergone significant modification over the years but can be classified as a 'legacy' system which will eventually be replaced. TOPS accesses the timetable plan, RSL, and communicates to and from signal control systems and performance systems (i.e. TRUST) which captures data on late running (manually or automatically) and requires attribution of those delays to the originating source.

In terms of recording train movements, the main system is one called Paladin (Performance **A**nd **L**oading **A**nalysis **D**atabase of **IN**formation). Paladin is a centralised storage of historic train movements (actual and planned), vehicle formations plus loading, and delay details. Paladin derives data from a variety of systems, principally TRUST, TOPS (see above) and GEMINI (maintenance information) and this is extracted from or passed to these systems. Note that RSL also provides data to Paladin (e.g. on unit formations) but it is unclear whether the full consist of freight trains is provided as a routine operation. However, it may be captured for the Infrastructure Manager's billing systems. Certainly the data are recorded in some programs but it may not necessarily be used by all systems downstream. However, once captured such data can be exported to analysis systems; the export may be requested directly by a user or by automatic interface process or could be obtained by running batch processes.

In terms of noise-related track access charges and the need to assess whether a 'noisy' or 'quiet' wagon operates it can be seen that the GB system could easily be modified to capture mileage data for the respective types of vehicle if it does not do so already. If noise-related charging was introduced, the requirements for the national vehicle register (NVR) would, in all likelihood, be adapted to reflect recording of information on the type of wagon and this would probably be incorporated in RSL or any successor system. Furthermore, the fact that the sys-

tems also capture train movements across the GB network, means that a system of charging based on passing noise 'hot spots' would also be feasible.

Note that the fact that this data exists does not automatically mean it is passed to billing systems; but as can be seen it is likely that this information can be provided following modification of some system functions.

B 5) Swiss CIS System

The Swiss Railway Reform of 1 January 1999 allows domestic and foreign train operating companies (also referred to as railway undertakings or "RUs") to use the Swiss rail network. In accordance with the network statement[31] all RU have to transmit electronically i.e. for freight trains all operational data necessary for operation before departure of the trains into the cargo information system of the Swiss railway infrastructure (CIS Infra[32]). Without this data input the signals may not be set to 'green' by train operation. These data can be handed over either by a defined Edifact message, using UIC Hermes with international traffic or directly into CIS Infra (discrimination-free, using Internet with remote access). To these operationally necessary data belong among other data such as car number and general technical data especially the brake design and the brake equipment of the wagons. Depending on access allowance and intended use of the data (evaluations, train real operation schedule etc.) the usage of CIS Infra is for RU's not free of charge.

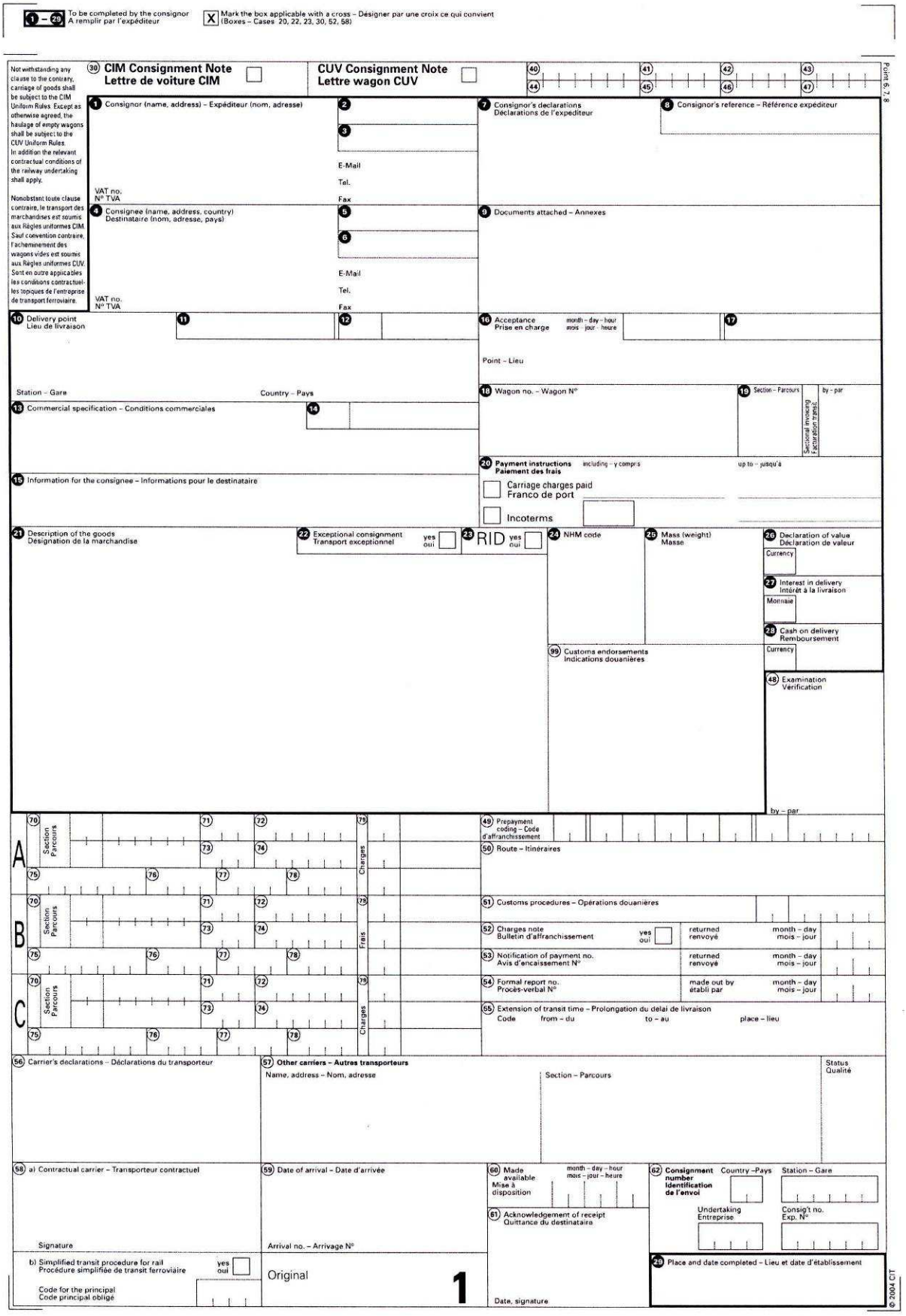
All data supplied by the RUs are stored in CIS Infra for 3 years together with all the other information from the train operation and monitoring, (i.e. used trains, transport chains, connection breaks, etc.) and are available for a fee for further evaluations (e.g. run mileage in Switzerland). The technical wagon data are stored in addition within a data base of CIS Infra and serve as master data for further transports with this wagon. These technical data can only be changed with special authorization or in part with an update using a dedicated UIC Hermes application. On request it is possible to place into this data base additional technical information from the RUs and/or owners of wagon. This takes into account the international data exchange, today using UIC Hermes and in the future also TSI TAF.

Concerning the braking equipment within the data base it is distinguished whether the brake design uses a normal (cast iron) braking equipment, disc brakes or composite brake blocs. All data within CIS infra are also forwarded to the Federal office of transportation as input into the national wagon register.

[31] http://mct.sbb.ch/mct/en/infra-dienstleistungen/infra-netze/infra-schiene/infra-oss.htm?=

[32] CIS Infra is used for entire normal gauged Swiss railway network. SBB Cargo runs a commercial, separate part of the CIS system.

ANNEX C: Customer Consignment Note



ANNEX D) Example of ARTIS Freight train data

Artis-GZ-57193.txt 26.02.2009

Bahnhof 81TULLN INFRA.TIS OEBB Wagenliste fuer Gueterzuege (Ausgangsdaten (Z)) Am: 04-02-09 14:24

Zug 57193 am 04-02-09 von 81LINZ VOESTALPINE nach 81KREMS A.D.DONAU Gleis 6 Seite 1

ueber Bahnhof mit Fracht von Zug 57193 vom 04-02-09 vorbereitet von Bf bis Bf

Triebfahrzeug 9381.1116.051-2
Bs/Dgw/Bgw/Hg G/ 86/ 67/ 25

Angaben fuer das Zugdatenblatt :

Ueberwiegende Bremsstellung (R/P oder G)	R/P		
Ueberw. Bremsausr. (Scheiben-D/Klotz-K/Kunststoff-KS)	KS		
Vorhandene Bremshundertstel Zug in %	76		
Laenge des Wagenzuges in Meter	232	Zugsystem:	
Gesamtgewicht des Wagenzuges in Tonnen	1517	PR-Code/Zugkennung:	
RID-Gut im Zugverband	NEIN	Qualitaetsstufe:	
aS im Zugverband	NEIN	Besteller:	GV-RCA
Nur Drehgestellwagen im Zugverband	JA	GFZF_ID:	57193:2009-02-04
Geringste Fz-Vmax	100		

Nummer des letzten Fahrzeuges: 3380.4670832-1

Nr	Wagennummer	P	Ax b	Ax l	LueP dm	IR	Bg t	GL t	Gg t	BaBs	Bg t	Hbr t	NHMnr	Ladegut	Versandbf	Bestimmbf	RRpc	Empf	Bemerkungen (1) Vmx	Ve	Gr TK	Re	B e	S C
1	3581.4673089-2	4		120	52	23	56	79	M	P	72	B21	720826	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	100		*		8	
2	3181.4777167-5	4		121		21	60	81	K	P	58	B20	720826	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	100		*		8	
3	3181.4777135-2	4		121	52	21	61	82	K	P	58	0	720838	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	100		*		8	
4	3181.4777180-8	4		121	52	21	61	82	K	P	58	0	720838	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	120		*		8	
5	3181.4777158-4	4		121	52	21	60	81	K	P	58	0	720838	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	100		*		8	
6	3181.4777115-4	4		121	72	21	60	81	K	P	58	0	720838	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	100		*		8	
7	3181.4777019-8	4		121	52	21	61	82	K	P	58	B20	720838	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	120		*		8	
8	3181.4777052-9	4		121	102	21	60	81	K	P	58	0	720838	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	100		*		8	
9	3581.4673178-3	4		121	72	23	56	79	M	P	72	B11	721049	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	100		*		8	
10	3581.4673221-1	4		121	62	23	52	75	M	P	72	B21	720838	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	100		*		8	
11	3581.4673279-9	4		121	52	23	52	75	M	P	72	B21	720838	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	100		*		8	
12	3780.4774175-6	4		141	72	25	48	73	M	P	48	0	720837	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	100		*		8	
13	3581.4677105-2	4		121	52	22	58	80	K	P	58	0	720838	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	120		*		8	
14	3581.4673049-6	4		121	52	23	52	75	M	P	72	B12	720838	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	100		*		8	
15	3181.4777147-7	4		121	52	21	60	81	K	P	58	0	720838	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	120		*		8	
16	3181.4777177-4	4		120	52	21	60	81	K	P	58	0	720838	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	100		*		8	
17	3181.4777197-2	4		121	52	21	61	82	K	P	58	0	720838	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	100		*		8	
18	3181.4777122-0	4		121	52	21	57	78	K	P	58	0	720826	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	120		*		8	
19	3380.4670832-1	4		120	52	22	66	88	M	P	58	B 0	720837	STAHLBLE	81LINZ VOES	81KREMS HAF	12064	VOESTALP	120		*		8	

In the above examples the brake equipment of the wagons (Ba) is recorded as follows:

K = graduated release block brake using composite brake shoes

M = graduated release normal block brake

The following definitions are not used in above example:

D = graduated release disc brake

E = direct release normal block brake

L = non-braked service wagons

U = unfit compressed air brake