SOME INFORMATION ASPECTS OF RAILWAY INFRASTRUCTURE CHARGING IN CZECH REPUBLIC

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Summary:

Main organizational, economical and information aspects of the railway infrastructure charging in Czech Republic, connected with EC harmonization directives and international co-operation in frames of EU are discussed in the paper. They are shown mainly from the point of view of information systems universal principles and its automated (software) support.

1. Introduction

Last decade of the 20th century was characterized by many changes in main both railway transport and operation conditions, as the part of both national and international transport. Rational development for the rail transport was searched in the frame of transport liberalization, the transformation of the rail companies to the commercial enterprises and the guarantee of the access rights to infrastructure for third subjects. Therefore among the main problems of this processes belong the prices and value relations too. The securing of the sustainable mobility in balance with quality of the life and economical potential of the society, however, requires the coordinated advancement of countries in the implementation of transport policy and unification of the options at architecture all over Europeans transport system.

The vital railway problems are, of course, connected with the incommensurable business and competitive conditions among various transport modes, especially railway and road. One of the attempts how to solve all problems told above is splitting railway infrastructure and operations too. Separation is seen as a means of enabling the railways to compete more fairly with roads, permitting a clearer means of subsidising the industry, allowing competition for business to take place on the track, increasing the efficiency of track maintenance, and encouraging the movement of freight trains across national borders. But separation is only one tool, which is connected with many legal, organizational, technical and other activities. The keywords of some of them are: revitalizing the railways, railway interoperability, privatization, and of course, charging of the railways infrastructure. This process is very difficult and it interferes with many traditions, customs, persistence etc., as is described e.g. in [14, 16].

The recent initiative for separation has come from European Union legislation which, in a series of directives starting in 1991, has stated that the national railways in EU countries should separate the accounting for infrastructure in such a way that the costs are transparent. Today are those principles wide spread in all over the Europe in many forms. This paper attends to actual state of this changes in Czech Republic.

2. Legal and organizational background

2.1. Main subjects

In Czech Republic is in progress great reorganization of all railway transport, operation and managing conditions. As is more detailed depicted in [2], former Czech Railways, State Organization (ČD, s.o.), successor of the former Czechoslovak Railways (ČSD), the largest national railway undertaking with a long tradition and operator of the vast majority of railway lines in the Czech Republic, was in 2002, by passing Act No.77/2002 Coll. and the Change of

Act No.266/1994 Coll., Railway Act [1], transformed into two succeeding entities as of 1 January 2003:

1. České dráhy, joint stock company (ČD a.s.), with the major areas of operation as follows:
    - operation of railway transport (in the essential segments of long-distance passenger transport, regional passenger transport and freight transport),
    - operation of the railway infrastructure,
    - other business activities namely:
        * messenger services;
        * accessory freight transport services;
        * organized trips and special events;
        * research and testing activities;
        * informatics and computer technology;
    - note: the government held a 100% interest in it,
2. Správa železniční dopravní cesty (Railway Route Administration), state organization (SŽDC s.o.), with the major areas of activities as follows:
    - action on behalf of the government in performing the duties of the owner with respect to the railway route,
    - exercise of the management right to the railway route operation, functionality, modernization and development,
    - management of assets that constitute the railway lines,
    - administration of payables and receivables discharged from former ČD s.o.

This steps are generally harmonizing with 2001/12 and 14 EC directives [3].

Since January 2003 the economic operation of ČD a.s. is no longer burdened with operating expenses and costs on maintenance and development of the route. These activities are performed by the joint stock company on the basis of a three-year contract entered into with the SŽDC s.o. ČD a.s. is a corporate person relieved of financial commitments and separated from the government that operates on a national level in a market-driven environment, has sufficient space for independent business decision-making and at the same time is aware of its business and management responsibility. The above provides a solid base for enhancement of economic effectiveness of the client oriented firm and concurrent reduction of funds required from the state budget.

SŽDC s.o is ensuring railway network functionality in the public interest and it also bears the costs of modernizing and developing the railway lines. Individual train operating companies that use the railway lines pay fees for their use to Railway Route Administration. The main contracts were entered into between ČD a.s. and SŽDC s.o. immediately after the transformation:

1. on the Method of Provision for the Operation of the Railway Infrastructure, Its Operability and Modernization and Development in Line with the Public Interest of 3 January 2003;
2. on Payment for the Use of the Railway Infrastructure in Operating Passenger and Freight Transport of 10 February 2003;
3. mandate Contract on Maintenance of Economic Agenda of 3 April 2003;
4. mandate Contract on Preparation of Financial and Statistical Statements of the Former ČD s.o. for 2002 of 20 February 2003.

In the Czech Republic, not all regional railway lines owned by the State are operated by the ČD a.s. For instance at February 28 1998 National Property Fund chairman and his counterpart from the Jindřichův Hradec Local Railways marked the transfer of two 760 mm gauge lines (from Jindřichův Hradec to Nová Bystřice (33 km) and Obrataň (46 km)) to corporate person JHMD for a symbolic Kč 1. Another 10 rural routes totalling 168 km have been leased out by ČD s.o. for private operation. E.g. the line from Šumperk to Kouty nad Desnou and the 3 km branch to Sobotín was transferred to the Federation of Desná Valley Municipalities. Other lines were leased to enterprises what are operated them. Even in circumstances where these railway lines are operated by other entities, Railway Route Administration entered into agreements with their operators that are based on the same principles as the agreements put in place with the ČD a.s.

Pursuant to the verdict of the Constitutional Court dated 19 February 2003, certain provisions of Act 77/2002 Coll. have been rendered null and void with effect from 31 October 2003.This matter will be followed up on by an amendment to the Act which, following the finalization of comments on the Government's bill, will be discussed by the Czech Parliament in the fall of this year.

Every railway lines entrepreneur or transport operator, including ČD a.s. have to be licensed by Railway Authority. Further, namely passenger transport planing process starts today on the regional level. This administrative subjects order transport services in the public interest and they are responsible for budget. Therefore this subjects have great influence to ČD's incomes and all activities of this type accentuate information support for managing, especially data about the railway lines and their surrounding.

The greatest amount of railway activities among all their operators has, of course, ČD a.s. As is written in [2], at 2002 each day,1,800 freight trains and 7,000 passenger trains were dispatched, from romantic trains operating on short local lines to trains included in the prestigious international EuroCity network.

Among [2] in 2002 ČD s.o. was used by more than half a million passengers daily and about 250 thousand tons of freight was transported each day. Almost everything was carried by ČD trains: small consignments, raw materials, industrial and agricultural products, as well as giant transformers. The Company ranked 4th in Europe in terms of output, following Germany, France and Poland, and 2nd in terms of transit freight transport, a very attractive sector from the business perspective. ČD co-operates with the individual regions and neighboring countries, e.g. cargo services were expanded by transport of containers in a train between Prague and Györ, Hungary etc.

In the last year ČD s.o. operated freight transport under the trademark ČD Cargo on over 9 thousand km of railway lines in the Czech Republic. Freight transport services were provided to clients in 1,143 railway stations throughout the country. The annual volume of merchandise transported by ČD ranked the company as four on the Western European and Central European level. More than 70% of freight transport was executed on ČD lines between railway sidings of customers. As it is typical for the majority of the world's railway companies, transport of bulk cargo represented the key activity within freight transport of ČD. Of the aggregate volume of goods carried on ČD lines, transport of solid fuels accounted for over one third, building material for one tenth, ore and iron products for another tenth, and timber for 6 percent. Combined transport accounted for 7 percent. For the purposes of actively resolving logistic needs, customers can consult sales managers, advisors, the Czech Railways Forwarding Agency, and foreign general representatives. The performance of transport activities is controlled and monitored by the Central Office's staff on an ongoing basis. The incommensurable

business conditions in the fields of railway and road transport in both the Czech and European market made ČD substantially rationalize its operations.

ČD a.s. provides all types of regular rail passenger transport and related services too. In collaboration with railway operators in the adjacent countries, ČD provides for connection between major European cities. Additionally, ČD operates special and charter trains designed to meet the customer's needs, and offers a number of other supporting and supplemental services that substantially increasing the travelling standard. Suburban transportation in fast growing metropolitan areas, such as Prague, Brno, Ostrava, Ústí nad Labem, Pardubice and Hradec Králove represents a specific component of regional services.

2.2. Infrastructure Charging System

Accurate pricing of track capacity and effort is a very complex task, given the very high fixed cost element and the almost infinite flexibility in pathing through the payoff between speed range and headway. Main form of transport pricing used today in ČD is based on calculation of the individual transport acts - the consignments, wagons or the trains, operated by central dispatching. In this process is no place for any Infrastructure Manager activities.

But the liberalisation of train path market and new railway undertakings ask for new pricing system, based on infrastructure charging, supported by today existing Adjustment of the price assessment[4], issued by the Ministry of Finance. It is determining for using on the intrastate railway infrastructure of national and regional railways and using following main conditions and principles:

1. For the purpose of determining the maximum price for using the railway infrastructure, the railway infrastructure of national and regional railways means the infrastructure determined for transport by means of rolling stock, fixed railway installations necessary to ensure the railway rolling stock movement and installations serving to ensure railway operation safety (especially railway stations, railway superstructure and substructure, structures, telecommunications and safety devices, fixed contact lines).
2. The maximum price for using the intrastate railway infrastructure does not include the costs of:
    - control of a railway vehicle;
    - power supply in the case of using electric traction units;
    - use of operations buildings owned by an operator of national or regional railways that serve for other purposes than traffic control (e.g. waiting rooms and other services for passengers etc.);
    - elaboration of timetables for all entitled transport operators;
    - a required train escort by a professional qualified staff of another entitled transport operator;
    - other performances required by transport operators, e.g. supply of fuels, greases, water, pre-heating of trains (cars), technical and commercial inspections of trains (cars), cleaning and fumigation etc.
3. The agreement on using railway infrastructure of national or regional railways is concluded between the operator of national or regional railways and an entitled transport operator which is a person authorized to carry business in a public railway transport when fulfilling the conditions determined by legal regulations for national or regional railways operation[1]).

[1]) E.g. Act No. 266/1994 Coll., on Railways, as last amended and its ordinance.

4. The maximum price for using railway infrastructure is applied for running of separate motive power units, loaded (in passenger transport, occupied) as well as empty trains, power cars including electrical and other separate rolling stock on its own wheels owned or leased by an entitled transport operator.
5. The maximum price is determined for:
   - Freight and mixed trains, locomotives and other motive power units and other separate rolling stock on its own wheels according to the prices given in Part I A and relevant coefficients determined in Part I C, D and E (see [4]);
   - Passenger trains, separate electrical and power cars according to the prices given in Part I B and relevant coefficients determined in Part I C, D and E (see [4]);
6. The decisive factor for determining the maximum price for using the railway infrastructure of national and regional railways is a type of train and a length of the train sections agreed according to the mileage published by the railway operator: Table No. 9 of the Amendment to D2 Instruction (Transport Regulation Concerning Railway Transport Organization and Operation; approved by the decision of Director General of ČD, s.o. 55079/97-011; issued in 1997). In an unscheduled running through diversion for reasons on the part of the railway operator the distance covered is determined according to the train sections agreed originally according to an internal instruction of the railway operator. If the railway operator discusses diverted routes with a transport operator at least 60 days before the scheduled running, he is entitled to charge for using the infrastructure through a diverted route.
7. With an unscheduled running through a diversion the operator submits on the entitled transport
   operator´s request the mileage abstract of the train sections agreed originally.
8. Routing is agreed between the railway operator and the entitled transport operator before the start of transport.
9. The maximum prices are given including 5% value added tax (VAT).

Maximum prices for using the intrastate railway infrastructure of national and regional railways is calculated according to the following formula:

$$C_m = S_1 \times b \times L + \frac{Q}{1000} \times S_2 \times \left[L - L_e\left(1 - e^p\right)\right]$$

where:

C_m the maximum price for using the intrastate railway infrastructure of national or regional railways by one train for an agreed route

S_1 a price for *1 train km* as a share of the price for operating the infrastructure (operations control) per train kilometer

b a coefficient taking into account the weight of trains in infrastructure operation

Q the gross weight of a train, in tons, taken:

- *for a freight train*: as the sum of railway rolling stock weights (motive power units, railway cars, other rolling stock on its own wheels) and the loaded goods weight (consignments), in tons, rounded up to whole tons
- *for a passenger train*: as the sum of railway rolling stock weights (motive power units, railway cars, other rolling stock on its own wheels) and passenger's weight (the number of seats × 0,08), in tons, rounded up to whole tons

S_2 a price for *1000 gross tkm* for a particular type of train as a share of the price for ensuring the infrastructure operability (infrastructure) for one thousand gross ton kilometers

L The distance of trains running, in kilometers, rounded up to whole kilometers

e a coefficient taking into account active motive power units of independent traction on electrified lines (it applies only to a part of a train running powered by a motive power unit of independent traction on an electrified line,

L_e the distance covered on an electrified line by a motive power unit of independent traction

p the number of motive power units referring to the coefficient ***e*** relating to the number of active motive power units

This parameters must enter to the calculation system. Some their values for freight transport are for first information only presented below:

- operating the infrastructure (S1) train CZK/train km : 50,88
- ensuring the infrastructure operability (S2) CZK/1000 gross tkm: 61,80

Very interesting is relatively large simplicity of the formula included in the Adjustment. Most complicated algorithm is concerned with penalization of both non ecological and economical using of motive power units of independent traction below the wire only. The former Adjustment version [5] was based on a little more complicated factors:

- track categorization (3 categories based on construction and operational principles),
- transported good categorization (8 categories based on universal statistical principles, e.g. solid. liquid and gas fuel, construction materials, row materials, scarp, dangerous and extraordinary consignments etc.).

Other European infrastructure organizations praxis offers more complicated calculations too. For example according [6] Italian infrastructure charging system obtains possibility to charge stop time in stations and Belgian one is able to distinguish between days in the week and hours in the day, in which is the transport executed. J.Sherp in [16] discusses many other possibilities, how to charge the infrastructure access to be non discriminating and supporting international railway transport. Therefore it is presumable, that present calculation principles should have been very changed in other transport, political or business conditions. It is very important from information point of view, data structures and algorithms design and other software features.

2.3. Other conditions

Spitting of the railway infrastructure and operation is very fundamental intervention to the workaday railway organization praxis. Therefore it clashes with many legal, institutional, organizational, financial and many other obstacles. Some of them are connected with the technical conditions, the others with informational ones.

From the technical point of view is, for example, important, that the use of contractors for maintenance and renewal has expanded rapidly, primarily through the privatisation of the railways‘ in-house track maintenance organisations. Those infrastructure organisations that have given long-term contracts will probably face a significant problem in the future, as when the contract does come up for renewal it is unlikely that any company will have the specialised equipment and personnel to bid against the existing contractor.

Other problems are connected with the inspection, safety and accidents on the railway. Inspection like any good quality assurance programme, must be independent. But it has not value for the train operation only. However, first step of every inspection starts in everyday managing praxis all over the organization hierarchy and it has many connections with their information system (IS). Therefore independent inspectors and internal management would use the unified IS. But when this system is automated and contains several subsystems, which was designed by various suppliers and which is based on several hardware, software and methodical platforms, the obstacles progress, maybe explode.

That is why the new concept of the railway infrastructure access charging needs several preconditions. In the current global world, which main processes are usually on-line and in real time connected, this step needs to build special own IS, combining both database and graphical railway description with plenty of marketing information about important features of the stations and the tracks and with calculation or billing processes. Many functions of that type are executed by the new organizational unit type - One-Stop-Shops (OSS). Therefore this unit probably has to be main user of new IS, based on the Internet technology and operated in close connection with other subsystems of the railway administrators (or undertakings).

There are several questions, which have to be answered before following steps:

1. who (which existing or new organizational unit) is the bearer of the OSS role,
2. who is the partner for the new information project designer and who has to order modifications in the connected subsystems,
3. who has to prepare and certificate needed data gathered from connected subsystems,
4. what Regulations and operational procedures used separately for infrastructure and traffic operation purposes is necessary to update to the new unified form.

3. Software support

3.1. Generally

The base for the comprehensive network description, which is necessary for the Infrastructure charging IS is the Network Statement, what has to be made by OSS in agreement with directive [3], annex 1 (see [16] for more information too). In the content of this document is hidden, that railway as a whole consists of three relatively independent branches - transport, traffic operation and infrastructure - every of them with very heterogeneous information demands, resulting from different substance of their characteristic entities. These entities are:

- transport and economical documents (tickets, bills of freight etc.)
- trains (here as one package, also as a line in chart timetable. It cannot be confused with independent locomotives, cars, train-crew and load),
- fixed facilities (tracks, bridges, signals, power-supply, etc.)

It should be reminded that the transport, economical and operation entities are practically immaterial, short-time and network-wide, while the infrastructure entities are always material, local, frequently very individual, existing over long time period (even more 100 years). From this result quite different demands of the both IS on the technique of data capturing, processing, storing and other details, including graphical presentation.

In contradiction to other modes of transportation (especially of road transportation, being so often compared with railway), these three branches are historically interconnected in a very complicated way, which has to be followed not only by IS but by charging system too. There-

fore is necessary to find new, modern approaches and methods for Infrastructure Manager services. They are not included in EU documents only, but in some IS projects, developed on the order of some international institutions, too. ČD took part in two of them.

3.2. European Infrastructure Charging Information System (EICIS)

EICIS is the project [6] especially focused on OSS functions and giving them automated support. Purchase order for its development was done by UIC, supply house is TLC Transport-, Informatik- und Logistik Consulting GmbH, Subsidiary of DB Systems GmbH in Austria. In this project took part, except of ČD, many European infrastructure managers, including DB Netz, MÁV, ÖBB, PKP, Railned, RFI, SBB, SNCB, ŽSR etc.

Today the EICIS authors finished basic version I and works on the more complicated and comprehensive version II was started. Routine EICIS service is based on Oracle Database and Web- and Application Server, situated in Budapest, the role of the General Manager is today played by DB, resident in Frankfurt a.M. It will rotate in future.

EICIS database is divided to two main parts managed by General Manager (main project parameters) and national Data Managers (all data describing the line networks and other conditions important for the charge computing). Many algorithms used for network and train description, including calculation formula, are using many parameters, entered by Data Manager. Therefore it is possible to change the charge calculation conditions in any time and in the wide data spectrum.

ČD database contains the network shown on fig. 1. This network contains main routes used for international transport, included in the lists of Agreements and projects TER [7], TINA [8], AGTC [9], AGC [10], Crete corridors etc. The database contains:

1. 20 track lines and 82 railway nodes identified using leaflet 920 UIC [11],
2. 92 line segments described with main parameters:
    - passenger line,
    - freight line,
    - electrified line,
3. 113 line sections with their length (accuracy 1 meter and GPS latitude and longitude coordinates of the nodes),
4. other data and formulas describing trains and other conditions used in calculation and results presentation.

On the fig. 2 is introduced proposal of the dataflow diagram describing connection between IS ČD and EICIS. EICIS ability to connect query user with ČD www pages with Network Statement and plenty of marketing information is very important. It is planned that majority of this connection details will be finished till the end 2003.

Actual EICIS database version was in ČD conditions derived from elder main international traffic routes description, which was originally prepared for the TER project.

3.3. Trans European Railway (TER)

Trans European Railway is project of United Nations Economic Commission for Europe. It aims to leveling construction and operational state of the Pan–European Transport Corridors and building processes realized on them monitoring. TER is managed by Steering Committee (SC) and Project Central Office (PCO), resident in Budapest. In TER project took part member countries : Austria, Bulgaria, Croatia, Czech Republic, Hungary, Poland, Slovakia and

Slovenia. There is useful the co-operation between TER and UIC and co-participation with the World Bank and other institutions. There is connection between SC activities and results from European Conference of Ministers of Transport too.

For the SC purposes PCO TER prepared Network Database and its automated support. In present version is this system based on the Excel, but new version is prepared in Access and its graphical part in MapInfo environments. The rules of its data capturing are published in [7]. This database contains:

1. master file with main definition of the line sections and nodes,
2. general data containing information about the country,
3. list of codes used in description of sections, nodes and other entities,
4. list of line sections with their length and many parameters concerning their state from the point of view of the railway and civil engineering (e.g. track gauge, mass per unit length, mass per axle, structure gauges etc.), signaling, operations etc,
5. list of nodes with their position on the line and cumulatively from the border of country or line beginning,
6. list of bridges with their length and many parameters concerning their state,
7. list of tunnels with their length and many parameters concerning their state,
8. list of overpasses,
9. list of level crossings with their length and many parameters concerning their state,
10. operational data about transport realized on described lines,
11. list of locomotives & railcars types and their count and some parameters,
12. list of coaches types and their count and some parameters,
13. list of wagons types and their count and some parameters,
14. some combined transport parameters.

Codes and terminology used for all entities description are derived from UIC leaflets (see [11]). In present third database actualization is proceeding.

3.4. ČD Infrastructure Information System

Information needed for the infrastructure charging and OSS as the main user is comprehensive and it integrates both operational and constructional point of view. It has at least two parts, devoted to both train and routs description. In the EICIS system the query user is drawing up data about trains and other transport conditions. The infrastructure data are much more stabilized and they are prepared by Data Manager of individual Infrastructure Managers.

But there are some distinctions between railway traffic route (RTR) description from the both operational and constructional point of view. This distinctions are usually shown in details. For example in accuracy of the measuring and rounding track or routes lengths, in definition of outer points starting and ending line sections, in time stability of the data validity etc. Hereat natural base for the railway traffic route description create construction projects and from the information point of view, GIS technology.

But experience of advanced European railway administrations, especially of SBB and DB shows, that the building up of the space oriented IS is the matter of long time and high expenses. However, designing itself presents less then one third of expenses and time consuming. The data capturing and the overall adaptation of a management system to the new information support seems to be much more exacting.

That is the reason, why routine ČD Infrastructure Information System as whole has not form of GIS yet, but database oriented system with some parts of GIS (see [17] for more information). It is used above all for the diagnostics and track and other installations maintenance, investment and managing processes etc. In this time it is separated from transport technological and control systems.

The base of this system creates documentary evidence with the top down hierarchy of the RTR description entities:

- railway network,
- railway lines and junctions,
- railway routes – tracks and turnouts (they are main parts of the superstructure line inventory),
- parts of the routes – rail strings, support, individual substructure constructions, signaling, electrification etc.,
- features of the routes – routing, inclination, mileage marking system, length etc.

Therefore main RTR description principles allow various views on the RTR (including economical, cadastral, geodetic etc.). They are based on the unique identification, localization and organization relevance of the entities and encoding system is allowing data processing for various end-users. RTR description has following hierarchical bottom up levels of data accuracy and precision:

1. level - construction projects,
2. level - object related documentation defined by various ČD Regulations e.g. for the superstructure description is used SR103/7(S) Instruction [14],
3. level - traffic routs (with their own internal mileage marking system),
4. level - definition sections (they are defined as surrounding routs by ČD Regulation M12 [12] and their description contains the mileage and marking system defined by ČD Regulation M21 [13], this mileage system is stabilized for long time and it has many irregularities)
5. level - route sections (aggregations of the definition sections defined by ČD Regulation M12)
6. level – special purpose route sections (defined by various end users, e.g. for the descrition of the national and regional routs was defined 185 respectively 194 SPRS on the base of the Railway Law 266/1994 [1] and other documents of Railway Administration).

Some quantitative characteristics of ČD Infrastructure network:

- 2812 significant traffic points
- 7977 definition sections including:
  - 4772 definition sections under SŽDC administration
  - 1955 definition sections of private railways
- about 50000 rail elements, several thousands pieces of the rail tracks etc.
- 9364 km of the routs, 16028 km of the tracks

This system was developed by ČD organization unit DATIS, specialized on information systems design, development and operation. To obtain higher economical and production efficiency, fusion of this unit with the unit operated ČD telecommunication and data networks in the new ČD organization structure is prepared. The system is on the local level operated by ČD service units (Track Administrations etc.) and on the central level by special ČD organization unit - TÚDC.

4. Conclusions

Rail transport can provide a significant contribution to the transport services of the 21th century. In the frames of changes, started at eighth decade of the last century and due to competition with other transport modes (namely road one), the law basis of the railways behaviour and their organizational structure are all over the Europe reforming.

Individual European states and their railway administrations have reached various experience in this reforming process. Therefore the international co-operation, organized on the bases of Universities or various institutions as UIC, TER etc. is very useful. But it is much more important from the point of view of IS automated support. However, this systems are very conservative and their rebuilding is very expensive. But international character of the traffic, business and communication demands need the extensive standardization and unification of all information processes.

Therefore information aspects of the railway infrastructure charging system need attention not only from the operational or economical point of view, but from the information one too. All the more the international co-operation and experience exchange is very useful.

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