



## INCREASING THE EFFICIENCY OF NIGHT TRAINS BY IMPROVING THEIR USABILITY IN DAYTIME TRANSPORT

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### Abstract

The use of night train rolling stock in daytime transport can be expected to increase efficiency by reducing idle times, but also has numerous challenges. The TANA project, which is funded as an R&D service in Austria as part of the “Mobility of the Future” programme by the Federal Ministry for Climate Protection, (BMK) and supported by the Schieneninfrastruktur-Dienstleistungsgesellschaft (SCHIG mbH), is developing concepts to improve the use of night trains in daytime transport.

*Keywords: night trains, day night use, HSR night trains*

### 1 Introduction

Night trains are a potential sustainable alternative to flights for medium- and long-haul routes. However, they are difficult to operate economically as they have a lower capacity compared to day trains and, due to their specific equipment, hardly have a sensible area of use in daytime transport. This results in unproductive, long idle times for couchette and sleeper carriages. Efforts have therefore been made to develop vehicle concepts that can be used equally in both daytime and night-time services. However, this involves compromises, as trains that are highly efficient in daytime traffic do not meet the comfort requirements of night travellers. Conversely, the use of standard night trains on daytime services is not economical as the achievable capacity is too low. Unless this is compensated for by the pricing. Night trains account for approx. 20% of ÖBB-PV AG's total revenue [1] and run for approx. 12 hours per day on selected routes. Day trains run for approx. 20 hours a day between 5 a.m. and 1 a.m. at night. It does not seem expedient to adapt day trains to the extent that they can also be used for night services, as economic disadvantages must be accepted for 80% of the range of services (measured in terms of revenue) and, conversely, the necessary compromises mean that the required quality cannot be achieved in night services. In addition, the requirements for vehicle ergonomics, accessibility and comfort factors also differ significantly. On the one hand, the usage behaviour of passengers differs greatly (rest, relaxation on night trains vs. work, communication on day trains), and on the other hand, travel times on night trains are significantly longer.

## 2 State of the art in Europe and project approach

The TANA project aims to develop a realistic overall concept for night trains that also enables a reasonable range of use in daytime transport. Elementary components of the design approach are the utilisation of multifunctional equipment elements, the development of complete vehicle systems and the derivation of suitable deployment scenarios. The equipment of night trains is primarily geared towards overnight stays on the train. Different levels of comfort are used, which differ in terms of price, facilities and services [2]:

- In the highest category, the sleeper carriages, compartments are offered with or without their own bathroom, which are generally used exclusively by one or more passengers travelling together.
- The middle category comprises so-called courette coaches with simplified furnishings and usually compartments, often shared with other travellers, with four to six berths. New concepts, which are already being used on the ÖBB Nightjet, provide individual berths for better privacy [3].
- The lowest comfort level comprises seating carriages (often compartment carriages, sometimes also saloon carriages). There are also so-called recliner carriages, but these also have a lower passenger capacity and have hardly become established, as only a certain seat inclination can be achieved, but not lying flat. In Norway, however, recliner carriages are being used again [4].

In the countries of the former USSR, there are also “Platzkartny” carriages. These are travelling dormitories in which there are no doors between the bunks and the aisle and there are also couches on the other side of the aisle. The lower bunks can be folded down mechanically and then serve as seats or tables between the seats [5].

Vehicles that can already be used for night and day train services are seating carriages and, in some cases, courette carriages, in which seats for up to six people per compartment are created by folding away the couches. However, seating comfort is limited by a continuous, non-adjustable bench seat. These carriages can already be used in daytime services at any time, although night trains currently usually form a continuous train formation that is not specially separated for daytime services. In principle, recliner coaches can also be used in daytime services and may be suitable for use as 1st class coaches.

Courette coaches with bunks do not appear to be suitable for daytime services, as the journey can only be made lying down. Sleeper carriages offer the most comfort, but allow a relatively low capacity, which means that they cannot cover costs or be used economically in daytime services with a normal fare scheme.

Day trains are operated with classic seating coaches, which currently consist mainly of large-capacity coaches and have a higher capacity in UIC coaches in 2nd class with approx. 80 seats per coach than coaches in night train services (e.g. max. 66 seats in courette coaches). Some daytime services, especially IC trains, also use compartment carriages, as on night trains.

Currently less so in Central Europe, but certainly in other regions of the world, night trains also run on long-distance routes that last several days and where travellers sit in the same vehicles both at night and during the day. Very often these are tourist trains with correspondingly comfortable facilities and high fares [6], but sometimes they are also classic passenger trains, such as in Russia [7]. In general, night trains have the advantage of covering the regions well in the pre- and onward carriage. This means that they not only enable point-to-point connections between larger cities such as aviation, but also directly open up considerably more areas in the region [8]. In addition, night trains start in the early evening or run into the morning the following day, which is why a daytime part is also integrated into such journeys.

The TANA project is developing an overall concept for night trains that can also be used efficiently in daytime transport. Areas of application could be, for example:

1. Night train connections with longer pre- and post-carriage times for more efficient connections to the regions and for more transfer-free direct transport.
2. Use as day trains in order to increase the efficiency of the night train rolling stock by reducing idle times.

### 3 Challenges and opportunities for use in daytime transport

The aim of the TANA project is not to restrict the quality of night trains, which is why real operational challenges must be taken into account. Rail operations are particularly restricted when arriving in larger cities during the morning peak, as the timetabled train paths are heavily occupied, especially by commuter trains, and there are hardly any train paths or platform edges available for night trains. On some sections of the route (e.g. Florence-Rome), night trains have to travel on HSR sections whose train paths are also well booked in the morning hours, which is why overtaking operations extend the de facto journey times [9].

It currently takes four to six hours to “dismantle and refit” overnight trains (cleaning, changing bed linen, catering, etc.). According to current quality requirements, a corresponding standing time must be planned for this period. At the same time, the current overnight train services are based on the infrastructure available at the departure and destination stations. Route extensions often mean that the infrastructure at the “new” departure and destination stations would first have to be created. The use of HSR night trains also sounds promising for extended areas of operation, as very large destinations can be travelled at night. On the other hand, there are currently the challenges that numerous HSR line sections in Europe are either intended for (relatively slow) goods train journeys at night or are closed for maintenance work. Another economic challenge is that some of the main production costs for a night train increase linearly with distance and, for labour law reasons, two shifts of staff are required from certain journey times. However, it is not possible to adjust fares according to distance without restriction, particularly in night transport. This is a competitive disadvantage compared to air transport, where costs increase sublinearly with distance [9].

The challenges presented in the overview, which are not exhaustive, are intended to illustrate that long-distance or HSR night transport services cannot currently be pursued without restrictions and at the same time economically. Conversely, however, they are not intended to destroy the appealing idea of expanding services, which is why the TANA project is also looking for future-proof solutions.

In order to achieve approximately the seating capacity of single-decker day trains for night trains in daytime operation, the design of the required adaptive equipment elements was based on a double-decker train concept. In order to eliminate restrictions on the use of HSR sections and at the same time not to restrict the possibility of future HSR night train operations, an HSR double-decker concept was used, which corresponds to the Euroduplex.

### 4 Passenger requirements

An online survey was conducted to ascertain the requirements. The results show that more than 60 per cent can imagine using night train connections that exceed a journey time of 16 hours. There are some basic requirements for vehicles that should offer a comparable level of comfort both during the day and at night. The majority of respondents were in favour of modern and bright equipment concepts. On the other hand, those that were perceived as very cramped and oppressive were criticised. On the other hand, coach interiors that allow travellers a certain degree of flexibility during the journey were praised. This includes work areas and facilities, as well as the option to sit or lie down during the journey.

Issues relating to sitting and sleeping comfort are generally among the most important requirements. At night, a comfortable place to lie down or sleep is the most important requirement. During the day, it is comfortable seating, whereby comfortable seating is also important for almost 80 per cent of respondents on an overnight train. For longer night train journeys in particular, respondents would most like to be able to convert the bed into a seat. When it comes to seating, the majority of respondents want a familiar sitting position, with adjustable seats being viewed very favourably. The arrangement of seats at right angles to the direction of travel is viewed rather negatively. In addition to seating and reclining comfort, there is also the space available for travellers. The concepts also give rise to clear points of criticism if the seats or reclining areas are perceived as too narrow or legroom is restricted. There is also a strong need for individually adjustable lighting and temperature regulation. Another important issue is privacy and security on the train. The need for privacy and lockable compartments is greater for night trains than for travelling during the day. Sleeping compartments that cannot be locked and those that are not opaque are viewed critically by the majority. There is also a recognisable tendency for people to refuse to share a compartment with strangers at night. Future carriage concepts should therefore be designed more for smaller compartments and individual sleeping berths that can be locked and are opaque. Wi-Fi is one of the three most important requirements for day and night trains. Work facilities are required much more frequently for travelling during the day than for night trains. In addition to Wi-Fi, this primarily includes desks that are arranged and dimensioned in such a way that they allow passengers to work properly.

The results also show that sufficient space for luggage on day and night trains is an important requirement. At the same time, luggage storage should be secure, especially at night, so that travellers do not have to worry about theft. Carrying bulky luggage and bicycles is only important for just under a third of respondents both during the day and at night. Nevertheless, future vehicles should have multi-purpose areas in which bicycles or skis can be transported.

Passenger information on the train is one of the most important requirements for those surveyed for day and night trains. There is a lot of potential for improvement here, especially for future night trains. At present, electronic passenger information systems are not the norm on night trains. In future, these should be implemented on night trains in a similar way to the systems on day trains.

Separate family and women's compartments are more important to respondents on night trains than when travelling during the day. The results show that women want these much more frequently. In the case of women's compartments, as many as three quarters of all women would like to have their own compartments on night trains. Just under 45 per cent would also rate separate business compartments positively. This could appeal to affluent business travellers in particular, as the results show that almost a third of respondents have already used an overnight train for a business trip.

On night trains, there is also a greater demand for services such as drinks and food. Similarly, the respondents would like to see snack and drinks vending machines on the train. These would offer the advantage that travellers could provide themselves with food and drinks at any time during the journey and this service would tie up fewer staff resources.

On the one hand, the ticket price shows that it plays an important role in the decision in favour of or against a means of transport. The ticket price was rated as more important than comfort or journey time. Nevertheless, there is a tendency to recognise that comfort plays a more important role in the choice of means of transport with increasing age of the respondents. On the other hand, a willingness to pay higher prices for more comfort can be recognised. On the other hand, there is less willingness to pay more for night train tickets than for travelling during the day, unless the service is seen as very comfortable and can also convince in terms of privacy, safety and facilities.

## 5 Interior design

The first interior design concepts are presented below. At the centre of the design of the day and night train is a multifunctional interior concept that offers passengers an individual and comfortable travel experience, regardless of whether they want to relax, work or sleep. The aim was to create spaces in which travellers enjoy spending time and which can be adapted to individual travel needs.

The aim is to create an alternation between a personal retreat with the greatest possible comfort and a more open design for relaxation or the opportunity to socialise freely. The understated and timeless aesthetic creates a unique travelling environment in which passengers can immerse themselves and unwind from the hustle and bustle of everyday life. The result: a forward-thinking, inviting design that appeals to the senses without overwhelming them.

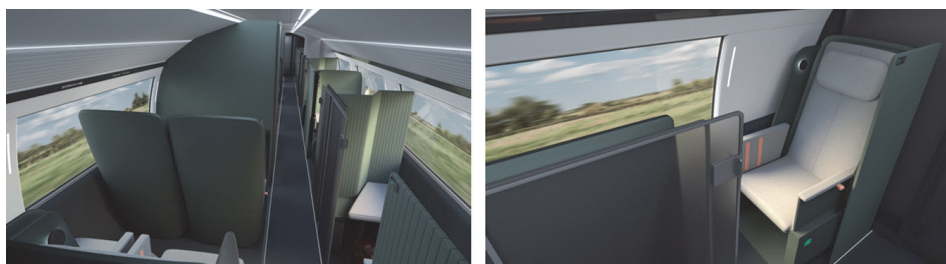


Figure 1 Single berth on the upper deck, design day and night train (© moodley)

The concept is based on the experience of designing first-class aircraft cabins inspired by the comfort of a living room, but offering maximum comfort in a small space to provide sufficient capacity. Lockable individual berths with half-height partition walls offer privacy and a special space for concentrated work on board. The acoustic panels of the flexible room-in-room systems can also be installed at ceiling height and reduce ambient noise. There is sufficient space under the seats and in the footwell for stowing several items of luggage.



Figure 2 Example of a zoning concept for the upper deck (© moodley)

Different zones with different functions are offered based on the various user requirements. Separate lockable family and women's compartments or business compartments allow more private use for up to four people during the day and offer space comfort and security for two at night.



Figure 3 Private compartments with pull-out bed function & modular seat design (© moodley)

Private compartments in the lower deck can be configured variably and offer small groups space for personal conversations and interaction. Lockable 4-seater compartments (Fig. 3 left), which are connected to the structure of conventional seating car compartments, through to comfortable 2-seater, 3-seater and 4-seater sleeping compartments with integrated wet room and storage space for large items of luggage have been designed. Other advantages include the option of connecting your own devices to the train's entertainment system and, depending on the operator's service concept, it may also be possible to order an on-demand menu via this system. The basis of the minimalist interior concept is a multi-functional modular seating system (Fig. 3 right) that combines comfortable sitting, reclining and sleeping (e.g. at night or in the early morning). The use of identical parts in combination with additional features enables travellers to create seating configurations for activities such as eating, relaxing, reading or working.

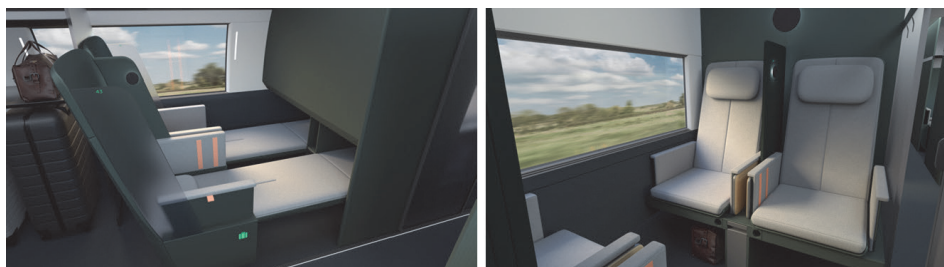


Figure 4 Private compartment & Space-saving sleeping concept (© moodley)

The seats have wider seat, back and head cushions that can be converted into a fully-fledged bed (Fig. 4 left). The space-saving memory foam upholstery ensures comfort in any sleeping position. All seats offer practical features (Fig. 4 right) such as work tables with special work lighting, reading lamps, power sockets, inductive charging stations for mobile devices, coat hooks, wall brackets for personal items and integrated seat speakers for a relaxed experience.

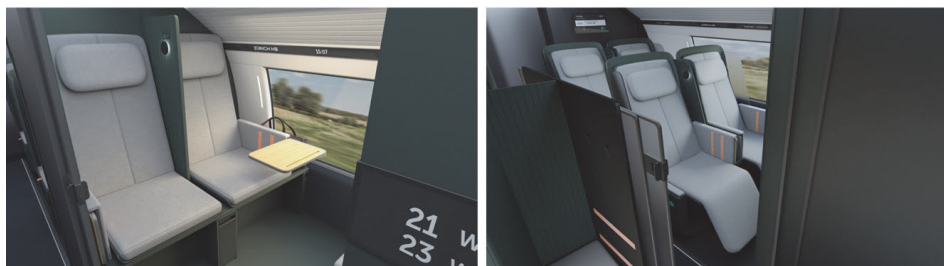


Figure 5 Mono-material seat & storage space for luggage in the seating area (© moodley)

Sufficient storage space is a recurring need for passengers. Openings under the seats (Fig. 5 left) offer the option of storing luggage or shoes directly at your seat and spacious, lockable luggage racks in the carriages offer this option for larger items of luggage. The interior concept takes sustainability and resource conservation into account. Special attention was paid to accessibility and barrier-free access. Wider entrances, easily accessible seats with armrests that can be adjusted downwards (Fig. 6 left) make it easier to sit down and stand up. Floor markings and tactile elements provide orientation for visually impaired passengers, while LED light signals (Fig. 6 right) also guide users through the space at night. The room is pleasantly illuminated by more extensive daylight, while the atmospheric ambient lighting can also be changed in colour to suit the time of day and promote relaxation and well-being.



Figure 6 Night view of the private compartment on the upper deck & adjustable armrest (Image: © moodley)

## 6 Conclusion

The project deliberately chose to “rethink” night train components. Even if many elements give the impression of being familiar, the new concepts, particularly in the compromise area of day and night operation, represent completely new approaches to space-saving room structures that enable both the necessary seating capacity in daytime operation and the necessary and desired privacy in night-time operation, and which can be chosen above all by price-sensitive passengers. In the higher-priced segment, closed compartments with corresponding equipment elements that offer extensive privacy and fulfil comfort requirements in the best possible way will continue to be promoted. These concepts are analogous to new types of sleeper cabins, although here, too, greater flexibility has been emphasised. The TANA project will run until June 2024, and potential areas of use for the corresponding rolling stock will be developed in the further course of the project with a view to economic operation.

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