Title of the article in the Slovak language
Regional Tram Projects in upper Austria – Taylor-made Solutions for Passengers

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Abstract

Here insert the Slovak translation. (Note: The Slovak translation of the title and abstract can be provided by the Organizer.)
For the text of the abstract shall be applied Century Gothic, 8 pt for common text. The abstract is indented from both margins of the page (right and also left) at 1 cm.
For the title Abstract shall be applied Century Gothic, 12 pt., bold. Under the title Abstract leave out 1 row 6 pt. Between the address and the title Abstract leave out 1 row 18 pt. The text of the abstract justify to the block.

Abstract

The paper presents the new public rail transport concept for the Upper Austrian central region. Taking the existing rail networks (railway, tram) as starting point, an improved integrated systems shall be developed, mainly by extending the existing tram network to densely populated areas in the surroundings of Linz and operating it with modern regional tram vehicles. The new concept is shifting the passenger's interest in the focus of the projects: a thoughtful combination of many aspects regarding infrastructure, vehicles and operation are the basis for a successful implementation of the new concept. The realisation is planned step-by-step, the first 2 sections are in operation since 2016, showing an unexpectedly high increase in passenger numbers.

1. Initial Situation in upper Austria

Linz and its surroundings are the industrial / commercial centre of Upper Austria and one of the economically most important regions in Austria: Approximately half a million of people are living in this region. Linz itself has 200.000 inhabitants and appr. 130.000 people are commuting to Linz every day.

Like in other cities as well also in Linz the existing rail infrastructure has evolved over time. Linz has an urban tram network (track width 900mm) with 4 tram lines; 1 regional and 4 long-distance railway lines are connected in Linz main station. A decade ago the Linz main station was rebuilt and established as central connecting

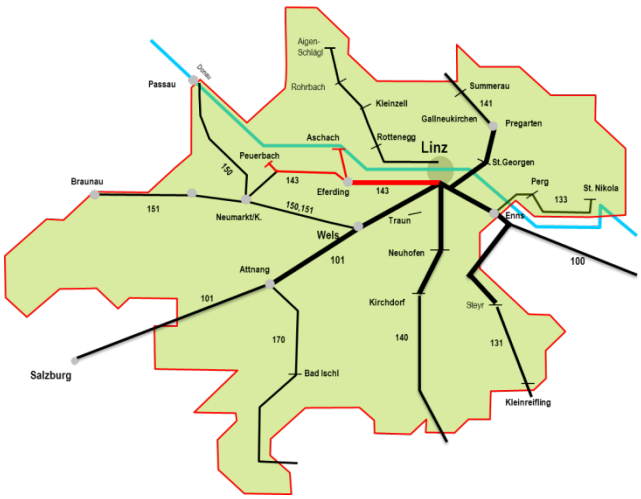

Figure 1: existing rail network in Upper Austria

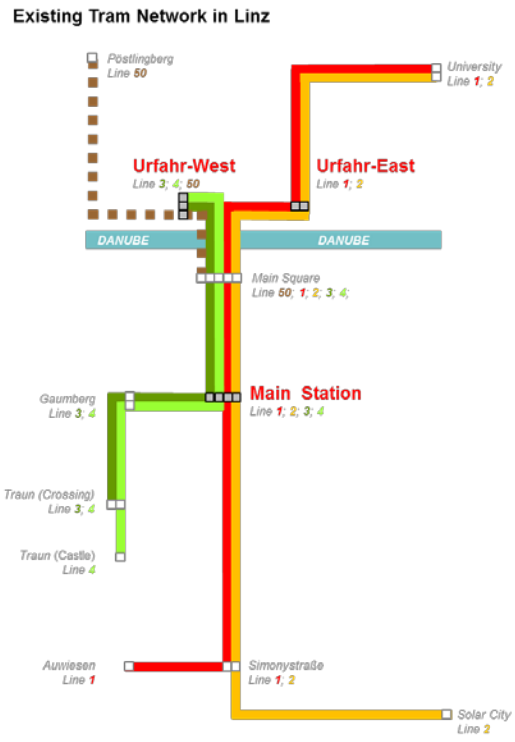

Figure 2: existing tram network in Linz

node between long-distance railway lines and urban tram lines as well as the urban / regional bus network. 1 railway line ends at the northern side of the Danube, without connection to the rest of the network since an old steel road-rail bridge had to be demolished due to corrosion.

The main problems in the existing rail based traffic transport system are:

- Appr. 65% of the passengers go to the city centre or to areas west or south of it respectively (more or less along the existing tram lines). Hence the tram axis running through the city centre is overloaded, in particular in peak hours; the capacity cannot be increased any more.
- Connecting the rail-network and the tram-network only at Linz main station is causing detours. The station is overloaded in peak hours.
- However, appr. 25% of the passengers go to the eastern part of the city, where there is no rail axis and 10% go to quarters north of the Danube.
- There is no attractive rail connection to the regions northwest and northeast of Linz (old railway lines with low capacity and unattractive journey times); in peak hours busses get often stuck in congested road traffic.

2. The new concept

In an urban environment, there typically are considerable constraints limiting the integrated use of existing rail networks in a city such as:

- The main destinations of commuters are not directly accessible by the existing railway lines
- Existing tracks (rail, tram) normally have different track widths and different gauges
- Train and tram vehicles normally cannot be operated on the same tracks due to different crash resistance requirements
- The operation of train vehicles in cities is limited due to space and weight limitations, size and equipment of stations etc.

The new concept is based on the idea to make the existing rail infrastructure

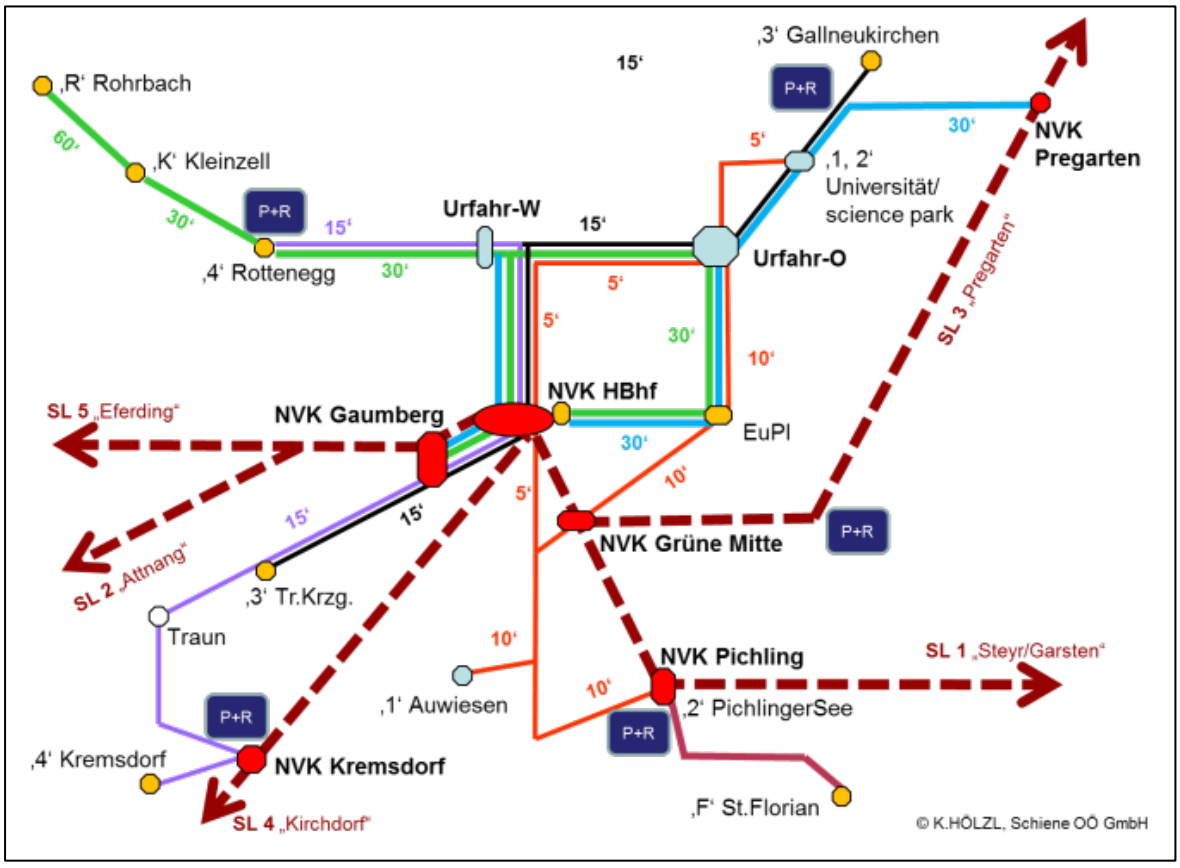

Figure 3: regional tram concept incl. connections to the regional transit system on existing railway lines (in red)

compatible as far as possible, shifting passengers needs in the focus. The subsequent principles are applied:

- Take advantage of the existing urban tram network (which is perfectly connecting central parts of the city).
- Extend the traffic on the tram network to surrounding areas.
- Avoid changing trams as far as possible.
- Optimize connecting stations where necessary.

This concept requires an integrated approach including.

- Infrastructure
- Vehicles
- Operation

In Upper Austria the new concept includes the following elements:

- Establish a second inner-urban tram line east of the existing trunk line.
- Extend the existing tram network (track width 900 mm) to the densely populated areas around Linz and operate it as regional tram system
    - In direction southwest – by expanding the existing tram line (purple line in fig. 3).
    - In direction northwest by upgrading the existing railway line (track width 1435 mm) and adapting it to tram track (green line in fig. 3).
    - In direction northeast by adding a new regional tram line to Gallneukirchen-Pregarten (blue line in fig. 3).
- Operate the network extension with new regional tram vehicles.
- Close down existing bus lines running in parallel to new regional tram lines.
- Optimize the access points to the regional tram system outside the city centre by
    - locating stops as close as possible to densely populated zones;
    - establishing a shuttle bus system to major stops;
    - installing a network of P&R stations at strategic points of the network.
- Establish a regional transit system on the existing railway lines through Linz main station, linked to long– distance rail traffic on the basis of a regular interval timetable.
- Establish new connecting points between rail and tram network.

The subsequent characteristics of the new regional tram system are envisaged:

- Vehicles:
  Light rail vehicle with high comfort for passengers and drivers, combining the comfort of modern passenger carriages with the operational flexibility of a tram vehicle
    - Coupleable bidirectional vehicles, 43m-45m long
    - Track width 900mm – according to existing tram network
    - Maximum speed 70km/h – 100km/h, climbing ability 7,5%
    - Width of rail car body – at least 2,40m
    - Modern low-floor vehicles with high comfort, fully accessible for disabled passengers
    - High comfort zones in seating areas combined with a spacious entrance zone next to doors
    - Multifunctional compartment for wheel chairs, baby buggies and bicycles

Figure 4: light rail vehicle © R. Schrempf

Figure 5: interior of regional tram vehicle © R. Schrempf

- Sophisticated lighting concept
- Video supervision inside and outside

- Operation (regional tram system):
  - Establish regional tram line as main public transport system – adapt bus network accordingly as feeder lines to tram stations.
  - Establish attractive connecting points to bus system and individual traffic (Park & Ride / Bike & Ride) in relevant regional tram stations outside of the city.
  - Accelerate operation – e.g. by establishing an own separate track where possible, by longer distances between stops or by specific stop patterns.
  - Operate regional trams outside urban areas with higher speed (using signalling systems) in urban areas with low speed (according to tram regulations).
  - Prioritize tram traffic by influencing traffic lights at level crossings and intersections.
  - Offer attractive regular time intervals for tram services (working days: at least 15 min, weekends: at least 30 min)

Figure 6: track during construction works © R. Schrempf

Figure 7: new station during construction © R. Schrempf

Figure 8: bike & ride facility © R. Schrempf

- Infrastructure:
  - Adapt track outside urban areas to maximum speed of appr. 80km/h wherever possible.
  - Implement noise protection where necessary (specific low noise protection barriers, automatic rail-lubrication facilities).
  - Implement track system with vibration protection where necessary.
  - Attractive design of relevant infrastructure elements – sensitive to neighbourhood (e.g. 80% turf track).
  - New stops with attractive uniform design & equipment
    - Standardized equipment, specifically designed for handicapped people
    - Visual & acoustic information systems
    - Seats in weather-protected zone as well as in the open
    - Multifunctional ticket vending machine (accepting coins, notes and cards)
    - Bike & Ride facility, with lockable boxes and e-loading system

3. Implementation of the projects

The whole concept includes several short-term, mid- and long-term projects at different levels of development and implementation:

- The tram network extension in direction south west towards Traun has already been built and was put into operation in 2016.
- The second tram axis through Linz is at the stage of predesign. The tender for the next

design stage is right under way, including all permissions necessary for realisation and the tendering of the construction works.

- For the regional tram axis in direction north-east towards Gallneukirchen/Pregarten the route selection process was finalized in 2015 and the new line has been fixed in a regional planning program in early 2017, thus securing the land required for its construction for the next planning stages.
- For the extension in direction Northwest – on the existing Mühlkreisbahn – a certain change in the concept has been envisaged recently. Instead of implementing the 900mm tram track on this railway line the 1435mm track shall be extended to the planned second tram axis through Linz, applying a 3 rail track system. Thus the existing Mühlkreisbahn can completely be integrated in the system using new regional tram vehicles but avoiding spending money for changing tracks.

4. Practical experience and closing remarks

The integrated rail concept for the Upper Austrian central region is a very ambitious program, including several projects at different levels of implementation. The experience from the sections already put into operation is encouraging and shows, that the orientation towards passengers needs is the right way.

In 2011, before opening the first section to traffic, the expectation was 2,7-3,0 Mio. passengers, which corresponds to an increase of 25%-30% in comparison to the bus services in operation before. In reality the expectations were by far exceeded: After opening of the first section (5km) the passenger numbers increased to 3,9 Mio., after opening of the second section (9,8km) to 5,8 Mio. per year; for 2017 6,2 Mio. passenger are expected.

Further, the new infrastructure standard has proven to be effective and functional and the quality of the modern new stations is very much appreciated by the passengers.

However for the implementation of the whole concept there is still a long way to go and many problems to solve such as

- in particular for new lines high investments are required, hence the long-term financing has to be secured
- furthermore additional resources for operating a considerably extended system are required as well
- in practice considerable organisational problems need to be solved, which are caused by existing traditional organisational structures and responsibilities.

However, in the long term perspective these problems should be solveable; it is essential to develop and continously maintain a concept, which guarantees the functionality and successful implementation of an efficient integrated public transport system.

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