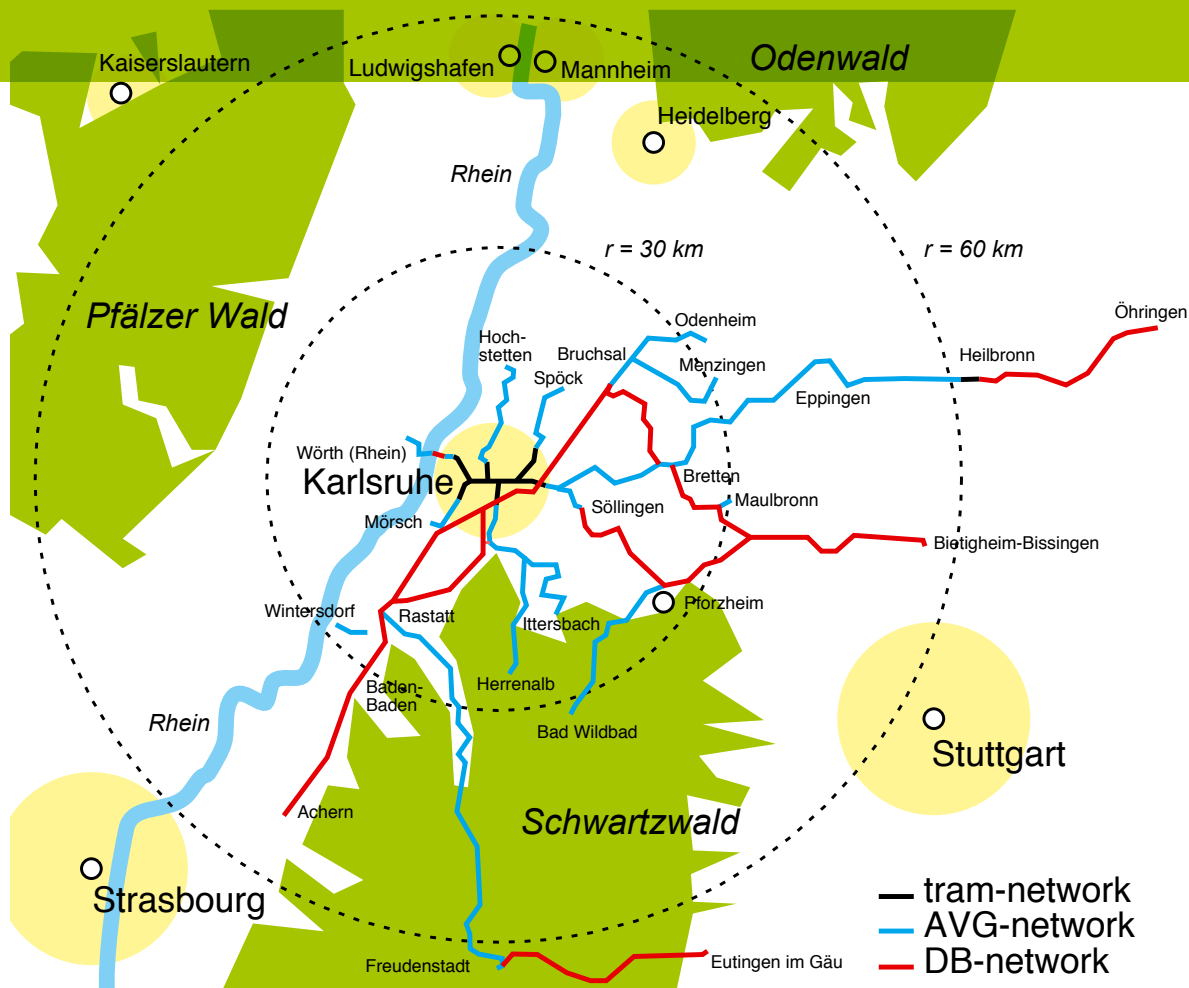


# TramTrain connects town and country

When in the early 1990s the Karlsruhe local/regional public transport operator (VBK/AVG) started to use sections of the rail network operated by Deutsche Bahn, the 'Karlsruhe model' was born. This innovative light rail concept has successfully changed the face of public transport in Greater Karlsruhe amid growing international acclaim. Eighteen years on, it is time to reflect and to look forward in this ongoing story of sustainable transport.



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Peak hour traffic congestion has become the rule rather than the exception in larger cities all over Europe. The results are air pollution, accidents and delays, all with a harmful effect on the environment

and the economy. Nevertheless, car ownership is still growing. Extending three-lane motorways beyond the city limits is no solution. To make the best use of the available space left in the cities we need an integrated urban and traffic plan that incorporates rural traffic flows and suburban and rural developments. It is only private cars that cannot cope with current and forecast traffic volumes, so this →

means that towns and cities with a well functioning, reliable public transport system have a real advantage over others that do not. Good public transport relieves congestion in and around the cities, makes the streets safer and improves quality of life for users and non-users alike.

#### INTEGRATION OF LOCAL AND REGIONAL PUBLIC TRANSPORT

A key ingredient for the good functioning of a public transport system is integration of local and regional connections. Often they are connected through transit hubs and interchanges, but not truly integrated. For decades public transport has taken this form in many urban regions, while it has been trying to attract new customers, and the resulting fragmentation is at the root of the problems it faces. Changeovers from the train to tram and vice versa discourage many potential passengers. It comes with delays, often waiting in cold, windy and social unsafe environments. The S-bahn rapid transit systems built in the larger German cities, such as Munich, Frankfurt, Stuttgart and Leipzig, provide seamless connections between the city and region, much like the RER in the Paris region. These rapid transit systems do have a serious drawback, though: the construction costs were immense. Tunnels had to be built in the city centres and the extension of existing routes often resulted in entirely new construction projects. These traffic concepts left hardly any place for the classic tram, and many German tram networks shrunk or disappeared all together, giving way to growing car traffic above ground.

#### PRIORITY FOR THE TRAM

The development that took place in Karlsruhe was quite different. The tram had been the backbone of the public transport system since 1900. In the 1960s Karlsruhe city council deliberately decided to preserve and even to extend its existing tram network. Step by step, the tramways were put on segregated tracks, improving the reliability and increasing the speed of the service, and now 80 per cent of the tram network operates independently from the individual motorised transport. A programme was implemented to give trams a 'built-in priority'. Tram drivers can push traffic lights to give their vehicles priority to allow rapid movement through the city. Such a powerful and modern tram network delivered the basic prerequisite for the Karlsruhe model: linking existing railway lines with the tram network and developing a special strain of Light Rail Transit: TramTrain. In the late 1950s Karlsruhe started operating a light rail line into the Black Forest using a former regional railway corridor and connecting this light rail infrastructure to the urban tram network. It was the beginning of a successful story, the Karlsruhe model.

#### THE ALBTALBAHN AS GERM CELL

The Karlsruhe Model is rooted in the Albtalbahn, a private rail company that ran from Karlsruhe to Bad Herrenalb. It started operation at the end of the nineteenth century and until the end of the 1950s the line was operated with narrow gauge trains. It served the city of Bad Herrenalb and Ettlingen and terminated close to Karlsruhe main station, far from the city centre. The Albtalbahn had a substantial passenger potential but encountered increasing economic difficulties and needed operational restructuring. The Albtal-Verkehrsgesellschaft (AVG) was founded to save the old railway line from closure. The old infrastructure was replaced by new regular gauge tracks, the electrification was adapted to the power supply of the Karlsruhe trams and at the former terminal in Karlsruhe new points now connect the tram and train networks. In 1961 the first modern light rail, operated by the AVG, reached the spa Bad Herrenalb.

#### THE MILESTONE: SHARING A DB LINE

The route to Bad Herrenalb (line A) was the beginning of a rapidly growing network of regional light rail connections operated by the AVG. A branch line to Ittersbach was added in 1975, and soon after another milestone was completed in October 1979 when a new line from Nordweststadt to Neureut came into service. The remnant of the Hardtbahn, the former railway line from Mühlburg via Eggenstein to Graben-Neudorf, passed through Neureut. Although this section of infrastructure was only short, it was an important breakthrough. For the first time in Germany, a local public transport operator was allowed to use track belonging to the German federal railways, Deutsche Bahn (DB). They used the track only sporadically for freight



Karlsruhe TramTrain.

**In the 1960s Karlsruhe city council deliberately decided to preserve and even to extend its existing tram network**

traffic and were finally willing to share it with AVG. Using the 1,5 kilometre section of railway resulted in a sharp increase in passenger numbers, prompting an investigation in 1984 into the feasibility of track sharing by light rail and heavy rail. This was the birth of the 'Karlsruhe model' or the TramTrain system. The idea was to connect the suburbs and rural surroundings directly with the city of Karlsruhe by using the tracks of the federal railway company and making changeovers unnecessary.

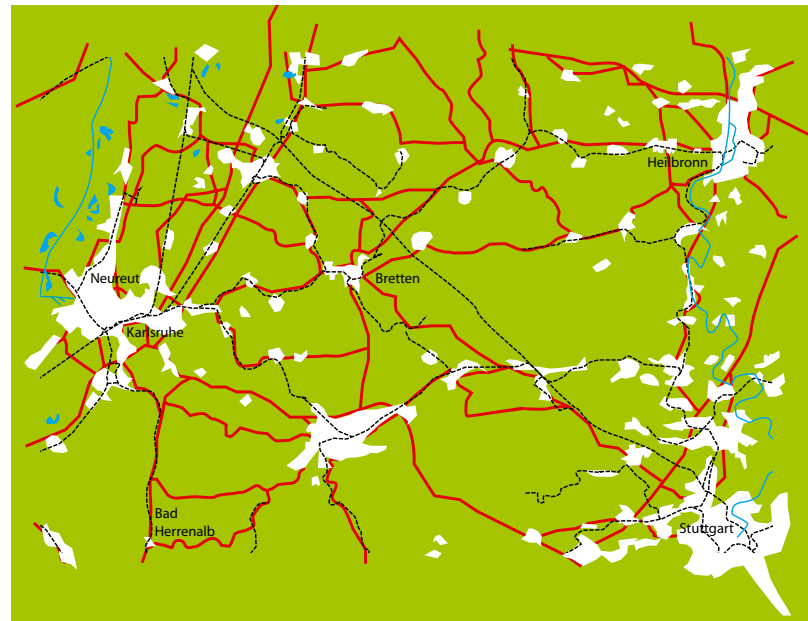
In 1989 this 'shared use' was extended to a further 4.4 kilometres of DB track to Hochstetten. The line, the S1, became one of the most important in the light rail network. It links two major residential areas with Karlsruhe city centre and provides seamless access to all important destinations, such as government offices, shops, leisure facilities and the university. On its way through the city the train switches function twice. In the periphery the light rail vehicles operate like a regular train, running at relative high speed and with larger distances between stops. In the city centre the light rail vehicles operate like trams, running at a slower speed and with shorter distances between the stops. On a few stretches, the light rail vehicles even share their infrastructure with regular road transport.

**THE INNOVATION: TRAMTRAIN DUAL-SYSTEM TRANSIT VEHICLE**

The integration of the Albtalbahn and the Hardtbahn into the Karlsruhe light rail system led to significant increases in the number of passengers. Ideas soon emerged for light rail services to the entire surrounding region of Karlsruhe and the city looked to the routes where the DB was only able to provide a marginal service. There were various reasons why the DB services were not performing well: obsolete rolling stock, low frequency, poor demand and unattractive fares. The new service needed to improve such issues.

From a technical point of view there was also a need to integrate the two networks physically. A vehicle had to be developed that could operate both on the DB tracks and on the tram network in Karlsruhe (dual mode or TramTrain vehicle). These vehicles must meet the technical standards of the official standards for tramways and for railways, equipped for the different power supplies of the DB (15 kV AC) and the Karlsruhe network (750 V DC). The TramTrain vehicles must meet DB safety standards and radio control systems as well as those of the Karlsruhe tram network operator. This dual mode vehicle also required a system link to allow the changeover between the tram and heavy rail networks.

But the idea behind the Karlsruhe model goes further than the engineering. The pillars of the system include a high frequency timetable throughout the day, starting early in the morning until late at night, to guarantee passengers flexibility and confidence in always having a connection home; a differentiated marketing strategy to attract all target groups; and an integrated ticketing system over the whole area for use on trains, trams and buses; and special offers (e.g. students, commuters or elderly) to create a strong customer relationship. New stops along the existing tracks have expanded the



(Illustration: Karin Dekker)

catchment area, and the modern rolling stock allows more stops to be served without losing travelling time. Bus services were adapted as feeders to the TramTrain connections and timetables coordinated to improve connections and avoid parallel traffic.

After eight years of research and testing, the first TramTrain line between Karlsruhe market square and the city of Bretten was opened in 1992. With the new connection directly into the heart of Karlsruhe, travelling time was reduced by 30 minutes. Demand rose during the initial days from 2000 to 8000 passengers per day. Today more than 20,000 passengers use the TramTrain service along this corridor.

**THE NETWORK GROWS**

From the 60 kilometre long old Albtalbahn, the AVG is now the second largest provider of rail services in Baden-Württemberg after Deutsche Bahn. Fuelled by the great success of the Karlsruhe model, in just 15 years the network has been extended by 530 kilometres, and is still expanding. Today over 110 dual-mode vehicles operate within the TramTrain network. The S4 operated by AVG is Germany's longest and most successful TramTrain line at more than 120 track kilometres. The line runs from Achern via Baden-Baden, Karlsruhe city centre, Bretten, Eppingen and Heilbronn city centre to Öhringen. Heilbronn City Council decided to build a new tram section through their city centre, connecting the city with its hinterland and making interchanges unnecessary. The same positive effects were obtained as in Karlsruhe some years before. Heilbronn Council have now voted for a second urban tram section and technical planning began in 2007.

**FUTURE DEVELOPMENTS**

Sustainable success of the Karlsruhe model depends on efficient infrastructure. The bottleneck in the system today is the pedestrian precinct in Karlsruhe city centre. Two TramTrain routes, two Light Rail Transit routes and five tram routes use the section running through →

these streets and share it with pedestrians and some delivery vans. As only a reduced speed is possible in this very sensitive section and a suitable detour is not available at the moment, the city council and the transport department decided on a 'combined solution'.

This 'millennium project for Karlsruhe' consists of three components:

- A light rail tunnel under the pedestrian precinct, with a southbound underground junction at the market square.
- A street tunnel along the Kriegsstraße to take the four-lane road.
- New tram tracks above the street tunnel, tapping into a new pool of passengers and providing a reliable detour during longer maintenance work inside the tunnel.

Total investment in this project is about 500 million euros.

Construction work will start in 2009, the first stage being the construction of the LRT tunnel, which will be opened in 2016.

All three components will be finished by 2020. The project is partly funded by the German federal financing system (Gemeindeverkehrsfinanzierungsgesetz) and the city of Karlsruhe.

Development of the TramTrain in Greater Karlsruhe is also continuing. In 2008 work began to adapt the railway route between the cities of Wörth and Germersheim for TramTrain operation. AVG will build seven additional stops with a length of 120 metres and will electrify the 30 kilometre stretch of double track railway line with the standard current of 15kV, 162/3 Hz. The regional railway route is owned by DB and will be leased during the planning and construction by AVG. After the upgrading and adoption work, AVG will hand over the tracks and stations to DB.

One of AVG's next objectives is to connect the successfully operating regional airport to the TramTrain network. Initial negotiations with the towns concerned and the district authority have already taken place.

#### EXPORTING SUCCESS

The success of the TramTrain made the Karlsruhe light rail transit a showcase for other cities facing similar issues. Smaller cities in particular seem to take note. They are too small to support a costly rapid transit system like the S-bahn or the RER and light rail transit suits them much better. To implement a TramTrain successfully there is no need for a city to already have a functioning tram network. Saarbrücken, the capital of the Saarland region, was the first light rail system to be based on the Karlsruhe model. The last tram line was closed in the 1960s; in 1997 an initial 19 kilometre TramTrain line came into operation. A 5 kilometre stretch of light rail line was built in Saarbrücken's inner city and connected to a DB line that runs to the French town of Sarreguemines just across the border. Other routes in the Saarbrücken region are under construction or in the planning stage. Kassel started TramTrain operation in 2007, while Nordhausen and Chemnitz are expanding the Karlsruhe experience.

Abroad, the French have taken note of the possibilities of what they call 'tram-trains': Strasbourg, Mulhouse and the T4 in the Paris region. The Dutch RandstadRail and the Rijn-Gouwelijn projects

belong in the same category. Even traffic planners in the Far East study the Karlsruhe model carefully. Groups of visitors from Japan, Korea or Taiwan are no longer an uncommon sight in Karlsruhe.

#### CONCLUSION

The number of captive riders is decreasing year by year and new passengers can only be generated by car users. It is nearly impossible to force them to change from the car to public transport. High parking charges in the city centre, traffic control (signal schemes) and the rise in fuel prices made only a few car drivers change their minds. A more successful strategy is to persuade car drivers of the quality and reliability of public transport systems.

Building a new light rail transit system is not just a question of laying tracks into the city centre. It is also about improving quality of life through reduced car traffic and reliable public transport, and about offering new locations for new urban development. Light rail schemes improve the streets through which the light rail run. The overall effect is a significant facelift along the route.

Building up a TramTrain network by using existing heavy rail tracks keep capital costs down. The operating costs of a TramTrain scheme are slightly higher than a tram scheme, but much cheaper than a heavy rail operation. In the Karlsruhe experience, a significant increase in passenger numbers brings a considerable increase in patronage and guarantees the best value for money. Karlsruhe shows that a wide TramTrain network can be implemented within a few years. TramTrain can be brought into operation gradually, running initially on the heavy rail to improve local train services, while the inner-city section is under construction (Heilbronn experience).

All this needs perseverance, tenacity and patience, as well as financial and administrative support from local and federal authorities. In the end, the mission comes down to bringing transit to the people, not people to the transit.

