Mobility Services

How we keep the world running

100% RAILability®
Efficiency, sustainability, reliability

Predictive Maintenance
Identify faults prior to their occurrence

Custom-made spare parts
Individually optimized and printed in high quality
What is important to you?

Is it the friendly „Good morning!“ from a bus driver? The firm handshake of the tradesman this morning? Or the constructive telephone call with the Internet provider last week?

There is service, and then there is „service“. We encounter it every day. What we mean by service, and what the important aspects of service are for us, are explained in an interview with Johannes Emmelheinz, CEO of Mobility Services, and Marko Feulner, CFO of Mobility Services.
What does good service mean to you personally?

**JE** To me, good service means the service provider being there when I need him ...

**MF** ... and offering exactly what I expect.

What does that mean for Siemens Mobility Services? How would you sum up your services in a single word?

**JE** In one word? 100% RAILability® – maximum availability for our customers. Siemens Mobility Services concentrates on a number of key issues. Efficiency, reliability and sustainability are the core requirements of future-oriented mobility.

**MF** Those are challenges that mobility systems and, above all, service concepts have to face. The rigorous pursuit of serviceability issues is therefore a vital key to our success.

What exactly does that mean? How can you ensure 100% RAILability®?

**JE** It is a matter of obtaining a higher-level view of the entire fleet. We achieve this with a range of innovative tools. The most important of them lies behind the key phrase “Predictive Maintenance”.

**MF** Actually, it is the core model for the future. We have up-to-date knowledge of the states of all the components of a train because we receive information from them continuously. We compare this with the corresponding trend patterns and, at the same time, we bring it together with data from other projects. In this way, we obtain very precise information on which we can then base well-founded predictions. Above all, we can also orientate the entire service toward preventing imminent faults from happening.

**MF** Yes, we can organize and run our entire service logistics the way the customer would like it. One example of this is the Velaro E operated by RENFE, National Network of Spanish Railways, for whom it is working excellently. We continually monitor status and detect patterns at an early stage so that we can act predictively.

Does that mean the trend is moving away from simply reacting and toward being proactive?

**JE** Without any doubt. For us, this is not just a future vision, it has already become reality.

That surely means that there is a lot going on in the background?

**JE** Absolutely. First of all, data from a very wide range of sources is systematically collected, compared and evaluated. Faults are then detected and diagnosed on this basis, and visualized on our Rail Remote Service Desk (RRSD). This also has an interface to the Computerized Maintenance Management System (CMMS).

**MF** For example, the CMMS records and plans all the repairs. This means that all the information about the states of the vehicles is always up to date. That enables the planning and tracking of the maintenance work to be improved. The system also has a module to record practical experience.

That sounds like a closely meshed net of effective tools, but it also seems very theoretical. What does the maintenance really look like?

**JE** It is very simple. A notification arrives in our Support Center before a fault occurs. There the experts check the data by means of remote diagnostics, analyze the cause of the fault, and initiate the requisite actions.

**MF** We then decide whether the imminent fault can be rectified in close cooperation with the railway and service personnel, and whether we will send a mobile technician or spare parts, or whether we will organize a transfer to a workshop ...

**JE** ... And we supervise the entire process. That helps us to learn from mistakes, and systematically transfer the knowledge we gain from rectifying faults into the system design process. In this way, we are continually improving our systems.

**MF** The same also applies to preventive, planned maintenance. Our tools support us there in the same way with a continuous flow of information.

**JE** That’s how we achieve 100% RAILability®. For our railway systems. For our customers. We keep the world running.

Thank you for the interview!
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Maintenance Services

Whether in London, Bratislava or St. Petersburg – our versatile maintenance concepts are already improving the reliability and economy of technology and logistics systems on rail and road.

Our service experts are on call all around the world. With innovative technologies they look after the maintenance of every kind of transportation system – always with the objective of raising their efficiency to the required level or keeping it there.

Both road and rail operators appreciate the flexibility of the versatile service concepts that can be customized to meet very specific needs. From basic consultation services to the comprehensive “carefree” package, Siemens Maintenance Services are completely scalable. One success story with many examples.
No, it’s nothing new to say that London is a lively city. Wherever you go on the streets of this city of 14 million people, you are surrounded by a seething cauldron of life. A million commuters make their way into the city every day. For this reason, the largest metropolis in Europe also has one of the most modern transportation systems in the world – one that is more advanced and more extensive than that in any other comparable city in the world. Because the city started at an early stage to look at the whole picture in a visionary way. They networked the most diverse systems, optimized existing infrastructures, and had the courage to innovate and to do so consistently. Today, London is already a long way down the road to the mobile future and is a shining example to other megacities such as Shanghai, São Paulo or Beijing, which are virtually suffocating from traffic every day. London has also responded to the needs of its inhabitants and promptly recognized the signs of the times.

But how does such a metropolis keep control of all its transportation? How do millions travel daily from the suburbs to the city and back again, or from A to B in the center – without massive congestion or smog, without delays or waiting times? And what does this all have to do with Maintenance Services from Siemens? Much more that you might think at first glance. Because if trains are supposed to run, they have to be maintained. And the more efficiently this is done, the more they can travel. At a profit. For example, the headways between trains can be reduced, which shortens waiting times. This makes the train a more attractive option and increases its acceptance by the public, which in turn reduces the level of road traffic, cutting noise and exhaust fumes, and making the city more attractive overall.

Yet, London is not only a pioneer in rail transportation, it has also been awake to the trend toward more intelligence in road transportation. With congestion charge zones for regulating the traffic, with observation and control systems that direct the flow of traffic online – and thus also the inner-city flow of goods – and with modern traffic light systems and much more. All technology from Siemens. For people in the megacities. And maintained by Siemens Mobility Services.

A city that never sleeps

Metropolitan London is already a long way down the road to the future
Total knowledge

The merging of data is a key aspect for the efficiency of these systems. In order to guide inner-city traffic with up-to-the-minute information so that everything keeps flowing smoothly. But it also means being able to use knowledge and experience from every source and system worldwide to keep trains running, for example, between cities and countries. So everyone benefits from everyone else and they all benefit from our Service.

Heathrow Express

Almost 445,800 kilometers per year and only four failures

Shining example:
50.5% less energy consumption, 98% availability

Like London, Bratislava is a shining example for our expertise: we were commissioned to modernize the streetlighting system in the Slovakian capital. The city’s objective: better lighting at a lower cost.

In the course of the project, which included an analysis of the inventory, identification of potential for optimization, and its implementation, we ultimately modernized 30,000 street lights and replaced another 12,000. The maintenance contract runs for 20 years and includes a 24/7 service.

The results can already been seen today. The availability of the lighting has risen from 35 to 98% (above the guaranteed figure of 95%) – and energy consumption has dropped by 50.5%!

A kingdom of transportation

It is not just London that is providing intelligent urban transport – the whole of the UK is thinking ahead in terms of transportation. The fact that the UK is already very advanced and is opting for groundbreaking solutions, is due to the early privatization of its rail system. Because efficiency and economy are weighed up differently by private operators. They simply calculate in a quite different way. Whether it is South West Trains or West Coast Mainline, Heathrow or TransPennine Express, London Midlands, Scotrail, Northern Rail or London Eastern: they are all on their way with Siemens Mobility Services. And with great success and reliability for the users and passengers.

Expertise all the way to the sea

1,140 new Desiro City regional rail cars from Siemens will be running on the newly constructed Thameslink route as of 2016. It will run right across London in a north-south direction and connect Bedford to the north with Brighton on the south coast. The Thameslink is one of the largest rail infrastructure projects in England. And for Siemens, it represents the largest order ever received in the UK. And Siemens Mobility Services is already on board. We are undertaking the maintenance of the complete fleet. Two new depots at Three Bridges, Crawley and in Hornsey will be our base, making us the market leader in maintenance in the UK. We have concluded long-term service contracts for all the fleets there. This means that the well-being of almost 3,000 rail cars in the United Kingdom rests in our hands.
United Expertise

From NORTH to SOUTH: project highlights in the United Kingdom

TransPennine Express: highly satisfied commuters

No more delays and canceled trains – that’s what’s been making passengers of the TransPennine Express happy since 2005. On their way between cities such as Liverpool, Manchester, Glasgow and Edinburgh, they can enjoy 100 percent reliability. The Desiro type trains that operate on these routes are maintained by Siemens Mobility Services as part of a service contract. On purchasing these trains, the customer also signed the maintenance agreement. The customer, First TransPennine Express, gave its reasons as follows: “The crucial factor in the purchase was not just the high quality of the actual product, but the fact that Siemens can also offer the right service. The total package was the right one.”

Heathrow Express: greater comfort for airport passengers

The Heathrow Express brings passengers from the center of London out to Heathrow Airport as if they were flying already. The line whisks 16,000 people every day from city to airport in just 15 minutes. And despite the short journey time, they travel in comfort. Chargers for mobile devices, real-time flight information and an atmospheric, energy-efficient lighting system contribute to a premium-class travel experience. Between 2010 and 2013, Siemens Mobility Services managed the extensive modernization of the complete fleet of trains as part of the existing service contract. What does the customer think? The wow-effect is on track. Objective achieved.

Road transport in Manchester: for a greener city

To switch from red to green – that’s what the client Transport for Greater Manchester wanted when they commissioned Siemens Mobility Services in 2011 to service their entire traffic light system. The target: energy costs cut by 60 percent, availability increased to 97 percent. 2,000 traffic signals in this metropolis of 2.7 million people help road traffic to flow smoothly. 60,000 individual lamps are in use. Efficient LEDs are now reducing the energy consumption as well as the level of CO₂ emissions, which was another aim of the city council. Variable message signs, surveillance cameras and intelligent access control systems are also installed. For 15 years, this customer has put its faith in our solutions. And why? The service package from Siemens enabled them to meet their task and to tackle the traffic problems strategically at a regional level.
Maintenance Services

Rail infrastructure in Scotland: an attractive connection

Since 2010, the route from Airdrie to Bathgate in central Scotland has been equipped with state-of-the-art signaling and communications equipment from Siemens. The existing single-track line was expanded to two tracks in two years. This double-track connection is now cutting the journey time between the cities of Edinburgh and Glasgow by a considerable amount and making rail travel an attractive alternative to the car. The journey now takes just 74 minutes in each direction. Previously under the name of Invensys Rail and now part of Siemens Rail Automation, our teams installed not only the new signaling technology, they also modernized the existing interlockings.

Merger of Invensys Rail and Siemens

We can be proud of this heritage: Invensys Rail, as a subsidiary of the Invensys Group, has a long and successful history in the field of rail automation. And since its foundation, the Siemens Rail Automation business unit has led the way technologically in control and signaling systems. The merger of these two companies has created a genuine global player, not only on the systems side, but also in service.
Come fly with our trains

The “peregrine falcon”: Russia’s Velaro is always on the move

Here are some figures to make any rail operator take wing: a fleet of eight trains that is always on the move, has covered about 14 million kilometers in two years at temperatures between -50°C and +40°C, and which boasts that only one of its trains ever suffers a monthly average delay of more than five minutes. Dream figures that mean well over 99% reliability. These figures are certified and have been achieved by our Velaro in Russia. How? Firstly, because it is made by Siemens. Secondly, because in Russia we work with our customers to provide the complete service. And lastly, because the trains transmit diagnostic data wirelessly to our maintenance depot on a regular basis. In this way, essential work steps are prepared for the next shift so that spare parts and technicians are all in the right place at the right time. In addition to this, the maintenance activities are split up. Balanced Maintenance refers to the concept, whereby non-functioning components are exchanged for replacement components. The defective parts are then maintained or repaired while the train is already back on the track and traveling at 250 km/h. Incidentally, the Velaro in Russia is named “Sapsan”, which means “peregrine falcon”. For this train is truly flying high. And success is bringing rewards. Russian Railways has already ordered another eight trains. Likewise with service from Siemens.
Charter Rail: 99% availability for rent

We have demonstrated this in Russia: The reliability of trains can be rented. 98% reliability was contractually agreed, 99% was delivered. This is because – and this is genuine chartering of expertise – we trained the customer’s personnel, included our Test- and Validation center, and implemented our powerful computerized maintenance management system for all maintenance activities. This means that everything relating to the maintenance is optimally networked and the necessary instructions are sent via monitors distributed throughout the depot directly to the technicians’ workstations. Using touchscreen terminals and mobile devices, the colleagues on site provide direct feedback on the work carried out. This feedback also indicates the materials taken from store. That is how we ensure 100% RAILability® with IT-based maintenance processes.

“Trains have to run, not stand still. Thanks to our concept of predictive maintenance, we have achieved such a high level of reliability for the Velaro RUS trains of 99% – and this for a fleet that was designed not to have a single reserve train! To achieve this figure, which admittedly makes us rather proud, we are collaborating closely with Russian Railways (RŽD) at all levels.”

Brigitte Baumann, Siemens AG, Project Manager for Maintenance of the Velaro RUS

Overhaul process: just one day, instead of months

How it used to be: after 1 million operations or ten years, whichever came first, point machines had to be mechanically reconditioned. This meant: dismantling, returning to the factory in Berlin for service, to have it sent back weeks or even months later. Certified for the next ten years. Expensive and time-consuming! But there was no other way.

And how it is done now: after 1 million operations or ten years, whichever comes first, the workshop comes to the points. And one day later? Exactly! The workshop moves on to the next set of points, wherever they are in the world.

Desiro RUS, the “little swallow” just keeps on flying

Our Desiro urban train in Russia is lovingly dubbed “Lastochka” or “little swallow”. Perhaps because it brings a sense of summer with it. Because, traveling at speeds of up to 160 km/h, the Desiro links the Russian suburbs with the metropolitan centers, operates reliably at temperatures as low as minus 40°C and offers an unusually high degree of comfort for passengers and operators alike. The first few “swallows” are already working tirelessly on the rails, and soon there will be 1,200 of them. To keep them “flying”, they need up to 30% less energy than their predecessors and are bringing travelers quickly and safely to Sochi as well. And as the contract states, we at Siemens will continue to care for these little swallows over the next 40 years.
Munich is where every locomotive passes by sometime because Munich is located at a junction of important north-south and east-west connections. Also, the Rail Service Center is only a short hop away from the main station. This means that railway operators can include service stays into their long-term route schedules, and the locomotives do not lose much time.

It is an answer that can only be given by Siemens. It is all about synergies. After all, the world’s most advanced locomotives are built in the same place – in the Siemens locomotive plant that shares the site with the Rail Service Center. More than 20,000 locomotives were built here over the past 170 years. “It’s hardly possible at all to assemble more locomotive expertise in a single place,” jokes Steffen Rogge, Vice President of Rail Services for Locomotives. More synergies are achieved in warehousing and spare parts and seemingly trivial things like staff rooms, cafeteria, works security, registration office and more.

But the topic of synergies reaches even further: Locomotives must run longer and become more service-friendly. In Allach, the colleagues from Engineering get direct feedback from Service, which is directly included in the next locomotive generations. This permits to increase the service intervals in the long run and enables the customer to keep his locomotives running – while Siemens increases the availability. It also increases the existing competence of the technical specialists. 100% RAILability® – Sustainability through contribution of our longtime expertise.

“Our Rail Service Center is an invaluable advantage – for Siemens and its customers.”

Steffen Rogge, Vice President Rail Services Locomotives.
Munich Allach: Facts, Figures, Fascination

700 employees at the location,
24,500 square meters of covered production area,
development, engineering,
carbody manufacturing, painting,
pre-assembly and final assembly,
testing and commissioning,
sprinkler facility for leakage tests,
all voltages commonly used around the world – everything is available in Allach, and synergies, are utilized wherever possible. All this saves time.

It is not surprising that multiple European state railways as well as very small railway operators have their locomotives serviced in Allach. Another reason is that the Center uses the most advanced tools and assumes all warranties. Today, Allach has a commissioning track and a test track, a component workshop is under construction, and everything related to service is covered here: limited inspection, various inspections, major inspections, full overhauls (1 & 2), retrofits and warranty work. The site offers technical support, a hotline, a direct link to a Rail Support Center, mobile service technicians and spare parts – both original and partly improved by innovative manufacturing processes. And expansion continues. For example, an underfloor lathe will be installed in the next phase. And: More and bigger things are planned for the future.

Allach: Close cooperation with the PCW

For special tasks, Munich Allach maintains a close cooperation with the PCW, the Siemens Test and Validation Center in Wegberg-Wildenrath. Here, Siemens specialists operate in special workshops and on more than 30 km of Siemens-owned track to test trains and locomotives under real-life or simulated extreme conditions on 365 days, around the clock. Static or dynamic testing of vehicles and systems – everything is possible here.
Spare Part Services

They are stored in Neu-Isenburg near Frankfurt/Main: more than 8,000 Mobility spare parts. Kept in high-bay storage facilities, they await shipment. And when the time comes, they reach their destination within a maximum of 24 hours inside the EU and 48 hours worldwide*.

Siemens Mobility Services has opted for seamless e-business solutions to ensure the provision of spare parts. They make logistics, processing and spare parts orders straightforward and convenient – all it takes is just one mouse click and people around the world know what they have to do.

Whether the task involves a logistics contract or a single order, the team responds to individual inquiries and delivers the required parts to the right place at the right time. So a late-evening order for delivery early next morning is no problem.

*up to customs clearance
Train arrives at the station. Doors open. Diagnostic system registers that the current flow to door relay 5 is too high. Just below the limit.

**ERROR MESSAGE**
Barcelona-Sants railway station

**FRIDAY** 10:05 a.m.

Error message received at Support Center. In a flash, humans and machines are analyzing the source of the fault and identifying the required spare parts.

**DIAGNOSIS**
Erlangen Support Center

**FRIDAY** 10:06 a.m.

Identified spare part made available as offer in Rail Mall. Customs documents (for worldwide shipping), certificates and the required software are prepared. Customer examines offer, states delivery date/time and orders by mouse click.

**OFFER & ORDER**
Administration in Madrid

**FRIDAY** 1:07 p.m.

Order arrives at the World Distribution Center (WDC). Fork-lift heads for high-bay storage space 21/8. Team packs spare part; inserts delivery note and prepared documents.

**EXPRESS LOGISTICS**
WDC Neu-Isenburg

**FRIDAY** 1:25 p.m.

100% RAILability® – Sustainable spare part logistics with paper-free ordering
Spare part package is ready on the loading ramp. Express agent picks up shipment. Shipment catches 2:55 p.m. flight to Madrid on time.

Airplane lands. Express agent is ready and picks up spare part.

Train arrives at depot. Express agent arrives with spare part at same time. Technician accepts delivery of the parcel. Maintenance work begins.

Spare part package is ready on the loading ramp. Express agent picks up shipment. Shipment catches 2:55 p.m. flight to Madrid on time.
20,000 Siemens vehicles are currently in service around the world – performing reliably for more than 30 years. And then something happens. After years of operation, a small and apparently insignificant part fails. Not a standard part. Not a common wearing part. But just as important. The only thing we have is a snapshot of it, not knowing its mounting position. We set all wheels in motion. Make phone calls. Do research. Make deductions. Scour old designs. We can get in touch with thousands of engineers whom we can rely on when necessary to come up with a technical clarification. We do this until we know which spare part we are looking for. After technical clarification, we look into any possible alternatives and, if needs be, even reproduce the part. With our know-how from today. With yesterday’s functionality in mind. That’s obsolescence management in practice at Siemens Mobility Services with a view to ensuring use that goes beyond tomorrow.
World Distribution Center (WDC)

It is the hub of our express logistics operations: our World Distribution Center (WDC) in Neu-Isenburg near Frankfurt/Main. All the important standard spare parts that our current customers need to ensure smooth road and rail operations are stored at our facility not far from Frankfurt International Airport. 365 days a year, 7 days a week, 24 hours a day – the employees at the WDC have just one mission: to get spare parts to their destination as quickly as possible or, at most, 48 hours later. Working in three shifts, they transport 25,000 parts per year with forklifts, pack them and deliver them a short time later to the loading ramp, where the forwarding agent is already waiting.

Adherence to delivery dates – without fail

Being fast is not always the top priority. But delivering spare parts for scheduled maintenance work according to plan. At the right place. At the right time. Reliable. With no compromises. In collaboration with our forwarding partners, we fine-tune the scheduling of our route planning and can deliver right to the hour. Right on time for the beginning of your maintenance work. To make sure things always go as planned, we subject our express agents to regular scrutiny. And only stick with the ones who are truly reliable.

“Experience has shown that we find a solution for every customer’s needs – from an off-the-shelf spare part to a complex system rebuilt with software modification.”

André Truszkowski-Jonas, Head of Business Support Spares, Siemens Mobility Services
Whenever there is a disturbance, they are on hand: our mobile technicians for road systems. They are at the scene of the problem in no time at all. And they are never without their mobile device. It keeps technicians up-to-date around the clock. As soon as the assignment planning is in the EDI system at the control center, a signal tone tells the technician the location of his next assignment. At the same time, the mobile device displays all important information about the work order. Before setting off on his assignment, the technician can get a quick idea of the situation and can immediately order all the spare parts he will need.

New LED signal heads are needed for a traffic light damaged during an accident? A spare part is urgently required for a defective module in a tunnel control system? The technician merely has to click on his smartphone and his colleagues at the World Distribution Center in Neu-Isenburg swing into action. They will then prepare the necessary spare parts for dispatch within 30 minutes. They are usually delivered to so-called drop-off points. At important transportation hubs, they act as 24/7/365 collection points and simplify the logistics process immensely. The technician can pick up the spare part whenever he is ready. Warehousing, waiting times and coordination processes are drastically reduced.

Assignment planning and spare parts delivery are fully automatic at Siemens Mobility Services
“When things go wrong, we mobile technicians have to react quickly. Fortunately, we have our drop-off points. They may look like ordinary gray boxes, but, for us, they are treasure chests. They contain the spare parts we ordered. We can pick them up right when we need them. For our customers, it means everything runs smoothly, no time is spent waiting, and the job is done very quickly.”

Franz Angermair,
Siemens Service Technician, Road Services
They are in service in Germany, Poland and Sweden – the more than 50 Vectron locomotives built by Siemens. And they are growing in number every month. So far, they have been sold to seven international customers. Superior and powerful in design, they reliably transport goods and people to their destinations. They will soon be running in Austria, Italy, Hungary and Finland as well. The locomotives have already clocked up over one million kilometers. Sooner or later it is bound to happen: a spare part is needed – and fast! But Vectron customers never have to worry about failures and downtimes because Siemens Mobility Services offers them a seamless spare parts solution, Easy Spares®. 100% RAILability® – Increased availability through optimized processes.

Example – Vectron: Easy Spares® spare parts concept opens up new horizons

Quick and easy identification of all Vectron spare parts is ensured worldwide by means of uniform numbers.

Spare parts across all borders
Over 10,000 parts stocked
In close consultation with Vectron engineers, Mobility Services has identified 1,200 spare parts that are absolutely essential to its customers. They are professionally stored at the World Distribution Center in Neu-Isenburg, Germany, and can be retrieved around the clock. So if worst comes to worst, help is only a few mouse clicks away. The desired spare part can be tracked down within a maximum of three minutes via Siemens’ Rail Mall online shop, where all available Vectron spare parts are clearly documented. The shop can be accessed via any common web browser. And what’s more, the Rail Mall features a direct electronic link to the warehouse logistics system in Neu-Isenburg. This means the shipping procedure is electronically triggered for every order.

Smooth spare parts logistics
Now it’s simply a race against time – normally, one that the Spare Parts team wins with convincing ease. Thanks to uniform coding in the high-bay warehouse, the fork-lift heads straight for the spare part. After retrieval, the part is promptly packed and taken to nearby Frankfurt International Airport via a well-established forwarding network or sent directly overland to its destination. Intelligent systems also work out the best route and the fastest means of transport. This ensures that the ordered part arrives within just a few hours and the Vectron can get back to work a short time later. And all in less than 24 hours. Orders for large components such as bogies are completed within four weeks.

Free to make new investments
Customers appreciate the central warehouse concept from Siemens Mobility Services. They’re happy to make use of the service offered by Easy Spares®. DB Schenker Rail Polska is one example. It’s not surprising because Easy Spares® reduces customers’ own inventories without jeopardizing the high level of availability of their fleets. The huge investments that used to go into keeping stocks are now freed up without any risk. That opens up entirely new horizons. For new goals way beyond borders.

„Identified in 10 seconds, ordered in 3 minutes, delivered in 24 hours!“

Modular service concept
In 2010, Siemens unveiled the Vectron and the experts were full of enthusiasm. As one journalist wrote, “Yes, I have actually driven it! Being at the controls of the […] new Vectron […] was a real treat.” Siemens developed this new generation of locomotives for the widest possible range of traction tasks. The locomotives can be used both for national and for cross-border passenger and freight traffic and are built for a maximum speed of either 160 km/h or 200 km/h.

Siemens Mobility Services worked out its new modular Railcover® service concept in parallel to the development of the Vectron. The Easy Spares® module is part of the concept. It is based on the idea that all essential Vectron spare parts should be stored at a central location. Easy Spares® also includes planned spare parts packages for wearing parts and repair solutions, complete obsolescence management and logistical processing.
When requirements change ...

... Siemens Mobility Services produces spare parts fast and easily by 3D printing

The laser beam runs quietly from right to left across the powder bed. In a smooth motion, the light-colored powder melts and becomes temporarily viscous – and then hard again. In a well-defined shape. Layer for layer. Slowly, a three-dimensional body is formed. But this will only become visible after the excess powder has been removed. “Here, we can see how a new armrest for the driver’s cab of our Combino trams is produced,” says Jürgen Spaeth, Head of Rail Vehicles at Stadtwerke Ulm / Neu-Ulm. When invited to launch a pilot project with Siemens, he had specifically requested this individual part. And soon it went into production, in close consultation with the customer: using an additive manufacturing process – with all its benefits.

New tasks in the driver’s cab

His fleet comprises eight low-floor Combinos that have been operating since 2003. Two more were put into service in 2008. They transport up to 175 people each on a line 10 kilometers long which runs through Ulm and Neu-Ulm. However, requirements have changed since they were purchased: “Our drivers have given us feedback that it would be helpful to have another switch for the direction indicators as well as having the switch for operating the points integrated directly into the armrest,” explains Spaeth, picking up the completed blank part which is still pretty colorless and rough. In the next step, its surface texture will be processed – and then it will be painted in a dark color.
Process for small quantities

Exactly ten of these armrests are needed in Ulm to equip the entire fleet, no more. “We then asked Siemens to make us this armrest as a new product,” adds the fleet manager. Siemens Mobility Services was able to supply the required part to the customer within a short space of time – thanks to the innovative generative manufacturing process technology that is commonly known as 3D printing. “Traditional production processes would have been far too expensive. Conventional processes are only economical for larger quantities, which were not needed in this case. For the generative manufacturing process, we had to work on the 3D model first, add the extra features and send the new data of the CAD (computer-aided design) model to a selective laser sintering system where production started,” says Mr. Kuczmiak, Head of Additive Manufacturing at Siemens Mobility Services. Here, the usability of the process is discussed and promoted, as it also is the case at other locations.

After necessary re-engineering work at the virtual level as well as numerous tests and trials, for example, for fire-resistant properties, the part could be properly installed so that the armrests are now ready for testing on the job – which, of course, is done personally by Juergen Spaeth. He is happily seated in the driver’s cab of one of his Combinos and activates the new switches. Indicator, point switching – everything is ready for daily use. “It is good that Siemens looks after the customer even in the case of such minor modifications,” he says before handing over the cabin to the actual driver.

Fast availability of spare parts after accidents

The sporadic demand of spare parts after accidents at unpredictable times is where 3D printing shows its strengths. One reason is that no special tools are needed which are usually time-consuming and cost-intensive to manufacture. Another reason is that it is often possible to improve the design of the parts, as it was the case with the sand filler housing for Rhein-Neckar-Verkehr GmbH (see figure). Originally a welded fabricated assembly, this part became a single component during 3D printing without welded seams – and thus without any mechanical weak points. Enhancements of the design itself can also easily be incorporated by Siemens AG and thus implemented through 3D printing.

“...It is good that Siemens looks after the customer even in the case of such minor modifications.”

Jürgen Späth, Head of Rail Vehicles at Stadtwerke Ulm.

The principle of 3D printing

Generative manufacturing facilities apply a material layer by layer, either by photopolymerization, extrusion or by depositing melted basic materials in powder form by means of a laser. These layers subsequently melt to form one unit. In this way, a three-dimensional body is gradually built up. Materials used include plastics, resins, ceramics or even metals. The systems operate under computer control using specially prepared CAD files.

3D printing has a wide range of applications and offers economic benefits, especially at low quantities as well as with complex component geometries. That way it is possible to produce parts that would be extremely expensive to make using conventional production methods. Decentralized production on demand allowing for innovative trends such as parts reduction, functional integration as well as weight and material savings is the future vision of the “Additive Manufacturing” department. The goal is to integrate generative manufacturing technologies with a customer focus into our portfolio. As the example shows, we are already making good progress to reach this goal.
Assistance Services

Identifying faults before they occur. Or, when they occur, rectifying them swiftly so that traffic keeps moving. That is what we ensure with our extremely efficient services. Worldwide. For road and rail.

Reducing emissions, avoiding congestion, ensuring safe and comfortable driving and rail travel conditions – the rising volumes of traffic in and between cities all over the world require perfect coordination. No matter if it’s a locomotive, an interlocking or traffic light control – even minor failures can soon have severe consequences. That’s why traffic equipment needs to work. Around the clock.

And we make sure it does. In Europe and around the world – not only in big cities – with advanced service concepts for preventive, corrective and predictive maintenance. Our experienced specialists aim to ensure that faults should not occur in the first place but should be identified and corrected beforehand. It’s the only way traffic will be able to grow – while easing the strain on resources, providing more comfort and more relaxation in harmony with the environment.
Assistance Services
Innovative services for safety, reliability, availability

The future has long since begun

Product and fleet monitoring online, around the world

Locomotives, trains, components, train automation systems – everything is a source of data nowadays. Once it is has been processed, the data can be used to analyze trends and constantly monitor the status of machinery. The result: Predictive Maintenance is possible – for vehicles and infrastructure. And that includes the highest security standards for data transmission. Algorithms tailored to the specific applications of operators monitor all the data, report any deviation from the norm and support strategies for correction. And: for troubleshooting, our global Rail Support Centers are online around the clock – for remote support from the head office and to coordinate ad-hoc calls by service technicians and spare part logistics. The findings from each fault are supplied to manufacturers, suppliers and developers – for continuously increasing quality at the highest level.
Rail transportation today: passenger and freight traffic is increasing, complexity as well, and vehicles and infrastructure are used more intensively. This presents huge challenges for rail services. Major keywords include: safety, system availability, lifecycle costs. The Siemens answer is: State-of-the-art IT, combined with our experience. Here, we are already a global leader thanks to our service concepts.

**Rail outpaces the plane: Velaro E in Spain**

The Velaro E has outpaced the plane on the Barcelona–Madrid line: While more than 80% of passengers preferred flying in 2008, these days more than 60% take the train. This is because it is on time on 2,299 out of 2,300 trips – the result of Predictive Maintenance: Identifying faults before they occur. 100% RAILability® through innovative maintenance.

**SMART DATA / DATA DRIVEN SERVICE**
The technology for the control and safety of road and rail traffic is becoming increasingly complex. Worldwide. Not only these systems, but also the vehicles need to be maintained and faults rectified promptly. A job that calls for specialists, preferably on-site. But for many companies, operators, federal states or local authorities, that is simply not an economic proposition. They need technology, but it’s just supposed to work and be beneficial to them. This is where Assistance Services from Siemens Mobility Services come in, all over the world.

How does this work in day-to-day operations? What benefits do the customers gain from this? What does the future hold? We asked the heads of the Support Centers about their exciting business.
Service for interlockings and points, service for road traffic and traffic management systems and service for rolling stock — how would you describe an “ordinary” assignment?

Paul Keppeler: In addition to the planning and coordination of maintenance intervals according to a schedule, which is preventive maintenance, our range of services also focuses on fault rectification and repair, which is corrective maintenance. In the event of a fault, assistance is needed fast – that calls for the optimum dispatching of technicians, vehicles and spare parts in order to minimize unscheduled downtimes.

So the main task is coordinating the support?

Paul Keppeler: Not at all. We solve a lot of problems there and then on the phone – around the clock, 365 days a year. Our customers can contact our vehicle experts directly at any time. They then work out a solution. In this situation, we make extensive use of remote diagnostics: a remote data transfer device built into the system provides environmental, operational and diagnostic data.

Bakir Bijedic-Hoffmann: In road traffic management systems, we tend more toward second level support. That means, in the event of a fault, municipal authorities always call their local service technician first. They then attempt to solve the problem themselves. They don’t contact us unless they fail to find a solution. We then establish a remote connection to the traffic management system or, if the technicians are on-site at the traffic lights, we guide them to a solution to the problem over the phone.

Perfectly tailored service for reliable vehicles.

Paul Keppeler

Around how many assignments are we talking about here?

Bakir Bijedic-Hoffmann: In the Region Germany alone, our call centers deal with about 70,000 assignments a year for maintenance and fault repairs. The technicians can repair most of the faults themselves out in the field, but in around 5% of the cases, they end up contacting us at the Support Center.

Just to give our readers a rough idea: How many sets of traffic lights does a city have on average?

Bakir Bijedic-Hoffmann: In a city like Vienna, for example, the traffic management system controls around 2,000 sets of traffic lights. You can assume that an average-sized city in Germany will have 400 to 600. Incidentally, in the past, they all failed at once whenever there was a fault at some place.

And today?

Bakir Bijedic-Hoffmann: Today, individual sets of traffic lights are “intelligent” and continue to work in spite of any fault in the traffic system. In the event of a fault, we establish a secure connection with the customer’s system via our certified common Remote Service Platform and correct the fault, load new software, carry out “hot fixes.”
What is the situation with railways?

Jürgen Kott: For example, when a key interlocking fails in a large urban center, especially during the rush hour, you will soon have 100,000 people stuck in stations and on platforms. In rail infrastructure too, we deal almost entirely with second level support. We provide support for our Siemens service technicians out in the field or for our customers themselves, who often carry out their own maintenance. They only call us if they can’t deal with a situation themselves – around the clock and from all over the world. That may sound very simple but when you imagine, for example, that a key interlocking fails in a large urban center, especially during the rush hour, within minutes you will have 100,000 people stuck in stations and on platforms, and the number will grow by the minute.

So you need to react quickly ...

Jürgen Kott: Absolutely! That’s why we’re organized so that our service technicians are out in the field with the customer. The Support Center acts as a single point of contact that can be called in at any time. And we have the right specialist available for every system – around the clock, 365 days a year.

We’re talking about very different sectors here, but you nevertheless collaborate very closely. What are the common interfaces?

Bakir Bijedic-Hoffmann: One aspect is definitely cooperation. We help each other to flourish, so to speak, we make use of shared tools ...

Paul Keppeler: ... we synchronize and standardize processes, share know-how and make it available ...

Support – an enjoyable job

We experience our customers’ satisfaction and relief almost every day. They’re usually desperate by the time they call us, they describe the situation and they’re stressed out. So when we’re able to give them rapid assistance, you feel their relief over the telephone when their system is up and running again. Sometimes, we’ll have two or even three experts on the phone. Is it the interlocking? Is it the automatic train control or the operations control system? The faults often cannot be assigned to one certain cause. But we often receive positive feedback from our customers to the effect that the measures we suggest work very well. And being able to help and the sense of relief is a really pleasing experience.

Jürgen Kott

Where networks come to life

Our connections to other experts are extremely important for our support. We work at maintaining them; the people know each other. That is the only way to ensure that you know who you can call and when and regarding what technical problem. Then you don’t need to phone around for ages and you can solve problems very quickly.

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Jürgen Kott

Paul Keppeler: Our optimized maintenance organization ensures reliable vehicles so that the customer can concentrate one hundred percent on his operation. Thanks to our long years of experience as a manufacturer and contact to our development departments, we are increasingly able to move corrective activities into the sphere of preventive maintenance. We also make targeted use of our know-how in the field of condition monitoring. We monitor the condition of vehicles as a basis for carrying out maintenance activities.

What do you think: What does the future bring?

Paul Keppeler: Predictive maintenance is the future without a doubt.

Jürgen Kott: Yes, predictive maintenance is definitely the field where we will see a lot of advances in the next few years. It is all about identifying faults before they occur.

This is where the potential truly lies for our customers. However, we must be realistic and recognize that, particularly in the field of fail-safety for railways, we still have to overcome a lot of obstacles before we can establish maintenance via remote access. Before the authorities certify anything at the highest safety level for the railway, you simply have to plan more time. But we’re already working on remote capability for the first products. That will be one of the great challenges of the future.

Bakir Bijedic-Hoffmann: In road services, we’re already a little further. Here, the future is definitely “in the clouds”: traffic management systems are becoming cloud-compatible. That means, the control center will not be on the customer’s premises anymore; there will simply be a large computer hosted in the cloud and the devices will automatically log on to the traffic management systems in the cloud. Countries in which we have no service technicians will therefore also be able to make use of this technology. My vision is a huge map of the world showing and monitoring all Siemens traffic management systems worldwide, i.e. displaying the actual status of the traffic management systems. In the event of a fault, the Support Center can establish a remote connection anywhere in the world, perform maintenance on the systems, load hot fixes and provide global support.

Jürgen Kott: But the main tendency is clear: many things, actually everything, should become “remote capable” and be “connected”. We are currently connecting as many existing and new systems as possible to our wayside systems – as it is already the case with road traffic management systems.

Thank you very much for the interview!

Experts through practical experience

Our staff in the Support Centers has gathered years of experience in the field, with customers and with their problems. This knowledge, combined with technical expertise, is an unbeatable advantage of the service we offer our customers.

Bakir Bijedic-Hoffmann and Paul Keppeler
As a technical backup, the Brunswick Support Center cares for the overall spectrum of the rail traffic infrastructure – over 300 products from operations control systems, signaling equipment and automatic train control through to points and interlockings.

The team consists of specialists, who are based at locations around the world. They are on standby and at our customers’ disposal around-the-clock.

The Support Center in Munich provides international support for the complete spectrum of traffic engineering – from traffic lights, traffic computers and traffic control rooms through to street lighting.

Repair via remote diagnostics
Erlangen

The Erlangen Support Center supervises rolling stock in the whole of Europe, mainly locomotives, but also metro vehicles including their control systems.

Backup around the clock

Safety nets for road and rail

Repair by mobile technicians on-site

Repair in the workshop
Challenges for locomotives and service in new markets

To learn more about the challenges and opportunities in the service business and in cross-border transportation, we interviewed Rainer Beller, Chief Technical Officer (CTO) at MRCE GmbH in Munich and MRCE B.V. in Amsterdam.

Mr. Beller, could you explain the freight locomotive leasing business of MRCE to us in simple terms?

Rainer Beller: Simply put, we as MRCE act on the market more as a “suppliers or seller of traction power” because we are not a pure investor in Locomotive Assets. That means: we not only lease the locomotives, but also offer the full service for them in one package.

So the lessees don’t have to worry at all about servicing the locomotives?

That’s right. Regarding Maintenance and Service, they only have to make sure that the locomotives are at certain locations – our partner workshops – at certain times or intervals determined by our specialists so the necessary maintenance work can be carried out.

So that means, you have a network of service partners?

We collaborate with approximately 50 workshops or service providers throughout Europe who have the specific technical knowledge to maintain our locomotives.

What do you see as the greatest challenge facing an international locomotive leasing company?

The question contains almost half the answer: in transportation across international borders. Although we have the European Union and a European train protection system, the certification procedures for the individual vehicles are almost just as national in character as they were before. This often involves a host of different individual requirements. And, if you want to operate a locomotive across international borders, this means: you must map the
certification packages of the individual corridor countries in this one locomotive. That can sometimes be a real challenge.

Is there any change in sight?

Yes. At present, discussions are taking place at the level of the European Commission on the “Fourth Railway Package”, which should bring about extended rules for the liberalized European rail market. Needless to say, we at MRCE are very interested in this, because it will hopefully bring us – and others – greater security in terms of planning.

You mentioned corridor countries. What exactly is meant by that?

At MRCE, our locomotives operate on several main corridor routes. First, there is the north-south axis from Rotterdam and the North Sea to the Italian ports and the Mediterranean area, and a newly added axis from the Baltic Sea to Trieste. Second, our locomotives also operate on an east-west axis from Poland, through Germany to the Netherlands.

And Poland is a new market for you?

Exactly. Although we do not yet have a network of contracted workshops and service providers there, we’re planning to develop this in Poland together with Siemens. That would give us and our customers big advantages: Siemens has the know-how for the extremely complex locomotives and we have central service providers and contact partners. And what’s really important to us in this respect is the handling of the spare parts that will be used in Poland. That’s going to be managed centrally through Siemens Poland. Especially in developing service and maintenance markets, like that in Poland, we need a stable and reliable partner for such a collaboration.

Do you see any other advantages in collaborating with Siemens?

So far our collaboration has shown that, above all, Siemens insists on a high level of quality in troubleshooting. We see a lot of promise, especially with regard to the future, but we also demand a great deal. For example, take the class 189 locomotive, a Siemens locomotive and the mainstay of our fleet. Such a locomotive has to be overhauled every 6 to 8 years – and that’s “heavy” maintenance. This involves almost completely dismantling and rebuilding the locomotive within several weeks. Together with Siemens and Deutsche Bahn, we intend to raise this maintenance interval from 1 million to 1.4 million kilometers. For this, we need Siemens as a partner who can carry out the technical tests, produce analyses and perform the technical calculations. And Siemens can also benefit from this.

And what is the benefit exactly?

Siemens knows why they have set the current maintenance intervals precisely to these values and can, essentially, verify this on the locomotive “in vivo” – that is, on the living object itself. From MRCE they’ll get very structured data from real cross border operation and maintenance – data that was not previously available to them – and can match it with their estimates as a manufacturer. We all expect this to result in an improvement in terms of the design and construction of future locomotives. So both sides stand to gain great deal from it.

That means, the locomotives will have longer service lives?

The maintenance intervals will be longer. We all firmly expect this will happen. And that will have effects on the entire business. Positive effects.

Thank you for talking with us.

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MRCE: Locomotives for rent

MRCE, or Mitsui Rail Capital Europe GmbH based in Munich and Amsterdam, is not just a leasing company, it is one of the leading providers of locomotives in Europe. It specializes in freight and has a fleet of several hundred locomotives that operate not only in the Netherlands, Germany, Austria, Switzerland and Italy, but also increasingly in central and eastern European countries such as Poland and Hungary.
Whether it’s Lisbon, Bangkok, Manchester or Bratislava, there is a movement going around the world among operators of rail and road traffic systems – one with impressive figures in terms of reliability, performance, safety and efficiency.

And what is the driving force behind it? Service concepts from Siemens that are innovative, tailored to the needs of our customers and exemplary in their success. A pleasing trend for us, of course. And one that also makes us a little bit proud. But above all, it drives us on not only to maintain our present level, but to achieve even more. Take a trip with us around the world and check out our successful projects.
Brown coal on the move:
20 years of satisfaction, 400 km of efficiency

Raw brown coal from the open-cast mines in Niederlausitz, Germany, has to be transported safely to various power plants. The railway line, 400 km, 436 sets of points, 520 signals, 1,236 low-voltage interlockings, 40 relay interlockings, 4 level-crossing protection systems and 438 level-crossing gates in 1994, Vattenfall Europe Generation AG & Co. KG placed an order with us to install the main electronic interlocking for the line. Conditions: training for inexperienced staff, organization of maintenance, adherence to all KPI (key performance indicators) standards.

The result: significant reduction in maintenance costs, increased freight transportation performance and a high level of customer satisfaction. The result so far: energy consumption went down by 50.5%, availability went up from 35% to 98% – 95% was guaranteed by the contract –, and the city’s 500,000 inhabitants have not only more, but also better light.

Success stories like those in Manchester (see map) earn travel round the world: in Portugal for example, Porto has followed in Lisbon’s footsteps and has now also asked Siemens for help with its traffic infrastructure maintenance. Our three-year contract has been running since 2011. It guarantees Transport for Greater Manchester (TfGM) 97.7% availability. Up to now, we have replaced 650 controllers and installed almost 15,000 120 optical units. The result: an energy saving worth 700,000 pounds sterling and a 30% reduction in the monthly failure rate.

Our project in Manchester shows the enormous potential of traffic lights alone. Our 15 year contract (with the option of a five-year extension) for 2,200 sets of traffic lights has been running since 2011. It guarantees Transport for Greater Manchester (TfGM) 97.7% availability.

The result so far: an energy saving worth 700,000 pounds sterling and a 30% reduction in the monthly failure rate.

Velaro, Spain: the rail high-speed train made by Siemens for the Spanish rail operator RENFE as a further development of the ICE was one of the first 150 m long bi-level EMUs in the world. The trains are capable of speeds of up to 500 km/h. Maintenance on the new eight-car units is carried out by Nertus, a joint venture between Siemens and Alstom. The result is impressive: maintenance-related delays longer than 45 minutes only occur every 1.5 million kilometres – that is less than 0.0005% of all journeys.

Slovakia: light as a shining example

The Velaro high-speed trains made by Siemens for the Slovakian rail operator ZSSK as a further development of the ICE 2 now have a total of over 550 million kilometres on the clock. The trains are capable of speeds from -20°C to +50°C at speeds of up to 350 km/h. Maintenance on the new eight-car units is carried out by Siemens and Siemens in Bratislava, Slovakia. Siemens has also been asked by the Skyscrapes to handle its traffic infrastructure maintenance and has been working under the contract for 10 years without a break. And: thanks to our know-how transfer, the customer’s personnel was able to carry out the final assembly of another 15 trains in Thailand. At the end of the period, the contract was extended for another 5 years.

We have been carrying out the maintenance on the Bangkok metro since it started operation in 2004. The work is based on a fixed-sum contract for a total of 19 trains and a 20 km section of track. Right from the beginning, all the work under the contract has been performed in Bangkok, with the expertise and know-how coming from Siemens Mobility Services. Today, Siemens is the top service provider in the region.

The result is impressive: we have saved that our contractual obligations throughout the whole 15-year term. This was the result of consistently excellent performance and adherence to all 95 (key performance indica- 
tor) standards.

São Paulo/Metropolitan also proved to be a reliable par- 
tner during the flooding disaster in 2011. We kept the city moving when many places were flooded "under water."
Upgrade Services

Reduced emissions, increased energy efficiency, greater comfort, additional functionality, optimized maintenance – everyone might have different reasons for modernizing. But what they’re all aiming for is: a longer service life.

A long service life saves resources – both financial and natural ones. Our Upgrade Services get the best out of mobility systems, and make road and rail fit for the long term. Our experts work in local repair and test centers all over the world.

No matter if the task calls for a complete modernization, a technological retrofit or component refurbishment – Siemens Mobility Services advises and works out a specific modernization concept together with the customer. Our team is happy not only to take over the engineering and conversion work, but also handle the entire project including logistics, acceptance and documentation. Examples from all over the world show how it is done in detail.
Upgrade Services lengthen the lives of mobility systems in cities all over the world. Big cities are attractive. They bubble with life. They make history. They move modernity ahead. They connect the past with the future. And that also applies to the quality of life and protection of the climate. Over 50% of the world’s population is living in cities. And this portion is even higher in Latin America. Some 81% of the population live in conurbations. One example is the city of Guadalajara in Mexico.

Guadalajara is the second largest city in Mexico. With its population of 4.4 million, it is a major center of trade and industry. It is a place where tradition and modernity meet. Guadalajara is a city in which the inhabitants, the Tapatíos, enjoy the Mexican way of life to the full. Film festivals, music and dancing are just as much a feature of the street scene as the millions of cars in endless traffic jams.
More energy every day

This major metropolis still has a long way to go when it comes to sustainability. This is where Siemens Mobility Services has come to help. We are working closely with the customer, SITEUR, to modernize the complete traction systems of 16 light rail trains. This involves converting the present traction system from DC to AC operation. This will enable the system to be used in future in train formations with other AC trains. The work is being done in close collaboration with the customer. The on-site Refurbishment Team is not only modernizing the traction system, but also the driver’s console and the main circuit-breakers. The modernization will not only benefit the customer, it will also be beneficial for the city and its inhabitants through substantially reduced CO₂ emissions, thanks to lower energy consumption.

Lightening up on the roads

On the other side of the Atlantic, 9,500 kilometers away from Guadalajara, the light is already fading on a cloudy winter afternoon. And the street lights switch on all over Düsseldorf, Germany. Shining brightly at full power. All over Düsseldorf? No, not in Danziger Strasse. Today, the lights are low on this freeway-standard federal highway. The reason: there is hardly any traffic. Düsseldorf has found an elegant way of ensuring maximal road safety while simultaneously lightening the city’s budget and improving the protection of the environment. Since it was upgraded, the intensity of the streetlighting is automatically adjusted to match traffic requirements. This involved integrating the existing street lights into a light management system that is, in turn, linked to a traffic management system.

The result: The first measurements have revealed that the street lighting only had to run at full power for some 220 hours in the whole year. That is only about 5 percent of the yearly total of 4,280 hours of darkness in Düsseldorf. This has enabled energy savings of between 60 and 90% to be made without impairing either safety or the traffic flow.
**Bogies:**
always on the move

Our Upgrade Services go right to the heart of every rail vehicle. Overhauled bogies not only improve passenger comfort, but also reduce both noise emissions and life cycle costs.

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**Interior design:**
nice outside, but not so great inside?

Not at all! It is the interior elegance that really counts. A modern interior design makes a big contribution toward making passengers feel comfortable. But, here again, the appearance is just one factor. For example, an up-to-date passenger information system also increases attractiveness.

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**Traction equipment:**
the key incentive

Modernized traction systems really boost energy efficiency. Whether it’s converting or adding innovative energy storage systems – our traction equipment upgrades cut operating costs over the long term.

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**The car body:**
it doesn’t get any better than this

Attractiveness is not a question of age. This applies equally to people and vehicles. Our services for modernizing the exterior design of vehicles provide more than just a facelift. They also improve the safety and stability of the car body.

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**Heating, ventilation and air conditioning:**
designed for every extreme

When you’re hot or cold, you’re hardly feeling comfortable. We therefore offer you and your passengers a very wide range of solutions for overhauling and retrofitting, or even completely replacing the heating, ventilation and air conditioning.

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**Safety systems:**
see and be seen!

Travel time means time for living. But it has to be safe! So safety has top priority in urban and interurban transportation. New safety technologies help to prevent accidents.
TRANSFORMING OLD INTO NEW

Or what modern retro really is

Streetlighting: More free energy

As street lights get older, they become more expensive because of their high energy consumption and maintenance requirement. Intelligent modernization solutions provide economical lamps with high availability. Siemens Mobility Services has been providing them for communities all over the world for many years.

LEDs for Cape Cod, Massachusetts

Inhabitants in the southeast part of Cape Cod, Massachusetts are also enjoying savings on electricity for streetlighting. Siemens Mobility Services installed a total of 17,000 modern LED lamps in a number of communities there. They consume between 40 and 50% less energy than conventional lamps and have a guaranteed lifetime of 10 years. This was a major project that involved a lot of consultation.

Complete renewal in Slovakia

Another example is the town of Trenčín in western Slovakia. Lying between the White Carpathians in the north and west, and the mountains in the south and east, the town’s almost 60,000 inhabitants have experienced a trouble-free complete renewal of its public streetlighting and traffic lights.

This had been preceded by a finely tuned plan that made it all possible. Within a mere four months, we replaced over 4,500 lamps with modern, more efficient lights. In a second phase, we modernized 2,000 lamp posts and 100 sets of switchgear, together with their cabling, most of which was laid underground. The town now consumes 35% less electricity while performance has improved by up to 70%.

First of all, the existing local lamps were analyzed, and our modernization concept was matched to the requirements of all the communities involved. Work started in Hyannis and will finish in Falmouth. This town, in the far west of the area, pays out over 200,000 dollars each year for its nocturnal streetlighting. This will be cut by half when the modernization is finished.
Always one step ahead

When it comes down to the technical infrastructure for road traffic, safety and availability have top priority. Only continuously maintained systems are safe systems. Disturbances usually build up slowly and first become evident, for example, when individual components slightly exceed their limits. With our Care Services system, experts detect such tendencies at an early stage before a real disturbance develops. They conduct regular, standardized system tests, install the latest versions, and initiate further upgrading measures. This keeps hardware, software and networks always up to date.

Instead of sending technicians, in many cases we just send the data and let our fingers travel over a keyboard: with our Siemens Remote Platform that enables our service engineers to access customer systems directly via remote data link – with the highest level of security. This makes it possible to “look into” a system from a workstation and make updates whenever necessary. Always one step ahead, so that your road safety does not fall by the wayside.

"You’ve reached your destination!"

System Care provides reliable town and country navigation for the future and always keeps road traffic systems up to date.
Upgrade Services

Particulate emissions limit

Optimized traffic flow

Lifelong planning security

Maintenance of the value of investments

High operating efficiency

 Efficient traffic control

67 hours of traffic jams

Maximum road safety

3 million road users

“Vous avez atteint votre destination!”

High operating efficiency

Maximum road safety
Qualification Services

As a provider of mobility systems with experience in service since 1881, we have acquired a vast amount of know-how. And we would like to pass it on. Be it in connection with our comprehensive test capabilities or certified training courses – 100% RAILability® through contribution of our long-time expertise.

Mobility providers depend on fully functioning systems – right from day one. To make sure nothing goes wrong, our experts from Siemens Mobility Services conduct extensive tests and inspections on systems and products. We simulate real-life conditions in our modern test centers and put hardware and software through its paces for our customers.

Well trained employees are a major factor for your success. We offer certified training courses for maintenance personnel, train drivers, traffic engineers, planners, etc. Our flexible and modular training elements enable our customers to acquire valuable know-how from us and to keep up with the state of the art.
Half the rail world as visitors

Getting a taste of the big wide world: a visit to the Wegberg-Wildenrath Test and Validation Center

We have set off in the direction of the Dutch border and are encountering fewer and fewer towns on the way. After a while, we only see isolated farms and endless fields. But then, coming out of a dark coniferous forest, we suddenly find ourselves in the middle of Europe. And a lot of action! At Test Oval 1 of the Wegberg-Wildenrath Test and Validation Center (PCW).

“I have been doing this job for many years now and I still enjoy it. I can’t image working in an office day after day. I prefer being outdoors.”

Michael Segedi, train driver and shunter. At the center since 2000.
At the fence bordering Test Oval 1, we get our first impression of the international spirit at the center: A regional train from a British rail operator races past us. Further away, we can imagine a Dutch tramway on a second test oval. We are still watching its rear lights when we hear the noise of a diesel locomotive rolling onto the facility on a connecting track to the DB rail network.

Rail vehicles for the whole world

As we do not want to be on the sidelines all day, we drive to the main entrance. No sooner does the red and white barrier go up than the Head of the Test and Validation Center is already there waving to us. “Welcome to the world’s largest and most modern certification facility for rolling stock,” laughs Dutch-born Robert Grootings. He is proud of the 15-year success story of this huge test facility: “Half the rail world has visited Wegberg-Wildenrath! Trains for Great Britain, Bulgaria, Spain or Vietnam, metros for Munich, Bangkok and Athens, trams for Paris and Amsterdam – this is where they all earned their certification.”

All of Europe on the doorstep

It was summer 1997 when Siemens officially opened the center at the former British Royal Air Force base. It covers 35 hectares and offers enough space for a large 6.1-kilometer test oval and a smaller 2.5-kilometer test oval. With a total of 80 specialists, the team tests rolling stock from all over the world, performing, for example, speed, braking, curving and grade climbing tests on several special test tracks, totaling 30 kilometers of mainly standard-gauge and some meter-gauge track. “Our team carries out virtually any kind of test under realistic and extreme conditions – at standstill or dynamically. For every technology, every vehicle, every system and every market. 365 days a year, around the clock. We can simulate rail operations from all around the world – including cross-border traffic in Europe,” Grootings explains and invites us to take a look inside the three train formation halls.

Rolling stock from A to Z

We only have to take a few steps. Immediately to our left, not far from the main entrance, are two 440-meter-long silver shimmering giants. Regally ensconced behind their roller doors, we see a Vectron, a Desiro and an Avenio. But appearances can be deceptive. “Not all trains that are tested here come from Siemens as we also make our infrastructure available to third parties,” Grootings stresses as

“I’m always very happy to hear that the trains we have worked on here at the center are running without any trouble for our customers. We recently shipped a vehicle to Turkey, too. As I’m Turkish, that pleased me very much.”

Aydin Sönmez, fitter. At the center since 2011.

Internationally unique

The accredited and certified Wegberg-Wildenrath Test and Validation Center combines know-how and technology. Just about every kind of standard- and meter-gauge vehicle along with systems and components are subjected to typical railway tests here. Special meter- and standard-gauge test tracks offer many options for testing, such as running through curves and on gradients, leakage tests and rain tests. Real-life situations can be accurately simulated on about 30 kilometers of track.
The test stations are spread over the whole facility. Rather than visiting all of them in one afternoon, we go over to the tracks in the middle of the test center and immerse ourselves once again in the comings and goings. The big wide world seems to appear before our very eyes. A paradise for rail enthusiasts.

And investments are continuing. New halls are being built for testing and commissioning. Even the location itself is undergoing a transformation. The focus is no longer solely on testing; the facility is evolving into a Rail Service Center where an increasing amount of maintenance work is being done – from accident repairs and general overhauls to upgrades. This is a location with a future.

The direct route to certification

The rail vehicles are brought up to scratch for deployment all over the world in the train formation halls and in an adjacent workshop. This includes undergoing extensive practical tests, some under extreme conditions. “The center is an internationally recognized test facility for rolling stock; it is certified and accredited by federal authorities for its tests,” says Grootings. Therefore, the next phase for the Vectrons, Desiros, Avenios and Velaros involves, for example, the turn-tilt table, the tilting device, the high-voltage testing facility and the acoustic measuring station – all of them tests that need to be passed prior to certification.

From the control room, we coordinate the shunting of the trains and the switching of the contact lines. My work is my vocation. It’s simply my world!”

Frank Reimer, dispatcher. At the center since it opened in 1997.

„When it comes to switching orders, the safety of every customer and of all the staff depends on me. After all, we are working with voltages as high as 30,000 volts here. I’m really proud of my work.“

Pierre Weikamp, industrial electrician and sub-dispatcher. At the center since 2012.
More than 800 employees of the Expert House are “at home” in Wegberg-Wildenrath, Erlangen, Munich and Brunswick. From there, they are deployed all over the world to support customers with rail issues, tests and services. They are often prepared in the center for their assignments and duties in project teams that operate in all parts of the world. Here, the complete range of rail expertise for mobile, flexible deployments around the globe is pooled in one place – from skilled workers to certified project managers.

Our specialists not only operate in 13 European countries but also in the USA, Brazil, Saudi Arabia, Australia and ten more countries. Our pool of experts covers the entire portfolio of Siemens Mobility Services: from commissioning, testing, service and maintenance to assembly, qualification and project management tasks. We are also there for you!
When Michael Schröder (MS) and Michael Baumgart (MB) set off to a new training course, they are always curious about what awaits them in the days ahead. What level of knowledge do the participants have? Are they motivated? Will the interpreter be able to translate the highly specific content? But none of this makes them nervous. In fact, both trainers look forward to meeting people from very different backgrounds – and to imparting their knowledge.

MR. SCHRODER, MR. BAUMGART, you have both been trainers at Siemens Mobility Services since 2010. How has your life changed as a result?

MB Before I became a trainer, I was an engineer for multiple units and specialized in traction systems. I now travel a lot more than I used to. Whenever Siemens sells a new train, you could say that I’m on board too as a trainer. I’ve been to China several times recently, but also to Russia. And I’ve been on a few trips to England. That means I have a lot of contact with other cultures. That is very exciting and you learn about completely different perspectives.
I don’t have to travel so much. Although I do travel in Europe sometimes, I usually teach at our training center in Munich. There we can simulate all kinds of processes perfectly. I enjoy working with people. Previously, as a service technician for traffic management systems, I didn’t get in touch with people very often and spent most of my time with silent systems.

Do you conduct the courses alone?

As an employee of Siemens Mobility Services, I cover the subjects of traction and power supply. But we need specialists from Siemens or our suppliers if we are to deal with all the systems and components in a multiple-unit train. Their experience is especially important in the practical section, which plays a major role in our training – around 50% of the course. Ideally, I contact the customer and reserve a complete train for the group so that the participants can learn directly on the product itself. In the theoretical section, we work a lot with technical documentation.

What is the attraction of imparting your practical knowledge to others?

Being able to pass on your professional experience to others makes you feel good. It’s always great to see how a group grows more closely together during the one or two weeks of a course and how complex interdependencies are suddenly understood.

That’s right – and the sense of achievement is faster and more direct. We ask for feedback after every course and the moment I read that someone has finally understood this or that, then it’s just perfect!

Who are your courses aimed at? Who makes up the majority of the participants?

As far as our customers are concerned, they are mostly technicians or they themselves are trainers who want to pass on their knowledge within the company. The group is composed of eight to ten people. They don’t all have the same level of knowledge to start off with. The really hard part is to find out where they all stand, get them involved and lead them to the same point.

I see that in my courses, too. And another thing is that the level of motivation varies quite a lot within a group. Some see a training course as a reward and are eager to learn, others see it more as a duty and are not so motivated.

There is no theory at all in our courses. We simulate everything and each participant has the opportunity of training on the system itself. We have invested a lot of money in this aspect – and it’s paid off. No other company offers this kind of highly specialized training.

You are more or less always on the move. Where are you off to next?

My next stop is Great Britain again. I’m planning courses for the Eurostar high speed train there – a very exciting project. After that, a group of customers from China is coming to Erlangen.

Stuttgart is the next place on my schedule, then Belgium followed by courses in Switzerland and Berlin.

I wish you both a good trip!

The trainers at a glance

Michael Baumgart has been a trainer for rail systems at Siemens Mobility Services since 2010. He has a degree in engineering and one of his previous jobs was adapting multiple-unit trains to fit customer requirements. In his current position as a trainer, he travels around the world expertly introducing customers to their new rail systems in tailored courses.

Michael Schröder has been a trainer for road traffic systems at Siemens Mobility Services since 2010. In his previous position as a service technician, he spent many years maintaining traffic computer systems. Most of his training courses take place at the training center in Munich, where he has a modern, comprehensive system at his disposal for simulating very different kinds of traffic situations.
Operation Services

Intelligent traffic lights, tablet-based mobile traffic control, high-performance traffic computers for cities and towns without local authorities having to build up their own server capacities – this is the trend in traffic management of the future. User-friendly and green, smart, efficient and affordable.

More and more cities in more and more countries worldwide are docking onto our pioneering, cloud-based solutions for free-flowing traffic on the roads – because they do not place unnecessary strain on budgets, they reduce pollution, and they effectively control and guide traffic flows.

An additional feature of this technology is the provision of information systems for road users – Smartphone apps give people all important and relevant traffic information up to the minute and enable them to avoid congestion, roadwork and other disruptions. And help them get to their destination – quickly, safely, for a long time.
ASP (Application Service Providing), such as with Sitraffic smartGuard, is the future for many cities because they won’t need their own traffic computer when their application is provided on a server. This means, there will be no local control center in future, but hosting in a cloud. As a result, cities with a low budget will be able to use centralized traffic applications without having to set up, own, operate and continuously maintain the relevant hardware, software and infrastructure. There is no doubt that Sitraffic smartGuard has the potential to change the world of intelligent traffic solutions.

The principle is as revolutionary as it is simple, and it works via Siemens Cloud. The necessary IT infrastructure is already available and capacity is simply rented. Access is granted in a matter of seconds via a highly secure Internet connection, e.g. from a normal workstation, via tablet or even on the move via smartphone.

We provide urban traffic control center (UTC) solutions all around the world with our hosting services for our Sitraffic Smart products. These are web-based, user-friendly and low-cost solutions that support and optimize our own service or the day-to-day work of our customers – with the basic functions of a traffic management system. A service from Siemens Mobility Services – smart and efficient.
Sitraffic smartGuard: intuitively simple

Sitraffic smartGuard requires no training at all: operation is intuitive. For unlimited monitoring, the user only has to log on with his user name and password; for active intervention, a mobile PIN is all that is needed – just like with home banking. The PIN arrives as a text message and is valid for 30 minutes. The user can then access traffic lights, detectors and parking garages, etc. and, with just a few mouse-clicks, also get a complete overview of the overall system on a license-free OpenStreetMap and use all of the functions.

Several projects are currently running in Germany, Austria, Norway and Finland, with 1,500 sets of traffic lights delivering their data in real-time on a daily basis. Sitraffic smartGuard – a solution that is interesting for local authorities that do not wish to invest but nevertheless want to profit from the latest in traffic control technology. Data security and functionality are our primary concerns, which is why we have had smartGuard certified by an independent inspection body.

Innovation without extra costs? – a contradiction?

We keep traffic flowing freely in many cities – with effective control systems that meet the needs of road users and the demands for more safety and less pollution. With intelligent parking space control and modern traffic engineering. We conduct research into new solutions and, with an eye on future conditions, implement them within tight and stagnant budgets.

Berlin: info every five minutes

The Siemens subsidiary VMZ Berlin Betreibergesellschaft mbH operates the city’s Traffic Information Center (VIZ), a comprehensive mobility portal for the city with numerous free services. The public, the media and industry are kept up-to-date regarding the situation on the roads. The system is based on the current traffic situation, which is determined via floating car data (FCD) and detector data, and is updated every 5 minutes. This data provides reliable information on the traffic situation which is broadcast live by the local station radioBerlin 88.8. In case of disruptions, the service offers less stressful alternatives which people can use to reach their destination. This is an example for Siemens’ developments and operations of multimodal information services that point out current mobility options.
One traffic computer „to go“, please!

In a pilot project, the city of Karlsruhe is testing ASP (Application Service Providing) with Sitraffic smartGuard

Identifying traffic light faults from a home PC. Checking parking space occupancy with a tablet. Or controlling traffic signs via smartphone while on the move.

What sounds like science fiction is already reality at Karlsruhe’s traffic control center: the city is using the ASP principle with Siemens smart-Guard Internet-based software.
Mr. Saal, you work in the field of traffic control systems. What is so special about your profession?

Jan Saal: Working in the road traffic field means, you’re always dealing with people. With road users, whom we somehow have to satisfy. That is exciting and it is a challenge. In fact, it is just like soccer: everybody knows better than the coach (laughs). And that is more or less the case with traffic control systems. We have to be able to explain to our customers – namely, the citizens of Karlsruhe – why we make certain decisions and how we also need to be open to suggestions. And, all the while, we have to keep traffic moving.

What specific challenges does Karlsruhe present in terms of road traffic?

Karlsruhe is a great city with just the right size: With around 300,000 inhabitants, it is the second largest city in the federal state of Baden-Württemberg. So you could say, Karlsruhe is something between a small town and a really large urban center. We have freeways to the south and east of Karlsruhe and four federal highways that pass through the city. One federal highway – called the South Expressway – is the main artery to the freeways west of the town. The expressway runs very close by built-up areas and by the network of inner-city streets. The challenge we face is to prevent any traffic congestion occurring on the South Expressway if at all possible.

Why did you decide for Siemens Mobility Services as your service partner to help tackle these challenges?

One very big advantage for us is the fact that Siemens has a branch office here in Karlsruhe. In the event of a fault, technicians can be dispatched from the traffic control systems section to carry out a repair. What’s more, our entire traffic management system was made by Siemens. All of our traffic light installations are from Siemens, too. We need to be able to rely on good service. And that’s what Siemens provides. I really must complement our local service technicians!
We spoke with Jan Saal about the cooperation between Karlsruhe and Siemens Mobility Services. Among other things, he is responsible for around 250 sets of traffic lights as head of Traffic Technology and Traffic Control at Karlsruhe’s Highways Department.

They’re real experts who know exactly what they’re doing. In some cases, we’ve known our contacts for decades because there is little fluctuation. And that’s very good for us.

How did you come to participate in the smartGuard pilot project?

The police in Karlsruhe approached us with a very concrete question: they asked us to give them the opportunity of viewing the condition of our traffic lights. They had noticed that, thanks to our traffic management system, we at the Highways Department were always informed about traffic light failures long before they occurred.

Our first thought was: we will make a small traffic management system available to the police so that they can see which lights have failed. But that proved to be technically complicated and would have required a lot of investment. That’s why we were happy that Siemens found an Internet-based solution for us – smartGuard. And so we decided to test the system.

And what happened after this decision was taken?

We then presented the system to the police. The great advantage of smartGuard is that all you need is an Internet-compatible computer. It provides you a good picture of the condition of the traffic lights. And the police is very happy with it.

How was the familiarization phase for you and your colleagues?

Familiarization was uncomplicated. We are already using Siemens’ Sitraffic Scala system on our traffic management system. Since smartGuard is based on the Scala system, the user interfaces are pretty similar. It’s just that smartGuard doesn’t have quite as many features as our traffic management system.

Where else do you use the system?

We spoke with Jan Saal about the cooperation between Karlsruhe and Siemens Mobility Services. Among other things, he is responsible for around 250 sets of traffic lights as head of Traffic Technology and Traffic Control at Karlsruhe’s Highways Department.
We use it much more frequently than we had originally intended. We mainly use the system for monitoring purposes. For example, if we receive a call about a fault message at the weekend, we simply go on the Internet at home and, from there, we can take a look at the condition of Karlsruhe’s traffic lights. That's really great. We used to have to establish an elaborate computer link-up via a radio modem. That was very time consuming. It takes no time at all via Internet.

**Do you only use this smartGuard visualization function? Or are there other benefits?**

We can change programs on our systems – for example, when the freeway is blocked and a detour needs to be set up. And the system shows us if there is a fault in a detector. So we also use it for repair jobs if we want to save ourselves a trip to the traffic management system.

**Will you use the system when the pilot project is over?**

Definitely. The police is very pleased with it. So are we at the Highways Department. It simplifies our communication with one another. It has improved the quality of information about our traffic lights. And, in the end, that benefits the citizens of Karlsruhe because improved coordination of motor vehicle and light rail vehicle movements leads to an enhanced traffic flow and, consequently, to shorter waiting times for drivers and passengers.

**Would you recommend this Internet-based solution to other cities?**

I believe, the system is definitely very well suited for small cities that don’t have their own traffic management system, for example. They can use the functions of smartGuard for applications similar to those provided by a traffic management system. In principle, a kind of small-scale traffic management system. We very much appreciate this approach by Siemens and are very happy with the job Siemens is doing and has already accomplished.

Thank you very much for this interview, Mr. Saal!
Knowledge transfer on tour

University campus in Qatar gets a mobile connection from Siemens

When elite students, reputable professors and renowned scientists meet to share expert findings on the large new university campus near Qatar’s capital of Doha, they will never lose sight of Siemens know-how from 2016 on. After all, 19 trams of the Avenio type will then operate on the campus – without a catenary and with extreme energy efficiency. The trams use the Sitras HES energy storage system. High-performance capacitors (High-Caps) on board are recharged at every stop and provide power for the trip to the next station.
Highly efficient technology

It is precisely this technology that impressed our customer, the “Qatar Foundation for Education, Science and Community Development”. “All our new systems are developed with an environmental focus. This innovative mass transit system underscores our commitment. After all, it is our goal to make the site of the “Qatar Foundation” a car-free zone, and with the introduction of the new tram system, we are on the right track to achieve this goal,” says engineer Saad Al Muhannadi, Qatar Foundation, Vice President Capital Projects and Facilities Management. The Foundation is a regional competence center for education and science that promotes the evolution of Qatar to become a knowledge- and education-based society.

Know-how that connects

To ensure that the knowledge transfer runs smoothly, not only mentally but also physically, Siemens will handle the complete operation as well as the maintenance of the tram line with a total length of 11.5 kilometers for the first three years. In addition to the Avenio vehicles, the service agreement also covers the signaling system, all track and point facilities, the telecommunication system, the traction power supply, SCADA – the scalable visualization system for monitoring automated processes –, the platform doors and the workshop equipment. A service from experts for experts.

100% availability at Duesseldorf Airport

The SkyTrain in Duesseldorf does not only hover at a considerable height, it is also a real highflyer itself in terms of performance: The automatic suspended monorail operated by Siemens runs virtually trouble-free. The SkyTrain has a record of more than three months operation at 100% availability. The top performance was measured from January to March 2014. This impressed the customer – Flughafen Duesseldorf GmbH – so much that the service agreement was extended by another 5 years.

The SkyTrain suspended monorail line links the long-distance railway station at Duesseldorf Airport to the airport terminals and has been operating since September 2006. “Meanwhile, we have an overall annual availability of the system of 99.9% that is permanently recorded. This is world-class performance,” explains Project Manager Sascha Guth. The declared aim is now to achieve 100% availability over the entire year. We will stay focused!
Does that sound boring?

The world is on the move and will stay that way. More and more people are traveling further and further and a lot more often. And they’re doing it much more individually and faster. That raises a number of questions.

Introducing Tina

Whenever we – Tim and Tom, the little helpers for rail and road traffic, for 100% RAILability® – become active, we have been sent on our journey by Tina. She always knows who and what is needed, when something is required and of course, where. Typical for Siemens Mobility Services. And we really are everywhere – as a small, friendly data medium in a world of traffic where hardly anything moves without data any more.

What – you don’t keep us yet? Please contact your Siemens partner. He will certainly find a way to get us to you soon. Right, Tina? You got it: We are there.
Who makes the necessary vehicles and systems, and makes them more reliable, more economical, more efficient, more available, safer, more energy-efficient, more attractive, more comfortable, easier on resources, more modern, more durable?

Siemens, naturally.

Who provides global service for these vehicles and systems, such as for trains and locomotives, metros, technical infrastructure in mainline and mass transit systems, traffic lights, lighting systems and traffic control centers, and who trains the specialists needed to do this work?

Siemens Mobility Services, obviously.

Who takes care of maintenance, repairs, modernization, logistics for spare parts, software updates, testing and inspections and training courses, and who also offers all kinds of platforms for this?

We do, of course.

Does that sound boring? We don’t think so. We enjoy our work. It is rewarding. It benefits each one of us, society as a whole and the environment.

Sometimes we make it so easy for ourselves.

Sometimes so hard.

So you can look forward to future innovations in all of these fields.

And who from?

Guess who!

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The information in this document contains general descriptions of the technical options available, which do not have to be present in all individual cases. The required features should therefore be specified in each case at the time of closing the contract.