

We take responsibility.



Protecting the climate, cutting costs.

Sustainable information and
communications technology solutions

Life is for sharing.





Green ICT.

Virtualization of servers in data centers.	5
Thin clients in PCs.	6
Datacenter 2020 – the data center of the future.	6



Dematerialization.

Tailored solutions for virtual meetings.	9
Reduced paper consumption through special digital pen.	10



Smart Grid.

Multi Utility Servers for smart electricity meters.	13
Demand side management and virtual power stations.	14
Securing benefits from the experience of T-City.	14
The strengths of T-Systems.	15



Smart Logistics.

ICT-based road toll systems.	17
Optimization of logistical processes.	18
Integrated all-in-one solutions from a single source.	20
Toll technologies.	22



Summary.

On the road to a low carbon society.	25
--------------------------------------	----



Publishing information.

Contacts.	26
-----------	----



Green ICT.

If ICT applications are to be used to systematically reduce emissions, the ICT industry itself first has to set an example and exploit opportunities to reduce its own emissions.

According to the SMART 2020 Germany Addendum, the ICT industry is responsible for a relatively small proportion of greenhouse gas emissions in Germany, accounting for approximately two percent in 2007, and rising to some three percent by 2020. Nevertheless, increases in efficiency and new technologies could cut this by more than 50 percent.

The SMART 2020 Study for Germany identified key technologies in this area, namely the virtualization of servers, the optimization of air conditioning in data centers, thin clients in PCs, and the optimization of the energy consumption of equipment during operation and in standby mode. These ICT solutions that help companies reduce the energy consumption of their own ICT systems are pooled under the concept of green ICT.

Within the scope of green ICT, Deutsche Telekom already offers all the solutions featured in the SMART 2020 report, underscoring its exemplary commitment to reducing emissions by saving energy and improving energy efficiency. T-Systems in particular has been a pioneer in this field. For years, Deutsche Telekom's business unit has been conducting research, developing and using innovative solutions to replace processes that are costly in terms of energy and materials, thereby tapping into substantial savings potential. T-Systems is positioning itself credibly as a green ICT service provider, and thus actively supports the important third focus of the Deutsche Telekom Corporate Responsibility strategy: the „low carbon society“. The acknowledgement of our activities in the form of the Green IT Award 2008 conferred by IDC Central Europe and the Environment Award 2009 of the City of Vienna is a further motivation.

Virtualization of servers in data centers.

The results of our efforts to improve energy efficiency in data centers can be felt above all by Deutsche Telekom customers whose systems and applications are professionally operated by T Systems through Dynamic Services. By virtualizing servers, storage and tapes as well as introducing a high degree of standardization in data centers, energy consumption is reduced by up to 80 percent. At the same time, this offer allows customers to cut their ICT costs by up to 30 percent.

„Green“ activities in data centers aim to facilitate a paradigm shift. They make a transition possible from excessively large fixed-capacity solutions

designed to allow for maximum requirements towards service-based solutions that offer customers flexible usage based on need, thereby saving resources. But is the gap between normal and maximum requirements really so big? Companies use up to 80 percent of their available data center capacities for just a few days a year, for instance for month-end closings or during seasonal peaks, such as around Christmas. Nevertheless, many companies still maintain IT reserves for just such peak times. They consume unnecessary energy, resulting in avoidable greenhouse gas emissions. It is much simpler, more economical and more ecological to procure ICT services as and when they are required, in the same way as electricity and water. It is precisely this model that T-Systems' Dynamic Services allow.

Figure 1: Deutsche Telekom as a pioneer

Deutsche Telekom actively pursues energy savings potential in the ICT sector in addition to and independently from the carbon freedom from RECS certificates

ICT subsector	Measures for reducing CO ₂ according to SMART 2020 Germany Addendum	Individual saving effects (Mt CO ₂ e)	Pursued by Deutsche Telekom
Data centers	. Virtualization/cloud computing ^{1,2}	2.7	✓
	. Optimization of HVAC	1.4	✓
	. Energy-efficient components	0.5	✓
	. Standby optimization	0.6	✓
	. Efficient archiving and storage	0.3	✓
End user infrastructure	. Energy-efficient components	2.6	✓
	. Standby optimization	1.7	✓
	. Thin clients/cloud computing ²	4.7	✓
Telco terminal equipment	. Energy-efficient components	1.1	✓
	. Standby optimization		
Network infrastructure	. More efficient mobile masts	0.9	✓
		16.5	

¹ Virtualization implicitly assumes physical consolidation of servers.

² Virtualization and thin clients used as key components of cloud computing.



Companies purchase computing power, data storage, software and bandwidth from the network as required and thereby reduce their energy consumption. T-Systems launched its Dynamic Services as early as 2004, making it one of the first providers to offer working business solutions under the cloud computing philosophy. For these services, the company primarily uses blade servers, which share the necessary IT resources. Hardware utilization is optimized at all times thanks to state-of-the-art virtualization technologies and extensive standardization, and in this way, energy consumption is reduced.

The optimized use of resources is evidenced by a simulation model developed by T Systems called Green Dynamics. It is based on a concept from Professor John D. Sterman of the Massachusetts Institute of Technology (MIT) and was produced with academic input from St. Poelten University of Applied Sciences in Austria. The mathematical model clearly shows how different technological measures can optimize energy efficiency in data centers. These include degrees of virtualization, pooling effects and an improvement in power usage effectiveness (PUE). The simulation takes account of all factors interacting over a longer period. Businesses can thus include energy parameters and costs as part of the basis of decision making.

Thin clients in PCs.

Energy consumption in end user infrastructure also benefits from Dynamic Services. The conventional, still relatively energy-intensive computer systems used by customers are replaced by thin clients. This can reduce electricity consumption, and with it carbon emissions caused by the systems in operation by up to 54 percent. Using thin clients instead of fully equipped computers also saves costs in procurement, operation and maintenance.

All this significantly distinguishes T-Systems' product range from the competition:

- As a vendor-independent company, T-Systems systematically uses energy-saving, efficient hardware and software from the most energy-efficient manufacturer in each case.
- The market research company Gartner confirms, that with its Dynamic Services, T-Systems is the market leader for virtualization solutions. In

addition to savings on server hardware, this solution allows companies to cut their electricity costs for ICT by up to 80 percent (basic calculation of the Green Dynamics simulation).

- T-Systems delivers ICT from a single source. Customers receive solutions and tailored concepts for infrastructure, applications and services from start to end and covering all needs, which means designed for use in their own network or possibly designed for being used at customer interfaces.
- From its many years of experience as an outsourcing service provider, T-Systems has acquired profound transformation expertise, in addition to its fundamental understanding of business processes and dynamics. Thanks to this expertise, it can offer the most complex applications and systems as part of Dynamic Services.
- T-Systems stands for the highest security standards and a permanently high level of availability and as such is a reliable business partner.

The growing energy efficiency of the network infrastructure is another important contributor to climate protection, especially as modern ICT continues to expand. Steadily rising data transmission rates and ever more powerful services, e. g., for high-speed data transmission, require increasing volumes of energy. Mindful of its responsibility for climate protection, Deutsche Telekom has therefore taken fundamental steps to limit the energy consumption of the network infrastructure using modern technology. When planning and optimizing the network infrastructure, it is conscious of potential energy savings from an early stage. Old systems technology is phased out and replaced with more energy-efficient network components.

Datacenter 2020 – the data center of the future.

Because of the offsetting of carbon emissions with RECS certificates, every single Deutsche Telekom customer benefits from our climate protection efforts. But not only that. Deutsche Telekom is already looking a long way ahead with regard to energy consumption, so that it can continue to offer its customers the most energy-efficient solutions in the future. For this purpose, in September 2009, Deutsche Telekom commissioned the Data-

-54 % cut in electricity consumption

over five years through thin clients

center 2020 in Munich, which is unrivalled worldwide. Here, T-Systems is working together with Intel on the data center of the future, with variable ceiling heights, temperatures and humidity and using the latest microchip technologies. The two companies are testing how current data centers could be run more economically and with greater energy efficiency. Their aim is to find out what the ideal data center of the future looks like.

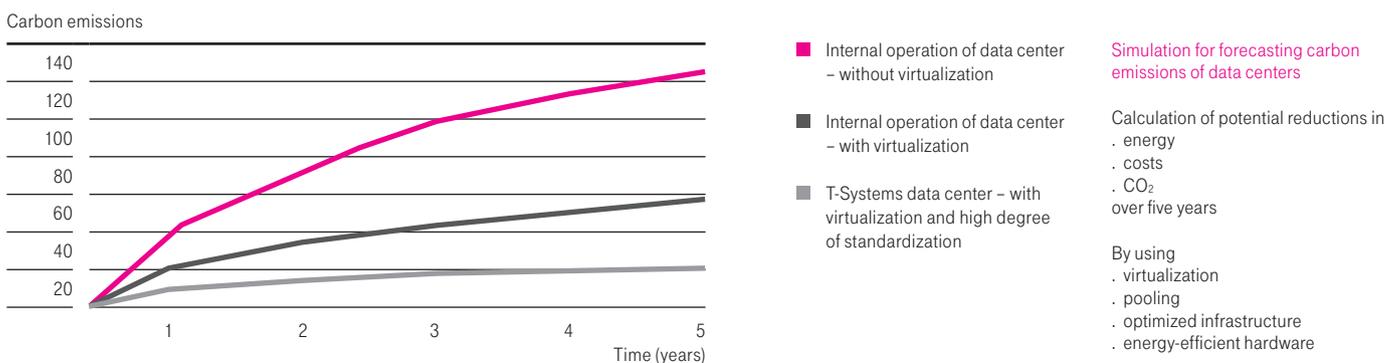
The test laboratory of approximately 70 square meters, which customers can visit to get an idea of, is equipped with 180 servers in eight racks and the latest energy, air-conditioning, measuring and control technology. Some 1,800 data points record values such as humidity, room temperature, temperature difference between inlet and outlet air, processor load and fan speed. In the double floor of the test laboratory, there is also a smoke

generator that makes air currents visible. The generated haze allows the direction and speed of air currents to be seen; this also enables engineers to identify circulation bypasses, and discover (air) leaks, especially in places that need to be hermetically sealed to prevent air-leakage. Above all, this should highlight potential for optimization in climate control (HVAC: heating, ventilation and air-conditioning), which accounts for approximately 30 per cent of energy consumption in data centers and which, according to the SMART 2020 report, holds considerable potential for emissions reductions.

In Datacenter 2020 too, however, the most important component is still the electricity meter - and the ambition to make it run as slowly as possible. In line with an open-source philosophy, T-Systems and Intel make their findings available to all market participants at www.datacenter2020.com.

Figure 2: Green-Dynamics-Modell*

The Green dynamics model is a simulation of ICT processes for forecasting carbon emissions in data centers over a period of five years. The existing structures can be compared.



* Based on the Business Dynamics Model, developed by Professor J. D. Sterman from the Massachusetts Institute of Technology (MIT)



Dematerialization.

Dematerialization is providing a service or carrying out a function without the use of materials. ICT can make a specific contribution here by replacing, for example, paper and plastic.

Products and services such as music CDs, business trips etc. can be replaced by low-carbon ICT-based applications. Deutsche Telekom also offers its customers superior solutions for all of the business concepts identified in the SMART 2020 study in the area of dematerialization, especially in teleworks, the most promising of business concepts in terms of reducing greenhouse gases.

Telework allows employees to do their work outside of the office building. Not only does this save up to 30 percent of operating and license costs, it also helps to reduce commuter traffic. Employees who can work from home do not have to travel to work every day, and as such reduce pollutant emissions from traffic as well as saving money by reducing their gas consumption. After all, some 20 percent of passenger traffic in Germany comprises journeys to and from the workplace, which by 2020 will account for around two percent of all emissions in Germany.

T-Systems' telework solution, introduced in 2009, enables customers to work simply, intuitively, securely and reliably while on the move. Employees use a special USB stick, called My Access Key, to access their desktop. They insert it into the USB port of any computer that has access to the internet. As nothing needs to be installed on this machine, no trace is left on the 'foreign' system after use.

A smartcard reader integrated into the key provides for a high level of security. Users insert their chip card and enter the associated password into the system. Only then do they have access to their desktop and their applications, which run entirely on the network. The more employees are given the opportunity to work from home and also take this opportunity,

the greater the reductions in emissions. By working from home for just one day a week, an employee with a daily commute of 40 kilometers in each direction would reduce his or her carbon emissions by up to 295 kilograms a year. A more than realistic target.

Tailored solutions for virtual meetings.

Deutsche Telekom's communications solutions work hand in hand with the concept of telework to create low carbon workstations for the future. Nowadays, teamwork and collaborations spanning the globe are commonplace, which often makes long-distance travel necessary for many more employees than was previously the case. Instead of collecting air miles, most of them could be scoring points at their desks. In the fixed network segment, T-Home offers value-added services for audio and data conferences that enable huge reductions in emissions. In 2007, for instance, carbon emissions were reduced by more than four million metric tons in this way.

Unified Communication and Collaboration allows real teamwork across all latitudes and company boundaries — in real time. Documents are worked on together at the same time; all the applications required are available on a single user interface as well as telephony, fax, e-mail, instant messaging and videoconferencing. And the environment benefits from up to 30 percent fewer business trips with the corresponding drop in carbon emissions, not to mention the cost savings.

1 x home office per week =

295 kg less CO₂ per year



T-Systems also offers virtual conferencing systems as individual solutions, especially for conference rooms. Here we offer all-in-one solutions of various sizes and specifications, which make long meetings interesting thanks to a user-friendly selection of technology. The high-end video conference solution „TelePresence“, with high-resolution HD video cameras and high-performance microphones gives participants the feeling of sitting in the same room together. Smaller services, such as workstation systems, room conferencing systems and transportable units provide solutions to specific on-site situations and individual requirements.

It is important, not just for its customers, but also for Deutsche Telekom itself to reduce travel activity, and thereby emissions, wherever reasonable and possible. The fact that these efforts pay off can be seen in the successful implementation of its video conference solutions, e. g., at T-Mobile. Some 3,000 employees benefit from the option of using conference solutions instead of having to make frequent trips, and the investment had paid off after just four months. Overall, the 40,000 or so video conferences carried out in the 24 months after they were introduced resulted in a reduction in carbon emissions of approximately 7,000 metric tons through avoided air travel.

Reduced paper consumption through special digital pen.

Another contribution to protecting the environment is the reduction in paper consumption. In addition, related costs are also reduced, such as for purchasing paper or for printing as well as for providing and maintaining the necessary equipment in a paper-based office or archives for storing paper documents. Even workflows which were previously entirely paper-

based can be made more ecological and efficient. This can be done, for example, with the innovative product Paper, Pen & Phone. This solution developed by T-Systems uses a special pen to record all the characteristics of handwriting via an integrated camera, thereby enabling digital recording and processing of documents written and signed by hand.

Compared to the former archiving process, paper consumption is thus reduced by up to 50 percent, and costs are reduced by as much as around 70 percent. In order to exploit this savings potential in our own Group as well, Deutsche Telekom launched Paper, Pen & Phone in February 2009 in its approximately 800 Telekom Shops across Germany. When writing, the pen creates a digital copy within the pen. The customer keeps the original, and the digital copy is sent via cell phone to a central server where it is archived: nothing is sent by mail, which means 50 percent less printed matter. Millions of agreements are recorded this way in Telekom Shops every year.

With Managed Document Services, companies can reduce their consumption of paper and energy by transferring all or part of their processes into a digital workflow. T-Systems provides the entire document management process – from digitizing through archiving to the dispatch of information by e-mail or letter post or for editing as a web page for the internet, and makes documents available in the archive to be retrieved electronically by all subsequent work steps. For example, all mail received by a company can be automatically scanned, typified and validated, so it can then be electronically forwarded as digital documents including attachments. But Managed Document Services also pick up electronic data from business applications. These can be billing systems like Siebel, Jupiter or Amdocs, or ERP solutions like SAP. This digital provision saves up to 90 percent of paper. The carbon emissions for the manufacturer and transport of this saved paper are also reduced accordingly.

50 % cut in paper consumption 70 % cut in costs

through Paper, Pen & Phone





Smart Grid.

New guidelines and laws aim to make society more aware of how it uses energy. For the medium term, they call for a paradigm shift from a central, passive electricity distribution network to a local active one (Smart Grid), which will fundamentally change the current structures and rules for electricity generation and distribution.

From 2010, electronic electricity meters (Smart Meters) and recording consumption information during the year will be made compulsory. From 2011, variable electricity rates will be introduced depending on peak loads and times, should this be technically feasible and economically reasonable. In addition, by 2020, the proportion of renewable energies (Renewable Energies Act) and the proportion accounted for by combined heat and power plants (Combined Heat and Power Generation Act) will be laid down in law. These new guidelines and laws form the basis on which synchronized ICT applications are set up to coordinate and control the Smart Grid and thus can go about reducing carbon emissions efficiently.

Corresponding ICT applications were identified and assessed in the SMART 2020 Germany Addendum. Advanced Smart Meters, e. g., Smart Meters which in addition to measuring consumption, also allow it to be controlled, provide an important starting point for further innovative business concepts.

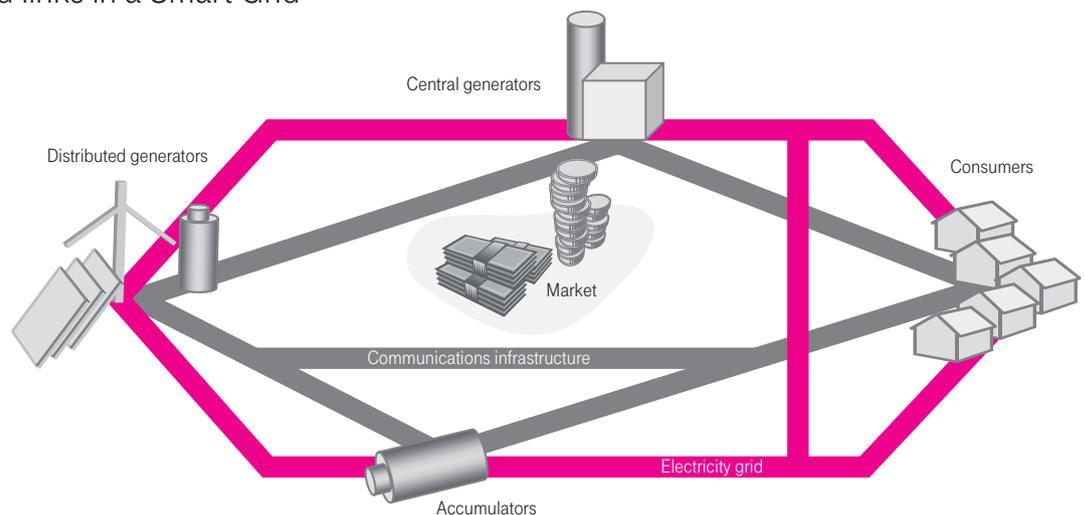
Multi Utility Servers for Smart Meters.

In order to be ready for the introduction of Smart Meters from 2010, Deutsche Telekom is already comprehensively testing its advanced

smart metering solution, the Multi Utility Server (MUS) in T-City in Friedrichshafen. In this pilot, more than 300 households have already been equipped with Smart Meters. They transmit the data via radio or DSL to the energy supplier or public utility – in the case of T-City, to Technische Werke Friedrichshafen. Software processes the information and makes it available to the household in a personalized internet portal – on request even in 15 minute intervals or in real time. Citizens can easily work out the energy consumption of all kinds of household appliances over the internet on their PC or smartphone. This will make personal consumption of electricity and gas much more transparent for users and thus easier to influence.

Energy providers can also make use of this transparency and apply it in real time to actively and efficiently regulate and manage the network. Peak loads can be leveled and network use can be adapted to individual demand, which would reduce investment costs. The available consumption data are required for pricing and designing various rate models, which can be used, for example, to adjust capacity utilization at peak times. Consumers also benefit from the new possibilities available to energy providers, since the resulting transparency will allow providers to ensure better security of supply and strengthen the quality of supply, even in the more complex network.

Figure 3: Components and links in a Smart Grid





Demand side management and virtual power stations.

The Multi Utility Server also provides a foundation for additional business concepts and solutions in the SMART 2020 environment, for example, for efficient demand side management. This covers all measures that are suitable for influencing end customers' electricity consumption by shifting it and reducing it at peak times. This can be done in two ways: the electricity provider introduces time-based rates that make electricity more expensive at peak times and thus motivate consumers to shift their consumption to cheaper times. Alternatively, electricity providers can directly access specially fitted out standardized household appliances and remotely switch them off during peak periods. Of course, this is only conceivable for appliances that can tolerate being temporarily switched off, for example, freezers. Participating households would be offered the incentive of cheaper electricity.

In addition to this, the MUS can control virtual power stations, i.e., networks of local electricity suppliers, energy accumulators and energy management systems. Virtual power stations and their ICT-based coordination and control are a basic requirement for the further expansion of renewable energies in Germany. They ensure that locally generated renewable energies are available at the right time in the right place and in the right volumes.

Because the measurement data on energy consumption are effectively available in real time, smart forecast mechanisms can be set up based on the current data. These forecasts can be provided within the Smart Grid and used to control the supply of renewable energy sources and the capacity utilization of balancing energy. This corresponds to the „Forecast services for the supply of renewable energies“ business concept from the SMART 2020 Germany Addendum.

Securing benefits from the experience of T-City.

So far, the experience of T-City suggests the following benefits for end customers and consumers of electricity:

- . The identification of energy guzzlers and the savings that could be achieved by getting rid of them.
- . The possibility of actively controlling their own personal consumption behavior.
- . The reduction of energy consumption and costs by being more aware and optimizing energy use.
- . Complete transparency of their personal contribution to climate protection.

In order to secure these benefits, T-Systems offers energy providers the following, among other things, as part of its service portfolio:

- . Installation and maintenance services for its smart metering solution, including MUSs. By connecting several meters to one MUS, synergies can be exploited.
- . Meter reading and control services, e. g., for electricity, gas and water. The data measured by the MUS are recorded, prepared and analyzed by the smart metering platform. Control signals can be sent to the household appliances via the platform based on recorded data or from the energy provider's customer systems. In this way, it is even possible to control a networked household and to enter the smart building sector of the SMART 2020 Germany Addendum. For this, the consumer can control all the appliances connected to the household network using software, according to usage patterns or energy saving criteria – in some cases fully automatically. In terms of recording and transferring data, economies of scale can be exploited if a large number of MUSs are connected to the smart metering platform.

The strengths of T-Systems.

In addition to experience gained from the pilot in T-City, T-Systems' strength lies primarily in the following points:

Speed

- By using existing, retrofitable technology, energy providers can better meet the needs of their customers and thus realize competitive advantages.
- Even local energy supply companies can be incorporated quickly and efficiently in the Smart Grid.

Flexibility

- Smart Grids make the network more intelligent, which allows for flexible „local distribution networks“ to be realized.
- Thanks to its flexibility, the open MUS can even be used for heating costs and sub-metering, the separate billing of e. g., gas costs, for industrial and business customers.
- Use of the smart metering platform can be retrofitted and is scalable.

Interactivity

- Creation of interactive access to home management systems that assume the smart control of household appliances (e. g., washing machines, freezers).
- A smart-metering platform provides an IT basis for two-way communication with local energy suppliers.

Efficiency

- Efficient use of resources by using economies of scale in the reading of many MUSs.
- Forecast precision is increasing, making efficient demand side management possible.
- Efficient incorporation of local energy suppliers.
- Smart metering enables synergies, thereby increasing efficiency, since MUSs also enable other meters, such as water meters, to be read.

T-City – A public future laboratory.

René Obermann, CEO of Deutsche Telekom, describes T-City in Friedrichshafen as „a public laboratory of the future with a particular radiance.“ The city, located on Lake Constance, was selected as the T-City in February 2007 from a total of 51 applicants. Friedrichshafen has joined forces with Deutsche Telekom to turn the world of tomorrow into a real experience as part of a globally unique partnership under the slogan „T-City Friedrichshafen. Living the future.“ It took Deutsche Telekom just a few months to equip the city with state-of-the-art broadband infrastructure in fixed network and mobile communications, which was completed by the end of 2007. T-City acts as a showcase and provides important impetus for economic and social developments as well as for modernizing the administration of other regions and municipalities in Germany and Europe. The individual projects and offers within T-City relate to various areas of life in the city and break down into six main project areas: „Learning and Research“, „Mobility and Transport“, „Tourism and Culture“, „Citizens and the State“, „Health and Support“, and „Business and Work“.



Smart Logistics.

The greatest potential for reductions in carbon emissions identified in the Germany Addendum of some 85 million metric tons lies in the smart logistics sector. This includes ICT business concepts for helping to reduce emissions caused by traffic.

ICT concepts for heavy goods vehicles (HGV) traffic optimize fleet management, and ensure improved utilization and fewer empty runs. Smart navigation systems are used for the collection and distribution of up-to-date traffic data and help drivers to avoid traffic jams.

Deutsche Telekom has already gained valuable experience using the ICT-based congestion toll, which was identified as having the largest savings effect in the SMART 2020 Study. Under Toll Collect, the world's largest satellite-based HGV toll system in Germany, the Company already offers proven-in-practice, reliable toll solutions. The expertise used here has since been pooled in our subsidiary Satellic Traffic Management, a company with which we are successfully making strategic investments in next generation and up and coming toll and traffic telematics solutions.

In addition to innovative, satellite-based toll solutions, there are also products for electronic tax discs, as well as new concepts for capacity management at cargo handling sites or an emissions modeling system (EMS). Solutions such as electronic tracking and tracing are automatically integrated into optimized logistics systems and are complemented by T-Systems' integrated telematics and logistics solutions. Such solutions are prime examples of the usefulness of the ICT approach. In addition to its technical expertise, T-Systems has access to a broad spectrum of industry knowledge from the relevant industry segments.

ICT-based road toll systems.

Due to the current political and public debate, reducing carbon emissions caused by transport is becoming increasingly important, which gives rise to challenges in optimizing logistics processes as well as in controlling and optimizing private traffic. This links with the European initiative to internalize external costs in the transport sector as well as with the occasionally substantial fiscal impact of European efforts toward freedom of movement and harmonization. More and more forwarding agencies, for example, register their vehicles in other countries or, like private persons living in border regions, only fill up with gas in countries with lower gas prices. Road toll systems could provide an answer to these challenges. They levy the costs of mobility directly and in accordance with use, and can have a much more targeted control effect on the traffic situation than the established financing elements (fuel and registration taxes) by using location- and

time-based pricing systems. At present, for HGVs, satellite-based recording systems are available, whereas the cheaper (but equally controllable) booking systems are generally discussed for cars.

Such systems require highly developed, automated ICT applications, which Satellic can already offer. The Satellic platform offers the ideal solution for implementing the measures envisaged and, thanks to its high degree of scalability and its ability to migrate between various recording methods, it offers maximum investment protection. In this way, it enables the efficient recording of toll charges and generates revenues for the state, while at the same time tangibly optimizing traffic flow control for road users and thus journey times, traffic emissions and traffic safety. But regions and municipalities can also benefit from the





technologies described. These days, municipal authorities struggle with overstretched budgets for construction and financing, which slow down the expansion of infrastructure in the cities and result in congested roads with rising emissions from exhaust fumes and higher noise levels. They also have to deal increasingly with the potentially massive consequences of law suits based on the German Federal Emission Control Act. The core challenges are improving quality of life and the flow of traffic and simultaneously reducing emissions, especially from pollutants and noise. This is the only way cities can achieve their goal of remaining attractive to inhabitants and companies and further enhancing their attractiveness.

With the innovative EMS, Satellic offers interest groups as well as affected road users a cost-effective system that records the space- and time-resolved emissions generated by individual vehicles without intruding into the vehicle, reports the emission levels to the driver, and conducts a central (anonymized) analysis. The EMS is therefore a useful addition to emissions simulations based on traffic models. Municipalities (or also fleet operators) can use the EMS as a method for drawing up a carbon card and take this as the basis for discussing further measures with all parties involved. For drivers, the direct feedback in the vehicle can be used as a basis for optimizing their driving behavior. On the basis of emissions cards, an urban or city toll can be part of an integrated traffic management approach, with which municipalities can overcome the challenges listed above.

The introduction of tolls in cities or urban areas also enables

- . the originators of traffic emissions to be pinpointed and charged for the emissions they produce in a city by driving through it,
- . control of the flow of traffic as part of integrated traffic management, based on predefined targets such as preventing emissions hotspots,
- . the expansion, improvement and increase in attractiveness of public transport by targeting use of the additional revenues,
- . investments in expanding bypasses.

A key issue in smart logistics and in toll collection systems is what the recorded data is used for. Careful compliance with data protection

regulations is not only required by law (European Data Protection Directive), it also substantially increases the acceptance of toll and logistics systems. Requirements can vary hugely, depending on local circumstances and laws. In Germany, personal data can only be stored, edited and used if (among other things) the principle of data avoidance and data economy is complied with. This principle relates to a data protection concept under which only as much personal data can be gathered as is absolutely necessary for a specific use (e. g., for toll collection).

This principle is deeply anchored in Satellic's toll solutions. For example, when checking bookings, data is reconciled by cameras directly on site. Data such as number plate recordings are only stored if there is a violation of toll regulations. In the case of the satellite-based toll system, no movement profiles are transmitted to the control center, rather aggregated data per rate class and per predefined period are transmitted from an on-board unit (OBU). Only the user has complete transparency by viewing the data on the OBU; proof of individual journeys which can be attached to the bills are an option. This principle can similarly be applied to telephone billing.

Optimization of logistical processes.

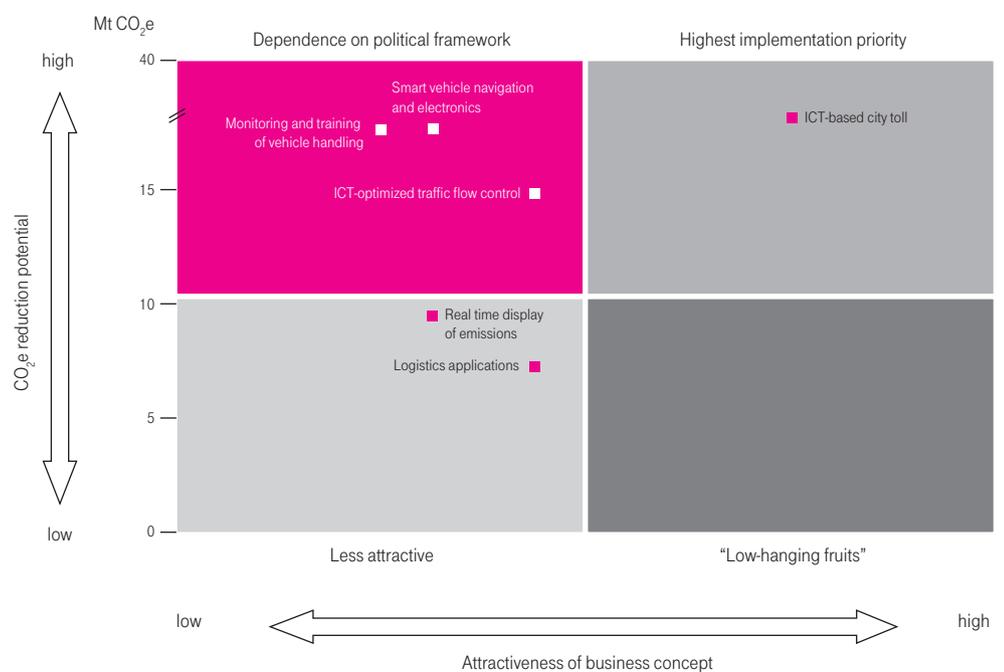
In addition to toll collection systems, information systems can make a significant contribution to optimizing traffic and logistics processes. The efficiency of cargo handling sites is crucial for the overall efficiency of logistical chains and is therefore a major competitive factor. Disruptions at cargo handling sites (e. g., holdups on arrival and departure and overloading of handling areas like ramps and parking spaces) result in disproportionately high follow-up costs. The directly associated disruptions in freight traffic have increased pollution from goods vehicles that are waiting or causing holdups as a consequence.

In order to optimize delivery and collection at cargo handling sites, T-Systems and Satellic offer further logistics applications such as capacity management. In its most simple form, this is a booking and information system, in which all parties realize the utilization of critical resources (parking spaces, ramps) in the future and can purchase tickets accordingly. (The charge depends on demand and does not necessarily have to be monetary in nature.) The capacities of public access roads can also be taken into account. Optional extras can include feeding booking, tracking and tracing

data into a capacity model and identifying bottlenecks in real time, as well as initiating alternative routes or requests to park goods vehicles en route to the cargo handling site, so as to avoid holdups at the entrance. Peak loads can be spread out and avoided through sanctions or incentives for drivers, bottlenecks can be bypassed. T-Systems also helps to optimize logistics processes with innovative vehicle telematics solutions that are already in use today. By electronically tracking and tracing goods wagons or trailers in HGV traffic, operating processes can be optimized, thereby saving time,

costs and emissions. The vehicle equipment used for this purpose can additionally measure vehicle and cargo-specific values (e. g., temperature, state of the brakes, door contacts) and thus improve the quality and safety of the logistics process, also for the drivers involved in the process. Other fields of application for the described technologies with direct public benefits would be, for example, administrating (registration, billing), monitoring and documenting transportation of hazardous materials and live animals at national or European level.

Figure 4: Classification of business concepts from smart logistics according to CO₂e reduction potential and attractiveness of the business concept



Integrated all-in-one solutions from a single source.

As a toll and telematics specialist, Satellic develops its customers' portfolios in the mobility segment, offering comprehensive, fully integrated, all-in-one solutions from a single source with recourse to the expertise of T-Systems. These solutions include the entire range of possible processes and technologies, such as the Global Naviga-

tion Satellite System (GNSS), dedicated short range communication (DSRC), and booking solutions, as well as the related complex back-end systems. Satellic covers all the relevant areas, from planning, design and implementation through to actual operation. For the implementation of toll systems and environment-specific telematics solutions, such as emissions modeling, Satellic supports its customers in an advisory capacity right from the start. Satellic helps customers to select the right technology to meet their specific requirements and local circumstances.

Satellic distinguishes itself from the competition in the following ways:

- . Offers planning, development, implementation and operation of a new toll system or migration of existing toll systems from a single source.
- . Extensive experience in developing integrated business processes in toll systems and incorporating value-added telematics services based on a platform approach.
- . Unrivalled experience in use of GNSS.
- . High degree of scalability in projects and products thanks to integration with T-Systems.
- . Independence in terms of the technologies used.



Toll Collect.

Precise billing according to use





Toll technologies.

Nationwide, regional or urban congestion charge solutions can be designed according to different billing schemes. Toll charges can be levied along sections, e. g., bridges or within certain regional boundaries or depending on distance traveled, time of day or length of journey/stay. Charges can also be differentiated according to vehicle types or emission classes. It is also possible to integrate parking space management.

Charging can be efficiently implemented in the respective scheme using three base technologies:

- Booking systems operated by Automatic Number Plate Recognition (ANPR). Here, users book a ticket by giving the number plate of their vehicle either shortly before entering or after a certain period. Using small, inconspicuous roadside cameras or handheld cameras for stationary traffic, the number plates of the vehicles are checked on a sample basis to identify violations. Specialized technology minimizes the sighting data on compliant vehicles which can be accessed centrally, and as such ensures maximum data privacy. The vehicles do not have to be fitted with equipment or paper tax discs since bookings are administrated centrally. This technology is suitable for permanent toll zones of varying sizes and can produce appreciable traffic controlling effects through variable time and location-based rates. This kind of booking system can also be used for nationwide electronic car tax discs.
- Dedicated short range communication (DSRC). Here, vehicles are fitted with tags that communicate in real time with the installed roadside

infrastructure, so-called beacons, which record the tags for toll collection. The technology is particularly suitable in limited areas, but must be treated as critical from a data privacy perspective since all vehicle sightings have to be processed centrally.

- Global Navigation Satellite System With Cellular Network (GNSS/CN) is Satellic's most extensive solution. In this system, toll collection is a fully automated process ensured by an on-board unit. The OBU determines the vehicle's current position via satellite signal, plots this on a digital map stored in the OBU, and calculates the toll charge incurred using a rates model. This technology is marked by a high degree of user transparency (the OBU can directly display toll events) as well as maximum data privacy. The individual results are aggregated on the OBU by rate class so that as little information as possible is sent to the control center, which is therefore unable to draw up detailed movement profiles. GNSS/CN is particularly suited to large, complex areas with lots of entry and exit points. No additional infrastructure is needed on the roads for actually detecting and transmitting toll events. In addition, the OBUs installed in the vehicles can also anonymously record traffic density and thus transmit relevant real time information via the mobile network to traffic control centers. Within the scope of the traffic models available there, and existing dynamic navigation, alternative routes can be offered to avoid hold-ups – one of the most effective methods for reducing emissions. The traffic loads determined are also suitable in historical terms for infrastructure planning (route maps) and for analyzing traffic-influencing measures or extraordinary events. The introduction of a GNSS toll therefore quickly emerges as an efficient way to protect the environment.



Toll Collect.

The satellite-based toll system Toll Collect has proven itself in everyday practice and also helps to protect the environment. Since toll collection began five years ago, the proportion of modern HGVs of more than 12 mt with low-emission exhaust technology has risen sharply. While the proportion of total traffic accounted for by the lowest emission vehicles from the S5 and EEV classes did not even account for one percent in 2005, this figure had reached about 40 percent by the end of October 2009. The system records and calculates the toll for HGVs with a permissible total weight of more than 12 mt on the entire free-way network and selected highways. The amount of this toll is measured on the basis of the distance traveled, the emission class and the number of axles. The vehicles are fitted with an on-board unit which can determine the position of the HGV using GPS satellites and compare this with the pre-installed toll road data. The OBU calculates the toll due based on the emission class and number of axles. The toll amount to be paid is transferred at regular intervals with a time-lag via mobile networks to the central Toll Collect data center. From there, the transport companies receive a monthly toll statement. These processes are subject to strict data protection and safety requirements. The data collected can only be used for toll-related purposes.



Summary.

The examples in this brochure from Deutsche Telekom's product portfolio clearly illustrate how serious Deutsche Telekom is about pursuing the „low carbon society“ field of activity set out in its Corporate Responsibility strategy.

The market success of its commitment to resource-efficient and environmentally friendly customer solutions gives Deutsche Telekom the necessary encouragement for continuing its efforts.

- . The implementation of a digitization solution for records and business transactions at a German pension insurance fund reduced their dispatch volume by more than 90 percent. This helped to lower paper consumption and the traffic emissions associated with the dispatch.
- . Using a telematics solution developed together with a manufacturer of heavy goods vehicles reduced diesel consumption by approximately 2,000 liters per HGV per year.
- . Thanks to the development and implementation of an electronic workflow and archiving solution for incoming invoices at a German automotive group, up to 150 mt of paper a year could be saved, thereby reducing transport distances for dispatch by approximately 800,000 kilometers overall.

By identifying ICT applications and the associated potential reductions, the SMART 2020 Study Germany Addendum laid down a considerable foundation for realizing the potential of ICT for reducing greenhouse gas emissions. Many of these solutions have already been integrated into our portfolio or are currently being trialed in pilot projects. Deutsche Telekom will systematically develop these solutions further so that it can provide its customers with the best and greenest possible benefits. By offering the solutions, however, it has only taken the first step toward leveraging the potential for reducing carbon emissions. Only when the solutions are actively used, we will begin to see a sustainable impact on our environment, and in all our lives.

Publishing information.

As at 05/10
Deutsche Telekom AG
Corporate Communications/Corporate Responsibility
PO Box 2000
D-53105 Bonn, Germany
www.telekom.com

Project management.

Luis Neves, Dr. Ignacio Campino
Telephone: +800 07381220
E-mail: corporate.responsibility@telekom.de

KNr. 642 200 192

Editorial office.

Deutsche Telekom AG

Design.

Deutsche Telekom AG, Ketchum Pleon GmbH, Bonn

Pictures.

Deutsche Telekom AG, Fotolia, Getty Images, iStockphoto,
plainpicture, Shotshop GmbH, Toll Collect

Printing.

Broermann Offset-Druck GmbH





Mixed Sources

Product group from well-managed
forests and other controlled sources
www.fsc.org Cert no. GFA-COC-001484
© 1996 Forest Stewardship Council

Life is for sharing.

