Everything in order?

New ways to master traffic chaos

Here speaks the future
Cooperative systems demonstrate their potential
“Does traffic ‘by nature’ tend to chaos or does it ultimately follow stochastic rules?”
Dear Reader,

In real life, transport professionals like us are working hard to prevent traffic chaos – but in the virtual world, the Web community deliberately jumps right in the middle of the biggest mayhem. On game portals such as funnygames.eu or GangOfGames.com, for example, the goal is to pilot taxis or delivery vans undamaged through the ant heap of urban traffic, dodge daring virtual pedestrians and take care to avoid the radar eye of law enforcement when committing one of those not-quite-legal maneuvers that make the game exciting.

But of course, when game theory scientists like the German Nobel prize winner Professor Dr. Dr. Reinhard Selten are investigating the game aspects of traffic, they are looking for something else than simple fun. In experimental studies, the interviewee of this issue of the ITS magazine tried to find out more about the fundamental principles governing the complex system of road traffic. Does traffic really tend "by nature" to deterministic chaos, as many traffic scientists think, or does it ultimately follow certain stochastic rules? Does the traffic load on a set of alternative routes reach a state of equilibrium at some point, and if so, at which level?

An additional question that the highly renowned researcher wanted to answer with his experiments was: What role does the quality of the information that the individual road users can draw on for their choice of route play in the quality of their decisions? And while I don’t want to spoil your reading experience, I can reveal that much about the interview’s conclusions: Information quality is a quite decisive factor.

But game theory can of course not tell us how to generate and efficiently use the high-quality information needed. This is why this question is looked into on other pages in this issue, for instance in connection with the competition among various technologies for dominance in the area of traffic monitoring. In the past, as you know, traffic monitoring was almost exclusively based on presence information provided by induction loops buried in the road surface. Today, we have a whole range of alternative "master detectives" who use much more innovative methods to capture the desired data.

As always, I wish you good reading.

Kind regards

Hauke Jürgensen
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“Traffic is not a zero-sum game”
Interview ■ Professor Dr. Dr. Reinhard Selten, pioneer of mathematical game theory and so far the only German Nobel laureate in economics, talks about his experimental studies on the behavior of road users, the state of equilibrium in chaotic and stochastic systems and the impact of additional information on the quality of individual decisions.
Professor Selten, you are known as the 1994 Nobel Prize winner in economics, awarded for your work in the field of game theory. Many years later, in cooperation with the congestion researcher Professor Michael Schreckenberg, you were investigating the behavior of motorists. Is road traffic a game? From the point of view of the public, the answer would probably be no, but game theory considers it as such. According to our definition a game is a mathematical model of an interaction situation involving conflict and/or cooperation. In traffic, such situations happen all the time. In our experiments, the players were the motorists. They all wanted to get from A to B as quickly as possible and they all had the same options available to them, in other words the same road network, in our case one main and one secondary route.

Does this mean that the road users who cover their route in a certain time have won – while the ones stuck in the jam have lost? We have to be careful with the terms ‘winning’ and ‘losing’ in this context, because traffic is not a zero-sum game, of course: The sum of all road users’ profit and loss does not necessarily have to equal zero. Theoretically there might be only winners and not one single loser – or in the most unfavorable case, the other way around.

Are you talking about real traffic or the setting for your experiments? Both. In our experimental studies the gamers have precisely two options for getting from A to B: using a main road or taking a secondary route. Before each period of the game, participants were allowed to make a fresh choice of which route they would take. The speed at which they traveled was to some extent dependent on the characteristics of the two routes, but above all on the total number of players who had opted for the respective route. For calculation purposes there were two different formulae: for the main road, 6 times the number of users; for the secondary route, 12 times the number of users. The products of the multiplication represented the individual journey times on the respective routes and were deducted from a predefined constant value, with the remaining amounts paid out to the players.

Paid out? So the subjects could actually win money? Yes, of course. This is common usage in game theory studies – as a means of maximizing the motivation of the participants. In fact the payouts to the players represent significant costs when budgeting for such projects because we have to play a great many periods to get the most precise results possible.

So did the insights of modern game theory lead to an expectation of certain results from your experiments or was the outcome completely open? There are nearly always certain expectations when carrying out these studies. But there are also frequent surprises, which is what makes science so exciting. In this case we thought that a state of equilibrium would set in after a large number of periods and that the participants would continue to play only around the level of that equilibrium.

“In traffic, the sum of profit and loss does not have to equal zero”

Is this the Nash Equilibrium, named after the US mathematician John F. Nash, who shared the Nobel Prize with you?

Quite right. The Nash Equilibrium describes a situation in which no player can achieve a benefit for himself by unilaterally deviating from his strategy. So put simply in our case: a situation in which both routes are equally fast between A and B. This balance was in fact reached, but all the same there were a number of phenomena that surprised us.

For instance? For instance, we had not counted on the presence of so many states of equilibrium in our abstract traffic system – and at quite different levels. Ultimately none of them was as stable as is predicted by the pure doctrine of game theory. Even with a state of equilibrium reached, there remained permanent fluctuations. No major swings, that’s true, but it was clear to see that the players were still trying to improve their scores when according to the book it was already impossible to do so.

What does this result mean for the efforts at optimizing the real-life traffic flows on our highways? Before drawing any concrete conclusions it’s important to make one thing clear: We were not investigating traffic but rather the behavior of people in similar situations. Nevertheless we did
gain an important insight into real decision-making processes, namely that there are limits to the predictions that can be made about how traffic streams will be distributed as long as you have no external impact on them.

So by its nature, does traffic have a tendency towards deterministic chaos, as some of your research colleagues believe?

In all honesty, I’m not so sure whether traffic by its nature has a tendency towards anything. To my mind the term “deterministic chaos” in this context is somewhat misleading. To me it seems more illuminating to model traffic as a stochastic system, similar to the movement of particles in fluids or gases. The fact is that in the traffic field there is a so-called attractor, in other words a set of conditions that is repeatedly

“I’m not sure whether traffic by its nature has a tendency towards anything”
they have an impact on the quality of the individual drivers’ decisions because they enable the recipients to tailor their strategy accordingly.

You have also investigated the strategies employed by road users when, for instance, they are alerted by the traffic message channel to the presence of congestion on certain routes. What were the results?

According to their behavior, motorists essentially fall into three groups: the sensitive, the gamblers and the conservatives. 44 percent of subjects responded very directly to congestion reports and immediately changed their routes; 14 percent began to think tactically attained. Experiments seem to be unable to clarify beyond any doubt whether the issue is one of deterministic chaos or a stochastic system in which the instantaneous condition produces a distribution of probabilities for the subsequent conditions.

Perhaps the motion of the traffic flows could be predicted with more precision if individual participants were briefed with outside information?

Of course we have investigated the impact of such a measure too. In a subset of the experiments, after completion of each period, participants were told the resulting travel times on both routes; in the other subset, they were informed only about their own travel time. The effect was clearly measurable: Those who were better informed experienced less of an impulse to try anything different – so throughout the experiment they swapped routes less often. And with this strategy they were more successful, as the results show.

With all due caution when applying experimental findings to real-world situations, could we infer from this that more traffic information would help in distributing the demand better over the road infrastructure? In my eyes this is less a matter of quantity and much more one of quality. Poor-quality information is generally either ignored – or else sooner or later it is exposed as a source of disruption because some actors nevertheless continue to trust it and throw everything into confusion. However, high-quality route recommendations can actually assist in optimizing the system of traffic flows – even when they are not strictly followed. Even in those cases they have an impact on the quality of the individual drivers’ decisions because they enable the recipients to tailor their strategy accordingly.

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and deliberately drove to the spot where the hold-ups were expected – in the hope that the forecast would scare off so many other drivers that the road would be clear by the time they arrived. That leaves the 42 percent of conservatives who paid no attention whatsoever to the traffic information and simply remained on the route they had originally planned. There was a sub-group of 1.5 percent of so-called stoics who simply always took the same route, regardless of what was going on around them. And in our study it was this imperturbable group who were the quickest by some margin.

So motorists are evidently always good for delivering a surprise. We only need look at the so-called Braess paradox, whose outcome is that far from relieving the stress on the network, the construction of additional roads increases the traffic load. Is that mere drab theory or real-world Technicolor experience? This paradox has indeed been observed to exist in the real world: Once in Sydney, if I recall correctly, and also in the opposite sense in Frankfurt am Main where, after a bridge closure, it became clear that contrary to expectation, traffic was suddenly flowing more freely than before. Mathematically the explanation is relatively complicated, but believe me, it can be calculated.

Your current research deals with bounded rationality. Are there points of similarity with traffic – in particular given the fact that relevant studies have proved that especially on familiar routes, many drivers are not fully switched on to the task of driving, but rather tend to be in autopilot mode? My project entitled “Rationality in the light of experimental economic research” primarily deals with emotional components in the areas of goal setting, aspiration balancing, qualitative reasoning, case-based decision making and inner conflicts in strategic economic choices that are basically supposed to be rational. In that respect my concrete work has little to do with traffic at the moment. However, the starting point of our treatment of the topic presents quite clear parallels: Bounded rationality has a role to play even in traffic, especially in cases where motorists find themselves in a hazardous situation which they are unable to grasp in its complexity.

So we are moving away from talking about traffic flow and towards a discussion on road safety? We are talking about circumstances in general that would require unlimited powers of thought and calculation to make a perfect analysis – and in the case of traffic in particular, about situations in which a decision must be made in the shortest imaginable time despite the impossibility of a thorough analysis. And when the quality of the necessarily spontaneous choice of options is examined and compared with the well-considered selection after the event, the results are startling.

“In hazardous situations spontaneous decisions are often better than considered ones”

Let me guess: The heart beats the head? For the most part that is spot on. There have been numerous investigations on this topic in widely differing areas of life. And apart from a few exceptions, the instantaneous decisions actually do prove to be superior.

How can that be explained? In fact it’s quite simple. Because human beings just do not have unlimited powers of thought and evaluation, there are two decision systems within our brains – one intuitive and one rational. In situations that we can still comprehend analytically we use the rational system. But when things become too complex, the intuitive system springs into action: In fractions of a second it links all our knowledge and all our experiences with the task at hand and selects the course of action that seems to promise the greatest success.

To begin with you said that game theory investigates interactions in conflict and cooperation. Which of the two configurations, do you think, figures more frequently in road traffic? It’s clear that the proportions of conflict and cooperation may widely differ depending on which region of the world is being looked at. In southern Italy for example, where a red traffic signal receives scant attention, it seems at first sight that there is a big potential for conflict. But it is precisely because of this that drivers there have to take careful notice of what others are doing. One of the most widely used strategies is probably simply to muddle through somehow. And, after all, even that is a form of cooperation.

Professor Selten, thank you very much for talking to us.

Curriculum vitae

Professor Dr. Dr. h. c. mult. Reinhard Selten was born in Wroclaw in 1930. Following his studies of mathematics in Frankfurt, he earned a doctorate in 1961. He worked as full university professor in Berlin and Bielefeld before being offered a professorship at the University of Bonn in 1984, where he founded the Laboratory for Experimental Economics. He is the first and to date the only German scientist to have received the Nobel Memorial Prize in Economic Sciences, shared with John F. Nash und John C. Harsanyi in 1994. Today he is director of the academic center “Rationality in the Light of Experimental Economics” at Bonn University.
Untangling the chaos

Traffic detection and control

From chaos to cosmos: No one has described the state of utter confusion and that of a perfect world order better than the ancient Greeks. To replace one with the other in the world of transport, a number of innovative monitoring and control technologies are available today. With their help, the chaos on our streets can actually be organized.
Theoretically, Albert Einstein brought a clearer structure to our understanding of space and time, but in practice he argued for the opposite. For decades, his legendary words have been smugly repeated in millions of untidy workplaces and children's bedrooms: "Only the stupid need organization, the genius controls the chaos." But that, just like his other famous ideas, is entirely relative.

For whatever degree of disorder its advocates may tolerate on their desks or in play areas, there is certainly no one who wishes for such chaos in other areas of life. For example, authorities and users alike are worried by the view of some researchers that transport systems, despite a dense mesh of rules and regulations, tend towards a so-called 'deterministic chaos'. For the individual, it may just be annoying when his automobile becomes a no-go-mobile – but for a mobile society, it gradually adds up to an economic and environmental disaster.

In the industrialized countries alone, the economic losses caused by road congestion are currently estimated to amount to €620 billion, a sum which, had it represented a country's nominal gross domestic product, would have been enough to give it a top 20 place in the GDP rankings in 2011. And the environment suffers too. It is well known that congestion forces motorists to consume more fuel in stop-and-go mode and thus – depending on the type of pollutant – to create up to 50 percent more emissions than at constant speeds.

In order to be able to channel the growing tendency to chaos on the streets in the face of a rising demand for mobility, the first step is to understand it more fully. Whether traffic controllers or computers, traffic engineering or management systems, modern tools are particularly efficient if they are fed with data that is as accurate as possible regarding vehicle frequency at location X at Y seconds. In the past, such presence information was provided almost exclusively by inductive loops, which need to be recessed in the road surface. Meanwhile, besides inductive loops, there is a whole new set of master detectives that are using innovative technologies to monitor traffic.

New master detectives use new technologies for traffic data recording

Although the induction method still offers advantages in terms of accuracy and reliability (see interview on page 30: "Race of technologies"), the newcomers are on the rise right across the world. This is mainly because they have a longer service life, are much cheaper to install and maintain and often provide even more sophisticated functions. As they are only triggered if the vehicle drives in the correct direction, they prevent for example, any misinformation due to drivers that don't keep exactly to their lane. Around 20 years ago, the first devices operating on the basis of new technologies came on the market. They have been considered to be viable alternatives for about ten years now.

The reliability of the induction loop is approached by the current generation of radar detectors, which also score with their high degree of flexibility. The Heimdall family of devices can, depending on the model, monitor vehicles, pedestrians and traffic data and provide information to the controller. The most cost-effective option for detection at larger traffic intersections has been proven to be video systems. In extremely unfavorable situations in the detection zone, however, they can sometimes be fooled by the shadows of moving branches, and are therefore not suitable for every application.

The innovative Sitraffic Wimag magnetic field detector is providing traffic planners with a very welcome new freedom of choice. Thanks to
wireless communications, the system works without any cables and can be installed within minutes. Furthermore, the distance of the detector from the controller plays as little a role as the type of road surface. The installation site can thus be selected based purely on traffic-engineering criteria, without being restricted by cost considerations. Overhead detectors based on infrared light have found their place in the international market, especially as low-power systems. For example, the successful Traffic Eye Universal gets its power from a solar panel, buffered by a battery, which can continue working for up to four weeks without sunlight.

A quantum leap over the local detection devices has been achieved by travel time measurement technologies. These can even deliver section-related information, which is especially useful for the further optimization of complex traffic management systems. In the past, such information required the extrapolation of selective measurements using estimation methods and models. Possible inaccuracies in the representation of reality could not, of course, be ruled out. This long way round can now be avoided thanks to some new high-tech solutions. They collect the desired data immediately, permitting a much more accurate calculation of congestion levels and traffic disruptions.

Bluetooth scanners are one such new technology: They read the Bluetooth IDs of the wireless devices that today are present in many vehicles, and are able to re-identify the devices accurately at other scanning stations. Since installing these scanners is fast and easy, they are suited also for mobile use, for instance at road works sites or on temporary diversion routes. Another option for collecting section-related information is the Sitraffic Wimag magnetic field detector: It measures the magnetic signatures, which vary from one vehicle to vehicle. Thanks to its good vehicle re-identification capability, the detector is ideally suited for measuring travel time – especially on sections that are only a few kilometers in length and have a small or medium number of access and exit events.

For all systems that require high-quality data – such as systems covering longer road stretches with many access or exit events – automatic number plate recognition (ANPR) is an option, for instance using the Sicore
An intelligence offensive has taken place, also with respect to traffic optimization

In recent years, a real intelligence offensive has taken place, not only in monitoring, but also in the subsequent use of high-quality data for the optimization of traffic flows. For urban traffic control, for example, this began with local traffic-actuated traffic signal switching, continued in the form of time-controlled coordinated green phases, and reached its peak with adaptive network control, which is considered to be the smartest answer to congestion and emissions. As a model-based control system, Sitrtraffic Motion MX does not cater for just one intersection, but for the dynamically coordinated green phases of an entire road network.

In a scientifically designed practice test carried out in Münster, the performance index, which assesses the situation for all road users, was improved by up to a third along the model axis. Similarly, innovative technologies are opening up more and more design options also for region- and nationwide systems. Motorway control centers such as Sitrtraffic Conduct+ use current measurement data for informed decisions on situation-specific measures to harmonize traffic. And traffic management systems stabilize, guide and separate traffic flows with the help of an extensive range of effective tools. These include modern variable direction signs and dynamic information panels, ramp metering or the temporary release of the hard shoulder.

A real milestone on the way to the future of mobility was the implementation of complex traffic management and information systems that, thanks to extensive, fully integrated solutions, provide for the networking of all modes of transport. Using a high-quality data mix that precisely reflects the current situation on the roads and railways, they calculate quick updates on the overall traffic situation and come up with recommendations for choosing the right means of transport and the best route. By simulation, it is even possible to predict how the situation will continue to develop, with a fairly high accuracy rate.

A holistic view of traffic places increased demands on the ability to integrate the various systems. But innovative technology can meet these demands as well. So, for example, a new central platform brings together the previously separate worlds of traffic management, traffic control and parking guidance. The modules use the same database and can be combined as required to enable individual solutions because the modular concepts makes them highly flexible and applicable to the widest variety of scenarios.

Modern methods of data fusion, for instance as part of urban air quality planning, make it even possible to take account of the current environmental situation when initiating appropriate control measures. For this purpose, specific emission, immission and propagation models that have been integrated into the traffic management systems calculate a complete overview of the current levels of air pollution in the urban area, including, of course, the transport-related proportion. On this basis, they can then initiate precisely tailored traffic measures such as specific traffic light switching routines that are optimized for low emissions, or so-called access metering.

Overall, Albert Einstein’s above quoted saying is relatively wrong with regard to traffic: Whether chaos can be controlled does indeed have something to do with intelligence – but in this case with technological intelligence, that for once, can create order out of chaos.
Here speaks the future

Car2X-Communication ■ Until recently, it was the basic researchers who were running with the baton. Now the product developers are taking it on. Roland Wunder, Product Manager for Innovation Technology in Cooperative Systems at Siemens, is convinced that it will soon be common practice that cars talk both to each other and with the roads as well. His experiences at the ‘Testfeld Telematik’ in Vienna have only served to confirm his views.
“Get ready,” says the traffic light, “the green light will follow shortly.” Its voice is actually quite friendly, and the timing is perfect: There is just enough time to engage gear and let the clutch out – and the journey can continue. Shortly after, the traffic control computer reports in, saying: “Coordinated green phases if you drive at 50 kilometers per hour.” And later, on the freeway, a warning arrives from another car. Earlier, in a blind bend some 100 meters further on, the other car had been involved in an accident and it has now come to rest, unable to move, across the fast lane.

20 years ago all of this was still science fiction. Five years ago it was mostly still science. Today, the vision of cooperation between the hitherto largely autonomous subsystems that exist in vehicles, the road infrastructure and traffic management centers is ready to make the leap into reality. In other words, research into the technological fundamentals is almost complete, and the next phase on the agenda is the development of specific products and solutions.

In order to make a significant step forward, the ‘Testfeld Telematik’ (ITS testing field) has been installed in time for the ITS World Congress 2012 in Vienna. The ‘Testfeld’ is a route of approximately 45 kilometers that covers the A2/A23/A4-S1 freeway interchange and links into the public transport system. Here, around 150 sensors and more than 150 cameras are continuously collecting data on the latest situation on the roads – the traffic flow and any hindrances, and also weather, because ice, rain and fog often have a tremendously adverse effect on the traffic.

At the ITS World Congress, visitors were able to experience first-hand how intelligent vehicles can inform other drivers of potential dangers via radio communication – for example, if conditions make other road users or vehicles difficult to see, or they are in the blind spot. But it is not only in the area of safety that the real-time data exchange via cooperative systems brings significant enhancements. It also offers benefits in terms of efficiency and the reduced environmental impact of the transport system. The overall effect of up-to-the-minute warnings of road works, micro-routing tips and recommendations for intermodal changes, including information regarding Park & Ride space availability, is going to speed up traffic flow and reduce emissions.

Cooperative systems also promise a real plus in the prioritization of public transport, as demonstrated by a special Siemens showcase in Vienna. Bus drivers can log into an intersection while the bus is still at the bus stop and obtain information immediately as to when the nearest traffic light is going to turn green. This allows them to decide with certainty if there is still time to take on more passengers or not. One of the public transport test drivers was so impressed with the system from the start that he asked, there and then: “When can I have it?”

For mobile society to be able to enjoy the benefits of cooperative systems as soon as possible, not only the technological components, but also the stakeholders themselves must work closely together. Also in this respect, the system in Vienna proved to carry out some real field testing: In the Austrian capital, over a period of around one and a half years, car manufacturers and suppliers of onboard units and infrastructure are working with Asfinag, the Austrian motorway operator, all partners providing their specific know-how towards the clearly defined common goal of exploring the options for effective and economically sustainable applications.

The responsibility for equipping the selected routes with roadside units, developing on-board units and providing support to project management at the Testfeld Telematik lies with Siemens Corporate Technology, the global research unit of the company. The current prototypes will later be integrated into the overall infrastructure of the metropolitan area of the Danube. The transfer should be relatively smooth, because even today, the investigations are not taking place in insular laboratory conditions, but rather in real life settings. At the moment that involves 25 vehicles, equipped with Car2X technology, being a part of normal traffic. The test fleet will soon be increased to 100 cars.

For experts, a popular topic of discussion for many years has been the percentage of vehicles that need to be equipped in order for the widespread introduction of cooperative systems to make sense. Until now, no one has been able to arrive at an exact percentage. For this reason, and especially in the initial phase, it is expected that the efficiency of individual projects will be the primary objective – a more complex system will, after a time, emerge all by itself. Here is an example: When more and more traffic lights are transmitting the green light periods for blind pedestrians, they can send this information to vehicles as well, thus contributing to the provision of a more complete picture of the current traffic situation.

For the leading automobile manufacturers, there is no doubt that cooperative systems will very soon lead to traffic optimization. A long time ago they joined forces in the so-called “Car 2 Car Communication Consortium” and decided that from the year 2015/16, all new premium cars will be equipped with the necessary technology. And Car2X is no longer a foreign word for the transport authorities in the municipalities either. The reaction to the showcases at this year’s ITS World Congress in Vienna demonstrated that municipal decision makers have long since realized the great opportunities the technology offers – not least because, in the long run, cooperative systems help them make even more effective and flexible use of their investment in road infrastructure.
Cloud navigation ■ Proactive, not reactive: The route calculations of conventional navigation systems include only those traffic obstructions that have already been reported. Now some German students of computer science have developed a routing algorithm that is able to detect traffic jams in the making and, in the ideal case, prevent them. At the world finals competition of the Microsoft Imagine Cup 2012, their project won two of the coveted sponsorship awards, earning the winners generous prize money.

The idea to use the wisdom of the crowd to balance traffic load was born over a frothy Latte Macchiato: What if we could ask a maximum number of drivers about their starting point and their destination and then distribute them evenly over different routes in the road network so that they wouldn’t get in each other’s way? That was the basic idea that occurred to Christian Brüggemann and Julian Nitescu, when enjoying their Latte in a café at a London street corner. Their source of inspiration: Of the two streets that they could watch, one was completely congested, the other was totally empty.

From the start, what the duo had in mind as the preferred means of information exchange between the omniscient route finder and the drivers, was a navigation application for smartphones. Because such an app knows the current destination of its user and is able to receive dynamic route recommendations. This was the inspiration phase of their invention, but now they needed to embark on the perspiration phase: the development of the inner core of the application, a complex algorithm able to efficiently distribute the flows of traffic.

The software itself provides the necessary data. Every 30 seconds it reports the current position and speed of the individual users. On the basis of these data, the algorithm calculates when the vehicles will be driving in which part of the network and “books” space for them on the corresponding roads. As soon as the forecast traffic density exceeds a predefined capacity limit, the system intervenes and changes the route recommendation for the next users – and the virtual game of musical chairs starts on the alternative route.

While those who come late are, in a sense, punished by the software because the second or third alternative tends to be a couple of kilometers...
Why do the schedules of major construction projects seem to be impossible to adhere to? Why is there always a traffic jam whenever we are in a big hurry? And why do so many family get-togethers spin out of control after a couple of hours? The answer is simple: Chaos is king!

Chaos, says the theory, arises whenever macro- or microcosmic systems are completely tipped out of balance by some small disruptive factor. And this happens just about always, everywhere and at the most inopportune moments. No matter if it is the beat of a butterfly’s wing in China that impacts weather conditions in Hamburg, or aunt Martha’s last glass of eggnog that turns the mood at the family gathering – often it is a mere trifle that sets a long series of unknown events into motion. Nobody knows where the whole thing will end.

There have always been honest efforts at getting a grip on the ever-present tohubohu. To ensure order on the road, for instance, man applies technical intelligence and traffic lights to organize traffic and channel it properly. Computer simulations have been invented with a will of predicting stock market trends. In the 1950s, the mathematician Benoît Mandelbrot, who is known as the father of the so-called fractal Mandelbrot set, eventually discovered that the development of cotton prices in the US since 1816 could be described with a mathematical formula.

This suggests that on the mathematical level at least, fully fledged chaos can be reduced to a common denominator. But how about underground train stations, major airports or more than ambitious concert halls – would a couple of mathematical tricks help keep chaos out of such projects? Can a few clever algorithms turn a total mess into perfect order? That would be too good to be true!

As experience teaches us, it seems to be a kind of natural law that chaos will always keep the upper hand in the end. Or to use the famous words of the US-American engineer Edward A. Murphy: “Anything that can go wrong will go wrong.” There at least we can discover a certain organizing principle.

In the side-view mirror

Tidy chaos

Chaos is everywhere. Are all our efforts at creating order simply a waste of time?

Why do the schedules of major construction projects seem to be impossible to adhere to? Why is there always a traffic jam whenever we are in a big hurry? And why do so many family get-togethers spin out of control after a couple of hours? The answer is simple: Chaos is king!

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As experience teaches us, it seems to be a kind of natural law that chaos will always keep the upper hand in the end. Or to use the famous words of the US-American engineer Edward A. Murphy: “Anything that can go wrong will go wrong.” There at least we can discover a certain organizing principle.
UK power play

Electromobility in London ■ The plan is literally electrifying and according to its architect, could become the master plan for all of Europe. London’s mayor Boris Johnson has an ambition to fast-track his city to the peak of the Champions’ League in electric mobility. The pacemaker for the sustainable rise to the top is the “Source London” project, which aims to install at least 1,300 electric charging points by 2013.

What is a better indicator of a politician’s credibility: openness to new insights or unwavering adherence to principles? Konrad Adenauer, the first German Federal Chancellor, was not of two minds about it: “What do I care about my chitchat from yesterday?” he is reported to have said when confronted with views that he had expressed earlier but did not share anymore at the time in question.

The modern British variant of the same pronouncement sounds hardly less trenchant: London mayor Boris Johnson was recently quoted as saying, “If the climate can change then why not my opinion too?” With this bon mot, Johnson dismissed media puzzlement at his latest commitment to sustainable mobility. And this in contrast to his rather more critical treatment of green topics in an earlier role as editor of “The Spectator”, as highlighted by the archives.

Perhaps the facts which have swayed him are the very ones which have been fundamental to the launch of his “Source London” project, namely that road traffic is currently responsible for 16 percent of CO₂ emissions and 45 percent of the nitrogen oxide output throughout the urban area, as well as 56 percent of fine particulates emissions in the city. A vehicle powered by electricity as generated by today’s domestic grid rather than fossil fuels would place about a 40 percent lower CO₂ burden on the atmosphere. And with the growing proportion of renewable generating capacity in the UK, the emissions profile of every electric vehicle keeps improving.

However, besides environmental concerns, economic considerations were among the factors prompting the implementation and ambitious timing of Source London. As the official presentation for the project points out, by 2025 the so-called low-carbon industries are projected to enrich the economy of the Thames-side capital with between 10,000 and 15,000 jobs and an additional annual turnover of some €750 million— further proof that sustainability is no mere romantic idea but a robust concept for the future.

At this early stage the numbers are somewhat smaller but they already have quite an impressive ring to them. To break the “sound barrier” of 100,000 charge guzzlers on London’s streets with the minimum of delay, the expansion of the charging infrastructure needs to be placed at the forefront of development. Boris Johnson is aiming for a minimum of
1,300 public charging stations by the end of 2013, their distribution optimized throughout the urban area. According to the published specification: "No Londoner should be more than a mile from the nearest charging point."

From the word go, center stage has been given to simplicity and convenience for users and their vehicles. Drivers of fully or partially electrically powered cars, motorcycles, scooters, vans or goods vehicles can use a customer card for easy identification at any charging point on the network. All that is required is registration on an internet portal, which in turn provides users with continually updated information, for example on additions to the constantly expanding network of charging points. All the charging points are linked to a Siemens-operated control center that controls, monitors and handles the entire operation. It goes without saying that there is an integrated electronic payment option for extra convenience in transactions.

Speaking of payment, Boris Johnson is not simply relying on the pioneer spirit of Londoners to put his electromobility plans into action. To this end, and with the support of the national government, he is in many respects meeting them halfway. For an annual fee of about €125, owners of electric vehicles may charge as often as they wish at stations on the Source London network. In addition, the "silent minority" are not only exempt from congestion charging but also from vehicle excise duty. Together with the one-off subsidy for new electric vehicle registrations, early adopters can look forward to something like a €10,000 bonus in their first year.

Boris Johnson’s commitment to his green targets for mobility is demonstrated by another development in parallel with the Source project. According to calculations by one web-based practical guide for sustainable lifestyles, there are now more hybrid buses on the streets of London than there are in the whole of Germany. They include a Siemens test fleet that is equipped with an intelligent combination of diesel-electric drive and energy storage. Under braking, the drive motors operate as generators and lithium-ion batteries store the reclaimed energy, which is then made available during subsequent acceleration phases. Compared with conventional diesel buses the hybrid variants consume about 40 percent less fuel and produce up to 40 percent lower CO₂ emissions.

The status of London’s streets as the perfect test track for innovative technologies is something of an open secret for conventional motor manufacturers, too. During a program of field trials on its first generation of the Fortwo Electric Drive, the Smart subsidiary of Mercedes used the British capital to gather priceless experience. In another test project, an electrically powered taxi version of the VW Up! was put through extensive trials more than a year prior to the launch of the conventional series-produced model.
Efficient data transfer

Standardized SID interface for detectors • Up to now, on their way to the traffic control center, traffic monitoring data often had to squeeze through the annoying “bottleneck” of an interface that was either only able to transmit basic data or required tedious adaptation to the sensor and detector types deployed. Since modern traffic control solutions often involve the use of increasingly complex detector data such as speeds, vehicle classes and travel times, Siemens and SWARCO TRAFFIC SYSTEMS are working on eliminating this bottleneck: In the future, the standardized SID interface will make it possible to link up detectors to any traffic control system – faster and easier than ever and regardless of the device technology used. Thus the new interface offers exactly the functionality that has been at the top of the traffic control authorities’ wish list for some time – completely unrestricted transfer of all kinds of data, from simple counter data up to complex applications.

Innovative technology exhibition

Gulf Traffic 2012 • “Keeping the Middle East on the Move” was the slogan for the most important traffic technology show in the entire Middle East, which took place from November 19 to 21 at the National Exhibition Center in Abu Dhabi. Since the constantly growing traffic volumes in the region’s urban and interurban transport networks continue pushing the demand for intelligent traffic solutions, the show’s focus was mainly on innovative control systems and ITS applications. Among the exhibits that met with particular interest from the top-flight visitors were for instance the Sitraffic Conduct motorway control center with its numerous functions, the traffic data analysis options provided by Sitraffic Concert/Scala, or the SCOOT traffic control system that optimizes urban traffic flows while minimizing traffic-related pollutant emissions at the same time. Other products in the focus of interest of the local traffic engineering authorities were automated number plate recognition systems, section-based speed control technology as well as modern intelligent systems for highly energy-efficient street lighting.

Reward-winning master’s thesis

Vienna • In the scope of the ITS World Congress, the Austrian Federal Ministry of Transport, Innovation, and Technology presented its Scientific Award ITS 2012. This year, Maoyan Zeng, graduate of the international Transportation Systems program at the Technical University (TU) Munich received the third prize and €700 in prize money for his master thesis on “Modeling Horizontal Queues for Offset Optimization: Adapting the Cell Transmission Model for Signalized Urban Networks.” Zeng worked as trainee at Siemens Mobility and Logistics, where he also did research for his master thesis in the field of Sitraffic Motion, the adaptive network control method for traffic light installations. One of the research and development goals for Sitraffic Motion is the further quality enhancement of coordinated green phase switching. Zeng’s paper sets the foundations for the application of higher-quality models in evaluating and optimizing so-called “green waves.” Today Zeng holds a research associate position at the Traffic Engineering Technology Department of the TU Munich and continues to be involved in the Sitraffic Motion research as advisor of the follow-up master’s thesis.
Kuwait City • Reducing accident numbers in general, pushing the number of lethal accidents substantially below the current mark of 1.4 deaths per day for a population of 3.5 million, optimizing traffic management – these are the key goals specified by the "UN-Kuwait National Transport Strategy 2010-2020," which is being implemented under the auspices of Kuwait's Deputy Prime Minister and Minister of Interior Sheikh Ahmed Hamoud Al-Sabah. The technical manager for the giant project, which involves top-flight representatives of a whole range of authorities in the Gulf state, is Professor Dr. Kim Jraiw. In November 2012, the internationally renowned transport scientist invited a team of experts, including a representative of Siemens Mobility and Logistics, to attend a one-week workshop in Kuwait City. An upcoming event on the agenda of international exchange will be the visit of a delegation led by Sheikh Ahmed Hamoud Al Sabah to Germany. The guests from Kuwait want to use this opportunity to gather first-hand knowledge of the highly efficient traffic management centers and motorway traffic management systems deployed at various locations in Europe with excellent results in terms of optimized traffic safety.

Mannheim/Augsburg • In November 2012, the total number of traffic controllers of the Cxx0x range delivered by the Augsburg factory reached the mark of 25,000 units. The milestone unit is now busy controlling all traffic lights in the Glückstein district of Mannheim. To be exact, the responsible authorities chose the controller type C940ES, the most modern member of the Cxx0x product family. This innovative device has been optimized for 40V LED lighting technology, which reduces energy consumption by up to 90% in comparison to conventional incandescent light sources. Thanks to its high safety class, the controller provides for checking changes in the behavior of the LED signals at a rate of 1,000 times per second, and reports any conflicting signal states and defective lamps. As a result, the use of C940ES controllers makes a substantial contribution not only to reducing the overall environmental impact, but also to improving system reliability and traffic safety.

Successful product range: In November 2012, the controller No. 25,000 of the Cxx0x series was installed

Well-balanced control

Concerted action: International experts flocked to Kuwait City to discuss the future of traffic safety in the Gulf state
The countdown is on, but there is absolutely no reason to get nervous: Despite the highly ambitious character of the numerous future-oriented infrastructure projects that Turkey wants to have completed by the 100th anniversary of the republic’s foundation in fall 2023, the work is well within schedule. Most of the construction projects have already been realized or will be so long before this deadline. This is also true for the huge suspension bridge across the Gulf of Izmit, which will be a key element of the new 420-kilometer long stretch of motorway connecting Istanbul and Izmir. The inauguration date for the world’s fourth-longest suspension bridge is 2015.

“Our timeline is challenging, but feasible,” says Barış Saraç, Business Unit Manager for Road and City Mobility at Siemens Mobility and Logistics in Turkey. “We from Siemens can contribute to speeding up completion by mounting all cable paths and transformers while the bridge proper is still under construction.” Together with expert teams from the competent Siemens units, Saraç is responsible for planning, installing and commissioning all electro-mechanical systems as well as all traffic control and communication systems.

Izmit Gulf Bridge ■ A main span of 1,550 meters, a 2,682-meter long suspended deck, 330 kilometers of electric cables, and a main suspension cable made of wire strands of a total length of 86,000 kilometers – these basic data make the suspension bridge currently built in Turkey one of the world’s largest. It is also one of the safest, thanks among other things to a GPS-based system that measures the oscillations of the towers with millimeter precision and sends the data to the SCADA control center.
For the entire project, safety is a top priority— the safety of the people who will use the bridge, but also the safety of the construction itself in view of ensuring a long service life. Among the technological highlights is a so-called Safety and Health Management System (SHMS) with GPS sensors that will permanently monitor the oscillations and the position of the towers. Additional sensors will continuously measure the elongation-expansion movements of the bridge, the loads on the bridge’s entrances and exits and the total load. Other highly efficient features are, for instance, the dehumidification system that will keep the humidity level in the entirely steel-based construction, including suspension cable system and towers, to below 40 percent—or the lightning protection system that will use the abutments in the water, the lightning rods on the towers as well as special solutions on the main steel cables to protect the entire bridge against lightning-induced overvoltage.

"Safety first" is also the guideline for the communication infrastructure that will transmit all data collected by the various bridge systems directly to the SCADA control center. From this central location, the operators will not only have an optimum overview of everything that happens on and around the bridge, but they will also be able to intervene immediately in case of anomalies in the sensor data or alarm messages from one of the numerous warning systems.

"Safety first" is also the basic rule for communications technology.

IHI: World record bridge builder

The main contractor for the construction of the suspension bridge across the gulf of Izmit is IHI Infrastructure Systems Co., Ltd. (IIS), a subsidiary of the world-renowned Japanese company IHI Corp., which has already built 4,500 bridges all over the world, including what is currently the world’s longest suspension bridge: the Akashi-Kaikyo bridge in Japan with a main span of 1,991 meters. However, IHI is set to top this world record quite soon, with the completion of the Messina bridge in Italy, which will have a main span of more than 3,000 meters.

Takeshi Kawakami, Project Manager, Masahiro Yanagihara, Deputy Project Manager, Tunc Cetinkaya, Project Control Coordination Manager, Junich Shaura, General Manager of Design, Ken Nishibori, Deputy General Manager of Overseas Sales, and Atahan Orhan, Assistant General Manager of IIS Turkey, list some of the special features of the Izmit Bay Crossing project:

In bridge projects of this magnitude, there are quite a few things to consider, especially in terms of electrical infrastructure. Power will be transmitted via high-voltage cables, for instance, which requires transformers to be installed at suitable places inside the deck wherever consumers will be located. To maintain a reliable power supply under all circumstances, power will be delivered from both sides of the bridge.

For maintenance purposes, lighting systems will be installed inside the towers, girders and anchorages. The carriageway will be equipped with highway lighting. The deck and the peaks of the towers will be marked with marine and aviation protection lights. The key element for managing all the electro-mechanical systems will be a SCADA system for the purpose of monitoring and controlling the whole bridge.

The traffic in the region will benefit from the bridge, which is part of the new Gebze-Orhangazi-Izmir motorway, in numerous respects: The new structure will relieve the traffic load on the existing road networks, reduce through-traffic in cities and towns and shorten travel times for business and private trips. In sum, the project will bring substantial benefits in terms of safety and economic efficiency.
Summit of variety

13th World Conference on Transport Research | Every three years, scientists and practitioners from all over the world flock to this international exchange forum on transportation issues. There will be more than enough to talk about at the next WCTR in Rio de Janeiro in summer 2013. In the topic area “Traffic Operations, Management and Control” alone, 290 topics have been suggested. For the ITS magazine the head of this topic area, Professor Dr. Manfred Boltze from Darmstadt University of Technology, has sifted through the mountain of ideas.

In point of fact, there is one thing that you will not find at the World Conference on Transport Research Society (WCTRS) – limits. Because the researchers’ perspective on transport can best be described by adding the prefix “multi” to virtually any aspect: multi-disciplinary, multi-sectoral and last but not least multi-national. With more than 1,500 members from over 60 countries, the WCTRS has become the international forum for continuous professional exchange between transport researchers, operators, policy makers and educators since its establishment in the early 1970s.

Every three years the leading experts meet for the World Conference on Transport Research to learn from each other. But also in between conferences, the WCTRS members continue their joint work in so called Special Interest Groups (SIG), for instance SIG 15: “Urban Traffic Control”. This group, which was established in 2011 by Professor Dr. Hideki Nakamura from Nagoya University, organized its second meeting in October 2012 in Darmstadt, Germany, for an intensive discussion of the experiences gathered to date in respect to different methods of intergreen time calculation for traffic light installations.

And since coming mega-events cast their shadows long before, as they say, preparations for the 13th World Conference on Transport Research in Rio de Janeiro from 15 to 18 July 2013 are in full swing already. Besides numerous tourist attractions, the dazzling metropolis near the Sugar Loaf Mountain has quite a few interesting highlights to offer in terms of transport, for instance situation-actuated tidal flow systems with reversible lanes on major arterials and modern Bus Rapid Transit Systems (BRT). Moreover, visitors to the city will be able to see the first transport infrastructure measures being implemented in preparation for the Soccer World Cup 2014 and the Olympic Games 2016.

For the roughly 1,300 conference attendees, however, the most important item on their agenda will of course be the World Conference program, with sessions grouped in eight so-called “topic areas”:
A. Transport Modes: General
B. Freight Transport and Logistics Systems
C. Traffic Operations, Management and Control
D. Activity and Transport Demand
E. Transport Economics and Finance
F. Transport, Land Use and Sustainability
G. Transport Planning, Policy and Management
H. Transport in Developing Countries

Issues relating to road traffic engineering are mainly discussed in the area “Traffic Operations, Management and Control.” This topic area covers all aspects of urban and interurban road transport, including traffic flow theory and modeling, traffic control and traffic management, traffic safety across all means of transport as well as traffic network analyses, intelligent transport systems (ITS) and infrastructure management. For this area alone, we count already as many as 290 topic suggestions from 50 countries – a thematic diversity that not only promises a very attractive and exciting event, but also
provides an excellent overview over the topics currently under research.

The abstracts submitted in the field of traffic flow theory and modeling, for example, are addressing such fundamental questions as speed selection, deceleration rates, vehicle equivalents and the drivers' acceptance of different priority regulations for pedestrians; or methods for model calibration, travel time estimates and online traffic situation monitoring including level of service (LOS) assessment, dynamic estimation of origin-destination matrices as well as incident detection processes. A considerable number of abstracts are dealing with the specific characteristics of driver behavior in emerging countries and with the flow of mixed-vehicles traffic.

In the field of traffic control and traffic management, numerous topic suggestions relate, as is to be expected, to traffic signal control and the most recent developments of the corresponding technologies: cooperative systems, environment-sensitive control strategies, pedestrian behavior and pedestrian signals, the effect of countdown signals, public transport priority systems, and robustness of control strategies. Typical dynamic traffic management topics are, for instance, flexible lane allocation in merging sections, efficiency of “High-Occupancy Toll” (HOT) lanes and strategies for incident management, besides capacity analyses for road infrastructure elements such as roundabouts and impact studies of traffic calming and speed monitoring measures.

Under the header "transport network analyses," several topics relating to the assignment of individual traffic and public transport have been submitted. Currently, researchers also focus on the analysis of congested road networks, more specifically travel time estimates systems, network assessment and "gridlock phenomena." In addition, there are also a number of ideas for methods that will allow to base priority decisions on infrastructure measures observed congestion phenomena, among other factors.

Video systems are playing an even more important role in traffic detection

With regard to traffic safety, numerous abstracts deal with comparative accident analyses of different countries, different seasons or other factors, and with safety analyses for various groups of road users, for instance of different driver age groups, pedestrians and motorcyclists. An increasingly important tool in this field is traffic safety modeling, used for instance to forecast accident rates or calculate the correlation of kinetic energy and conflict potential. A number of individual factors, such as streetscape design, speed limits and speed enforcement, sun glare effects, mobile phone use, road geometry and traffic density, are the object of especially detailed research. Other papers address the topics of risk assessment for hazardous goods transports or safety at road construction sites.

In the field of Intelligent Transport Systems (ITS), the use of video cameras for traffic recording is increasingly in the focus, especially in terms of vehicle trajectory analysis, video system performance for mixed traffic and the detection of conflicts with pedestrian traffic. Floating-car- and floating-phone data, too, are meeting with growing interest from researchers all over the world. Other topics are driver assistance systems such as lane departure warning and distance monitoring systems, the effect of traffic information on road network capacity, as well as warning systems that will help increase safety in road construction areas. Another paper to look forward to is the presentation of a method that uses social networks such as Twitter to capture and analyze the reaction of drivers to traffic information and traffic management measures. The abstracts relating to infrastructure management address mainly the lifecycle assessment of infrastructure elements and the optimization of maintenance and refurbishment measures. The focus is currently on how to assess and mitigate the impact of construction activities on traffic quality.

There is one thing that this exciting variety of key topics reveals at first glance: The world of road transport engineering will profit from Rio 2013, not only due to the sheer quantity of papers, but also because of their high level of quality. For the attendees of this summit of variety there is a little drop of bitterness, though: The packed conference agenda will probably leave hardly any time to enjoy Samba and Copacabana.
Concentrated knowledge

Book presentation “Morgenstadt” – The City of Tomorrow

Every year, across the world, some 60 million people move from the countryside to the city. And along with a more clustered living space, the problems tend to cluster too. But maybe the opportunities do as well. Professor Dr. Hans-Jörg Bullinger, President of the Fraunhofer Society until 2012, and science writer Brigitte Röthlein sketch out their “Solutions for the urban life of the future” – not least in terms of mobility.

Remember the days when, with a population of 2.65 million, London was the largest city in the world. Foucault and his pendulum had just provided evidence of the Earth’s rotation, and Emperor Franz Joseph had approved the first national weather service in Austria. Today, only around one and a half centuries later, London’s population of back then would occupy not even ten percent of the current urban area of Tokyo. And the number of mega-cities – those with more than ten million inhabitants – is growing ever faster: In 1950, there was only one, New York. By 1985 there were nine, 19 in 2004 and today there are 25 such cities. In terms of area, cities account for only two percent of the Earth’s land surface, but they are now home to more than half of all humans and consume about three quarters of all the resources – for risks and side effects, ask your emissions or waste disposal expert.

In their book, published by Hanser in September 2012, Professor Dr. Hans-Jörg Bullinger, recently retired President of the Fraunhofer Society, and science writer Brigitte Röthlein deal with misguided development in cities and its consequences. But the main focus of their interest is an alternative concept: the city of tomorrow. They devote one particularly interesting chapter to mobility – and for good reason. “Above all, it is traffic problems that plague urban planners, local politicians and business leaders.” In support of this view, they quote from a Siemens-commissioned study entitled ‘Megacity Challenges’: “The respondents believe that the transport infrastructure is the most important factor for a city to remain competitive.” What happens when traffic is left to its own devices is described by the authors using the frightening example of the Pakistani city of Karachi – the world’s only city without a rail network for public transport. “Now there are no longer enough public buses available for the city’s population, so commuters have to ride on the roofs of the buses […] with all the dangers that involves. Monster traffic jams on the access and exit roads that last hours are now part of everyday life, and air pollution has reached scary levels. In order to make faster progress through the traffic chaos, many of the population have bought a motorcycle […] In 1990, Karachi had 500,000 motorcycles, while in 2010, there were one million. And in 2030 there will be 3.5 million, expects the Karachi Transportation and Improvement Project set up by the city council […] The consequences are fatal in the true sense of the word: The number of serious accidents has increased, as have road congestion, noise and air pollution.”

From this horror scenario, the question directly derives of how traffic should be organized in the city of tomorrow. To find this out, the authors have sifted through the multitude of available future studies and filtered out the three main goals.

• City centers should change back from being car-oriented to being people-centered: quiet, with little traffic and no emissions.

• Private and public transport need to be integrated more closely with each other because time is becoming more valuable to most people.

• Mobility must become more sustainable, not least by giving preferential treatment to the increasing number of electric vehicles that run on renewable electricity.

The technical means for turning the city of tomorrow into reality are already available – now we would just have to put them into practice. The blurb on the
cover reflects this, giving an idea of the character of what is covered in the book. The authors do not give in to speculating wildly, or to promoting Utopian models, but rather they concentrate on navigating the fine line between the present and the future. That means that they mainly address the technological, social and organizational changes that have already started. Such as the implementation of a comprehensive mobility concept in the booming Chinese city of Hefei, where, amongst other measures, the responsible authorities use the floating car data from 8,000 taxis as the basis for simulations that will help fight air pollution. Or the very promising experiences gathered with a dynamic traffic control system in Nuremberg, which considerably expands the capacity of the traffic space through improved utilization of the existing infrastructure. Or the participation of the South-German automotive capital of Stuttgart in a large-scale car-sharing project using electric vehicles. “There will be cars in the city of tomorrow too,” predict Professor Bullinger and Brigitte Röthlein, “but private vehicles will no longer play a dominant role.”

On the other hand, they forecast the growing importance of public transport – especially if the stakeholders manage to clear up the ticketing mess and make the interfaces between the different modes of transport more efficient. For a prime example of the first of these tasks, they cite the so-called Octopus Card in Hong Kong, which enables cashless payment for all public transport systems. A promising idea for the second task is the SMART-WAY mobile app, which was developed by nine European partners and is as easy to use as the navigation system in your car. You simply type in the destination address and allow yourself to be guided accurately and in time to the best available means of transport, and any stops and transfer points that involves.

The authors also show that the means used for public transport do not even have to look like the vehicles we have today, as demonstrated by AutoTram, a development by the Fraunhofer Institute for Transportation and Infrastructure Systems. The name says it all. This “cross between a bus and a tram” is around 30 meters long, has a top speed of 60 km/h and is easy to keep on track, even without a driver, using optical methods or GPS. This automobile hybrid type demonstrates its flexibility in its drive train too. It can be powered by various types of battery, diesel engines, fuel cells or, experimentally, purely by electricity.

When it comes to the debate about who or what will propel the vehicles of the future, the authors offer a condensed overview of the current state of research in various new drive technologies. But they are also interested in how people are dealing with inventions and ideas. For example, the Fraunhofer researchers have invented an imaginary woman, born in 1990, who over the course of her life benefits from the latest innovations in her transport environment. In 2050, for example, her story goes like this: “This year, Mobi L. (60) has moved to the city. Just recently, since the last vehicles using internal combustion engines have been taken out of service, she has been able to sleep with the windows open every night […] and going on holiday has become more relaxed as well. In the right-hand lane, Mobi switches her fuel-cell vehicle to autonomous mode and takes a nice little nap, before taking the steering wheel again on the last kilometer to her destination.”


Professor Bullinger, “City of Tomorrow” pictures provided by Fraunhofer Gesellschaft: One reason why the book is such an interesting read is the rather concrete character of the approach – the authors do not give in to promoting Utopian models, but concentrate on navigating the fine line between the present and the future.
Dr. Roth, we have radar, video, infra-red, ultrasound, magnetic field: in recent years any number of new competitors have lined up against inductive technology. When will we finally call time on these systems?

No one today can seriously forecast that. There are simply too many factors in play. No doubt the decisive ones are the prevailing budgetary conditions faced by highways operators and the further progress in developing the alternative methods. While it seems fairly certain to me that in the longer term, the innovative technologies will win the day, no one knows yet when the field will be theirs and theirs alone.

But when compared with traditional loop detectors, surely the newcomers already offer greater cost efficiency – and improved performance on top?

Unfortunately it’s not that simple. Strictly speaking the answer to your question is three yes and a no. Yes, the installation of induction loops is comparatively labor- and cost-intensive because they have to be buried deep within the tarmac. Yes, the maintenance costs are relatively high because conventional inductive loops suffer the detrimental effects of both traffic and weathering. And a third yes, because radar, video, magnetic field and so on offer a longer service life and thus ensure higher system availability.

But to finish with, there is also a no, because as we speak, in terms of precision the old technology remains slightly ahead of the new ones.

So to some extent there’s a strategic speed limit that applies to the replacement of existing systems?

That’s it. Although the good old induction loop was pronounced dead some ten years ago, in my view it will continue to live for a while yet, especially in critical applications where even 99 percent precision would be insufficient. If I require more information and can live with a one percent risk – which is quite acceptable in many systems – then the new generation will certainly come under consider-
ation, from the point of view of both costs and greater flexibility.

And against that background, how quickly is that generation change proceeding?
To my knowledge, more than 50 percent of all new systems to this day are still being built using induction loops. The rest are shared between the new technologies.

According to your observation is there a clear favorite emerging?
Actually, I don’t think there is. Every technology scores with its own particular strengths: In terms of its precision, radar is closest to the induction loop, while in many cases, video is proving the most economical option, infrared is attractive because of its energy efficiency, and in the case of magnetic field detectors, installation even at greater distances from the intersection is very cost-effective.

Bringing together information from widely differing sources fortunately no longer poses a problem in traffic systems. For that reason, an intelligent mix of the modern set of detection methods is the best choice in many cases. The choice of the technology to be deployed at a specific location comes down to decisions based on its cost-effectiveness and the targets set for the application at hand. In the end, there are also regional preferences and special conditions that should not be underestimated.

Such as?
At the often very large intersections in the USA for example, video solutions have been among the favorites from the start because a single camera can monitor even large intersection access roads with multiple lanes. For Germany’s smaller junctions, this technology started to be used more widely only when system prices fell significantly. By contrast the UK is, as much as ever, a typical radar country, partly because these solutions harmonize optimally with the local traffic control systems commonly installed in the UK, and partly because on the island’s roads there are hardly any suitable cantilever masts to mount the cameras in a position where they can fully play out their strengths.

In some countries, the data protection authorities probably have a say in the matter too ...
Indeed, the data protection regulations concerning automatic number plate recognition (ANPR) differ very widely in practice. In Germany even the individual Federal States have their different views on the matter.

Is the fear of Big Brother justified in this case?
Not from the engineer’s point of view, because fundamentally the systems operate on the basis of anonymized information. And you have to realize that direct recording of section-related data is one of the most important conditions for further optimizing traffic flows. To monitor events on short sections of a few kilometers in length and with few entrances and exits, magnetic field sensors or Bluetooth systems are perfectly sufficient. Whenever things get more complicated, then automatic number plate recognition is unbeatable.

It sounds as though overall, you would like to see the authorities around the world showing a greater spirit of innovation in matters of traffic control and traffic management?
No, I have no wish to give that impression. To begin with it goes without saying that the providers of novel systems are the ones who have the primary duty to persuade users of their benefits. And despite critical budgetary conditions that discussion generally tends to be highly positive. There has been a whole series of very ambitious projects that undoubtedly should be regarded as groundbreaking not only for detection but also for the efficient channeling of traffic at the level of control and traffic management. In this context Berlin is a good example for the integration of all types of systems in a city of several million inhabitants. The traffic management center VMZ and the traffic control center VKRZ in the German capital have access to a common pool of information: The VKRZ supplies the measurement data from the induction loops, the VMZ adds the measured values from over 300 additional Traffic Eye Universal overhead infrared detectors and generates a traffic situation report complete with a forecast for the entire arterial road network.

In the spring of 2012, right next door to Berlin, the city of Potsdam put an environmentally driven traffic control system into service to reduce the high levels of fine particulate emissions in the urban area. That’s correct. There too, Traffic Eye Universal devices are delivering valuable data for an innovative traffic management system that helps prevent nitrogen dioxide and particulate matter values from exceeding the thresholds defined for the city center. To this end, the controllers at key traffic light installations have been equipped with additional functions that use current traffic and environmental data to calculate the optimum switching routine for keeping urban traffic flowing as freely as possible.

Would that be the kind of system that you would have installed in your city if you were mayor?
Without a doubt. I believe that quite independently of its specifically environmental core, this project reflects two of the most important trends in the future organization of mobility. In order to channel traffic flows as efficiently as possible, we increasingly need more high-quality data from differing sources – and we need well-informed road users who trust the applicable regulations or recommendations because they understand and accept their sense and purpose.

Dr. Roth, thank you very much for talking to us.

Dr. Christoph Roth

Key career steps at a glance:
• 1982: High school graduation, Gymnasium Gießen
• 1989: Graduation in Physics at Gießen University
• 1992: Doctoral degree (Dr. rer. nat.) from Munich University
• 1992-1994: Development engineer for Hoechst Japan
• 1994-2001: Various positions within Siemens Corporate Technology (1998 to 2001 at Siemens Japan)
• Since 2001: Product manager for Siemens ITS