Go green!

Every car driver has been there at one time or another: you just want to get from A to B through the city as quickly as possible – and every light is red. In today's world, traffic flow can be organized to run much more smoothly. In the university town of Münster, Germany, Siemens Mobility installed the latest network-adaptive signal-control system. And now traffic is running better than ever.

Let's be honest, a personal "green wave" is a driver's ultimate dream. Wherever you're heading, the next traffic light automatically turns to green. After all, the principle is actually quite simple. All traffic lights on a stretch of road are configured so that cars – as long as they are driving at a certain speed, the so-called progression speed – reach each traffic light in its green phase. This enables a smooth flow of traffic, reduces the amount braking and accelerating required, and saves fuel resulting in lower emissions of CO_2, nitric oxide and particulate matter. What could be simpler?

Unfortunately things are a bit more complicated in practice. This type of fixed-time green wave only works on one road and in one direction. As the traffic volume fluctuates throughout the day, as is normally the case on arterial roads in and out of cities, the green phases need to be adjusted appropriately according to a signal phase plan. On routes taking commuter traffic into cities, longer green phases are required in the morning than in the afternoon, and the other way around for routes in the opposite direction. Temporary peaks in traffic levels, for example at the end of a football game or other large event, ordinarily have to be regulated manually. One thing is certain: fixed-time control systems don't necessarily work quite convincingly even after very careful planning – not least because traffic itself never really sticks to the plan.

Traffic actuated: not always optimal

This is why cities usually opt for traffic-actuated control, which makes it possible to regulate traffic locally at crossings as required. The control programs process data from allocated traffic detectors, and then lengthen or shorten green phas-

> When it comes to traffic and the environment, most cities are facing a Herculean task: existing road networks must be able to handle increasing traffic volumes and help reduce emissions.

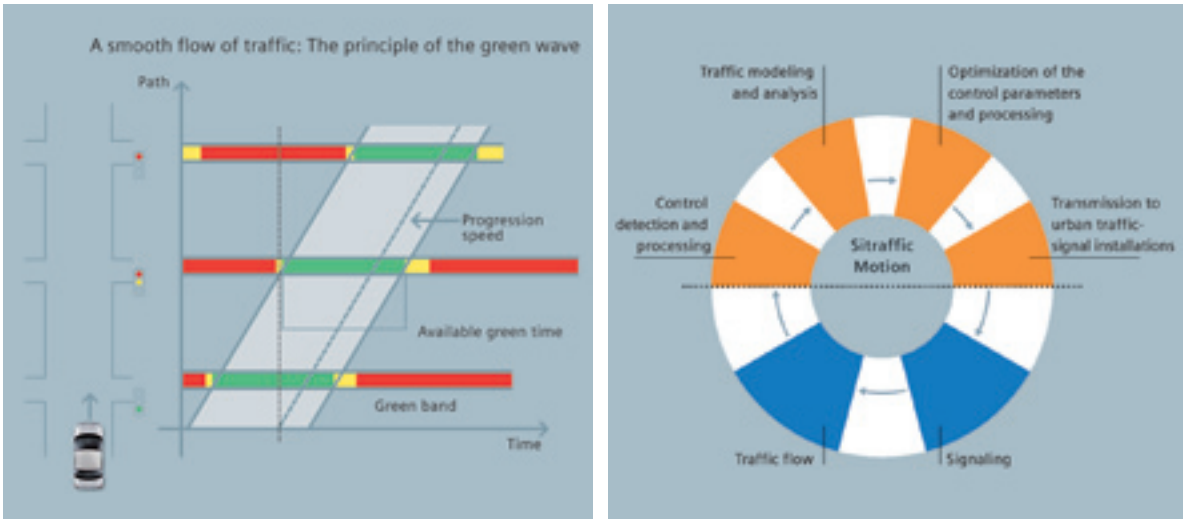
es at each individual entry to an intersection. To a certain extent, the traffic-actuated control systems can adjust themselves locally to changing volumes at their own intersection. They can also give preference to certain types of traffic such as buses and trains. However, preferential settings of this sort can lead to green phases being drastically reduced for automobiles. Also, such systems often do not take congestion at the next intersection into consideration.

The solution: intelligent control systems

But even problems like these can be overcome by intelligent control systems. The Sitraffic Motion MX from Siemens is a model-based adaptive network control system that takes into consideration the current traffic conditions at all relevant intersections in the traffic network and also produces short-term forecasts. With the assistance of a new traffic computer, the Sitraffic Motion uses this data to continually calculate the level of traffic at traffic lights in the surrounding traffic network and optimize the distribution of green phases. This means that the system can react flexibly to changing traffic volumes without limiting the scope of local control systems, and create a truly dynamic green wave.

The system works on two functional levels: On a tactical level the network control system prescribes cycle times, phase sequences, distribution and coordination for green phases via a signal framework that is updated every 15 minutes. On an operational level the control system adapts the current phase sequence and duration of green phases within the cycles. The control of the phase transition is even accurate to the second. All forms of road users are considered: public transport and individual motorized traffic, pedestrians and bicyclists.

A green wave in Münster: optimized travel reduces traffic jams and lowers CO_2 emissions.



A fixed-time green wave (left) works for one direction only, and is not flexible enough for more complex environments. Traffic-adaptive solutions analyze the situation continuously (right).

Traffic-adaptive solutions

Just how efficiently this type of traffic-adaptive solution can be implemented is demonstrated by the reworking of the traffic control system in Copenhagen's Valby district. The Danish traffic planners wanted to accelerate their four bus routes by 20 percent without having to slow down individual motorized traffic. In the end it was possible to do even better than this, and buses in Valby are now 27 percent faster. Even individual motorized traffic is now moving faster than before.

Modernization on the roads with the help of Sitraffic Motion has even greater potential still, as is well demonstrated by the conversion of the classic green wave into a model-based, traffic-adaptive method on the busy Albersloher Weg in the university town of Münster in Germany. Installed in mid-2008 at 24 intersections, a Sitraffic Motion traffic signal control system now analyzes how many vehicles are on the roads, which way they are turning and where congestions is threatening to develop. The system receives data from detectors that are installed at approaches. A central traffic computer gathers the data, analyses the traffic situation at the intersections along the six-kilometer road every five minutes, and automatically adapts the red and green light phases and the green wave to this information every 20 minutes, and even more frequently where required. But what is the actual effect of this complex control system?

An empirical study carried out by the Faculty of Transport Studies at the Ruhr University in Bochum got to the bottom of the question. The scientists compared three different development stages of the traffic system in use on

Albersloher Weg: the original situation with fixed-time control; the conventionally planned, traffic-dependent control system in the individual traffic signal installations; and finally, the Siemens approach in the form of the traffic-adaptive, model-based control system. The research team also used values from their own measurements with detectors, GPS measuring vehicles and video systems as well as the telematics data of the city's bus network.

In a summary report, the researchers calculated so-called performance indexes for all road users, from cars and public buses all the way to cyclists and pedestrians, which served as a measurement of traffic quality along the route. This made it apparent that while the conventional traffic-dependant control system did offer improvements compared to the original situation, the adaptive control system with Sitraffic Motion was able to optimize the traffic quality considerably. The result is a significantly improved flow of traffic, up to 49 percent fewer stops compared to the original fixed-time control solution, and on average 38 percent shorter waiting times for car drivers.

"The level of improvement observed has been unexpectedly high," reported the researchers in Bochum, adding that "all in all, the introduction of the new traffic light control system on Albersloher Weg can be considered a success." The conclusion of the study is equally clear: "It can be assumed that, based on current technological levels, an optimum technical state has been achieved with the signal control system installed on Albersloher Weg." A result that also convinced the traffic planners in Münster: the city council has since decided to equip further busy roads with adaptive Sitraffic Motion network control systems in coming years. □

An overview of the traffic situation: systems like the Traffic Eye Universal from Siemens send additional data on current traffic conditions to the software solution.

Sitraffic Motion: A green plan

Sitraffic Motion MX is software that can be installed on modern traffic computers such as the Sitraffic Scala to control urban traffic-signal installations. As the first adaptive network control system, the software can exchange data with control units and traffic lights from practically any European manufacturer, making it compatible with existing technical traffic infrastructures. Because the system not only takes individual interchanges into consideration but also includes entire areas of the network, it can react much more appropriately to the broader traffic situation than classic traffic-light control systems, which work according to rigid principles. The system uses a newly developed method of modeling and estimating traffic parameters, and it can also be incorporated into the simulation mode of the Sitraffic Scala traffic computer. When planning traffic signal installations, it is possible to simulate the various effects of fixed-time controlling and traffic-dependent controlling to assess traffic quality and predict levels of emission reductions.