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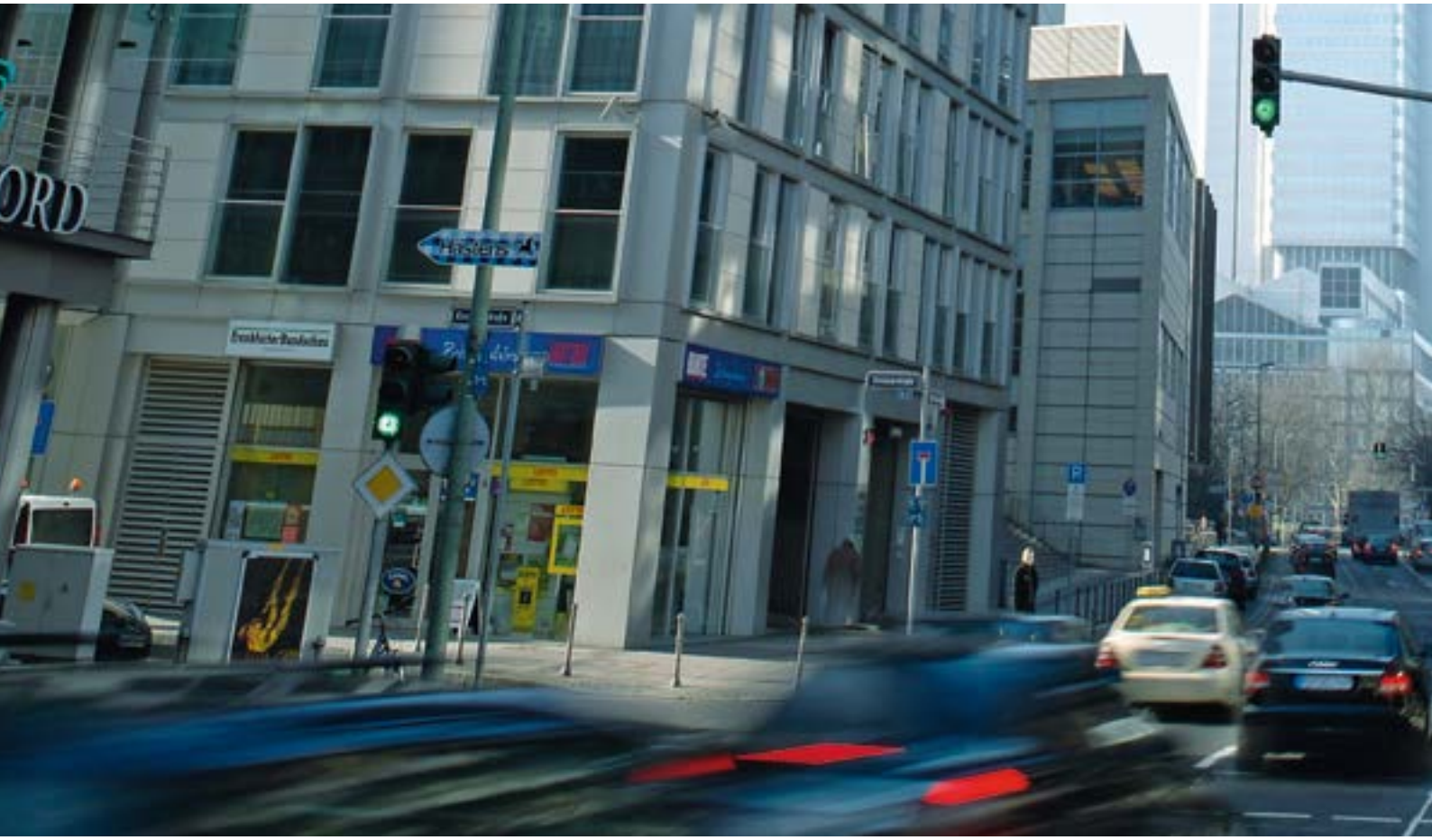
Adaptive network control Sitraffic Motion MX

The intelligent answer to congestion and pollution



An innovative solution for a Herculean task

Today most cities are confronted with a Herculean task in traffic and environmental policy: They must find a way to enable the existing road network to accommodate an ever increasing traffic load while ensuring at the same time that the defined emission limits are adhered to. With Sitraffic® Motion MX 4, the model-based, adaptive network control system from Siemens, they can now achieve both goals at once. In conjunction with a modern traffic computer, this traffic-actuated network control system coordinates traffic light switching for a dynamic "green wave" – for considerably less congestion and pollution. Due to the model-based concept, the achievable positive effects exceed by far the benefits of rule-based systems.

Dynamic "green wave" – for both traffic and the environment

By dynamically coordinating green phases in a street network, Sitraffic Motion MX substantially improves traffic flow. Besides benefiting all road users, these "green waves" have been proven to have a strong impact on fuel consumption and emission levels, too. Compared to stop-and-go traffic, smooth traffic flow reduces fuel consumption and emission levels by two-digit percentages. Moreover, as traffic moves more evenly, noise emissions are reduced, lightening the burden on the residents.

What is Sitraffic Motion MX?

Sitraffic Motion MX is a software system for installation on modern traffic computers (Sitraffic Scala). The system optimizes the switching of a city's traffic lights in such a way that traffic moves measurably faster within the existing infrastructure. As Motion MX "keeps an eye" on the entire network and not just on individual intersections and is able to react very quickly to changing traffic conditions, it is by far more effective than conventional traffic light control systems alone, because the latter are based on fixed rules.

In version 4.0 or higher, Motion MX uses a newly developed method for assessing traffic parameters, modeling traffic flows and optimizing the control routines for the connected traffic lights. This makes Sitraffic Motion the only adaptive network control system that is truly able to calculate optimally coordinated green phases for both travel directions across several signaled intersections.

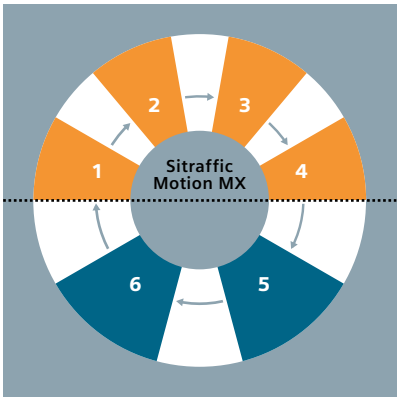
With Sitraffic Motion MX 4.2 you can even go a step further and select appropriate signal plans on the basis of traffic models. To this purpose, different optimization parameters such as minimum waiting times, maximum capacity and optimum coordination can be automatically balanced against each other during ongoing operation. No manual planning and entry of complex rule systems is required.

Open for traffic control components from a wide variety of manufacturers

Sitraffic Motion MX is the first adaptive network control that is designed for data exchange based on the OCIT® standard. Hence the system is compatible with controllers and traffic lights from virtually all European manufacturers – a considerable advantage for municipalities because no city starts "from scratch" and there is usually already an extensive technical infrastructure installed. Modernization or extension with Sitraffic Motion MX ensures that the existing infrastructure can continue to be used, thus effectively protecting previous investments for the long term.

Excellent interaction with the newest simulation systems

Motion MX 4.0 or higher can be combined with the simulation model Vissim, which simulates traffic in the given road network. This makes it possible to test the mutual compatibility of the traffic light control routines realized with Sitraffic Motion MX prior to implementation right at the workstation to practically eliminate the risk of inconsistencies between different control settings emerging during commissioning. With a suitably precise calibration of the Vissim network, simulation studies exploring the effects of various control methods on traffic flow can now also include Sitraffic Motion.



The Sitraffic Motion MX control circuit

1 Data collection and processing
2 Traffic modeling and analysis
3 Control parameter optimization
4 Transmission to the traffic light installations
5 Signaling
6 Traffic flow

Smoother ride for everyone with Sitraffic Motion MX – in Copenhagen, Prague and many other places

Sitraffic Motion is already smoothing the flow of traffic in many cities – for less congestion and less stressful travel. Experience has shown that the system can bring its strengths to bear in projects of all sizes. Wherever Motion MX has been implemented, significantly smoother traffic flows and a substantial reduction in noise and pollutant emissions were the result. These effects could be achieved no matter if the project encompassed 3 or 140 intersections, with Motion MX as stand-alone solution or as integral part of a complex traffic management system.

Example Copenhagen, Denmark: Priority for mass transit

The task of the traffic control system to be implemented in Valby, a municipal district of Copenhagen, had been clearly defined by the customer: The system was to make service on the four municipal bus routes 20 percent faster without slowing down private traffic in any way. Sitraffic Motion was not only able to fulfill this task, but even provide benefits in excess of this goal. Before-and-after analyses carried out by the customer showed that Motion shortens travel times for all road users in Valby. Buses now travel up to 27 percent faster with no adverse effect on individual traffic. On the contrary, also private travel speed has increased by up to 6 percent.

Example Prague: Seven years of totally autonomous traffic control

IOur network control system in Prague was commissioned in summer 2005. Until the spring of 2012, when the complete

Places where Sitraffic Motion MX makes traffic move faster

City/Country	Traffic signal installations	Year installed
Abu Dhabi, United Arab Emirates	12	under development
Amberg, Germany	31	2012
Belgrade, Serbia	15	2010/2011
Bialystok, Poland	ca. 20	under development
Brunswick, Germany	5	2005
Bremen, Germany	14 + 21	2004/under development
Bremerhaven, Germany	21	2008/2009
Heidelberg, Germany	5	2008/2013
Copenhagen, Denmark	36	2000/2002/2006
Cracow, Poland	37	2008/2009
Lugano, Switzerland	39	2013
Magdeburg, Germany	21	2005/2012
Mannheim, Germany	8	2004/2006
Odense, Denmark	31	2001 et seq.
Poznan, Poland	ca. 20	under development
Prague, Czech Republic	21	2005/2012
Rzeszow, Poland	ca. 20	under development
Speyer, Germany	6	2012
Vilnius, Lithuania	140	2007/2008/2009
Warsaw, Poland	25	2008/2009

control system was migrated to the most recent Sitraffic Scala version, Sitraffic Motion demonstrated every day its capability of controlling traffic in total autonomy and without any intervention from traffic planners. The system dynamically optimized coordinated green phases, minimized pedestrian waiting times and provided support to traffic management in selecting the optimum response to incidents and traffic disruptions in the nearby tunnels and the neighboring city center. Since spring of 2012, the newest version of Sitraffic Motion carries on this excellent job, with even better results thanks to its new, advanced algorithms.

Coordinated green phases: Performance index improved by up to 38 percent

The coordinated traffic light switching implemented on the basis of our Sitraffic Motion MX across 24 intersections on a 6-km arterial road section has been proven to substantially benefit traffic in general: An empirical study carried out by Ruhr University Bochum showed that buses and cars now lose about one third less time on this road section, with the added benefit of burning correspondingly less fuel and producing considerably less nitrogen oxide.

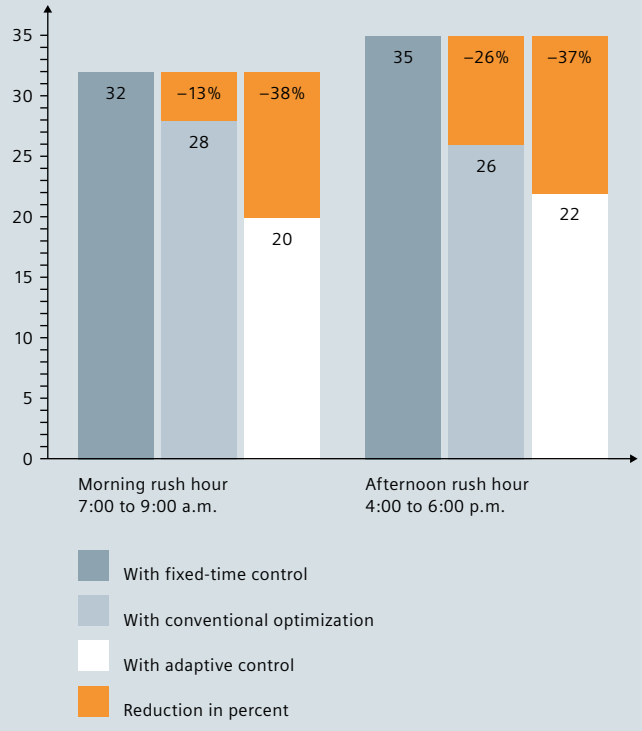
Thanks to the adaptive traffic control, the frequency and length of the stops could be reduced by 35 to 45 percent compared to the former situation.

The performance index calculated on the basis of quality indicators measured for all traffic modes (private and public traffic, pedestrians, cyclists) shows a 29 percent improvement during morning traffic.

As the study showed, the difference between a traditional rule-based control method for "green waves" and the model-based Sitraffic Motion concept has been especially marked for motorized traffic. While the traditional traffic-actuated control system improved traffic quality by a respectable 13 percent, the adaptive, model-based solution boosted the positive effect to an impressive 35 percent!

A university study proved the superior performance of the model-based control system Sitraffic Motion MX 4.0.

Comparison of performance indices



Source: Ruhr University Bochum, Institute for Transportation and Traffic Engineering

Sitraffic Motion MX 4.2: Further improved performance for optimum traffic flow

Sitraffic Motion MX 4.2 in Magdeburg
Today two traffic areas in Magdeburg use the new model-based signal plan selection function offered by Sitraffic Motion MX 4.2 (the picture shows part of the control zone on the B1 state road controlled by Sitraffic Motion MX since 2005). The new system is able to activate the eight signal plans developed by the customer for the northern part of the August-Bebel-Damm in a much more targeted and effective manner than the former rule-based network control system, because it applies traffic models that automatically balance the different control goals (capacity, coordination, waiting times) during ongoing operation without the need for manually planning and entering any complex rules for this in advance

Only with the continuous evolution of our products, we can make sure that our systems offer our customers the highest possible benefits. In the case of Sitraffic Motion MX, substantial further improvements have been achieved in the most recent projects, in terms of optimization methods and response times as well as in respect to traffic light control and synchronization or the integration of earlier generations of controllers.

Network-wide optimization combined with local flexibility
Sitraffic Motion MX combines the advantages of an adaptive network control system with the operative flexibility of a quick-response local intersection controller. This double advantage relies on the intelligent distribution of tasks between the network control and the local controllers. The network control system provides a frame signal plan, which can now be updated every 3 minutes and includes cycle times, phase sequences, green-time split and offset times, while every controller still keeps all operative functions required for controlling private traffic and public transport.

As multidimensional as any traffic situation
Sitraffic Motion MX 4.2 is completely integrated in the control concept of Sitraffic Scala.

- All control parameters of the signal plans are considered: cycle time, green-time split, offset time and phase sequence.

New features implemented in Sitraffic Motion MX 4.2:

- The improved green phase distribution does not only allow effective control of signal capacity, but also the targeted provision of spare capacities for particular phases.
- In German-speaking countries, Sitraffic Motion MX is the only control method that is able to select cycle times truly on the basis of the traffic effects calculated by the traffic models. A new algorithm shortens response times in case of strong load fluctuations (e.g. during the morning rush hour) while stabilizing the cycle times when load fluctuations are limited.
- Now the desired coordination structures can be defined as a criterion for cycle time selection, for instance for morning and afternoon rush hours.
- Update intervals for the connected traffic light installations have been shortened to 3 minutes, allowing even more finely tuned adaptations to changing traffic conditions.
- A new process excludes synchronization problems arising from the dynamically optimized "green waves", reliably preventing the occasional traffic flow disturbances observed in older projects using less advanced technologies.

- The system operates on two function levels on the tactical level at intervals of 3 to 30 minutes (cycle time, average green-time split, basic phase sequence and network coordination), and on the operational level at intervals of 60 to 140 seconds (cycle, current phase sequence) or one second (phase transition switching).
- The system allows for the needs of all road users: private vehicles, public transport, pedestrians and cyclists.

Model-based network control with signal plan selection function: Start simple and expand step-by-step

In many cases, the existing signal plans applied in a particular control area are performing well, their green phases are finely coordinated and the motorists are satisfied with the result. Often there are also other reasons for the authorities to continue using existing controllers, for instance limited budgets that leave no room for the replacement of relatively old equipment. Now the adaptive network control system allows the efficient integration of such traffic light installations without requiring adaptations on the existing controllers or traffic light switching plans. This makes integration in Sitraffic Motion MX easier and even more affordable while still producing substantial positive effects because the signal plans are selected to suit the prevailing traffic situation:

- The system selects exactly those plans that are the most appropriate for controlling the current traffic situation.
- The system includes the effects on green phase coordination in its choice.
- Pedestrian traffic benefits too, because long cycle times (resulting in long pedestrian waiting times) are only selected if absolutely necessary.

After the introduction of "model-based signal plan selection" in a particular traffic area, the traffic light systems in this area can successively be modernized as needed to gradually use the full optimization potential of Sitraffic Motion MX.

Lugano in Switzerland is one of the cities benefiting from the advantages offered by adaptive network control. Here, Sitraffic Motion MX matches the control routines for 39 traffic light installations to the current traffic situation

Technical requirements for Sitraffic Motion MX

Central level	
Traffic computer system	Sitraffic Scala
Control method	Sitraffic Motion MX as part of the online control system
System concept	• OCIT interface (**O**pen **C**ommunication **I**nterface for Road **T**raffic Control Systems) • Canto (**C**ommunication in **A**dvanced **N**ew **T**echnology in **O**utstations) • Others on request
Control and visualization for Sitraffic Motion MX	Within Sitraffic Scala
Local level	
Controllers	• Sitraffic C800V/C900V • Third-party equipment • Others on request
Control method	• PDM and S-L with MX • Any thanks to the signal plan selection function • Other control methods on request
Detector equipment	• Inductive loops • Passive infrared detectors • Others on request

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