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Network-oriented traffic and system control based on Sitraffic Conduct+ software from Siemens makes South Bavaria's traffic regulating systems easier to operate

Translated reprint from:
Straßenverkehrstechnik, July 2013
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Network-oriented traffic and system control based on Sitraffic Conduct+ software from Siemens makes South Bavaria's traffic regulating systems easier to operate

Over the past decades, the traffic regulating systems (VBA) for the motorway network in South Bavaria have been constantly expanded. In the greater Munich area, so many subcenters have been added that their control and monitoring have become highly complex and time-consuming. Every day, the employees at the traffic and operations control center (Verkehrs- und Betriebszentrale/VBZ) for South Bavaria in Munich-Freimann have to face the huge challenge of keeping an eye on all 38 monitoring screens and thus on the traffic in the entire region and the operation of the now 11 subcenters. New traffic management center software now allows network-oriented traffic and system control (NoVA) and provides the VBZ employees not only with an integrated and clearly structured operational concept, but also with easily manageable hardware architecture.

Using Sitraffic Conduct+ software from Siemens, NoVa enables the central operation of all VBAs under the responsibility of the South Bavaria Motorways Authority from one central workstation.

The subcenters of the VBZ South Bavaria in Munich-Freimann

The traffic and operations control center (Verkehrs- und Betriebszentrale/VBZ) South Bavaria in Munich-Freimann monitors and operates all VBA subcenters for South Bavaria's entire motorway network. For this task, the specialized staff uses 11 workstations, each dedicated to a different VBA. Currently, the following subcenters are implemented at the VBZ:

- VBA A 8 Ost (Subcenter Holzkirchen)
- VBA A 8 Ost (Subcenter Siegsdorf)
- VBA A 99
- VBA A 94
- VBA A 9 Nord
- VBA A 9 Süd
- VBA A 92
- VBA A 99/A8 West
- VBA A 93 Nord
- VBA A 7
- VBA A 94 Tunnel Wimpasing.

Each of these subcenters is operated from a dedicated workstation at the VBZ, a local workstation (service building) and in some cases also one or several workstations at the motorway maintenance station responsible for the corresponding motorway section.

From two physical subcenters to a single virtual one

The large number of substations and sensors installed in the scope of the project for the "temporary opening of the hard shoulders on the A 9 motorway between the interchange Neufahrn and the three-way interchange Holledau" made it necessary to divide the control functions of the existing subcenter between two independent control components, the subcenters A 9 Nord and A 9 Süd. For operational and safety reasons, however, the operating staff should have to work with a single "virtual" subcenter only. This requires the reconciliation of the traffic control routines (automatic switching and special programs) at the junction of the two physical subcenters. For this purpose, the CONDUCT+ traffic center software (which has already been implemented in part at the VBZ South Bavaria) and its software basis, the SCADA system WIN CC OA, were utilized for the development of a higher-level traffic management center system that enables network-oriented traffic and system control (NoVa). NoVa allows the central operation of all traffic regulating systems (VBAs) under the responsibility of the South Bavaria Motorways Authority from one central workstation. Currently, the system integrates three VBA: A 9 Nord, A 9 Süd and A 92. Commissioning of the higher-level management system was carried out smoothly during ongoing operation. Thanks to the distributed system architecture, the required processing power can be distributed across the hardware of the existing subcenters, allowing a virtually unlimited expansion of the system in terms of processing power. After completion of the final expansion stage, NoVa will control and monitor a total of 12,500 data terminals (actors and sensors).

The new operational concept makes it possible to reduce the number of hardware components (computers including mice, keyboards and screens) needed at the VBZ to a minimum.

Once the system is completed, all components will use the same user interface and follow the same operational philosophy. This consistency will ensure efficient operation and reduce the risk of operating errors.

COMO: higher-level control module allows switching routines across several subcenter systems

As the traffic flows between the sections controlled by neighboring subcenters are extremely complex, the availability of cross-subcenter switching functions is essential for the operational staff. The NoVa system provides this type of functions. The cross-subcenter switching functions have been realized with the help of a specially developed "higher-level instance" of

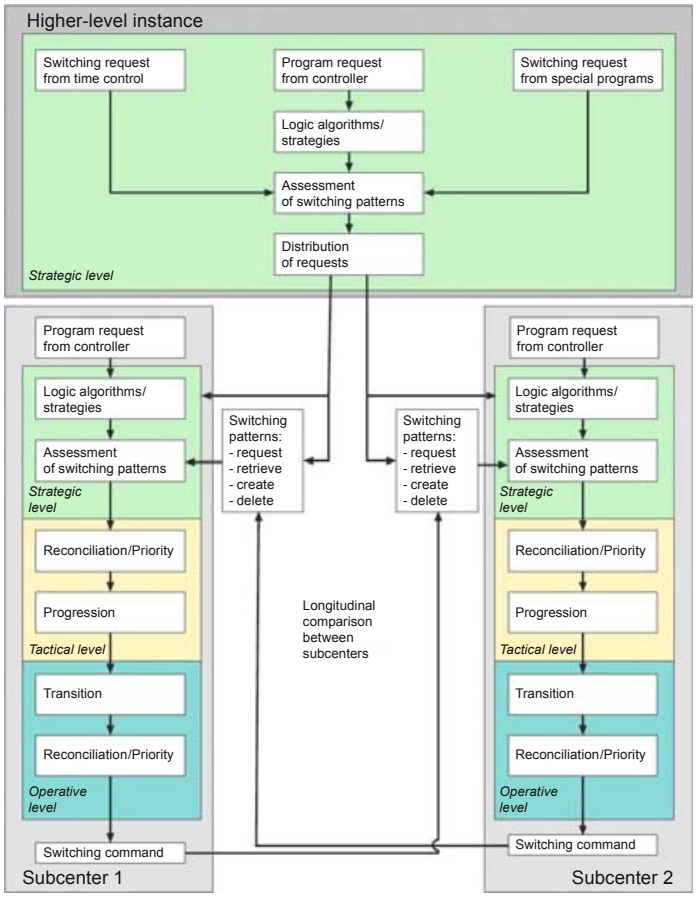

Fig. 1: Higher-level system overview

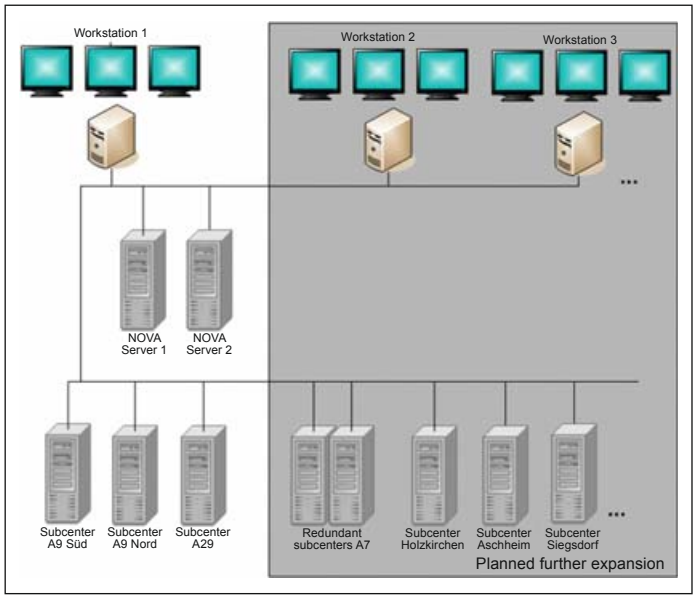

Fig. 2: System layout

the CONDUCT+ control module COMO implemented on the NoVa server.

In a mostly automatic process, this higher-level instance of the control module derives program activation demands from the data of the traffic-actuated control level. The main application areas are speed harmonization, temporary opening of hard shoulders, and traffic rerouting in case of tunnel closures. The key task of this instance is to assure coordinated traffic control measures (if necessary, using the dynamic lane allocation function) in the transition zones between the motorway sections covered by different subcenters. Moreover, it is able to generate switching demands for manual intervention and special programs, which are either activated immediately by the operator (e.g. in case of accidents or roadworks) or executed at a predefined time (for instance speed limits valid for specific time slots).

The higher-level instance distributes the switching demands for automated and special programs to the different subcenters concerned and computes which symbols have to be switched on at the sign gantries controlled by the individual subcenters. In this context, the system checks the plausibility of the activated switching routines across the different infrastructure systems and, if possible, automatically remedies any conflicts detected, or sends an alarm message to the operating staff (in the case of special programs and manual interventions). This allows the harmonization of the traffic regulating measures, for instance speed limits at the transition point between different subcenters. The introduction of the higher-level control module marks the shift from line- respectively section-oriented traffic control to network-oriented traffic management.

The higher-level strategy module COSMOS offers graphical planning tools for response programs

For the operating personnel, the COSMOS strategy module is a powerful tool for interactive graphics-based planning of response programs that can be implemented across different sections and systems to respond to various traffic situations requiring intervention.

Technical design

For the exchange of data between the NoVa server and the connected subcenters, the "distributed system" function of WIN CC OA is used. In the simplest case, a distributed system is the combined operation of two projects running on different computers using the same or different operating systems. Distributed CONDUCT+-systems are interlinked using a dedicated WIN CC OA manager. Via a network, this manager is able to maintain a logical connection to several other CONDUCT+ systems.

Distributed system topology for the NoVa project

The NoVa system established on the basis of CONDUCT+ is hierarchically structured. On the highest hierarchical level are the redundant NoVa servers, which are responsible for all higher-level functions. All integrated subsystems – in the present project the different subcenters of the traffic regulating systems using CONDUCT+ – form the lower level.

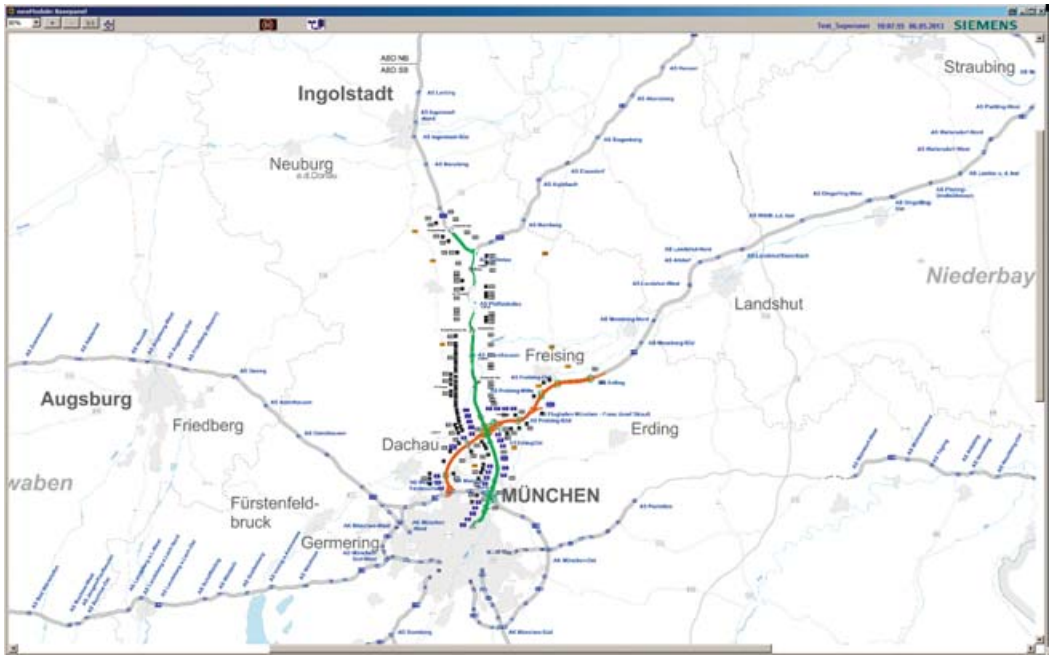

Fig. 3: Screen 1 "Overview South Bavaria"

Content displayed on the screens at the NoVa workstation

In the standard version, a workstation is equipped with 3 screens. For special applications such as a NoVa workstation at a motorway maintenance center, more or fewer screens may be used. With a special focus on user-friendliness and ergonomic layout, the distribution of the display functions between the operating and visualization screens is as follows:

Screen 1 (figure 3) shows the overview diagram of the "South Bavaria" network. The pale colors of the background have been chosen deliberately to allow the operator to focus on the display objects that are relevant for traffic control functions. The background layout is user-selectable.

As an overlay on this background map, the following items are displayed:

- Symbols for the variable message signs
  Variable message signs are displayed in the form of symbols indicating the activated switching program (current switching status).
- Level of Service
  The measuring sections are displayed in the form of a contour line for each traffic direction indicating the current Level of Service (LoS) value.
- Environmental sensors (visibility and wetness)
  The wet-road sensors are displayed as symbols visualizing the current degree of wetness.

If there is a fault message for an individual object, the corresponding symbol has a red frame. With a click on an object or a LoS contour line on the map, the corresponding line diagram including all details is displayed on the line overview screen (on screen 2 or 3). The displayed information concerns principally the selected object. The layout of screen 2 (figure 4) is composed of the sections "Control/ Switching", "Status information/ System overview" and "Line overview".

The leftmost window contains the menu tree for selecting the functions that are enabled for all users, for instance:

- Temporary opening of hard shoulders
- Control of dynamic routing displays
- Editing of dynamic routing (dWiSta) symbols using the fully graphical CONDUCT+ editor
- Control of ramp metering systems
- Activation of tunnel programs
- Activation of rerouting programs in case of tunnel closures
- Switching programs in case of accidents or road works
- Switching of manual and automatic programs
- Configuration of time-controlled action plans.

To the right side of the menu tree, an overview list shows the status of all lower-level subcenters integrated in the NoVa system.

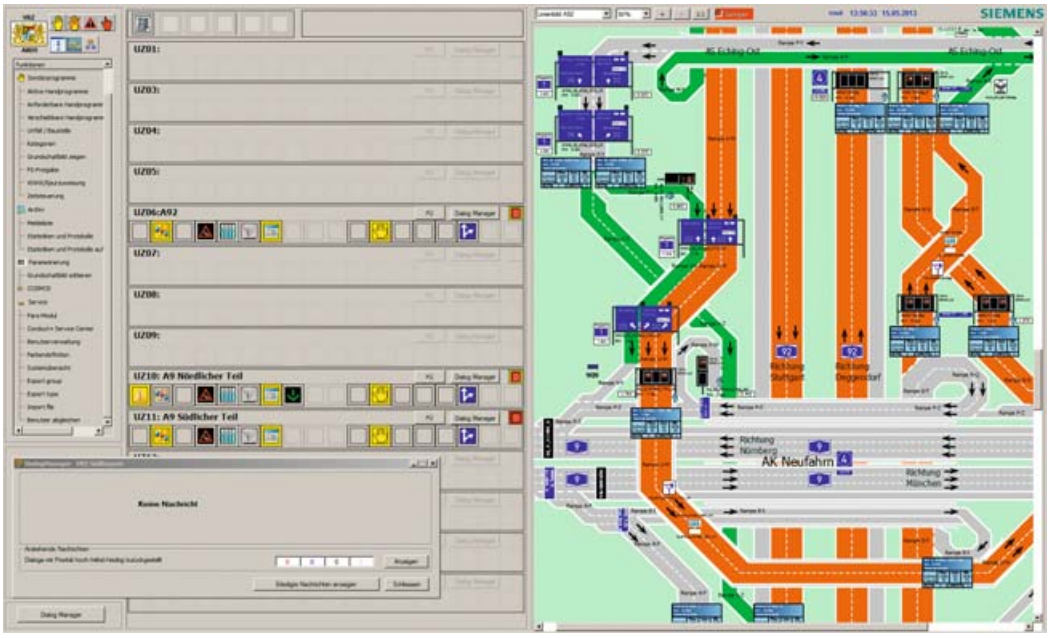

Fig. 4: Screen 2 "System overview and line diagram"

The following status types can be indicated:

- Connection between NoVA and subcenter interrupted
- Equipment failure of an outstation
- Failure of a data terminal (actor/ sensor)
- Wet-road alarm
- Congestion alarm
- Message regarding opening of hard shoulder
- Message regarding dynamic message sign switching
- Visibility alarm
- Equipment controlled manually, locally or in open-loop mode
- Equipment disabled
- Plausibility error
- Manual switching activated
- Time-controlled switching activated
- Connection to third-party system (e.g. video) interrupted
- Wrong-way driver alarm
- Hardware monitoring for subcenter (server).

These status indications provide the operators with gapless information on failures and alarms even from those subcenters whose line diagram is not currently displayed. This prevents any situations requiring an intervention or response from being overlooked.

The right-hand section of the screen displays one of a series of line diagrams. To ensure that the menu tree and the status indications are always in the operator's field of vision, the exact layout of this screen is predefined.

The third screen usually displays two line diagrams. In this case, the layout of the screen is user-definable. Consequently, the current system allows the simultaneous display of three line diagrams, which can be individually configured.

Future steps:

- Integration of an additional 10 traffic regulation systems covering sections of the South Bavarian motorway network. Currently three subcenters are integrated in the system. As soon as the funds have been allocated, all VBAs in South Bavaria are to be successively integrated in the NoVa system.
- The possibility offered by CONDUCT+ to distribute computing loads (data processing) makes it possible to create systems covering a virtually unlimited range of outdoor equipment.

With its intuitive user interface that minimizes operator errors and the network-oriented traffic control concept and the prevention of erroneous, implausible or conflicting switching events, in particular in the transition zones between different subcenters, NoVa helps make traffic control easier and safer and improves traffic flows.

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Printed in Germany
DEI 73/49774 SD 09133.
Dispo No. 22300 K No. 690
Order No. A19100-V350-B156-X-7600

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