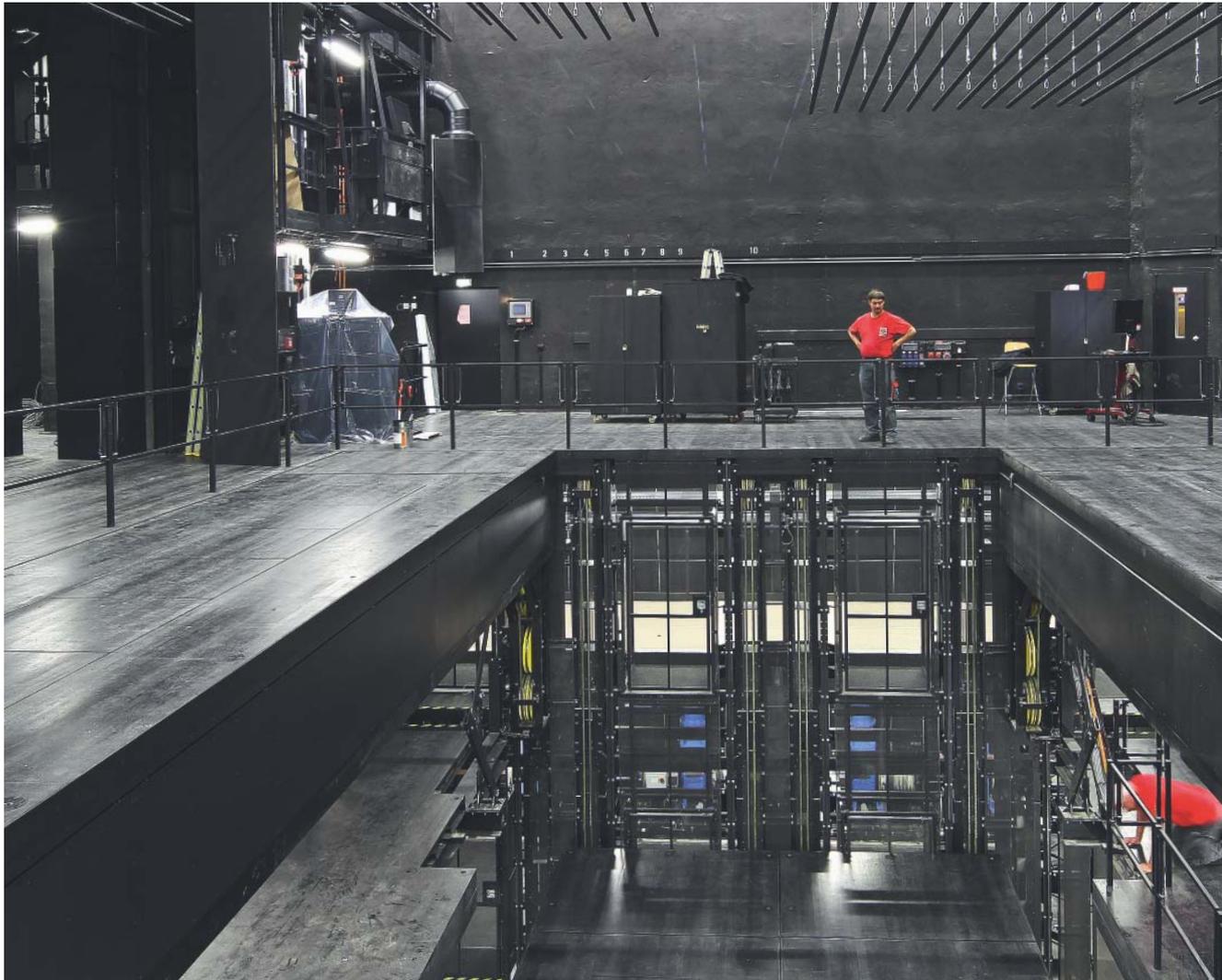


View of the overstage machinery with the cable winches: following the complete rebuild of the stage, the Schauspielhaus in Nuremberg now has 47 machine hoists for the backdrop, panorama, portal, gallery lighting, overhead lighting, rear stage and forestage hoists, ten point hoists and four lowering devices for the stage podiums, which can be moved independently of one another.



The stage has a total area of 20 m x 35 m, wherein the main area, the four movable podiums, takes up a total area of 10.5 x 12 m.





In addition to the redesigned auditorium, the Schauspielhaus in Nuremberg now has ultra-modern stage equipment following the rebuild work, offering state-of-the-art working conditions and revitalized artistic/technical possibilities.

New control solution for Schauspielhaus renovation in Nuremberg

Complex stage and theatre technology with PC- and EtherCAT-based control

Flawless performances in opera houses and theatres require ultramodern and complex stage systems and technology. To meet these demands, the Schauspielhaus in Nuremberg, Germany has been completely renovated over a two-year construction period. The contract for the renovation of the entire stage equipment was awarded to TTS Theatertechnische Systeme, who, for the first time ever, relied entirely on PC-based control technology from Beckhoff with EtherCAT connectivity throughout for this complex project.

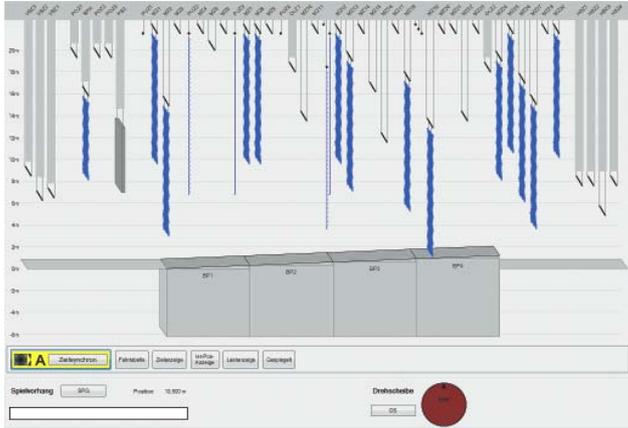


Up to 14 different performances take place each week in the Schauspielhaus of the State Theatre in Nuremberg. This is possible only with ultramodern stage technology, with lifting podiums, computer-controlled flies and turntable, as well as state-of-the-art lighting technology. For this reason the decision was made in favor of a general overhaul of the theatre: apart from the reception area, the renovation covered the seating and auditorium as well as the entire understage/overstage machinery. TTS GmbH was commissioned to carry out the entire renovation, from the steelwork through to the electrical and control installations. Specializing in technical theatre systems, TTS GmbH is based in Syke in north Germany and has been active in theatre and stage technology for 20 years and has used Beckhoff components since 2002.

EtherCAT – high-speed Ethernet as the higher-level bus system

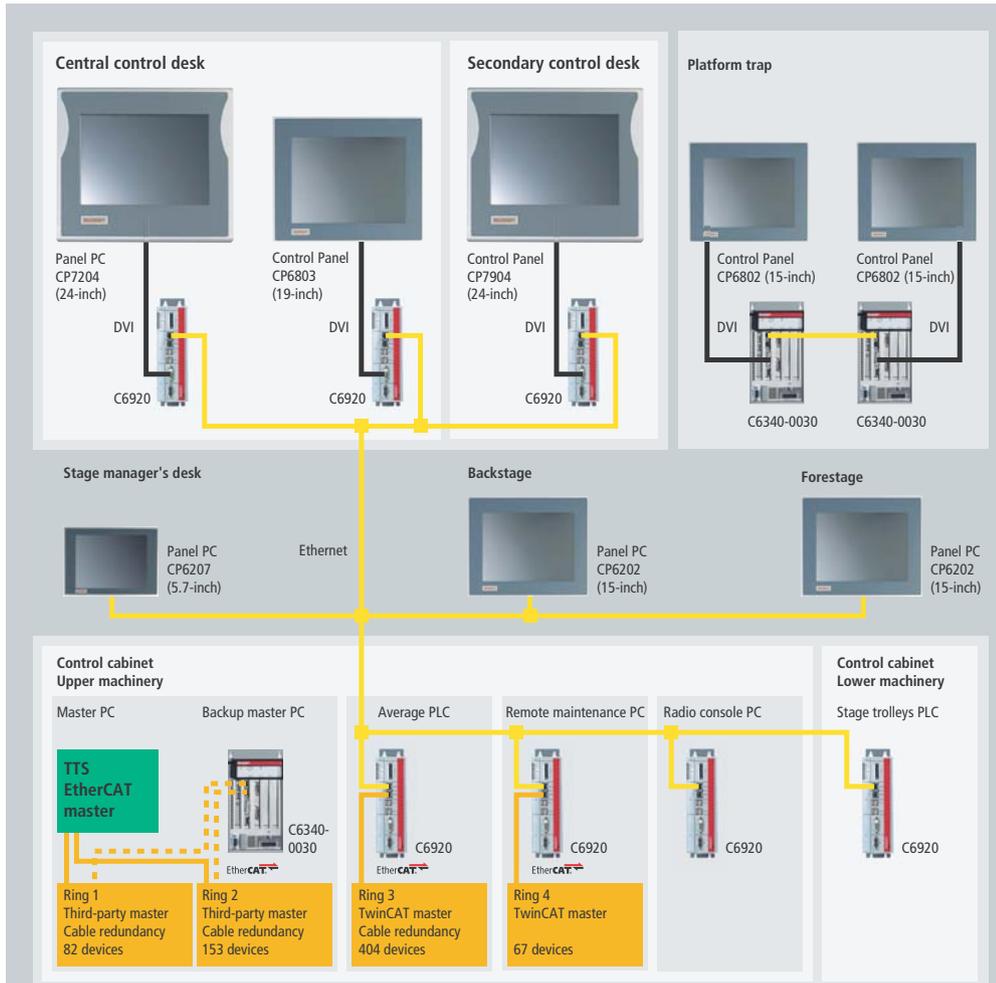
The stage control is subdivided into different task areas and functional areas, for which various Beckhoff Industrial PCs and the EtherCAT bus system are used throughout. (see page. 31) The main controller is a TTS computer, which is implemented as a cable-redundant EtherCAT master. Safety functions are controlled via software specially developed for theatres. The back-up master computer is a Beckhoff C6340-0020 control cabinet Industrial PC running TwinCAT I/O software, which takes control of the cable-redundant EtherCAT network in the event of failure of the main computer.

Three Beckhoff C6920 control cabinet Industrial PCs with customized operating panels are in use on the main and auxiliary control consoles; four more Industrial PCs control the understage/overstage machinery.



The stage area is visualized and operated via software specially developed by TTS.

TTS has been using Beckhoff components since 2002. "The use of local I/O peripherals from Beckhoff enables us to tailor our systems precisely to the needs of our customers. The successful introduction of the Bus Terminals was followed by a switch to Beckhoff Panel PCs and TwinCAT automation software," explains Frank Kremer. "In the last step, which was the search for a bus system to suit our purposes, we decided on EtherCAT, which encompasses the most important characteristics for us: real-time capability, high bandwidth, cable redundancy and impressive diagnostic properties."



Customized Beckhoff control panel on the main control console. The 24-inch display provides the stage technician with an overview of the entire system without scrolling the screen.



Hans-Helmut Mandel, Beckhoff Hanover Sales, supervised the implementation of the project in close cooperation with TTS Theatertechnische Systeme: "One of the absolute highlights of this application is the EtherCAT redundancy, which guarantees maximum availability."



Frank Kremer, project manager at TTS Theatertechnische Systeme and Ole Sörensen, TTS software development

Three CP6202 and CP6207 Panel PCs are responsible for the control of the stage manager's console, the main stage and the forestage. The lowering of the platform is controlled by two C6340 control cabinet PCs with detached 15-inch panels. More than 5000 I/O points are distributed around the stage area; these are monitored and controlled via 700 EtherCAT Terminals which are divided into four individual EtherCAT I/O strands or rings:

- | Ring 1: TTS controller (C6340 Backup PC), cable redundancy: 82 devices
- | Ring 2: TTS controller (C6340 Backup PC), cable redundancy: 153 devices
- | Ring 3: Beckhoff C6340 IPC with TwinCAT master, cable redundancy: 404 devices
- | Ring 4: Beckhoff C6920 IPC with TwinCAT master: 67 devices

The entire system can be controlled wirelessly from different control consoles, which are stationary, mobile or portable, depending upon the version. Eight customized control panels with touchscreen functionality are used, some with an integrated or a detached Industrial PC and display sizes ranging from 5.7 to 24 inches.

Scenery changes with the curtain open

Following the complete rebuild of the stage, the Schauspielhaus in Nuremberg now has 47 machine hoists, ten point hoists and four lowering devices (podiums), which can be moved independently of each other. The stage has a total area of 20 m x 35 m, wherein the main area, the four movable podiums, takes up a total area of 10.5 x 12 m. Each podium is equipped with a so-called tilting cover, which serves to tilt the entire podium surface by up to 10 degrees. In each tilting cover there are seven trap doors with electric drives, which enable the opening of the stage floor. Two lowering platforms can be placed on the lug subpodium of the podium under the trap doors. In addition, there is a foldable stage wagon with an integrated turntable of 10 m in diameter and a weight of 20 tons. If the turntable wagon is not in use, it is folded up at the rear of the stage and pulled upwards into a parking position. The lifting/folding movement is performed by a hydraulic cylinder that can pull up to 60 tons.

The technical functions of the stage offer a wide range of new possibilities for performances. One example of this is the open transformation of the stage, i.e. the scenery can be changed with the curtain open. To this end, the stage technician selects previously created movement sequences (so-called transformations) on the operator interface and subsequently executes them. Thus complex movements on the stage can be carried out at the push of a button. All driving modes are synchronized, so that synchronous move-

ments between the understage and overstage machinery are easily possible. "Theatre operators place great importance on safety and very high availability of the controller. Redundant EtherCAT bus masters and EtherCAT with cable redundancy have been used in order to guarantee compliance with the SIL 3 safety requirements," explains TTS project manager Frank Kremer.

EtherCAT provides precisely synchronized movement sequences

There is an axis computer for each of the drives that need to be controlled, regardless of whether it is a backdrop hoist or a point hoist; a total of 70 EtherCAT drives were installed for this. The central computer from TTS controls the entire drive equipment. Each axis computer is responsible for the positioning and monitoring of the drive axis assigned to it, wherein it receives its drive commands and setpoint values from the master computer via a bus system. "With this latest controller generation we have used EtherCAT throughout as the bus system. EtherCAT combines the advantages of high bandwidth with real-time capability for the synchronization of the drives and with higher availability due to the cable redundancy characteristics," comments Frank Kremer.

The dual-channel master computer evaluates the input data from the various control consoles and the drive commands from the individual drive levers. It also relays the data to the axis computers and controls the entire data communication of the controller, adherence to specified movement sequences and the positioning of the axes. The axes of the overstage and understage machinery can be controlled simultaneously from the master computer so that, for example, a podium and a backdrop hoist resting on it can be driven synchronously.

Everything available at a glance

"In conclusion, it can be said that our requirements and functions have been entirely fulfilled by the new installation," confirms Florian Steinmann, stage inspector at the Schauspielhaus in Nuremberg: "Due to the elaborate decorations and the increasingly complex and numerous transformations of the stage area, we are well equipped for the future, too, with the new stage machinery. The 24-inch displays provide an overview of the entire stage without scrolling the screen. The operation and monitoring of the complex system has become much simpler and is more user-friendly as a result."

TTS Theatertechnische Systeme www.ttssyke.de
Schauspielhaus Nürnberg www.staatstheater-nuernberg.de