MONITORING CENTRES - 
A DEVELOPMENTAL JOURNEY INTO THE NEXT DECADE

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ABSTRACT

Control centres for traffic monitoring are the heart of each operation unit of a road network. All the electronically provided input comes together at one location and the persons on duty have to be provided by the most important information concerning traffic on the road network to be monitored. Although much information and data is handled and stored in the SCADA system, it is task of the system to bring abnormal traffic and operation situations to the awareness of the operators. This concerns all information which is required to run the network smoothly and to provide a safe journey for the users of the network.

The technical development in data transfer and communication technology allowed for an integration of huge parts of road networks including many critical infrastructure parts, like road tunnels. Hence the demands on such control centres have changed during the last decades dramatically. Nowadays the operation of a road network relies strongly on automatic support provided by the systems.

Keywords: Road tunnels, monitoring centres, SCADA systems

1. INTRODUCTION

Tunnel monitoring centres have evolved over the past 20 years from primarily performing system monitoring to currently processing traffic monitoring tasks. The original mosaic display with static system images and the display of operating notifications have been replaced by projection screens consisting of individual monitors. The resulting display flexibility has been primarily used for displaying video images from traffic monitoring.

![Figure 1: Tunnel control station Plabutsch Tunnel 1987](image)

The requirement to monitor the function and plausibility of automatic processes was the original purpose for displaying system images. The performance capability of simple controls was insufficient for complex processes such as a fire and therefore still required manual controls. Functional and plausibility control via machines only became possible with the rapid advances in automation. Further progress in video image analysis constituted the next step towards depicting a practice-oriented number of live images from the traffic systems since traffic irregularities were automatically detected in the background and a notification was subsequently displayed with video image intrusion on the control console.
However, the currently available hardware potential is not utilised sufficiently. In fact, advancements in monitoring technology seem to be at a standstill for years.

2. CURRENT INSTALLATIONS

Due to budgetary constraints, a low-cost, small control console, which incorporates all the functions of a large monitoring centre, had to be constructed for the traffic control station Liezen, which acts as Monitoring Centre North (ÜZ-North) for huge parts of the road network of northern region of Styria. Among other things, the plan included designing a projection screen that was as flexible as possible and could be sufficiently equipped with cost-efficient standard LCDs, which provided the possibility for utilising OLED display screens at least in the second generation without the need for further technical restructuring work.

![Figure 2: Projection screen construction ÜZ-Nord 2011](image)

All subsystems, such as emergency services, video, avalanche warning and tunnel guidance devices etc., had to be completely integrated into the guidance system in order to ensure full flexibility. This is also the most prominent distinctive feature in comparison to the technical state of current control console technology. The standard has even regressed in some areas such as for real-time identification.

![Figure 3: Input monitors at the control station WELS 2003](image)

Due to this currently unique integration of all subsystems (which even includes the house intercom and gate control system), operators no longer have to differentiate between old integrated systems. The guidance system performs command executions in the background.

For the first time, all audio signals have been integrated into the guidance system with a network-compatible mixer console in order to provide automatic switching or automatic volume control according to prior signals such as emergency service, telephone etc.
During the course of constructing the station ÜZ-Nord, a completely new emergency call system with standard telecontrol protocol including IEC 104 and the standardised SIP protocol (without add-on) for voice transmission was realised. For the first time, the video packages for the tunnel systems via the network have also been standardised with H264. Actual commands can be entered via touch panels for all external and internal controls.

All systems, including workstation computers, have been expanded redundantly in order to ensure operational safety. Only the external telephone centre building and the early warning system for icy conditions were not integrated into the system upon request of the operator.

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**Figure 4:** Screen input via touch panels or mouse and keyboard 2011

**Figure 5:** System overview ÜZ-Nord
These new technologies achieved a cost reduction for the control console or console system, which amounted to approximately 0.5 million euros. The little available space could be optimally used due to the optimal utilisation of the available technical hardware and software. Manufacturer-specific problems have been kept out of the system by using standard protocols. The operator does not notice any difference between old and newly constructed tunnel systems.

The requirement was to ensure that each function for control and guidance of all tunnel systems could be loaded and controlled from anywhere in the monitoring area via a network-integrated notebook on-site or service control console in accordance with authorisation. Additionally, video images from all available traffic cameras can be loaded onto the notebook. These TV images are also available to the respectively responsible external road maintenance depots.

This also constitutes the first step towards so-called Internet and/or desk control consoles. Operation no longer requires hundreds of background images since the active image elements can be added, removed or combined according to the requirements of tunnel subsystems. For the first time, bands instead of images have been used for the visualisation, which fully realise all advantages by combining layer, pan and zoom technology.

Thus, all framework conditions, such as cost optimisation, full-content display and uniform control of all subsystems, have been fulfilled. This, however, does not imply that a new technical standard has already been achieved. It has, however, provided proof that a full integration of all tunnel system parts is possible with little expenditure resulting in the establishment of an advanced monitoring centre.

Figure 6: Tunnel control and display level on the input screen
Thus, the basis for cost optimisation including operating costs has been established, and the cornerstone for a new control console technology for tunnel monitoring has been laid.

First and foremost, we take the situation of the operators into consideration, which greatly contributes to the safety on the streets. Appropriate hardware and functions must be made available to the operators. Of course, acquisition costs and operational management must also be taken into account.

3. CURRENT AND FUTURE TECHNOLOGY

Currently, the following SCADA tools are available or will establish themselves in the near future:

**Human-machine communication:**
The most relevant part for the operator is the connection between control operations and the associated actions within the system.

**Hardware reduction:**
Large workstations with an enormous amount of equipment will no longer be necessary and become less important in the near future. Operators will process tasks on relatively small, location-independent workstations.

**Technical systems are already available for directly utilising the latest developments.**

**Standardisation of communication protocols:**
By now we also have a data world that covers the largest share of information with standardised protocols. Of course, further specific protocols will be required depending on the application, but these do not concern the operator. The operator will be independent of various communications and system parts and have consistent control over the same activities.
Location-independent system control:
Network connections with an appropriate bandwidth are available everywhere and no longer constitute a public limitation. All required services have advanced significantly and are fully available via the network.

Figure 8: Micro control console as notebook control console with tunnel remote control

Mini consoles:
New hardware components shrink the necessary workstation space to an unprecedented size. The development of OLED monitors is the decisive achievement in this area. The compression of computing power also contributes significantly to these advancements.

Based on these achievements, the workstation can develop into a compact unit that is no longer bound to local conditions. The workstation consists of only one monitor (8K/77") and two upstream touch-capable 24” input devices. Headphones are used for language services, which frees up the operators’ hands for other work.

In an 8K resolution of a new OLED screen 70 video images could be displayed at full 4CIF resolution at the same time. Due to the compact arrangement is thus the representation ability much higher than in a conventional screen with rear projectors!

Voice and gesture control will not play an important role and should be disregarded on account of safety considerations.

The video wall functions are directly integrated into the visualisation, and all subsystems are also fully integrated.

What would such a control station look like?
What advantages will the new control console technology provide?

1.) Operational simplicity, advanced training and safety for all systems
   First and foremost, operational simplicity must be mentioned here.
   The operator can assemble the surface himself. The system in the background ensures a
   consistent and uniform operation for various system functions. Training and induction
   times for operators are reduced to a minimum. Improper interventions can be avoided
   for the most part.

2.) No investment costs for large spaces, light shading and air-conditioning for display
   devices
   Halls for control consoles will no longer be necessary due to these new technologies.
   Desk control consoles can be used in a normal office environment.

3.) Availability like never before
   Desk control consoles can be equipped with redundancies and spare or parallel work
   stations.

4.) Cost savings
   In a cost comparison, a total savings of 60% of the current cost of control consoles was
   calculated.

**Figure 9:** Structure plan and 3D illustration of a control station