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Alarm and announcement systems, systems for data transmission and monitoring of transportation means and power supply systems for electric traction – overview of solutions from TELVIS developed for mining industry

The paper outlines scope of business activities mainstreamed for TELVIS Co., Ltd., the company that for 25 years has been perceived as a manufacturer of intrinsically safe solutions for mining and industrial telecommunication. Attention is focused on individual products with more detailed description of their key advantages and benefits that can be accomplished due to application of these products alone or in combination with other systems and equipment. Particular considerations are dedicated to general purpose systems for transmission of analog and binary signals as well as the system for monitoring of transportation means and power supply voltage for electric traction.

1. SAT SYSTEM FOR TELEPHONE COMMUNICATION RAISING ALARMS AND ANNOUNCEMENT BROADCASTING

The system features with integration of telephone functionalities with alarm and announcement broadcasting abilities that are combined in a single device – the PST messaging and telephone device for underground applications [1]. In particular, the device is able to perform the following functions:

- establishing of telephone connections in excavations with potentially explosive atmospheres and associated hazards of methane and /or coal dust explosion,
- collaboration with any telephone exchange provided with analog ports,
- receiving of calls at the control room of the operation in the ordinary and emergency modes with exact localization of the caller,
- conversation between a engineer-on-duty and a subscriber in the simplex or duplex modes,
- broadcasting of alarm announcements or prerecorded voice messages automatically retrieved from the device memory,
- ability to control up to four devices connected to outputs of the PST messaging and telephone device,
- ability to monitor status of up to four devices connected to inputs of the PST messaging and telephone device,
- phone conversations with use of either a receiver or a loud-speaking facilities,
- automatic recording of emergency calls, other calls can be recorded upon request of the engineer-on-duty,
- keeping records on the system operation with compiling relevant reports,
- checking condition of the telephone lines.

The SAT system has a modular structure. Its part located at the mine surface is made up of the central station that comprises racks for line drivers as well as central control panels with a maintenance workstation. Control functions re executed by central control panels and the maintenance workstation. The system configuration is monitored and managed by the maintenance workstation.

Due to its open architecture the SAT system can collaborate with other equipment or systems that can be connected to the internal RS485 transmission bus

via Buffers of External Devices (BUZ) or via Ethernet network. It is possible to arrange collaboration according to several layouts [2].

1.1. Integration of the messaging and alarm system with the systems for monitoring of air parameters

Combination of the systems for monitoring of air parameters with the system for raising alarms and announcement broadcasting enables automatic dissemination of voice messages and alarm signals to predefined groups of subscribers. A good example is the case when a methane gauge installed at a specific location detects that the permissible level of methane concentration is exceeded. Typically, such a situation results in advising the operator of the methane monitoring system and a message about a methane hazard within a specific region is displayed on the operator's control panel. Owing to integration of the system for monitoring or air parameters with the system for alarm and announcement broadcasting enables automatic transmission of an alarm signal to PST messaging and telephone devices installed within the methane gauge that triggered the foregoing sequence of events and the PST devices alone shall announce preprogrammed voice messages. Such a procedure makes it possible to speed up evacuation of mining staff from the endangered region [2]. It is necessary to add that the operator of the methane monitoring system is able to willfully interrupt broadcasting of alarm signals or to amend content of broadcasted messages.

Integration of the SAT system with system for monitoring of air parameters can be carried out in two manners:

- by direct links between underground equipment (e.g. contact of the CH_4 limit sensor connected to a binary input of a PST device),
- by interaction of systems installed at central control stations – information is exchanged via the LAN network of the central control room.

Such systems that automatically inform personnel about existing hazards due to improper composition of mining air or due to inefficient ventilation of excavations have already been in use at such coal mines as 'Pniówek', 'Budryk', 'Zofiówka', 'Chwałowice' and 'Brzeszcze'. However a market novelty is the MAW device that enables easy and fast integration of the alarm and announcement broadcasting system with the most popular systems for monitoring of air parameters.

1.2. Integration of the messaging and alarm system with loud-speaking systems for technological communication

Coupling of the SAT system with loud-speaking systems for technological communication enables offers the following benefits:

- dissemination of signals and messages to loud-speaking equipment from the central control panel PDK-SAT,
- possibility to use the central control panel PDK-SAT to listen to conversations carried out through loud-speaking device,
- receiving of regular and emergency calls from user of the system for technological communication (not all system offer that option).

The integration is achieved by means of a PST-T messaging and telephone device (with use UWSG or SW1 coupling devices) manufactured by TELVIS or by means of coupling equipment offered by manufacturers of telecommunication systems for technological purposes.

Under the foregoing terms the SAT system is capable of collaborating with loud-speaking devices for telecommunication systems offered by ELEKTROMETAL plc., ATUT Co., Ltd., ELTEL Co., Ltd., and BECKER ELEKTRONIKA.

1.3. Integration of the messaging and alarm system with wireless communication systems

In spite of numerous advantages the wireless communication systems that are now more and more frequently used for mining applications still offer much less communication and broadcasting functionalities than conventional wired technology. Therefore, integration of wireless systems with alarm and announcement broadcasting systems installed in parallel at mining operations substantially improves reliability of such combined systems and is advantageous to occupational safety of mining personnel.

An example of such integration that was carried out at copper mining operation of KGHM is the STAR-DOTRA communication system that is the result of coupling between the STAR and DOTRA systems and was developed owing to collaboration between the Institute of Innovative Technologies EMAG and two manufacturing companies, i.e. INOVA Co. Ltd., and TELVIS CO., Ltd.

Currently, within the upgrade of communication and alarm systems the SAT-DOTRA system is being implemented at KGHM mining operations.

The DOTRA communication system is based on RF transmission with use of so called 'leaking cable' that serve as an antenna and radiotelephones as user devices. The system assumes that each user has its unique and individual number and such functionalities are available as clear and full identification of callers, establishing communication between callers and assigning authorization rights to individual subscribers. The radiotelephones that are used within the system can be used to make a call to each individual subscriber and establish connection with any other telephone, make a call to a group of subscribers, broadcast an unidirectional announcement and send a text message to a display of the addressee radiotelephone.

Key functions of the DOTRA system include:

- individual calls,
- group calls,
- broadcasting of announcements,
- priority calls,
- alarm calls,
- establishing of telephone connections,
- paging,
- calling by shortcut numbers,
- information about calling and called subscribers,
- information about battery status,
- information about signal level,
- information about leaving the signal reach,
- protection with access codes,
- queuing of calls,
- intrusion to established calls (teleconference calls),
- numbers transferable from one telephone to another,
- computer aided workstation of the system operator,
- transmission of telephone statuses,
- transmission of short text messages – SDM,
- rising alarms,
- data transmission.

The system is made up of one central station assigned for the entire mine and located at the mine surface as well as regional control stations installed at underground excavations. Regional control stations are capable of handling 6 RF channels per each region (5 channels for phone calls and 1 channel for control information) that enables queue-free communication between 100 to 200 terminals (radiotelephones).

The DOTRA system comprises individual portable radiotelephones as well as transportable and fixed ones. The system capacity is defined as the multiplicity of 700 numbers since that numbers corresponds to the stock of numbers. Typical quantities that are used at Mining Operations of KGHM equal to 700, 1400 or even 2100 numbers in future. The system are coupled within the central control stations (at the mine surface) as well as at the level of control panels for the both systems. It enabled to substitute the DOTRA operator's control panel that is typically installed inside the central control room with the SAT (STAR) control panel. To accomplish the replacement the capacity of the SAT (STAR) control panel was extended with the following functions:

- ability to receive calls from any user of a radiotelephone and display identification data of the caller on the control panel of the alarm and announcement broadcasting system,
- ability of the control system operator to make a call and have individual conversation with a user of any radiotelephone,
- broadcasting of alarm signals or messages to groups of subscribers who share a common radio (RF) channel.

The structure of the coupled system is shown in Fig. 1.

Currently efforts are in progress to couple alarm and announcement broadcasting systems offered by TELVIS Co., Ltd., with wireless communication systems provided by other manufacturers and installed at hard coal mines.

The imaginable and most desired solution consists in integration of wireless communication systems with an announcement broadcasting system and, simultaneously, with a system for measurement and keeping records on air parameters. Such a solution would enable even faster warning any member of the mining personnel about possible hazards.

1.4. Collaboration of the messaging and alarm system with systems for visualization of equipment operation and its technological parameters

Incorporation of the SAT system for alarm raising and announcement broadcasting into the LAN network of the central control room enables collaboration of the messaging and alarm system with systems for visualization of equipment operation and its technological parameters. For instance, operation of messaging and telephone devices can be visualized on a mimic table or on a computer display of the chief engineer for the mine.

Operation status of the messaging and alarm systems manufactured by TELVIS Co., Ltd., is currently handed over to THOR systems offered by SEVITEL Co., Ltd., SD-2000 systems from ITI EMAG and ZEFIR systems from Laboratory of Computer Software 'Prunella', civil partnership.

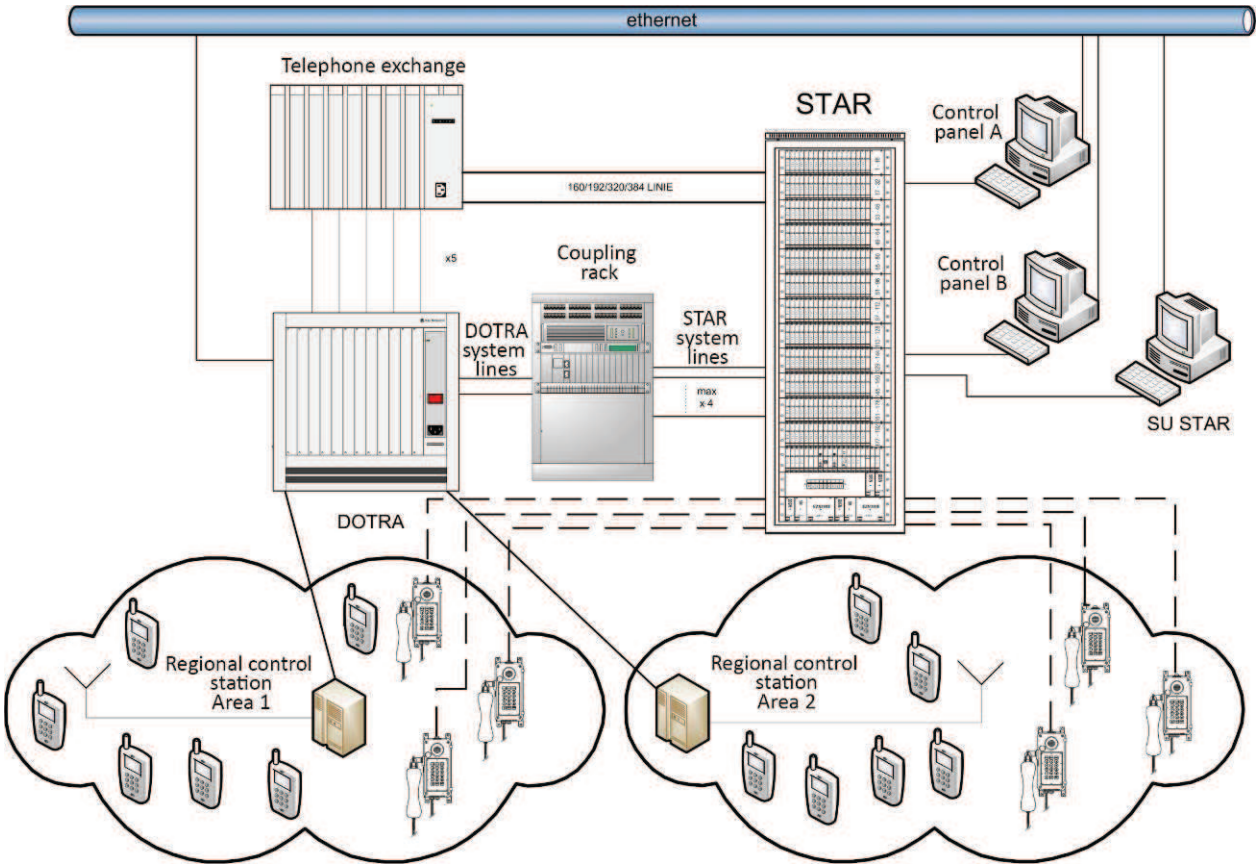

Fig. 1. Structure of the integrated system STAR-DOTRA (own development)

1.5. Collaboration of the messaging and alarm system with systems for personnel identification

Increasing interest to systems for identification of personnel has led to development of coupling tools with such systems [3]. Eventually, two types of coupling have been developed.

The first one is a rather typical solution that benefits from a computer network. Due to the fact that within the both systems information is chiefly acquired, collected and stored by computers, interconnection through network seems to be the simplest and the most efficient solution. Such interconnection makes it possible to transfer data directly between servers of the personnel identification system and computers of the SAT system. Since no separate computer is provided within the SAT system for collaboration with other systems, the communication tasks are carried out by the Maintenance Workstation. If no Maintenance Workstation is present, the communication tasks are delegated to the 'C' Control Panel and next, in case of its failure, the 'B' control panel becomes responsible for execution of commands. Finally, when the 'B' control panel is broken the collaboration and interconnection functions are relied onto the 'A' control panel. The function of the SAT system that is used for collaboration consists in broadcasting of voice messages and the system is used as a tool for dissipation of information to the personnel. The most apparent use of such a coupling between the two systems enables searching for a specific person or certain persons. It is accomplished by installation of a messaging device nearby a gate of the personnel identification system. When the system for personnel identification detects that the searched person appears nearby one of the gates it sends the appropriate command to the SAT system. At that moment the person who passes the gate is automatically informed that he/she is searched for and is asked to call a certain person.

The mechanism for searching a specific person can be configured both within the identification system and in computers of the SAT system. Visualization of the system tripping, i.e. the moment when a searched person appears within vicinity of an identification gate, can be also carried out on computers of the both systems. In that way the process becomes fully automated and gets rid of the uncertainty component resulting from a human factor and associated with information exchange between operators of the both systems. Opportunity for bidirectional and fast exchange of information between the two systems combined with the advanced technology of speech syn-

thesis enables more clear and forcible dissemination of information. Configuration of the paging mechanism enables definition how to use families of persons to be informed. The system of access control and identification of personnel not only detects that the desired person appeared within vicinity of the system gate but also uses the personnel database to find out personal details (name and surname) of the person. Finally, the broadcasted message may adopt the following form: 'Mr. Adam Kowalski is requested to call the engineer-on-duty'.

Another benefit from combined systems of such types is automatic announcement about the fact that the number of persons who are present within a hazardous region (with potentially explosive atmosphere) is exceeded. Gates of the access control system are installed at two ends of the hazardous region and when an excessive person appears within vicinity of an entry gate and the maximum permissible number of people are already present in the hazardous area that excessive person may receive a warning message. For such announcements the system uses messaging and telephone devices installed at the gates. Obviously, information about the event (access violation) can be also conveyed to control panels of the personnel identification and access control system as well as to the SAT system. The entire process is carried out automatically.

The system algorithm can be also configured in the manner that is quite similar to the previous case so that to use families of persons that have to be advised about the danger. Therefore the respective message may adopt the following wording: 'Mr. Adam Kowalski, please abstain from entering the hazardous area since the maximum permissible number of persons on that area is exceed'.

Another method of the system integration has found application in equipment that is deployed in underground excavations of mines. The key feature of the method developed for that solution consisted in development of a dedicated RF transducer with very low consumption of electric power. Such a module acts as a miniature gate that is able to detect several tags within the closest vicinity of the gate. The gate coverage is only about several meters, but the module consumes very little electric power, hence it can be connected directly to the circuits of the PST device. Transmission between the CPU of the PST device and the personnel identification module is carried out via a bidirectional serial link. The module is installed directly beneath the casing of the PST module that is made of plastic, so that to enable unrestricted propagation of RF waves through the casing. The basic use of the connected module consists in informing of the engineer-on-duty about the person who stays the most closely to the PST device during conversation with the central control room operator. The most frequent operation that is carried out by users with the messaging and telephone device, beside talking on phone, is calling an engineer-on-duty that can be accomplished by depressing one of the buttons DYSP (Engineer-on-duty) or ALARM (Emergency call). It is the way how to call an engineer-on-duty in normal and emergency modes. Before coupling with the personnel identification system the system operator had only known in which mode the operator is called and from which device, i.e. from which location [3]. Installation of a new module inside the PST device enables the operator (engineer-on-duty) to identify the caller.

2. INTRINSICALLY SAFE SYSTEM FOR SHAFT COMMUNICATION

The system ITS offered by TELVIS for telephone communication down a mining shaft is designed for organization of local telecommunication at mining operations with potentially explosive atmospheres [4].

The ITS system comprise telephones of the TIG-S (TIG-SD) types or programmable messaging and telephone devices of the PST type, a system telephone for a winder operator and a system rack. Also a gate loud-speaking telephone can be incorporated as an option and installed at the entry door to the winder machinery hall. The system rack houses a telephone exchange, a block of power supply units together with rechargeable backup batteries and a the KSI cassette with intrinsically safe separators of ZSI4 or LPI types assembled on printed circuit boards of the EUROCARD type.

The ITS system for telephone communication down mining shafts enable easy and convenient exchange of information between subscribers at various extraction levels of a mine. Capacities of the telephone exchange allow establishing of conference calls from the telephone of the winder operator and let him to use the function of intruding the established call as the third participant while two other users of the ITS system are talking. The systemic telephone of the winder operator makes it possible to monitor operation of individual components of the telecom system installed at the signalling stations of the shaft as well as to talk on phone in the loud-speaking mode.

The capacity of a standard ITS system allows connection of 22 subscriber devices (including the telephone of the winder operator and the gate loud-speaking phone). The system can be expanded with further 16 devices by installation of supplementary PCBs inside the telephone exchange and provision of an additional intrinsically safe KSI cassette. The structure of connections between components of the system is shown in Fig. 2.

3. SYSTEM FOR LOCAL TELECOMMUNICATION FOR UNDERGROUND TRANSPORT

Among many systems that are used for underground transport the LSTI system [5] offered by TELVIS deserves a more detailed outline. The system structure is shown in Fig. 3.

The system enables fast and reliable telecommunication down paths of underground transport, between the traffic supervisor and traffic participants.

The system comprises the following components:
- LST rack,
- rack for SSI cards – intrinsically safe separators,
- ZZB rack (a rack for guaranteed power supply voltage),
- control panel MD-1 for the system supervisor (installed in the control room of the traffic supervisor or in his back facilities),
- TIG-S telephones,
- loud-speaking telephones of the PST type (installed at stations deployed down the paths of underground transport).

The control panel MD-1 for the system supervisor enables quick dialing to any local telephone (50 buttons for shortcut dialing), whilst the calling subscriber is identified on the display of the MD-1 con-

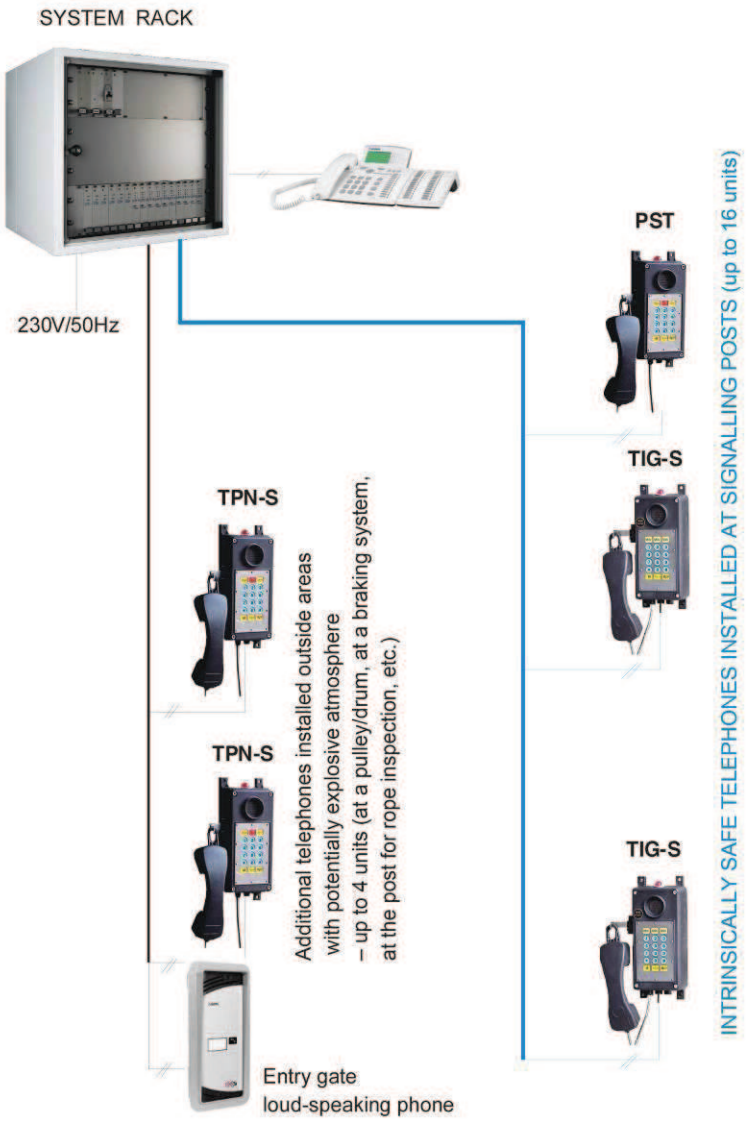

Fig. 2. Structure of the ITS telecommunication system for mining shafts (own development)

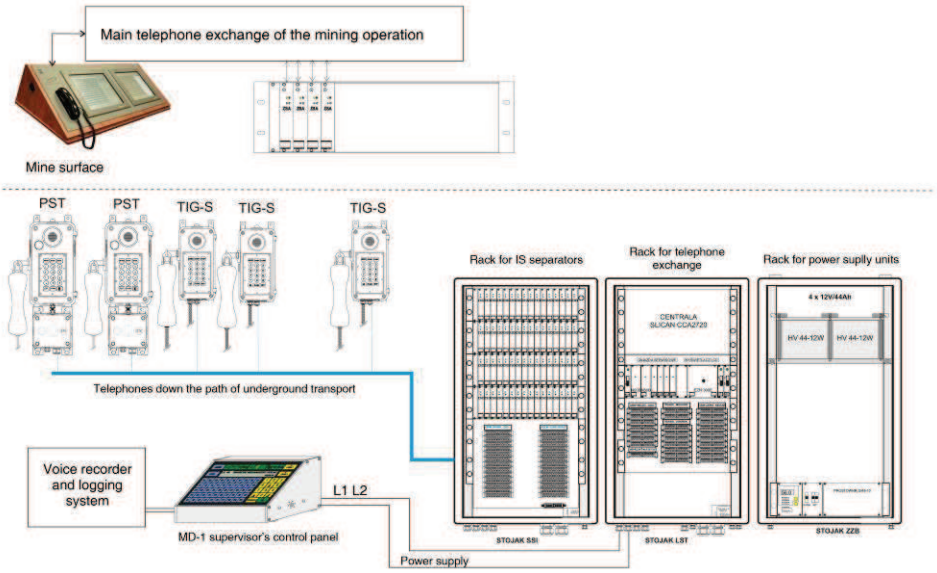

Fig. 3. Structure of the LSTI local communication system for underground transport (own development)

trol panel. The control panel may receive two telephone lines (when a conversation is carried out on the line 2, the line 1 is on standby).

The system can be incorporated into the plant telephone network through LISA links connected to ports of the telephone exchange for the operation. LISA links manufactured by TELVIS make it possible o establish connections for a separate telecom network for intrinsically safe circuits.

4. GENERAL PURPOSE SYSTEMS FOR TRANSMISSION OF ANALOG AND BINARY SIGNALS

The UTS-2 system for transmission of analog and binary signals is designed for exchange of information between the underground and surface parts of the system.

Components of the TS-2 system can be split into four groups [6]:
– underground part,
– cabling and wiring,
– central station,
– visualization subsystem.

The underground part comprises interface hardware combined into three modules:
– SDA analog module – 4 intrinsically safe analog inputs that can be used to supply various devices,
– SDD binary module – 4 intrinsically safe binary inputs that can be used to supply various devices,
– SDW actuator module – 4 electronic binary outputs.

The system is cabled with use of typical telecom cables for mining applications with the wire diameter of 0.8 mm. Due to quite mild demand to cable quality the connections between stations are implemented with use of the existing cable infrastructure. The maximum distance from the surface station to the most distant underground station is 10 km, whilst the maximum distance from a binary sensor to the SDD station makes the next 8 to 10 km.

The central station comprises the following modules:
– power supply unit that can be installed as a single module or with redundancy of the stand-by one,
– control cassette that is made up of the doubled ZSC controller (for redundancy) and up to maximum 16 ZUT modules. Each ZUT module controls two lines of the system.
– cassette of galvanic barriers to safeguard intrinsical safety of system lines. Similarly to ZUT modules, each singe barrier handles two lines.

The visualization subsystem is made up of two computers, i.e. a maintenance station and a redundant (stand-by) maintenance station. The computers are meant to enable configuration of the system and collaboration with central control stations of the system operator in order to transmit acquired information. The redundant maintenance station is on hot stand-by. The full configuration of the system is transferred from the main station to the redundant one on current basis. At the moment of the main computer breakdown all its functions are assigned to the stand-by one and operators are announced about the situation occurred. The UTS-2 system that is used for visualization has interfaces to three central control systems that are used at Polish mines, i.e. THOR, SD2000 and ZEFIR.

Key features of the system include:
– use of conventional copper cables for telecom connections,
– serial and star combined topology that enables immediate identification of failure locations
– high tolerance to consequences of equipment faults and connection failures owing to application of line checking between neighbouring stations,
– galvanic separation between the I/O module and the transmission circuit of the station,
– increased reliability due to redundancy of the power supply and control modules as well as the module for data transmission to the visualization systems,
– possible manual control or operation in the automatic mode when control commands are produced on the basis of binary and analog inputs,
– easy scalability of the system (it is possible to install the version that handles 16 lines when only a half of rack sockets are used, 32 lines with full utilization of the rack capacities or multiplicity of 32 lines),
– huge capacity of the system (the basic full configuration is capable of handling 1024 binary inputs and outputs or up to 256 analog inputs). In case when a typical rack is used it is possible to insert 3 fully equipped system cassettes that can handle up to 3072 binary inputs/outputs or up to 728 analog inputs
– compact dimensions (the part of central station for the basic version of the system has the height of 6U, it is the space that the system cassette occupies in the rack),
– possibility to collaborate with the UST controller for a mimic table capable of handling up to 1024 LEDs or 512 LED modules and up to 48 relays,
– collaboration with SD2000, THOR and ZEFIR central control systems that enables visualization, alarming and keeping records for all status changes of sensors connected to the system,
– low power consumption (ZUT circuits are energized only at moments when they send signals and wait for responses, otherwise they remain in the power down mode),
– designed for operation under heavy duty conditions with high level of interferences (the advantage that is achieved owing to the applied transmission system that is extremely tolerant to environment with high content of interferences and to poor parameter of transmission cables, i.e. frequent earth faults or local leaks due to drops of insulation resistance),
– system for self-checking of transmission lines enables early detection that conditions for data transmission are deteriorated (even before the connection is interrupted),
– remote power supply for all underground components of the system with the possibility to supply sensors and gauges connected to the system,
– main and redundant (stand-by) maintenance stations are designed as computers of rack-mounted industrial design and assembled on separate rack stands, such solution improves operating conditions for computers and protects against unauthorized access,
– update time for information about the entire system is only four seconds, whilst the special version of the binary module is capable of recognizing and conditioning of pulses with their length of only 100 ms and can be used for counter-type inputs of central control systems (e.g. certain solution of skip counters).

5. SYSTEM FOR MONITORING OF TRANSPORTATION MEANS

Key functions of the WLSS™ system manufactured by TELVIS under licence from ITI MAG include [7]:
- exact determination of vehicle location in the real time mode,
- simultaneous visualization of vehicle deployment by means of a GIS/SCADA application,
- warning about possible collisions

The WLSS system comprises the following components:
- track-mounted devices (LHU location heads and DHU diagnostic heads),
- vehicle interfaces of the CDU type,
- RFID readers installed at locomotives,
- RFID tags installed on excavation (roadway) floors,
- transmission hubs (of the μZist type),
- visualization and communication workstations (underground and surface ones) for the system operators,
- optional auxiliary devices (OKO-1R CCRV cameras for visual monitoring)

The system incorporates various components that can be roughly split into track-mounted equipment and control workstations.

5.1. Track-mounted equipment

To enable efficient operation of the location system the operator must make sure that the excavations are covered with sufficient networks of LHU locating heads.

The optimum solution that guarantees minimization of takeover points for local power supply assumes implementation of the topology where the adjacent location heads are arranged in a chain that enables the shortest paths for both signal transmission and power supply. Branches of such a network are then terminated at transmission hubs of the μZist type and these hubs are, in turn, connected to the trunk lines deployed as a backbone network based on single-mode fiber light pipes.

The μZist transmission hubs are provided with modules of remote and intrinsically safe power supply and supply power voltage with the level sufficient to overcome voltage drops, even for the maximum possible line length assumed for the system. Total current consumption is also enough to safeguard reliable operation of sensor heads (LHU/DHU). The transmission subsystem is implemented on the basis of an intrinsically safe version of the RS-485 serial interface, where one copper pair is used for data transmission whilst the second pair provides intrinsically safe power voltage for sensor heads. Transmission hubs are supplied from intrinsically safe local power voltage units with output voltage of 15V and current of 1.5A, where the primary sides of these units are connected to ports of the electric power grid.

The offered solution enables to connect up to 10 locating heads down the network branch (2 pair of a telecom cable) with the length up to 2 km. The first and last head of each branch are connected to interfaces of power supply and data transmission hubs, whilst all other head are connected to the network line like to a system bus. Every single hub of the μZist station is capable of receiving up to four such network branches. All μZist stations are mutually connected by means of a light pipe and make up a network of line or ring topology. As is commonly known, the latter topology makes it possible to substantially improve reliability of the system since for the case of a line break a redundant transmission path is available.

The system can also incorporate diagnostic heads of the DHU type that are provided with and vibroacoustic sensors. It is the solution that enables remote detection of some defects in rolling units (bogies), e.g. seizure of bearings in traveling rolls of monorails. Diagnostic heads subject to the same requirements with regard to line lengths and number of units down a single line as in case of locating heads.

The mobile part of the system comprises vehicle-mounted interfaces of the CDU type. They are designed for installation in drivers' cabins of vehicles (monorails or trains). The RF subsystem of the CDU interface enables communication with the track-mounted part of the system and execution of location-finding procedures. CDU units are provided with sockets embedded into the device casing and designed for connection of and external antenna and an intrinsically safe power supply line. Electronic modules of the device are encapsulated by an enclosure that protects them against penetration of coal dust and water streams. As it was mentioned before, the device can be optionally provided with a RFID reader module that interacts with RFID tags embedded into the excavation (roadway) floor. Information about the fact that the RFID reader is right over a specific tag is transmitted to the system, that enables exact determination of a track that the vehicle travels on.

5.2. Central control workstation

The central control workstation for an underground operator is used for visualization of the system operation by means of a GIS/SCADA application that runs on a computer of industrial design with the enclosure of the IP54 protection class and provided with a large-sized LCD display. The workstation communicates with the visualization and communication workstation installed on the mine surface via a light pipe link. Next, information form the surface workstation are conveyed to the central control system operator via local Ethernet network of the control room that enables launching of the application on an arbitrary selected computer with appropriate settings for authorization rights (e.g. only visualization, elected informative layers, full access rights, etc.)

6. SYSTEM FOR MONITORING OF POWER VOLTAGE FOR ELECTRIC TRACTION

The newly developed system is aimed at monitoring of power supply status for all section of the traction cable down the railway transportation route. In addition, it enables supervision over operation of APSPa stations that are used to supply electric power to traction cables as well as execution of certain control functions of these stations. The system recognizes status of all switched that voltage to traction cables as well as status of all switches at switchgear sections. Status of all system components can be viewed on computers located at vehicles depots, in rooms of central control system operators or at other locations. These computers also allow remote control for all APSPa stations.

Application of the system enables more efficient management of monorail and train traffic which, in

turn, substantially improves utilization factor of rolling stock and reduces downtimes.

7. RECAPITULATION

The paper overview various systems manufactured by TELVIS Co. Ltd and offered for underground mining operations. Consideration is given to alarm and messaging systems as well as to systems for intrinsically safe telephone communication. These solutions have already been implemented at all Polish and many foreign mines of hard coal, copper ore or salts. The company can also boast about modern and innovative solutions for monitoring of underground transport. The new development serve as the evidence that the company belongs to the most innovative manufacturers of electronic equipment for mining operations and is deeply involved in improvement of occupational safety for mining personnel and reduction of maintenance and operation expenses.

References

1. *Integrated SAT system for Intrinsically Safe Telephone Communication with Central Control Operators and for alarm and announcement broadcasting,* Operation and Maintenance Manual, Katowice, April 2006.
2. Kowalski A., Mirek G., Wojtas M.: Conference Proceedings, The 22th World Mining Congress & Expo, Stambuł, 11-16 Septemer 2011.
3. Kowalski A., Mirek G., Wojtas M.: *Coupling of the system for personnel indetifiction with a system for alarm raising and announcement broadcasting, Conference Proceedings of the 'School of Underground Mining, 20th to 24th February 2013.*
4. *Operation and Maintenance Manual for the ITS/TS systems for shaft communication,* TELVIS, Co., Ltd., Katowice, January 2013.
5. *Operation and Maintenance Manual for the LSTI system,* TELVIS, Co., Ltd., Katowice, August 2013.
6. *Operation and Maintenance Manual for the UTS-2 system,* EMAG Centre, Katowice, August 2008.
7. Babecki D., Mirek G., Wiszniowski P.: *Monitoring of transport means in underground excavations,* Conference Proceedings, ATI 2011, The 38th Conference of the 'Cybernetics in Mining' Section of KG PAN, Szczyrk, 15 – 17 June 2011.