Krzysztof BRZESKI
Jerzy DZIERŻKO
COMONET Gdańsk, Poland

Łukasz WOJCIESZKIEWICZ
COMFORTEL Tychy, Poland

Antoni WOJACZEK
Silesian Technical University

HETMAN - A NEW ALARM-DISPATCH-BROADCAST SYSTEM FOR MINING INDUSTRY

Summary: The paper describes the design and principle of operation of Hetman, a new alarm-broadcast system for mining industry. The system is intended for telephone and loudspeaker dispatch-alarm-broadcast communication. It has been built on the basis of the DGT MILLENIUM digital exchange. The system will operate with the new intrinsically safe JANTAR telephone signalling devices and KORAL telephones.

1. Introduction

In case of emergency owing to alarm communication it is possible to warn miners and manage their evacuation. Dispatch-alarm-broadcast communication should make it possible to:

- send a message about a hazard in the underground working to the dispatcher;
- send by the dispatch console operator an alarm signal to the underground working;
- simplex loud-speaking communication to miners in underground working.

In 2005 DGT Gdańsk jointly with COMONET Gdańsk developed a new alarm-broadcast system called HETMAN dedicated mainly to underground methane and non-methane mines. The basic element of the alarm system in the ground section is the DGT MILLENIUM dispatch-alarm server.

2. HETMAN System Description.

HETMAN is a new integrated intrinsically safe telecommunication system for underground mines. It is an autonomous system which may play various functions in a mine telecommunication system. Depending on the needs the system may provide:

- **corporate telephone communication** with the use of typical telephone sets and mining telephones KORAL designed by COMONET,
- **Dispatch telephone communication** integrated with the DGT MILLENIUM digital telephone switch with the use of minimum two dispatch telephone consoles.
- **Alarm-broadcast communication** independent from the corporate telephone system with the use of the DGT MILLENIUM dispatch-alarm server, two DGT 3780 dispatch consoles and new JANTAR intrinsically safe signalling telephone devices.

3. Requirements for HETMAN Alarm System.

An alarm system should allow signals or evacuation, warning and information messages about possible danger to be sent to workplaces, and furthermore:

- it should allow an alarm signal about the danger to be sent from each signalling device;
- signals and messages should be sent to one signalling device or a group of such devices, and it should be possible to send several messages at the same time;
- it should be possible to control the sending of messages both manually and automatically; all calls and messages sent in the alarm mode should be recorded in the time function;
- an alarm system should ensure protection of the installed software against direct access of unauthorized persons, the telecommunication system network should be a separated network with an outside access through the so called "mirror server" only.

When designing and building the HETMAN system additional requirements were also set, of which the most important ones include the following:

- An alarm system should be designed in such a way that its functionality should be in all respects independent from the efficiency of the mining exchange, i.e. continuous access to all functional features of the alarm system should be provided particularly in the event of a failure of the mining exchange.

- It should be possible to provide a network alarm system for multi-department mines.
- If telephone signalling devices are used, a failure of the alarm system should not have any effect on the availability of the telephone set functions in operation with the corporate telephone exchange.
- It should be possible for the HETMAN system to cooperate with the mining exchanges of any type and manufacturer (e.g. Hicom, Hipath of SIEMENS, A4400 of Alcatel, AVAYA, DGT MILLENIUM, etc.).
- The alarm system capacity should allow several up to several hundred (e.g. 500 NN) integrated signalling telephone devices to be connected.
- The system should make it possible to transmit data from the sensors connected to the telephone signalling device.
- The dispatch console operator should be able to have remote control from the dispatch console over the underground telephone signalling device (operator should to be able to "hang up" the microtelephone if it has been improperly placed on the cradle).

4. HETMAN System Structure

The system comprises (Fig.1):

- **DGT MILLENIUM dispatch-alarm server** (modified DGT MILLENIUM digital subscriber exchange);
- **two DGT 3780 dispatch consoles** (PC in a special casing integrated with an LCD touch screen and a system digital telephone set) ;
- **two call and event recorders** (two DGT NetCRR recorders - main and back-up);
- intrinsically safe barriers - individually for each subscriber device;
- **JANTAR spark-proof mining signalling telephone devices.**

The system may be operated also in non-methane mines as a non-spark-proof system without the necessity to use MSI spark-proof barriers when using the same station equipment (telecommunication server) and JANTAR telephones with a call signal adapted for a typical subscriber switch. Typical telephone sets (Cba), new industrial KORAL telephones with a dialling keypad (identical as JANTAR in external appearance but lacking the alarm button) may be also connected to the HETMAN system.

A simplified structure of the company-wide alarm-broadcast HETMAN system has been shown on Figure 1.

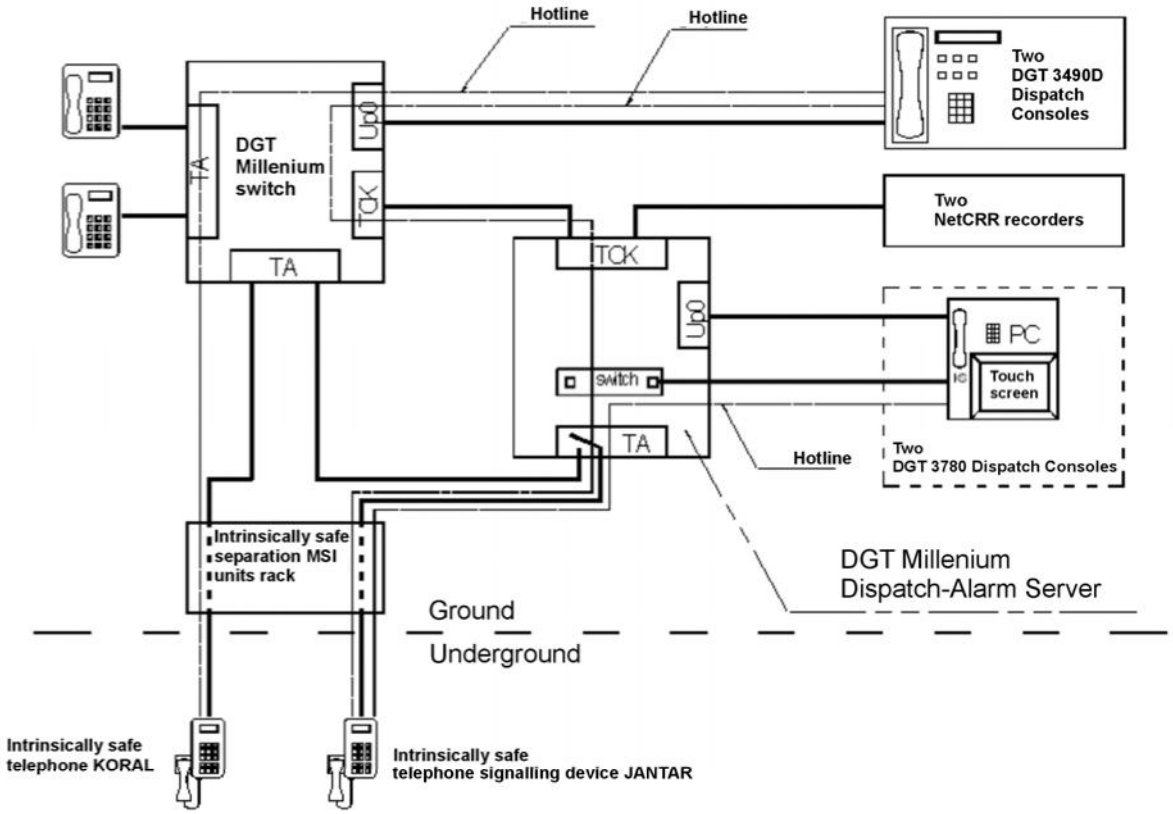

Figure 1 Simplified block diagram of HETMAN system

A rich set of alarm functions has been implemented in the HETMAN system. It is possible to send warning and information messages about various hazards to users, groups of users or to all telephone sets.

The system allows current monitoring of the telephone signalling devices status and malfunctioning on the symmetrical telecommunication line, calling set identification and the type of call (alarm/normal). Signalling telephone devices may be visualized on a digital map with the CTI/GIS system support.

Sensor from technological process control systems and actuator devices may be also connected to an "underground" telephone set. Such additional functions are possible due to the use of special splitters installed on the MSI intrinsically safe barrier and on the telephones.

The dispatch console operator has access to a typical dispatch set of services enriched with the following alarm and maintenance functions:

- sending alarm signals to a single signalling device, a group of or all signalling devices;
- sending warning and information messages about various hazards to users, groups of users or all sets (sent directly to the dispatch console operator or recorded earlier);
- setting any telephone to tap mode;
- additional functions facilitating dispatch calls service (intercepting a call 'directed" to a different dispatch console operator, call breakthrough, etc.)

The dispatch communication functions are fulfilled on the basis of state-of-the-art DGT 3780 dispatch terminals using LCD touch-screens. This makes it possible to arrange the presentation of the status and access to many lines (up to 1000 lines) in a user-friendly

manner (tabs, groups, etc.). Compared to the traditional (keyboard) dispatch console (DGT 3490) the line status signalling has been extended:

- line called by the dispatch console operator in the alarm mode;
- alarm call to the dispatch console operator;
- alarm communication with the dispatch console operator;
- alarm communication with another dispatch console operator;
- broadcasting;
- tap.

An additional advantage is the queuing of calls coming to the dispatch console operator with a division into alarm and normal calls - presented in the form of independent lists allowing for selection of any subscriber for a call.

It is possible to permanently record all statistical and traffic events in the system and to record communication with the use of two (due to the redundancy) DGT NetCRR recorders. Each recorder is connected to the switch via PCM 32/20.

5. DGT 3780 Dispatch Console

The terminal used as the dispatching console in the HETMAN alarm system is the DGT 3780 Dispatch Console (Fig. 3) made in the form of a touch screen. The program allows for full control of telephone (or alarm) incoming and outgoing calls. The manipulation console has been organized in such a was so as to facilitate the operator's setting up and receiving calls. A system of panels - so called multi-functional tabs (Fig. 2) has been introduced.

For reliability reasons and to ensure redundancy, two identical DGT 3780 dispatch consoles to be used as manipulation consoles will be installed at the dispatch station. Each of them is equipped with:

- **Ethernet interface** – connection to a local computer network of the DGT MILLENIUM alarm server;
- **system terminal interface** - connection with line digital equipment (Up0 interface) of the DGT MILLENIUM server.

The DGT MILLENIUM alarm server is equipped with two Up0 interfaces cards separate for each dispatch manipulation console.

Each DGT 3780 dispatch manipulation console (touch screen) with appropriate software, provides the operator (computer maintenance station) and two dispatch console operators through two independent communication channels (digital system telephone medium and the separated dispatch computer Ethernet network) with information required for efficient operation. Each operation is performed when the operator has pressed a key corresponding to a command on the touch-screed with his/her finger.

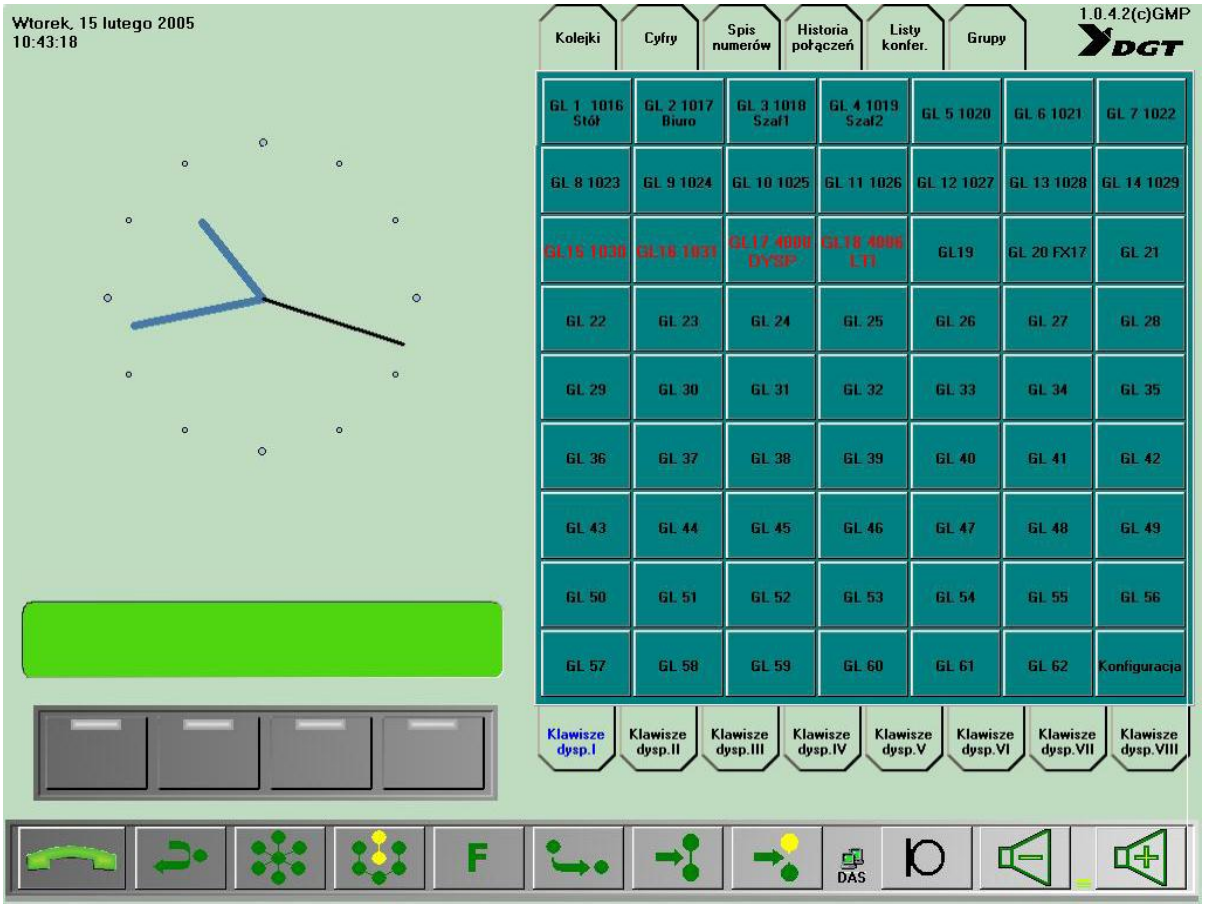

Fig. 2 View of dispatch console for 8 groups.

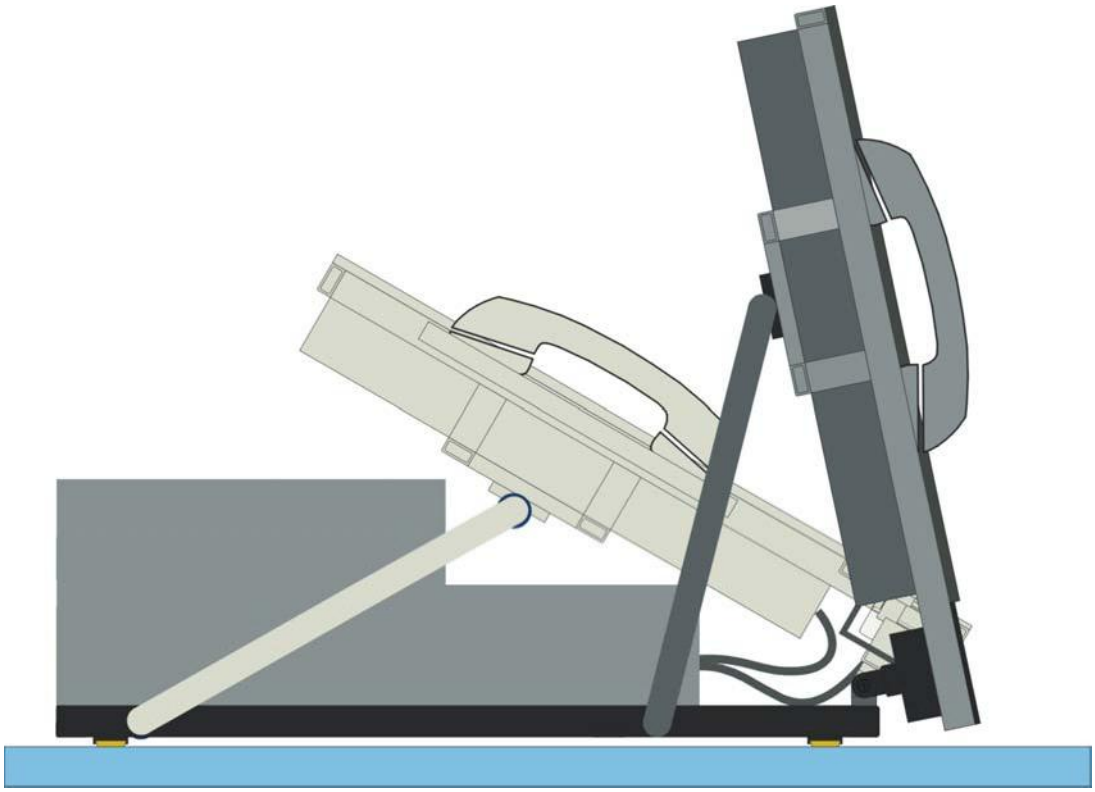

Fig. 3 Side view of DGT 3780 dispatch console.

The screen functions have been divided into "thematic groups", e.g. hot line service, telephone directory service (list of telephone numbers), alarm system, broadcast service, etc. which allows the screen area available for the application to be used in a maximum way, and at the same time the current status is very legible for the operator. The dispatch-alarm-broadcast console is used as an alarm system element both during normal operation and to send warning messages about hazards. The basic dispatch console screen has been divided into several sections of which the most important ones are the following:

- **context keys** (12 keys) - always available - to execute typical connection functions;
- **bar display** - the calling subscriber's number and other informative messages are displayed (suggestions to the dispatch console operator what he/she should do when using the screen);
- **direct dialling keys** - 62 NN hotlines are available at one level (tab) depending on the touch-screen size, access to 8 (for 494 NN) or 16 (for 992 NN) levels (tabs) is possible, there are 62 direct dialling keys and a configuration key;
- **call hold keys** - are used to hold calls served by the operator;
- **window with conference participants list;**
- **selector conference** - a specific type of a conference connection where after having set up the connection, the dispatch console operator fully controls its progress (as opposed to a typical conference service for 64 NN);
- **number list panel;**
- **"Digit" panel** - used in all situations when it is required to enter digits, for instance to select the number of a subscriber that is not included on the list;
- **queue service panel (calls)** - is used to serve calls incoming to the operator;
- **call history panel;**
- **conference lists panel;**
- **message broadcasting panel** - the "**Group**" key having been pressed, a panel appears on the left side of the screen to conduct an alarm or message broadcasting operation;
- **alarming** - acoustic alarms to telephone sets are sent from the alarm panel, having chosen a group (one out of six) or all group subscribers the "SWITCH ON ALARM" key should be pressed, the message on the key changes to "SWITCH OFF ALARM"; the acoustic alarm is sent continuously until the " SWITCH OFF ALARM" key is pressed".

Owing to the proper arrangement in the DGT MILLENIUM switch, each dispatch key may play a hotline function. The operator may define which hotline will be served by a selected key and enter a description of the key (on the computer keyboard to which the touch-screen is connected or on a keyboard displayed on the touch screen).

The way of highlighting the message on the key is very interesting. It is at the same time an additional status indicator of the hotline assigned to the key. As many as five colours are used (black, green, red, orange, yellow and yellow and orange interchangeably). The colours may be backlit with a continuous light or they may be flashing. The following hotline statuses are distinguished.

- Stand-by status - black inscription
- Call to the dispatch console operator - green inscription flashing quickly
- Call by the dispatch console operator - green inscription flashing slowly
- Conversation - green inscription highlighted continuously
- Unavailable subscriber (blockade, switching status) - red inscription highlighted continuously
- Subscriber busy with a possibility of third party intrusion - red inscription flashing

- Selector conference or tap mode - yellow inscription
- Alarm call to the dispatch console operator - orange inscription flashing quickly
- Alarm call by the dispatch console operator - orange inscription flashing slowly
- Line in alarm communication status with the dispatch console - orange inscription highlighted continuously
- Line in alarm communication status with another line - yellow inscription flashing slowly
- Line in broadcast status - yellow and orange flashing slowly and interchangeably.

In order to set up/receive a call from a subscriber with an assigned key, the key should be indicated. Thus, the touch screen has great abilities: both in respect of line monitoring, alarm system operation status visualisation and sound control in the normal and alarm mode. The dispatch console may play the role of an attendant console, telecommunication and alarm dispatch console.

The are many options (possibilities) available from the dispatch console due to the alarm system implementation of which the most important are the following:

- Tapping of an telephone signalling device by the dispatch console operator in the simplex mode with a simultaneous emission of a warning signal during such event. It is possible to select a set or a number signalling telephone signalling device to be tapped simultaneously. Tap is activated by the appropriate DTMF code (so called microphone coding).
- Subscriber calling by the dispatch console operator and sending messages to the subscriber. It is possible to send a calling signal to any predefined group or to any subscribers selected directly on the console by the use of "hotline" keys.
- Sending an alarm signal to the subscriber or any number of selected subscribers (groups). It is possible to prepare (record) voice alarm messages and send them to the selected groups simultaneously. All information concerning to an alarm (time, list of subscribers etc.) are recorded,
- Priority of calls made to the subscriber from the dispatch console over another calls,
- Line status monitoring (particularly line breaks, switch-off status of signalling telephone device).
- Making a call in a loud-speaker mode from the dispatch console in duplex with a possibility of switching to simplex.
- editing voice messages from the dispatch console.
- of sending alarm messages to a group of signalling telephone devices automatically - initiated by another safety system (i. e. methane monitoring system).

6. Conclusion

In program terms the HETMAN telephone and alarm system is modelled on a military dispatch system that has already been operated in our army for several years. In terms of equipment the system uses DGT MILLENIUM digital subscriber telephone switches and medial servers that have been successfully operated in mines for several years.

The proposed HETMAN alarm-broadcast communication system offers more functions than the systems currently used in mining establishments. It will be possible to evaluate the usefulness of the new functions during operation of the HETMAN system in mines.

References

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