


Solutions for underground mines

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What pain do we solve?

1. Vehicles running into people
2. Clash of equipment with each other
3. Prompt staff location in emergency situations
4. Confirmation of staff absence in dangerous areas
5. Low staff operation efficiency
6. Traffic lights control at UG mine
7. Search of staff in cases of accidents

Client's pain and Collision Awareness System (CAS)

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Collision Awareness System

Display and antennas on the vehicle

Vehicle braking system

Cabinet for charging and issuing tags

Personal Tags

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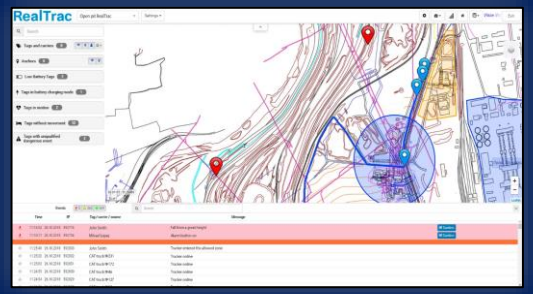
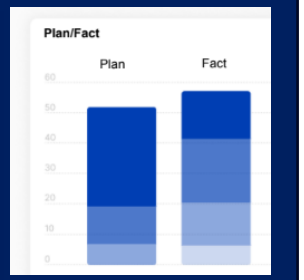
Positioning System

Map with marks and reports for the dispatcher



Plan-fact analytics



Cabinet for charging and issuing tags

Personal Tags

Zonal positioning (±20m) is a basic tool for ensuring safety and efficiency

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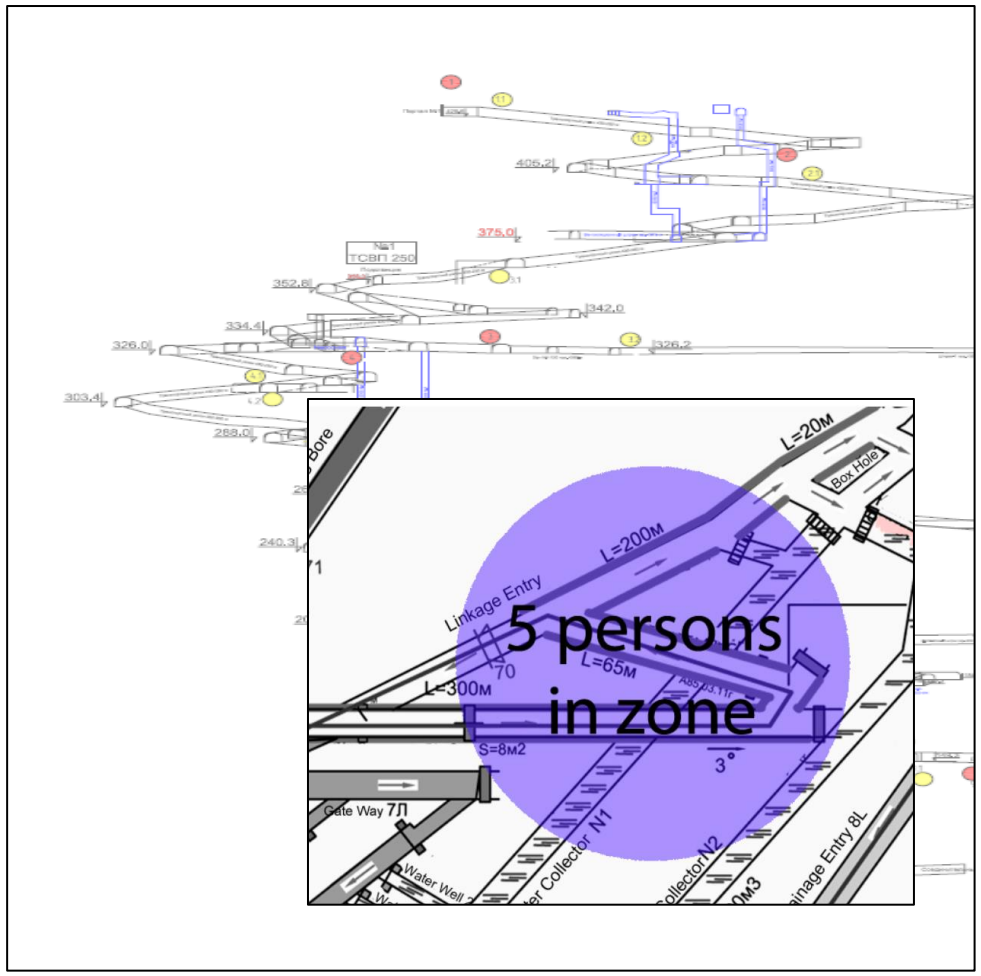
Basic functions:

1. Quick determination of the current location of people and transport in case of emergency.
2. Determination of the last location of people and transport before the loss of communication.
3. Basic analysis of the effectiveness of: the movement of people between zones for a specified time period.
4. Global alarm from the control center to all tags Individual notification to a specific miner.



Precise or graph positioning (±1m) is an advanced tool for increased efficiency and safety

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Advanced features:

1. Digital twin of the mine in real time (full transparency of current activity of employees and transport for management)
2. Plan-fact analysis of shift assignments (where they were supposed to work and where they were in fact; response time to requests)
3. Analysis of the efficiency of movement of people, equipment
4. Control of the absence of people in dangerous areas and on conveyors

Simplify tags issuing and servicing process by integrating Positioning System with Charging SmartWall and existing Access Control System

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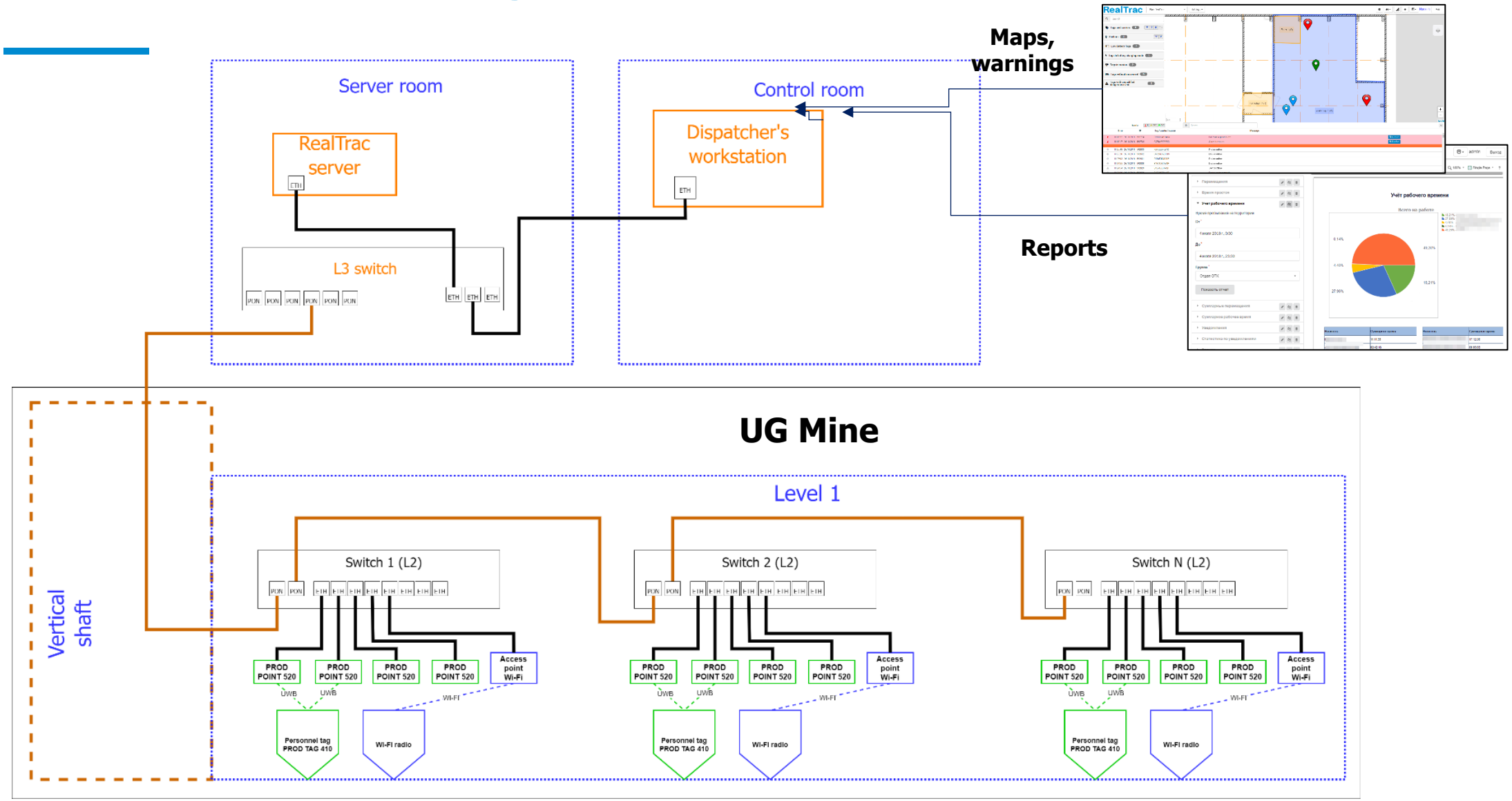
- When the SmartWall for charging and tag issuance is installed, it is integrated with the local access control system (ACS).
- An employee can enter the production area only after retrieving a charged tag from the cabinet, which links his ACS card to the tag. Thus, without the tag, the employee will not be able to access the work zone.
- SmartWall not only charges and links tag to the person, but also checks for malfunctioning and uploads the latest firmware.

RealTrac Positioning System architecture



Traffic lights control in a mine based on a positioning system

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Tasks of traffic light regulation:

1. Increasing speed of decisions on entering/exiting the shaft
2. Getting rid of "traffic jams" in the shaft with long reversing exits
3. Safety at underground intersections

Possible scenario:

- When the vehicle enters "Zone 1", the signal from the transport tag is read. If the trunk is free, then "Traffic Light 1" turns green, and "Traffic Light 2" turns red.
- The vehicle passes "Zone 1 and 2", the trunk is considered occupied. The red light comes on "Traffic Light 1 and 2".
- The vehicle continues moving, passes "Zone 3 and 4", the trunk is considered free again - the green light comes on.

Collision Awareness System not only warns, but also brakes the vehicle in automated way

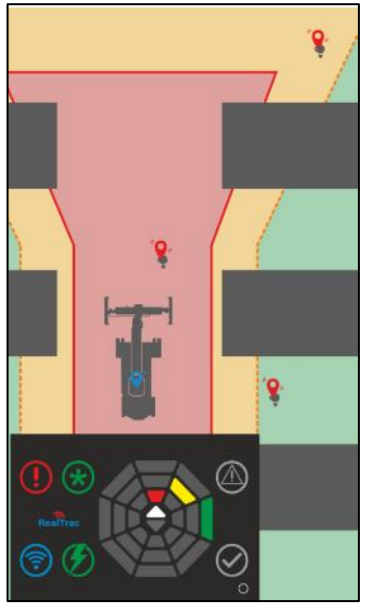
1. Warns pedestrians and drivers,
2. Doesn't bother the driver for the false alerts
3. Brakes vehicle in automated way
4. Works indoors and outdoors
5. Notifies the operator regarding failures

Zone Attention **Warning zone** **Braking zone**

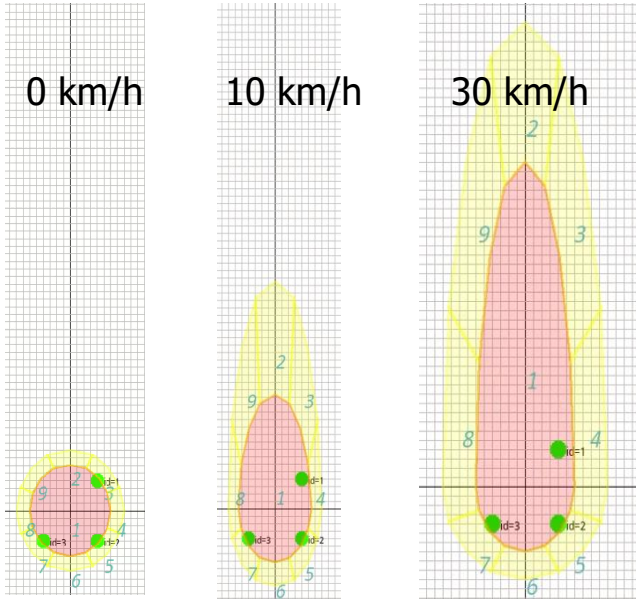
Display and antennas installed on a vehicle to see other vehicles and staff around

Collision Awareness System is made in the way to prevent false alerts

The area around the vehicle is drawn in an optimal shape (narrow on the sides and back, long in front)



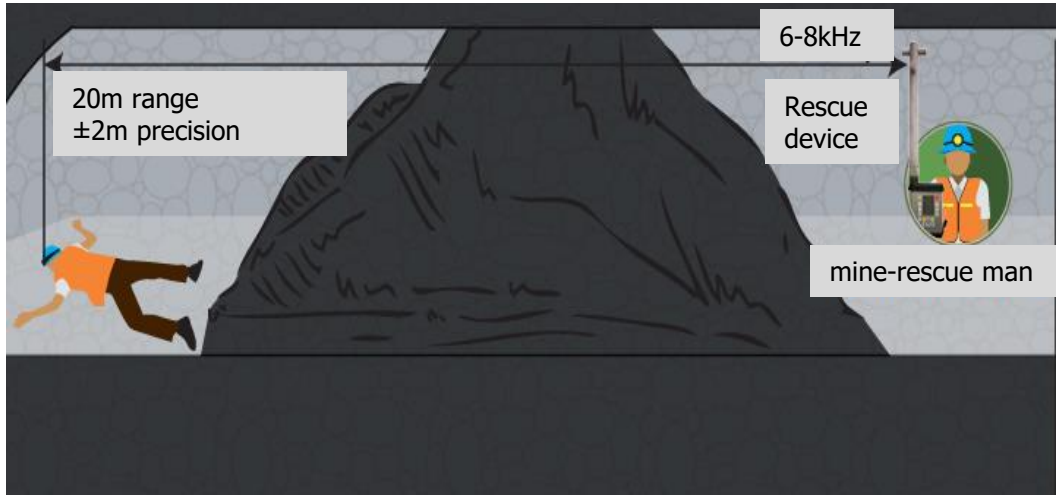
The zones around the vehicle change their shape depending on the speed, direction of movement, position of the handbrake, and direction of motion.



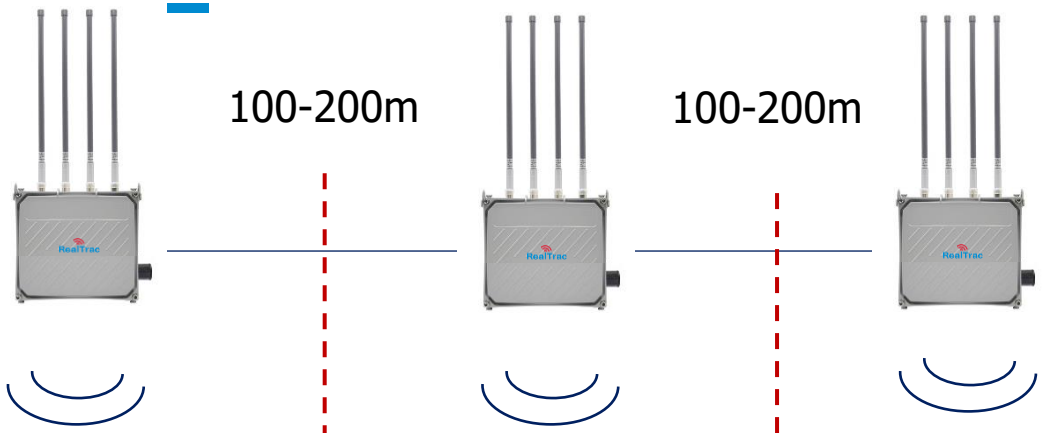
The system stops alarming to the driver as soon as he gets into the cabin.

System for searching for people under rubble

The system allows, within 36 hours after an accident in a mine, to detect personnel at a distance of up to 20 m through collapsed rock with +-2 meter precision



Seamless WiFi network at underground mine



System capabilities:

- Organization of seamless switching of PoC terminals between WiFi access points
- Transmission of telemetry data from vehicles
- Optional - data transmission from cameras

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