Data transmission in mining excevations using the RESYS system

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Data transmission in mining excevations

1. Forms of wired transmission
    - Copper wires,
    - Optical fibers.
2. Most common forms of wireless transmission
    1. VHF (dispatcher systems) 150–159 MHz and 165–174 MHz bandwidth,
    2. UHF (ranking systems) –410–420 MHz and 420–430 MHz bandwidth,
    3. 20 – 120 MHz bandwidth, (video signal transmission),
    4. 868 MHz,
    5. 2,4 GHz.

Transmission in gasometric systems

- wired digital transmission - range up to 10 km,
- central power supply from the surface,
- repetition of measurements, depending on systems and sensors, from 1s,
- centralized structure,
- network managed by mining services,
- network access limited by dedicated communication interfaces.

Transmission in technological data systems

- wired digital transmission based on optical fibers and copper cables,
- local power supply,
- high capacity,
- distributed structure,
- defined access interfaces,
- a network managed by the mining services.

Basic RESYS system devices:

- PC1.0 Personal Communicators - radiotelephone, personal equipment of the rescuer,
- REP1.0 repeaters - elements which form a wireless backbone network,
- M1 Base- (optionally with a PC/tablet) - managing communication with the hosts, equipping the Action Manager at the bottom,
- MC1.0 mediaconverters - conversion of electrical signals into optical, network elements,
- PC application - visualization of actions at the bottom, data monitoring, including location, voice communication with the Base, listening to the hosts.

Repeater REP1.0

- Two-way and two-rail transmission (radio and optical fiber),
- The average distance obtained in tests under real conditions is 140 m,
- Usable battery capacity: 2.2Ah
- Statistical average current consumption: 100mA (without MC)
- Powered by intrinsically safe power supply or battery.
- Batteries can be replaced in an explosive atmosphere.

REP 1.0 repeater with MC1.0 Mediaconverter

Additional equipment:

- accelerometer (motionless detection, free fall, impact detection)
- microSD memory card
- light signaling (RGBW LED) and sound

Communication interfaces - backbone network

- Transmitter / receiver at 880 MHz,
- 2 MHz channel width,

power <27 dBm (declared - for the standard for devices with a transmitter up to 0.5 W),

In practice, we reach approx. +25 dBm

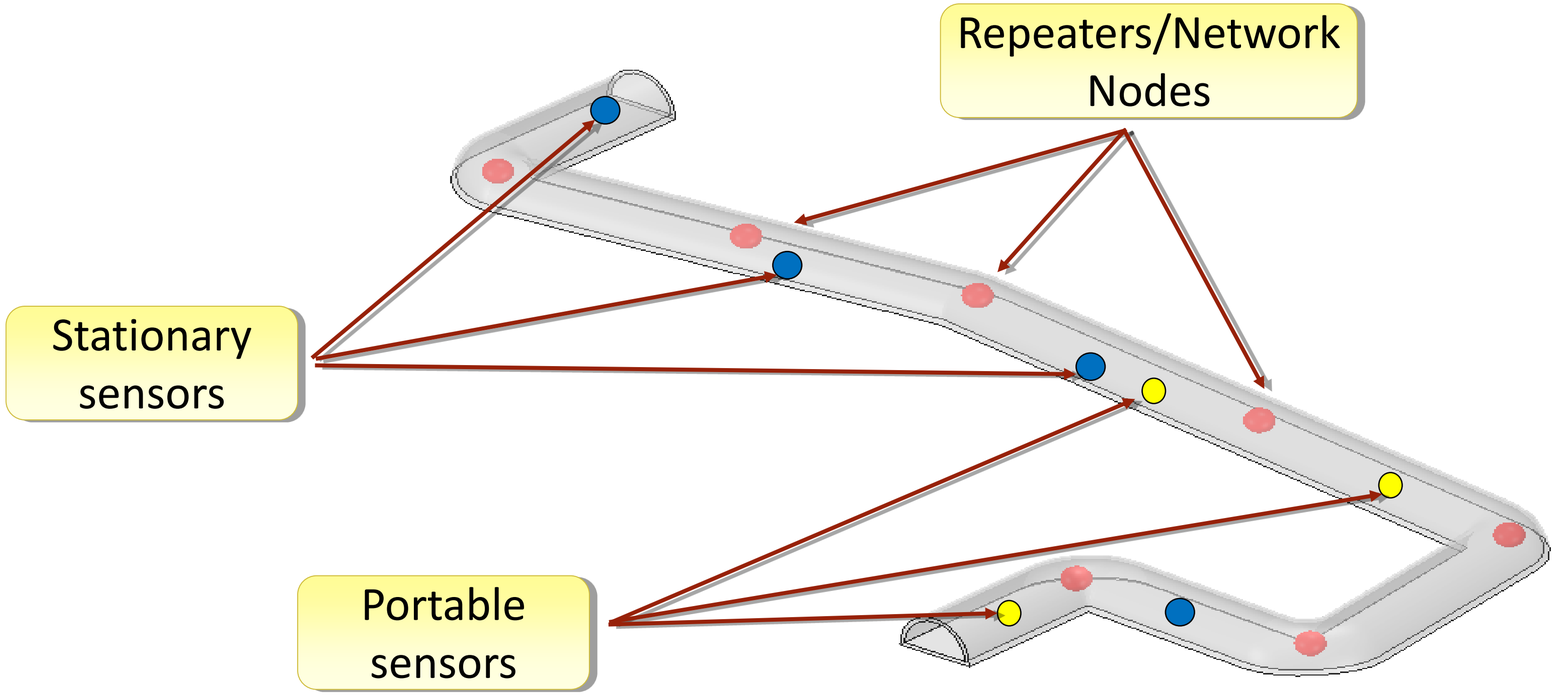
- access sharing method: TDMA,
- bandwidth available for the IP protocol layer: 100 kBps (regardless of the number of working devices),
- statistical input delay on a single retransmission: 30ms,
- maximum number of retransmissions: 256.

Communication interfaces - access network

Radio 2 (receiving data from communicators / terminals)
- Receiver on 840MHz frequency.

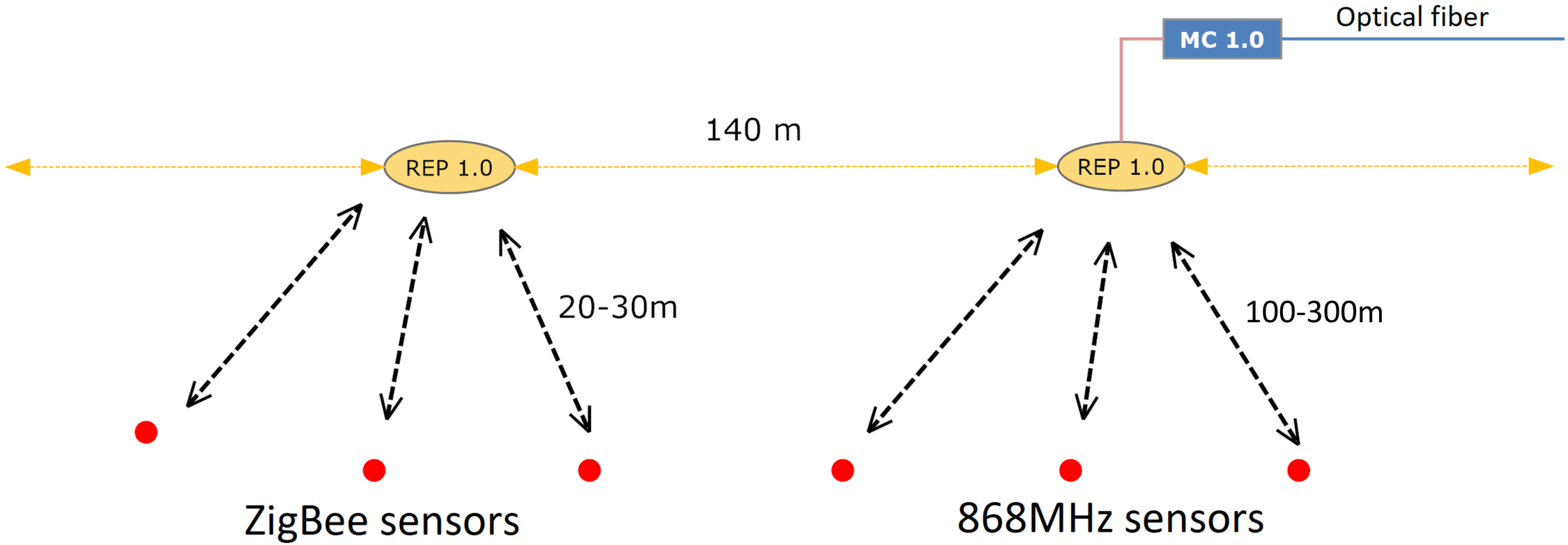
Radio 3 (communication with sensors / external devices)
- Transmitter / receiver at 2400-2480 MHz,
- 16 channels with a width of 5 MHz,
- Compliant with ZigBee specification (IEEE 802.15.4),
- power <+ 3dBm.

Media converter connector:
- 2 x USART (synchronous or asynchronous serial transmission, convertible to e.g. RS485 / RS232)
- maximum bandwidth: 5.2 Mbit (each),
- MODBUS ASCII / RTU protocol support possible,
- possibility of connecting repeaters / base with optical fibers (after using MC1.0 mediaconverters),
- ability to access network resources via ethernet (after using the MCETH1.0 converter).

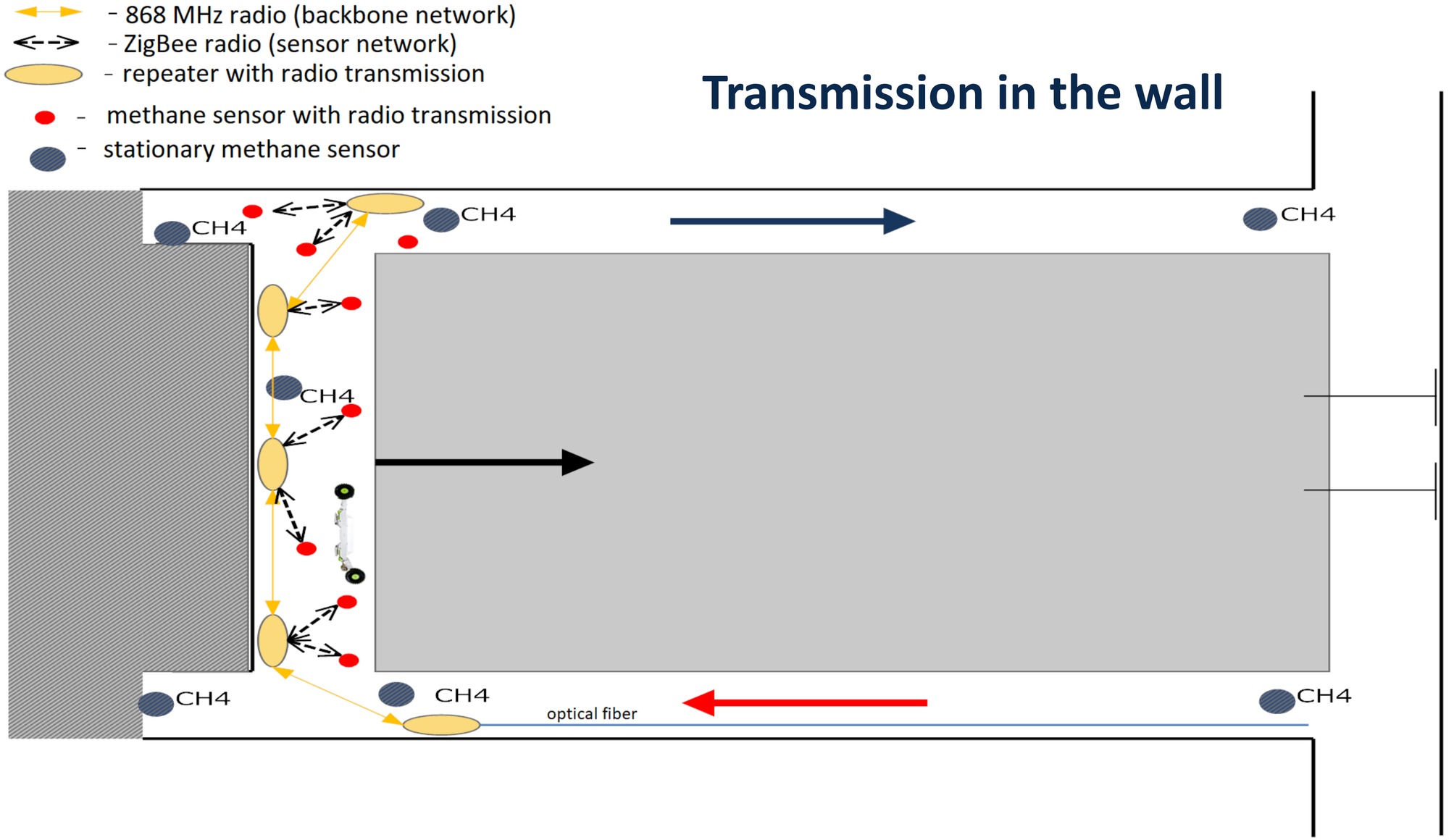


An example of the layout of repeaters in the mining excavation

Example of installation



Transmission in the wall



Potenital applications

- Longwall gasometry systems,
- Mining excevation gasometry systems,
- data transmission from technological devices,
- data transmission, e.g. of pressure sensors in pressure monitoring systems in powered roof support

World Trends- Internet of things

- the increasing use of wireless networks,
- integration within the network of voice, video and data transmission services,
- construction of backbone networks with open access,
- using the wireless network to increase the safety of mining crews (location, communication, e.g. text messages, monitoring places where people are using e.g. methane sensors built in lamps).

Summary

- wireless network is more and more commonly used in underground mining,
- thanks to the use of wireless networks, there will be new possibilities in the field of monitoring and control of processes (similarly to the industry),
- elements of the RESYS system can be successfully used to implement an access network in mining excavations.

Thank you for your attention