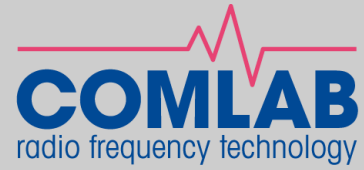




Kabelwerk

EUPEN AG

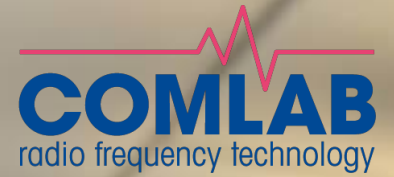
cable



Kabelwerk

EUPEN AG

cable



Measured by:

STRAPAG Strahm und Partner AG
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4G LTE MIMO REPEATER SYSTEMS

This white paper proves that LTE MIMO technology can be achieved with COMLAB digital Multioperator- & Multiband Repeater System combined with EUPEN Radiating Cable. The system is optimized for Indoor-, Tunnel- and Railway applications.

SOLUTIONS THAT DELIVER FULL BANDWIDTH

The demand for mobile data transmission doubles every year. COMLAB's Multiband- Multioperator Repeater System overcomes the challenge of the exploding needs for bandwidth and data throughput at very low operating cost.

We are proud to present the worlds first Digital Repeater System using only one Radiating Cable for MIMO 2x2 and two Radiating Cable for LTE Advanced.

INTRODUCTION

COMLAB presents a highly flexible and modular multiband digital repeater system MUD/RUD(19)-5 for a large variety of frequency bands. It supports all kinds of services such as CDMA, TDMA, OFDMA, GSM, UMTS and LTE. The system is designed to be used as Inline-, Offair- or Intrain Repeater. All Signals are transmitted over EUPEN leaky cable.

PRINCIPLE

LTE MIMO 2x2 and 4x4 configurations can be achieved through different uncorrelated propagation paths. The principle of MIMO 2x2 is shown in Figure 1. It consists to use two transmitting (T1 and T2) and two receiving (R1 and R2) antennas in order to create four propagation paths (T1 to R1, T1 to R2, T2 to R1 and T2 to R2). Compared to the configuration which uses only one transmitting and one receiving antennas, the throughput can, at least theoretically, be severely increased.

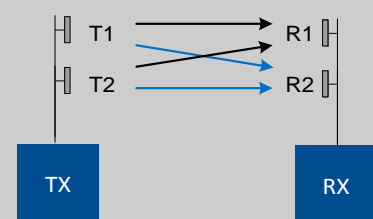


Figure 1

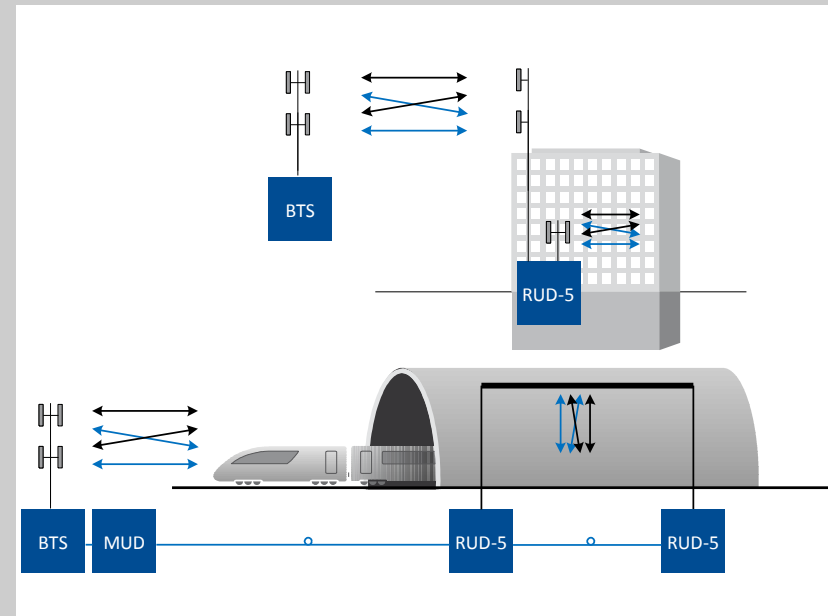


Figure 2

One condition is that four different propagation paths do not experience, simultaneously, the same fading which could be due to signal blockage by an obstacle, destructive interference, etc. The propagation paths are said "uncorrelated" when this condition is satisfied.

The use of cross polarized panel Antennas provides a solution where T1 Antenna stubs are -45° and T2 +45° relative to the vertical axis. As a result, two waves at right angle to each other are radiated.

Similar principle can be implemented with special designed EUPEN radiating cables.

In particular the RMC158 (A-Series) radiation characteristics allow producing different polarizations.

MIMO 2x2 transmissions is achieved with only one leaky cable and MIMO 4x4 with two leaky cables, installed on the same or opposite tunnel wall.

Furthermore to uncorrelated signal distribution, the system supports Inter Symbol Interference free data modulation which leads to low Cyclic Prefix and thus LTE Advanced capable MIMO 4x4 coverage.

Figure 3 demonstrates how maximum bandwidth is applied with digital technology and uncorrelated propagation paths over one and two leaky cables.

TARGET SEGMENT

- Safety and Emergency Organisation
- Army, Border Guard and Civil Protection
- Mobile Network Operator
- Radio and TV Station
- Railway and Subway Operator
- Radio and Network Operator
- Public Authorities, Authority
- Private, Industry, Enterprise

APPLICATION

- Road and Motorway tunnels
- Traffic and Escape routes
- Railway tunnels, Subway lines
- Football stadiums, Malls, Car parks, Stations
- Hospitals, Clinics
- Military and Civil Protection installations
- Intrain, Airports
- Industrial areas, Construction zones

GUARANTEED QUALITY

COMLAB's systems demonstrate excellent MTBF (mean time between failures) values. Optimum product and system quality ensures fewer faults and hence lower life cycle costs.

LTE Signal transmission, comparison with and without MIMO optimization

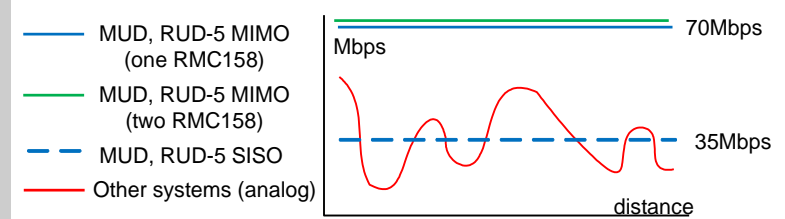


Figure 3

REPEATER SYSTEM

Master Unit Digital (MUD)
Modular Master Unit Digital for secure radio applications and cellular operator services.

Remote Unit Digital (RUD-5)
More than five Band in one 19" or wall mount enclosure.



Figure 4

RADIATING CABLE

Radiating Cable RMC158
More than just a cable, phase adjusted design for MIMO.



Figure 6

USER GUI

COSweb
Web based Configuration and Operation Software with map tool.

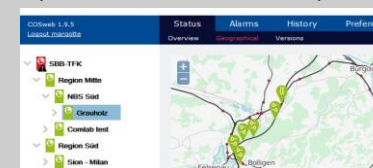


Figure 5

SPECIFICATIONS

Key Advantages

- Multiple band, multiple operator
- Application modulation independent
- Five bands in one RUD enclosure
- Highest power efficiency
- More than 16 sub-bands
- Signal distribution inside tunnel via leaky feeder cable or antennas
- Software defined radio applied
- Auto setup
- Band specific configuration
- Web based configuration
- Remote control by HSDM
- Extreme high reliability by system redundancy
- Best total cost of ownership