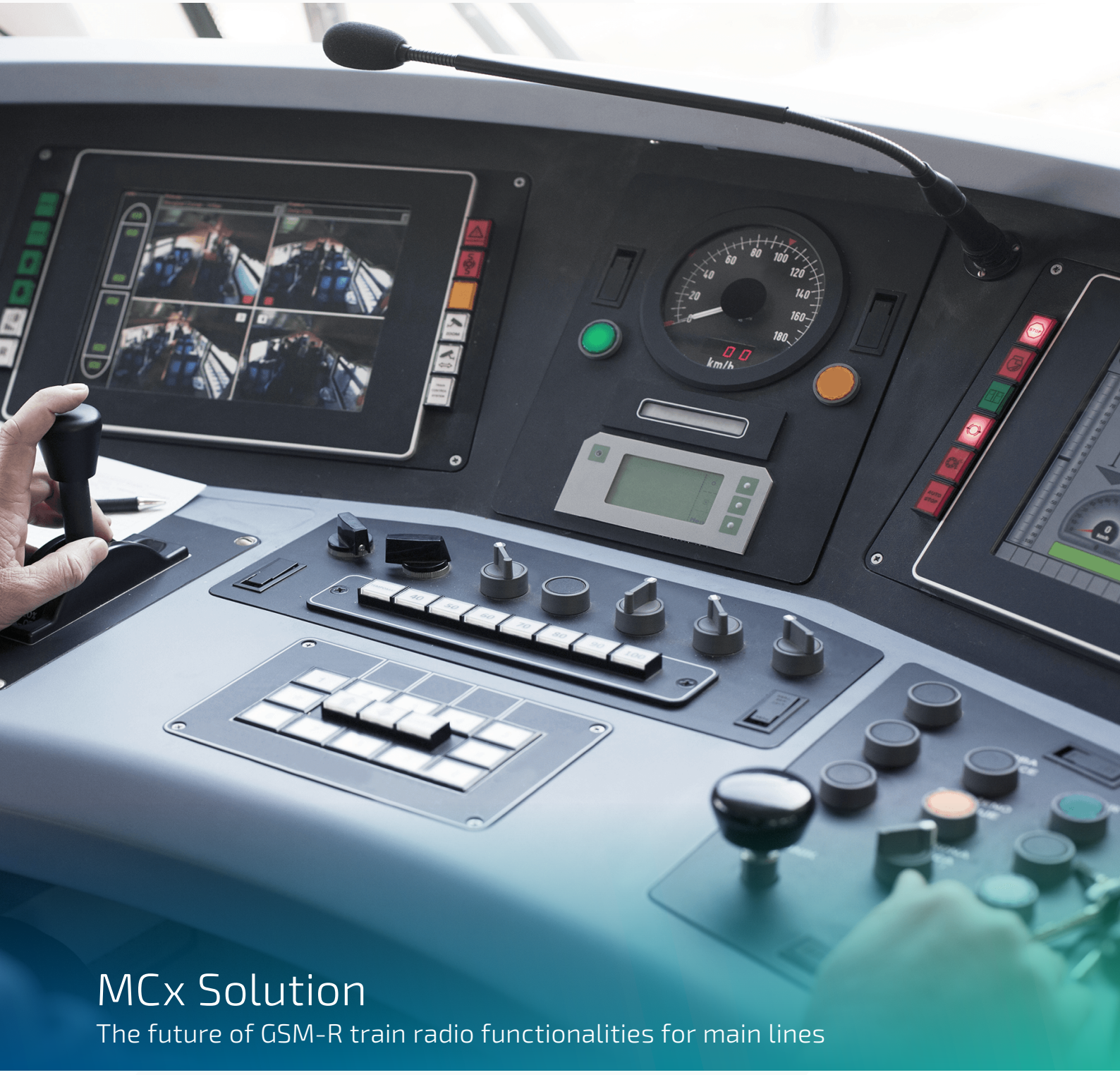


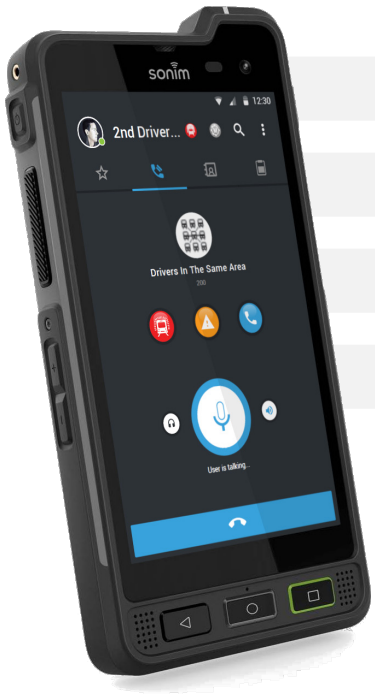
MCx Solution

The future of GSM-R train radio functionalities for main lines

kontron
The Power of IoT

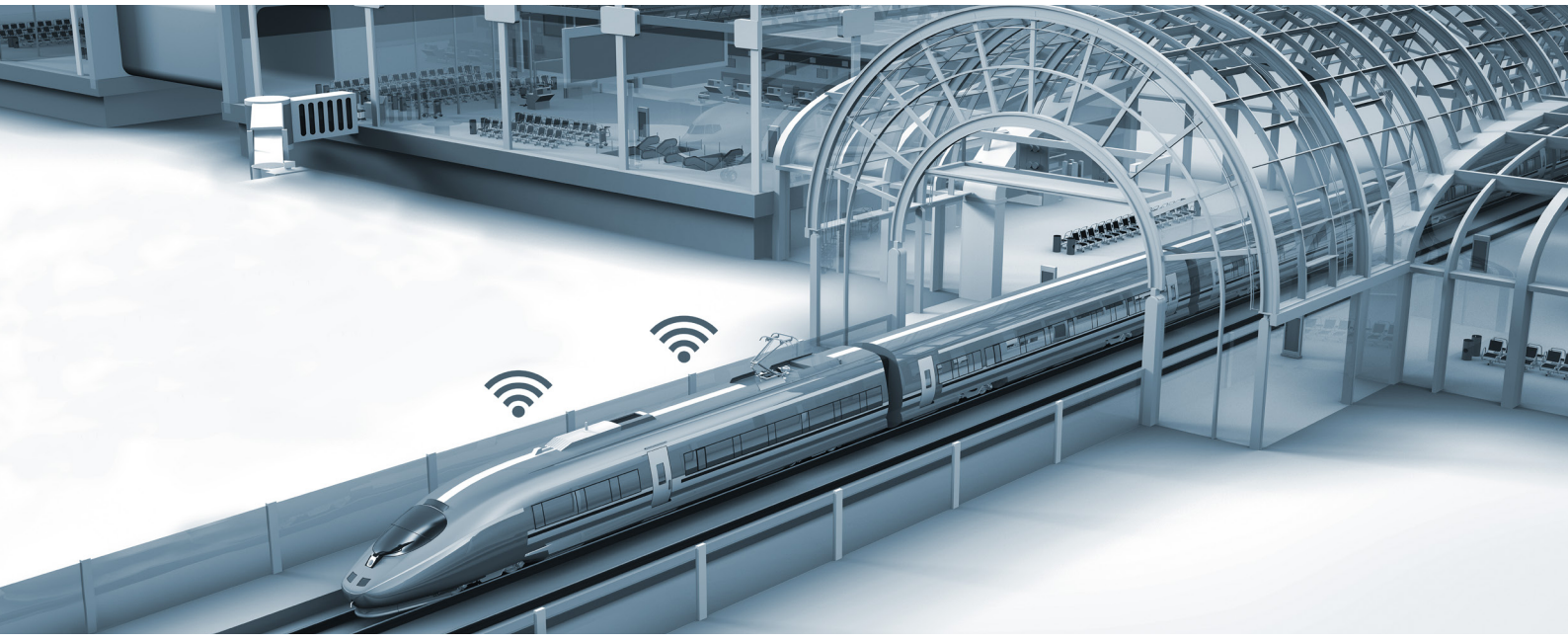
Kontron Transportation is developing the MCx and 5G based FRMCS solution for main lines that need to build their own infrastructure. The private 5G networks of the main lines are used as transport medium for the MCx application with GSM-R features such as single call, group call and train emergency call. Based on the future FRMCS standardization (3GPP, ETSI), the Kontron Transportation MCx solution extends obsolete analog radio communication means with modern state-of-the-art train radio functionalities.

Kontron Transportation offers the solution as a „hosted solution" in a data center or as a server solution in the railroad's own IT departments. Private 5G IP-68 industrial-grade smartphones with an MCx client, IP-enabled Dispatchers with several modern user interfaces, and private 5G capable cab radios, that follow the FRMCS standard, serve as end devices.



- Usage of private 5G network as data service to support railway communication services
- Introduction of a mobile app for railway communication services
- Complies with future FRMCS architecture and 3GPP-MCPTT specifications
- Ready fo adjustments and additional operational improvements

Future-proof solution to support voice communication on main lines



Heart-beat function

A unique heart-beat function was developed, which allows the client software to be in constant contact with the application.

This has the advantage that the user in the railcar or on the locomotive can see at a glance whether he/she is connected to the MCx application on the server.
This functionality goes beyond the current FRMCS standard and offers further security in train-to-land communication.

Messenger service

Another feature is the own messenger service, which extends the MCx solution with preset or freely selectable messages.

With this service, important messages can be transmitted between the Dispatcher and the user on the train or in the locomotive/traction unit even with minimal available bandwidth. As standardization continues, video application, file transfer and functional train number entry will also be possible.

Dispatcher

The IP-enabled Dispatcher is another important component in the Kontron Transportation MCx solution. In addition to the existing functionalities such as individual call, group call or train emergency call, the Dispatcher also provides further intelligent innovations. For example, a geographical map which makes it possible to detect the individual trains based on their GPS coordinates and display them on the map, is provided.

This helps the Dispatcher to detect possible radio gaps on the track at an early stage and to initiate appropriate measures. Additional call lists, mails and predefined messages help to send recurring news quickly and effectively. The Dispatcher's display is freely programmable and assignable, ensuring an individual configuration adapted to operational requirements.

Lone Worker Protection

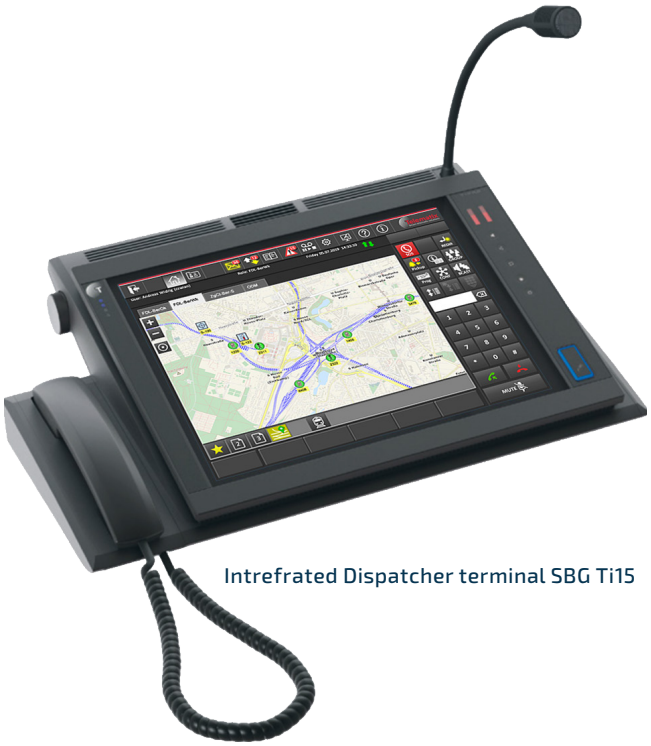
The Lone Worker Protection feature provides the best safety for staff who works alone
and out of sight. It reports incidents such as falls and slips together with the geographical location of the user to the dispatcher or selected colleagues and safeguards the lone worker in real-time.

The smart safeguarding feature detects false alarms and helps to minimise false-positive alerts. The alerted dispatcher can dispose of emergency services to the user's location or use the remote ambient listening call to acoustically monitor surrounding of the user which might be immobilized and calling for help.
No external sensor device is required to be worn.

Voice Recorder

As required for a train-to-land communications solution, Kontron Transportation also provides voice recording in the MCx solution.

Kontron Transportation works with the same manufacturer as in many GSM-R projects with major railroad companies. This enables the biggest possible security to comply with all GSM-R specifications and features.



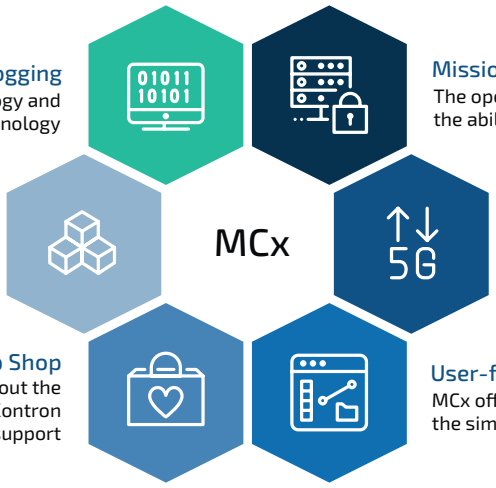
Intrefrated Dispatcher terminal SBG Ti15

Localisation

The solution provides location management and reporting for mission-critical users using geo-location data from various sources such as GPS, external beacons or mobile network information such as cell ID.
Sharing of accurate geolocation is essential for critical services based on geofencing like calculating emergency group call areas to invite all affected participants.

Supplementary Services

The supplementary services enhancing the communication capabilities with Call Forward, Call Transfer, Call Hold and others are imperative for mission-critical scenarios. Not only do all the supplementary services supports Functional Aliases but provides backward compatibility with legacy functions such as ring closure test or UUS signalling.



Technologie Leap-Frogging
Leapfrogging GSM-R-technology and providing modern digital technology

Mission-critical communication
The operational sequence guarantees the safety and the ability to bridge the dead spots

Turnkey solution
MCx is very easy to implement and is perfectly adapted for each customer

Future-oriented implementation
Basic building block for FRMCS requirements and the possibility of using rail owned 5G frequencies

One Stop Shop
Professional handling and advice throughout the whole project thanks to the expertise of Kontron Transportation in rail support

User-friendly
MCx offers optimized and intuitive operation thanks to the simple and professional user interface

Reference Cases

Research collaboration between Digitale Schiene Deutschland (Deutsche Bahn AG) and Kontron Transportation
"Design and Evaluation of a FRMCS End2End System for Future Rail Operation"

Key aspects of the 5G based Future Railway Mobile Communication System (FRMCS) have been investigated within four research projects by major industry partners, like Kontron Transportation and Digitale Schiene Deutschland (DSD). The insights are paying into an FRMCS design that serves the digital rail operation needs.

The support of MCx technology in the FRMCS has been investigated in a collaboration between Kontron Transportation, a leading global supplier of end-to-end communications solutions for mission-critical and carrier networks, and DSD. Due to the fact that the standardization activities were/are still ongoing, the project aimed to investigate potential MCx technologies to be maximally leveraged in FRMCS for future digital railway operation. In the project, a set of key MCx/FRMCS services has been identified for the digital railway operations, including the relevance of 3GPP specifications and how these functions are required for corresponding railway applications. Moreover, potential technical realizations, including MCx building blocks and reference points in the FRMCS system were further elaborated. Finally, the integration of 5G and MCx in the FRMCS system has been investigated, resulting in some technical recommendations for future FRMCS standardisation work.

Secondary Lines

In October 2020, Kontron Transportation demonstrated the functions of MCx over the top (over the public network) in a two-week test at the Bahnbetriebe Blumberg in Baden Württemberg, locally and on the moving train. The "hosted" solution was used, as this did not require any technical effort in terms of infrastructure on the part of the Bahnbetriebe Blumberg. The MCx application was provided in a Kontron Transportation data center.

At the time, this was the first solution of its kind to be tested in an operational railroad environment. Kontron Transportation, together with the Bahnbetriebe Blumberg and the Ministry of Transportation of Baden Württemberg, successfully executed a test catalog in which all functionalities could be flawlessly demonstrated. In December 2021 Kontron Transportation won the tender to realize MCx at the Bahnbetriebe Blumberg and is currently in the implementation phase.

In December 2020, Kontron Transportation received the first order for a MCx solution from Westfälische Landes-Eisenbahn. With this first important step on the way to a FRMCS-based future, the MCx solution replaces the old analog radio system without any additional investment in infrastructure. The Westfälische Landes-Eisenbahn also opted for a hosted solution in order to benefit from the reliability of a data center and to keep the costs of its own hardware and services as low as possible. The solution with MCx application, Dispatcher and voice recorder was successfully implemented in October 2021. In Mai 2022 the operating permit of the regional railway board was given.

About Kontron Transportation

Kontron Transportation GmbH is a global leading supplier of end-to-end communication solutions for mission-critical networks. The core customer segment is railways throughout Europe and beyond.
The focus is on systems that produce, transport, and process voice, data, and video information reliably, securely, efficiently, and sustainably. This includes GSM-Railways, FRMCS (future railway mobile communication system), MCx (mission-critical over public networks) with IWF (interworking functions), enhanced radio solutions and radio access networks, transmission networks, private cloud platforms and cybersecurity concepts round off the portfolio. This portfolio also offers selected communication products to utilities and enterprises. In addition, specific mobility products such as validators and fare collection systems are provided to public transport operators.

As a driving force in the definition and specification of FRMCS standards, Kontron Transportation is significantly involved in standardization working groups and European research projects such as Morane2.
The company has more than 700 employees, 11 sites all over Europe and is headquartered in Vienna.

Kontron Transportation is part of Kontron Group.

For more information, please visit: **www.kontron.com/ktrdn**

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