

Tactical LTE Box

White paper



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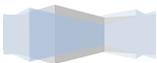
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JRC *Japan Radio Co., Ltd.*

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Introduction

Public safety and security forces have the difficult task of bringing order to chaos. Those First responders must be able to communicate during an emergency, reliably and without any security threats. Effective emergency and natural disaster management depends on the efficient mission-critical voice and data communication between first responders and victims. Land mobile radio system (LMRS) is a legacy narrowband technology used for critical voice communications with limited use for data applications. The new long term evolution (LTE) broadband communication technology has the ability to transform the capabilities of public safety technologies by providing broadband, ubiquitous, and mission-critical voice and data support.

Too often in critical situations the commercial communication networks are not reliable or don't support the security level needed for public safety forces. The first 30 minutes of a fire or active shooter situation usually defines what the next several hours are going to be used for. During those first critical minutes, the first responders need a simple yet advanced communication system that connects with all the human resources that are involved or will be involved and most likely all of them will use cell phones. Those troops need an independent, reliable broadband wireless solution that allows voice, video and data transmission without dependency on any commercial resources.

JRC LTE box solution is a 4G/LTE mobile tactical cell, lightweight ruggedize system that is built within a single box solution. The solution enables rapid deployment of private LTE network that may be operated independently and within an existing cellular wireless coverage. The mobile tactical cell supports several standard LTE frequencies and several bandwidth capacities, so a signal box may provide dedicated wireless throughput of up to 150 Mb/s. JRC LTE box is suitable for both stationary and on the move implementations. JRC LTE box is pre-equipped with applications such as MCPTT, Voice gateway to allow voice, video, text and file transfer capabilities, however it also can host the customer private applications.

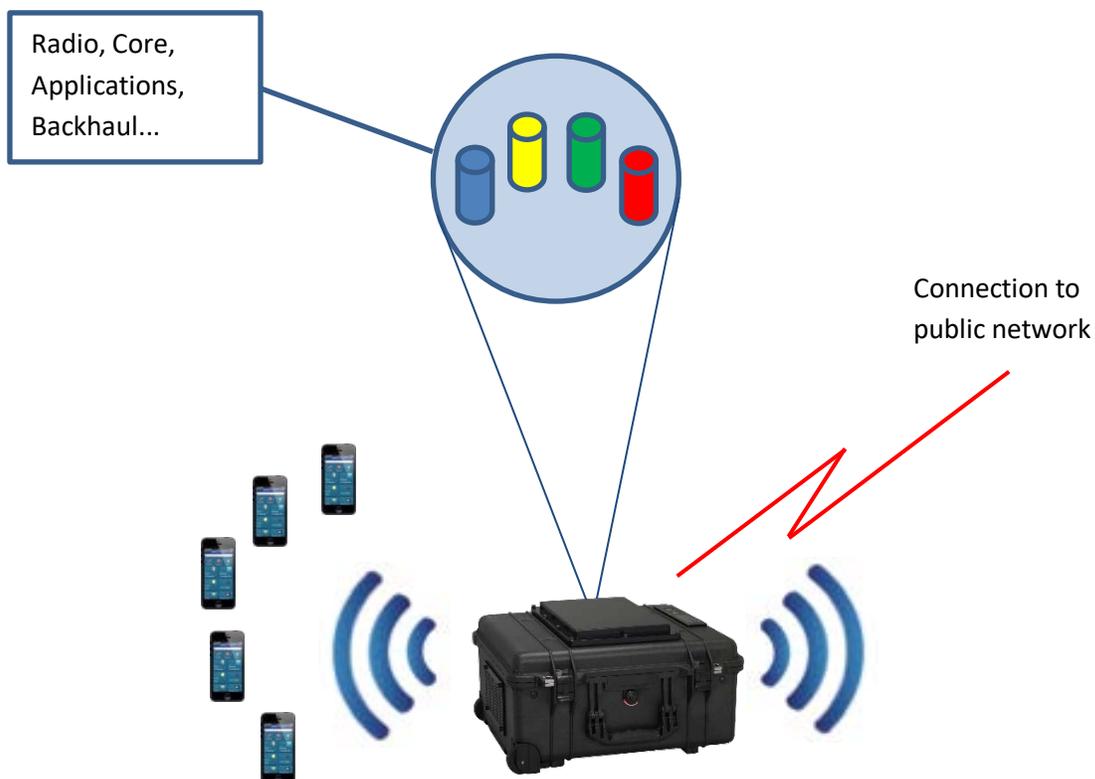


LTE Box deployment

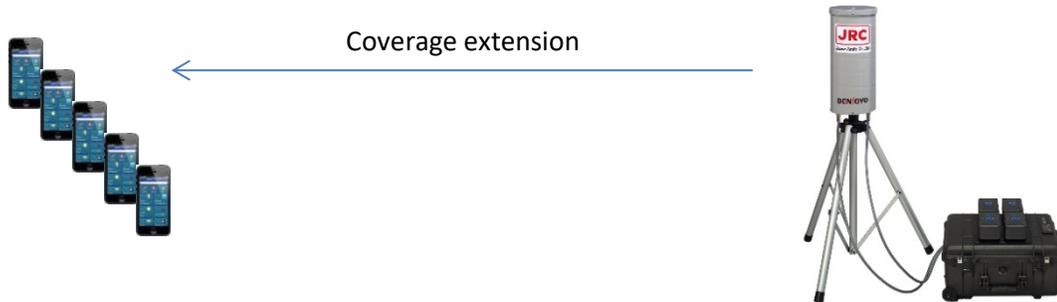
JRC LTE Box may be deployed in various scenarios to provide static or dynamic ad-hoc wireless coverage. The box operation is very simple, so practically by pushing the power bottom the system is up and running.

Standalone private network

The most common scenario for LTE box would be an ad-hoc wireless coverage for a group of first responders. The box may be hand carry and should be placed in a centralized position so all users may use its services. The LTE box acts as a private LTE network with all the essential elements such as LTE core, eNB and etc, and all the required services such as SIM authentication, QoS, application control and etc. The box is equipped with portable batteries that allow operation of up to four hours. The batteries are hot-swappable to allow safe replacement without shutting down the box. The box may also have an access to other network (for example for public network) with internal or external communication device.

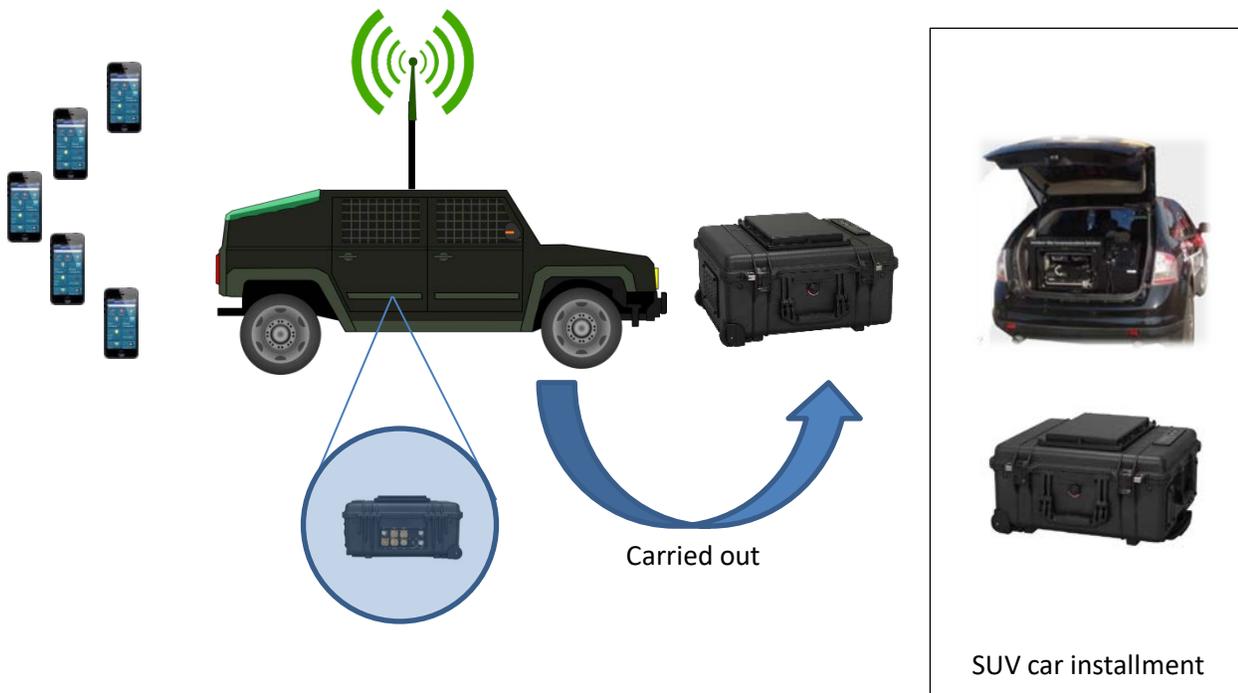


JRC LTE Box includes N-Type coaxial antenna connectors. It enables to connect easily the radio entity to a remote external antenna with a better gain and located on higher point. That allows extending the LTE box wireless coverage significantly.



Car mounted

The LTE box may be installed/placed within a car to allow mobile network coverage. The box may use the car power to operate, however when the car is shut down the batteries powers the box operation. The box also may be connected to a car mounted antenna to extend the wireless coverage. The LTE box may be simply carried out to a different location when the car is parking.

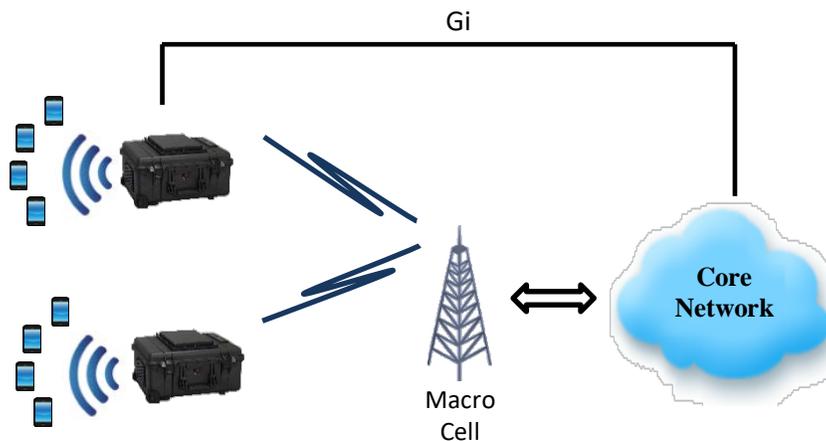


Integration within existing cellular network

JRC LTE box may be integrated with existing cellular network. The cellular network can be either fully commercial or private for public safety use. There are three main operation modes.

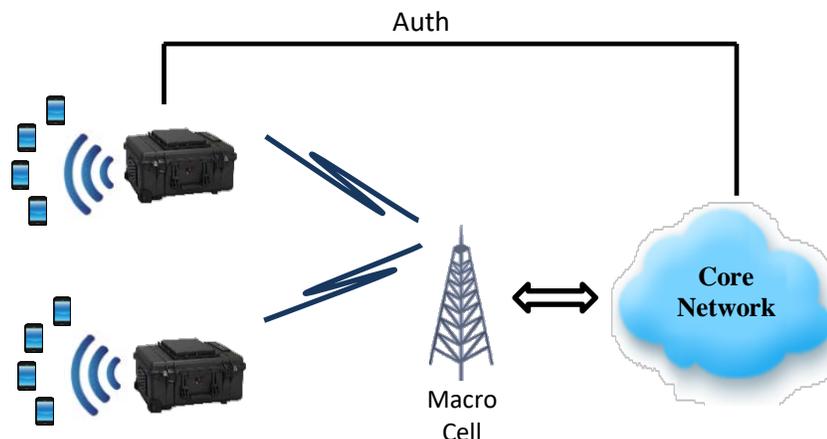
Existing network acts as backhaul

The LTE box in this operation mode uses the existing network as pure backhaul to the core network. The core network is only aware of the backhaul device BUT is not aware of the LTE box or the users connected to it.



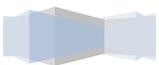
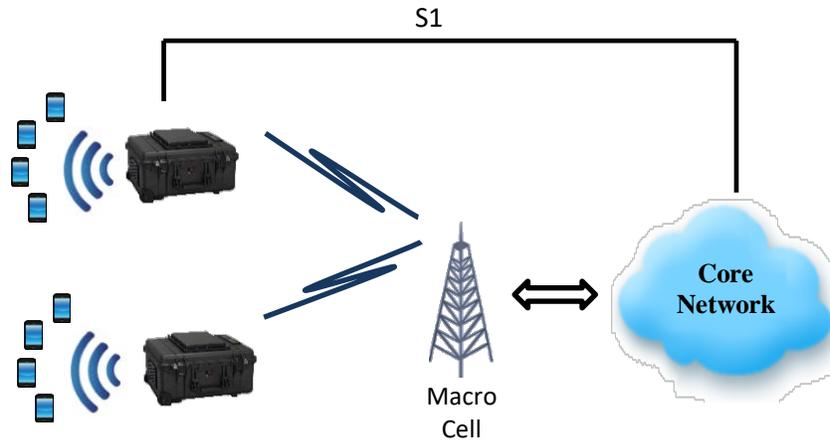
Existing network acts as authenticator

The LTE box in this operation mode allows users of the main network to connect to the box. The users are authenticated by the main core. The box uses the existing network also as a backhaul to the core network. The core network is aware of the box, of the connected users and can influence on the QoS within the box area.



Existing network acts full core

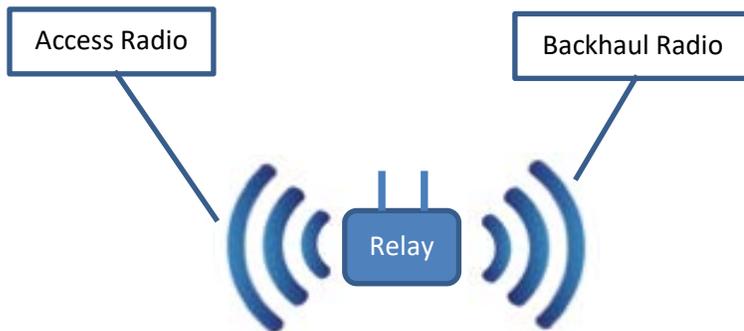
The LTE box in this operation mode is actually merges with the existing network and becomes like additional radio node in the macro network. The core network controls completely the radio entity in the box and controls the uses and the allocated service.



Coverage Extension by Relay Nodes

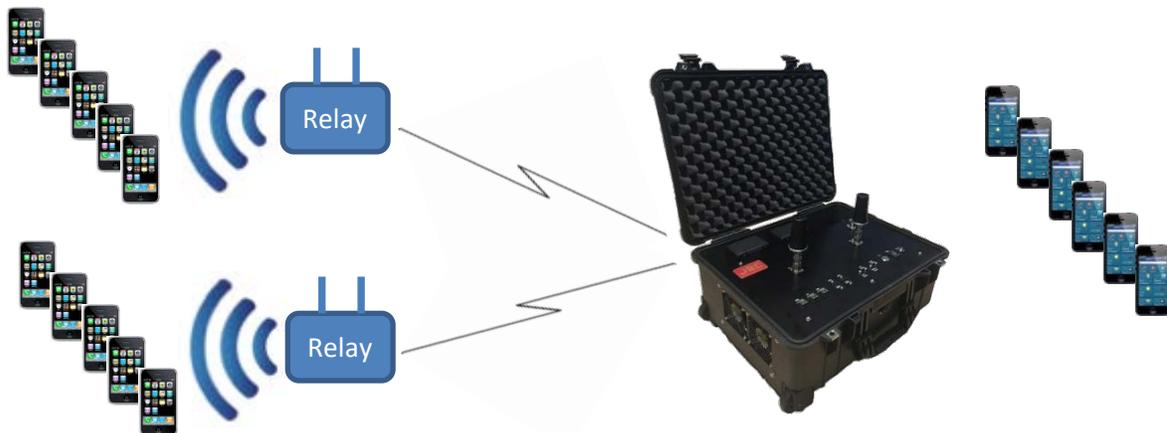
Sometimes the LTE box coverage is not sufficient to cover all required locations. In such cases the use of portable LTE relay devices may extend the RF coverage of an LTE box to un-covered areas such as tunnels, underground, basements and etc.

A Relay device is a dual radio entity that consists of two radio types, an access and backhaul. Such device is usually located on the edge of the cellular main network coverage. It connects to the main radio network (LTE box or Macro cells) via an in-band radio link. The core network is aware of the relay node and handles it as a regular base station (in case of pure LTE) or as an AP in cases of other radio technology such as WiFi. The relay nodes solution supports mobility (HO) between the relay devices or between a relay device and the main network. This functionality is supported by the core entity located in the LTE box.

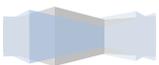
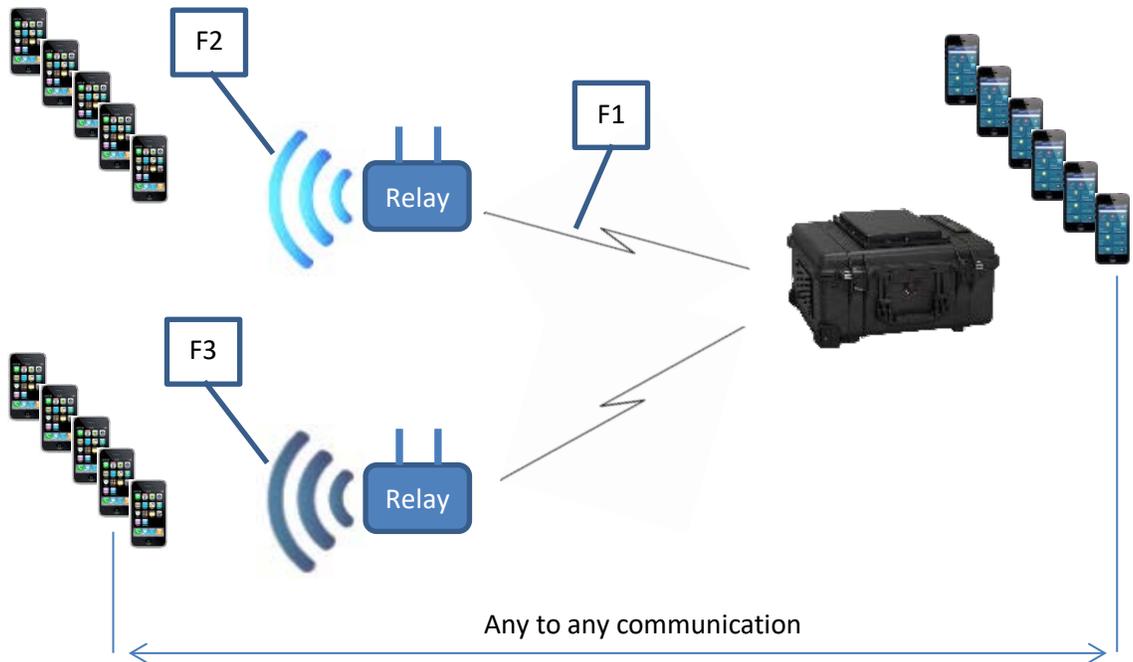


Relay devices are not used only to extend the wireless coverage of an LTE box. They also expand the total users' concurrency. The total number of concurrent users that are handled by a single LTE box increased dramatically.

Several relay devices may be connected to one LTE box so the network coverage can be expand in several dimension.

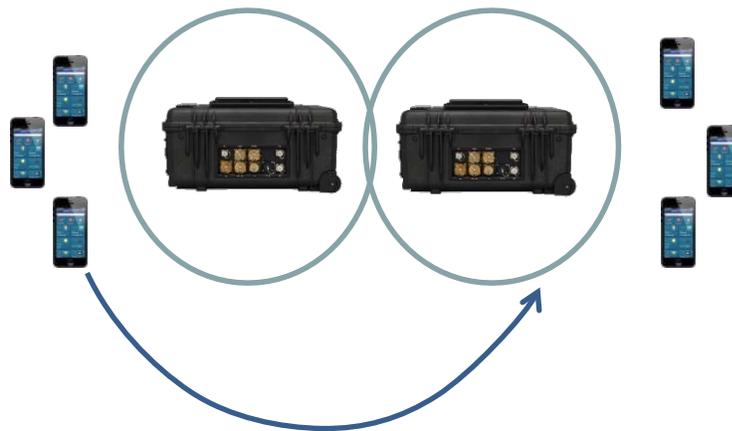


The use of relay devices may allow the existence of a multi frequencies network. Each relay device may transmit on the access radio a different frequency, and actually execute frequency shifting from the main frequency transmitted by the box. Thus, in the same area several frequencies may be used to provide communication through a single LTE box.



Multi Bubbles Concept

JRC LTE box supports the multi bubble concept that allows one LTE box to communicate automatically with other boxes. A wireless Bubble is an LTE box that equipped with in-band wireless backhaul. When two boxes are getting close they automatically sense each other and use the in-band frequency to create a data channel between the boxes. The two boxes after establishing the communication channel are actually creating a combined wireless network that now serves users of both bubbles. The users may communicate with each other and also can use the new extended wireless coverage.



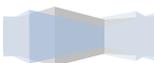
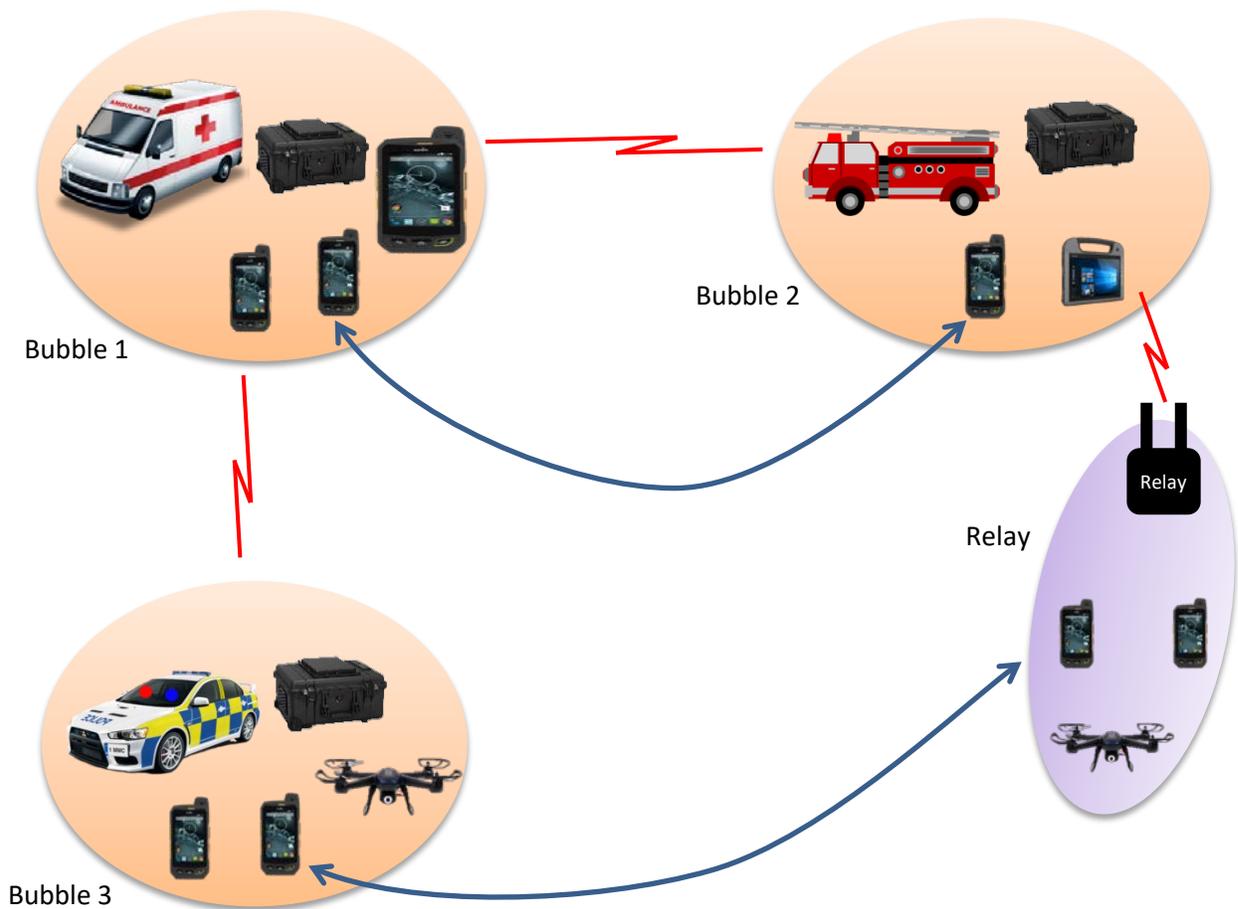
Extended wireless coverage may be used by all users

The multi bubble technology allows several LTE boxes to communicate with each other to build a much larger wireless coverage for several agencies groups. Each agency group uses its own LTE box. Upon an emergency even when several groups need to handle the same event on the same area, communication channels are established automatically to allow communication and coordination between the groups without any technical action taken. This technology allows the different agencies groups also to use different radio frequencies.



The below diagram illustrates a three bubbles communication network. Each bubble represents different public safety authority. The fire troops use a relay device to extend their coverage. Each bubble includes various applications, some are dedicated to the group and some may be used by other groups.

The bubbles sense each other and build automatically the communication links so all users of all public safety authorities can communicate with each other. The users may move from their bubble to another bubble and still get a service due to bubble to bubble protocol.



Interoperability with Legacy Radio (LMR to LTE interop)

JRC LTE box allows interoperability of mobile phones and legacy radio systems (LMR). It provides a middleware solution to overcome the challenges of integration by interconnecting a PMR System with advanced LTE mobile phones applications. It is designed to integrate advanced IP based PTT with a PMR radio network over voice (group and individual calls) and message communication.

The interoperability function extends the flexibility of the network by connecting two different PMR systems (e.g. TETRA and MOTOTRBO™) with the LTE infrastructure that may consist of smartphones across various operating systems.

Main features:

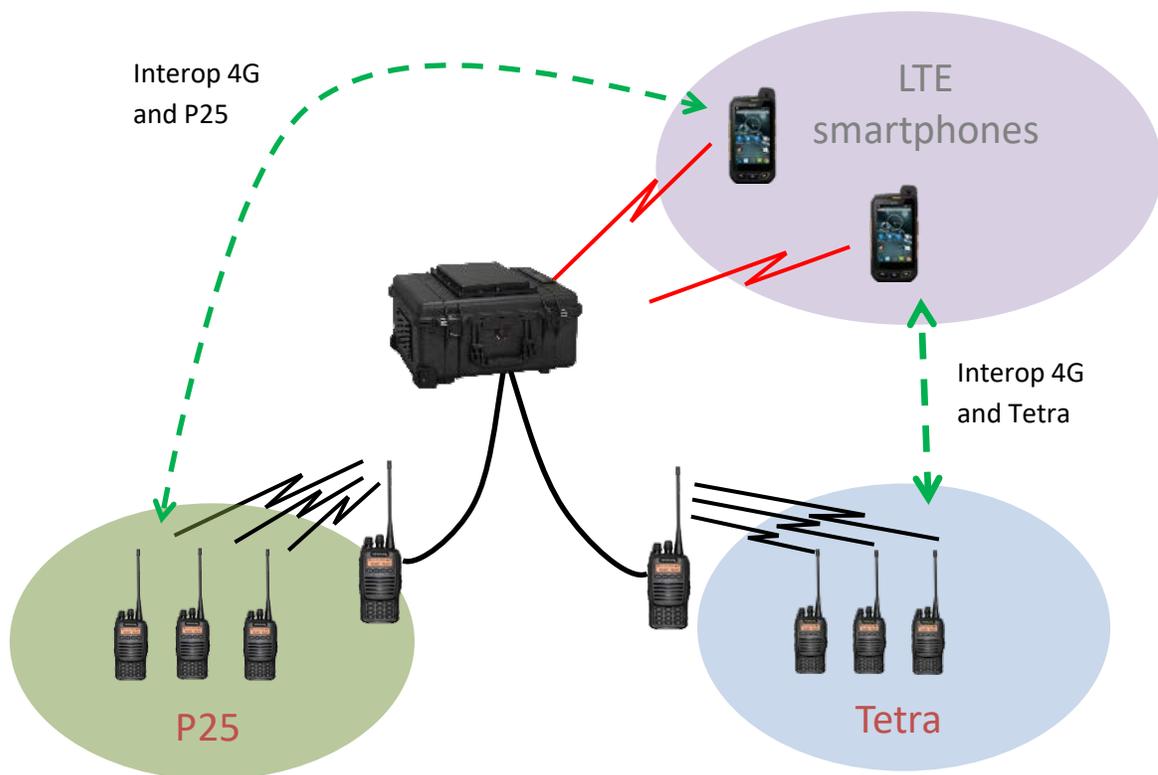
Group Call – Voice communication in group

Intelligent hub – The PMR networks can be interconnected to LTE private network and to clients located on other corners of the world

Interface to PMR – The LTE box is connected to PMR radio infrastructure via defined interfaces (e.g. API, PEI, XCMP or any other).

Different Frequency Bands – The solution is not limited by frequency band. It fully depends on radio network infrastructure

A common deployment scenario would allow communication between several LMR radio groups and LTE smart phones.



MC-PTT Capabilities

MC-PTT capabilities provides Mission Critical Push-To-Talk functionality. This capability comprises application service and network service.

Application service provides most of the on-network call types defined in the 3GPP MCPTT specifications such as private call, group call, etc. JRC provides appropriate MC-PTT functions which meet customer's requirement. Also, MCPTT application service that customer already has can be integrated in LTE-BOX.

Network service supports Mission Critical QoS feature. This feature guarantees MCPTT audio/video performance in system level even under high traffic conditions.

JRC integrates mission critical application service and mission critical network service tightly which enables to provide true mission critical service to MCPTT users.

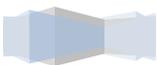
Main features:

MCPTT Application Service:

- Private Call
- Normal Group Call
- Emergency Group Call
- Floor Control
- Encryption

MCPTT Network service:

- Mission Critical QoS:



Key Features

Item	Description
Complete LTE Network in-a-Box	EPC, eNB, application servers are in a box
End users devices	Supports standard commercial mobile devices
Advanced LTE	Advanced LTE-MIMO Radio Technology
Simple Operation	Fully standalone operation and simplified operation
Fast bring up	Two to three minutes from power up to full operation (no further actions)
Backup	Battery backup Hot swappable battery replacement to allow continues system operation
Multi-Bubble Communication	Supports multiple box connection w/o backhaul
Communication tools	Optional integrated PTT App server, Video server and Location based service
Interoperability with legacy voice system	Optional interoperability with legacy system e.g. P25, Tetra
Backhaul	Optional backhaul 3G/4G Cellular modem, WiFi backhaul, VSAT link
Remote access	Allow an operating center to connect remotely to the box and manage it
Maintenance	Simple maintenance with snapshot support
LTE Frequency	Supports any standard and non-standard band

