

# Non-ISSI LMR to LTE MCPTT

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NIST

#PSCR2020





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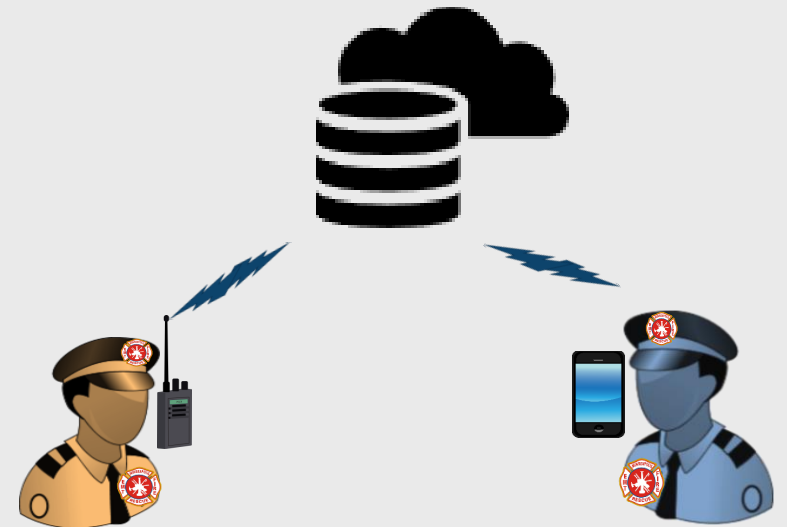
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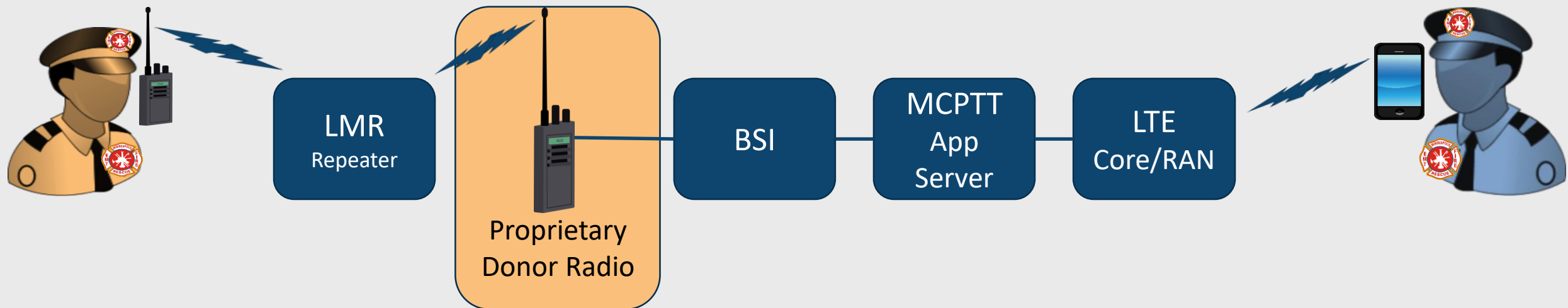
# Executive Summary

- Current Status of LMR to LTE Capabilities and Development
- A Missing Combination
- PSCR's LMR to LTE Strategy
- Recognized Challenges
- Current Research Project



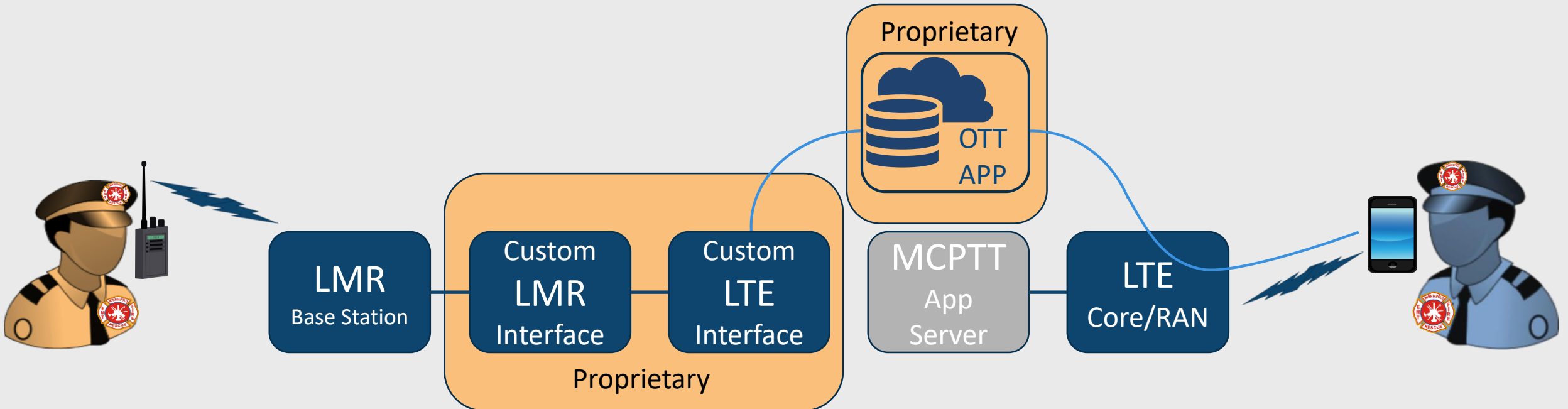
# Status of LMR to LTE Capabilities and Development

- **Bridging System Interfaces (Radio Over IP <ROIP>)**
  - Originally designed for non-ISSI LMR Systems
  - Requires Donor Radios or System Level Connection
  - Proprietary Interfaces
    - Initial ROIP designs were proprietary, this was remedied via BSI
    - May include 3GPP IWF (DHS Small Business Innovation Research) Interface



# Status of LMR to LTE Capabilities and Development

- Custom Solutions
  - LMR infrastructure to LTE App
  - Do not inherently function on LTE Devices



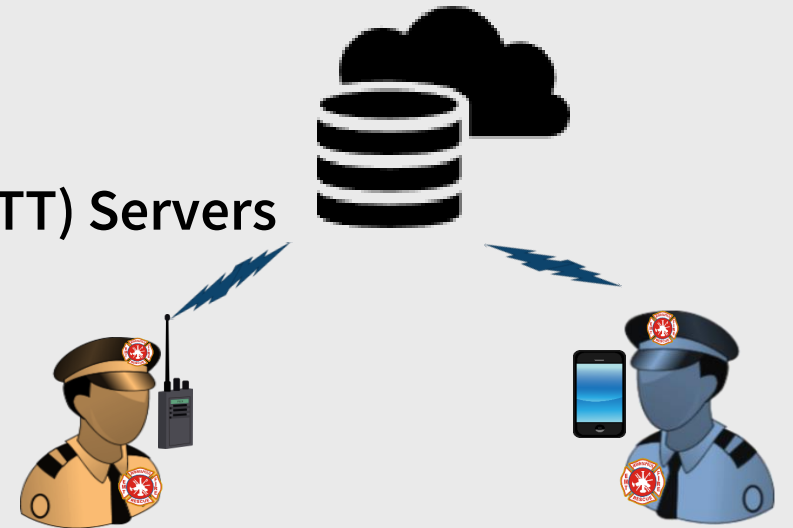
# Status of LMR to LTE Capabilities and Development

- **Inter-RF Subsystem Interface (ISSI)**
  - Originally designed for P25 to P25 System Interoperability
  - Focus of Government and Industry for LMR to LTE
  - Solution for compatible systems (Newer P25)
  - 3GPP Interface Compliant through Interworking Function (IWF)



# The Missing Combination

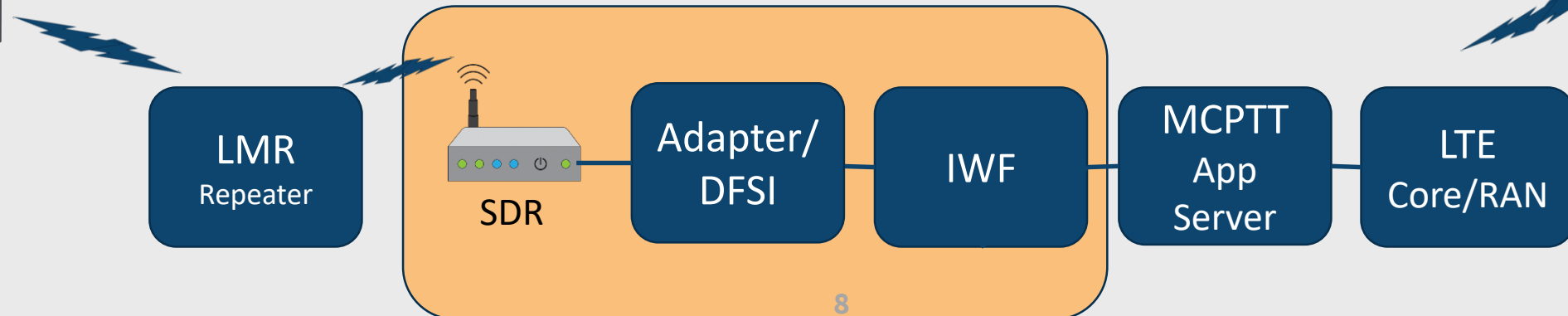
- Support of analog FM LMR
- Air-Interface (RF) Based
  - Does not require a special interface to existing systems
- Affordable
  - No Donor Radios required
  - No Highly Proprietary solutions
- 3GPP Standards-Based
  - Compatible with IWF and Mission Critical Push-to-Talk (MCPTT) Servers
  - Does not require Middleware Service
  - No special Apps
- Open Source
  - Competitive environment for companies



# PSCR's LMR to LTE Strategy

- Research Objectives

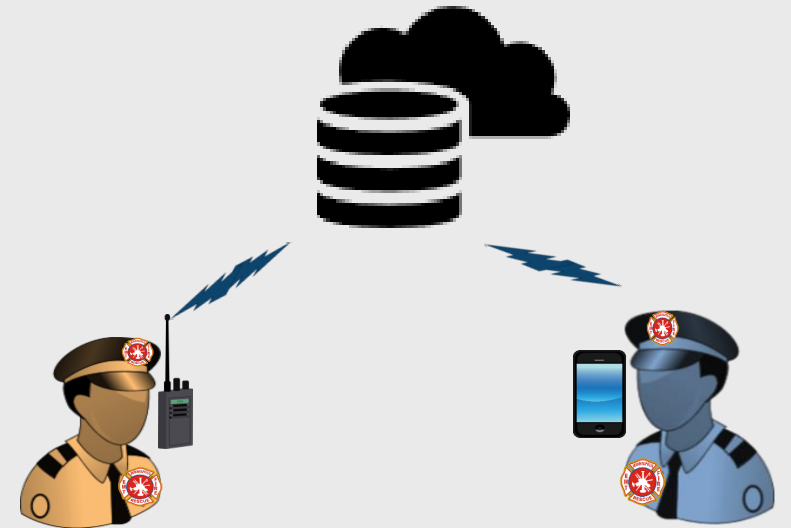
- Research and Prototype Software Defined Radio (SDR) Solutions
  - “LTE core talks to the tower like it’s a radio”
  - Focus on analog FM and non-ISSI compatible P25
- Determine if Existing IWF and MCPTT Capabilities Are Sufficient
  - Target efforts to fill gaps
- 3GPP Standards involvement and contributions
- Creating capabilities to benefit Public Safety





# PSCR's LMR to LTE Plan

- **Overall Goal: Fill the Technology Gaps**
  - ISSI is being addressed by Industry
  - ROIP and other Custom Solutions exist
- **Current Project (Basic Floor Control and Audio Passthrough)**
  - Basic Floor Control
  - Audio Passthrough
- **Full LMR to LTE Effort**
  - One to two years
- **Next Steps**
  - Full duplex RTP audio on single channel
  - MCPTT Features



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# Current Research and Development

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# LMR to LTE - PSCR Passthrough Solution

Design Philosophy

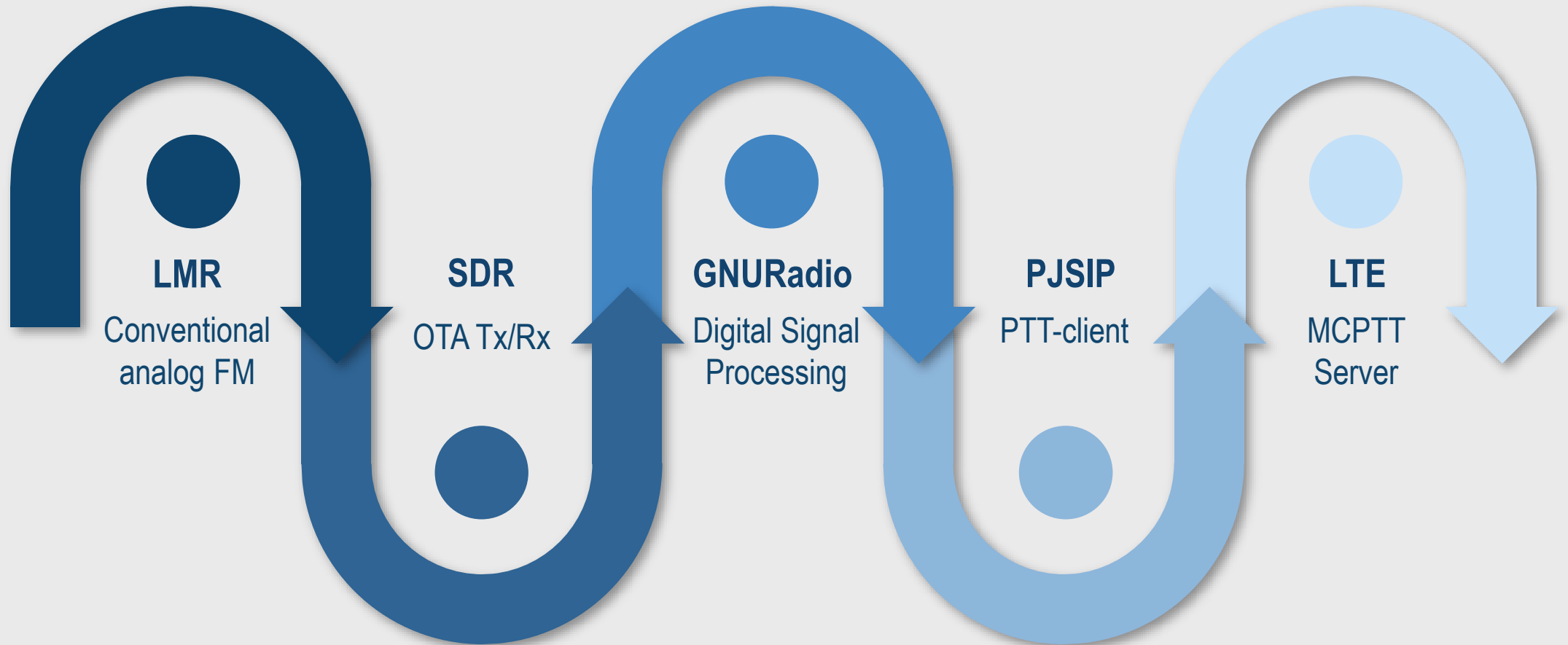
## Scope:

Create a proof of concept conventional analog  
LMR to MCPTT LTE interoperability technology



# Putting the Pieces Together

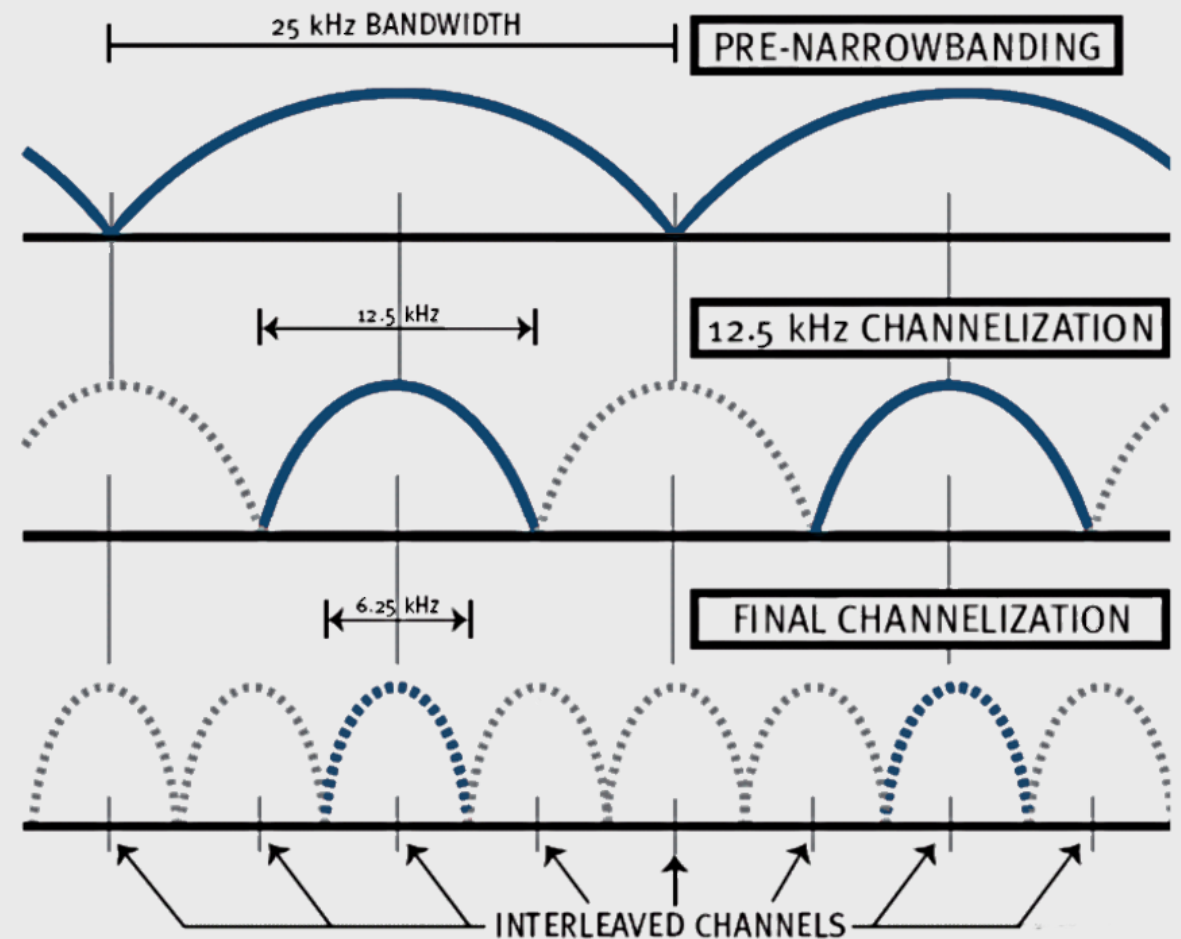
Passthrough Client



# Land Mobile Radio

## Conventional Analog FM

- Defining conventional analog FM LMR
  - Simplex / Duplex operation
  - No Digital capability
  - No Vocoder
- Channel bandwidth of 12.5 kHz or less
- Commonly in VHF / UHF spectrum



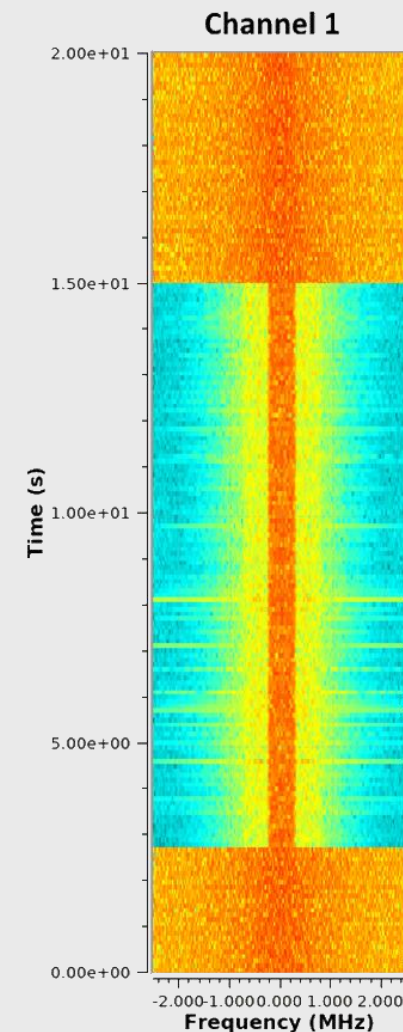


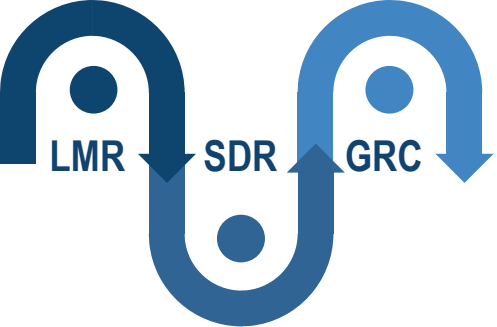


# LMR – SDR

Targeting Over-The-Air Interface

- Highly configurable RF front end
- Compact and durable form factor
- USB 3.0 interface
- High availability
- Relatively Low Cost when compared with existing solutions

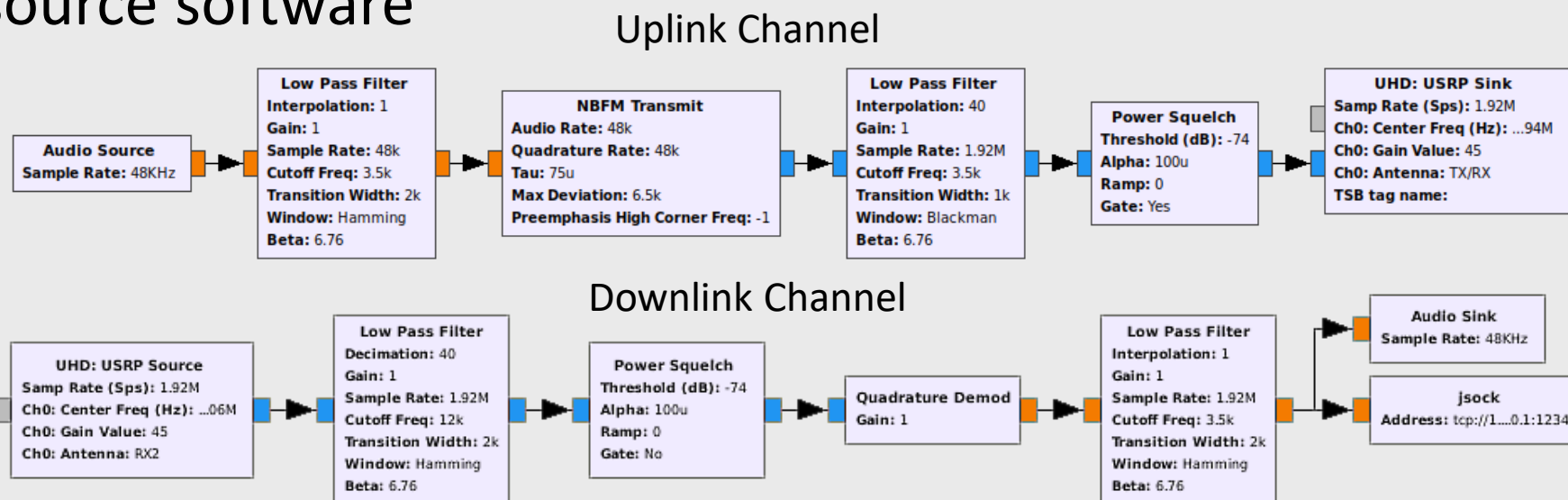


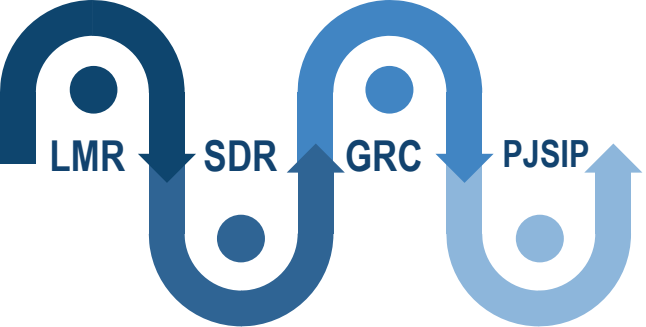


# SDR - GNURadio

Real-Time DSP

- Process data sampled by SDR
  - Demodulate / Modulate
- Real time operation
  - Command burst Tx of SDR
- Open-source software





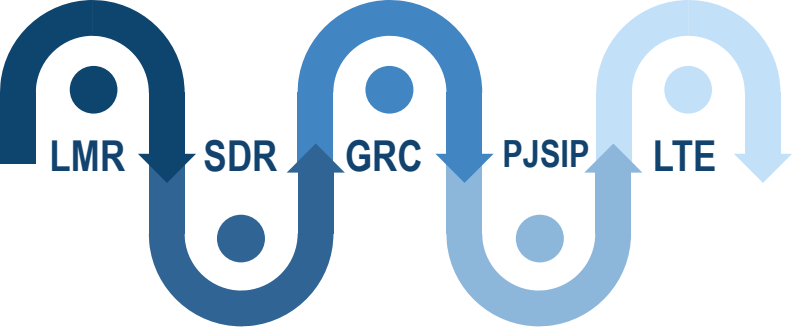
# GNURadio – PJSIP

PTT-Client

- AMR-NB/WB and Opus codec support
- Transport protocol: RTP, UDP, SIP
- AKA and Digest encryption
- Open-source software



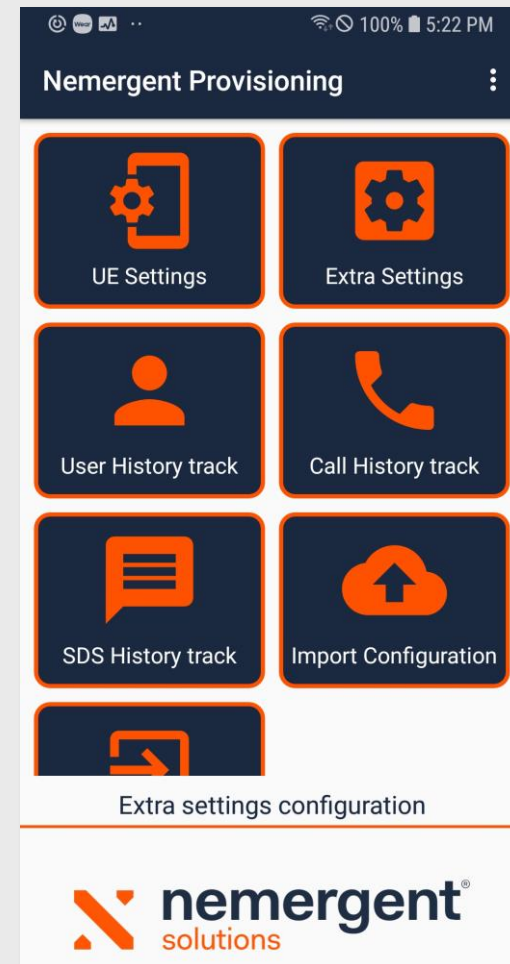
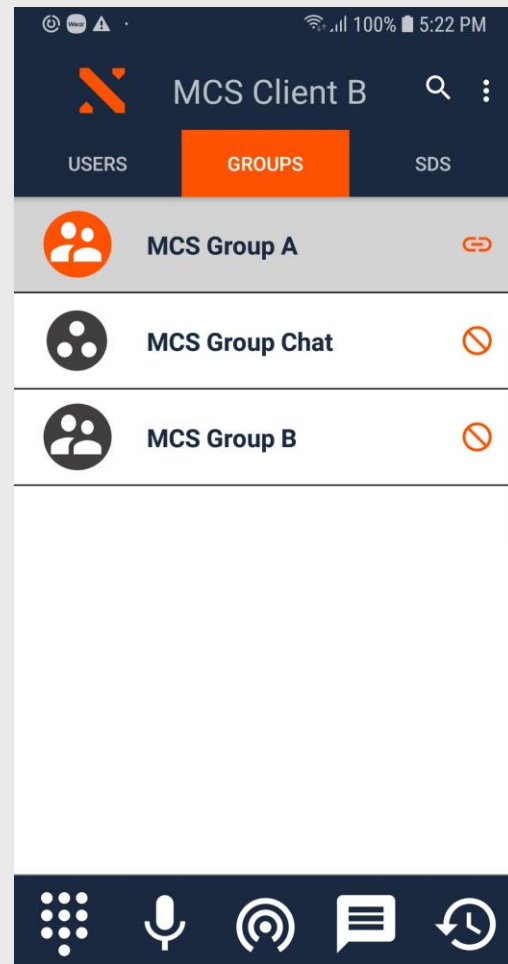
```
jodell@ubuntu-mcv:~/Desktop$ ./PJSUA_fs.bin
10:07:04.531      os_core_unix.c !pjl原因 2.9-svn for POSIX initialized
10:07:04.532      sip_endpoint.c .Creating endpoint instance...
10:07:04.532      pjlib      .select() I/O Queue created (0x55dd40dd39b0)
10:07:04.532      sip_endpoint.c .Module "mod-msg-print" registered
10:07:04.532      sip_transport.c .Transport manager created.
10:07:04.532      pjsua_core.c .PJSUA state changed: NULL --> CREATED
connecting to GNURadio ZMQ socket...
Connected to socket!
Options:
  1. Press 'h' to hangup all calls
  2. Press 'c' to make a call
  3. Press 't' to request the floor
  4. Press 'r' to release the floor
  5. Press 'q' to quit
```



# LTE

## MCPTT Ecosystem

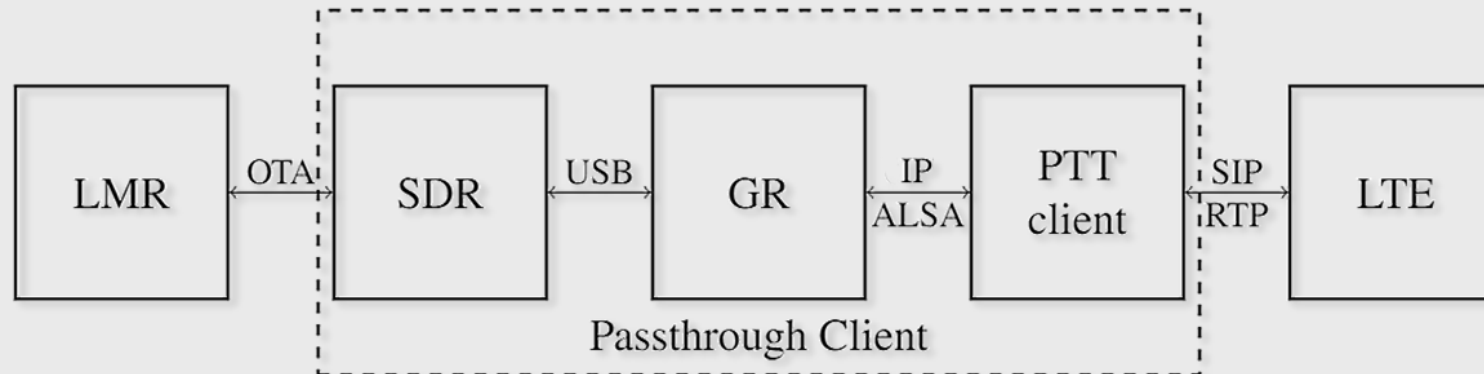
- MCX Application Server
  - MCx: PTT, Data, and Video
  - Operations and Maintenance GUI
- MCx client/Non-MCx client
- IWF vs Enabler



# Floor Control

## A Closer Look

- Floor control request by the LMR end point in an on-going call between LMR and LTE users.
  - The SDR monitors the selected conventional LMR channel(s)
  - GNURadio speech detection triggers IP based floor control messaging to the Passthrough Client
  - The Passthrough Client requests the floor via SIP based messaging to the host MCPTT server
- Floor control request by the LTE end point in an on-going call between LMR and LTE users.
  - Passthrough client forwards all incoming audio to GNURadio
  - GNURadio speech detection commands burst transmit of call data stream
  - SDR retransmits commanded call audio into LRM channel(s)





# Future Work

- Latency testing and characterization of the Passthrough Client
- Addition of the IWF
  - Encryption and KMS
- Continued Passthrough Client development
  - Audio Handling
  - In-Band Signaling
  - Support of digital LMR
- Better understand the impacts of transcoding
- Rolling more Passthrough client functionality into GNURadio blocks to simplify usage.

# THANK YOU



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