

SCA-Compatible Public Safety P25-FM3TR-VoIP Bridge

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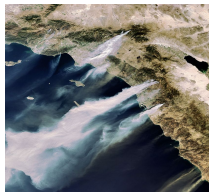


Outline

- 1 Motivation and Introduction
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- 4 Design of the P25-FM3TR-VoIP Bridge
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The Need for Interoperability



- Military and civilian public safety collaboration
 - ▶ Radio communication interoperability
 - ▶ Communication bridge



Introduction

- Interoperability inside military
 - ▶ Joint tactical radio system (JTRS)
- Interoperability within public safety communities
 - ▶ Project 25 by APCO, NASTD, NCS, etc.
- Future multiband multiwaveform modular tactical radio (FM3TR)
 - ▶ Developed as an international cooperative effort
 - ▶ Open standard for test and demonstration
- Voice over IP (VoIP) and session initiation protocol (SIP)
 - ▶ Carry packetized voices over the IP network
 - ▶ SIP is a signal protocol controlling multimedia communications



Project Goals

- Implement P25 and FM3TR systems
 - ▶ SCA core framework
 - ▶ SDR-4000 from Spectrum Signal Processing
- Develop a gateway bridging P25, FM3TR and VoIP
 - ▶ FM3TR represents of legacy military radio systems
 - ▶ VoIP represents the modern IP network applications
- Address key design issues
 - ▶ Support push-to-talk (PTT) operation with VoIP clients
 - ▶ Voice translation
 - ▶ Collision resolution and arbitration



Platform Description

- SDR-4000 IDS

- ▶ Spectrum Signal Processing
- ▶ Pro-4600
 - ★ Power PC
 - ★ DSP and FPGA
- ▶ XMC-3321
 - ★ 14-bit 105MSPS ADC
 - ★ 14-bit 300MSPS DAC

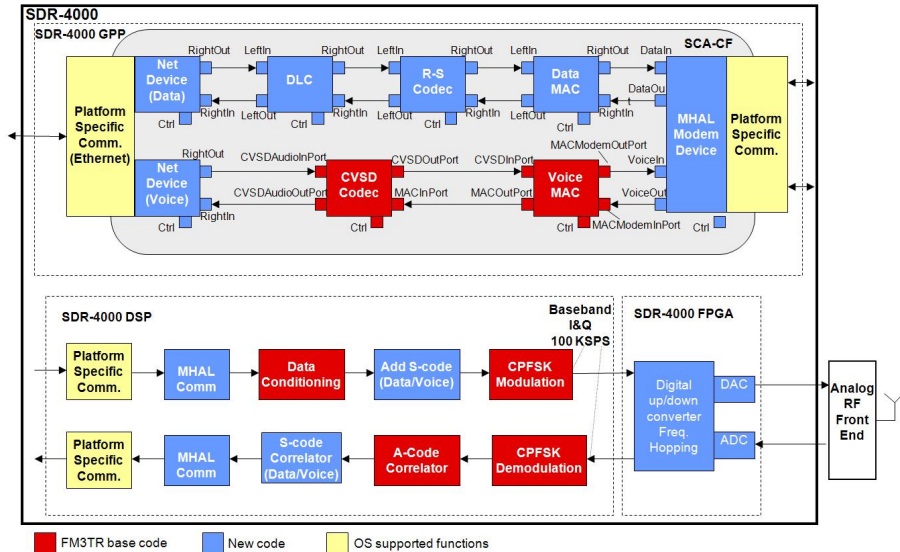


- PXI Chassis

- ▶ National Instruments
- ▶ Up-convertor
 - ★ PXI-5610
- ▶ Down-convertor
 - ★ PXI-5600

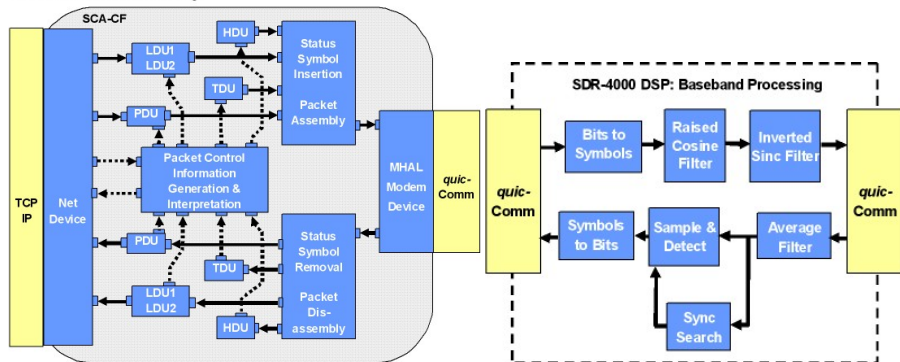


SCA-compatible FM3TR Implementation

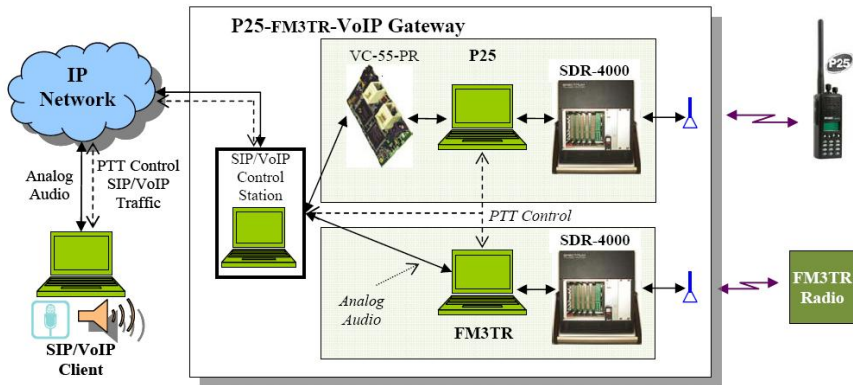


SCA-compatible P25 Implementation

SDR-4000 GPP: Packet Processing



P25-FM3TR-VoIP Bridge Architecture



SIP/VoIP Operations in the Bridge

- The bridge adopts SIP client/server architecture
 - ▶ Scalability to bridge other systems, such as legacy analog FM LMR
- SIP client for P25/FM3TR
 - ▶ P25/FM3TR are PTT based voice systems without IP support
 - ▶ One SIP client per system
 - ★ Taking advantages of the broadcast nature of PTT systems
 - ▶ Bridge operator is necessary
 - ★ Manual (human) or automatic (software)
- SIP server session profiles
 - ▶ Four possible profiles among P25, FM3TR and VoIP clients
 - ▶ SIP/VoIP server operation mode
 - ★ Handles call setup and maintenance only
 - ★ Forces all calls go through the server

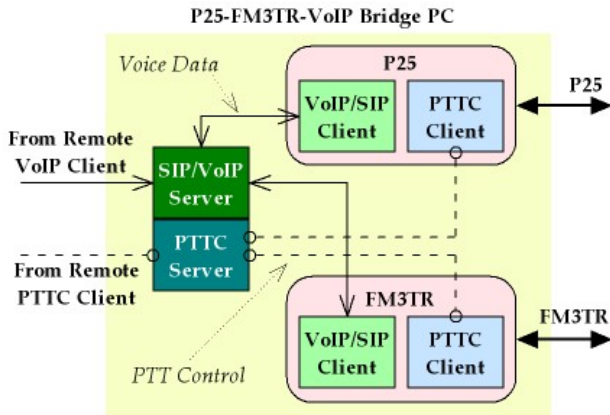


Push-to-Talk Control (PTTC) Protocol (1)

- Problem statement
 - ▶ The P25 needs to push the talk button on the FM3TR side
- The PTTC protocol
 - ▶ is a data signaling protocol to manage the PTT sessions
 - ▶ emulates the "push the talk button" action
 - ▶ adopts client/server structure
- PTTC protocol operations
 - ▶ Registration
 - ▶ Channel requests, grant or refusal
 - ▶ Status update
 - ▶ Timeout



Push-to-Talk Control (PTTC) Protocol (2)



Voice Translation in the P25-FM3TR-VoIP Bridge

- Different systems use different voice codec
 - ▶ P25 – Improved multi-band excitation (IMBE)
 - ▶ FM3TR – Continuous variable slope delta (CVSD)
 - ▶ VoIP – G.711 μ -law, i.e., linear PCM
- The main challenge
 - ▶ IMBE of P25 is a proprietary property of DVSI.
- The solution
 - ▶ Using analog voice as the common format
 - ▶ Pairwise transcoders vs. common format
 - ★ $n(n-1)/2$ vs. $n-1$ or n



Collision Resolution and Arbitration

- Collision occurs in a single PTT system
 - ▶ Multiple users press the talk button simultaneously
 - ▶ Users follow certain behavior protocols
- Collisions among users from different subsystems
 - ▶ Talking-request collision at the bridge
 - ▶ PTTC channel request handles collision resolution and arbitration
- Remote radio terminal is still a challenge
 - ▶ Traditional behavior protocol is still useful



Summary and Acknowledgement

- A P25-FM3TR-VoIP bridge is designed and implemented
- A PTTC protocol is developed to support PTT operation in the bridge
- Both VoIP/SIP and PTTC adopt client/server architecture
- This work was supported by the Joint Program Executive Office of the Joint Tactical Radio System (JPEO JTRS) through SPAWAR Systems Center

