Mission Critical Voice Quality of Experience Measurement Methods Overview

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Certain commercial entities, equipment, or materials may be identified in this document in order to describe an experimental procedure or concept adequately.

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* Please note, unless mentioned in reference to a NIST Publication, all information and data presented is preliminary/in-progress and subject to change

INTRODUCTION

- Key Performance Indicator (KPI) Measurement Methods Review
- Related On-Demand Sessions
- Interconnected Systems
- Future Direction

QUALITY OF EXPERIENCE (QoE) KPIs FOR MCV – MCV ROUNDTABLE 2017

- Mouth-to-Ear (M2E) Latency
  - Time it takes audio to get from transmitting user to receiving user
- End-to-End Access Time
  - Time between PTT button press & receiving user hearing intelligible voice
  - Access Delay + M2E Latency
- Voice Quality/Intelligibility
  - Public Safety cares most about intelligibility
- Probability of Successful Delivery
  - Formerly defined as Access/Retention Probability

TECHNOLOGY AGNOSTIC MEASUREMENTS

- Goal is to create a black box measurement system
  - Based upon the user experience -- speech
  - Comparable and fair across all voice communication technologies
- Not intended to analyze internal system design/construction
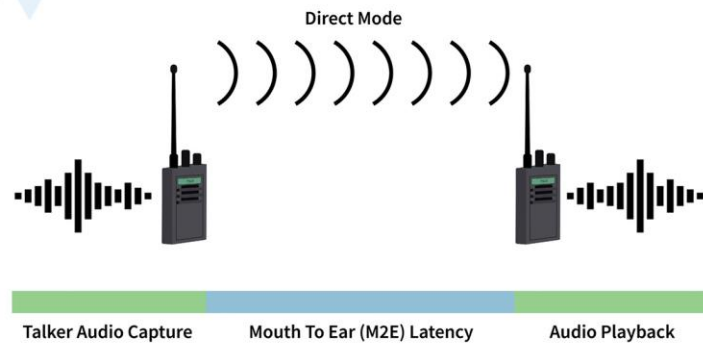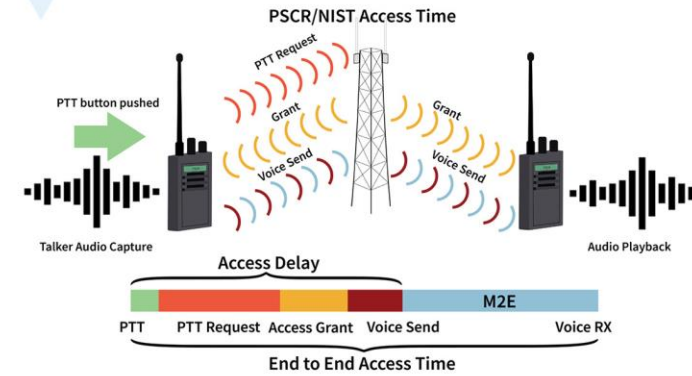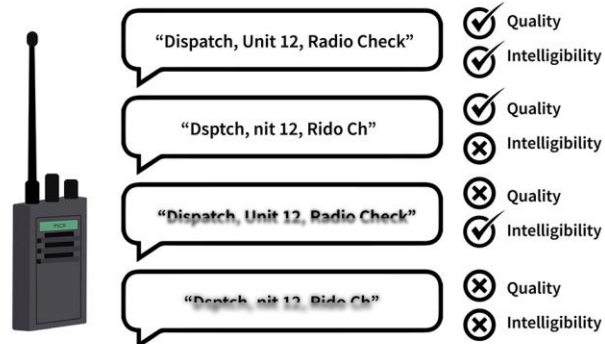
TECHNOLOGY AGNOSTIC MEASUREMENTS

Communication System

KPIs:

- Mouth-to-Ear Latency
- End-to-End Access Time
- Voice Quality/Intelligibility
- Probability of Successful Delivery
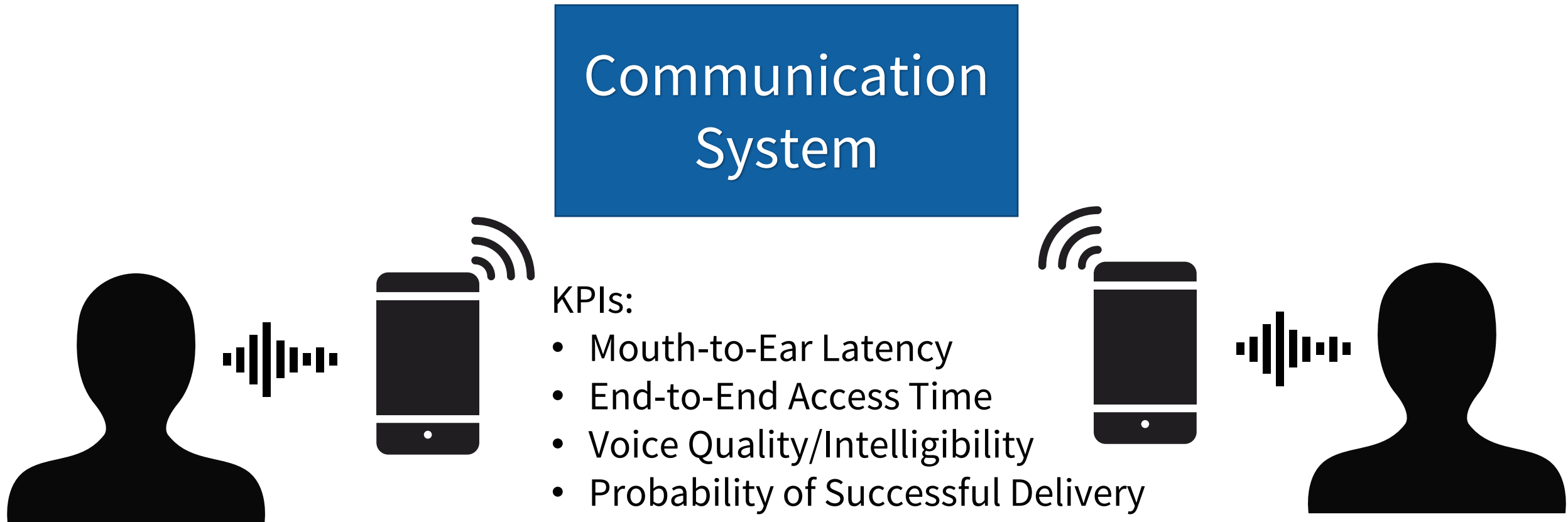
QOE KPIs FOR MCV

MISSION CRITICAL VOICE (MCV) QUALITY OF EXPERIENCE (QOE) MEASUREMENTS

MOUTH TO EAR LATENCY

Direct Mode

Talker Audio Capture | Mouth To Ear (M2E) Latency | Audio Playback

END TO END ACCESS TIME

PSCR/NIST Access Time

PTT Request
Grant
Voice Send
PTT button pushed
Grant
Voice Send

Talker Audio Capture | Audio Playback

Access Delay

PTT | PTT Request | Access Grant | Voice Send | M2E | Voice RX

End to End Access Time

VOICE QUALITY & SPEECH INTELLIGIBILITY

"Dispatch, Unit 12, Radio Check" — Quality ✓ / Intelligibility ✓

"Dsptch, nit 12, Rido Ch" — Quality ✓ / Intelligibility ✗

"Dispatch, Unit 12, Radio Check" — Quality ✗ / Intelligibility ✓

"Dsptch, nit 12, Rido Ch" — Quality ✗ / Intelligibility ✗

PROBABILITY OF SUCCESSFUL DELIVERY

Send the same message 5 times
Radio

Full message intelligible?

Examples of received messages:
Radio ✓ | Ra...o ✗ | ...dio ✗ | Radio ✓ | Radi... ✗

Probability of Successful Delivery of "Radio" = $\frac{2}{5}$ = 40%
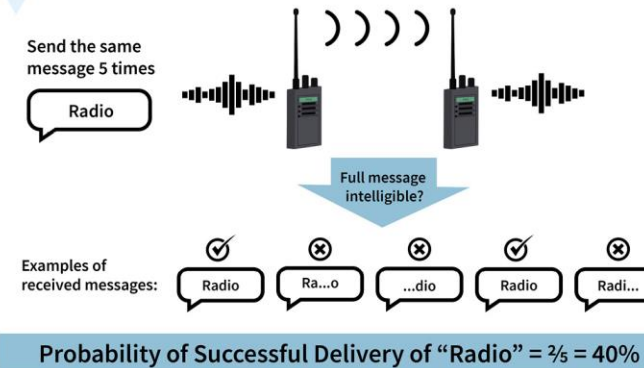
QOE KPIs FOR MCV – M2E LATENCY

Direct Mode

Talker Audio Capture | **Mouth To Ear (M2E) Latency** | **Audio Playback**
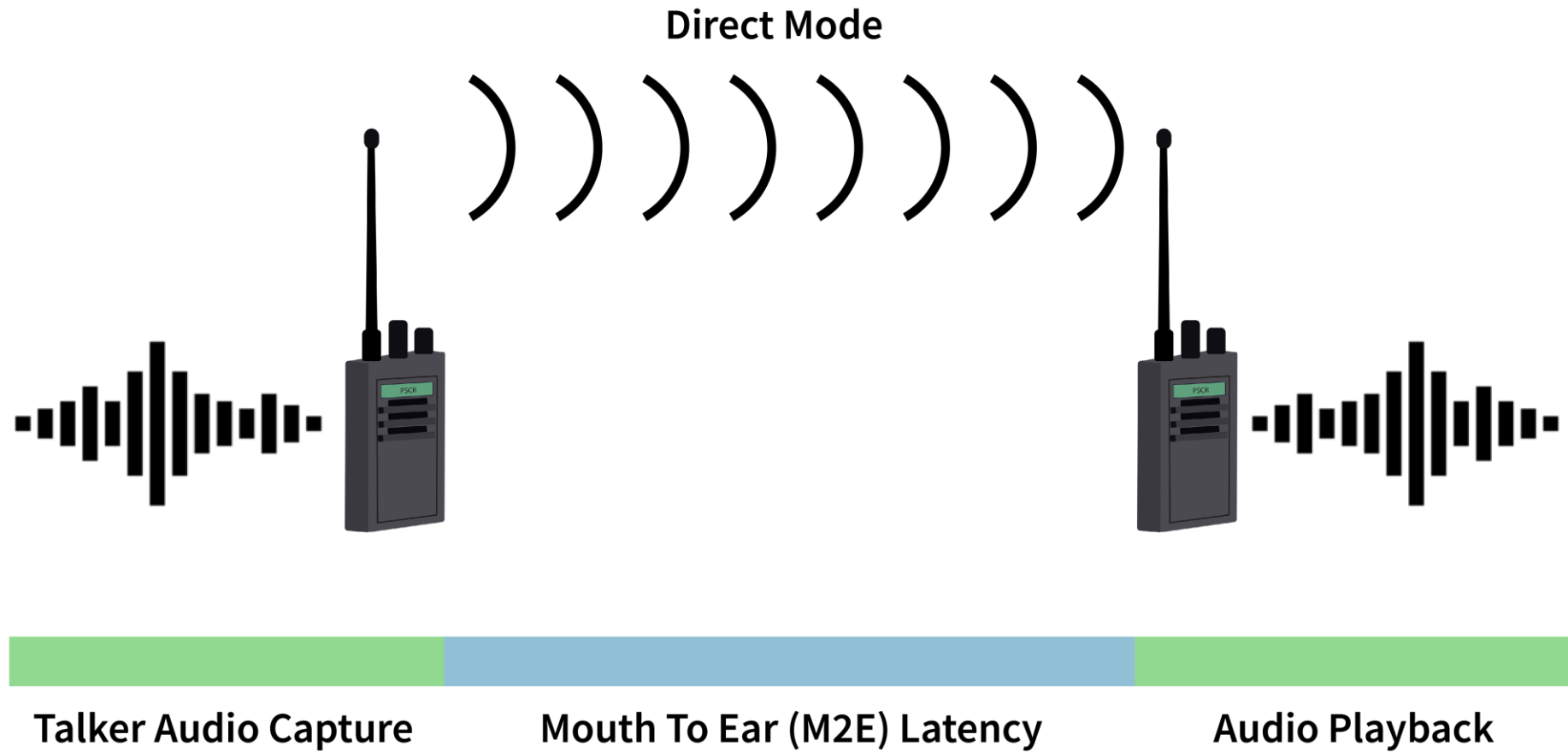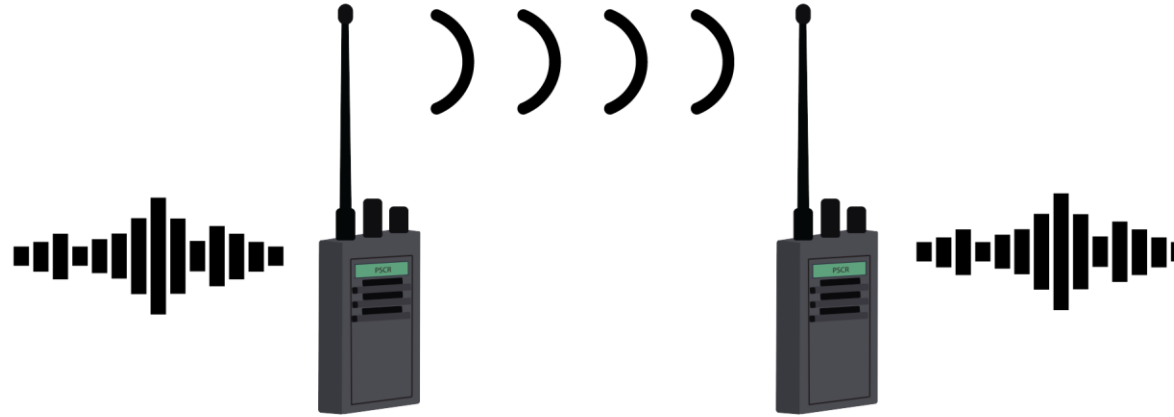
QOE KPIs FOR MCV – END-TO-END ACCESS TIME
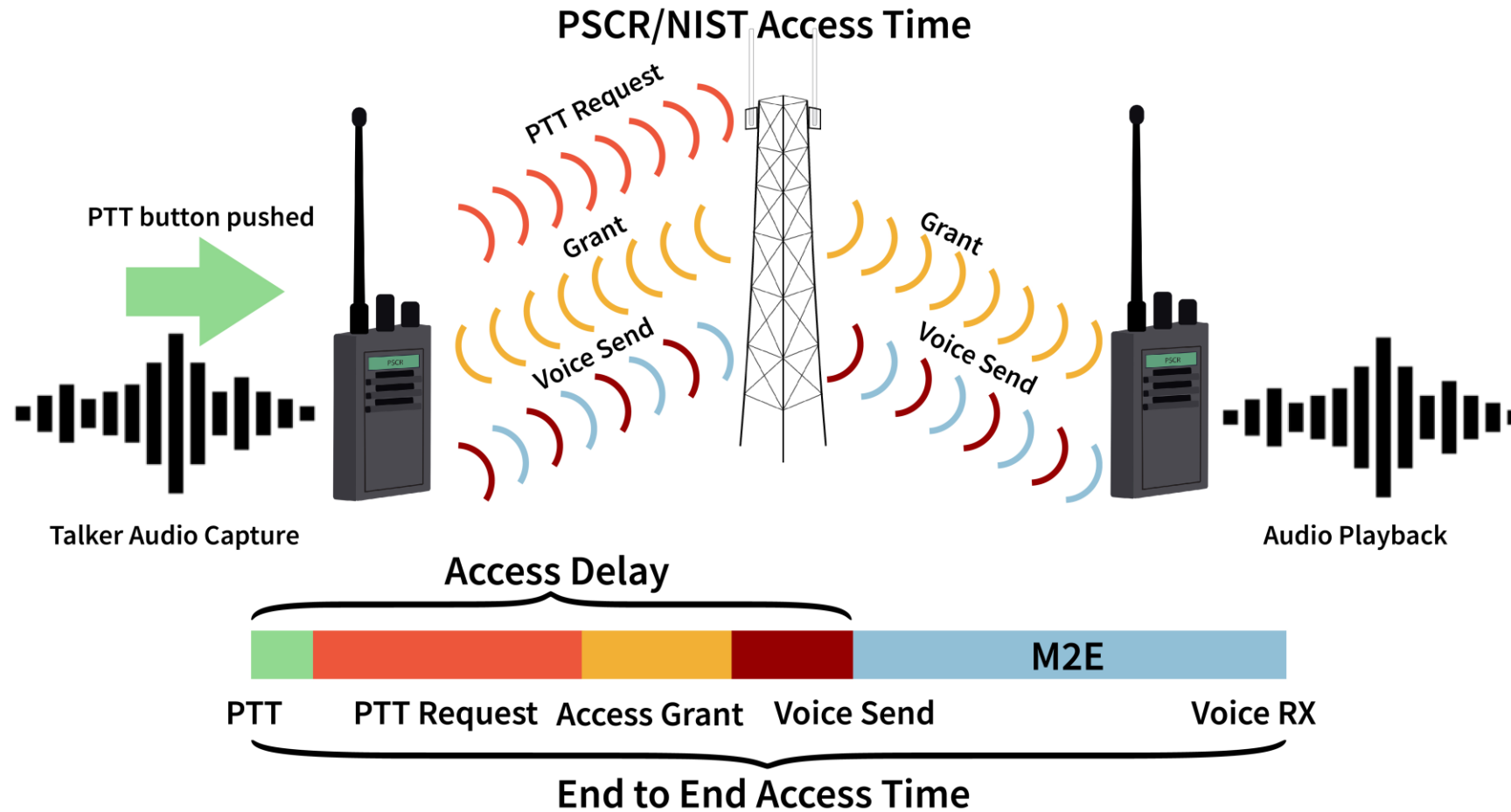
QOE KPIs FOR MCV – PROBABILITY OF SUCCESSFUL DELIVERY

Send the same message 5 times

Radio

Full message intelligible?

Examples of received messages:

✓ Radio ✗ Ra...o ✗ ...dio ✓ Radio ✗ Radi...

Probability of Successful Delivery of "Radio" = ⅖ = 40%

RELATED ON-DEMAND SESSIONS

- Measuring the Probability of Successful Delivery: a QoE Based Approach
  - Jesse Frey and Jaden Pieper
- Introducing a Start of Word Correction for Access Delay Measurements
  - Jaden Pieper and William Magrogan
- Designing Remote Listening Experiments for the Partially Muted Word Impairment
  - Jaden Pieper and Jesse Frey
- Optimal Transmit Volume Conditions for MCV QoE Measurement Systems
  - Chelsea Greene and William Magrogan

RELATED ON-DEMAND SESSIONS

- QoE Software and Hardware Packaging
  - Jesse Frey, John Marts, and Peter Fink
- QUARC: Quality Under Adjustable Realistic Conditions for Communication Systems
  - Kevin Berman
- Lab from Home: Distributed QoE Testing for Mission Critical Voice
  - Henning Schulzrinne
- LMR to Broadband (LTE/5G) Research and Funding Strategy
 - Chris Walton, Jon Cook, and Tim Thompson

INTERCONNECTED SYSTEMS

- Interconnected Systems via Inter-RF Subsystem Interface (ISSI)
  - Purchased two ISSI licenses with our Project 25 (P25) system
  - Land Mobile Radio (LMR) to Enhanced Push To Talk (EPTT)
    - Motorola ASTRO 25 to AT&T's EPTT system
    - First step in interconnecting disparate PTT systems
      - Challenges in establishing physical connection and network configuration (steep learning curve, limited expertise industry wide)
    - Indiana statewide Motorola ASTRO 25 system interconnected to AT&T's EPTT system

INTERCONNECTED SYSTEMS
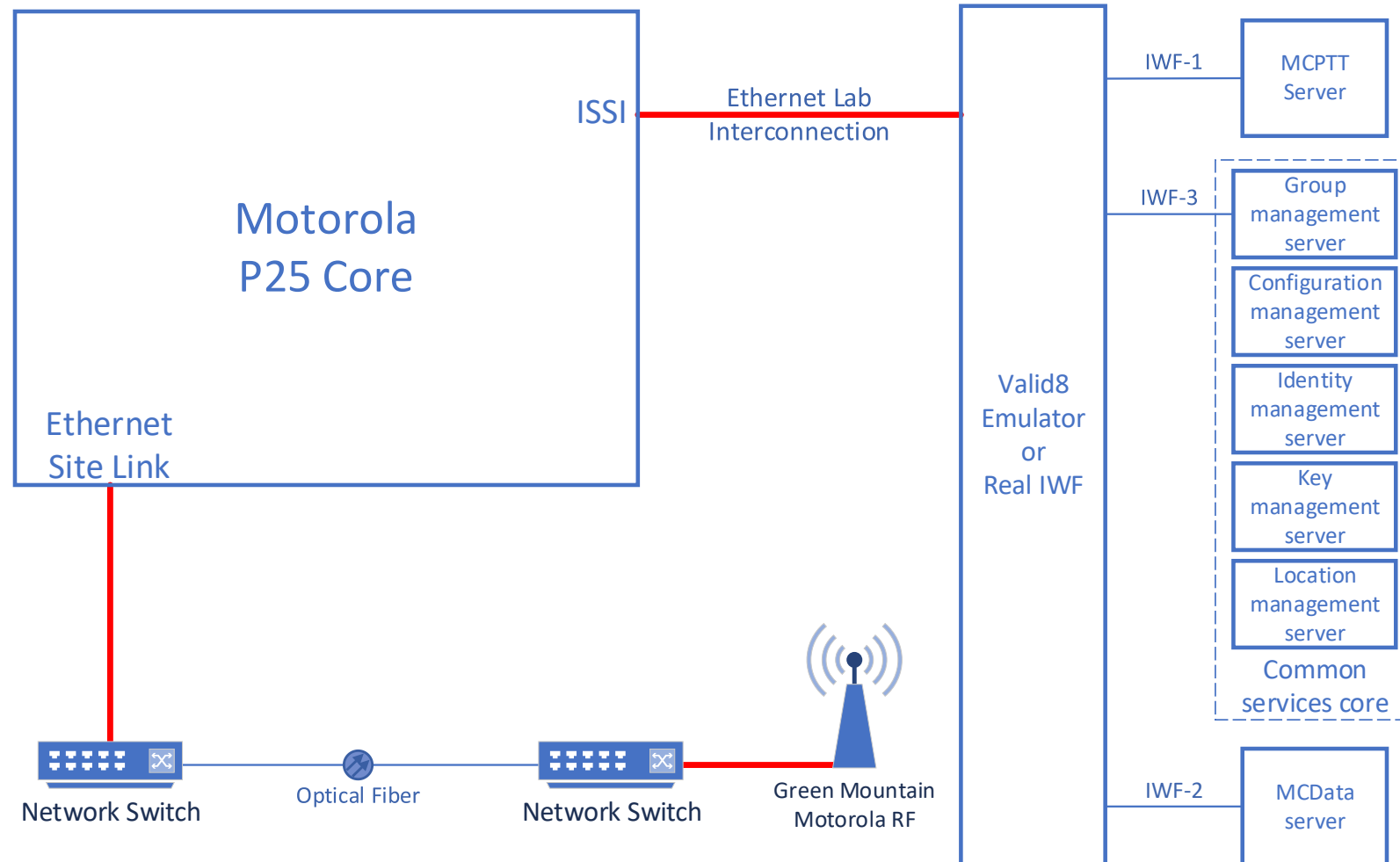## CONNECTION DIAGRAM FOR AT&T EPTT
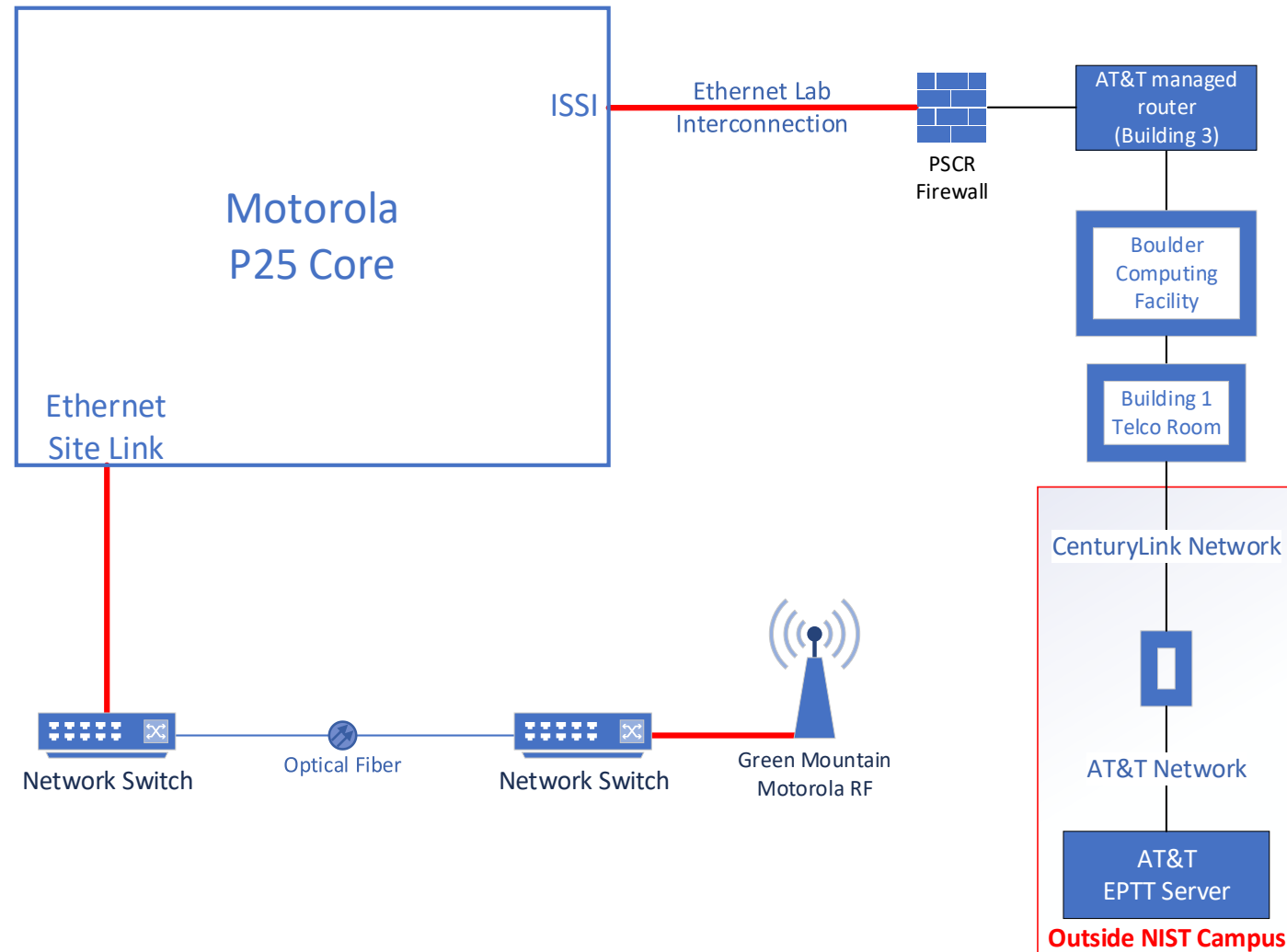
INTERCONNECTED SYSTEMS

- Interconnected Systems via ISSI
  - LMR to Mission Critical PTT (MCPTT)
    - Valid8 developing Interworking Function (IWF) tester and emulator
  - LMR to MCPTT
    - Nemergent developing fully 3GPP-compliant IWF
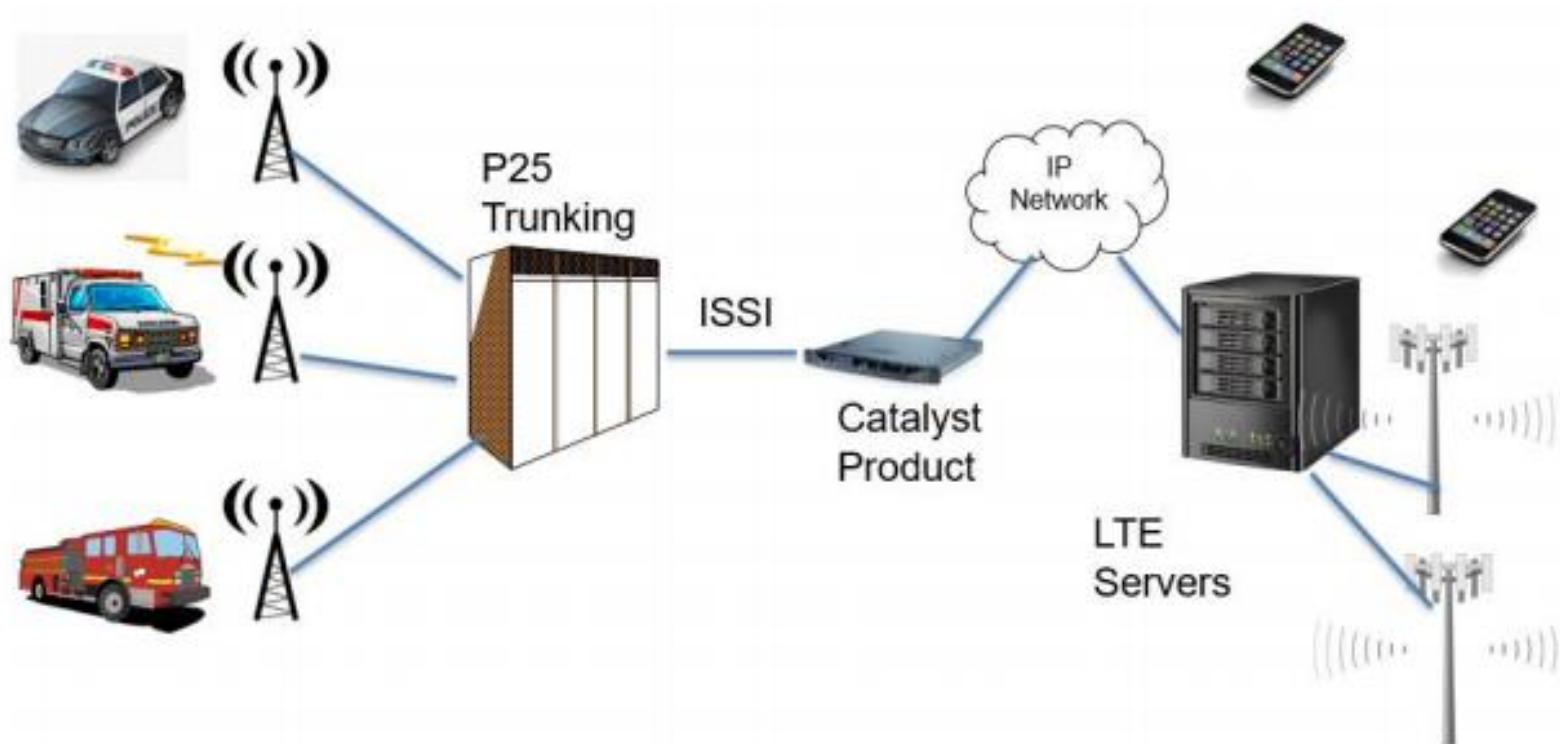
INTERCONNECTED SYSTEMS

CONNECTION DIAGRAM FOR IWF OR IWF EMULATOR

INTERCONNECTED SYSTEMS

- Interconnected Systems via ISSI
    - LMR to Radio over IP (RoIP) Gateway
        - Catalyst developing
        - Supports various LMR interfaces

INTERCONNECTED SYSTEMS

FUTURE DIRECTION

- Finish development of the Probability of Successful Delivery measurement method
  - Test using RF channel emulator vs field testing
- Test interconnected systems
  - M2E Latency
  - End-to-end Access Time
  - Probability of Successful Delivery
- QoE software and hardware packaging

REVIEW

- Key Performance Indicator (KPI) Measurement Methods Review

- Related On-Demand Sessions

- Interconnected Systems

- Future Direction

ADDITIONAL RESOURCES

- M2E Latency (NIST.IR.8206)
  - https://www.nist.gov/ctl/pscr/mission-critical-voice-qoe-mouth-ear-latency-measurement-methods

- End-to-end Access Time (NIST.IR.8275)
  - https://www.nist.gov/ctl/pscr/mission-critical-voice-qoe-access-time-measurement-methods

THANK YOU

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