

eCall  
112

**QUALCOMM**<sup>®</sup>

CORPORATE ENGINEERING

ESG

**eCall – The Special Kind of ‘Fast’ Mobile  
Data Transmission: First Results of a  
European-Wide Field Test Campaign**

**80-W3757-1 Rev A**

**May 2012**



QUALCOMM Incorporated  
5775 Morehouse Drive  
San Diego, CA 92121-1714  
U.S.A.

Copyright © 2012 QUALCOMM Incorporated.  
All rights reserved.

QUALCOMM is a registered trademark of QUALCOMM Incorporated in the United States and may be registered in other countries. Other product and brand names may be trademarks or registered trademarks of their respective owners. This technical data may be subject to U.S. and international export, re-export or transfer (“export”) laws. Diversion contrary to U.S. and international law is strictly prohibited.

**CORPORATE ENGINEERING**  
**ESG**

## eCall – The Special Kind of ‘Fast’ Mobile Data Transmission: First Results of a European-Wide Field Test Campaign

80-W3757-1 Rev A

May 2012



# Outline

---

- Introduction
- Overview of Test Campaign
- Overall eCall Transmission Performance
- Impact of Network Echo Cancellers (NEC)
- Conclusions



# Introduction

---

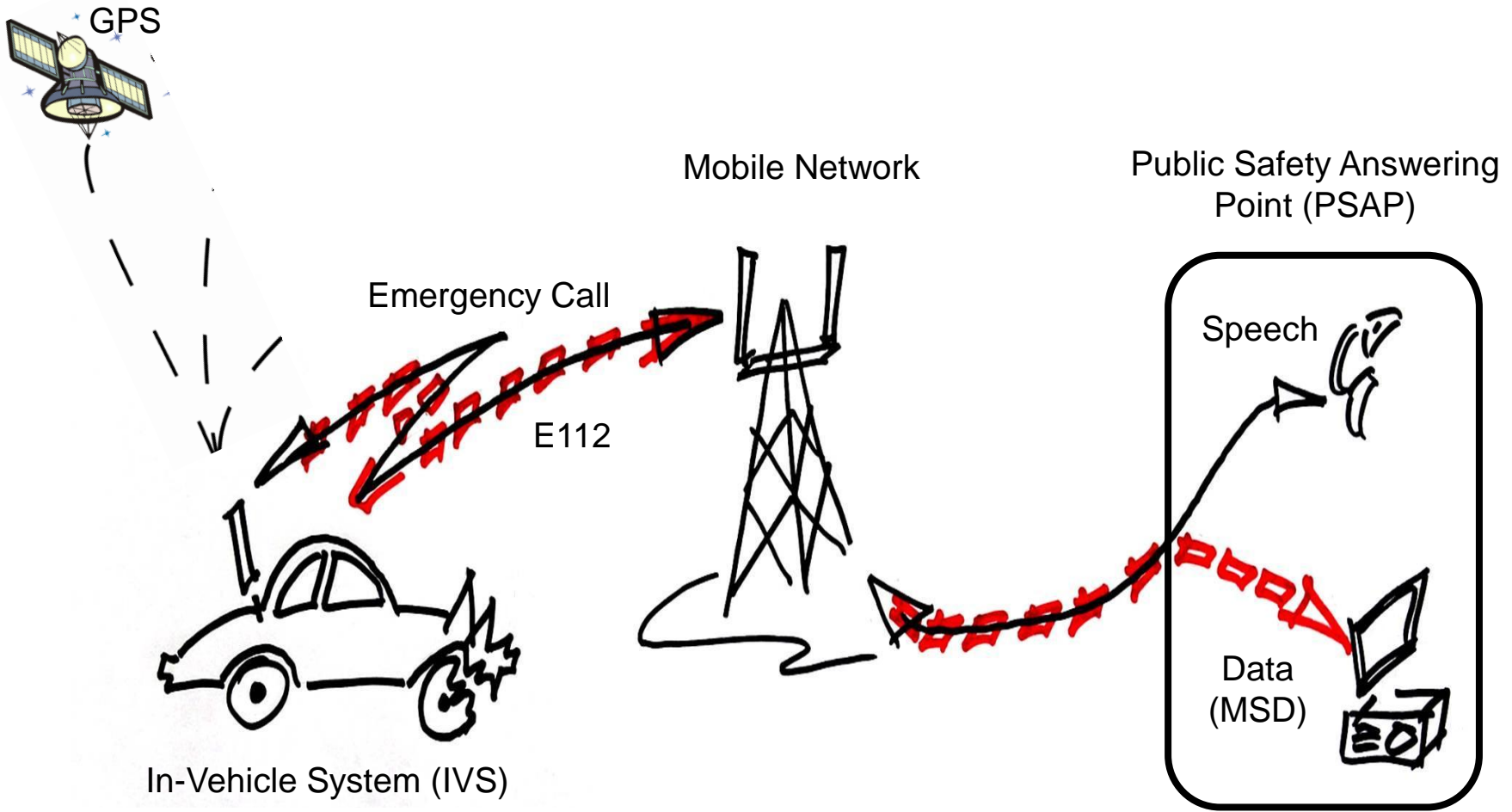
## What is eCall?

- eCall is the upcoming pan-European and Russian in-vehicle emergency call system utilizing connectivity over mobile networks
- Triggered by the eSafety Forum, an initiative of the relevant stakeholders, brought together by the European Commission who adopted the proposal on Sept 8, 2011
  
- Russia plans to introduce the same technology
  
- Potential to save 2500 lives and € 26 billion each year in the EU
  
- Planned Rollout:
  - eCall IVS to be installed in all new vehicles
    - In Russia from 2013
    - In the EU from 2015
  - Existing PSAPs need to be upgraded with eCall software



# Introduction (cont'd)

## eCall: How does it work?

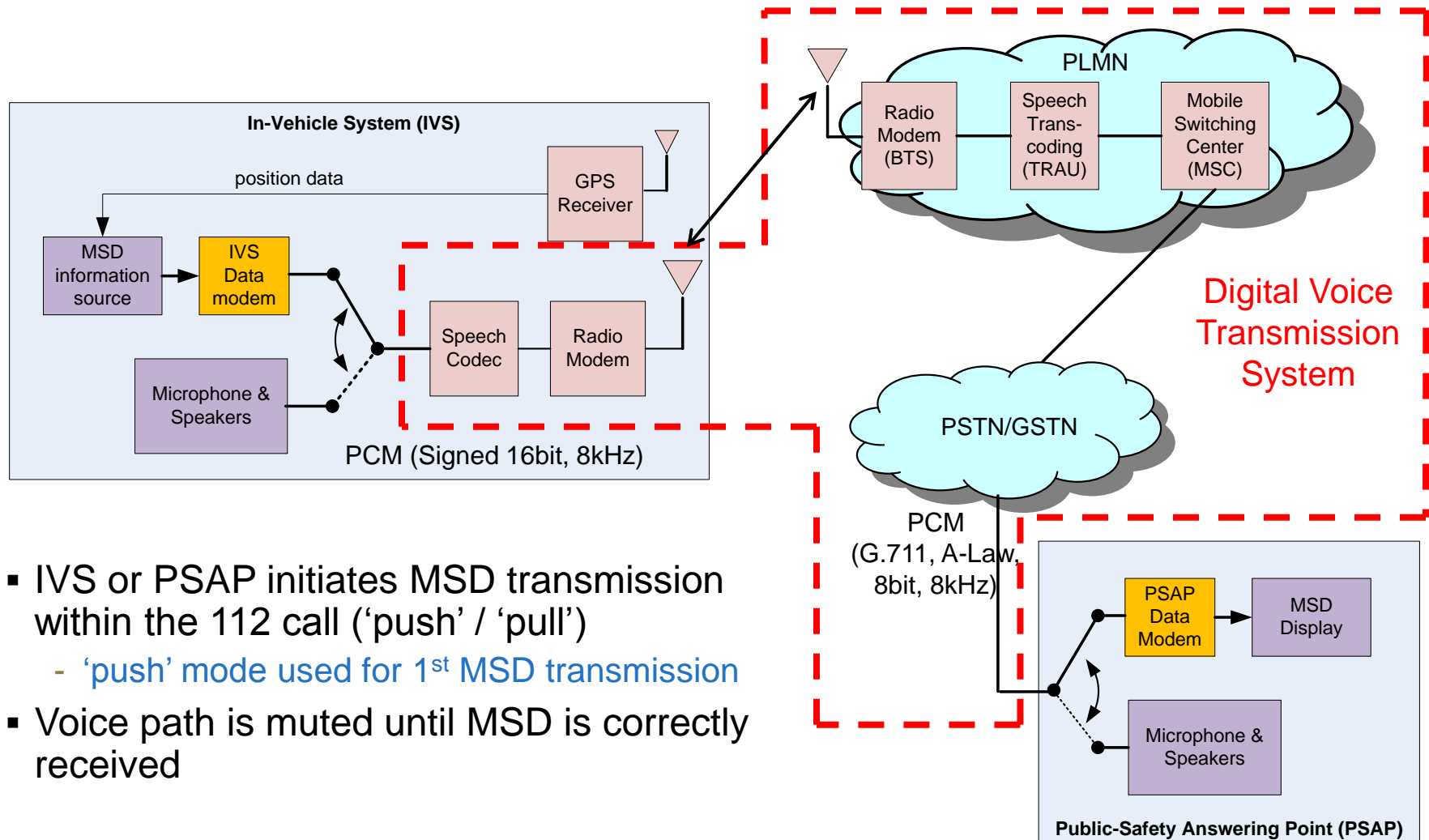


MSD = Minimum Set of Data



# Introduction (cont'd)

## eCall In-band Modem in MNO Environment



- IVS or PSAP initiates MSD transmission within the 112 call ('push' / 'pull')
  - 'push' mode used for 1<sup>st</sup> MSD transmission
- Voice path is muted until MSD is correctly received

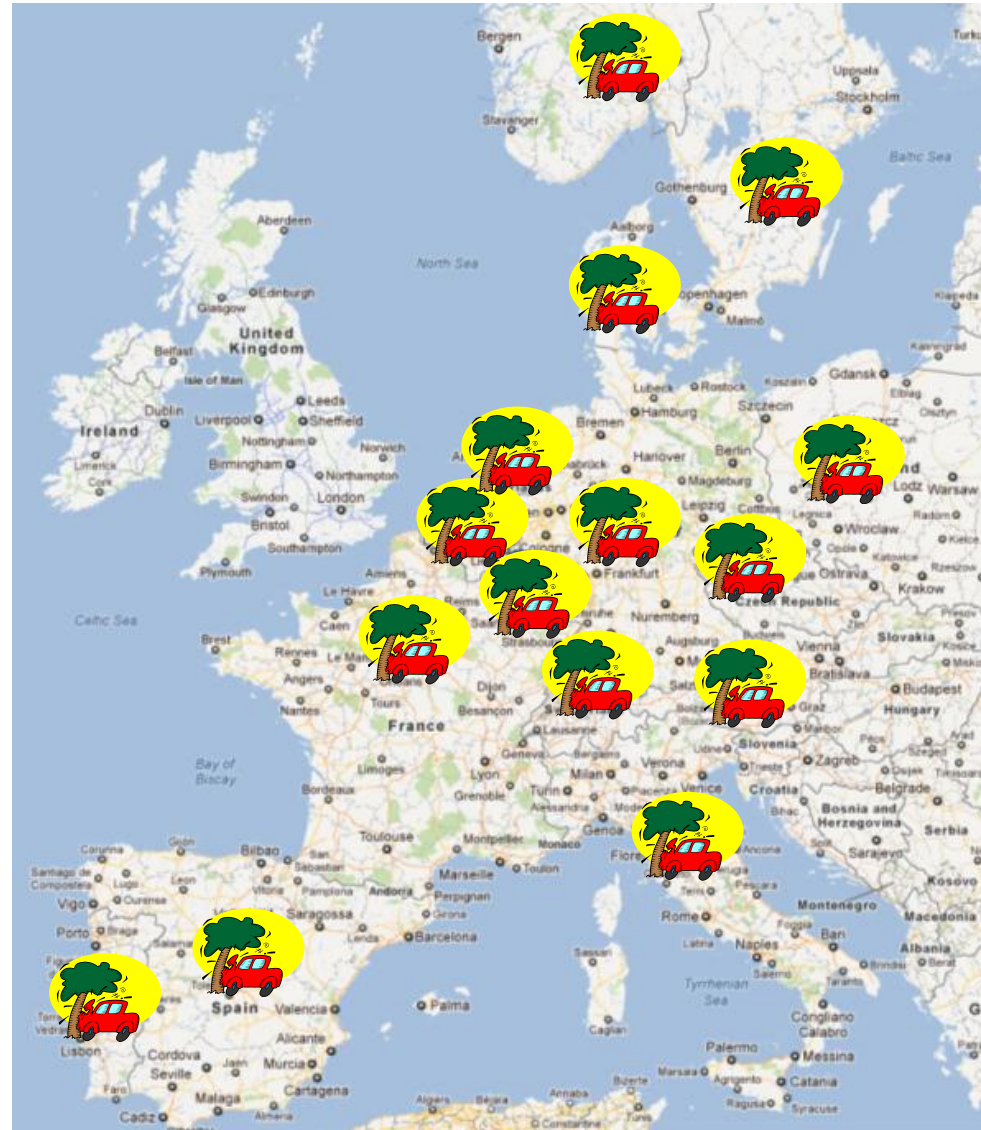
# Test Campaign Overview

## 48 Networks in 15 countries

- ❑ 22 stationary locations
- ❑ 12 mobility routes
- ❑ >16000 calls
- ❑ >25000 MSD transmissions
- ❑ Feb 13 – Mar 02, 2012

## Networks by country

Country	PLMN1	PLMN2	PLMN3	PLMN4
Austria	H3GA	ONE	A1	TMA
Belgium	BASE	Mobistar	Proximus	
Czech-Republic	EurostarCZ	TMCZ	OSKARCZ	
Denmark	TelenorDK	Telia	TDC	
France	Bouygues	SFR	OrangeF	
Germany	EPLUS	O2	TMD	VF
Italy	WIND	TIM	Omnitel	
Luxembourg	LuxGSM	OrangeLU	Tango	
Netherlands	KPN	BEN	VFNL	
Norway	TelenorN	NCOM		
Poland	PlusPL	OrangePL	ERAPL	PlayPL
Portugal	Optimus	TMN	VFPT	
Spain	OrangeES	YOIGO	VFES	TME
Sweden	Sweden3G	H3GS	TelenorS	
Switzerland	Sunrise	OrangeCH	Swisscom	





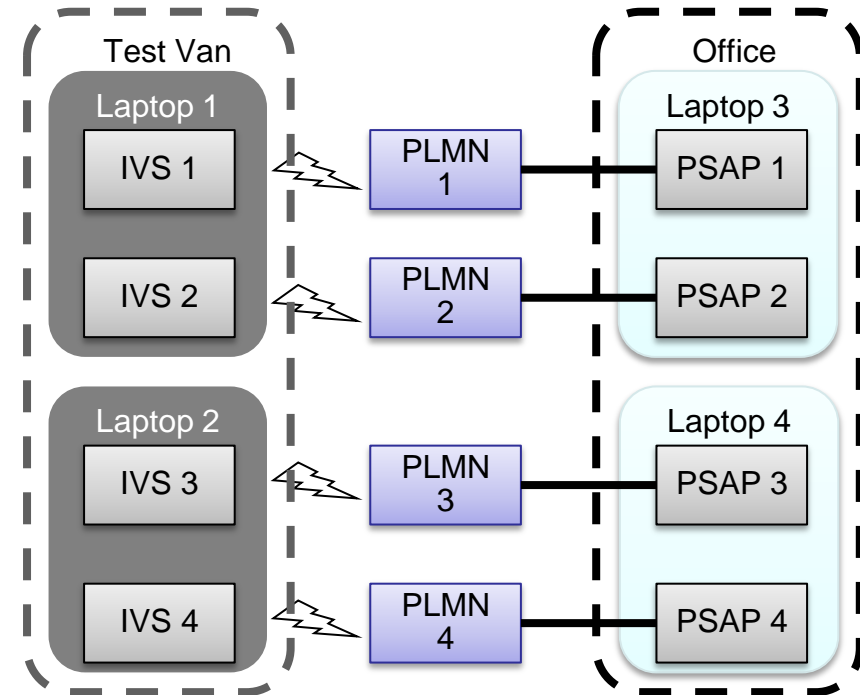
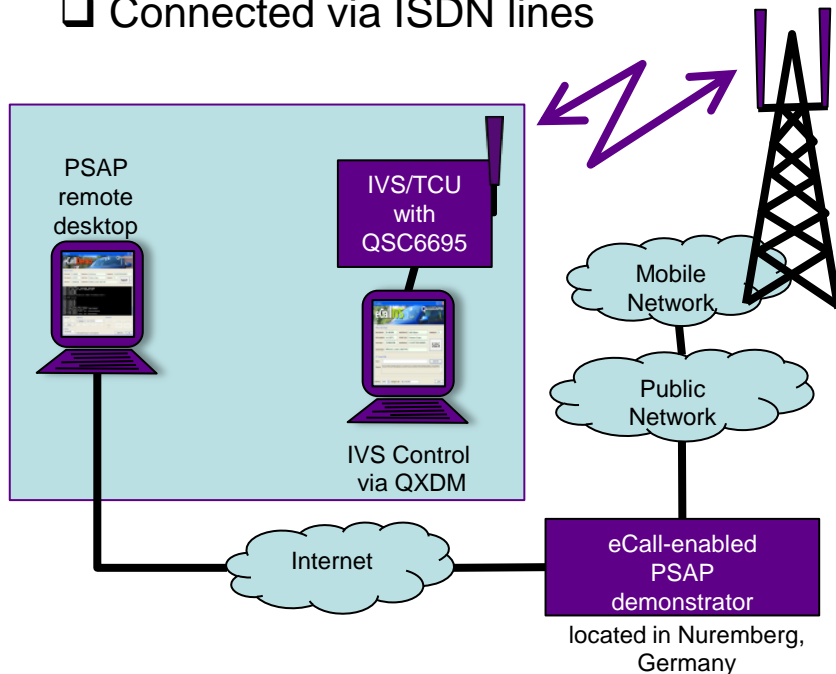
# Test Campaign Overview

## 4 \* IVS: Qualcomm Test Phones

- ❑ QSC6695 with recent eCall build
- ❑ Control/Logging via USB & Laptops
- ❑ German pre-paid SIMs (Roaming)

## 4 \* Qualcomm Test PSAP

- ❑ Modems running on laptops
- ❑ Connected via ISDN lines



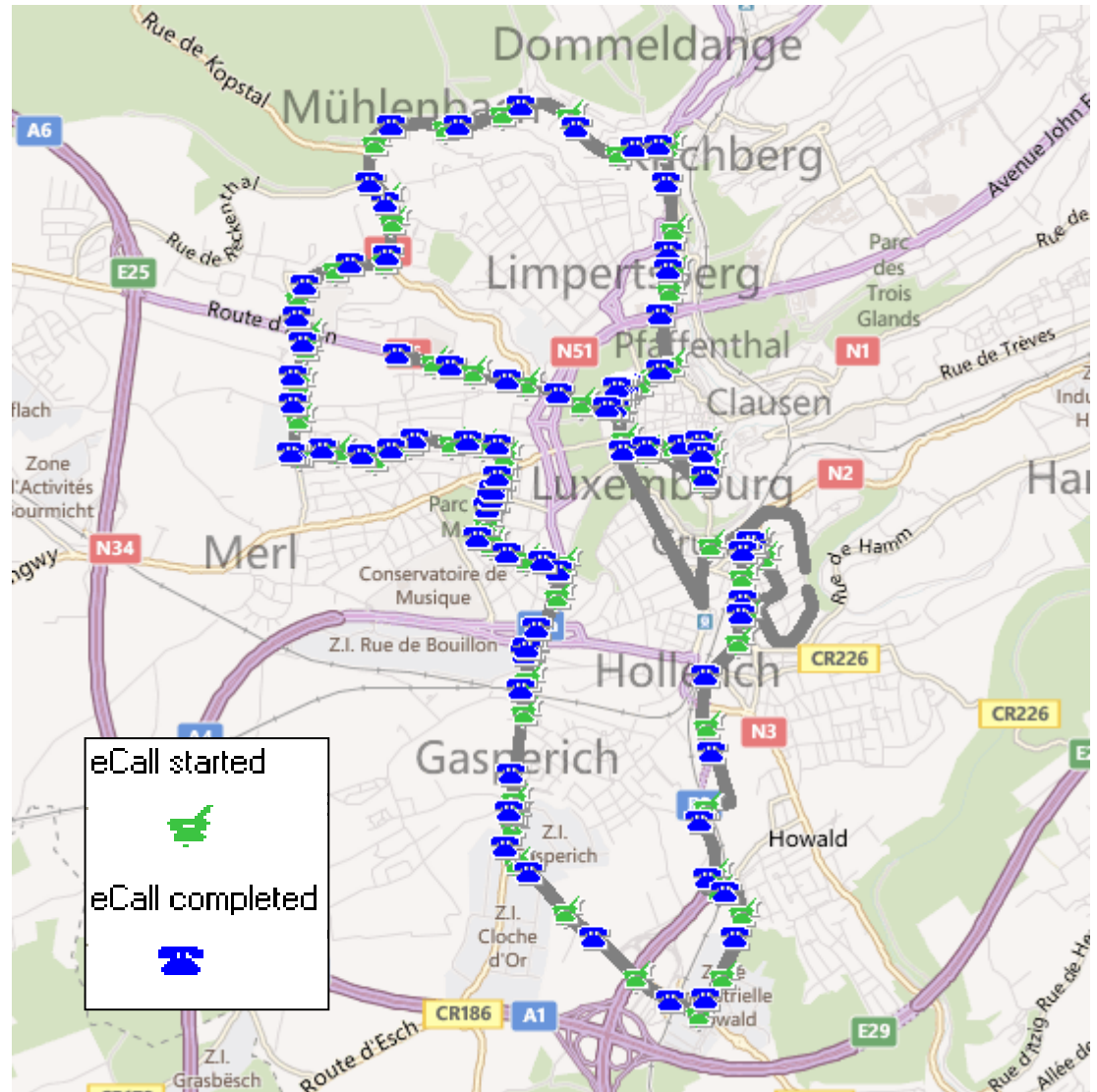
- eCall modems according to 3GPP 26.268 v8.6.0
- 50% of the calls were using NEC disabler tone



# Mobility Example: eCalls conducted along route

## Test Scenario

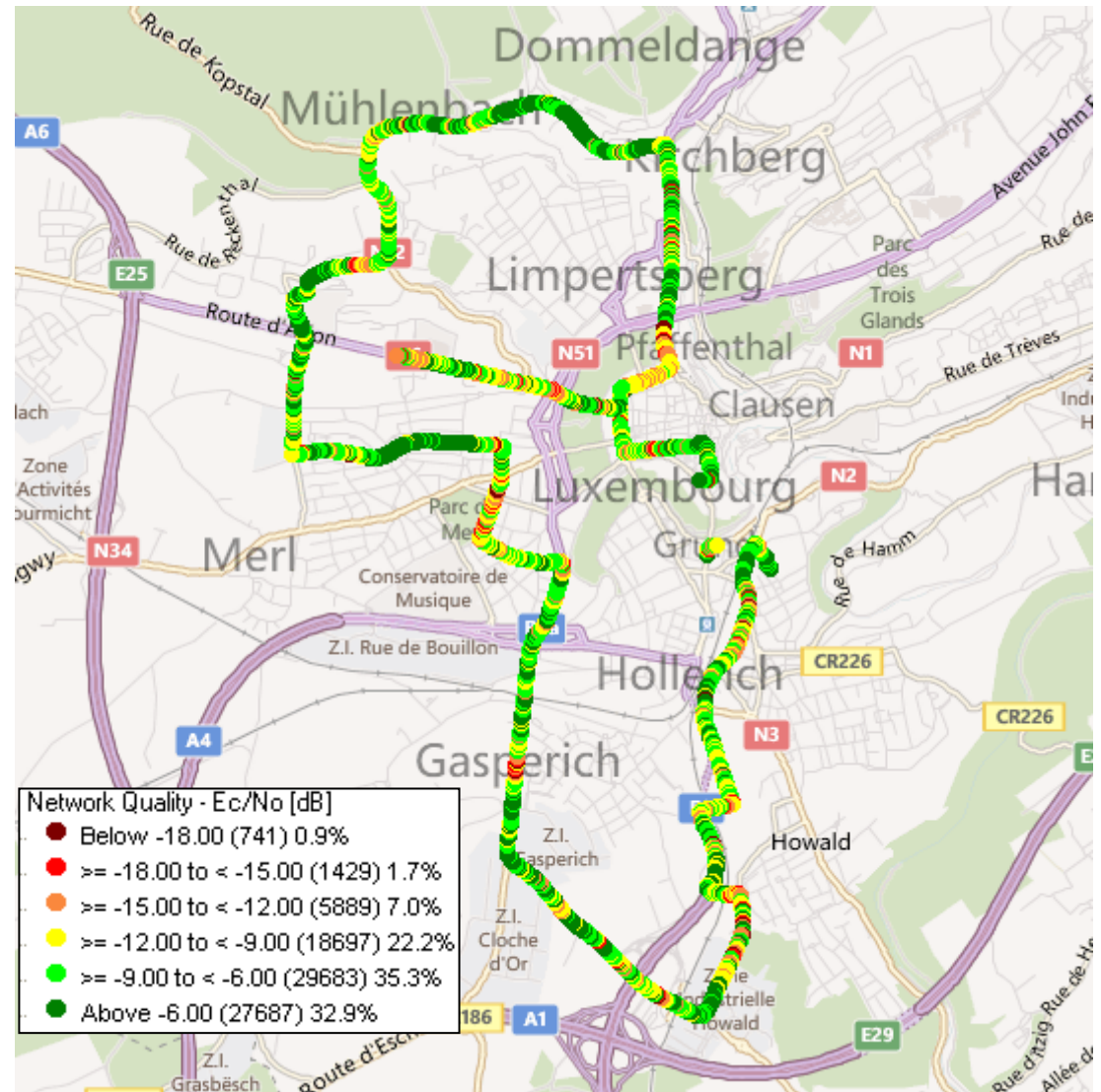
- ❑ Repeated call setup while driving
- ❑ NEC tone played by PSAP every 2nd call
- ❑ IVS placed inside car
  - no external antenna
- ❑ Only one operator shown
  - 98% MSD Success rate
  - One call failed due to UE issue



# Mobility Example: eCalls conducted along route

## Test Scenario

- ❑ Repeated call setup while driving
- ❑ NEC tone played by PSAP every 2nd call
- ❑ IVS placed inside car
  - no external antenna
- ❑ Only one operator shown
  - 98% MSD Success rate
  - One call failed due to UE issue



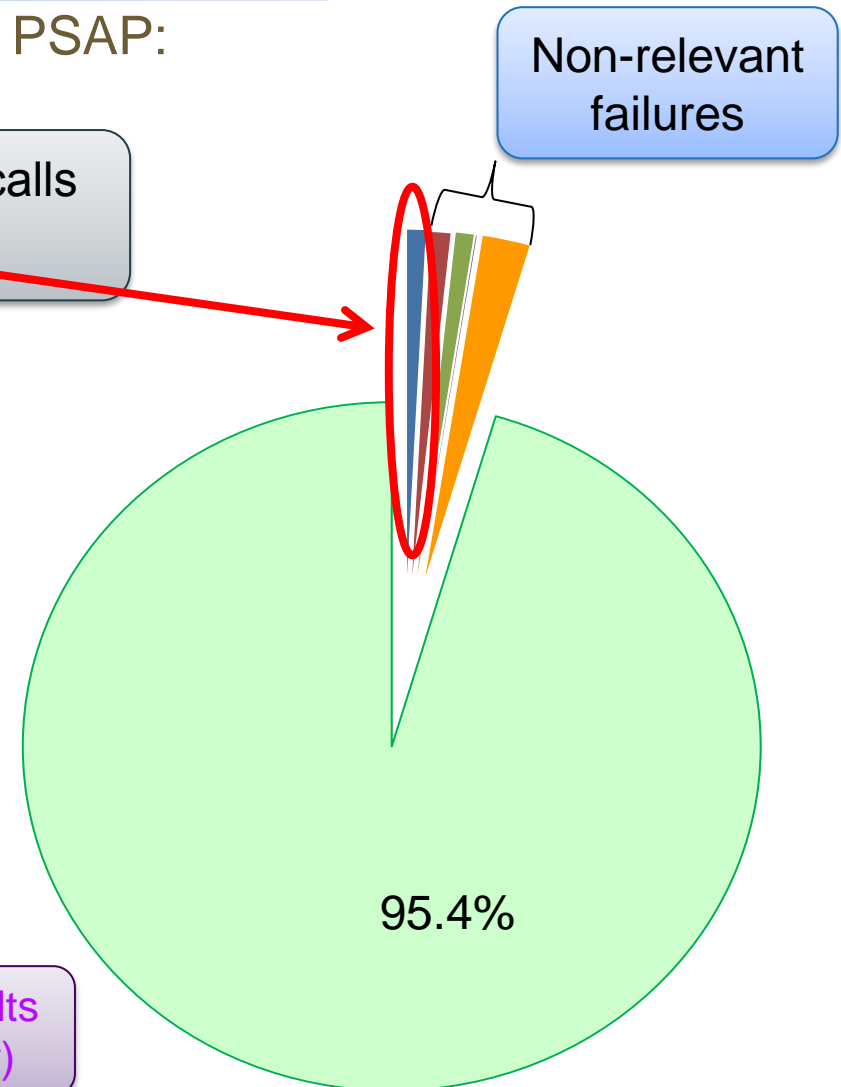
# Overall Performance Results

Considered failures of eCalls reaching PSAP:

- Most failures will not occur in 'real' 112 calls
- **Only 0.8% were 'real' MSD failures**

■ MSD Failures	=	0.8%
■ UE issues	=	0.9%
■ NW issues	=	0.8%
■ Test setup issue	<	0.1%
■ PSAP Issues	=	2.1%
■ Successful MSD	=	95.4%

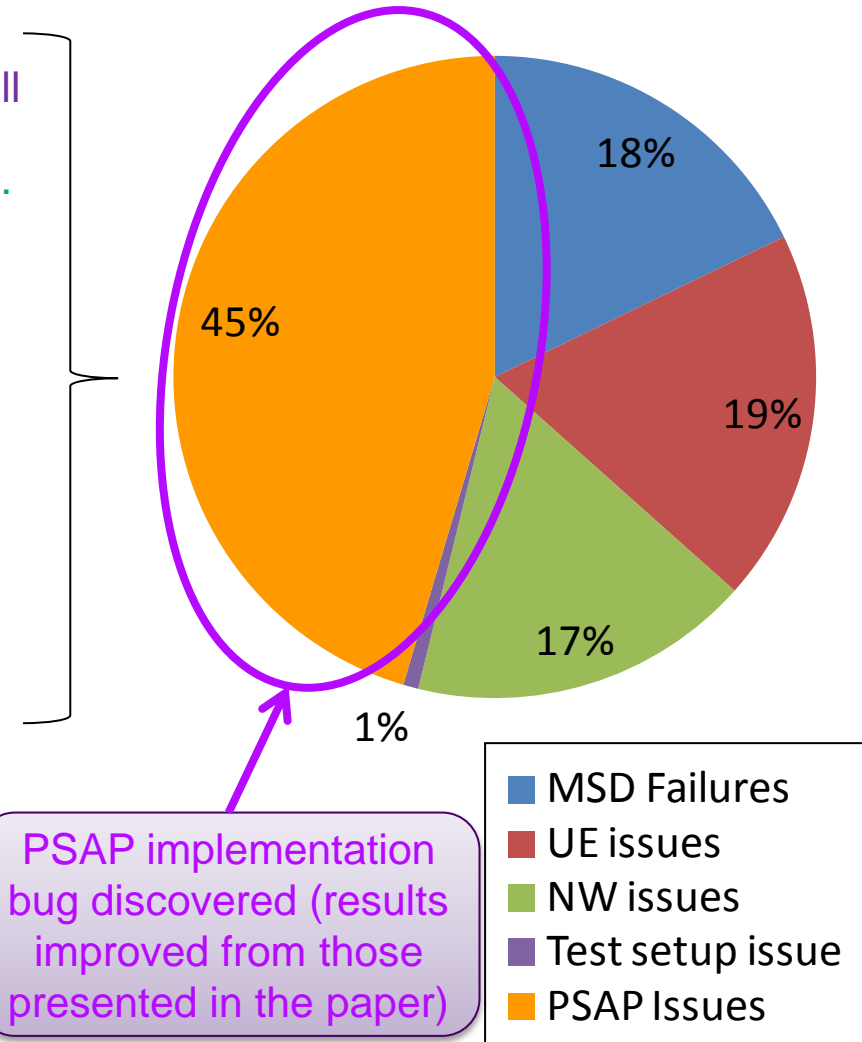
- PSAP implementation bug discovered (results improved from those presented in the paper)



# Classification of Failure Cases (Status April 30)

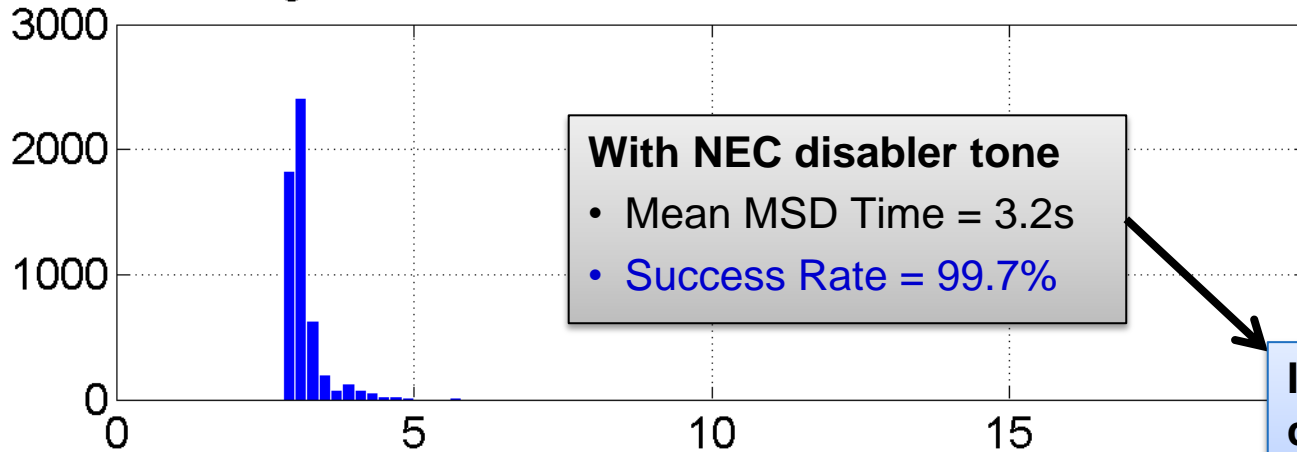
## Overview of Failure Cases

- **Abnormal Effects**
  - Test setup timeout (e.g. in case of long call setup delays)
  - Abnormal systematic Network effects (e.g. termination, no audio on one link)
  - IVS implementation issues (e.g. TX stopped after codec change)
  - PSAP implementation issues (e.g. UL sync-tracking triggered too often)
- **'Real' MSD Transmission Failures**
  - Call Drops
  - Test setup timeout, MSD not received within test time window
  - MSD received, but T>20s
- **Call Setup Failures (not eCall specific)**
  - Call did not reach PSAP modem
    - Lack of SIM credit
    - Office PBX busy
    - NW congestion/admission control
    - No radio network coverage
    - UE/Laptop crash

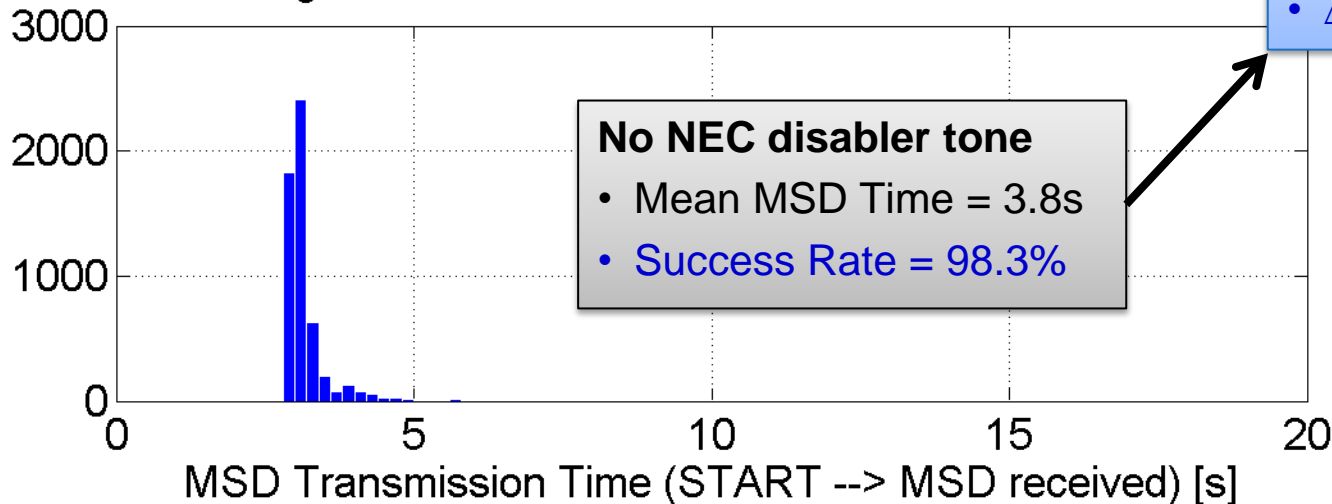


# Overall eCall Performance (adapted PSAP)

Histogram of MSD Transmission Times < 20s: with tone



Histogram of MSD Transmission Times < 20s: no tone

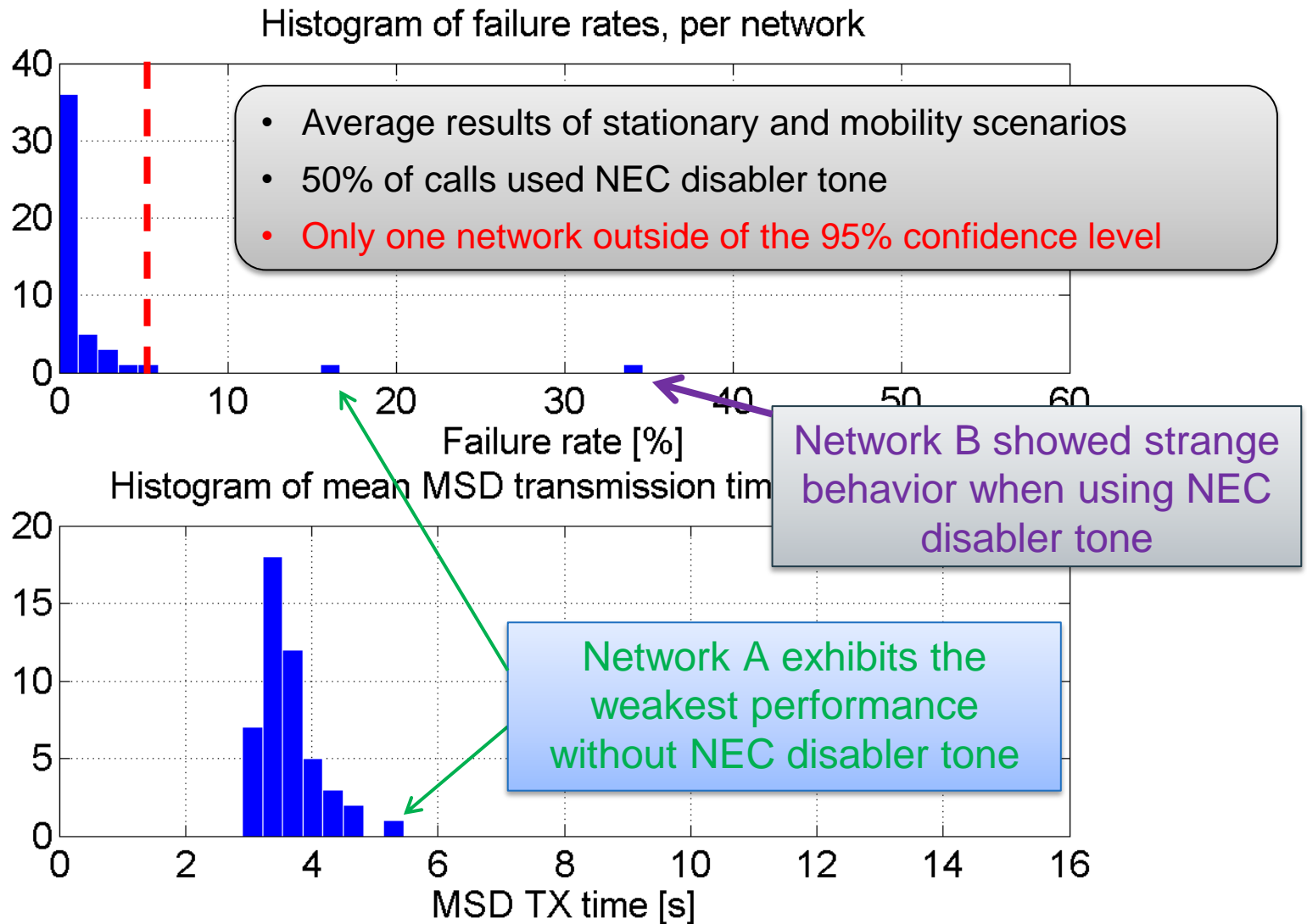


## Improvements by NEC disabler tone

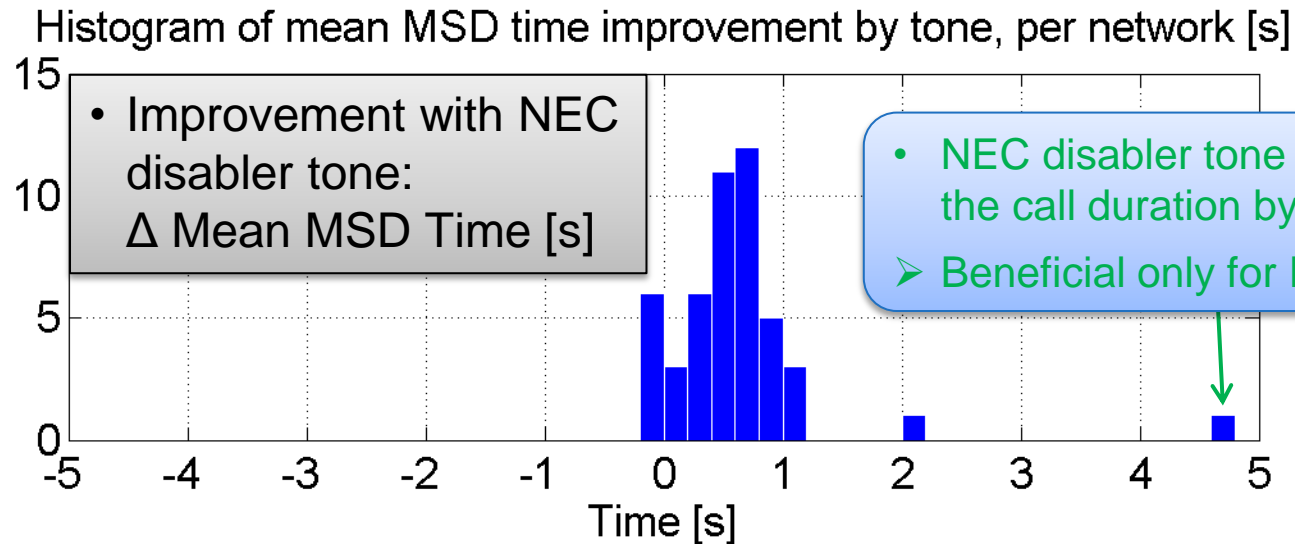
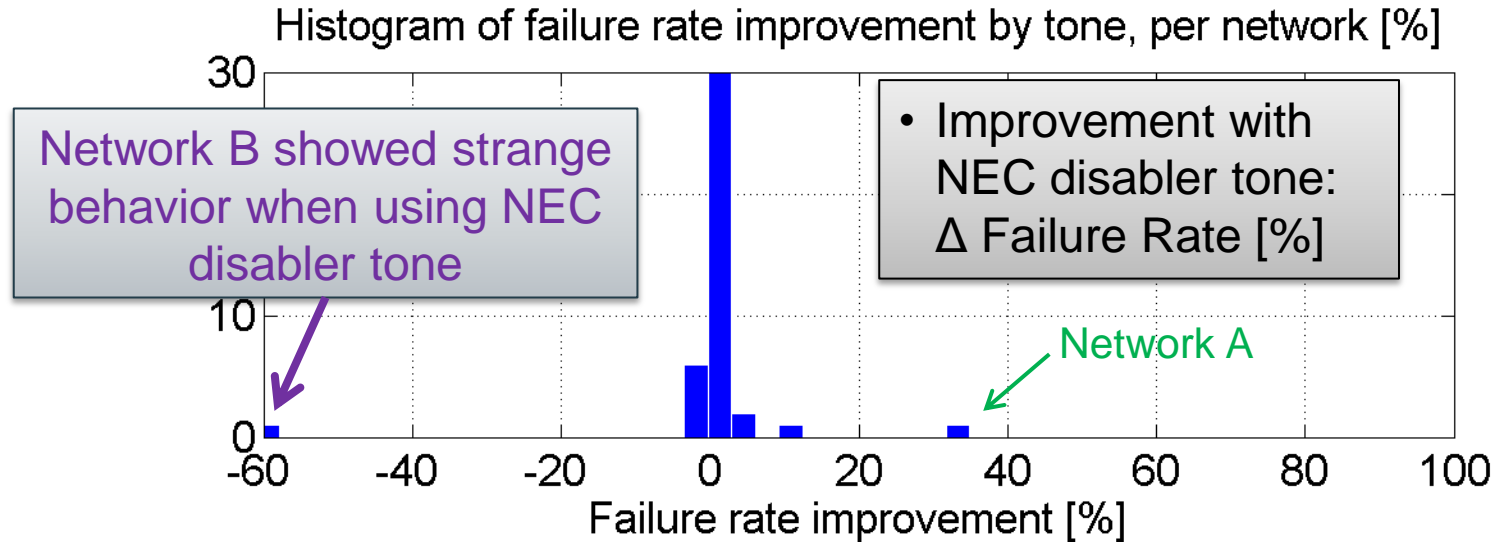
- $\Delta$  Mean MSD Time = 0.6s
- $\Delta$  Success Rate = 1.4%

**Note:** NEC disabler tone increases call duration by ~ 3.6s

# Performance across Different Networks (adapted PSAP)



# Impact of NECs: Improvement by Tone (adapted PSAP)





# Conclusions

## First Results

- From extensive drive tests to investigate performance of eCall in-band modem
- Overall, very good MSD transmission times and success rates even in the presence of active NECs: >98%
- Excellent success rate for the case of tone-disabled NECs: >99%
- Only a few networks (3 out of 48) with notable performance degradation due to NECs
  - **We recommend a disabler tone as an option only in these few cases**
  - **For only one network we clearly recommend action for improvement**
  - One other network exhibited abnormal behavior with NEC disabler tone
    - Note that this network had very good performance without NEC disabler tone
- **Results are still preliminary as further analysis is ongoing**





# Conclusions (cont'd)

## Lessons Learnt

- When conducting field tests a detailed failure analysis is required to allow proper performance assessment of eCall systems and to identify the root cause of MSD failure issues, e.g.
  - ‘real’ modem transmission failures which can happen in 112 eCalls
  - call setup and retention performance (roaming/non-roaming),
  - abnormal network behavior
  - implementation bugs at IVS
  - implementation bugs at PSAP
    - Qualcomm identified and corrected a bug in its PSAP test implementation
    - Re-processed collected field test PCM data to evaluate proper performance
    - Resulted in much better performance than provided in the paper



# Thank You !

Questions?



Contact:

- [Ralf Weber \(rweber@qualcomm.com\)](mailto:rweber@qualcomm.com)