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# Testing Emergency Call Services: 911, Enhanced 911 (E-911) and NG-911

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# Background

- Rapid emergency services are essential
- FCC mandate - locate callers < 50 meters / 80 percent of time - 2021
- A Landline phone has a fixed location
- A VoIP phone can be relocated
- A Mobile phone is mobile, but locatable
- TTY, TDD, or Relay for Deaf
- Text-to-911 is becoming available
- Almost all mobile phones have GPS
- Smartphones have accurate location info and can provide it directly to PSAPs

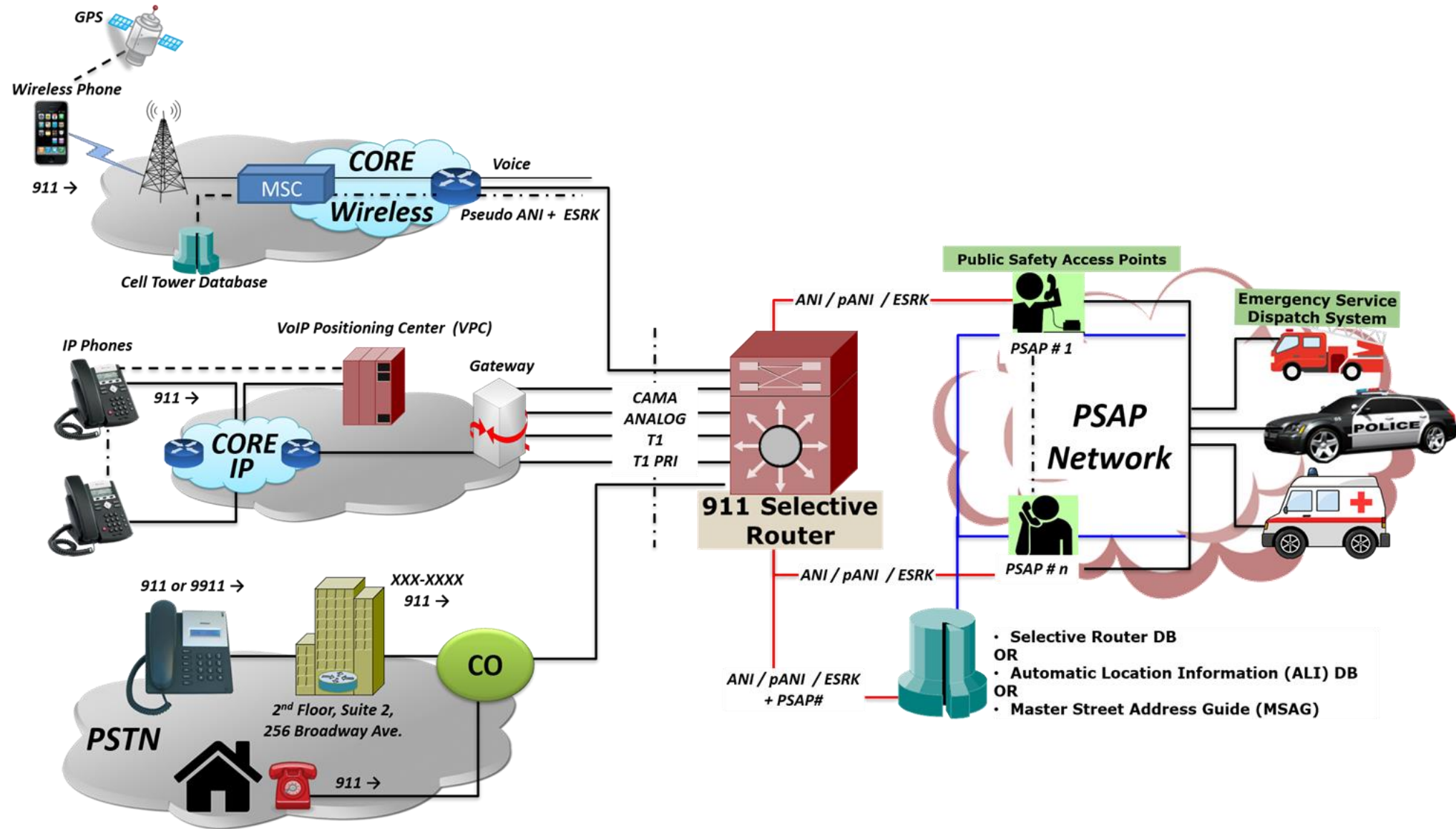
# Over the Top (OTT Apps for 911)

- Apple announced - iPhone users who call 9-1-1 to automatically and securely share their location data with PSAPs
- The announcement could refocus wireless 9-1-1 location to device-based solutions from network-based technologies
- Smartphone based location is better than network-based because smartphones are providing better accuracy, emergency call routing, and emergency caller tracking

# 911 Landscape – Past, Present, Future

- Why test CAMA trunks? - After all, they are 2-wire legacy circuits
- **Carriers** – rapidly transitioning to IP and Wireless infrastructure from Legacy
- **PSAPs** will be last to convert from Legacy to NG, price sensitive, tax payer funded
- Evolution – 911, E-911, NG-911, OTT
- Gateways to interface to Legacy PSAPs

# 911 and E-911 Emergency Services



# Introduction

- **Centralized Automatic Message Accounting (CAMA) Trunk** - 2 wire analog trunk
- **Selective Router (SR)** - routes the call to the proper PSAP
- **Public Safety Access Point** - attendant and dispatch centers for emergency vehicles
- **ANI** - Automatic Number Identification (ANI) i.e., the calling number of the distressed person
- **Database Lookup** - calling # to street address

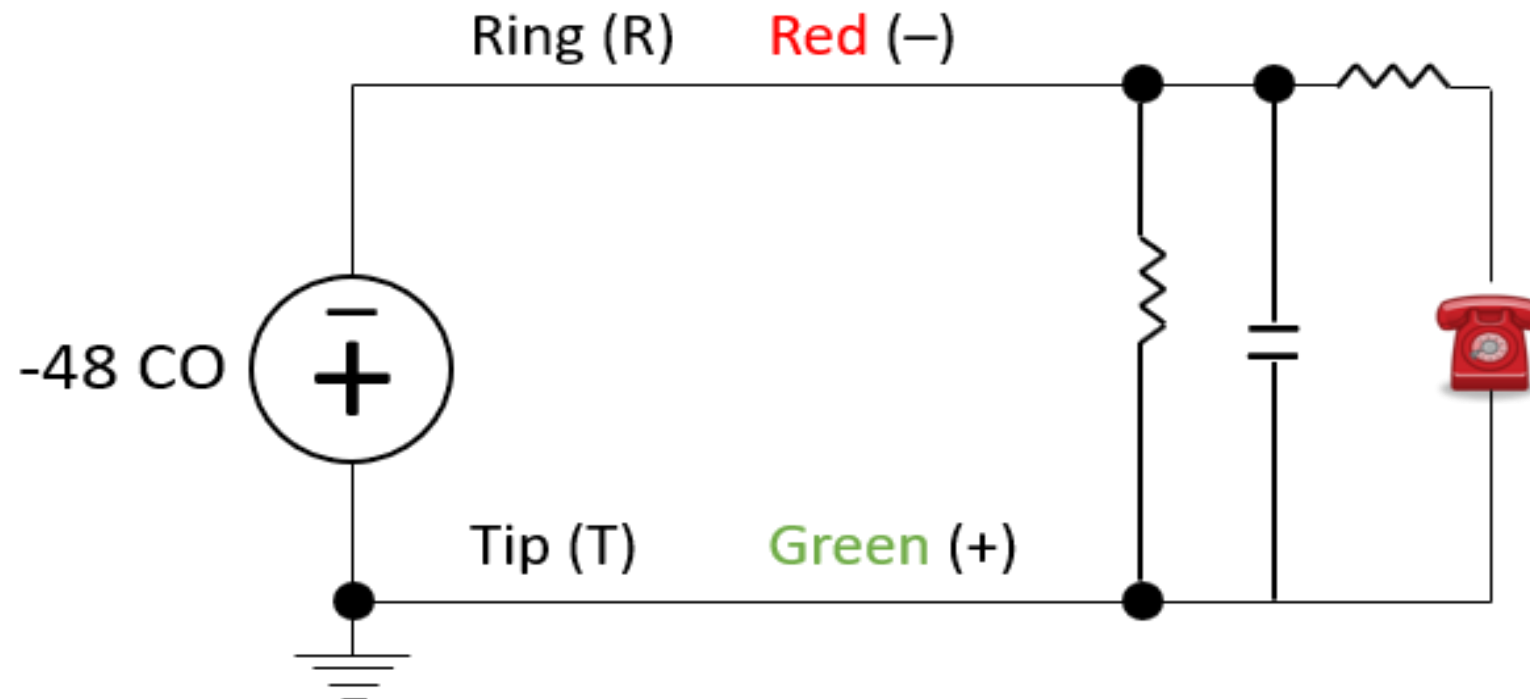
# CAMA 2-wire Trunks vs. 2wire LoopStart Subscriber Lines

## CAMA Trunk

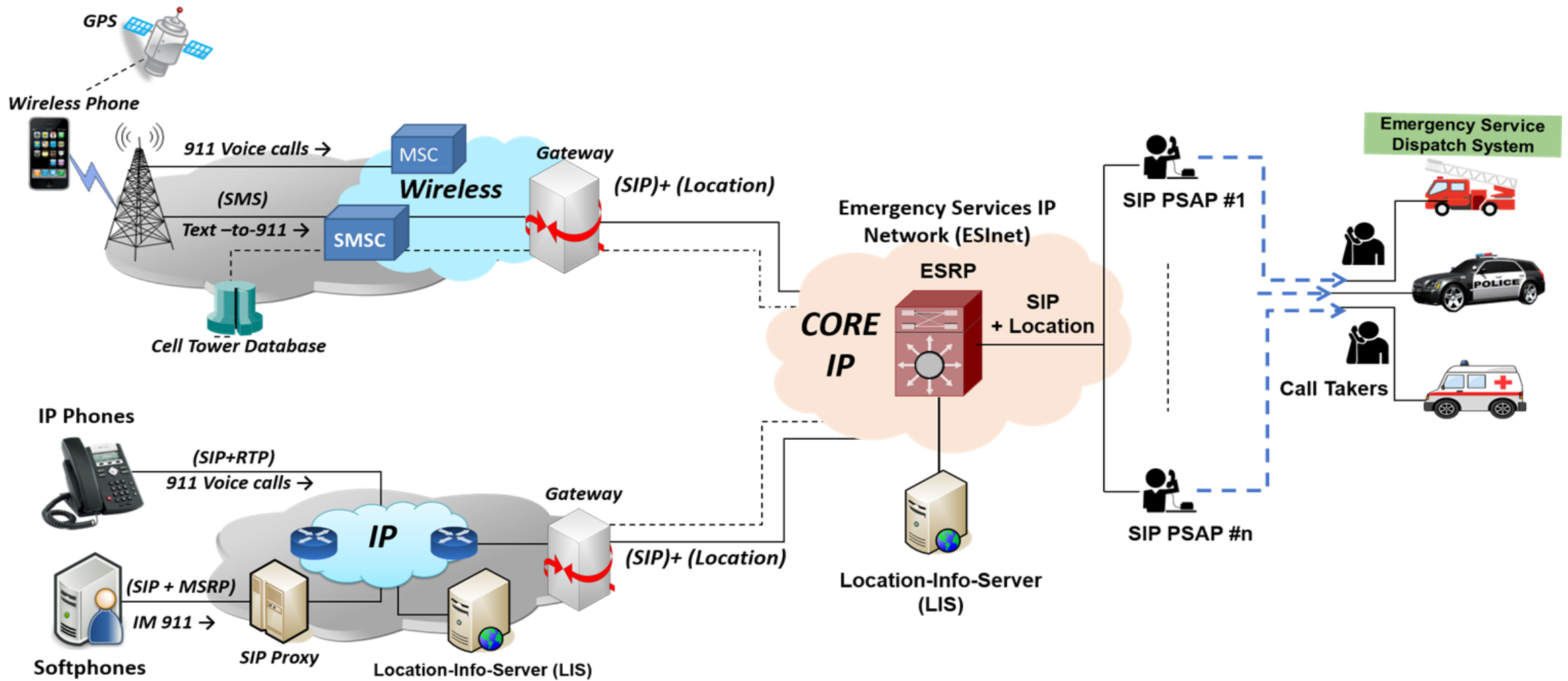
- No Dial Tone in response to Off Hook
- ANI
- Answer Supervision
- Wink

## 2-wire LoopStart

- Dial Tone in response to Off Hook
- No ANI
- No Answer Supervision
- No Wink

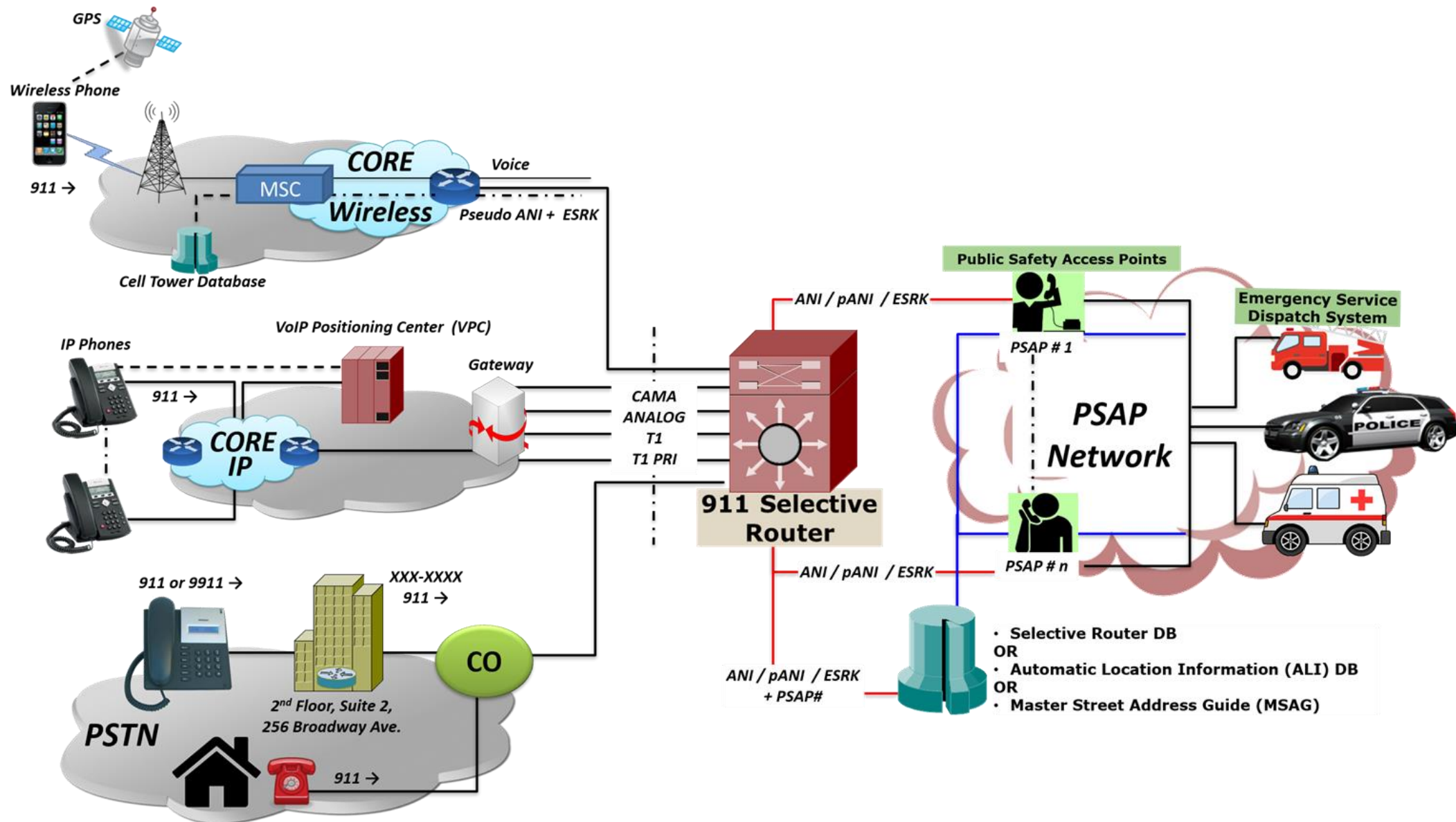


# Next Generation 911 (NG-911) Emergency Services





# Test 911 and E-911 Emergency Services



# 911 Requirements and Solution

- **Requirement:** One of the major PSAP vendor wished to emulate and analyze legacy 911 Emergency calls to test their 911 elements (PSAP, 911 Selective Router)
  - Emulate T1 CAMA trunks with CAMA signaling for the purpose of testing 911 Selective Router and/or the PSAP side
  - Emulate an analog PSAP trunk – again either 911 Selective Router side and/or the PSAP side
  - Analyze analog CAMA trunk – with CDR, signaling analysis, digit analysis, and more
  - Easy set up via GUI, but also programmability to satisfy slight variations

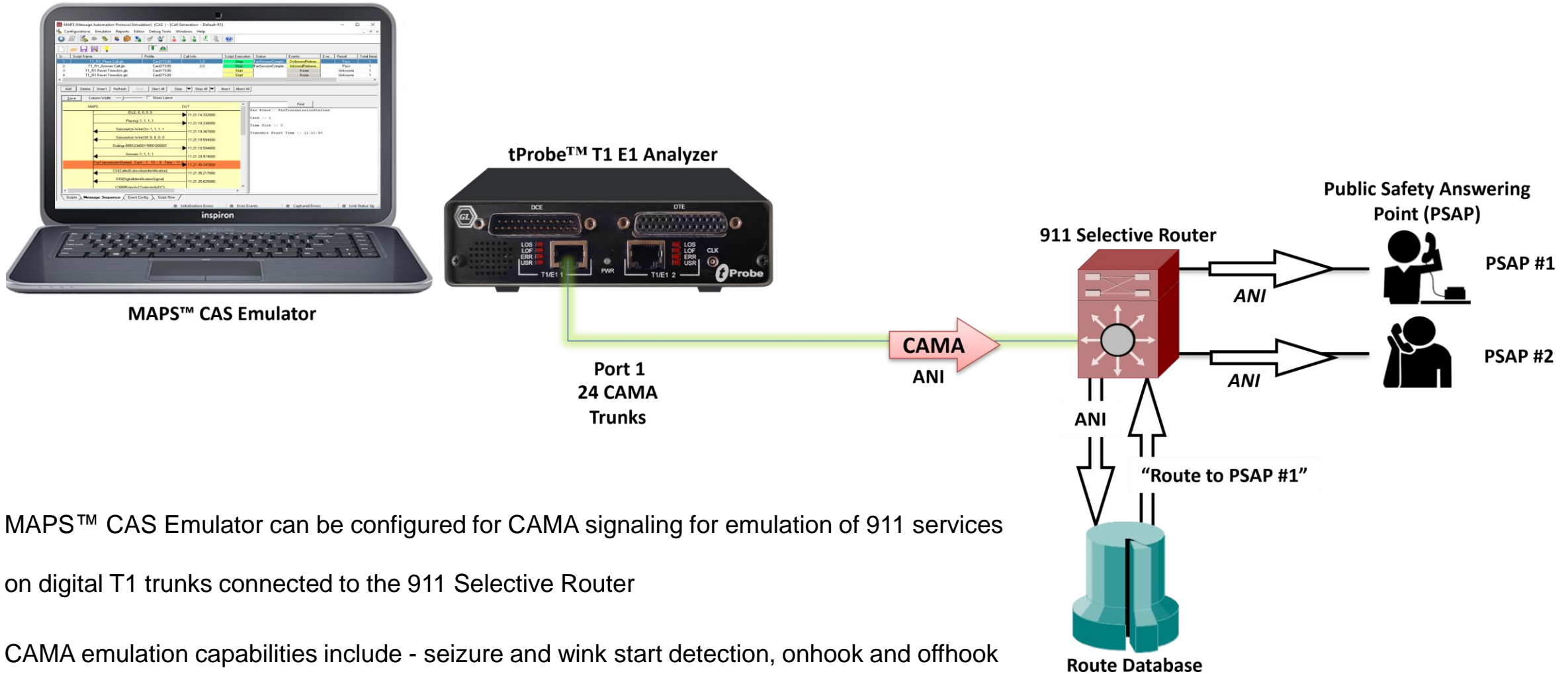
# 911 Requirements and Solution (Contd.)

- **Solution:** GL's versatile tProbe™ or any of our T1 E1 rack mount solution can perform all the requirement functionalities
  - Generate/Receive 911 Emergency CAMA calls over T1 – in bulk, and continue indefinitely
  - Be the 911 Selective Router or the PSAP end – or both simultaneously
  - Generate 911 Emergency CAMA calls over analog FXO or FXS, and continue indefinitely
  - Follow the CAMA protocol precisely - MF signaling for “calling #”
  - Reverse Battery
  - Analyze/monitor T1 CAMA trunks for 911 calls, generate CDRs, get precise protocol exchange

# Required GL Hardware, Software, and Accessories

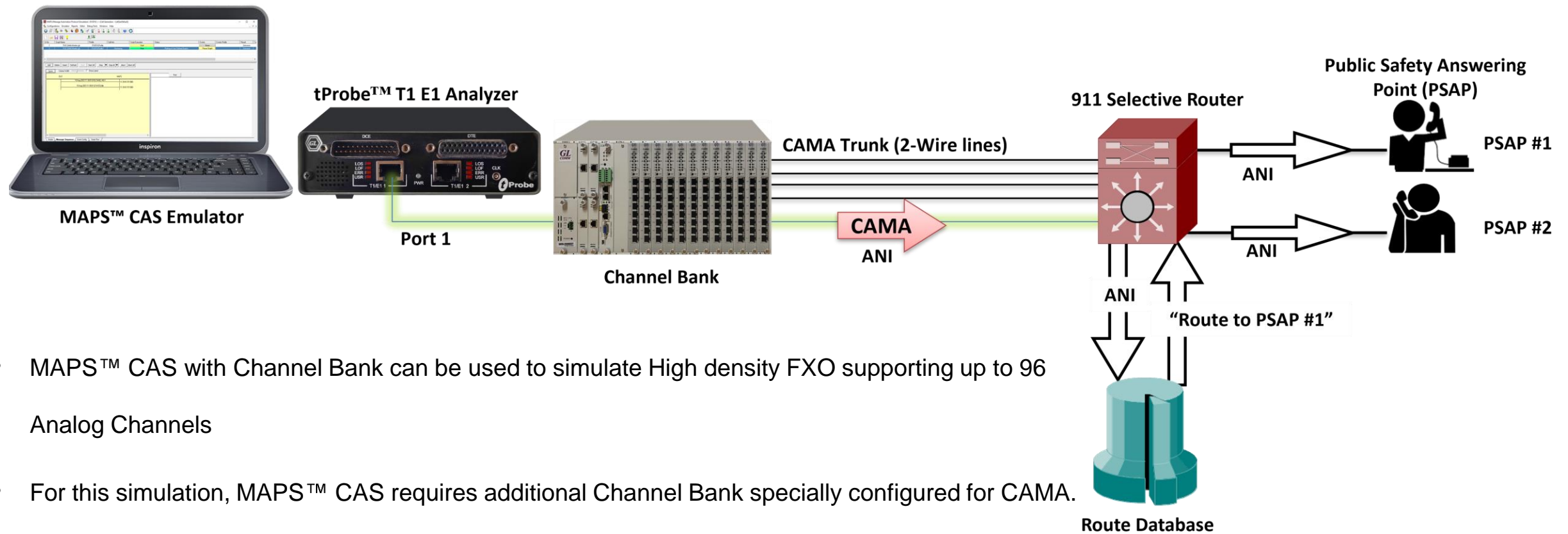
- High End Notebook PC (SA005d)
- tProbe™ T1 (PTE001) with FXO/FXS Card (PTE015)
- Software - MAPS™ FXO/FXS (PTA624), MAPS™ CAS Emulation (PTA651), CLI support for both MAPS™ products (PKS170), MAPS™ SIP (PKS120), RTP Core (PKS102)

# Digital CAMA Simulation



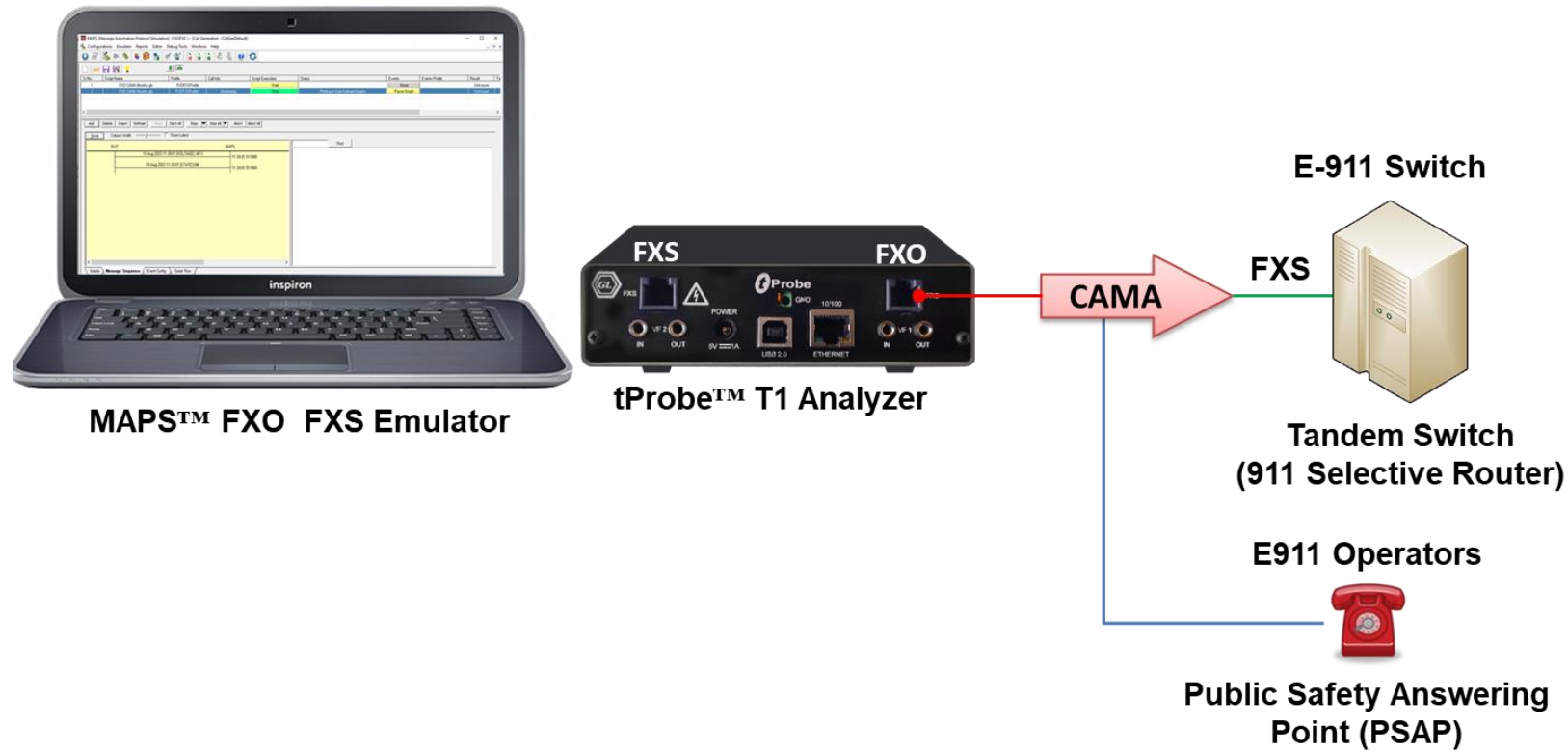
- MAPS™ CAS Emulator can be configured for CAMA signaling for emulation of 911 services on digital T1 trunks connected to the 911 Selective Router
- CAMA emulation capabilities include - seizure and wink start detection, onhook and offhook detection and MF digit (ANI) generation/detection

# Analog CAMA Simulation via Channel Bank



- MAPS™ CAS with Channel Bank can be used to simulate High density FXO supporting up to 96 Analog Channels
- For this simulation, MAPS™ CAS requires additional Channel Bank specially configured for CAMA. The tProbe™ T1 line is connected to Channel Bank with FXO cards for interfacing to 2-wire equipment (911 selective router)
- Single FXO board within the channel bank can convert one digital T1 line into 8 Analog lines

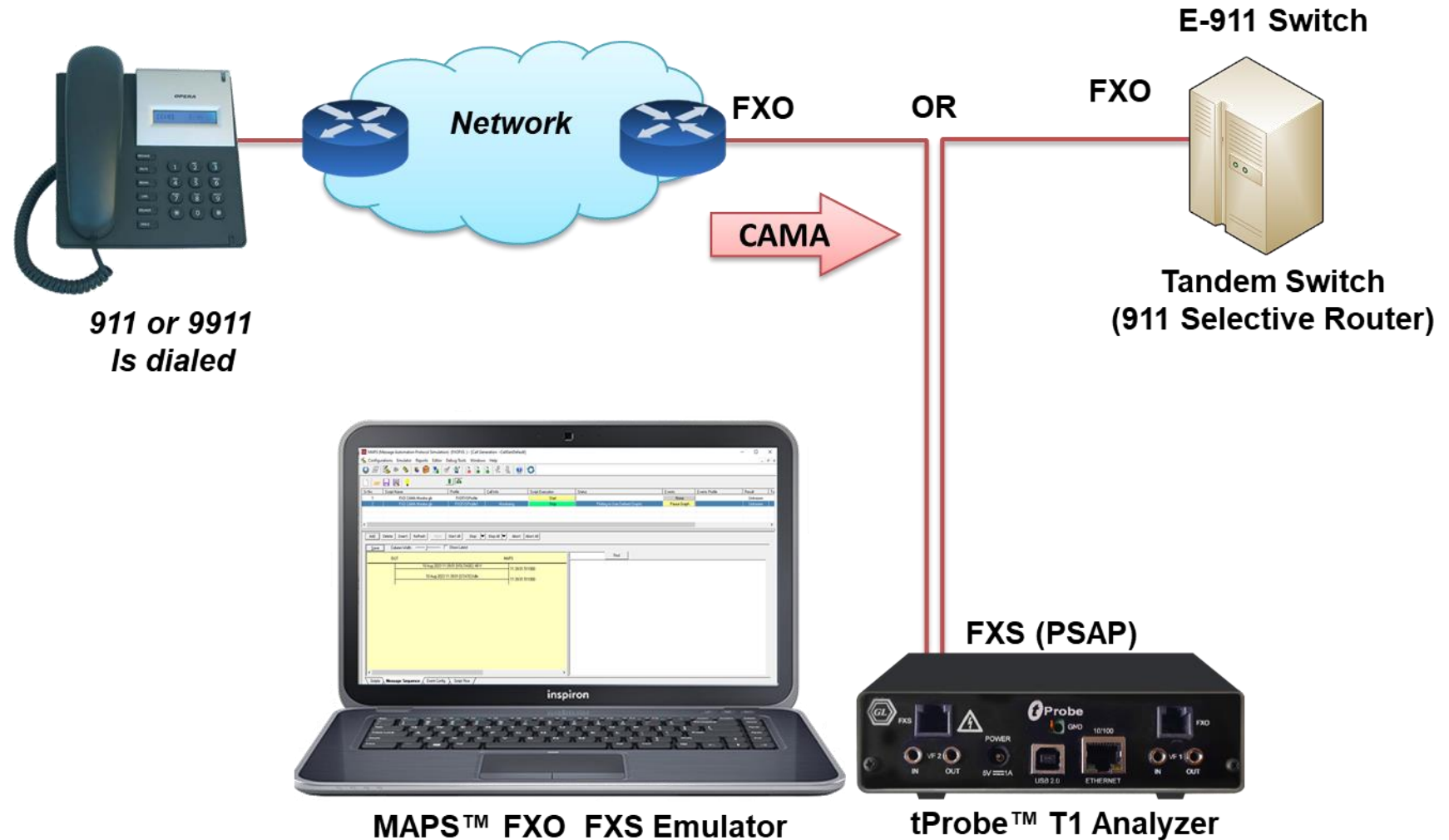
# Originating CAMA Call Simulation (FXO ports)



- The tProbe™ FXO port can be directly connected to 911 selective router or PSAP on CAMA-type circuits for simulation of CAMA calls to the selective router or PSAP
- The script will seize the line, wait for wink, dial ANI and wait for call connect

# Terminating CAMA Call Simulation (FXS ports)

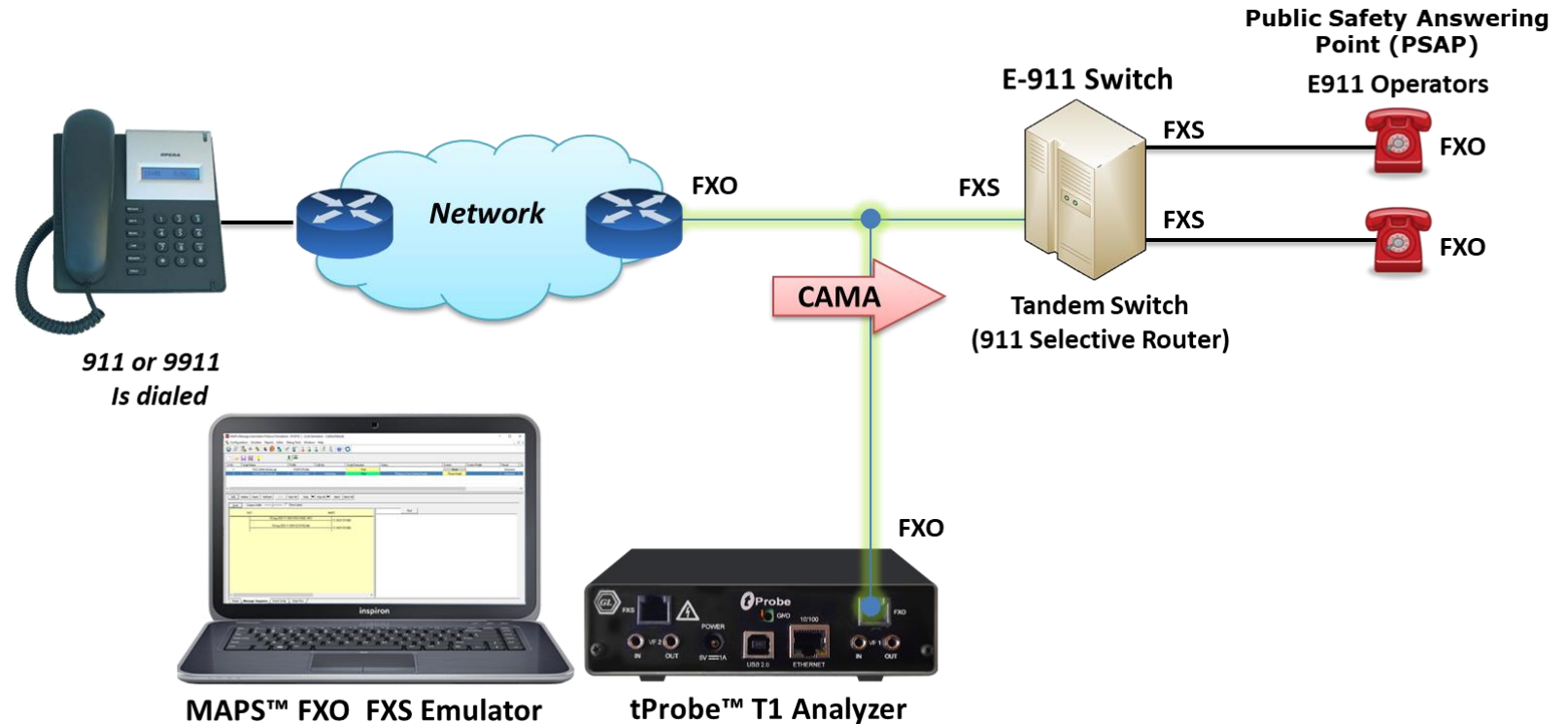
- tProbe™ FXS port connected to central office or selective router for terminating CAMA calls
- The script will detect seizure from far side, provide wink, wait for ANI, and connect the call





# Monitoring of CAMA type trunks using MAPS™ FXO FXS

- The tProbe™ T1 FXO port can be tapped onto CAMA-type circuits for non-intrusive monitoring of 911 service
- Monitoring capabilities include seizure and wink start detection, onhook and offhook detection and MF digit (calling party ANI) detection
- A normal analog call is routed based on the destination (called party) phone number. However, 911 calls are routed based on the calling party number



# Call Monitoring Process of a 10-digit ANI Transmission

GL MAPS (Message Automation Protocol Simulation) (FXO/FXS) - [Call Generation - CallGenDefault]

Configurations Emulator Reports Editor Windows Help

Icons: [Icons for various functions]

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events
1	FXO_CAMA_Monitor.gls	FXO/FXSProfile	Monitoring	Stop	Plotting in User Defined Graphs	Pause Graph

Buttons: Add, Delete, Insert, Refresh, Start, Start All, Stop, Stop All, Abort, Abort All

Save Column Width

DUT (FXS/SR)

MAPS (FXO)

Idle 12:59:36.267000

Seize Offhook 12:59:40.083000

Wink :: 225 msec RB 12:59:40.682000

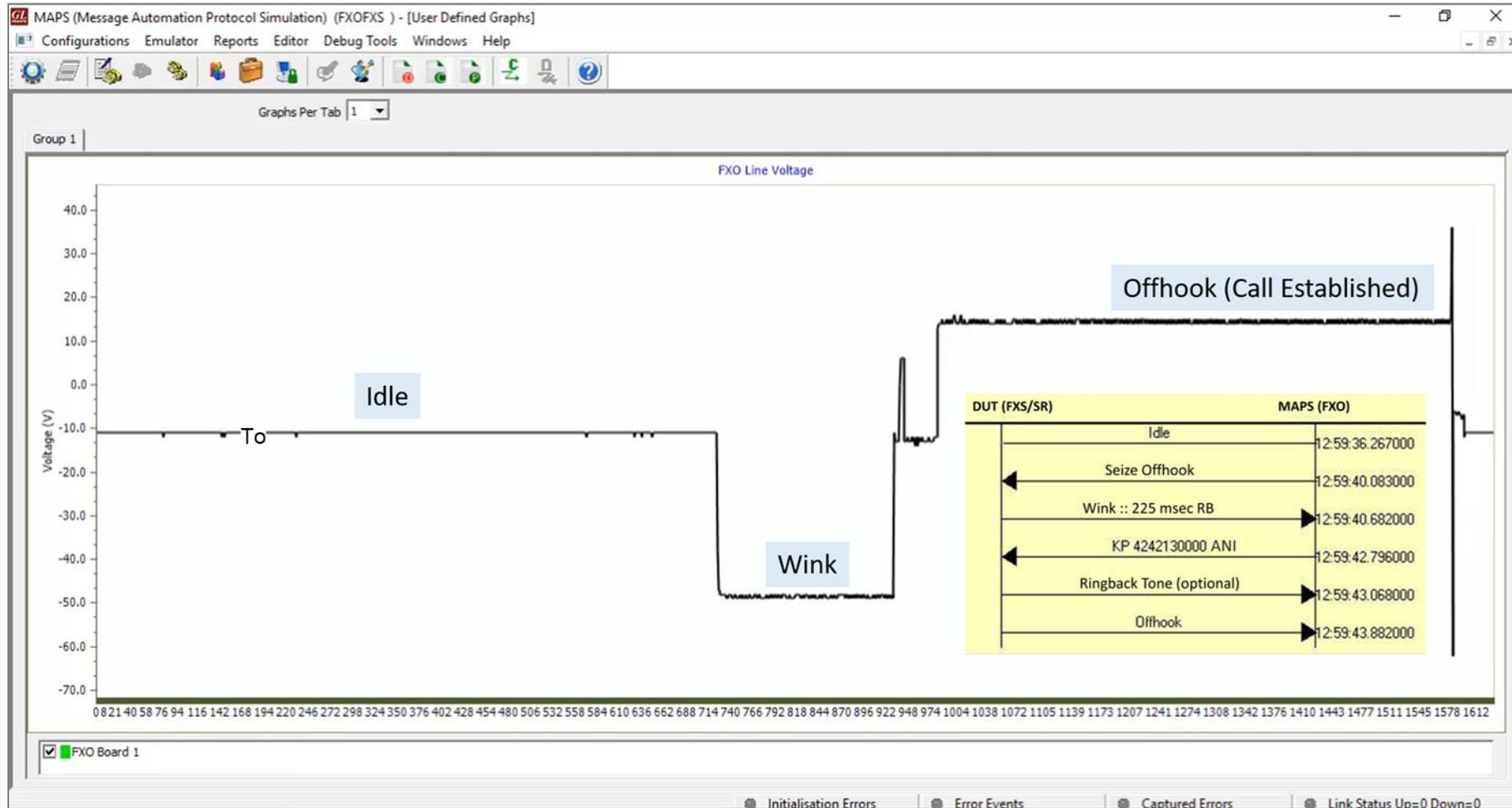
KP 4242130000 ANI 12:59:42.796000

Ringback Tone (optional) 12:59:43.068000

Offhook 12:59:43.882000

Scripts Message Sequence Event Config Script Flow

# 2-Wire Line Volt Graph



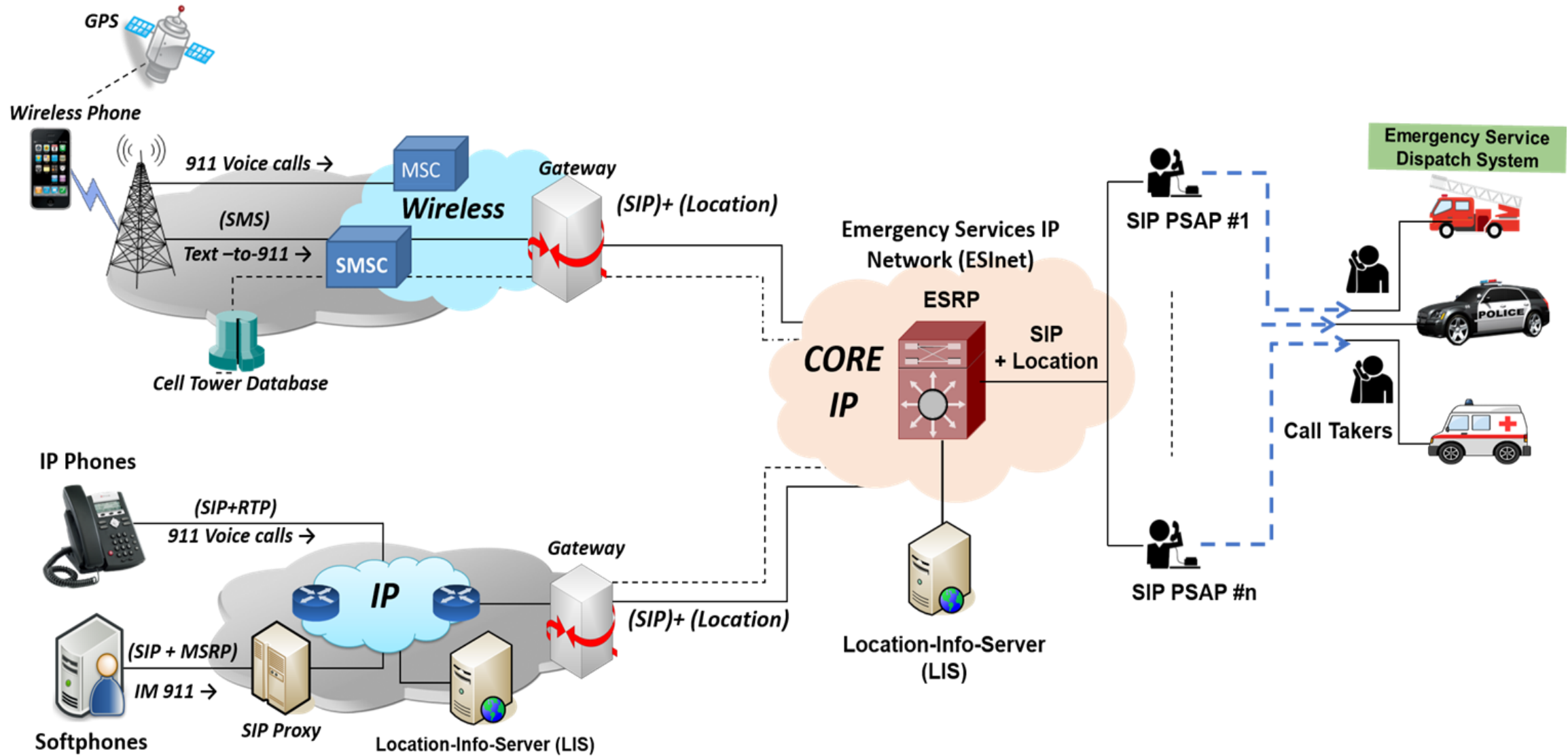
- The monitoring script is used to monitor a CAMA line between the central office and selective router, or between the selective router and PSAP. This script continuously monitor line current and voltages of FXO and FXS ports

# Next Generation (NG) 911

# NG-911 Introduction

- The FCC mandates that all PSTN, VoIP, and Wireless networks provide 911 services
- NG 911 networks based on NENA i3 standards - multimedia
- Text-to-911 services already becoming available

# Test Solutions for Next Generation 911 (NG-911) for Public Safety



# Test Requirements for NG 911

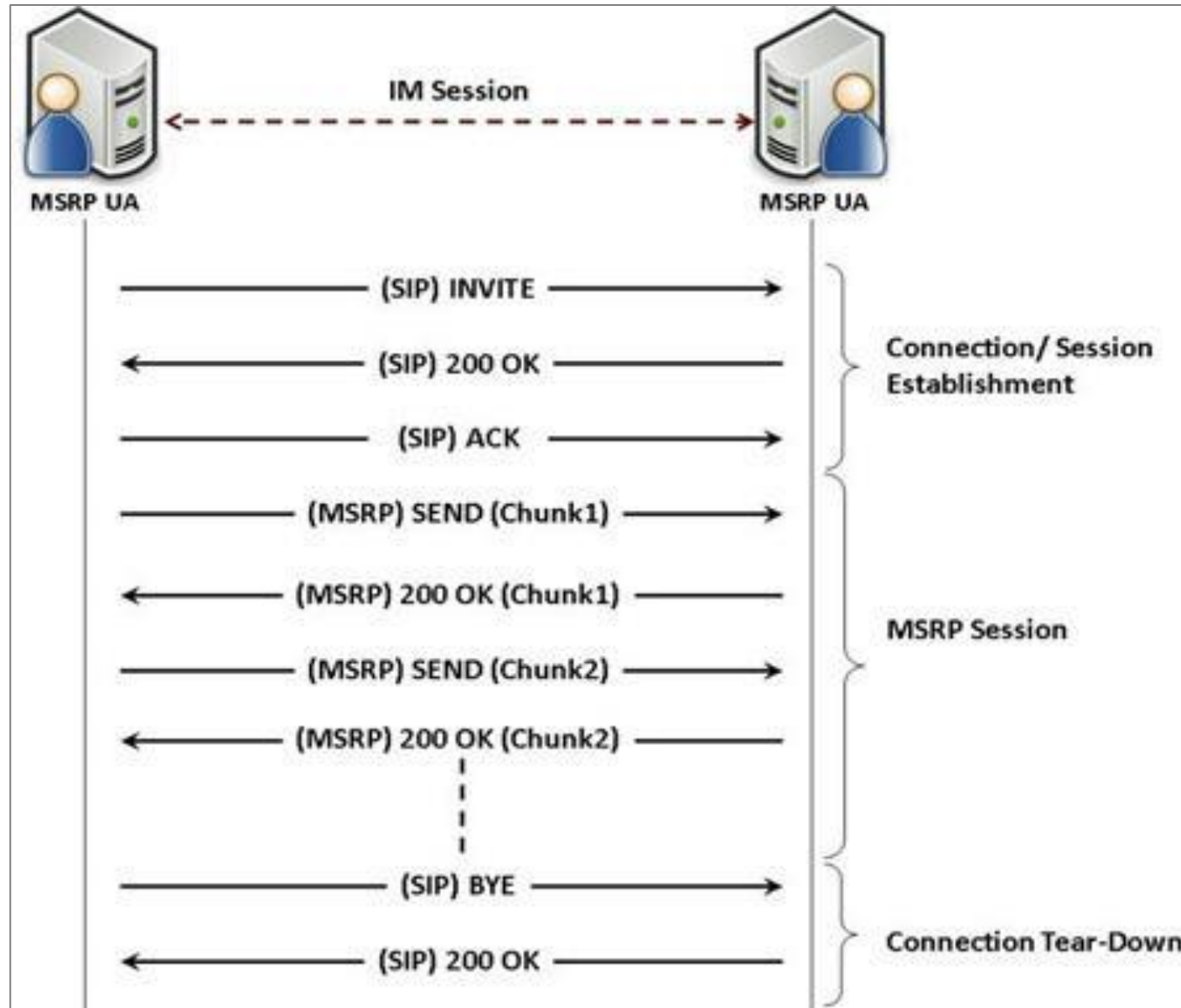
- Test NG-PSAP(s) for Voice calls, SMS and Instant Messaging
- Test solution to simulate SIP+MSRP endpoints, establish the connected sessions, and record related transport statistics on the MSRP text flows as part of the results
- Testing call performance based on different voice codec, narrowband and wideband codec
- Scripts to perform advanced tests using SIP methods like SUBSCRIBE/NOTIFY, REFER and INFO for testing NG 911 interfaces.
- API Integration for automated testing
- Test advanced voice features such as interactive voice response (IVR), conferencing
- Measurement and reporting tools to monitor overall network health, signaling performance, call volume – quality vs time, call duration, identify problem and alert management
- Speech quality measurements – Listening MOS, Conversational MOS, PESQ, POLQA, Delay, SNR, Signal Level, Packet Loss

# GL's Test Solutions for NG-911

- GL offers enhanced **MAPS™ SIP** emulator for Emergency Services Internet Protocol Networks (ESInets) to enable call delivery using **Session Internet Protocol** (SIP), as well as **Instant Messaging** (IM) delivery conforming with RFC 4975/4976 - Message Session Relay Protocol (MSRP) protocol
- MAPS™ SIP allows SIP vendors, wireless carriers, NG-911 service providers, and emergency communications centers to test IP applications for satisfactory working of NG-911 services prior to deployment
- MAPS™ SIP can simulate the end-points (SIP/RTP or SIP/MSRP User Agents) in an NG-911 network and send and receive communications over ESInets



# Typical IM Simulation between SIP/MSRP Endpoints



# Audio and IM Call Generation

GL MAPS (Message Automation Protocol Simulation) (SIP) (MSRP) - [Call Generation - CallGenDefault]

Configurations Emulator Reports Editor Debug Tools Windows Help

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Eve...	Result	Total Iterations	Completed Iterations
1	SipCallControl.gls	Profile0001	GL-MAPS_4_255764793-3591-3500@192.168.12.212	Start	PCMU Call Terminated	None		Pass	1	1
2	SipCallControl.gls	Profile0002	GL-MAPS_40_256266267-3638-3500@192.168.12.212	Stop	Send_File-Completed	SIP_TerminateCall		Pass	1	0
3	SipCallControl.gls	Profile0003	GL-MAPS_31_255937103-3628-3500@192.168.12.212	Start	PCMU Call Terminated	None		Pass	1	1

Add Delete Insert Refresh Start Start All Stop Stop All Abort Abort All

Save Column Width Show Latest

Message	Time
REPORT	18:43:12.308.9586
200 O	18:43:12.317.2016
REPORT	18:43:12.40.4091
SEND	18:43:13.305.2956
SEND	18:43:13.310.3601
200 OK	18:43:13.311.7781
REPORT	18:43:13.312.3798
200 O	18:43:13.320.2887
REPORT	18:43:13.43.8557
File Transmitted :: VoiceFiles\Send\G711\ULAW\vijay	18:43:36.292.3551

Find

```
MSRP GL_MAPS_MSRP_502 SEND
To-Path: msrp://192.168.12.212:20031/GL_MAPS_42_256266313;tcp
From-Path: msrp://192.168.12.213:20031/GL_MAPS_39_256266477;tcp
Message-ID: GL_MAPS_MSRP_501
Success-Report: no
Failure-Report: yes
Byte-Range: 1-153/153
Content-Type: text/plain

The Message Session Relay Protocol (MSRP) is a protocol for transmitting a series of related instant
-----GL_MAPS_MSRP_502?
```

Scripts Message Sequence Event Config Script Flow

Initialisation Errors Error Events Captured Errors Link Status Up=0 Down=0

# IM Only Call Generation

GL MAPS (Message Automation Protocol Simulation) (SIP) (MSRP) - [Call Generation - CallGenDefault]

Configurations Emulator Reports Editor Debug Tools Windows Help

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Eve...	Result	Total Iterations	Completed Iterations
1	SipCallControl.gls	Profile0001	GL-MAPS_4_255764793-3591-3500@192.168.12.212	Start	PCMU Call Terminated	None		Pass	1	1
2	SipCallControl.gls	Profile0002	GL-MAPS_13_255812934-3608-3500@192.168.12.212	Start	PCMU Call Terminated	None		Pass	1	1
3	SipCallControl.gls	Profile0003	GL-MAPS_31_255937103-3628-3500@192.168.12.212	Start	PCMU Call Terminated	None		Pass	1	1

Add Delete Insert Refresh Start Start All Stop Stop All Abort Abort All

Save Column Width Show Latest

MAPS DUT

INVITE	18:34:49.56.9629
100 Trying	18:34:49.69.8642
180 Ringing	18:34:49.72.8766
200 OK	18:34:49.114.3293
ACK	18:34:49.124.5245
SEND	18:34:49.147.2791
SEND	18:34:49.151.4463
200 OK	18:34:49.152.68
REPORT	18:34:49.152.1949
200 O	18:34:49.162.998

Find

```
MSRP GL_MAPS_MSRP_3582 SEND
To-Path: msrp://192.168.12.213:20027/GL_MAPS_7_255764997;tcp
From-Path: msrp://192.168.12.212:20027/GL_MAPS_6_255764830;tcp
Message-ID: GL_MAPS_MSRP_3581
Success-Report: no
Failure-Report: yes
Byte-Range: 1-131/131
Content-Type: text/plain

GL Communications Specializes in PC-Based & Laptop-Based Telecommunications Testing and Measurement )
-----GL_MAPS_MSRP_3582#
```

Scripts Message Sequence Event Config Script Flow

Initialisation Errors Error Events Captured Errors Link Status Up=0 Down=0

# NetSurveyorWeb™ for Monitoring Emergency Services Network


# NetSurveyorWeb™ – Main Features


- Web-based network surveillance system for air traffic monitoring
- Works with multiple PacketScan™ Probes to non-intrusively monitor at remote locations
- Scalable and Flexible Architecture
- Real-time and/or historical analysis
- Multi-user support and user-friendly interface
- Filter and Search Options. Provides quick database query methods
- Results are displayed both in tabular and graphical formats
- Provides protocol signaling, traffic, and call detail records (CDRs)
- Generates Reports and Alarms





# NetSurveyorWeb™ - CDR View (CAS)

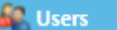
GL NetSurveyorWeb

 GI


 Data

 Reports

 Alarms


 Users

System Status at  
2018-06-20 18:43:37

 Refresh

Protocol Type CAS


My Account

 Quick CDR


All Calls

Failed Calls


Passed Calls


 Custom CDR


CDR


 Basic KPIs

Basic KPIs

 MailBox

 Config

 Admin

 Utilization

Quick CDR \ All Calls

Date : 2018-06-17 2018-06-20 Time : 00:00:00 23:59:59 Ok













Today Yesterday Last 7 Days Last 30 Days All


Actions Query Execution Time : 0.09374 Seconds

Quick Search: CALL ID GO

Y M D H < > H D M Y

Page Size: 20 Sort Order : STARTTIME DESC


	SINo	CALL ID	PROBE NAME	CAS STD	CALLING NUMBER	CALLED NUMBER	EAST DEVNO	WEST DEVNO	TIME SLOT	RESULT	BILLING DURATION(mSec)	START TIME
	1	26	CAS	MFCR2	5550031	6660031	1	64	30	Pass	60214	2018-06-18 16:07:21.000
	2	24	CAS	MFCR2	5550032	6660032	1	64	31	Pass	60190	2018-06-18 16:07:21.000
	3	22	CAS	MFCR2	5550029	6660029	1	64	28	Pass	60202	2018-06-18 16:07:20.999
	4	20	CAS	MFCR2	5550030	6660030	1	64	29	Pass	60226	2018-06-18 16:07:20.999
	5	25	CAS	MFCR2	5550028	6660028	1	64	27	Pass	60202	2018-06-18 16:07:20.999
	6	21	CAS	MFCR2	5550027	6660027	1	64	26	Pass	60208	2018-06-18 16:07:20.988
	7	16	CAS	MFCR2	5550026	6660026	1	64	25	Pass	60220	2018-06-18 16:07:20.988
	8	15	CAS	MFCR2	5550024	6660024	1	64	23	Pass	60214	2018-06-18 16:07:20.977
	9	14	CAS	MFCR2	5550025	6660025	1	64	24	Pass	60212	2018-06-18 16:07:20.977
	10	13	CAS	MFCR2	5550023	6660023	1	64	22	Pass	60196	2018-06-18 16:07:20.977
	11	18	CAS	MFCR2	5550022	6660022	1	64	21	Pass	60202	2018-06-18 16:07:20.966
	12	10	CAS	MFCR2	5550021	6660021	1	64	20	Pass	60230	2018-06-18 16:07:20.966

 **GL**  
Communications

30

# NetSurveyorWeb™ - Playing Voice Files (CAS)

GL NetSurveyorWeb

 GI

Data

Reports

Alarms

Users

System Status at 2018-06-20 18:44:37

Protocol Type CAS

My Account

Quick CDR

All Calls

Failed Calls

Passed Calls

Custom CDR

CDR

Basic KPIs

Basic KPIs

MailBox

Config

Admin

Utilization

Quick CDR \ All Calls

Date : 2018-06-17 2018-06-20 Time : 00:00:00 23:59:59 Ok

Today Yesterday Last 7 Days Last 30 Days All

Actions Query Execution Time : 0.09374 Seconds

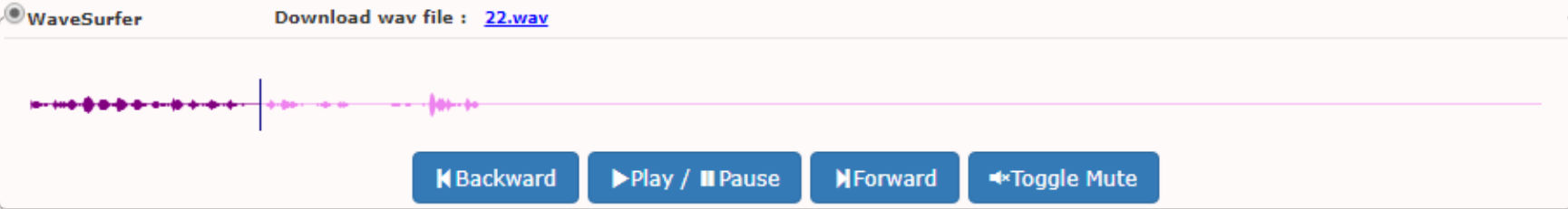
Quick Search: CALL ID 60

Page Size: 20 Sort Order : STARTTIME DESC

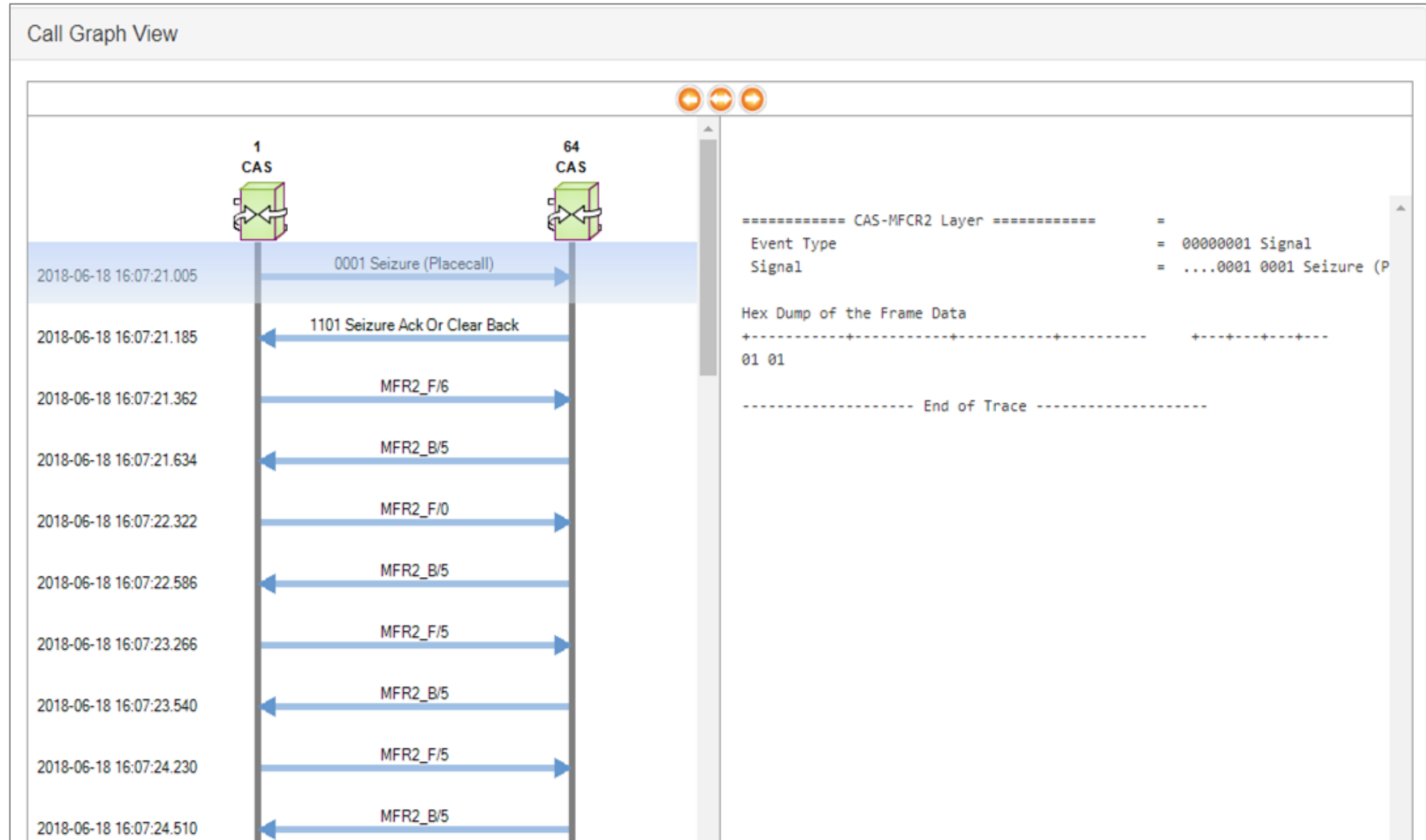
	SINo	CALL ID	PROBE NAME	CAS STD	CALLING NUMBER	CALLED NUMBER	EAST DEVNO	WEST DEVNO	TIME SLOT	RESULT	BILLING DURATION(mSec)	START TIME
<input type="checkbox"/> Call Flow	1	26	CAS	MFCR2	5550031	6660031	1	64	30	Pass	60214	2018-06-18 16:07:21.00!
<input type="checkbox"/> Call Flow	2	24	CAS	MFCR2	5550032	6660032	1	64	31	Pass	60190	2018-06-18 16:07:21.00!
<input type="checkbox"/> Call Flow	3	22	CAS	MFCR2	5550029	6660029	1	64	28	Pass	60202	2018-06-18 16:07:20.99!
<input type="checkbox"/> Call Flow	4	20	CAS	MFCR2	5550030	6660030	1	64	29	Pass	60226	2018-06-18 16:07:20.99!
<input type="checkbox"/> Call Flow	5	25	CAS	MFCR2	5550028	6660028	1	64	27	Pass	60202	2018-06-18 16:07:20.99!

WaveSurfer

Download wav file : 22.wav



# NetSurveyorWeb™ - Call Graph (CAS)





# NetSurveyorWeb™ – CDR View (SIP)

- Web-based network surveillance system for air traffic monitoring
- Works with multiple PacketScan™ Probes to non-intrusively monitor at remote locations
- Scalable and Flexible Architecture
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- Filter and Search Options. Provides quick database query methods
- Results are displayed both in tabular and graphical formats
- Provides protocol signaling, traffic, and call detail records (CDRs)
- Generates Reports and Alarms

GL NetSurveyorWeb

Refresh Protocol Type VOIP (SIP & H323) My Account

GI

Quick CDR \ All Calls

Date: 2018-02-28 2018-03-21 Time: 00:00:00 23:59:59 Ok

Today Yesterday Last 7 Days Last 30 Days All

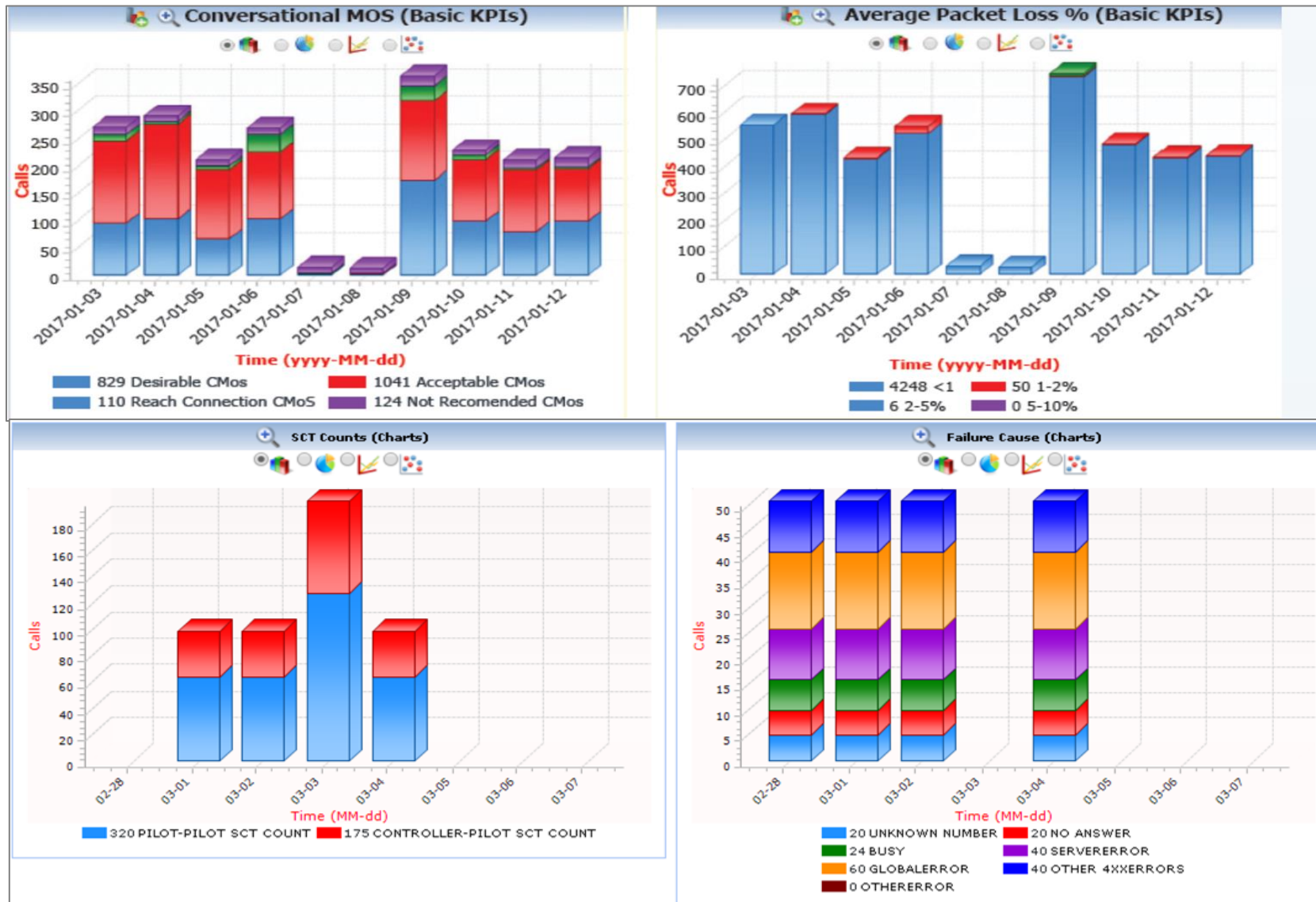
Actions Query Execution Time : 0.54164 Seconds

Quick Search: Trafficsumid 60 Page Size: 20 Sort Order : STARTTIME DESC

SI No	Calling Number	Called Number	Starttime	Duration	Call Success	Failure Cause	Listening Mos1	Listening Mos2	Payload1
4	0001@192.168.2.96	GRS-TxRx@192.168.2.15	2018-03-06 04:19:13.069	00:00:51.228	1	0	4.20	4.20	PCMU/8000
5	0001@192.168.2.96	GRS-TxRx@192.168.2.15	2018-03-06 04:14:58.842	00:01:00.016	1	0	4.20	4.20	PCMU/8000
6	0001@192.168.2.96	GRS-TxRx@192.168.2.15	2018-03-06 04:13:16.914	00:00:06.255	1	0	4.20	4.20	PCMU/8000
7	0001@192.168.2.96	GRS-TxRx@192.168.2.15	2018-03-06 04:11:31.061	00:00:50.126	1	0	4.20	4.20	PCMU/8000
8	0001@192.168.2.96	GRS-TxRx@192.168.2.15	2018-03-06 04:02:26.638	00:00:37.118	1	0	4.20	4.20	PCMU/8000
9	CWP05@192.168.2.96	CWP15@192.168.2.15	2018-03-06 03:52:27.647	00:00:12.543	1	0	4.20	4.20	PCMA/8000
10	CWP05@192.168.2.96	CWP15@192.168.2.15	2018-03-06 03:52:27.647	00:00:12.543	1	0	4.20	4.20	PCMA/8000
11	CWP01@192.168.2.96	CWP11@192.168.2.15	2018-03-06 03:47:02.763	00:00:03.369	1	0	4.20	4.20	PCMA/8000
12	CWP01@192.168.2.96	CWP11@192.168.2.15	2018-03-06 03:43:26.042	00:00:39.677	1	0	4.20	4.20	PCMA/8000
13	CWP01@192.168.2.96	CWP11@192.168.2.15	2018-03-06 03:41:24.777	00:00:07.034	1	0	4.20	4.20	PCMA/8000

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# NetSurveyorWeb™ – Reports and Graphs



# NetSurveyorWeb™ – Notifications / Alarm Alerts

## Alert Types

- Email Alerts
- Visual Alarm
- Audible Alarm
- Set Alarm Severity
- Log to File

**AUDIBLE**



**VISUAL**



**LOG INTO TABLE**

	Serial No.	Alarm Name	Alarm Severity	Timestamp	Email_Message
<a href="#">View Calls</a>	156	testfilter	Minor	2014-10-16 11:08:16	voip cdr alarm filter
<a href="#">View Calls</a>	155	testkpi	Minor	2014-10-16 11:08:16	alarm kpis
<a href="#">View Calls</a>	156	testfilter	Minor	2014-10-16 11:08:16	voip cdr alarm filter

- Define real-time network conditions to generate alarms
- Define different actions based on the generated alarms

# NetSurveyorWeb™ – Notifications / Alarm Alerts

## Alerts

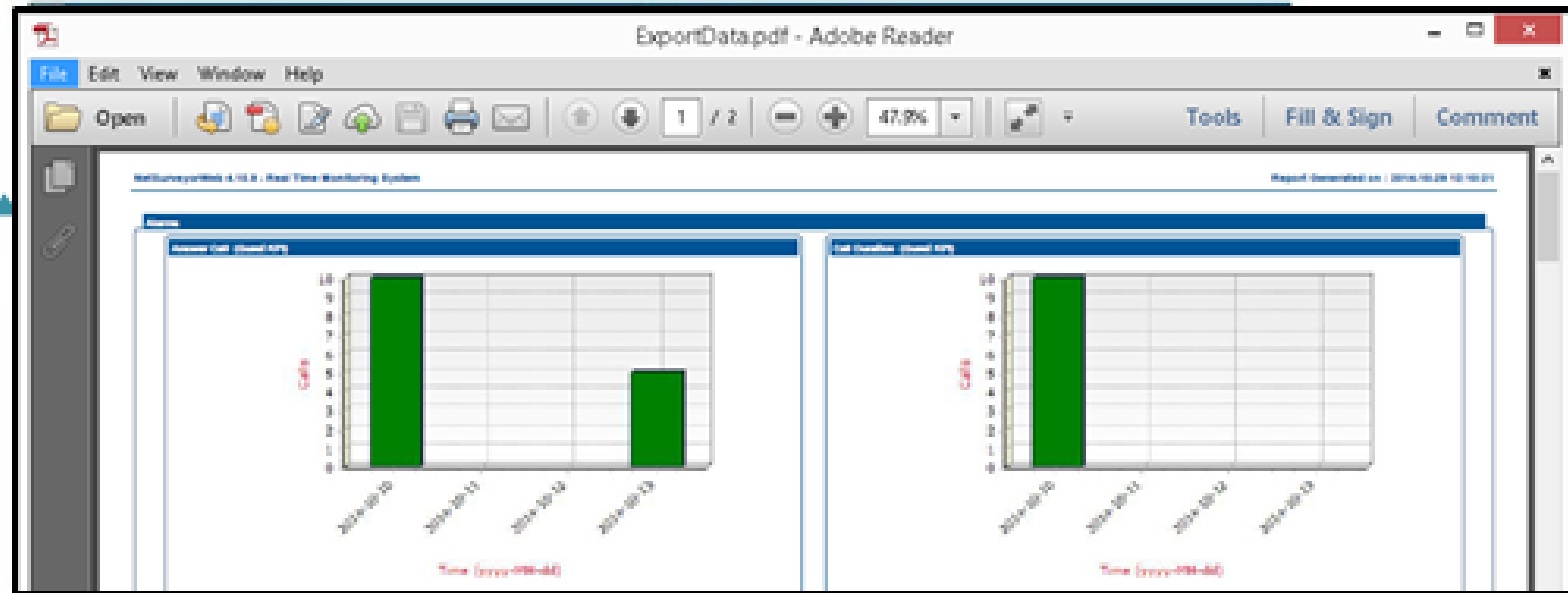
EMAIL



CDR View

Report View

GL Communications Inc. Telecommunication Products and Consulting					
NetSurveyorWeb 4.10.9 - Real Time Monitoring System				Report Generated on : 2014-10-29 12:15:34	
TRAFFICSUMID	CALLINGNUMBER	STARTTIME	DURATION	CALLID	FILENAME
15	008@192.168.1.142	2014-10-13 16:35:51.799	00:00:00.947	GLPG-10762604165937	
14	008@192.168.1.142	2014-10-13 16:20:51.799	00:00:00.947	GLPG-10762604165937	
13	008@192.168.1.142	2014-10-13 14:35:51.799	00:00:00.947	GLPG-10762604165937	
12	008@192.168.1.142	2014-10-13 14:10:51.799	00:00:00.947	GLPG-10762604165937	
11	008@192.168.1.142	2014-10-13 00:53:51.799	00:00:00.947	GLPG-10762604165937	



[View Calls](#)

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testfilter

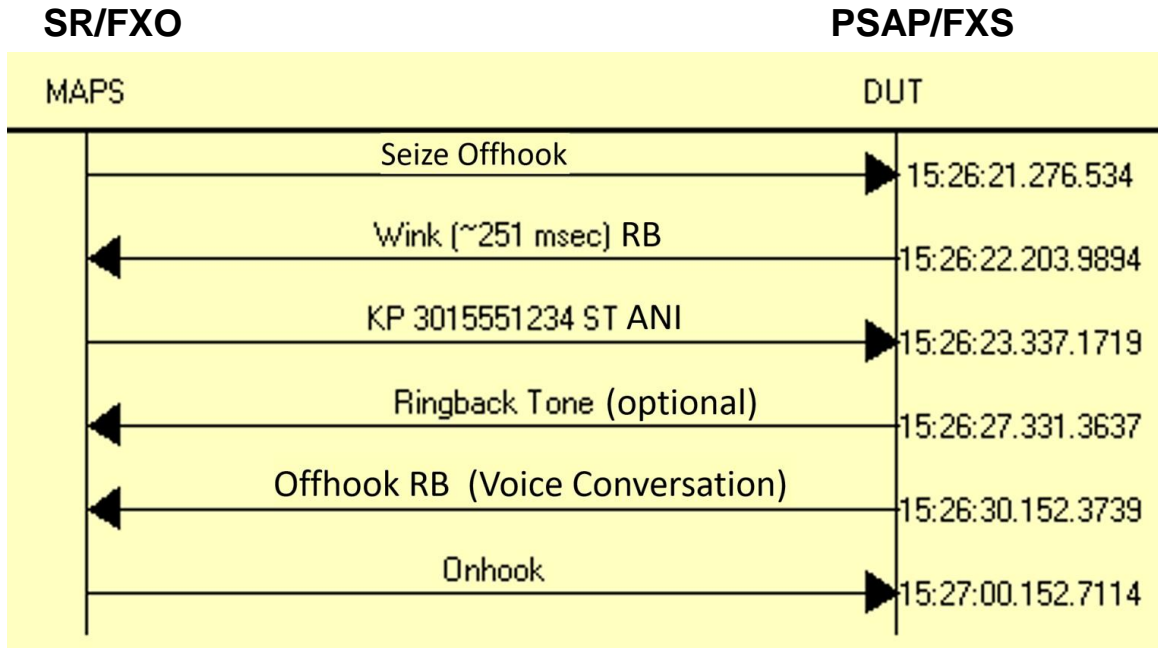
Minor

2014-10-16 11:08:16

voip cdr alarm filter

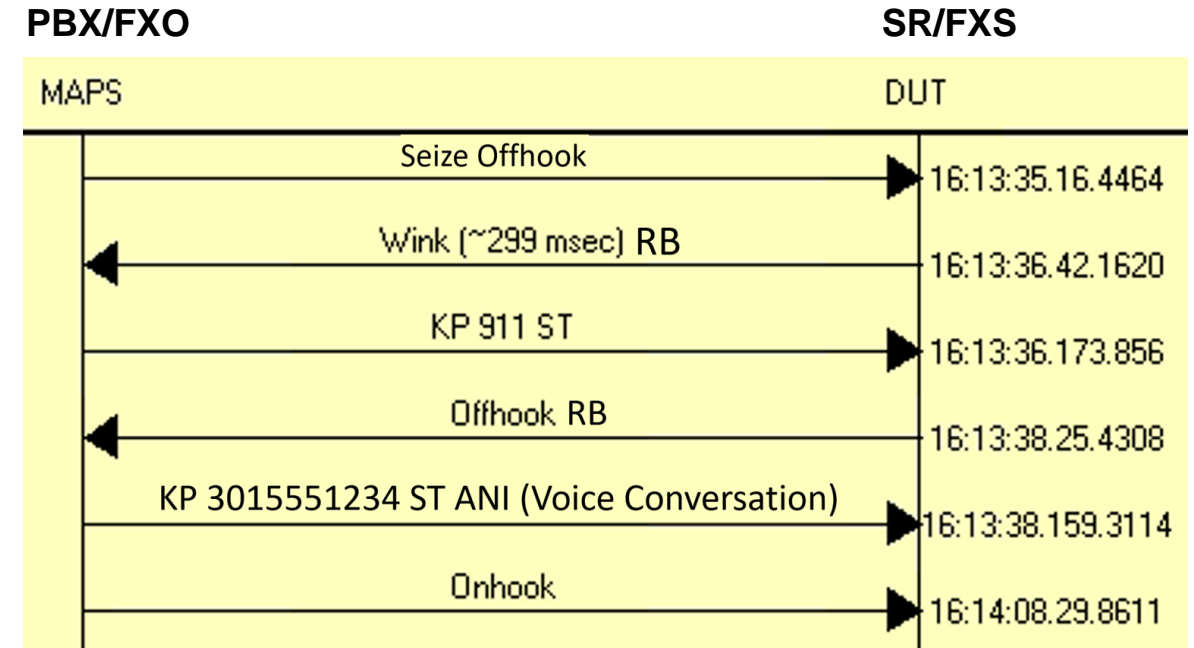
# Call Flow Comparison using PSAP and Selective Router

## Terminating to “PSAP”



Off Hook,  
Reverse Battery (RB)  
Automatic Number Identification (ANI)

## Terminating to “Selective Router (SR)”



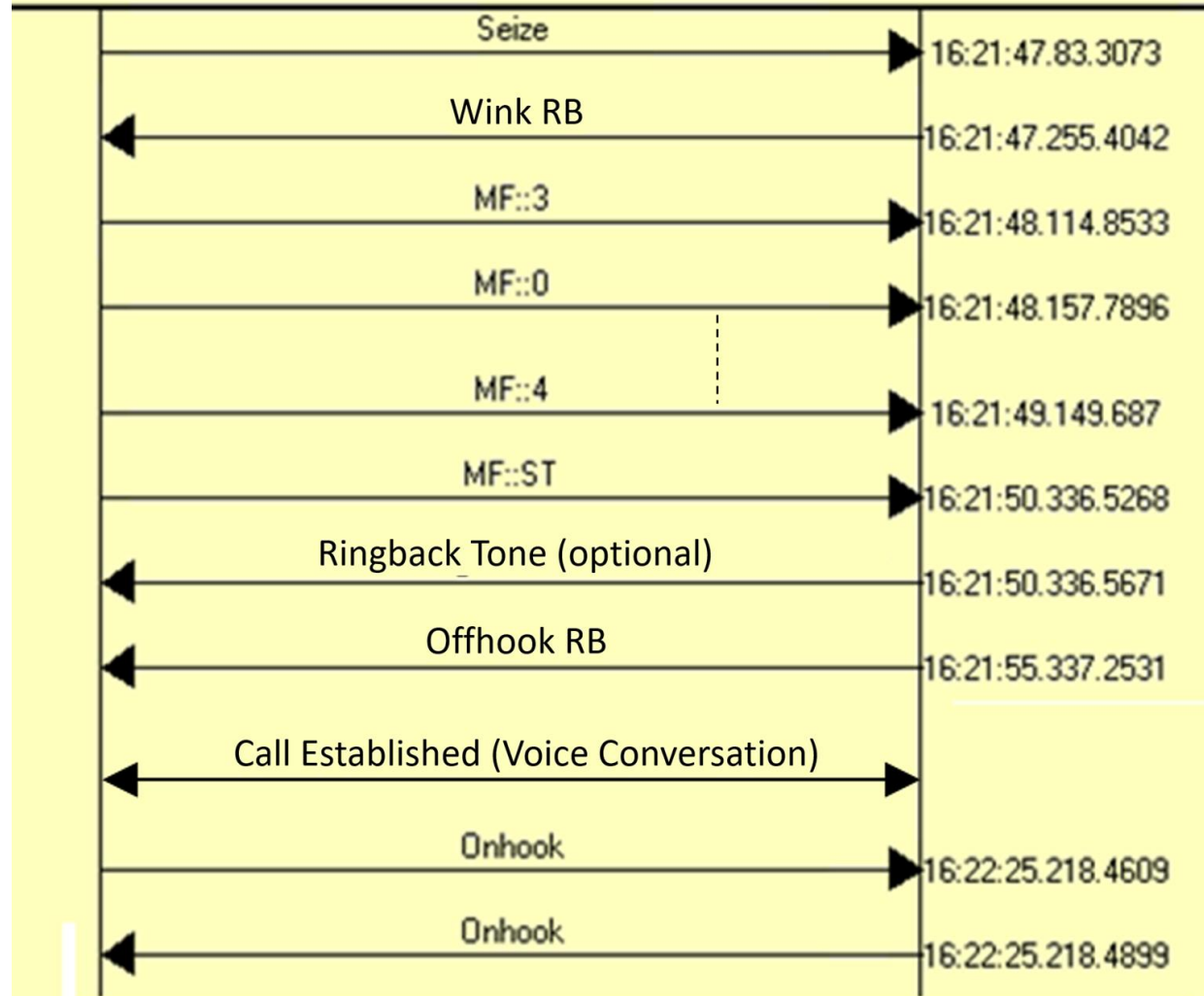
PBX acts like a landline phone and sends 911 to a CO or in this case directly to a Selective Router

# Call Flow Comparison using PSAP and Selective Router (Contd.)

## Termination to “PSAP”

SR/FXO

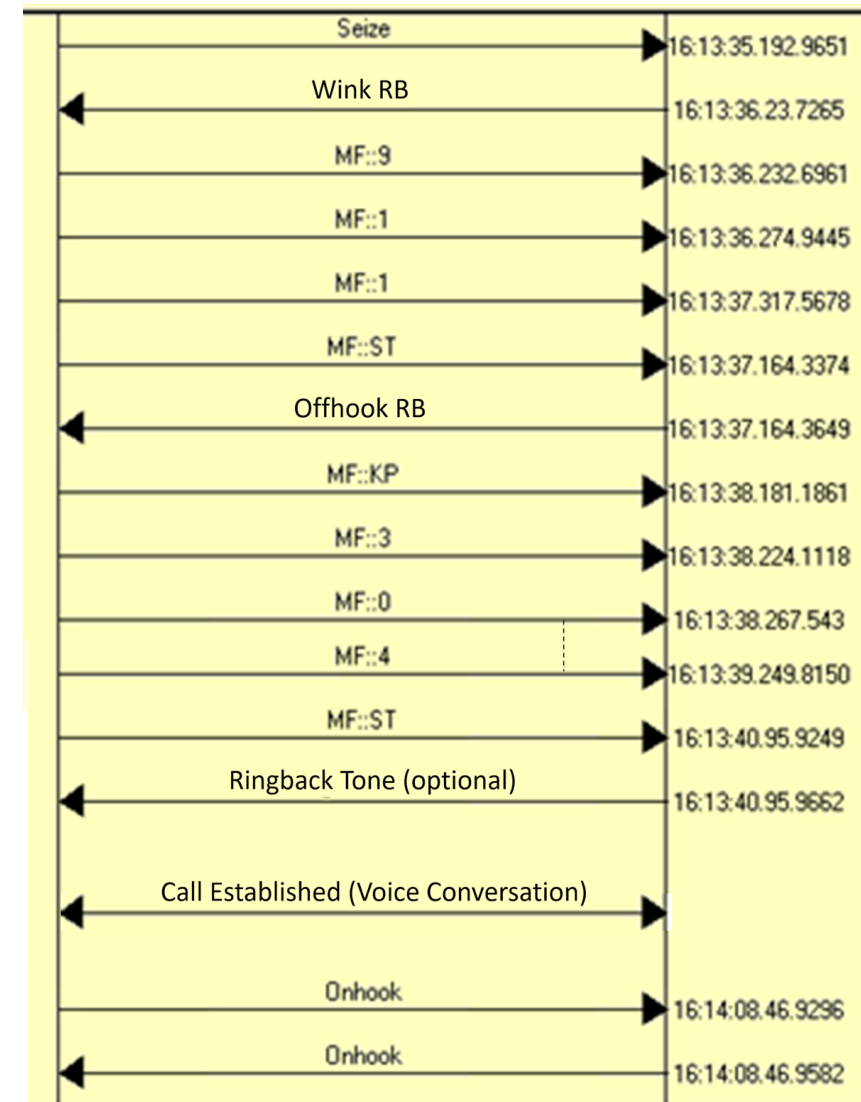
PSAP/FXS



## Termination to “Selective Router”

PBX/FXO

SR/FXS



**Thank you**