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

Presenters:

Vijay Kulkarni  Matt Yost
• Located in the United States – Gaithersburg, Maryland
• Founded in 1986
• Engineering Consulting Services
• Test & Measurement Equipment
  ➢ Wireless, VoIP, SONET-SDH, TDM
  ➢ Visualization, Capture, Storage, Portability, Cost-Effectiveness
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
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

[Diagram showing the elements of a 911 and E-911 Emergency Services network, including core entities like PSTN, VoIP, and GPS, and how they connect to a 911 Selective Router and PSAP Network.]
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

Diagram:
- Ring (R) and Red (-)
- Tip (T) and Green (+)

Next Generation 911 (NG-911) Emergency Services
**LoCation Services (LCS) in Mobile Networks – Architecture and Test Methods**

Mar 2017

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Presented by: Matt Yost & Savita Majjagi
Test 911 and E-911 Emergency Services
911 Test Requirement & Solutions

- **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
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.
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.
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.
• 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
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.

GL Communications Inc.
Demonstrations
Next Generation 911
Introduction (NG-911)

- 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

IM Session

Connection/Session Establishment

MSRP Session

Connection Tear-Down

(SIP) INVITE
(SIP) 200 OK
(SIP) ACK
(MSRP) SEND (Chunk1)
(MSRP) 200 OK (Chunk1)
(MSRP) SEND (Chunk2)
(MSRP) 200 OK (Chunk2)
(SIP) BYE
(SIP) 200 OK
Audio and IM Call Generation

The Message Session Relay Protocol (MSRP) is a protocol for transmitting a series of related instances.

--- GL_Maps_MSRP_502 ---
IM Only Call Generation
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)

The image shows a screenshot of a network monitoring tool interface, specifically the CDR View for CAS (Customer Access Service). The interface is used to view call detail records (CDRs) for a given date range. The screenshot displays a list of CDRs with columns for Call Flow, Call ID, Probe Name, CAS Type, Calling Number, Called Number, EAST DEVNO, WEST DEVNO, TIME SLOT, RESULT, BILLING DURATION, and START TIME. The data is sorted by START TIME in descending order. The interface also includes options for reporting, alarms, users, and system status.
NetSurveyorWeb™ - Playing Voice Files (CAS)
NetSurveyorWeb™ - Call Graph (CAS)
NetSurveyorWeb™ – CDR View (SIP)

- Web-based network surveillance system for air traffic monitoring
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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

- Define real-time network conditions to generate alarms
- Define different actions based on the generated alarms
NetSurveyorWeb™ – Notifications / Alarm Alerts
Webinar and Live Demo

Click on the below Play icon to view the webinar
# Call Flow Comparison using PSAP and Selective Router

## Terminating to “PSAP”

<table>
<thead>
<tr>
<th>SR/FXO</th>
<th>MAPS</th>
<th>DUT</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Seize Offhook</td>
<td>15:26:21.276.534</td>
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<tr>
<td></td>
<td>Wink (~251 msec) RB</td>
<td>15:26:22.203.9894</td>
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<td></td>
<td>KP 3015551234 ST ANI</td>
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<td></td>
<td>Ringback Tone (optional)</td>
<td>15:26:27.331.3637</td>
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<td></td>
<td>Offhook RB (Voice Conversation)</td>
<td>15:26:30.152.3739</td>
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<tr>
<td></td>
<td>Onhook</td>
<td>15:27:00.152.7114</td>
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## Terminating to “Selective Router (SR)”

<table>
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<th>DUT</th>
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<tr>
<td></td>
<td>Seize Offhook</td>
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<tr>
<td></td>
<td>Wink (~299 msec) RB</td>
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<td>KP 911 ST</td>
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<td>Offhook RB</td>
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<td>KP 3015551234 ST ANI (Voice Conversation)</td>
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<tr>
<td></td>
<td>Onhook</td>
<td>16:14:08.29.8611</td>
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</tbody>
</table>

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

PBX acts like a landline phone and sends 911 to a CO or in this case directly to a Selective Router.
Thank you
Any Questions?