NENA

Recommendation

for the implementation of

Enhanced MF Signaling,

E9-1-1 Tandem to PSAP

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NENA
TECHNICAL REFERENCE

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1.   **INTRODUCTION**

1.1   **Purpose**

This NENA Technical Reference defines the use of a Feature Group D like signaling protocol between the E9-1-1 selective routing tandem and E9-1-1 customer premise equipment (CPE) which is called "Enhanced MF Signaling". This document does not suggest the implementation of Feature Group D trunking - there are tariff issues associated with FGD that do not apply to 9-1-1. Rather, it recommends borrowing the "off the shelf" MF signaling protocol from Feature Group D in order to facilitate the delivery of one or two ten-digit ANI's to the PSAP over existing facilities, without creating an entirely new protocol.

1.2   Overview and Benefits

This Technical Reference is a guide for designers and manufacturers of selective routing tandems and PSAP CPE. It may also be of value to purchasers, maintainers and users of such equipment.

This document describes the use of a Enhanced MF Signaling in place of the protocol described in Bellcore Technical Reference TR-TSY-000350. It does not recommend any changes to, or the replacement of, in-place multi-frequency (MF) signaling used between the E9-1-1 selective routing tandem and the E9-1-1 PSAP CPE, nor does this document recommend any other modifications to selective routing tandems or CPE, beyond those necessary to implement Enhanced MF Signaling

The purpose of utilizing Enhanced MF Signaling is to facilitate the delivery of one or two ten-digit ANI transmissions to the PSAP. The protocol supports both.

The existing protocol, as described in Bellcore TR-TSY-000350, limits the PSAP to receiving 9-1-1 calls from callers in up to four area codes only. The implementation of Enhanced MF Signaling removes that limitation by delivering all ten digits of the caller's telephone number.

Enhanced MF Signaling also provides for the delivery of two ten-digit numbers to the PSAP. This capability is required to implement Phase 1 of FCC Report and Order 96-264 (also commonly known as FCC Docket 94-102), the delivery of a wireless 9-1-1 caller's ten digit callback number plus a ten digit number that identifies the cell/sector through which the call originated.

1.3   Reason for Reissue
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1.5 Acronyms and Terms

Acronym/Term	Definition
Automatic Location Identification (ALI)	The automatic display at the PSAP of the caller's telephone number, the address/location of the telephone and supplementary emergency services information.
Automatic Number Identification (ANI)	The telephone number associated with the access line from which a call originates.
ANI II Digits	Digits in the Enhanced MF Signaling protocol that indicate to the PSAP CPE ANI display device whether the display should remain steady or flash, or if the call is a test call.
CPE (Customer Premises Equipment)	Terminal Equipment at a PSAP.
DN (Directory Number)	A dialable 10-digit telephone number associated with a telephone subscriber or call destination..
Feature Group D (FGD)	An MF signaling protocol, originally developed to support equal access to long distance services, capable of carrying one or two ten digit telephone numbers.
Key Pulse (KP)	An MF signaling tone (digit)
Multi-frequency (MF)	A type of signaling used on analog interoffice and 9-1-1 trunks.
Public Safety Answering Point (PSAP)	A facility equipped and staffed to receive 9-1-1 calls. A Primary PSAP receives the calls directly. If the call is relayed or transferred, the next receiving PSAP is designated a Secondary PSAP.
Start (ST)	An MF signaling tone (digit).
Start Prime (STP)	An MF signaling tone (digit).
E9-1-1 Control (Tandem) Office	The central office that provides the tandem switching of E9-1-1 calls. It controls delivery of the voice call with ANI to the PSAP and provides Selective Routing, Speed Calling, Selective Transfer, Fixed Transfer and certain maintenance functions for each PSAP. Also known as 9-1-1 Selective Routing Tandem or Selective Router.

2. **CALL PROGRESS SIGNALS**

2.1   E9-1-1 PSAP to Tandem with 10/20 Digit ANI via Enhanced MF Signaling

MF outpulsing is required to send ANI to the E9-1-1 PSAP. An idle 9-1-1 trunk to the PSAP is seized and an attempt is made to seize and connect an idle MF transmitter to the outgoing 9-1-1 trunk. When an MF transmitter is available, it is seized and connected to an E9-1-1 outgoing trunk to the PSAP. Standard, start-dial timing is done for receipt of the ANI start signal (approximately 250 +50 ms wink signal) from the PSAP CPE. There are several failure modes that can occur after the E9-1-1 tandem seizes a dedicated E9-1-1 outgoing trunk and connects an MF transmitter.

The normal sequence of events that occurs after a 9-1-1 trunk seizure is described below. Failure modes are discussed as they are applicable to a particular sequence. (Sections 1-3 following are reprinted verbatim from NENA Technical Reference NENA-04-001, Generic Standards for E9-1-1 PSAP Equipment, dated June 20, 1996. Sections 4 and 5 have been taken from NENA-04-001 but modified to address the differences and requirements of the FGD type protocol.)

1. The E9-1-1 tandem office sends an off-hook signal to the PSAP indicating 9-1-1 trunk seizure.

2. The E9-1-1 tandem office waits 4 to 20 seconds for receipt of the ANI start pulsing wink from the PSAP. The normal call sequence continues if the PSAP returns the outpulsing wink signal. If the start pulsing wink signal is not received within 4 to 20 seconds, the E9-1-1 tandem office puts the trunk on the trunk maintenance list and makes one retry on a different E9-1-1 trunk to the PSAP. In this case, the trunk hunting and the connection phase begin again.

3. When the PSAP recognizes the E9-1-1 trunk seizure, it shall return an ANI start pulsing wink signal (250+50 ms Line Reversal) to the E9-1-1 tandem within 4 seconds. After sending the start pulsing wink signal, if the MF pulses are not received within 6 seconds (**NOTE**: This is increased from 4 seconds in the eight-digit protocol.), or garbled pulses are received, the PSAP completes the call as if an ANI failure has occurred. That is, the CPE shall immediately signal the attendant(s) and return audible ringing to the calling station via the E9-1-1 network. In this case, when the attendant answers, all zeros are displayed on the ANI display. Otherwise, receipt of the start pulsing wink signal typically causes the E9-1-1 tandem office to start MF outpulsing.

4. The MF outpulsing consists of a stream of MF tone pulses, 53 ms to 65 ms duration, separated by silent intervals of 55 ms to 65 ms. The ANI II and DN digits are preceded by a KP digit of 115 ms to 125 ms duration and followed by an STP digit of 55 to 65 ms duration when a single, ten digit ANI is transmitted, or an ST digit of 55 to 65 ms duration when two ten digit numbers are transmitted. (The KP, ST and STP digits are within the family of MF signals.) For transmission of a single, ten digit ANI, the E9-1-1 tandem begins MF outpulsing the ANI information to the PSAP in the form KP II NPA NXX YYYY STP. For transmission of two, ten digit numbers, MF outpulsing begins in the form KP II NPA NXX YYYY (calling party's number) ST KP NPA NXX YYYY (dialed number or pseudo ANI) ST.

The "II" represents encoded information indicating whether the calling line display device (ANI display) should remain steady or flash, or if the call is a test call. II digits will be used as follows:

II Digit	Meaning
40	Steady ANI display
44	Flashing ANI display
48	Test call

ANI Failures

If a valid ANI is not available at the E9-1-1 tandem office, a fictitious NPA-NXX-YYYY ANI is sent to the PSAP as either 000-911-0000 or 000-911-0TTT. The digits TTT indicate the E9-1-1 tandem switch Central Office number (also known as ESCO code) associated with the originating office.

000-911-0TTT may be sent due to ANI failures, multi-party or QZ billing lines, and possibly a 9-1-1 call received via a message trunk.

Where trunks that deliver two telephone numbers (calling party's number and pseudo ANI) are implemented between the Mobile Switching Office (MSC) and the 9-1-1 tandem office, it is conceivable that an ANI failure may occur in the transmission of either or both numbers. In that event, the failure(s) shall be indicated to the PSAP as follows:

If the pseudo ANI fails, but the CPN is received intact, the tandem will transmit the CPN as normal and substitute 000-911-0TTT for the pseudo ANI, where 0TTT represents the ESCO code for the MSC from which the call originated.

If the pseudo ANI is received intact, but the CPN fails, the tandem will transmit the pseudo ANI as received and substitute 000-911-0TTT for the CPN, where OTTT represents the ESCO code for the MSC from which the call originated.

If both numbers fail, the tandem will transmit 000-911-0TTT in both the CPN and pseudo ANI fields.

If, for some reason, only one ANI is transmitted by the MSC and it fails, the tandem should transmit a dual ANI failure to the PSAP (as described above), if possible. If that is not possible, 000-911-0TTT shall be transmitted to the PSAP.

Implementation Options:

1. If the originating end office serves a single NPA, it may be possible to send NPA-911-0TTT.
2. The 9-1-1 Service Provider may chose, or be forced, to expand ESCO codes from three to four digits. In that case, ANI transmission for an ANI failure may be sent as 000-911-TTTT or NPA-911-TTTT.

000-911-0000 is sent when an anonymous call is made to a PSAP. An anonymous call is a 7 or 10-digit call (non 9-1-1) to the DN of the PSAP (where applicable).

Note: If an ANI failure occurs between the E9-1-1 tandem office and the PSAP, the digits that may be displayed are 000-000-0000.

5. Upon receipt of the complete ANI information, the PSAP shall signal the attendant(s) and return audible ringing to the calling party. When the call is answered, the PSAP shall disconnect audible ringing, connect the call to the answering attendant, display the calling party's number on the ANI display, and return an off-hook signal to the E9-1-1 tandem office, indicating that the call has been answered.

If a single, ten digit ANI has been delivered with the call, the E9-1-1 PSAP CPE will display the number on the ANI display and use that number to query the ALI database.

In Phase 1 wireless implementations, when two, ten digit numbers have been delivered, the PSAP CPE will display the calling party's number on the ANI display, but use the pseudo ANI to query the ALI database.

In Phase 2 wireless implementations, the calling party's number may be used to

query the ALI database, depending upon the configuration of the location determination technology (LDT) interface. In this instance, the pseudo ANI would only be used to query the ALI database in the event the calling party's number was garbled or not received.

Calls originated from non-service-initialized wireless telephones may not have a calling party number to display. It is also conceivable that multiple calls from non-service-initialized wireless telephones could be received at the PSAP simultaneously. In this event, a "pseudo CPN" may be assigned by the MSC (possibly as a temporary local directory number, or TLDN). This pseudo CPN will be used to tie the x and y coordinates computed by the LDT system to the voice call, but may not be usable as a callback number.

6. After the answer is detected, the E9-1-1 tandem office supervises the call for disconnect and a PSAP transfer request.

3. Trunk Maintenance Test Calls

For a PSAP equipped with CPE for ANI display, test calls can be made from the E9-1-1 tandem office using encoded ANI. The PSAP CPE should decode the special ANI as a test call and connect the trunk under test to a test termination facility in the PSAP CPE. Specifically, when KP 48 STP is outpulsed to the PSAP, the E9-1-1 trunk under test should be connected to a permanent busy circuit without answer supervision (no battery reversal) in the PSAP CPE. This allows the E9-1-1 tandem office to verify the integrity of the circuit using the trunk diagnostic program. The test call sequence is listed in the following three steps:

1. After seizing the selected idle trunk and receiving the wink start signal prior to time-out, the E9-1-1 tandem office outpulses KP 48 STP to the PSAP.

2. The PSAP should interpret the digits 4 and 8 as a maintenance test call and connectthe incoming E9-1-1 trunk to a permanent busy tone (continuous 60-ipm, tone) without answer supervision (normal battery polarity). The tone should be returned to the E9-1-1 tandem office within 20 seconds after receipt of the wink start pulse, otherwise, the E9-1-1 tandem office would consider the trunk test a failure.

3. Approximately 5 seconds after receiving the 60-ipm tone, the E9-1-1 tandem office disconnects and idles the trunk under test. It is not necessary for the PSAP to do any timing for a maintenance call, but merely react to the seizure and disconnect from the E9-1-1 tandem office.

4. DATABASE QUERY PROTOCOL

4.1 Change to Query Protocol

The change to the ANI delivery protocol will necessitate a corresponding change in the ALI database query protocol. In short, the NPD digit will be replaced by the three digit NPA. No other modifications are envisioned at this time.

The resulting protocol will be as follows:

Query:
Old protocol: NPD-NXX-YYYY-POS-TRNK-CHECK-CARRIAGE RETURN
New Protocol: NPA-NXX-YYYY-POS-TRNK-CHECK-CARRIAGE RETURN

No modifications are required for ACK's, NAK's, heartbeats or ALI text messages sent from the ALI/DMS to the PSAP.

5. ACKNOWLEDGMENTS

This Recommendation has been created through the cooperative efforts of:

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6. **TECHNICAL REFERENCES**

6.1 Technical References

Document Number	Description	Issue Date
TR-TSY-000350	Bellcore. E9-1-1 Public Safety Answering Point: Interface Between a 1/1AESS Switch and Customer Premise Equipment	Issue 1, 1987
GR-2953-CORE	Bellcore. Enhanced MF Signaling: E9-1-1 Tandem to PSAP Interface (Intended to be used in conjunction with TR-TSY-000350)	Issue 1, March 1997
NENA-04-001	NENA. Generic Standards for E9-1-1 PSAP	Issue 1, 1996,
N/A	E9-1-1 ALI Multiplexer System (ALI/DMS) PSAP -Node Interface Specification (AT&T)	1988