



ATIS-0100034

ATIS Standard on -

**NRSC 9-1-1 CAMA TRUNK THROUGHPUT OPTIMIZATION ANALYSIS**



ATIS is the leading technical planning and standards development organization committed to the rapid development of global, market-driven standards for the information, entertainment and communications industry. More than 200 companies actively formulate standards in ATIS' Committees, covering issues including: IPTV, Cloud Services, Energy Efficiency, IP-Based and Wireless Technologies, Quality of Service, Billing and Operational Support, Emergency Services, Architectural Platforms and Emerging Networks. In addition, numerous Incubators, Focus and Exploratory Groups address evolving industry priorities including Smart Grid, Machine-to-Machine, Networked Car, IP Downloadable Security, Policy Management and Network Optimization.

ATIS is the North American Organizational Partner for the 3rd Generation Partnership Project (3GPP), a member and major U.S. contributor to the International Telecommunication Union (ITU) Radio and Telecommunications' Sectors, and a member of the Inter-American Telecommunication Commission (CITEL). ATIS is accredited by the American National Standards Institute (ANSI). For more information, please visit < <http://www.atis.org> >.

---

### **Notice of Disclaimer & Limitation of Liability**

The information provided in this document is directed solely to professionals who have the appropriate degree of experience to understand and interpret its contents in accordance with generally accepted engineering or other professional standards and applicable regulations. No recommendation as to products or vendors is made or should be implied.

NO REPRESENTATION OR WARRANTY IS MADE THAT THE INFORMATION IS TECHNICALLY ACCURATE OR SUFFICIENT OR CONFORMS TO ANY STATUTE, GOVERNMENTAL RULE OR REGULATION, AND FURTHER, NO REPRESENTATION OR WARRANTY IS MADE OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. ATIS SHALL NOT BE LIABLE, BEYOND THE AMOUNT OF ANY SUM RECEIVED IN PAYMENT BY ATIS FOR THIS DOCUMENT, WITH RESPECT TO ANY CLAIM, AND IN NO EVENT SHALL ATIS BE LIABLE FOR LOST PROFITS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES. ATIS EXPRESSLY ADVISES ANY AND ALL USE OF OR RELIANCE UPON THIS INFORMATION PROVIDED IN THIS DOCUMENT IS AT THE RISK OF THE USER.

<p>NOTE - The user's attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights. By publication of this standard, no position is taken with respect to whether use of an invention covered by patent rights will be required, and if any such use is required no position is taken regarding the validity of this claim or any patent rights in connection therewith.</p>
---

---

ATIS-0100034, *NRSC 9-1-1 CAMA Trunk Throughput Optimization Analysis*

Is an ATIS Standard developed by the **ATIS Network Reliability Steering Committee (NRSC)**.

*Published by*

**Alliance for Telecommunications Industry Solutions**  
**1200 G Street, NW, Suite 500**  
**Washington, DC 20005**

Copyright © 2011 by Alliance for Telecommunications Industry Solutions  
All rights reserved.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher. For information contact ATIS at 202.628.6380. ATIS is online at < <http://www.atis.org> >.

Printed in the United States of America.

## NRSC 9-1-1 CAMA TRUNK THROUGHPUT OPTIMIZATION ANALYSIS

**Alliance for Telecommunications Industry Solutions**

Approved November 2011

### **Abstract**

This paper addresses the Alliance for Telecommunications Industry Solutions' (ATIS) Network Reliability Steering Committee's (NRSC's) review of Centralized Automatic Message Accounting (CAMA) trunks used in some 9-1-1 configurations. As part of this review, incidents of high call volume and the current 9-1-1 architecture were reviewed. This report provides the industry with recommendations to assist in mitigating these types of incidents in the future; as well as, to maximize 9-1-1 call throughput to PSAPs during high call volume conditions.

## FOREWORD

---

The Alliance for Telecommunication Industry Solutions (ATIS) serves the public through improved understanding between providers, customers, and manufacturers. The ATIS Network Reliability Steering Committee (NRSC) was formed at the request of the first Network Reliability Council (NRC-1) to monitor network reliability. NRSC is a consensus-based industry committee that analyzes the communications industry's reporting of network outages, makes recommendations aimed at improving network reliability, distributes the results of its findings to industry, and, where applicable, refers matters to appropriate industry forums for further resolution. The NRSC also reviews regulatory developments affecting network reliability and submits consensus-developed comments on matters of common interest to NRSC members.

The mandatory requirements are designated by the word *shall* and recommendations by the word *should*. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identifiable as having distinct compatibility or performance advantages. The word *may* denotes a optional capability that could augment the standard. The standard is fully functional without the incorporation of this optional capability.

Suggestions for improvement of this document are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, NRSC, 1200 G Street NW, Suite 500, Washington, DC 20005.

### *CAMA Trunk Project Schedule*

The NRSC, during the preparation of this paper, held 21 subject matter expert or technical writing sessions bringing together industry experts in 9-1-1 Selective Router network design and network operation from no less than seven major communication providers and Telcordia. The dates of the sessions covered the period from May to August 2011. Below are the individual dates of the sessions:

- 05/19/2011, 05/26/2011, 06/02/2011, 06/09/2011, 06/14/2011, 06/16/2011, 06/21/2011, 06/23/2011, 06/28/2011, 06/30/2011, 07/05/2011, 07/07/2011, 07/12/2011, 07/14/2011, 07/19/2011, 07/21/2011, 07/26/2011, 07/27/2011, 07/28/2011, 08/02/2011, and 08/04/2011.

### *Participating Companies*

- AT&T
- CenturyLink
- Cox Communications
- T-Mobile USA
- Telcordia
- Verizon
- Verizon Wireless

## TABLE OF CONTENTS

---

ISSUE OVERVIEW .....	1
CALL FLOW OVERVIEW: 9-1-1 CALL FLOW OVER MULTI-FREQUENCY (MF) CENTRALIZED AUTOMATIC MESSAGE ACCOUNTING (CAMA) PUBLIC SAFETY ANSWERING POINT (PSAP) TRUNKS .....	2
ARCHITECTURAL REVIEW .....	3
INITIAL ANALYSIS.....	4
TECHNICAL SPECIFICATION REVIEW .....	4
TRUNK SIZING.....	5
TRUNK BUSY PERCENTAGE CONFIGURATION .....	6
Pros/Cons with ALLOWING 100% OF MEMBERS OF A TRUNK GROUP TO BE MADE BUSY BY THE NETWORK .....	6
Pros/Cons with NOT ALLOWING 100% OF MEMBERS OF A TRUNK GROUP TO BE MADE BUSY BY THE NETWORK .....	7
TRUNK OVERFLOW ROUTE.....	7
TRUNK ALARM RECOMMENDATION .....	8
ROOT CAUSE ANALYSIS.....	9
STEPS TAKEN TO PREVENT REOCCURRENCE .....	11
NRSC RECOMMENDATIONS FOR 9-1-1 SELECTIVE ROUTER SERVICE PROVIDER MITIGATION.....	11
NRSC RECOMMENDATIONS FOR CHANGES TO PSAP OPERATIONS AND SOPS.....	12
OTHER CONSIDERATIONS .....	13
CONCLUSION .....	14
REFERENCES .....	16
DEFINITIONS.....	17
TERM.....	17
DEFINITION .....	17
ABBREVIATIONS AND ACRONYMS .....	18
APPENDIX A – THE SIGNAL STATE DIAGRAM OF PSAP TRUNK.....	19
APPENDIX B – THE LADDER DIAGRAM OF A STANDARD CALL TO ACTIVE STATE .....	20
APPENDIX C – THE DISCONNECT OF A CALL, AND THE NO-WINK CONDITION .....	22
APPENDIX D – THE DISCONNECT OF A CALL BEFORE ANSWER (ABANDONED CALL, AND THE NO-WINK CONDITION).....	24
APPENDIX E – GENBAND DMS-100 E911 LOG MESSAGES.....	26
APPENDIX F - LAB TEST SUMMARY.....	27

## TABLE OF FIGURES

---

FIGURE 1: NETWORK ARCHITECTURE OVERVIEW .....	3
FIGURE 2: SR SIGNALING STATES.....	19

ATIS Standard on –

# NRSC 9-1-1 CAMA Trunk Throughput Optimization Analysis

## ISSUE OVERVIEW

---

Service Providers and the Federal Communications Commission (FCC) have observed a 9-1-1 service-affecting issue that may occur during a sustained Mass Calling Event to 9-1-1 that causes a Focused Overload of the E9-1-1 system. The NRSC will reference Telcordia Technologies' definition of a *Focused Overload*:

A focused overload is generally directed toward a particular location and may result from media stimulation (news programs, advertising, call-in contests, telethons) or events that cause mass calling to government or public-service agencies, weather bureaus, or public utilities. Without the application of appropriate network controls, the effects of these types of overloads could spread throughout the network. Focused overloads are normally managed using code controls or, if anticipated, trunk-limited or choke networks.<sup>1</sup>

For purposes of this report, *Mass Calling Events* or *Focused Overloads* will be hereafter referred to as *periods of heavy call volume to 9-1-1*.

Recently, the industry has observed some heavy call volumes that can result in *Wink Failures* of Selective Router (SR) to Public Safety Answering Point (PSAP) Centralized Automatic Message Accounting (CAMA)<sup>2</sup> trunks. These trunks transmit the caller's Automatic Number Identification (ANI) using Multi-Frequency (MF) digits based upon CAMA signaling standards. CAMA trunk technology, which was originally designed to provide a method for delivering the calling (originating) number from End Office to Toll Office, has widespread support across many platforms within the industry and has proven to be a highly reliable 9-1-1 standard. In the 9-1-1 context, the ANI digits that identify the 9-1-1 caller are relayed across the CAMA trunk to the PSAP. CAMA trunks utilize in-band signaling for call setup and, if the call setup is not successful due to a signaling failure, the SR can remove the CAMA trunk from service.

Wink Failures can occur during heavy call volume events to 9-1-1 PSAPs and result in a 9-1-1 SR removing PSAP trunks from service during call setup. These Wink Failures occur when a SR presents a new call to the PSAP over an idle trunk and the SR does not receive a supervisory OFF-HOOK Wink to signify the Customer Premise Equipment's (CPE's) ability to receive the ANI digits using MF Signaling Tones. This can happen if the time needed for the 9-1-1 CPE to both recognize an ON-HOOK condition from the SR and be ready for the next 9-1-1 call exceeds the duration of the ON-HOOK condition (i.e., from the time that a caller disconnects to when a new 9-1-1 call is sent to the CPE from the SR). In this case, if the 9-1-1 CPE does not recognize the call as a new call, then the CPE may not provide a Wink to the re-seizure of the trunk. As a result, the 9-1-1 SR would count one No-Wink condition for this trunk. During normal operation, if the 9-1-1 SR detected a No-Wink condition on a trunk, the call would

---

<sup>1</sup> Telcordia Technologies, *Telcordia Notes on the Networks* (SR-2275, Issue 4, October 2000), page 10-6.

<sup>2</sup> GR-350 requirements do not specify the use of CAMA trunks -- as an example, GENBAND SR uses Line Digital Trunks (LDT), which is not based on their CAMA software. NENA sometimes considers these as CAMA-Like or Enhanced MF trunks.