ADVANCED COMMUNICATIONS TECHNOLOGY

First Coast Guard District Traffic Model Report

repared for:

nited States Coast Guard
esearch and Development Center
dvanced Communications Technology Project

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elivery Order DTCG-39-97-F-E00178

November 1997

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1. Introduction

1.1 Purpose

The purpose of this report is to describe the methodology used in developing the First Coast Guard District (CGD1) Traffic Model and to document the potential National Distress System (NDS) voice and data traffic forecasted for the year 2001.

1.2 Background

The NDS is a network of approximately 300 remotely-controlled very high frequency (VHF) frequency modulated (FM) radios and antennas used for monitoring the maritime distress frequency (CH 16-156.8MHz) and for providing distress, safety, and United States Coast Guard (USCG) command and control (C^2) communications coverage. Currently, the USCG is researching alternative communications systems for potential use in the modernization of the NDS. A contributing factor to selecting an alternative system is the amount of traffic capacity needed. As part of this effort, a baseline model of NDS communications in the CGD1 was developed to provide a reference for forecasting potential future NDS traffic volume.

The forecasting of the future NDS traffic volume includes the consideration of data communications along with the changes to the voice traffic volume. These models provide the information for input to computer simulations using OPNET. OPNET is a network simulation tool which will provide data to support capacity requirements for different alterative equipment and communications configurations.

1.3 Scope

This report describes the CGD1 Traffic Model. Included in this report is a discussion of the model structure, the forecasting methodology, an analysis of the data, and the forecasted model.

2. Model Structure

The structure of the CGD1 NDS Traffic Model is similar to the CGD1 NDS Voice Traffic Baseline Model as described in reference (a). The model is constructed in a similar format and provides data reflecting communications in CGD1 projected to the year 2001 (four years hence from 1997).

The baseline model consisted of a series of three objects: (1) frequency, (2) duration, and (3) recipient, one series for each unit type represented in the model. The data representing the frequency and duration was presented in a series of computer files formatted for input to OPNET while the recipient data was presented in a series of histograms. There is no evidence that the probability of duration or recipient will change with the forecasted change in NDS communications. The only anticipated change will be to the probability of frequency. Therefore, the baseline frequency data was extrapolated to reflect the forecasted change. The same probabilities for duration and recipient used in the baseline model were used in the CGD1 NDS Traffic Model.

3. Forecasting Methodology

The CGD1 Voice Traffic Baseline Model was used as the foundation for developing the CGD1 NDS Traffic Model. The forecasting trends provided in the traffic model were primarily developed from the Abstract of Operations Reports (AOO) provided as government furnished information (GFI). A linear method was used to extend the 1991 through 1996 data out to the year 2001. In those instances where additional data that indicated that extrapolation of data should be other then linear, an applicable method, derived from the data, was used. Each instance that deviates from the norm is fully described in the section reporting on that data.

As discussed in the Desired Capabilities Report, a majority of CG operational personnel interviewed indicated there is limited desire for data communications in NDS. However, automatic position or user identification attached to each transmission was identified as a potential use of data communication. An assessment of the impact of this type of data attachment was inconclusive. To quantify this impact requires analysis of the alternative system architectures being considered in the NDS modernization project. We will address in the final report a projection of voice communications with a data attachment of position and location information on each transmission for terrestrial and satellite alternatives.

New data collected during the CG Operational Information Systems II (OIS II) delivery order was reviewed. The OIS II system provided for entry of information concerning operations at the source, such as, the information collected during ELT Fisheries was entered into a computer installed in a helicopter and transmitted via satellite to a database at a central location. Also, data such as position and "Ops normal" was transmitted automatically. Although there are many advantages to this type of system, the function of interest for this assessment is the transmission of data and how it impacts system capacity. There is an obvious reduction in the time required to transmit the same amount of information via data instead of voice. However, to quantify the impact requires knowledge about the system architecture. The potential data communications impact on the NDS in 2001 is not considered in this report. We will address in the final report a projection of the data communications impact. The NDS modernization project alternatives will be considered in this analysis.

One area that may have some impact but is not well defined at this time is the possibility of marine information bulletins (MIB) being issued on an "on demand" basis instead of as a broadcast. This capability is dependent on the alternative hardware configuration selected. "User pull" MIB's would have a significant impact (possible reduction in voice communications) on all three model objects: frequency, duration, and recipient. The implementation of an "on demand" MIB system could have a significant impact on recreational and commercial users of the system by requiring the purchase and installation of additional equipment. It would also be an additional expense to the USCG because of the requirement for additional equipment. Considering the lack of hardware configuration information available at this time for NDS, this issue has not been considered in this model.

The AOO and SAR information that was available during model development was centered on USCG Group Woods Hole (GWH) operations. Information about other geographic and organizational areas in CGD1 was not available; therefore, it is assumed that the GWH information is representative of all of CGD1.

4. Analysis

Provided below is a description of the methodology used for developing the CGD1 Traffic Model. Included is a discussion of the techniques involved in acquiring data on commerce fishing, and recreational boating.

4.1 Analysis Methodology

The overall approach for the projection of NDS communications to the year 2001 was accomplished by analyzing data contained in the AOO database provided as GFI. The GFI data was for fiscal years (FY) 1991 through FY 1996 for CG GWH. Partial data (first three quarters) for FY 1997 was provided but not used because it did not represent a complete year. A linear method was used to project the data for the years 1997 through 2001. A proportional change in the data was developed and used to extrapolate the frequency of communications data.

A study of other influences impacting future communications was conducted. It was determined that three areas would have significant impact: (1) commerce, (2) fishing, and (3) recreational boating. Research provided data that was used to develop projections for the change expected in these areas. This information was used to modify the projections developed from the AOO data.

4.1.1 Commerce

The approach for projecting commercial communications to the year 2001 was accomplished by analyzing data obtained from the World Wide Web (WWW) and individuals in the shipping industry. The data from the WWW was taken from the U.S. Army Corps of Engineers Waterborne Commerce Statistics site. These statistics provided data for years 1992 through 1996. A linear method was used to project the data for the years 1997 through 2001.

Individuals from the American Bureau of Shipping (ABS) provided data that reinforced that data extrapolated from the WWW. The data obtained from the ABS provided statistics for the years 1992 through 1996. A linear method was used to project the data for the years 1997 through 2001.

4.1.2 Fishing

Projecting fishing communications to the year 2001 was accomplished by analyzing data obtained from the WWW. The statistics provided for fishing were categorized by commercial fishing and recreational fishing. Data was extrapolated through both these avenues to represent fishing as it is defined by those in the industry.

The data from the WWW was obtained through the National Marine Fisheries Service economic statistics web site. These statistics provided data for the years 1992 through 1996. A linear method was used to project the data for the years 1997 through 2001. Statistics for commercial fishing were represented by dollar value and tonnage of fish caught. Statistics for recreational fishing were represented by an estimate of trips taken on the Atlantic Coast.

4.1.3 Recreational Boating

The approach for projecting recreational boating communications to the year 2001 was accomplished by analyzing data obtained from the WWW and individuals affiliated with recreational boating associations. The data from the WWW was taken from several recreational boating web sites including the National Safety Boating Campaign and Boat Owners Association of The United States (BOAT/U.S.) web sites. These statistics provided data for the years 1992 through 1996. A linear method was used to project the data for the years 1997 through 2001.

Individuals from the National Marine Manufacturers Association (NMMA) were contacted and provided data that reinforced that data extrapolated from the WWW. The data obtained from the NMMA provided statistics for the years 1992 through 1996. A linear method was used to project the data for the years 1997 through 2001.

5. Traffic Model

Provided below is an overall description of the traffic model along with the analysis of data for each unit type.

5.1 Model Description

The CGD1 Traffic Model consists of probability distributions functions, empirical data, or histograms for each of the unit types. For each unit type, functions are provided in three areas (or objects): duration of transmissions, frequency of transmissions, and the recipient of transmissions. The functions are provided for transmission on VHF-FM channel 16 and VHF-FM working channels. The frequency function is a projection from the baseline model. However, the duration and recipient functions are the same as in the baseline model. To distinguish between the computer files containing the baseline and the projected frequency functions, the name of all the files containing projected data start with a "T".

5.2 Model of Unit Types

For each unit type, information is provided in one of two forms. The duration and frequency of transmissions are represented by continuous data that are provided as empirical data formatted for use in OPNET. Due to the length of data for duration and frequency of transmission, it is provided only as a file on a disk. The recipient function is represented by discrete data that are displayed as a histogram. This histogram shows the relative frequency for each of the unit type's probability of being the recipient of a transmission from the unit type being modeled.

5.2.1 Group/Activity (GP)

The forecasted data for the Group/Activity units was accomplished by using all the categories of data that are available in the AOO data received as GFI. The use of all categories of data is relevant because Group/Activity units provide NDS communications for all phases of C^2 and distress communications. The AOO data is the only data considered for this projection.

Group	Total Of Hours From 1990-1996	1990	1991	1992	1993	1994	1995	1996
Hours	59545	7759	6654	7500	7608	10370	9595	10059

	Total Of Hours From 1997-2001	1997	1998	1999	2000	2001
Hours	59302	10742	11301	11860	12419	12978

The data for the years 1997 through 2001 is a projection based on the data for years 1990 through 1996.

5.2.1.1 Frequency Function

VHF-FM channel 16 TGPFEQ16.DAT

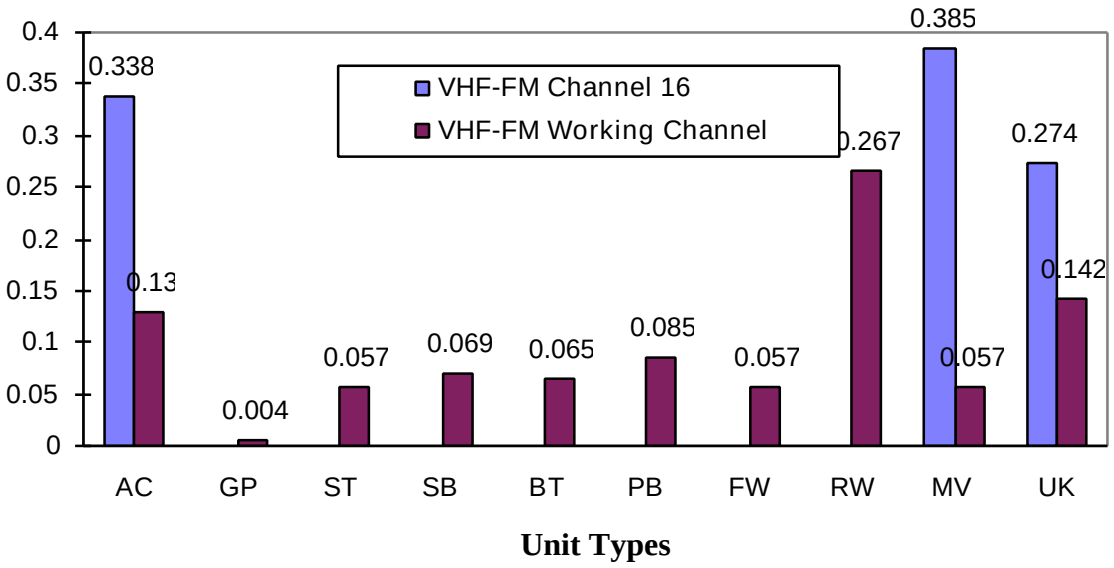
VHF-FM working channels TGPFEQWK.DAT

5.2.1.2 Duration Function

VHF-FM channel 16 GPDUR16.DAT

VHF-FM working channels GPDURWK.DAT

5.2.1.3 Recipient Function



5.2.2 Station (ST)

The forecasted data for the station unit type was accomplished by using the categories related to small boat communications of data that are available in the AOO data received as GFI. The use of small boat communications data is relevant because a significant amount of station communications is related to small boat operations. The AOO data is the only data considered for this projection.

	Total Of Hours From 1990-1996	1990	1991	1992	1993	1994	1995	1996
GWH	45268	6170	5815	6685	6991	6910	6119	6578

	Total Of Hours From 1990-1996	1997	1998	1999	2000	2001
GWH	34538	6761	6834	6908	6981	7055

The data for the years 1997 through 2001 is a projection based on the data for years 1990 through 1996.

5.2.2.1 Frequency Function

VHF-FM channel 16 TSTFEQ16.DAT

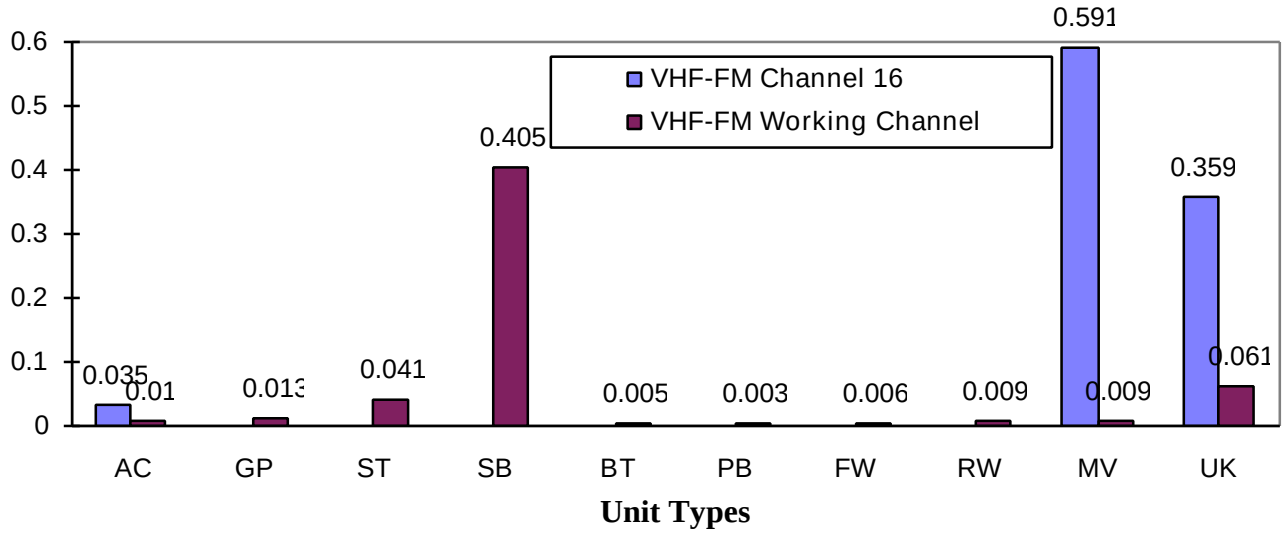
VHF-FM working channels TSTFEQWK.DAT

5.2.2.2 Duration Function

VHF-FM channel 16 STDUR16.DAT

VHF-FM working channels STDURWK.DAT

5.2.2.3 Recipient Function



5.2.3 Small Boat (SB)

The forecasted data for the small boat unit type was accomplished by using the categories related to small boat communications of data that are available in the AOO data received as GFI. The use of small boat communications data is relevant because it is the communications related to small boat operations. The AOO data is the only data considered for this projection.

	Total Of Hours From 1990-1996	1990	1991	1992	1993	1994	1995	1996
GWH	45268	6170	5815	6685	6991	6910	6119	6578

	Total Of Hours From 1990-1996	1997	1998	1999	2000	2001
GWH	34538	6761	6834	6908	6981	7055

The data for the years 1997 through 2001 is a projection based on the data for years 1990 through 1996.

5.2.3.1 Frequency Function

VHF-FM channel 16 TSBFEQ16.DAT

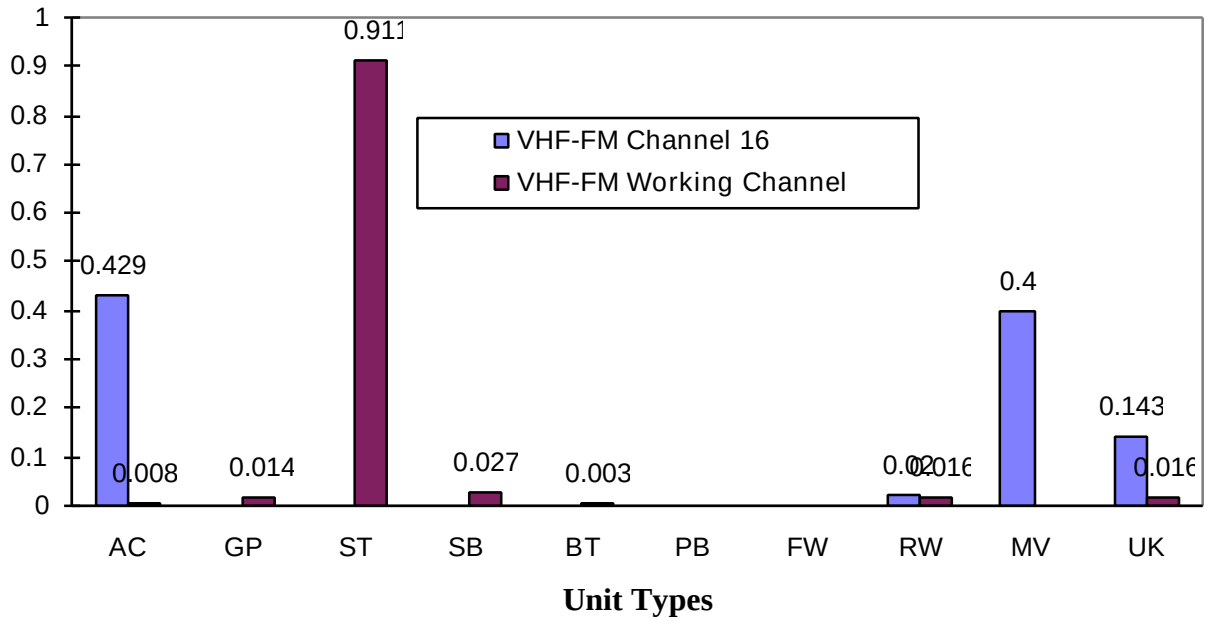
VHF-FM working channels TSBFEQWK.DAT

5.2.3.2 Duration Function

VHF-FM channel 16 SBDUR16.DAT

VHF-FM working channels SBDURWK.DAT

5.2.3.3 Recipient Function



5.2.4 Buoy Tenders (BT)

The forecasted data for the buoy tender unit type was accomplished by using all the categories of data that are available in the AOO data received as GFI. The use of all categories of data is relevant because it is the most generalized category of data and insufficient data concerning buoy tender operation is available due to the available data being concentrated about GWH operations. The AOO data is the only data considered for this projection.

Group	Total Of Hours From 1990-1996	1990	1991	1992	1993	1994	1995	1996
Hours	59545	7759	6654	7500	7608	10370	9595	10059

	Total Of Hours From 1997-2001	1997	1998	1999	2000	2001
Hours	59302	10742	11301	11860	12419	12978

The data for the years 1997 through 2001 is a projection based on the data for years 1990 through 1996.

5.2.4.1 Frequency Function

VHF-FM channel 16 TBTFEQ16.DAT

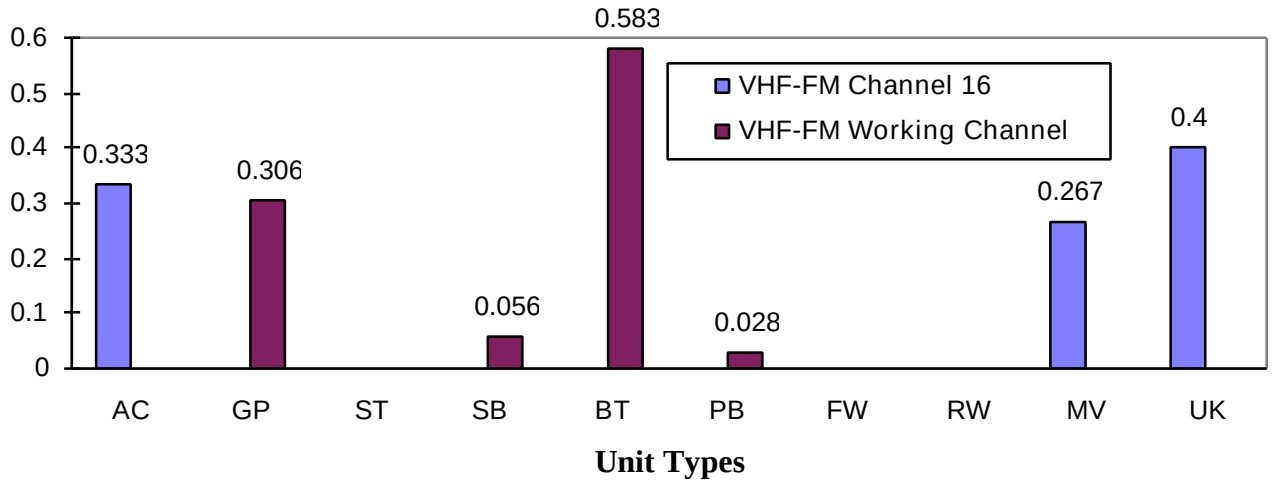
VHF-FM working channels TBTFEQWK.DAT

5.2.4.2 Duration Function

VHF-FM channel 16 BTDUR16.DAT

VHF-FM working channels BTDURWK.DAT

5.2.4.3 Recipient Function



5.2.5 Other Cutters (PB)

The forecasted data for the other cutters unit type was accomplished by using the patrol boat categories of data that are available in the AOO data received as GFI. The use of the patrol boat category of data is relevant because it is the data contains information about patrol boat C^2 and distress communications. The AOO data is the only data considered for this projection.

	Total Of Hours From 1994-1996	1994	1995	1996
GWH	7501	2581	2508	2412

	Total Of Hours From 1997-2001	1997	1998	1999	2000	2001
GWH	7501	2331	2247	2162	2078	1993

The data for the years 1997 through 2001 is a projection based on the data for years 1990 through 1996.

5.2.5.1 Frequency Function

VHF-FM channel 16 TPBFEQ16.DAT

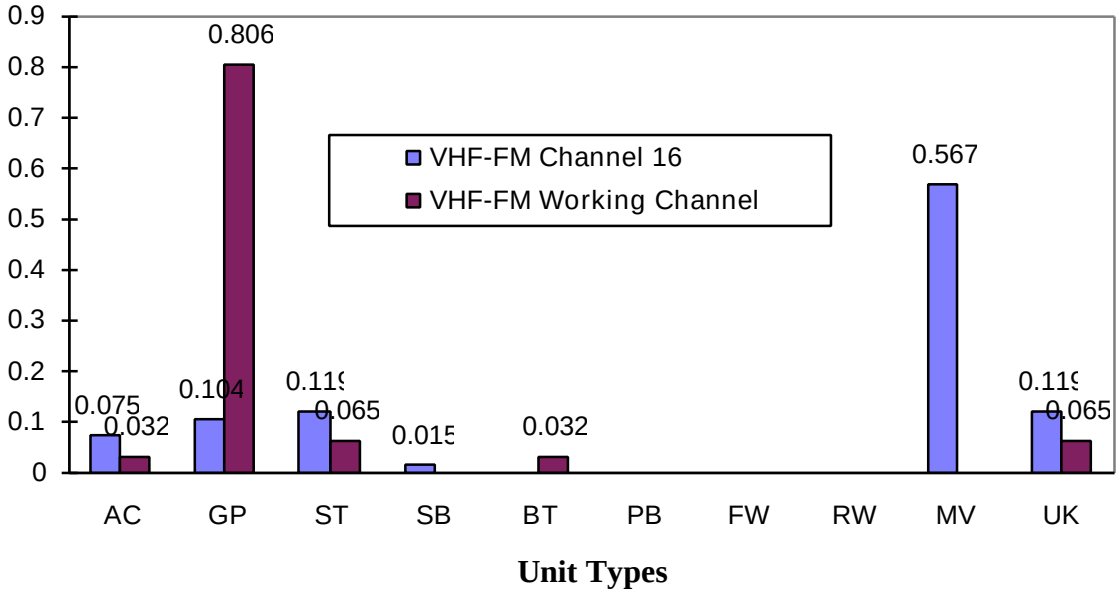
VHF-FM working channels TPBFEQWK.DAT

5.2.5.2 Duration Function

VHF-FM channel 16 PBDUR16.DAT

VHF-FM working channels PBDURWK.DAT

5.2.5.3 Recipient Function



5.2.6 Fixed-Wing Aircraft (FW)

The forecasted data for the fixed-wing aircraft unit type was accomplished by using the SAR and ELT Fisheries categories of data that are available in the AOO data received as GFI. The use of the these categories of data is relevant because the data contains information about law enforcement and distress communications. The AOO data is the only data considered for this projection.

	Total Of Hours From 1990-1996	1990	1991	1992	1993	1994	1995	1996
GWH	19095	1805	1870	1862	2020	4226	4111	3201

	Total Of Hours From 1997-2001	1997	1998	1999	2000	2001
GWH	25461	4304	4698	5092	5486	5880

The data for the years 1997 through 2001 is a projection based on the data for years 1990 through 1996.

5.2.6.1 Frequency Function

VHF-FM channel 16 Insufficient Data

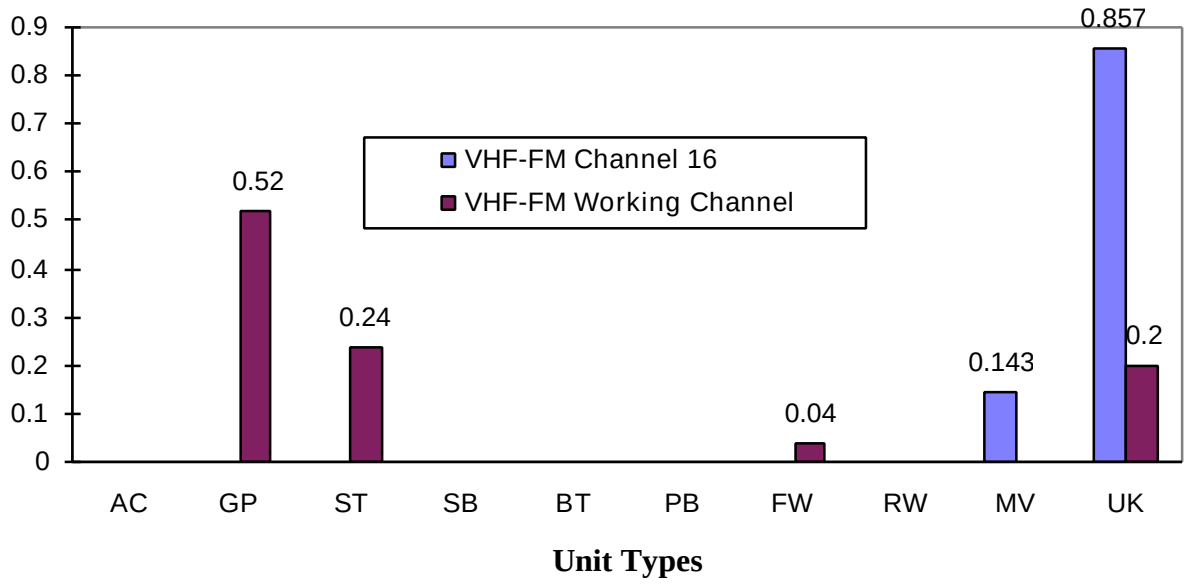
VHF-FM working channels TFWFEQWK.DAT

5.2.6.2 Duration Function

VHF-FM channel 16 Insufficient Data

VHF-FM working channels FWDURWK.DAT

5.2.6.3 Recipient Function



5.2.7 Rotary-Wing Aircraft (RW)

The forecasted data for the rotary-wing aircraft unit type was accomplished by using the SAR and ELT Fisheries categories of data that are available in the AOO data received as GFI. The use of the these categories of data is relevant because the data contains information about law enforcement and distress communications. The AOO data is the only data considered for this projection.

	Total Of Hours From 1990-1996	1990	1991	1992	1993	1994	1995	1996
GWH	19095	1805	1870	1862	2020	4226	4111	3201

	Total Of Hours From 1997-2001	1997	1998	1999	2000	2001
GWH	25461	4304	4698	5092	5486	5880

The data for the years 1997 through 2001 is a projection based on the data for years 1990 through 1996.

5.2.7.1 Frequency Function

VHF-FM channel 16 TRWFEQ16.DAT

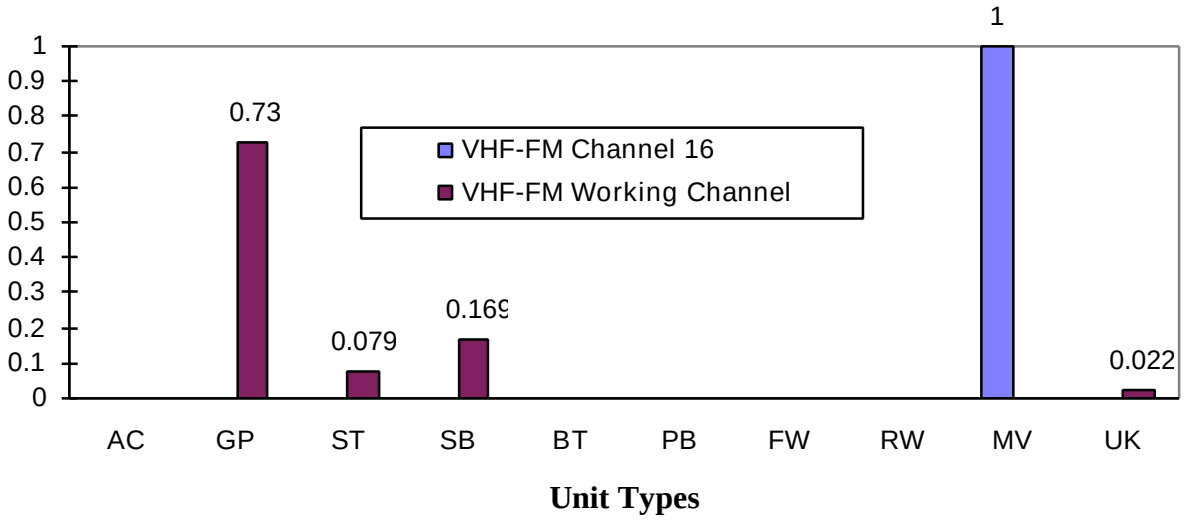
VHF-FM working channels TRWFEQWK.DAT

5.2.7.2 Duration Function

VHF-FM channel 16 RWDUR16.DAT

VHF-FM working channels RWDURWK.DAT

5.2.7.3 Recipient Function



5.2.8 Motor Vessel (MV)

The forecasted data for the motor vessel unit type was accomplished by using all of the categories of data that are available in the AOO data received as GFI and considering the impact of commerce, fishing, and recreational boating. The use of all categories of data is relevant because motor vessel unit types indulge in communications in all phases of the NDS. The following tables show the data used in this analysis.

AOO data

Group	Total Of Hours From 1990-1996	1990	1991	1992	1993	1994	1995	1996
Hours	59545	7759	6654	7500	7608	10370	9595	10059

	Total Of Hours From 1997-2001	1997	1998	1999	2000	2001
Hours	59302	10742	11301	11860	12419	12978

The data for the years 1997 through 2001 is a projection based on the data for years 1990 through 1996.

Commerce data—Domestic Waterborne Commerce Of The U.S.

	1992	1993	1994	1995	1996
Millions of Tons	1094.6	1068.2	1099	1093	1113

	1997	1998	1999	2000	2001
Millions of Tons	1112	1118.2	1124.4	1130.5	1136.7

Fishing-—Commercial Landings for New England States

	1992	1993	1994	1995	1996
Landings	488,870,446	452,868,067	449,705,051	532,569,510	477,762,305

	1997	1998	1999	2000	2001
Landings	497,600,624	503,349,140	509,097,656	514,846,172	520,594,689

Recreational boating—Boating Registration Statistics

	1992	1993	1994	1995	1996
Registered	879,420	906,406	933,392	960,378	987,364

	1997	1998	1999	2000	2001
Registered	1,014,350	1,041,336	1,068,322	1,095,308	1,122,294

5.2.8.1 Frequency Function

VHF-FM channel 16 TMVFEQ16.DAT

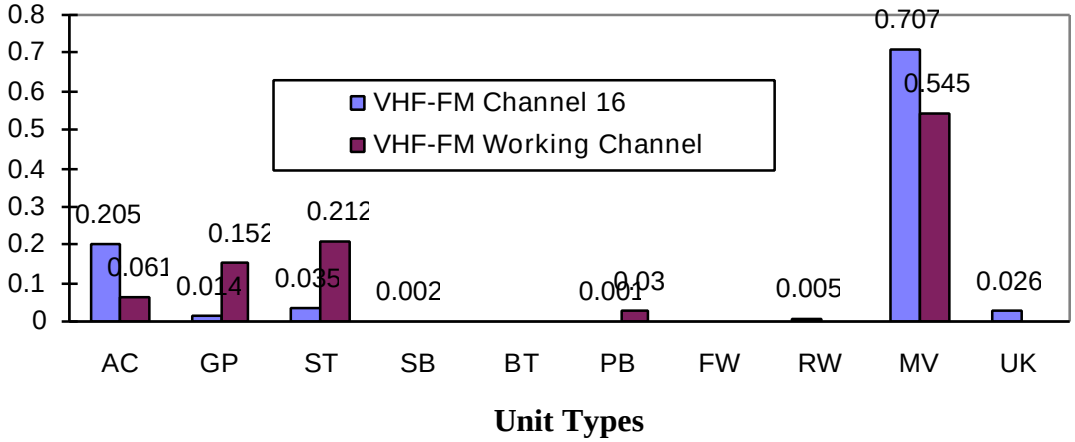
VHF-FM working channels TMVFEQWK.DAT

5.2.8.2 Duration Function

VHF-FM channel 16 MVDUR16.DAT

VHF-FM working channels MVDURWK.DAT

5.2.8.3 Recipient Function



6. Summary

The CGD1 Traffic Model was developed using the CGD1 Voice Traffic Baseline Model and data available from the AOO. Data about commerce, fishing, and recreational boating supplemented the AOO data where applicable. It is possible that additional data may become available at a future time that could significantly impact the model. The model is modular and can easily be changed to reflect new data. It is important to remember that future NDS communications capacity needs are very sensitive to the system configuration alternative selected.

Appendix A--List of Empirical Data Files

Listing of Empirical Data Files

(Disk attached)

GPDUR16.TXT

GPDURWK.DAT

TGPFEQ16.DAT

TGPFEQWK.DAT

STDUR16.DAT

STDURWK.DAT

TSTFEQ16.DAT

TSTFEQWK.DAT

SBDUR16.DAT

SBDURWK.DAT

TSBFEQ16.DAT

TSBFEQWK.DAT

BTDUR16.DAT

BTDURWK.DAT

TBTFEQ16.DAT

TBTFEQWK.DAT

PBDUR16.DAT

PBDURWK.DAT

TPBFEQ16.DAT

TPBFEQWK.DAT

FWDURWK.DAT

TFWFEQWK.DAT

RWDUR16.DAT

RWDURWK.DAT

TRWFEQ16.DAT

TRWFEQWK.DAT

MVDUR16.DAT

MVDURWK.DAT

TMVFEQ16.DAT

TMVFEQWK.DAT

Appendix B--Acronyms

Acronym	Definition
ABS	American Bureau of Shipping
AOO	Abstract of Operations
C^2	Command and control
CGD1	First Coast Guard District
CH	Channel
FM	Frequency modulation
FY	Fiscal years
GFI	Government furnished information
GWH	Group Woods Hole
MHz	Megahertz
MIB	Marine Information Broadcast
NDS	National Distress System
NMMA	National Marine Manufacturers Association
USCG	United States Coast Guard
VHF	Very high frequency
WWW	World wide web

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