



**NMFS**  
**Sustainable Fisheries**

**Interactive Voice Response System**  
**for**  
**Halibut Guided Charter Data Collection**

**Feasibility Study**

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Submitted by

Wostmann & Associates, Inc.

# TABLE OF CONTENTS

<b><u>1</u></b>	<b><u>INTRODUCTION</u></b>	<b>4</b>
1.1	PURPOSE	4
1.2	SCOPE	4
1.3	METHODOLOGY	5
1.4	DEFINITIONS, ACRONYMS, AND ABBREVIATIONS	5
1.5	REFERENCES	6
1.5.1	CONTACTS	6
1.6	EXECUTIVE SUMMARY	7
<b><u>2</u></b>	<b><u>CURRENT ENVIRONMENT</u></b>	<b>8</b>
2.1	HARDWARE & SOFTWARE INFRASTRUCTURE	8
2.1.1	COMPUTER NETWORK	8
2.1.2	PHONE SYSTEM	8
2.2	HUMAN RESOURCES	9
2.2.1	IT SUPPORT STAFF	9
2.2.1.1	Skills	9
2.2.1.2	Application Support Responsibilities	11
2.2.2	DEVELOPMENT STAFF	11
2.2.2.1	Skills	11
2.2.2.2	Application Development Responsibilities	13
2.3	APPLICATION REQUIREMENTS	13
2.3.1	PHONE LINE REQUIREMENTS	13
2.3.1.1	Call Length	13
2.3.1.2	Call Volume	14
2.3.1.3	Call Times	14
2.3.1.4	Required Ports Calculation	15
2.3.2	AVAILABILITY REQUIREMENTS	15
2.3.3	WEB APPLICATION COMPATIBILITY	15
2.3.4	GO-LIVE DATE	16
<b><u>3</u></b>	<b><u>IVR SYSTEM REQUIREMENTS</u></b>	<b>17</b>
3.1	HARDWARE & SOFTWARE	17
3.1.1	PHONE SYSTEM	17
3.1.2	COMPUTER HARDWARE & SOFTWARE	18
3.2	IVR APPLICATION DEVELOPMENT	19
3.2.1	DESIGN CONSIDERATIONS	19
3.2.2	DEVELOPMENT ENVIRONMENT CONSIDERATIONS	20
3.2.2.1	VXML	20
3.2.2.2	SALT	21
3.2.2.3	Other Languages	21
3.2.3	DEVELOPMENT TASKS	21
3.2.4	MAINTENANCE REQUIREMENTS	22

3.2.5	OTHER CONSIDERATIONS.....	23
3.2.5.1	Scalability.....	23
3.2.5.2	Availability and Disaster Recovery .....	23
3.2.5.3	Network Configuration and Security .....	23
<b>4</b>	<b><u>IVR HOSTING SERVICES.....</u></b>	<b>24</b>
<b>5</b>	<b><u>EVALUATION .....</u></b>	<b>25</b>
<b>5.1</b>	<b>OPTIONS 1 AND 2.....</b>	<b>26</b>
5.1.1	PHONE SERVICE COSTS .....	26
5.1.2	IVR HARDWARE AND SOFTWARE PLATFORM COSTS .....	28
5.1.3	IVR DEVELOPMENT SOFTWARE COSTS .....	28
5.1.4	DEVELOPMENT COSTS .....	28
5.1.5	MAINTENANCE AND SUPPORT.....	29
<b>5.2</b>	<b>OPTION 3 .....</b>	<b>30</b>
5.2.1	REQUIREMENTS AND DESIGN.....	30
5.2.2	SYSTEM DEVELOPMENT AND TESTING .....	30
5.2.3	HOSTING.....	30
5.2.4	COST ESTIMATES.....	31
5.2.4.1	Rate Estimates:.....	31
5.2.4.2	Design and Development Time.....	31
5.2.4.3	Hosting Costs .....	32
<b>5.3</b>	<b>COST COMPARISONS .....</b>	<b>32</b>
<b>6</b>	<b><u>RECOMMENDATIONS.....</u></b>	<b>33</b>
<b>6.1</b>	<b>IN-HOUSE IVR SOLUTION .....</b>	<b>33</b>
<b>6.2</b>	<b>ADDITIONAL RECOMMENDATIONS.....</b>	<b>34</b>
6.2.1	SELF-TRAINING .....	34
6.2.2	DETAILED REQUIREMENTS AND DESIGN .....	34
6.2.3	DTMF VERSUS ASR.....	34
6.2.4	TEXT-TO-SPEECH.....	35
6.2.5	HELP DESK SUPPORT .....	35
<b>7</b>	<b><u>VENDOR SURVEY.....</u></b>	<b>36</b>

# 1 Introduction

## 1.1 Purpose

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The purpose of this document is to evaluate alternatives for developing and hosting an Interactive Voice Response (IVR) system for the National Marine Fisheries Service (NMFS) located at the Juneau Federal Building. The IVR system is being considered to support the data reporting requirements of a proposed management program for the Halibut Guided Sport Charter industry as described under the "Halibut Sport Charter Data Collection Conceptual Design" report prepared by Wostmann & Associates, Inc. (WAI), and dated November, 2003.

The document summarizes the hardware and software requirements as well as the human resource skills needed to develop and maintain such a solution. It provides a synopsis of the current environment of the Alaska Regional Office (AKR) of the NMFS located in the Juneau Federal Building. It also discusses a range of alternatives for developing or out-sourcing an IVR system. The ultimate intent of the report is to document the results of the investigations and recommend a preferred alternative for the NMFS to pursue.

## 1.2 Scope

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The scope of this effort was limited to the high-level identification and evaluation of options available to NMFS for developing an IVR solution. The evaluation was based on a comparison of the requirements for each option against the current environment of the Alaska Regional Office of the NMFS in terms of:

- development and maintenance costs;
- staff time and skills;
- hardware infrastructure;
- data collection system requirements

While several vendors and service providers were evaluated and are specifically listed in the report in order to obtain a general idea of the costs and requirements of the various options, an exhaustive review of all vendors and providers is specifically beyond the scope of this effort. The goal of this report is to evaluate and recommend an approach to implementing an IVR system, but not to endorse any specific vendor or provider.

## 1.3 Methodology

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The evaluation represented by this document was performed by conducting Internet research and interviewing a number of subject matter experts including NMFS staff, sales and technical staff from the phone company (ACS) and from IVR solution providers, and developers with direct experience implementing successful IVR systems.

The research and interviews were targeted to perform the following tasks outlined in the statement of work for the project:

- Investigate the telephone and systems infrastructure at the Federal Building in Juneau in terms of its suitability for hosting an IVR system.
- Review hardware and software alternatives for IVR systems, focusing on their suitability for hosting the system described in the "Halibut Sport Charter Data Collection Conceptual Design", including both appliance-type IVR solutions as well as IVR hardware and software components.
- Identify the skills needed to develop and maintain an IVR system and how the required skills match up with current NMFS personnel skill sets.
- Identify the availability and costs of IVR service provider offerings that might be an alternative to developing and maintaining an in-house IVR system.

## 1.4 Definitions, Acronyms, and Abbreviations

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Term	Definition
ACD	Automated Call Distribution
ASR	Automatic Speech Recognition – technology that translates voice signals to text
Centrex	Central Office Exchange System - Centralized call distribution managed by the phone company
CTI	Computer Telephony Integration
DTMF	Dual Tone Multi-Frequency – Technical term for Touch Tone dialing.
FTS	Federal Toll System
IVR	Interactive Voice Response – Blanket term for automated call handling systems using either touch tone phone or voice recognition.
OA&M	Operations, Administration, and Maintenance

PBX	Private Branch Exchange
PSTN	Public Switched Telephone Network – regular old-fashioned telephone system (also POTS – Plain Old Telephone System)
SALT	Speech Application Language Tags
TTS	Text To Speech
VoIP	Voice over Internet Protocol
VUI	Voice User Interface
VXML	VoiceXML
VB	Visual Basic
W3C	World wide web consortium

## 1.5 References

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*Halibut Guided Charter Data Collection – Conceptual Design*; November 2003; Wostmann & Associates, Inc.

*Halibut Guided Charter Data Collection Survey of Data Collection Methods in other Jurisdictions*; November 2003; Wostmann & Associates, Inc.

Doug Denson, Interview, September 20, 2004

### 1.5.1 Contacts

The following people are among those contacted during the course of this project and are potentially valuable resources for continuing work on development of an IVR solution:

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## 1.6 Executive Summary

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The Alaska Regional Office of NMFS currently has a suitable telephone and computer network infrastructure to develop and host an IVR solution for data collection in the Halibut Sport Charter IFQ program. The office also employs staff with appropriate skills and IT industry experience to be able to learn, implement, and support solutions using IVR technology. The office currently has 13 analog phone lines supporting the ATM terminals used for IFQ data reporting but scheduled to be taken offline in early 2005. An IVR system for data reporting in the proposed program is estimated to require up to 8 phone lines. WAI recommends that the existing phone lines be repurposed for the IVR solution, if it is developed.

In addition to the basic telephony network, IVR systems require specialized hardware and software to connect to the phone network, interpret speech and/or touch-tone prompts, synthesize speech, or replay recorded prompts, and execute voice scripts to implement the functional behavior of the system. Modern IVR systems are designed to integrate with Internet technology for data communication.

The AKR would need to research, purchase, install, and configure IVR system hardware in order to host an IVR solution in-house. The office would also need to research and select an IVR software platform from a wide selection of available products with which to develop the solution. Many IVR servers/appliances are marketed as packaged solutions including all necessary telephony interface boards, and operating, administration, and development platform software. The AKR should select an IVR platform that supports one or both of the major XML-based standards for voice scripting, VXML and SALT. A partial survey of major vendors and products is provided at the end of this report.

Contracting with an IVR hosting service to develop and host the system initially can provide some benefits to NMFS. These benefits include elimination of risk involved in developing a new system for the first time in an unfamiliar technology as well as the elimination of the impact of added maintenance and support tasks that would otherwise be imposed on the AKR development and IT support staff. Hosting fees for an outsourced solution, however, are significant, and over time the outsourced solution would most likely be more expensive than developing and hosting the system in-house.

WAI recommends that if a decision is made to develop the IVR system for data collection that the AKR develop and host the IVR system in-house. WAI also recommends that outside contract assistance be sought for training and mentoring as well as the development of the initial system to compensate for anticipated lack of availability from existing staff due to assignments to other large, mission-critical projects.

## 2 Current Environment

### 2.1 Hardware & Software Infrastructure

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#### 2.1.1 Computer Network

The computer network and enterprise applications for the AKR offices are primarily physically hosted at the Juneau Federal Building. The site includes a professional grade server room housing roughly 20 primary servers supporting the area network and the region's databases and applications.

The network is a Windows NT network, currently undergoing conversion to Active Directory. The domain controllers as well as the file, mail, print, and other central network servers are all running Windows NT, 2000, or 2003. The application servers include a GIS mapping server running ARC MIS, ARC SD on Windows 2000, and the Region's public web site is hosted on a Windows server in IIS 5. The network also includes 4 HP-UX (11.11) servers hosting the Oracle databases (8i,9i,10G) and several public web applications for IFQ data reporting running in Enhydra.

There are no existing IVR applications or hardware components. The IFQ Landing Report application, however, includes a bank of modems that receives landing data submitted at ATM card-swipe terminals over analog phone lines.

#### 2.1.2 Phone System

For NMFS, switching of the phone network at the Juneau Federal Building is provided through a Central Office Exchange Service (Centrex) provided by ACS. ACS owns and manages all the communications equipment and performs line switching at its central office. Some of the phone lines are contracted directly through ACS, while others are contracted through GSA as part of the Federal Toll System (FTS).

There are currently 12 direct analog lines wired into the NMFS server room to support the original IFQ ATM system. These lines are grouped into 2 hunt groups, each with one 1-800 number and several local numbers associated. A hunt group consists of a number of lines that handles call dialed into the 1-800 or the primary local number. If a caller calls on either of these numbers and the line is busy, the central office automatically switches the call to the next available line in the hunt group. An additional line handles calls from a 1-888 number and a



single local number and supports the Deuce Downloader used to automatically download ATM software updates to the ATM stations.

The phone numbers are:

**Group 1**

1-800-441-6637  
586-7290  
586-7291  
586-7292  
586-7294  
586-7295  
586-7297  
586-7298  
586-7105

**Group 2**

(for Satellite phones)  
1-800-770-3880  
586-4205  
586-4206  
586-4207  
586-4208

**Deuce Downloader Line**

1-888-584-6599  
586-6599

Group 1 and the Deuce Downloader line are paid for through the FTS contract. The exact cost of these lines is unknown, but is assumed to be the same or slightly less than the cost of the ACS lines. Group 2 is contracted through ACS. The standard ACS rate is \$18.70 per line, per month.

These 13 lines were originally scheduled to be disconnected in early 2005. NMFS could elect to repurpose these lines for the proposed IVR system. Otherwise they would need to contract with ACS to install new analog lines or a fractional T1 line at development time.

## **2.2 Human Resources**

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### **2.2.1 IT Support Staff**

The Information Resources Office (IRO) is responsible for systems and network maintenance for the majority of the computer systems of the NMFS in the Juneau Federal Building and various remote offices. The network supports roughly 120 employees across several divisions.

#### *2.2.1.1 Skills*

In addition to the Director, the office staff includes five full-time staff members responsible for systems support. Their job responsibilities are roughly divided as follows:

- Help Desk (2) – Responsible for supporting the help desk, installing and configuring employee desktops, providing user support to employees, managing backups, and performing installations and upgrades of licensed applications and desktop hardware.
- Systems Administrator – Responsible for maintaining network user and group accounts, installing, configuring and maintaining enterprise and application servers in the server room, environmental monitoring in the server room, GIS hardware support, and physical network cabling and connectivity throughout the building.
- Unix/Oracle Database Administrator – Responsible for user and group account maintenance on Unix and in the Oracle databases, Oracle application support, database backups, tuning, and maintenance, email server maintenance, administering the Visual Source Safe database, and deploying and supporting all production enterprise applications.
- Web Master – Responsible for designing, developing and maintaining the content for the region's public web site, and for maintaining and supporting the web server software and hardware.

As a group, the staff has strong skills in the following areas:

- Windows NT/Active Directory administration
- Windows NT/2000/2003 Server operating system configuration and administration
- HP-UX operating system configuration and administration
- Windows and Unix scripting
- Oracle (8i/9i/10g) database administration
- ARC SDE maintenance and administration
- Physical network design and wiring
- Enterprise data backup & recovery
- Server and desktop hardware assembly and maintenance
- HTML design and development
- Web application development with Cold Fusion
- Windows IIS configuration and administration
- Enhydra multi-server configuration and administration
- jBoss application server configuration and administration

Currently none of the staff have any training or experience with IVR system development, administration, or maintenance, but the group as a whole has the

technical skills and industry experience to be easily trained in IVR system maintenance requirements.

### *2.2.1.2 Application Support Responsibilities*

In addition to providing network administration and supporting desktop installations for approximately 120 employees, the IRO currently supports the production installations of a number of enterprise applications in the following areas:

- GIS mapping services
- Oracle databases and associated user applications for Permitting and Catch Accounting
- Enhydra web applications for IFQ data reporting
- File Receipt Handling and Data Import for Electronic Reporting

None of these applications currently enjoy guaranteed 24/7 availability. The office reserves midnight until 6:00 a.m. every day for maintenance activities during which time any of the systems may be down.

## **2.2.2 Development Staff**

The Alaska Regional Office of the NMFS consists of two divisions responsible for fisheries management in the region: Restricted Access Management (RAM) and Sustainable Fisheries (SF). Responsibility for the development of an IVR system for the Halibut sport charter data collection effort would fall primarily to the RAM division. Developer resources, however, are sometimes shared between the two divisions.

The RAM division staff includes 4 full-time analyst/programmer positions, currently fully staffed. The SF division staff includes 4 full-time analyst/programmer positions, of which 3 are staffed at the time of this writing.

### *2.2.2.1 Skills*

Development responsibilities at the time of this writing are currently roughly divided as follows:

**RAM AP #1 (Toni Fratzke)** – System administrator for the IFQ and CDQ Halibut data reporting systems. Supports the existing Oracle database applications for IFQ catch accounting. Heavily involved in the design and development of new systems to support the crab rationalization initiative.

**RAM AP #2 (Mukya)** – Supports existing Oracle database applications for the FFP, FPP, and LLP permitting programs. Also involved with design and development activities to support crab rationalization.

**RAM AP #3 (Tamara)** – Supports the Java/Enhydra web applications for IFQ data reporting. Also involved with design and development activities to support crab rationalization, as well as the inter-agency electronic reporting project.

**RAM AP #4 (Robin)** – Provides Oracle Reports development support for existing database applications. Also involved with crab rationalization.

**SF AP #1 (previously Tom Fletcher)** – Currently not staffed

**SF AP #2 (Steve Kocsis)** – Maintains the in-season electronic reporting system, particularly monitoring transmission file receipts and return receipt processing. Also assists in catch accounting system development and support.

**SF AP #3 (Joan Thompson)** – Develops and maintains in-season catch accounting systems primarily developed using Oracle Forms & Reports.

**SF AP #4 (Pam Mason)** – Develops and maintains in-season catch accounting systems, particularly the CDQ program, primarily developed in Oracle Forms & Reports.

As a group, the development staff across the two divisions has strong skills in the following technologies:

- Oracle relational database design and development, including Oracle Designer, Oracle Forms & Reports, SQL Plus, SQL Navigator, SQL Loader, and other Oracle development tools
- Web application development with Enhydra and XMLC
- Java
- Perl
- Windows and Unix scripting
- HTML
- XML

None of the development staff currently have any training or experience with IVR system development, administration, or maintenance, but the group as a whole has the technical skills and industry experience to be easily trained in IVR system design and development.

### 2.2.2.2 *Application Development Responsibilities*

There are currently two major development initiatives underway that affect the availability of both the RAM and SF development staff:

- Crab Rationalization
- Inter-agency Electronic Reporting

The Crab Rationalization project is a full-featured permit and landings system, including major functions of account management, annual issuance of numerous permits, in-season quota transfers, cap monitoring, and management of a complex interagency landings reporting system which includes instant messaging to Enforcement personnel. The Inter-agency Electronic Reporting project concerns the development of systems supporting the electronic reporting of fish ticket information to a centralized database shared by NMFS, ADF&G, and the PSMFC. The projects overlap in that the Inter-agency Electronic Reporting system is expected to be used to report data from crab fisherman participating in the Crab IFQ program.

All developers from both programs are currently fully utilized maintaining existing systems and participating in one or both of the above initiatives. It is anticipated that all in-house developers will remain fully booked *at least* until August, 2005 when the Crab IFQ program is scheduled to begin operation. It is likely that all developers will remain highly utilized beyond that date maintaining and enhancing both systems.

## **2.3 Application Requirements**

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### **2.3.1 Phone Line Requirements**

In order to estimate the total number of phone lines (ports) required to support the envisioned IVR system, estimates for average length of call, anticipated call volume, and peak call times need to be established.

#### *2.3.1.1 Call Length*

The IVR system described in the conceptual design document would provide 5 basic functions:

- Submit Landing Report
- Review Landing Report
- Check IFQ Balance

- Check-in/Check-out
- Report No-fishing Day

It is acknowledged in the conceptual design that the IVR system might be cumbersome for reporting large amounts of data such as a landing report for a multi-day trip with many fishermen. On the other hand, it would be convenient for short communications, such as checking in or out, or checking an IFQ balance.

The conceptual design provides sketches of sample scripts for reporting daily catch information. These scripts would need to be filled out and rehearsed in order to obtain accurate estimates of the average length of call. For the purposes of this report, we roughly estimate that the Check-in, Check-out, Check IFQ Balance, and Reporting No Fishing Day conversations will take one minute or less on average. We estimate that the Submit Landing Report and Review Landing Report functions will take between 3 – 5 minutes on average.

### *2.3.1.2 Call Volume*

The ADF&G Saltwater Vessel Logbook program currently issues about 1500 logbooks each year. The operators currently required to participate in the Saltwater Vessel Logbook Program are assumed to include most of the operators who would be required to report under the Halibut Sport Charter Data Collection program. Not all operators required to maintain Saltwater Vessel Logbooks are active every week, however, and not all operators are fishing for Halibut. During the peak of the season, approximately 1100 logbook forms are received and processed each week by the ADF&G.

Based on these statistics, we estimate that the maximum initial user base of the IVR component of the Halibut Sport Charter data collection system described in the conceptual design document would be approximately 1100 users. For the purpose of estimating the total number of phone lines required, we assume that half of the total potential user base (550) will choose to use the IVR system over the web-based system.

### *2.3.1.3 Call Times*

The program is seasonal. Halibut Sport Charter businesses operate between May and September. So, the IVR system would only need to be supported during this time period.

Although operators doing multiple trips may report multiple times throughout the day, we assume that the peak times for data reporting would most likely be at the end of the fishing day, anywhere between 5:00 – 10:00 p.m. (5-hour window).

### 2.3.1.4 Required Ports Calculation

A formula now known as "Erlang's Formula" is commonly used to calculate the number of ports or phone lines required to support an IVR system. The formula was developed by A.K. Erlang during the study of telephone networks in 1917. The math is beyond the scope of this report. We used a free web tool at [http://www.vocomosoft.com/port\\_calculator.htm](http://www.vocomosoft.com/port_calculator.htm) to apply Erlang's formula to calculate the number of ports required using the estimates derived in the above sections.

Average Duration of Call:	3 minutes
Number of Calls during Peak Hour:	110 (550 users/5 hours)
% of Calls Receiving Busy Signal at Peak Time:	10%
<b>Ports Required:</b>	<b>8</b>

This calculation is based on the hypothetical estimates described in the previous sections. Based on anecdotal information from developers of IVR systems for larger user communities, the above estimate may turn out to be higher than actually necessary when the system is developed. The existing IFQ Landing Report ATM system serves a larger group of fishermen, but has shorter call lengths than can be expected from the envisioned IVR system. It uses 12 lines, but activity logs show that many of the lines are unused most or all of the time.

### 2.3.2 Availability Requirements

An important motivation for considering IVR for data reporting is to provide increased availability to a larger segment of users required to report catch data. Those benefiting from this increased availability includes fishermen at sea who may have cell phone coverage but not web access. Having increased availability means being able to report during off-hours. While guaranteed 24/7 service is not mission critical, maximum possible uptime is desirable.

The IVR system will also need to be available to sport charter operators around the State. A toll-free number should be provided for callers from outside of the local area.

### 2.3.3 Web Application Compatibility

The conceptual design of the data collection system specifies a parallel web application providing the identical set of data reporting and querying functions. Both the web application and the IVR system would access the same back-end

database. Wherever possible, the system design for both systems should share common application code and hardware to minimize initial development costs as well as ongoing production and maintenance costs.

#### **2.3.4 Go-live Date**

The regulations outlining the data collection program are currently expected to be finalized in time for data collection in the Halibut Sport Charter fishery to begin during the 2006 fishing season. In order to be ready to begin the data collection program using the proposed IVR system, development of the system would need to begin in time for the system to be operational by January, 2006. The proposed IVR system, however, does not have a hard deadline for implementation. The data collection program could begin initially using only a web application for data collection, and an IVR system could be added later. While all database and web development to support the web application must be complete by January, 2006; production deployment of an IVR system could realistically be postponed until May, 2006 when the bulk of sport charter fishing for the year begins.



## 3 IVR System Requirements

The following diagram illustrates a typical, enterprise IVR system architecture:

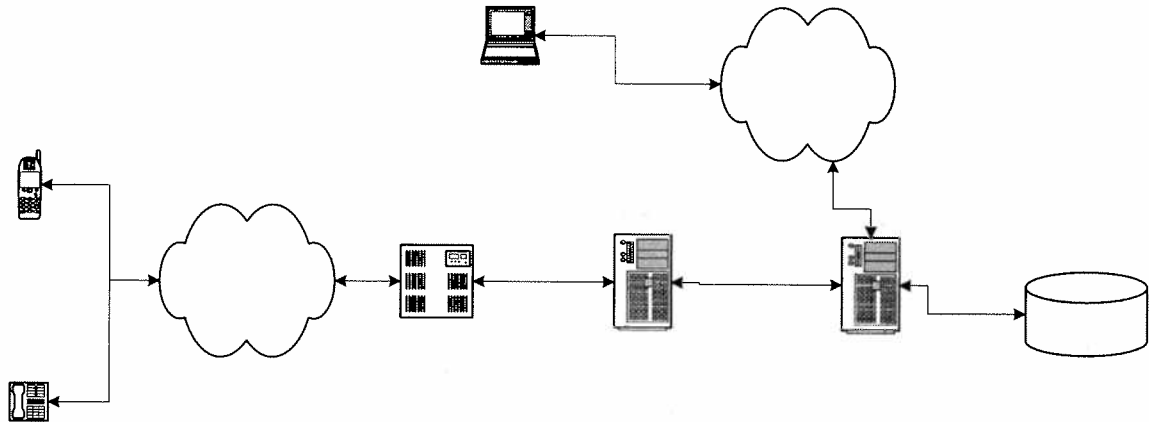


Figure 1 - IVR System Architecture

In a typical scenario, calls are routed through the telephony network to an IVR server/appliance connected to the enterprise's phone switch. Then depending on the number dialed (or spoken voice response), the IVR software running on the IVR server/appliance prepares and sends a request to the application server. The application server processes the request according to a voice script and returns content to the IVR server/appliance, in the same way that a web application processes HTTP requests and returns HTML content to a web browser. The IVR server then executes a recorded prompt or synthesizes a voice response from the returned content and plays it back to the caller.

### 3.1 Hardware & Software

PSTN

#### 3.1.1 Phone System

ACD/PBX

Of course the basic prerequisite for an IVR solution is phone service and connectivity to the external telephone network. In an enterprise environment, the external phone lines are connected to a call routing switch (i.e., Automated Call Distribution (ACD)/Private Branch Exchange (PBX)) that manages the routing of calls between the internal phone network and external phone lines. With regards to phone service, an IVR system requires:

- Telephone service on one or more dedicated, external phone lines
- Connectivity to the external phone lines, often through the internal ACD/PBX switch.

Because the Juneau Federal Building phone network uses a Centrex system managed by ACS, rather than a local ACD/PBX, the proposed IVR solution would require the wiring of dedicated lines from ACS to support the system.

Selection of an easy-to-remember local phone number as well as whether to purchase additional toll-free phone number(s) for remote callers are important considerations when establishing phone service for an IVR solution.

### 3.1.2 Computer Hardware & Software

In addition to the basic telephony network, IVR systems are comprised of the following specialized hardware and software components:

- **Telephony board** - connects the IVR server/appliance to the phone system; commonly features embedded speech processing technology
- **IVR server software** – interacts with the caller and the application server through the interpretation of voice scripts, analogous to web server software
- **Automatic Speech Recognition (ASR) software** – supports the IVR server software by interpreting spoken responses
- **Text-to-speech (TTS) software** – synthesizes speech based on scripted input
- **Operations, administration, and maintenance (OA&M) software** – provides user interfaces to system administrators for configuring, monitoring and tuning the IVR server software
- **Voice script development environment** – programmer’s tool for creating IVR applications

Important considerations in purchasing and configuring an IVR solution include whether to connect the telephony hardware in the IVR server directly to external phone lines or to internal lines through the ACD/PBX. *(In the Juneau Federal Building environment, the connection will be made directly to external phone lines with switching handled by ACS.)* Another important consideration is the number of lines required. Up to 4 ports (distinct phone lines) can be connected to the IVR server through a standard phone cable. A T1 line will support up to 24 ports and requires a different type of cable and connector, and corresponding telephony board.

Most vendors market packaged solutions containing all of the above components pre-configured in a single IVR server/appliance. In addition, modern

phone switching technology often includes IVR features embedded directly in the switch. IVR capabilities included in phone switching hardware are typically based on proprietary scripting environments and are generally less flexible for application development than IVR packaged solutions.

Chapter 7 contains a survey of a number of vendor packages, their feature lists and associated prices. As illustrated by the above discussion, in addition to capacity and price, the existing telephony network environment of the enterprise must be taken into consideration when evaluating an IVR packaged solution.

## **3.2 IVR Application Development**

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This section describes the significant design issues and activities that should be carefully considered and planned for implementing an IVR solution.

### **3.2.1 Design Considerations**

Designing a Voice User Interface (VUI) is a science and art just like Graphical User Interface (GUI) design is for the web. In order to design a successful interface, expertise needs to be developed in the concepts of VUI design. VUI design is considerably different than GUI design and requires a different set of skills.

For example, a general rule of thumb of VUI design is that a phone navigation tree should never be more than 5 levels deep. The target user audience and specific service being provided by the system should be carefully considered at design time and used to determine the types of prompts that will be most easily followed. Attention should also be given to the actual voice that will be used to develop recorded prompts. Whether the voice is male, female, computerized, or has an accent of one sort or another, as well as the specific vocabulary used all have a large impact on the usability of the system and on users' perceptions of the company/agency itself.

The IVR industry is over 20 years old and specialized fields of study and consulting expertise have emerged relating to its associated skill sets. In addition to technical fields such as Speech Recognition and Computational Linguistics, fields such as Sociology and Psychology steer the field of IVR system design in important ways. Large companies whose bottom line depends significantly on the success of their call centers will invest significant time and effort using specialists to evaluate their user audience and brand the voices for the system to reflect the image of the company they wish to portray.

On the other hand, the State of Alaska (SOA) developed the following IVR systems using entirely internal resources with just basic training in technical skills required for IVR system development.

- DMV Registration Renewal System
- Department of Elections Voting Location Service
- CSED Child Support Check Status Service

The SOA developers used internal resources to record voice prompts. They found that using the same voice for all prompts was important. They also found that voice recognition features contributed to user frustration because of poor success rates in recognizing users' voice responses. Voice recognition was subsequently disabled in these applications.

### **3.2.2 Development Environment Considerations**

Traditional IVR solutions are often tightly coupled with phone switching hardware and use proprietary scripting languages. Developing solutions using these technologies requires specialized contractors trained in the development environment or expensive training to learn the environment. Since training in these specific languages is not wide-spread, ongoing maintenance can be difficult and result in dependence on specific people or vendors.

Two standards for voice system development have emerged fairly recently that mitigate the problems associated with proprietary scripting languages. One is VoiceXML (VXML), and the other is Speech Application Language Tags (SALT). In addition, some vendors provide IVR scripting environments using familiar scripting languages such as VB.

#### **3.2.2.1 VXML**

Voice Extensible Markup Language (VXML) is a markup language designed for creating audio dialogs that feature synthesized speech, digitized audio, recognition of spoken and DTMF key input, and recording of spoken input. It is a mature standard a few years older than SALT. A draft of the standard was originally submitted to the World Wide Web Consortium (W3C) in August 1999. Version 2.0 was approved in March, 2004 (<http://www.w3.org/TR/voicexml20/>).

The key benefit of both VXML and SALT is that developers with experience in XML can develop voice applications without specialized training in proprietary IVR scripting languages. Development experience using XML is now wide-spread throughout the industry.

VXML also shields application developers from low-level, platform-specific details. It is designed to support the separation of voice interface logic from the back-end business logic and database interaction. This in turn makes it possible for a single code base of application logic to support multiple user interface applications including both voice and web applications.

### 3.2.2.2 SALT

SALT is also a speech interface markup language. It consists of a small set of XML elements with associated attributes and Document Object Model (DOM) object properties events and methods, which apply a speech interface to web pages. It can be used to develop voice-only applications (IVR) or multi-modal applications for the web or other devices such as wireless PDAs.

SALT was developed by an industry consortium, called the SALT Forum, (<http://www.saltforum.org>) founded by Microsoft, Cisco, Comverse, Intel, Philips, and ScanSoft. The current version of the specification is 1.0, which was submitted to the W3C as a proposed standard in July, 2002.

While SALT is a generic standard, it is particularly suited to developers using Microsoft development tools. A number of vendors have developed speech browsers based on SALT that can be used in combination with Microsoft's .NET Speech SDK and Visual Studio .NET to develop IVR solutions.

Both SALT and VXML appear to be well-adopted standards in the industry. Both can be used to develop voice-only telephony applications, where SALT is particularly targeted towards multi-modal application development. Voice development environments from most of the major vendors support both VXML and SALT.

### 3.2.2.3 *Other Languages*

Some IVR solution vendors provide development environments that support script developing using other non-proprietary scripting languages such java or Visual Basic (VB). The SOA chose Visual Voice to develop their IVR solutions. This product supported voice scripting in VB. Visual Voice was selected by the SOA primarily because of its low cost. The product appears to be no longer supported.

## 3.2.3 Development Tasks

The design and development tasks for an IVR system are similar to those for any enterprise software development project. They include Requirements Analysis, System Design, Environment Configuration, Development, Testing, and Deployment. If the system is to be developed with in-house resources, an allowance for Developer Training should be made to precede other activities.

Because the proposed IVR solution will be accompanied by a parallel web application, the requirements and design phases for both applications should be combined to insure a system design that properly supports both applications from a common database and minimizes duplication of code.

Designing and rehearsing the voice prompts and choosing the voice and vocabulary for the prompts are design activities unique to IVR system development. These are commonly implemented through multiple iterations of Piloting, Testing, and Tuning the scripts.

Another activity that should be considered when developing a project plan is Launch Planning. Launch planning includes a period to build user awareness of the new system, set expectations, and promote usage. This can be combined with the pilot iterations described above by getting potential users involved in testing beta versions of the application.

### **3.2.4 Maintenance Requirements**

Once an IVR system reaches production, the primary support requirement is to insure the system stays up and running. Some type of alarm software should be installed to notify system administrators if the IVR servers go down or become hung. In addition, a process should be in place so that callers can notify help staff who can in turn notify IT support staff when the system is inaccessible.

In addition to insuring that the system is up and running, it is important for the support staff to monitor its performance, which means tracking the following types of information:

- number of calls (per day, week, month, etc.)
- peak volumes and times during the day and over the year
- call lengths (shortest, longest, average, standard deviation)
- percent of time all lines are busy
- number of incomplete vs. successful calls

This information is critical to tuning the system performance based on real time usage. Good IVR packages include OA&M software to monitor and administer the system and generate reports with this type of information. The feedback from these reports can be used to determine if more or fewer phone lines are needed to support current traffic, to accurately plan for future scaling requirements, or to determine if design or script changes need to be made to lower the rate of unsuccessful calls.

As with any IT system, the support staff must be adequately trained in the operation and maintenance of the system. A critical tool for ongoing maintenance is good technical documentation. Whether the system is developed in-house or contracted out, thorough documentation of the following information should be provided to the IT support staff who will maintain the system:

- Hardware & software specifications and configuration instructions
- Development Environment setup guide
- Application-specific deployment and configuration instructions and scripts
- Application software specifications
- Maintenance task descriptions and instructions
- Troubleshooting guide
- User's Guide

### **3.2.5 Other Considerations**

#### *3.2.5.1 Scalability*

The IVR server and phone network should have the ability to add ports quickly and easily if necessary to support increased traffic without system re-design. Likewise, server memory (RAM) and disk space (ROM) should be easily expandable.

#### *3.2.5.2 Availability and Disaster Recovery*

Storage redundancy (e.g., RAID) should be considered to minimize downtime due to disk failure. Careful consideration, balancing availability requirements with cost, should be given to architecture decisions affecting disaster recovery such as whether to purchase and configure clustered servers or a redundant server as a warm standby. Regardless of whether one or multiple servers are configured, a backup and recovery plan should be developed and documented before production deployment.

#### *3.2.5.3 Network Configuration and Security*

Careful consideration should be given to the security requirements of the application. A multi-tier design separating VUI and GUI logic on one machine outside a firewall from application logic and database access on another machine inside the network provides a layer of isolation between callers and the enterprise's internal network and data.

## 4 IVR Hosting Services

Contracting through an IVR hosting service may provide an alternative to developing and hosting the IVR solution in-house. IVR hosting service providers can provide fully hosted solutions and associated maintenance and support services. They may offer end-to-end consulting services to completely design and develop the scripts and associated server-side functionality of the system. Alternatively they may provide limited support during a joint effort to develop the scripts and back-end logic.

An obvious benefit of outsourcing the development and hosting of the IVR system to an IVR service provider is that the system quality, performance and availability is likely to be superior to what NMFS will be able to provide, at least initially, simply due to the differences in existing infrastructure and technical experience between NMFS and the IVR service provider. Outsourcing the system support also removes the responsibility and associated cost for maintaining and providing technical support for the system from NMFS IT support staff. Using an IVR service provider can also be an effective mechanism for handling the fact that the actual expected call volume is currently unknown. Outsourcing the solution initially, with the intention of bringing the system in-house later, can be a good way of identifying the actual call volumes so that planning for the configuration of an in-house infrastructure can be done more precisely.

The significant downside of outsourcing the solution is cost. Over time, the hosted solution will most likely be more expensive to host and maintain than an in-house solution. Developing and hosting the system in-house will also provide NMFS with more flexibility to perform enhancements as experience with the system grows or needs change without necessarily having to contract with the provider to perform the updates.

The most likely scenario for outsourcing the system development to an IVR service provider given the requirements of the proposed data collection system would be for the service provider to implement and host the telephony portion of the IVR system. NMFS staff or contractors, however, would still be responsible for doing the bulk of the design work to insure compatibility with the web application and for developing the back-end database interaction to support both the web application and the IVR solution. This work constitutes a significant portion of the overall development effort required to get the solution up and running. The IVR solution would communicate with the NMFS database over the Internet through an HTTP or SOAP web service interface layer.



## 5 Evaluation

In the commercial environment, the primary business benefits of an IVR system typically fall under one of the following categories:

- Handling high transaction (call) volumes or volume spikes
- Automatic handling of calls that have low value to the company (e.g. "what's your mailing address")
- Off-hour service
- 24x7 operation
- Providing remote access or caller verification
- Supporting entry of information not easily manipulated by keypad

None of these categories is particularly applicable to NMFS with regard to the Halibut Sport Charter data collection program. The primary benefit of an IVR system for the Halibut Sport Charter data collection program is that it would provide an alternative to the web for data reporting when Internet access is unavailable, (i.e. when fishing at sea, or for operators without Internet access) or for users who prefer using the phone over the Internet. This solution provides a benefit to the fishermen (data reporters) and in turn may improve the timeliness and quality of the data reported. It will, however, also increase the overall cost of development and maintenance of the data reporting system for the agency. Both NMFS, and the Halibut Sport Charter Industry who will ultimately bear the cost of the program, should determine whether the projected cost of the program is justified by the anticipated benefits.

In addition to considering cost versus benefits for implementing the system in the first place, there are several other factors to consider when evaluating an approach for NMFS to implement an IVR solution.

- **Outsourcing Constraints** – The RAM division is wary of outsourcing hosting and support of a production system because the annual budget process does not guarantee that the support contract will receive continued funding in any given year. (However, funding for system hosting might be obtained through cost recovery provisions of the Magnuson-Stevens Act)
- **Timing and Resource Availability** – In-house development resources are fully allocated at least until mid-2005. This issue must be weighed against the target timeframe for development of the IVR system.

- **Support Requirements** – Requirements for on-going support of the application must be aligned with available in-house or contracted resources.

There are various options regarding use of out-sourced versus in-house resources for development, hosting, and support of the proposed IVR system. The following three options outline the most likely possibilities given the current environment:

- **Option 1** – Develop and host the IVR system in-house using in-house resources. Provide help call support for system users through the IRO help desk staff.
- **Option 2** – Purchase and configure the hardware and phone lines to host the system in-house. Hire a contractor to design and develop the IVR solution for the NMFS environment. Train in-house developers and IT support staff to maintain the system. Provide help call support for system users through the IRO help desk staff.
- **Option 3** – Contract out the development, hosting, and technical support for the system to an IVR hosting service.

## 5.1 Options 1 and 2

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The difference between options 1 and 2 is whether the original development of the system is performed by in-house resources or contractors. The main incentive for contracting the work out is the current lack of available in-house resources due to allocation to other projects. Since both Options 1 and 2 involve hosting the IVR solution at the Federal Building, the telephone and hardware considerations and costs are the same.

### 5.1.1 Phone Service Costs

The IVR system will require 8 phone lines to begin with. These could be either analog lines or digital lines over a fractional T1 line. There are some technical differences between analog lines and digital lines at development time, but either will suit the needs of the Halibut data collection system. In general, digital lines provide clearer service with less noise and therefore better performance interpreting spoken input. If more than 8 lines are ever required for the system, digital lines will be easier to scale up and will be more cost effective over the long term. Analog lines on the other hand are typically simpler to set-up for first-time IVR developers.

If analog lines are used, the logical choice would be to re-use the analog lines currently being used for the IFQ ATM system to be taken off-line in January, 2005. NMFS would need to pay to place these lines “on vacation” between January

and the time that the IVR system development begins. The main disadvantage of this option is that adding new lines, if necessary, would require wiring a new connection from the phone company into the server room, paying corresponding service wiring and one-time service order fees, and purchasing an additional telephony board to accommodate the new line.

The following tables provide cost summary estimates for both analog and digital options. Price estimates were obtained from an ACS sales representative at the time of this writing.

<b>Re-use 8 existing analog lines</b>	<b>Cost</b>	<b>Notes</b>
Annual service fees	\$1,795.20	\$18.70/month/line - 12 months
6 month "vacation" fees	\$448.80	\$9.35/month/line - 6 months
Total first year	\$1,346.40	
Total three years	<b>\$4,936.80</b>	

If digital lines are used, ACS would need to be contracted to wire a fractional T1 line into the server room initially supporting 8 channels or ports. The main advantage of this option is that additional lines (up to 24) could easily be added by simply increasing the available channels on the existing line. No new wiring or hardware would be required.

<b>Fractional T1 - 8 initial lines</b>	<b>Cost</b>	<b>Notes</b>
T1 Installation	\$650	One-time wiring fee: \$125 x 2 (each end) + \$400 service initiation fee
Channel initiation	\$1,162	\$842 initial service order fee + \$40 per channel
Annual T1 fees	\$3,000	\$250/month
Annual 8 channels	\$1,464.96	\$15.26/month/channel
Total first year	\$6,276.96	
Total three years	<b>\$15,206.88</b>	
To add more:	\$239/line	\$199 service order fee + \$40/channel

In general, digital lines offer a discount for quantity because they are cheaper per line to support (\$18.70/month for analog vs. \$15.26/month for digital) but have significant installation and recurring T1 line fees. The IVR system would need to utilize a significant proportion of the T1 bandwidth (up to 24 lines) over a long

period of time before a cost savings over using the existing analog lines would be realized.

### **5.1.2 IVR Hardware and Software Platform Costs**

The ideal architecture for the IVR system is a two-server solution with all business logic and database access centralized on an internal application server and the telephony hardware and DTMF/voice handling software configured on a specialized external IVR server. Since the application server will be required in any case for the web application, this is not considered in the net additional hardware required to support IVR.

Many IVR servers/appliances come pre-configured with all required telephony boards and IVR operating system software. The costs for these servers are comparable to those for other specialized servers, such as web or database servers. Depending on the options selected for number of phone lines, processors, processor speed, software configuration, and storage, these can range from **\$10,000 - \$20,000** (see the Vendor Survey).

### **5.1.3 IVR Development Software Costs**

Many IVR servers, in addition to coming configured with all necessary hardware and operating system software, come with pre-installed development software. There are, however, some high-end development environments sold separately that are worth considering (see the Vendor Survey). The choice of environment will depend on the chosen operating system platform (i.e., Unix vs. Windows) and voice scripting language (i.e. VXML vs. SALT).

### **5.1.4 Development Costs**

The development costs depend on whether option 1 (in-house) or option 2 (contracted) is considered. The requirements for the IVR system are not sufficiently detailed to provide an exact cost estimate. The following table itemizes the major tasks/phases to be considered and provides some ranges of estimates based on anecdotal feedback from SOA IVR developers and WAI experience with software development projects of similar scope. The hourly ranges may be considered for planning for in-house development. Those hourly estimates are multiplied by an average rate of \$100/hour to provide an estimate of cost to contract the effort out. The estimates below do not include time for Launch Planning which is an important activity that should be undertaken by NMFS staff regardless of whether the development is done in-house or contracted out.

<b>Task/Phase</b>	<b>Person Hours</b>	<b>Cost Range</b>	<b>Notes</b>
Training Time	80-120	8000-12000	2-3 people – 1 week
Class Fees	-	10000-15000	5K per person
Requirements	40-80	4000-8000	2 people, 1- 2 weeks, ½ time
Detailed Design	40-80	4000-8000	2 people, 1- 2 weeks, ½ time
Hardware config - development environment setup	20-40	2000-4000	1 person, ½-1 week
Development	80-160	8000-16000	2 people, 2 weeks, ½-full time
Documentation	40-60	4000-6000	1 person, 1 - 1½ weeks
Support Team Training	20-40	2000-4000	2 people, ½-1 week
Testing and Tuning	120-240	12000-24000	3 people, 1-2 weeks
<b>Total</b>	<b>440-820</b>	<b>\$54,000-\$97,000</b>	

### 5.1.5 Maintenance and Support

For both options 1 and 2, maintenance and support will be provided by in-house development staff (RAM and/or SF divisions) and help desk and system administration staff (IRO division). The divisions will need to allocate staff time to perform the following activities:

- Generate and review performance reports (e.g., number of calls, peak times, etc.)
- Guarantee system up-time (i.e., respond to problems, reboot servers, restore from backup, etc.)
- Install hardware and software upgrades when necessary
- Respond to and route help calls from system users

- Develop, test, and deploy enhancements based on feedback and observed performance

Because most of these tasks are highly variable, and the agency does not have historical cost data on maintaining similar systems, it is difficult to estimate the time and cost requirements associated with these activities. Experience with the existing ATM system for IFQ data collection indicates that these costs will be relatively high during initial years of production and should gradually decline as the system matures and stabilizes.

## **5.2 Option 3**

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The alternative to developing and hosting the IVR system in-house is to outsource the project to an IVR hosting service provider. WAI worked with sales representatives of First Data Voice Services to formulate a potential outsourcing scenario for the Halibut Sport Charter data collection system.

### **5.2.1 Requirements and Design**

Outsourcing the development of the system to an IVR solution provider such as First Data Corporation would involve contracting for project management and analysis time from the IVR solution provider to gather and document the system requirements and to design the voice scripts and interfaces with the NMFS data environment.

### **5.2.2 System Development and Testing**

Once the voice scripts and data interfaces between the IVR provider's phone system and the NMFS data environment are designed and documented, the development of the IVR portion of the system would also be contracted out on an hourly basis to the IVR solution provider. NMFS staff would be responsible for developing the server-side scripts or web services to interact with the NMFS databases and interface with the IVR system. The development project plan and contracting budget would need to allow for coordinated testing to include both the IVR provider and the NMFS development teams.

### **5.2.3 Hosting**

Once both sides of the system have been developed and tested, the IVR solution provider would host the IVR portion of the system in their environment. Hosting fees would be calculated monthly based on a rate per minute of actual call time by system users and would vary directly with usage. Hosting rates do not

include data transmission services. Additional charges would be incurred for all data exchanged through the HTTP/web service interface with the NMFS database.

## 5.2.4 Cost Estimates

Actual hosting fees are calculated on a multi-tier basis reflecting discounted rates as usage minutes increase. The hosting rate used in the following estimate is the highest rate (minimum usage tier) quoted by First Data at the time of this writing. Telecom fees also vary. The rate used below is the telecom rate charged by First Data's carrier (AT&T) as quoted at the time of this writing. It may be higher or lower for another carrier. The contractor developer rate used in the following estimates will also vary among solution providers and over time at First Data. First Data and other hosting service providers will generally provide a fixed bid proposal to perform the design and development work required based on their current hourly developer rate.

### 5.2.4.1 Rate Estimates:

Description	Cost
Developer Time	\$200/hour
Hosting Fees	\$.17/minute
Telecom Fees	\$.035/minute
Data Communication Fees	\$.04/transaction

### 5.2.4.2 Design and Development Time

The estimated time frame for requirements, design, development, and testing of the system from the Development Costs section above is 340-660 person hours. Some of this time estimate includes back-end development work that would be performed by NMFS staff or other outside contractors. Reducing the estimate by 25% to account for the back-end work will result in an estimate of 255-495 person hours.

**255-495 \* \$200 = \$51,000 - \$99,000 one-time development cost**

NOTE: This estimate was derived by WAI and does not constitute an estimate or quote from First Data. Although the First Data sales representative we spoke to confirmed the above range is reasonable, First Data would need to review the system requirements and provide their own solution proposal to establish a firm cost estimate.

### 5.2.4.3 Hosting Costs

Using the same estimates used to calculate the number of phone ports needed, the monthly cost of hosting the application is calculated as:

550 users \* 3 minutes on average per call \* 1 call per day \* 20 calls per month =

33,000 minutes per month \* \$.205 per minute = **\$6,765 per month hosting fees**

+ 550 users \* 1 call per day \* 20 calls per month = 11,000 calls per month \* .04 per call = **\$440 per month data transmission fees**

\$6,765 + \$440 = \$7,205 \* 5 months (seasonal application) = **\$36,025 per year**

## 5.3 Cost Comparisons

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The following table compares cost estimates to develop and maintain the IVR system for the three options over a 3-year period.

Item	Option 1	Option 2	Option 3
Phone Lines	\$4,936.80	\$4,936.80	0
IVR Hardware & Software	\$10,000-\$20,000	\$10,000 - \$20,000	0
Initial Development Costs	440-820 hours	\$54,000 - \$97,000	\$51,000-\$99,000 plus 110-205 hours
Hosting Fees	0	0	\$108,075
Maintenance & Support	variable	variable	0
System Enhancements	variable	variable	\$200/hour



## 6 Recommendations

### 6.1 In-house IVR Solution

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Based on the evaluation above, WAI recommends that NMFS pursue Option 2 described in the previous section to implement an IVR solution and host the solution in-house. Specifically, WAI recommends that:

- NMFS developers and IT support staff be identified to assist in the design and development of the system and to be responsible for its ongoing maintenance and support;
- Formal training in IVR technologies be secured for the NMFS staff identified to maintain the system;
- Existing analog phone lines currently in use to support the IFQ ATM terminals be put "on vacation" until system development begins and used to implement the IVR solution;
- IVR hardware and software be purchased and configured to develop and host the IVR solution in-house at the Juneau Federal Building;
- Additional outside developers be contracted to perform the bulk of the initial system design and development;

The recommendation to develop and host the system in-house rather than outsource to an IVR hosting service is based primarily on cost. Although the system may be less expensive to get online initially by going through a service provider, the ongoing service fees are significant and within three years will likely exceed the overall cost of developing and maintaining the system in-house. The uncertainty that an outsourced solution will receive funding in future years is another consideration, although it is recognized that recurring hosting fees may be covered through cost recovery provisions of the Magnuson-Stevens Act. Also, NMFS will have more flexibility to modify and enhance the system without being dependent on contracted resources from the solution provider to implement changes in the future.

The recommendation to use existing analog phone lines instead of installing new digital lines is also based primarily on cost. Current estimates of required ports are based on rough estimates and are more likely high than low. It appears unlikely that the system will ever need more than the 13 lines currently available and the three-year cost of installing and servicing a T1 line with 8 ports is more than double the three-year cost of maintaining the existing analog lines.

The recommendation to use outside contractors to perform the bulk of the initial system design and development is based primarily on the anticipated lack of availability of existing in-house developers to take on a project of this scope.

## **6.2 Additional Recommendations**

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### **6.2.1 Self-training**

A number of free or inexpensive IVR developer communities are available on the web (see the Vendor Survey). These communities provide web-based development environments that allow IVR developers to create sample applications that run on the vendor-hosted IVR platform. These communities also include tutorials and other learning tools to assist new IVR developers in learning VXML and other IVR development concepts. Before committing to a specific vendor or IVR platform, WAI recommends that NMFS staff take advantage of one or more of these developer services to conduct some self-training in IVR development technology to develop some technical background in order to make the best-informed selection of IVR vendor and platform as possible.

### **6.2.2 Detailed Requirements and Design**

A detailed requirements and design effort defining the functional requirements of both the web application and the IVR system should be conducted up front to insure a system design that properly supports both applications from a common database and minimizes duplication of code. Even if an IVR service provider is selected to develop the IVR portion of the solution, thorough requirements for the companion web application and its associated back-end logic should be documented before initiating a project with the solution provider to minimize contracting expense.

### **6.2.3 DTMF versus ASR**

The initial version of the IVR solution should utilize just DTMF (touch-tone navigation) and not automatic speech recognition to get input from users. This will eliminate a class of potential usability problems due to voice recognition failures. This in turn will reduce testing and tuning time during initial development and contribute to better chances of initial system acceptance from users. This will also reduce the initial software investment required.

## **6.2.4 Text-To-Speech**

Although, the initial version of the IVR solution does not necessarily require TTS, WAI recommends incorporating TTS technology. This will insure consistency of voice prompts and eliminate time and cost associated with pre-recording prompts during initial development and over time as requirements change and new voice prompts are needed. This may increase the initial cost of hardware and software to support the system. Some vendors include TTS as basic functionality, while others charge extra based on number of ports (see the Vendor Survey).

## **6.2.5 Help Desk Support**

Careful planning for help desk support should be conducted early in the project. Individuals should be identified to handle support calls from users. Allowances should be made to conduct suitable training of help desk staff in advance of system rollout, and steps taken to insure the staff will have suitable time availability to handle calls. How calls will be routed to the help desk from within the IVR system will need to be designed into the navigation tree early in the IVR system design.

## 7 Vendor Survey

Note: Packaged solutions from these vendors have variable pricing models based on the size of the prospective system (# of ports, speech technology required, etc.) For these solutions we used the following guidelines to obtain price estimates from the vendors:

- 8 analog ports
- DTMF only
- Text-to-Speech (TTS)
- No Automatic Speech Recognition (ASR)

### Hardware/Packages

Vendor	Product	Price	Notes
Vocomo ( <a href="http://www.vocomosoft.com">http://www.vocomosoft.com</a> )	Mid-Tower IVR Server 12-port analog Dialogic card TTS (\$400 per port) Response 2.0 server software Studio 2.1 dev. Software Standard service Hardware Support Shipping	\$2,718 \$2,985 \$3,200 \$4,800 \$645 \$3,807 \$1,001 <u>\$211</u> <b>\$19,467</b>	Package deal. Server base includes Windows OS. Server software, TTS, ASR priced by port. (for ASR add \$800/port). VXML support
Plum Voice Portals ( <a href="http://www.plumvoiceportals.com">http://www.plumvoiceportals.com</a> )	Standard Enterprise Server Carrier Grade Datacenter Server Intel Dialogic D/120JCT-LS Intel Dialogic D/480JCT-1T1 Gateway Platform Soft. Gold Service (20%)	\$1,195 - \$3,895 \$2,995 - \$5,395 \$3,360 \$1,510 - <u>\$2,530</u> <b>\$9,060 -</b> <b>\$15,180</b>	Package deal. Low-end = basic needed, High-end = 24-48 digital ports + min. ASR. ASR priced by port: \$500 - \$1600/port. Basic Eng.-only TTS inc., others to \$750/port
DealTime ( <a href="http://www.dealtime.com">http://www.dealtime.com</a> )	Intel Dialogic D/120JCT-LSU (12-port analog) Intel Dialogic D/240JCT-T1 (8-channel T1) Brooktrout Vantage (8-port analog)	\$2,099- \$2,711 \$3,403- \$5,870.00 \$1,355- \$2,150.53	Price ranges of telephony boards alone

## Software

Vendor	Product	Price	Notes
Voxio ( <a href="http://www.voxio.com">http://www.voxio.com</a> )	Community IVR Developer Professional IVR Developer	Free \$239.95/6-mos	Web-based development platform using Voxio infrastructure – free or low-cost way to learn IVR development
VoiceGenie ( <a href="http://www.voicegenie.com">http://www.voicegenie.com</a> )	NeXusPoint VoiceXML Platform GenieBuilder, GenieFactory	Call for quote	Java-based IVR platform & dev. software
	Developer Workshop	Free	Web-based development platform using VoiceGenie infrastructure.
Katalina Technologies ( <a href="http://voiceguide.com">http://voiceguide.com</a> )	VoiceGuide	\$549 - \$1,399	8 port license Prof – Ent. Graphical IDE. Uses VB for scripting language. MS OS only.
Nuance ( <a href="http://www.nuance.com">http://www.nuance.com</a> )	Nuance Conversation Server Nuance Management Station Nuance Application Environment	\$4,800- \$20,000+	License fees depending on features (\$600-\$2,500 per port). J2EE-based. Small solutions typically marketed through partners.
Genesys <a href="http://www.genesyslab.com">http://www.genesyslab.com</a>	Genesis Voice Platform	Call for quote	IVR server platform
enCue <a href="http://www.encue.com">http://www.encue.com</a>	Voice.NET Server Voice.NET SDK	Call for quote	Based in South Africa. Microsoft-centric w/SALT+VXML support. C#-based. Tight integration w/Win2K, Visual Studio.NET, Nuance speech engines

Intervoice ( <a href="http://www.intervoice.com">http://www.intervoice.com</a> )	Omvia Voice Framework	Call for quote	SALT and VXML support. Co-winner Best Development Environment from Avios.
Plum Voice Portals ( <a href="http://www.plumvoiceportals.com">http://www.plumvoiceportals.com</a> )	Plum Voice Gateway	\$5,600	\$700/port 0-25 ports. Note 40% discount with package deal above. Free 12-month trial available. Windows, Linux, Unix
Carnegie Mellon University ( <a href="http://hap.speech.cs.cmu.edu/salt">http://hap.speech.cs.cmu.edu/salt</a> )	OpenSALT	Free	Open source SALT browser implementation

### Hosting/IVR Development

Vendor	Website/Location	Notes
First Data Government Solutions	<a href="http://www.fdgs.com/">http://www.fdgs.com/</a> Denver, CO	Integrated tax payment IVR system for State of AK under previous incarnation (GovOne)
Nextcom	<a href="http://www.nextcom.net">http://www.nextcom.net</a> Los Angeles, CA	Local CA service only?
West Corporation	<a href="http://www.west.com">http://www.west.com</a> Omaha, Nebraska	Founded 1986
Voxio	<a href="http://www.voxio.com">http://www.voxio.com</a> Orlando, FL	Founded 1999. Hosting fees start at \$.18/minute
BeVocal	<a href="http://www.bevocal.com">http://www.bevocal.com</a> Mountain View, CA	Founded 1999. Work in Government: Delaware, Minnesota
Versay	<a href="http://www.versay.com">http://www.versay.com</a> Deerfield, IL	Integration partner of Nuance.
Vail	<a href="http://www.vailsys.com">http://www.vailsys.com</a> Deerfield, IL	Hosting partner of Versay

### Other Resources

What	Website/Location	Notes
Avios - Applied Voice Input/Output Society	<a href="http://www.avios.com">http://www.avios.com</a>	Major community for IVR industry

SALT Forum	<a href="http://www.saltforum.org">http://www.saltforum.org</a>	
VXML 2.0 Specification	<a href="http://www.w3.org/TR/voicexml20">http://www.w3.org/TR/voicexml20</a>	



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